

A revision and phylogenetic analysis of *Stoiba* Spaeth 1909 (Coleoptera, Chrysomelidae)

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Abstract

Stoiba Spaeth, 1909 is revised with a phylogenetic analysis of 38 adult morphological characters for nine *Stoiba* species and 11 outgroup species (Mesomphaliini, Ischyrosonychini, and Hemisphaerotini). Four Cuban species of *Stoiba* were not sampled. Parsimony analysis located the four most parsimonious trees. The strict consensus (CI=0.59, RI=0.78, Steps=83) resolved the monophyly of *Stoiba*. The monophyly of *Stoiba* is supported by pale yellow antennae, antennomere VII broader than its length, and rounded basal line of pronotum. An illustrated key to ten species of *Stoiba* is provided along with a distribution map of 11 species. *Stoiba rufa* Blake is synonymized with *S. swartzii* (Thunberg) by a morphological comparison which includes female genitalia.

Keywords

Chrysomelidae, Cassidinae, Mesomphaliini, *Stoiba*, Flightlessness, Cuba, Jamaica

Introduction

Stoiba Spaeth 1909 was erected for *Chelymorpha flavicollis* Klug, 1829. Spaeth noted that he did not have other species on hand but that *Chelymorpha swartzii* Thunberg 1808 and *Chelymorpha angusticollis* Suffrian, 1868 might also belong in this new genus. Suffrian (1868) described *Chelymorpha fimbrialis* Suffrian and *Chelymorpha lurida* Suffrian from Cuba. Later, Borowiec (1999) classified these two as *Stoiba* species. Blake (1930) described *Stoiba bruneri* Blake, *S. quatuordecimmaculata* Blake, and *S. indivisa* Blake from Cuba. Later, she added *S. fascicollis* Blake and *S. marginata* Blake also from

Cuba (Blake 1934). Zayas (1939) described *Stoiba clarilidae* Zayas and *S. nigricans* Zayas from Cuba. By 1946, ten *Stoiba* species were known (Blackwelder 1946).

Four more species were added in the subsequent decade—*Stoiba oteroi* Zayas and *S. barroi* Zayas from Cuba (Zayas 1952), and *S. fuscicornis* and *S. rufa* from Jamaica (Blake 1966). Chaboo (2000) synonymized *S. quatuordecimmaculata* with *Elytrogona bulla* Boheman based on a new generic definition of *Elytrogona* Chevrolat. Key diagnostic features were profile shape, elytral inflation, surface sculpture, and claw basal shape. Borowiec and Świętojańska (2012) listed 15 species in *Stoiba*. *Stoiba* and *Elytrogona* are regarded as closely related genera (Blake 1930) within the tribe Mesomphaliini because these species exhibit a range of wing development (fully developed, brachypterous, and vestigial). Their distribution is also interesting (Fig. 1). *Stoiba* occurs mainly on Cuba with the exception of four specimens of *S. flavicollis* (Klug) from Yucatan, Mexico and three species on Jamaica [*S. fuscicornis*, *S. rufa*, *S. swartzii*]. *Elytrogona* occurs only on Hispaniola with the exception of one species, *Elytrogona bulla*, from Cuba (Chaboo 2000). Chaboo (2000) found *Elytrogona* to be monophyletic based on profile shape, elytral maculation, and claw basal form (Chaboo 2000), and resolved these two genera as sister taxa in Chaboo (2007). Another phylogenetic hypothesis of Cassidinae, Hsiao and Windsor (1997), did not sample these two genera.

Stoiba is classified in the tribe Mesomphaliini because of this character combination: metepisternum not entirely fused with metepimeron; explanate margin of pronotum and elytra usually broad; adult head mostly hidden by pronotum; adult pronotal and elytral margin usually broad; mouthparts partly hidden by pronotum and prosternal collar; clypeus oblique and moderately long; labrum without carina; antennae filiform; pronotum without sensory setae and pores; elytra usually without sculpture, but open with large punctures; adult claws with basal tooth (Borowiec 1995). Spaeth's (1909) generic diagnosis is based on overall body shape, but this is vague. We provide a new definition of *Stoiba* as well as notes on ten species and synonymize *S. rufa* with

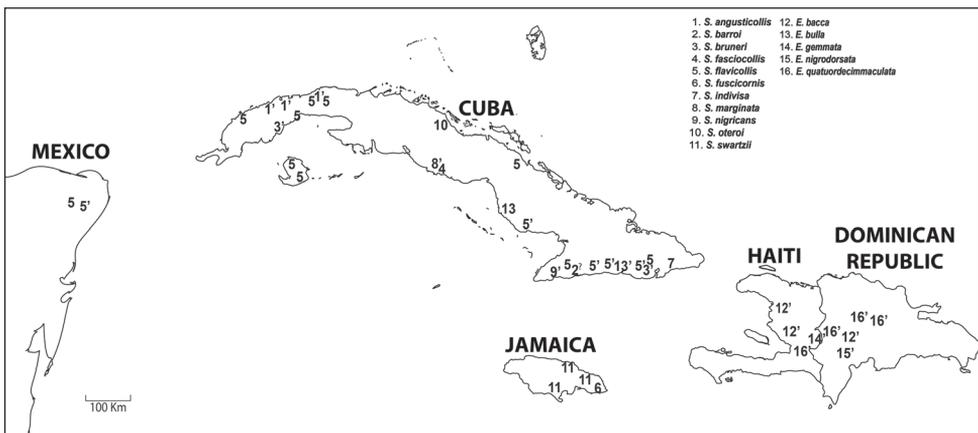


Figure 1. Distribution. Numbers with ' (single quotation mark) indicate brachypterous or vestigial winged species; with ? (question mark) for species with wing status unknown.

S. swartzii. We were unable to examine four species [*S. barroii* Zayas, *S. fimbrialis*, *S. lurida*, and *S. oteroi*] due to the restrictions in obtaining specimens from Cuban institutions. We excluded these four species from the identification key and included the English translated original descriptions in this study.

Materials and methods

Specimen examination. We examined a total of 200 *Stoiba* specimens from 15 museums and collections; museum acronyms (Table 1) follow Evenhuis (2012). We examined holotypes of eight species [*S. bruneri* (Fig. 3), *S. clarildae* (Fig. 4), *S. fascicollis* (Fig. 5), *S. fuscicornis* (Fig. 6), *S. indivisa* (Fig. 7), *S. marginata* (Fig. 8), *S. nigricans* (Fig. 9), *S. rufa* (Fig. 10)] from USNM, six specimens of the type series of *S. flavicollis* from ZNHB (Figs 23–25), and a type specimen of *S. swartzii* (Figs 38–40) from NHRS.

Four species—*S. barroii*, *S. fimbrialis*, *S. lurida*, *S. oteroi*—were not included in the present study. *Stoiba barroii* and *S. oteroi* are held by a private Cuban museum (the Zayas cassidine collection) and not available for loan. We obtained two photographs of the holotype of *S. barroii* (Fig. 2) from Dr. Michael A. Ivie (Montana State University) who visited this collection.

Descriptions are based on pinned adult specimens; host plant and immature stages of *Stoiba* are unknown (Chaboo 2007; Świętojańska 2009; Borowiec and Świętojańska 2012). For the description of sexual organs, the separated abdomen parts were treated in 5–10% KOH and dissected in 95% alcohol or glycerin. Voucher dissections were preserved in glycerin. However, dissection was restricted because of limited numbers of specimens. Specimens were examined with an Olympus SZX7 microscope and an Olympus BX51 compound microscope. Measurements were made with an ocular micrometer. Photographs were taken with the Microptics® camera system. Illustrations were made with a camera lucida attached to the microscope. Terminology follows Lawrence and Britton (1991) and Chaboo (2000, 2007). We used terms “moderately convex” and “distinctly convex” to describe elytral height when the pronotum and elytra are connected continuously (Figs 15, 21, 24, 27, 30, 36, 39) or discontinuously (Figs 12, 18) in profile.

Phylogenetic methods. The phylogenetic analysis addressed the monophyly and species relationships of *Stoiba*. We revised the data matrix of *Elytrogona* (Chaboo 2000) and presented a new matrix for nine *Stoiba* species (Figs 11–40). Attention was paid to analyzing the morphology associated with flightlessness to determine if this arose independently in *Stoiba* and *Elytrogona*. *Stoiba clarildae* is not included because of a limited number of specimens and missing data.

Spaethiella sp. (Hemisphaerotini) (Fig. 81), *Asteriza flavicornis* (Olivier) (Fig. 82) and *Physonota alutacea* Boheman (Fig. 83) (Ischyrosynychini), a species from each genus *Stolas*, *Chelymorpha*, and *Phytodectoidea* (Figs 84–86), and five known *Elytrogona* species (Figs 87–91) (Mesomphaliini) were also sampled as outgroups based on Chaboo’s (2007) phylogenetic analysis. We used color of antennae as a character because it is possibly a

Table 1. Museums which provided specimens for the present study.

AMNH	American Museum of Natural History, New York, New York, U.S.A.
BMNH	British Museum of Natural History, London, United Kingdom.
FMNH	Field Museum of Natural History, Chicago, Illinois, U.S.A.
FSCA	Division of Plant Industry, Florida State Collection of Arthropods, Gainesville, Florida, U.S.A.
IJSM	Institute of Jamaica, Natural History Museum, Kingston, Jamaica.
INHS	Illinois Natural History Survey, Champaign, Illinois, U.S.A.
MCZ	Harvard University, Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A.
MMUE	The University of Manchester Museum, Manchester, United Kingdom.
MZH	Finnish Museum of Natural History, Helsinki, Finland.
MLUH	Martin-Luther-Universität, Wissenschaftsbereich Zoologie, Halle-Wittenberg, Germany
NHRS	Naturhistoriska Riksmuseet, Stockholm, Sweden
SEMC	University of Kansas, Snow Entomological Museum, Lawrence, Kansas, U.S.A.
USNM	National Museum of Natural History, Washington D.C., U.S.A.
UWCP	Museum of Natural History, University of Wrocław, Wrocław, Poland.
TAMU	Texas A & M University, College Station, Texas, U.S.A.
ZMHB	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

shared character between species of *Stoiba* and *Elytrogonia* (Borowiec and Świętojańska 2012). But other coloration was not included in our phylogenetic analysis because adult Cassidinae can be polymorphic in body colors, and coloration of dead specimens often does not match that of living specimens (Chaboo 2007). The data matrix of 38 morphological characters and 20 species (Tables 2–3) was created using WINCLADA (Nixon 2002), which incorporates Nona (Goloboff 1998) to analyze datasets using parsimony. All characters were equally weighted and unordered (Fitch optimization).

Results

Stoiba Spaeth, 1909: 720

<http://species-id.net/wiki/Stoiba>

[type species *S. flavicollis* as originally designated], 1914: 51 [catalog]; Hincks 1952: 335 [checklist]; Jolivet 1959: 83 [locality with wing figure]; Seno and Wilcox 1982: 174 [checklist]; Jolivet and Hawkeswood 1995: 158 [microptery]; Borowiec 1999: 130 [catalog]; Chaboo 2000: 379 [outgroup in phylogenetic analysis]; Jolivet and Verma 2002: 64 [microptery]; Chaboo 2007: 184 [phylogeny]; Borowiec and Świętojańska 2012 [online catalog].

Diagnosis. *Stoiba* differs from most of mesomphaliine genera by pale antennal color (except for *S. bruneri* with 11th antennal segment black) and from *Elytrogonia* by the quadrate basal tooth of claws, rounded basal line of pronotum, separate elytral suture, moderately and distinctly convex profile, and fully-developed or brachypterous hind wing.

Table 2. Characters and states for the phylogenetic analysis

Ch. No	Character
0	Head, well exposed=0 (Fig. 81); mostly concealed=1 (Figs 11–40); entirely concealed=2 (Figs 82–83)
1	Antennomeres III–X, mainly pale yellow=0 (Figs 11–40); brown with black or mixed=1 (Figs 84–86)
2	Antennomere III (Figs 47–56), 2 times as long or longer than II=0; less than 2 times=1
3	Antennomere III (Figs 47–56), shorter than IV=0; as long as IV or slightly longer (1.1 times)=1; distinctly longer (over 1.2 times)=2
4	Antennomere VII (Figs 47–56), longer than width=0; broader than length or as broad as long=1
5	Mandible, teeth number five=0 (Fig. 58); 4 or 4 with vestigial teeth=1 (Fig. 59)
6	Mandible, without horizontal thickening=0 (Figs 100–101); with horizontal thickening=1 (Figs 58–59)
7	Labial palpomere I shape, sub-quadrangle=0 (Fig. 102); triangular=1 (Figs 62–63, 103)
8	Pronotum, anterior edge continuous=0 (Figs 82–91); discontinuous=1 (Fig. 81)
9	Prosternum, antero-lateral edge rounded or slightly angled=0 (Fig. 64); distinctly angled=1
10	Pronotum, base, angled=0 (Figs 84–86); transverse=1 (Figs 87–91)
11	Pronotum, widest at base=0 (Figs 82–86, 88); at middle=1 (Figs 87, 99); at front=2 (Fig. 81)
12	Pronotum, basal line, linear=0 (Figs 87–91); sinuate=1 (Figs 85–86); rounded=2 (Figs 81–83)
13	Pronotum postero-medial angle extending more than postero-lateral margin=0; (Figs 82, 84–86); not extended or slightly extended=1 (Figs 83, 87–91)
14	Prosternal process, slightly inflated=0 (Fig. 64); straight sided=1
15	Scutellum, hidden or small=0 (Figs 84, 88–91); well exposed=1 (Figs 81–83, 85–87)
16	Meso-, metanotum, separated=0 (Figs 65–66), fused=1 (Fig. 84)
17	Metasternum, medially broad and flat=0 (Fig. 67); not flat with deep groove medially=1
18	Elytral disc height/length ratio, less than 0.34=0 (Fig. 30); between 0.35–0.5=1 (Fig. 33); over 0.5=2
19	Elytra surface, smooth=0 (Figs 29, 82–87); rough=1 (Figs 11, 32, 81, 88–91)
20	Elytral puncture size, small=0 (Fig. 82–87); large=1 (Figs 81, 88–81)
21	Elytral punctuation, fine=0 (Fig. 29); rough=1 (Fig. 32); coarse (Figs 88–91)
22	Base of elytral disc, distinctly broader than discal base of pronotum=0 (Fig. 84); as broad as or slightly broader=1 (Fig. 85–86); narrower=2 (Figs 87–91)
23	Elytra, umbone indistinct=0 (Figs 87–91); distinct=1 (Figs 81–86)
24	Elytra margin, lateral edge, rounded=0 (Figs 81–87); angled=1 (Figs 88–91)
25	Elytra margin expanded toward venter=0 (81–86); horizontally=1 (87–91)
26	Elytra margin posterior half distinct from disc=0 (Fig. 23); vague=1 (Fig. 29)
27	Elytral suture, separate=0 (Fig. 35), partly fused=1 (Fig. 89), fused=2 (Fig. 88)
28	Elytral longitudinal carina and brace, parallel=0 (Fig. 96); angled=1 (Fig. 95)
29	Hind wing, fully developed=0 (Fig. 92); brachypterous=1 (Fig. 93); vestigial=2 (Fig. 94)
30	Claw basal tooth absent=0; present=1 (Figs 97–98)
31	Claw basal part, simple=0; quadrate=1 (Fig. 97); pointed=2 (Fig. 98)
32	Spermathecal duct, short=0; long=1 (Figs 72–80)
33	Spermathecal receptacle, short=0, shorter than ¼ of pump (Fig. 72); long, over ¼ of pump length =1 (Fig. 73)
34	Spermathecal duct, loosely coiled=0 (Fig. 79); tightly coiled=1 (Fig. 74)
35	Male genitalia, deversment=1; without deversment=0
36	Seminal vesicle, much thicker than ejaculatory duct=0 (Fig. 99); slightly thicker=1 (Figs 68–71)
37	Aedeagal spicule, divided into two segments=0 (Fig. 99); not divided, Y or V-shaped=1 (Figs 68–71)

Table 3. Matrix of characters (\$=polymorphism with states 0 and 1; N=not applicable)

TAXA	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37		
<i>Spaethiella</i> sp.	0	1	1	0	0	N	0	1	0	0	2	2	0	0	1	0	0	1	1	1	1	2	0	1	0	0	0	0	0	0	0	N	1	1	1	0	0	1		
<i>Physonota albatacea</i>	2	1	0	2	0	0	0	0	1	0	0	0	2	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	N	1	1	0	1	0	0	0		
<i>Asteriza flavicornis</i>	2	0	1	1	0	0	0	0	1	0	0	0	2	1	0	1	0	0	1	0	0	1	1	1	0	0	0	0	0	0	N	1	1	0	1	0	0	0		
<i>Chelymorphia</i> sp.	1	1	0	1	0	0	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	0	1	1	1	1	
<i>Phytodectoidea</i> sp.	1	1	1	1	0	0	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	1	1	1	
<i>Stolas</i> sp.	1	1	0	1	0	1	1	1	1	2	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	1	
<i>S. angusticollis</i>	1	0	0	2	0	0	1	1	1	1	0	0	2	1	0	1	0	0	1	1	1	1	1	1	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	
<i>S. bruneri</i>	1	0	0	1	0	0	1	1	1	1	0	0	2	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	1	0	1	1	1	1	1	1	
<i>S. fascicollis</i>	1	0	1	1	0	1	1	1	1	1	0	0	2	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	
<i>S. flavicollis</i>	1	0	0	2	0	0	1	1	1	1	0	0	2	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	
<i>S. faucicornis</i>	1	0	0	1	1	1	1	1	1	1	0	0	2	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	1	0	1	1	1	
<i>S. indivisa</i>	1	0	0	2	1	0	1	1	1	1	0	0	2	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1	1	1	
<i>S. marginata</i>	1	0	0	2	0	0	1	1	1	1	0	0	2	1	0	1	0	0	1	0	1	1	1	1	0	0	0	0	1	1	0	1	0	1	0	1	1	1	1	
<i>S. nigricans</i>	1	0	0	2	1	0	1	1	1	1	0	0	2	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	1	0	1	1	1	1	1	1	
<i>S. suartzii</i>	1	0	0	1	1	1	1	1	1	1	0	0	2	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	1	0	1	1	1	
<i>E. bacca</i>	1	0	0	2	1	1	1	1	1	2	1	0	0	1	1	0	1	1	2	1	1	2	2	0	1	1	0	2	0	2	1	1	0	1	0	1	1	1	1	
<i>E. gemmata</i>	1	0	0	2	0	1	1	1	1	2	1	1	0	1	1	0	1	1	2	1	1	2	2	0	1	1	0	1	0	2	1	1	0	1	0	1	1	1	1	
<i>E. nigrodorsata</i>	1	0	0	2	1	1	1	1	1	2	1	0	0	1	1	0	1	1	2	1	1	2	2	0	1	1	0	2	0	2	1	1	0	1	0	1	1	1	1	1
<i>E. quatuordecimmaculata</i>	1	0	0	2	1	1	1	1	1	2	1	0	0	1	1	0	1	1	2	1	1	2	2	0	1	1	0	2	0	2	1	1	0	1	0	1	1	1	1	
<i>E. bulla</i>	1	0	0	2	0	1	1	1	1	2	1	1	0	1	1	1	1	?	2	0	0	0	2	0	0	1	0	1	0	2	1	1	0	1	1	1	1	1	1	

Description. Body (Figs 11–40) generally rounded to oval with pronotum and elytra slightly to distinctly discontinuous in dorsal view, hemispherical in lateral view, widest and highest between basal 1/3 and middle of elytra.

Head (Figs 44–46) concealed by prothorax except for half of eyes and inter-ocular region in dorsal view, rounded to subquadrate (in disarticulate specimen), widest at middle, 1.25 times as broad as long; gena and eye well exposed in lateral view. Eyes large, oval, bulging, located on upper antero-lateral region of head; inter-ocular area twice as broad as eye diameter, slightly depressed or flat with antennal sockets and mid-cranial suture. Frontoclypeus (Fig. 45) broad and rounded pentagonal, rarely subquadrate with surface flat to slightly swollen (individual variation), sparsely setose; ventral angle slightly arched with frontoclypeal suture. Antenna 11-segmented (Figs 47–56), longer than lateral edge of pronotum; interantennal region as broad as antennal socket or slightly narrower; scape twice as long as broad, over 2 times longer than pedicel; pedicel as long as broad or slight longer; antennomeres III–IV slender, shiny, parallel to slightly broader apically, sparsely setose; antennomeres V–VII pale, pubescent, slightly longer or as long as broad; antennomeres VIII–X pale, as long as broad or slightly broader, pubescent setose with fine long setae on sub-apical region; antennomere IX as long as scape or slightly longer, twice longer than width, densely setose with long setae on sub-apex.

Mouth fossa (Fig. 46) rounded subquadrate with upper half broader and well-sclerotized. Labrum (Fig. 57) with basal half withdrawn into frons; anterior half shifted ventrally, sparsely punctate with long setae, broadest at shifted line with anterior edge well-sclerotized and medially emarginate. Mandible (Figs 58–59) well-sclerotized, fist-shaped with 4–5 teeth or 4 teeth with a vestigial projection ventrally; apical half shifted toward mouth fossa; basal half punctate and setose. Maxilla (Figs 60–61) long and slender; cardo long, medially narrower; stipes weakly sclerotized, irregularly triangular with short and fine setose medially; lacinia small, membranous, petal-shaped with basal region more sclerotized, densely setose; galea irregularly oval, setose with apical half more sclerotized than basal half; maxillary palpus 4-segmented with palpifer laterally connected to stipes; palpomere I shortest, triangular; II over 2 times longer than I, broader apically, slightly curved; III shorter than II and IV, broader apically with long setae on sub-apex; IV about 1.5 times as long as III, setose with apex flat and with sensilla structure. Labium (Figs 62–63) with mentum withdrawn into prosternum; ligula hemispherical with apex slightly pointed or rounded, and long setae on apical region; labial palpus 3-segmented; palpomere I triangular shorter than II and III; II as long as III, broader apically with long setae on sub-apical region; III sparsely setose with sensilla on apex.

Pronotum (Figs 11, 14, 17, 20, 23, 26, 29, 32, 35, 38) hemispherical or trapezoidal in dorsal view with anterior edge linear or slightly emarginate, broadest between middle and base; base broadly rounded with postero-medial edge extended, covering anterior half of scutellum; disc with explanate margin distinct or posterior half indistinct, smooth [except for *S. fascicollis* (Fig. 20) and *S. marginata* (Fig. 32)], slightly convex with longitudinal cleavage medially; margin area broader basally, slightly inclined upward, weakly punctate (except for some *S. flavicollis* specimens with smooth

surface); profile irregularly trapezoidal, highest at base; lateral edge rounded to slightly angled with postero-lateral edge slightly extended.

Prosternum (Fig. 64) flat or slightly convex; anterior prosternal edge linear to slightly curved, forming cervical cavity; prosternal process smooth or occasionally with shallow depression, reaching mesocoxae with arrow-shaped apex.

Mesonotum (Fig. 65) transverse with basal edge line well-sclerotized, weakly fused to metanotum; scutellum well-sclerotized, triangular, convex with anterior half withdrawn into pronotal base.

Mesosternum (Fig. 67) deeply notched; mesepisternal ridge well defined; mesosternal process extended to posterior end of mesocoxal cavity, fused to metasternum.

Metanotum (Fig. 66) weakly sclerotized; scutellar groove and scutoscutellar suture distinct. Metasternum (Fig. 67) flat or slightly convex medially with distinct longitudinal line, transverse posteriorly, laterally declined; intercoxal notch distinct, as long as or slightly shorter than hind trochanter.

Elytra (Figs 11, 14, 17, 20, 23, 26, 29, 32, 35, 38) oval to round with base transverse, explanate laterally, moderately to distinctly convex; outline slightly to moderately discontinuous between anterior 1/3 and middle in dorsal view; surface fine scaled-like, shining to murky, finely to coarsely or roughly punctate; punctures evenly sized; brace (Fig. 95) distinct with posterior end weakly connected to longitudinal carina forming angle; color various; margin area broadest between anterior 1/3 and middle, gradually narrower posteriorly. Hind wing (Figs 92–93) fully developed or brachypterous.

Legs (Figs 13, 16, 19, 22, 25, 28, 31, 34, 37, 40) slender, long, shiny, brown to black, extending beyond elytral margin; trochanters short, triangular; femora moderately broad, broadest at middle, much narrower toward base rather than distal end; tibiae as long as femur or slightly shorter, slightly broader apically with apical end notched, broadest at notched region; distal 1/3 (lateral areas of notched region) coarsely setose; with tarsomeres I, II, III, IV dorsally convex with long setae; ventral surface densely setose, pale; tarsomere I small, rounded triangular; II with apex slightly bilobed, 2 times as long as I; III deeply bilobed, *ca.* 3 times as long as I; IV 3 times as long as tarsomere I, slightly broader apically, covering base of claws; claws evenly curved, tapered with quadrate basal tooth.

Abdomen (Figs 13, 16, 19, 22, 25, 28, 31, 34, 37, 40) fully covered by elytra, broad, rounded laterally, slightly convex medially; each ventrite well-sclerotized, same size in length (without hind coxal process on ventrite I), sparsely setose with posterior and lateral areas more setose; ventrite V much narrower than I–IV with longer setae.

Aedeagus (Figs 68–71) curved in lateral view (only *S. flavicollis* and *S. swartzii* dissected), laid laterally (male genitalia deversement) with aedeagal base piece oval, membranous structure basally, slightly broader apically with apex pointed; tegmen sclerotized, Y-shaped; spicule V-shaped with anterior end slightly extended; ejaculatory duct longer than base piece; seminal vesicle slightly longer than base piece with sclerotized bead between ejaculatory duct and seminal vesicle.

Spermatheca (Figs 72–80) irregular falcate or irregular J-shaped to C-shaped, short to elongated; receptacle distinct from pump with two openings; spermathecal duct various in shape and length, loosely coiled to moderately coiled or entwined.

Remarks. We found some morphological variation especially in body shape, pronotum, and elytra. From the dissected or sex-determined specimens we considered those variations in males and females, but could not find any sexual dimorphism.

Key to species

- 1 Elytral disc mainly black to dark blue (Figs 14, 17, 20, 23, 29, 32, 35).....**2**
- Elytral disc brown to reddish brown with or without blue metallic tint (Figs 11, 26, 38).....**8**
- 2(1) Pronotum bicolored (Figs 20, 32); pronotal disc black with margin area brown to reddish brown; prosternal process black with black coloration extending to hypomeron; meso-, metafemur (Figs 22, 34) with more than proximal 1/3 black.....**3**
- Pronotum unicolored (brown or pitchy brown; Figs 14, 17, 23, 29, 35); prosternal process black with hypomeron brown to dark brown; each femur brown with less than proximal 1/3 black (Fig. 19, 19, 25, 31, 37).....**4**
- 3(2) Elytra and pronotum (Fig. 20) finely punctate with surface scale-like; elytra unicolored (black or dark blue); prosternum (Fig. 22) black with black coloration extending to antero-lateral area of hypomeron; elytral base as wide as pronotal base (Fig. 20); hind wing fully developed; meso-, metafemur up to half black (Fig. 21)..... ***S. fascicollis* Blake**
- Elytra and pronotum (Fig. 32) coarsely and roughly punctate; prosternum (Fig. 34) black with black coloration extending to middle of hypomeron; elytra (Fig. 32) bicolored with disc black; black coloration extending to middle of elytra margin area, surrounded by brown margin area; elytral base (Fig. 32) distinctly broader than pronotal base; hind wing brachypterous (Fig. 32); femora (Fig. 34) with more than proximal half black.....***S. marginata* Blake**
- 4(2) Pronotum (Fig. 35) pitchy brown or black; antennae, thoracic sterna, coxae, tarsi black with head, femora, tibiae blackish brown (Fig. 37); hind wing brachypterous.....***S. nigricans* Zayas**
- Pronotum (Figs 14, 17, 23, 29) brown to reddish brown; thoracic sterna, coxae, trochanters, distal region of femora brown to reddish brown; proximal end of femora black (Figs 16, 19, 25, 31); hind wing fully developed or brachypterous.....**5**
- 5(4) Pronotum hemispherical without angle at posterior 1/3 of lateral edge; elytra (Fig. 29) dark blue to purple; margin in posterior half narrow, indistinct (Fig. 29); hind wing fully developed.....***S. indivisa* Blake**
- Pronotum trapezoidal, rarely hemispherical; elytra (Figs 14, 17, 23) black to bluish black; margin in posterior half wide, distinct; hind wing brachypterous or fully developed.....**6**
- 6(5) Antennomere XI pale (Figs 4, 17, 23).....**7**
- Antennomere XI black (Figs 3, 14, 48)..... ***S. bruneri* Blake**

- 7(6) Body distinctly convex (Fig. 18); elytral base much broader than pronotal base (Fig. 17); elytra broadest near basal 1/3, black without metallic luster...
..... *S. clarildae* Zayas
- Body moderately convex (Fig. 24); elytral base as broad as pronotal base or slightly broader than pronotal base (Fig. 23); elytra broadest near middle, brownish black to black with weak metallic luster.....*S. flavicollis* (Klug)
- 8(1) Body (Fig. 12) distinctly convex; mandible (Fig. 58) with 5 teeth; pronotum and elytra (Figs 11–12) opaque; elytra (Fig. 11) coarsely and roughly punctate; collected from Cuba.....*S. angusticollis* (Suffrian)
- Body (Figs 27, 39) moderately convex; mandible (Fig. 59) with 4 teeth or 4 teeth with additional small vestigial tooth ventrally; elytra (Figs 26, 38) finely punctate; collected from Jamaica 9
- 9(8) Body (Fig. 26) unicolored (leathery brown to reddish brown); posterior half of explanate margin not well defined*S. fuscicornis* Blake
- Pronotum and elytra (Fig. 38) shiny; elytra opalescent, always darker (or more reddish) than pronotum; elytral disc moderately defined.....*S. swartzii* (Thunberg)

***Stoiba angusticollis* (Suffrian, 1868)**

http://species-id.net/wiki/Stoiba_angusticollis

Figures 11–13

Chelymorpha angusticollis Suffrian 1868: 239; Gemminger and Harold 1876: 3638 [catalog]; Leng and Mutchler 1914: 458 [list of the West Indies Coleoptera].

Stoiba angusticollis: Spaeth 1909: 720 [catalog], 1914: 51 [catalog]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Borowiec 1996: 229 [faunistic record], 1999: 130 [catalog]; Takizawa 2003: 105 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Unknown.

Type locality. “Cuba”

Specimens examined. Cuba: Prov. La Havana: ex FC Bowditch collection (MCZ: 2); ex F Monrós collection (USNM: 1); no further data (AMNH: 2; MCZ: 1; MMUE: 1; USNM: 1); Pinar del Rio: Pan de Guajaibon, May 17 1953, MJ Jaime (INHS: 1); Soroa July 6–7 1974, Z&M Mészáros (UWCP: 1).

Diagnosis. *Stoiba angusticollis* is one of three species with brown tone elytra. This species is easily distinguished from the other two *Stoiba* species (*S. fuscicornis* and *S. swartzii*) with brown elytra by body shape, dorsal surface coarsely and roughly punctate, opaque coloration, mouth parts, and collecting locality. Body distinctly (Fig. 12) convex; dorsal surface coarsely and densely punctate (Fig. 11), opaque brown; mandible (Fig. 58) with 5 teeth; maxillary palpus (Fig. 60) and labial palpus (Fig. 62) compact; collection locality in Cuba.

Description. Adult (n=10) length 6.1–8.0 mm, width 6.0–7.8 mm. Body (Figs 11–13) rounded with elytral base broader than pronotal base; profile (Fig. 12), 0.5 times as convex as long, often discontinuous between pronotal and elytral bases, highest at anterior 1/3 of elytra; color brown to reddish brown, opaque; surface texture scale-like, roughly and coarsely punctate. Antenna (Figs 11, 47) as long as or slightly longer than pronotal lateral edge; antennomeres I–II reddish brown, shiny, darker apically; III long, broader apically, 2 times longer than II, 1.2 times longer than IV; V–XI pubescent with long setae on apex. Mandible with 5 teeth; maxillary palpus and labial palpus compact. Pronotum (Fig. 11) hemispherical with anterior margin slightly emarginate; disc slightly convex with longitudinal cleavage on surface medially. Elytra distinctly convex, finely and more coarsely punctate than pronotum. Spermatheca (Fig. 72) falcate with two openings; receptacle 0.2 times as long as pump; spermathecal duct moderately coiled.

Distribution. Cuba: Prov. La Havana; Pinar del Rio.

Remarks. Our description was made by observing the examined specimens and comparing to the original description (Suffrian 1868). The original description is sufficient to recognize the species with features such as convex body, coloration, and collecting location. The description corresponds to our observation.

Stoiba barroii Zayas, 1952

http://species-id.net/wiki/Stoiba_barroii

Figure 2

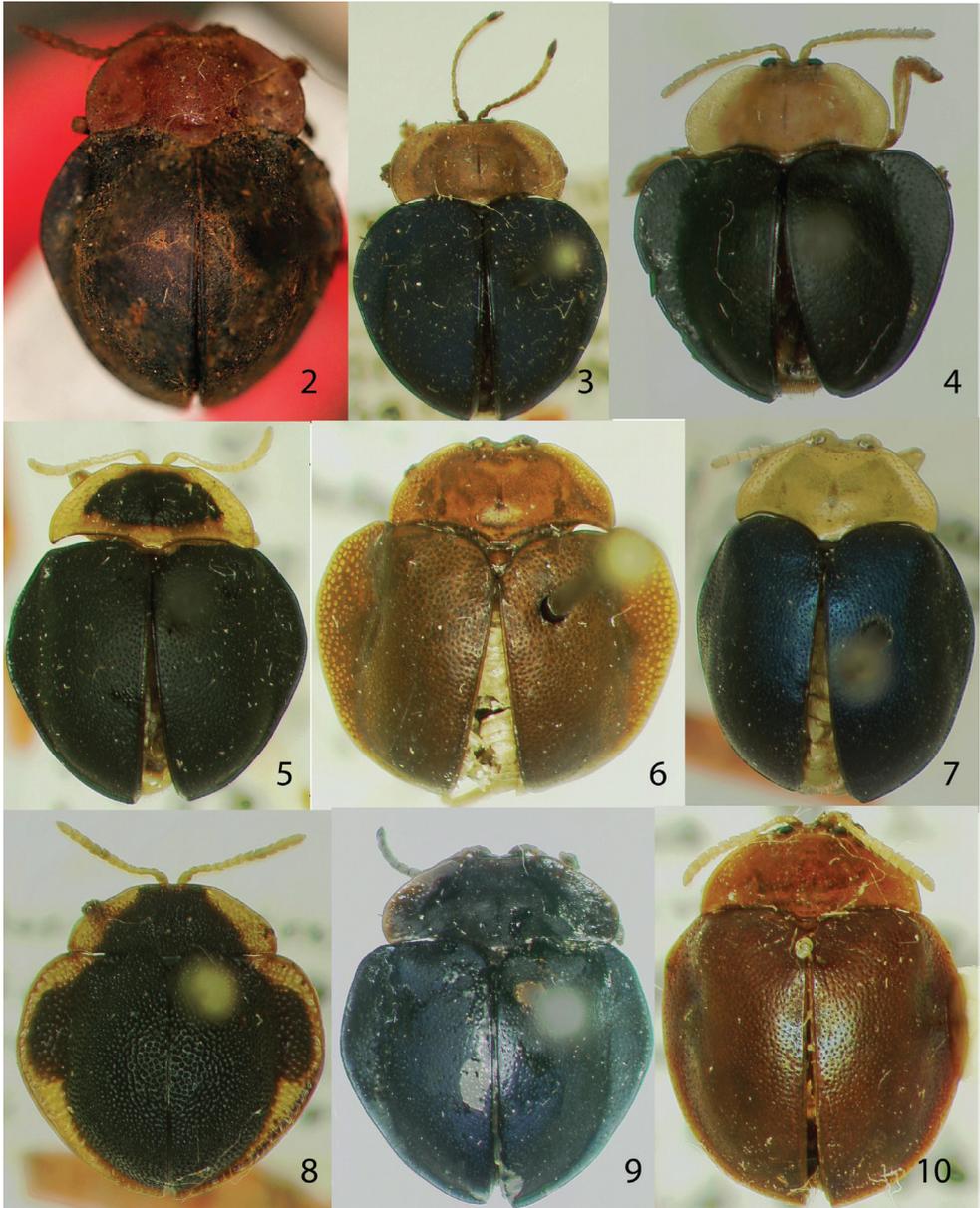
Stoiba barroii Zayas 1952: 72 [original description including figure]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 130 [catalog]; Takizawa 2003: 105 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Holotype (Fig. 2).

Type locality. Cuba: Prov. Granma or Santiago de Cuba: Sierra Maestra, between Loma Pico Palma Mocha and Pico Biscupe de Joaquín, 3500 ft (see “Remarks” portion below).

Diagnosis (from original description by Zayas 1952). *Stoiba barroii* is the largest among the Cuban species, similar to *S. flavicollis* but separated by coloration of antennae, head, and legs. *Stoiba barroii* is also similar to *S. bruneri* but distinguished by the color of the elytra, which is clearly blue, and the colors of head and legs, which are also conspicuous. Compared to *S. clarilda*, *S. barroii* is more elongated and differs in colors of head, legs, and antennae.

Description (from original description by Zayas 1952). Adult length 10.0 mm, width 8.0 mm. Body robust, strongly convex with antennomere XI and elytra matte black; legs dark ferruginous; lateral margin of pronotum dark yellow, depressed and convex at edge. Head concealed in dorsal view. Pronotum broadly expanded, lateral margin very upturned with well-marked transverse furrow between pronotal disc and



Figures 2–10. Holotypes. **2** *Stoiba barroi* **3** *Stoiba bruneri* **4** *Stoiba clarilldae* **5** *Stoiba fascicollis* **6** *Stoiba fuscicornis* **7** *Stoiba indivisa* **8** *Stoiba marginata* **9** *Stoiba nigricans* **10** *Stoiba rufa* (= *Stoiba swartzii*).

scutellum; surface finely wrinkled with scattered punctures, faintly printed; wrinkles almost imperceptible on discal area, conspicuous at the edges. Elytra strongly convex with expanded margins and elytral suture significantly lifted; surface slightly rough as on pronotum and more densely and roughly punctate.

Distribution. Cuba: Prov. Granma or Santiago de Cuba.

Remarks. According to the photograph of the holotype of *S. barroii* (Fig. 2), it is easily distinguished from *S. bruneri* by brown antennomere XI (black in *S. bruneri*). The locality information in the original description (Zayas 1952) is not precise enough to define the province. We indicated two provinces (Granma or Santiago de Cuba) based on the collecting locality data.

***Stoiba bruneri* Blake, 1930**

http://species-id.net/wiki/Stoiba_bruneri

Figures 3, 14–16

Stoiba bruneri Blake 1930: 219 [original description including figure]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 130 [catalog]; Chaboo 2000: 379 [outgroup in phylogenetic analysis]; Takizawa 2003: 105 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Holotype (Fig. 3) and four paratypes in USNM (Type No. 43117).

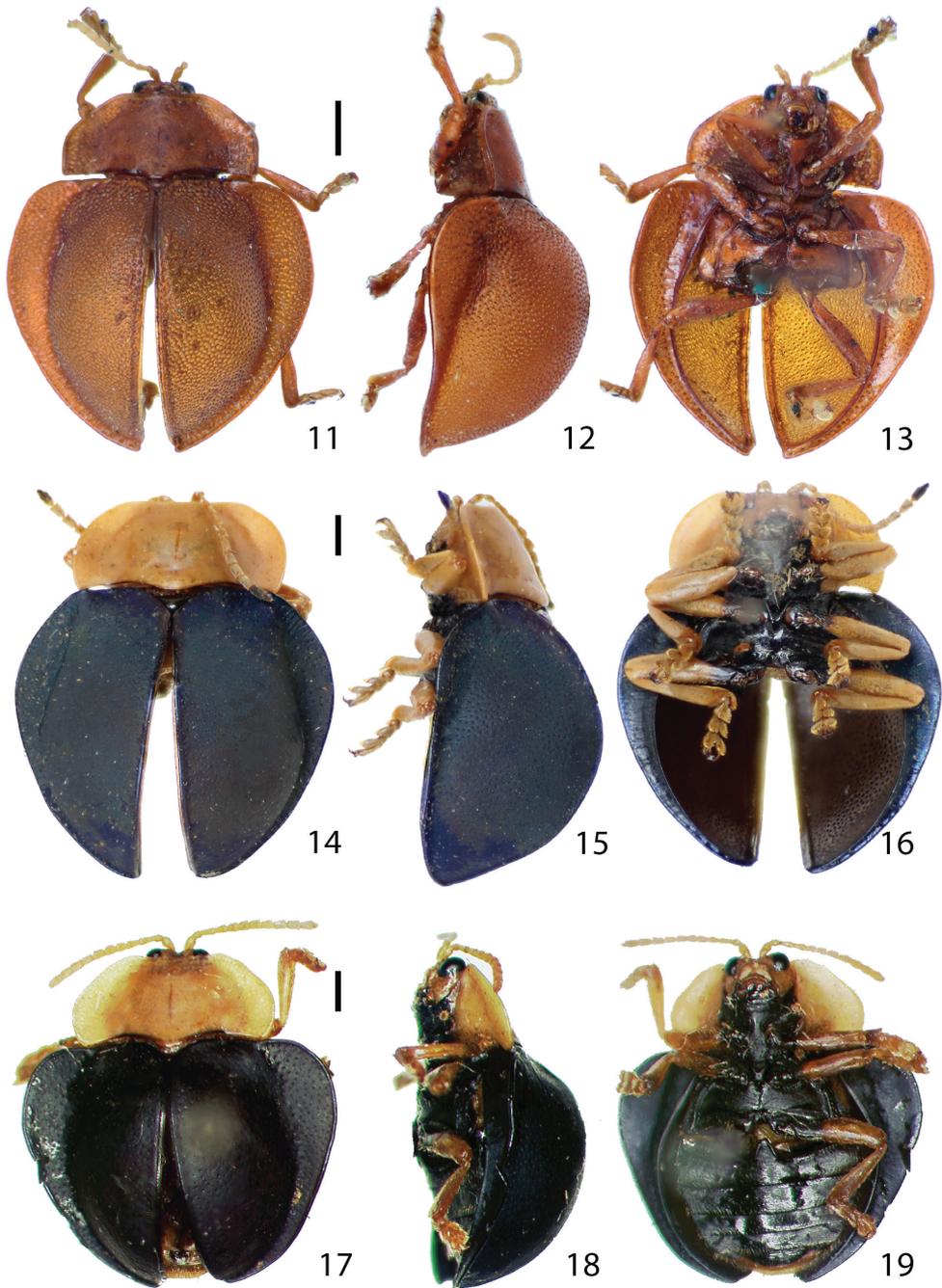
Type locality. Cuba: Prov. Guantánamo: Sierra Maestra Palma Mocha 1386 m.

Specimens examined. Cuba: Prov. Guantánamo: Sierra Maestra July 10–20 1922, CH Ballou, SC Bruner, Palma Mocha 1386 m. (USNM: holotype, male; paratype, type No. 43117); Sierra Maestra 900–1200 m, July 10–20 1922, CH Ballou, SC Bruner, EEA. de Cuba, No. 9355, (USNM: paratype, type No. 43117); Sierra Maestra July 10–20 1922, CH Ballou, SC Bruner, 4000–5000 ft. EEA. de Cuba, No. 9355, (USNM: 2 paratypes, type No. 43117); Sierra Maestra, Pico Joaquin, 5300 ft. May 18 1948, J Ferras (USNM: 1 female, MCZ: 1).

Diagnosis. *Stoiba bruneri* (Figs 14–16) is similar to *S. clarilda*, *S. flavicollis* and *S. indivisa* but it is mainly distinguished by the black antennomere XI and more rounded lateral edge of the pronotum. It is also distinguished from *S. clarilda* by its shiny black scutellum and brachypterous hind wing and from *S. indivisa* by the distinct posterior half of the elytral margin and brachypterous hind wing.

Description. Adult (n=7) length 7.0–8.5 mm, width 7.0–8.5 mm. Body (Fig. 14–16) rounded, as long as wide, discontinuous between pronotum and elytra, broadest at anterior 1/3 of elytra in dorsal view; profile moderately convex, highest at middle. Antennae pale with antennomere XI black; antennomere III slightly broader apically, almost as long as IV (Fig. 48). Mandible (Fig. 58) with 5 teeth; maxillary palpus (Fig. 60) and labial palpus (Fig. 62) compact. Pronotum (Fig. 14) brown to dark brown, hemispherical with anterior margin slightly emarginate, laterally rounded, slightly convex with surface smooth; margin area distinct in anterior half, vague in posterior half, shallowly and sparsely punctate. Elytra (Fig. 15) moderately convex, blue to dark blue, finely and moderately punctate, broadest at anterior 1/3; margin area distinctly narrower posteriorly, not extending to terminal end. Spermatheca (Fig. 73) falcate with two openings, receptacle 0.5 times as long as pump.

Distribution. Cuba: Prov. Guantánamo.



Figures 11–19. Habitus. 11–13 *Stoiba angusticollis* 11 dorsal view 12 lateral view 13 ventral view 14–16 *Stoiba bruneri* 14 dorsal view 15 lateral view 16 ventral view 17–19 *Stoiba clarildae* (Holotype) 17 dorsal view 18 lateral view 19 ventral view. (scale bar = 1.0 mm)

***Stoiba clarildae* Zayas, 1939**

http://species-id.net/wiki/Stoiba_clarildae

Figures 4, 17–19

Stoiba clarildae Zayas 1939: 253 [original description including figure]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 130 [catalog]; Takizawa 2003: 105 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Holotype (Figs 4, 17–19) in USNM (Type No. 43117).

Type locality. Cuba: Prov. Guantánamo: Baracoa, El Yunque.

Specimens examined. Cuba: Prov. Guantánamo: Baracoa, El Yunque, July 1935 (USNM: holotype, type No. 53529).

Diagnosis. *Stoiba clarildae* is similar to *S. bruneri* and *S. flavicollis*, but it differs from *S. bruneri* by pale, unicolored antennae, less explanate pronotal margin, shiny, dark brown scutellum, and fully developed hind wing. It differs from *S. flavicollis* by black elytra without metallic luster, pronotum shape, elytral base much broader than pronotal base, and elytra broadest near basal 1/3.

Description. Adult (n=1) length 7.7 mm, width 7.6 mm. Body (Figs 17–19) rounded, as long as wide greatly discontinuous between pronotum and elytra in dorsal view; profile distinctly convex, broadest and highest at anterior 1/3 of elytra. Head and pronotum brown; antennae pale brown; scutellum shiny, dark brown; prosternal process black with hypomeron brown; thoracic sterna, coxae, trochanters, proximal 1/3 of femora black; elytra black. Mandible (Fig. 58) with 5 teeth; maxillary palpus (Fig. 60) and labial palpus (Fig. 62) compact. Pronotum (Fig. 17) hemispherical with anterior margin slightly emarginate; lateral edge rounded, slightly angled at middle; pronotal disc slightly convex with surface scale-like, sparsely and finely punctate; explanate margin moderately distinct, shallowly and sparsely punctate. Elytra (Fig. 18) distinctly convex; surface scale-like, finely and moderately punctate, broadest at anterior 1/3; margin area narrower posteriorly, extending to terminal end.

Distribution. Cuba: Prov. Guantánamo.

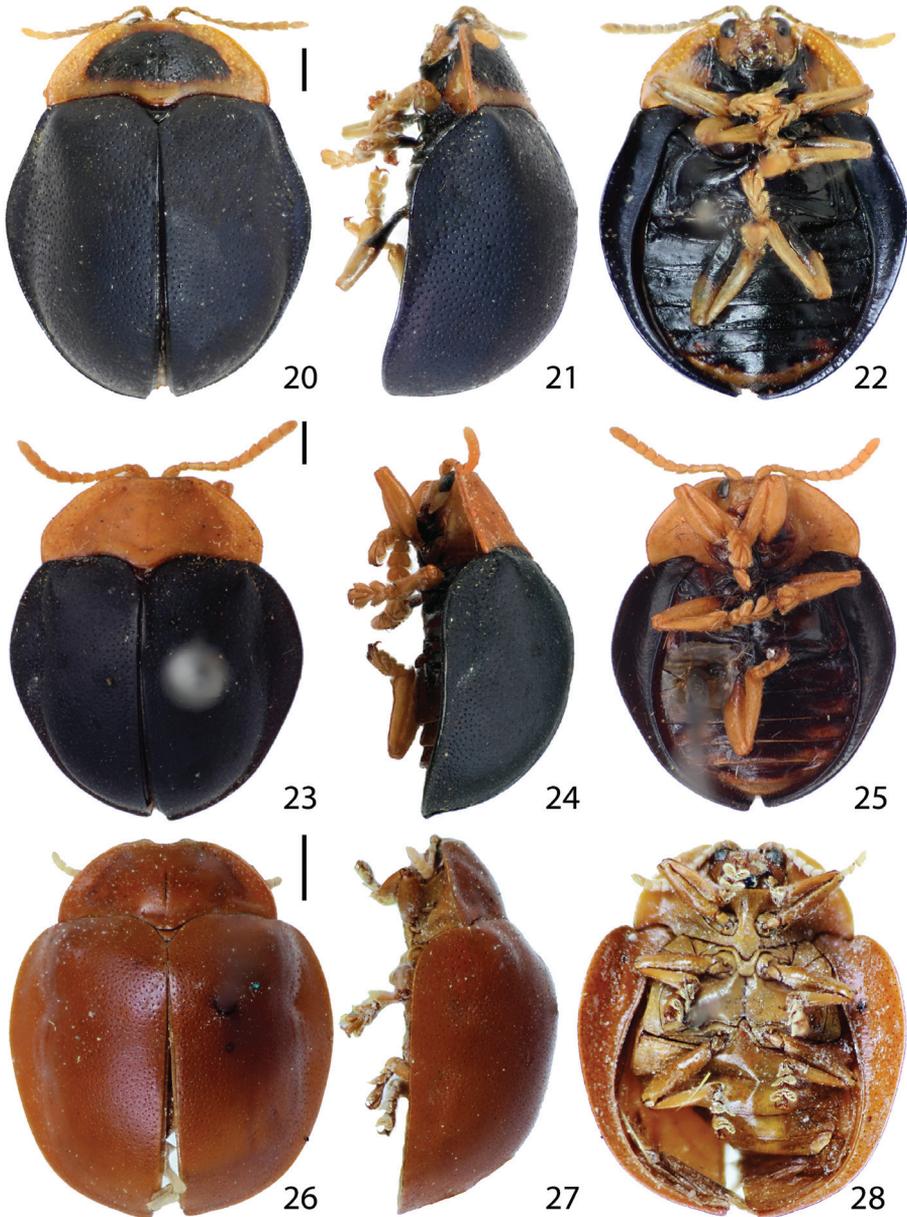
***Stoiba fascicollis* Blake, 1934**

http://species-id.net/wiki/Stoiba_fascicollis

Figs 5, 20–22

Stoiba fascicollis Blake 1934: 54 [original description including figure]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 130 [catalog]; Takizawa 2003: 105 [checklist]; Chaboo 2007: 28 [figure I misnamed]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Holotype (Fig. 5) and paratype in USNM (Type No. 44326).



Figures 20–28. Habitus. **20–22** *Stoiba fascicollis* **20** dorsal view **21** lateral view **22** ventral view **23–25** *Stoiba flavicollis* (Syntype) **23** dorsal view **24** lateral view **25** ventral view **26–28** *Stoiba fuscicornis* **26** dorsal view **27** lateral view **28** ventral view. (scale bar = 1.0 mm)

Type locality. Cuba: Prov. Sancti Spíritus: Buenos Aires, Trinidad Mts. 2350–2800 ft.

Specimens examined. Cuba: Prov. Sancti Spíritus: Buenos Aires, Trinidad Mts., May 4 1932, SC Bruner, A Ohro, EEA. de Cuba No. 9873, 2350–2800 ft. (USNM:

holotype, paratype, type No. 44326); 25 June 1940, Folk, ex F Monrós collection (USNM: 1). Buenos Aires, Trinidad Mts., May 8–14 1936, 2500–3500 ft. Darlington (MCZ: 1); Topes de Collantes, Sierra de Trinidad, June 11 1959, MW Sanderson C59–25 (INHS: 1).

Diagnosis. *Stoiba fascicollis* (Figs 20–22) is similar to *S. marginata* but it differs by the black pronotal coloration surrounded by a brown margin, unicolorated elytra, pronotal base as broad as elytral base, fully developed hind wing and proximal 1/3 of pro-femur and proximal half of meso- and meta-femur black.

Description. Adult (n=4) length 8.3–8.7 mm, width 7.5–7.6 mm. Body (Figs 20–22) oval; elytral base as broad as pronotal base in dorsal view; profile moderately convex, highest at anterior 1/3 of elytra. Antenna (Figs 22, 50) brown with antennomeres I and II reddish and polished. Mandible (Fig. 58) with 5 teeth, maxillary palpus (Fig. 60) and labial palpus (Fig. 62) compact. Pronotum (Fig. 20) hemispherical with anterior margin slightly emarginate; dorsal surface slightly convex, more coarsely punctate than elytra with black coloration in middle; margin area brown, shallowly and sparsely punctate. Scutellum shiny black. Elytra (Fig. 21) moderately convex, black with blue luster, finely and coarsely punctate; explanate margin broadest at middle, narrower posteriorly, not extending to terminal end. Hind wing fully developed. Pro-femur brown with proximal 1/3 black; meso- and meta-femur brown with proximal 1/2 black. Spermatheca (Fig. 74) falcate with 2 openings; receptacle 1/3 as long as pump; spermathecal duct long and coarsely coiled.

Distribution. Cuba: Prov. Sancti Spiritus.

Stoiba fimbrialis (Suffrian, 1868)

http://species-id.net/wiki/Stoiba_fimbrialis

Chelymorpha fimbrialis Suffrian 1868: 241 [original description]; Gemminger and Harold 1876: 3640 [catalog]; Leng and Mutchler 1914: 458 [list of the West Indies Coleoptera]; Spaeth 1914: 58 [catalog]; Blackwelder 1946: 745 [checklist]; Wilcox 1975: 152 [checklist].

Stoiba fimbrialis: Borowiec 1999: 130 [catalog]; Takizawa 2003: 106 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Unknown

Type locality. “Cuba”

Description (from original description by Suffrian 1868). Adult length 5.7 mm, width 3.8 mm. Body oval, convex, blue. Head, antennae, pronotum, legs, elytral lateral margin dusky, densely and deeply punctured. The background color is deep blue; venter is black; head (except for black eyes), antennae, lateral margin of pronotum (moderately broad, curved upward) and legs (except for infusate base) yellowish red; posterior edges of ventrites yellowish red and tan with posterior edge slightly raised. Antennae shorter and stockier than other *Stoiba* species, pronotum shiny, sparsely

punctate with medio-longitudinal depression. Scutellum short and broad, bluish black with brown center. Elytra densely and coarsely punctate, sieve-like (as surface of a thimble) with lateral margin extended beyond discal edge and having discontinuous wrinkles. Claws tanned, hook-shaped with strong basal teeth.

Distribution. “Cuba”

Remark. According to the original description, the coloration and surface of *S. fimbrialis* is very similar to *S. marginata*. However, the type specimen is missing and no figures of *S. fimbrialis* exist. It is possible that they are the same species. In this case, *S. marginata* would be a junior synonym of *S. fimbrialis*.

***Stoiba flavicollis* (Klug, 1829)**

http://species-id.net/wiki/Stoiba_flavicollis

Figures 23–25

Cassida flavicollis Klug 1829: 14 [original description as key couplet 204].

Chelymorpha flavicollis: Boheman 1854: 25 [description], 1856: 75 [checklist], 1862: 199 [checklist]; Suffrian 1868: 238 [description]; Gemminger and Harold 1876: 3640 [catalog]; Leng and Mutchler 1914: 458 [list of the West Indies Coleoptera].

Stoiba flavicollis: Spaeth 1909: 720 [catalog], 1914: 51 [catalog]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Medvedev 1993: 9 [checklist]; Borowiec 1996: 229 [faunistic record], 1999: 130 [catalog], 2002: 116 [checklist]; Takizawa 2003: 106 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Chelymorpha nigripennis: Sturm 1826: 151 [nomen nudum].

Type material. Syntypes (6) (one pictured in Figs 23–25), each with label “14169” [Klug’s collection], each with red label added “SYNTYPE, *Cassida flavicollis* Klug 1829, det. by C. Shin 2012”, deposited in ZMHB.

Type locality. “Cuba”

Specimens examined (with fully developed wings). Cuba: 14169 [Klug’s collection] (ZMHB: six syntypes); Isla de la Juventud: June 29 1921 (AMNH: 1); Prov. Ciego de Ávila: Jaronu Camaguey, Oct. 20 1934, LC Scamuzza, Bushes (USNM: 1); La Havana: ex K Kaab collection, 1916 (USNM: 3); ex FC Bowditch collection (MCZ: 5); Prov. Pinar del Río: Las Anima, S. 1500 ft. Sept. 3–5 1934, SC Bruner and AR Otero (USNM: 3); Rangel, 1935, Zayas-Garcia (UWCP: 4); Vinales, Sept. 16–22 1913 (AMNH: 1); Vinales, May 14 1913 (USNM: 1); Vinales, San Vincente, July (USNM: 1); Sierra de los Organos Vinales, 16 Jan. 1967 (UWCP: 1); Soroa, July 6–7 1974, Z and M Meszaros (UWCP: 1); Sierra Anafe, Nov. 20 1932 (MMUE: 1, USNM: 1); Sierra Anafe, July 23 1932 (MCZ: 2); Sierra Rangel, 500–1000 ft. Aug. 28–30 1927 (USNM: 1); Aspiro-Rangel, June 16 1959, NW Sanderson, C59–28 (INHS: 3); San Blas WM Mann, 1918 (USNM: 2); Sierra Rangel, 1500 ft. Aug. 29 1927 (USNM: 1); Santiago de Cuba: Gran Piedra, June 29 1955, Otero, AFA. (AMNH: 1); Loma del Gato, Sierra del Cobre, 2600–3325 ft. Sept. 24–30 1935, J

Acuña, SC Bruner, LC Scaramuzza, EEA. Cuba Ento Na.10643 (USNM: 1); Bito de Cardero Turquino, June 1964, Zayas-Garcia (UWCP: 1); Loma de Gato Sierra Maestra, May 26–28 1959 (INHS: 1); Loma de Gato Sierra del Cobre, Sept. 24–30 1935 (USNM: 1); Pico Turquino, June 1936, Darlington (USNM: 3); Villa Clara: Piedra Gorda WM (USNM: 1); Gortham acc. 68498 (USNM: 1); ex Geittner collection (HNHM: 1); ex Em Friv collection (HNHM:1): no further data (BMNH: 4; MCZ: 1; FMNH: 1; MMUE: 5; MZH: 10; NHRS: 5; USNM: 1; ZNHB: 17); Mexico: Yucatan: GF Gaumer (SEMC: 3).

Specimens examined (with brachypterous wings). Cuba: Prov. Sancti Spíritus: Jarahueca Ote. July 14–18 1927, SC Bruner (USNM: 1); Santiago de Cuba: Gran Piedra 1100 m (HNHM: 1); Loma de Gato, Range, July 3–7 1936, 3000 ft. (MCZ: 4); Loma del Gato, Sierra del Cobre, 2600–3325 ft. Sept. 24–30 1935, ex F Monrós collection (USNM: 7); Pico Turquino, South side, 1000 ft. June 1936 (USNM: 1); Pico Turquino, South side, 30 May 1985 (UWCP: 1); Sierra Maestra, July 10–20 1922, 600–900 m, CH Ballou and SC Bruner (USNM: 1); Loma de Cala to Pico Palma Mocha, Sierra Maestra, 3600–3900 ft. May 16 1948, J Acuna (USNM: 1); Loma Cardero Pico Turquino, Aug. 1 1935, J Acuna Col. (USNM: 1); Pinares 1918 WM Mann (USNM: 1); no further data (MCZ: 2, MMUE: 2, ZMHB: 2); Mexico: Yucatan: GF Gaumer (SEMC: 1).

Diagnosis. *Stoiba flavicollis* is a widely distributed species with many morphological variations such as pronotal shape (trapezoidal, rarely hemispherical without angle at postero-lateral 1/3), elytra explanate margin (broadest between anterior 1/3 and middle), elytral color (brownish black to black, often with metallic luster), and hind wing (fully-developed or brachypterous). It is mainly distinguished from *S. bruneri* by pale antennomere XI, from *S. clarilda* by elytra shape and coloration with metallic luster, and from *S. indivisa* by distinct posterior half of elytra margin and black elytra with weak metallic luster.

Description. Adult (n=118) length 6.8–9.4 mm, width 5.6–7.5 mm. Body oval (Figs 23–25), slightly or distinctly discontinuous between pronotum and elytra in dorsal view (individual variation); profile moderately convex, highest between anterior 1/3 of elytra and middle. Antennae (Figs 23, 51) reaching elytral base, brown to pale brown; antennomeres I, III and XI same in length, 2.5 times long than II; V–XI pubescent with long setae on each antennomere apex. Mandible (Fig. 58) with 5 teeth. Maxilla (Fig. 60) compact; palpifer weakly sclerotized; palpomere I 0.5 times as long as palpifer with setae apically; II 1.5 times as long as palpifer with apical region setose; III 0.8 times as long as II, setose apically; palpomere IV 1.2 times as long as III, setose with sensilla structure on apex. Labium (Fig. 62) compact; prementum subquadrate with anterior edge notched; ligula half oval with long setae; labial palpus 3-segmented; palpomere I triangular with long setae; II 2 times as long as I with long setae sub-apically; III more sclerotized than I and II with short setae and sensilla structure on apex. Pronotum (Fig. 23) hemispherical with anterior margin linear or slightly emarginate; lateral margin rounded or slightly angled or slight expanded without angle; disc moderately distinct, slightly

convex; surface scale-like, smooth; lateral margin shallowly and sparsely punctate, or rarely smooth. Procoxal process (Figs 25, 64) black with hypomeron brown. Scutellum blackish brown to black. Elytra (Fig. 24) moderately convex, often bluish black to black, rarely brownish black, finely punctate; margin broadest between anterior 1/3 and middle, narrower posteriorly. Hind wing fully developed (Fig. 92) or brachypterous (Fig. 93). Legs (Fig. 25) brown except for coxae, trochanters, base of pro- and meso-femur and proximal 1/4 of meta-femur dark brown to black. Male genitalia (Figs 68–69) curved, laid laterally (deverisement); aedeagal base piece rounded with membranous structure, terminal end pointed; tegmen Y-shaped; spicule V-shaped with jointed part slightly extended; ejaculatory duct loosened. Spermatheca (Fig. 75) falcate; receptacle round with 2 openings; pump area 4 times as long as receptacle.

Distribution. Cuba: Isla de la Juventud; Prov. Ciego de Ávila; Pinar del Río; Santiago de Cuba; Villa Clara; Mexico: Yucatan.

Remarks. *Stoiba flavicollis* is well distributed over a large area of Cuba. It is the only species with both fully developed and brachypterous wings (Figs 92–93) in our study. In the present study, we located four adult specimens collected by GF Gaumer (Dr. George Franklin Gaumer, American botanist, 1850–1929) in Yucatan, Mexico, deposited in the SEMC, and identified as *S. flavicollis*. We confirmed this species identification; three of Gaumer's four specimens have fully developed wings and one is brachypterous. This finding represents the possible extension of a range for *Stoiba* from the Caribbean islands to the Mexican mainland. However, there is no further known record of *S. flavicollis* from Yucatan or other Mexican regions.

***Stoiba fuscicornis* Blake, 1966**

http://species-id.net/wiki/Stoiba_fuscicornis

Figs 6, 26–28

Stoiba fuscicornis Blake 1966: 219 [original description including figure]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 131 [catalog]; Takizawa 2003: 106 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Holotype (Fig. 6) and four paratypes in USNM; five paratypes in IJSM.

Type locality. “Jamaica”

Specimens examined. Jamaica: Aug 9 1941, LV Burns (USNM: holotype, four paratypes, type No. 68196); St. Thomas Corn Puss Cap, Aug. 1941, CB Lewis (BMNH: 3).

Diagnosis. *Stoiba fuscicornis* (Figs 26–28) is one of the two Jamaican species (with *S. swartzii*). It is easily distinguished from *S. swartzii* by leathery brown or reddish brown coloration of pronotum and elytra (not opalescent), and distinguished from *S. angusticollis* by rounded body shape, finely and coarsely punctate surface, mandible with 4 teeth (Fig. 59), and elongate labial palpus (Fig. 61).

Description. Adult (n=8) length 6.4–8.0 mm, width 5.6–6.7 mm. Body (Figs 26–28) round; profile moderately convex, highest between anterior 1/3 of elytra and middle. Body color leathery brown to reddish brown (not opalescent); antennae (Figs 28, 52) pale brown to dark brown. Antenna (Fig. 52) reaching elytra, pale brown to dark brown; antennomere II shortest, 0.5 times as long as III or slightly shorter; III 2 times as long as broad, as long as IV or slightly longer; III–VII gradually broader; VII as long as broad; V–XI pubescent. Mandible (Fig. 59) with 4 teeth (rarely with vestigial tooth ventrally). Maxilla (Fig. 61) elongated; palpomere IV setose with fine sensilla structure on apex. Pronotum (Fig. 26) hemispherical with anterior margin slightly emarginate, slightly angled antero-laterally; disc moderately distinct, slightly convex, shiny, smooth or finely punctate; margin area moderately punctate. Scutellum shiny brown, same as pronotum. Elytra (Figs 26–27) finely punctate; explanate margin narrower posteriorly, vague in posterior 1/3.

Distribution. Jamaica: St. Thomas.

***Stoiba indivisa* Blake, 1930**

http://species-id.net/wiki/Stoiba_indivisa

Figures 7, 29–31

Stoiba indivisa Blake 1930: 218 [original description including figure]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Borowiec 1996: 229 [faunistic record], 1999: 131 [catalog]; Takizawa 2003: 106 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

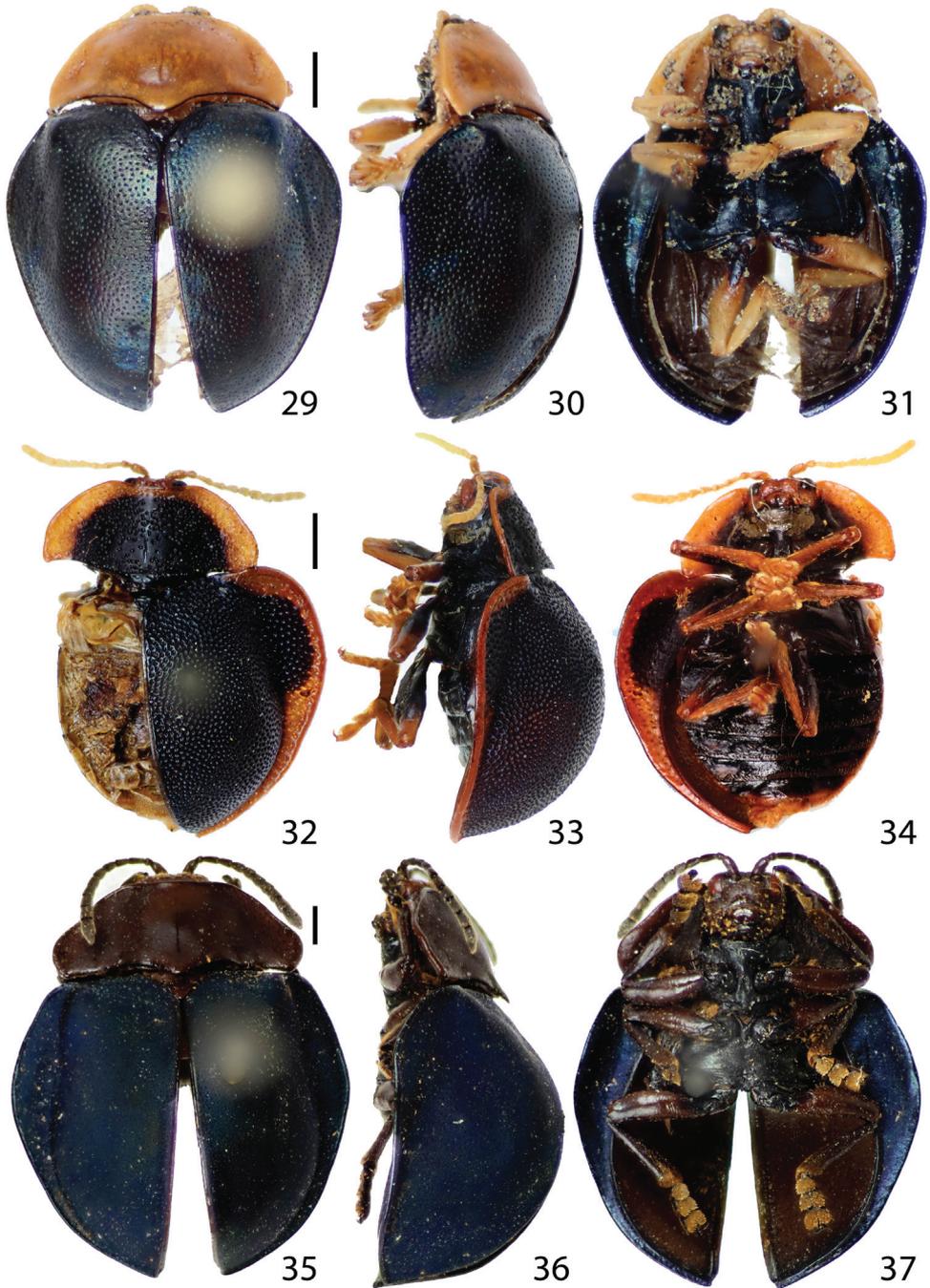
Type material. Holotype (Fig. 7) and paratype in USNM (Type No. 43116); paratype (AMNH with USNM label, Type No. 43116).

Type locality. Cuba: Prov. Guáantanamo.

Specimens examined. Cuba: Prov. Guáantanamo: WM Mann, 1918 (USNM: holotype, type No. 43116); June 22 1910, at light (AMNH: paratype, type No. 43116); ex H Rolle collection (MMUE: 1); ex Donckier collection (MMUE: 1); Prov. Santiago de Cuba: Alto de Cardero, Turquino, VI 1964, Zayas-Garcia (UWCP: 1).

Diagnosis. *Stoiba indivisa* (Figs 29–31) is distinguished from *S. bruneri* by pale antennae, from *S. clarildae* by moderately convex profile, and from *S. flavicollis* by hemispherical pronotum without anterior margin angle. It also differs by a more emarginate pronotum anterior margin than other species and by elytra dark blue (in naked eyes) to purple (under microscope) with posterior half of margin indistinct.

Description. Adult (n=5) length 6.5–6.7 mm, width 5.5–5.7 mm. Body (Figs 29–31) oval, widest at near middle in dorsal view. Head, antennae, pronotum, and legs brown with pro- and meso-femur proximal end black; meta-femur brown with proximal 1/3 black; elytra dark blue to purple and slightly opalescent. Head withdrawn into prothorax except entire eyes and epicranial suture exposed in dorsal view; inter-ocular area 2 times as broad as eye, slightly depressed medially; maxillary palpus (Fig. 60) and labial palpus



Figures 29–37. Habitus. **29–31** *Stoiba indivisa* **29** dorsal view **30** lateral view **31** ventral view **32–34** *Stoiba marginata* **32** dorsal view **33** lateral view **34** ventral view **35–37** *Stoiba nigricans* **35** dorsal view **36** lateral view **37** ventral view (scale bar = 1.0 mm)

(Fig. 62) compact. Pronotum (Figs 7, 29) hemispherical, brown with base line black; base 2 times as broad as anterior edge; anterior edge moderately emarginate, anterior 2/3 of lateral edge gradually broader, curved at posterior 1/3; margin moderately defined, sparsely punctate. Procoxal process (Fig. 31) slightly convex, shiny, black. Scutellum triangular, shiny black. Elytra (Fig. 30) moderately convex with surface scale-like, shiny, finely and coarsely punctate; umbone moderately projected and angled; margin distinct in anterior half and vague in posterior half. Hind wing fully developed. Legs (Fig. 31) brown with coxae, trochanters, proximal end of pro- and mesofemur, proximal 1/3 metafemur black.

Distribution. Cuba: Guántanamo; Santiago de Cuba.

***Stoiba lurida* (Suffrian, 1868)**

http://species-id.net/wiki/Stoiba_lurida

Chelymorpha lurida Suffrian 1868: 240 [original description]; Gemminger and Harold 1876: 3640 [catalog]; Leng and Mutchler 1914: 458 [list of the West Indies Coleoptera]; Spaeth 1914: 59 [catalog]; Blackwelder 1946: 745 [checklist]; Wilcox 1975: 152 [checklist].

Stoiba lurida: Borowiec 1999: 131 [catalog]; Takizawa 2003: 106 [checklist-misspelled]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Unknown

Type locality. “Cuba”

Description (from original description by Suffrian 1868). Adult length 9.0 mm, width 7.4 mm. *Stoiba lurida* is generally similar to large size of *S. flavicollis*, but *S. lurida* shows brownish yellow pronotum when it is dried and shows gold shimmering in fresh specimens; pronotal and elytral margins more coarsely and roughly punctate. Sometimes it was identified as *Calligrapha spiraeae* (Say) in North America. Body slightly oval, convex, broadest within anterior half of elytra, dark reddish brown, opalescent with punctures on lateral margins of pronotum and elytra. Pronotum with posterior margin broad, flat; disc finely and sparsely punctate, lateral margin slightly more punctate. Elytra with posterior half of lateral margin not clearly explanate; lateral decline margin area slightly more punctate than raised edge area. Ventral surface (abdomen) brownish yellow to reddish yellow.

Distribution. “Cuba”

***Stoiba marginata* Blake, 1934**

http://species-id.net/wiki/Stoiba_marginata

Figures 8, 32–34

Stoiba marginata Blake 1934: 53 [original description including figure]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 131 [catalog]; Takizawa 2003: 106 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Holotype and paratype in USNM (Type No. 44325).

Type locality. Cuba: Prov. Sancti Spíritus, Buenos Aires, Trinidad Mts., 2350–2800 ft.

Specimens examined. Cuba: Prov. Sancti Spíritus, Buenos Aires, Trinidad Mts., 2350–2800 ft. May 4 1932, SC Bruner, Otero. EEA de Cuba No. 9872. (USNM: holotype, paratype, type No. 44325); June 17–23 1939, CT Parsons (MCZ: 1).

Diagnosis. *Stoiba marginata* (Figs 32–34) differs from *S. fascicollis* by the elytral base broader than the pronotal base, black pronotal coloration extending to the base, prosternum black, coarsely punctate dorsal surface of the pronotum and elytra, black elytral disc with coloration extending to antero-lateral region of marginal area and femora black over their proximal half.

Description. Adult (n=3) length 8.2–8.4 mm, width 7.6–7.8 mm. Body (Figs 32–34) rounded, widest and highest near middle. Color of head, antennae, pronotum margin area and elytra margin area brown except for black antero-lateral region of elytra margin; legs brown with coxae, trochanters and over proximal half of femora black. Head withdrawn into prothorax, up to half of eyes in dorsal view; inter-ocular area 2 times as broad as eye, flat with cranial suture and antennal sockets medially; maxillary palpus (Fig. 60) and labial palpus (Fig. 62) compact. Pronotum hemispherical with anterior edge slightly emarginate; surface coarsely and roughly punctate; base 2.2 times as broad as anterior edge; disc well defined by black coloration surrounded brown margin area except for anterior region. Prosternum (Fig. 34) black with brown hypomeron. Scutellum triangular, black, scale-like or occasionally punctate. Elytra (Fig. 33) moderately convex with surface coarsely and roughly punctate; discal area defined by black coloration with black coloration extending to middle of margin area; umbone slightly projected; margin area mainly brown, narrower posteriorly, extending to rear end. Hind wing brachypterous. Legs (Fig. 34) mainly brown with coxae, trochanters, and over proximal half of femora black. Spermatheca (Fig. 77) falcate with two openings, gradually narrower; receptacle area narrow and not well defined; spermathecal duct loosely coiled.

Distribution. Cuba: Sancti Spíritus.

Stoiba nigricans Zayas, 1939

http://species-id.net/wiki/Stoiba_nigricans

Figures 9, 35–37

Stoiba nigricans Zayas 1939: 255 [original description including figure]; Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 131 [catalog]; Takizawa 2003: 106 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Type material. Holotype in USNM (Type No. 53530).

Type locality. Cuba: Prov. Santiago de Cuba: Loma Gato, Clemente.

Specimens examined. Cuba: Prov. Santiago de Cuba: Loma Gato, Clemente, July 1938 (USNM: holotype No. 53530); Sierra Maestra 800–4000 m, Aug 7 1929, Frere Clement, ex FC Monrós collection (USNM: 1).

Diagnosis. *Stoiba nigricans* (Figs 35–37) is distinguished by dark antennae, brownish black pronotum and elongate, C-shaped spermatheca, these serving to separate it from *S. bruneri* and *S. clarildae*. It also differs from *S. bruneri* by the unicolorous antennae and trapezoidal pronotum, and from *S. clarildae* by the pronotal base as broad as the elytral base.

Description. Adult (n=2) length 8.8–9.0mm, width 6.9–7.0mm. Body (Figs 35–37) oval, broadest between anterior 1/3 and middle of elytra in dorsal view; profile moderately convex, highest at middle of elytra. Antennae (Figs 35, 55) brownish black with antennomeres VI–XI pubescent with pale setae; antennomeres I–IV shiny, glabrous; antennomere III 3 times as long as II, 1.3 times as long as IV. Mandible (Fig. 58) with 5 teeth, maxillary palpus (Fig. 60) and labial palpus (Fig. 62) compact. Pronotum (Fig. 35) brownish black, trapezoidal with anterior edge linear; antero-lateral edge smoothly angled, anterior 2/3 gradually broader, rounded and slightly narrower in posterior 1/3; disc slightly convex; with discal surface smooth, scale-like; lateral margin region finely and sparsely punctate. Elytra (Fig. 35) bluish black, slightly opalescent, finely punctate; margin area distinct, narrower posteriorly. Hind wing brachypterous. Spermatheca (Fig. 78) elongate, C-shaped with two openings, receptacle 0.2 times as long as pump; spermathecal duct short and coarsely coiled.

Distribution. Cuba: Prov. Santiago de Cuba.

Stoiba oteroi Zayas, 1952

http://species-id.net/wiki/Stoiba_oteroi

Stoiba oteroi Zayas 1952: 72 [original description includes figure]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 131 [catalog]; Takizawa 2003: 106 [checklist]; Borowiec and Świątojańska 2012 [online catalog].

Type material. Unknown.

Type locality. Cuba: Villa Clara, Lomas de Trinidad.

Description (from original description by Zayas 1952). Adult length 8.0 mm, width 7.0 mm. Body flattened, rounded, slightly steel black with antennae, head, margin area of pronotum, and legs (except basal half of femora) dull yellow. Head with anterior half visible in dorsal view; antennae short, yellow, brighter distally; eyes black; mandible and palpi ferruginous at apex. Pronotum small, narrow, and short with discal area widely dark stained and with strongly marked longitudinal groove medially; surface sparsely and coarsely punctate, more punctate medially extending posteriorly. Scutellum shiny black. Elytra dark stained as on pronotum, symmetrically and deeply punctured with external margins slightly expanded and declined. Hind wing fully developed. Legs dull yellow with tips of tibiae and femora black.

Distribution. Cuba: Prov. Villa Clara.

***Stoiba swartzii* (Thunberg in Schönherr 1808)**

http://species-id.net/wiki/Stoiba_swartzii

Figures 38–43

Cassida swartzii Thunberg in Schönherr 1808: 229 [original description with figure]; Sekerka 2008: 305 [Thunberg's collection list in Uppsala University Zoological Museum].

Chelymormpha swartzii: Boheman 1854: 26 [description], 1856: 76 [checklist]; Leng and Mutchler 1917: 212 [supplement of previous list].

Chelymormpha swartzii: Boheman 1862: 199 [checklist]; Gemminger and Harold 1876: 3641 [catalog]; Leng and Mutchler 1914: 458 [list of the West Indies Coleoptera].

Stoiba swartzii: Spaeth 1914: 51 [catalog]; Blake 1966: 214 [figure]; Borowiec 1996: 229 [faunistic record], 1999: 131 [catalog].

Stoiba swartzii: Blackwelder 1946: 743 [checklist]; Wilcox 1975: 151 [checklist]; Chaboo 2000: 379 [outgroup in phylogenetic analysis]; Takizawa 2003: 107 [checklist]; Borowiec and Świętojańska 2012 [online catalog].

Stoiba rufa Blake 1966: 218 [original description including figure]; Wilcox 1975: 151 [checklist]; Borowiec 1999: 131 [catalog]; Takizawa 2003: 106 [checklist]; Borowiec and Świętojańska 2012 [online catalog]. *syn. nov.*

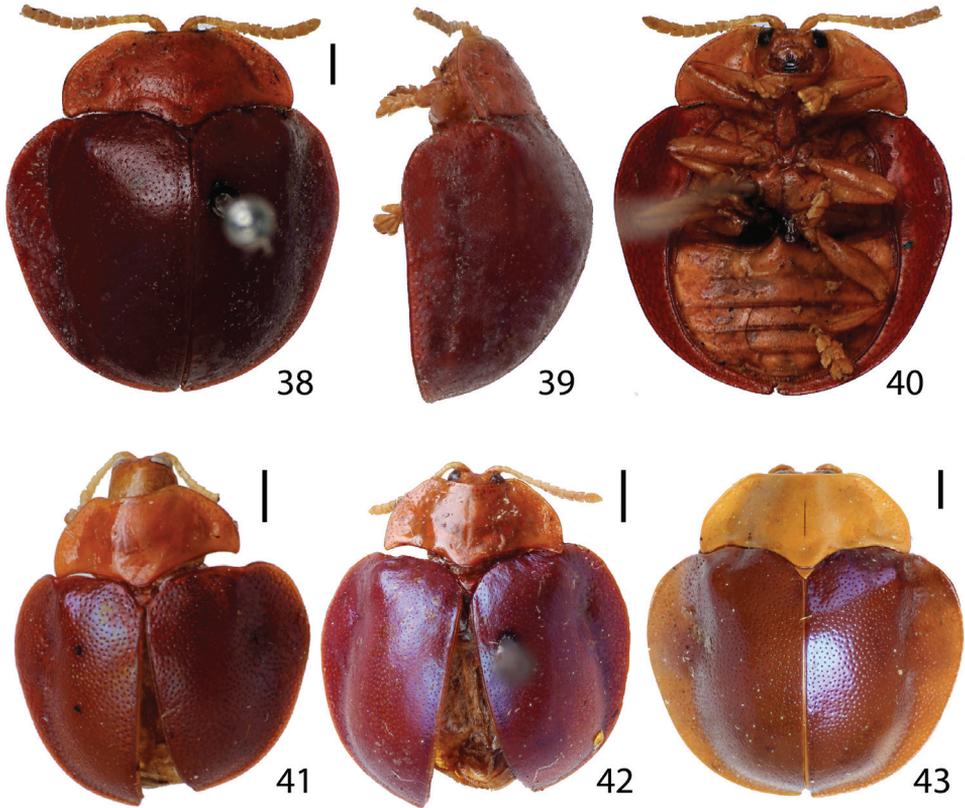
Type material. Holotype (Figs 38–40), with label “Jamaica”, with red label added “HOLOTYPE, *Cassida swartzii* Thunberg 1808, det. by C. Shin 2012”, deposited in NHRS.

Type locality. “Jamaica”

Specimens examined. Jamaica: Clarendon Parish: Cumberland District, 3000 ft. Dec. 15–18 1919 (AMNH: 1); W Robinson (AMNH: 2); Kingston Parish: Dec. 1967, NLH Krauss (USNM: 1); Portland Parish: Morces Gap, July 22 1958, MW Sander-son (INHS: 1); St. Andrew Parish: Cinchona Garden in Blue Mts. on vine, June 13 1931, M Kisliuk (AMNH: 1, USNM: 21); Cinchona Garden in Blue Mts. 4900 ft. July 23 1923, FR Mason (MMUE: 1); St. Thomas Parish: Corn Puss Gap, June 1937 (CMNH: 2); Morant Bay Rd. 14.5 miles east of Kingston, 21 July 1963, TH Farr (USNM: holotype of *S. rufa*, type No. 68195); Morant Bay Rd. 14.5 miles east of Kingston, Sept. 6 1964, TH Farr (USNM: paratype of *S. rufa*, type No. 68195); no further data: ex Holland collection (CMNH: 2); F Klages, ex Holland collection (CMNH: 1); “5433C” (BMNH: 1); “45 100” [1845 Jamaica, purchased from Gosse] (BMNH: 1); “1867, 6756” [67–56, acquired in 1867] (BMNH: 2); ex Baly collection [retained by Spaeth] (MMUE: 1); no further data (NHRS: holotype; UWCP: 2).

Diagnosis. *Stoiba swartzii* (Figs 10, 38–43) is distinguished from *S. angusticollis* and *S. fuscicornis* by its brown pronotum and reddish and opalescent elytra. It also differs from *S. angusticollis* by its 4-toothed mandible (Fig. 59), elongate maxillary palpus (Fig. 61), and elongate labial palpus (Fig. 63) and from *S. fuscicornis* by a moderately distinct elytral margin.

Description. Adult (n=42) length 5.2–10.3 mm, width 5.0–9.6 mm. Body (Figs 10, 38–43) rounded to oval, broadest at anterior 1/3 of elytra in dorsal view; pro-

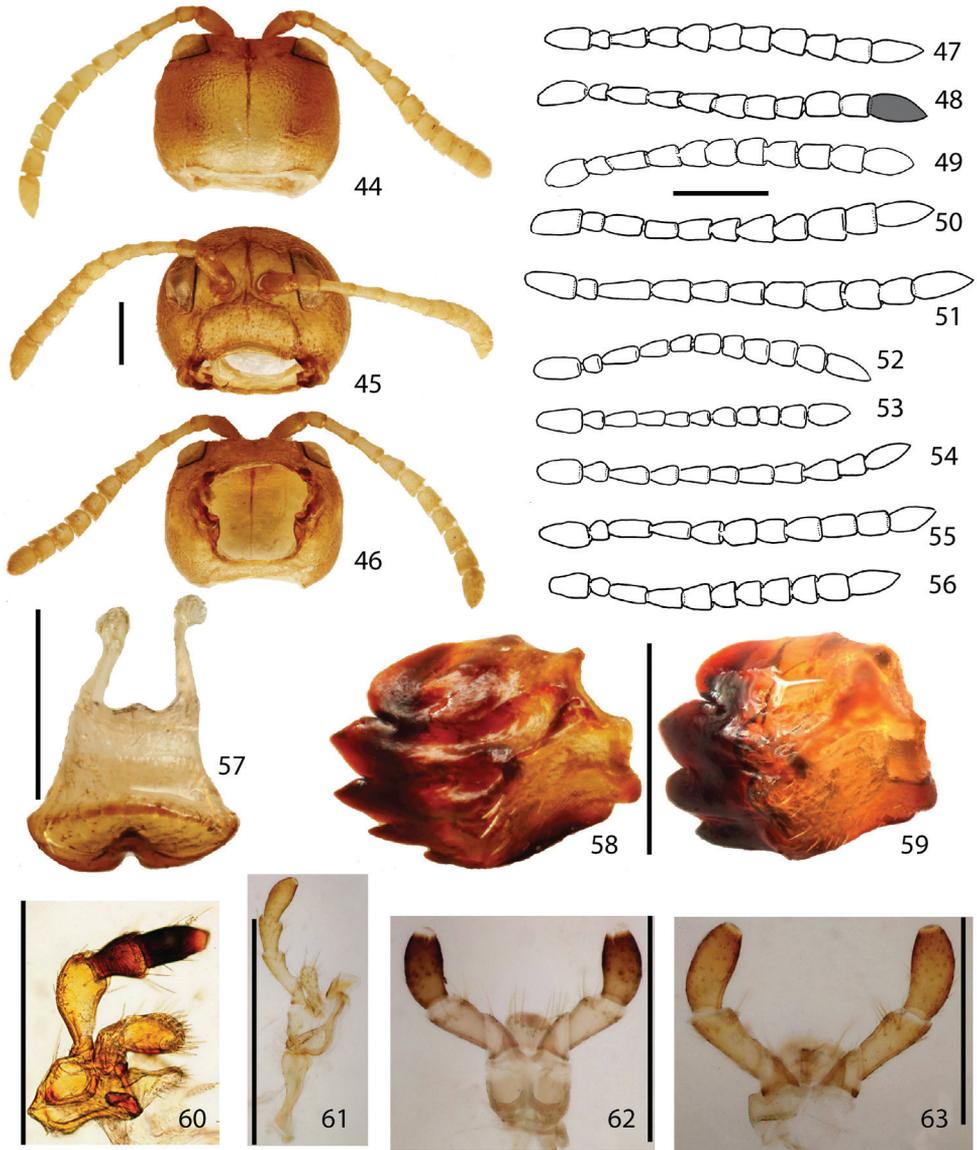


Figures 38–43. Habitus. **38–40** *Stoiba swartzii* (Holotype) **38** dorsal view **39** lateral view **40** ventral view **41** paratype of *Stoiba rufa* (= *S. swartzii*) **42–43** *Stoiba swartzii*. (scale bar = 1.0 mm)

file moderately convex, highest at anterior 1/3 of elytra. Antennae (Figs 38, 56) pale brown; antennomere III 2 times as long as II; IV as long as III or slightly shorter; V–XI pubescent; VII as long as broad; XI as long as antennomere I. Mandible (Fig. 59) with four distinct teeth with one vestigial tooth ventrally or absent; maxillary palpus (Fig. 61) and labial palpus (Fig. 63) elongated. Pronotum (Figs 38–43) hemispherical or trapezoidal with anterior margin slightly emarginated or linear. Scutellum shiny, yellowish brown to deep red (coloration same as pronotum or elytra). Elytra reddish brown to deep red, finely punctate, distinctly opalescent (blue); elytra margin area often entirely distinct. Hind wing fully developed.

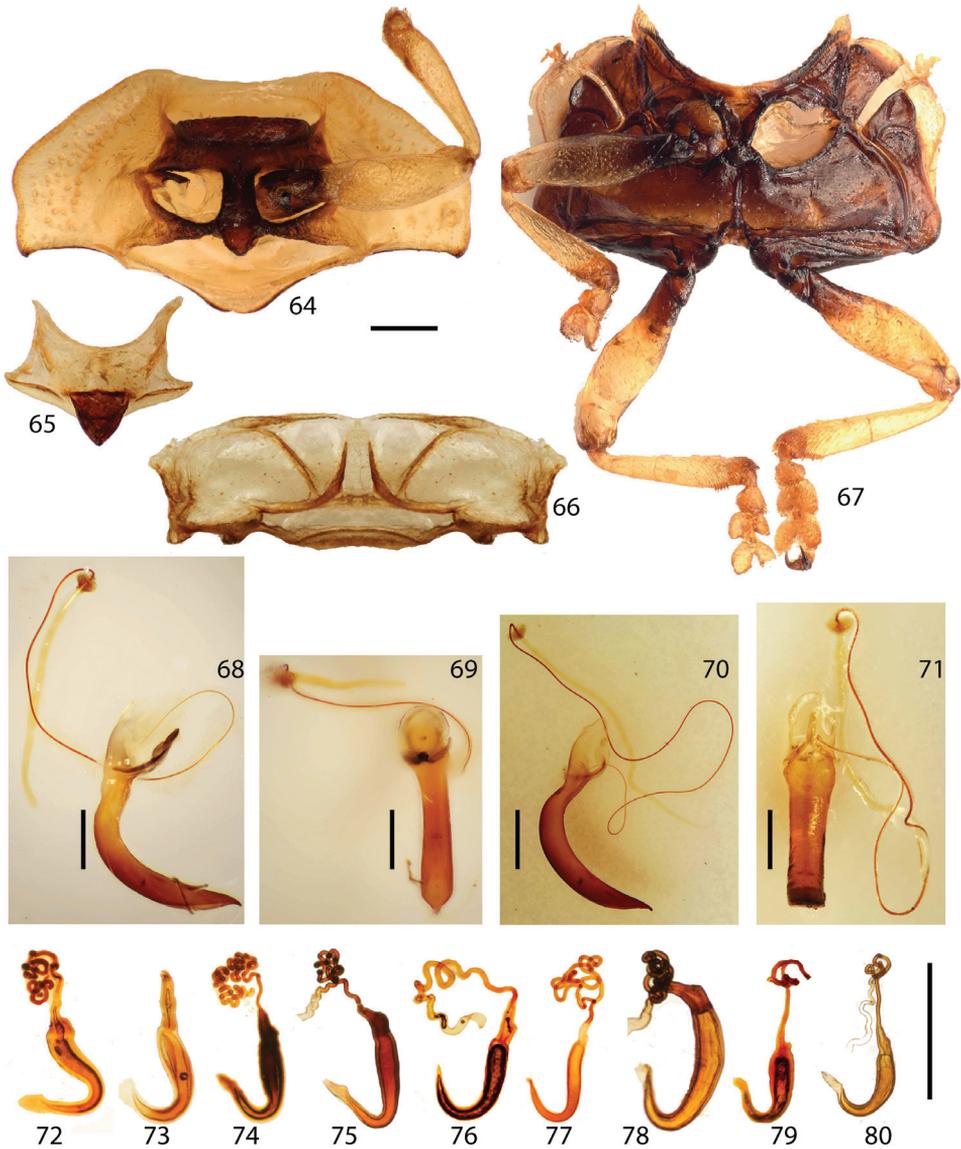
Distribution. Jamaica: Clarendon Parish; Kingston Parish; Portland Parish; St. Andrew Parish; St. Thomas Parish.

Nomenclature. Borowiec (1996) indicated Boheman (1862) as the author of *S. swartzii*. Sekerka (2008) clarified Thunberg as the author and the year (1808). In the original description (Thunberg in Schönherr 1808), Thunberg described with both named *Cassida swartzii* and *C. swartzii*. According to ICZN [Article 32.2.1], “If a name is spelled in more than one way in the work in which it was established, then, except



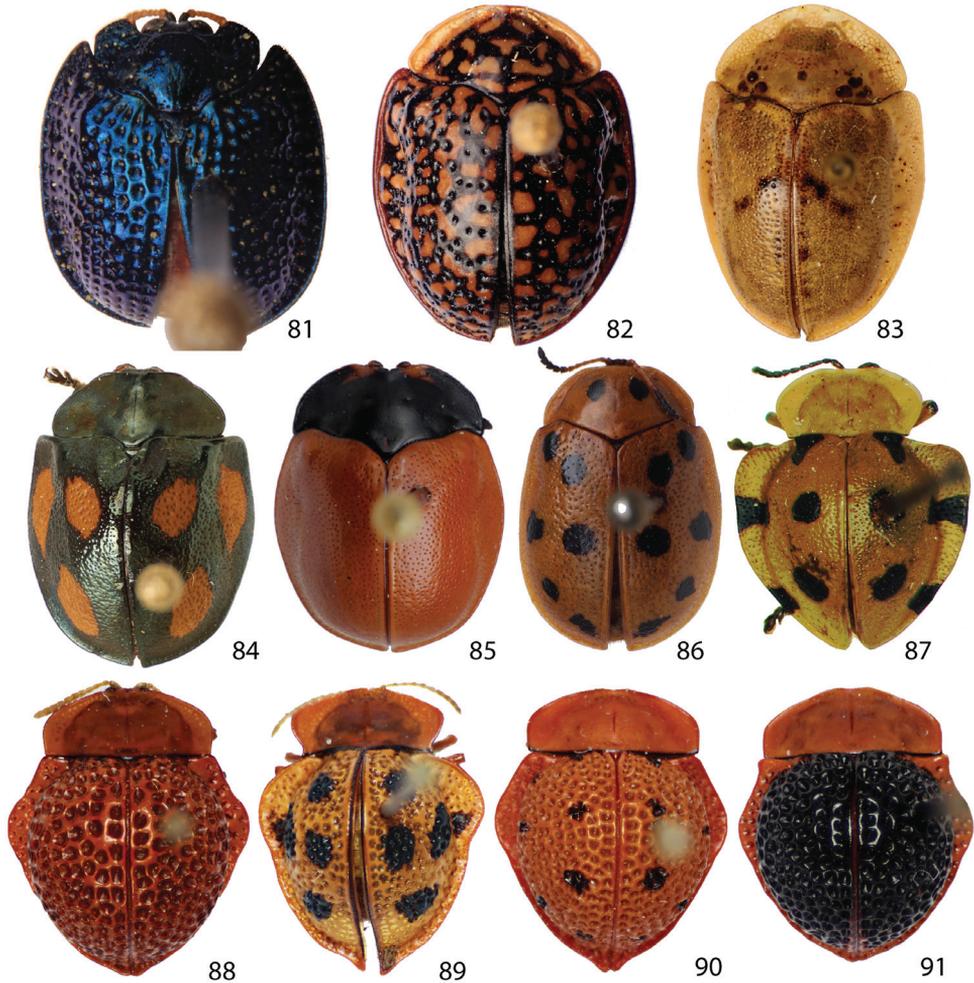
Figures 44–63. Head of *Stoiba flavicollis*. **44** dorsal view **45** anterior view **46** ventral view **47–56** antennae **47** *Stoiba angusticollis* **48** *Stoiba bruneri* **49** *Stoiba clarilidae* **50** *Stoiba fascicornis* **51** *Stoiba flavicollis* **52** *Stoiba fuscicornis* **53** *Stoiba indivisa* **54** *Stoiba marginata* **55** *Stoiba nigricans* **56** *Stoiba swartzii* **57–63** mouth parts **57** labrum (*S. flavicollis*) **58** mandible (*S. flavicollis*) **59** mandible (*S. swartzii*) **60** maxilla (*S. flavicollis*) **61** maxilla (*S. swartzii*) **62** labium (*S. flavicollis*) **63** labium (*S. swartzii*). (scale bar = 1.0 mm)

as provided otherwise in this Article, the correct original spelling is that chosen by the First Reviser [Art. 24.2.3] (or, if applicable, by an original author when acting as First Reviser [Art. 24.2.4]).” Therefore, the correct name is *S. swartzii* which was used by the first reviser, Boheman (1854).



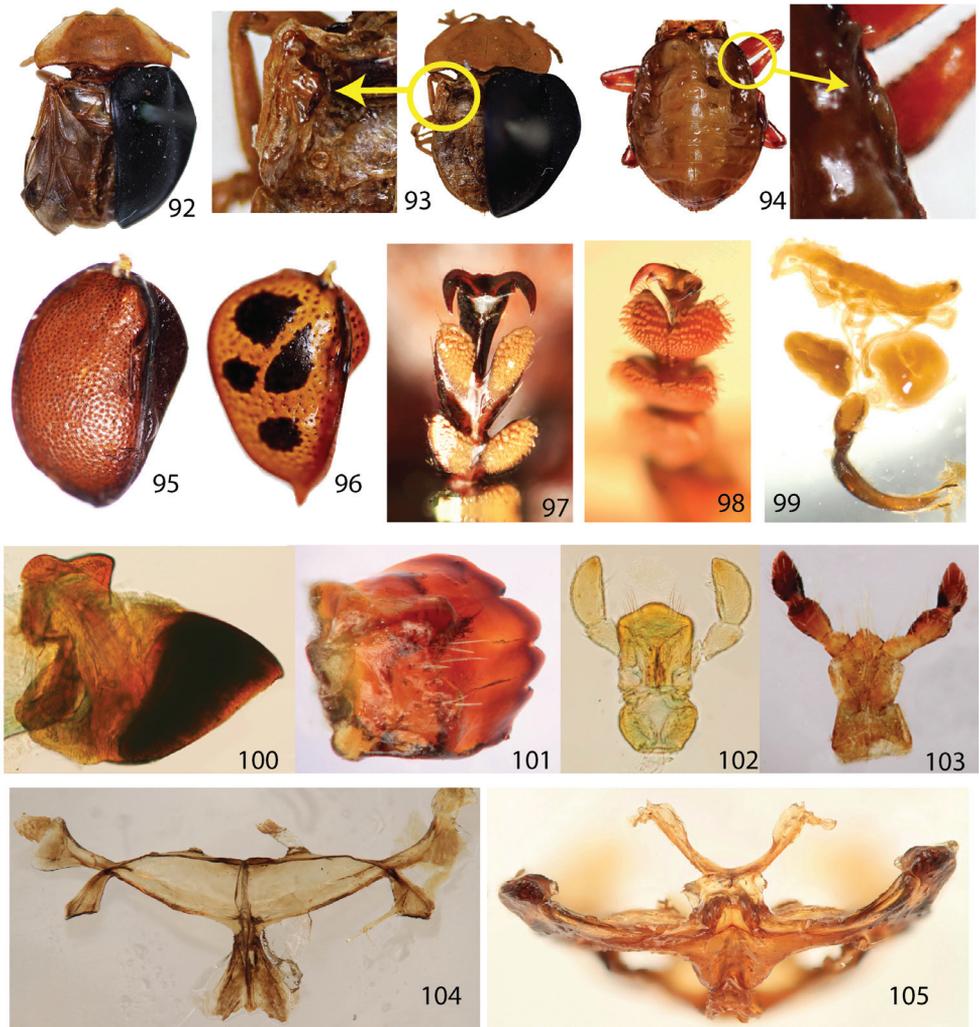
Figures 64–80. 64–67 Thorax. 64 prosternum 65 mesonotum 66 metanotum 67, meso-, metathoracic sterna 68–69 male genitalia (*S. flavicollis*) 70–71 male genitalia (*S. swartzii*) 72–80 Spermathecae 72 *Stoiba angusticollis* 73 *Stoiba bruneri* 74 *Stoiba fascicornis* 75 *Stoiba flavicollis* 76 *Stoiba fuscicornis* 77 *Stoiba marginata* 78 *Stoiba nigricans* 79 *Stoiba swartzii* 80 *Stoiba rufa* (= *Stoiba swartzii*). (scale bar = 1.0 mm)

Remarks. The type specimen of *S. swartzii* is included in the catalog of Thunberg’s collection at UUZM, however the physical location of the specimen is within Schöenherr’s collection at NHRS. Thunberg described *S. swartzii* mainly by coloration. He mentioned the scutellum with the same color as the elytra. We found the color of scutellum can be the same color of either the pronotum or the elytra. Blake



Figures 81–91. Outgroup **81** *Spaethiella* sp. **82** *Asteriza flavicornis* **83** *Physonota alutacea* **84** *Stolas* sp. **85** *Chelymorpha* sp. **86** *Phytodectoidea* sp. **87** *Elytrogonia bulla* **88** *Elytrogonia Bacca* **89** *Elytrogonia gemmata* **90** *Elytrogonia nigrodorsata* **91** *Elytrogonia quatuordecimmaculata*.

(1966) distinguished *S. swartzii* from *S. rufa* by mentioning the coloration of *S. swartzii* as having “deep purple blue or even deep reddish blue elytra.” It needs to be clarified that the purple or blue coloration is not the basic color of elytra but is from opalescence. Blake (1966) also used body size, proportion, and other coloration to distinguish between *S. swartzii* and *S. rufa*. During our study, we found that different sized specimens of *S. swartzii* have different color variations. We also found variation in body proportion, elytral width, and pronotum shape (Figs 10, 38, 41–43). The figure of *S. swartzii* in the original description (Thunberg in Schönherr 1808) shows a rounded body shape, which is different from the oval body shape on the



Figures 92–105. 92–94 Hind wings 92 fully developed hind wing (*S. flavicollis*) 93 brachypterous wing (*S. flavicollis*) 94 vestigial wing (*E. gemmata*) 95–96 ventral surface of elytra 95 *Stoiba flavicollis* 96 *Elytrogonia gemmata*. 97–98 basal tooth of claw 97 *Stoiba flavicollis* 98 *Elytrogonia gemmata* 99 male genitalia of *Asteriza flavicornis* 100 mandible (*Spaethiella* sp.) 101 mandible (*A. flavicornis*) 102 labium (*Spaethiella* sp.) 103 labium (*A. flavicornis*) 104 metendosternite (*S. flavicollis*) 105 metendosternite (*E. gemmata*).

holotype of *S. rufa* (Fig. 10). However, the paratype of *S. rufa* (Fig. 41), which is from the same collecting event and designated by Blake (1966), looks more similar to other *S. swartzii* (Figs 38, 42–43). After comparing the holotypes of *S. swartzii* and *S. rufa* (Fig. 10), and other specimens, including a female genitalia comparison (Figs 79–80), we concluded that the variation between *S. swartzii* and *S. rufa* is continuous. Therefore, we synonymized *S. rufa* with *S. swartzii*.

Discussion

Phylogeny. Parsimony analysis found the four most parsimonious trees with 83 steps (CI=0.59, RI=0.78). Monophyly (Fig. 106) of the genus *Stoiba* is supported by three characters—pale yellow antennae (#1), antennomere VII broader than its length (#4), and rounded basal line of pronotum (#12). The pale coloration of antennae (#1) was hypothesized as a possible synapomorphy of genera *Stoiba* and *Elytrogonia* based on the identification keys by Borowiec and Świętojańska (2012). Our study shows that pale antennae evolved independently in *Stoiba* and *Elytrogonia*. *Stoiba* and *Elytrogonia* were thought to be sister taxa, or *Elytrogonia* was thought to be a derived group from *Stoiba* because of vestigial hind wing (Blake 1930; Chaboo 2007). For the phylogenetic analysis, we made three character states [fully developed (Fig. 92), brachypterous (Fig. 93), and vestigial (Fig. 94)] for the hind wing modification. According to our analysis, *Stoiba* and *Elytrogonia* are not sister taxa. We show that the brachypterous wings of *Stoiba* and the vestigial wings of *Elytrogonia* evolved independently in each clade. Other characters [membranous meso-, metanotum, fused thoracic notum (Fig. 94), fused elytral suture (Figs 87–91), and broad and rigid metendosternite (Fig. 105)] occurred only in *Elytrogonia*. Those *Stoiba* species with brachypterous wings showed the same morphology as in other *Stoiba* species with fully developed wings.

The genus *Stoiba* is divided into two clades: seven Cuban species grouped by a tightly coiled spermathecal duct (#34) and two Jamaican species grouped by a mandible with 4 teeth or 4 teeth and vestigial teeth (#5).

Five *Stoiba* species with brachypterous wings form a clade within the seven Cuban species. Interestingly, this clade can also be supported by antennomere VII longer than its width (#4), which is a reversed character state from the monophyly of the genus *Stoiba*.

The reduced hind wing is one of the most interesting features of *Stoiba* and *Elytrogonia*. Generally, it occurs because of stable habitats, metabolism efficiency, parasitism, or trade-offs (Zera 1985; Roff 1990; Wagner and Liebherr 1992; Mole and Zera 1993). We cannot tell what caused this hind wing modification. However, this hind wing modification is not related to body size or sexual dimorphism.

Type specimens. The depositories for types of *S. angusticollis*, *S. fimbrialis*, *S. lurida*, *S. oteroi* are unknown.

According to Horn and Kahle (1936) and Borowiec and Świętojańska (2012), the possible depositories of the type specimens of *S. angusticollis*, *S. fimbrialis*, and *S. lurida* (Suffrian collection) are MLUH or ZMHB. We contacted both museums, but those type specimens were not located in MLUH and ZMHB.

Dr. Michael A. Ivie (Montana State University) provided photographs of the type specimen of *S. barroi*, which we confirmed in several drawers of photographs of the Zayas cassidine collection taken by Marc Branham and Jennifer Zaspel (University of Florida). However, the type specimen of *S. oteroi* was not found in these same drawers or in the rest of the Zayas collection of Cassidinae.

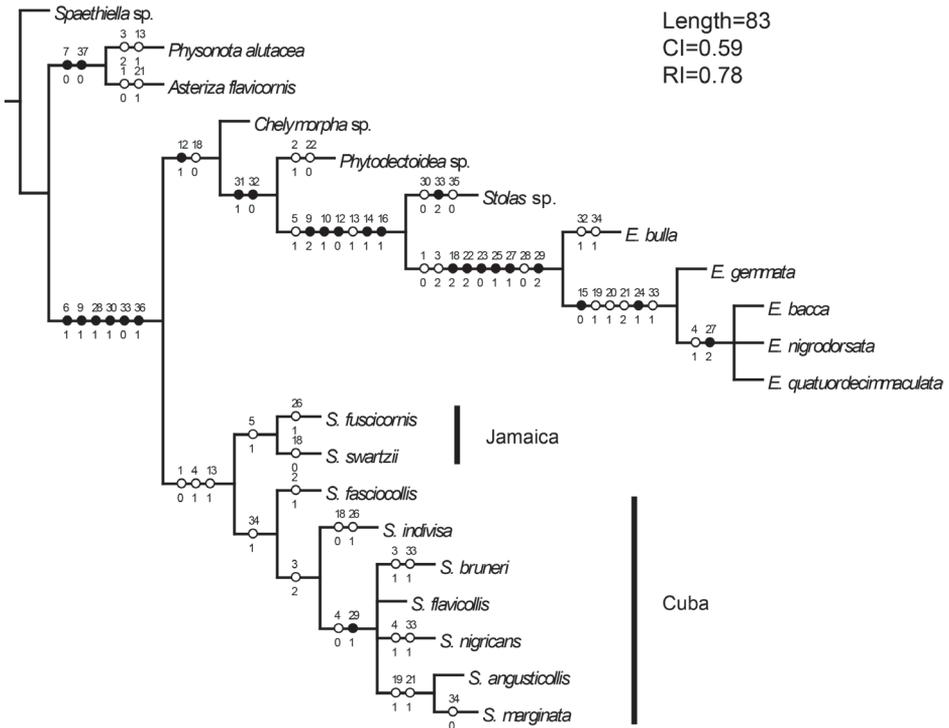


Figure 106. Consensus tree.

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References

Blackwelder RE (1946) Checklist of the coleopterous insects of Mexico, Central America, The West Indies and South America, Part 4. U.S. National Museum, Bulletin 185: 1–763.

- Blake DH (1930) Synonymies of Antillean Chrysomelidae with descriptions of new species. *Bulletin of the Brooklyn Entomological Society* 25: 209–223.
- Blake DH (1934) New West Indian and Central American Chrysomelidae. *Bulletin of the Brooklyn Entomological Society* 29: 45–56.
- Blake DH (1966) Ten new chrysomelid beetles from the West Indies. *Proceedings of the Entomological Society of Washington* 68: 213–222.
- Boheman CH (1854) *Monographia Cassidarum. Tomus secundus. Holmiae*, 506 pp. + 2 tab.
- Boheman CH (1856) *Catalogue of Coleopterous Insects in the Collection of the British Museum, Part IX, Cassididae. London*, 225 pp.
- Boheman CH (1862) *Monographia Cassidarum. Tomus quartus. Holmiae*, 504 pp.
- Borowiec L (1995) Tribal classification of the cassidoid Hispinae (Coleoptera: Chrysomelidae). In: Pakaluk J, Slipinski SA (Eds) *Biology, phylogeny and classification of Coleoptera. Muzeum I Instytut Zoologii, Warszawa (Poland)*, 451–558.
- Borowiec L (1996) Faunistic records of Neotropical Cassidinae (Coleoptera: Chrysomelidae). *Polskie Pismo Entomologiczne* 65: 119–251.
- Borowiec L (1999) *A World Catalogue of the Cassidinae (Coleoptera: Chrysomelidae). Biologica Silesiae, Wrocław*, 476 pp.
- Borowiec L (2002) New records of Neotropical Cassidinae, with description of three new species (Coleoptera: Chrysomelidae). *Genus* 13: 43–138.
- Borowiec L, Świętojańska J (2012) Cassidinae of the world – an interactive manual (Coleoptera: Chrysomelidae) <http://www.biol.uni.wroc.pl/cassidae/katalog%20internetowy/index.htm> [date of access, Sept. 14th 2012]
- Chaboo CS (2000) Revision and phylogeny of the Caribbean genus *Elytrogonia* (Coleoptera: Chrysomelidae: Cassidinae: Stolaini). *Coleopterists Bulletin* 54(3): 379–394. doi: 10.1649/0010-065X(2000)054[0379:RAPOTC]2.0.CO;2
- Chaboo CS (2007) Biology and phylogeny of Cassidinae Gyllenhal (tortoise and leaf-mining beetles) (Coleoptera: Chrysomelidae). *Bulletin of the American Museum of Natural History* 305: 1–250. doi: 10.1206/0003-0090(2007)305[1:BAPOTC]2.0.CO;2
- Evenhuis NL (2012) Abbreviations for Insect and Spider Collections of the World <http://hbs.bishopmuseum.org/codens/codens-inst.html> [date of access, Sept. 14th 2012]
- Gemminger M, von Harold E (1876) *Catalogus Coleopterorum hucusque descriptorum synonymicus et systematicus. Chrysomelidae (II), Languriidae, Erotylidae, Endomychidae, Coccinellidae, Coryophidae, Platypyllidae, Acredit Index Generum universalis* 12: 3479–3822.
- Goloboff PA (1998) Nona <http://www.cladistics.com/aboutNona.htm> [date of access, Sept. 14th 2012]
- Hincks WD (1952) The genera of the Cassidinae (Coleoptera: Chrysomelidae). *Transactions of the Royal Entomological Society of London* 103: 327–358. doi: 10.1111/j.1365-2311.1952.tb01061.x
- Horn W, Kahle I (1936) Über entomologische Sammlungen, Entomologen & Entomo-Museologie (Ein Beitrag zur Geschichte der Entomologie). *Entomologische Beihefte, Band 3*: 161–296 + 10 Plates [Tafel XVII–XXVI].

- Hsiao TH, Windsor DM (1999) Historical and biological relationships among Hispinae inferred from 12S mtDNA sequence data. In: Cox ML (Ed) *Advances in Chrysomelidae Biology 1*, Backhuys Publishers, Leiden 39–50.
- Jolivet P (1959) *Recherches sur l'aile des Chrysomeloidea (Coleoptera)*. PhD Thesis, Paris, France: Paris University and Memoires de l'Institut Royal des Sciences Naturelles Belgique 58: 1–152.
- Jolivet P, Hawkeswood TJ (1995) *Host-plants of Chrysomelidae of the world*. Backhuys, Leiden, 281 pp.
- Jolivet P, Verma KK (2002) *Biology of leaf beetles*. Intercept Ltd, Andover, USA, 332 pp.
- Klug K (1829) *Preissverzeichniss vorräthiger Insecten-Doubletten des Königl. Zoologischen Museums der Universität, Berlin*, 18 pp.
- Lawrence JF, Britton EB (1991) *Coleoptera (beetles)*. In: CSIRO, *The Insect of Australia*, Second edition, Volume II. Cornell University Press, Ithaca, New York, 543–683.
- Leng CW, Mutchler AJ (1914) A preliminary list of the Coleoptera of the West Indies as recorded to Jan. 1, 1914. *Bulletin of the American Museum of Natural History* 35(30): 391–493.
- Leng CW, Mutchler AJ (1917) Supplement to preliminary list of the Coleoptera of the West Indies. *Bulletin of the American Museum of Natural History* 37(5): 191–220.
- Medvedev LN (1993) К фауне и зоогеографии листоедов Вест-Индии. In: (Ed) АН Северцова Исследования фауны Кубы. Москва Наука 4–17. [On the fauna and zoogeography of leaf beetles of the West Indies. In: (Ed) VE Sokolov The fauna of Cuba. Science, Moscow 4–17.]
- Mole S, Zera AJ (1993) Differential allocation of resources underlies the dispersal-reproduction trade-off in the wing-dimorphic cricket, *Gryllus rubens*. *Oecologia* 93(1): 121–127.
- Nixon KC (2002) Winclada <http://www.cladistics.com/aboutWinc.htm> [date of access, Sept. 14th 2012]
- Roff DA (1990) The evolution of flightlessness in insects. *Ecological Monographs* 60(4): 389–421. doi: 10.2307/1943013
- Schönherr CJ (1808) *Synonymia insectorum, oder Versuch einer Synonymie aller bisher bekannten Insecten, nach Fabricii Systema Eleutheratorum Geordnet. Erster Band. Eleuthera oder Käfer. Zweiter Theil. Spercheus–Cryptocephalus Carl Friedr. Marquard, Stockholm. [i] + x + . 424 pp., plate 4.*
- Seeno TN, Wilcox JA (1982) Leaf beetle genera. *Entomography* 1: 1–221.
- Sekerka L (2008) Species of *Cassida* Linné, 1758 described by Thunberg and their present status (Coleoptera, Chrysomelidae, Cassidinae). *Genus* 19: 301–306.
- Spaeth F (1909) Kritische Studien über *Chelymorpha* Boheman und die verwandten Gattungen (Col.). *Deutsche Entomologische Zeitschrift* 1909: 715–732.
- Spaeth F (1914) Chrysomelidae: 16. Cassidinae. In: Junk W, Schenkling S (Eds) *Coleopterorum Catalogus, Pars 62*, Berlin, 182 pp.
- Suffrian E (1868) Verzeichniss der von Dr. Gundlach auf der Insel Cuba gesammelten Chrysomelinen. *Archiv Für Naturgeschichte* 34: 163–252.
- Sturm J (1826) *Katalog meiner Insekten Sammlung 1. Käfer*, 207 pp. + 4 tabs.

- Świętojańska J (2009) The immatures of tortoise beetles with bibliographic catalogue of all taxa (Coleoptera: Chrysomelidae: Cassidinae). Polish Taxonomical Monographs 16, 157 pp.
- Takizawa H (2003) Checklist of Chrysomelidae in West Indies (Coleoptera). Hispaniolana, Nueva Serie 2: 1–125.
- Wagner DL, Liebherr JK (1992) Flightlessness in insects. Trends in Ecology and Evolution 7(7): 216–220. doi: 10.1016/0169-5347(92)90047-F
- Wilcox JA (1975) Family 129. Chrysomelidae. In: Arnett RH Jr. (Ed) Checklist of the Beetles of North and Central America and the West Indies. North American Beetle Fauna Series. Flora & Fauna Publications, Gainesville, 166 pp.
- Zayas F (1939) Dos nuevas especies de Chrysomelidae (Cassidinae) por Cubana. Memorias de la Sociedad Cubana Historia Natural 13(4): 253–256.
- Zayas F (1952) Nuevos Crisomelidos de las subfamilias Cassidinae y Clytrinae. III Contribucion al conocimiento de los insectos de Cuba. Memorias de la Sociedad Cubana Historia Natural 21: 71–74 + 1 tab.
- Zera AJ (1985) Wing polymorphism in water striders (Gerridae: Hemiptera): Mechanism of morph determination and fitness differences between morphs. Contributions in Marine Science 27: 674–676.

The first precinctive Carabidae from Moorea, Society Islands: new *Mecyclothorax* spp. (Coleoptera) from the summit of Mont Tohiea

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Abstract

Seven species of *Mecyclothorax* Sharp from Moorea, Society Islands are newly described; *M. perraulti* sp. n., *M. pabere* sp. n., *M. menemene* sp. n., *M. mahatahi* sp. n., *M. popotioaoa* sp. n., *M. mapo* sp. n., and *M. fatata* sp. n. These constitute the first *Mecyclothorax* species described from Moorea, and the first carabid beetle species shown to be geographically restricted to that island. Each of the newly described species is most similar to a different species on the island of Tahiti, suggesting that none of the seven Moorean taxa are evolutionary end-products of autochthonous speciation within Moorea. The occurrence of precinctive *Mecyclothorax* species on both Moorea and Tahiti demonstrates that radiation of *Mecyclothorax* in the Society Islands has been facilitated by speciation events implicating both islands. Whether this speciation has been preceded by vicariance or dispersal is discussed, with the generality of a dispersal hypothesis tested using information from Society Island Nabidae (Hemiptera). Salient morphological characters for taxa in the Society and Hawaiian Islands are compared to those representing a broad survey of southwest Pacific *Mecyclothorax* spp. This comparison supports the independent founding of each radiation in the Societies and Hawaii from an Australian ancestral propagule, likely drawn from the ecologically general, geographically widespread *M. punctipennis* (Macleay).

Keywords

French Polynesia, Moriomorphini, adaptive radiation, biogeography, colonization

Introduction

The genus *Mecyclothorax* Sharp is distributed throughout Australia and associated landmasses and islands including New Guinea, the Greater Sundas of Java and Borneo, Lord Howe and Norfolk Islands, and St. Paul and Amsterdam Islands of the Indian Ocean (Baehr 1998; Baehr and Lorenz 1999; Moore 1985, 1992). *Mecyclothorax* has also diversified in New Caledonia (Jeannel 1943; Deuve 1987) and New Zealand (Liebherr and Marris 2009). But it is on two Polynesian archipelagoes that *Mecyclothorax* has undergone radiations that are so rich in species that these radiations dwarf the levels of diversity observed over all other areas of the generic distribution. The Hawaiian Islands house a *Mecyclothorax* fauna that includes 166 valid species (Liebherr 2006, 2007, 2008, 2009a, 2009b, 2011a; Liebherr and Krushelnycky 2011), with an estimated 73 additional species in the process of description from Haleakala volcano, Maui Island (unpubl. data). *Mecyclothorax* beetles are distributed on the Hawaiian islands of Oahu, Molokai, Lanai, Maui and Hawaii Island, but not Kauai. The Society archipelago, specifically Tahiti, also supports an impressively diverse radiation, with 67 species recognized from the island of Tahiti (Perrault 1992). Why have these two Polynesian archipelagoes been home to such diverse *Mecyclothorax* radiations? Based on shared attributes of Tahiti and the Hawaiian Islands, *Mecyclothorax* have thrived in these places in association with subtropical montane rain forest that is dissected by lava flows or by low-elevation erosionally formed valleys, with the islands' orographic relief resulting in extensively subdivided habitats ranging from 1000–3000 m elevation. In Tahiti Perrault (1992) discovered that different, neighboring mountain ridges emanating from the central peak Mont Orohena mostly supported distinct species. Though some species are shared between adjacent ridges—e.g. the ridges culminating at Mont Marau and Mont Aorai—the majority of species are not so shared between different ridges (Perrault 1992: 211). These montane habitats receive anywhere from 4000–6000 mm of precipitation per year in Hawaii (Giambelluca and Schroeder 1998) and up to 8000 mm/yr in Tahiti (Mueller-Dombois and Fosberg 1998; Craig et al. 2001). That *Mecyclothorax* speciation is facilitated by the geological subdivision of wet to mesic montane forest habitats is strongly supported by the geographic restriction of the vast majority of species in both radiations to rain forest habitats. The high levels of diversity in these subtropical islands contrasts sharply with the low *Mecyclothorax* diversity resident in Australia and New Zealand (Moore et al. 1987; Liebherr and Marris 2009), where species distributions are centered on open habitats including grasslands, moorlands, riparian corridors, and dry to mesic *Eucalyptus* forest.

This paper extends the comparison of the Hawaiian and Tahitian *Mecyclothorax* radiations by describing the first collections of *Mecyclothorax* species from a second Society Island, Moorea. Whereas Tahiti, including the volcanoes Tahiti Nui and Tahiti Iti, or Presqu'île de Taiaapu, encompasses 1040 km², with highest elevations of 2241 m and 1332 m respectively on the two constituent volcanoes, Moorea has a much smaller land area of 142 km² and a peak elevation of 1207 m at the summit of Mont Tohiea (Fig. 1). Rainfall is also less abundant on Moorea, though the 5000 mm/yr recorded



Figure 1. Mont Tohiea, Moorea, east face. Collections of *Mecyclothorax* spp. have been limited to the highest portions of the summit ridge, from 1100 m to the summit, elevation 1207 m.

precipitation (Craig et al. 2001) is similar to that observed in many windward areas of Hawaii that house distributions of Hawaiian *Mecyclothorax*. Hypotheses of sister-group relationships for each of the new Moorean species are proposed based on morphological characteristics, with independent relationships to different Tahitian species posited for each of the Moorean species. Therefore the faunas of these two islands that are currently separated by 23 km of ocean are closely related biogeographically, though there has been sufficient isolation—as predicted by the extreme endemism previously reported on Tahiti—to have resulted in *Mecyclothorax* faunas on the two islands that are absolutely distinct at the species level. Characters presented by taxa across the Society Island *Mecyclothorax* radiation distinctively differ from those characterizing the more generalized members of the Hawaiian *Mecyclothorax* radiation, supporting independent colonization events from Australia and subsequent adaptive radiations for each of these lineages on their particular archipelagoes.

Methods

Taxonomic material

Type specimens of Tahitian *Mecyclothorax* species used in the diagnosis of the new species were borrowed from the Naturhistorisches Museum, Basel (NHMB) and the

Muséum national d'Histoire naturelle, Paris (MNHN). Primary type specimens of the new Moorean species, and associated allotypic paratypes where available, are deposited in the MNHN and incorporated into the Georges G. Perrault collection of Tahitian Carabidae. Other institutional depositories include: Cornell University Insect Collection (CUIC); Essig Museum of Entomology Collection (EMEC); U.S. National Museum of Natural History (NMNH).

Laboratory techniques

Specimens were killed in ethyl acetate impregnated killing jars, maintained under that atmosphere for 24 hr, and then transferred to 70% ethanol for transport to the laboratory, or preserved directly in 100% ethanol. The former specimens were pointed or platen-mounted from ethanol. The latter specimens were maintained in ethanol at -16° C and examined under ethanol at room temperature, or removed from ethanol and pointed when a specimen was required for a holotype or allotype specimen. Description of characters was based only on air-dried specimens viewed using a dissecting microscope under bidirectional halogen light.

Labeling is presented verbatim for holotype and associated allotype specimens. Individual lines on labels are separated by a single slash (/), and separate labels are indicated by a double slash (//). Data for the other paratypes is presented in a standardized, condensed format organized chronologically by collection. Where information is repeated in adjacent, subsequent collections, that field is removed from the data string and is to be interpolated from the previous paratype data entry. Paratypes labeled with an MBI0#### lot number were retained in 100% ethanol and returned to EMEC for ensuing DNA extraction.

Dissection, clearing and staining techniques follow Liebherr (2009a). Genitalic dissections are maintained with the specimens in polyethylene genitalia vials. Photographs were made using a Microptics® (now Visionary Digital®) macrophotographic apparatus, including strobe flash illumination conveyed via fiber-optic wands, and a transmissible light stage. Habitus photos were taken using transmitted and reflected light, with specimens mounted on microscope slides and surrounded with two inter-nested plexiglass rings lined with translucent Mylar® film. Genitalic dissections were photographed using transmitted light.

Descriptive conventions build upon data reported by Perrault (1978a, 1978b, 1984, 1986, 1987, 1988, 1989), with both standardized body length and setal formula presented in each diagnosis. The former consists of the sum of three measurements: 1, the distance from the anteriormost labral margin to the cervical ridge, estimated when necessary by extrapolation from the lateral reaches of the ridge; 2, the median length of the pronotum; 3, the distance from the base of the scutellum, where the scutellar dorsal surface dips ventrally, to the apex of the longer elytron, measured parallel to the suture. The setal formula (e.g., 1234) is based on the number of setae on one side of the beetle, with the four numbers signifying: 1, the number of supraorbital setae, either

one or two; 2, the number setae along the lateral margin of the pronotum, either one or two; 3, the number of dorsal elytral setae in the discal portion of the third elytral interval, ranging from 0–3 in Tahitian *Mecyclothorax*; and 4, the number of setae at the apex of the elytra. There are either one or two supraorbital setae; if one is absent it is the anterior seta. There are either one or two pronotal setae; if one is absent, the loss occurs at the setal position near the hind angle. There may be one or two dorsal elytral setae (or three unilaterally in one instance herein), and if a seta is lost evolutionarily, it is lost from the more apical position. Plesiomorphically there are two setae near the elytral apex, an apical seta near the apex of the second elytral stria along the elytral margin, and a subapical seta located in the seventh elytral stria anywhere from dorsad the subapical situation to closer to the apex of stria 7. Perrault (1978a et. seq.) reported the number of setae near the elytral apex without regard to their homology. In Moorean *Mecyclothorax*, the apical seta is always present; the subapical may be present or absent.

Various ratios are used to characterize shapes or relative dimensions. The ocular ratio is the measurement across the outer surface of the compound eyes divided by the minimum distance across the frons between the eyes. The ocular lobe ratio is the distance from the anterior to posterior margin of the eye measured from directly above, divided by the distance from the anterior margin of the eye to the groove at the juncture of the gena and ocular lobe using the same viewpoint. Various body measurements are presented as ratios, with the measurements including: APW, anterior pronotal width, i.e. the width between the most anteriormost pronotal margins at the front angles; MPW, maximum pronotal width; BPW, basal pronotal width measure across the hind angles; PL, median pronotal length; HuW, humeral width, or distance between the anteriormost points along the basal groove-humeral juncture, i.e., the humeral angle; MEW, maximum elytral width. In order to present infraspecific variation in body shape, a maximum of five specimens, where available, were measured to compose these ratios. All available specimens were scanned and the largest individual, the smallest individual, and representatives of both sexes were included in the sample of five. Each of these specimens was labeled with a small number label that corresponds to its entry in the character matrix (unpubl. data). This sampling produced a range of ratios, with the smallest and largest individuals often producing the most disparate ratios. The number of sampled individuals, which may range from 1 to 5, is presented as (n = X).

The configuration of the antennae—moniliform, submoniliform, filiform, or elongate filiform—is categorized using a ratio of the dimensions of the eighth antennomere; length from basal juncture with seventh antennomere to apex divided by the maximal breadth, excluding the dense setal pelage. The configuration of the metathorax is quantified by the metepisternum width/length ratio. Width is measured perpendicular to the longitudinal body axis from the lateral edge adjacent to elytral epipleuron, to the medial juncture of mesepimeron, metasternum and metepisternum. Length is measured as the length of the medial edge from mesepimeron to juncture with metepimeron.

Elytral setation is described based on the dorsal setal positions in the third elytral interval relative to overall elytral length as measure in the standardized body length. The lateral elytral setae of the ninth interval, just laterad the eighth stria, are arrayed in

an anterior series starting laterad the humerus, and an apical series that terminates just anterad the subapical situation. The two series are presented as A + B, with variation in setal number among individuals reported in parentheses; (B – C). When a particular setal count varied, and one state was observed only rarely, the rarely observed setal number is presented alone in parentheses; i.e., B(C).

Coloration is graded relatively from flavous (i.e. yellow without melanization), to rufoflavous, and then to rufobrunneous. Colors darker than rufobrunneous may entail dominant reddish coloration, thereby leading to rufous, dark rufous, and rufopiceous, or the colors may be dominated by browns, leading from rufobrunneous to brunneous, to rufopiceous. The darkest coloration observed is piceous, or shiny coal black. These base colors may be modified by a darker cast; incomplete melanization of the surface near setae or in thicker portions of the cuticle.

Description of microsculpture follows the general terms used in Lindroth (1974). A mature male specimen was assessed when available, though no consistent differences were observed between male and female specimens; far greater differences were observable when comparing mature, sclerotized individuals versus those partially melanized and sclerotized.

Features of the male aedeagal internal sac were described based on the homology system of Maddison (1993). Terms for the ovipositors used in the female genitalic descriptions were based on those presented by Ball and Shpeley (1983) and Liebherr and Will (1998). The number of male or female individuals dissected is noted in the appropriate section of the description.

Taxonomic treatment

Moriomorphini Sloane, 1890: 646 (sensu Liebherr 2011a; type genus *Moriomorpha* Castelnau).

Subtribe Moriomorphina Sloane, 1890: 646.

Melisoderides Sloane, 1898: 470 (synonymy Bouchard et al. 2011; type genus *Melisodera* Westwood).

Subtribe Amblytelina Blackburn, 1892: 85 (type genus *Amblytelus* Erichson).

Meonides Sloane, 1898: 470 (synonymy Liebherr 2011b; type genus *Meonis* Castelnau).

Tropopterides Sloane, 1898: 470 (synonymy Liebherr 2011b; type genus *Tropopterus* Solier).

Mecyclothoracitae Jeannel, 1940: 97 (synonymy Liebherr 2011b, type genus *Mecyclothorax* Sharp).

Mecyclothorax Sharp was classified in the subtribe Amblytelina based on the shared presence of elongate, apically narrowed male parameres that bear setae along the ventral margin of the right paramere and at the apex of the left paramere (Liebherr 2011b, fig. 6). The degree of parameral elongation and apical narrowing varies across

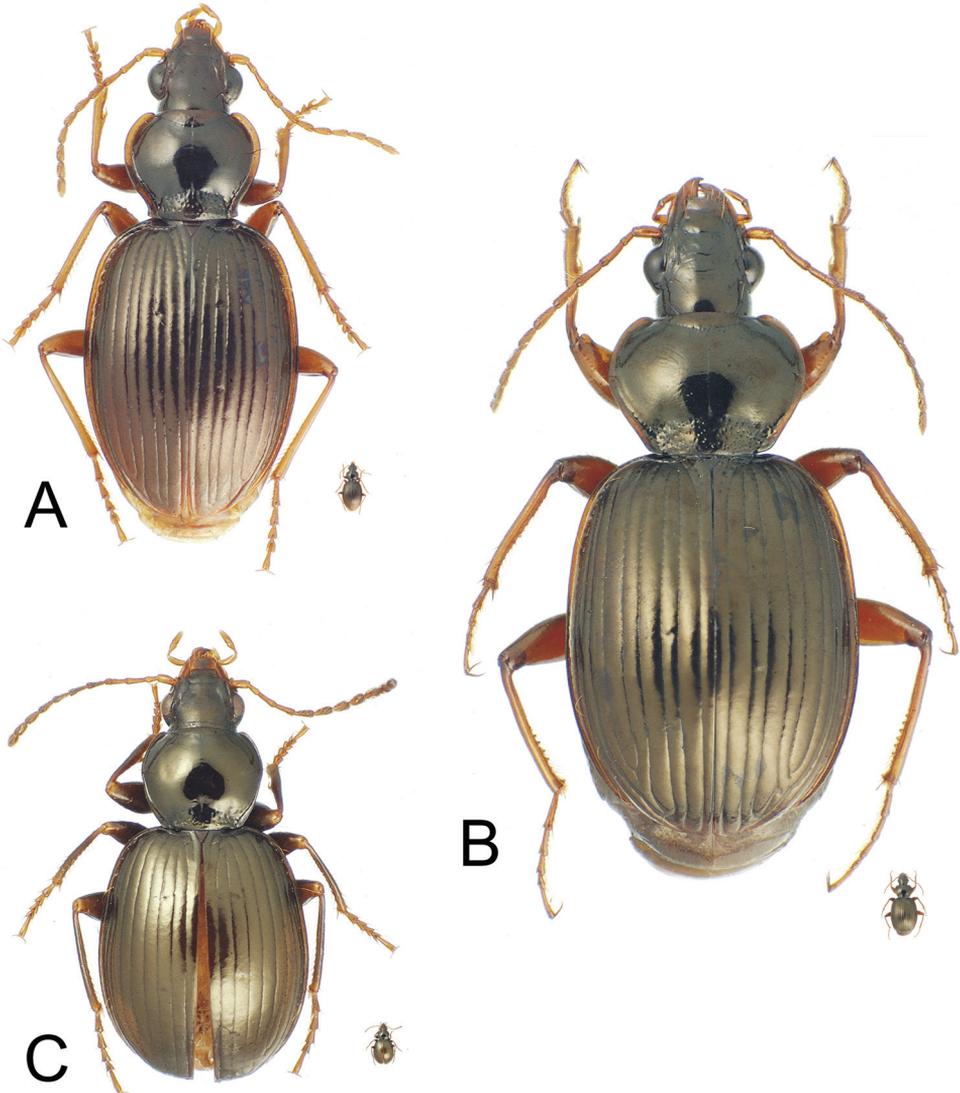


Figure 2. *Mecyclothorax* spp., dorsal view; silhouette to lower right of each habitus photo indicates actual size of beetle specimen at printed journal page size **A** *M. perraulti* male holotype **B** *M. pahere* male holotype **C** *M. menemene* male holotype.

the taxa placed in *Amblytelina* by that cladistic parsimony analysis, but all members of *Amblytelina* differ from those assigned to subtribe *Moriomorpha*, wherein the male parameres are parallel-sided, broad to their broadly rounded apex, and glabrous (e.g. Liebherr 2011b, fig. 1A–B). Within *Amblytelina*, *Amblytelus* Erichson and associated genera (Baehr 2004) comprise the sister group to *Mecyclothorax*. Taxa across *Amblytelina* exhibit derived transformations of the spermathecal duct entrance into the bursa, from the plesiomorphic position near the juncture of the common oviduct and bursa, to positions remote from that juncture. For example in *Amblytelus curtus*

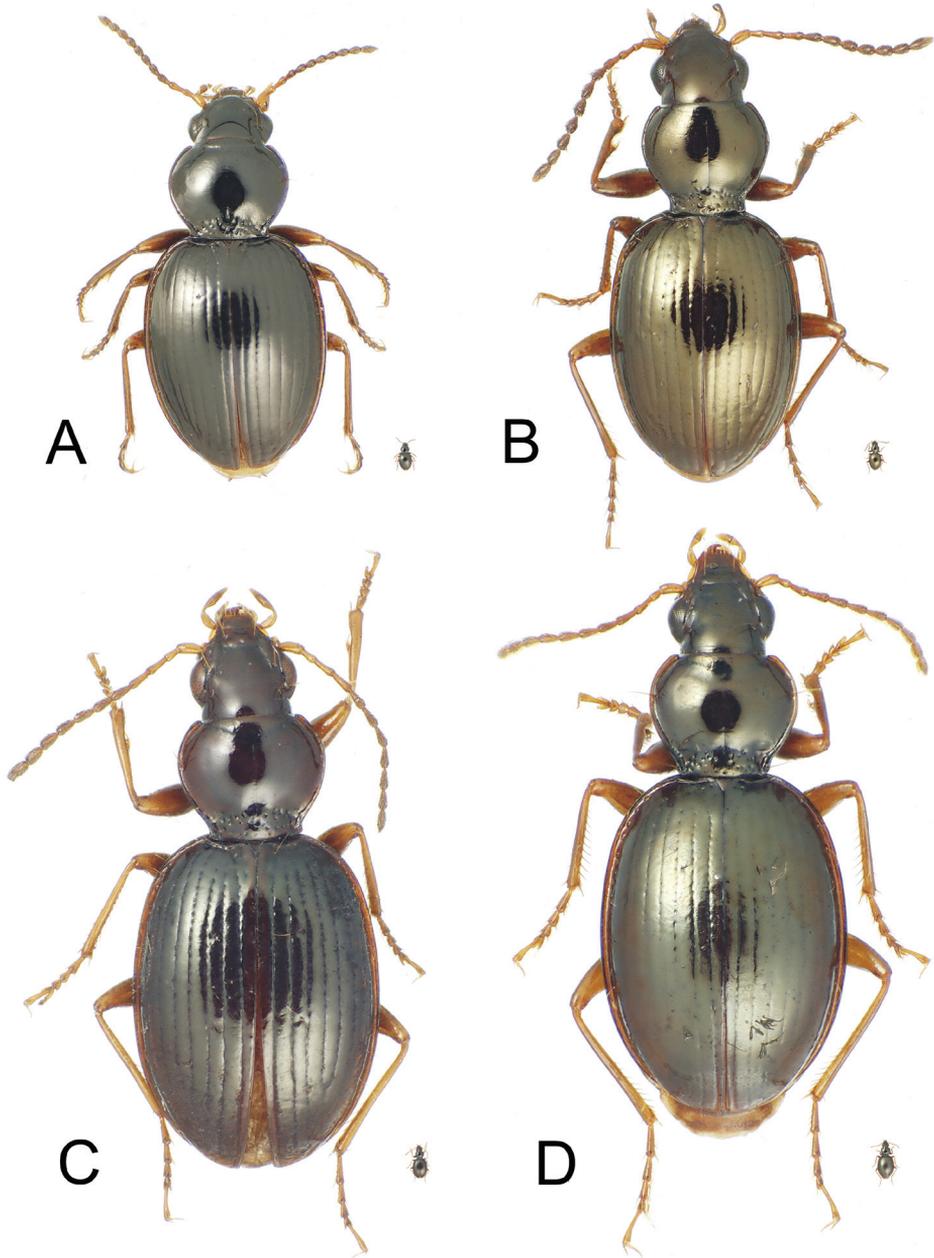


Figure 3. *Mecyclothorax* spp., dorsal view; silhouette to lower right of each habitus photo indicates actual size of beetle specimen at printed journal page size **A** *M. mahatabi* female holotype **B** *M. popotioaoo* male holotype **C** *M. mapo* male paratype (CUIC) **D** *M. fatata* female paratype (CUIC).

(F.) the spermathecal duct joins the bursa on its ventrolateral margin, about halfway from the bursal-oviduct juncture toward the bursal apex (Liebherr 2011b, fig. 3C). In many *Mecyclothorax* spp., the spermathecal duct-bursal juncture has transformed to a

position on the dorsal surface of the bursa, directly dorsad the bursal-oviduct juncture (as in Fig. 5). However, in females of *Mecyclothorax lophoides* Chaudoir of Australia the spermathecal duct enters the bursa at the plesiomorphic position at the bursal-oviduct juncture; a plesiomorphic condition also exhibited by *Meonochilus bellorum* Liebherr of New Zealand (Liebherr 2011b, fig. 8A). With regard to the Society Islands' *Mecyclothorax* fauna, the female reproductive tracts exhibit a spermathecal duct that enters the dorsal surface of the bursa copulatrix (Fig. 5), and male aedeagal internal sacs with a broadly rounded, spoon-shaped flagellar plate (Fig. 4G), both configurations shared with the Hawaiian generotype *Mecyclothorax montivagus* (Blackburn). These characters therefore support Perrault's (1978a, b) generic assignment of the Society Islands' fauna.

Identification key to adults of *Mecyclothorax* spp. known from Moorea

- 1 Pronotal lateral margin explanate throughout pronotal length, translucent....2
- Pronotal lateral margin narrowly reflexed, edge narrowly upturned or beaded adjacent to pronotal lateral seta.....3
- 2 Pronotal margin broadly explanate entire pronotal length, sinuate anterad hind angle..... ***M. perraulti* sp. n.**
- Pronotal margin broadest near posterior angle, narrowed anterad toward position of lateral seta, not sinuate anterad the broadly rounded hind angle..... ***M. pahere* sp. n.**
- 3 Pronotum cordate, margin distinctly sinuate anterad hind angle..... 4
- Pronotum ovate, margin straight to slightly convex anterad obtuse hind angle..... ***M. menemene* sp. n.**
- 4 Both anterior and posterior supraorbital setae present, a thin carina present between dorsoanterior margin of eye and anterior seta..... 5
- Posterior supraorbital seta present, anterior supraorbital seta absent, only a low broad convexity mesad dorsoanterior margin of eye..... ***M. mahatahi* sp. n.**
- 5 Pronotum bisetose, both lateral and basal setae present; pronotum moderately cordate, MPW/BPW ratio 1.52–1.64, pronotal lateral margins subparallel to slightly divergent anterad obtuse-rounded hind angles..... 6
- Pronotum unisetose, only the lateral seta present, hind angle glabrous; pronotum distinctly cordate, MPW/BPW ratio 1.67– 1.76, pronotal lateral margins convergent for $\sim\frac{1}{9}$ pronotal length anterad sharply right hind angle..... ***M. popotioaoo* sp. n.**
- 6 Body size larger, standardized body length 4.7–5.0 mm; a single dorsal elytral seta present at ~ 0.25 distance from base of scutellum to elytral apex; both apical and subapical elytral setae present ***M. mapo* sp. n.**
- Body size smaller, standardized body length 3.8–4.4 mm; two dorsal elytral setae positioned at ~ 0.32 – 0.34 and ~ 0.66 – 0.68 distance from base of scutellum to elytral apex; apical elytral seta (apex 2nd stria) present, subapical elytral seta (in 7th stria) absent ***M. fatata* sp. n.**

M. gourvesi species group

Diagnosis. Perrault (1986, 1988) based recognition of this species group on presence of a broadly margined pronotum, with sinuate basolateral margins and glabrous, right hind angles.

Mecyclothorax perraulti sp. n.

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http://species-id.net/wiki/Mecyclothorax_perraulti

Diagnosis. Consistent with species group membership, the pronotal lateral margins are broadly explanate and translucent, with the basolateral margin sinuate anterad the projected, nearly right hind angles (Fig. 2A). The elytral lateral margin is also broadly expanded and translucent, with the margin upraised just laterad the angulate humerus. *M. perraulti* is most similar to *M. gourvesi*, though the pronotal base is narrower relative to pronotal maximum width in *M. perraulti* (MPW/BPW = 1.49–1.52), versus the basally broader pronotum of *M. gourvesi* (MPW/BPW = 1.37–1.39). The male aedeagal median lobe of *M. perraulti* has a broadened, adze-shaped apex, with the apical face straighter than the dorsal and ventral margins (Fig. 4A). Individuals of *M. perraulti* are also larger than those of *M. gourvesi*; standardized body length 5.8–6.2 mm versus a body length of 5.5 mm for the latter (Perrault 1988). Setal formula: 2122.

Description. *Head capsule* with broadly excavate, straight frontal grooves, bordered laterally by a finely raised carina just mesad the anterior supraorbital seta, the mesal face indistinctly wrinkled between the eyes; neck not depressed dorsally between the eyes, frons flat in lateral view; ocular lobe distinctly projected, the posterior margin abruptly meeting gena behind eye, a fine, shallow groove at ocular lobe-genal juncture; ocular ratio 1.48–1.58 (n = 4); ocular lobe ratio 0.79–0.85 (n = 4); anterior margin of labrum broadly, shallowly emarginate, emargination about $\frac{1}{3}$ labral length; antennomeres 1–3 glabrous except for apical setae; antennae filiform, antennomere 8 length 2.4× greatest width; mentum tooth with sides defining an acute angle, the apex tightly rounded. *Prothorax* moderately transverse, MPW/PL = 1.24–1.31 (n = 4); median base slightly depressed relative to disc, 25–27 small, isolated punctures each side of depressed area; basal margin broadly convex between laterobasal depressions, nearly straight medially; median longitudinal impression fine and shallow on disc, a lenticular broadening at front of median base; anterior transverse impression finely incised throughout breadth, shallower medially; anterior callosity slightly convex, crossed with indistinct longitudinal wrinkles; front angles protruded, subangulate medially adjacent to head, broadly convex laterally; distance between front angles less than between hind angles, APW/BPW 0.87–0.94 (n = 4); lateral marginal depression canaliculate where the convex pronotal disc meets the explanate, angularly upraised lateral margin; laterobasal depression a linear extension of the narrow, deep lateral depression; proepisternum with ~7 indistinct punctulae along hind margin, smaller irregularities along posterior mar-

ginal bead of proepimeron; prosternal process broad, slightly depressed anterad coxal cavities, convex posteriorly at juncture with posterior face. *Elytra* subquadrate, MEW/HuW = 2.29–2.37 (n = 4); disc flat medially, markedly sloped laterad interval 7 to near vertical juncture with lateral marginal depression; basal groove indistinctly though broadly recurved to angulate humerus; parascutellar seta present; parascutellar striole 6–7 punctate, continuously depressed between punctures; sutural interval elevated to sutural juncture, more convex than intervals 2–4; sutural and second striae subequally depressed at elytral apex; striae 1–7 minutely punctate basally, smooth apically, intervals distinctly convex; eighth interval distinctly carinate laterad stria 7 in apical half of elytron, the lateral portions of interval 8 depressed enhancing carina and change in discal curvature; 2 dorsal elytral setae, positioned at 0.24–0.25× and 0.57–0.61× elytral length, each seta in an indistinct depression that spans half or less the width of interval 3; both apical and subapical setae present; lateral elytral setae 7 + 6; elytral marginal depression broadly reflexed, translucent posterolaterad humerus; slightly broader laterad anterior lateral elytral setal series, narrowed apically to a beadlike margin anterad subapical sinuation; subapical sinuation abrupt, internal plica evident beneath sinuation in ectal view. *Mesepisternum* distinctly punctate anteriorly, ~18 evident punctures in 2–3 rows; metepisternum moderately foreshortened, width to length ratio 0.67; mesepisternal/mesepimeral suture distinct; metathoracic flight wing a narrow, elongate vestigium, length 3× width, remnants of veins C, R, M, and Cu discernible. *Abdomen* with visible ventrites 1–4 irregularly wrinkled laterally, ventrites 3–6 with round depressions laterally; suture between visible ventrites 2 and 3 effaced laterally. *Legs* moderately elongate, ratio of metatarsomere 1 length to metatibia length 0.23; metatarsomere 4 lobate, length including outer apical lobe 1.5× median tarsomere length; metatarsomere 4 with apical setae only, subapical setae absent; metatarsal dorsolateral sulci very shallow, obsolete, tarsomere dorsum broadly convex. *Microsculpture* of frons obsolete, surface glossy, shallow isodiametric sculpticells in transverse rows on neck; pronotal disc with mesh of transverse sculpticells 2–3× broad as long; pronotal median base covered with irregular, swirling isodiametric and transverse sculpticells between punctures; elytral disc with transverse microsculpture, sculpticells connected into a mesh, to parallel, unconnected transverse lines; metasternum covered with distinct transverse mesh; basal 2 abdominal ventrites covered with swirling isodiametric and transverse sculpticells. *Coloration* a somber reddish brown; head capsule rufous with a piceous cast; antennomere 1 rufoflavous, 2–11 rufobrunneous; pronotal disc rufopiceous, base, apex and lateral margins rufobrunneous; proepipleuron rufoflavous, proepisternum rufous; elytral disc rufobrunneous with purplish reflection due to transverse microsculpture; sutural interval paler, rufous basally, rufoflavous apically; elytral lateral margins rufoflavous, lateral marginal depression flavous inside dark margin; elytral apex broadly, slightly paler, rufoflavous; elytral epipleuron rufoflavous, metepisternum rufobrunneous with a piceous cast; abdominal ventrites 1–3 rufobrunneous, 4–6 paler, rufoflavous; metafemur rufoflavous with medial brunneous cloud; metatibia rufoflavous with brunneous cast.

Male Genitalia. (n = 1). Aedeagal median lobe narrowed dorsoventrally in apical half, apex dorsoventrally expanded to an adze-like tip (Fig. 4A), the apical face of tip

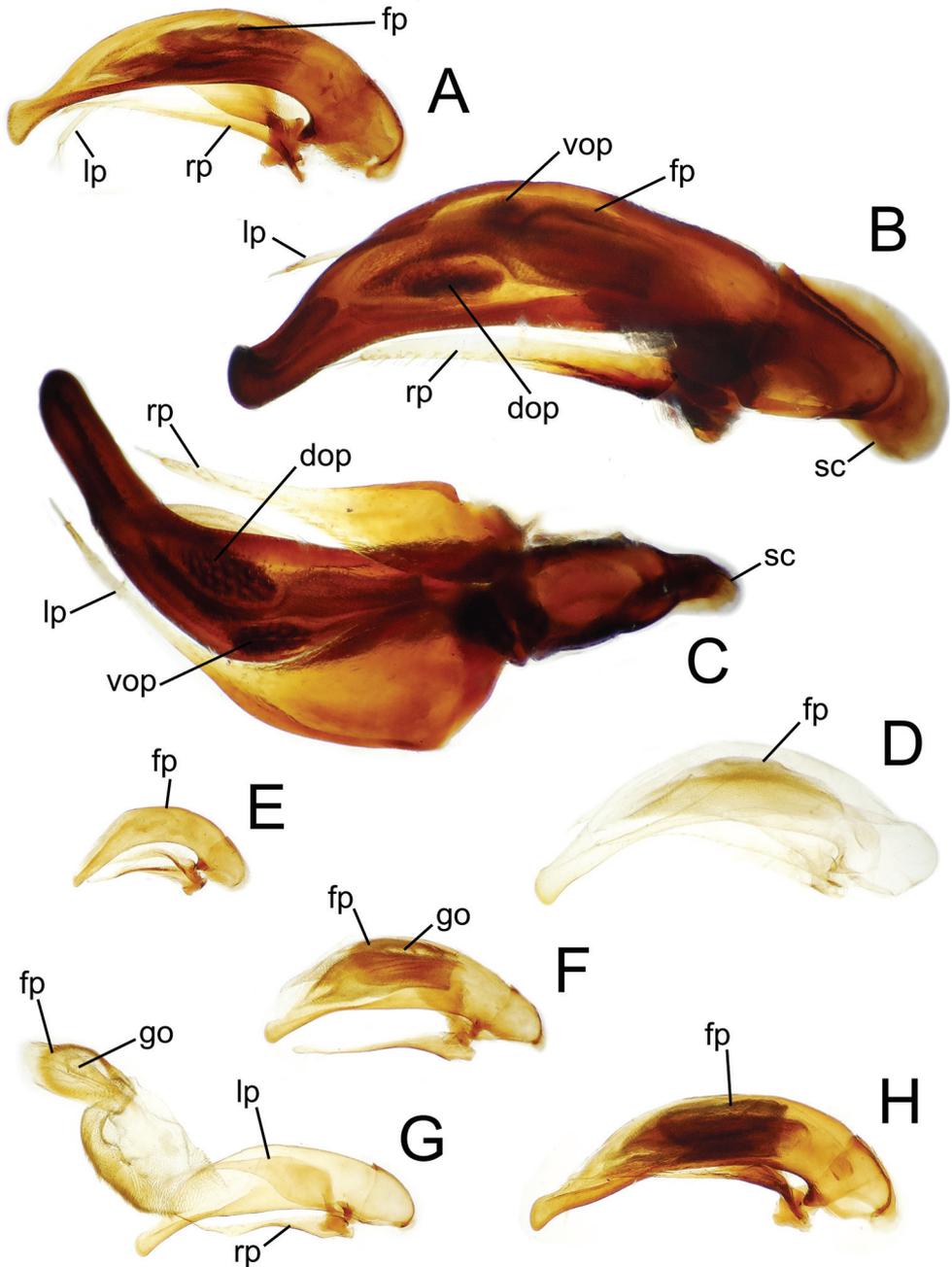


Figure 4. Male aedeagal median lobe and associated parameres. **A** *M. perraulti*, right lateral view **B** *M. pabere*, right lateral view **C** *M. pabere*, euventral view **D** *M. menemene*, right lateral view (teneral specimen) **E** *M. popotioaoo*, right lateral view **F** *M. mapo*, right lateral view **G** *M. mapo*, right lateral view, internal sac everted **H** *M. fatata*, right lateral view. Abbreviations: **dop** dorsal ostial microtrichial patch **fp** flagellar plate **go** gonopore **lp** left paramere **rp** right paramere **sc** sagittal crest **vop** ventral ostial microtrichial patch.

much less convex than dorsal and ventral margins; flagellar plate large, length 0.5× distance from parameral articulation to apical face of tip; right paramere extended to 0.8× distance from parameral articulation to apical face, left paramere extended nearly to tip; internal sac with broad dense ventral microtrichial field, and small, lightly spinose dorsal ostial microtrichial patch (assessed in unverted condition).

Female Reproductive Tract. (n = 1). Bursa copulatrix columnar, elongate, length 3× maximum breadth in slide-mounted specimen (Fig. 5A); bursa membranous, lightly sclerotized based on amount of Chlorazol Black staining; spermatheca reniform, spermathecal gland duct long enough so that gland extends beyond apex of bursa; basal gonocoxite 1 with apical fringe of 2–3 setae, 6–7 smaller setae along mesal margin (Fig. 6A); apical gonocoxite 2 subacuminate, apex tightly rounded, basolateral area moderately expanded; 2 lateral ensiform setae, the apical seta stouter, 1 dorsal ensiform setae, and 2 apical nematiform setae.

Holotype male (MNHN), labeled: FRENCH POLYNESIA: Moorea / Toheia, off trail beneath ridge / 26-ix-2009 el. 1145 m C. Ewing/-17.55152 -149.82147 pyr. fog / unknown tree MBIO6551 // HOLOTYPE / *Mecyclothorax* / perraulti / J.K. Liebherr 2012 (black-bordered red label)

Allotype female (MNHN), labeled: FRENCH POLYNESIA / Moorea Toheia summit / 12-IX-2006 lot 07 / S17°33.03', W149°49.33' / el. 1150-1200 m beating / flowering *Myrsine* after / dark J.K. Liebherr // ALLOTYPE / *Mecyclothorax* / perraulti / J.K. Liebherr 2012 (black-bordered red label)

Other paratypes. SOCIETY ISLANDS. Moorea: Toheia summit, 1120 m el., S17°33.07', W149°49.38', 12-ix-2006 lot 05, beating rotten *Freycinetia* and ferns, Liebherr (CUIC, 1); 1097 m el., S17°33.05', W149°49.28', 13-ix-2006 lot 02, Berlese extraction of fern litter, Ewing (CUIC, 1); muddy gulch on trail, 1170 m el., S17°33.08', W149°49.31', 25-ix-2009, pyrethrin fog mossy tree, MBIO 5853, Ewing (EMEC, 1).

Etymology. This species epithet honors the memory of Georges G. Perrault, the principal describer and reviser of the Tahitian *Mecyclothorax* fauna.

Distribution and habitat. Individuals of this species have been found from the summit at 1207 m elevation down to 1100 m. Specimens have been found microsymptotically in rotten *Freycinetia* stalks with *M. mapo*, and in association with *M. mapo* and *M. fatata* on flowering *Myrsine* at night, and in a pyrethrin fog sample of a mossy tree trunk. An individual of this species was the lone carabid beetle recovered from a Berlese extraction sample of leaf litter taken at 1100 m.

M. altiusculus species group

Diagnosis. All species of this group as first defined by Perrault (1986) lacked the basolateral pronotal seta, though in his grouping the pronotal shape varied from trapezoidal with a convex or straight basolateral margin, to cordate wherein the basolateral margin is sinuate anterad a nearly right hind angle. Subsequently Perrault (1988) placed three

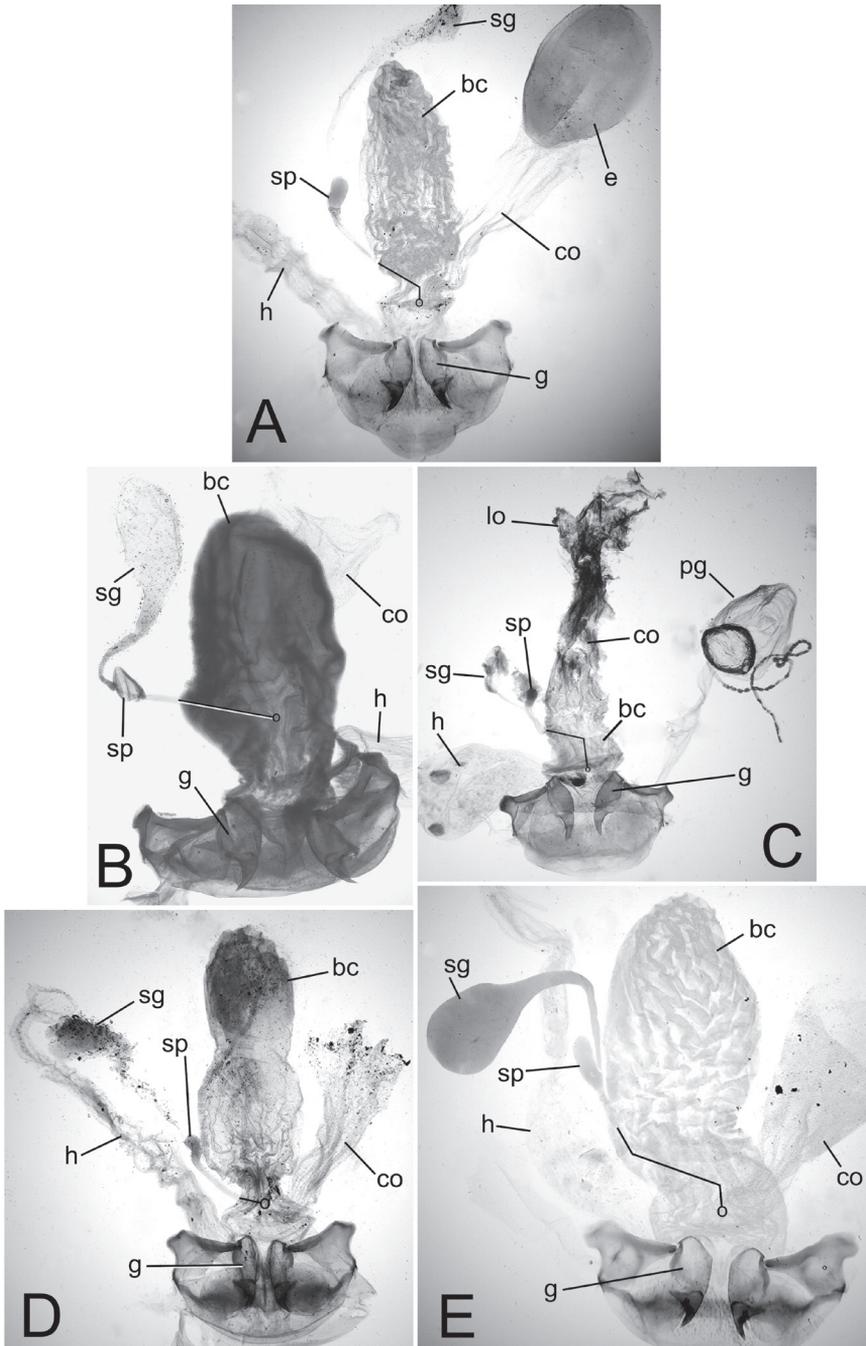


Figure 5. Female reproductive tract and associated abdominal structures, ventral view. Black line indicates position of spermathecal duct dorsad bursa copulatrix or common oviduct; circle at end of line indicates position of juncture of spermathecal duct and dorsal wall of bursa. **A** *M. perraulti* **B** *M. pabere* **C** *M. popotioa* **D** *M. mapo* **E** *M. fatata*. Abbreviations: **bc** bursa copulatrix **co** common oviduct **e** egg **g** gonocoxa **h** rectum of hindgut **lo** lateral oviduct **pg** pygidial gland reservoir **sg** spermathecal gland **sp** spermatheca.

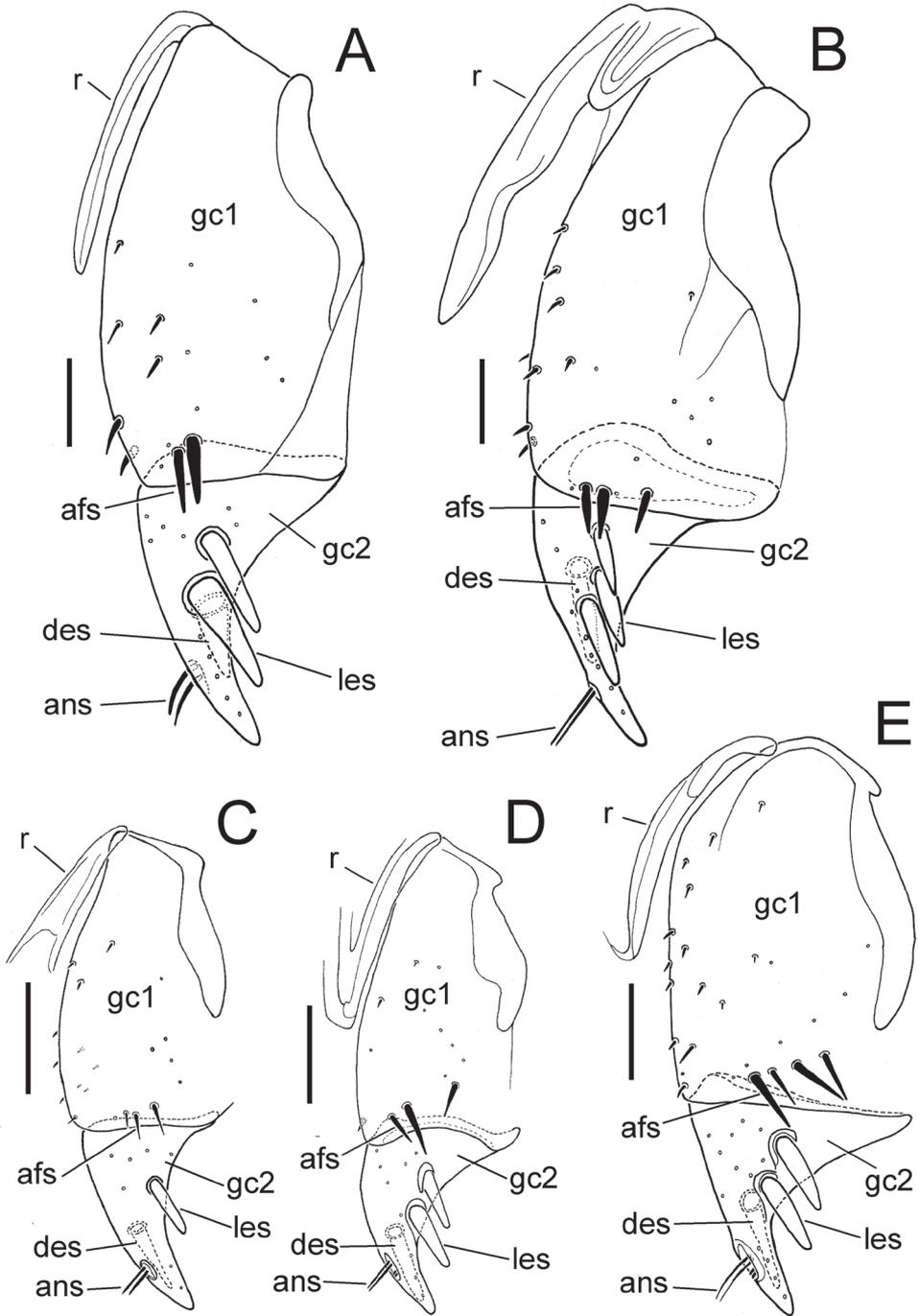


Figure 6. Female left gonocoxa, ventral view; scale bar = 0.05 mm. **A** *M. perraulti* **B** *M. pahere* **C** *M. popotioaoo* **D** *M. mapo* **E** *M. fatata*. Abbreviations: **afs** apical fringe setae of gonocoxite 1 **ans** apical nematiform seta **des** dorsal ensiform seta **gc1** basal gonocoxite 1 **gc2** apical gonocoxite 2 **les** lateral ensiform seta(e) **r** ramus.

species with basolateral pronotal setae in the group, while surmising that the species group was composed of several phylogenetic elements that might bear subdivision. The two new species placed here have the glabrous pronotal hind angles and convex basolateral pronotal margins also exhibited by *M. altiusculus* Britton, suggesting that these new species would remain in this group after such a subdivision.

***Mecyclothorax pahere* sp. n.**

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http://species-id.net/wiki/Mecyclothorax_pahere

Diagnosis. This species plus *M. altiusculus*, *M. pseudaltiusculus* Perrault, and *M. paraltiusculus* Perrault share a bisetose, trapezoidal pronotum with rounded hind angles, and a setal formula of 2122, however individuals of this new species are larger; standardized body length 7.5–7.9 mm. The pronotum is also more transverse; MPW/PL = 1.35–1.36 (n = 2). The striae are deep and distinctly punctate in their basal half, and the convex intervals are covered with dense transverse microsculpture consisting of a mixture of parallel transverse lines and transverse-mesh sculpticells 2–4× broad as long. The mesal face of the male metatibia is lined with pectinate swellings at the points of articulation of the mesal longitudinal setal series (Fig. 2B). Of the three species listed above, *M. paraltiusculus* is most similar, attaining a similar body size—7.0 mm—and possessing elytral microsculpture consisting of a mixture of transverse lines and transverse mesh.

Description. *Head capsule* with broad, shallow frontal grooves, the frontal surface transversely wrinkled between the grooves, and a broad, low convexity bordering the groove mesad the anterior supraorbital seta; dorsally the head capsule is flat from the frons to the pronotum; ocular lobe moderately prominent and largely covered by eyes, the posterior portion of lobe obtusely joined to gena, the juncture marked by fine, shallow groove; ocular ratio 1.47, ocular lobe ratio 0.79–0.83; labral anterior margin broadly emarginate 0.2× length; antennomeres glabrous except for apical setae; antennae elongate filiform, antennomere 8 length 3× greatest width; mentum tooth with sides defining an acute angle, the apex rounded. *Prothorax* transverse, the basolateral margins straight to slightly concave due to the upcurved margin anterad the rounded hind angles, MPW/BPW = 1.55–1.60 (n = 2); median base slightly depressed medially, more so laterally, with more than 40 small punctures each side; basal margin broadly, slightly convex between laterobasal depressions; median longitudinal impression obsolete but traceable on disc, present as a lenticular depression at front of median base; anterior transverse impression deep, finely incised, with 7–8 elongate punctures each side bordered by longitudinal carinae that span impression from disc to anterior callosity; anterior callosity moderately convex, covered with indistinct longitudinal wrinkles; front angles protruded, broadly rounded, APW/BPW = 0.95–0.96 (n = 2); lateral marginal depression broadly explanate, translucent, edge upturned anteriorly, more beadlike near lateral seta; laterobasal depression a broadened continuation of the lateral depression, surface punctured as median base, deepest portion meeting posterior margin at lateral

edge of basal margin convexity; proepisternum with 7 distinct punctulae along hind margin, ~10 smaller punctures along posterior marginal bead of proepimeron; prosternal process broad, slightly depressed anteriorly between coxal cavities, convex posterad at juncture with posterior face. *Elytra* broad, subquadrate, MEW/HuW = 2.32–2.35 (n = 2); disc convex medially, sides sloped to nearly vertical; basal groove moderately curved to subangulate humerus, elytral margin at humerus only slightly upraised; parascutellar seta present; parascutellar striole defined by 4 separated punctures, the striole depressed between punctures; sutural intervals elevated to meet at suture, only slightly more convex than distinctly convex discal intervals; striae 1–8 deep, finely impressed, and distinctly punctate in basal half; all striae deep and smooth at elytral apex; eighth interval upraised in a narrow bulbous carina laterad subapical seta, the interval's outer face nearly vertical; 2 dorsal elytral setae (one individual with 3 setae on one elytron) positioned at 0.22× and 0.52–0.60× elytral length (asymmetrical third seta at 0.75× elytral length), each seta within evident depressions that span $\frac{2}{3}$ width of interval 3; both apical and subapical elytral setae present; lateral elytral setae 7 + (5–6); elytral marginal depression moderately broad throughout length, translucent, reduced to beadlike margin only just anterad abruptly concave subapical situation. *Mesepisternum* distinctly punctate anteriorly, ~19 deep punctures in 2–3 rows; metepisternum short, width to length ratio 0.87; metepisternal-metepimeral suture varied, a distinct suture in one individual, an indistinct, broad depression in the second; metathoracic flight wing an elongate strap-like vestigium, length 4× width, and apical $\frac{1}{4}$ of wing length surpassing hind margin of metathorax, rudimentary R and M veins evident. *Abdomen* with irregular wrinkles on visible ventrites 1–4, and indistinct round depressions laterally on ventrites 4–6; suture between visible ventrites 2 and 3 complete. *Legs* with metatarsomere 1 moderate, length 0.19× length of metatibia; metatarsomere 4 with short apical lobes, maximal tarsomere length 1.2× median tarsomere length; metatarsomere 4 with very short subapical setae and longer apical setae; metatarsal dorsolateral sulci very shallow, obsolete, dorsum broadly convex. *Microsculpture* on frons and vertex a transverse mesh, sculpticell breadth 2× length; pronotal disc with obsolete microsculpture, indistinct transverse mesh with sculpticells 3–4× broad as long visible near edge of light reflections; pronotal median base with evident transverse-mesh microsculpture between punctures, sculpticell breadth 2–3× length; elytral disc covered with a mixture of transverse lines and transverse mesh with sculpticell breadth 2–4× length; elytral apex covered with transverse mesh, sculpticell breadth 2–4× length; metasternum glossy with obsolete transverse sculpticells; laterobasal abdominal ventrites glossy with shallow, swirling isodiametric and transverse mesh sculpticells. *Coloration* of frons and vertex piceous; antennomeres 1–4 rufoflavous to brunneous, segments 5–11 slightly darker; pronotal disc rufopiceous with metallic silvery reflection; reflexed pronotal margins translucent brunneous; proepipleuron rufobrunneous, proepisternum rufopiceous; elytral disc rufopiceous with cupreous reflection; sutural interval concolorous basally, rufous apically; reflexed elytral margin brunneous, elytral apex narrowly, indistinctly paler, brunneous; elytral epipleuron rufobrunneous, metepisternum rufopiceous; abdominal ventrites glossy rufopiceous, apical ventrite narrowly rufobrunneous; metafemur and metatibia rufobrunneous.

Male genitalia. ($n = 1$). Aedeagal median lobe broadest dorsoventrally near midlength, apex hooklike, with small dorsal toothlike expansion (Fig. 4B); median lobe curved to right in ventral view (Fig. 4C), the apex elongated beyond apical margin of ostium; internal sac with well-developed dorsal and ventral ostial microtrichial patches; flagellar plate moderately large, length $0.3\times$ distance from apex to parameral articulation; parameres broad basally, right paramere extended $0.7\times$ distance from parameral articulation to apex (Fig. 4B), left paramere longer, extended $0.9\times$ distance to apex (Fig. 4C).

Female reproductive tract. ($n = 1$). Bursa copulatrix columnar, heavily sclerotized, the surface leathery, bursal length $2\times$ maximal width in slide-mounted dissection (Fig. 5B); spermathecal duct entering on dorsal bursal wall apicad position along length of bursal juncture with common oviduct; spermathecal gland duct short, little longer than spermatheca, the glandular reservoir elongate and gradually widened in diameter from duct; basal gonocoxite 1 with 3–4 apical fringe setae, and 8–10 setae along ventromesal margin (Fig. 6B); apical gonocoxite 2 broad basally with narrow, acuminate tip, and 2–3 lateral ensiform setae, 1 dorsal ensiform seta, and 2 apical nematiform setae.

Holotype male (MNHN), labeled: FRENCH POLYNESIA: Moorea / Tohica, muddy gulch along trail / 24-ix-2009 el. 1150 m C. Ewing / -17.55130 -149.82178 pyr. fog / mossy tree trunk MBIO 5860 // HOLOTYPE / *Mecyclothorax* / pahere / J.K. Liebherr 2012 (black-bordered red label).

Allotype female (MNHN), labeled: FRENCH POLYNESIA: Moorea / Tohica, muddy gulch along trail / 25-ix-2009 el. 1150 m C. Ewing / -17.55130 -149.82178 pyr. fog / mossy tree trunk MBIO 5859 // ALLOTYPE / *Mecyclothorax* / pahere / J.K. Liebherr 2012 (black-bordered red label).

Etymology. The species epithet is the Tahitian word pahere, or comb in English, either the noun or verb form (Wahlroos, 2002), and being indeclinable, is to be treated as a noun in apposition. The name is indicative of the metatibial comb in the male, formed by the evaginated bosslike articulatory processes associated with with the mediolongitudinal series of tibial setae.

Distribution and habitat. The allotype female was collected in a pyrethrin fog sample from a mossy tree trunk along with one individual each of *M. fatata* and *M. mapo*. The holotype male comprised the only beetle collected in a similar situation the day earlier.

***Mecyclothorax menemene* sp. n.**

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http://species-id.net/wiki/Mecyclothorax_menemene

Diagnosis. This species shares an ovoid, bisetose pronotum, and indistinctly striate elytra with *M. jarrigei* Perrault, however the striae are even less developed in *M. jarrigei*, and individuals of that species at 6.2 mm are larger than the unique specimen of this new species; standardized body length 5.2 mm. This species exhibits a setal for-

mula of 2121 as in *M. jarrigei*; setae in the new species include both discal elytral setae and the apical elytral seta positioned just laterad the apex of the second stria. The elytra are exceedingly convex in the unique holotype (Fig. 2C), perhaps due to the slightly teneral nature of the specimen leading to apical distortion of the elytra. The dense transverse microsculpture on the elytra results in a silvery metallic reflection.

Description. *Head capsule* frontal grooves smooth, with deepest portions sinusously curved mesad anterior margin of eye, broadest near frontoclypeal suture, and with low rounded carina mesad anterior supraorbital seta; dorsum of head slightly concave between anterior portions of eyes, neck slightly convex; ocular lobe broadly protruded, the posterior portion very obtusely meeting gena at very shallow or obsolete groove; eyes small, about 16 ommatidia along a horizontal diameter commencing posterad ventral edge of antennal articulatory socket; ocular ratio 1.36, ocular lobe ratio 0.75; labral anterior margin straight; antennomeres 1–3 glabrous except for apical setae; antennae robust, submoniliform, antennomere 8 length 1.9× greatest width; mentum tooth with sides defining acute angle, apex rounded. *Prothorax* subovoid, hind angle definable by abrupt change in curvature of pronotal margin, but basolateral margin convex anterad angle, MPW/PL = 1.17 (n = 1); median base slightly depressed relative to disc, ~10 punctures of varying depth each side; basal margin slightly convex between laterobasal depressions; median longitudinal impression obsolete on disc, indicated by darker color of endocarina, present as a narrow elongate depression on front of median base; anterior transverse impression very fine and shallow, obsolete medially, finely incised mesad front angles; anterior callosity narrow, slightly elevated but flat, crossed by irregular longitudinal wrinkles; front angles slightly protruded, rounded, distance between somewhat greater than basal pronotal width, APW/BPW = 1.08; lateral marginal depression very narrow laterally, margin beaded, slightly broader with edge little upturned at front angles, gradually broadened toward laterobasal depression, edge upturned basally; laterobasal depression a broadened continuation of lateral depression, deepest portions mostly smooth but with minute irregularities; proepisternum with ~7 indistinct punctulae along hind margin, proepimeron with minute irregularities along marginal collar; prosternal process broad, slightly depressed mesad anterior margins of procoxal cavities, convex posterad at juncture with posterior face. *Elytra* subovoid, disc upraised above position of scutellum, MEW/HuW = 2.39; basal groove moderately curved to meet subangulate humerus; parascutellar seta present; parascutellar striole shallow, broadly impressed, smooth; sutural interval slightly elevated at sutural juncture, but not more convex than interval 2 laterally; striae 1–8 of same depth in basal half, shallow but complete, generally smooth but with minute irregularities associated with slight change of direction of deepest portions; at elytral apex, sutural striae 1 and 7 deeply incised, stria 2 shallow, almost discontinuous, striae 3 and 4 shallow but continuous; eighth interval convex apically, the convexity oriented laterally above subapical sinuation; 2 dorsal elytral setae at 0.25× and 0.60× elytral length, set in a moderate impression that spans 2/3 width of interval 3; apical elytral seta present, subapical seta absent; lateral elytral setae 7 + 6; elytral marginal depression narrow but margin narrowly up-

turned at humerus, depression somewhat broader with more gently upturned edge at midlength, margin becoming less upturned without bead anterad subapical sinuation; subapical sinuation shallow, only slightly changing curvature of apical marginal bead. *Mesepisternum* punctate anteriorly, ~18 punctures in 2–3 rows; mesepisternum longer than broad, width to length ratio 0.77; metepisternum separated from metepimeron by distinct suture; metathoracic flight wing vestigium apex extended to hind margin of metathorax, venation not assessed. *Abdomen* with irregular wrinkles laterally on visible ventrites 1–4, indistinct rounded impressions laterally on ventrites 4–6; suture between ventrites 2 and 3 complete laterally. *Metatarsomere 4* with emarginate apical margin, overall length including apical lobes 1.4× median tarsomere length; metatarsomere 4 with short subapical and longer apical setae; metatarsal dorsolateral sulci shallow, lateral, the median surface broadly convex; male metatibia with four rounded projections at bases of four apical setae in mesal longitudinal series. *Microsculpture* of frons, obsolete, surface glossy, neck with indistinct isodiametric sculpticells in transverse rows; pronotal disc covered with shallow transverse mesh, sculpticell breadth 2–4× length; pronotal median base with shallow, swirling isodiametric and transverse sculpticells between punctures; elytral disc covered with mixture of well-developed transverse mesh, sculpticell breadth 2–4× length, and transverse lines; elytral apex with transverse mesh, sculpticells 2–4× broad as long; metasternum with distinct transverse-mesh microsculpture; laterobasal abdominal ventrites covered with swirling isodiametric and transverse mesh. *Coloration* of head capsule rufous with piceous cast; antennomeres 1–2 rufoflavous, 3–11 darker, brunneous; pronotal disc rufobrunneous medially, darker than head laterally on disc, lateral marginal depression concolorous, only extreme basal and apical margins paler, rufoflavous; proepipleuron dark rufoflavous, proepisternum rufobrunneous; elytral disc rufobrunneous with silvery reflection, sutural interval concolorous; elytral marginal depression narrowly translucent, slightly paler than disc, apex not paler than more basal portions; elytral epipleuron, metepisternum, and abdominal ventrites concolorous, rufobrunneous; metafemur and metatibia brunneous medially, apices paler, rufoflavous.

Male Genitalia. (n = 1). Aedeagal median lobe evenly narrowed dorsoventrally from midlength to broadly rounded apex, the apex slightly expanded on ventral margin (Fig. 4D); flagellar plate smaller, length 0.26× distance from parameral articulation to apex (assessed in uneverted, teneral dissection); internal sac dorsal surface apparently covered with field of fine spicules, neither dorsal nor ventral ostial microtrichial patch apparent; both parameres extended apically about 0.8× distance from parameral articulation to apex.

Holotype male (MNHN), labeled: French Polynesia: Moorea / Tohicia summit el. 1130 m / 12-IX-2006 lot10 / 17°33.07'S, 149°49.38'W / pyrethrin fog mossy logs / D.A. Polhemus// HOLOTYPE / Mecyclothorax / menemene / J.K. Liebherr 2012.

Etymology. The species epithet is the Tahitian word menemene, i.e. round or spherical in English (Wahlroos, 2002), denoting the rounded pronotum and broadly rounded, convex elytra of this species. Being indeclinable, the epithet is to be treated as a noun in apposition.

Distribution and habitat. The unique holotype of this species was collected from a rotten log situated in a deep, wet gulch, in association with four individuals of *M. mapo* and one of *M. popotioaoo*.

M. globosus species group

Diagnosis. Species in this group are characterized by cordate pronota, the basolateral margin distinctly sinuate anterad the projected hind angle, with the lateral marginal depression very narrow and of even breadth throughout the length of the pronotum. The elytra are very convex, with the eighth interval nearly vertical at the juncture with the elytral lateral marginal depression (Perrault, 1986, 1988). Individuals of the included species are smaller; body lengths range 3.3–5.0 mm (Perrault, 1989).

Mecyclothorax mahatahi sp. n.

urn:lsid:zoobank.org:act:A5DBBF5A-AAF8-487C-90B1-20CDD9E34633
http://species-id.net/wiki/Mecyclothorax_mahatahi

Diagnosis. This species shares reduced setation, setal formula 1111 (Fig. 3A), with four other species in the group; *M. sabulicola* Britton, *M. ataraensis* Perrault, *M. taiarapu* Perrault, and *M. cupripennis* Perrault. Of these, *M. cupripennis* shares reduced microsculpture with this species, the pronotal disc lacking any discernible sculpticells. The two species differ in elytral microsculpture. This new species is characterized by a glossy elytral integument, with only sporadic small patches of indistinct isodiametric sculpticells in transverse rows, whereas *M. cupripennis* is characterized by presence of a more regular, though shallow, transverse mesh on the discal elytral intervals; the sculpticells consistently visible outside the reflection of bright, direct microscope light. Body size is similar for the two species; standardized body length of the new species is 3.7 mm, that for *M. cupripennis* 3.5 mm (measurement made on male specimen, CUIC).

Description. *Head capsule* with sinuous frontal grooves, closest at frontoclypeal suture and defining a lyre shape, adjacent area of frons broadly depressed mesad anterior margin of eye, base of frontal groove separated from eye by a broad, low convexity; dorsum of head flat on frons in lateral view, neck convex; anterior supraorbital seta absent, posterior seta situated at dorsal terminus of broad shallow groove between ocular lobe and gena; eyes and ocular lobe little protruded, posterior portion of lobe meeting gena at about 135° angle; compound eye with 10 ommatidia on horizontal diameter defined by lower margin of antennal articulatory socket; ocular ratio 1.37, ocular lobe ratio 0.67; labral anterior margin broadly, shallowly emarginate $\frac{1}{12}$ length; antennomeres 1–3 glabrous except for apical setae; antennae moniliform, antennomere 8 length subequal to greatest width; mentum tooth with sides defining acute angle, apex tightly rounded. *Prothorax* cordate, disc convex, basolateral margins convergent anterad acute, projected hind angles, MPW/BPW = 1.53, MPW/PL = 1.18

(Fig. 3A); median base slightly depressed relative to disc, more so laterally, with ~13 larger isolated punctures each side; basal margin broadly convex between laterobasal depressions; median longitudinal impression absent on basal half of disc, obsolete and traceable anterad due to indistinct transverse wrinkles at position of impression; anterior transverse impression shallow, broad, smooth medially, finely incised in lateral $\frac{2}{3}$ of breadth; anterior callosity slightly convex, smooth; front angles slightly protruded, tightly rounded, APW/BPW = 0.99 (n = 1); lateral marginal depression very narrow, slightly broader at front angle, edge beaded throughout; laterobasal depression a deep continuation of lateral depression, bordered anteromesally by punctate median base, and laterally and posteriorly by raised marginal bead at hind angle; proepisternum with 5 minute punctures along hind margin; prosternal process narrowly depressed medially, broadly upraised each side between coxae. *Elytra* subovoid, MEW/HuW = 2.14 (n = 1), middle of disc flat, intervals 2–8 increasingly depressed to near vertical juncture with lateral marginal depression; basal groove distinctly curved forward to angulate humerus that lies distinctly anterad base of scutellum; parascutellar seta present, immediately adjacent to parascutellar striole; parascutellar striole finely incised, smooth anterad, 1–2 small punctures near apex; sutural interval coplanar with stria 2; striae 1–6 shallow, complete, with very small punctures at stria depth, the punctures less distinct in lateral striae; sutural stria 1 deepest at elytral apex, striae 2, 3, and 7 shallow but complete apically; discal elytral intervals slightly convex; interval 8 narrowly subcarinate laterad apex of stria 7, slightly more convex than more mesal intervals; a single dorsal elytral seta at 0.24× elytral length set in small setal depression spanning less than half of interval 3; apical elytral seta present, subapical seta absent; lateral elytral setae 7 + 6; elytral marginal depression moderately narrow, margin upraised near humerus, beadlike only near subapical sinuation; subapical sinuation deep, abruptly excavate anteriorly. *Mesepisternum* punctate anteriorly, with ~14 punctures in 2–3 rows; metepisternum short, anterior and mesal edges subequal, width to length ratio 0.8; metepisternum separated from metepimeron by a distinct suture. *Abdomen* irregularly wrinkled on lateral portions of visible ventrites 1–4, indistinct rounded depressions laterally on ventrites 4–6; suture between ventrites 2 and 3 effaced laterally. *Legs* with short, stout tarsomeres, metatarsomere 4 overall length subequal to breadth, length including apical lobes 1.2× median tarsomere length; metatarsomere 4 with both apical and subapical setae; metatarsal dorsolateral sulci deep, lateral, median broadly convex. *Microsculpture* of frons obsolete, surface glossy, indistinct transverse mesh in deepest portions of frontal grooves; pronotal disc glossy with indistinct elongate transverse mesh—sculpticell breadth 3–4× length—visible near edge of areas of reflected light; pronotal median base glossy except for obsolete transverse mesh near discal margin; elytral disc mostly glossy, patches of transverse mesh, breadth 3–4× length, visible near striae; elytral apex glossy, transverse mesh visible at apical margin; metasternum with evident transverse mesh; laterobasal abdominal ventrites with swirling isodiametric and transverse sculpticells. *Coloration* of head capsule a glossy rufopiceous; antennomere 1 flavous, 2–3 rufoflavous, 4–11 rufobrunneous; pronotal disc glossy rufopiceous, pronotal lateral margins concolorous, base and apex slightly paler at edge;

proepipleuron rufopiceous along edge, mediolongitudinally rufoflavous, rufobrunneous along margin with rufobrunneous proepisternum; elytral disc glossy rufopiceous; scutellum and base of sutural interval dark rufous, apex of sutural interval broadly rufobrunneous; elytral margin concolorous with disc near elytral base, lateral marginal depression paler, rufoflavous behind; elytral apex broadly, slightly paler, brunneous; elytral epipleuron paler, rufoflavous dorsally, rufobrunneous ventrally to match metepisternum; abdominal visible ventrite 1 rufobrunneous; ventrites 2–3 rufopiceous medially, brunneous laterally along with ventrites 4–6; apical ventrite 6 rufoflavous in apical $\frac{1}{3}$; metafemur rufoflavous; metatibia rufoflavous with brunneous cast.

Female reproductive tract. The unique female holotype was not dissected.

Holotype female (MNHN), labeled: FRENCH POLYNESIA: Moorea / Tohicia, off trail beneath ridge / 25-ix-2009 el. 1145 m C. Ewing / -17.55152 -149.82147 pyr. fog / unknown tree MBIO5551 // HOLOTYPE / *Mecyclothorax* / mahatahi / J.K. Liebherr 2012 (black-bordered red label).

Etymology. The species epithet is a compounding of maha, Tahitian for the number four, and tahi, Tahitian for one (Wahlroos, 2002), indicative of the reduced setation in this species resulting in the setal formula of 1111. As tahi is indeclinable, the epithet is to be treated as a noun in apposition.

Distribution and habitat. The unique specimen was collected in pyrethrin fog sample of a mossmat in association with one specimen of *M. perraulti*.

***Mecyclothorax popotioaoa* sp. n.**

urn:lsid:zoobank.org:act:CD0E0395-531F-4DD2-B68C-8761EA70D2F5

http://species-id.net/wiki/Mecyclothorax_popotioaoa

Diagnosis. Within the *M. globosus* group, this is the only species for which individuals lack dorsal elytral setae, resulting in a setal formula of 2101; one individual of the five type specimens has an asymmetrically positioned dorsal elytral seta at 0.24 \times length on the left elytron, however this is considered a variant condition not characterizing the species. This species is also characterized by shallow elytral striae (Fig. 3B), and much reduced microsculpture across the entire dorsum. The most similar species in the group, *M. hemisphaericus* Perrault, shares much reduced elytral striae, though in this species they are nearly obsolete. *M. hemisphaericus* also exhibits reduced setation, though presence of a single dorsal elytral seta results in a setal formula of 2111. The new species can also be distinguished from *M. hemisphaericus* by the more narrowly ovoid elytra, MEW/MPW = 1.43–1.48 (n = 4), versus more broadly ovoid elytra in *M. hemisphaericus*, MEW/MPW = 1.61 (n = 2 paratypes, MNHN). Individuals of both species are of similar size; standardized body length for this species is 3.7–4.0 mm, versus 3.5–3.9 mm for *M. hemisphaericus*, as determined from two examined paratypes (MNHN).

Description. *Head capsule* with slightly sinuous frontal grooves, the two grooves approaching each other mesad a broad convexity near frontoclypeal suture, frons mesad grooves depressed and transversely wrinkled, groove bordered laterally by thin carina

mesad anterior supraorbital seta; dorsum of head flat on frons in lateral view, neck convex; ocular lobe little projected, posterior portion meeting gena at $>135^\circ$, a narrow, shallow groove at juncture; eyes slightly more convex than ocular lobe, 14–15 ommatidia along horizontal diameter oriented to ventral margin of antennal articulatory socket; ocular ratio 1.36–1.42 ($n = 4$), ocular lobe ratio 0.74–0.76 ($n = 4$); labral anterior margin broadly, shallowly emarginate $\frac{1}{6}$ of length; antennomeres 1–3 glabrous except for apical setae; antennae submoniliform, antennomere 8 length $1.75\times$ greatest breadth; mentum tooth with sides defining an acute angle, apex tightly rounded. *Pronotum* narrow, little transverse, distinctly cordate, the basolateral margins subparallel to slightly convergent for $\frac{1}{9}$ pronotal length anterad projected, slightly obtuse hind angles (Fig. 3B), $MPW/BPW = 1.67\text{--}1.76$ ($n = 4$), $MPW/PL = 1.12\text{--}1.16$ ($n = 4$); median base slightly depressed relative to disc, 12–14 large punctures each side; basal margin broadly convex between hind angles; median longitudinal impression very shallow, finely incised, but traceable across disc, briefly extended as an elongate puncture at front of median base; anterior transverse impression very shallow, smooth, obsolete medially, finely incised in outer half of breadth each side; anterior callosity slightly convex, smooth but with very minute longitudinal wrinkles; front angles not protruded anterad, the margin perpendicular to longitudinal axis and curving posterad in a tight curve, $APW/BPW = 1.13\text{--}1.19$ ($n = 4$); lateral marginal depression very narrow, pronotal margin beaded throughout length to hind angle and posterad laterobasal depression; laterobasal depressions ill defined, punctate, coplanar with lateral portion of median base; proepisternum with ~ 10 very fine irregularities along hind margin; prosternal process narrowly depressed medially, sides broadly upraised mesad coxal cavities. *Elytra* narrowly subovoid (Fig. 3B), disc convex, sides distinctly sloped to near vertical; basal groove evenly curved anterad to angulate humerus, $MEW/HuW = 2.2\text{--}2.3$ ($n = 4$); parascutellar seta present; parascutellar striole 3–4 punctate, shallow but continuous; sutural interval slightly elevated at sutural juncture basally, moreso apically; striae 1–6 shallow on disc, indistinctly punctate, stria 7 obsolete but traceable, smooth; striae 1 and 7 deep and smooth apically, striae 2–6 shallower but traceable, though juncture of 5 and 6 is deeper; discal intervals slightly convex, lateral intervals less upraised, though convex due to curvature of elytron; interval 8 distinctly bulbous laterad stria 7, broadly subcarinate dorsal subapical sinuation; apical elytral seta present, subapical seta absent; lateral elytral setae (5–6) + (4–5); elytral marginal depression narrow with little upraised margin at humerus, slightly broader laterally, margin beaded anterad subapical sinuation. *Mesepisternum* densely punctate anteriorly, ~ 14 large punctures in 2–3 rows; metepisternum slightly longer than broad, width to length ratio 0.75; metepisternum separated from metepimeron by distinct suture. *Abdomen* with visible ventrites 1–5 irregularly wrinkled laterally, ventrites 3–6 with rounded depressions laterally; suture between visible ventrites 2 and 3 effaced laterally. *Metatarsomere 4* indistinctly lobate, overall length including lobes $1.5\times$ median tarsomere length, both subapical and apical setae present; metatarsal dorsolateral sulci very shallow, lateral, median surface of tarsomere broadly convex. *Microsculpture* obsolete on frons, surface glossy, shallow isodiametric sculpticells in transverse rows on neck; pronotal disc glossy, micro-

sculpture obsolete but indistinct transverse sculpticells, 3–4× broad as long, discernible just outside areas of light reflection; pronotal median base with indistinct isodiametric mesh between punctures; elytral disc glossy, obsolete transverse mesh visible along edge of reflected light; elytral apex with shallow isodiametric and transverse sculpticells; metasternum with distinct transverse mesh; laterobasal abdominal ventrites covered with swirling isodiametric and transverse sculpticells. *Coloration* of head capsule rufous with slight piceous cast; antennomeres 1–3 rufoflavous, 4–11 slightly darker, the apical antennomeres rufobrunneous; pronotal disc dark rufous, pronotal margins with piceous cast, basal and apical edge slightly paler, rufobrunneous where narrowed in thickness; proepipleuron rufoflavous medially, dark dorsally, rufous with piceous cast ventrally to match proepisternum; elytral disc dark rufous, sutural interval rufous basally, rufoflavous apically; elytral marginal depression concolorous at humerus, rufoflavous in deepest portion laterally and to subapical sinuation; elytral apex broadly slightly paler, rufobrunneous; elytral epipleuron rufoflavous ventrad dark margin, rufobrunneous ventrally, metepisternum slightly darker, rufous with piceous cast; abdomen dark rufous basally, ventrites 4–6 paler, rufobrunneous, apical ventrite with apical third paler, rufoflavous; metafemur rufoflavous; metatibia rufoflavous with brunneous cast.

Male genitalia. (n = 1). Aedeagal median lobe evenly curved and of subequal diameter in basal half, narrowed apically to tightly rounded apex that extends little beyond apical ostial margin (Fig. 4E); internal sac lightly sclerotized, only flagellar plate visible in unverted dissection, length of plate 0.33× distance from parameral articulation to apex; right paramere short, apex extended toward apex 0.7× distance from parameral articulation to apex, left paramere longer, extended 0.9× that distance.

Female reproductive tract. (n = 1). Bursa copulatrix very short, present as a very short lobe situated dorsad the broad common oviduct (Fig. 5C); bursal apex extended beyond evident transverse fold at base of oviduct the same distance as that from transverse fold to a line drawn between bases of basal gonocoxites; bursal surface lightly sclerotized, as membranous as surface of median oviduct; spermatheca reniform, spermathecal gland connected to base of spermatheca by a short duct; basal gonocoxite 1 with apical fringe of 3–4 setae, and 10–11 smaller setae along mesal margin, spanning ventromedial to dorsomedial surfaces of gonocoxite (Fig. 6C); apical gonocoxite 2 narrow basally with tightly rounded apex, single dorsal and lateral ensiform setae and 2 apical nematiform setae.

Holotype male (MNHN) labeled: French Polynesia: Moorea / Tohiewa summit el. 1080- / 1120 m 12-IX-2006 lot 09 / 17°33.07'S, 149°49.38'W / beating dead fern fronds / C.P. Ewing // HOLOTYPE / Mecyclothorax / popotioaoa / J.K. Liebherr 2012 (black-bordered red label).

Allotype female (MNHN): French Polynesia: Moorea / Tohiewa summit el. 1120 m / 12-IX-2006 lot 08 / 17°33.07'S, 149°49.38'W / beating ferns C.P. Ewing // ALLOTYPE / Mecyclothorax / popotioaoa / J.K. Liebherr 2012 (black-bordered red label).

Other paratypes. SOCIETY ISLANDS. Moorea: Tohiewa summit, 1120 m el., S17°33.07', W149°49.38', 12-ix-2006 lot08, beating ferns, Ewing (CUIC, 1); 1120 m el., S17°33.07', W149°49.38' 12-ix-2006 lot 10, pyrethrin fog mossy log, deep gulch,

Polhemus (NMNH, 1); gulch S of summit, 1160–1180 m el., S17°33.03', W149°49.36', 24-ix-2009, on fern frond, gulch wall, MBIO 5852, Ewing & Yang (EMEC, 1).

Etymology. The species epithet is a compounding of the Tahitian word *popoti*, beetle or cockroach, and *oaoa*, the Tahitian adjective narrow (Wahlroos, 2002), signifying the constricted pronotal base and narrow body of adult beetles of this species. As *oaoa* is indeclinable, the epithet is to be treated as a noun in apposition.

Distribution and habitat. Four of the five specimens recorded for the species have been collected on fern fronds, either living or dead, in all such instances associated with individuals of *M. mapo*. The fifth specimen was collected in association with *M. mapo* and the single known *M. menemene* by pyrethrin fogging of a mossy log complex in a deep, wet gulch.

M. viridis species group

Diagnosis. Perrault (1986) assigned four species to this group, all of which exhibit: 1, cordate pronotum with sinuate basolateral margins, and right, setose hind angles; 2, distinctly convex elytra with upraised humeral margin; and 3, presence of 1 or 2 dorsal elytral setae. He noted that the four species comprise two geographic pairs, *M. balli* Perrault and *M. castaneus* Perrault from Marau, and *M. ata* Perrault and *M. viridis* Perrault from adjacent Aorai. Subsequently, four undescribed species have been found on Pito Hiti, the triangular summit ENE of Mont Orohena (E.M. Claridge, pers. comm.). Another undescribed species possessing the above characteristics, and thus assignable to this group upon description, has been collected on Mauru, a peak isolated far to the east of Orohena by the broad valley of the Papenoo River and tributaries (Liebherr in press).

Mecyclothorax mapo sp. n.

urn:lsid:zoobank.org:act:6E037A49-8874-4791-BCC4-F3FD8EC5556F

http://species-id.net/wiki/Mecyclothorax_mapo

Diagnosis. This species shares transverse-line elytral microsculpture and deep punctate elytral striae with *M. castaneus*, and individuals are of similar body size; standardized body length for this species 3.8–4.4 mm versus 3.8 mm for *M. castaneus*. The pronotum is of similar dimensions in the two species, with MPW/PL = 1.14–1.17 (n = 5) in this species, versus a ratio of 1.19 in *M. castaneus* (Perrault, 1986). The species differ in setation, with this species consistently characterized by two discal elytral setae, and therefore a setal formula of 2221, versus *M. castaneus* where one of the two type specimens had two discal setae on one elytron, whereas the other three elytra of the two beetles were unisetose. In addition, the pronotal base of this species is relatively broader, MPW/BPW = 1.52–1.64 (n = 5), versus a narrower base and greater ratio of 1.70 for *M. castaneus*.

Description. *Head capsule* with frontal grooves nearly straight on lateral margins, depressed area of frons triangular with broadest portion at frontoclypeal suture, groove terminated posteriorly at thin carina mesad anterior supraorbital seta; dorsum of head flat on frons in lateral view, neck convex; ocular lobe broadly convex, little protruded from head capsule, hind portion meeting gena at 135° angle, at a fine groove bordered posterad by fine carina; compound eye with 15–16 ommatidia along a horizontal diameter defined by lower margin of antennal articulatory socket; ocular ratio 1.40–1.49 (n = 5), ocular lobe ratio 0.73–0.83 (n = 5); labral anterior margin nearly straight, only slightly emarginate; antennomeres 1–3 glabrous except for apical setae; antennae submoniliform, antennomere 8 length 1.6× greatest breadth; mentum tooth sides defining an acute angle, apex subacuminate. *Pronotum* quadrisetose, cordate (Fig. 3C), margin variously, slightly convergent, subparallel, or slightly divergent anterad obtuse hind angles; median base depressed relative to disc, margined anteriorly by a row of punctures, some elongate, 13–14 punctures each side of base, punctures sparser medially; basal margin convex between the laterobasal depressions; median longitudinal impression fine, shallow but continuous on disc, continued as fine impression onto front of median base; anterior transverse impression broad, shallow, smooth, finely incised only mesad front angle; anterior callosity only slightly convex, with very fine and shallow longitudinal wrinkles, variously restricted to front margin of pronotum to crossing callosity and anterior transverse impression; front angles slightly protruded, tightly rounded, apical and basal pronotal widths subequal, APW/BPW = 1.0–1.09 (n = 5); lateral marginal depression very narrow, edge beaded throughout most of length, except at front angle where margin is slightly upturned to flat, and along basolateral situation where margin is broadly upturned; laterobasal depression defined by linear mesal extension of lateral depression and lateral raised basolateral margin, punctures of median base not reaching deepest linear portion; proepisternum with 6 distinct punctulae along hind margin, ~5 smaller punctures along marginal collar of proepimeron; prosternal process narrowly depressed between broadly upraised lateral areas between procoxae, convex posterad at juncture with posterior face. *Elytra* subovoid, sides broadly convex; disc convex with sides sloping to near vertical juncture with lateral marginal depression; basal groove short, distinctly, anteriorly curved to proximate, angulate humeri, MEW/HuW = 2.29–2.43 (n = 5); parascutellar seta present; parascutellar striole 3–4 punctate, irregularly depressed or not between punctures; sutural interval dorsally expanded to meet at a sutural callosity that extends to apex; striae 1–4 distinctly impressed on disc, elongately punctate at depth, striae 5–6 shallower but also elongately punctate, stria 7 reduced to series of isolated punctures; sutural stria 1 deep and smooth apically, stria 7 nearly as deep apicad subapical situation, 2–6 shallow, continuous, with rudimentary punctures in deeper portions; intervals 2–6 slightly convex on disc; interval 8 bulbously carinate laterad stria 7 dorsad subapical situation, the interval nearly vertical in orientation laterad its midpoint; two dorsal elytral setae in impressions that span ½ to ⅔ of interval 3, positioned at 0.32–0.34× and 0.66–0.68× elytral length; apical elytral seta present, subapical seta absent; lateral elytral setae 6 + 5; elytral marginal depres-

sion narrow, edge thick and upturned at humerus, more thinly upturned laterally, beadlike anterad subapical sinuation; subapical sinuation shallowly excavate, broad. *Mesepisternum* anteriorly with 6 large, isolated punctures in 1–2 rows; metepisternum longer than wide, width to length ratio 0.72; metepisternum separated from metepimeron by distinct suture; metathoracic wing vestigium an elongate strap, 1.57× long as wide that extends from base to 0.73× length of metanotum, rudiments of R and M veins visible on strap. *Abdomen* with irregular wrinkles laterally on visible ventrites 1–4, rounded depressions laterally on ventrites 3–6; suture between visible ventrites 2 and 3 laterally effaced. *Metatarsomere 4* triangular in dorsal view, lobate, length including lobes 1.6× median tarsomere length, subapical and apical setae present; metarsal dorsolateral sulci shallow, lateral, tarsomeres broadly convex medially. *Microsculpture* of frons reduced, surface glossy, shallow transverse mesh visible adjacent to area of reflected light; pronotal disc glossy, shallow, indistinct transverse mesh, sculpticells 3–4× broad as long, visible adjacent to area of reflected light; pronotal median base glossy between punctures; elytral disc with distinct, subiridescent transverse mesh, sculpticells 3–4× broad as long, mixed with less cross-connected transverse lines; elytral apex with transverse mesh, sculpticells 2–3× broad as long; metasternum glossy with obsolete transverse mesh; laterobasal abdominal ventrites glossy, covered with shallow swirling isodiametric and transverse mesh. *Coloration* of head capsule rufobrunneous with piceous cast; antennomeres 1–2 flavous, 3–4 rufoflavous, 5–11 slightly darker; pronotal disc rufobrunneous, anterior transverse impression rufopiceous; proepipleuron rufoflavous, proepisternum rufobrunneous; elytral disc rufobrunneous with silvery to bluish reflection; sutural interval rufous basally, rufoflavous apically; elytral lateral marginal depression concolorous with disc at humerus, increasingly paler to rufoflavous anterad subapical sinuation; elytral apex narrowly rufoflavous anterad incised portion of stria 7; elytral epipleuron rufoflavous, metepisternum rufobrunneous; abdomen rufobrunneous, lateral margins concolorous to darker, with piceous cast, abdominal apical ventrite rufoflavous in apical ¼; metafemur flavous with medial brunneous cast; metatibia flavous.

Male genitalia. (n = 3). Aedeagal median lobe broad in basal ⅔ of length, narrowed apically to broadly rounded apex with blunt apical face, ventral portion of median lobe straight (Fig. 4F); internal sac ventrally covered with dense microspiculate field, distinct ventral or dorsal microtrichial patches absent; flagellar plate large, length 0.57× distance between parameral articulation and apex, gonopore visible on middle of dorsal surface, longitudinally radiate sclerotic ridges on inner, ventral, surface of plate; right paramere narrowly elongate (Fig. 4G), tip extended 0.85× distance from parameral articulation to apex, left paramere slightly longer, extended 0.90× such distance.

Female reproductive tract. (n = 1). Bursa copulatrix constricted basally apical juncture with common oviduct (Fig. 5D), bursa columnar, length 3× greatest breadth in slide-mounted dissection, surface thin, membranous based on staining with Chlorazol Black; spermatheca reniform, spermathecal duct heavily sclerotized, inflexible; spermathecal gland attached to spermatheca by an elongate duct; basal gonocoxite 1

with 2–3 apical fringe setae, and 2–3 smaller setae along the mesal surfaces of coxite (Fig. 6D); gonocoxite 2 broad basally, subacuminate apically, the lateral margin broadly concave; 2 lateral ensiform setae, 1 dorsal ensiform seta, and 2 apical nematiform setae present on gonocoxite 2.

Holotype male (MNHN), labeled: French Polynesia: Moorea / Tohiewa summit el. 1125– / 1200 m 12–IX–2006 lot 01 / 17°33.03'S, 149°49.33'W / beating ferns & *Myrsine* / J.K. Liebherr // HOLOTYPE / *Mecyclothorax* / mapo / J.K. Liebherr 2012 (black-bordered red label).

Allotype female (MNHN), labeled as holotype but with black-bordered red ALLOTYPE label.

Other Paratypes. SOCIETY ISLANDS. Moorea: Tohiewa summit, 1125–1200 m el., S17°33.03', W149°49.33', 12–ix–2006 lot 01, beating *Myrsine* + ferns, Liebherr (CUIC, 8); 1125 m el., S17°33.07', W149°49.38', 12–ix–2006 lot 02, pyrethrin fog *Weinmannia* moss + roots, Liebherr (CUIC, 3); 1120 m el., S17°33.07', W149°49.38', 12–ix–2006 lot 03, beating *Dicranopteris* ferns, Liebherr (CUIC, 5); lot 05, beating rotten *Freyinetia*, Liebherr (CUIC, 4); 1150–1200 m el., S17°33.03', W149°49.33', 12–ix–2006 lot 07, beating flowering *Myrsine* at night, Liebherr (CUIC, 12; NMNH, 2); 1120 m el., S17°33.07', W149°49.38', 12–ix–2006 lot 08, beating ferns, Ewing (EMEC, 2); 1120 m el., S17°33.07', W149°49.38', 12–ix–2006 lot 09, dead fern fronds, deep gulch, Ewing (CUIC, 2; EMEC, 2); 1120 m el., S17°33.07', W149°49.38', 12–ix–2006 lot 10, pyrethrin fog mossy log, deep gulch, Polhemus (NMNH, 4); gulch S of summit 1160–1180 m el., S17°33.03', W149°49.36', 24–ix–2009 on fern frond, gulch wall, MBIO 5852, Ewing & Yang (EMEC, 5); muddy gulch on trail, 1150 m el., S17°33.08', W149°49.31', 24–ix–2009, pyrethrin fog mossy tree trunk, MBIO 5856, Ewing (CUIC, 1; EMEC, 1); summit along ridge to west, 1190–1207 m el., S17°33.04', W149°49.34', 24–ix–2009, beating *Myrsine*, MBIO 5857, Ewing (CUIC, 1; EMEC, 6); muddy gulch on trail, 1150 m el., S17°33.08', W149°49.31', 24–ix–2009, beating *Angiopteris evecta*, MBIO 5854, Stavrinides (EMEC, 2); 1170 m el., S17°33.08', W149°49.31', 25–ix–2009, pyrethrin fog mossy tree, MBIO 5853, Ewing (EMEC, 2); 1150 m el., S17°33.08', W149°49.31', 25–ix–2009, pyrethrin fog mossy tree trunk, MBIO 5859, Ewing (EMEC, 1); gulch S of summit, 1150–1170 m el., S17°33.03', W149°49.36', 26–ix–2009, on fern frond steep gulch, MBIO 5861, Ewing (EMEC, 3).

Etymology. Given that this species is most similar to *M. castaneus*, the common name of the Tahitian chestnut tree, *Inocarpus fagifer* (Parkinson) (Fabaceae)—i.e. mapo (Wahlroos, 2002)—was chosen for the species epithet. The epithet is to be treated as a noun in apposition.

Distribution and habitat. This species has been found in a variety of situations on Mont Tohiewa, accounting for 68 of the 90 specimens of *Mecyclothorax* collected on or near the summit. Specimens have been found by sampling ferns, *Angiopteris*, rotten *Freyinetia*, *Myrsine* foliage and flowers, and moss-covered *Weinmannia* trunks and roots. In keeping with this species' numerical dominance, it has been collected in association with all other *Mecyclothorax* spp. known from Mont Tohiewa.

***Mecyclothorax fatata* sp. n.**

urn:lsid:zoobank.org:act:14EE6095-7917-4D0F-8D25-42F7C8763199

http://species-id.net/wiki/Mecyclothorax_fatata

Diagnosis. This species shares upturned pronotal margins with a visible lateral depression (Fig. 3D) and regular transverse–mesh elytral microsculpture with *M. ata* Perrault. Individuals of the two species are of similar body size; standardized body length 4.7–5.0 for this species versus 4.5 mm for *M. ata*. However this species deviates from *M. ata* by presence of only the anterior elytral seta resulting in a setal formula of 2211 versus 2221 for *M. ata*. The pronotal base is also more constricted in this species, MPW/BPW = 1.53–1.62 (n = 5) versus a ratio of 1.49 in *M. ata* (Perrault 1986).

Description. *Head capsule* gracile, elongate, frontal grooves subparallel at thin carina posteriorly, mesad anterior supraorbital seta, convergent anterad, clypeo–ocular prolongation broadly convex, frons between groove densely covered with fine transverse wrinkles; dorsum of head flat on frons in lateral view, neck convex; ocular lobe protruded, posterior portion meeting gena at broad, moderately deep groove; compound eye slightly protruded from ocular lobe, slightly convex dorsally laterad supraorbital seta, more than 20 ommatidia along diameter defined by lower margin of antennal articulatory socket; ocular ratio 1.48–1.60, ocular lobe ratio 0.79–0.86; labral anterior margin broadly shallowly emarginate $\frac{1}{3}$ length; antennomeres 1–3 mostly glabrous except for apical seta, antennomere 3 with a few very short setae on posterior surface of shaft; antennae moderately elongate, antennomere 8 length 1.8× maximum breadth; mentum tooth sides defining an acute angle, apex tightly rounded. *Pronotum* smoothly cordate, basolateral margins nearly subparallel anterad rounded obtuse hind angles, distinctly divergent just anterad basal pronotal setae; pronotum somewhat transverse, MPW/PL = 1.15–1.20 (n = 5); median base distinctly depressed relative to disc, punctures arrayed along margin of base and disc, 13–14 punctures of various sizes each side; basal margin slightly convex between laterobasal depressions; median longitudinal impression very fine and shallow but complete on disc, prolonged as longitudinal crease on median base; anterior transverse impression broad and shallow, smooth, finely incised only mesad front angles; anterior callosity flat, little upraised, densely covered with shallow longitudinal wrinkles; front angles very slightly protruded anterad, broadly rounded, distances between front and hind angles subequal, APW/BPW = 0.99–1.05 (n = 5); lateral marginal depression bordered by upraised lateral margin at lateral pronotal seta, broader with margin less upraised at front angle, broader basally joining laterobasal depression which is broader, the surface irregularly punctured; proepisternum with 7 distinct punctulae along hind margin, proepimeron with about 10 very small punctures along marginal collar; prosternal process narrowly depressed medially, sides broadly upraised between procoxae, surface convex posterad at juncture with posterior face. *Elytra* ellipsoid, humeri proximate, disc convex medially, surface sloping laterally to near vertical juncture with lateral marginal depression; basal groove briefly curved to angulate humerus, MEW/HuW =

2.43–2.67 (n = 5); parascutellar seta present; parascutellar striole 3–4 punctate, surface not depressed between punctures; sutural intervals elevated to meet at suture, more convex, callouslike apically; striae 1–6 punctate, the punctures expanding strial width, but striae shallow between punctures, and striae progressively shallower laterally, stria 7 obsolete, indicated by irregularly evident shallow, longitudinal punctulae; intervals on disc flat; sutural stria 1 and stria 7 deep, well defined at apex, striae 2–6 very shallow, difficult to trace; mesal margin of interval 8 protruded as a distinct carina apicad the subapical sinuation; anterior dorsal elytral setae in small impression spanning $\frac{1}{2}$ of interval 3, the setae situated at 0.25–0.26 \times elytral length; apical elytral seta present, subapical seta absent; lateral elytral setae 7 + 6; elytral marginal depression moderately narrow, edge upturned at humerus, depression broader and edge more upturned laterally to elytral midlength, then depression narrowed, margin beadlike anterad subapical sinuation; subapical sinuation very shallow and brief, nearly obsolete. *Mesepisternum* with single dorsoventral row of 5–6 large punctures; metepisternum moderately elongate, width to length ratio 0.68; metepisternum separated from metepimeron by distinct suture; metathoracic flight wing vestigium an elongate strap, length 3 \times width, the apical half of strap extended beyond hind margin of metanotum, with rudiments of wing veins C, R, M, and Cu visible in vestigium. *Abdomen* with visible ventrites 1–4 irregularly wrinkled laterally, ventrites 3–6 with rounded depressions laterally; suture between visible ventrites 2 and 3 effaced laterally. *Metatarsomere 4* emarginate apically, short apical lobes present, overall tarsomere length 1.5 \times median tarsomere length; metatarsomere 4 with long apical and very short subapical setae that are situated along dorsal margin of tarsal apical lobes; metatarsal dorsolateral sulci shallow and lateral, tarsomere dorsum broad, nearly flat. *Microsculpture* on frons a regular transverse mesh, sculpticell breadth 2–3 \times length, neck with isodiametric sculpticells in transverse rows; pronotal disc with a mixture of transverse lines and transverse mesh with sculpticell breadth 3–4 \times length, the surface subiridescent due to microsculpture; pronotal median base covered with dense, swirling isodiametric and transverse sculpticells between punctures; elytral disc with distinct transverse mesh, sculpticell breadth 2–4 \times length, the surface subiridescent; elytral apex with transverse mesh, sculpticells 2–4 \times broad as long, the sculpticells slightly upraised; metasternum with distinct elongate transverse mesh; laterobasal abdominal ventrites with glossy surface, swirling isodiametric and transverse sculpticells plainly visible. *Coloration* of head capsule rufobrunneous with a piceous cast; antennomeres 1–2 flavous, 3–11 rufoflavous; pronotal disc rufobrunneous with silvery metallic reflection, lateral margins, base and anterior callosity darker than disc, with piceous cast; proepipleuron rufoflavous, proepisternum rufobrunneous; elytral disc rufobrunneous with silvery reflection; sutural interval concolorous with disc basally paler, rufoflavous apically; elytral marginal depression concolorous with disc at humerus, depressed area rufoflavous from midlength to subapical sinuation; elytral epipleuron rufoflavous, metepisternum rufobrunneous; abdomen rufobrunneous, broadly paler apically to rufoflavous apex of visible ventrite 6; metafemur rufoflavous; metatibia rufoflavous with brunneous cast.

Male genitalia. (n = 2). Aedeagal median lobe of equal diameter in basal $\frac{2}{3}$ of length, narrowed to a bluntly rounded, ventrally expanded apex (Fig. 4H); internal sac with melanized microspicules on surface, appearing dark in unevverted dissection; flagellar plate large, melanized, length $0.5\times$ distance from parameral articulation to apex; right paramere narrowly elongate, apex extended $0.85\times$ distance from parameral articulation to apex, left paramere longer, apex extended $0.90\times$ such distance.

Female reproductive tract. (n = 1). Bursa copulatrix columnar, length $2.4\times$ greatest width in microslide-mounted dissection (Fig. 5E), bursal surface lightly sclerotized based on staining with Chlorazol Black; spermatheca reniform, spermathecal duct thin and lightly sclerotized; spermathecal gland bulbous, apparently filled with material that did not clear in 10% KOH in dissected individual, attached to spermatheca by short duct; basal gonocoxite 1 with apical fringe of 4 setae (Fig. 6E), 13–14 small setae arrayed across medial portion of coxite; apical gonocoxite 2 broad basolaterally, the lateral margin broadly excavate, the apex subacuminate; 2 lateral and 1 dorsal ensiform setae, and 2 apical nematiform setae present.

Variation. Marginal setation of the apical visible ventrite in males is unstable in this species. Of the four male specimens, one individual has 4 terminal abdominal setae along the apical margin of visible ventrite 6, 2 on each side (EMEC); one has 3 apical setae, 1 on the right and 2 on the left (CUIC); and two others exhibit the usual 2 setae, 1 each side (MNHN, EMEC).

Holotype male (MNHN), labeled: FRENCH POLYNESIA: / Moorea Tohicia summit / 12–IX–2006 lot 07 / S17°33.03', W149°49.33' / el. 1150–1200 m beating / flowering *Myrsine* after / dark J.K. Liebherr // HOLOTYPE / Mecyclothorax / fatata / J.K. Liebherr 2012 (black-bordered red label).

Allotype female (MNHN), labeled as holotype but with black-bordered red ALLOTYPE label.

Other Paratypes. SOCIETY ISLANDS. Moorea: Tohicia summit, 1125–1200 m el., S17°33.03', W149°49.33', 12–ix–2006 lot 01, beating *Myrsine* + ferns, Liebherr (CUIC, 2); 1125 m el., S17°33.07', W149°49.38', 12–ix–2006 lot 02, pyrethrin fog *Weinmannia*, moss + roots, Liebherr (CUIC, 1); summit along ridge to west, 1190–1207 m el., S17°33.04', W149°49.34', 24–ix–2009, beating *Myrsine*, MBIO 5857, Ewing (EMEC, 1); muddy gulch on trail, 1170 m el., S17°33.08', W149°49.31', 25–ix–2009, pyrethrin fog mossy tree, MBIO 5853, Ewing (CUIC, 1); 1150 m el., S17°33.08', W149°49.31', 25–ix–2009, pyrethrin fog mossy tree trunk, MBIO 5859, Ewing (EMEC, 1).

Etymology. Because this species is most similar to *M. ata*, the Tahitian epithet fatata, near or nearly (Wahlroos 2002) was chosen to express the similarity. The epithet is indeclinable and is to be treated as a noun in apposition.

Distribution and habitat. All six collections and eight specimens of *M. fatata* were made in association with the numerically dominant *M. mapo*. In two instances *M. perraulti* was also present in the sample. Five of the eight *M. fatata* specimens were collected from *Myrsine*, one from moss-covered *Weinmannia*, and two others from unidentified trees.

Discussion

The greatest similarity of the seven Moorean *Mecyclothorax* spp. to seven different Tahitian *Mecyclothorax* spp. (Table 1) points to independent biogeographic relationships—i.e. independent speciation events—for the seven sister–species pairs. This pattern suggests that all seven speciation events have occurred such that the descendant species occupy allopatric distributions on either side of the Moorea Channel. Isolation by this Channel leading to speciation could have conceivably involved three biogeographic phenomena: 1, vicariance between Moorea and Tahiti based on subsidence of intermediate land areas and associated oceanic incursion; 2, dispersal of an ancestral population from Tahiti to Moorea; 3, dispersal of an ancestral population from Moorea to Tahiti. The first option involving subsidence of an ancient mountain range was favored by Crampton (1917, 16; 1932, 194) in his interpretation of the biogeographic history of *Partula* land snails. Minimum oceanic depths between Moorea and Tahiti are more than 1500 m (U.K. Hydrographic Office 2012). Currently there are no data on the amount of subsidence by Moorea caused by Pacific Plate loading associated with the shield–building phase of the younger volcanoes of Tahiti. However, data from the Hawaiian Islands may be pertinent. During the development of Hawaii Island, subsidence levels of 1300–2000 m occurred along the Hana Ridge to the east of Maui Island (Price and Elliott–Fisk 2004; Faichney et al. 2010), the next youngest island in the Hawaiian chain. If the Tahiti–Moorea island pair interacted similarly at their position on the Pacific Plate, Crampton’s scenario may be correct. Submarine mapping of ancient reef systems surrounding Moorea and Tahiti is required to further evaluate the geological underpinnings for this option.

Taking up the hypotheses that the biogeographic relationships of the Moorean and Tahitian taxa are due to dispersal, we can ask whether a consistent biogeographic relationship between Mont Tohiea and an area of endemism in Tahiti is observed. If *Mecyclothorax* beetles dispersed between these islands, they necessarily did so over water, not in the air, as all *Mecyclothorax* spp. on both islands possess vestigial flight wings and a truncated metathoracic flight apparatus evolutionarily associated with winglessness (Darlington 1936). Given that restriction, dispersal would most likely have been associated with flooding events, landslides, and subsequent rafting between islands on vegetative masses broken loose from the very steep, highly eroded volcanic flanks present on both islands (Zimmerman 1948). Marau and Aorai represent the Tahitian mountain ridges most proximate to Moorea, and thus most likely to be implicated in dispersal to or from Moorea. Based on the distributional ranges of the Tahitian adelphotaxa (Table 1), there is majority support for this pattern as five of the seven species occur on either Aorai or Marau. However two of the adelphotaxa are restricted to Tairapu, a geographically distant source or recipient.

The generality of the proposed, most prevalent dispersal pattern can be tested using information from other taxa. To date the best example of such a test involves the Moorean Nabidae, which comprise three micropterous species, all related to different micropterous species in Tahiti (Polhemus 2010). *Nabis tohiea* Polhemus is the putative adelphotaxon to *N. orohena* Polhemus, the latter broadly distributed on Marau, Aorai,

Table 1. Moorean *Mecyclothorax* spp. and hypothesized Tahitian adelphotaxa based on greatest morphological similarity, plus distributional range in Tahiti of hypothesized adelphotaxa. The distributional ranges Aorai and Marau are the ridges culminating in those peaks to the south. Tairarapu represents species collected in the Mts. Teatara, Presqu'île de Tairarapu.

Moorean species	Tahitian adelphotaxon	Adelphotaxon range
<i>M. perraulti</i>	<i>M. gourvesi</i>	Aorai + Marau
<i>M. pahere</i>	<i>M. paraltiusculus</i>	Tairarapu
<i>M. menemene</i>	<i>M. jarrigei</i>	Aorai
<i>M. mahatabi</i>	<i>M. cupripennis</i>	Tairarapu
<i>M. popotioaoo</i>	<i>M. hemisphaericus</i>	Marau
<i>M. mapo</i>	<i>M. castaneus</i>	Marau
<i>M. fatata</i>	<i>M. ata</i>	Aorai

Orohena, Pito Hiti, Tairarapu, and Mont Mauru on the eastern versant of Tahiti Nui. *Nabis mooreana* Polhemus is considered closest to *N. tangaroa* Polhemus, with the Tahitian *N. tangaroa* known only from Marau. And the third Moorean species, *N. polynesica* Polhemus, is sister to *N. tahitiensis* Polhemus, a species recorded from Marau, Mauru, and Tairarapu. Based on information from *Nabis* spp., Marau is represented in the distributions of all three Tahitian adelphotaxa of the Moorean taxa, consistent with a dispersal scenario involving over-water transport on vegetative debris cut loose by floodwater induced land slips.

At present we have no evidence that Moorean *Mecyclothorax* have undergone autochthonous speciation in Moorea. Hoch (2006) proposed that two Moorean species of *Oteana* Hoch (Hemiptera: Cixiidae) are adelphotaxa, suggesting that the island has had a complicated enough geographical and botanical history during its 1.52 Myr subaerial lifespan (Guillou et al. 2000) to have supported speciation within its bounds. Recent collections of *Mecyclothorax* beetles have all occurred near the summit of Mont Toheia, from 1100–1207 m elevation. During his Tahitian collecting, Perrault (1986, 1987, 1988) found singleton specimens he described as three species—*M. teatara* Perrault, *M. ferruginosus* Perrault, and *M. sinuatus* Perrault—in habitats from 800–1000 m. During the 2006 survey that resulted in the first collections of *Mecyclothorax* on Mont Toheia, another undescribed *Mecyclothorax* was discovered in a riparian habitat at 705 m elevation on Mont Mauru in eastern Tahiti Nui (unpubl. data). Thus 700 m elevation stands as a likely lower limit for present-day distributions of *Mecyclothorax* beetles on Tahiti. Assuming a similar lower elevational limit for taxa in Moorea suggests that Moorea's Mt. Rotui, isolated by low-lying valleys and peaking at 899 m elevation, is the locality most likely to contain Moorean adelphotaxa to one or more of the seven species precinctive to Mont Toheia. Other peaks on the main Mont Toheia massif—e.g. Mont Mouaroa—may also support *Mecyclothorax*, though this summit at 880 m elevation is connected to Mont Toheia by a ridgeline supporting montane forest, and thus would be less likely to house distinct species.

The most speciose radiations of *Mecyclothorax* spp. are concentrated in the Society and Hawaiian island chains. Is this shared level of extreme diversity indicative

of phylogenetic affinity for these two radiations? The most generalized species in the genus are Australian. Moore (1984) redescribed the two most widespread Australian *Mecyclothorax*—*M. punctipennis* (Macleay) and *M. ambiguus* (Erichson)—and clarified their nomenclatural status. Both species inhabit broad geographic ranges in Australia. *M. punctipennis* occurs in dry to mesic, subtropical lowland to montane forest and is found in both West Australia and along the east coast, whereas *M. ambiguus* is restricted to wetter more temperate forests from New South Wales to Tasmania. Both species comprise flight-capable individuals living in a wide variety of habitats. Of these two, Britton (1948) proposed the Australian *M. punctipennis* (his “*M. ambiguus*” prior to Moore’s [1984] clarification) (Fig. 7A) as the species most similar to the generalized Hawaiian *M. montivagus* (Blackburn) (Fig. 7C) based on pronotal, elytral and aedeagal configurations (Fig. 8). He considered *M. montivagus* to represent the most generalized Hawaiian *Mecyclothorax*. Recent study confirms his conclusion. Among the entirely brachypterous Hawaiian *Mecyclothorax* fauna, *M. montivagus* exhibits the largest flight-wing vestigium, with the wing rudiment a narrowed stenopterous strap of length 3.3× breadth, and including rudiments of the costa, radius, medius, and cubitus wing veins. This strap extends about 0.40× its length past the posterior margin of the metanotum. No other Hawaiian *Mecyclothorax* species has a flight wing rudiment this well developed (unpubl. data). Thus best evidence points to *M. montivagus* as the most generalized extant Hawaiian species, and it is hypothesized to be the closest phylogenetic descendant of the ancestral Hawaiian *Mecyclothorax* propagule. Choosing among potential extant *Mecyclothorax* spp. from the southwest Pacific to have colonized Hawaii, *M. punctipennis* of Australia represents the morphologically most similar and ecologically most appropriate candidate.

Based on comparison of the seven new Moorean species plus all Tahitian species described by G.G. Perrault (MNHN) to representatives of all Australian and New Zealand species (Moore et al. 1987; Baehr 2009; Liebherr and Marris 2009), the greatest morphological similarity also links Australia’s *M. punctipennis* to the Tahitian members of the *M. striatopunctatus* species group (Perrault 1986) (Fig. 7B). The four *M. striatopunctatus* group species all display the maximal setal formula of 2222, as does *M. punctipennis*. Members of the *M. striatopunctatus* species group also exhibit an ovoid pronotum with little projected hind angles, and punctate elytral striae. Being vestigially winged, the elytra have more rounded humeri, as also observed in *M. montivagus* (Figs 7B, C), and the elytral striae are the deepest of the three, with lateral striae more well developed than in *M. punctipennis* or *M. montivagus* (Fig. 7). Aedeagal conformation is also very similar in males of all three species. The aedeagal lobe of the Tahitian species terminates in moderately expanded apex (Perrault 1986, figs 22, 23) similar to the aedeagal median lobe of *M. punctipennis* (Fig. 8A) and *M. montivagus* (Fig. 8B). The internal sac of the latter two taxa are also similar (data for the Tahitian species not available), sharing: 1, robust, moderately elongate shape; 2, a well-developed dorsal ostial microtrichial patch with short spicules; 3, a ventral ostial microtrichial patch; 4, a broad ventral field of fine microspicules that extends to the flagellar plate; and 5, a relatively large flagellar plate. Thus it would appear that *M. punctipennis* also represents

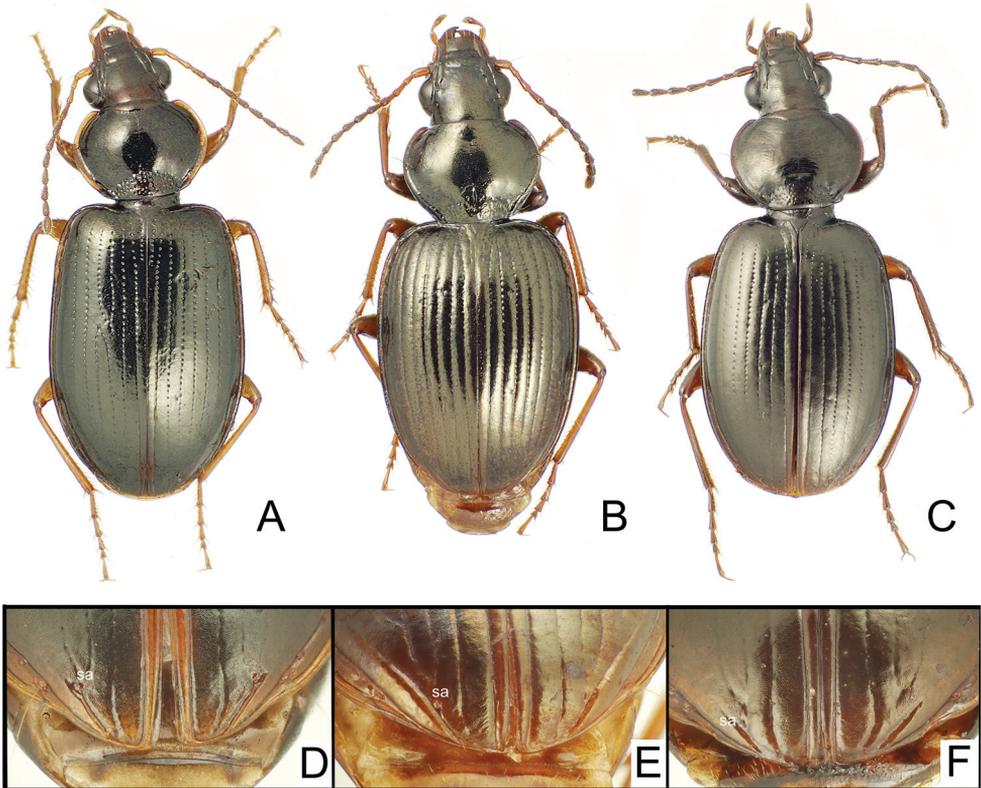


Figure 7. A–C *Mecyclothorax* spp., females, dorsal view. **A** *M. punctipennis*, Mt. Buffalo S.P., Victoria, Australia; proposed adelphotaxon to both the Society Island and Hawaiian *Mecyclothorax* radiations **B** *M. wallisi*, female, Aorai, Tahiti; member of *M. striatopunctatus* species group **C** *M. montivagus*, Haleakala, Maui; proposed as closest extant relative to founding Hawaiian *Mecyclothorax* species **D–F** Elytral apex, dorsal view; sa, subapical elytral seta **D** *M. punctipennis* **E** *M. wallisi* **F** *M. montivagus*; subapical seta absent from right elytron.

the generalized mainland species that is most similar to any extant Tahitian taxon, and therefore the most likely candidate to have colonized the Society Islands.

If *M. punctipennis* spawned the colonizing propagules that founded radiations on both Hawaiian and Society archipelagoes, were these radiations founded in a stepping–stone like manner from a source in the southwest Pacific? Such a stepping–stone pattern of colonization has been shown for the dominant Hawaiian Ohi`a, *Metrosideros polymorpha* (Myrtaceae) and allied species, with dispersal stemming from New Zealand and Lord Howe Island to the Marquesas and the Societies, and ultimately to the Hawaiian Islands (Wright et al. 2001; Percy et al. 2008). Elytral configuration in the two *Mecyclothorax* radiations argues against such a conclusion. In the Tahitian *M. striatopunctatus* species group, as well as most other Society Island *Mecyclothorax*, the eighth elytral interval just laterad the seventh stria is developed into a subcarinate margin that extends from the elytral apex to well anterad the position of the subapical elytral seta (Fig. 7E). This subcarinate ridge may be developed further in Society species,

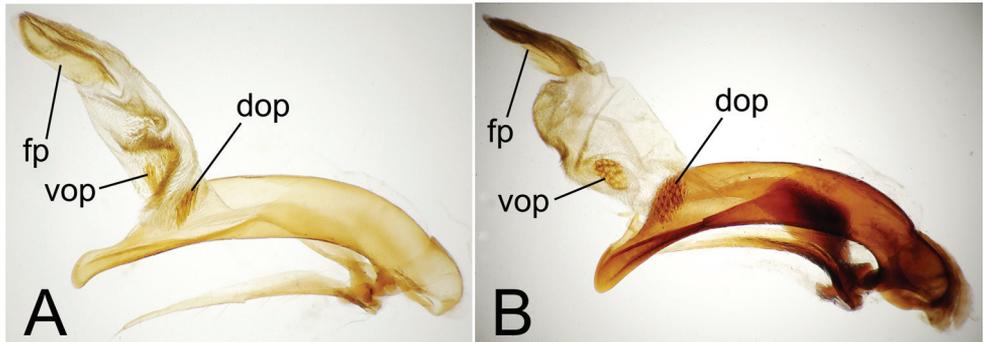


Figure 8. *Mecyclothorax* spp., male aedeagal median lobe and parameres, internal sac everted. **A** *M. punctipennis*. **B** *M. montivagus*. Abbreviations: **dop** dorsal ostial microtrichial patch; **fp** flagellar plate; **vop** ventral ostial microtrichial patch.

taking the form of a carinate ridge that extends anterad various lengths on the elytron (Figs 2A, B). This carinate condition has evolved several times during the evolution of Moriomorphini (Liebherr 2011b). Both the subcarinate and elongate carinate conditions were derived from the more briefly subcarinate eighth interval observable in *M. punctipennis*, where the distinct mesal margin of the eighth interval does not extend appreciably anterad the subapical setal depression (Fig. 7D). This brief, marked depression of the eighth interval occurs in spite of the generally shallow lateral elytral striae characteristic of this species (Fig. 7A). Several other Austral–Pacific *Mecyclothorax* species share the elytral configuration observed in *M. punctipennis*: *M. ambiguus* and *M. lophoides* (Chaudoir) of Australia; *M. basepunctus* Louwerens and *M. lissus* (Andrewes) of Java; and *M. rotundicollis* (White) plus *M. oopterooides* Liebherr and Marris (2009) from New Zealand. Therefore colonization of the Societies has been followed during diversification by evolutionary enhancement of this carina (Fig. 7E). Conversely in the Hawaiian *M. montivagus*, this carina is less developed than in *M. punctipennis*; i.e. the eighth interval is more rounded mesally, with its margin most distinct, though still broadly rounded, laterad the subapical setal depression (Fig. 7F). Thus the Hawaiian and Australian taxa share the absence of a subcarinate interval extension anterad the subapical seta. Based on the pattern of evolutionary transformation in this character, whereby the Australian condition is considered plesiomorphic (Fig. 7D), evolution has proceeded independently in two directions; 1, toward more carinate elytra in the Societies (Fig. 7E); and 2, to a less carinate, more rounded eighth interval in Hawaii (Fig. 7F). Given this pattern, it is most parsimonious to hypothesize two independent colonization events involving the same colonizing species, with subsequent independent radiations in the Tahitian and Hawaiian archipelagos.

Independent colonization of the Societies and Hawaii by propagules derived from populations of *M. punctipennis* suggests several ancillary conclusions. First, both colonizing events would seem to have involved propagules derived from one of the currently most common carabid beetle species in Australia, *M. punctipennis*. The numerical dominance and ecological plasticity of this species, which occurs from dry *Xanth-*

orrhea-Eucalyptus forest at sea level to open montane snow gum (*Eucalyptus pauciflora* Sieber) forests at over 1500 m elevation (unpubl. data), enhances the probability that were a propagule produced from this species, the colonizers would possess substantial genetic variability to allow survival as ecological pioneers across the range of habitats occupied by the beetles in Australia. This range would include the present-day leeward montane shrubland habitat of *M. montivagus* in Maui.

Second, if *M. punctipennis* were the source of colonizing propagules, colonization of both the Society and Hawaiian Islands must have occurred recently. Present evidence for the Society radiation, with species restricted to Moorea and Tahiti, would place the age of origin of the fauna at no more than 2.25 Ma were the radiation founded on Moorea, or 1.75 Ma if founded on Tahiti (Craig et al. 2001). In Hawaii, the most generalized species, *M. montivagus*, occurs on Haleakala, a volcano that completed the shield-building stage by 0.95 Ma (Sherrod et al. 2003). In Hawaii, there are no *Mecyclothorax* in Kauai, and the Oahu taxa have sister groups on Maui Nui (Liebherr 2009a; Liebherr and Krushelnycky 2011). This places Maui Nui, and most defensibly Haleakala based on extant, observable taxa, as the point of original *Mecyclothorax* colonization in Hawaii. Thus both island radiations have evolved over the past 1–2 Myr. Bocher (1995) found that nearly all of the 140 carabid beetle species assembled in 2 Myr old glacial deposits at Kap København, North Greenland remain extant. If the widespread, ecologically plastic *M. punctipennis* responded to climatic change as did the broadly distributed Holarctic coleopteran species that tracked Pleistocene climate change (Coope 1979), then a 2 Myr species duration for *M. punctipennis* seems a reasonable working hypothesis.

Finally, as the Tahitian and Hawaiian radiations have the same, extant sister species as their adelphotaxon, intense acceleration of the speciation rate is demonstrable in both island archipelagoes. This accelerated diversification must be directly attributable to life on these isolated volcanic islands. The subtropical Hawaiian and Society volcanic islands developed forests quickly, as orographic rainfall synergized nutrient transfer to forest plants within thousands of years of plant colonization (Kitayama et al. 1997; Vitousek et al. 1997). Evolutionary loss of flight wings in both of these island radiations enhanced speciation rate in the flightless *Mecyclothorax* by reducing gene flow among populations (Liebherr 1988), thereby facilitating adaptation to specific locales (Darlington 1943; Southwood 1977). Allopatric speciation among these poorly connected populations was facilitated initially by range fragmentation caused by by emplacement of new lava flows on the landscape resulting in isolated forest kipukas (Zimmerman 1948). Upon cessation of major volcanic activity, rampant erosion and valley formation isolated organisms in islands or peninsulas of montane forest habitat. The number of ecological components in these habitats was restricted by the colonization process, and those taxa present faced reduced competition for resources except among phylogenetic relatives that shared their general way of life. This restrictive competition favored subsequent specialization within what remained a more generalized way of life in the mainland source community. In the Tahitian *Mecyclothorax* fauna, this has resulted in species that have specialized to live predominantly in leaf

litter, such as the large-bodied *M. muriauxi* species group (Perrault 1984) and others that are observed nearly always in arboreal microhabitats, such as species of the small-bodied *M. globosus* group (Perrault 1989). This ecological divergence took place without the ability to colonize remote habitat patches via winged flight. However, forest habitats anastomosed through time as lava flows became forested, allowing beetles to colonize newly available habitats terrestrially, with subsequent lava flows dissecting the landscape in new and different ways. The beetles' various ecological specializations combined with their aggregate role as one of the dominant predatory lineages, ensuring that these radiating insects persisted in the many historically colonized forest patches, thereby setting the stage for multiplicative generation of ever more allopatric species; an island variant of Noonan's (1988) continental cyclic vicariance. This multiply-layered *Mecyclothorax* fauna, with many sympatric species representing different sublineages of the radiation, prompted Perrault (1992) to suggest that Tahiti was colonized repeatedly by numerous waves of different *Mecyclothorax* colonists. However, the presence of a very similar pattern of intense levels of sympatry and extreme specialization in the much more isolated Hawaiian Islands, coupled with the extreme similarity of only the mainland *M. punctipennis* to any of the Hawaiian *Mecyclothorax*, supports evolution from a single colonization event in Hawaii. In the Society Islands, moreover, the presence of species assignable to *Mecyclothorax* based on appropriate generic-level characters, yet exceedingly different (e.g., Fig. 2B) from any other *Mecyclothorax* species present anywhere beyond the Society Islands, suggests that diversification has proceeded apace within this archipelago to produce today's incredibly diverse fauna.

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References

- Baehr M (1998) A preliminary survey of the classification of Psydrinae (Coleoptera: Carabidae). In Ball GE, Casale A, Vigna Taglianti V (Eds) Phylogeny and classification of Caraboidea (Coleoptera: Adephaga). Proceedings of a symposium (28 August, 1996, Florence, Italy). 20 International Congress of Entomology, Atti Museo Regionale di Scienze Naturali (Museo Regionale di Scienze Naturali–Torino, Torino), 359–368.
- Baehr M (2004) The Amblytelini, a tribe of corticolous ground beetles from Australia: taxonomy, phylogeny, biogeography. (Coleoptera: Carabidae: Psydrinae). *Coleoptera* 8: 1–238.
- Baehr M (2009) A new species of the genus *Mecyclothorax* Sharp from New South Wales (Insecta: Carabidae: Psydrinae). *Records of the Australian Museum* 61: 89–92. doi: 10.3853/j.0067-1975.61.2009.1519
- Baehr M, Lorenz W (1999) A reevaluation of *Loeffleria globicollis* Mandl from Borneo (Insecta, Coleoptera, Carabidae, Psydrinae). *Spixiana* 22: 263–267.
- Ball GE, Shpeley D (1983) The species of eucheiloid Pericalina: classification and evolutionary considerations (Coleoptera: Carabidae: Lebiini). *Canadian Entomologist* 115: 743–806. doi: 10.4039/Ent115743-7
- Blackburn T (1892) Notes on Australian Coleoptera, with descriptions of new species. Proceedings of the Linnean Society of New South Wales (Ser. 2) 6: 479–550.
- Bocher J (1995) Paleoentomology of the Kap København Formation, a Plio–Pleistocene sequence in Peary Land, North Greenland. *Meddelelser om Grønland, Geoscience* 33: 82 pp.
- Bouchard P, Bousquet Y, Davies AE, Alonzo–Zarazaga MA, Lawrence JF, Lyal CHC, Newton AF, Reid CAM, Schmitt M, Ślipiński SA, Smith ABT (2011) Family–group names in Coleoptera (Insecta). *Zookeys* 88: 1–972. doi: 10.3897/zookeys.88.807
- Britton EB (1948) A revision of the Hawaiian species of *Mecyclothorax* (Coleoptera: Carabidae). *Occasional Papers of Bernice P. Bishop Museum* 19: 107–166.
- Coope GR (1979) Late Cenozoic fossil Coleoptera: evolution, biogeography, and ecology. *Annual Review of Ecology and Systematics* 10: 247–267. doi: 10.1146/annurev.es.10.110179.001335
- Craig DA, Currie DC, Joy DA (2001) Geographical history of the central–western Pacific black fly subgenus *Inselliellum* (Diptera: Simuliidae: *Simulium*) based on a reconstructed phylogeny of the species, hot–spot archipelagoes and hydrological considerations. *Journal of Biogeography* 28: 1101–1127. doi: 10.1046/j.1365-2699.2001.00619.x
- Crampton HE (1917[1916]) Studies on the variation, distribution, and evolution of the genus *Partula*, the species inhabiting Tahiti. Washington, DC, The Carnegie Institution of Washington, 313 pp. + 34 pls.
- Crampton HE (1932) Studies on the variation, distribution, and evolution of the genus *Partula*, the species inhabiting Moorea. Washington, DC, Carnegie Institute of Washington, vi + 335 pp. + 8 pls.
- Darlington PJ Jr (1936) Variation and atrophy of flying wings of some carabid beetles. *Annals of the Entomological Society of America* 24: 136–179.

- Darlington PJ Jr (1943) Carabidae of mountains and islands: data on the evolution of isolated faunas, and on atrophy of wings. *Ecological Monographs* 13: 37–61. doi: 10.2307/1943589
- Deuve T (1987) Descriptions de deux carabiques nouveaux de Nouvelle-Calédonie et de Thaïlande (Coleoptera, Caraboidea, Psydridae, Trechidae). *Revue Française d'Entomologie (NS)* 9: 143–146.
- Faichney IDE, Webster JM, Clague DA, Paduan JB, Fullagar P (2010). Unraveling the tilting history of the submerged reefs surrounding Oahu and the Maui Nui Complex, Hawaii. *Geochemistry Geophysics Geosystems* 11(7): 20pp. doi: 10.1029/2010GC003044
- Giambelluca TW, Schroeder TA (1998) Climate. In Juvik SP, Juvik JO (Eds) *Atlas of Hawaii*. Honolulu, University of Hawaii Press, 49–59.
- Guillou H, Blais S, Guille G, Legendre C, Maury RC, Caroff M., Cotten J (2000) Unspiked K–Ar dating of the subaerial volcanic activity of Moorea, Huahine, Raiatea, Bora Bora and Maupiti (Society Islands). *EOS, Transactions of the American Geophysical Union* 81(48): F1369.
- Hoch H (2006) New Cixiidae from eastern Polynesia: *Oteana* gen. nov. and *Manurevana* gen. nov. (Hemiptera: Fulgoromorpha). *Zootaxa* 1209: 1–47.
- Jeannel R (1940) III. Coléoptères. Croisière du Bougainville aux îles australes Françaises. *Mémoires du Muséum National d'Histoire Naturelle* 14: 63–201.
- Jeannel R (1943) Un carabique nouveau de la Nouvelle-Calédonie. *Revue Française d'Entomologie* 10: 84–86.
- Kitayama K, Schuur EAG, Drake DR, Mueller-Dombois D (1997) Fate of a wet montane forest during soil ageing in Hawaii. *Journal of Ecology* 85: 669–679. doi: 10.2307/2960537
- Liebherr JK (1988) Gene flow in ground beetles (Coleoptera: Carabidae) of differing habitat preference and flight-wing development. *Evolution* 42: 129–137. doi: 10.2307/2409121
- Liebherr JK (2006[“2005”]) Newspecies of *Mecyclothorax* (Coleoptera: Carabidae, Psydrini) from Polipoli, Maui define an area of endemism on Haleakala Volcano, Hawaii. *Journal of the New York Entomological Society* 113: 97–128. doi: 10.1664/0028-7199(2005)113[0097:NS OMCC]2.0.CO;2
- Liebherr JK (2007[“2006”]) Taxonomic revision of the *Mecyclothorax* beetles (Coleoptera: Carabidae, Psydrini) of Molokai, Hawaii and recognition of areas of endemism on Kamakou volcano. *Journal of the New York Entomological Society* 114: 179–281. doi: 10.1664/0028-7199(2007)114[179:TROTMB]2.0.CO;2
- Liebherr JK (2008) Taxonomic revision of *Mecyclothorax* Sharp (Coleoptera, Carabidae) of Hawaii Island: abundant genitalic variation in a nascent island radiation. *Deutsche Entomologische Zeitschrift* 55: 19–78. doi: 10.1002/mmnd.200800004
- Liebherr JK (2009a) Taxonomic revision of the *Mecyclothorax* beetles (Coleoptera: Carabidae) of Oahu: epithets as epitaphs for an endangered fauna? *Systematic Entomology* 34: 649–687. doi: 10.1111/j.1365-3113.2009.00477.x
- Liebherr JK (2009b) Native and alien Carabidae (Coleoptera) share Lanai, an ecologically devastated island. *The Coleopterists Bulletin* 63: 383–411. doi: 10.1649/1176.1

- Liebherr JK (2011a) The *Mecyclothorax* beetles (Coleoptera: Carabidae: Moriomorhini) of West Maui, Hawaii: taxonomy, biogeography, and conservation. *Deutsche Entomologische Zeitschrift* 58: 15–76. doi: 10.1002/mmnd.201100005
- Liebherr JK (2011b) Cladistic assessment of subtribal affinities within the tribe Moriomorhini with description of *Rossjoycea glacialis*, gen. n. and sp. n. from the South Island, and revision of *Meonochilus* Liebherr and Marris from the North Island, New Zealand (Coleoptera, Carabidae). *ZooKeys* 147: 277–335. doi: 10.3897/zookeys.147.1898
- Liebherr JK (in press) New *Mecyclothorax* spp. (Coleoptera: Carabidae: Moriomorhini) define Mont Mauru, eastern Tahiti Nui, as a distinct area of endemism. *ZooKeys*.
- Liebherr JK, Krushelnycky PD (2011). *Mecyclothorax palikea* sp. n. from the Waianae Range, Oahu, and the biogeographical history of Hawaii's *M. flavomarginatus* species group (Coleoptera: Carabidae: Moriomorhini). *Insect Systematics & Evolution* 42: 365–384. doi: 10.1163/187631211X608718
- Liebherr JK, Marris JWM (2009) Revision of the New Zealand species of *Mecyclothorax* Sharp (Coleoptera: Carabidae: Psydrinae, Mecyclothoracini) and the consequent removal of several species to *Meonochilus* gen. n. (Psydrinae: Meonini). *New Zealand Entomologist* 32: 5–22. doi: 10.1080/00779962.2009.9722172
- Liebherr JK, Will KW (1998) Inferring phylogenetic relationships within Carabidae (Insecta, Coleoptera) from characters of the female reproductive tract. In Ball GE, Casale A, Vigna Taglianti V (Eds) *Phylogeny and classification of Caraboidea (Coleoptera: Adephaga)*. Proceedings of a symposium (28 August, 1996, Florence, Italy). 20 International Congress of Entomology, Atti Museo Regionale di Scienze Naturali (Museo Regionale di Scienze Naturali–Torino, Torino), 107–170.
- Lindroth CH (1974) On the elytral microsculpture of carabid beetles (Col. Carabidae). *Entomologica Scandinavica* 5: 251–264. doi: 10.1163/187631274X00290
- Maddison DR (1993) Systematics of the Holarctic beetle subgenus *Bracteon* and related *Bembidion* (Coleoptera: Carabidae). *Bulletin of the Museum of Comparative Zoology* 153: 143–299.
- Moore BP (1984) Taxonomic notes on some Australasian *Mecyclothorax* Sharp (Coleoptera: Carabidae: Psydrinae) and descriptions of new species. *Journal of the Australian Entomological Society* 23: 161–166. doi: 10.1111/j.1440-6055.1984.tb01935.x
- Moore BP (1985) The Carabidae of Norfolk Island. In Ball GE (Ed) *Taxonomy, Phylogeny and Zoogeography of Beetles and Ants*. Dr W Junk Publishers, Dordrecht, 237–256.
- Moore BP (1992) The Carabidae of Lord Howe Island (Coleoptera: Carabidae). In Noonan GR, Ball GE, Stork NE (Eds) *The Biogeography of Ground Beetles of Mountains and Islands*. Intercept, Ltd., Andover, Hampshire, UK, 159–173.
- Moore BP, Weir TA, Pike JE (1987) Coleoptera: Adephaga: Rhysodidae and Carabidae. *Zoological Catalogue of Australia*. Australian Government Printing Service, Canberra 4: 17–320.
- Mueller-Dombois D, Fosberg FR (1998) *Vegetation of the Tropical Pacific Islands*. New York, NY, Springer Verlag, xvii + 733 pp.
- Noonan GR (1988) Biogeography of North American and Mexican insects, and a critique of vicariance biogeography. *Systematic Zoology* 37: 366–384. doi: 10.2307/2992199
- Percy DM, Garver AM, Wagner WL, James HF, Cunningham CW, Miller SE, Fleischer RC (2008) Progressive island colonization and ancient origin of Hawaiian *Metrosi-*

- deros* (Myrtaceae). Proceedings of the Royal Society B 275: 1479–1490. doi: 10.1098/rspb.2008.0191
- Perrault GG (1978a) La faune des Carabidae de Tahiti II. genre *Mecyclothorax* (Sharp). Nouvelle Revue d'Entomologie 8: 27–36.
- Perrault GG (1978b) La faune des Carabidae de Tahiti II. Genre *Mecyclothorax* (Sharp). Nouvelle Revue d'Entomologie 8: 133–162.
- Perrault GG (1984) La faune des Carabidae de Tahiti VI. révision du genre *Mecyclothorax* (Sharp) (Psydrini). 1. le groupe de *M. muriauxi* Perrault (Coleoptera). Nouvelle Revue d'Entomologie (NS) 1: 19–31.
- Perrault GG (1986). La faune des Carabidae de Tahiti VII. Révision du genre *Mecyclothorax* (Sharp) (Psydrini). 2. les groupes de *M. striatopunctatus* n. sp., *M. dannieae* Perrault, *M. marginatus* Perrault et *M. viridis* Perrault (Coleoptera). Nouvelle Revue d'Entomologie (NS) 3: 439–455.
- Perrault GG (1987) Microendemisme et spéciation du genre *Mecyclothorax* (Coleoptera – Carabidae Psydrini) à Tahiti. Bulletin de la Société Zoologique de France 112: 419–427.
- Perrault GG (1988) La faune des Carabidae de Tahiti. VIII. révision du genre *Mecyclothorax* Sharp (Psydrini) 3. les groupes de *M. altiusculus* Britton et de *M. gourvesi* Perrault (Coleoptera). Nouvelle Revue d'Entomologie (NS) 5: 229–245.
- Perrault GG (1989) La faune des Carabidae de Tahiti: IX. révision du genre *Mecyclothorax* (Sharp) (Psydrini) 4. le groupe de *M. globosus* Britton (Coleoptera). Nouvelle Revue d'Entomologie (NS) 6: 57–70.
- Perrault GG (1992) Endemism and biogeography among Tahitian *Mecyclothorax* species (Coleoptera: Carabidae: Psydrini). In Noonan, GR, Ball GE, Stork NE (Eds), The Biogeography of Ground Beetles of Mountains and Islands. Intercept, Ltd., Andover, Hampshire, UK, 201–215.
- Polhemus DA (2010) Eight new species of micropterous Nabidae (Heteroptera) from the Society Islands, French Polynesia, with consideration of hotspot island speciation patterns. Tijdschrift voor Entomologie 153: 53–78.
- Price JP, Elliott–Fisk D (2004) Topographic history of the Maui Nui Complex, Hawaii, and its implication for biogeography. Pacific Science 58: 27–45. doi: 10.1353/psc.2004.0008
- Sherrod DR, Nishimitsu Y, Tagami T (2003) New K–Ar ages of the geological evidence against rejuvenated–stage volcanism at Haleakalā, East Maui, a post–shield–stage volcano of the Hawaiian island chain. Geological Society of America Bulletin 115: 683–694. doi: 10.1130/0016-7606(2003)115<0683:NKAATG>2.0.CO;2
- Sloane TG (1890) Studies in Australian Entomology. No. IV.—new genera and species of Carabidae. Proceedings of the Linnean Society of New South Wales 5(2nd series): 641–653.
- Sloane TG (1898) On Carabidae from West Australia, sent by Mr. A M Lea (with descriptions of new genera and species, synoptic tables, &c.). Proceedings of the Linnean Society of New South Wales 23: 444–520.
- Southwood TRE (1977) Habitat, the templet for ecological strategies? Journal of Animal Ecology 46: 337–365. doi: 10.2307/3817
- United Kingdom Hydrographic Office (2012) South Pacific Ocean, Polynésie Française, Approaches to Tahiti and Moorea, scale 1:100,000 at 17°40'S. Taunton, Somerset, UK.

- Vitousek PM, Chadwick OA, Crews TE, Fownes JH, Hendricks DM, Herbert D (1997) Soil and ecosystem development across the Hawaiian Islands. *GSA Today* 7(9): 1–8.
- Wahlroos S (2002) English–Tahitian Tahitian–English Dictionary. Honolulu, Hawai`i, The Mā`ohi Heritage Press, xxvi + 684 pp.
- Wright SD, Yong CG, Dawson JW, Gardner RC (2001) Stepping stones to Hawaii: a trans-equatorial dispersal pathway for *Metrosideros* (Myrtaceae) inferred from nrDNA (ITS + ETS). *Journal of Biogeography* 28: 769–774. doi: 10.1046/j.1365-2699.2001.00605.x
- Zimmerman EC (1948) Introduction. *Insects of Hawaii* 1: xliv + 206 pp (2001 reissue).

A new species of *Angeloptyromyia* Korneyev, 2001 (Diptera, Platystomatidae) from Iran, with the key to the species

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Abstract

Angeloptyromyia korneyevi Mohamadzade Namin, **sp. n.** from Iran is described and figured. The new species is similar to other species of *Angeloptyromyia* in having abdominal spiracles 5 of females not approximated medially, as well as clypeus extended postero-ventrally, antenna shorter than face, and R_1 and R_{4+5} setulose on dorsal side. It differs from other species of *Angeloptyromyia* by having mostly brown wing with 3 hyaline crossbands and a few hyaline spots, and dark brownish basal and costal cells without hyaline spots.

Keywords

Diptera, Platystomatidae, Iran, new species

Introduction

The signal flies (Platystomatidae) are small to large-sized flies (3.5–20 mm) often with grayish microtrichose or bright and metallic blue or green body. Wings are usually strongly patterned and the cell *bcu* is closed by arcuate or straight vein at apex, without a posteroapical lobe (Korneyev 2001). There are about 1200 described species in 119 genera worldwide (McAlpine 2001), with about 66 species in 8 genera occurring in the Palaearctic Region (Soós 1984, Korneyev 2001). Keys to the species of the family Platystomatidae was provided by Hennig (1945); that paper is partly out-of-date now; the most comprehensive keys to the Palaearctic genera of the family were provided by McAlpine (1998) and Korneyev (2001).

Angeloferomyia Korneyev, 2001 is a genus of the subfamily Platystomatinae with 3 described species occurring in Central Asia (*A. alf* Korneyev, 2001, *A. chvalai* Korneyev, 2001 and *A. merzi* Korneyev, 2001). According to Korneyev (2001), *Angeloferomyia* differs from all other Platystomatidae genera by the following combination of characters: facialia wider than parafacialia, projected anterolaterally; clypeus extended posteroventrally; antenna shorter than face; 1 medial and 1 lateral vertical, 0–1 genal setae. Thorax slightly wider than head, with 1 postpronotal, 0–2+1–6 supraalar, 1–2 postalar, 1–2 intraalar, 1–2 pairs of Scapular (usually inconspicuous), 1–2 dorsocentral close to scutellum, 1–2 Acrostichal, 1+1 notopleural, 1 anepisternal, 0 katepisternal, 3–5 pairs of scut; wings with dark reticulate pattern; cells *bcu* and *bm* closed by straight or arcuate vein, R_1 and R_{4+5} setulose on dorsal side; female abdominal spiracles 5 not approximated medially; epandrium long, surstyli arisen posteriorly with 1 claw-like preniseta, the second preniseta is not clearly visible; phallus with 2 long mostly separated acrophallic tubes; hypandrium asymmetrical anteriorly; vanes of phallapodeme separate. It clearly differs from *Platystoma*, which possesses also a reticulate wing pattern, by the lateral position of abdominal spiracles 5 of female (strongly approximated ventrally in *Platystoma*).

While studying the tephritoid flies fauna in West Azerbaijan Province (Iran), a previously undescribed species of *Angeloferomyia* was collected by the first author. The new species is described and figured below.

Methods

Material is collected by standard sweeping net and minuten-pinned in side. Morphological terminology generally follows McAlpine (1981). The material examined is deposited in collections of the following institutions:

JAZM Jalal Afashar Zoological Museum, College of Agriculture, University of Tehran, Karaj, Iran.

SIZK I. I. Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, Kiev, Ukraine.

Results

Angellopteromyia korneyevi Mohamadzade Namin, sp. n.

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http://species-id.net/wiki/Angellopteromyia_korneyevi

Figs 1–12

Type material. Holotype m#: Iran, West Azerbaijan Province, 10km west Ziveh, 37°08'N, 44°52'E, h 2700m, 8 July 2011 (Mohamadzade leg.) (JAZM).

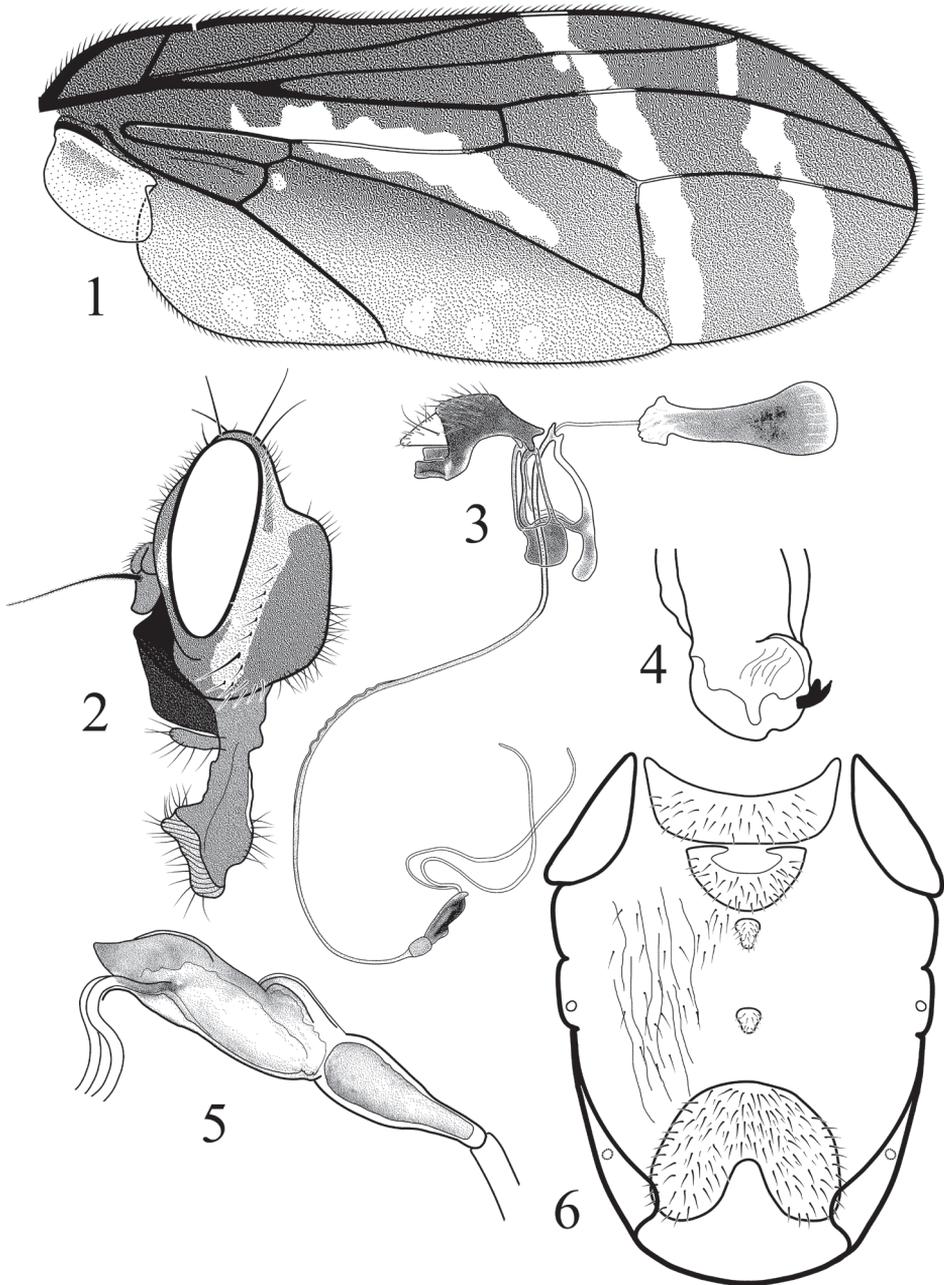
Paratypes: 4♂, 1♀, same collection data as in holotype (JAZM; SIZK and first author's personal collection).

Description. Male.

Head (fig. 2): Head length: height: width ratio = 1: 1.26: 1.48. Eye elongate elliptical. Lunule, antennal grooves and facial ridge black. Frons black, densely dark brownish tomentose, with black setulae and with shining black dots at bases of setulae and setae; ocellar triangle black. Lower two thirds of occiput conspicuously expanded posteriorly; postocellar, occipital and supracerical setulae black. Antenna black, first flagellomere rounded apico-dorsally, arista brownish black and grayish microtrichose with small pubescence. Antennae short and shorter than face, pedicel about half as long as first flagellomere, apical part of first flagellomere rounded and grayish microtrichose. Face shining black, concave in profile. Clypeus large, subshining black. Gena subshining dark brown and 1.2 times as long as first flagellomere. Sides of frons near compound eyes with triangular white microtrichose area. Anterior part of postgena around posterior margin of compound eyes with white microtrichose area that reaches to posterior margin of head. Proboscis brownish black, labellum large and black with long black setae. Palp rounded at apex, black with long black setae. Chaetotaxy: 2 orbital, 1 ocellar, 1 medial vertical, 1.15 times as long as 1 lateral vertical and 1.3 times as long as orbital setae and about twice as long as ocellar seta. All setae and setulae black.

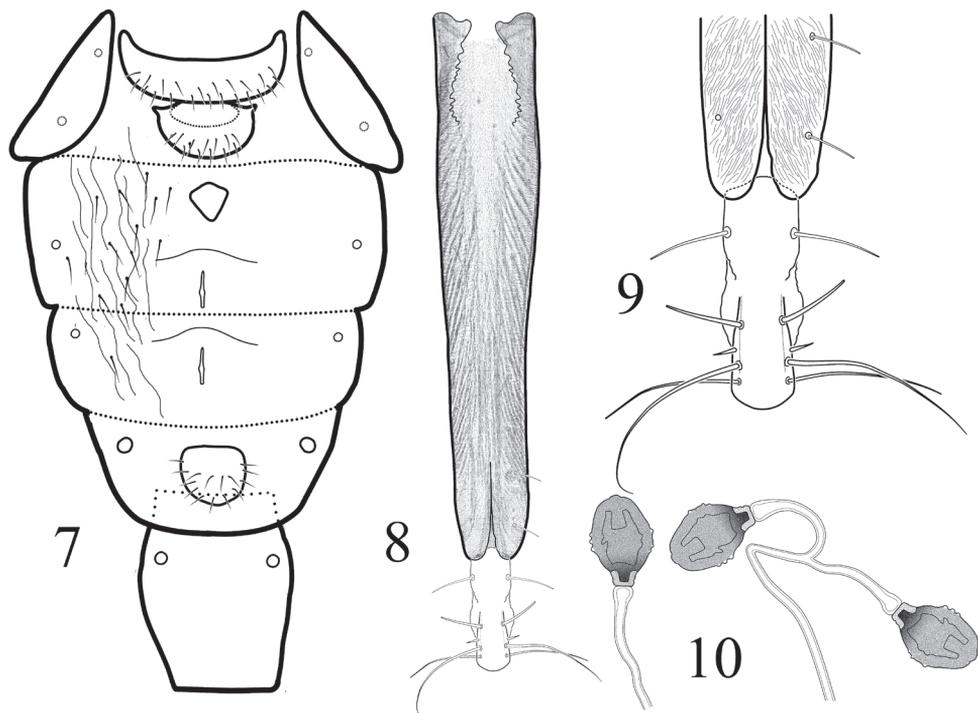
Thorax: all parts of thorax subshining black with numerous black dots at bases of setulae and setae (fig. 12). Chaetotaxy: 1 postpronotal, 1+1 notopleural, 2+3 supraalar, 1 intraalar, 1 dorsocentral, close to scutellum, 1 prescutellar acrostichal, 1 anepisternal and no katepisternal setae present. Scutellum black with 3 pairs of equal setae.

Wing (fig. 1) 2.4 times as long as wide, with dark brown disc, and pattern of 3 hyaline crossbands. Base of wing and costal cell dark brown. Pterostigma brown without hyaline spots. Only 2 oblique hyaline bands present in apical part of the wing: one band crossing wing from r_1 cell to posterior margin of the wing. Another hyaline band crossing wing from r_{2+3} cell near terminal part of R_{2+3} to posterior margin of the wing. Posterior part of apical two-thirds of cell br with oblique hyaline crossband penetrating into cell dm. Anal lobe and cubital cell light brown, containing several hyaline spots at wing posterior margin. R_1 and R_{4+5} setulose dorsally with 13–21 setulae (in holotype 13 on right and 15 on left wing) in whole length of R_{4+5} .



Figures 1–6. *Angelopteromyia korneyevi* sp. n. **1** wing **2** head in profile **3** male genitalia, right aspect **4** surstyli apex, ventral aspect **5** male terminalia **6** abdominal sclerites in male, ventral aspect.

Penultimate section of M 2.3 times shorter than ultimate section and 1.2 times longer than dm-cu. Lower calypter light brown with dark brown spot in middle part. Knob of halter brown, stalk yellow.



Figures 7–10. *Angeloapteromyia korneyevi* sp. n. **7** abdominal sclerites in female, ventral aspect **8** aculeus, ventral aspect **9** aculeus apex, ventral aspect **10** spermathecae.

Legs with black coxae, trochanters, femora and tibiae; fore tarsus black, only basal one-fourth of first and second tarsomeres yellow. First and second tarsomeres of mid and hind tarsus yellow, remaining tarsomeres black. Fore femur subshining black and sparsely microtrichose, with long black setulae and 2 rows of ventro-lateral long black setae. All tibiae and tarsi with black setulae (fig. 11).

Abdomen: subshining black, tergite 5 of male longer than tergites 1–4 together, with shining black posterior margin. Pleura velvet grey with black hairs. Sternites dark brown; sternite 5 of male very large and broad (fig. 6). Male terminalia as on figs 3–5. Proctiger triangular, swelling part of glans about three times longer than wide. Terminal filaments of acrophallus equally thick in whole length. Surstyli with one bifurcated claw-like preniseta visible from ventral view (fig. 4).

Body length: 4.2 mm. Wing length: 4.2 mm

Female. Similar to male. Abdominal spiracles 5 of female not approximated medially (fig. 7). Female terminalia as on figs 8–9 and Spermatheca as in fig. 10.

Measurements. Male: Body length: 4.2–4.5 mm. Wing length: 4.0–4.7 mm; Female: 4.3 mm. Wing length: 4.0 mm

Etymology. The species is named for Dr. Valery A. Korneyev (I. I. Schmalhausen Institute of Zoology, Ukraine), who has made a valuable contribution to the study of Palearctic Platystomatidae.



11



12

Figures 11–12. *Angeloapteromyia korneyevi* sp. n. 11 ♂, total view, lateral 12 ♂, total view, dorsal.

Discussion

The new species is similar to other species of *Angellopteromyia* sharing most of generic characters, and first of all, abdominal spiracles 5 of females not approximated medially. *A. korneyevi* sp. n. differs from other species of *Angellopteromyia* in having entirely different wing pattern: dark brownish basal and costal cells without hyaline spots (in *A. alf*, *A. chvalai* and *A. merzi*, basal cells of wing reticulated with numerous hyaline spots). In addition, face in *A. korneyevi* sp. n. is completely shining black (only ventral half of face is shining black in *A. merzi* and half of face at least in the middle is densely microtrichose in *A. alf* and *A. chvalai* ventrally). Furthermore, the proctiger in *A. korneyevi* sp. n. is triangular in profile (apical part of proctiger is rounded in *A. alf* and *A. chvalai*). Acrophallic tubes in *A. korneyevi* sp. n. are equal in diameter and length (unequal (one thick and one thin) in *A. merzi*, and apically with cup-like extensions each in *A. alf*).

Key to species of *Angellopteromyia*

- 1 Basal and costal cells dark brown and without hyaline spots (fig. 1), face shining back, femur and tibia black, Fore femur ventro-laterally with 2 rows of slightly thickened long black setae. Male genitalia: acrophallic tubes equal in diameter and length, apex of proctiger triangular in profile (fig. 3)***A. korneyevi* sp. n.**
- Basal and costal cells with several hyaline spots. Other characters variable.....**2**
- 2 Lower half of face and femora shining black. Fore femur postero-ventrally with black non-thickened setae. Male genitalia: acrophallic tubes unequal (one thick and one thin), apex of proctiger rounded (Korneyev 2001: fig. 51).....***A. merzi***
- Lower half of face at least in the middle densely microtrichose; femora more or less microtrichose. Fore femur postero-ventrally either with black thickened or with fine white setae. Other characters variable**3**
- 3 Lower half of face below antennal grooves with 2 large shining black areas; facialia strongly projected antero-laterally, genal ridge well-developed (especially in females) (Korneyev 2001: figs22–23); fore femur postero-ventrally with fine white setae. Anterior portion of mesonotum whitish setulose, with shining black anterior margin. Wing of female proximally of costagial break with large triangular projection of costal vein (Korneyev 2001: fig. 39). Abdomen whitish setulose. Male genitalia: Acrophallic tubes equally thick (Korneyev 2001: fig. 41), apex of proctiger rounded. Female abdominal pleura with bunch of long yellowish white setulae (Korneyev 2001: figs43–44)***A. alf***
- Lower half of face below antennal grooves completely microtrichose or at most with two black dots; facialia not projected antero-laterally, genal ridge poorly developed in both sexes (Korneyev 2001: figs24–25); fore femur postero-ventrally with thickened and short, spine-like black setae. Anterior portion of me-

sonotum black setulose, without shining black marginal area. Wing of female proximally of costagial break without any modification of costal vein. Abdomen black setulose. Male genitalia not examined. Female abdominal pleura velvet black, without long yellowish-white setulae.....*A. chvalai*

Acknowledgments

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References

- Hennig W (1945) 48. Platystomidae. In: Lindner E (Ed) Die Fliegen der palaearktischen Region. Schweizerbart, Verl., Stuttgart, 5(Lfg. 155), 1–56 + I–III.
- Korneyev VA (2001) A key to genera of Palaearctic Platystomatidae (Diptera), with descriptions of a new genus and new species. Entomological problems 32(1): 1–16.
- McAlpine FJ (1981) Morphology and terminology. Adults 2. In: McAlpine JF, Peterson BV, Shewell GE, Teskey HJ, Vockeroth JR, Wood DM (Eds) Manual of Nearctic Diptera. Volume 1, Agriculture Canada Monograph 27: 9–63.
- McAlpine DK (1998) 3.13. Family Platystomatidae. In: Papp L, Darvas B (Eds) Contributions to a Manual of Palaearctic Diptera (with special reference to flies of economic importance). Volume 3. Higher Brachycera. Science Herald, Budapest, 193–199. doi: 10.3853/j.0067-1975.53.2001.1327
- McAlpine DK (2001) Review of the Australasian genera of signal flies (Diptera: Platystomatidae). Records of the Australian Museum 53: 113–199.
- Soós Á (1984) Family Platystomatidae (Platystomidae). In: Soós Á, Papp L (Eds) Catalogue of Palaearctic Diptera. Vol. 9. Micropezidae–Agromyzidae. Budapest, Akadémiai Kiadó, 38–45.

Description of a new species of *Calliostoma* (Gastropoda, Calliostomatidae) from Southeastern Brazil

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Citation: Dornellas APS (2012) Description of a new species of *Calliostoma* (Gastropoda, Calliostomatidae) from Southeastern Brazil. ZooKeys 224: 89–106. doi: 10.3897/zookeys.224.3684

Abstract

Calliostoma tupinamba is a new species from Southeastern Brazil, ranging from southern Rio de Janeiro to northern São Paulo, and found only on coastal islands, on rocks and sessile invertebrates at 3 to 5 meters of depth. Shell and soft part morphology is described here in detail. *Calliostoma tupinamba* is mainly characterized by a depressed trochoid shell; eight slightly convex whorls; a sharply suprasutural carina starting on the third whorl and forming a peripheral rounded keel; and a whitish, funnel-shaped and deep umbilicus, measuring about 5%–10% of maximum shell width. *Calliostoma tupinamba* resembles *C. bullisi* Clench & Turner, 1960 in shape, but differs from it in being taller and wider, having a smaller umbilicus and lacking a strong and large innermost spiral cord at its base. Finally, an identification key of Brazilian *Calliostoma* species is presented.

Keywords

Anatomy, *Calliostoma tupinamba*, coastal island, new species, taxonomy

Introduction

The speciose genus *Calliostoma* Swanson, 1840 has a worldwide distribution, occurring from the intertidal zone to depths of several hundred meters (Clench and Turner 1960). The species are frequently found in association with sessile invertebrates, such

as hydrozoans, gorgonians and urchins, and many of them are carnivorous (Perron 1975; Perron and Turner 1978; Quinn 1981; Marshall 1988, 1995; Williams et al. 2010; Dornellas and Simone 2011).

An astounding diversity of *Calliostoma* species is found in the Western Atlantic: almost 100 species, 18 of which occur in Brazilian waters (Clench and Turner 1960; Quinn 1992; Rosenberg 2009). *Calliostoma* shells generally have spire typically straight-sided, but may be redounded, and the base ranges from flat to convex, umbilicate or imperforate, sculptured by spiral beaded cords, with a subquadrate aperture and an arched columella. Their ground colors usually are slightly yellowish or brownish, while their secondary coloration consists of white, red or reddish-brown blotches (Hickman and McLean 1990). On anatomical grounds, *Calliostoma* shows some apparently unique features, such as the presence of an ampulla in females, the reduction or lack of cephalic lappets, the presence of a pseudoproboscis and the intestinal loop placed outside of the haemocoel (Randles 1905; Fretter and Graham 1962; Sá and Coelho 1986; Dornellas and Simone in press; Dornellas personal observation).

A new species of *Calliostoma* from Southeastern Brazil is here described, with a detailed morpho-anatomical description. An identification key, based on shell characters of fully grown Brazilian *Calliostoma* species is provided.

Material and methods

Anatomical abbreviations: **an**, anus; **ap**, ampulla; **aoc**, anterior odontophore cartilage; **bc**, buccal commissure; **bg**, buccal ganglion; **cc**, cerebral commissure; **ccn**, cerebro-pedal connective; **ce**, cerebral ganglion; **cm**, columellar muscle; **cp**, cerebropleural connective; **ct**, cephalic tentacle; **cv**, ctenidial vein or efferent gill vessel; **dc**, dorsal chamber of buccal mass; **df**, dorsal fold; **el**, esophageal papillae; **es**, esophagus; **eso**, epipodial sense organ; **et**, epipodial tentacle; **ev**, esophageal valve; **ft**, foot; **gi**, gill; **hg**, hypobranchial gland; **il**, inner lips; **jm**, jaw and peribuccal muscles; **jw**, jaws; **lg**, labial ganglia; **lp**, lateromarginal plate; **m1** to **m11**, odontophore muscles; **mb**, mantle border; **mo**, mouth; **ne**, nerve; **nl**, neck lobe; **od**, odontophore; **om**, ommatophore; **op**, operculum; **opd**, opercular pad; **os**, osphradium; **pb**, pseudoproboscis; **pc**, pericardium; **pg**, anterior furrow of pedal glands; **poc**, posterior odontophore cartilage; **ps**, papillary sac; **ra**, radula; **rc**, radichian; **re**, rectum; **rk**, right kidney; **rn**, radular nucleus; **rt**, radular tissue; **sc**, subradular cartilage; **sg**, skeleton of gill; **sn**, snout; **vc**, ventral chamber of buccal mass; **vf**, ventral fold.

Specimens preserved in 70% alcohol were extracted from their shells and dissected under a stereomicroscope. All drawings were made with a *camera lucida*. For detailed examination of radulae, jaws and protoconch, samples were mounted on stubs, coated with a gold-palladium and observed under a scanning electron microscope. Dimensions for the holotype are given as height X width. Protoconch and shell whorls are counted following Diver (1939) methodology. The list of examined material, housed at MZSP, MNRJ and MOFURG, follows the species description.

Material examined. *Calliostoma tupinamba* types. Brazil, São Paulo state, Ilhabela island, 1 specimen, MZSP 59090 (Simone, col v/1995); Búzios Island, Aquário coast, MZSP 105574, 07 specimens (Dornellas col., 16/v/2012). *C. bullisi*. Brazil, Amapá, Cabo Orange holotype USNM 612702. *C. hassler*. Brazil, Bahia; Belmonte, MZSP 37264, 03 specimens (A. Bodart, col. vii/2003); Alcobaça, MZSP 34885, 11 specimens (Coltro leg.). Espírito Santo; Guarapari, 05 specimens (vi/2006); MZSP 69424, 09 specimens (A. Bodart, col. v/2004); MZSP 57485, 09 specimens (Coltro leg. iv/1992). *C. depictum*. Brazil, Bahia, Salvador, MZSP 66727, (Linhares, col. vii/1998) 01 specimen. *C. militare*. Brazil, Rio de Janeiro, off Saquarema, MZSP 66961, 02 specimens (P. Gonçalves col. viii/2002). *C. brunneopictum*. Brazil, Rio de Janeiro, off Santana, MZSP 73915, 14 specimens (col. xi/1999). *C. viscardii*. Brazil, Rio de Janeiro, off Saquarema, MZSP 68597, 02 specimens (P. Gonçalves col. vii/2006). *C. carcellesi*. Brazil, Rio de Janeiro, Arraial do Cabo, MZSP 70459, 01 specimen (col. v/2001). *C. adspersum*. Brazil, São Paulo, São Sebastião, MZSP 94332, 02 specimens (J. Vaz leg. 03/iii/1998). *C. rota*. Brazil, São Paulo, Ubatuba, MZSP 38524, 02 specimens (BIOTA-FAPESP col. 10/vi/2001). *C. jucundum*. Brazil, Rio de Janeiro, Niterói, MZSP 66598, 02 specimens (col. xii/2001). *C. gemmosum*. Brazil, Bahia, Salvador, MZSP 34850, 02 specimens.

Institutional abbreviations: MNRJ, Museu Nacional da Universidade Federal do Rio de Janeiro, Brazil; MOFURG, Museu Oceanográfico "Prof. E.C. Rios", da Universidade Federal do Rio Grande, Brazil; MZSP, Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil; NMNH, National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

Systematics

Clade Vetigastropoda Salvini-Plawen, 1980

Superfamily Trochoidea Rafinesque, 1815

Family Calliostomatidae Thiele, 1924

Genus *Calliostoma* Swainson, 1840

Type species: *Trochus conulus* Linné, 1758: 3579 (SD by Herrmannsen 1846: 154).

***Calliostoma tupinamba* sp. n.**

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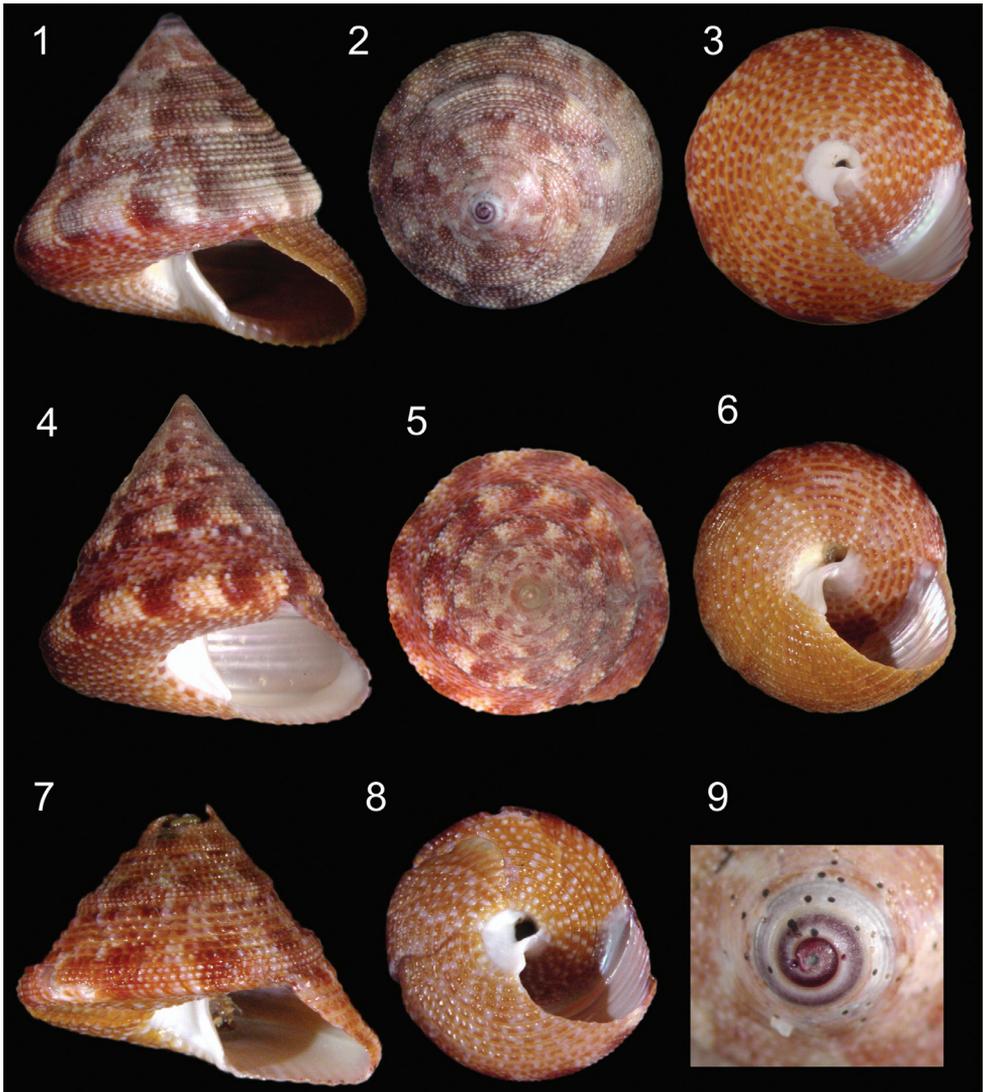
http://species-id.net/wiki/Calliostoma_tupinamba

Figures 1–9, 16–28

Calliostoma ilhabelensis Prado, 2003. (*nomen nudum*)

Calliostoma ilhabelense: Rosenberg 2009. (*nomen nudum*)

Calliostoma jujubinum: Sá and Coelho 1986: 263–271; Rios 2009: 49 (fig. 105) (in part; *non* Gmelin 1791).



Figures 1–9. *Calliostoma tupinamba* sp. n. shells. **1–3, 9** Holotype MZSP 105740 **1–3** Apertural, apical and umbilical views, 37.3 mm height **4–6** Paratype MZSP 102223, apertural, apical and umbilical views, 32 mm height **7–8** Paratype MZSP 91745, apertural and umbilical views, 22 mm height **9** Apical view, detail of protoconch.

Type material. Holotype MZSP 105740 (37.3 mm × 38.2 mm). Paratypes: MZSP 91745, 4 specimens, from type locality. São Paulo state; São Sebastião, Therezinha wreck, 23°54'26"S, 45°27'57"W, 10 m (col. 20.i.2012), MZSP 103766, 2 specimens; Alcatrazes Archipelago, Farol Island, 24°05'44.7"S, 45°42'08.0"W, 6–9 m (coll. 05.x.2011), MZSP 102223, 7 specimens, MNRJ 30603, 1 specimen, MOFURG 51661, 1 specimen; Ilhabela, Saco do Eustáquio, 23°50'11"S, 45°14'21"W, 12 m (col. 09.i.2012), MZSP 105118, 1 specimen; Vitória Island, Saco do Paia, 23°44.658'S,

45°01.343'W, 6–9 m (15.v.2012), MZSP 105660, 4 specimens, MNRJ 30602, 1 specimen, MOFURG 51662, 1 specimen.

Type locality. Brazil, Rio de Janeiro state, Angra dos Reis, Jorge Grego Island, 23°13'S, 44°08'W, 5–7 m (col. 08–09.viii.2009).

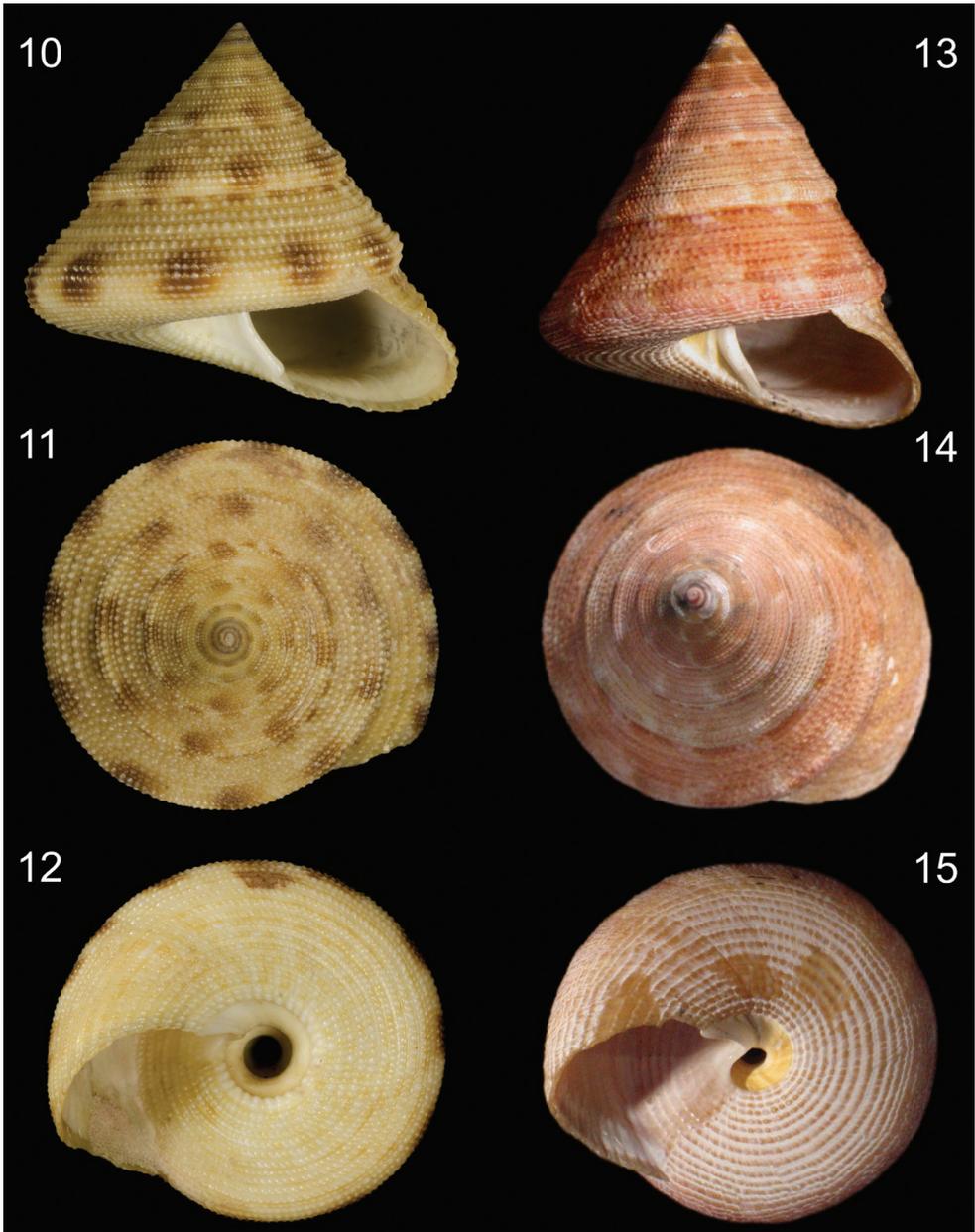
Etymology. Reference to the Ecological Station (Esec) Tupinambás for expeditions along the southeastern coast of Brazil and is an arbitrary combination of letters.

Diagnosis. Shell reaching 38 mm in height, with sharply suprasutural carina starting on the third whorl and forming a large peripheral rounded keel. Umbilicus deep, white, funnel-shaped, narrow (5% to 10% of maximum shell width). Base convex.

Description. Shell (Figs 1–9, 16). Attaining 37.6 mm × 38.2 mm; depressed trochoid; 8 whorls, slightly convex. Sharp suprasutural carina starting on third whorl and forming peripheral rounded keel. Basic color of shell pale or tawny brown to pinkish-brown with white and dark red to purple spots and axial flammules, especially on periphery; apex purple; base with numerous white dots on beads. Protoconch (Figs 9, 16) of 0.75 whorls, sculptured with tiny pustules. Transition to teleoconch marked by a weak terminal varix. Teleoconch sculptured by beaded spiral cords (beads crowded and rounded), with one or two smaller intercalary beaded spiral cords between, without a pattern. About 20 beaded cords on the last whorl. Cords on the body whorls becoming remarkably narrower towards periphery. First three whorls of teleoconch with weak axial riblets. First whorl with about 15 axial riblets and two weakly spiral cords that produce reticulate sculpture at their intersections (Fig. 16). The spiral cords become stronger starting on the second whorl. Base convex (flattened in juveniles), with about 15 cords between umbilicus and periphery. Cords equal in size and smoother than that of the teleoconch. Spire angle ~80°. Aperture subquadrate, with base round in adults but flat in juveniles; outer lip at ~55° angle from base. Columella truncated, heavily arched, thickened, white, terminating in a rounded denticle. Umbilicus deep, white, funnel-shaped, 5% to 10% of maximum shell width.

Head-foot (Figs 29–30, 32). Total length two whorls. Head rounded located approximately at anterior end of head-foot. Snout reddish, wide, cylindrical; distal end slightly wider than base; dorsal surface papillated, with short, rounded and white papillae; distal surface folded. Outer lips with pseudoproboscis (Fig. 32: pb). Mouth circular, located in middle of ventral surface of snout. Cephalic lappets absent. Cephalic tentacles usually twice larger than snout, sometimes asymmetrical, reddish, dorsoventrally flattened, grooved, narrowing gradually up to lightly pointed tip. Ommatophores located at outer base of cephalic tentacles, ~1/3 of tentacles' length. Eyes dark and round, at tip of ommatophores.

Foot thick, occupying ~3/4 of total head-foot length; reddish colored; dorsal region covered by numerous white papillae. Epipodium (Figs 29–30) surrounding lateral-dorsal region of foot, equidistant from sole and base of ommatophore. Opercular pad (Fig. 29: opd) located in the middle of dorsal region; rounded, edge free on posterior area; posterior end with several V-shaped furrows, apex pointed toward posterior end and pair of longitudinal furrows on median line. Furrow of pedal glands present along entire anterior edge of foot (Fig. 30: pg); single aperture of pedal glands located



Figures 10–15. Shells of *Calliostoma bullisi* and *C. hassler*. **10–12** *C. bullisi* holotype NMNH 612702, frontal, apical and umbilical views, length = 24.2 mm, courtesy of NMNH **13–15** *C. hassler*, MZSP 49814, frontal, apical and umbilical views, length = 34 mm.

in median region of furrow. Anterior third of epipodium formed by well-developed neck lobes (Figs 29–30: nl); left neck lobe smooth, right neck lobe with fine digitations. Remaining 2/3 of epipodium relatively low, thick; 4 pairs of slender tentacles inserted at its distal edge on each side and located approximately equidistant, well away

from each other, symmetrical on both sides, becoming shorter towards posterior end. Epipodial sense organ present at base of each tentacle, indistinguishable from the foot papillae on the lateral sides of the foot. Pair of columellar muscles thick, $\sim 1/4$ whorl, fused with each other in median line.

Operculum. About 13 mm in diameter, closing entire aperture. Yellowish gold, thin, corneous, multispiral, nucleus central. Inner side convex, outer side concave.

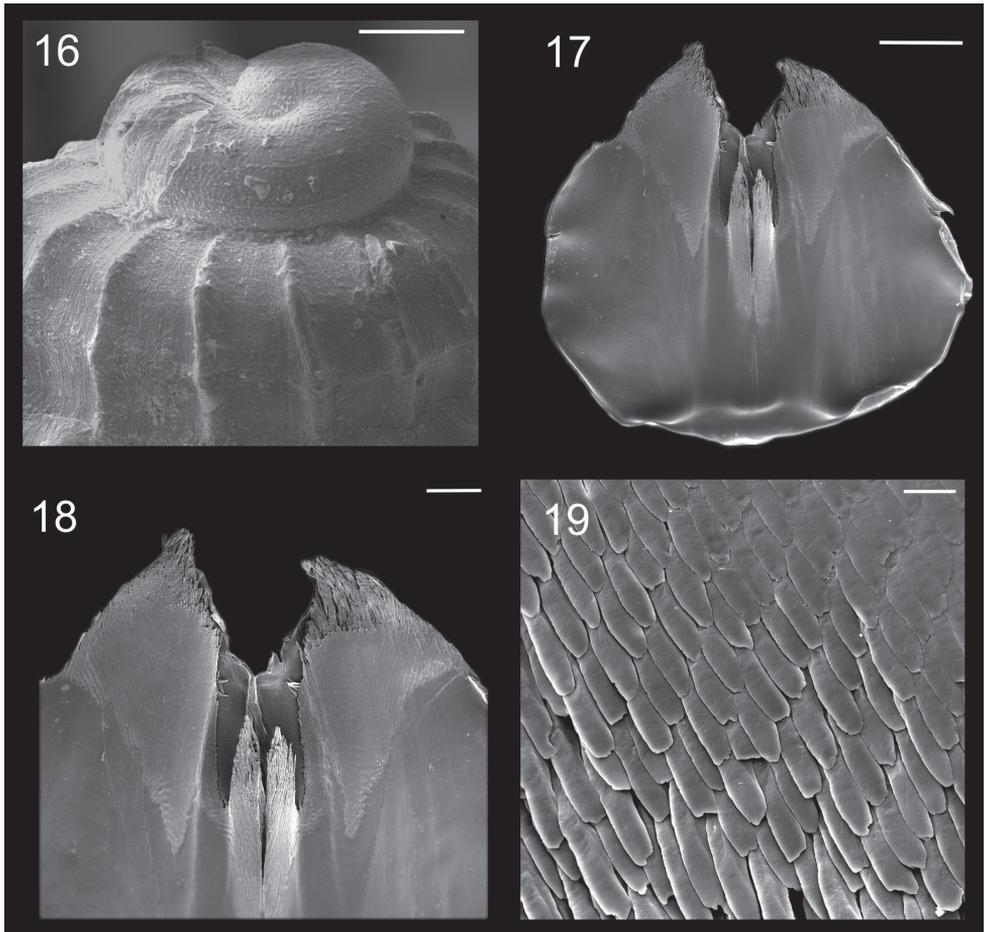
Mantle organs (Fig. 31). Pallial cavity $\sim 3/4$ whorl. Mantle border (mb) thick, white with irregular band of brown; anterior end papillated, occupying $\sim 1/3$ of mantle border. Gill located on left side of pallial cavity, occupying almost its entire length, projecting anteriorly and sustained by gill rod (sg) and suspensory membrane. Anterior end of gill narrow, with pointed tip, gradually increasing towards narrow posterior end. Osphradium rounded located at base of gill rod. Afferent gill vessel $\sim 2/3$ of gill's length, arising from transverse pallial vessel, running in distal region of central axis of gill. Transverse pallial vessel arising off from left nephrostome, discharging in afferent gill vessel. Ctenidial vein (cv) (= efferent gill) vessel about $1/3$ longer than afferent vessel, running in basal region of gill central axis; its posterior $1/9$ free from gill filaments, lying parallel, at left from afferent vessel up to pericardium. Hypobranchial gland (hg) on both sides of rectum; more developed on left side. Rectum $\sim 1/4$ of pallial cavity width, sigmoid on posterior region under kidneys, gradually straightening towards the anus. Anus siphoned, smaller than rectum's width; pleated, short free end, located on anterior right side of pallial cavity. Kidneys posteriorly located in pallial cavity, $\sim 1/3$ of rectum's length.

Visceral mass. Not studied.

Circulatory and excretory systems (Fig. 31). Pericardium (pc) located between pallial cavity and visceral mass, immediately posterior to kidneys, close to median line; its left side receiving ctenidial vein and right side receiving right pallial vein.

Papillary sac (ps) of left kidney $\sim 1/3$ of rectum's length; oval, with wide base; gradually narrowing towards anterior, ending at left of nephrostome; inner wall with numerous thin and long papillae projecting inward from all surfaces. Right kidney (rk) divided in two regions: anterior region hollow, a tube $\sim 1/3$ of rectum's length and $\sim 1/2$ width of papillary sac in male; in female called ampulla (ap), large, oval, hollow, filled by mucus, $\sim 3/4$ larger than papillary sac; kidney expanding ventrally, covering right half of surface of adjacent visceral hump; posterior region spreading around visceral mass immediately beneath mantle, encircling inner surface of columellar muscle.

Digestive system (Figs 17–28; 32–38). Oral tube $\sim 1/2$ of odontophore in length and width; walls with circular muscles. Jaws triangular in shape, dark brown; very long denticles on anterior end, projecting in tufts (Figs 17–19). Pair of dorsal folds starting posteriorly to jaws (Fig. 33; dc), each dorsal fold bending, partially overlapping, forming two slits; upper slit rounded, ventral slit triangular. Series of transverse muscles separating outer surface of esophagus from odontophore. Odontophore about twice longer than snout. Odontophore muscles (Figs 34–38): **m1**, series of small muscles connecting buccal mass with adjacent inner surface of snout and haemocoel; **m1d**, pair

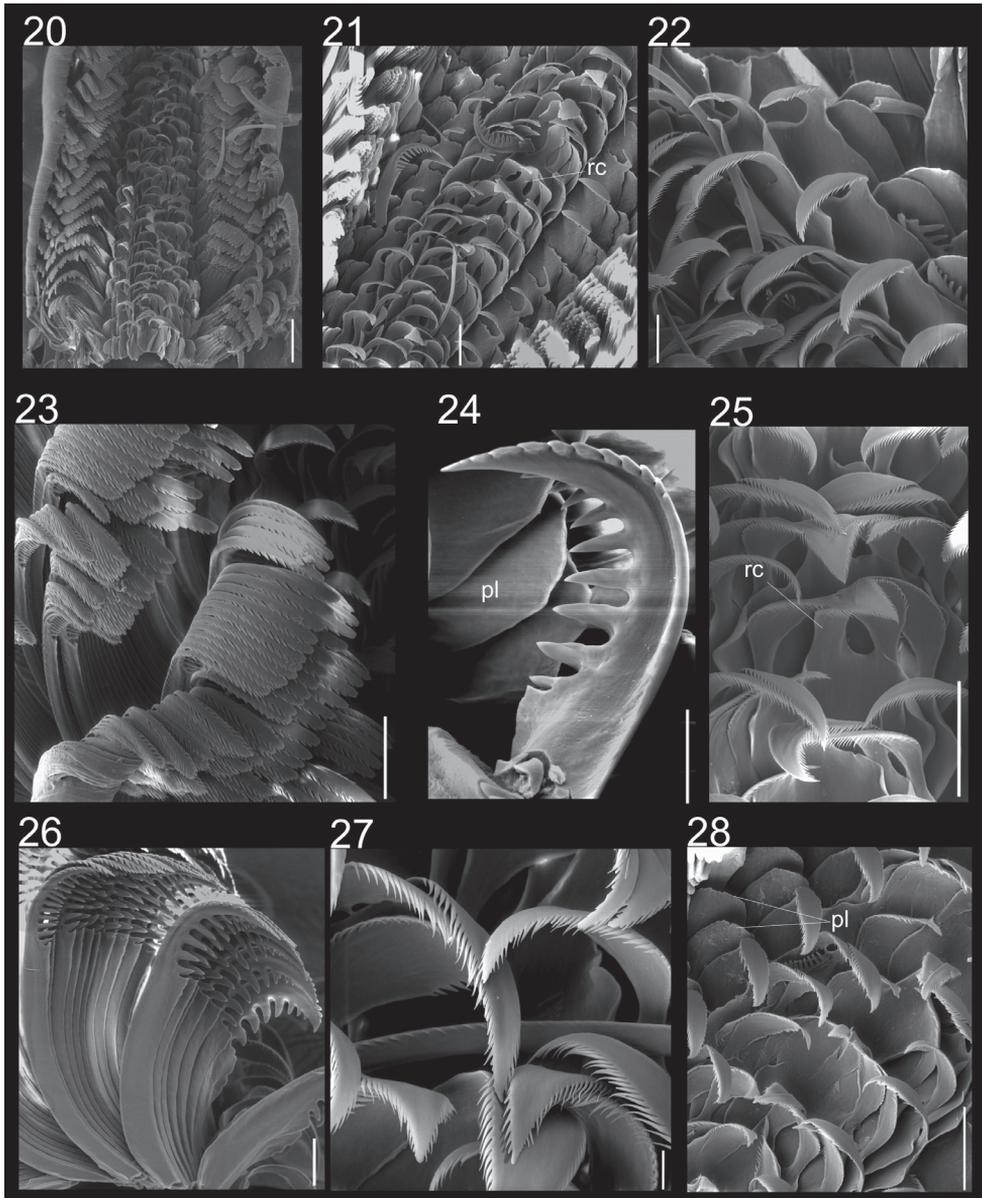


Figures 16–19. Protoconch and jaws of *C. tupinamba* holotype in SEM **16** Protoconch profile and apical view, scale bar = 100 µm **17–19.** Jaws **17** Ventral view, scale bar = 500 µm **18** Ventral view of anterior edge, scale bar = 200 µm **19** Detail of anterior area, scale bar = 20 µm.

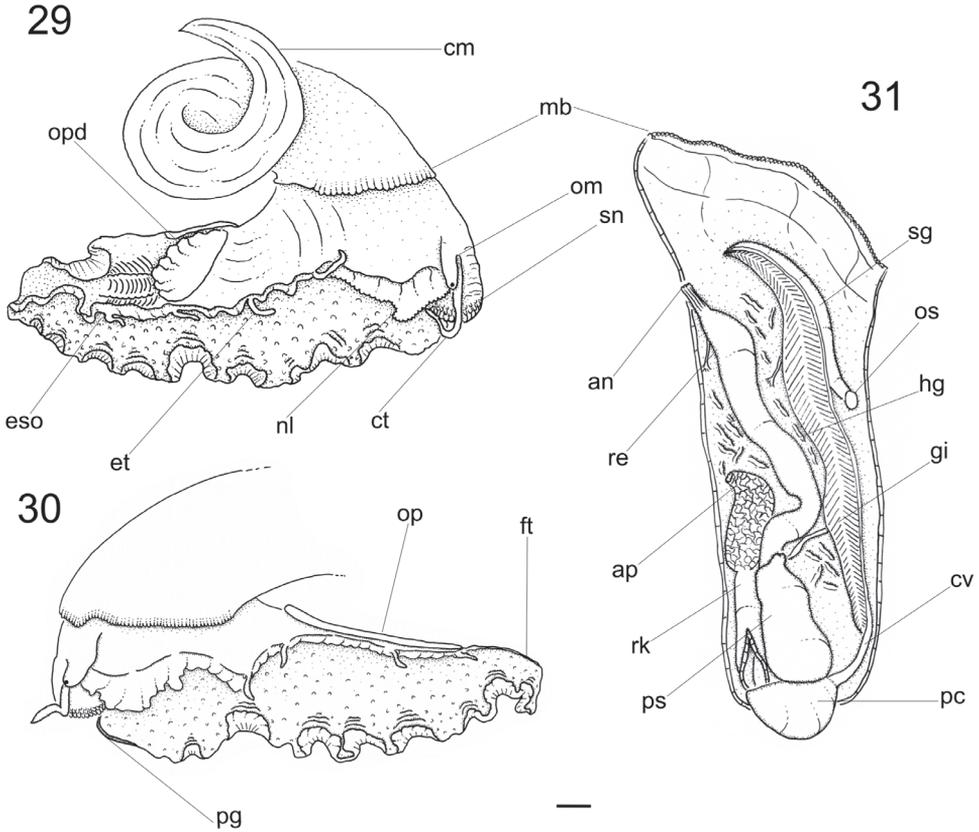
of small dorsal retractors muscles, originating in postero-lateral region of mouth sphincter (Figs 35–36: mc), inserting itself in antero-lateral edge of posterior cartilage; **m1v**, pair of small ventral protractors muscles of odontophore, originating on surface central of oral tube, running posteriorly away from each other, inserting in postero-ventral region of odontophore, in median surface of posterior cartilages; **m2a**, anterior retractor muscles of odontophore, originating in antero-lateral surface of anterior cartilages and inserting in hemocelic lateral walls; **m2b**, posterior retractor muscles of odontophore, originating in lateral surface of anterior cartilages, posterior to m2a, inserting in haemocelic lateral walls; **m4**, broad pair of dorsal tensor muscles of radula, subradular membrane, originating partly in anterior cartilages, along their ventral surfaces at some distance from median line, and partly in posterior cartilages, in their posterior, lateral surfaces, surrounding anterior cartilages lateral, ventral surfaces, and inserting along

subradular membrane, in its dorsal region exposed inside buccal cavity, with portion in radular ribbon in its region preceding buccal cavity; **m5**, pair of large accessory dorsal tensor muscles of radula, originating in ventral surface of posterior cartilages, running towards median dorsal region, subsequently running anteriorly, inserting in posterior region of radular ribbon; **m6**, horizontal muscle, uniting both anterior cartilages almost along entire ventral edge, except for short posterior region, in their external surface; **m7a**, very long, thick pair of muscles, originating in hemocelic ventral surface, running dorsally, inserting in radular sac, posteriorly to insertion of m5; **m7b**, pair of muscles originating in lateral inside wall of radular sac, dividing into three thin beam muscles, two of them inserting in posterior cartilage and other entering through m10l; **m8**, pair of broad approximator muscles of cartilages, originating in anterior cartilages, along its lateral surface, posterior to insertion of jm, running posterior, decreasing gradually, inserting in middle region of anterior surface of posterior cartilages; **m10**, pair of broad ventral protractor muscles of odontophore, originating from ventral region of mouth and buccal sphincter, running posteriorly, inserting in anterior region of posterior cartilage just ventral to m8 insertion; **m10l**, pair of broad lateral protractor muscles of odontophore, originating from lateral oral cavity, inserting in outside of anterior region of posterior cartilage; **m11**, two pairs of ventral tensor muscles of radula, originating in middle region of ventral surface of posterior cartilage, one separated from other by distance equivalent to their width, running anteriorly covering m6, anterior cartilage's ventral surface, becoming wider in anterior region, inserting in subradular membrane distal edge; **m11a**, very long, thin pair of oblique tensor muscles of radula, originating in hemocelic anterior surface near pleural ganglia, running dorsally through between anterior edge of anterior cartilages, inserting in subradular membrane distal edge; **jm**, jaw muscles, originating gradually from dorsal surface of oral tube, close to median line, running divergently towards posterior and sides, inserting themselves in latero-ventral surface of the anterior cartilage; **jma**, dorsal jaw pair muscles, originating in antero-dorsal region of anterior cartilage, running dorsally for short distance, surrounding oral cavity; **ml**, two pairs of wide and thick lateral muscles, originating in hemocelic lateral wall, running straightly forward, internal through the side wall of buccal cavity, inserting themselves in median line of lateral surface of anterior cartilage.

Radula (Figs 20–28): symmetrical, arched. **Radichian** (Figs 21, 25: rc) $\sim 1/10$ of total radula width, with very large base slightly rounded in shape; slender shaft; cutting edge turned posteriorly, tip narrowly tapered; finely serrated with delicate, thin, pointed and slightly elongated cusps on both sides; apical portion short, with rounded tip. **Lateral teeth** (Figs 21, 22, 27, 28): four pairs, $\sim 1/3$ of total radular width; shaped similarly to radichian, but with narrower base; shaft finely denticulate with long, slender cusps, becoming very slender on outer laterals; two pairs of lateromarginal plates (Figs 24, 28: pl) between innermost marginal teeth and outermost lateral teeth. **Marginal teeth** (Figs 23, 24, 26): about 30 teeth, occupying more than $1/2$ of total radula width; more than twice as tall and thinner ($\sim 1/2$) than lateral and radichian teeth; innermost pair greatly enlarged (Fig. 24), with broad base and coarsely serrated and hooked cusps; cusps curved, inner ones twice as large as outer ones; succeeding inner marginals



Figures 20–28. Radulae of *C. tupinamba* holotype and paratype MZSP 102223 in SEM. **20** Ventral view of radular ribbon, scale bar = 200 μm **21** Ventral view of middle region, scale bar = 100 μm **22** Detail of outermost lateral tooth and lateromarginal plate, scale bar = 50 μm **23** Marginal teeth, ventral view, scale bar = 100 μm **24** Detail of innermost marginal tooth, scale bar = 50 μm **25** Rachidian and lateral teeth, scale = 100 μm **26** Marginal teeth, lateral view, scale bar = 50 μm **27** Detail of lateral teeth, scale = bar 20 μm **28** Rachidian, lateral teeth and lateromarginal plate, scale bar = 100 μm .



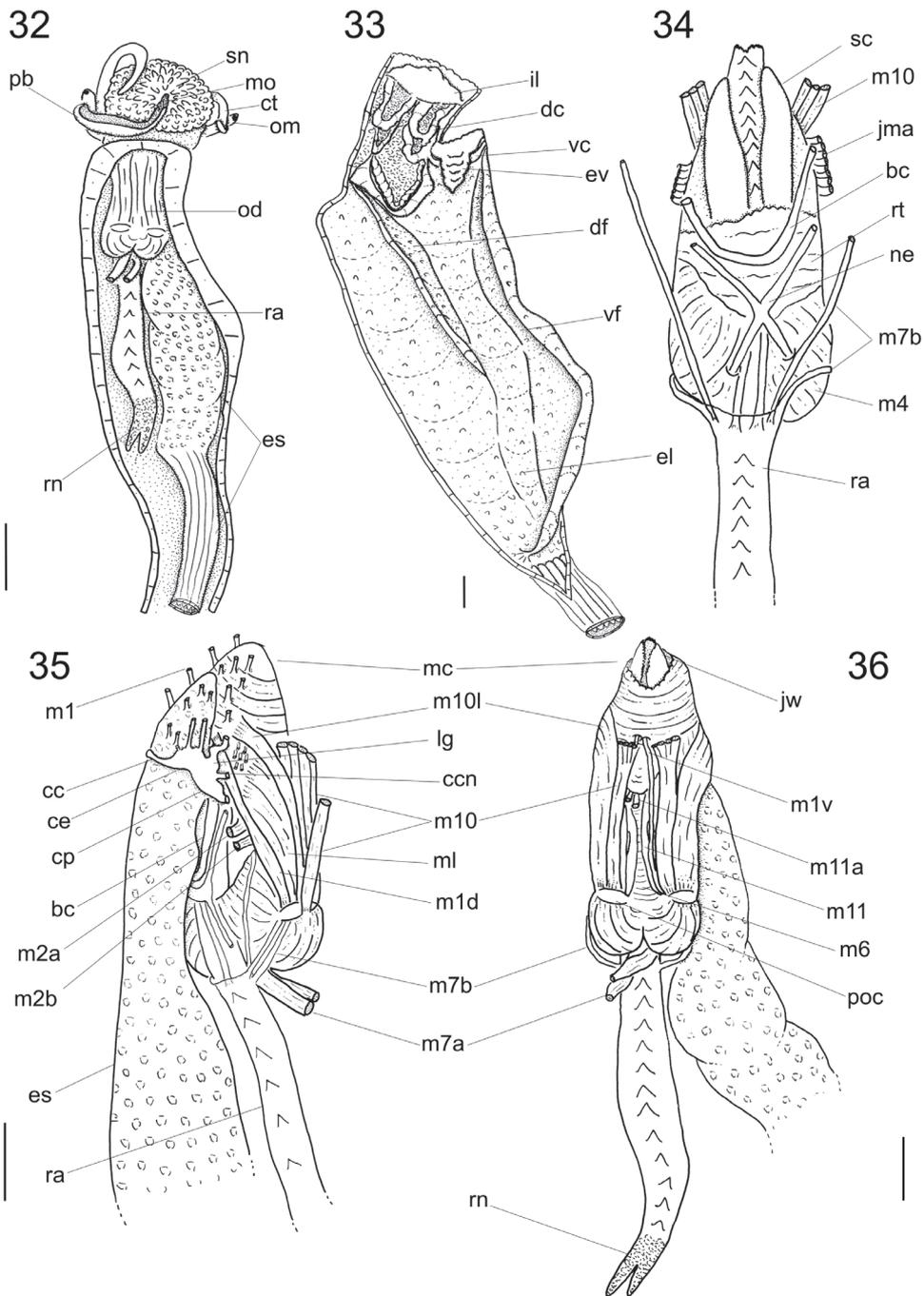
Figures 29–31. *Calliostoma tupinamba* anatomy, scale bar = 2 mm. **29–30** Head-foot, right and left sides **31** Pallial cavity roof, ventral view.

of uniform shape; outer marginals becoming slender towards outermost region; food groove on anterior edge of shaft, below the posterior secondary cusps.

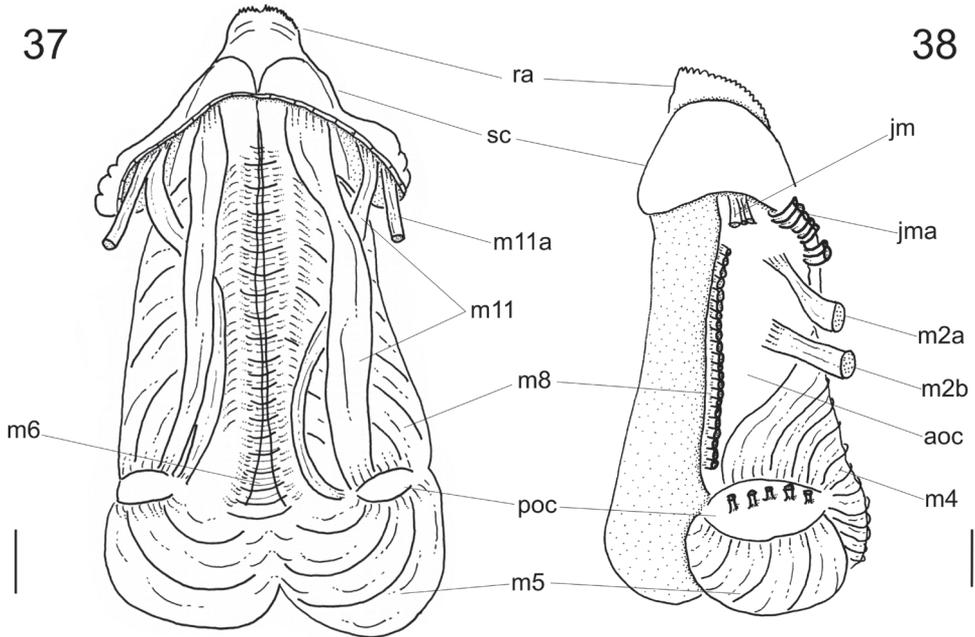
Salivary gland indistinguishable from dorsal region of buccal cavity; salivary aperture in mid-dorsal region of buccal cavity, on dorsal folds. Four dorsal fold channels; two of them are a continuation of dorsal folds in mid esophagus (Fig. 33: df); ventral food channel continuing ventral esophageal fold; esophageal valve (Fig. 33: ev) located on ventral food channel; mid esophagus with two esophageal folds, a higher ventral fold and right dorsal fold. Posterior esophagus narrow; inner surface with some longitudinal, narrow folds. Esophagus insertion and stomach not observed. Rectum, anus described above (pallial organs).

Genital system: not observed due to damage during extraction of soft parts.

Central nervous system (Figs 34–35): Nerve ring surrounding anterior half of buccal mass. Cerebral ganglia (Fig. 35: ce) rounded, located on lateral region of buccal



Figures 32–36. *Calliostoma tupinamba* anatomy. **32** Head and hemocoel, ventral view, scale bar = 5 mm **33** Buccal cavity and esophagus opened longitudinally, ventral-inner view, odontophore removed **34** Odontophore, dorsal view **35–36** Buccal mass and central nervous system, right and ventral views. Scales bar = 2 mm.



Figures 37–38. *Calliostoma tupinamba* odontophore, scale bar = 1 mm. **37** Ventral view, subradular cartilage opened longitudinally, m10 and m10l muscles removed **38** Left view, m8, m10 and m10l muscles removed.

mass and occupying $\sim 1/3$ of it; commissure thick, long; both dorsoventrally flattened cerebropleural and cerebropedal connectives (Fig. 35: cp, ccn) long and thin, originating in anterior region of cerebral ganglia, running ventrally and back to pedal and pleural ganglia. Cerebropleural connective twice as thick as cerebropedal. Labial ganglia (Fig. 35: lg) very small, $\sim 1/5$ of cerebral ganglia, located in ventro-lateral region of buccal mass, anteriorly to cerebral ganglia; linked to cerebral ganglia by short cerebrolabial connective. Buccal ganglia about same size as labia ganglia; located posteriorly to cerebral ganglia; connected united to cerebral ganglia by buccolabial connective; buccal commissure (Fig. 34: bc) thick, lying dorsally to radular sac.

Distribution. From southern Rio de Janeiro to northern São Paulo, 23° to 24° S, 44° to 45° W, only on coastal islands (from Alcatrazes Archipelago to Jorge Grego Island).

Habitat. On rocks and sessile invertebrates, at 3–5 meters.

Discussion

The overall shell shape of *Calliostoma tupinamba* closely resembles *C. bullisi* Clench & Turner, 1960 from northern Brazil. It differs in being taller and wider: the holotype of *C. bullisi* (Figs 10–12) is a 2 cm tall, has a convex base and a well-developed and rounded peripheral keel, indicating an adult stage, while all examined specimens of *C. tupinamba* of 2 cm are juveniles, showing a flattened base and a less developed periph-

eral keel (Fig. 7). The base of the shell of *C. bullisi* has a strongly and larger innermost spiral cord (Fig. 12). When it is present in *C. tupinamba*, this cord is half the size from that of *C. bullisi*. The umbilicus of *C. tupinamba* is much narrower, occupying only 5% to 10% of the maximum shell width, while in *C. bullisi* the umbilicus occupies 20%. Unfortunately, there is no reference in the literature regarding the soft parts' anatomy of *C. bullisi*: Clench and Turner (1960) described only the head-foot morphology, but without illustration of it differentiating apparently by having uniform red brown tentacle while *C. tupinamba* has a thin darker longitudinal line in median dorsal region of tentacle. The radula of the holotype of *C. bullisi* was illustrated with a drawing by Clench and Turner (1960: 5, pl. 5, fig. 1). The radula of *C. tupinamba* differs from *C. bullisi* by having slender rachidian and lateral shafts.

The protoconch sculpture with a honeycomb pattern is diagnosed for calliostomatids (Hickman and McLean 1990). Marshall (1995) also observed this pattern in an excellent revision of calliostomatids from New Caledonia. *Calliostoma tupinamba* has not such a pattern, which is also absent in *C. torrei* Clench & Aguayo, 1940 (following Harasewych 2006), *C. depictum* Dall, 1927 and *C. adpersum* (Philippi, 1851) (Dornellas and Simone in press). As protoconch sculpture descriptions are lacking in major revisions of the fauna of the western Atlantic (see Clench and Turner 1960; Quinn 1992) it is hard to know whether the honeycomb pattern is present in the western Atlantic *Calliostoma*.

Calliostoma tupinamba differs from *C. hassler* Clench & Aguayo, 1939 (Figs 13–15) from Southeastern Brazil by being wider, having spiral cords with coarser beads and a uniform pattern of mottled color. Anatomically, the snout is more papillated on the dorsal surface in *C. tupinamba*. The rachidian tooth of *C. tupinamba* has a rounded base, while the tooth of *C. hassler* is triangular. Moreover, there are differences in the odontophore's muscles: *Calliostoma hassler* has not a jma pair and a thicker ml pair (Dornellas and Simone in press).

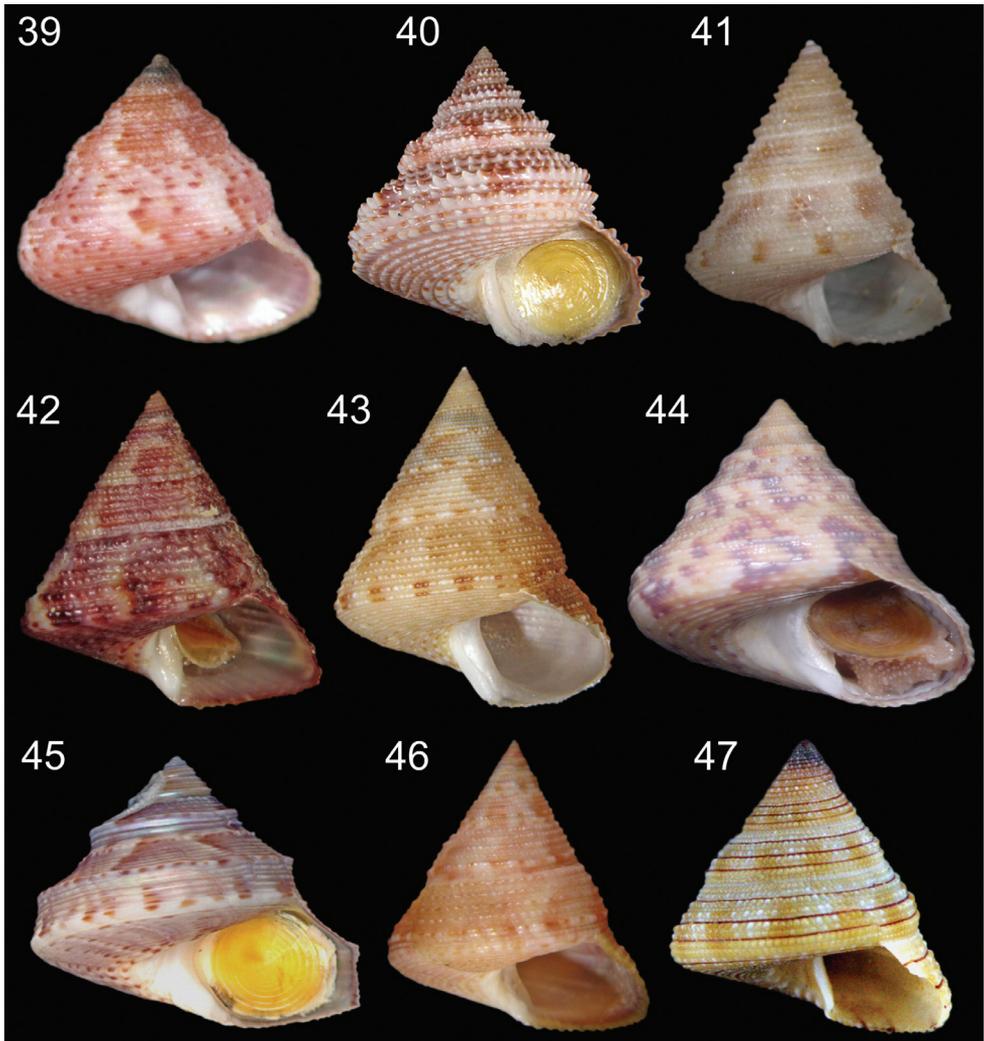
In a revision of the Western Atlantic's *Calliostoma*, Clench & Turner (1960) allocated some species such as *C. jujubinum*, *C. bullisi* in the subgenus *Elmerlinia*. This taxon is characterized by the triangular shape of the jaws, with denticles projecting in tufts on the distal edge, and by the two lateromarginal plates in the radula. The same pattern is observed in *C. tupinamba* and *C. hassler* and, therefore, it seems to be closely related with species of *Elmerlinia*.

Key for the identification of fully grown Brazilian *Calliostoma* species based on shell characters

- | | | |
|------|---|---------------------------------|
| 1 | Concave to rounded whorls | 2 |
| – | Convex to flat whorls..... | 3 |
| 2(1) | Slightly concave whorls. Umbilicate. Base smooth, with reddish brown, non-interrupted concentric bands (Quinn, 1992: Figs 88–89; Rios, 2009: fig. 109)..... | <i>C. axelsonni</i> Quinn, 1992 |

- Greatly rounded convex whorls. Imperforate, with umbilical chink. Base with spiral cords and with sp (Fig. 39) ***C. depictum* Dall, 1927**
- 3 (1) Spire taller than wide **4**
- Spire about as high as wide **10**
- 4 (3) Spiral cords with conical beds **5**
- Spiral cords with rounded beds **7**
- 5 (4) Suture canaliculated. Large shells, up to 40 mm height (Fig. 40) ***C. militare* Ihering, 1907**
- Suture indistinct, non-caliculated. Small shells, up to 9 **6**
- 5 (5) Columella nearly straight. Shell uniformly colored, without darker patches (Clench and Turner 1960: plate 36) ***C. echinatum* Dall, 1881**
- Columella curved. Shell ivory colored with irregular patches of brown (Fig. 41)..... ***C. brunneopictum* Quinn, 1992**
- 6 (4) Teleoconch with shouldered whorls. Suprasutural cords smooth and keeled (Rios, 2009: fig. 120)..... ***C. nordenskjordi* Strebel, 1908**
- Teleoconch with almost 6 flat sided whorls, not forming shoulders. Suprasutural cords beaded..... **8**
- 7 (7) Interspaces of first whorls lacking axial sculpture, subsequent whorls with low folds. Height up to 13 mm (Fig. 42)..... ***C. viscardii* Quinn, 1992**
- All interspaces between spiral cords with oblique axial riblets or low plicae. Shell large, up to 27 mm..... **9**
- 8 (8) Shell wide, spire angle 55° to 70° (Fig. 43) ***C. carcellesi* Clench & Aguayo, 1940**
- Shell narrow, spire angle 35° to 40° (Quinn, 1992: Figs 29–30) ***C. moscatelli* Quinn, 1992**
- 9 (3) All whorls with a distinct shoulder angulation **11**
- Whorls not shouldered, with convex or flat sides **13**
- 10 (10) Peripheral keels beaded (Fig. 44) ***C. adspersum* (Philippi, 1851)**
- Peripheral keels non-beaded, weakly undulated to smooth..... **12**
- 11 (11) Circumbasal cords absent or very weak; interspaces between peripheral keels nearly straight (Clench and Turner 1960: plate 18)..... ***C. coppingeri* (Smith, 1880)**
- Circumbasal cords weak to strong; interspaces between peripheral keels concave (Fig. 45) ***C. rota* Quinn, 1992**
- 12 (10) Imperforate..... **14**
- Umbilicate..... **15**
- 13 (13) Whorl periphery with three widely spaced spiral cords (Quinn, 1992: Figs 27–28)..... ***C. tenebrosum* Quinn, 1992**
- Whorl periphery with two spiral cords (Fig. 46) ... ***C. jucundum* (Gould, 1849)**
- 14 (13) Three reddish brown bands encircling each whorl; apex of shell deep purple (Fig. 47)..... ***C. gemmosum* (Reeve, 1842)**
- Absence of contrasting colored bands encircling each whorl **16**

- 15 Shell narrow, spire angle $\sim 60^\circ$. Final portion of columella arched (Figs 13–15)..... *C. hassler* Clench & Aguayo, 1939
 – Shell wide; spire angle 70° to 80° . Final portion of columella truncated.... 17
 16 Innermost spiral cord at base strong and large. Umbilicus broad (Figs 10–12)..... *C. bullisi* Clench & Turner, 1960
 – Innermost spiral cord at base very weak or absent. Umbilicus narrow (Figs 1–9)..... *C. tupinamba* Dornellas sp. n.



Figures 39–47. *Calliostoma* species in frontal view. **39** *Calliostoma depictum* MZSP 66727, length = 13.3 mm **40** *Calliostoma militare* MZSP 66961, length = 31.8 mm **41** *Calliostoma brunneopictum* MZSP 73915, length = 9.1 mm **42** *Calliostoma viscardii* MZSP 68597, length = 11.3 mm **43** *Calliostoma carcellesi* MZSP 70459, length = 22.2 mm **44** *Calliostoma adspersum* MZSP 94332, length = 16.5 mm **45** *Calliostoma rota* MZSP 38524, length = 8.9 mm **46** *Calliostoma jucundum* MZSP 66598, length = 26 mm **47** *Calliostoma gemmosum* MZSP 34850, length = 12.6 mm.

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References

- Clench WJ, Turner RD (1960) The Genus *Calliostoma* in the Western Atlantic. *Johnsonia* 4: 1–80.
- Diver C (1939) A method of determining the number of the whorls of a shell and its application to *Cepaea hortensis* Müll. And *C. nemoralis* L. *Proceedings of the Malacological Society* 19: 234–239.
- Dornellas APS, Simone LRL (2011) Bivalves in the stomach contents of *Calliostoma coppingeri* (Calliostomatidae: Gastropoda). *Strombus* 18(1–2): 10–12.
- Dornellas APS, Simone LRL (in press) Comparative morphology and rescription of four species of *Calliostoma* (Gastropoda, Trochoidea) from Brazilian coast. *Malacologia*.
- Fretter V, Graham A (1962) *British Prosobranch Molluscs. Their functional anatomy and ecology.* Ray Society Publications, London, xvi + 755pp.
- Hickman CS, McLean JH (1990) Systematic revision and suprageneric classification of trochacean gastropods. *Natural History Museum of Los Angeles County* 35: 1–169.
- Marshall BA (1988) Thysanodontinae: new subfamily of the Trochidae (Gastropoda). *Journal of Molluscan Studies* 54: 215–229. doi: 10.1093/mollus/54.2.215
- Marshall BA (1995) Calliostomatidae (Gastropoda: Trochoidea) from New Caledonia, the Loyalty Islands, and the northern Lord Howe Rise. In: Bouchet P (Ed) *Résultats des Campagnes MUSORSTOM, v.14. Mémoires du Muséum National d'Histoire Naturelle* 167: 381–458.
- Perron FE (1975) Carnivorous *Calliostoma* (Prosobranchia: Trochidae) from northeastern Pacific. *The Veliger* 18: 52–54.
- Perron FE, Turner RD (1978) The feeding behaviour *Calliostoma occidentale*, a coelenterate-associated prosobranch gastropod. *The Journal of Molluscan Studies* 44: 100–103.
- Prado AC (2003) *Calliostoma ilhabelensis*. <http://www.conchasbrasil.org.br/conquiliologia/newespecies.asp> [accessed on 05/25/2012]
- Quinn JF Jr (1981) The gastropods, *Calliostoma orion* Dall, 1889 (Trochidae) and *Heliciscus (Gyriscus) worsfoldi* n.sp. (Architectonicaidae), from the Bahama Islands. *The Nautilus* 95(3): 150–156.
- Quinn JF Jr (1992) New species of *Calliostoma* Swainson, 1840 (Gastropoda: Trochidae), and Notes on Some Poorly Known Species from the Western Atlantic Ocean. *The Nautilus* 106 (3): 77–114.

- Randles WB (1905) Some observations on the Anatomy and Affinities of the Trochidae. Quarterly Journal of Microscopical Science 48: 33–78.
- Rosenberg G (2009) Malacolog 4.1.1: A database of Western Atlantic Marine Mollusca. <http://www.malacolog.org/> [accessed on 04/23/2012]
- Sá MR, Coelho ACS (1986) Aspectos da morfologia interna de *Calliostoma (Elmerlinia) jujubinum* (Gmelin, 1791) (Mollusca, Gastropoda, Trochidae). Boletim de Zoologia 10: 263–271.
- Williams ST, Donald KM, Spencer HG, Nakano T (2010) Molecular systematics of the marine gastropod families Trochidae and Calliostomatidae (Mollusca: Superfamily Trochoidea). Molecular Phylogenetics and Evolution 54: 783–809. doi: 10.1016/j.ymp.2009.11.0088