

## ***Systemotelus*, a remarkable new genus of weevil (Coleoptera: Curculionidae) associated with *Carludovica* (Cyclanthaceae) in Costa Rica and Panamá**

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**Abstract:** *Systemotelus* Anderson & Gómez, new genus, is described with three included species, *S. carludovicae* Anderson & Gómez, new species (Costa Rica), *S. costaricensis* Anderson & Gómez, new species (Costa Rica and Panama), and *S. stockwelli* Anderson & Gómez, new species (Panama). Adults of *Systemotelus* are distinguished by very elongate-narrow genitalia in females, female pygidium constricted near the midlength, and tumescent mesosternal process. They are relatively large in body size (4.9-12.4 mm), are pale to dark yellow in color and possess various black dorsal and lateral maculations. Adults are remarkable in that the apex of the abdomen is moderately to markedly tapered in females and the genitalia and associated structures of both sexes are modified and very elongate-narrow. Adults of *S. carludovicae* have been collected on freshly opened inflorescences of *Carludovica palmata* Ruiz & Pavón and *C. drudei* Masters (Cyclanthaceae) in Costa Rica; adults of *S. costaricensis* have been collected on inflorescences of *Carludovica drudei* in Panama; and, adults of *S. stockwelli* have been collected on inflorescences of *Carludovica palmata* in Panama. *Systemotelus* is a member of the tribe Derelomini of the Curculioninae (*sensu* Kuschel), many other species of which attend flowers of various Cyclanthaceae and Arecaceae. The closest relative of *Systemotelus* appears to be an undescribed monotypic genus associated with *Sphaeradenia hamata* Harl. (Cyclanthaceae) in Colombia.

**Key words:** Taxonomy, Coleoptera, Curculioninae, Derelomini, *Systemotelus*, Cyclanthaceae, Neotropical.

The floral biology of Cyclanthaceae was first studied by Drude (1877) under cultivated conditions. Harling (1958) confirmed many of these early findings through field studies, observed association of weevils with Cyclanthaceae, found their larvae in dissected inflorescences, and assumed their adults to be the primary pollinators of these plants. Recent publications concerning the pollination of the Cyclanthaceae confirm them to be cantharophilous (Beach 1982; Gottsberger 1991; Eriksson 1994; Seres and Ramírez 1995).

Two subfamilies constitute this plant family, the Cyclanthoideae (represented only by

the monotypic genus *Cyclanthus*) and the Carludovicoideae, with the remainder of the species. Beach (1982) and Seres and Ramírez (1995) reported that *Cyclanthus bipartitus* Poiteau is attended and pollinated by scarab beetles of the genus *Cyclocephala* in Costa Rica and Venezuela respectively. However, one of us (LDG) has found *Cyclocephala* to be rather infrequent in the inflorescences of several hundred populations of *Carludovica* and *Cyclanthus* in SW Costa Rica, from sea level to 2000 m elevation.

In the Carludovicoideae on the other hand, weevils (Curculionidae) are the primary pollinators. Gottsberger (1991) in Perú,

reported that weevils of the tribe Derelomini are the pollinators of two *Asplundia* species, *Evodianthus funifer* (Poit.) Lindman and *Carludovica palmata* Ruíz & Pavón. In Venezuela, Seres and Ramírez (1995) also record derelomine weevils as the primary pollinators of four *Asplundia* species and *Evodianthus funifer*. Similarly, Eriksson (1994) in Colombia, found that species of this same tribe of weevils are pollinators of *Sphaeradenia hamata* Harl.

Studies on the pollination biology of *Carludovica palmata* and *C. drudei* Masters in Costa Rica by one of us (LDG) have found both of these plant species also to be attended and pollinated by a variety of derelomine curculionids. Collections made by Henry P. Stockwell confirm that this same group of weevils attend *C. palmata* in Panama as well. Gottsberger (1991), Eriksson (1994) and Seres and Ramírez (1995) report that at least some of the derelomine weevils in their studies tentatively were placed as members of the genus *Phyllotrox* Schoenherr. One of us (RSA) has examined voucher specimens of the weevil species involved in the first two aforementioned studies and (as for the species of weevils attending Costa Rican and Panamanian *Carludovica* species), would not assign any of the species involved to *Phyllotrox*. Rather, all of these curculionids attending cyclanths are considered to represent a variety of undescribed genera and undescribed species near to, but distinct from *Phyllotrox*. The only species which could be confidently identified was *Perelleschus carludovicae* (Günther) from *Carludovica palmata* in Costa Rica, Panama and Peru.

In order to permit an evolutionary perspective of the pollination biology of these plants based on the evolutionary history of their weevil associates, we here describe the most remarkable and distinctive taxon, species of which are found in association with *Carludovica* species in Costa Rica and Panama. We also present notes about the nature of the association of these weevils with these plants and discuss their phylogenetic relationships.

Higher taxonomic ranking and placement of derelomine weevils has been confused. Traditionally they have been regarded as Curculionidae: Erihinae; however, the recent

reclassification of Curculionoidea by Kuschel (1995) recognizes only six subfamilies of Curculionidae with most traditional subfamilies of Curculionidae relegated to tribal status in Curculioninae. This classification would appear to recognize Derelomini as a tribe within Curculioninae although this is not explicitly stated. Thompson (1992) on the other hand, places them as a subfamily of Curculionidae, a position not inconsistent with Kuschel's presumed placement (given that tribes within Curculioninae of Kuschel are more or less equivalent to subfamilies within Curculionidae of Thompson). Regardless, derelomines clearly are not Erihinae *sensu* Kuschel (or Erihinae *sensu* Thompson) given their apomorphic non-orthocerous male genitalia which contrasts with the plesiomorphic orthocerous male genitalia of true Erihinae. We regard derelomine weevils presently as best placed in the system of Kuschel within Curculioninae as the distinct tribe Derelomini (or as Derelominae within Curculionidae [system of Thompson]).

Codons for insect collections follow Arnett *et al.* (1993).

*Systemotelus* New Genus, Anderson & Gómez

**Size:** Large to very large (for Derelomini). Total body length of male, 4.9-10.9 mm; female, 5.4-12.4 mm.

**Form:** Elongate-narrow to elongate-robust; greatest width at about midlength, variously tapered both anteriorly and posteriorly, extremely so in female specimens of *S. carludovicae*.

**Color:** Pale yellow, with pronotum with black median line; elytra with various dorsal and/or lateral black maculations, or maculations lacking.

**Rostrum:** Slightly shorter than length pronotum in male; slightly shorter than length pronotum to subequal in length to pronotum in female. Narrow, straight to very slightly arcuate, of uniform thickness throughout length; in dorsal view, widest at base, very slightly tapered to apex. Antennae inserted at

about midlength or slightly anterior to midlength in female, at apical one-third in male. Cuticle shiny, densely and finely punctate; with fine indistinct appressed hair-like vestiture, vestiture longer, more erect medially on venter. Scrobe well-defined, deep, continued anteriorly past point of antennal insertion as fine, narrow moderately deep groove.

**Antennae:** Small, compact and robust; scape subequal to or very slightly longer than length of funicle and club combined. Funicle of seven articles; article 1 clavate, as long as articles 2-4 combined; article 2 slightly clavate, slightly longer than article 3; articles 3-7 transverse, widened towards apex of funicle. Club small, compact, of three articles; basal and apical articles longer than middle article.

**Eyes:** Large, round, slightly protruded; widely separated dorsally.

**Head:** Cuticle shiny, coarsely punctate.

Pronotum. Cuticle shiny, smooth; uniformly, very finely and very densely punctate, with dense, fine, indistinct appressed hair-like vestiture. Form robust to elongate ( $l/w=0.8-1.4$ ); widest at or immediately anterior to base, uniformly tapered anteriorly to apex, width at apex subequal to width head; with very slight lateral and ventral subapical constriction. Basal margin bilobed posteriorly at middle. Anterior margin lacking lateral postocular lobes.

**Elytra:** Cuticle shiny, smooth. Form elongate ( $l/w=2.5-3.0$ ), widest at or immediately anterior to humeri, variously tapered posteriorly to apex. Striae ten; 1-8 very slightly impressed, 9-10 more deeply impressed; finely and densely punctate. Intervals impunctate to minutely and densely punctate throughout, with or without dense, fine, indistinct appressed hair-like vestiture. Elytral apices separately rounded, pygidium moderately to extensively exposed in dorsal view. Humeri subquadrate.

**Scutellum:** Visible, large, with fine, indistinct appressed hair-like vestiture.

**Wings:** Present, long.

**Thoracic Sterna:** Pale yellow throughout. Procoxal cavities contiguous, coxae inserted very close to posterior margin of prosternum, distant from anterior margin. Prosternum in front of coxae flat, with short but acuminate posterior intercoxal projection. Mesosternum short, markedly tumescent at middle between mesocoxae. Metasternum long, finely shallowly punctate, with dense, fine, indistinct appressed hair-like vestiture; posteriorly medially furrowed in female, broadly concave in male.

**Abdomen:** Pale yellow throughout. Cuticle dull to shiny, finely shallowly punctate, with dense, fine, indistinct appressed hair-like vestiture. Visible sterna of various lengths; sternum V long, with lateral margins directed dorsally, partially enclosing latero-dorsal portions of pygidium in female. Pygidium of female flat to very slightly convex, moderately long to very long; in dorsal view variously constricted at from middle to basal one-third, variously expanded subapically, bluntly lobed at apex; of male, flat dorsally, uniformly rounded and somewhat bulbous apically, ventrally with "v" shaped emargination.

**Legs:** Pale yellow throughout. Short and stout; hind legs very slightly longer than middle legs, middle legs slightly longer than front legs. Cuticle shiny, very finely and densely punctate, with dense, fine, indistinct appressed hair-like vestiture. Femur robust to very robust, variously laterally flattened, with or without large bluntly rounded tooth on inner margin near apex. Tibia straight, more or less uniform in width throughout; apical comb of numerous, small spines. Tarsus of five distinct articles (usually concealed article 4 of Curculionidae distinctly visible between lobes of article 3); article 1 stout, very slightly longer than article 2; article 2 stout, shorter than article 3; article 3 with elongate lateral apically projected lobes; article 4 very short, narrow, visible between bases of lobes of article 3; article 5 elongate, projected beyond apex of lobes of article 3 by very slightly more than length of article 3. Tarsal claws large and robust, simple.

**Genitalia and associated structures:**

Genitalia of female with tergum VIII moderate to elongate-narrow; sternum VIII well-sclerotized, elongate-narrow, extended to base gonocoxite II, apodeme elongate-narrow, "y" shaped at base; foretube sclerotized or not; gonocoxite II well sclerotized, moderate to elongate-narrow, stylus lacking; vagina elongate, membranous, irregular in form throughout length; bursa copulatrix small to large, membranous, with spermathecal duct inserted on venter of bursa copulatrix at confluence with vagina and common oviduct; spermathecal duct short or long, spermathecal gland small or large, spermatheca somewhat globose, bluntly rounded, point of insertion of duct and gland apical. Genitalia of male with sternum VIII represented by small lateral, triangular sclerotized lobes; sternum IX well-sclerotized, "y" shaped, apodeme moderately long; aedeagus very long and slender.

**Recognition:** Species of *Systemotelus* are recognized easily by their relatively large body size (4.9-12.4 mm) for Derelomini, pale to dark yellow color with various black dorsal and lateral maculations and general dorsal habitus. They are recognized further by the tumescent mesosternal process, tapered apex of the abdomen and associated very elongate-narrow genitalia in females, and by the form of the female pygidium which in dorsal view is constricted at the midlength.

With the exception of the primarily South American genus *Celetes* Schoenherr, species that are associated primarily with palms, other Derelomini have shorter total body lengths than species of *Systemotellus*. *Celetes* species can easily be distinguished from *Systemotelus* species by the much more elongate antennal funicle (with the individual articles much longer than wide), the non-tumescent mesosternal process, form of female pygidium which is not constricted, the generally more elongate, cylindrical and curved rostrum and -in some species- by the elongate front legs of males. All other Derelomini (including *Phyllostrox*) which possess a short, stout antennal funicle can be separated from *Systemotelus* species by their smaller size, non-tumescent mesosternal process, and by the form of the female pygidium which in dorsal view is not constricted.

**Phylogenetic relationships:** Monophyly of *Systemotelus* is indicated by the character states of very elongate-narrow genitalia in females, medially constricted form of the female pygidium, and tumescent mesosternal process. The closest relative of *Systemotelus* is presumed to be an undescribed large derelomine collected in ovaries of infructescences of *Sphaeradenia hamata* in Colombia. A sister group relationship with this taxon is presumed on the basis of the character states of relatively large body size for Derelomini, pattern of dark maculations on a pale yellow background, and general habitus. Along with various other Derelomini, the two taxa also share the character state of a small compact antennal funicle.

**Type species:** *Systemotelus carludovicae* Anderson & Gómez, by present designation.

**Natural history:** All specimens of *Systemotelus carludovicae* were collected on opening inflorescences of *Carludovica palmata* and *C. drudei* in December and January in the vicinity of San Vito, Costa Rica. Adults of *S. carludovicae* were observed copulating on, and females were observed ovipositing in, inflorescences of *C. palmata*. All adult specimens of *S. stockwelli* were collected on freshly opened inflorescences of *Carludovica palmata* in February, April and June near Gamboa in Panama. At this same site in June, larvae and pupae of *S. stockwelli* were collected in an older spadix of *C. palmata* which was green and firm. Adults of *S. costaricensis* were collected in Panama in July on opening inflorescences of *C. drudei*. No information is available on the plant associations of *S. costaricensis* in Costa Rica although it is expected also to be associated with species of *Carludovica*. In Costa Rica, *S. costaricensis* has been collected from June through August.

**Included species:** There are three species presently recognized in this genus; *S. carludovicae* Anderson & Gómez, *S. costaricensis* Anderson & Gómez, and *S. stockwelli* Anderson & Gómez.

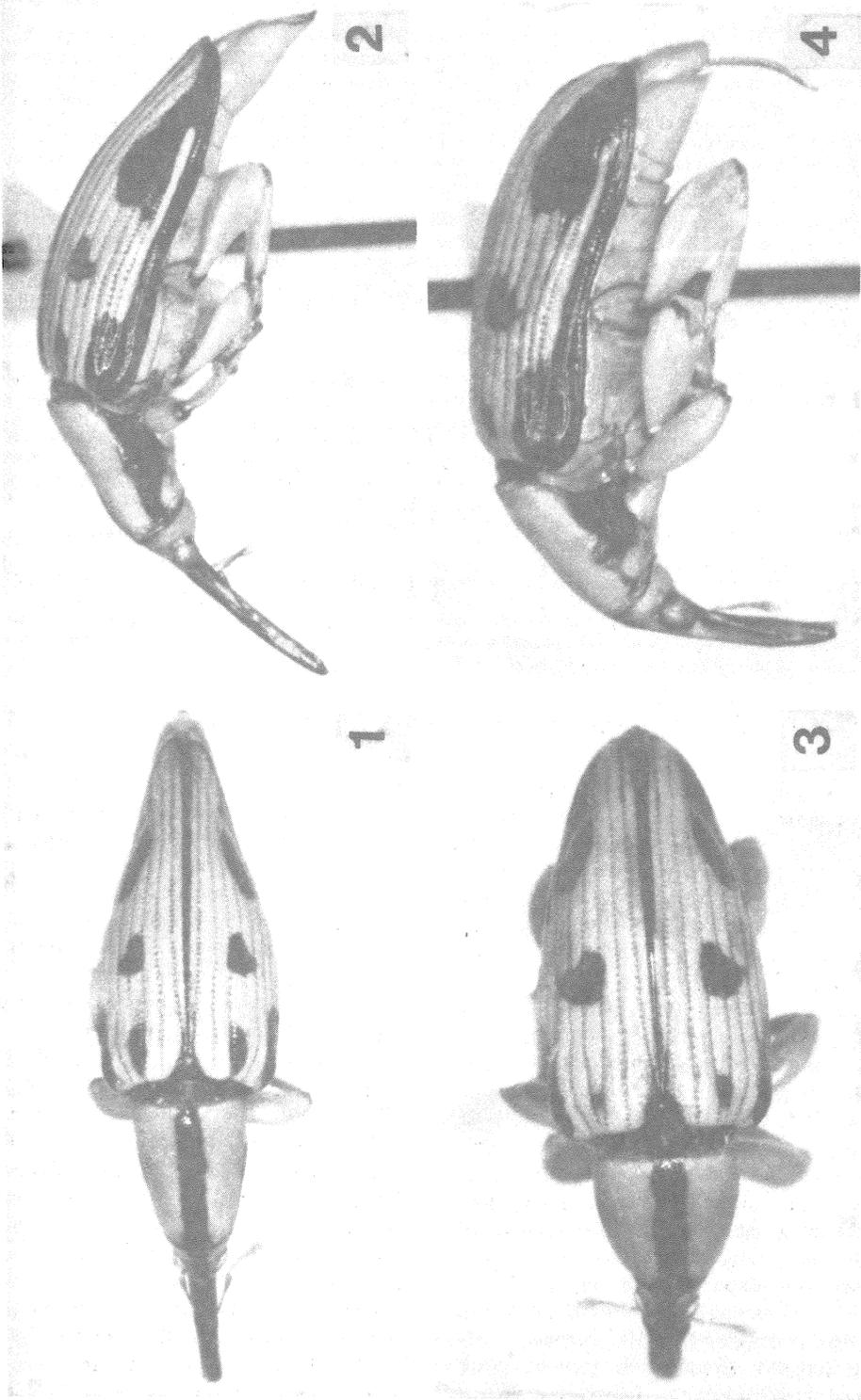
Key to adults of the known species of *Systemotelus*

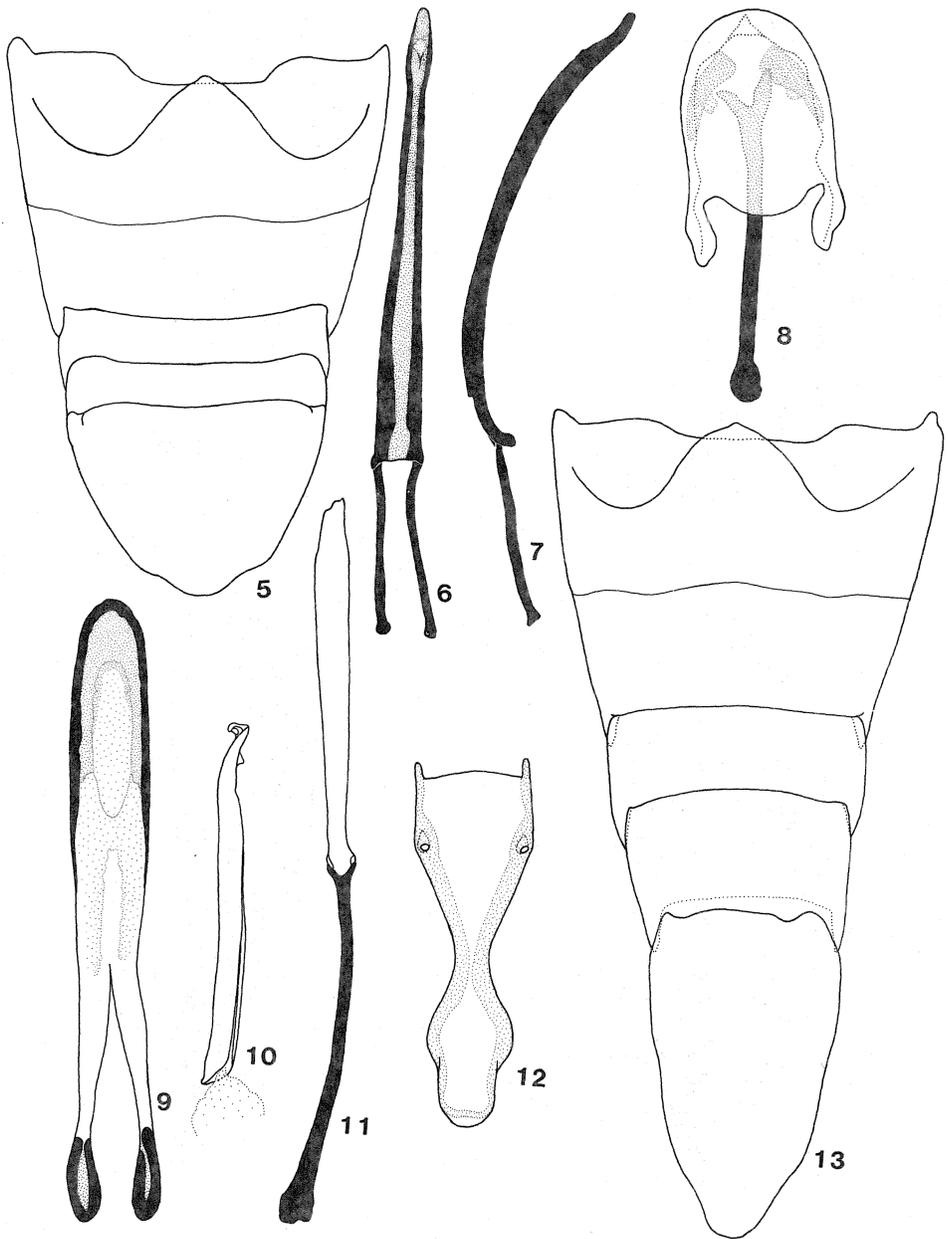
- 1 Pronotum longer than wide ( $l/w=1.12-1.15$  in male [Fig. 3];  $1.42-1.46$  in female [Fig. 1]). Rostrum relatively long (0.77-0.78 times the length of pronotum in male [Figs. 3,4]; 0.96-1.04 times the length of the pronotum in female [Figs. 1,2]). Each femur of male and middle and hind femora of female with large subapical blunt angulation. Abdominal sternum V of female long and narrow, much longer than wide; about as long as sterna I and II combined (Fig. 13). Elytra of female in dorsal view with posterior one-half tapered to narrow apex (Fig. 1). Aedeagus in dorsal view with margins uniform, not sinuate (Fig. 6). .....*S. carludovicae* Anderson & Gómez (Costa Rica; on *Carludovica palmata* Ruiz & Pavón and *C. drudei* Masters)
- 1' Pronotum wider than long ( $l/w=0.84-0.95$  in male [Figs. 16, 29];  $l/w=0.89-0.94$  in female [Figs. 14, 27]). Rostrum short (0.69-0.79 the length of pronotum in male [Figs. 16, 17, 29, 30]; 0.75-0.82 in female [Figs. 14, 15, 27, 28]). Femora without subapical angulation, uniformly rounded. Abdominal sternum V of female robust, as long as wide; about as long as sterna I-IV combined (Figs. 26, 39). Elytra of female in dorsal view with posterior one-quarter tapered to broad apex (Figs. 14, 27). Aedeagus in dorsal view with margins sinuate (Figs. 19, 32) .....2
- 2 (1') Body size 7.7-9.9 mm. Dorsal elytral black maculations present, on intervals 3-4 near base (lacking in some specimens), interval 4 at anterior one-third, posthumeral region on intervals 7-9, posterior portion of intervals 5-8, and intervals 10-11 throughout length (Figs. 14-17). Rostrum in lateral view slightly ventrally arcuate in female, slightly tapered to apex in both sexes (Figs. 15, 17). Aedeagus in dorsal view uniformly tapered from base to near apex (Fig. 19).....*S. costaricensis* Anderson & Gómez (Costa Rica, Panama; on *Carludovica drudei* Masters)
- 2' Body size 4.9-6.9 mm. Dorsal elytral black maculation either entirely lacking or limited to lateral marginal region and entire posterolateral one-half to two-fifths (Figs. 27-30). Rostrum in lateral view straight in female, distinctly tapered to apex in both sexes but especially so in female (Figs. 28, 30). Aedeagus in dorsal view constricted near base, then tapered to near apex (Fig. 32).....*S. stockwelli* Anderson & Gómez (Panama; on *Carludovica palmata* Ruiz & Pavón)

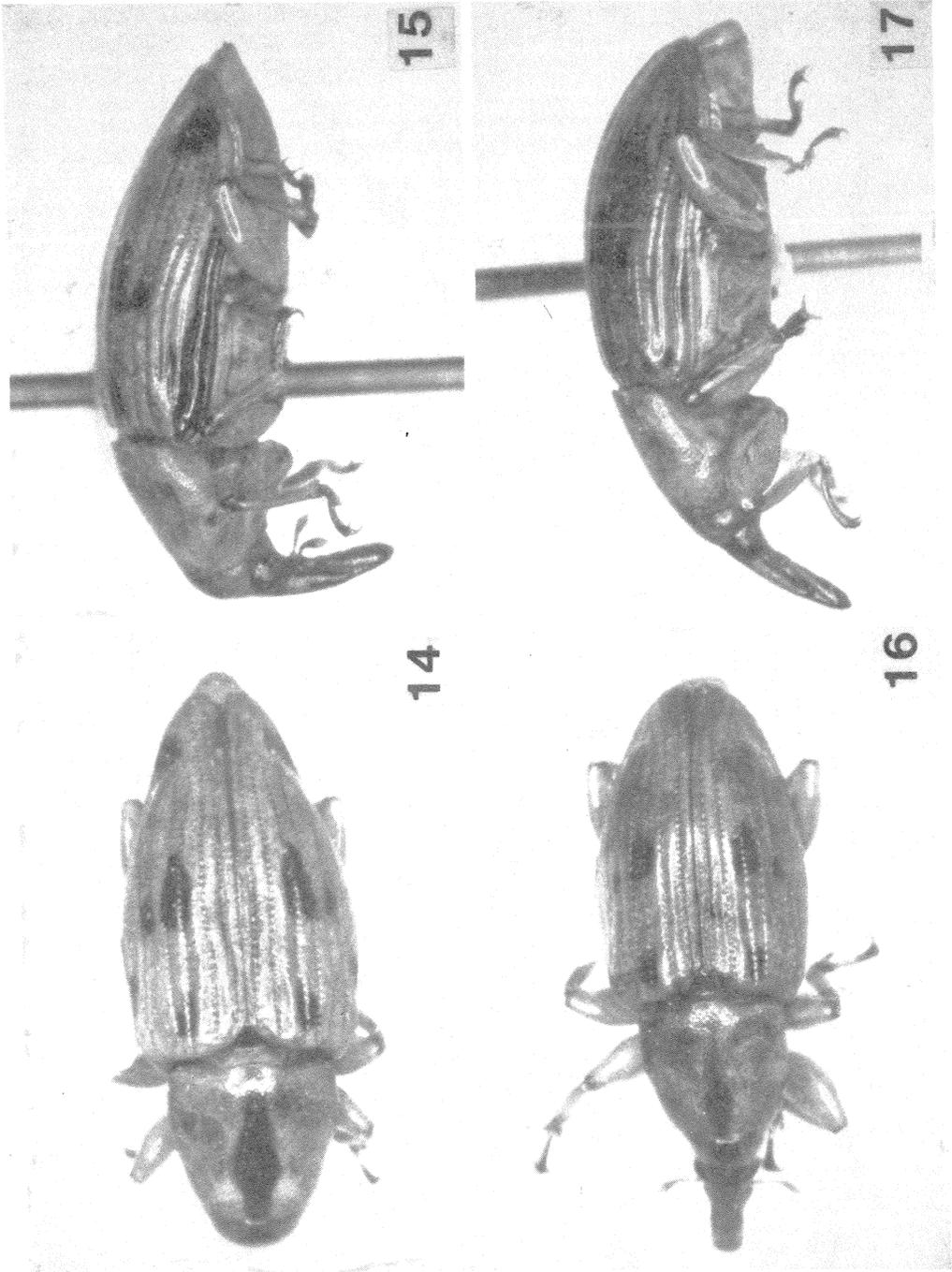
*Systemotelus carludovicae* New Species, Anderson & Gómez  
(Figures 1-13, 40-41)

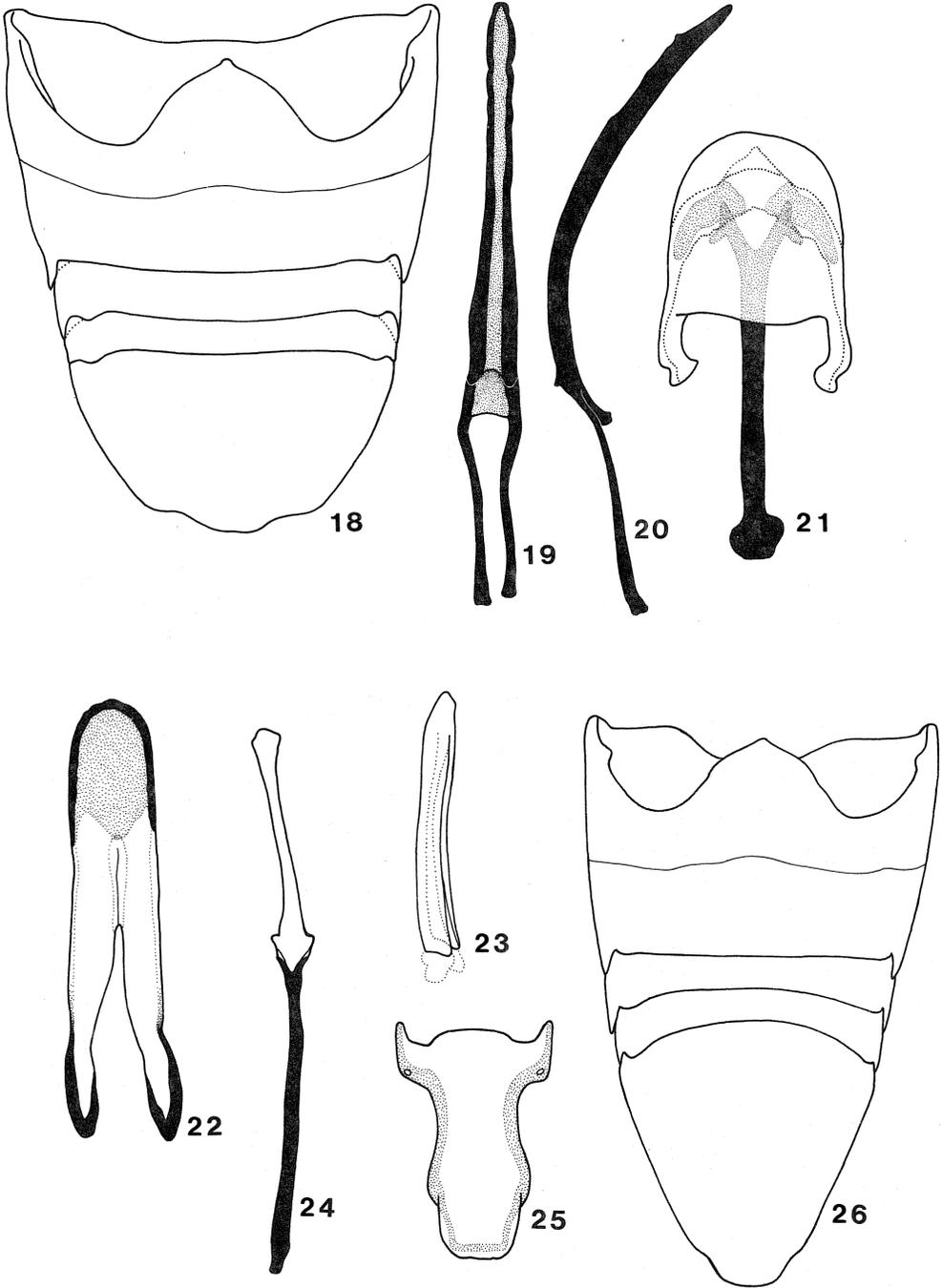
**Description:** (Figs. 1-13). Total body length of male 9.9-10.8 mm ( $n=10$ ); female, 11.2-12.4 mm ( $n=10$ ). Maximum body width (across widest point of elytra) of male 3.7-4.1 mm; female, 3.8-4.1 mm. Color pale yellow with following areas black: rostrum; midline of head near posterior margin; flanks and midline of pronotum; scutellar region; elytral sutural line, base of intervals 4-5, intervals 4-5 at anterior one-third, humeral region, posterior one-third to two-fifths of intervals 4-8, and intervals 10-11 throughout length; and coxae. Rostrum 0.77-0.78 times the length of pronotum in male; 0.96-1.04 times the length of pronotum in female. Rostrum in lateral view not to only slightly tapered to apex, more so in the male. Antennal insertion at anterior one-third in male, submedial in female. Antennae with scape not reaching eye by at least width of antennal club or more. Pronotum longer than wide ( $l/w=1.12-1.15$  in male;  $1.42-1.46$  in female). Elytra with various black dorsal and lateral markings; intervals with fine

dense punctures and fine hair-like vestiture. Elytra of female in dorsal view with posterior one-half tapered to narrow apex. Mesosternum markedly tuberculate at middle between mesocoxae. Abdominal sternites I-II of male subequal in length, each about twice the length of each of sternites III-IV; sternites III-IV relatively long, subequal in length; sternum V about as long as wide, about as long as sterna I and II combined. Abdominal sternites I-IV of female more or less similar in length, sternum I slightly longer than II, II slightly longer than III, III slightly shorter than IV; sternum V long and narrow, much longer than wide, about as long as sterna I and II combined. Pygidium of female very long, in dorsal view markedly constricted at middle, expanded subapically, bluntly lobed at apex; of male, flat dorsally, uniformly rounded and somewhat bulbous apically, ventrally with "v" shaped incision. Each femur of male with large blunt subapical tooth; front femora of female lacking angulation, uniformly rounded, middle and hind



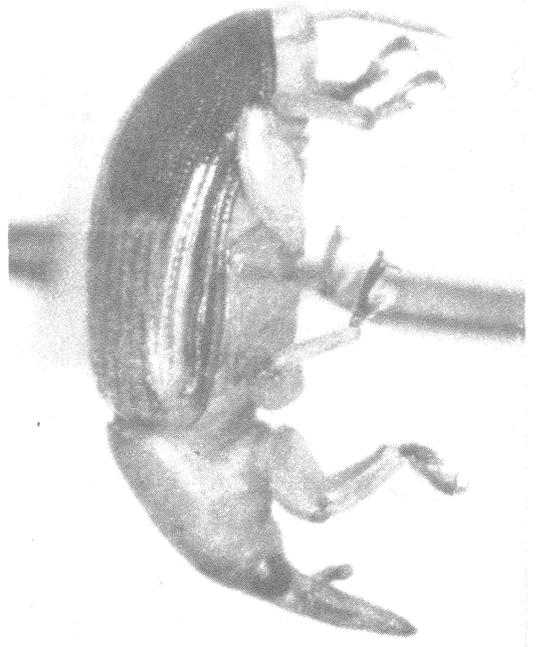




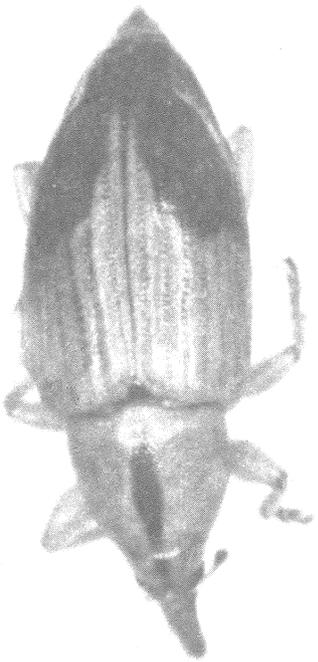




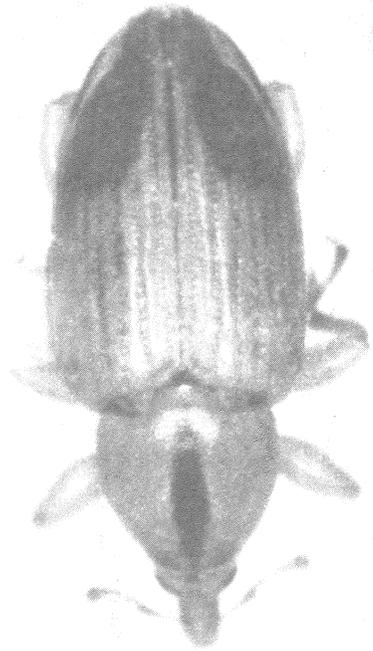
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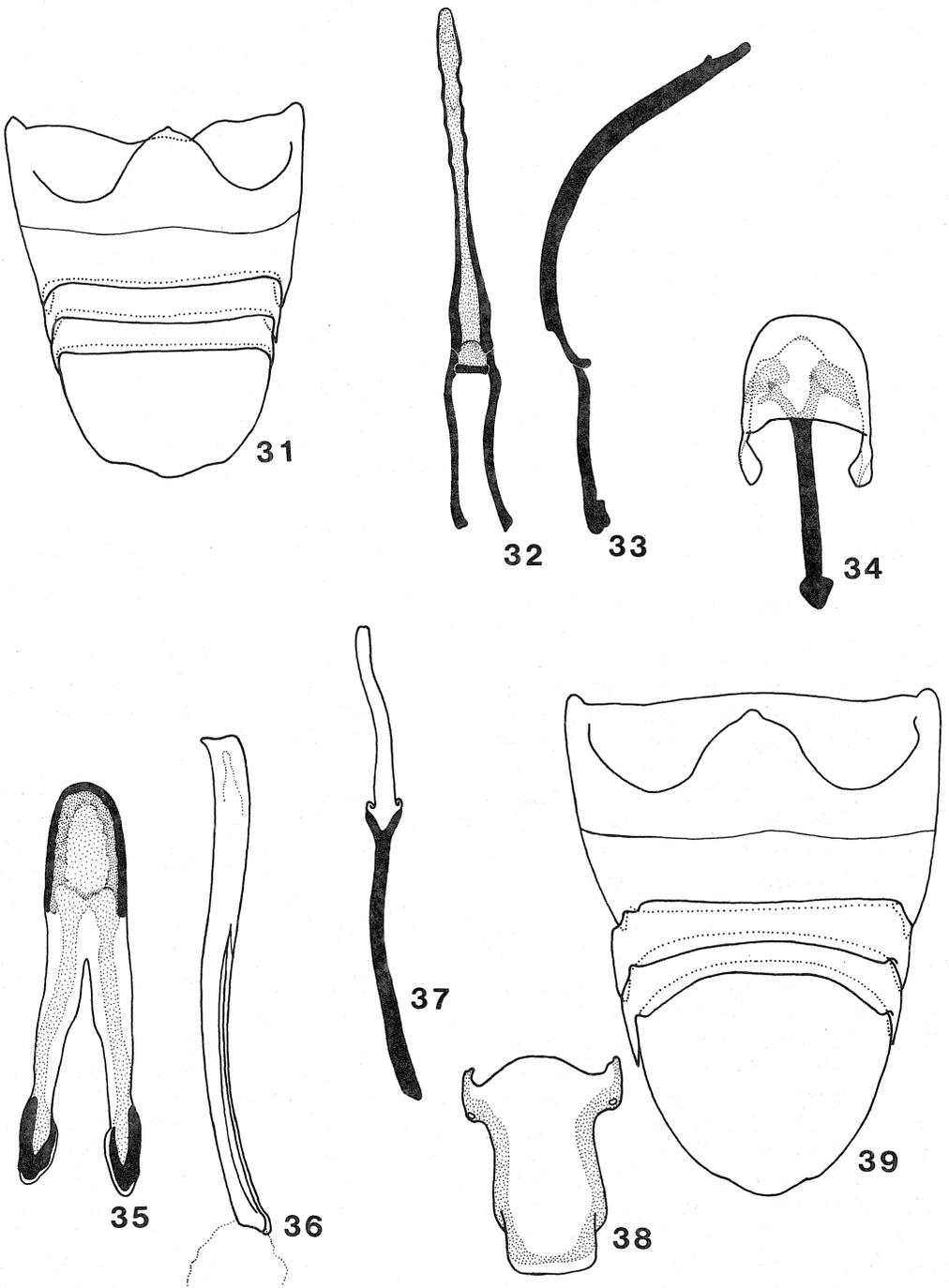
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femora of female with subapical blunt angulation. Genitalia of female with tergum VIII extremely elongate-narrow, much longer than wide, apically very heavily sclerotized, black in color; sternum VIII well-sclerotized, elongate-narrow, extended to base gonocoxite II, apodeme similarly elongate-narrow, "y" shaped at base; foretube sclerotized; gonocoxite II very elongate, length many times width, with laterally directed small heavily sclerotized apical tooth; bursa copulatrix short. Genitalia of male with sternum IX "y" shaped, apodeme moderately long, slender; aedeagus extremely long and slender (length about 11 time the width at base), in dorsal view tapered from base to about apical one-quarter then slightly swollen laterally then tapered to bluntly rounded apex; in lateral view uniformly slightly arcuate, apex slightly deflexed; no internal sac or internal sclerotization evident; apodemes relatively short, about one-third length aedeagus; tegmen narrow, basal apodeme as long as each apodeme of aedeagus.

**Type material:** Holotype male, "COSTA RICA: Punt. Las Cruces Biol. Stn. Coto Brus, 1100m. I.1994, L. D. Gómez P. on opening inflorescence of *Carludovica palmata*" (INBC). Allotype female (INBC) and 7 female and 3 male paratypes labelled as holotype. Paratypes, 6 females, 10 males, "COSTA RICA: Punt. Las Cruces Biol. Stn. Coto Brus, 1100m., XII.1994, L. D. Gómez P. on opening inflorescence of *Carludovica palmata*". Paratype female, "COSTA RICA: Punt., San Vito, 1200m, May 1993, Luis D. Gómez-P. inflores. of *Carludovica drudei* & *C. palmata*". Paratypes, 2 males, "COSTA RICA: Punt. Coto Brus, Cerro Paraguas, 1430 m, 18.XII.1994, (941316) L. D. Gómez, on *Carludovica palmata*". Paratypes, 1 female, 2 males, "COSTA RICA: Punt. Coto Brus, Cerro Paraguas, 1600m, 18.XII.1994, (941314) L.D. Gómez, on *Carludovica drudei*". Paratypes, 2 females, "COSTA RICA: Punt. Cerro Neilly (3 km.N.W.), 200m. 18.XII.1994,(941313) L.D. Gómez, on *Carludovica drudei*". Paratypes, 3 females, 1 male, "COSTA RICA: Punt. Las Cruces (15 km.S.E.) del Tajo Viejo, Fila de Cal 560m. 16.XII.1994, (941305) L. D. Gómez, on *Carludovica drudei*". Paratypes, 1 female, 2 males, "COSTA RICA: Punt.Las Cruces (15

km.S.E.) de Tajo Viejo, Fila Cal, 330m. 16.XII.1994,(941309) L. D. Gómez, on *Carludovica palmata*". Paratypes, 2 females, 5 males, "COSTA RICA: Punt. Coto Brus, Las Cruces 1100m. 21.XII.1994, L. D. Gómez, on *Carludovica palmata*". Paratypes, 18 females, 21 males, "COSTA RICA: Punt.Coto Brus, Las Cruces 1100m. XII.1994, L. D. Gómez, on *Carludovica palmata*". Paratypes, 17 females, 18 males, "COSTA RICA: Punt. Coto Brus, Las Cruces, 1100m. 28.XII.1994 Luis D. Gómez, on *Carludovica palmata*". Paratype male, "COSTA RICA: Punt.Osa Península, Chacarita, >100m, 20.III.1995, L. D. Gómez, on *Carludovica palmata*". Paratypes in AMNH (4), BMNH (4), CASC (2), CMNC (51), CNCI (4), CWOB (6), FMNH (2), HAHC (4), INBC (20), MUCR (8), SEMC (4) and personal collection of LDG (14). Total 59 females, 66 males.

**Variation:** Specimens vary slightly in the extent of black markings on the elytra, particularly those on intervals 4 and 5 near the base and at the anterior one-third.

**Distribution:** This species is known only from the Valle de Coto Brus and the Osa Península in Prov. Puntarenas, in southern Costa Rica (Fig. 41).

**Natural history:** All specimens of *Systemotelus carludovicae* were collected on opening inflorescences of *Carludovica palmata* and *C. drudei* (Cyclanthaceae) in December and January in the Valle de Coto Brus and in March in the Osa Península. Adults of *S. carludovicae* were observed copulating on, and females were observed ovipositing in, flowers of *C. palmata* (Fig. 40) in the vicinity of San Vito.

A brief description of the natural history of *Carludovica* species at Coto Brus, Puntarenas Province, Costa Rica follows. Although plants of *Carludovica* bloom sporadically throughout the year, their populations are flowering from December to May, with peak production between April and May. Clumps of *Carludovica palmata* and *C. drudei* produce, on average, five stalked inflorescences during the peak of their flowering period (late-April to early-May) at 1100m in cloud forest habitat. Inflorescences do not mature synchronously and

simultaneous anthesis of more than two is very rare. Usually, inflorescences open in a sequence of 24-36 hour intervals. In both species, the inflorescence is a peduncled spadix with flowers arranged in very compact, spiral rows. When maturity is reached, and through the initial stages of anthesis, the inflorescence is demonstrably thermogenetic and by the time the spathe bracts open and the osmophoric staminodes expand, volatilized scents are released. The aroma is a mixture of spicy and fruity, with a distinct lemon component. Anthesis begins at dusk with a bulging of the bracts and an increase in temperature and is completed in the early morning with the full expansion of the staminodes. With the first openings between the bracts, beetles start to enter the inflorescence and continue to increase in number as anthesis proceeds.

Examination of half-opened inflorescences sometimes reveals the presence of several insects such as Dermoptera and Coleoptera (Nitidulidae and Staphylinidae), particularly when the cyclanths are in proximity to species of Araceae. In more isolated *Carludovica* clumps, one may find a few Scarabaeidae (*Cyclocephala* spp.), but almost exclusively the insects are a variety of Curculioninae of the tribe Derelomini. At the outset of their aggregation, the weevils (which may be very numerous) move over the inflorescence scurrying around the bases of the extruded staminodes. Mating, as evidenced by many mounted and copulating pairs of weevils (including *S. carludovicae* and various other derelomines), occurs when the staminodes start to fall off the flowers. By the time the staminodes have fully dropped, many weevils are burrowing into the inflorescence; however, other weevils may fall to the ground or may fly to nearby inflorescences. Other visitors attracted by the scent and the availability of pollen are stingless bees (*Trigona fulviventris*) and an occasional euglossine bee.

**Phylogenetic relationships.** This species is presumed to be the sister species to the lineage comprised of *S. stockwelli* and *S. costaricensis*. *Systemotelus costaricensis* New Species, Anderson & Gómez (Figures 14-26, 41)

**Description:** (Figs. 14-26). Total body length of male 7.7-9.2 mm (n=5); female 8.8-9.9 mm (n=8). Maximum body width (across widest point of elytra) of male 3.5-4.2 mm; female 3.4-4.2 mm. Color pale yellow with following areas black: rostrum; midline of head near posterior margin; flanks and midline of pronotum; scutellar region; intervals 3-4 near base (lacking in some specimens), interval 4 at anterior one-third, posthumeral region on intervals 7-9, posterior portion of intervals 5-8, and intervals 10-11 throughout length; and coxae. Rostrum 0.75-0.79 time the length of pronotum in male; 0.75-0.80 the length of the pronotum in female. Rostrum in lateral view slightly tapered to apex, slightly ventrally arcuate in female, straight in male. Antennal insertion at anterior two-fifths in male and female. Antennae with scape not reaching eye by much less than width of antennal club. Pronotum wider than long ( $l/w = 0.93-0.95$  in male;  $l/w=0.89-0.90$  in female). Elytra with various black dorsal and lateral markings; intervals with fine dense punctures and fine hair-like vestiture. Elytra of female in dorsal view with posterior one-quarter tapered to relatively broad apex. Mesosternum markedly tuberculate at middle between mesocoxae. Abdominal sternites I-II of male subequal in length, each about twice length of each of sternites III-IV; sternites III-IV short, subequal in length; sternum V slightly wider than long, about as long as sterna I and II combined. Abdominal sternites I-II of female subequal in length, each about 1.5 the length of sternites III-IV combined; sternites III-IV very short, subequal in length; sternum V robust, as long as wide; about as long as sterna I-IV combined. Pygidium of female long, in dorsal view constricted at basal one-third, very slightly expanded subapically, bluntly lobed at apex; of male, flat dorsally, uniformly rounded and somewhat bulbous apically, ventrally with "v" shaped incision. Femora of male and female lacking subapical blunt angulation, uniformly rounded. Genitalia of female with tergum VIII elongate-narrow, much longer than wide, apically very heavily sclerotized, black in color, with lateral arms extended to base gonocoxite II, somewhat expanded, heavily sclerotized; sternum VIII well-sclerotized, elongate-narrow, extended to base gonocoxite

II, apodeme similarly elongate-narrow, "y" shaped at base; foretube sclerotized; gonocoxite II elongate, length many times width, lacking apical tooth; bursa copulatrix moderate. Genitalia of male with sternum IX "y" shaped, apodeme moderately long; aedeagus extremely long and slender (length about 11 x width at base), in dorsal view tapered from base to about apical one-quarter then slightly swollen

laterally then tapered to bluntly rounded apex; margins somewhat irregularly sinuate throughout apical one-half; in lateral view uniformly slightly arcuate, apex slightly deflexed; no internal sac or internal sclerotization evident; apodemes relatively short, about one-third length aedeagus; tegmen narrow, basal apodeme as long as each apodeme of aedeagus.

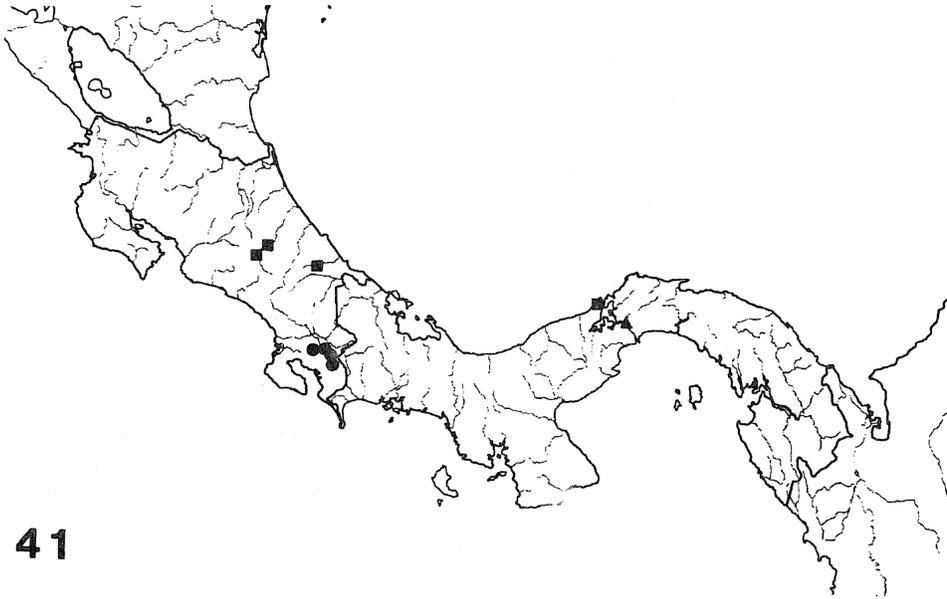


Figure 41. Collection localities of *Systemotelus* species. *S. carludovicae*, circles; *S. costaricensis*, squares; *S. stockwelli*, triangles.

**Type material:** Holotype male, "Ref. Nac. Fauna Silv. Tapantí, 1250m. Prov. Cart. COSTA RICA, G. Mora, Ago. 1991, L-N-194000, 559800" (INBC). Allotype female (INBC) and 2 female and 3 male paratypes labelled as holotype. Paratypes, 4 females, 1 male, "Est. Hitoy Cerere, 100m. R.Cerere, Res. Biol. Hitoy-Cerere, Prov. Limón, Costa Rica, 30 Jul.- 20 Jun. 1992, F.A. Quesada L-N-184200, 643300" Paratype female, "COSTA RICA Cart. Prov. Turrialba, CATIE grounds, ca. 2000' rainfall, II-12-1990, J. Rifkind & P. Gum". Paratypes, 6 females, 7 males, "PANAMA. Colón, C.Z. Ft. Sherman, Old Ft. San Lorenzo Rd. 7-25-1995, C.W. & L.B. O'Brien" "on *Carludovica drudei* flower, (Cyclanthaceae)". Paratypes, 1 female, 3 males, "Panama. Provincia de Colón, Fuerte Sherman, *Carludovica drudei* / 25.VII.1995, H.

Barrios". Paratypes in CMNC (8), CWOB (11), INBC (5), STRI (4). Total 16 females, 14 males.

**Variation:** There is slight variation in the pattern of black elytral maculations. In most specimens the pattern is typical; however, in a few specimens the median portion of the elytral disk is more extensively maculated. In a few specimens, the midline of the pronotum is black only in the anterior one-half.

**Distribution:** This species is known from three proximal sites in the provinces of Cartago, Limón and Turrialba, Costa Rica, and from the Canal Zone in Panama (Fig. 41).

**Natural history:** Adult specimens of *Systemotelus costaricensis* were collected on

freshly opened inflorescences of *Carludovica drudei* (Cyclanthaceae) in July near Fort Sherman, Panama in lowland rain forest. There is no information on the plant associations of this species in Costa Rica; adults have been collected in Costa Rica from June through August.

**Phylogenetic relationships:** *Systemotelus stockwelli* and *S. costaricensis* are presumed to be sister species based on the shared apomorphic character states of aedeagus in dorsal view with lateral margins sinuate, and the very short abdominal sternites III and IV.

*Systemotelus stockwelli* New Species,  
Anderson & Gómez

(Figures 27-39, 41)

**Description:** (Figs. 27-39). Total body length of male 4.9-6.2 mm (n=10); female 5.4-6.9 mm (n=10). Maximum body width (across widest point of elytra) of male 2.3-3.0 mm; female 2.5-3.0 mm. Color pale yellow with following areas black: midline of head near posterior margin (lacking in some specimens); midline of pronotum; elytral intervals 10-11 throughout length and intervals 2-9 or 3-9 in posterior one-half to two-fifths (lacking in some specimens). Rostrum 0.69-0.72 x length pronotum in male; 0.80-0.82 x length pronotum in female. Rostrum in lateral view distinctly tapered to apex, especially so in female; straight in both sexes. Antennal insertion at anterior two-fifths in male, sudmedian in female. Antennae with scape not reaching eye by much less than width of antennal club. Pronotum wider than long ( $l/w = 0.84-0.92$  in male;  $l/w=0.89-0.94$  in female). Elytra with various black dorsal and lateral markings (some specimens lacking black maculations); intervals with fine dense punctures and fine hair-like vestiture. Elytra of female in dorsal view with posterior one-quarter tapered to relatively broad apex. Mesosternum markedly tuberculate at middle between mesocoxae. Abdominal sternites I-II of male subequal in length, each about twice the length of each of sternites III-IV; sternites III-IV short, subequal in length; sternum V slightly wider than long, about as long as sterna I and II combined. Abdominal sternites I-II of female subequal in length, each about 1.5-2.0 x length of sternites III-IV combined; sternites III-IV

very short, subequal in length; sternum V robust, as long as wide; about as long as sterna I-IV combined. Pygidium of female long, in dorsal view constricted at basal one-third, very slightly expanded subapically, bluntly lobed at apex; of male, flat dorsally, uniformly rounded and somewhat bulbous apically, ventrally with "v" shaped incision. Femora of male and female lacking subapical blunt angulation, uniformly rounded. Genitalia of female with tergum VIII elongate-narrow, much longer than wide, apically heavily sclerotized, dark brown in color, with lateral arms extended to base gonocoxite II, somewhat expanded, heavily sclerotized; sternum VIII well-sclerotized, elongate-narrow, extended to base gonocoxite II, apodeme similarly elongate-narrow, "y" shaped at base; foretube sclerotized; gonocoxite II elongate, length many times width, lacking apical tooth; bursa copulatrix moderate. Genitalia of male with sternum IX "y" shaped, apodeme moderately long; aedeagus extremely long and slender (length about 11 times the width at base), in dorsal view constricted at about basal one-sixth then tapered to about apical one-sixth then very slightly swollen laterally then tapered to bluntly rounded apex; margins irregularly sinuate throughout apical one-half; in lateral view uniformly slightly arcuate, apex not deflexed; no internal sac or internal sclerotization evident; apodemes relatively short, about one-third length aedeagus; tegmen narrow, basal apodeme as long as each apodeme of aedeagus.

**Type material:** Holotype male, "PANAMA: Canal Area, Pipeline Road 4 km. N.W. Gamboa, 25 Feb. '95, Stockwell", "on inflorescence of *Carludovica palmata*" (CMNC). Allotype female (CMNC) and 2 female paratypes labelled as holotype. Paratypes, 6 females, 6 males, labelled as holotype except "3 km. N.W. Gamboa". Paratypes, 10 females, 14 males, labelled as holotype except "3 km. N.W. Gamboa, 2 Apr. '95". Paratypes, 19 females, 18 males, labelled "PANAMA: Panama . Pipeline Rd. km.4.0-6.0 nr. Gamboa, 40m, 23.VI.1995, R.S. Anderson, trop. lowland for. ex. flowers *Carludovica palmata*, 95-040". Paratypes in AMNH (4), BMNH (4), CMNC (39), CWOB (4 + 4), HAHC (4), HPS (12), USNM (4). Total 38 females, 39 males.

**Variation:** Specimens vary in the extent of dorsal elytral black maculations which are almost entirely lacking in some specimens.

**Distribution:** This species is known only from Pipeline Road near Gamboa in the Canal Area of Panama (Fig. 41).

**Natural history.** All specimens of *Systemotelus stockwelli* were collected on freshly opened inflorescences of *Carludovica palmata* (Cyclanthaceae) in February, April and in June near Gamboa in Panama in lowland rain forest. Flowering in *C. palmata* at this site takes place most frequently from March to April and during intensive examination of many individuals in June (most of which bore from 1-5 mature spadices bearing fruit) only one flower was found.

In June, immature stages of *S. stockwelli* were found in an older spadix which was green and firm and which had not yet started to decompose and expose seeds and the bright red fleshy fruit pulp. Each mature *S. stockwelli* larva was found to have fully consumed a package of seeds but did not appear to have consumed or otherwise entered the surrounding red fleshy fruit pulp. Although a number of spadices were examined, only 12 mature larvae and 2 pupae were recovered, all from a single spadix. Pupation takes place in the seed cavity and adult emergence, while not observed (but see comments following on *Perelleschus carludovicae*), likely awaits natural exposure of the spadix contents.

During dissection of green spadices while looking for *S. stockwelli*, numerous adults of *Perelleschus carludovicae* emerged, indicating that even though adults, they had not exited the spadix and were likely awaiting natural exposure.

**Phylogenetic relationships:** *Systemotelus stockwelli* and *S. costaricensis* are presumed to be sister species based on the shared apomorphic character states of aedeagus in dorsal view with lateral margins sinuate, and the very short abdominal sternites III and IV.

## DISCUSSION

Although there are no confirmed fossil records of Cyclanthaceae, except for the "protocyclanthoid" structures described from the Eocene of India, which could represent Arecaceae or Pandanaceae rather than Cyclanthaceae (the present distribution of which is exclusively New World), most systematists agree that Cyclanthaceae are an old group whose affinities are with the palms (Arecaceae) and screw-pines. Palms are well known as cantharophilous plants, and have a variety of Curculionidae, including many Derelomini, among their beetle associates. Weevils of the Derelomini are also associated with Cyclanthaceae; however, the derelomines recorded by us from cyclanths are absent from flowers of other plant families (including palms) when cyclanths are not blooming, suggesting an exclusive association of these taxa with cyclanths. Similarly, palm-associated Derelomini do not appear to be found on cyclanths. Eriksson (1994) suggested that the relationship of weevils with Cyclanthaceae is not necessarily an ancient, co-evolved system, despite the presence of Derelomini on flowers of both cyclanths and palms, and based on presently available data we agree.

Curculionoidea are an old group of beetles whose fossil record predates that of the emergence of the early flowering plants (see Kuschel *et al.* 1994 for a review of known Cretaceous [and Upper Jurassic] weevil fossils). All of these early weevil fossils are assignable to the primitive curculionoid families Nemonychidae, Belidae, and Brentidae (both Carinae and Brentinae: Eurhynchini). Host plants of fossil taxa in at least two of these families (Nemonychidae and Belidae) appear likely to have been various gymnosperms, such as conifers and cycads (or related plants), as these are the among the known hosts of extant members of these families and are present as fossils in these assemblages. Possible hosts of the Brentidae are less clear. True Curculionidae first appear in Upper Cretaceous deposits in North America, China and Chile, well after the presumed origin of angiosperms in the Lower Cretaceous; hosts of these taxa are not known. However, among the Baltic amber Curculionidae of Oligocene age is *Electrotribus weigangae* (Ulke) (Kuschel

1992), a taxon apparently most closely related to the palm-associated Neotropical genus *Celetes* Schoenherr of the Derelomini. Since palms were well-represented at the time of formation of Baltic amber, *E. weigangae* also may have been associated with palms. Thus the association of some Derelomini with palms would appear to extend to at least the Oligocene and would make the prospect of other early Cenozoic Derelomini being associated with Cyclanthaceae at least possible.

On the other hand, while their exact phylogenetic relationships are not clear, weevils associated with palms and cyclanths are not primitive in their phylogenetic position within Curculionidae despite traditional placement as Eirrhiniinae (see Introduction). Apomorphic features of male genitalic structure indicate placement with other Curculionidae having similar non-orthocerous genitalia. Kuschel (1952) had assigned derelomines to Petalochilinae but later (1964) questioned this placement and in the recent checklists of New World weevils (O'Brien and Wibmer 1982; Wibmer and O'Brien 1986) they inappropriately (but traditionally) are placed back in Eirrhiniinae.

While it is possible that association of Derelomini with cyclanths may date to the early Cenozoic, we do not expect parallel cladogenesis or a close coevolutionary history between these weevil species and the Cyclanthaceae-Arecaceae lineage of plants. Association of *Cyclocephala* scarabs with Cyclanthoideae, and lack of any known derelomine weevil associates for Cyclanthoideae, suggests the independent origin of associations of derelomines with each of palms and cyclanths, perhaps because of similarities in floral structure and habitat associations. In support of this view, Anderson (1993) in a general review of evidence for cospeciation in weevils and plants, did not find evidence for cospeciation, rather factors mediating speciation in weevils appeared likely to be primarily ecological in nature, a common factor being similarity in habitat associations. However, before cospeciation can be dismissed as the mode of evolution in these taxa, more information on the range of host plant associations and phylogenetic relationships in Derelomini is necessary.

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## RESUMEN

Se describe un nuevo género y tres nuevas especies de coleópteros (Curculionidae, Curculioninae, Derelomini), asociados con las inflorescencias de especies de las ciclantáceas, *Carludovica palmata* y *C. drudei*, en Costa Rica y Panamá. Aunque se conocía la polinización de estas plantas por coleópteros, el informe más reciente asignaba los insectos al género *Phyllotrox*. Un estudio del material descrito nos confirma que esa identificación es incorrecta y, además, que el material costarricense y panameño incluye un número de géneros y especies aún no descritas. Aquí se describe el primer material obtenido de nuestros estudios y se presentan notas sobre la historia natural de las tres especies del nuevo género *Systemotelus*: *S. carludovicae*, *S. costaricensis* y *S. stockwelli*.

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