

**Studies of the Subtribe Tachyina
(Coleoptera: Carabidae: Bembidiini)
Supplement E: A Revision of the Genus *Costitachys* Erwin 1974**

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The Neotropical genus *Costitachys* Erwin 1974 is revised. Newly discovered specimens of a new species of *Costitachys* from Ecuador provide comparative genitalic characters of males for the genus and extend its range 2900 km west of its previously known distribution into an additional center of species radiation in South America, the “North Andean Slope.” A new species, *Costitachys tena* Erwin and Kavanaugh sp. nov. (type locality: Ecuador, Napo Province, Tena, 598 m, 0°59'S, 077°49'W) is described. One additional locality for *Costitachys inusitatus* Erwin is recorded from Brazil and another noted from French Guyana. A key to facilitate identification of adults of the two species is included.

KEYWORDS: Brazil, Ecuador, French Guyana, Perú, Trinidad, Carabidae, Bembidiini, Tachyina, *Costitachys* Erwin.

Resumen

El género Neotropical *Costitachys* Erwin 1974 es revisado. El descubrimiento de especímenes de una nueva especie de *Costitachys* provenientes de Ecuador proporcionaron caracteres comparativos de la genitalia de los machos para este género y extendió su rango de distribución 2,900 km al oeste de la distribución previamente conocida, dentro de un centro de radiación de especies adicional en Sudamérica, la “Pendiente Andina del Norte.” Una nueva especie, *Costitachys tena* Erwin and Kavanaugh sp. nov. (Localidad tipo: Ecuador, Provincia de Napo, Tena, 598 m, 0°59'S, 077°49'W) es descrita. Una nueva localidad para *Costitachys inusitatus* Erwin se agrega para Brasil y otra para Guayana Francesa. Se incluye una clave para facilitar la identificación de los adultos de ambas especies.

PALABRAS CLAVAE: Brasil, Ecuador, Guayana Francesa, Perú, Trinidad, Carabidae, Bembidiini, Tachyina, *Costitachys* Erwin.

Costitachys inusitatus Erwin was described (Erwin 1974b) on the basis of a single female from Santarém, Pará, Brazil. This beetle's distinctive form (Fig. 1), striking among Tachyina worldwide, warranted its description as both a new species and new genus even though only a single specimen was known. Two additional specimens were found subsequently among unsorted carabid beetles at the California Academy of Sciences (CAS) and Museu Goeldi (MGBB) (one female and one male, respectively); and updated information about the genus, including description and illustration of the unusual male genitalia, was provided by Erwin and Kavanaugh (1999).

Recently, we discovered an additional specimen of *C. inusitatus* among specimens borrowed from the collection of Museu Goeldi as well as another 11 specimens among unsorted materials in the National Museum of Natural History (NMNH). The latter are undoubtedly members of *Costitachys* but represent an undescribed species from the western side of the Amazon Basin in Ecuador and Perú. The purpose of this paper is to present new information, compare and contrast the two known species, and provide hypotheses regarding their way of life and trans-Amazon distribution.

METHODS

Measurements recorded here include ABL (apparent body length = distance along midline from apex of labrum to apex of longer elytron); SBL (standardized body length = the sum of the lengths of the head [measured from apex of clypeus to a point on midline at level of posterior margin of compound eye], pronotum [measured from apical margin to basal margin along midline], and elytra [measured along midline from apex of scutellum to apex of the longer elytron]); and TW (total width = width across both elytra at their widest point). The code for elytral chaetotaxy is as proposed by Erwin (1974a).

Male specimens were dissected as previously described by Erwin and Kavanaugh (1981) and Kavanaugh (1979). We did not dissect and examine female reproductive tract structures for two reasons. First, because of the small size of these beetles and the extreme difficulty associated with safe dissection of these delicate structures, the likelihood of causing irreparable damage during dissection is high. Second, little or no comparative data exist for characters of the female reproductive tract in other tachyine taxa. We chose not to risk destroying reproductive tract structures in these few important *Costitachys* specimens at a time when the dissections, even if successfully done, would have little comparative value. Study of the female tract of these specimens should await the development of a body of comparative data based on dissections of specimens of more abundant and easily obtained tachyine species.

Illustrations of the male aedeagal median lobe and parameres were made using a camera lucida mounted on a Wild compound microscope. Digital images of habitus were taken using an Automontage imaging system by Syncroscopy® with a Leica M420 dissecting microscope.

Costitachys Erwin, 1974

Costitachys Erwin, 1974:128. Type species: *C. inusitatus* Erwin, 1974, by monotypy.

DERIVATION OF NAME.— Latin, *costa*, meaning rib and referring to the longitudinal carinae of the head, pronotum, and elytra; plus *Tachys*, the nominate genus of the subtribe, hence the Tachyina with ribs.

DIAGNOSIS.— Broad and subdepressed, easily distinguished from other Tachyina by the multiple carinae of the head, pronotum, and elytra. In addition, adults have only one pair of supraorbital setae, a feature found elsewhere among tachyines only in genus *Micratopus* Casey, all known members of which are non-carinate.

DESCRIPTION.— Size moderately small for subtribe: ABL males = 1.7 to 2.3, females = 1.9 to 2.6 mm; SBL males = 1.5 to 2.3 mm, females = 1.9 to 2.4 mm; TW males = 0.8 to 1.0 mm, females = 0.9 to 1.2 mm *Color*: flavotestaceous throughout or elytron with darker discal cloud; antennae testaceous. *Luster*: surface shiny. *Head*: clypeus and dorsum of head with three longitudinally oriented carinae; one supra-orbital seta per eye; eyes micro-setiferous; mentum without foveae, with minute tooth along anterior margin; antennae short, extended to base of prothorax, and antennomeres 2–11 pubescent. *Prothorax*: pronotum with five longitudinally oriented carinae; without

setae at base or along lateral margin. *Pterothorax*: elytra impunctate; with eight longitudinally oriented carinae, sixth continuous with rounded humeral margin; marginal explanation nonsetose, nonserrate; recurrent groove absent; chaetotaxy formula Eo 1a, 2a, 3a, 4a, 5c, 6b, 7, 8a; Ed 1, 7b. *Legs*: anterior tibia markedly obliquely notched apicolaterally; males with basitarsomere (tarsomere 1) on anterior tarsi expanded, about 1.5 times wider than tarsomere 4, medially dentiform, and with a small pad of adhesive setae ventrally (anterior tarsomere 1 more slender, edentate, and without pad of adhesive setae ventrally in females); otherwise, legs normal for Tachyina. *Abdomen*: last visible sternite of male and female each with one pair of ambulatory setigerous pores, females with very short pubescence either broadly and sparsely distributed over sternite or confined to a small patch located medially on the sternite between the two "ambulatory" setae, males with or without broadly and sparsely distributed pubescence.

GEOGRAPHIC DISTRIBUTION.— Widespread in the eastern Amazon Basin, north to French Guyana and Trinidad, west to the eastern Andean slopes of Ecuador and Perú.

Checklist of Species of *Costitachys* Erwin

Costitachys inusitatus Erwin. Brazil, French Guyana, Trinidad

Costitachys tena Erwin and Kavanaugh, sp. nov. Ecuador, Perú

Key to Species of *Costitachys* Erwin

- 1 Pronotum with side margins rounded (Fig. 1) *C. inusitatus* Erwin
 1' Pronotum with side margins sinuate posteriorly (Fig. 2). *C. tena* Erwin and Kavanaugh, sp. nov.

Costitachys inusitatus Erwin

Figures 1, 3, and 5.

TYPE.— HOLOTYPE, a female (deposited in Museum of Comparative Zoology, Harvard University), Santarém, Pará, Brazil.

DERIVATION OF NAME.— Latin, *inusitatus*, meaning unusual and referring to the bizarre structure of the dorsal surface of these beetles in relation to other Tachyina.

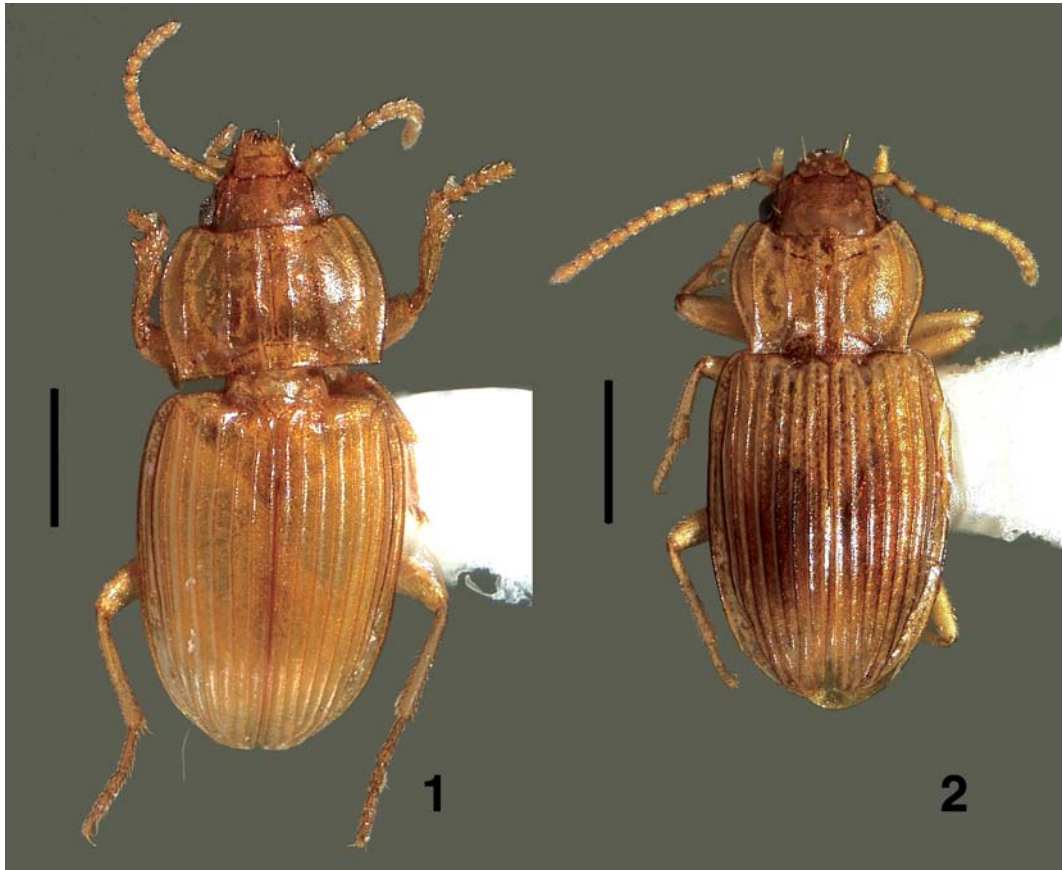
COMMON NAME.— Unusual ribbed rapid carabid.

DIAGNOSIS.— Pronotum with side margins rounded, hind angles obtuse; central disc of elytron without diffuse darker cloud; female with pubescence on last visible sternite confined to a small patch medially between the two "ambulatory" setae, male without pubescence; male with left paramere of aedeagus broad, conchoid, truncate apically, with four or five lanceolate apical setae (Fig. 3b).

DESCRIPTION.— With the attributes listed above in the genus description; size large for genus: ABL males = 2.3 mm, females = 2.3 to 2.6 mm; SBL males = 2.2 mm, females = 2.2 to 2.4 mm; TW males = 1.0 mm, females = 1.0 to 1.2 mm. *Color*: flavotestaceous throughout, antennomeres paler. *Prothorax*: pronotum with side margins rounded, hind angles obtuse. *Male*: median lobe of aedeagus (Fig. 3a) with apex broadly rounded; left paramere (Fig. 3b) conchoid, truncate apically, with four or five long and lanceolate apical setae; right paramere short and slender with four very long, slender apical setae.

SPECIMENS EXAMINED.— A total of four specimens (2 males and 2 females) from the following localities: BRAZIL: Pará, Salinas [6 January 1962; J. & B. Bechyné collectors] (1 male; MGBB), Santa Isabel [6 June 1962; J. & B. Bechyné collectors] (1 male; MGBB), Santarém [April 1963, F.G. Werner collector] (1 female; MGBB). TRINIDAD: Cocos Bay [1 February 1969; L. & C.W. O'Brien collectors] (1 female; CAS).

The male specimen from Salinas (probably at 1°17'49"S, 47°55'06"W, 37 m), Pará, Brazil, collected by



FIGURES 1–2. Digital images of habitus, dorsal aspect.; scale lines = 0.5 mm. 1. *Costitachys inusitatus* Erwin; 2. *Costitachys tena* Erwin and Kavanaugh, sp. nov.

J. & B. Bechyné (Museu Goeldi) (ADP103054), is here reported for the first time. Unfortunately, there are several “Salinas” east of Belém, Brazil, in the area where the Bechynés worked during the early 1960s. However, the site cannot be far from Santa Isabel (probably at $1^{\circ}17'34''\text{S}$, $48^{\circ}08'57''\text{W}$, 20 m) because the two specimens from “Salinas” and Santa Isabel were collected on the same day.

NOTES.— When we described the male genitalia of *C. inusitatus* (Erwin and Kavanaugh 1999), we had overlooked a previous description by Perrault (1984) in a “Scientific Note” based on a specimen from French Guyana. We have not yet had an opportunity to examine that specimen, which Perrault recorded as slightly smaller (2.2 mm) than specimens we have examined, but our illustration of the genitalia of the male from Santa Isabel, Brazil agrees in detail with that Perrault’s of the French Guyanan specimen, except that the latter appears (in Perrault’s Fig. 1a) to have four apical setae, rather than five as we illustrated (our Fig. 1).

HABITAT DISTRIBUTION.— Perrault (1984) reported that his specimen, collected by N. Dagallier (ORSTOM), was found “by sifting sand on Montjoly Beach near Cayenne”. This is solid evidence that this species is riparian, occurring on light colored sandy river margins.

***Costitachys tena* Erwin and Kavanaugh, sp. nov**

Figures 2, 4, and 5.

TYPES.— HOLOTYPE, a female (deposited in NMNH), labeled: “Ecuador: Napo Tena 26 May 1977, W.E. Steiner”/ [♀]/ “ADP 103048”/ “HOLOTYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [red label]. A total of 10 paratypes (6 males and 4 females): 1 male (NMNH), labeled: “Ecuador: Napo Tena 26 May 1977, W.E. Steiner”/ [♂]/ “ADP 103056”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 1 male (NMNH) labeled: “Ecuador, Post. Tena (3 km N) Blacklight 5 July 1976 Jeffrey Cohen”/ “Ecuador – Peace Corps – Smithsonian Institution Aquatic Insect Survey”/ [♂]/ “ADP 103050”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 1 male (NMNH) labeled: “Ecuador, Post. Tena (3 km N) Blacklight 5 July 1976 Jeffrey Cohen”/ “Ecuador – Peace Corps – Smithsonian Institution Aquatic Insect Survey”/ [♂]/ “ADP 103052”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 1 male (CAS), labeled: “Ecuador, Post. Tena (3 km. N) Blacklight 5 July 1976 Jeffrey Cohen”/ “Ecuador – Peace Corps – Smithsonian Institution Aquatic Insect Survey”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 2 females (1 in CAS, 1 in NMNH), labeled: “Ecuador: Napo Puerto Nuevo (2 km S) 9 July 1976 Jeffrey Cohen”/ “collected at black light”/ “Ecuador – Peace Corps – Smithsonian Institution Aquatic Insect Survey”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 1 female (NMNH), labeled: “Ecuador: Napo; Puerto Nuevo 8 July 1976 at blacklight J. Cohen”/ “Ecuador – Peace Corps – Smithsonian Institution Aquatic Insect Survey”/ “ADP 103058”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 1 female (NMNH), labeled: “Ecuador: Napo; Puerto Nuevo 8 July 1976 at blacklight J. Cohen”/ “Ecuador – Peace Corps – Smithsonian Institution Aquatic Insect Survey”/ [ADP 103060]/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 1 male (NMNH), labeled: “Ecuador: Napo; Puerto Nuevo 8 July 1976 at blacklight J. Cohen”/ “Ecuador – Peace Corps – Smithsonian Institution Aquatic Insect Survey”/ “ADP 103072”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label]; 1 male (NMNH), labeled “PERU, Guanaco, Penguin Biological Station, Rio Yuyapichis, 9°37'S, 74°56'W, W. Hanagarth collector”/ “RB248 Bem XVa”/ “PARATYPE *Costitachys tena* n. sp. designated by T.L. Erwin & D.H. Kavanaugh 2007” [yellow label].

DERIVATION OF NAME.— Tena is the name of a town, which is near the type locality and is used as a noun in apposition.

COMMON NAME.— Tena ribbed rapid carabid.

DIAGNOSIS.— Pronotum cordiform with lateral margins sinuate posteriorly; head (Fig. 2) markedly wider in relation to the width of the pronotum; central disc of elytra with a diffuse slightly darker cloud; both male and female with broadly and sparsely distributed pubescence on last visible sternite; left paramere of male aedeagus long and slender, with three long and slender apical setae (Fig. 4b).

Members of this species are easily distinguished from those of *C. inusitatus* by their cordiform pronota with lateral margins distinctly sinuate posteriorly (pronota not cordiform and lateral margins arcuate throughout their length in *C. inusitatus* adults [Fig. 1]) and heads that are wide in relation to pronotal width (head relatively narrower in *C. inusitatus* adults).

DESCRIPTION.— With the attributes listed above under the genus description; size small for genus: ABL males = 1.7 to 2.0 mm, females = 1.9 to 2.1 mm; SBL males = 1.5 to 1.8 mm, females = 1.9 to 2.0 mm; TW males = 0.8 to 0.9 mm, females = 0.9 to 1.0 mm. *Color:* flavotestaceous, disc of elytra with a dark cloud, antennomeres testaceous. *Prothorax:* pronotum with side margins sinuate basally, hind angles approximately rectangular. *Male:* median lobe of aedeagus (Fig. 4a) with apex narrowly produced; left paramere (Fig. 4b) long and slender, with three long and slender apical setae; right paramere short and slender with three medium-length apical setae.

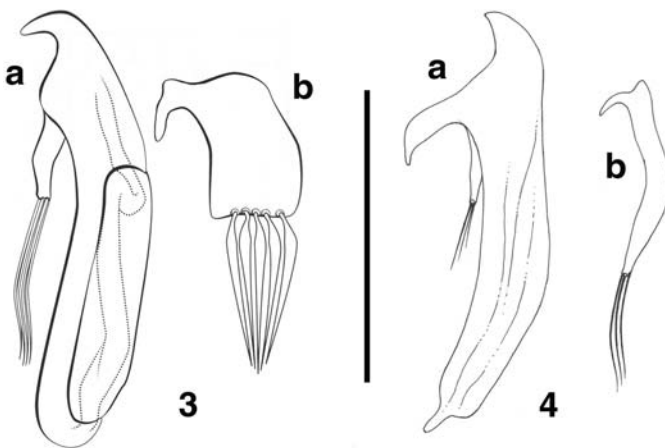
SPECIMENS EXAMINED.— The type series of 11 specimens is listed above.

HABITAT DISTRIBUTION.— All the Ecuadorian specimens representing this new species were collected at a blacklight set up on the graveled shore of a small tributary of the Napo River at Tena, also near Tena, and at “Puerto Nuevo”, now named Puerto Napo. This is good evidence that this species is riparian, occurring on graveled and/or sandy river margins.

DISCUSSION

Morphological Considerations

Two of the most intriguing morphological features of *Costitachys inusitatus* males are the shapes of the left paramere of the aedeagus and of the apical setae found on that structure. The conchoid form and broadly truncate apex of the paramere and its long and flattened lanceolate apical setae (Fig. 3b) are highly distinctive features among tachyine carabids. When we found and described these features (Erwin and Kavanaugh 1999), we assumed that they would prove to be good characters (i.e., synapomorphies) not just for *C. inusitatus* males, but also for males of any and all other species of *Costitachys* that might be discovered subsequently (i.e., that they would represent synapomorphies at a higher taxonomic level). So we were surprised to find in the second species, *C. tena*, described here, forms of the left paramere and of its apical setae (Fig. 4b) more typical of tachyines in general than of *C. inusitatus* males. This was all the more surprising given the obvious synapomorphies of external form and structure (e.g., the distinctive carinae of the head, pronotum, and elytra found nowhere else among tachyines) uniting these two species. We have no idea what differences in function or evolutionary significance there may be to this divergence between *Costitachys* species, but it may also be reflected in the differences between the pubescence patterns on the last visible sternite of the two species. In both males and females of *C. tena*, there is similar sparse, very short pubescence broadly distributed over the sternite; but in *C. inusitatus*, males have no pubescence on this sternite and females have the pubescence denser and restricted to a patch on the medial area between the apical paramedial “ambulatory” setae. This is probably an area on the female that comes in contact with the left paramere of the male during copulation; so it may be that the differences in features of the left paramere and of the last visible sternite are somehow correlated and coevolved.



FIGURES 3–4. Male genitalia, left lateral aspect; a = median lobe with right paramere attached; b = left paramere (detached); scale line = 0.25 mm. 3. *Costitachys inusitatus* Erwin; 4. *Costitachys tena* Erwin and Kavanaugh sp. nov.

Zoogeographical Considerations

Discovery of *C. inusitatus* Erwin in Cocos Bay, Trinidad, extended the range of that species north of its originally known type locality by 1550 km (Erwin and Kavanaugh 1999). The discovery of a second species of *Costitachys* in the cis-Andean region of Ecuador and Perú extends the

known range of the genus to the west some 2900 km (Fig. 5). The genus now has been recorded from three “centers of species radiation” in the Neotropics — namely, the “North Atlantic Coast,” the “Lower Amazon — Mid-Atlantic Coast,” and the “North Andean Slope” (see Erwin and Pogue 1988 for named centers). The western Amazonian species has been recorded along the margins of the Rio Napo (in Ecuador) and Rio Yuyapichis (in Perú); thus it is likely that members of this genus will be found throughout the Amazon Basin because they live along first-order rivers in the Amazon watershed. It is also likely that additional undescribed species await discovery. The margins of large Amazon Basin rivers have various types of microhabitats including both broad sand bars and cuts into forests resulting in steep banks of dark soil and roots. The pale color of adults of both *C. inusitatus* and *C. tena* suggests that these beetles probably occur on light-colored sandy alluvium, and this microhabitat is distributed throughout the Amazon drainage basin. The upper Napo River also has sand with an over-layer of small stones and gravel interspersed with exposed light-colored sand. Additional evidence for light-colored sand habitat comes from the specimen noted by Perrault (1984) collected on the beach at Montjoly in Cayenne, French Guyana. All of these habitats should be explored to discover more about these unusual Tachyina.

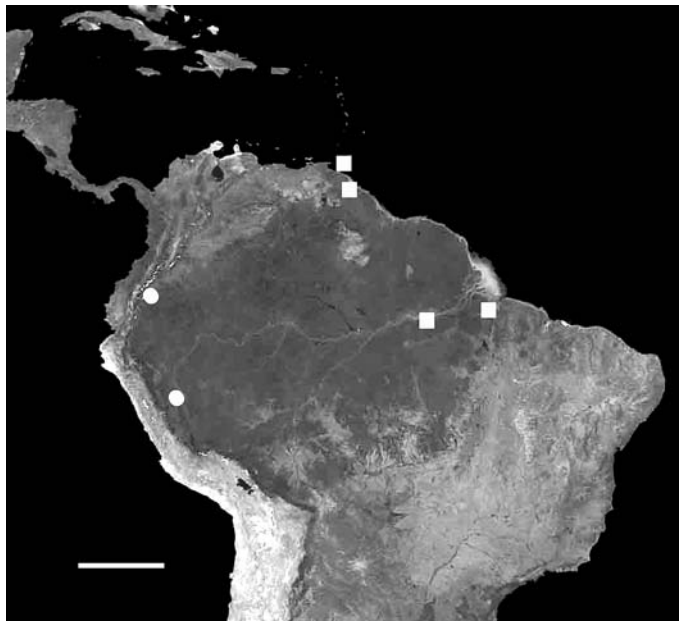


FIGURE 5. Map illustrating the geographical locations of known samples of *Costitachys inusitatus* Erwin (white squares) and *Costitachys tena* Erwin and Kavanaugh sp. nov. (white dots); scale line = 1000 km; map produced with NASA's World Wind.

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LITERATURE CITED

- ERWIN, T.L. 1974a. *Studies of the Subtribe Tachyina (Coleoptera: Carabidae: Bembidiini), Part II: A Revision of the New World-Australian Pericompsus LeConte*. Smithsonian Contributions to Zoology, No. 162. iv + 96 pp.
- ERWIN, T.L. 1974b. Studies of the subtribe Tachyina (Coleoptera: Carabidae: Bembidiini). Supplement A: Lectotype designations for New World species, two new genera, and notes on generic concepts. *Proceedings of the Entomological Society of Washington* 76:123–155.

- ERWIN, T.L., AND D.H. KAVANAUGH. 1981. Systematics and zoogeography of *Bembidion* Latreille: I. The *carlhi* and *erasum* groups of Western North America (Coleoptera: Carabidae: Bembidiini). *Entomologica Scandinavica*, Supplement 15:33–72.
- ERWIN, T.L., AND D.H. KAVANAUGH. 1999. Studies of the subtribe Tachyina (Coleoptera: Carabidae: Bembidiini) Supplement D: Description of a male of *Costitachys inusitatus* Erwin, with notes on distribution of this species. *The Coleopterists Bulletin* 53:52–55.
- ERWIN, T.L., AND M.G. POGUE. 1988. *Agra*, arboreal beetles of Neotropical forests: Biogeography and the forest refugium hypothesis (Carabidae). Pages 161–188 in W.R. Heyer and P.E. Vanzolini, eds., *Proceedings of a Workshop on Neotropical Distribution Patterns*. Academia Brasileira de Ciencias, Rio de Janeiro, Brazil.
- JEANNEL, R. 1941. *Coléoptères Carabiques. Première partie*. Faune de France, 39. P. Lechevalier et Fils, Paris, France. 571pp.
- KAVANAUGH, D.H. 1979. Studies on the Nebriini (Coleoptera: Carabidae), III. New Nearctic *Nebria* species and subspecies, nomenclatural notes, and lectotype designations. *Proceedings of the California Academy of Sciences*, ser. 4, 42:87–133.
- PERRAULT, G.G. 1984. Studies on French Guyana Carabidae. I. A new record for *Costitachys inusitatus* Erwin (Tachyina). *The Coleopterists Bulletin* 38:119.