A new *Potamobates* Champion species (Heteroptera: Gerridae) from Ecuador with new distribution records for *P. williamsi* Hungerford

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Abstract: *Potamobates sumaco* new species is described from the Ecuadorian Amazon. Male and female genitalia differentiate *P. sumaco* from a similar parapatric species, *P. williamsi* Hungerford. Phylogenetic analysis indicates *P. sumaco* is closely related to the species of the *P. tridentatus* group which includes *P. williamsi.* A distribution map and revised key to *Potamobates* species are provided.

Resúmen: Se describe *Potamobates sumaco* nueva especies del Amazonas Ecuatoriano. Los genitales del macho y la hembra distinguen *P. sumaco* de la especie mas cercana *P. williamsi* Hungerford. El análisis filogenético indica que *P. sumaco* partenece al grupo *P. tridentatus.* Se incluye un mapa de la distribución y una clave modificada para la identificación de las especies de *Pomatombates.*

Introduction

Potamobates Champion waterstriders inhabit montane streams of low to intermediate elevations from southern Mexico to Peru (Polhemus and Polhemus, 1995). However, collection localities for South America are sparse (Hungerford, 1936; Hungerford, 1937; Hungerford, 1938; Polhemus and Polhemus, 1995). Recent collecting in the Ecuadorian Amazon has provided additional specimens of *Potamobates* species from previously uncollected regions. In this paper, I describe a new species of *Potamobates,* report new distribution records for *P. williamsi* Hungerford and re-examine the phylogeny of *Potamobates* spp. hypothesized by Polhemus and Polhemus (1995).

The following description follows the format and vocabulary of the species descriptions given by Polhemus and Polhemus (1995). All specimens were compared to the holotype and allotype of *P. williamsi.* Elevation and GPS coordinates were not available for all sites. GPS coordinates were measured with Scout Master II, Trimbale. Collection abbreviations throughout follow Arnett *et al.* 1993, unless noted.

Potamobates sumaco Cognato, new species

Figs 1-8.

Diagnosis: *Potamobates sumaco* is morphologically similar to *P. williamsi,* but differs by the widely spaced, thin, posteroventrally directed spines of the distal lobe of male abdominal segment VIII (Fig. 1; compare with Hungerford 1937, Fig. 1) and the 90° rotation of the proctiger process (Fig. 2). In *P. williamsi* males the spines of abdominal segment VIII are thicker, the space between them is shorter, and proctiger process is not rotated. The female left lobe of ventrite VIII is dorsally visible for *P. sumaco* (Fig. 3) and does not fold over tergite VIII as in *P. williamsi.*

Description. (All measurements in mm, taken from the holotype unless noted.) *Apterous male*: Ground color black, shining, covered with short dark pubescence. The following body parts are brownish yellow to leucine unless noted: head except vertex along eyes, and longitudinal oval black spot anterior to eyes if present; median longitudinal wedge shaped marking on pronotum; markings on mesonotum, if present; propleura; mesoplura; metacetabulae; coxae; trochanters except for a ventral longitudinal black stripe; dorsum of fore femur except distally; pygophore except distally; and venter. Anterolateral angles of pronotum; longitudinal stripe on lateral and posterolateral margins of mesonotum; lateral margins of abdominal tergites; and dorsal surfaces of coxal cavities covered with short bright pubescence.

Head (1.0) 2.5 times longer than narrowest interocular space (0.4); eye width 0.8; eyes extended posteriorly approximately 0.25 length of propleura. Rostrum extended to mid prosternum. Pronotum (1.0) equal to length of head, width (1.8) almost twice the length. Mesonotum long (2.8), widest across the mesocoxae (3.0). Metanotum short (0.8), widest across the metacoxae (2.5). Abdomen excluding genital segments (2.5), approximately equal to genital segments (2.4). Tergites III-IV short (each 0.2), tergites

II & V longer (each 0.3), tergites VI & VII longest (0.4 & 0.6, respectively). Tergite VIII (1.5) large, highly modified with a lobe on the right side bearing two slender spines, width of proximal spine (0.075-0.125, n= 35), separated by a relatively wide space (0.4-0.5, n= 50) (Fig. 1); proctiger with a 90° rotated uncurved projection reaching between and slightly beyond the two spines (Fig. 2). Connexiva angulate caudally, not produced.

Antennomeres I & IV each longer than either II or III; length of antennomeres I-IV: 1.5; 0.7; 0.7; 0.9 respectively. Leg segment lengths (femur, tibia, tarsus I, tarsus II) are as follows: fore, 2.7: 2.6: 0.2: 0.6, middle, 10.2: 6.9: 3.0: 0.8 and hind, 10.4: 5.7: 0.5: 0.2.

Length 10.0-10.8 (mean = 10.3, N = 20).
Width 2.6-2.9 (mean = 2.78, N = 20).

Apterous female: Body more robust than male, otherwise general form and coloration similar. Connexiva produced posteriorly into slender digitate lobes, mostly parallel. Abdominal ventrite VIII produced asymmetrically, left side extended to middle of connexival digitate lobe, paralleling, never embracing, truncate tergite VIII (Fig. 3).

Length 8.5-9.0 (mean = 8.8, N = 10).
Width 2.7-3.0 (mean = 2.9 N = 10).

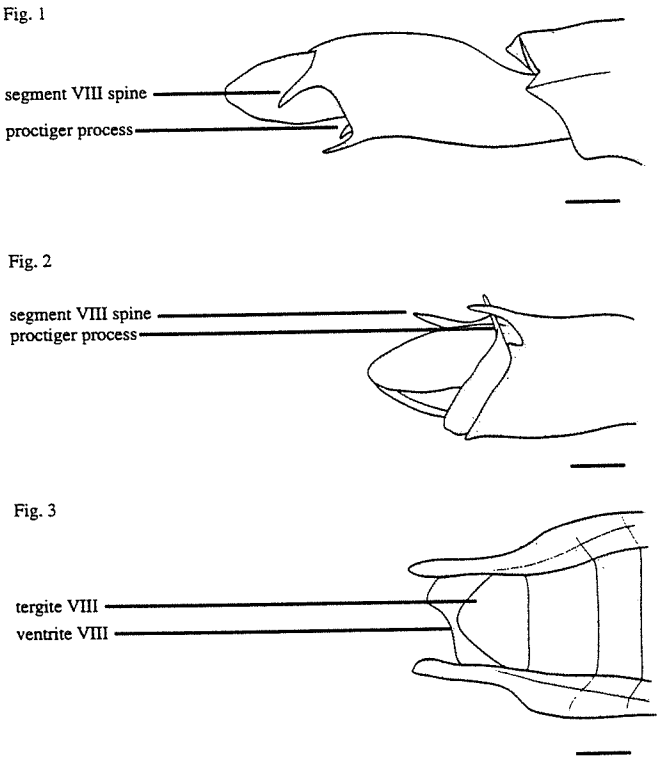
Macropterous male and *female*. unknown.

Etymology: Sumaco refers to the volcano that looms over the type locality.

Ecological notes: Specimens of this species were taken on clear swift streams 1-2 m wide.

Remarks: Markings on the mesonotum of *Potamabates sumaco* are polymorphic in design (Figs. 4-6). The absence of mesothoracic markings often coincides with the presence of a longitudinal oval black spot located anterior to the eyes and *vice versa*. The markings of individuals become more intense and complete from northern to southern populations. Individuals from collection sites 1-4 have no pattern (Fig. 4) while, populations from collection sites 5, 6 and 7 contain individuals with either no pattern, incomplete faint patterns (Fig. 5) or a complete pattern (Fig. 6).

Genetic evidence from the mitochondrial genome indicates the presence of *P. williamsi* haplotype in individuals (n=10) at site 7 and some individuals at site 6 (3/8). A hybrid haplotype is observed for some individuals at sites 6 (5/8) and 5 (2/9) (Galacatos et al. unpublished). *Potamobates sumaco* is given species status because all individuals from all examined populations maintain distinct genitalic morphology



Figures 1-3. *Potamobates sumaco* Cognato new species 1,2, Male terminal abdomen. 1, Lateral view. 2, Oblique view. 3, Female terminal abdomen, dorsal view.

from *P. williamsi*.

Material examined: Locality numbers refer to Fig.7. *Holotype*, male and allotype **(5)** Ecuador: Napo Prov., tributary to Rio Huatarac, near Via Loreto, 16-IX-1996, R. Barriga & K. Galacatos (Museu Escuela Politécnica Nacional, MEPN; Quito, Ecuador). *Paratypes*. 17 males, 14 females, same data as holotype (MEPN, USNM, CAS, SEMC, ZMUC); **(1)** 1 male, Ecuador: Sucumbios Prov., tributary to Rio Blanco, elv. 410m, 19-III-1996, R. Barriga (MEPN); **(2)** 2 males, 1 female, Ecuador: Sucumbios Prov., Rio Crystal, elv. 450m, 18-III-1996, R. Barriga (MEPN, USNM); **(3)** 8 males, 1 female, Ecuador: Sucumbios Prov., S 0° 01' W 77° 08' (approximated from a 1:1,000,000 map of Ecuador, Intstituto Geográfico Militar,1985), 9-12-VIII-1996, R. Barriga (MEPN, USNM); **(4)** 4 males, 8 females, Ecuador: Napo Prov., tributary to Rio Paushiyacu, elv. 510m, 17-19-IV-1996, R. Barriga & K. Galacatos (MEPN, USNM); **(6)** 12 males, 8 females, Ecuador: Napo Prov., tributary to Rio Cotapino, near village of Cotapino, 9-IX-1996, R. Barriga & K. Galacatos (MEPN, USNM, SEMC, ZMUC); **(7)** 46 males, 33 females, Ecuador: Napo

Fig. 4

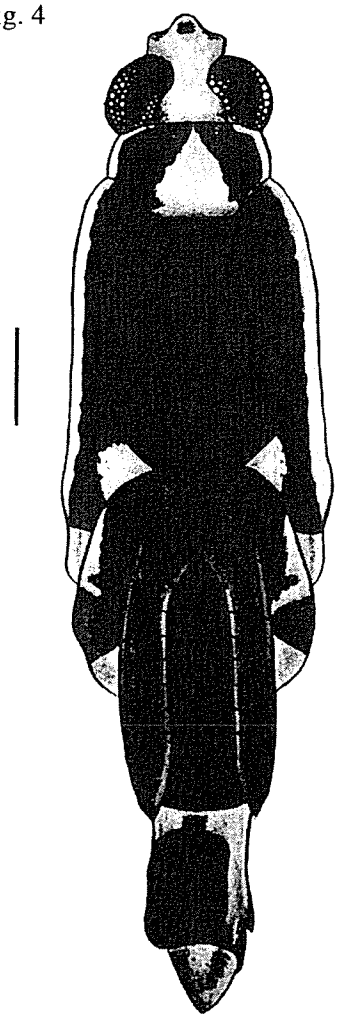


Fig. 5

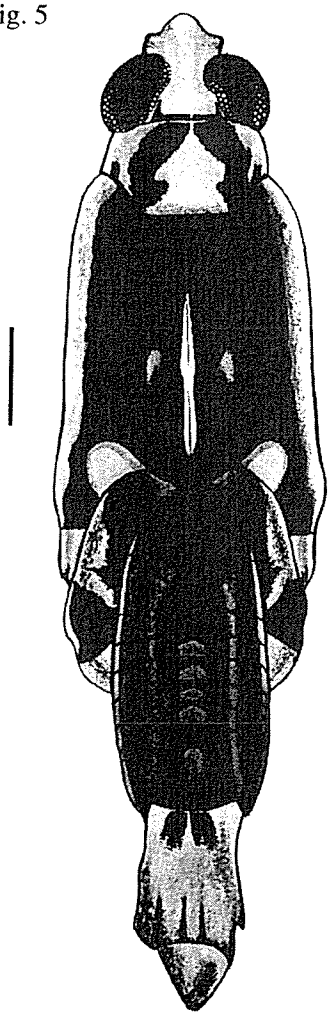
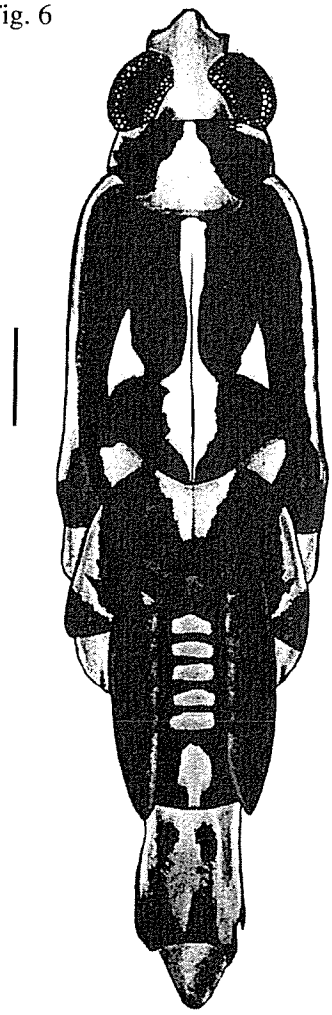


Fig. 6



Figures 4-6. *Potamobates sumaco* Cognato new species, Male dorsal habitus (legs excluded). 4, Mesonotum with no figure pattern. 5, Mesonotum with incomplete, faint pattern variation. 6, Mesonotum with complete pattern.

Prov., stream near community of Guacamayo, near Mondana, 26-II-1997, K. Galacatos (MEPN, USNM, CAS, SEMC, ZMUC, EMEC).

Potamobates williamsi Hungerford

Fig. 7

Potamobates williamsi was previously known from the following Ecuadorian locations: Tena, Mera (Hungerford, 1932) and Rio Jatunyacu (~20 km west of Tena). The range of this species is increased east and southeast approximately 100 km (from Tena) with the following records: 13 males, 7 females **(8)** Ecuador: Napo Prov., Mondana, Rio Mondana, **GPS:** S 0° 52' W 77° 16', 26-VII-1996, K. Galacatos & A.I. Cognato (MEPN, USNM); 8 males, 4 females same data as previous locality, 2-X-1996, K. Galacatos (MEPN, USNM, ZMUC); 4 males, 7 females same data as previous locality, 27-ii-1997, K. Galacatos (MEPN, USNM); 3 males, 2 females **(9)** Ecuador: Napo Prov., tributary to Rio Tiputini, **GPS:** S 0° 49' W 76° 24', 25-30-VI-1996, K. Galacatos, A.I. Cognato & R. Barriga; 0 males, 1 female (10) Ecuador: Napo Prov., south of Coca on Via Auca, 2-XII-1988, R. Barriga & J. Tiviran (MEPN); 2 males, 0 females **(11)** Ecuador: Pastaza Prov., Rio Laudoyacu, near the middle of Rio Manderoyacu, 9-XII-1990, R. Barriga (MEPN).

Revised couplets for key to the species of *Potamobates* (Polhemus and Polhemus 1995)

13. Distal lobe on right side of male abdominal segment VIII with two widely spacedposteroventrally directed spines (Fig. 1; Hungerford, 1937, Fig. 1);

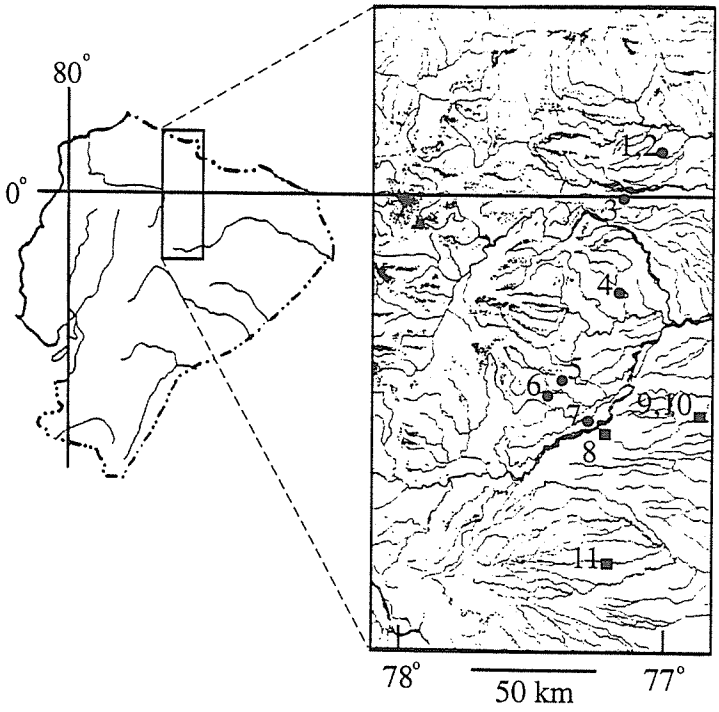


Figure 7. Collection sites of *Potamobates sumaco* Cognato new species (circles) and *P. williamsi* Hungerford (squares) in the Ecuadorian Amazon. See text for locality names.

process of proctiger extends laterally between and slightly beyond the two widely spacedspines. Female abdominal segment VIII with short dorsal triangular process and short ventral flap-like process (Fig. 3; Polhemus & Polhemus 1995, Fig. 29) 15

14. Same as in Polhemus and Polhemus (1995).

15. Distance between the two widely spaced posteroventrally directed spines on the lobe on right . side of male abdominal segment VIII shorter (0.3 - 0.4); proctiger with a curved, flat, projection (Hungerford, 1937, Fig. 1). Female abdomen with ventral short flap-like process embracing short triangular process of segment VIII (Polhemus and Polhemus, 1995, Fig. 29) .... *P. williamsi* Hungerford

— Distance between the two widely spaced posteroventrally directed spines on the lobe onright side of male abdominal segment VIII longer (0.4 - 0.5)(Fig. 1); proctiger with an uncurved, 90° rotated, projection (Fig. 2). Female abdomen with ventral short flap-like process produced asymmetrically, left side extended to middle of the connexival digitate lobe, paralleling, never embracing, the short triangular process of segment VIII (Fig. 3) .... *P. sumaco* Cognato new species

Cladistic analysis of the *Potamobates* spp. revisited.

Polhemus and Polhemus (1995) presented a preliminary phylogeny of the *Potamobates* spp. based on 10 ordered morphological characters. Their analysis resulted in 3 most parsimonious trees.

Potamobates sumaco and 1 character (#11: Process of the proctiger extending between the two spines of tergite VIII; absent = 0, present = 1) are added to a revised cladistic analysis (Table 1). An exhaustive search located the most parsimonious trees using PAUP 3.1 (Swofford, 1990). Default settings were employed and the characters were ordered as in Polhemus and Polhemus (1995). Polymorphism of the markings on the mesonotum is observed for *P. sumaco* and *P. carvalhoi* (Polhemus and Polhemus 1995). It is unclear if ordering of the above character is appropriate given that it varies within species. Therefore, the cladistic analysis was performed with and without ordering of character 6 and without character 6 all together.

Ten most parsimonious (MP) trees were found in analysis with character 6 ordered, and 9 MP trees were found in analysis with character 6 unordered. The incongruence among the above trees and the 3 MP trees presented by Polhemus and Polhemus (1995) lies in the relationships among the species of the *P. tridentatus* group, including *P. sumaco* (Fig. 8).

Two MP trees were found in the analysis with character 6 excluded (consensus tree shown, Fig. 9) and the *P. tridentatus* group is more resolved. The *P. anchicaya* - *P. tridentatus* and *P. spiculus* - *P. vivatus* subclades are concordant with 2/3 MP trees reconstructed by Polhemus and Polhemus (1995). However, the tree differs with respect to the placement of *P. variabilis* (Fig. 9). This alternative phylogeny continues to support a phylogeographic hypothesis of north to south progression of derived morphological traits (Polhemus & Polhemus 1995).

The bootstrap proportions (500 replicates) are low for both trees (Figs. 8, 9). Support above 50% is not observed for subclades within the *P. tridentatus* group and the relationships among species are tenuous. The inclusion of more morphological or molecular characters may allow for increased resolution in the *P. tridentatus* group.

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Fig. 8

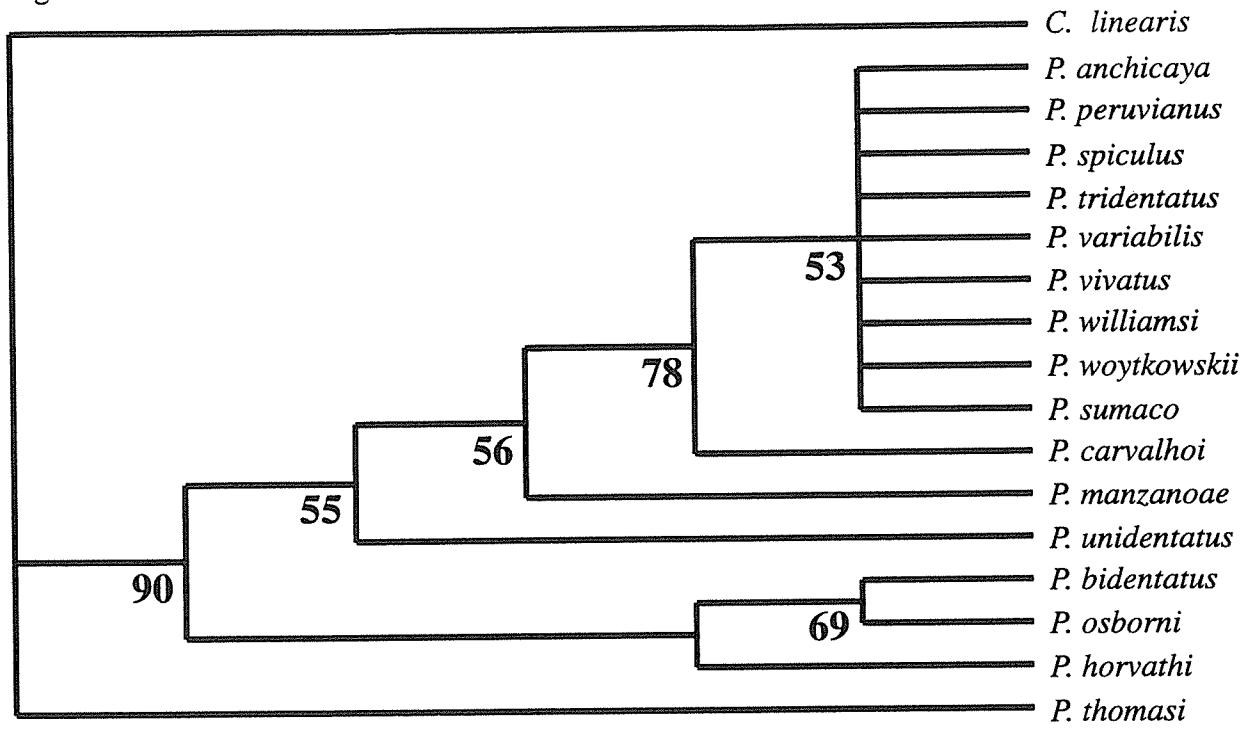
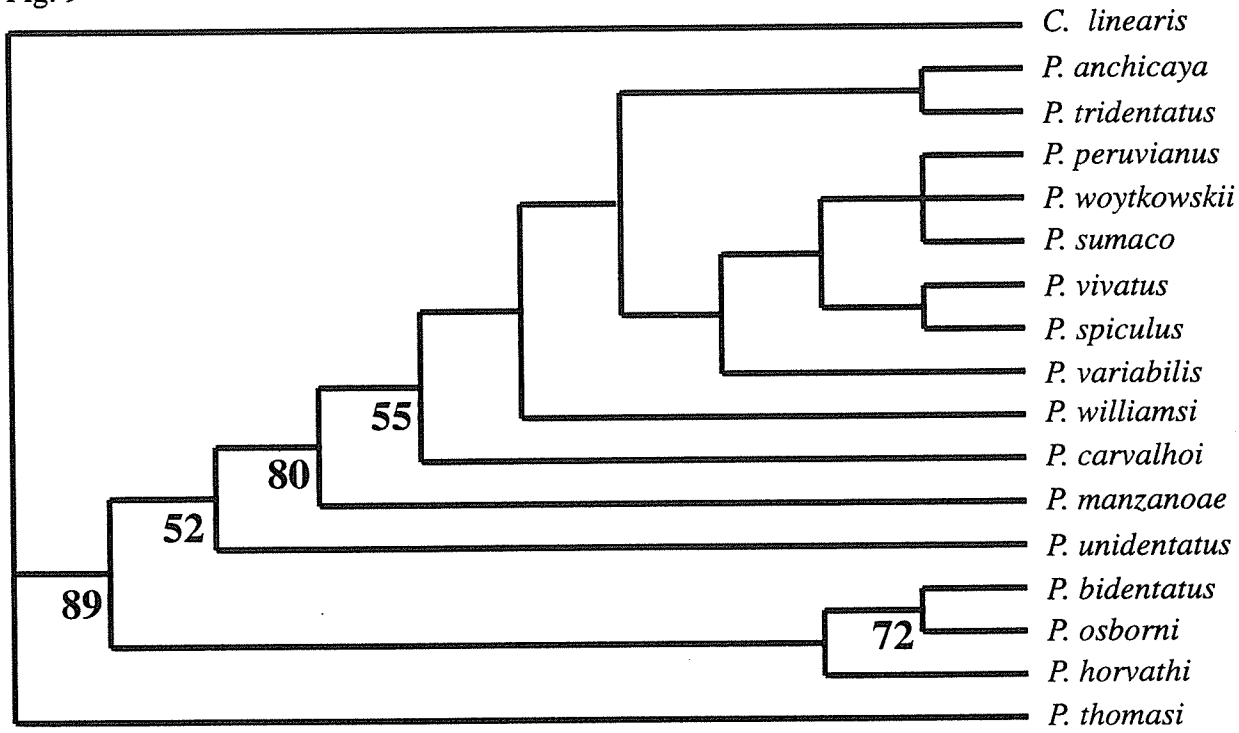


Fig. 9



Figures 8-9. 8, Consensus tree for *Potamobates* spp. from cladistic analyses with character 6 ordered. Bootstrap values >50% are given. Consistency index (CI) = 0.53 and rescaled consistency index (RCI) = 0.41. Tree topology, bootstrap values, consistency index, and rescaled consistency index produced with character 6 unordered are similar to phylogenetic analyses with character 6 ordered. 9, Consensus of 2 most parsimonious trees for *Potamobates* spp. from an analysis excluding character 6. Bootstrap values >50% are given. CI= 0.59., RCI= 0.47.

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Table 1. Characters and states used for the cladistic analysis of *Potamobates* spp. *Cylindrostethus linearis* is the outgroup. Revised from Polhemus and Polhemus (1995).

	Characters										
	1	2	3	4	5	6	7	8	9	10	11
Species	Character States										
C. linearis	0	0	0	0	1	0	0	0	0	1	0
P. anchicaya	3	4	1	2	0	2	0	1	2	2	0
P. bidentatus	2	1	0	1	2	0	0	2	2	1	0
P. carvalhoi	3	2	1	2	0	2	0	2	0	1	0
P. horvathi	2	1	0	1	2	1	0	0	0	0	0
P. manzanoae	2	1	1	1	0	2	0	0	2	4	0
P. osborni	2	1	0	1	2	1	0	1	2	1	0
P. peruvianus	3	3	1	2	0	0	0	4	0	2	0
P. spiculus	3	4	1	2	0	0	0	4	2	3	0
P. thomasi	0	0	0	0	1	1	1	0	0	0	0
P. tridentatus	3	4	1	2	0	1	0	1	2	2	0
P. unidentatus	1	1	1	1	1	2	0	0	0	2	0
P. variabilis	3	4	1	2	0	0	0	3	1	2	0
P. vivatus	3	3	1	2	0	1	0	4	2	2	0
P. williamsi	3	4	1	2	0	2	0	1	0	2	1
P. woytkowskii	3	4	1	2	0	2	0	4	0	3	?
P. sumaco	3	4	1	2	0	2	0	4	0	2	1