NEW *CARABODES* FROM EASTERN UNITED STATES (ACARI : ORIBATIDA : CARABODIDAE)

BY R. Marcel REEVES [1]

TAXONOMY
CARABODES
APPALACHIAN
MOUNTAINS

ABSTRACT : Adults of two new species of *Carabodes*, *C. spiniformis* and *C. coweetaensis*, are described. Both were most abundant in coniferous or hardwood leaf litter, with the former also common in rotten wood.

TAXONOMIE
CARABODES
MONTAGNES
DES
APPALACHES

RÉSUMÉ : Les adultes de deux nouvelles espèces de *Carabodes*, *C. spiniformis* et *C. coweetaensis*, sont décrits. Toutes deux se trouvaient en plus grande abondance dans des échantillons de feuilles de bois dur et conifères, *C. spiniformis* se trouvant aussi communément dans du bois pourri.

INTRODUCTION

The Appalachian Mountains extend along the eastern edge of the North American continent from the Gulf of St. Lawrence in Canada to northern Alabama in the southeastern United States. Originally formed in the Palaeozoic period, they have since been considerably eroded with the highest elevations (i. e. Mount Mitchell at 2037 m in western North Carolina) found in the south where Tennessee, North Carolina, Georgia and South Carolina abut. The southern part of region has the greatest species richness of *Carabodes* in North America and includes *C. floridus* Berlese, *C. radiatus* Berlese, *C. rugosior* Berlese, *C. brevis* Banks, *C. granulatus* Banks, *C. niger* Banks, *C. clavatus* Jacot, *C. falcatus* Jacot, *C. chandleri* Reeves, *C. cherokee* Reeves, *C. cochleaformis* Reeves, *C. erectus* Reeves, *C. higginsi* Reeves, *C. interruptus* Reeves, *C. nantahalaensis* Reeves, *C. pentasetosus* Reeves, *C. phylliformis* Reeves, and *C. polyporetes* Reeves. Distributions of the 18 species known from this region have been reviewed by REEVES (1987, 1988, 1989, 1991, 1992a, 1992b, 1993) and REEVES and NORTON (1990). This paper completes the descriptions of the remaining new species known to me from this region. The only described North American species not present in the southern Appalachians are *Carabodes labyrinthicus* Michael, *C. willmanni* Bernini, *C. gibbiceps* Berlese and *C. wonalancetanus* Reeves.

Terminology and abbreviations are those developed by F. GRANDJEAN, as summarized by BALOGH and MAHUNKA (1983). All measurements are given in micrometers (μm), and are taken from specimens mounted temporarily on cavity slides. Specimen measurements are as follows : total length (tip of rostrum to posterior edge of notogaster) ; width (widest part of notogaster) ; height (from between genital and anal plates to highest point of notogaster) ; prodorsal length (tip of rostrum to posterior edge of dorsosejugal depression). All the above body measurements are expressed as a mean (n = 10) followed by the range in parentheses. Setal measurement ratios are expressed as total length (L), width at widest part (W) and distance between

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setal insertions (D). Thus, *lm*/*lm-lp* L/D should be read as " The ratio of the length of seta *lm* to the distance between the insertions of *lm* and *lp*. "

Scanning electron micrographs (SEMs) were made from mites stored in 70 % ethyl alcohol, ultra-sonically cleaned to remove cerotegument, air dried, placed onto tape on 1/2 inch (1.27 cm) aluminum stubs, and coated with 20 nm AuPd in a Hummer IV sputter coater before observation in an AMR1000 Scanning Electron Microscope.

All holotypes will be deposited in the Canadian National Insect Collection, Centre for Land and Biological Resources Research, Ottawa, Ontario, Canada. Paratypes will be deposited in the National Museum of Natural History, Washington, DC ; Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts ; Canadian National Insect Collection ; and the personal collections of R. A. NORTON and the author.

Carabodes spiniformis n. sp.

Figs. 1-8, 10A

DIAGNOSTIC CHARACTERS

Body surface mostly foveate-reticulate, many fovea rosettiform on notogaster and sternal plate. Dorsosejugal depression a narrow slit. Sensilli clavate, fan-shaped, barbed. Circumgastric depression present. All notogastral setae spiniform, *lm*/*lm-lp* L/D 0.24-0.35, p_1/p_1-p_1 L/D 0.22-0.31, c_2 inserted anterior to *lm*. Five pairs of genital setae. One pair of aggenital setae. Setae (*u*) of all tarsi attenuate.

ADULT

Measurements. Total length : ♀ 382 (360-400), ♂ 319 (310-340). Width : ♂ 211 (195-220), ♀ 170 (160-180). Height : ♀ 188 (175-200), 150 (140-160).

Integument. Brown, body surface mostly foveate-reticulate, many fovea rosettiform on notogaster and sternal plate, rosettes may be 2, 3, 4 or 5 lobed (Figs. 1, 2, 3, 6). Surface covered with minute tubercles. Thin cerotegument covers body.

Prodorsum (Figs. 1, 3, 4). Prodorsal length : ♀ 132 (120-140), ♂ 114 (100-130). Dorsosejugal depression a narrow slit. Rostral (*ro*) and lamellar (*le*) setae setiform, interlamellar (*in*) setae spiniform, lengths similar (15-25), *ro* and *le* arched mediad, *in* arched anteriad, *le* inserted on lateral margin of lamellae near tip, *in* inserted laterally on lamellae near base. Sensillus (*ss*) clavate, fan-shaped, barbed (Fig. 8). Bothridial rim notched, anterior edge of notch pointed, posterior edge rounded (Fig. 8).

Notogaster (Figs. 1, 3, 5). Circumgastric depression present, surface medial to depression with many fovea rosettiform (diameter 4-12), irregularly ridged lateral to depression. All notogastral setae spiniform, short, *lm*/*lm-lp* L/D 0.24-0.35, p_1/p_1-p_1 L/D 0.22-0.31. Seta c_2 inserted anterior to *lm* forming two medial rows of four (c_2, *lm*, *lp*, h_1) and two lateral rows of two setae (*la*, h_2).

Gnathosoma. Palp setal formula 0-2-1-3-9 (+1 solenidion). Mentum foveate.

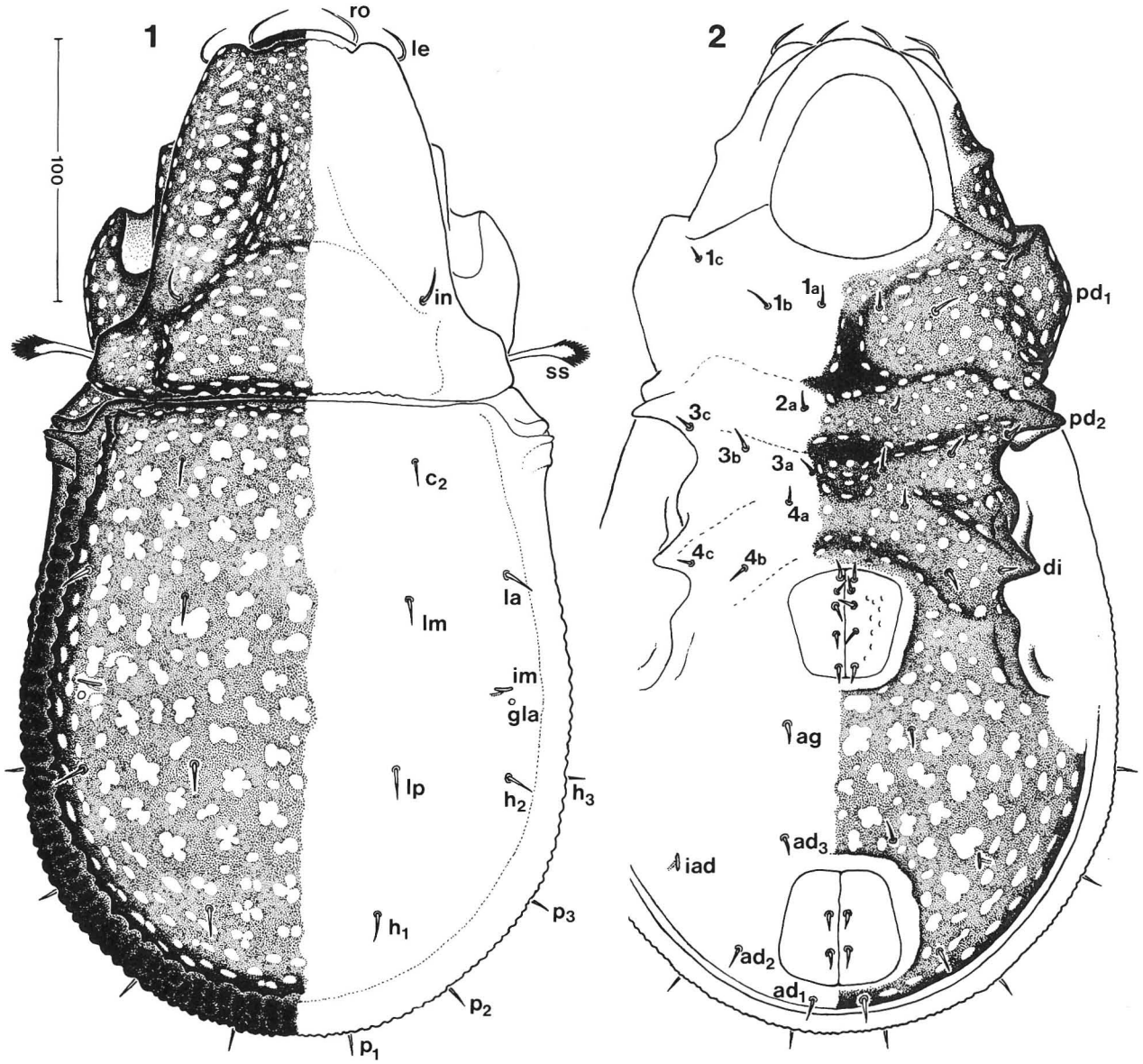
Ventral surface (Figs, 2, 6, 7). Epimera foveate, fovea similar to those on prodorsum ; sternal plate fovea similar to those on central notogastral region ; genital and anal plates with small fovea or fovea absent. Longitudinal medial depression between epimera I, circular medial depression between epimera III. Epimeral setae short, spiniform, formula 3-1-3-3. Genitoanal region formula 5-1-2-3, all setae short, spiniform ; ad_3 inserted anterior to anal plate. Lyrifissure *iad* lateral to ad_3.

Lateral surface. Small tubercles on central body region above acetabula II-IV and below bothridial and notogastral margins.

Legs. Abaxial surfaces of femora I and II and trochanters and femora III and IV partially or entirely foveate. Ventrodistal spurs present on femora III and IV. Setation of legs I-IV (solenidia in parentheses), trochanters 1-1-2-1, femora 4-4-3-2, genua 3(1)-3(1)-1(1)-2, tibiae 4(2)-3(1)-2(1)-2(1), tarsi 15(2)-14(2)-13-12. Distal setae (*p*) (except tarsus I), (*a*), (*it*) and (*tc*) end in " shepherd's crook. " Setae (*u*) of all tarsi attenuate. Tarsi II and III are unusual by the absence of setae *it'* and (*it*), respectively.

IMMATURES. Unknown.

MATERIAL EXAMINED. *Holotype*. Adult ♀, U.S.A. : North Carolina : Macon Co., Coweeta Hydro-

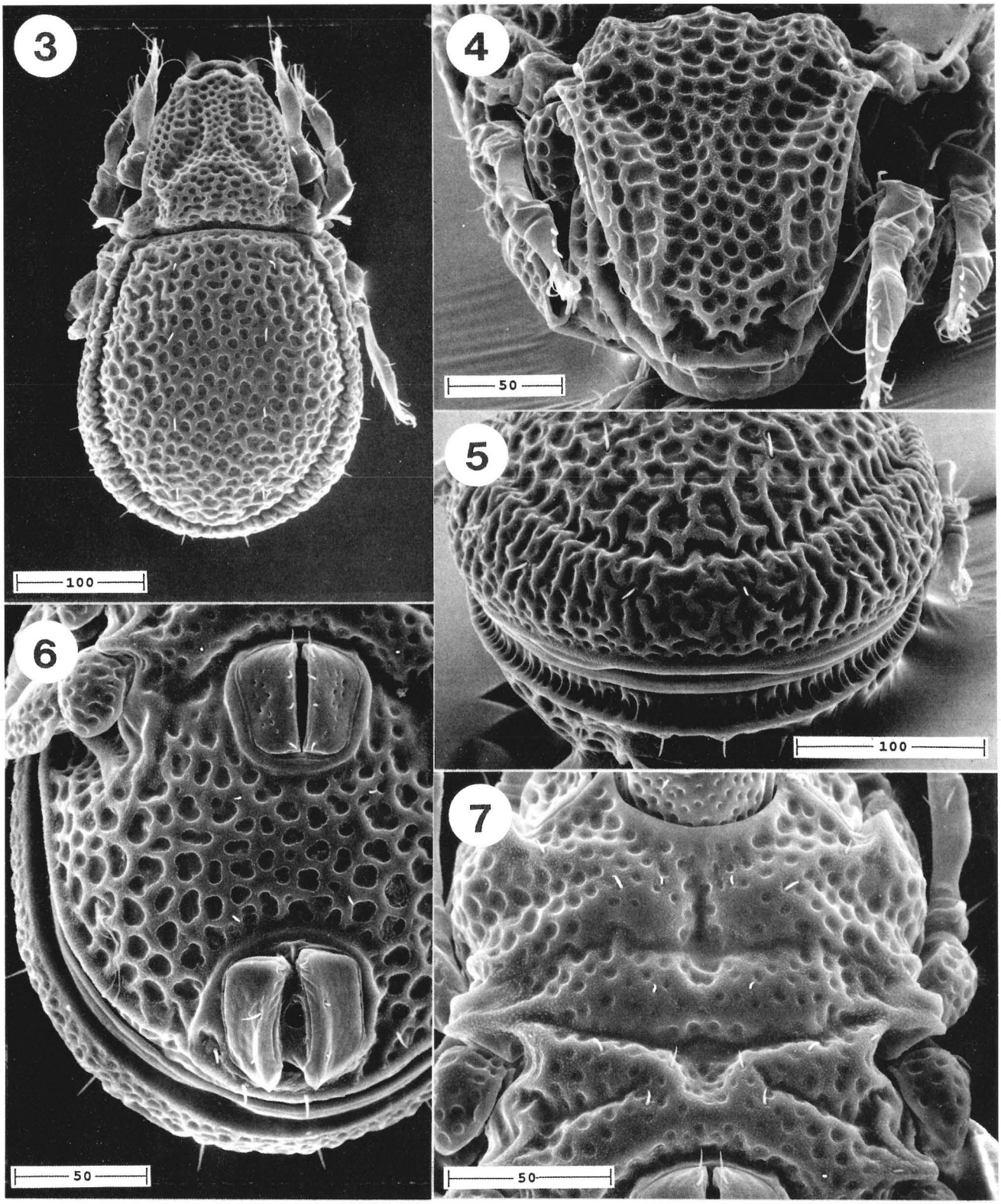


FIGS. 1-2 : *Carabodes spiniformis* n. sp., adult, gnathosoma and legs removed. 1. — Dorsal aspect. 2. — Ventral aspect. See text for explanation of abbreviations. Scale bar in micrometers.

biological Sta., 975 m, 29.V.1983, R. M. REEVES, litter under rhododendrons and azaleas ; 365 long, 200 wide, 175 high. *Paratypes*. 75 adults, same data as holotype.

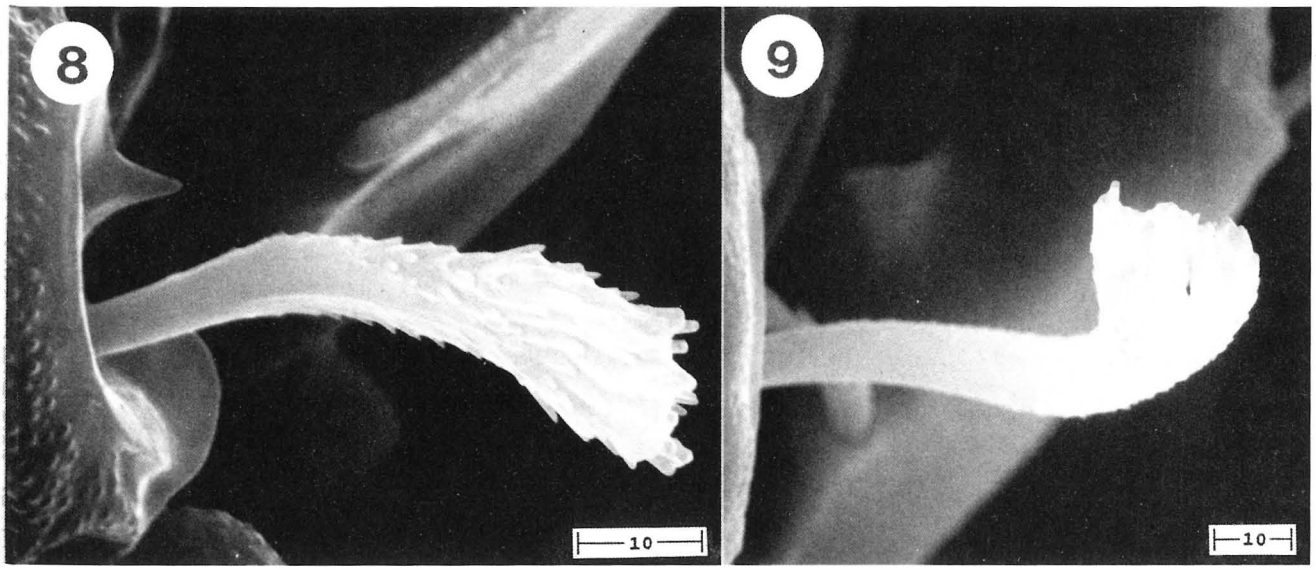
The known distribution of this species is from New Jersey and Pennsylvania south through the Appalachian Mountains to central Georgia (Fig. 10A). The state and county records for the 472 additional adult specimens examined are : U.S.A. : New Jersey (Ocean Co.), Pennsylvania (Somerset Co.), Virginia (Smyth Co.), West Virginia (Pendleton and Pocohantas Cos.), Kentucky (Whitney Co.), North Carolina (Buncomb, Burke, Clay, Graham, Macon, Swain and Yancey Cos.) and Georgia (Jones and Putnam Cos.).

This species has been collected from hardwood and coniferous leaf litter and rotten wood, moss, beach drift, and the fungus *Trametes versicolor* (Fr.)



FIGS. 3-7 : *Carabodes spiniformis* n. sp., adult.

3. — Dorsal aspect. 4. — Prodorsum, anterior view. 5. — Notogaster, posterior view. 6. — Genitoanal region. 7. — Epimeral region. Scale bars in micrometers.



FIGS. 8-9 : *Carabodes spiniformis* n. sp., adult, right sensillus, dorsal aspect (FIG. 8) and *Carabodes coweetaensis* n. sp., adult, right sensillus, dorsal aspect (FIG. 9). Scale bars in micrometers.

Pil. Specimens were most abundant in coniferous or hardwood leaf litter (48 %) or rotten wood (37 %).

This species is named for the spiniform setae on the notogaster.

REMARKS

Carabodes spiniformis is most similar to *C. pentasetosus* Reeves in body size and shape, sensillar form, and number of genital setal pairs, but differs principally in the wider dorsosejugal depression, darker color, and fusiform notogastral setae in *C. pentasetosus*. Rosettiform notogastral fovea are present in only one other North American species in this genus, *C. granulatus* Banks, but this species has penicilliform interlamellar and notogastral setae, a narrower body, and a darker color. Spiniform notogastral setae are present in two other North American species of *Carabodes*, *C. labyrinthicus* Michael and *C. higginsi* Reeves ; the latter two species differ mainly in the presence of tubercles on the notogaster (separate in *C. higginsi*, coalesced into irregular ridges of single tubercle width in *C. labyrinthicus*). The absence of tarsal seta *it'* on leg II and setal pair (*it*) on leg III has been observed only in *C. chandleri* Reeves.

Carabodes coweetaensis n. sp.

Figs. 9, 10B, 11-17

DIAGNOSTIC CHARACTERS

Body cuticle mostly foveate-reticulate. Dorsosejugal depression wide, deep, of equal width throughout, anterior margin weakly arched. Lateral protuberances in interlamellar region poorly developed with only a shallow depression medially. Sensilli short, clavate, grooved laterally at tip, arched dorsad. Interlamellar setae attenuate, grooved dorsally, usually arched mediad but may vary in direction. Circumgastric depression present. Notogastral setae dimorphic, central setae narrowly clavate, minutely barbed, grooved dorsally, seta *lm* L/W 4.6-7.5, *lm*/*lm-lp* L/D 0.40-0.64, posteromarginal setae spiniform, minutely barbed, grooved dorsally, arched mediad, p_1/p_1-p_1 L/D 0.38-0.60.

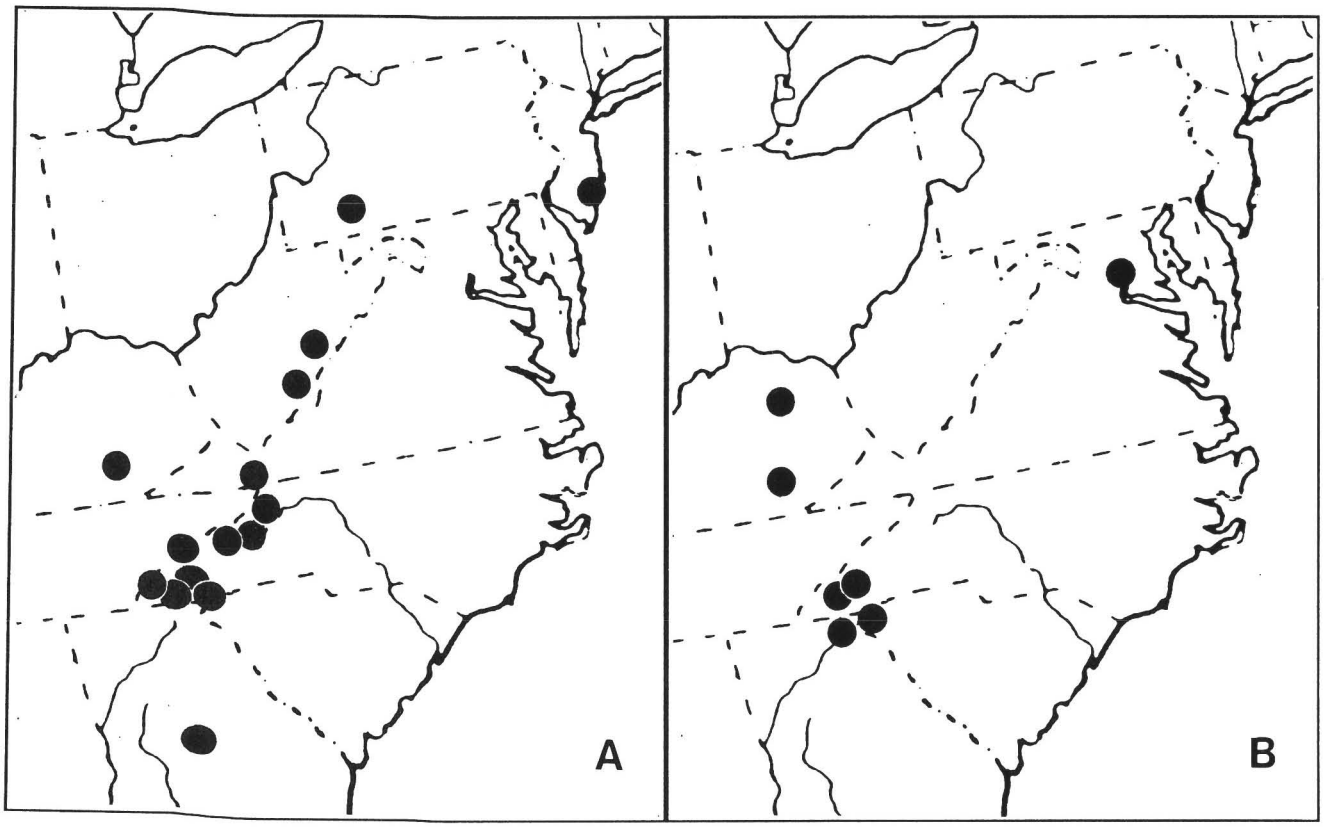


FIG. 10 : Collection locations for A. — *Carabodes spiniformis* n. sp. and B. — *Carabodes coweetaensis* n. sp.

Two pairs of aggenital setae. Setae (*u*) of all tarsi short, scale-like.

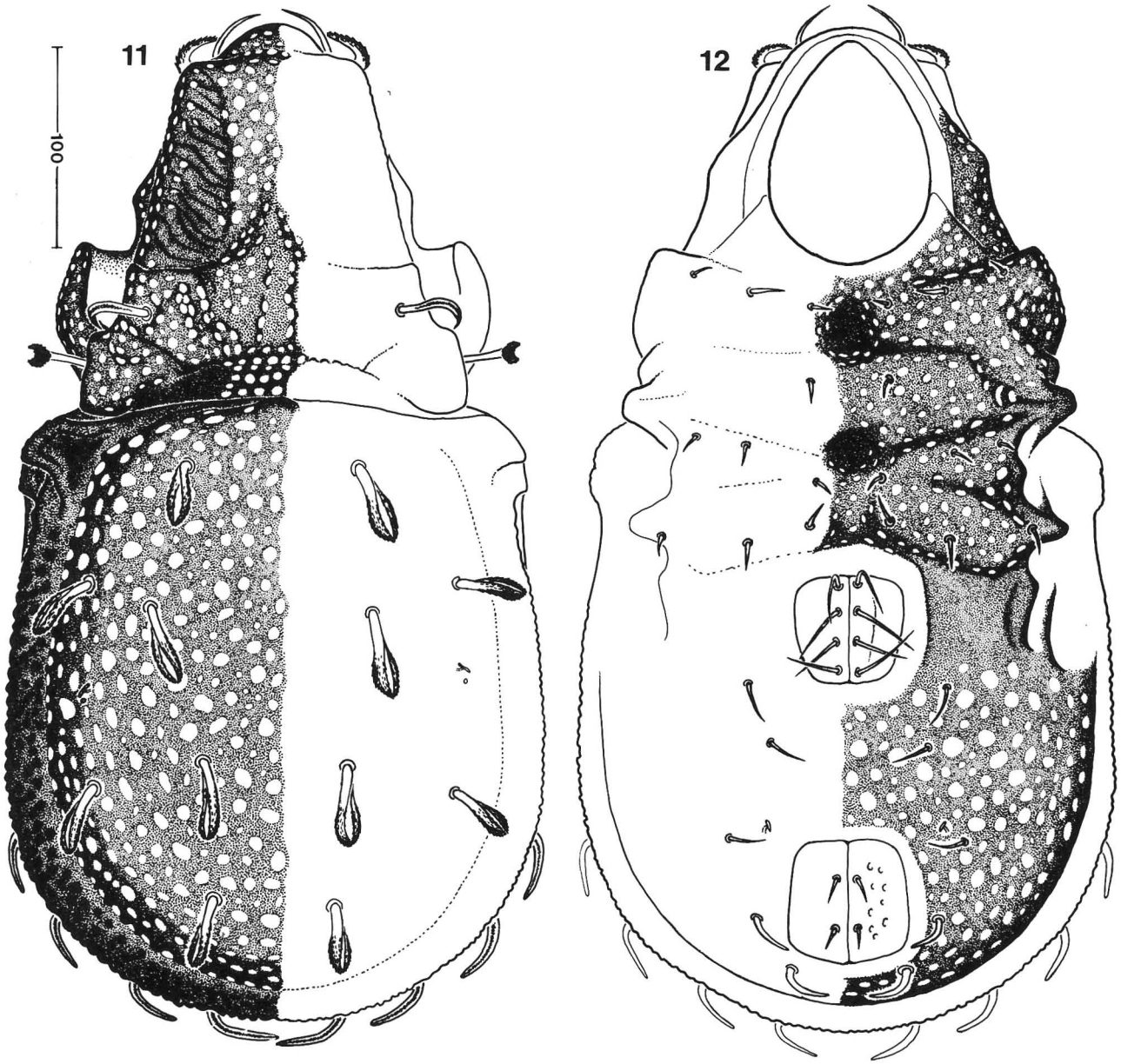
ADULT

Measurements. Total length : ♀ 462 (410-480), ♂ 428 (370-465). Width : ♀ 242 (205-255), ♂ 224 (195-245). Height : ♀ 212 (175-230) ♂ 191 (160-210).

Integument. Dark brown. Most body surfaces foveate-reticulate and covered with minute tubercles. Thin inconspicuous cerotegument covers body.

Prodorsum (Figs. 11, 13, 15). Prodorsal length : ♀ 172 (160-180), 161 (135-170). Surface foveate-reticulate except for granulate, transversely ridged lamellae. Dorsosejugal depression wide, deep, of nearly equal width throughout, anterior margin weakly arched, bottom foveate medially. Lateral protuberances in interlamellar region poorly developed with only a shallow depression medially (Fig. 15). Rostral and lamellar setae setiform, arched mediad, *ro* 20-30 long, tips may cross, *le* 25-32 long, barbed, 2-4 times thickness of *ro* in dorsal view, tips usually directed mediad, inserted on anterolateral margin of lamella near tip. Interlamellar setae setiform, attenuate, 60-75 long, grooved dorsally, inserted near anterolateral corners of protuberances in interlamellar region, variously oriented but mostly mediad or posteriad (see comment under remarks). Sensillus short, narrowly clavate, minutely barbed, club laterodistally grooved, arched dorsad (Fig. 9). Bothridial rim incised.

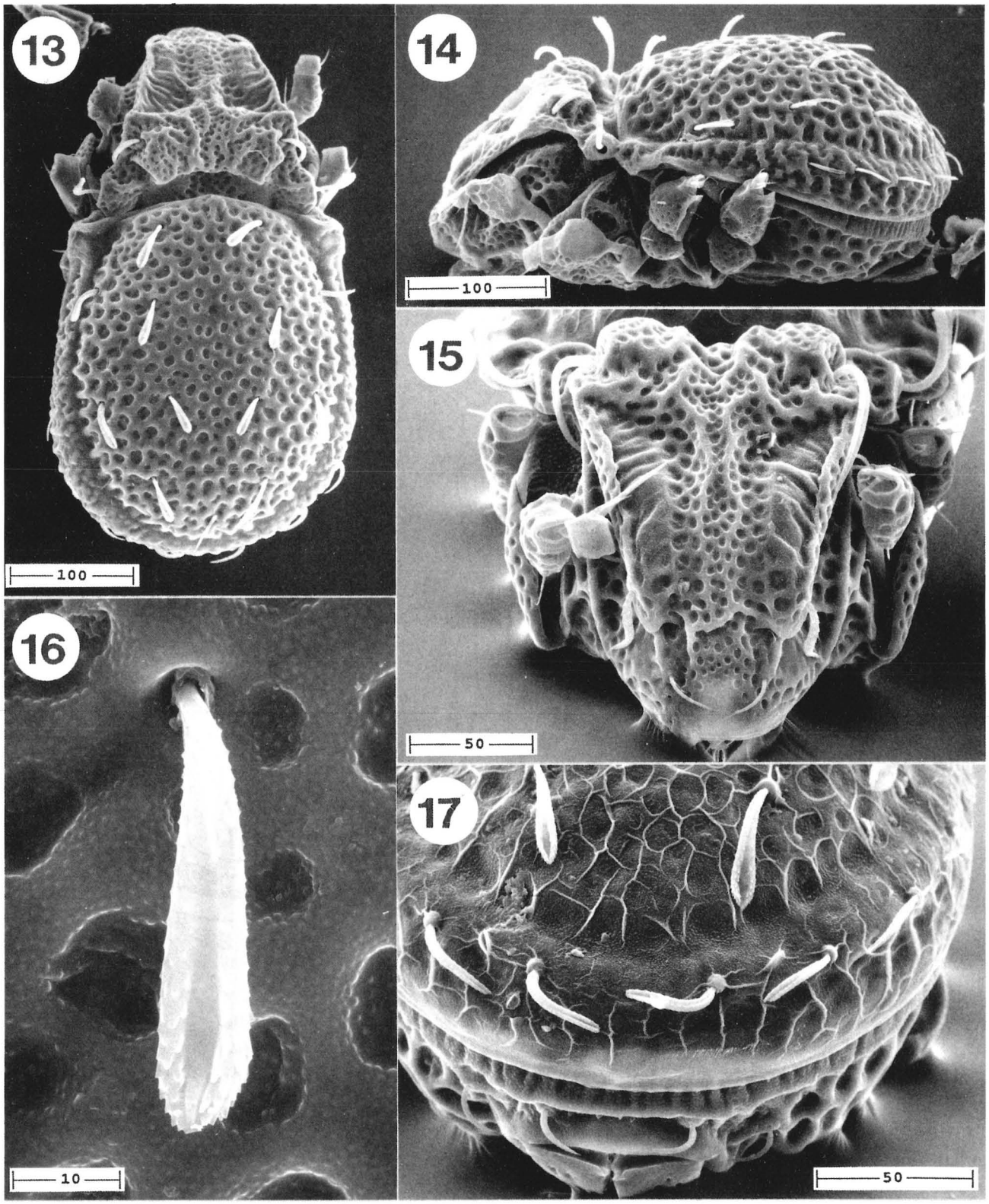
Notogaster (Figs. 11, 13). Circumgastric depression present, area mediad to depression foveate-reticulate, " shelf " of depression tuberculate. Notogastral setae dimorphic. Central setae (c_2, *lm*, *la*, *lp*, h_1, h_2) narrowly clavate, minutely barbed, grooved dorsally, seta *lm* L/W 4.6-7.5, *lm*/*lm-lp* L/D 0.40-0.64. Posteromarginal setae (p_1, p_2, p_3, h_3) spiniform, arched mediad, minutely barbed, grooved dorsally, p_1/p_1-p_1 L/D 0.38-0.60. Seta c_2 positioned anterior to *lm* forming two medial rows of four (c_2, *lm*, *lp*, h_1) and two lateral rows of two (*la*, h_2) setae.



FIGS. 11-12 : *Carabodes coweetaensis* n. sp., adult, gnathosoma and legs removed. 11. — Dorsal aspect. 12. — Ventral aspect. Scale bar in micrometers.

Gnathosoma. Palp setal formula 0-2-1-3-9 (+1 solenidion). Mentum foveate.

Ventral surface (Fig. 12). Epimeral region fovea similar in size to those of prodorsum ; fovea of ventral plate similar in size to those of notogaster ; genital plates usually with a longitudinal groove, anal plates with small fovea. Round medial depressions between epimera I and II-III. Epimeral setal formula 3-1-3-3, setae short (7-11), spiniform. Genitoanal region formula 4-2-2-3. Genital setae setiform, 18-28 long, g_1 directed posteriad, g_2 longest, 0.38-0.59 length of genital plate, g_2 and g_3 directed laterad, g_4 directed anterolaterad. Aggenital setae setiform, 15-20 long, anal setae spiniform, 8-10 long, adanal setae setiform, thicker than ag, ad_1 thickest, ad_3 inserted lateral to and 2-3 times its



FIGS. 13-17 : *Carabodes coweetaensis* n. sp., adult.

13. — Dorsal aspect. 14. — Lateral aspect. 15. — Prodorsum, anterior view. 16. — Seta *lm*. 17. — Notogaster, posterior view. Scale bars in micrometers.

length from the anterolateral corner of anal plate. Lyrifissure *iad* medial to ad_3.

Lateral surface (Fig. 14). Small tubercles on central body region above acetabula and below bothridial and notogastral margins ; remaining surfaces mostly foveate. *Legs*. Fovea on part or all of abaxial surfaces of femora I and II and trochanters and femora III and IV (Fig. 14). Ventrodistal spur present on femora III and IV (Fig. 14). Setation of legs I-IV (solenidia in parentheses), trochanters 1-1-2-1, femora 4-4-3-2, genua 3(1)-3(1)-1(1)-2, tibiae 4(2)-3(1)-2(1)-2(1), tarsi 15(2)-15(2)-15-12. Distal tarsal setae (*p*) (except tarsus I), (*a*), (*it*), and (*tc*) end in " shepherd's crook. " Setae (*u*) of all tarsi short, scale-like.

IMMATURES. Unknown.

MATERIAL EXAMINED. *Holotype*. Adult ♀. U.S.A. : North Carolina : Macon Co., Coweeta Hydrobiological Sta., 975 m, 30.V.1983, R. M. REEVES, oak, maple and beech litter at base of stump ; 490 long, 255 wide, 220 high. *Paratypes*. 126 adults, same data as holotype.

The known distribution of this species is Washington, DC, eastern Kentucky, and the Appalachian Mountains where North Carolina, South Carolina and Georgia abut. The state and county records for the 40 additional adult specimens examined are : U.S.A. : Washington, DC, South Carolina (Oconee Co.), Georgia (Habersham Co.), Kentucky (Menifee and Whitley Cos.).

All specimens of this species were collected from hardwood leaf litter except for one individual from rotten wood.

This species is named for the Coweeta Hydrobiological Station, the type locality for the two species described in this paper.

REMARKS

Carabodes coweetaensis most closely resembles *C. polyporetes* Reeves and *C. nantahalaensis* Reeves in the form of the dorsosejugal depression and the presence of short, scale-like setae (*u*) on the tarsi. *Carabodes polyporetes* differs by having thinner, acuminate posteromarginal setae and *C. nantahalaensis* differs by having bacilliform central notogastral setae. In both these species the sensillus is directed laterad or posterolaterad rather than dorsad as in *C. coweetaensis*, and both lack any medial depression in the interlamellar region. The character states for the dorsosejugal depression, sensillus, notogastral setae, and shape of tarsal seta *u* will separate *C. coweetaensis* from all other *Carabodes* species in North America.

The variation in the orientation of the interlamellar setae was observed only in specimens from the type locality. This orientation often varied on the same specimen. The percentages based on 10 ♀ and 10 ♂ specimens was mediad 46 %, posteriad 36 %, laterad 10 % (as in Figs. 11, 13 and 15), and anteriad 8 %. This is the only species from North America where I have observed this type of variation.

The shape and arrangement of the genital setae, presence of two pairs of aggenital setae, the well-developed circumgastric depression, thicker and barbed lamellar setae compared to rostral, and form of the interlamellar setae are similar to several other *Carabodes* from eastern North America, namely *C. niger* Banks, *C. floridus* Berlese, *C. gibbiceps* Berlese, *C. falcatus* Jacot, *C. clavatus* Jacot, *C. polyporetes* Reeves, *C. erectus* Reeves, *C. interruptus* Reeves (except *le*, which is similar to *ro*), *C. cherokee* Reeves, *C. phylliformis* Reeves and *C. nantahalaensis* Reeves.

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