

REVIEW OF *ANILLINUS*, WITH DESCRIPTIONS OF 17 NEW
SPECIES AND A KEY TO SOIL AND LITTER SPECIES
(COLEOPTERA: CARABIDAE: TRECHINAE: BEMBIDIINI)

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Abstract

The subtribe Anillina in southeastern United States includes the genera *Serranillus* and *Anillinus*, both of which are endemic to the region. *Serranillus* contains two species, *S. jeanneli* Barr, the type-species and *S. dunavani* (Jeannel), **new combination**, transferred from *Anillinus*. Both occur in the southern Appalachian Mountains. *Anillinus* contains 28 species, 11 previously described from southeastern U. S., east of the Mississippi River and the following 17 described here as **new species**: *A. balli* (SE. Kentucky), *A. barri* (E. Tennessee), *A. cornelli* (W. North Carolina, N. South Carolina), *A. daggyi* (North Carolina), *A. docwatsoni* (North Carolina), *A. erwini* (W. North Carolina), *A. folkertsi* (SW. Alabama), *A. kovariki* (N. Florida), *A. langdoni* (E. Tennessee), *A. lescheni* (E. Oklahoma), *A. loweae* (W. North and South Carolina, E. Tennessee), *A. magazinensis* (W. Arkansas), *A. moseleyae* (W. North Carolina, E. Tennessee), *A. murrayae* (W. North Carolina), *A. robisoni* (W. Arkansas), *A. stephani* (E. Oklahoma), and *A. tishechkini* (W. Arkansas). A neotype is designated for *A. elongatus* Jeannel. Species are arranged in groups on the basis of microsculpture and morphometric characters. Trends and correlations in general body form and proportions, microsculpture patterns, aedeagal morphology, and distributions are discussed.

Species of the bembidiine ground beetle subtribe Anillina (ranked at the tribal level by Jeannel 1963a) live in many parts of the world, including North and South America, Africa, especially Madagascar, Mediterranean Europe, Asia Minor, southern Asia, and New Zealand (Cicchino and Roig-Juñent 2001; Demire 1986; Erwin 1982; Garetto and Giachino 1999; Giachino 2003; Jeanne 1973; Jeannel 1963a; Mateu 1969; Moore 1980; Vigna-Taglianti 1980; Zaballos 1988). Anilline species share certain physical similarities and habitat associations. Adults are blind, wingless, small (typically less than 3 mm body length), and those of many species possess characteristic minute serrations along the prothoracic and elytral margins, especially the elytral humeri. Larvae of anillines were described by Grebennikov (2002) based on presumed first instar *Geocharidius*.

Anillines occur in deep forest litters, beneath rocks and in soil (endogean), or as true troglobites in caves. Many species are extremely restricted in distribution (precinctive), especially troglobitic forms that may be confined to a single cave or cave system. Genera such as *Anillinus* that occur in topographically complex areas (e.g., mountains, karst landscapes) are rich in species, with distributions that reflect local and regional

patterns of endemism. This is presumably due to the isolating effects imposed by physical barriers on populations of these tiny, wingless organisms.

In the United States, anillines are represented by the following six genera: *Micranilloides* Jeannel (1963a), based on a single female specimen of *M. depressus* Jeannel from Travis County, Texas; *Anilloides* Jeannel (1963a), known from five species in California and Texas; *Anillaspis* Casey (1918), known from two California species, each based on a single female specimen; *Horologion* Valentine (1932), based on a single specimen of *H. speokoites* Valentine from a cave in West Virginia; *Serranillus* Barr (1995), a southern Appalachian genus previously containing only *S. jeanneli* Barr, but now including a second species transferred from *Anillinus* Casey (1918) in this paper; and *Anillinus*, the main focus of this paper, a southeastern U.S. genus containing 11 previously described species (Ball and Bousquet 2001, key to genera) and 17 described herein.

Anillinus is one of the most taxonomically obscure groups of ground-beetles in the eastern U.S. Correct identification of most species has been hampered by the absence of useable keys and the presence of more undescribed species than described species. The history of study of the genus began during the late 19th century with descriptions of *A. fortis* (Horn) and *A. dohrni* (Ehlers), both based on single specimens (Horn 1868; Ehlers 1884) and described as members of the European genus *Anillus* Jacquelin-Duval. Casey (1918) erected *Anillinus* as a subgenus for *A. carolinae* Casey (= *A. fortis*), and no further information was published until Jeannel's world revision of Anillina (Jeannel 1963a), in which *Anillinus* was elevated to generic status. Jeannel used a combination of external and aedeagal characters to diagnose American anilline species and provided the first key for distinguishing them. In that publication and a later supplement (Jeannel 1963b) he described nine new species. These descriptions and Jeannel's interpretation of previously described species were based on extremely limited material and accompanied by recording of only the most obvious aedeagal characters. Recently, in a well-illustrated paper, Barr (1995) clarified the identity of the widespread species *A. fortis*, described *Anillinus steevesi* Barr, and transferred *Trogilanillus valentinei* Jeannel to *Anillinus*. As a result of a labeling mistake by Jeannel (1963a), Barr misinterpreted the identity of one of the most commonly illustrated species, *A. dunavani* Jeannel.

Many problems with the identification of anillines are the result of insufficient material for study. Collecting *Anillinus* specimens requires special techniques because of their small size and cryptic mode of life. Forest litter inhabiting anillines may be readily collected by sifting or using Berlese/Tullgren funnels, but euedaphic species (*sensu* Eisenbeis and Wichard 1987) often require soil washing/flotation techniques for recovery. This may explain why some species are represented by only a few specimens and are collected so infrequently.

Using Berlese extraction, soil washing, and careful hand collecting, we have accumulated a large number of anilline specimens and species from localities throughout the southeastern United States. Our inability to positively identify these specimens and CEC's involvement in the All Taxon Biodiversity Inventory (ATBI) in Great Smoky Mountain National Park, where at least five anilline species are found, prompted this contribution to the knowledge of *Anillinus*. Our goals were to provide a modern descriptive framework for understanding the genus, describe new species present in our collections or loans, and provide a key permitting discrimination of soil and litter inhabiting species *Anillinus* with minimal need for genitalia dissections.

Material and Methods

Materials. This study was based on examination of ~500 specimens of *Anillinus* and *Serranillus*, including nine holotypes and two cotypes. Collections and curators

from which specimens were borrowed and type depositories, with codens used in text, are as follows: J. F. Cornell Collection (JFC); Florida State Collection of Arthropods, Gainesville, FL, Paul Skelley (FSCA); Great Smoky Mountain National Park Collection, Gatlinburg, TN, Adriean Mayor (GRSM); Louisiana State Arthropod Museum, Baton Rouge, LA, Victoria Bayless (LSAM); North Carolina State University Insect Collection, Raleigh, NC, Robert Blinn (NCSU); U.S. National Museum, Smithsonian Institution, Washington, DC, Terry L. Erwin and Warren Steiner (USNM); University of Tennessee, Knoxville, TN, Ernest Bernard, Adriean Mayor (UTEK); Texas A&M University Insect Collection, College Station TX, Edward Riley (TAMU). The J. F. Cornell Collection will eventually be deposited in the NCSU.

Methods. Dissections were made using standard techniques. Hot water was used to soften specimens prior to dissection and remounting. Genitalia were preserved in glycerine vials or in glycerine within depressions on small polyethylene squares. These were pinned beneath the specimens. Specimens were measured electronically using a Leica MZ 125 microscope equipped with PC and SPOT image analysis program (vers.3.4 for Windows, Diagnostic Instruments, Inc.) in most cases, or using a camera lucida for a few. Measurements for various body parts are coded as follows: ABL = apparent body length, from clypeus to apex of elytra; WH = width of head, at level of first orbital setae; WPm = maximum width across pronotum; WPa = width across anterior angles of pronotum; WPp = width across posterior angles of pronotum; LP = length of pronotum from base to apex along midline; WE = width of elytra, at level of 2nd discal setae; LE = length of the elytra, from apex of scutellum to apex of left elytron. Only ABL measurements are reported, the other measurements are given as 7 ratios: general width –WH/WPm and WPm/We and body parts –WPa/WPp, WPm/WPp, WPm/LP and WE/ABL. Measurements are in mm. Microsculpture micrographs were made for species with sufficient study material using a Cambridge 260 StereoScan SEM.

Specimens selected for compound microscopy were cleared in warm (70–80°C) 10% KOH solution for no more than 1 h. Genitalia were extracted and the specimens were washed in an excess of 95% ethanol and mounted on microscope slides using euparal®.

Verbatim label data are given for holotypes that we have examined of previously described species and for type specimens of all newly described species. Label breaks are indicated by a slash (“/”).

Species Recognition. Generally, the authors agree with Erwin's concept for species recognition (Erwin 1970). In *Anillinus* the number of species significantly exceeds the number of useful external characters, so the role of genitalic morphology in species recognition is more important. Our criteria in recognizing new species were the following: two or more similar forms that are sympatric were considered separate species if they differed in genitalic morphology and at least one external character; allopatric forms that were similar in external morphology were considered separate species if they differed in general form of the median lobe and armature of the internal sac; allopatric forms were considered conspecific if they show intergradation of external characters and/or intergradation of the shape and armature of the median lobe. Therefore, morphological recognition of species was based on external gross characters, including forebody proportions, and form and convexity of the elytra. Fine external characters that were considered included the patterns of forebody microsculpture, and the patterns of elytral striae. Genitalic characters included form of the median lobe, especially the apex, and the armature of the internal sac observed retracted inside the median lobe.

Terms. All of the terms used are standard in carabid taxonomy. Nevertheless, some of them need additional explanation.

Abdominal sterna. We use the term sternum VII as a definition of the anal sternite (*sensu* Ball and Shepley 1983). Among anillines it is also referred to as sternum VI (Erwin 1982) or even sternum VIII (Cicchino and Roig-Juñent 2001).

Microsculpture. The pattern of microsculpture on the forebody is an important feature for recognizing species. Variation in microsculpture ranges from a distinct network of more or less isodiametric polygonal meshes to complete absence of microsculpticells (*sensu* Allen and Ball 1980) with intermediate patterns of indistinct microsculpture. Reduction in the development of microsculpture can be divided into several stages. The first stage is elongation of the meshes with loss of isodiametric symmetry. Second is formation of gaps throughout the network with development of open elongate meshes. Third is elimination of all meshes, but with remnants of boundaries preserved as microlines. The fourth and final stage is a smooth, polished surface with absence of any microsculpture. Accordingly, we use three shorthand descriptions of microsculpture development: distinct (well-developed through stage 1), indistinct (stages 2 and 3) and absent (stage 4).

Interneurs. Elytral interneurs (*sensu* Erwin 1974) are numbered according to their proximity to the elytral suture. The 1st is the closest to the suture and always visible. Outer interneurs become obsolete at different numbers (counting away from the suture). Generally, the striation on *Anillinus* elytra compared to the other bembidiines is shallow and indistinct, with interneurs best observed in the middle of the elytra and at certain angles. For species recognition, the two important patterns of elytron striation are: interneurs occupy the space only between the elytral suture and the row of discal pores (interneurs range from one to three); and interneurs also visible laterally between the row of discal pores and elytral margin (the number of interneurs more than then three).

Femora. Males of several species of *Anillinus* possess a denticulate projection on the posterior margin of each male metafemur. If present, the femur is referred to as modified. If absent, it is referred to as simple.

Aedeagus. The aedeagus is positioned inside abdominal cavity with its apparent morphological right side oriented dorsally and morphological left side oriented ventrally; in other words, rotated 90° counterclockwise. We used presumed morphological dorsal and ventral in describing the positions of various aedeagal characters in the descriptions and in reference to the figures.

Systematic Treatment

In southeastern United States, anillines are presently represented by the two genera: *Anillinus* Casey and *Serranillus* Barr.

Serranillus Barr, 1995

Type species: *Serranillus jeanneli* Barr, 1995, by monotypy.

Serranillus dunavani (Jeannel), **new combination.**

Anillinus dunavani Jeannel (1963a:76). Type—male, glued on triangle and labeled / Rocky Bottom, Pickens Co., S.C., 25 Aug 1932, D.Dunavan Col./ Sassafras Mtn. 3,500 ft/ in leaf mold/ TYPE/ TYPE No 69542 USNM/ *Anillinus dunavani* n.sp. (Jeannel's handwriting) R.Jeannel det. 19 / deposited USNM.

Holotype examined. Specimen is in good condition, not damaged or dissected. This species belongs, without doubt, in *Serranillus* because the male holotype has three denticles on the apex of the sternum VII. But the specimen illustrated under this name by Jeannel (1963a) and Barr (1995) is a member of *Anillinus*. Obviously, Jeannel had a mixture of species among the type material, and after dissecting and illustrating the *Anillinus* species, he erroneously labeled a specimen of a different genus and species as the holotype that was deposited in the USNM. Thus, one of the most illustrated

Anillinus species has, until now, remained undescribed. That species is described herein as *A. loweae* Sokolov and Carlton.

This species represents the second described species of *Serranillinus*. From the type-species, *S. jeanneli* Barr, it may be distinguished by its small size (ABL=1.83 mm versus 2.5 to 3.2 mm, according to the description of *S. jeanneli* Barr) (Barr 1995).

Anillinus Casey, 1918

Type species: *Anillus* (*Anillinus*) *carolinae* Casey, 1918, by original designation.
Troglanillus Jeannel, 1963*b*. Synonymized by Barr 1995:240. Type species:
Troglanillus valentinei Jeannel, 1963*b*, by monotypy.

Description. Habitus (Fig. 1) various, from relatively short, ovoid and moderately convex to slender, elongate and flattened. Integument various in color, from dark brown (ovoid species) to depigmented, amber testaceous (in elongate species). Body setose, vestiture of elytra shorter, one third or less length of discal fixed setae and usually obviously shorter than vestiture on disc of pronotum. Microsculpture mesh pattern polygonal and nearly isodiametric.

Head (Figs. 2–5) various, large to normally proportioned relative to other bembidiines, tempora swollen, eyes absent. Frontal impressions obvious, short; lateral frontal carinae moderately developed; front with small tubercle at middle. Maxillary palpomere 3 elongate and setose, mentum free, mentum toothed. Chaetotaxy of dorsum of head comprising a pair of frontoclypeal setae, a pair of setae in frontal impressions (one in each groove) and two pairs of supraorbital setae. Clypeus, front and tempora also with short scattered setae. Microsculpture various from covering head to absent from most of its dorsal surface.

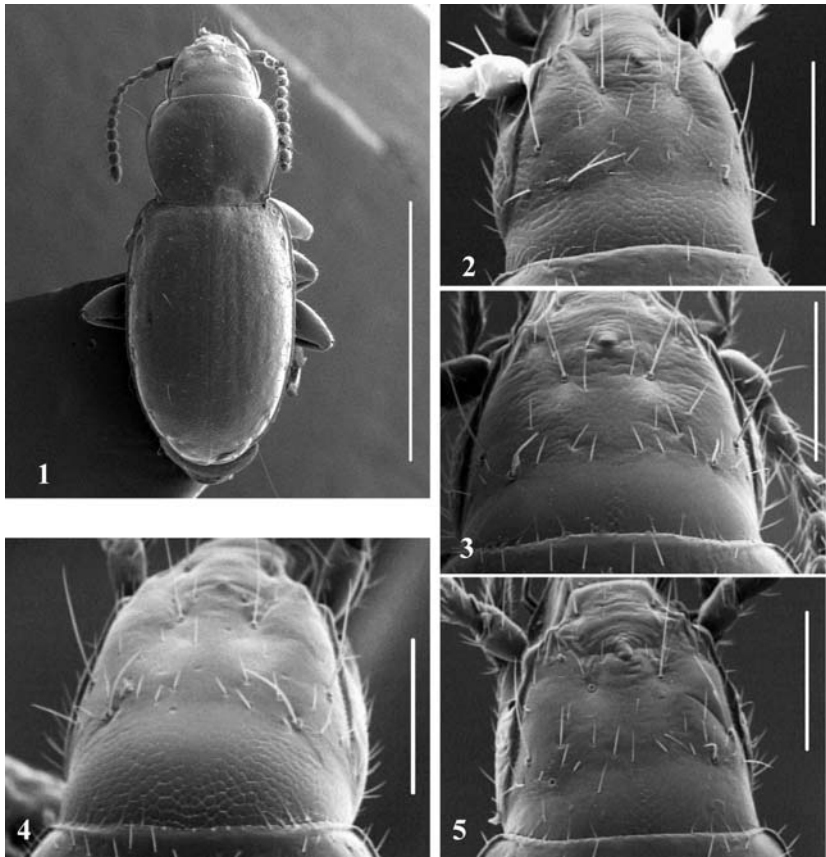
Pronotum (Figs. 6–9) variously cordate, with lateral margins straight or slightly sinuate before posterior angles. Anterior angles slightly prominent. A pair of anterolateral setae between one-fourth and one-third the pronotal distance from the anterior angle and a posterolateral pair on lateral margin right near posterior angles. Posterior angles prominent and various, from obtuse (100–120°) to nearly rectangular (90–100°). Thus, lateral margins of pronotum either rectilinear, convergent posteriad (toward base), or with a shallow sinuation before posterior angles. Ratio of width across anterior angles/width across posterior angles from 0.85 to 1.15. Lateral margins sparsely setose and crenulate, with 3–5 small denticles, either acute or rounded apically. Vestiture of pronotum in most species longer than on the elytra. Microsculpture various, from covering pronotum to absent from most of pronotal disc.

Elytral shape various, ovoid and convex to elongate, subparallel, and flattened. Humeri various, rounded in species having oval elytra and from rounded to prominent among species with subparallel elytra. Number of elytral interneurs various, from one to five, best seen at middle of elytron. Microsculpture on elytra isodiametric. Chaetotaxy represented by basal (scutellar) seta, 3 discal setae (punctures) and umbilicate series of type A (*sensu* Jeannel 1963*a*): nine setae arranged in three groups, subhumeral (3+1), middle (2) and subapical (1+2), the 8th and 9th setae approximate and “geminat.” Basal and discal setae subequal in length. Subhumeral margins of elytra serrate.

Apical margin of sternum VII entire in both sexes. Metacoxae widely separated. Besides vestiture, chaetotaxy of sternum VII typical for Bembidiini; comprising a pair of paramedian setae on sterna IV–VI and either two (males) or four (females) setae near apex of sternum VII.

Males with protarsomere I enlarged, bearing oval plate of adhesive articulo-setae (*sensu* Stork 1980) beneath, tarsi pentamerous. Females with protarsomeres subequal. Posterior row of 5–7 small setigerous spines of mesotibiae various in size. Males with metafemora (Figs. 10–13) simple (at most minutely granulate along posterior margin), slender or slightly swollen, or with obvious tubercles or a denticulate process on each ventral face. Females with metafemora simple. Males with metatibiae (Figs. 14–17) slender and simple, or with coarse granules along posterior margin. Females with metatibiae simple.

Median lobe of aedeagus (Figs. 18–37) various and species-diagnostic, either evenly arcuate, or twisted. Apex simple or enlarged and modified. Internal sac with copulatory pieces various; generally of two groups of sclerites, dorsal (present) and ventral (present or absent), and group(s) of spines (present or absent).



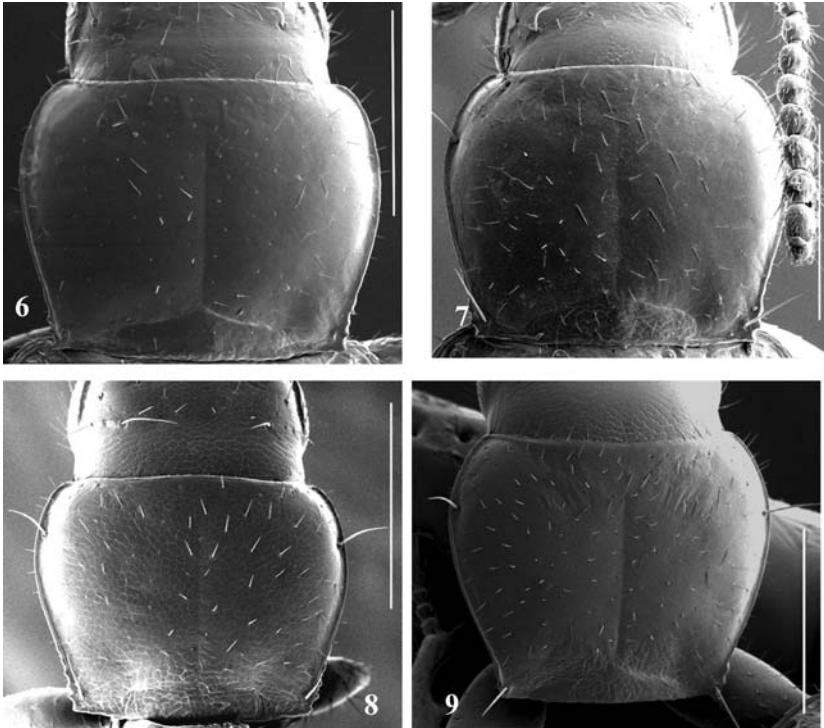
Figs. 1–5. *Anillinus* spp. **1)** *Anillinus fortis* (Horn), dorsal aspect, scale = 1.0 mm. **2–7)** Dorsal aspects of heads, showing microsculpture, scale = 0.2 mm. **2)** *Anillinus magazinensis* n. sp.; **3)** *A. fortis* (Horn); **4)** *A. robisoni* n. sp.; **5)** *A. erwini* n. sp.

Discriminating *Anillinus* and *Serranillus*

Anillinus is broadly sympatric with *Serranillus*. Previous keys have relied on male characters for distinguishing these two genera (e.g., Ball and Bousquet 2001). We offer the following set of characters to facilitate discrimination of the two genera.

- Elytral discal primary setae not reduced in length, same size as basal (scutellar) setae
 - Vestiture of elytra less than one-third length of discal primary setae
 - Microsculpture of head and pronotum various.
 - Sternum VII in males with entire apical margin.
- *Anillinus* Casey

- Elytral discal primary setae greatly reduced in length, at most one-half length of basal (scutellar) setae
 - Vestiture of elytra more than one-third length of discal primary setae.
 - Microsculpture absent from head and pronotum (except small triangle at middle of vertex).
 - Sternum VII in males with apical margin bearing three denticles.
- *Serranillus* Barr

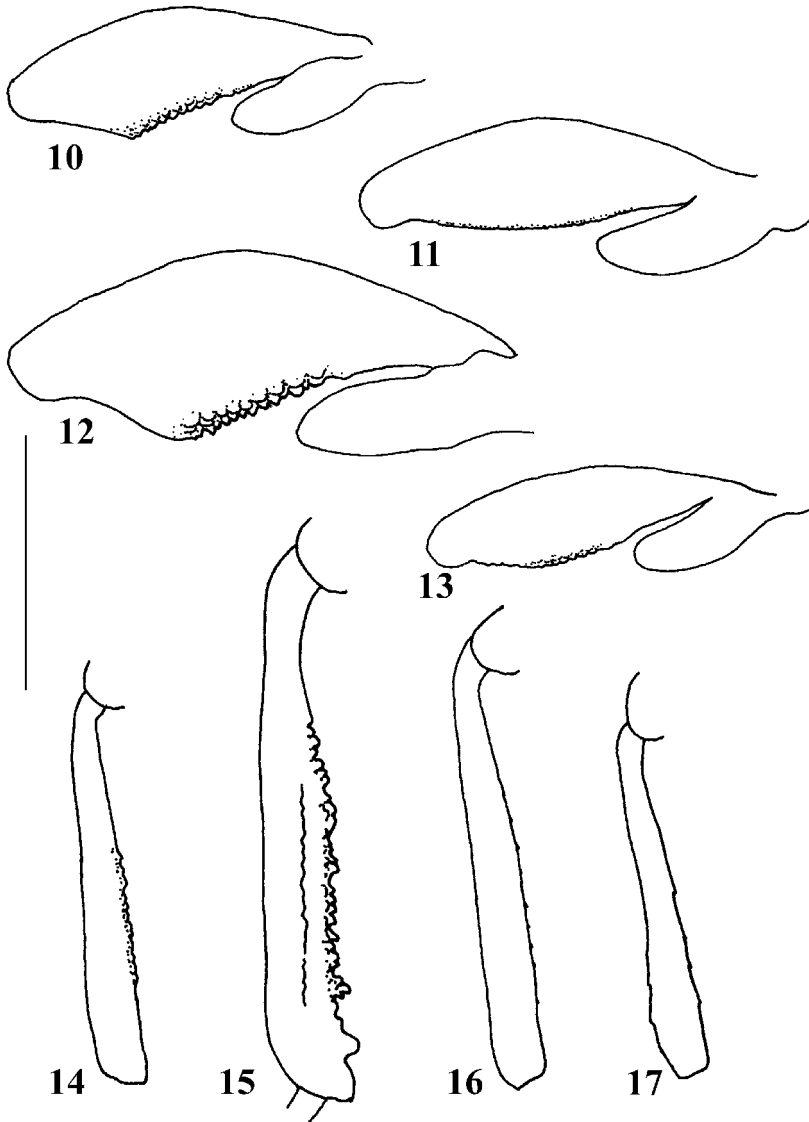


Figs. 6–9. Pronota of *Anillinus* spp., scale = 0.3 mm. **6)** *Anillinus erwini* n. sp.; **7)** *A. fortis* (Hom); **8)** *A. magazinensis* n. sp.; **9)** *A. robisoni* n. sp.

Key to Soil and Litter Species of *Anillinus*

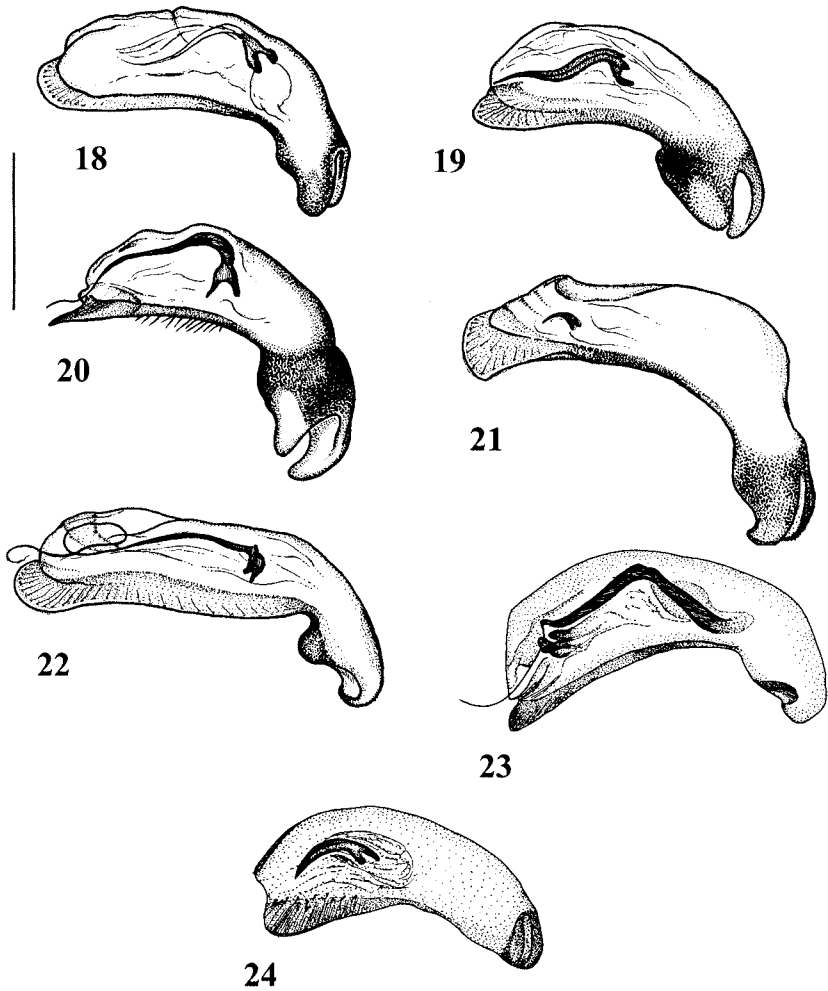
The following identification key for non-troglobitic *Anillinus* includes all described species except *A. dohrni* (whereabouts of type unknown). The key makes use of distributional information that may prove to be incomplete with additional sampling. Therefore, dissection and examination of male genitalia should be used for confirmation when possible.

- 1 Microsculpture indistinct or absent from pronotal disc (Figs. 6–7, 9) 2
- 1' Microsculpture of pronotum pronounced or fine but evident across disc as a network of isodiametric polygonal meshes (Fig. 8). 12
- 2 Beetles from states outside Appalachian Mountains (Arkansas, Florida). Larger (>1.8 mm); elytral interneurs obvious laterad discal setae; male metafemora bearing a denticulate expansion in apical third (as in Figs. 10, 12) 3
- 2' Beetles from Appalachian Mountains of Georgia, North and South Carolina, Tennessee, and Virginia (including piedmont region). Smaller (<2.1 mm); elytral interneurs obvious only mediad discal setae; male metafemora simple (as in Figs. 11, 13) 4
- 3 Body robust; pronotum with margins more or less rectilinearly convergent posteriorly (ratio of pronotal maximum width/width of pronotal base 1.26), not



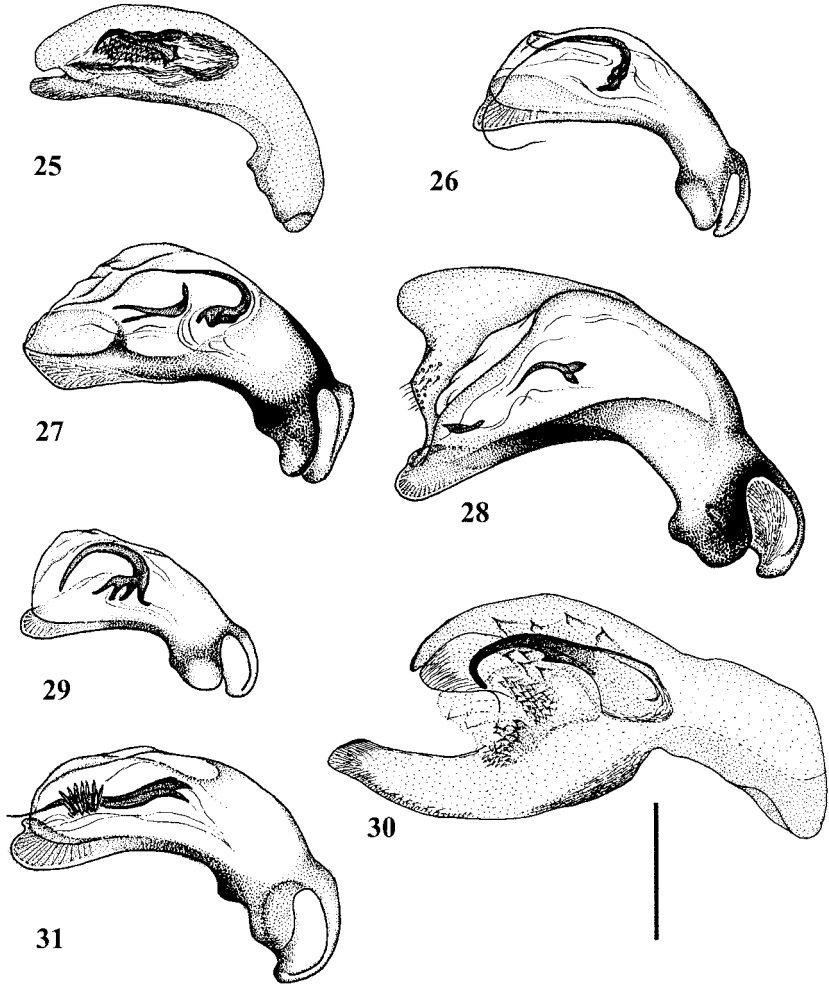
Figs. 10–13. *Anillinus* spp., right metafemora, setae omitted. **10)** *A. elongatus* Jeannel; **11)** *A. fortis* (Horn); **12)** *A. lescheni* n. sp.; **13)** *A. stephani*.

Figs. 14–17. *Anillinus* spp., right metatibiae, setae and spurs omitted. **14)** *A. elongatus* Jeannel; **15)** *A. lescheni* n. sp.; **16)** *A. fortis* (Horn); **17)** *A. stephani* n. sp.



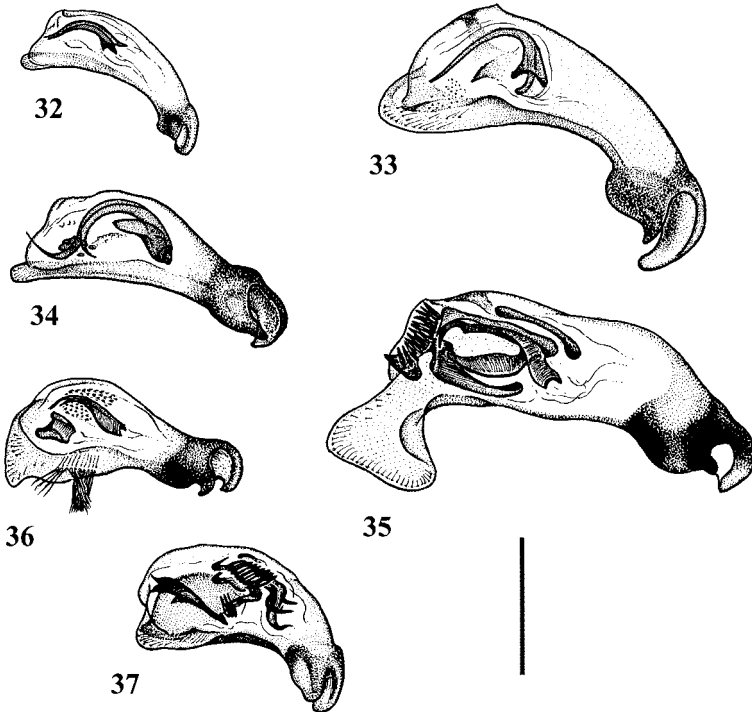
Figs. 18–24. Aedeagi of *Anillinus* spp., right lateral aspects, scale = 0.1 mm. **18)** *A. elongatus* Jeannel; **19)** *A. fortis* (Hom); **20)** *A. steevesi* Barr; **21)** *A. balli* n. sp.; **22)** *A. barri* n. sp.; **23)** *A. cornelli* n. sp.; **24)** *A. daggyi* n. sp.

- sinuate before posterior angles (as in Fig. 6); width across anterior angles of pronotum less than across posterior angles (ratio apex/base 0.90). Larger, total length >2.3 mm; beetles from east of Mississippi River (Florida) *Anillinus kovariki* new species
- 3' Body elongate; pronotum markedly constricted posteriad (ratio of pronotal maximum width/width of pronotal base 1.38–1.47) with shallow sinuation before posterior angles (Fig. 9); width between posterior angles of pronotum less than between anterior angles (ratio apex/base >1.05); smaller, length <2.1 mm; beetles from west of Mississippi River (Arkansas) *Anillinus robisoni* new species



Figs. 25–31. Aedeagi of *Anillinus* spp., right lateral aspects, scale = 0.1 mm. 25) *A. docwatsoni* n. sp.; 26) *A. erwini* n.sp.; 27) *A. folkertsi* n.sp.; 28) *A. kovariki* n.sp.; 29) *Anillinus langdoni* n.sp.; 30) *A. lescheni* n. sp.; 31) *A. loweae* n.sp.

- 4 Clypeus and most of frons bearing distinct microsculpture (at most with two confluent areas without microsculpture at the border between frons and vertex (as in Figs. 2, 4) 5
- 4' Clypeus and most of frons smooth (?? microsculpture, if present, covering vertex and narrow areas along frontal grooves and clypeal suture (as in Figs. 3, 5) 8
- 5 Head with two confluent areas of indistinct microsculpture on vertex (as in Fig. 3), elytra ovoid. Larger (1.63–1.91 mm). Beetles from north of French Broad River (North Carolina, Virginia) (Fig. 42) *Anillinus erwini* new species (in part)



Figs. 32–37. Aedeagi of *Anillinus* spp., right lateral aspects, scale = 0.1 mm. 32) *A. magazinensis* n.sp.; 33) *A. moseleyae* n.sp.; 34) *Anillinus murrayae* n.sp.; 35) *A. robisoni* n. sp.; 36) *A. stephani* n. sp.; 37) *A. tishechkini* n. sp.

- 5' Vertex covered with distinct microsculpture throughout (as in Fig. 2), elytra parallel-sided. Smaller (≤ 1.7 mm). Beetles from north or south of French Broad River 6
- 6 Beetles from piedmont of North North Carolina east of French Broad River. Male metafemora expanded and finely granulate along posterior margin (Fig. 10). Larger (1.6–2.0 mm) *Anillinus elongatus* Jeannel
- 6' Beetles not from piedmont of North Carolina (Georgia and Tennessee). Male metafemora at most minutely granulate along evenly arcuate posterior margin (as in Figs. 11, 13). Smaller (< 1.6 mm) 7
- 7 Pronotum more transverse (ratio of pronotal maximum width/medial length 1.35) and more constricted posteriad (ratio of pronotal maximum width/width of pronotal base 1.34). Elytra interneurs obvious laterad discal setae. Beetles from Georgia *Anillinus turneri* Jeannel
- 7' Pronotum less transverse (ratio of pronotal maximum width/medial length 1.31) and less constricted posteriad (ratio of pronotal maximum width/width of pronotal base 1.28). Elytra interneurs obvious only mediad discal setae; beetles from Tennessee *Anillinus sinuaticollis* Jeannel
- 8 Pronotum more constricted posteriad (ratio of pronotal maximum width/width of pronotal base 1.36–1.42) with shallow sinuation before posterior angles (Fig. 9); width between posterior angles of pronotum much less than between anterior

- angles (ratio apex/base >1.05). Microsculpture covering entire vertex (as in Fig. 4). Elytra elongate and flattened; beetles from southern Appalachian Mountains (Tennessee, North Carolina) *Anillinus moseleyae* new species
- 8' Pronotum with margins more or less rectilinearly convergent posteriad (ratio of pronotal maximum width/width of pronotal base 1.26–1.28), not sinuate before posterior angles (Fig. 6); width across anterior angles of pronotum narrower than across posterior angles (ratio apex/base 0.93–0.96). Microsculpture absent from vertex except small triangle at middle (Fig. 5). Elytra convex and ovoid in form ... 9
- 9 Beetles from north and/or east of French Broad River (Fig. 42) (North and South Carolina, Virginia) 10
- 9' Beetles from south and/or west of French Broad River (North Carolina and Tennessee) 11
- 10 Pronotum moderately constricted at base, W_{Pm}/W_{Pp} greater than 1.20. Beetles from Appalachian Mountains of North Carolina and Virginia *Anillinus erwini* new species (in part)
- 10' Pronotum slightly constricted at base, W_{Pm}/W_{Pp} less than 1.20. Beetles from western piedmont of North and South Carolina. *Anillinus cornelli* new species
- 11 Beetles from west of major divide (Appalachian Trail) of Great Smoky Mountains *Anillinus barri* new species
- 11' Beetles from east of major divide (Appalachian Trail) of Great Smoky Mountains *Anillinus murrayae* new species
- 12 Beetles from Appalachian Mountains (Tennessee, North and South Carolina, Virginia, Maryland) 13
- 12' Beetles from outside Appalachian Mountains (Oklahoma, Arkansas, Alabama, Indiana, Kentucky) 19
- 13 Vertex with small paramedian patches without microsculpture on each side (Fig. 3) 14
- 13' Vertex with distinct microsculpture across entire surface (Fig. 2) 17
- 14 Beetles from north and/or east of French Broad River (North Carolina) 15
- 14' Beetles from south and/or west of French Broad River (North and South Carolina, Tennessee and Georgia) 16
- 15 Accessory ventral copulatory sclerite of aedeagus absent, internal sac not spined near aperture (Fig. 19) *Anillinus fortis* (Horn)
- 15' Accessory ventral copulatory sclerite of aedeagus present, internal sac covered with spines near aperture (Fig. 25) *Anillinus docwatsoni* new species
- 16 Beetles from east of major divide (Appalachian Trail) of Great Smoky Mountains, east and southeast to Sassafras Mts., South Carolina. Elytra more ovate and short (ratio LE/ABL 0.57); darker, dark brunneous to brunneorufous *Anillinus loweae* new species
- 16' Beetles from west of major divide (Appalachian Trail) of Great Smoky Mountains, west and southwest to Cloudland Canyon State Park, Georgia. Elytra more parallel and elongate (ratio LE/ABL 0.60); lighter, light brunneorufous to rufous *Anillinus steevesi* Barr
- 17 Smaller: 1.41–1.74 mm. Beetles from south and west of French Broad River (North Carolina and Tennessee) *Anillinus langdoni* new species
- 17' Larger: 1.64–1.98 mm. Beetles from north of French Broad River (Virginia, Maryland) 18
- 18 Smaller (1.64–1.75 mm); pronotum less constricted posteriad (ratio of pronotal maximum width/width of pronotal base 1.25) with wider base (ratio apex/base 0.94). Microsculpture on pronotum with mesh pattern larger: 7–8 sculpticells on line equal to 0.1 mm; beetles from Virginia *Anillinus virginiae* Jeannel

- 18' Larger (1.98 mm); pronotum more constricted posteriad (ratio of pronotal maximum width/width of pronotal base 1.29) with narrower base (ratio apex/base 0.98). Microsculpture on pronotum with mesh pattern smaller: 10–11 sculpticells on line equal to 0.1 mm; beetles from the northern border of Virginia and Maryland *Anillinus barberi* Jeannel
- 19 Elytra interneurs obvious only mediad the discal setae. Beetles from Kentucky *Anillinus balli* new species
- 19' Elytra interneurs obvious laterad the discal setae 20
- 20 Beetles from the east of Mississippi River 21
- 20' Beetles from the west of Mississippi River (Arkansas, Oklahoma) 22
- 21 Pronotum markedly constricted posteriad (ratio of pronotal maximum width/width of pronotal base greater than 1.25) with narrower base (ratio apex/base 0.97); beetles from Indiana *Anillinus indianae* Jeannel
- 21' Pronotum less constricted posteriad (ratio of pronotal maximum width/width of pronotal base less than 1.25) with wider base (ratio apex/base less than 0.93); beetles from Alabama *Anillinus folkertsi* new species
- 22 Elytra oval. Clypeus and head covered with distinct microsculpture. Pronotum with margins rectilinearly convergent posteriad, not sinuate before posterior angles; beetles from Mt. Magazine, Arkansas *Anillinus magazinensis* new species
- 22' Elytra parallel. Clypeus partly smooth, head with two lateral areas of indistinct microsculpture near junction of frontal carinae and clypeal suture. Pronotum sinuate before posterior angles; beetles from Arkansas and Oklahoma 23
- 23 Head narrower (ratio head/pronotum 0.78); pronotum slightly sinuate before obtuse posterior angles (100–110°); pronotum wider across base (ratio apex/base 1.05); beetles from Arkansas *Anillinus tishechkini* new species
- 23' Head broader (ratio head/pronotum 0.84 or more); pronotum with distinct long sinuation before nearly rectangular posterior angles (90–100°); pronotum narrower across base (ratio apex/base 1.11 or greater); beetles from Oklahoma 24
- 24 Small species, body length 1.60 mm or less, metatibiae of males simple (Fig. 17) *Anillinus stephani* new species
- 24' Large species, body length 2.20 mm or greater, metatibiae bearing irregular tubercles (Fig. 15) *Anillinus lescheni* new species

Previously Described *Anillinus* Species

Anillinus barberi Jeannel

(Map fig. 38)

Anillinus barberi Jeannel 1963b:150. Holotype female glued on triangle and labeled / Plummer Is., Md. 44 22 5 H.S. Barber/ TYPE/ TYPE No 69545 USNM/ *Anillinus barberi* type R. Jeannel det., 19 / deposited USNM.

Holotype examined. Specimen is in good condition, not damaged or dissected.

Description. Large-sized for genus (ABL 1.98 mm). Habitus moderately convex, ovoid (WE/ABL, 0.39), head of moderate size (WH/WPm, 0.73), elytra relatively narrow (WPm/WE, 0.83). Color of body brunneorufous, appendages testaceous. Dorsal microsculpture distinct over all dorsal surfaces of head and pronotum with meshes of small diameter: 10–11 versus 7–8 sculpticells of other species on line equal to 0.1 mm (counted on pronotum left and below intersection of median line and antero-transverse impression).

Pronotum moderately convex and transverse (WPm/LP, 1.34), with margins moderately and rectilinear constricted posteriad (WPm/WPp, 1.29), without sinuation before posterior angles. Anterior angles evident, prominent. Posterior angles obtuse. Width between posterior angles approximately the same as between anterior angles (WPa/WPp, 0.98).

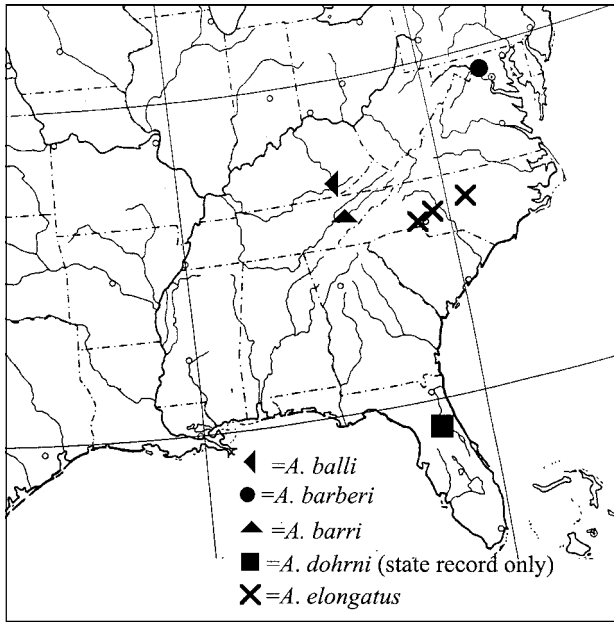


Fig. 38. Locality records for *Anillinus* spp.

Elytra moderately convex, subparallel at middle, slightly depressed along suture, relatively elongate (LE/ABL, 0.59), with traces of 1–2 interneurs. Humeri prominent, slightly rounded. Vestiture of elytra short.

Genitalia not examined.

Distribution. Known only from the type locality on the Potomac River in Virginia and Maryland (Fig. 38).

Habitat. No data.

Differential Diagnosis. *Anillinus barberi* is ovoid in form with distinct microsculpture on the forebody (Table 2, species group I of litter species). This species is not known to be sympatric with any other members of the genus. The limited distribution and relatively large size make it unlikely that this species will be confused with others. Additional specimens and aedeagal examination are required for further diagnosis.

Anillinus dohrni (Ehlers)
(Map fig. 38)

Anillus dohrni Ehlers 1884:36. Type female from “Florida,” without precise locality, location of type unknown.

Anillinus dohrni (Ehlers), Jeannel (1963a: 76).

Type not examined. We have not studied this species and have been unable to determine the location of the type. According to the original description it is a small-sized *Anillinus* (length of type 1.50 mm). Microsculpture on the forebody and other taxonomically valuable features were not mentioned in the description, so a more precise interpretation of *A. dohrni* is not possible at present. Jeannel’s (1963a) interpretation of the species was based on material identified by G. H. Horn from

Clayton and other localities in Rabun County, Georgia. A single male of *Anillinus* (ABL 2.66 mm) from near Tallahassee differs from both the original description of *A. dohrni* and from Jeannel's dubious interpretation of the species. The Florida specimen differs in length from Ehlers's species (original description), and in the shape of median lobe from Jeannel's interpretation (Jeannel 1963a: Fig. 64, p. 75). These differences and the relatively great distance between Rabun County, Georgia (situated on the Tennessee border) and Tallahassee, Florida have led us to conclude that three different species are involved. The first is Ehlers's *A. dohrni*, the identity of which is unknown beyond the original description, the second is Jeannel's concept of the species, which apparently was not based on type comparison, and the third is our specimen from Florida, described herein as *A. kovariki* Sokolov and Carlton.

Distribution. Known from "Florida" from holotype only (Fig. 38).

Anillinus elongatus Jeannel
(Figs. 10, 14, 18, Map fig. 38)

Anillinus elongatus Jeannel, 1963b:151. Remnants of type (probably female) glued on plastic triangle /white card rectangle with glued abdomen with both hind legs of unknown ?Trechini/ Chapel Hill, N.C., 18 April 1932, J.M.Valentine/ *Anillinus elongatus* Bar ♀ Allotype HSB. 1932/ TYPE/ TYPE No 69544 USNM/ *Anillinus elongatus* type R.Jeannel det., 19 / specimens destroyed ? or on box bottom, reglued 28 Sept 71, T. L. Erwin/ deposited USNM. **Neotype here designated.** Male, point-mounted with aedeagus in genitalia vial labeled /NC, Orange Co., Chapel Hill, Morgan Cr. 17.IV.94, J.F.Cornell, ex soil 994 IV 17-1-5/ deposited NCSU.

Holotype examined. Specimen is glued on plastic triangle and totally destroyed, the remains include an abdomen and metathorax with right posterior leg, abdomen without content (dissected?). The type bears the label "specimen destroyed ? or on box bottom, reglued 28 Sept 71, T.L. Erwin" and a hand-drawn cartoon of the glued posterior parts of a male, probably of some Trechini. Jeannel (1963b) based this species on two specimens, the USNM holotype that is destroyed, and a male paratype at the Museum National de'Histoire Naturelle that we have not seen. The International Code of Zoological Nomenclature (1999: Article 75, Recommendation 75A) recommends that surviving paratypes be given priority in designating neotypes but does not exclude designation of specimens that were not part of the original type series. In the current situation, the surviving paratype has not been seen, but additional specimens from the type locality are available, fit the original description, and no additional *Anillinus* species are known to occur in the eastern piedmont region of North Carolina. Therefore, in the interest of nomenclatural stability and to fix the name *A. elongatus* to a primary type, we are designating one of those specimens as the neotype.

Description. Small to large-sized for genus (ABL range of topotypic specimens, 1.63–1.70 mm; mean, 1.66 mm, n = 3; ABL range of Mecklenburg Co., NC specimens, 2.06–2.14 mm; mean 2.10 mm, n = 2). Habitus slightly convex, elongate (WE/ABL, 0.35) with normally proportioned head for genus (WH/WPm, 0.76) and narrow pronotum and elytra (WPm/WE, 0.84). Color of body brunneorufous, appendages testaceous. Dorsal microsculpture distinct across head and most part of pronotum except narrow area with indistinct microsculpture along midline. Width of smooth part on disc of pronotum various, from one-third to one-fourth of total pronotal width.

Pronotum moderately convex, moderately transverse (WPm/LP, 1.34), with margins moderately and rectilinearly constricted posteriad (WPm/WPp, 1.34). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (100–110°). Width between posterior angles slightly less than between anterior angles (WPa/WPp, 1.05).

Elytra slightly convex, moderately depressed along suture, of normal length for genus (LE/ABL, 0.58), with traces of 2–3 interneurs. Humeri slightly prominent, markedly rounded. Vestiture of elytra relatively short (less than one-fourth the length of discal setae).

Males with metafemora (Fig. 10) modified; each bearing a small granulate projection along posterior margin in apical third and small regular tubercles along basal two-thirds. Each metatibiae (Fig. 14) also bearing a posterior row of small tubercles.

Median lobe (Fig. 18) evenly arcuate and twisted, with enlarged quadrangular apex. Internal sac with weak development of copulatory pieces. Dorsal sclerite forming a filament-like structure that is short and does not extend far beyond internal sac. Ventral sclerite and spines absent.

Material Examined (8, JFC). Two specimens bearing same data as neotype; 1 specimen labeled /NC, Orange Co., 10 mi N Chapel Hill, 4 Apr 74, P Debs. UndOakLog/; 2 specimens labeled /NC Mecklenburg Co nr Mint Hill on McAlpine Cr 12 Apr 94 JF Cornell ex Soil under Stream Debr/; 2 specimens labeled /NC Cabarrus Co 5 mi W Davidson 11 Ap. 94 JF Cornell III Don Sheldon ex soil nr log/.

Distribution. This species is known from several localities in the eastern (Orange County) and western (Mecklenburg and Cabarrus Counties) piedmont of North Carolina. (Fig. 38).

Habitat. Specimens were collected from soil and under logs and stream debris. Remaining habitat at the type locality is a mixture of piedmont oak/hickory forest, including pockets of beech/maple forest in ravines and riparian areas (North Carolina Botanical Garden) and second growth deciduous/pine flatwoods (Old Mason Farm Nature Preserve).

Differential Diagnosis. *Anillinus elongatus* is parallel-sided with indistinct microsculpture on the disc of the pronotum (Table 2, group V of endogean species). The species is allopatric with respect to other described species of *Anillinus*. From its geographically closest congeners it differs by its elongate subparallel habitus, and by the characteristic microsculpture pattern on the forebody in addition to features mentioned in the key. The posterior rows of tubercles on the male metafemora and metatibiae are similar to those of *A. lescheni*, far to the west in Oklahoma, though they are less developed than in that species and aedeagal characters are totally different.

Comments. Thomas Barr was kind enough to provide CEC the following information regarding the type locality of this species that was not included in Jeannel's description (communicated to him by J. Manson Valentine, the collector): "along Morgan Creek, which is on the southeast side of Chapel Hill" (T. Barr pers. comm., July 2002). One of us (CEC) visited the area in southern Chapel Hill during early August 2002 and collected three large (~10 kg) Berlese samples from promising habitat on property owned by the University of North Carolina and managed by the North Carolina Botanical Garden. Litter in the area was dry due to an extended drought. Litter dwelling arthropods were recovered, including a typical assemblage of beetles, but no specimens of *Anillinus*. During December 2002, Debra Murray (University of Kentucky, Lexington) and members of her family joined the search and collected litter from the same area and others in and around Chapel Hill. Again, numerous beetles were collected, but no *Anillinus* specimens. We subsequently learned that J. F. Cornell had conducted an earlier successful search for the species at the type locality and had been collecting and studying the genus for almost 30 years. All of Cornell's specimens were collected using a soil washing/flootation technique. This method entails submerging soil samples in water and agitating, then removing the organisms as they rise to the surface. Extensive Berlese sampling by Cornell during various seasons between 1971 and 1993 were unsuccessful.

The specimens from Mecklenburg County are substantially larger than those from the type locality or from nearby Cabarrus County. The details of the male aedeagus, modified male metafemora, and overall proportions compare favorably with specimens

from the type locality. Additional sampling at and between the somewhat distantly separated collecting localities is needed to determine the current degree of continuity and variation among populations.

Anillinus fortis (Horn)

(Figs. 1, 3, 7, 11, 16, 19, Map fig. 39)

Anillus fortis Horn, 1868:127. Type (sex unknown) from "mountainous regions of Eastern Tennessee." Deposited Academy of Natural Sciences, Philadelphia.

Anillinus fortis (Horn), Jeannel 1963a:75.

Anillinus fortis, Barr 1995:241.

Anillus (*Anillinus*) *carolinae* Casey, 1918:168. Synonymized by Barr 1995:241.

Holotype not examined. Our interpretation of the species is based on examination of the cotype of *A. carolinae* (female bearing labels: "Black Mts. N.C. IX." and "fortis, compared with type"). We are in agreement with Barr's (1995) concept of this species.

Description. Medium to large-sized for the genus (ABL range, 1.70–2.08 mm; mean, 1.96 $n = 10$). Habitus (Fig. 1) markedly convex, ovoid, head of moderate size (WH/WPm, 0.73), elytra relatively wide (WPM/WE, 0.78). Color of body various, from brunneous to brunneofeous, appendages testaceous. Pronotal microsculpture fine but distinct across entire disc. Microsculpture on head absent on two paralaral patches at vertex (Fig. 3).

Pronotum moderately convex and transverse (WPm/LP, 1.30), with margins slightly constricted and rectilinear convergent posteriad (WPm/WPp, 1.24) (Fig. 7). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105–115°). Width between posterior angles much greater than between anterior angles (WPa/WPp, 0.92).

Elytra markedly convex, slightly depressed along suture, length normal for genus (LE/ABL, 0.57), with traces of 1–3 (occasionally 4) interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra short.

Males with metafemora (Fig. 11) and metatibiae (Fig. 16) simple.

Median lobe (Fig. 19) evenly arcuate, with small protrusion at dorsal margin of apex. Internal sac with copulatory pieces of spirally-curved dorsal sclerites, in form of a blade-like structure with a peculiar prominence near base; ventral sclerite of internal sac absent; small oval cluster of spines often visible at base of copulatory sclerite under high magnification.

Material Examined (39). Twelve specimens labeled /NC, Avery Co., nr. Globe, 17 Aug 1996, J. F. Cornell/ (JFC); 3 specimens labeled /NC, Caldwell Co., Edgemont, 17 Aug 1996, J. F. Cornell/ (JFC); 17 specimens labeled /USA: NC, McDowell Co., Deerlick Gap Overlook, elev. 3,500, B.R.Pkw. 2.2 mi SW intersec. 221, 2.VI.1991, C.E. Carlton/ (LSAM); 7 specimens labeled /NC, McDowell Co., Green Knob, BRP. MP 350.4, 7 Aug 1991, J. F. Cornell, rhododendron litter/ (JFC).

Distribution. Known from north of the French Broad River in North Carolina (Fig. 39) and presumably eastern Tennessee. Tennessee localities not corroborated.

Habitat. Deep, moist hardwood litter.

Differential Diagnosis. *Anillinus fortis* is ovoid in form with patches lacking microsculpture on the lateral surfaces of the vertex (Table 2, species group II of litter species). The median lobe is diagnostic. Based on similarities in the structure of the median lobe and the distribution, *A. fortis* may be the allopatric sister-taxon to *A. loweae*, from which it differs in having a smaller apical process of the median lobe (larger in *A. loweae*) and in the absence of a group of closed spines associated with the copulatory sclerites. *Anillinus fortis* is sympatric with at least two species of *Anillinus*, described herein as *A. erwini* and *A. daggyi*. From the first species it differs by the presence of distinct microsculpture on the disc of the pronotum and from the second by its substantially larger size. All three may be separated using aedeagal characters.

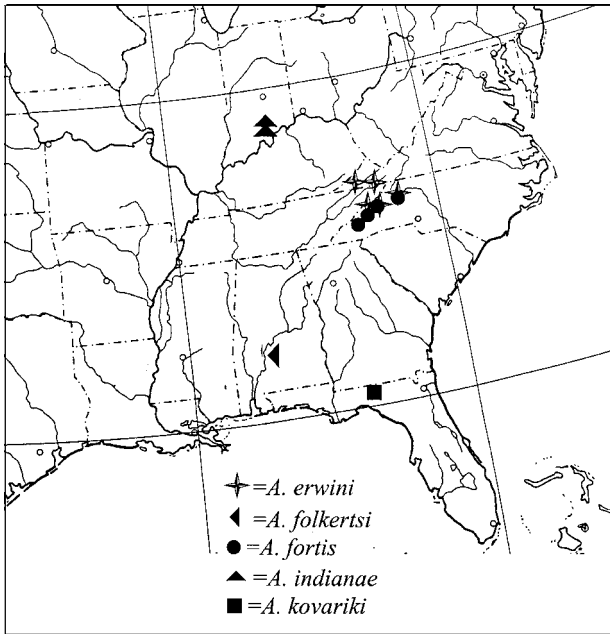


Fig. 39. Locality records for *Anillinus* spp.

Anillinus indianae Jeannel
(Map fig. 39)

Anillinus indianae Jeannel, 1963b:152. Holotype female glued on rectangular card and labeled /LaurenCe Co., Ind. W.S.B. 7-16-16/ TYPE/ TYPE No69548 USNM/ *Anillinus indianae* type R.Jeannel det., 19 / . Deposited USNM.

Holotype examined. Specimen is in good condition, not damaged or dissected.

Description. Medium-sized species for genus (ABL, 1.69 mm). Habitus subconvex, ovoid (WE/ABL, 0.40), head of moderate size (WH/WPm, 0.75), elytra relatively wide (WPm/WE, 0.79). Color of body rufotestaceous, appendages testaceous. Dorsal microsculpture distinct over all dorsal surfaces of head and pronotum.

Pronotum moderately convex and transverse (WPm/LP, 1.32), margins moderately rectilinear convergent posteriad (WPm/WPp, 1.28). Anterior angles evident, slightly prominent. Posterior angles nearly rectangular. Width between posterior angles approximately the same as between anterior angles (WPa/WPp, 0.97).

Elytra moderately convex, moderately depressed along suture, length normal for genus (LE/ABL, 0.58), with traces of interneurs 4–5. Humeri prominent, moderately rounded. Vestiture of elytra short.

Genitalia not examined.

Distribution. Known only by the type specimens from Lawrence and Crawford Co., Indiana (Fig. 39).

Habitat. Unknown.

Differential Diagnosis. *Anillinus indianae* is ovoid in form with distinct microsculpture on the forebody (Table 2, species group I of litter species). This species is not known to be sympatric with any other members of the genus. From most species of

group I it can be distinguished by the presence of the elytral interneurs laterad to the discal setae, also by its limited distribution. Additional specimens and aedeagal examination are required for further diagnosis.

Anillinus longiceps Jeannel
(Map fig. 40)

Anillinus longiceps Jeannel, 1963b:149. Holotype male glued on rectangular card and labeled /red rectangular card/Monteagle Tenn., 17 March 1931, Crystal Cave, Col. J.M.Valentine/ *Anillinus fortis* Horn ? Barber det./ TYPE/ TYPE No 69547 USNM/ *Anillinus longiceps* type R.Jeannel det., 19 /. Deposited USNM.

Holotype examined. Specimen is damaged, without head or contents of abdomen (dissected but without genitalia), other parts of body in good condition.

Description. Large-sized for genus (sum of LP and LE, 1.91 mm). Color of body brunneorufous, appendages testaceous. Pronotum with distinct microsculpture across disc.

Pronotum moderately convex, transverse (WPm/LP, 1.28), with margins slightly constricted posteriad (WPm/WPp, 1.21) and slightly sinuate before posterior angles. Anterior angles evident, slightly prominent. Posterior angles nearly rectangular. Width between posterior angles slightly greater than between anterior angles (WPa/WPp, 0.94). Crenulation at posterior angles less developed than in other species of the genus with denticles at each margin with rounded tips.

Elytra oval, apical one-third convergent toward apex, moderately convex, moderately depressed along the suture, relatively long (WE/LE, 0.61), with traces of at least 5 interneurs. Humeri prominent, slightly rounded. Vestiture of elytra short.

Male metafemora apparently simple, but basal one-half concealed by mounting glue.

Genitalia not examined (missing).

Distribution. Known only from the type locality in Marion County, Tennessee (Fig. 40).

Habitat. A true troglobite according to the label.

Differential Diagnosis. *Anillinus longiceps* is a troglobitic species with distinct microsculpture on the forebody, judging from the pronotum. The obtuse serrulations at the base of the lateral margins of the pronotum are unique. Additional specimens and aedeagal examination are required for further diagnosis, but its large size sets it apart from most species. Presumably, the species is restricted to a single cave system, making it unlikely to be confused with other endogean species.

Anillinus sinuaticollis Jeannel
(Map fig. 40)

Anillinus sinuaticollis Jeannel, 1963b:152. Holotype female glued on rectangle and labeled /Roane Co., Tenn., Feb 23, 38, T-9135 38 -2819/ from soil of peach orchards/ *Anillinus* sp./TYPE/ *Anillinus sinuaticollis* typ R.Jeannel det., 19 / TYPE No 69541 USNM/ deposited USNM.

Holotype examined. Specimen is in good condition, not damaged or dissected.

Description. Small-sized for genus (ABL, 1.51 mm). Habitus subconvex, parallel-sided and elongate (WE/ABL, 0.35) with relatively large head (WH/WPm, 0.79) and narrow pronotum and elytra (WPm/WE, 0.85). Color of body rufotestaceous, appendages testaceous. Dorsal microsculpture indistinct on disc of pronotum, distinct along base of pronotum. Head with distinct microsculpture.

Pronotum moderately convex and transverse (WPm/LP, 1.31), margins moderately constricted posteriad and slightly sinuate before posterior angles (WPm/WPp, 1.28). Anterior angles evident, slightly prominent. Posterior angles nearly rectangular. Width between posterior angles approximately the same as between anterior angles (WPa/WPp, 1.01).

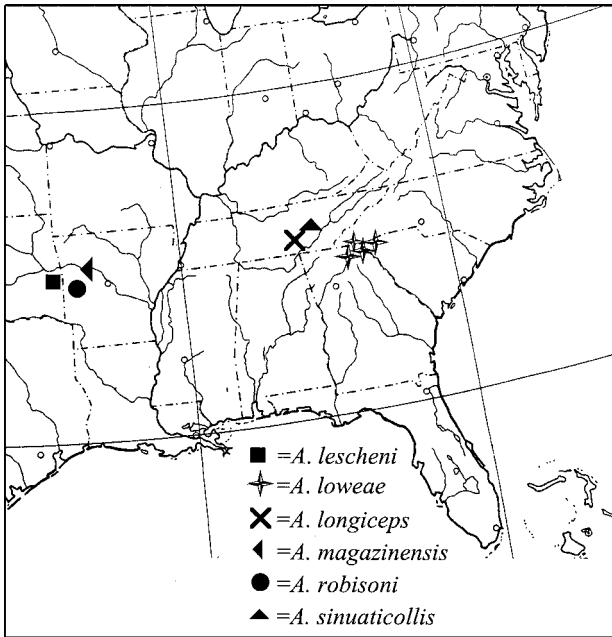


Fig. 40. Locality records for *Anillinus* spp.

Elytra markedly convex, slightly depressed along suture, relatively short (LE/ABL, 0.56), with traces of only 2 interneurs. Humeri prominent, slightly rounded. Vestiture of elytra short. Genitalia not examined.

Distribution. Known only from the holotype from Roane Co., Tennessee (Fig. 40).

Habitat. Type specimen bears the label "from soil of peach orchards."

Differential Diagnosis. *Anillinus sinuaticollis* is the single member of parallel-sided species with distinct microsculpture on the head (Table 2, group V of endogean species). The combination of microsculptured head with absence of microsculpture on the pronotum distinguish these species from the others. Additional specimens and aedeagal examination are required for further diagnosis.

Anillinus steevesi Barr
(Fig. 20, Map figs. 41, 43)

Anillinus steevesi Barr, 1995:243. Holotype male from "Cloudland Canyon State Park, Dade County, Georgia." Deposited Carnegie Museum of Natural History, Pittsburgh, PA.

Type not examined. We have at hand a series of specimens from Tennessee and North Carolina that were identified by us as *A. steevesi*. Identification was based on comparison of main aedeagal features of the dissected males (overall form of median lobe, finger-like projection on apex, filament-shape of the inner sclerite and the presence of ventrolateral setae on the outer wall of median lobe) with the drawing accompanying the description of the species (Barr 1995). The following description of *A. steevesi* is based on those specimens.

Description. Medium sized for genus (ABL range, 1.67–1.98 mm; mean 1.84 mm, n = 8). Habitus markedly convex, ovoid (WE/ABL, 0.39), head of moderate size (WH/WPm, 0.73), elytra relatively wide (WPm/WE, 0.79). Color of body various from brunneorufous to rufous, appendages testaceous. Microsculpture on head absent from two confluent paralaralateral patches at vertex, otherwise distinct over all surface. Pronotal microsculpture distinct across surface of disc.

Pronotum moderately convex and transverse (WPm/LP, 1.29), with margins only slightly (WPm/WPp, 1.24) rectilinear convergent posteriad. Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105–115°). Width between posterior angles much wider than between anterior angles (WPa/WPp, 0.90).

Elytra markedly convex, slightly depressed along suture, relatively long for genus (LE/ABL, 0.60), with traces of 2–3 (occasionally 4) interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra short (less than one-fourth length of discal seta).

Males with metafemora simple.

Median lobe (Fig. 20) evenly arcuate and twisted, with an obvious round invagination on the right ventrolateral side just behind the apex. Apex ventrally with a finger-like projection. Internal sac with copulatory pieces of dorsal sclerites, which form a long, filament-like structure, extending beyond internal sac; ventral sclerite and spines of internal sac absent. Ventral surface of median lobe with several conspicuous setae.

Material Examined (27, LSAM unless indicated otherwise). Nine specimens labeled /USA: TN, Blount Co., Foothills Pkwy., Look Rock Campgr., berlesate betwn. rocks, 31.V.1991, C.E.Carlton/; 1 specimen labeled /Tennessee: Blount Co.: GSMNP, Lynn Hollow, burned, Sample 1, Upward Bound, Gamma Chi, Beetle Blitz, 30 June 2001/; 5 specimens labeled /USA: TN: Blount Co., GSMNP, Cades Cove, ~1 mi N Methodist Church, 36°36'41"N, 83°46'60"W, 610 m, forest litter, 17 July 2003, A.Tishechkin/ (GRSM); 4 specimens labeled /USA: TN: Blount Co., GSMNP, NE corner of Cades Cove at 36°36'33"N, 83°47'12"W, 640 m, forest litter, 17 July 2003, A.Tishechkin/ (GRSM); 7 specimens labeled /USA: NC: Swain Co., GSMNP, Hazel Creek Trail at 36°28'27"N, 83°42'27"W, 600 m, forest litter, 18 July 2003, A.Tishechkin/; 1 specimen labeled /USA: NC: Swain Co., GSMNP, Lakeshore Trail at 36°28'20"N, 83°43'14"W, 630 m, forest litter, 18 July 2003, A.Tishechkin/.

Distribution (Figs. 41, 43). Known from western part of Great Smoky Mountains National Park to at least Cloudland Canyon State Park, Georgia (type locality).

Habitat. Specimens have been taken in Berlese samples among rocks.

Differential Diagnosis. *Anillinus steevesi* belongs to ovoid species with areas lacking microsculpture on the head (group II of litter species). It can be distinguished from all other species in this group by the form of the median lobe.

This species is narrowly sympatric with *A. langdoni* in the western part of the Smoky Mountains and separated from nearest populations of *A. loweae* by only about 20 km (Fig. 43). From its closest congeners it differs by the features mentioned in the key with the exception of *A. loweae*. Externally, *A. steevesi* is similar to *A. loweae*, but they may be distinguished easily by the form of median lobe and by the armature of the internal sac.

Anillinus turneri Jeannel
(Map fig. 41)

Anillinus turneri Jeannel, 1963a:77. Holotype female glued on rectangle and labeled / Peach Co., Ga., 15 Nov 1941, in soil peach orch. 18951 W.F.Turner/ TYPE/ TYPE No 69543 USNM/ *Anillinus Turneri* n.sp. R.Jeannel det., 19 /. Deposited USNM.

Holotype examined. Specimen is in good condition, not damaged or dissected.

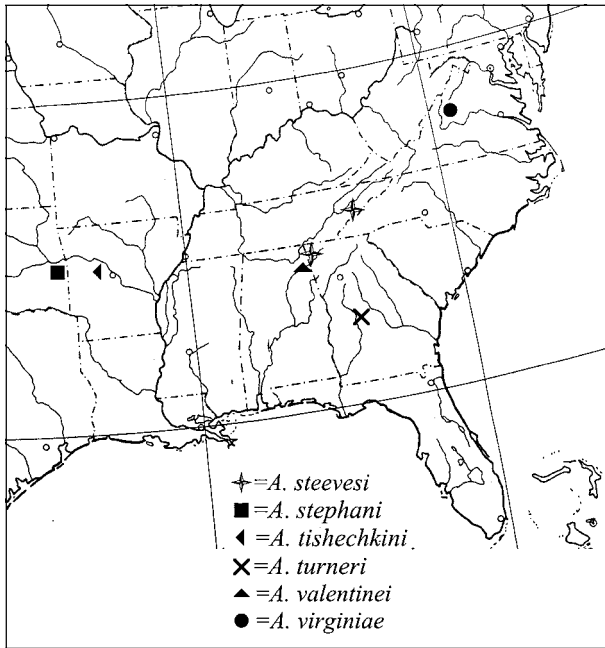


Fig. 41. Locality records for *Anillinus* spp.

Description. Small-sized for genus (ABL, 1.58 mm). Habitus subconvex, elongate (WE/ABL, 0.36), head of moderate size (WH/WPm, 0.77), pronotum and elytra relatively narrow (WPm/WE, 0.85). Color of body brunneorufous, appendages testaceous. Dorsal microsculpture effaced to different degrees on head and pronotum. Head with distinct microsculpture throughout except area with indistinct microsculpture on clypeus and central part of head between the supraorbital punctures. Microsculpture indistinct on disc of pronotum.

Pronotum moderately convex and transverse (WPm/LP, 1.35), margins markedly constricted posteriad (WPm/WPp, 1.34) and slightly sinuate before posterior angles. Anterior angles evident, slightly prominent. Posterior angles nearly rectangular. Width between posterior angles slightly less than between anterior angles (WPa/WPp, 1.04).

Elytra markedly convex, slightly depressed along suture, relatively short (LE/ABL, 0.56), with traces of at least 5 interneurs. Humeri prominent, slightly rounded. Vestiture of elytra short.

Genitalia not examined.

Distribution. Known only from type locality in Peach County, Georgia (Fig. 41).

Habitat. Holotype specimen bears the label "in soil peach. orch."

Differential Diagnosis. *Anillinus turneri* is a single member of parallel-sided species with patches of effaced microsculpture on the head (Table 2, group VI of endogean species). Additional specimens and aedeagal examination are required for further diagnosis.

Comments. J.F. Cornell tried to collect *A. turneri* in Peach Co. Georgia during 1972–73 using Berlese techniques, but was unsuccessful. Soil washing, as mentioned under *A. elongatus*, may prove more effective. The 1932 collection by Turner was probably made during a USDA project sampling uncultivated areas between fields and orchards in search of overwintering peach and boll weevils. These collections also

recovered the eyeless histerid *Geocolus caesus* Wentzel, which, like *A. turneri*, apparently has not been collected since.

Anillinus valentinei (Jeannel)

(Map fig. 41)

Troglanillus valentinei Jeannel, 1963b:148. Holotype male glued on thin straw attached to trapezoidal card and labeled /Ft. Payne Cave Ft., Ala., 3 Oct 1931, J.M.Valentine/ 'white rectangle' / 420/ TYPE/ TYPE No 69550 USNM/ Troglanillus valentinei type R.Jeannel det., 19 /. Deposited USNM.

Anillinus valentinei (Jeannel). Synonymized by Barr 1995:242.

Holotype examined. Type specimen badly damaged, represented by only the thorax, abdomen without internal contents, and four legs (second and third pairs).

Barr correctly placed *Troglanillus* in synonymy with *Anillinus* (Barr 1995). The presence of the spines in the internal sac of median lobe was the feature cited by Jeannel (1963b) to justify placing the species in a separate genus. But these spines occur in several different groups of *Anillinus* apparently independently derived. Thus, the presence of spines is insufficient reason for establishing a new taxon above the species level unless more careful phylogenetic analysis suggests otherwise.

Distribution. According to Barr (1995:243) this species is "distributed throughout the caves of northeast Alabama, east of the Wills Creek anticline" (Fig. 41).

Habitat. This species is a true troglobite as far as known.

Anillinus virginiae Jeannel

(Map fig. 41)

Anillinus virginiae Jeannel, 1963a:76. Holotype female glued on triangle and labeled / 'white rectangle'/ Ernest Shoemaker Collection 1956/ 783/ Skyland, Virginia/ A.Nicolay IX-16-1933/ TYPE/ TYPE No 69546 USNM/ *Anillinus virginiae* n. R.Jeannel det., 19 /. Deposited USNM. Cotype-female labeled / Skyland, Virginia/ A.Nicolay IX-16-1933/ deposited LSAM.

Holotype examined. Specimen is in good condition, not damaged or dissected.

Description. Medium-sized for genus (ABL, 1.70 mm). Habitus moderately convex, ovoid (WE/ABL, 0.40), with maximum width behind middle of elytra, head of moderate size (WH/WPm, 0.74), elytra relatively wide (WPm/WE, 0.78). Color of body brunneorufous, appendages testaceous. Dorsal microsculpture distinct across head and pronotum.

Pronotum moderately convex and transverse (WPm/LP, 1.28), margins slightly and rectilinearly constricted posteriad (WPm/WPp, 1.24), not sinuate before posterior angles. Anterior angles evident, slightly prominent. Posterior angles obtuse. Width between posterior angles greater than between anterior angles (WPa/WPp, 0.93).

Elytra moderately convex, slightly depressed along suture, relatively long (LE/ABL, 0.61), with traces of only 2 interneurons. Humeri prominent, slightly rounded. Vestiture of elytra short.

Genitalia not examined.

Distribution. Known only from the type locality in Virginia (Fig. 41).

Habitat. No data.

Differential Diagnosis. *Anillinus virginiae* is ovoid in form with distinct microsculpture on forebody (Table 2, group I of litter species). From other species in this group it may be distinguished only by its limited distribution. Additional specimens and aedeagal examination are required for further diagnosis.

Descriptions of New Species

Anillinus balli Sokolov and Carlton, **new species**

(Fig. 21, Map fig. 38)

Holotype (USNM). Male labeled /USA: KY, Laurel Co., Bald Rock Picnic Area, Hardwood berlese, 4.IV.1991, C.E.Carlton/ LSAM0017691/ HOLOTYPE, *Anillinus balli* Sokolov and Carlton, des. 2003/.

Paratypes (LSAM). One male with the same locality data as the holotype.

Specific Epithet. This species is named after George Ball (University of Alberta, Edmonton, AB) in honor of his contributions to the systematics of carabid beetles.

Description. Medium-sized for genus (ABL range, 1.69–1.74 mm; mean, 1.71 mm, n = 2). Habitus moderately convex, ovoid (WE/ABL, 0.41) with head relatively narrow for genus (WH/WPm, 0.71) pronotum relatively narrow compared to elytra (WPm/WE, 0.79). Color of body brunneous, appendages testaceous. Dorsal microsculpture distinct across head and pronotum.

Pronotum moderately convex and transverse (WPm/LP, 1.30), with margins rectilinear and slightly constricted posteriad (WPm/WPp, 1.25). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105–115°). Width between posterior angles much wider than between anterior angles (WPa/WPp, 0.91).

Elytra moderately convex, depressed along suture, of normal length for genus (LE/ABL, 0.59), with traces of 2–3 interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra relatively short (less than one-fourth the length of discal setae).

Males with metafemora simple.

Females unknown.

Median lobe (Fig. 21) nearly rectangular arcuate, with enlarged angulate apex. Internal sac with copulatory pieces relatively small, of a pair of curved dorsal sclerites that form a tiny blade-like structure in apical part of median lobe; ventral sclerite and spines of internal sac absent.

Distribution. Known only from the type locality in Laurel Co., Kentucky (Fig. 38).

Habitat. Specimens were collected from a Berlese sample of hardwood litter.

Differential Diagnosis. *Anillinus balli* is ovoid in form with distinct microsculpture on forebody (Table 2, group I of litter species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe.

This species is allopatric with respect to other described species of *Anillinus*. From its geographically closest congeners it differs by the features mentioned in the key.

Anillinus barri Sokolov and Carlton, **new species**

(Fig. 22, Map fig. 38)

Holotype (USNM). Male labeled /USA: TN, Monroe Co., Indian Boundry (*sic*) Campground, Berlesate, 29.V.1991, C.E.Carlton/ LSAM0017693/ HOLOTYPE, *Anillinus barri* Sokolov and Carlton, des.2003/.

Paratypes (LSAM). Two males with same collection data as holotype.

Specific Epithet. The specific epithet honors Thomas C. Barr (Nashville, TN) in recognition of his contributions to carabid systematics.

Description. Medium-sized for genus (ABL range, 1.62–1.69 mm; mean, 1.66 mm, n = 3). Habitus moderately convex, ovoid (WE/ABL, 0.39) head normally proportioned for genus (WH/WPm, 0.74), with relatively narrow pronotum and elytra (WPm/WE, 0.81). Color of body brunneorufous, appendages testaceous. Microsculpture of head limited to small triangular area at middle of vertex, microsculpture absent on disc of pronotum.

Pronotum moderately convex, and transverse (WPm/LP, 1.31), with margins rectilinear and moderately constricted posteriad (WPm/WPp, 1.28). Anterior angles evident, slightly prominent.

Posterior angles slightly obtuse (105–115°). Width between posterior angles greater than between anterior angles (WPa/WPp, 0.96).

Elytra moderately convex, moderately depressed along suture, of normal length for genus (LE/ABL, 0.58), with traces of 1–2 interneurs. Humeri moderately prominent, slightly rounded. Vestiture is relatively short (less than one-fourth the length of the discal setae).

Males with metafemora simple.

Females unknown.

Median lobe (Fig. 22) elongate, twisted, with enlarged, rounded apex and enlarged acute ventral margin. Internal sac with copulatory piece forming a long, filament-like structure, with apex extended beyond the internal sac; ventral sclerite and spines of internal sac absent.

Distribution. This species is known only from the type locality in Monroe County, Tennessee (Fig. 38).

Habitat. Beetles were collected in hardwood forest litter at mid-elevations (700–1,300 m).

Differential Diagnosis. *Anillinus barri* is ovoid in form without microsculpture on the forebody (Table 2, group VIII of litter species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe and dorsal copulatory sclerite.

This species is sympatric with *A. langdoni* and two species of *Serranillus*. From *A. langdoni* it differs by the absence of microsculpture on the disc of the pronotum.

Anillinus cornelli Sokolov and Carlton, **new species**

(Fig. 23, Map fig. 42)

Holotype (USNM). Male labeled / NC Gaston Co. Crowders Mt St Pk 23VI82 JF Cornell pine log litter 982VI23-3/ HOLOTYPE, *Anillinus cornelli* Sokolov and Carlton, des. 2004/.

Paratypes (11). Three males and 1 female, same data as holotype; 1 male labeled / SC York Co nr Kings Mt Kings Mt St Pk 20 V 72 JF Cornell/ (JFC); 1 male labeled / SC York Co Kings Mt St Pk nr Kings Mt 9 I 83 JF Cornell Ulogs stones stream Debr 983-I-9-2C/; 5 males labeled /SC York Co Kings Mt St Pk Oct 28, 89 JF Cornell 989-X-28-3/ (JFC).

Specific Epithet. The species is named after Jim Cornell, collector of the type series and many other specimens of the genus.

Description. Medium-sized for genus (ABL range, 1.61–2.08 mm, mean, 1.90 mm, n = 10). Habitus moderately convex, ovoid (WE/ABL, 0.38); head normally proportioned for genus (WH/WPm, 0.80); pronotum and elytra relatively narrow (WPm/WE, 0.75). Color of body brunneus, appendages testaceous. Microsculpture of head limited to small triangular area at middle of vertex and frontal impressions, absent from disc of pronotum.

Pronotum moderately convex, and transverse (WPm/LP, 1.16), with margins rectilinear and slightly constricted posteriad (WPm/WPp, 1.10). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105°). Width between posterior angles slightly greater than width between anterior angles (WPa/WPp, 0.91).

Elytra moderately convex, moderately depressed along suture, of normal length for genus (LE/ABL, 0.54), with traces of 2–3 interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra relatively short (less than one-fourth the length of the discal setae).

Males with metafemora simple.

Median lobe (Fig. 23) arcuate, twisted, with small, narrowly rounded apex. Internal sac with copulatory pieces of dorsal and ventral sclerites. Dorsal sclerite strongly arched near midpoint of median lobe, apex extending far beyond internal sac when fully extended. Ventral sclerite formed from three elongate subapical tubercles.

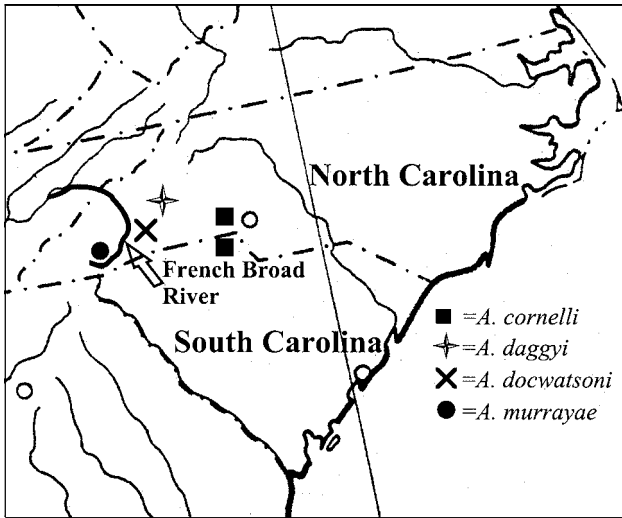


Fig. 42. Locality records for *Anillinus* spp. occurring within North and South Carolina, with the French Broad River indicated.

Distribution. This species is known from two nearby localities in Gaston County, North Carolina (Crowders Mountain State Park) and York County, South Carolina (Kings Mountain State Park) (Fig. 42).

Habitat. The holotype was collected in pine log litter.

Differential Diagnosis. *Anillinus cornelli* is ovoid in form without microsculpture on the forebody (Table 2, group VIII of litter species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe and armature of the internal sac.

This species is apparently allopatric with respect to other described species of *Anillinus* and likely is sympatric with at least one species of *Serranillus*. From *A. loweae* it differs by the absence of microsculpture at the disc of pronotum and in lacking head microsculpture, except a small triangle at the middle of the vertex, and by the distinctive aedeagus. *Anillinus cornelli* is similar to *A. murrayae* in habitus and the general shape of the main dorsal copulatory sclerite of the aedeagus and may represent its allopatric sister taxon. In *A. cornelli* that structure is more strongly arched and elongate than it is in *A. murrayae*. Also, the accessory aedeagal sclerites of the two species are quite different, with *A. cornelli* lacking the ventral blade-like sclerite and clusters of spines. *Anillinus cornelli* also differs in having the male metafemora not expanded (*i.e.*, evenly convex along posterior margin) and the tubercles along the posterior margin are much smaller and are visible only under very high magnification and strong illumination.

Anillinus daggyi Sokolov and Carlton, **new species**
(Fig. 24, Map fig. 42)

Holotype (NCSU). Male labeled /69348/ Glen Alpine Springs Burke Co., NC IV 17 1977 Tom Daggy/ HOLOTYPE, *Anillinus daggyi* Sokolov and Carlton, des. 2004/.

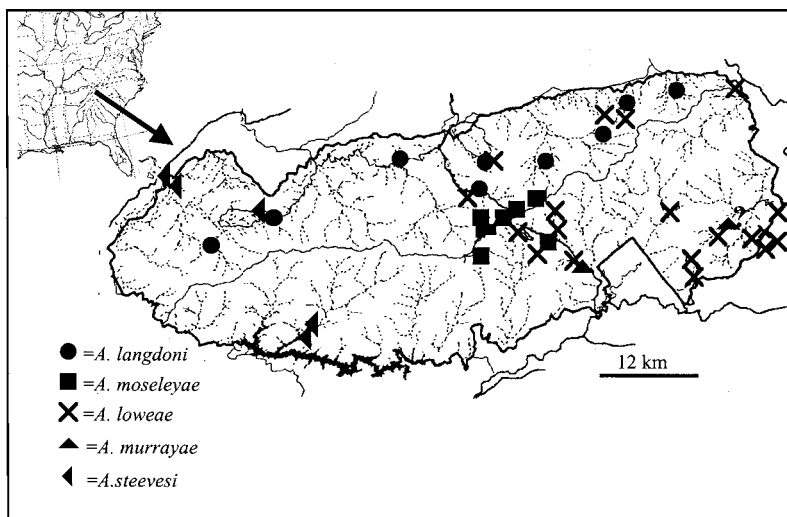


Fig. 43. Locality records for *Anillinus* spp. occurring within Great Smoky Mountain National Park.

Paratypes (18). Four males, 5 females, same data as holotype and bearing the following top labels /69342/; /69343/; /69344/; /69345/; /69346/; /69347/; /69349/; /69350/ (NCSU); 3 males (1 slide mounted) and 2 females labeled /Glen Alpine Springs Burke Co., NC XI 29 1973 Tom Daggy/ and bearing the following top labels /61786/; /61787/; 61789/; /61790/; /61791/ (NCSU); 1 male and 3 females labeled /NC Burke Co 8 mi S Enola CR1969 4Oct70 JCornell ex rot stump (JFC).

Specific Epithet. The species is named for the collector, Tom Daggy.

Description. Small-sized for genus (ABL range, 1.53–1.77 mm; mean, 1.65 mm, $n = 10$). Habitus moderately convex, ovoid (WE/ABL, 0.38), head of moderate size (WH/WPm, 0.75), elytra relatively wide (WPm/WE, 0.77). Color of body rufotestaceous, appendages testaceous.

Head with microsculpture evident across frons and vertex, except indistinct in paramedian areas of vertex. Dorsal microsculpture distinct across most pronotum; indistinct along midline.

Pronotum moderately convex and transverse (WPm/LP, 1.23), with margins moderately and rectilinear convergent towards base (WPm/WPp, 1.29). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse ($100\text{--}110^\circ$). Width between posterior angles equal to width between anterior angles (WPa/WPp, 1.00).

Elytra moderately convex, slightly depressed along suture, length normal for genus (LE/ABL, 0.57), with traces of 1–2 interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra short (less than one-quarter length of discal setae).

Males with metafemora simple.

Median lobe (Fig. 24) weakly arcuate with broad lobate apex. Internal sac with dorsal copulatory sclerite short and sickle-shaped; ventral sclerites and spine patches absent.

Distribution. This species is known from two nearby localities in Burke County, NC (Fig. 42).

Habitat. A series of four specimens was collected from a rotten stump.

Differential Diagnosis. *Anillinus daggyi* is ovoid in form with microsculpture on the forebody except paramedian patches of vertex (Table 2, group II of litter species). In

addition, it may be distinguished from all other species in this group (for which males are known) by the form of the copulatory sclerites and armature of the internal sac.

This species is sympatric with *A. fortis* and probably with *A. erwini*, and it is likely sympatric with at least one species of *Serranillus*. From *A. erwini* it differs by the presence of microsculpture across most of the disc of the pronotum and head, and by the shorter and more arcuate dorsal copulatory sclerite. *Anillinus daggyi* may be distinguished from *A. fortis* by its smaller size (mean ABL of *A. fortis*, 1.95; of *A. daggyi*, 1.65) and paler color, in addition to aedeagal differences.

Anillinus docwatsoni Sokolov and Carlton, **new species**

(Fig. 25, Map fig. 42)

Holotype (NCSU). Male labeled / USA, NC Rutherford Co., Chimney Rock, 15 Sept 1996, J. F. Cornell, Broad R. flood debris/ HOLOTYPE, *Anillinus docwatsoni* Sokolov and Carlton, des. 2004/.

Paratypes (5, JFC). Five females, same data as holotype.

Specific Epithet. The species is named after Arthel "Doc" Watson, legendary bluegrass musician from North Carolina.

Description. Medium-sized for genus (ABL range, 1.81–2.08 mm; mean 1.90 mm, n = 6). Habitus markedly convex, ovoid (WE/ABL, 0.39), head of moderate size (WH/WPm, 0.73), elytra relatively wide (WPm/WE, 0.80). Color of body brunneorufous, appendages testaceous. Head with microsculpture evident across frons and vertex except in paramedian areas of vertex, where it is indistinct. Dorsal microsculpture distinct across most pronotum; indistinct along midline.

Pronotum moderately convex and transverse (WPm/LP, 1.39), with margins moderately and rectilinear convergent towards base (WPm/WPp, 1.33). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (100–110°). Width between posterior angles equal to width between anterior angles (WPa/WPp, 1.00).

Elytra markedly convex, slightly depressed along suture, length normal for genus (LE/ABL, 0.56), with traces of 1–2 intermeurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra short (less than one-quarter length of discal setae).

Males with metafemora simple.

Median lobe (Fig. 25) evenly arcuate with simple narrowly rounded apex. Internal sac with dorsal copulatory sclerite weakly sinuate then twisted and curved ventrally in apical one-third; ventral sclerite diverging from base of dorsal sclerite, overlapping it basally, then curved ventrally. Internal sac ventral to sclerites bearing dense rows of fine triangular spines.

Distribution. This species is known from a single locality in Rutherford County, NC (Fig. 42).

Habitat. The type series was collected in flood debris along the Broad River.

Differential Diagnosis. *Anillinus docwatsoni* is ovoid in form with microsculpture on the forebody except paramedian patches of vertex (Table 2, group II of litter species), though in this last regard the microsculptured areas are slightly more extensive than in other members of the group. In addition, it may be distinguished from all other species in this group (for which males are known) by the form of the copulatory sclerites and armature of the internal sac.

This species is apparently allopatric with respect to other described species of *Anillinus*, though several species occur nearby, and it is likely sympatric with at least one species of *Serranillus*. From *A. cornelli* and *A. murrayae*, known from localities to the southeast and west, respectively, it differs by the presence of microsculpture across most of the disc of the pronotum and head, and by the distinctive aedeagus. The main dorsal copulatory sclerite is similar to that of *A. loweae* and *A. fortis*, but these two species lack the secondary ventral copulatory sclerite and the distinctive spine

arrangement of the internal sac ventral to the sclerites. Also, *A. docwatsoni* lacks the distinctive subapical patch of spines on the internal sac of *A. loweae*.

Anillinus erwini Sokolov and Carlton, **new species**

(Figs. 5–6, 26, Map fig. 39)

Holotype (USNM). Male labeled /USA: NC, Watauga Co., Rough Ridge Trailhead, 8 mi SW Blowing Rock, elev. 4,200', 2.VI.1991/ LSAM0017672/ HOLOTYPE, *Anillinus erwini* Sokolov and Carlton, des. 2003/.

Paratypes (34, LSAM unless otherwise indicated). Three females with same locality data as holotype. Two females labeled /USA: NC, McDowell Co., Deerlick Gap. Overlook, elev. 3,500', B.R.Pkw. 2.2 mi SW intersect. 221, 2.VI.1991, C.E. Carlton/; 4 females labeled /USA: NC, Yancy Co., B.R.Pkw., 37.4 mi SW intersection US 221, elev. 4,600', log litter, 2.VI.1991, C. Carlton/; 6 males and 3 females labeled /Avery Co., NC, V-4 1973, Tom Daggy (also with numbers 6586–6594 on separate labels) (NCSU); 1 male and 6 females labeled /Grandfather Mt., NC, IV-30 1955, Tom Daggy (also with numbers 2310–2316 on separate labels) (NCSU); 2 males and 4 females labeled /USA: VA, Grayson Co., Grayson Highlands St.Pk., picnic area near visitors center, Berlesate, 3.VI.1991, C.E. Carlton/; 1 male and 2 females labeled /USA: VA, Wash. Co., E. of Damascus, leaf litter, 3.VI.1991, C.E. Carlton/.

Specific Epithet. This species is named after Terry Erwin (Smithsonian Institution, Washington, DC) in honor of his contributions to carabid systematics and studies of beetle diversity.

Description. Medium-sized for genus (ABL range, 1.63–1.91 mm; mean 1.77 mm, $n = 19$). Habitus markedly convex, ovoid (WE/ABL, 0.39), head of moderate size (WH/WPm, 0.75), elytra relatively wide (WPm/WE, 0.78). Color of body various, from brunneous to brunneofeous, appendages testaceous. Head (Fig. 5) without microsculpture in two paralaral areas at vertex that are confluent at the middle of frons, this area often extended over central parts of frons, where microsculpture becomes indistinct. Dorsal microsculpture indistinct across pronotum, at most with traces of microlines throughout and polygonal meshes next to lateral margins.

Pronotum (Fig. 6) moderately convex and transverse (WPm/LP, 1.29), with margins moderately and rectilinear convergent towards base (WPm/WPp, 1.28) (some specimens from Virginia have shallow sinuation before the posterior angles). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse ($100\text{--}110^\circ$). Width between posterior angles approximately equal to width between anterior angles (WPa/WPp, 0.97).

Elytra markedly convex, slightly depressed along suture, length normal for genus (LE/ABL, 0.57), with traces of 1–2 interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra short (less than one-quarter length of discal setae).

Males with metafemora slightly, evenly enlarged at middle.

Median lobe (Fig. 26) evenly arcuate with simple acuminate apex. Internal sac with dorsal copulatory sclerite forming long, filament-like structure, the apex extending beyond the internal sac; ventral sclerite and spines of internal sac absent.

Distribution. Known from a large area north of the French Broad River in North Carolina, north to the southwestern counties of Virginia (Fig. 39).

Habitat. Specimens were collected in Berlese samples taken in moist hardwood forests.

Differential Diagnosis. *Anillinus erwini* is a single member of ovoid species with patches of effaced microsculpture on the head and smooth pronotum (Table 2, group VI of litter species).

Anillinus erwini occurs sympatrically with *A. fortis* (Horn) and possibly with *A. virginiae* in the northern part of its range. It differs from both species in having microsculpture effaced on the pronotum and also by the microsculpture more effaced on the head.

Anillinus folkertsi Sokolov and Carlton, **new species**

(Fig. 27, Map fig. 39)

Holotype (USNM). Male labeled /ALA, Monroe County, 1 mi S Claiborne Dam, 31° 35' 30" N 87° 32' 21" W, 31.V.1995 C.E. Carlton /Beech/Magnolia riparian berlese / William H. Cross Expedition 1995/ LSAM0017115/ HOLOTYPE, *Anillinus folkertsi* Sokolov and Carlton, des. 2003/.

Paratypes (5, LSAM). Three males and 2 females with same data as holotype.

Specific Epithet. This species is named after George Folkerts (Auburn University, Auburn, AL), natural historian extraordinaire for the state of Alabama.

Description. Medium-sized for genus (ABL range, 1.59–1.85 mm; mean, 1.77 mm, n = 6). Habitus moderately convex, ovoid (WE/ABL, 0.40) head normal in size (WH/WPm, 0.74) pronotum relatively narrow compared to elytra (WPm/WE, 0.78). Color of body various, from brunnescens to brunneofuscous, appendages testaceous. Dorsal microsculpture distinct across head and pronotum.

Pronotum moderately convex, markedly transverse (WPm/LP, 1.35), with margins rectilinear and slightly constricted posteriad (WPm/WPp, 1.23). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105–115°). Width between posterior angles much greater than between anterior angles (WPa/WPp, 0.92).

Elytra moderately convex, moderately depressed along suture, of normal length (LE/ABL, 0.59), with traces of 4–5 interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra relatively short (less than one-fourth length of discal setae).

Males with metafemora simple.

Median lobe (Fig. 27) evenly arcuate, with enlarged apex acute at middle where outermost membranous part of sac wall is attached. Thus, apical ostium divides apex into ventral and dorsal portions and reaches the aedeagal apex. Internal sac with copulatory pieces of both dorsal and ventral sclerites. Dorsal sclerites in form of a filament-like structure, which is relatively short and does not extend beyond internal sac. Ventral sclerite in form of 3-pronged curved plate. Spines of internal sac absent.

Distribution. Known from the type locality in the “Red Hills” area of Monroe Co., Alabama (Fig. 39).

Habitat. Specimens were collected from a Berlese sample taken in a riparian forest near the Alabama River. This sample also yielded an undescribed species of the pselaphine staphylinid genus *Arianops*. Other unique faunal elements found in the Red Hills area include the plesiotypic gyrid *Spanglergyrus albiventris* Folkerts (Folkerts 1979) and the endemic salamander *Phaeognathus hubrichti* Highton (Highton 1961).

Differential Diagnosis. *Anillinus folkertsi* is a member of ovoid species with completely developed microsculpture on forebody (Table 2, group I of litter species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe and armature of the internal sac.

This species is allopatric with respect to other described species of *Anillinus*, and is quite isolated from the nearest populations of other species. From its geographically closest congeners it differs by the presence of the 4–5 interneurs on the elytra and by the features mentioned in the key.

Anillinus kovariki Sokolov and Carlton, **new species**

(Fig. 28, Map fig. 39)

Holotype (FSCA). Male labeled /Florida, Jefferson Co., Monticello, 3.5 mi NW, 2.5 mi W Rt-259 on West Lake rd. (Mays Pond), 18–27-1-1999, P. Skelley & P. Kovarik, *Geomys burrow pitfall*/ HOLOTYPE, *Anillinus kovariki* Sokolov and Carlton, des. 2003/.

Paratypes. None.

Specific Epithet. This species is named for Peter Kovarik (Columbus, OH) in honor of his contributions to Coleoptera systematics and his research on the faunas of pocket gopher burrows.

Description. Large-sized species (ABL = 2.66 mm). Habitus markedly convex, ovoid (WE/ABL 0.37), head relatively narrow (WH/WPm 0.67), pronotum extremely wide (WPm/WE 0.87). Color of body brunneorufous, appendages testaceous. Dorsal microsculpture effaced on pronotal disc and mostly effaced on head, where it covers only vertex.

Pronotum markedly convex, markedly transverse (WPm/LP 1.37), with margins rectilinear and moderately constricted posteriorly (WPm/WPp 1.26). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (108°). Width between posterior angles much greater than between anterior angles (WPa/WPp 0.90).

Elytra moderately convex, moderately depressed along suture, of normal length (LE/ABL 0.57), with traces of 4–5 interneurons. Humeri moderately prominent, slightly rounded. Vestiture of elytra relatively short (less than one-fourth length of discal setae).

Males with metafemora modified; bearing a small sharp denticulate projection along posterior margin in apical third.

Females unknown.

Median lobe (Fig. 28) large, evenly arcuate, with enlarged rounded apex bent in dorsoventral aspect. Apex with a small incision at the right side. Both sides of apical ostium modified to form walls, the larger bearing several setae and a narrow appendix, united at apex. Thus, apex of median lobe bears a small incision at the right side and in dorsal view the apex has an asymmetrical “left palm” contour with long “thumb.” Internal sac with copulatory pieces of dorsal and ventral sclerites. Dorsal sclerites small, arcuate, in form of a blade-like structure. Ventral sclerite formed from a small angulate plate. Spines of internal sac absent.

Distribution. Known from the type locality in Jefferson Co., Florida (Fig. 39).

Habitat. The holotype was collected in a pocket gopher burrow. Peter Kovarik and Paul Skelley have collected extensively from this habitat in Florida but have taken only one specimen of this species. Probably the species is subterranean in areas where pocket gophers occur and was accidentally collected in the burrow trap.

Differential Diagnosis. *Anillinus kovariki* is a single member of ovoid species without microsculpture on the pronotum and mostly effaced microsculpture on the head (Table 2, group VII of litter species). The large size of the beetle, large median lobe, and enlarged lateral walls of the aedeagal apex set this species apart from all other members of the genus for which males are known.

This species is allopatric with respect to other described species of *Anillinus*. From its geographically closest congeners it differs by its large size, and by its transverse and smooth pronotum, in addition to features mentioned in the key. From *A. dohrni*, described from Florida without precise locality information, it differs by its larger size (*A. dohrni*: length—1.50 mm, width—0.50 mm; *A. kovariki*: length—2.66 mm, width—0.98 mm).

Anillinus langdoni Sokolov and Carlton, **new species**

(Fig. 29, Map fig. 43)

Holotype (USNM). Male labeled /USA: TN, Sevier Co., GSMNP, Laurel Falls Trail, 83°35'36"W 35°40' 19"N/ elv. 747 m, leaf litter berlese, 1 July 2001, C.Carlton, V.Moseley, A.Tishechkin/ LSAM0003244/ HOLOTYPE, *Anillinus langdoni* Sokolov and Carlton, des. 2003/.

Paratypes (61). Nine males with the same collection data labels as holotype (GRSM). One specimen labeled /USA: TN: Blount Co., Great Smoky Mt.N.P., S. of entrance, elv. 3,080', leaf/log litter, 1.VI.1991, C.E.Carlton/ (LSAM); 2 males and 1 female labeled /USA: TN: Cocke Co., GSMNP, Gabes Mountain Trail at Hen Wallow

Falls, UTM 297649 E 3959487 N, moist forest berlese C. Carlton, N. Lowe 19 July 2002/ (GRSM); 3 females labeled /USA, TN, Cocke Co., GSMNP, Cosby Creek/ Lot # 77-58, 18 June 1977, Berlesate, R. Chenoweth/ (LSAM); 2 males and 1 female labeled /USA, TN, Sevier Co., GSMNP, Ramsey Cascade Trail (middle), 83°18'24"W 35°42'34"N/ elev. 1,300 m, forest litter berlese, 21 March 2002, C.E. Carlton, V.L. Moseley/ (GRSM); 3 males and 1 female labeled /USA, TN, Sevier Co., GSMNP, Porters Crk. Trail, 83°23'52"W 35°40'13"N/ elev. 870 m, 18 Oct 2001, A. Tishechkin, A. Cline/ (GRSM); 3 males and 11 females labeled /USA: TN, Monroe Co., Indian Boundary Campground, 29.V.1991/ (LSAM); 5 males and 3 females labeled /TN: Sevier Co., GSMNP, Porter's Creek Trail 9617, El. 738 m, 18–19 June 1996, Coyle, Brooks, Aiken, Davis/ (LSAM); 1 male and 1 female labeled /TN, Sevier Co., GSMNP, Porter's Creek Trail 9731, Elev. 2,420', 31 July 1997, Coyle, Brooks, Aiken, Davis / (LSAM); 2 males and 2 females labeled /Tennessee: Sevier Co., GSMNP, Porters Crk., 2nd Growth Cove Hardwood Upward Bound–Lambda Epsilon: Beetle Blitz. 30 Jun 2001, Ground sample/ (LSAM); 1 male and 2 females labeled /USA, TN, Sevier Co., GSMNP, Chimneys Picnic Area Nature Trail, 83°29'45"W 35°38'06"N, elev. 891 m/ forest litter berlese, 30 June 2001, C. Carlton, A. Tishechkin, V. Moseley/ (LSAM); 3 males and 4 females labeled /USA: TN: Sevier Co., GSMNP, Roaring Fork area, Rainbow Falls Trail, UTM 275540 E 3949710 N, moist cave berlese C. Carlton 1 Aug 2002/ (LSAM).

Additional Material (36, LSAM). 3 specimens labeled /USA: TN, Blount Co., GSMNP, Cades Cove, 83°46'31"W, 35°35'59"N/ elev. 625 m, forest litter berlese, 22 March 2002, CE. Carlton, VL. Moseley/; 1 specimen labeled /USA: TN, Blount Co., GSMNP, Gregory Ridge Trail, 83°50'06"W 35°32'25"N/ elev. 900 m, forest litter berlese, 22 March 2002, CE. Carlton, VL. Moseley/; 32 specimens labeled/Tennessee: Sevier Co., GSMNP, Porters Creek Tr., sift. litter near rotten logs, Beetle Blitz-2003, 18 July 2003, S.O'Keefe/.

Specific Epithet. The specific epithet honors Keith Langdon, Coordinator of Inventory and Monitoring at Great Smoky Mountain National Park, and an active advocate of the ATBI in GSMNP.

Description. Small to medium-sized for genus (ABL range, 1.41–1.75 mm; mean, 1.59 mm, $n = 20$). Habitus markedly convex, ovoid (WE/ABL, 0.40), head normally proportioned for genus (WH/WPm, 0.74), pronotum narrow compared to elytra (WPm/WE, 0.77). Body color various, from dark brunnescens to brunneorufous, appendages testaceous. Microsculpture distinct across dorsal surface of head and pronotum.

Pronotum moderately convex and transverse (WPm/LP, 1.30), with margins rectilinear and slightly constricted posteriad (WPm/WPp, 1.25). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105–115°). Width between posterior angles greater than between anterior angles (WPa/WPp, 0.94).

Elytra markedly convex, slightly depressed along the suture, of normal length for genus (LE/ABL, 0.58), with traces of 1–2 interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra short (less than one-fourth the length of the discal setae).

Males with metafemora simple.

Median lobe (Fig. 29) evenly arcuate, with simple rounded apex. Internal sac with copulatory pieces of markedly curved dorsal sclerites, blade-like in form with peculiar prominences at base; ventral sclerite and spines of internal sac absent.

Distribution. Known from the northwest ranges of the Great Smoky Mountains in Cocke, Monroe, and Sevier Counties of Tennessee (Fig. 43).

Habitat. Beetles were collected in the litter of hardwood forests at low to middle altitudes of the Smoky Mountains (700–1,300 m).

Differential Diagnosis. *Anillinus langdoni* is ovoid in form with distinct microsculpture on the forebody (Table 2, group I of litter species). It is distinguished from all

other species in this group (for which males are known) by the form of the median lobe and armature of the internal sac.

Anillinus langdoni occurs sympatrically with at least three species of *Anillinus* and two species of *Serranillius*. From all *Serranillius* species (besides the other differences mentioned in genus key) and two (*A. barri* and *A. moseleyae*) of the three sympatric *Anillinus* species it differs by its distinct microsculpture on the pronotum. From *A. loweae*, described below, it differs in the distribution of microsculpture of the head (distinct and covering all frons and vertex), and by its smaller size and greater width across the posterior angles of the pronotum.

Anillinus lescheni Sokolov and Carlton, **new species**
(Figs. 12, 15, 30, Map fig. 40)

Holotype (USNM). Male labeled /Oklahoma, Latimer Co., IV-85, K.Stephan/ HOLOTYPE, *Anillinus lescheni* Sokolov and Carlton, des. 2004/.

Paratypes (21). Four males and 2 females with same data as holotype. One female labeled /Oklahoma, Latimer Co., April 1982, Karl Stephan/ collected under rock (TAMU); 2 males, 1 female labeled /Oklahoma, Latimer Co., -IV-83, Karl Stephan/ collected under rock/ (TAMU, JFC); 1 male labeled /Oklahoma, Latimer Co., IV-85, Karl Stephan/ collected under rock/ (JFC); 1 male labeled /Oklahoma, Latimer Co., VI-1985, K.Stephan/ (TAMU); 1 male labeled /Oklahoma, Latimer Co., III-1987, Karl Stephan/ (JFC); 1 male labeled /Oklahoma, Latimer Co., IV-1987, Karl Stephan/ (JFC); 1 male labeled /Oklahoma, Latimer Co., III-1989, Karl Stephan/ (JFC); 1 male, 1 female labeled /Oklahoma, Latimer Co., -IV-1991, Karl Stephan/ (TAMU); 1 male, 1 female labeled /Oklahoma, Latimer Co., -III-1992, Karl Stephan/ (TAMU); 2 females labeled /Oklahoma, Latimer Co., -III-1992, Karl Stephan/ ex gopher burrow/ (TAMU).

Specific Epithet. This species is named for Richard Leschen (Landcare Research, Auckland, New Zealand) in honor of his contributions to Coleoptera systematics and in recognition of Karl Stephan's effectiveness in training coleopterists how to collect.

Description. Large-sized species (ABL range, 2.20–2.50 mm; mean, 2.38 mm, n = 10). Habitus elongate, parallel-sided (WE/ABL, 0.29), head relatively broad (WH/WPm, 0.81), pronotum wide (WPm/WE, 0.97). Color of body various, from rufotestaceous to amber testaceous, appendages testaceous. Dorsal microsculpture distinct, covering pronotum and head except for small areas with indistinct microsculpture at anterior parts of frons between frontal carinae and frontal grooves.

Pronotum moderately convex, broad (WPm/LP, 1.46), with margins markedly constricted posteriorly (WPm/WPp, 1.52) and slightly sinuate before posterior angles. Anterior angles evident, slightly prominent. Posterior angles nearly rectangular (95–100°). Width between anterior angles much greater than between posterior angles (WPa/WPp, 1.05).

Elytra slightly convex, widely depressed along suture, relatively short (LE/ABL, 0.57), with traces 3–4 interneurs. Humeri prominent, only slightly rounded. Vestiture of elytra short (less than one-fourth length of discal setae).

Males with mesotibiae bearing a posterior row of approximately six, evenly spaced teeth. Metafemora (Fig. 12) swollen, broadest in apical one-third and bearing a posterior row of low tubercles in middle one-third. Metatibiae (Fig. 15) bearing a posterior row of irregular rounded, granular tubercles.

Median lobe (Fig. 30) large, slightly arcuate, with an elongate ventrolateral lobe. Internal sac with large curved copulatory sclerite. Internal sac bearing approximately ten sharp, conical spines. Ventral sclerite absent, but two dense clusters of ventral spines present.

Distribution. Known from Latimer Co., Oklahoma (Fig. 40). This species and its sympatric congener *A. stephani* represent the western-most occurrences of the genus.

Habitat. Although Karl Stephan's collecting efforts encompass the entire area of Latimer County, two of his favorite collecting localities are his house near Red Oak and Robbers Cave State Park. Habitat where specimens were collected at the state park is rocky upland oak/hickory/shortleaf pine forest. Specimens were taken from beneath large rocks during rainy weather (K. Stephan pers. comm.). This locality is also the type and only known locality for the pselaphine staphylinid *Arianops stephani* Carlton and Allen (Carlton and Allen 1989).

Differential Diagnosis. *Anillinus lescheni* is parallel-sided with distinct microsculpture on the forebody (Table 2, group II of endogean species). This species is sympatric with *A. stephani*, which shares the elongate habitus and distinct microsculpture. The unusual tubercles of the metatibiae and large ventrolateral process of the aedeagus of males distinguish this species from *A. stephani* and all other species. It is also much larger than *A. stephani*.

Anillinus loweae Sokolov and Carlton, **new species**

(Fig. 31, Map figs. 40, 43)

Holotype (USNM). Male labeled /USA: NC: Haywood Co., GSMNP, Cataloochee Divide Trail near Purchase, UTM 311819 E 3940339 N Carlton 17 July 2002 / LSAM0017493 / HOLOTYPE, *Anillinus loweae* Sokolov and Carlton, des. 2003 /.

Paratypes (154, all LSAM unless indicated otherwise), Twelve males and 7 females with the same locality data as holotype (GRSM). Three males and 5 females labeled /USA: NC: Haywood Co., GSMNP, Cataloochee Divide Trail (north) UTM 313142 E 3942802 N moist upland berlese C. Carlton 23 July 2002/; 2 males and 5 females labeled /USA: NC: Haywood Co., GSMNP, Cataloochee area, Rough Fork Trail (upper), UTM 305981 E 3940519 N, moist upland berlese C. Carlton 29 July 2002/; 6 males and 4 females labeled /USA: NC: Haywood Co., GSMNP, Purchase Knob UTM 313124 E 3939640 N upland decid. berlese, elev. 5,089 ft C. Carlton 20 July 2002/ (GRSM); 1 male labeled /USA: NC: Haywood Co., GSMNP, cabin - Purchase Knob UTM 312103 3939281, under hemlock in litter, P. Super 22 Jul 2002/ (GRSM); 1 male labeled /USA: NC: Haywood Co., GSMNP, McKee Branch Trail 35°35'6"N 83°05'W, ulm, in gilled fungus sample C. Carlton 14 July 2002/; 1 male and 1 female labeled /USA, TN, Sevier Co., GSMNP, Chimneys Picnic Area Nature Trail, 83°29'45"W 35°38'06"N, elev. 891 m/ forest litter berlese, 30 June 2001, C. Carlton, A. Tishechkin, V. Moseley/; 1 male labeled /USA: TN: Sevier Co., GSMNP, Roaring Fork area, Rainbow Falls Trail, UTM 275540 E 3949710 N, moist cave berlese C. Carlton 1 Aug 2002/; 3 males and 2 females labeled /USA: NC: Swain Co., GSMNP, Collins Picnic Area, Quiet Walk UTM 287857 E 3938299 N C. Carlton 20 July 2002/; 2 males labeled /USA: NC: Swain Co., GSMNP, Deep Creek Trail (upper) UTM 280352 E 3942040 N moist upland berlese C. Carlton 22 July 2002/; 2 males labeled /USA: NC: Swain Co., GSMNP, Kanati Fork Trail UTM 284832 E 3939580 N moist upland berlese C. Carlton, N. Lowe 20 July 2002/; 24 males and 11 females labeled /USA: NC: Swain Co., GSMNP, Kanati Fork Trail UTM 284435 E 3939504 N moist upland berlese C. Carlton 22 July 2002/; 6 males and 5 females labeled /USA: NC: Swain Co., GSMNP, Quietwalk across from Kanati Fork Trailhead, UTM 285913 E 3940599 N, riparian area berlese C. Carlton 20 July 2002/; 10 males and 1 female labeled /USA, NC, Swain Co., GSMNP, Flat Creek Tr., 83°10'21"W 35°33'01"N/ elev. 1,500 m (this elevation in error), leaf litter berlese, 31 July 2001, A. Tishechkin/; 3 males and 4 females labeled /USA, NC, Swain Co., GSMNP, Beech Gap Trail, 83°12'42"W 35°37'39"N/ elev. 1,100 m, 20 Oct 2001, berlese, Carlton/Cline/; 2 males and 1 female labeled /USA, NC, Swain Co., GSMNP, Beech Gap Trail, 83°12'42"W

35°37'39"N/ elv. 1,400 m, 20 Oct 2001, N. hardwood berlese, C.Carlton/; 7 males and 14 females labeled /USA: TN, Cocke Co., GSMNP, Albright Grove Trail, 83°16'45"W 35°44'10"N/ elv. 1,000 m, decid.berlese, 19 October 2001, C.Carlton, A.Cline, A.Tishechkin/; 1 male and 5 females labeled /USA: TN:Cocke Co., GSMNP, Gabes Mountain Trail at Hen Wallow Fall, UTM 297649 E 3959487 N, moist forest berlese C.Carlton, N.Lowe 19 July 2002/; 1 male and 2 females labeled /USA: TN, Cocke Co., GSMNP, Albright Grove Trail, 83°16'45"W 35°44'10"N/ elv. 1,000 m, old growth berlese, 29 June 2001, C.Carlton, A.Tishechkin, V.Moseley/.

Additional Material (77). Four specimens labeled /USA: TN: Blount Co., Great Smoky Mt.N.P., S. of entrance, elv. 3,080', leaf/log litter, 1.VI.1991, C.E.Carlton/; 4 specimens labeled /USA: NC: Swain Co., GSMNP, Heintooga overlook, 29 June 1994, J. F. Cornell/; 14 specimens labeled /USA: NC: Swain Co., 2 mi S Heintooga overlook, beech-fir berlesate, 1.VI.1990, C.E.Carlton/; 2 specimens labeled /USA: NC: Swain Co., 5.8 mi S Heintooga Overlook, Great Smoky Mt.N.P., 1.VI.1991, C.E.Carlton/; 9 specimens labeled /N.Carolina: Great Smoky Mt.NP, Chestnut Branch Tr., 35°45.6'N 83°7.4'W, forest leaf litter, 1 Aug 2001, A.Tishechkin/; 39 specimens labeled /USA: NC: Transylvania Co., Pisgah NF, along FS 215, 35°10'N 83°52'W, upland hdwd. berlese, 4 Mar 1997 C.E.Carlton/; 4 specimens labeled /USA: NC: Swain Co., GSMNP, Kephart Prong. Trail at 36°36'36"N 83°21'56"W, 980 m, forest litter, 20 July 2003, A.Tishechkin/.

Specific Epithet. The specific epithet honors Nancy Lowe (Atlanta, GA) in recognition of her volunteer work as an illustrator for the ATBI at GSMNP.

Description. Medium to large-sized for genus (ABL range, 1.85–2.05 mm; mean, 1.94 mm, $n = 10$). Habitus markedly convex, ovoid (WE/ABL, 0.39), head of moderate size (WH/WPm, 0.74), elytra relatively wide (WPm/WE, 0.78). Color of body brunneous to brunneorufous, appendages testaceous. Microsculpture on head absent only from two paralateral patches at vertex, otherwise distinct. Pronotal microsculpture distinct across surface of disc.

Pronotum moderately convex and transverse (WPm/LP, 1.30), with margins only slightly (WPm/WPp, 1.25) rectilinear convergent posteriad. Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105–115°). Width between posterior angles much wider than between anterior angles (WPa/WPp, 0.91).

Elytra markedly convex, slightly depressed along suture, length normal for genus (LE/ABL, 0.57), with traces of 2–3 (–4) interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra short (less than one-fourth length of discal setae).

Males with metafemora simple.

Median lobe (Fig. 31) evenly arcuate, with a conspicuous dentiform expansion at dorsal margin of apex. Internal sac with copulatory pieces of spiral-curved dorsal sclerites and a group of closed spines. Dorsal sclerites in form of blade-like structure with equal prominences at base, and apex extending slightly beyond internal sac. Ventral sclerite of internal sac absent.

Distribution. Known from south of the French Broad River in North Carolina south to Sassafras Mountain in South Carolina (Barr 1995) and from the Great Smoky Mountains in Tennessee in the west to the Pisgah Mountains, North Carolina to the east (Figs. 40, 43).

Habitat. Most specimens have been taken in Berlese samples from moist deciduous forests and mixed forests at a variety of altitudes in the southern Appalachian Mountains.

Differential Diagnosis. *Anillinus loweae* belongs to ovoid species with patches without microsculpture on the head (Table 2, group II of litter species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe and armature of the internal sac.

The species occurs sympatrically with at least three species of *Anillinus* and two species of *Serranillus*. From all *Serranillus* species (besides the other differences

mentioned in the genus key) and two of the sympatric *Anillinus* (*A. murrayae* and *A. moseleyae*) it differs by the presence of microsculpture on the pronotum. From *A. langdoni* it differs by having areas without microsculpture on the head. That species has distinct microsculpture across the dorsal surface of the head. See previous discussion under *A. fortis* for comparison to *A. loweae*. These two apparently form an allopatric sister species pair separated by the French Broad River.

Anillinus magazinensis Sokolov and Carlton, **new species**
(Figs. 2, 8, 32, Map fig. 40)

Holotype (USNM). Male labeled /USA, AR, Logan Co., 0.5 mi S Greenfield Picnic Area, Mt.Magazine/ hdwd. berlesate, C.Carlton, 21 May 1987/ C.E.Carlton Collection/ LSAM0017651/ HOLOTYPE, *Anillinus magazinensis* Sokolov and Carlton, des. 2003/.

Paratypes (20, LSAM). Two males and 5 females with the same locality data as holotype. One female labeled /USA: Ar: Logan Co., Bear Hollow, Mt.Magazine, 27 Oct 1992, C.Carlton/; 1 female labeled /Ark., Logan Co., Mt.Magazine, Electronic Site/ 27 Aug 1986 S.Tedder, Berlesate/; 1 male labeled /USA, AR, Logan County, Mt.Magazine, Cameron Bluff Campground, Hardwood Berlese, 20 July 1996, C.E.Carlton/; 4 females labeled /USA, AR, Logan County, Mt.Magazine, Green Bench, Gutter Rock Creek/ Mixed berlesate, 5 May 1986, D.Bowles/; 1 female labeled /USA, AR, Logan County, Mt.Magazine, W.end Electronic Site, North face scree/ berl. from rocks, 29 Nov 1986, S.Tedder/; 1 male and 1 female labeled /USA, Ark., Logan Co., 0.4 mi S of Greenfield, E of Hwy., 2,500 ft, Mt.Magazine/ berlesate, 12 Jul 1987, S.A.Tedder/; 1 male labeled /USA, AR, Logan Co., Magazine Mt., Cove Lk. Trail, nr.top/ under rocks, 6 June 1989, R.T.Allen/; 1 female labeled /USA, AR, Logan Co., Magazine Mt., Electronic Site/ 21 Feb 1987, Berlesate, S.A.Tedder/; 1 male labeled /Ark., Logan Co., Mt.Magazine, NW corner below bluff (electronic site)/ duff under rocks, S.Tedder, 21 Jul 1986/.

Additional Material. Richard Leschen (Landcare Research, Auckland, New Zealand) provided additional records of this species, as follows: 2 specimens* labeled /USA, AR, Logan Co., Mt. Magazine, Bear Hollow, 10 March 1988, with ants, Richard Leschen/; 3 specimens labeled /USA, AR, Logan Co., Mt. Magazine, Dripping Springs, 10 March 1988, with ants, Richard Leschen. He included this note: "pinned with these specimens are the ants, and for * these are unknown, but one may be *Lasius*, and for ** two are *Camponotus* and one undetermined."

Specific Epithet. This species is named for the type locality, Mt. Magazine, highest point in Arkansas and an important outpost of insect diversity.

Description. Small-sized for genus (ABL range, 1.37–1.60 mm; mean, 1.50 mm, n = 15). Habitus subdepressed, slightly ovoid (WE/ABL, 0.38) with relatively large head for genus (WH/WPm, 0.79) (Fig. 2) and relatively narrow pronotum compared to elytra (WPm/WE, 0.79). Color of body various, from brunneorufous to rufotestaceous, appendages testaceous. Dorsal microsculpture distinct across head and pronotum (Figs. 2, 8).

Pronotum (Fig. 8) moderately convex, moderately transverse (WPm/LP, 1.34), with margins moderately and rectilinearly constricted posteriad (WPm/WPp, 1.31) (Fig. 8). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105–115°). Width between posterior angles approximately the same as between anterior angles (WPa/WPp, 1.03).

Elytra slightly convex, moderately depressed along suture, of normal length (LE/ABL, 0.57), with the traces of 4–5 interneurs. Humeri moderately prominent, moderately rounded. Vestiture of elytra relatively short (less than one-fourth the length of discal setae).

Males with metafemora simple.

Median lobe (Fig. 32) small, evenly arcuate, with simple round apex. Internal sac with copulatory pieces of a pair of moderately arcuate dorsal sclerites, in form of a blade-like structure; ventral sclerite and spines absent.

Distribution. Known only from Mt. Magazine, Logan County, Arkansas (Fig. 40).

Habitat. Specimens were collected from deep hardwood forest litter, under rocks, and from accumulations of litter between rocks. Other wingless litter-inhabiting beetles that are sympatric with *A. magazinensis* include the pselaphine staphylinids *Arianops sandersoni* Barr (precinctive to Mt. Magazine; Carlton and Allen 1989), *Ouachitychus parvoculus* Chandler, and *Pseudactium magazinensis* Carlton and Chandler (both precinctive to Mt. Magazine and the Ouachita Mountains to the south; Chandler 1988; Carlton and Chandler 1994).

Differential Diagnosis. *Anillinus magazinensis* is ovoid in form with distinct microsculpture on forebody (Table 2, group I of litter species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe and armature of the internal sac.

This species is allopatric with respect to other described species of *Anillinus*. From its geographically closest congeners it differs by the features recorded in the key.

Anillinus moseleyae Sokolov and Carlton, **new species**

(Fig. 33, Map fig. 43)

Holotype (USNM). Male labeled /USA: NC: Swain Co., GSMNP, Appalachian Trail 1.5 mi NE Newfound Gap, UTM 281639 E 3944038 N, ridgetop berlese C. Carlton, V. Moseley 18 July 2002/ LSAM 0017401/ HOLOTYPE, *Anillinus moseleyae* Sokolov and Carlton, des. 2003/.

Paratypes (27, all LSAM unless indicated otherwise). One male and four females with the same collection data labels as holotype. One male and 1 female labeled /USA: NC: Swain Co., GSMNP, Appalachian Trail at Sweat Heifer Cr Trail, UTM 282160 E 3944324 N, ridgetop berlese C. Carlton 18 July 2002/; 1 female labeled /USA: NC: Swain Co., GSMNP, Kanati Fork Trail # 2 UTM 284435 E 3939504 N moist upland berlese C. Carlton 22 July 2002/; 1 male labeled /USA, NC, Swain Co. GSMNP, Clingmans Dome, Fork Ridge Tr., 28 June 1994, J. F. Cornell, forest litter/ (slide mounted, JFC); 1 male and 1 female labeled /USA: TN: Blount Co., 5.8 mi E Cling.Dome, 1.VI.1991, C.E. Carlton/; 1 female labeled /USA, TN, Sevier Co., Appalachian Trail at Beech Gap on Clingmans Dome Rd., 83°26'50"W 35°36'36"N/ elev. 1,750 m, forest litter berlese, 28 June 2001, C. Carlton, A. Tishechkin, V. Moseley/; 1 male and 2 females labeled /USA: NC: Swain Co., GSMNP, Noland Divide Trail at 36°33'67.6"N 83°28'36"W, 1,770 m, leaf/moss mat litter, 19 July 2003, A. Tishechkin/; 2 males and 1 female labeled /USA: TN: Sevier Co., GSMNP, Road Prong. Trail at 36°36'36"N 83°27'03"W, 1,680 m, moss mat/leaf litter, 20 July 2003, A. Tishechkin/ (GRSM); 2 males and 1 female labeled /Tennessee: Sevier Co., GSMNP, Indian Head Tr., 35.60944°N 83.44659°W, sift.litter, 5,290', 20 July 2003, S.O'Keefe/ (GRSM); 6 females labeled /Tennessee|N.Carol.border.GSMNP, Newfound Gap, 35.611°N 83.425°W, 5,075' sift.litter, 19 July 2003, S.O'Keefe/.

Specific Epithet. The specific epithet honors Victoria Moseley (now Victoria M. Bayless), Curator of the Louisiana State Arthropod Museum and co-collector of the holotype.

Description. Medium to large-sized for genus (ABL range, 1.80–2.08 mm; mean, 1.89 mm, n = 10). Habitus slightly convex, elongate (WE/ABL, 0.37) with relatively large head (WH/WPm, 0.80) and narrow pronotum and elytra (WPm/WE, 0.81). Color of body amber testaceous,

appendages testaceous. Microsculpture of the head extended over anterior frons and all of vertex with the smooth area between them. Microsculpture absent from disc of pronotum.

Pronotum moderately convex, more elongate than in most species of genus (WPm/LP, 1.27), with margins markedly constricted posteriad (WPm/WPp, 1.41) and slightly sinuate before posterior angles. Anterior angles evident, slightly prominent. Posterior angles nearly rectangular (95–99°). Width between anterior angles obviously greater than between posterior angles (WPa/WPp, 1.11).

Elytra slightly convex, widely depressed along suture, of normal length for genus (LE/ABL, 0.57), with traces of 2–3 interneurs. Humeri slightly prominent, markedly rounded. Vestiture of elytra relatively short (less than one-fourth the length of discal setae).

Males with metafemora simple.

Median lobe (Fig. 33) evenly arcuate and twisted, with enlarged rounded apex. Internal sac with copulatory piece of markedly curved dorsal sclerites, in form of a blade-like structure; ventral sclerite and the spines absent.

Distribution. This species is known from high elevations (1,700–1,800 m) in central Great Smoky Mountain National Park north and south of Newfound Gap along the Appalachian Trail (Sevier County, Tennessee/ Swain County, North Carolina) (Fig. 43).

Habitat. All specimens were collected from deep forest litter.

Differential Diagnosis. *Anillinus moseleyae* is parallel-sided with effaced microsculpture on the forebody (Table 2, group VII of endogean species). The species is sympatric with at least two species of *Anillinus*. From these, *A. langdoni* and *A. loweae*, it differs by the absence of microsculpture on the disc of the pronotum and the more elongate body.

Anillinus murrayae Sokolov and Carlton, **new species**
(Fig. 34, Map fig. 42–43)

Holotype (USNM). Male labeled / USA: NC: Swain Co., GSMNP, Collins Picnic Area, Quiet Walk UTM 287857 E 3938299 N/ LSAM0017616/ HOLOTYPE, *Anillinus murrayae* Sokolov and Carlton, des. 2003/.

Paratypes (10, NCSU). Six males and 4 females labeled /Jackson Co., NC, V-18 1972, Tom Daggy (also with numbers 60043–60053 on separate labels).

Specific Epithet. The specific epithet honors Ms. Judy Murray in recognition of her hospitality during CEC's visit to Chapel Hill and for organizing the search for *A. elongatus* by the Murray family.

Description. Medium-sized for genus (ABL = 1.72 mm, n = 10). Habitus moderately convex, ovoid (WE/ABL 0.41); head normally proportioned for genus (WH/WPm 0.75); pronotum and elytra relatively narrow (WPm/WE 0.80). Color of body brunneorufous, appendages testaceous. Microsculpture of head limited to small triangular area at middle of vertex, absent from disc of pronotum.

Pronotum moderately convex, and transverse (WPm/LP 1.24), with margins rectilinear and moderately constricted posteriad (WPm/WPp 1.30). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (105°). Width between posterior angles equal to width between anterior angles (WPa/WPp 1.00).

Elytra moderately convex, moderately depressed along suture, of normal length for genus (LE/ABL 0.55), with traces of 2–3 interneurs. Humeri moderately prominent, slightly rounded. Vestiture of elytra relatively short (less than one-fourth the length of the discal setae).

Males with metafemora slightly swollen.

Median lobe (Fig. 34) arcuate, twisted, with small, rectangular apex. Internal sac with copulatory pieces of dorsal and ventral sclerites. Dorsal sclerites forming relatively large arcuate blade-like structure, and apex extending beyond internal sac. Ventral sclerites comprising several separate components, including a large recurved sclerite diverging from dorsal sclerite and several

clusters of spines and tubercles, including a cluster of ovate or elongate tubercles subapically that vary in number and shape.

Distribution. This species is known from the type locality in Swain County, North Carolina in Great Smoky Mountain National Park (Fig. 43) and from Jackson County, NC (Fig. 43) to the south. Probably two teneral specimens (male and female) from Haywood County, NC (Great Smoky Mountain National Park, Cataloochee area, Rough Fork Trail, moist upland berlese) also belong to this species, but their teneral condition does not permit a conclusive determination.

Habitat. The holotype was collected in hardwood forest litter at mid-elevation (900 m).

Differential Diagnosis. *Anillinus murrayae* is ovoid in form without microsculpture on the forebody (Table 2, group VIII of litter species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe and armature of the internal sac.

This species is likely to be sympatric with at least one species of *Anillinus* (*A. loweae*) and one species of *Serranillus*. From *A. loweae* it differs by the absence of microsculpture on the disc of the pronotum and in lacking head microsculpture, except a small triangle at the middle of the vertex, and by the distinctive aedeagus. The aedeagus of *A. murrayae* is similar to *A. cornelli* in that the main dorsal copulatory sclerite is arched and elongate. The accessory aedeagal sclerites of the two species are quite different, with *A. cornelli* lacking the ventral recurved blade-like sclerite and clusters of spines. *Anillinus murrayae* also differs in being more ovoid in form and having the male metafemora slightly expanded and bearing a posterior row of small tubercles.

Variation. The group of rounded tubercles borne on the internal sac near the aperture of the median lobe is distinctive and geographically variable. In the holotype, they form a single dense irregular cluster. In specimens from Jackson County, approximately eight regular-sized tubercles form a radially symmetrical, flower-shaped group.

Anillinus robisoni Sokolov and Carlton, **new species**

(Figs. 4, 9, 35, Map fig. 40)

Holotype (USNM). Male labeled /USA, AR, Polk Co., 5.0 mi SW Big Fork, Decid.berl., Carlton and Robison, 4 Apr 1992/ C.E.Carlton Collection/LSAM0017121/ HOLOTYPE, *Anillinus robisoni* Sokolov and Carlton, des. 2003/.

Paratypes (14, LSAM). Two males and 2 females labeled /USA, AR, Montgomery Co., Little Mo. Falls Rec. Ar., Slopes SW of river, Decid. forest berlesate, Carlton/Robison, 26 Jul 1991/; 1 male labeled /USA, AR, Montgomery Co., Lit. Mo. Falls Rec. Area, Decid. berl., Carlton and Robison, 6 Jun 1992/; 1 female labeled /USA, AR, Montgomery Co., 1.5 mi E Cryst. Rec. Area, Slopes at FS.177K, Decid. forest berlesate, Carlton/Robison, 26 Jul 1991/; 1 male labeled /USA, AR, Montg. Co., N edge Albert Pike Rec. Area, Decid. berl., Carlton and Robison, 24 Aug 1991/; 1 female labeled /USA, AR, Polk Co., Caney Crk. W. A., Carlton/Robison, 25 Jul 1991/; 1 female labeled /USA, AR, Polk Co., Caney Crk. Wild. Ar., 3.5 mi N Bard Spgs., leaf lt./flood berlesate, Carlton/Robison, 23 Aug 1991/; 1 female labeled /USA, AR, Polk Co., Caney Crk. Wild. Ar., 3.5 mi N Bard Spgs., Maple, beech berlesate, Carlton/Robison, 28 Sept 1991/; 1 female labeled /USA, AR, Polk Co., Caney Crk. Wild. Ar., 3.0 mi N Bard Spgs., Beech-maple berlesate, Carlton/Robison, 19 Oct 1991/; 1 female labeled /USA, AR, Polk Co., Caney Crk. Wild. Ar., 3.5 mi N Bard Spgs., Beech-maple berlesate, Carlton/Robison, 7 Mar 1992/; 1 female labeled /USA, AR, Polk Co., Caney Crk. Wild. Ar., 3.5 mi N Bard Spgs., Decid. berl., Carlton and Robison, 24 Mar 1992/;

1 female labeled /USA, AR, Polk Co., Caney Crk. Wild. Ar., 3.5 mi N Bard Spgs., Beech-maple berlesate, Carlton/Robison, 3 Apr 1992/.

Specific Epithet. This species is named after Henry Robison (Southern Arkansas University, Magnolia, AR), co-collector of the type series and enthusiastic student and teacher of Arkansas natural history.

Description. Medium to large-sized for genus (ABL range, 1.77–2.11 mm; mean, 1.92 mm, n = 15). Habitus slightly convex, elongate (WE/ABL, 0.36) with head normally proportioned for genus (WH/WPm, 0.76) (Fig. 4) and with narrow pronotum and elytra (WPm/WE, 0.80). Color of body varies from rufotestaceous to amber testaceous, appendages testaceous. Microsculpture of head extended over vertex and various on anterior parts of frons (Fig. 4). Microsculpture of pronotum absent from disc.

Pronotum (Fig. 9) moderately convex, more elongate than in most species of genus (WPm/LP, 1.27), with margins markedly constricted posteriad (WPm/WPp, 1.42) and slightly sinuate before the posterior angles (Fig. 9). Anterior angles almost effaced. Posterior angles nearly rectangular (95–100°). Width between anterior angles slightly greater than width between posterior angles (WPa/WPp, 1.06).

Elytra slightly convex, widely depressed along suture, of normal length for genus (LE/ABL, 0.57), with traces of 4–5 interneurs. Humeri slightly prominent, markedly rounded. Vestiture of elytra relatively long (one third to one-fourth the length of discal setae), approximately the same length as vestiture on disc of pronotum.

Males with metafemora modified; bearing a small obtuse denticulate projection along posterior margin in apical third.

Median lobe (Fig. 35) large, slightly arcuate, with enlarged axiniform apex. Internal sac with copulatory pieces with a variety of structures: dorsal and ventral sclerites and patches of spines. Dorsal sclerites short and large, together in form of angulate stick-like structures. Ventral sclerite large, of complicated plate-like form and located immediately over the apex. A group of large spines occupies outermost apical position, crossed in lateral view by the apical parts of dorsal and ventral sclerites.

Distribution. Known from the southern parts of the Ouachita National Forest in the vicinity of Shady Lake and Bard Springs Recreation Areas near the boundary between Polk and Montgomery Co., Arkansas (Fig. 40).

Habitat. Specimens were collected from Berlese samples of deep forest litter in hardwood and pine/hardwood forests (see Carlton and Robison 1998 for details about beetle diversity in this area).

Differential Diagnosis. *Anillinus robisoni* is parallel-sided with microsculpture effaced on the forebody (Table 2, group VII of endogean species). It is distinguished from all other species in this group (for which males are known) by the form of the median lobe and the presence of elytral interneurs laterad the discal setae.

This species is allopatric with respect to other described species of *Anillinus*. From its geographically closest congeners it differs by its size and by the smooth forebody; and by features mentioned in the key.

Variation. The form of the median lobe of this species varies in the degree of development of the axe-shaped apex. Whether this variation reflects individual or population-level variation, or even the degree of maturity of the specimen is difficult to say because of the scarcity of male specimens. The armature of the internal sac seems to be constant in all cases.

Anillinus stephani Sokolov and Carlton, **new species**

(Figs. 13, 17, 36, Map fig. 41)

Holotype (FSCA). Male labeled /Oklahoma, Latimer Co., IV-1984, K.Stephan/
HOLOTYPE, *Anillinus stephani* Sokolov and Carlton, des. 2003/.

Paratypes (62). Six males and 7 females with same locality data as holotype (FSCA, LSAM). Two females labeled /Oklahoma, Latimer Co., 5 mi W. Red Oak, March 1981, K. Stephan/ collected under rock/ (TAMU); 1 male and 1 female labeled /Oklahoma, Latimer Co., -III-83, Karl Stephan/ (FSCA); 3 males and 3 females labeled /Oklahoma, Latimer Co., X-1984, K. Stephan/ (FSCA); 5 males labeled /Oklahoma, Latimer Co., II-1985, Karl Stephan/ collected under rock / (FSCA); 5 males and 6 females labeled /Oklahoma, Latimer Co., III-1985, Karl Stephan/ collected under rock / (FSCA); 4 males labeled /Oklahoma, Latimer Co., IV-1985, Karl Stephan/ collected under rock / (FSCA); 1 male labeled /Oklahoma, Latimer Co., IV-1987, Karl Stephan/ (FSCA); 1 male labeled /Oklahoma, Latimer Co., III-1988, Karl Stephan/ (FSCA); 1 female labeled /Oklahoma, Latimer Co., IV-1988, Karl Stephan/ (FSCA); 1 female labeled /Oklahoma, Latimer Co., V-1988, Karl Stephan/ (FSCA); 1 female labeled /Oklahoma, Latimer Co., X-1988, Karl Stephan/ (FSCA); 1 male and 2 females labeled /Oklahoma, Latimer Co., -III-91, Karl Stephan/ (TAMU); 1 female labeled /Oklahoma, Latimer Co., -IV-91, Karl Stephan/ (TAMU); 4 females labeled /Oklahoma, Latimer Co., -III-92, Karl Stephan/ (TAMU); 1 male and 1 female labeled /Oklahoma, Latimer Co., -IV-92, Karl Stephan/ (TAMU); 1 female labeled /Oklahoma, Latimer Co., -V-92, Karl Stephan/ (TAMU).

Specific Epithet. This species is named for Karl Stephan (Red Oak, OK) in honor of his many beetle discoveries and his extraordinary documentation of the beetle fauna of Latimer County, Oklahoma.

Description. Small-sized for genus (ABL range, 1.39–1.60 mm; mean, 1.52 mm, $n = 20$). Habitus subdepressed, elongate and subparallel (WE/ABL, 0.33) with large head (WH/WPm, 0.84) and narrow pronotum and elytra (WPm/WE, 0.86). Color of body various, from rufotestaceous to amber testaceous, appendages testaceous. Dorsal microsculpture distinct, covering pronotum and head except for small areas with indistinct microsculpture at anterior parts of frons between frontal carinae and frontal grooves.

Pronotum moderately convex, more elongate than in most species of the genus (WPm/LP, 1.27), with margins markedly constricted posteriad (WPm/WPp, 1.37) and slightly sinuate before posterior angles. Anterior angles evident, slightly prominent. Posterior angles nearly rectangular (95–100°). Width between anterior angles obviously greater than between posterior angles (WPp/WPp, 1.11).

Elytra slightly convex, widely depressed along suture, relatively short (LE/ABL, 0.56), with traces 3–4 interneurs. Humeri prominent, only slightly rounded. Vestiture of elytra short (less than one-fourth length of discal setae).

Male metafemora (Fig. 13) slender, weakly tuberculate along posterior margin; metatibiae (Fig. 17) slender and simple.

Median lobe (Fig. 36) elongate and enlarged in apical one-half, with enlarged, modified bill-shaped apex. Ventral surface of median lobe bearing an oblique row of pores, each pore bearing a long erect seta. Internal sac with copulatory pieces both dorsal and ventral sclerites. Dorsal sclerites arcuate, in form of a blade-like structure, with relatively wide base. Ventral sclerite in form of a small quadrately curved plate. Spines absent.

Distribution. Known from Latimer Co., Oklahoma (Fig. 41). This species and its sympatric congener, *A. lescheni*, represent the western-most occurrence of the genus.

Habitat. Comments under *A. lescheni* above apply to this species as well.

Differential Diagnosis. *Anillinus stephani* is parallel-sided with distinct microsculpture on the forebody (Table 2, group II of endogean species). This species is sympatric with *A. lescheni*, which shares the elongate habitus and distinct microsculpture. The row of unusual setigerous pores on the ventral surface of the median lobe separates this species from all other members of the genus for which males are known. It lacks the unusual tubercles of the metatibiae of *A. lescheni* and is smaller.

Anillinus tishechkini Sokolov and Carlton, **new species**
(Fig. 37, Map fig. 41)

Holotype (USNM). Male labeled /USA: AR: Perry Co., Winona Forest Dr., calc. 10 mi W L.Sylvia, litter among rocks, along crest of ridge 27 Nov 1995 C.E.Carlton/.

Paratypes (4, LSAM). One male and 3 females with same locality data as holotype.

Specific Epithet. This species is named for Alexey Tishechkin (Louisiana State Arthropod Museum, Baton Rouge, LA), who found these specimens in the unmounted specimen backlog and brought them to our attention.

Description. Small to medium-sized for genus (ABL range 1.53–1.66 mm; mean, 1.60 mm, $n = 5$). Habitus subdepressed, elongate and subparallel (WE/ABL, 0.36), head moderate in size (WH/WPm, 0.78) pronotum and elytra narrow (WPm/WE, 0.81). Color of body rufotestaceous, appendages testaceous. Dorsal microsculpture distinct, extended over pronotum and head, except for small areas with indistinct microsculpture at anterior parts of frons between frontal carinae and frontal grooves and side areas of clypeus.

Pronotum moderately convex, moderately transverse (WPm/LP, 1.33), with margins rectilinear and markedly constricted posteriad (WPm/WPp, 1.36). Anterior angles evident, slightly prominent. Posterior angles slightly obtuse (100–110°). Width between posterior angles approximately the same as between anterior angles (WPa/WPp, 1.03). Width between anterior angles obviously greater than between posterior angles (WPa/WPp, 1.05).

Elytra slightly convex, widely depressed along suture, of normal length for genus (LE/ABL, 0.57), with traces of 3–4 interneurs. Humeri prominent, only slightly rounded. Vestiture of elytra short (less than one-fourth length of discal seta).

Males with metafemora simple.

Median lobe (Fig. 41) evenly arcuate and enlarged in apical two-thirds, with simple apex. Right side of apical ostium in form of a wall, with a small protrusion and united at apex at some distance from dorsal margin. In dorsal view apex median lobe with obvious crevice on right side. Internal sac with copulatory pieces of both dorsal and ventral sclerites and two groups of spines. Dorsal sclerites markedly arcuate, distant from each other, especially at base. Ventral sclerite in form of a long, evenly enlarged narrow plate with few irregularities toward ostium. Spines occupy positions between dorsal and ventral sclerites near the left side of median lobe and above the middle of dorsal sclerites.

Distribution. Known only from the type locality in Perry Co, Arkansas (Fig. 41) west of Lake Sylvia in the Ouachita National Forest.

Habitat. Habitat where the specimens were collected is rocky upland pine/hardwood forest along a ridgetop having extensive sandstone outcrops and small bluffs.

Differential Diagnosis. *Anillinus tishechkini* is parallel-sided with distinct microsculpture on the forebody (group II of endogean species). The transverse pronotum, narrow head and the armature of the internal sac distinguishes that species from the similar *A. stepheni*, described above.

This species is allopatric with respect to other described species of *Anillinus*. From its geographically closest congeners it differs by its small size, by its depressed subparallel habitus, and by the reticulated pronotum, in addition to features mentioned in the key.

Discussion

The number of *Anillinus* species is now 28, but this undoubtedly does not account for the total species diversity in the region. Only nine described species are represented by more than 10 specimens and the aedeagal structure is known for 20. Thus, at present a detailed cladistic, biogeographic or ecological analysis of the genus is not possible, but some interesting trends and associations are identified.

Table 1. Morphometric relationship between general habitus and form of pronotum in *Anillinus* (Casey)*.

	WE/ABL	No		Wpa/WPp
0.29	<i>A. lescheni</i>	1	1.11	<i>A. stephani</i>
0.33	<i>A. stephani</i>	2	1.06	<i>A. robisoni</i>
0.35	<i>A. elongatus</i>	3	1.05	<i>A. lescheni</i>
0.35	<i>A. sinuaticollis</i>	4	1.05	<i>A. elongatus</i>
0.35	<i>A. moseleyae</i>	5	1.05	<i>A. tishechkini</i>
0.36	<i>A. turneri</i>	6	1.04	<i>A. turneri</i>
0.36	<i>A. tishechkini</i>	7	1.03	<i>A. magazinensis</i>
0.36	<i>A. robisoni</i>	8	1.01	<i>A. sinuaticollis</i>
0.37	<i>A. kovariki</i>	9	1.00	<i>A. daggyi</i>
0.38	<i>A. cornelli</i>	10	1.00	<i>A. docwatsoni</i>
0.38	<i>A. daggyi</i>	11	0.98	<i>A. barberi</i>
0.38	<i>A. magazinensis</i>	12	0.97	<i>A. erwini</i>
0.39	<i>A. docwatsoni</i>	13	0.97	<i>A. indiana</i>
0.39	<i>A. erwini</i>	14	0.96	<i>A. barri</i>
0.39	<i>A. murrayae</i>	15	0.94	<i>A. virginiae</i>
0.39	<i>A. folkertsi</i>	16	0.94	<i>A. langdoni</i>
0.39	<i>A. barberi</i>	17	0.94	<i>A. longiceps</i>
0.39	<i>A. barri</i>	18	0.93	<i>A. murrayae</i>
0.39	<i>A. virginiae</i>	19	0.92	<i>A. fortis</i>
0.39	<i>A. loweae</i>	20	0.92	<i>A. folkertsi</i>
0.39	<i>A. steevesi</i>	21	0.91	<i>A. cornelli</i>
0.40	<i>A. fortis</i>	22	0.91	<i>A. loweae</i>
0.40	<i>A. langdoni</i>	23	0.91	<i>A. balli</i>
0.40	<i>A. indiana</i>	24	0.90	<i>A. steevesi</i>
0.41	<i>A. balli</i>	25	0.90	<i>A. kovariki</i>
No data	<i>A. longiceps</i>	26		

* Endogean species in bold, litter species not in bold.

Two main patterns of habitus adaptation among species are apparent (Table 1). Ovoid, moderately convex, usually dark pigmented species are associated with litter or other organic debris. Subparallel, flattened, depigmented species are associated with endogean habitats such as soil-rock interfaces or in soil. Intermediate forms exist between the extremes and both habitus types are correlated with other trends in species morphology (*e.g.*, microsculpture and aedeagal structure) and distribution.

General habitus of the species, ovoid or elongate, correlates with the form of the pronotum. Generally, elongate (endogean) species have the pronotum narrower, especially towards the base. More ovoid (litter) species possess a relatively wide pronotum at the base (Table 1). In the first column of table 1 species were sorted in ascending order based on the ratio WE/ABL. The species with ratios less than 0.36 are visually elongate species; the ones with ratios more than 0.39 are ovoid. In the second column the same species were sorted in descending order based on the ratio WPa/WPp.

Microsculpture patterns in *Anillinus* vary in the degree of reduction on the head and pronotum (Table 2). The following groupings are based on the head: (A) head completely covered with microsculpture; (B) head mostly covered with microsculpture, areas with effaced microsculpture occupying small patches on clypeus and/or frons and/or vertex; (C) head mostly smooth, microsculpture covering vertex and areas along frontal grooves and/or clypeal suture; (D) all of clypeus, frons and vertex smooth except small median triangle on vertex. The pronotum either has the disc covered with

Table 2. Grouping of *Anillinus* species in accordance with their microsculpture patterns.

Pronotum	Microsculptured								Smooth							
	A		B		C		D		A		B		C		D	
Head (groups*)	I		II		III		IV		V		VI		VII		VIII	
Group	I		II		III		IV		V		VI		VII		VIII	
Litter species																
1	<i>A. balli</i>		<i>A. daggyi</i>													
2	<i>A. barberi</i>		<i>A. docwatsoni</i>								<i>A. erwini</i>		<i>A. kovariki</i>		<i>A. barri</i>	
3	<i>A. folkerts</i>		<i>A. fontis</i>												<i>A. cornelli</i>	
4	<i>A. indianae</i>		<i>A. loweae</i>												<i>A. murrayae</i>	
5	<i>A. langdoni</i>		<i>A. steevesi</i>													
6	<i>A. magaziniensis</i>															
7	<i>A. virginiae</i>															
Endogean species																
1			<i>A. lescheni</i>						<i>A. sinuaticollis</i>		<i>A. turneri</i>		<i>A. moseleyae</i>			
2			<i>A. stephani</i>						<i>A. elongatus</i>				<i>A. robisoni</i>			
3			<i>A. fischechikini</i>													

* See Discussion section, in text.

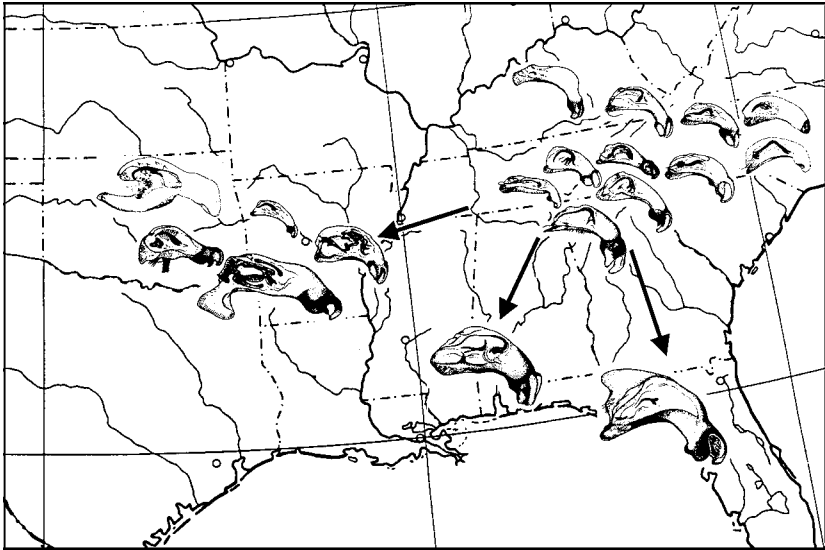


Fig. 44. Schematic representation of major trends in aedeagal diversification in *Anillinus* spp.

microsculpture or totally smooth. Totally microsculptured forms (Group I) comprise the largest group of *Anillinus* species and may be close to the ancestral groundplan. Endogean species are mostly smooth, with only three microsculptured species known.

The most important aedeagal characters are: general form of median lobe (arcuate or twisted), shape of apex (small semicircular or enlarged one, of different shapes), and size and shape of dorsal sclerites. Defining characters based on the ventral sclerites and spines is problematic for analytical purposes but they are useful for identification. Both sets of characters appear independently in different species/species-groups of *Anillinus*. The formation of ventral plates in the internal sac of the median lobe also appears to be of polyphyletic origin. The simplest type of median lobe is represented in *A. fortis*, from the Appalachian Mountains, NC (Fig. 19); *A. langdoni*, from north-western slopes of the Smoky Mountains, TN (Fig. 29); *A. magazinensis* from the Interior Highlands, AR (Fig. 32), and others. These structures have a simple arcuate form, a small semicircular apex and a group of dorsal sclerites of moderate sizes in the form of a curved blade-shaped plate. Most are litter species with well-developed microsculpture on the foreparts (Table 1, groups I and II), so this form of median lobe may also be relatively plesiomorphic. The presence of species in the southern Appalachians and far to the west, across the Mississippi Embayment, reinforces this notion if this represents a relictual distribution. By mapping known median lobes (Fig. 44) two trends in the divergence of aedeagal structure are apparent. The first trend is peripheral, and probably is the result of lengthy isolation of peripheral isolates from the concentrated area of diversity in the southern Appalachians. These peripheral species have extensive enlargement of all important aedeagal characters including general form of median lobe, shape of the apex, and form of distal sclerites (often in combination). Among known species this trend is most obvious in species in the south and southwest of the overall range, but is also manifested in *A. barberi*, the most northern representative (Jeannel 1963b:150, Fig. 5). The second trend is aboriginal, possibly connected with

local adaptations to certain niches or character displacement in markedly localized species. In litter species the reduced microsculpture corellates with changes in the shape of the dorsal sclerites from blade-shaped to filament-like structures (compare Fig. 29 and Fig. 22 versus 19 and 26, respectively) in sympatric species pairs (*A. langdoni*–*A. barri* and *A. fortis*–*A. erwini*).

Litter forms are often represented at localities (indeed, in single samples) by sympatric species pairs (syntopy). Endogean species are usually allopatric. But, species representing both groups can be found at single localities (for example, *A. loweae* and *A. moseleyae* in the same samples from GMSNP). Syntopy among litter forms are especially characteristic among southern Appalachian species. The following pairs of litter species have been collected from the same samples: *A. fortis*–*A. erwini* north of the French Broad River, *A. langdoni*–*A. barri* and *A. langdoni*–*A. loweae* in GMSNP, Tennessee side, and *A. loweae*–*A. murrayae* in GMSNP, North Carolina side. Members of all mentioned pairs belong to different species groups according to our criteria. Perhaps this reflects a parallel adaptation of different lineages within *Anillinus* to the same niches, and this can be tested cladistically when more material becomes available.

The biogeography of *Anillinus* species can be compared to that of some other beetle genera that are highly diverse in the southern Appalachians south of glacial maxima. Examples include the carabid beetle genera *Trechus* (Barr 1962, 1979) and *Scaphinotus*, especially subgenus *Steniridia* (Barr 1969), and the staphylinid genera *Arianops* (Barr 1974) and *Geostiba* (Gusarov 2002). Our frequent mentions of the French Broad River (Fig. 42) in the identification key and discussions of distributions and possible relationships follow numerous previous authors that noted its importance as a vicariant barrier in shaping the distributions of southern Appalachian montane taxa. The possibility that *A. loweae*/*A. fortis* and *A. murrayae*/*A. cornelli* represent allopatric sister species pairs separated by the French Broad River valley is mirrored by similar distributions within *Trechus*. For example, *Trechus pisgahensis* Barr occurs in mountains west of the French Broad River in North Carolina and its presumed sister species *T. vandykei* (Jeannel) occurs in mountains to the east and north (Barr 1979). These taxa were considered subspecies of *T. vandykei* by Barr, but were subsequently elevated to species (Bousquet and Laroche 1993). In his revision of the pselaphine staphylinid genus *Arianops*, Barr (1974) noted the importance of the French Broad River as a barrier separating a high diversity (18 species) fauna containing multiple species groups to the south and west from a low diversity (three species) fauna in a single species group to the north and east. Southern Appalachian *Anillinus* species are evenly divided by the French Broad River, with six species occurring on either side.

In his revision of the aleocharine staphylinid genus *Geostiba*, Gusarov (2002) presented a more detailed picture of the distribution of high altitude, habitat restricted (above 1,200 m, spruce/fir forest) southern Appalachian species. He reiterated the importance of the French Broad River Valley in separating species groups, but also noted the importance of lesser river valleys as barriers preventing dispersal across mountain ranges and isolated massifs of the region. The extreme sensitivity of *Geostiba* species does not seem to be reflected in the distributions of *Anillinus* species, which occur at various elevations and forest types. Nevertheless, some localized barriers apparently do separate species in topographically complex area such as the Great Smoky and Balsam Mountains (Fig. 43). *Anillinus moseleyae* is limited to the highest elevations in the Smokies in the vicinity of Clingmans Dome. *Anillinus langdoni* has been documented north of the major east-west divide, but not south. *Anillinus loweae* appears to be absent from the western half of the Smokies. This latter species occurs in a variety of forest litter types at various altitudes, so the exclusion from the west half of the range is difficult to understand and may relate to less obvious ecological or historical factors. Likewise, *Anillinus steevesi* seems to be completely absent from the

eastern half of the Smokies range, but occurs at scattered localities in the western Smokies and in Walker County, Georgia over 125 km to the southwest, and presumably points between.

Distribution of *Anillinus* species outside the southern Appalachians is even less well known and without a doubt many undescribed species await discovery, especially of endogean species. Species occurring to the west in the Ouachita and Ozark Highlands probably represent ancient relictual distributions such as those hypothesized for *Arianops* by Carlton and Cox (1990) that predate the formation of the Mississippi Embayment. Highly precinctive species of *Arianops* (also blind and wingless) occur sympatrically with three of the five precinctive Interior Highland *Anillinus* species, making random dispersal seem extremely unlikely. At least their occurrence in upland regions is consistent with the general pattern of diversification in the southern Appalachians. Occurrence of *Anillinus* in flatlands requires more imaginative explanations involving dispersal AND adaptation to dramatically different landscapes and presumably different microhabitats. Downstream dispersal of founder populations and subsequent divergence from aboriginal populations in the Appalachians may explain species such as *A. folkertsi*, from southwestern Alabama. The type locality is riparian habitat on the Alabama River, which has headwaters north of the fall line (boundary between upland and coastal physiographies) via the Coosa and Tallapoosa Rivers. This explanation may seem overly contrived, but is reinforced by the occurrence of a single specimen of an undescribed species of *Arianops* from the same locality (in fact the same Berlese sample) (C. Carlton unpubl.). The latter represents the only collection that we know of an *Arianops* from the Gulf Coastal Plain. Cladistic studies have the potential to corroborate or refute such hypotheses by establishing sister taxa relationships with species in the targeted areas of origin (corroborate) or elsewhere (refute). Such hypotheses also predict the occurrence of additional "downstream species" along this and other river systems with southern Appalachian origins. Downstream transport was favored by Barr (1985) to explain patterns of distribution in trechine carabids. Distributions of some widespread species of *Anillinus* and *Seranillus* also might be relictual from Pleistocene glaciation, as suggested by Howden (1985) for *Mycotrupes* (Geotrupidae).

We have attempted to identify a few characters, transformations, and distributional patterns that will facilitate a more complete understanding of the phylogenetic and biogeographic history of this endemic southeastern U.S. genus. Clearly, we are far from the being able to provide an adequate understanding of *Anillinus* evolution and biogeography. Further discovery of new species and additional material of described but poorly known species (especially males) and careful character analysis, including molecular methods, will be required to fully understand this cryptic group of American Carabidae.

Acknowledgments

We thank Terry Erwin and Warren Steiner (USNM) for loans of *Anillinus* types, without which this study would not have been possible. Thomas Barr provided valuable background information on the type locality of *A. elongatus* and much additional helpful information and feedback. Judy Murray was kind enough to provide CEC with a tour of Chapel Hill, NC to locate likely areas where *A. elongatus* populations might occur. We thank William and Margaret C. Henks and Olga Borkhsenius for their assistance in preparing the electron micrographs. Earlier drafts were read and commented on by George Ball, Thomas Barr, Jr., Victoria Bayless, Andrew Cline, Richard Leschen, Dorothy Prowell, Alexey Tishechkin, and Kipling Will. Fieldwork was supported by a grant from Discover Life in America, Inc.

Logistical support and collecting permits were provided by the National Park Service, Great Smoky Mountain National Park.

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(Received 14 July 2002; accepted 1 October 2003. Publication 13 July 2004.)