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A review of the genus *Agapetus* Curtis  
(Trichoptera: Glossosomatidae) in eastern and central  
North America, with description of 12 new species

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A review of the genus *Agapetus* Curtis  
(Trichoptera: Glossosomatidae) in eastern and central  
North America, with description of 12 new species

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**Abstract.** Twenty-nine species of caddisflies in the genus *Agapetus* Curtis in eastern and central North America are reviewed. Twelve are described as **new species**: *Agapetus aphallus* (known only from females); *Agapetus baueri*, *Agapetus flinti*, *Agapetus harrisi*, *Agapetus hesperus*, *Agapetus ibis*, *Agapetus kirchneri*, *Agapetus meridionalis*, *Agapetus pegram*, *Agapetus ruiteri*, *Agapetus stylifer*, and *Agapetus tricornutus*. *Agapetus rossi* Denning 1941 is recognized as a junior subjective synonym of *Agapetus walkeri* (Betten and Mosely 1940), **new synonym**. A key to males is provided, and species' distributions are mapped.

**Key words.** Trichoptera, Glossosomatidae, *Agapetus*, new species, North America

## Introduction

Ross (1944) included ten species of *Agapetus* Curtis in eastern and central North America, and Ross (1947) added *A. gelbae* to that list. Leonard and Leonard (1949) described *A. hessi* from Michigan. Edwards (1956a, 1956b) added *A. diacanthus* and *A. avitus*, respectively, to that list based on Tennessee specimens. About 20-30 years later, Etnier and Way (1973), Harris (1986), and Morse et al. (1989) described, respectively, *A. spinosus* from Tennessee, *A. alabamensis* from Alabama, and *A. jocassee* from North and South Carolina. From this trend, one would guess that biodiversity associated with the genus *Agapetus* in that region had largely been discovered. During the years 1998 through 2005, we were surprised to discover 12 additional species (one known only from females), less than half of them cryptic, in the southeastern United States.

This remarkable increase in *Agapetus* biodiversity in an area where Trichoptera are rather well studied is attributable to our using a different search strategy. We searched springs, spring runs, and high quality small creeks to medium rivers during April and May, seeking pupae and prepupae (larvae that have completed their pupal capsule but have not yet transformed) which were placed in a cooler and

returned to the laboratory for rearing to adulthood. This strategy works extremely well with *Agapetus*, the adults of which are not commonly collected by traditional light trapping and sweep netting approaches.

In this paper we describe males and larvae of 28 species of *Agapetus* from Eastern North America, including 11 new species, and the female and larva of one new species for which no males are known. A key to the males is provided, and maps of the distributions of all species are presented. Females of all species will be treated in a subsequent work.

## Methods

Prepupae and pupae were separated from their pebble cases under a dissecting microscope and put into 4-oz jars with loose lids and enough stream water to barely cover them. These were placed, 1-3 per jar, in an incubator set at approximately ground water temperature (15°C), with a toothpick added as an emergence platform. Jars were checked daily when possible. Adults often emerged well over a month after collection. Incubator mortality before developing at least to the mature pupa stage, although not tabulated, was probably about 10%. Because nearly all adults examined were reared, association of females and larvae with males is inferred based on localities from which only one species of male was present in our material. Numerous localities produced two or even three species, so there is some risk associated with this approach. Females, including the apparently all-female species formally described herein, will be treated in a forthcoming paper. Nominal and new species occurring in eastern and central North America are treated in alphabetical order, with ranges listed by two-letter state/province abbreviation followed by counties and number of occurrences per county if more than one. More detailed locality information is given for new species.

In every case where it was possible, we deliberately designated type localities in National Forests or National Parks as we anticipate that those localities will be more secure in the long term than in almost any other location. All holotypes, allotypes, and some paratypes have been deposited at the National Museum of Natural History (NMNH). Paratypes, when sufficient material was available, have been deposited at California Academy of Sciences (CASC), Clemson University (CUAC), Illinois Natural History Survey (INHS), Royal Ontario Museum (ROME), the S. C. Harris collection (SCHC), the University of Minnesota (UMSP), and the University of Tennessee (UTKC).

Published distributional information is from Betten (1934), Etnier et al. (1998), Flint et al. (2004), Floyd and Morse (1993), Floyd and Schuster (1990), Masteller and Flint (1992), Morse and Blickle (1953), Moulton and Stewart (1996), Neves (1979), Resh (1975), Roy and Harper (1975), Schmid (1982), and Unzicker et al. (1970). Unpublished records were provided by Clemson University, Cornell University, M. A. Floyd, D. E. Ruiter, S. C. Harris, INHS, E. C. Masteller, G. A. Schuster, D. C. Tarter, Univ. of Alabama, UMSP, NMNH, and UTKC. References in the text to specific lots of specimens identified such as "UT 1.422" are to vials of specimens deposited at UTKC and having a unique identifying number.

Emergence dates include mature pupae that emerged from the pupal case but did not successfully transform, as well as adults.

Angles and relative lengths associated with male genitalic structures were estimated from Figure 1-29, based on digital images of cleared specimens, with the aid of a protractor and millimeter rule. Segment X and the paired inferior appendages are both capable of considerable pivoting in a vertical plane; thus, angles associated with each other and with the horizontal plane can differ due to their relative position. Descriptions of preanal appendages and ventral arms of X are based on exposed portions of those structures, and do not include portions overlain by segment IX. The inferior appendages are also capable of coupled lateral movement, but within the same plane, resulting in variation in angles relative to the body axis (sagittal plane). Some larval characters, especially the distribution of muscle scars, are best seen on the shed sclerites accompanying metamorphotypes.

**Illustrations.** Male genitalia were cleared in KOH and placed in a drop of glycerin on a clean slide. Digital photos were taken (60X magnification) and then sketched in pencil on a light table. The sketches were then compared with the actual specimen, and finer details were added to the sketch. All sketches were digitally scanned to serve as guides for constructing the final illustrations, which were rendered using the Adobe Illustrator CS3 software application. Setae other than those on the preanal appendages are not shown in illustrations of males.

**Abbreviations.** States and provinces are abbreviated to their two-letter postal abbreviations throughout. Other abbreviations are as follows:

I - X	= abdominal segments: Roman numerals are used throughout
Br.	= Branch
Co.	= county
co rd	= county road
Cr.	= Creek
e, n, ne, ene, etc.	= east, north, northeast, east-northeast.
N, W	= north and west used for latitude and longitude
EX	= former catalogue number
US 11	= United States Highway 11, etc.,
GA 2	= Georgia State Highway 2, etc.
I-40	= Interstate Highway 40, etc.
jct.	= junction
m	= meter(s)
mm	= millimeter(s)
MMT	= metamorphotype
R.	= River
rd mi	= road miles
trib.	= tributary
TWRA	= Tennessee Wildlife Resources Agency
USFS	= United States Forest Service

## Genus Description

### *Agapetus* Curtis, 1834

Type species: *Agapetus fuscipes* Curtis, 1834, by subsequent designation of Westwood (1839).

**Diagnosis.** Schmid (1998) provided a thorough description of males and females. Pupae are characterized in Ross (1944) and Lepneva (1964), and larvae are described in Lepneva (1964) and Wiggins (1996a, 1996b). To these descriptions we add the following: Larvae have the pair of prosternal plates prominent, pentagonal, with dark anterior margin, plate-like, but apparently not meeting on the midline; a pair of dark, linear sclerites is present posteriolaterally (prosternal apodemes). Posteroventral margin of genae, posterior margin of pronotum, pleural sutures, margins of both ends of the coxae, dorsal base of tibia, denticles on anal claw, and anterior margin of sclerite bearing the anal claw typically darker than adjacent areas. In MMTs, the pair of prosternal sclerites and their posterior apodemes typically remain united by non-pigmented connective tissue. Mesosternal sclerites are transverse and occur in the groove between the last 2 thoracic segments. Each has a projection at about mid-length that is directed anteriolaterad. These sclerites range from black in larvae with dark gray sclerites to straw-colored in less darkly pigmented species. In pale-headed larvae, the 3-4 barely visible horizontal lines behind the eye probably represent the underlying musculature, as they are not present on genae from MMTs of these species. Larvae possess paired clusters of microsetae on the sternite of abdominal segment II. We have examined the mandibles, microsculpture of sclerites, setation patterns, microsetae clusters on abdominal segment II, anal claws, and tergum IX for taxonomic characters, but have yet to discover variation important to species discrimination.

**Adults.** The eyes are hairy. Antennal flagellae have 27 or 28 articulations. Wings are discussed and illustrated by Ross (1956).

**Male genitalia.** Males possess a prominent scent gland laterally on segment V. We have not examined these for taxonomic characters. We also feel that the ventral process of segment VI is sufficiently similar in all species (except *A. hessi* and *A. illini*) that it is not discussed in the descriptions (in *A. hessi* and *A. illini* the ventral surface of the denticle on VI is conspicuously non-sclerotized). Segment IX (lateral

view) consistently with the following characters: a straight, horizontal, thickened internal ridge (muscle attachment area?) extends from articulation of inferior appendage to or nearly to anterior margin of IX; fused dorsal inner margins of inferior appendages extend into IX about 1/2 its length; in ventral view, a faint transverse line near anterior margin of IX extends onto sides of segment, and may represent the anterior extent of telescoping of IX into VIII. Erect dorsal setae on preanal appendages are on the dorsolateral margin and typically angle away from the body axis at about 30°; in dorsal view preanal appendage recurved through about 180° at its base and smoothly continuous with the heavily sclerotized, ventral arms of X, a character that supports the monophyly of North American *Agapetus* [referred to as the celatus group by Ross (1956)].

**Female genitalia** will be described in the forthcoming paper on female *Agapetus* of eastern and central North America.

## Species Descriptions

### *Agapetus alabamensis* Harris

Fig. 1a, 1b, 1c. Map 1

*Agapetus alabamensis* Harris 1986: 30

Type locality, unnamed tributary to Wallace Branch, 5 mi se of Berry, T17S, R10W, S2, Tuscaloosa Co., AL. (NMNH)

**Diagnosis.** The numerous sharp denticles on the posterior margin of segment X (lateral view) separates this species from other central and eastern North American species except the illini group (*A. illini*, *A. minutus*, *A. ruiteri*), and *A. tricornutus*. These denticles are small, regular, and numerous in the illini group, typically only 3 in *A. tricornutus*, and irregular and varying from 4 to 9 in *A. alabamensis*. *Agapetus alabamensis* further differs from *A. tricornutus* in having the posteroventral margin of X down-curved in its distal 1/4 (straight to up-curved in *A. tricornutus*).

**Description. Male.** Length 4.5-6.1 mm (n = 5). Male genitalia: Lateral view (Fig. 1a), segment IX anterior margin slants down and forward to below middle at 60°; lower 1/3 slants down and back at 75°, slightly convex, to ventral margin; dorsal margin straight, about 2/3 length of ventral margin, sloping down and back at about 10°; posterior margin concave to upper base of preanal appendage, vertical and convex to inferior appendage base. Preanal appendage clavate, 1/2 length of X, its maximum depth (past mid-length) about 1/4 length; distal 1/2 of dorsal margin and posterior end with about 12 long, erect setae. Sides of X sclerotized, more opaque along ventral arm; dorsal margin slightly concave on basal 7/8, then depressed to base of most anteriodorsal denticle near apex. Ventral margin slopes downward for basal 1/3, then upward to near tip where it is again curved downward. Terminal denticles irregular, 4-9 in number, directed horizontally ventrad, gradually grading to nearly vertical dorsad. Inferior appendage length = 2.4 times depth; dorsal and ventral margins slightly convex, nearly parallel; posterior margin concave and angling down and forward from tip at 60°. Black submarginal denticle visible on inner surface at posteriodorsal corner; sclerotized ridge at posteroventral corner visible as a dark line.

Dorsal view (Fig. 1b). Segment IX with anterior margin concave, its mid-length about 1/2 that of preanal appendages, posterior margin slightly concave, often poorly differentiated from X. Preanal appendages with outer margin straight and parallel to body axis; inner margin convex on distal 1/2; tip pointed. Sclerotized inner margins of X narrowly separated by dorsal membranous area and convergent to V-shaped basal fusion. Dorsolateral margins of X converge slightly from base to tip; ventral arms (not shown on Fig. 1b) with inner margins strongly convergent on basal 1/4 and divergent on distal 3/4. Dorsal subterminal denticles of X convergent, dorsal terminal denticles of X divergent. Inferior appendages (not shown on Fig. 1b) with denticle near posteriodorsal margin pointed, transverse.

Ventral view (Fig. 1c). Anterior margin of IX concave, posterior margin V-shaped (90-100° angle) between inferior appendage bases; triangular depigmented area on IX anterior to inferior appendage bases. Inferior appendages with lateral margin swollen near base, then straight and slightly divergent to

rounded tip. Inner margins straight and divergent from each other (15° angle) to just past mid-length, where a tiny dark denticle marks the anterior end of a concave, heavily sclerotized ridge that diverges to the posteroventral angle of the inferior appendage; there it thickens to form another weak denticle; the ridge then abruptly more concave and more divergent nearly to base of submarginal posteriodorsal denticle. Posteroventral tip of X and its denticle-like prolongation (not shown on Fig. 1c) diverge from body axis at about 45°.

**Larva.** Genae and frontoclypeus gray except for pale area around eye. No muscle scars visible on head of larvae; frontoclypeus of MMT with arc of about 7 pale muscle scars extending across sclerite just posterior to lateral angles. Pronotum gray except for paler anterior third; 2 rows of 3 pale muscle scars diverge from each other at 40°, from middle of segment near midline. Mesonotal and metanotal sclerites paler, the former slightly darker at anteriolateral corners, occasionally difficult to differentiate from adjacent membrane. Legs, sterna, and sclerites on IX and X typical for genus.

**Emergence dates.** 11 April-6 May.

**Distribution.** AL Blount (4), Cullman (2), Etowah (2), Fayette (2), Lawrence, Tuscaloosa (2).

**Discussion.** As is the case for *A. meridionalis* and *A. vireo*, and *A. pegram* and *A. stylifer*, *Agapetus alabamensis* and *A. tricornutus* appear to be closely related. We have seen considerable variation in the number of denticles on segment X in *A. alabamensis*, but nothing of that sort in *A. tricornutus*. The only other character that appears to be diagnostic for males (see diagnosis) involves the shape of the ventral margin of X. Other subtle differences in the male descriptions may be specimen- or population-based rather than species-based. Additional study of males in this portion of Alabama is certainly warranted.

**Etymology.** *alabamensis* = of Alabama.

### ***Agapetus aphallus* Etnier, Baxter, and Parker new species**

Fig. 2a, 2b, 2c. Map 2

**Type material.** Holotype, female, length 5.5 mm, EX UT 1.980. Little Duck R. at TN 55, 35.4805° N, 86.0793° W, Manchester, Coffee Co., TN, 10 May 2005, emerged 23 May, D. A. Etnier. (NMNH)

Paratopotypes, all EX UT 1.980. 1 female MMT each to CASC, CUAC, INHS, ROME, SCHC, UMSP, and NMNH; 1 remains in UT 1.980, emerged 18 May-8 June.

Additional paratopotypes, all EX UT 1.491. Little Duck R. at TN 55, Manchester, Coffee Co., TN, 1 April 1999, UT Aquatic Insects class. One larva each to CUAC, INHS, ROME, and NMNH.

**Additional material examined.** **TN, Cannon Co.:** UT 1.421, Cavender Br. 0.1 rd mi n of TN 53 on Cavender Road, n of Woodbury, 24 May 1998, 3 larvae/prepupae, 11 female mature pupae/adults; UT 1.423, Connell Cr. along TN 53, 2.4 rd mi s of DeKalb County line, 24 May 1998, 4 larvae/prepupae, 11 female mature pupae/adults; UT 1.502, same site, 9 May 1999, 27 female mature pupae/adults. **Cheatham Co.:** UT 1.805, Sycamore Cr. 0.8 rd mi se of TN 49 on Old Clarksville Road, 18 April 2002, 2 larvae, 9 female mature pupae/adults; UT 1.806, Spring Cr. at Old Clarksville Road, 1.7 rd mi nw of TN 49, 18 April 2002, 3 larvae/prepupae, 13 female mature pupae/adults. **Clay Co.:** UT 1.428, Trace Cr. at jct. Clementsville Kentucky Road and Grady Cherry Road, Oak Grove, 30 May 1998, 12 larvae/prepupae, 9 female mature pupae/adults; UT 1.642, same site, 13 May 2000, 4 larva/prepupae, 26 female mature pupae/adults; UT 1.636, Wet Mill Cr. trib. at Wet Mill Cr. Road near Overton County line, 13 May 2000, 1 larva, 9 female mature pupae/adults; UT 1.637, Wet Mill Cr., ford on private drive 0.9 rd mi from Wet Mill Cr. Road, near Overton County line, 13 May 2000, 4 larvae/prepupae, 11 female mature pupae/adults; UT 1.639, Sweetwater Cr. at jct. Boles Road and Paul Reecer Road, 13 May 2000, 8 female mature pupae/adults; UT 1.640, creek at Old Mulkey Road 0.7 rd mi n of jct. Clementsville Kentucky Road, 13 May 2000, 8 larvae/ prepupae, 11 female mature pupae/adults; UT 1.641, Hurricane Cr. , Clementsville Kentucky Road at Clementsville Church of Christ, 0.3 rd mi e of Line Cr. Road, 13 May 2000, 14 female mature pupae/adults; UT 1.1011, Little Proctor Cr. at jct. Proctor Cr. Road and Old Watson Road, 13

May 2000, 1 female pupa; UT 1.1046, Little Trace Cr. at TN 52, 13 May 2000, 3 female mature pupae/adults. **Coffee Co.:** UT 1.491, Little Duck R. at TN 55, Manchester, 11 April 1999, 10 female mature pupae/adults. **DeKalb Co.:** UT 1.422, Dry Cr. trib., Dry Cr. Road 0.5 rd mi above Pea Ridge Road, 24 May 1998, 1 prepupa, 3 females. **Jackson Co.:** UT 1.644, Pine Lick Cr. at jct. Pine Lick Cr. Road and TN 135, 13 May 2000, 6 larvae/prepupae, 29 female mature pupae/adults. **Macon Co.:** UT 1.629, Spring Cr. at Spring Cr. Missionary Baptist Church, 10 May 2000, 4 prepupae, 15 female mature pupae/adults. **Montgomery Co.:** UT 1.802, Camp Cr. at jct. Chapel Hill Road and Seven Mile Ferry Road, s of Cumberland R., 17 April 2002, 6 larvae/prepupae, 12 female mature pupae/adults; UT 1.803, Dodson Cr. at Chapel Hill Road, 18 April 2002, 9 larvae/prepupae, 16 female mature pupae/adults; UT 1.804, spring run at Hampton Station, ne of Clarksville, 0.5 rd mi e of US 79, 18 April 2002, 12 female mature pupae/adults. **Moore Co.:** UT 1.429, Shipman Cr. 0.2 rd mi below Ledfords Mill on Ledford Mill Road, 24 May 1998, 1 female. **Robertson Co.:** UT 1.765, Brush Cr. 100 ft above Ed Ross Road, 16 May 1999, 2 females; UT 1.801, Brush Cr. above TN 256, n of I-24, 17 April 2002, 4 larva/prepupae, 5 female mature pupae/adults. **Sumner Co.:** UT 1.538, Caney Fork Cr. at TN 52, 28 May 1999, 3 female pupae; UT 1.1015, Twin springs at jct. Tyree Springs rd and Ben Albert, 4.0 rd mi s of White House, 16 April 2000, 21 larvae/prepupae, 13 female mature pupae/adults. **Williamson Co.:** UT 1.344, Kelly Cr. 0.5 mi above Blowing Springs Br., 12.8 air mi wsw of Franklin, 8 May 1997 and 13 June 2004, female, MMT female; UT 1.721, Leipers Fork Cr. at Floyd Road, James K. Angtin Bridge, wsw of Franklin, 19 March and 13 April 2001, many larvae/prepupae, 15 female mature pupae/adults; UT 1.727, Pinewood Br. at TN 46 (Pinewood Road), just w of Hillsboro Road, s of Leipers Fork, 13 April 2001, 5 larvae/prepupae, 2 mature female pupae. **Wilson Co.:** UT 1.565, Big Springs run just above Cedar Cr., at jct. Old Rome Pike and Big Springs Road, n of I-40, 9 larvae, 21 female mature pupae/adults, 29 April 2000; UT 1.631, Johnson Br. at Big Springs Road, about 0.8 rd mi s of Taylorsville Road, 10 May 2000, 2 prepupae, 10 female mature pupae/adults.

**Diagnosis.** Differs from all known female *Agapetus* of eastern and central North America (the female of *A. flinti* is unknown) in having a steep-sided ventral tubercle (Fig. 2a, 2c) on the anterioventral area of segment VIII. This ventral tubercle is clearly visible in ventral view as a U-shaped area, open end anteriorly. In the similar female of *A. avitus*, the ventral tubercle is not apparent in ventral view.

**Description. Male.** Unknown and possibly non-existent, see Discussion.

**Female.** Length 5.5-6.3 mm (n = 15). Antennal segments 27. Female genitalia: Lateral view (Fig. 2a), ventromedian process sternite VI ventrally projecting, thick and blunt. Segment VIII having ventral tubercle prominent at anterior base, protruding ventrally approximately 1/4 of segment VIII height caudad of tubercle, with sides of ventral tubercle nearly vertical, and with numerous coarse spicules on lateral and ventral surfaces; ventral margin beyond tubercle extending straight to near apex where it becomes desclerotized and difficult to discern in uncleared specimens; anterior margin convex or sinuous, and slanted down and forward to attachment point of ventral apodeme, then slanted down and back at 45°, its continuation below the apodeme difficult to see. Dorsal margin straight, converging slightly toward ventral margin; posterior margin irregularly sinuous, weakly defined.

Dorsal view (Fig. 2b), widest at level of attachment of ventral apodemes, with lateral margins converging posteriad to about 2/3 width of anterior maximum, and with prominent V- or U-shaped emargination, which may have small median projection; anterior margin concave, weakly sclerotized and difficult to differentiate from membranous areas.

Ventral view (Fig. 2c), outline as in dorsal view, with posterior emargination deeper. Ventral tubercle with posterior and lateral edges clearly defined and broadly U-shaped, with prominent coarse spicules (not shown, visible at 100X).

Inner cylinder VIII in lateral view occupying much of segment VIII dorsad of ventral tubercle, dorsal and ventral margins straight and parallel, anterior margin rounded, extending anteriorly of anterior margin segment VIII as far as anterioventral lobe, and having distinct desclerotized margin extending anteriorly into segment VII; in dorsal and ventral views, anterior margin with deep concavity between large, transparent lobes.

**Larva.** Head and pronotum light brown, other sclerites pale yellow. Details visible on intact larvae, but more apparent on shed sclerites. Head with oval pale area around eye and pale adjacent to vertex;

darker brown muscle scars prominent on posterior 1/2, forming 3 parallel horizontal rows behind eye and scattered elsewhere. Frontoclypeus with irregular pale spot larger than eye spot posteriolateral to each eye, and with 3 closely approximated muscle scars in transverse row on middle of posterior 1/2 of sclerite. Pronotum with posterior 1/2 covered with brown muscle scars with pale centers; posterior 1/2 paler than anterior 1/2. Mesonotal sclerites each with 1-2 brown freckles laterally. Metanotal sclerites same color as freckles, thus darker than adjacent membrane. Weak brown freckles on legs. Prosternal sclerite dark brown, lateral margin slightly shorter than mesal margin. Mesosternal sclerites tan. Legs, sterna, and sclerites on IX and X otherwise typical for genus.

**Emergence dates.** TN, 19 April-late June.

**Distribution.** TN, virtually restricted to the Nashville Basin physiographic province, and probably extending into the Basin in south-central Kentucky. Cannon (3), Cheatham (2), Clay (8), Coffee (2), DeKalb, Jackson, Macon, Montgomery (3), Moore, Robertson (2), Sumner (2), Williamson (3), Wilson (2). Edwards' (1966) record of *A. avitus* from "Coffee Co., Duck River at Manchester," based on 3 larvae, presumably represents *A. aphallus*.

**Discussion.** Our extensive holdings of this species (29 lots, 27 localities, 348 female pupae/adults) resulted from our efforts to secure males. None was found, and because obtaining specimens from rearing pupae can hardly introduce a sexual bias, it appears that this is an all-female species. In *Psychomyia flavida* Hagen (Psychomyiidae) and *Apatania zonella* (Zetterstedt) (Apataniidae), females typically outnumber males, and there are numerous populations or large collections from which males are unknown. Corbet (1966) discusses these two species plus the hydropsyche *Amphipsyche senegalensis* (Brauer) from Lake Victoria, Uganda, Africa, as potentially parthenogenetic species under certain circumstances, but males are known for all three species. This may turn out to be the situation in *Agapetus aphallus*. Based on larval and female similarities with *A. avitus*, we consider these to be sister species. *Agapetus aphallus* is primarily a species of the Nashville Basin physiographic province, with outliers in the Barrens Plateau (Highland Rim province) and Ridge and Valley province, while *A. avitus* has a curious circular distribution around the Nashville Basin on the Highland Rim proper. They are known to co-occur in Montgomery and Moore counties, TN. In Montgomery Co. *A. aphallus* is known from the eastern portion of the county, and *A. avitus* only from the northwestern portion; in Moore Co. the *A. aphallus* record is only 5 air miles ne of an *A. avitus* locality. *Agapetus* lots from the Nashville Basin area in which females outnumber males are likely to yield additional specimens of the distinctive female of *A. aphallus*. The very unexpected find of a MMT female in Pope Cr., Dade Co., GA, (Ridge and Valley province, not included in distribution because of possible locality confusion) suggests that with our capability of recognizing the distinctive larva and female, additional localities outside of the Nashville Basin may be found. We have taken *A. gelbae*, *A. ibis*, *A. styliifer*, and *A. tomus* with *A. aphallus*.

**Etymology.** *aphallus* = lacking a phallus, in reference to the apparent lack of males in this species.

### ***Agapetus artesus* Ross**

Fig. 3a, 3b, 3c. Map 3

*Agapetus artesus* Ross 1938: 106

Type locality, Greer Spring, Phelps Co., MO. (INHS)

**Diagnosis.** *Agapetus artesus* males lack denticles on the ventral arms or posterior margin of segment X. All other *Agapetus* species of the region covered have at least one denticle associated with the ventral arms and/or posterior margin of segment X.

**Description. Male.** Length 4.5-5.0 mm (n = 2). Male genitalia: Lateral view (Fig. 3a), segment IX anterior margin angles down and forward at 60° to mid-depth, then smoothly rounded and angling down

and back at 65° to slightly convex ventral margin; dorsal margin straight, 2/3 length of ventral margin; posterior margin angles down and back at 75° to mid-depth and then down and forward at 60°. Preanal appendage clavate, narrow at base, maximum depth 1/3 length, length 1/2 length of X; dorsal edge with about 8 erect setae. Sides of segment X sclerotized throughout, slightly more so along ventral margin; dorsal margin convex and smoothly sloping down to contact end of ventral arm; tip of X nearly reaching tips of inferior appendages. Inferior appendage length = 2.5 times depth; ventral margin slightly convex, dorsal margin straight, barely convergent toward symmetrically or asymmetrically rounded tip; the marginal denticle at distal end of ventral margin and similar submarginal denticle nearer dorsal margin than posterior margin appear as dark dots joined by a dark, straight, oblique line that slopes up and back at 65° from the ventral denticle.

Dorsal view (Fig. 3b). Segment IX with both anterior and posterior margins concave, posterior margin not apparent near midline where continuous with X. Segment X widest at base, sides of X sinuous and converging distally, apparently separated by membrane throughout on only specimen we have examined. Ventral arms of X not conspicuous. Preanal appendages clavate, narrowest at base, diverging from body axis at 30°; tips rounded to produced into slight point on outer margin. Both pairs of denticles on distal 1/2 of inferior appendage pointed, transverse.

Ventral view (Fig. 3c). Anterior base of IX weakly concave, posterior base slightly produced (160° angle) between inferior appendage bases. Inferior appendage bases slightly swollen, in contact at base; outer margin nearly straight to rounded tip; inner margins remain nearly in contact for basal 1/3, then concave and divergent on middle 1/3 to ventral denticle, then concave and diverging from body axis at 30° to near tip; dorsal margin from distal denticle to tip slightly divergent from body axis.

**Emergence dates.** 28 March-7 June, 8 October, 1 January.

**Distribution.** MO Oregon (2), Phelps (2).

**Discussion.** Apparently restricted to a few springs in only two counties in Missouri, and listed as a Category 2 species by the U.S. Fish and Wildlife Service Office of Endangered Species (Moulton and Stewart 1996).

**Etymology.** Not mentioned in the description, but presumably based on artesian, an adjective pertaining to water flow in the spring-like habitats it and many *Agapetus* inhabit.

### ***Agapetus avitus* Edwards**

Fig. 4a, 4b, 4c. Map 4

*Agapetus avitus* Edwards 1956b: 17

Type locality, stream (probably headwaters of Carr Creek, just nw of Moore Co. line) at US 41A 6 mi nw of Tullahoma, Bedford Co., TN. (NMNH)

**Diagnosis.** Among species with inferior appendage length less than 4 times depth, only *A. avitus* (lateral view, Fig. 4a) has the combination of a smoothly rounded tip of the inferior appendage, and segment X with dorsal margin tapering from just past mid-length to a terminal, ventral, horizontal denticle or point (may have additional denticles anteriodorsal to the terminal one). Most similar to *A. hesperus*, in which the inferior appendage is distinctly rhomboid, there are 3 pairs of denticles on the inferior appendages (only 2 pairs of denticles in *A. avitus*), and there is a C-shaped notch on the dorsum of X between the subterminal and terminal denticle (dorsum of X smoothly convergent to base of terminal denticle in *A. avitus*). Variants of *A. avitus* that have only one terminal denticle on each arm of X and distal denticle of inferior appendage terminal rather than subterminal resemble *A. walkeri*, but differ in lacking a concave area above the distal denticle of the inferior appendage, and in having distal portion of ventral arms of X and its terminal denticle horizontal (curved dorsad in *A. walkeri*).

**Description. Male.** Length 5.5-6.6 mm (n = 6). Male genitalia: Lateral view (Fig. 4a), segment IX anterior margin smoothly and rather symmetrically convex to convex ventral margin; dorsal margin length of ventral margin; posterior margin sloping down and back (20°) to upper edge of preanal appendage, then down and back at 40° angle to mid-depth, then nearly vertical to ventral margin. Preanal appendage slender, basal 1/4 covered by posterior margin of IX, depth less than 1/4 visible length, which has 10-12 long, erect setae on dorsal edge. Sides of segment X membranous dorsally, sclerotized on ventral 1/2; ventral arms more heavily sclerotized and terminating in dark, horizontal to slightly upturned, acute denticle; additional darkened denticles often present subterminally along dorsal edge of sclerotized area, and laterally on distal 1/2 of ventral arms. Dorsally, X horizontal on basal 2/3, then sloping down to middle of terminal denticle. Inferior appendage length = 2.6 times depth; ventral margin horizontal basally, distal 1/3-1/2 sloped upward, dorsal margin convex to rounded posteriodorsal corner; posterior margin varying from smoothly and symmetrically rounded to asymmetrically rounded to bluntly pointed. Internally, a dark denticle, submarginal to marginal and slightly protruding, visible at near mid-depth; another denticle visible on ventral margin at about 3/4 length of inferior appendage.

Dorsal view (Fig. 4b). Segment IX anterior margin broadly U-shaped, posterior margin faint or not apparent. Sclerotized sides of X with dorsal edges parallel basally, separated by membrane throughout or only on distal 1/3-1/2; ventral arms narrow at base, converging and thickening to nearly contact at about 20° angle near mid-length, then diverging at same angle and narrowing to often swollen base of terminal denticle; subterminal denticles (not shown in Fig. 4b) transverse to parallel to body axis when present. Preanal appendages smoothly curved, parallel-sided, inner margins convex, tips divergent from body axis at 30°-40°. Both pairs of denticles on distal 1/2 of inferior appendage (not shown) pointed, transverse.

Ventral view (Fig. 4c). Anterior base of IX concave, posterior base broadly V-shaped (90° angle) between inferior appendage bases; depigmented triangular area between inferior appendage bases extends anteriorly to slightly anterior to inferior appendage bases, bounded anteriorly by a transverse band of setae. Inferior appendage inner base at 45° to body axis; outer margins concave, a nearly straight longitudinal carina on basal 3/4, distal 1/2 of outer margin formed by dorsal edge of appendage; inner margins in contact at base, straight to concave and diverging from each other at 20° angle to 2/3 length, then more divergent to pair of denticles on ventral margin, then rounded to terminal pair of denticles.

**Larva.** Head and pronotum light brown, other sclerites pale yellow. Details visible on intact larvae, but more so on shed sclerites. Head with oval pale area around eye and pale adjacent to vertex; darker brown muscle scars prominent on posterior 1/2, forming 3 parallel horizontal rows behind eye and scattered elsewhere. Frontoclypeus with irregular pale spot same size as eye spot posteriolateral to each eye, and with 3 equally spaced rows of transverse dark muscle scars, anterior row (middle of sclerite) and middle row with 2 scars each, posterior row (middle of posterior 1/2 of sclerite) with 5 scars. Pronotum with posterior 1/2 paler than anterior 1/2 and covered with brown muscle scars. Mesonotal sclerites each with brown freckles laterally. Metanotal sclerites same color as freckles, thus darker than adjacent membrane. Brown freckles on legs. Mesosternal sclerites tan. Legs, sterna, and sclerites on IX and X otherwise typical for genus.

**Emergence dates.** 9 April-20 June.

**Distribution.** AL Colbert (3), Franklin, Jackson (9), Lauderdale (5), Limestone, Madison (2). KY Clinton, McCreary, Trigg, Warren, Wayne (2). MS Tishomingo. TN Bedford, Decatur, Fentress (3), Franklin, Giles, Grundy, Hardin (3), Houston (2), Humphreys (3), Lawrence, Lewis, Montgomery (2), Moore, Overton (2), Perry (3), Pickett (2), Putnam (3), Stewart (2), Van Buren (2), Wayne (4), White. We consider Edwards (1966) record from "Coffee Co., Duck River at Manchester," based on 3 larvae, to represent *A. aphallus*, which is abundant in that area.

**Discussion.** We have taken *A. crasmus*, *A. gelbae*, *A. hesperus*, *A. illini*, and *A. vireo* syntopically with *A. avitus*. Edwards (1956b) mentioned "the considerable difference in the shape and size of the inferior appendages and in the tenth tergite." Harris (1984) further considered this situation; the holotype has a basoventral pair of denticles on X that was not present in any of the males of the 84 specimens of both sexes he examined, but denticles (or at least a darkened area) are present near that position in several of the many males we have examined. In addition to the variation noted by Harris, we have seen numerous

specimens that have no other denticles on X except for the terminal pair. Inferior appendage variation in shape and relative size of the two pairs of denticles also occurs. These variants were taken with typical males, and at widely separated localities. The similarity of larvae and females with those of *A. aphallus* suggests that the presumably all-female *A. aphallus* is closely related to *A. avitus*. The apparently parapatric distribution (Maps 1 and 3) of the two taxa does not detract from that possibility. This is primarily a species of the Highland Rim physiographic province, with its donut-shaped distribution reflecting a strong avoidance for the Central (Nashville) Basin physiographic province, where *A. aphallus* occurs.

**Etymology.** Not mentioned in the description, but presumably based on the Latin *avitus* = ancestral.

***Agapetus baueri* Etnier, Parker, and Baxter new species**

Fig. 5a, 5b, 5c. Map 5

**Type material.** Holotype, male, length 6.0 mm, EX UT 1.424, North Indian Creek at USFS picnic area, 1.2 rd mi e of TN 173 on TN 107, 36.1665° N. 82.2520° W, Unicoi Co., TN, 17 May 1998, D. A. Etnier, emerged 8 June 1998. (NMNH)

Allotype, female, length 5.8 mm, same data as for holotype, emerged 26 May. (NMNH)

Paratopotypes, all EX UT 1.424. CASC, male MMT emerged 11 June; CUAC, male MMT emerged 2 June, female MMT emerged 7 June, 1 larva; INHS, male + female MMT, emerged 4 June, 1 larva; ROME, 2 June MMT male, 7 June MMT female, 1 larva; SCHC, male MMT emerged 11 June; NMNH, 1 larva; 2 male MMT, 1 female MMT, 3 early pupae, 1 prepupa, and 1 larva remain in UT 1.424.

**Additional material examined.** **North Carolina, Buncombe Co.:** UT 1.931, creek at Christmont Conference Center, about 2 rd mi s of I-40 on NC 9, Black Mountain, 7 April & 22 May 2004, 3 larvae/prepupae, 5 male + 5 female mature pupae/adults; UT 1.944, Texas Road cutoff at NC 9, Montreat, 22 May 2004, larvae/prepupae, early pupae, 9 male + 4 female mature pupae/adults; UT 1.949, Cabin Cr., 1130 NC 9, n of Black Mountain, 22 May 2004, 9 male + 5 female mature pupae/adults; **Burke Co.:** UT 1.673, Linville R. trib. at Leafy Way, about 0.2 rd mi s of NC 183 Linville R. bridge, 26 May 2000, 5 larvae/prepupae, 3 male + 2 female mature pupae/adults; UT 1.683, stream 2.3 rd mi w of Caldwell Co. line on NC 2 (Brown Mountain Road), 26 May 2000, 2 male + 1 female mature pupae/adults; **Caldwell Co.:** UT 1.763, creek at ne edge of Jim and Carolyn Wagner property, 2.8 air mi ne of jct. US 321 & NC 268, 31 May 2001, 2 early pupae, 7 male + 6 female mature pupae/adults; **Haywood Co.:** UT 1.583, Cold Spring Cr. 1.2 rd mi n of I-40, Harmon Den Exit, 12 April & 20 May 2000, 7 larvae/prepupae, 9 male + 6 female mature pupae/adults; UT 1.731, Cove Cr. at Cove Road, 0.3 rd mi above Sutton Town Road, 28 April 2001, 20 larvae; UT 1.758, same locality, 28 April 2001, 4 larvae/prepupae, 5 early pupae, 9 male + 3 female mature pupae/adults; UT 1.1124, Pisgah Cr., 1st bridge above Little Pisgah Creek, 12 June 2008, 12 males; UT 1.1163, Pisgah Cr., Chinquapin Road, 1/2 rd mi e of US 276, 4 larvae/prepupae, 2 male + 2 female mature pupae/adults; **McDowell Co.:** UT 1.933, 3116 Pine Cove Road, about 0.7 rd mi n of Mt. Hebron Road (co rd 1100), 27 April 2004, 4 male + 35 female mature pupae/adults; UT 1.934, 1101 Hebron Hill Drive, at Mt. Hebron Road, 27 April, many male + female mature pupae/adults; **Polk Co.:** UT 1.820, creek at Midway Baptist Church, 2.3 rd mi ssw of NC 9 on NC 108, 1 May 2002, 3 male + 6 female mature pupae/adults; UT 1.822, Ostin Cr., Holbert Cove Road 1.2 rd mi above Silver Cr. Road, w of Mill Springs, 1 May 2002, 2 male + 5 female mature pupae/adults; **Watauga Co.:** Blue Ridge Parkway, at beaver pond at Milepost 286.0 left, 10 July 2007, 1 male. **Tennessee, Carter Co.:** UT 1.928, upper Gap Creek at TN 362, ca 0.5 rd mi n of TN 361, 3 May 2004, 2 larvae, 3 male + 3 female mature pupae/adults; UT 1.948, 0.4 rd mi s of Roan Mountain State Park “cabins road” on TN 143, 3 May 2004, 2 male mature pupae/adults. **Johnson Co.:** UT 1.894, Atcheson Branch, TN 91 at Atcheson Road, near Laurel Bloomery, 3 May 2003, 2 mm; UT 1.906, Campbell Cr., Mack Branch Road, 28 May 2003, 5 male + 2 female mature pupae/adults; UT 1.914, same site, 28 May 2003, 4 male + 1 female; UT 1.915, Greer Branch, TN 91 3.1 rd mi s of VA state line, 3 May 2003, 1 MMT female pupa; UT 1.1049, Big Dry Run, Dry Run Road just below mouth of Baker Branch, 11.5 air mi sw of Mountain city; **Unicoi Co.:** UT 1.412, Rocky Fork trib. at TWRA Management Area gate, 17 May 1998, 1 male; UT 1.434, Scioto Cr., Scioto Cr. Road at TN 107, 17 May 1998, 2 larvae, 3 male + 2 female mature pupae/adults; **Virginia,**

**Floyd Co.:** Blue Ridge Parkway, outflow of Mabry Mill Pond, downstream to approximately 30 m, Milepost 176.2 right, 8 June 2006, 2 males; Blue Ridge Parkway, confluence of two streams feeding Mabry Mill pond, along paved trail, Milepost 176.2 left, 20 July 2007, 1 male.

**Diagnosis.** The very elongate inferior appendages (length > 4.5 times depth) separate *A. baueri* from all North American *Agapetus* except *A. flinti*, *A. iridis*, *A. jocassee*, and *A. pinatus*. It differs from all of these except *A. jocassee* in having each inferior appendage with only 2 denticles (lacking terminal denticle), versus 3 denticles per appendage (terminal denticle present) in *A. flinti*, *A. iridis*, and *A. pinatus*. Differs from *A. jocassee* (ventral view) in having a single denticle in middle of narrow, triangular ridge along internal margin of inferior appendage (broad, serrate, trapezoidal ridge with the largest denticle at posterior end of ridge in *A. jocassee*). Additionally differing from *A. jocassee* in having preanal appendages outcurved in dorsal view (straight in dorsal view in *A. jocassee*). In ventral view (Fig. 5c vs. Fig. 16c) inferior appendages of *A. baueri* have the subterminal denticle 1.5-2.0 “denticle lengths” from tip of appendage (only 1 “denticle length” from tip of appendage in *A. jocassee*).

**Description. Male.** Length 6.0-6.6 mm (n = 11). Male genitalia: Lateral view (Fig. 5a), anterior margin of IX thickened, sloping down and forward at 45° to midline, then smoothly down and back at 35° angle to ventral margin. Dorsal margin of IX essentially absent (see dorsal view), much of upper portion of posterior margin narrow, concealed behind variously developed lateral shoulder; dorsal margin of shoulder conceals basal fifth of preanal appendage; posterior margin of IX below preanal appendage convex, angling down and forward at 75°. Preanal appendage linear, 3/4 length of inferior appendage, length = 9 times depth, 10-15 long, erect setae evenly spaced along entire exposed dorsal margin. Segment X sclerotized only on ventral margin, sclerotized portion thickest on basal 1/3, which slopes down and back; distal 2/3 with sclerotized area mostly confined to ventral arms, which extend well past inferior appendage tip, and form a 130° angle with basal 1/3; each arm terminating in a pair of sharp denticles. Distal (outer) denticle a straight continuation of dorsal edge of sclerotized area; proximal (inner) denticle dorsal to other denticle, tip decurved. Inferior appendage horizontal, nearly parallel-sided, length = 6 times depth; dorsal margin concave on basal 1/3, slightly convex on distal 2/3, tip rounded. Lateral carina slopes down from near dorsal base and becomes lateral edge of inferior appendage, appearing as a line in mid-lateral area. Subterminal black denticle on inner surface visible, located an “inferior appendage depth” from tip and just dorsal to lateral carina. Ventral margin of inferior appendage slightly sinuate, convex basad and distad, and concave on either side of small denticle on inner margin located nearly 2/3 distance from base.

Dorsal view (Fig. 5b). Anterior margin of IX deeply concave; posterior margin with median V-shaped emargination nearly contacting anterior margin on midline. Preanal appendages with concave outer margin, slightly thicker at base. Sclerotized arms of X medial to preanal appendages, inner and outer margins nearly parallel, denticle-bearing tips swollen, divergent. Outer denticle a straight continuation of outer sclerotized margin; inner denticle straight, dorsal, medial, and proximal to outer denticle. Inferior appendages sinuate, median and subterminal denticles visible, transverse.

Ventral view (Fig. 5c). Anterior margin of IX concave, posterior margin poorly differentiated, forming 110° angle between inferior appendage bases, area between inferior appendage bases depigmented forward to transverse row of conspicuous setae. Inferior appendage with outer margin sinuate, basal 1/4 convex, middle concave, distally convex. Inner margin of inferior appendages in or near contact for basal 1/3, then divergent (110° from each other) and concave, much less divergent (20°) to tip. Each inferior appendage with a single pointed denticle near middle of sharp ridge that occupies middle 1/4 of inferior appendage; a second, longer denticle on inner margin 2 “denticle-lengths” from tip of inferior appendage.

**Larva.** Legs, sterna, and sclerites on IX and X typical for genus. Otherwise, all sclerites straw-colored. Genae with four horizontal rows of darker pigment behind eye barely visible on larvae but not on MMT sclerites. Frontoclypeus with transverse arc (concave anteriorly) of 5-6 elongate muscle scars extending across widest portion of sclerite, most easily seen in MMT sclerites. Prosternum with inner margin slightly longer than outer margin. Genae of MMT with area around eye and posterior third noticeably paler than remainder of sclerite.

**Emergence dates.** 3 May-28 June.

**Distribution.** NC Buncombe (3), Burke (2), Caldwell, Haywood (5), McDowell (2), Polk (2), Watauga. TN Carter (2), Johnson (4), Unicoi (3). VA Floyd (2)

**Discussion.** Taken with *A. iridis*, *A. pinatus*, *A. ruiteri*, and *A. tomus*. Males, females, and larvae are very similar to those of *A. jocassee*. The range of *A. baueri* is northeast of Great Smoky Mountains National Park, while that of *A. jocassee* includes the Park and areas to the south and west. Both species occur in Haywood Co., NC, with *A. baueri* known from the north side and extreme headwaters (Pisgah Creek) of Pigeon River, and *A. jocassee* from the south side of the river, in the Park. Both species also occur in Buncombe Co., NC, with *A. baueri* records from the eastern portion of the county (Black Mountain area) and many records of *A. jocassee* from Bent Creek southwest of Asheville, collected by Dr. Cornelius Betten in the 1930s. Preliminary data suggest that males are larger than females in this species.

**Etymology.** Named in honor of Bruce H. Bauer, colleague and participant in many aquatic biology efforts throughout the area covered.

### ***Agapetus crasmus* Ross**

Fig. 6a, 6b, 6c. Map 6

*Agapetus crasmus* Ross 1939: 66

Type locality, Martin Springs, Marion Co., TN. (INHS)

**Diagnosis.** The inferior appendage, lateral view, forms a nearly perfect rhombus only in this species and in *A. diacanthus*. Details of the heavily sclerotized ventral arm of segment X are very different in the two species (scoop-shaped in *A. crasmus*, with short, sharp, upturned terminal and subterminal dorsal denticles separated by a concavity, versus terminal dorsal and ventral denticles separated by nearly vertical, slightly concave, posterior margin of X in *A. diacanthus*). In addition, in *A. crasmus* the internal darkened ridge along posterior margin of inferior appendage has a denticle at the middle of the ridge and one at each end; in *A. diacanthus* there are only two denticles, one at each end of the ridge.

**Description. Male.** Length = 4.7-5.9 mm (n = 13). Male genitalia: Lateral view (Fig. 6c), anterior margin of IX slopes down and forward at 45° angle to midline, then convex and sloped down and back at 75°, to convex ventral margin; dorsal margin straight, 3/4 length of ventral margin, sloping down and back at 20° angle; posterior margin angles slightly posteriad down to midline, then angled down and forward at 70° angle to near ventral margin. Preanal appendage subrectangular, 1/2 length of X, length = 3 times depth, 12-15 setae dorsally on entire exposed length. Segment X lateral areas sclerotized throughout, more heavily so on ventral arm, which is nearly horizontal to sloping upward at 15°. Ventral arm narrowest at base, gradually widening to subterminal dorsal denticle, then concave to terminal denticle; ventral margin straight, convex toward tip which curves dorsad to terminal denticle; area between dorsal denticle and terminal denticle 2/3 preanal appendage length, with tip of terminal denticle and dorsal denticle at about same level. Dorsal margin of X smoothly convex from posteriodorsal corner of IX to tip of subterminal denticle. Inferior appendage nearly a perfect rhombus, horizontal length = nearly 2 times depth; dorsal, ventral, and posterior margins equal, basal margin slightly shorter; acute angles 60°; ventral margin convex, other margins straight; internal dark ridge visible, parallel to and slightly anterior to posterior margin.

Dorsal view (Fig. 6b). Anterior margin of IX deeply concave, posterior margin truncate, mid-dorsal length = 3/4 length of preanal appendage. Preanal appendages with inner margin convex; outer margin parallel to inner margin, tip rounded. Dorsal inner edges of X joined near base, then gently concave to dorsal denticle on ventral arm. Inner margins of ventral arms converge on basal 1/3 to nearly meet, then curved and divergent to bluntly pointed terminal denticle. Inferior appendages with dorsal inner edge concave.

Ventral view (Fig. 6c). Anterior margin of IX concave, posterior margin forming 90° angle between bases of inferior appendages; area posterior to linear transverse row of setae depigmented (posterior 1/3 of segment). Inferior appendages with outer margin nearly straight; inner margin straight, in contact at base, diverging from each other at about 25° to small denticle at anterior end of biconcave denticulate ridge (posterior margin of appendage); ridge with blunt denticle at about 2/3 length, basally more concave than distally; posteriodorsal end of denticulate ridge often bearing a tiny denticle. Ventral arms of X convergent to 3/8 length, meeting at 20° angle from each other, then divergent at same angle; distally convex on inner margin to tips of terminal denticle.

**Larva.** Head and pronotum dusky yellow, other sclerites paler, straw-yellow. Darker markings on sclerites as described for genus. Head may have dark pigment behind eye broken into 2 rows of large spots by paler area, and may have a large brown spot or two on each side of the vertex. Frontoclypeus with a pale area size of eye spot on each side at mid-length; a dark muscle scar often visible at median and posterior margin of each spot; additional dark muscle scars may be visible as one or two transverse rows of 2-3 scars per row across middle of posterior 1/4 of sclerite. Eye spot surrounded by circular pale area. Pronotum with 3-6 large, dark muscle scars on posterior 1/2. Prosternum with inner side 1/2-2/3 length of outer side.

**Emergence dates.** 17 April-6 June.

**Distribution.** AL Jackson (14), Madison (4), Marshall (3). TN Franklin (4), Grundy (3), Marion, Van Buren, Warren.

**Discussion.** Taken with *A. avitus* and *A. spinosus*.

**Etymology.** Unknown.

### ***Agapetus diacanthus* Edwards**

Fig. 7a, 7b, 7c. Map 7

*Agapetus diacanthus* Edwards 1956a: 4

Type locality, 1.5 mi nw of Dunlap on TN 108, Sequatchie Co., TN (but see discussion). (NMNH)

**Diagnosis.** The inferior appendage, lateral view, forms a nearly perfect rhombus only in this species and in *A. crasmus*. Details of the ventral arm of segment X are very different in the two species—in *A. diacanthus* the two denticles are terminal and separated by a vertical concavity (versus denticles dorsal, at same level, and separated by a horizontal concavity in *A. crasmus*). In addition, in *A. diacanthus* the internal darkened ridge along posterior margin of inferior appendage has only two denticles, one at each end of the ridge; in *A. crasmus* there is a third denticle about midway on this ridge.

**Description. Male.** Length = 5.5-5.7 mm (n = 2). Male genitalia: Lateral view (Fig. 7a), anterior margin of IX slopes down and forward, slightly concave, at 60° angle to middle of segment, then slopes down and back at 75°, slightly convex, to convex ventral margin; dorsal margin straight, sloping down and back at 10°, 3/4 length of ventral margin; posterior margin slopes down and back at 75° to midline, then angled down and forward at 75° to ventral margin; both dorsal and ventral halves of posterior margin straight. Preanal appendages 1/2 length of X, length = 3 times depth, with dorsal and ventral margins parallel, posterior edge symmetrically rounded, about 15 setae dorsally on entire exposed length. Segment X lateral areas sclerotized throughout, more heavily so on ventral arm; ventral arm terminating distally in darkened denticle that is a smooth continuation of ventral margin. Ventral arm narrowest at base, gradually widening to base of nearly vertical, concave posterior portion of X which terminates dorsally in a darkened denticle. Inferior appendage nearly a perfect rhombus, length = 2.5 times depth, dorsal, ventral, and posterior margins slightly convex, basal margin straight, dorsal and ventral margins slightly

longer than basal and posterior margins; acute angles about 45°. Dark, internal ridge along posterior margin with denticles at each end of ridge visible as a slight swelling.

Dorsal view (Fig. 7b). Anterior margin of IX deeply concave, posterior margin truncate, weakly defined, mid-dorsal length = 3/4 length of preanal appendage. Preanal appendages with margins slightly sinuate, inner margin concave at base, convex distally; outer margin parallel to inner margin; tip rounded. Basal junction of dorsal inner edges of X form 60° angle, divergent 2/3 distance to dorsal denticle, then convergent to dorsal denticle. Ventral arms converge to nearly meet slightly past mid-length and then diverge to tips. Inferior appendages (not shown in Fig. 7b) with outer and inner edges straight, subterminal denticle transverse.

Ventral view (Fig. 7c). Anterior margin of IX concave, posterior margin forming 90° angle between bases of inferior appendages; triangular area posterior to bases of inferior appendages depigmented. Outer margin of inferior appendage straight or slightly concave between bulbous base and rounded tip; basal half of inner margin straight; diverging from each other at about 60°; distal half concave, with small basal denticle and larger, transverse denticle at each end of denticulate ridge. Ventral arms of X (not shown in Fig. 7c) as in dorsal view but dorsal denticle not visible.

**Larva.** Very similar to that of *A. crasmus*. Potential differences are as follows. No large brown spot or spots on each side of the vertex. Frontoclypeus lacking a pale area size of dark eye spot on each side at mid-length.

**Emergence dates.** 7-23 June.

**Distribution.** TN, Marion and Sequatchie counties. Besides the type locality (see **Discussion**) we have records from: UT 1.387, tributary to Coops Cr. at 523 Mountain View Circle on road to Coke Ovens, off Hickory Street, Dunlap, Sequatchie Co.; UT 1.388, Hendrix Cr. at TN 28, Marion/Sequatchie Co. line; UT 1.1022, seep at 1744 TN 108, w side, 2.4 rd mi n of jct. TN 28 in Whitwell, Marion Co.; and UT 1.1025 (probable type locality), creek at TN 108 1.9 rd mi n of jct. TN 28 in Whitwell.

**Discussion.** Edwards (1956a) lists the type locality in reference to Dunlap, Sequatchie Co. In his 1966 paper on Trichoptera of middle and west TN, he lists only one locality for *A. diacanthus*, presumably the type locality, as 1.5 miles nw of Travis Mills on TN 108, the same information associated with his original type locality except the place name is changed from Dunlap to Travis Mills. We find no Travis Mills near Dunlap, nor in Sequatchie Co., and TN 108 does not approach Dunlap or even enter Sequatchie Co. The only Travis Mills we could locate in Tennessee is well to the north, in Overton Co. We suspect that the actual type locality is on TN 108 1.5 mi n of Whitwell, in Marion Co. We visited this last locality (but 1.9 rd mi n of jct. TN 28 on TN 108) on 19 April 2006, and found only dead, mature pupae. We suspect these were from the previous spring, and that the stream had gone dry and remained dry until shortly before our visit. *Agapetus diacanthus* appears to be of very limited distribution, and may well be restricted to a small portion of the western rim of the Sequatchie Valley. It should definitely be considered for protected status. Based on larval, male, and female similarities, *A. crasmus* appears to be closely related.

**Etymology.** Not given in original description; = two-spined, probably in reference to the two denticles on the ventral arms of X or those on each inferior appendage.

### ***Agapetus flinti* Parker, Etnier, and Baxter new species**

Fig. 8a, 8b, 8c. Map 8

**Type material.** Holotype, male, EX UT 1.1129, Scotsman Cr. at Bullpen Road (SR 1100) 4.1 rd mi w of NC 107, 27.0 air mi wsw of Brevard, 35.02124° N, 83.11340° W, Jackson Co., NC, 4 June 2008, Jason L. Robinson, black light. (NMNH)

Paratopotype, INHS, 1 male, taken with holotype.

Additional paratypes. NMNH (2 males), French Broad R. at boat launch area just below Wilson Road bridge, 3.7 air km ne of jct. US 64 and US 276 in Brevard, 35°15.1' N, 82°42.0' W, Transylvania Co., NC, 17 May 1994.

**Diagnosis.** The very elongate inferior appendages (length > 4.5 times depth) separate *A. flinti* from all North American *Agapetus* except *A. baueri*, *A. iridis*, *A. jocassee*, and *A. pinatus*. Differs from *A. baueri* and *A. jocassee* in having 3 denticles per inferior appendage (versus 2 per appendage). Differs from *A. pinatus* in having the median terminal denticle on X with a single point (2 or more points in *A. pinatus*), and in having the 3 denticles on the inferior appendage well separated (2 proximal denticles in *A. pinatus* close together, one dorsal to the other). Most similar to *A. iridis*, from which it differs in having inferior appendages with both non-terminal denticles near mid-depth (proximal denticle on ventral margin, sub-terminal denticle near dorsal margin in *A. iridis*). Also, tip of inferior appendage tapering, smoothly rounded in *A. flinti*, versus non-tapering, truncate in *A. iridis*. In *A. flinti* the 2-5 small denticles associated with the terminal denticle on the ventral arms of X are separated from that denticle, while in *A. iridis* the denticle itself is multi-cusped, with 1-4 points.

**Description. Male.** Length 5.5-5.9 mm (n = 3). Male genitalia: Lateral view (Fig. 8a), anterior margin of IX slopes down and forward at 35° to midline, then down and back at 65° to convex ventral margin; dorsal portion of IX very narrow, its anterior margin not apparent; posterior margin of IX straight, sloped down and back (50°) to horizontal shoulder extending anteriorly from base of preanal appendage, then down and forward at 80°, thickened, and straight to ventral margin. Preanal appendage linear, horizontal, 1/2 length of X, length = 8-10 times depth, basal 1/8 covered by posteriodorsal shoulder of IX, 10-12 long, erect setae on distal 3/4 of exposed portion. Ventral margin of X sclerotized, smoothly decurved from base of preanal appendage, then slightly convex to 3/4 length, concave to nearly straight on distal 1/4; ventral sclerotized area of nearly uniform depth, slightly more slender than preanal appendage; length of segment X = 1.1 times that of inferior appendage, terminating in a dark, sharp denticle. At the ventrolateral base of this denticle is a linear array of 2-5 smaller dark denticles extending anteriorly. Dorsal to the anterior base of this row of denticles is an additional dark, curved denticle subequal to the terminal denticle and directed posteriorly (this denticle and terminal denticle are bifid on right side in holotype, and there are only 2 lateral denticles). Inferior appendage parallel-sided, linear, length = 6 times depth; dorsal margin slightly convex, tip blunt, decurved; ventral margin slightly concave; outer edge visible as a dark line extending from near dorsal margin at base to near ventral margin toward tip. Each inferior appendage with 3 denticles on inner margin, visible as dark dots. Terminal denticle on ventral margin, denticle at middle of inferior appendage at mid-depth, intervening denticle slightly closer to terminal denticle and slightly dorsal to midline.

Dorsal view (Fig. 8b). Anterior margin of IX deeply concave, posterior margin poorly differentiated from X. Preanal appendages with concave outer margin, slightly constricted at base, tip pointed. Segment X membranous dorsally between lateral margins on basal 2/3; lightly sclerotized lateral margins of X converge from base of preanal appendages to 1/4 length of X, then diverge to tips, with denticles near tip slightly more divergent from body axis than are arms of X. Sclerotized ventral arms of X, not conspicuous in dorsal or ventral view, converge from base to nearly meet at 1/3 length, then diverge to tips.

Ventral view (Fig. 8c). Anterior margin of IX concave; posterior margin poorly differentiated, forming 120° angle between inferior appendage bases, area between inferior appendage bases not noticeably more transparent than rest of segment. Inferior appendages nearly straight, with a slight concavity at basal 1/3 and near incurved tip; inner margins in contact at base, then divergent at about 20° from each other and convergent with outer margins to tips. All three pairs of denticles transverse and approximately the same size. Ventral arms of X as in dorsal view.

**Larva.** Unknown.

**Emergence dates.** 17 May-4 June.

**Distribution.** NC, Jackson and Transylvania counties. Known only from the 4 male types mentioned above.

**Discussion.** Taken with *A. jocassee*, *A. pinatus*, and *A. walkeri*. This species appears at present to be very rare (2 collections in a 14-year time span, during which we and Jason Robinson made about 10 visits to areas around the 2 known localities in search of pupae). In spring of 2009 we reared 13 male *Agapetus* pupae from the type locality and an additional 10 males from two creeks within 1.2 rd mi east of the type

locality; all were *A. jocassee*. The two known localities where *A. flinti* adults were taken (in light traps) are both rather close to much larger creeks/streams (Chattooga River and French Broad River), and *Agapetus* collected with *A. flinti* were *A. pinatus* and *A. walkeri*, both of which we associate with larger streams than those in which we find *A. jocassee*. It may be that *A. flinti* is a species of larger streams than we have sampled in that area.

**Etymology.** Named in honor of Oliver S. Flint, Jr., colleague, friend, curator of neuropteroid insects at NMNH, and incredibly productive trichopterist for five decades and counting.

***Agapetus gelbae* Ross**

Fig. 9a, 9b, 9c. Map 9

*Agapetus gelbae* Ross 1947: 47

Type locality, May's Spring 2 mi sw of Bloomington, Monroe Co., IN. (NMNH)

**Diagnosis.** Inferior appendages in lateral view with distal 1/3 produced (Fig. 9a) into a long, finger-like projection, its depth about 0.4 times basal depth (versus inferior appendages rhomboid, rectangular, ovoid, gradually tapering, distally emarginated, or produced mesally or ventrally in other species of eastern and central North America).

**Description. Male.** Length 5.0-5.1 mm (n = 3). Male genitalia: Lateral view (Fig. 9a), anterior margin of IX slopes down and forward at 60° to below midline, then down and nearly vertical to convex ventral margin; dorsal margin short, horizontal, 1/8 length of ventral margin; posterior margin straight, sloped down and back at 70° to mid-depth, then down and forward at 10° to ventral margin; both anterior and posterior margins thickened. Preanal appendage extending posteriad to middle of X; convex dorsal margin and concave ventral margin parallel, posteroventral corner somewhat produced, length = 2.5 times depth, about 10 long, erect setae along exposed dorsal margin. Segment X sclerotized throughout, more heavily so on ventral arms and posterior margin; ventral margin with basal 1/4 convex, distal 3/4 concave, terminating in a short, dark denticle continuous with ventral margin; heavily sclerotized area expanding to form triangle on distal 1/3 that extends to darkened denticle at posteriodorsal corner; both denticles on X short and blunt; posterior margin nearly perpendicular to ventral margin, concave or with shallow, angular emargination just above mid-depth; dorsal margin sloped irregularly upward from base to mid-length, then downward to base of posteriodorsal denticle, with a slight concavity at 1/4 length. Inferior appendage extends slightly past end of X, length 4 times maximum depth; distal 1/3 finger-like, less than 1/2 as deep as basal 2/3; dorsal margin concave on basal 1/3, then straight or slightly convex to rounded tip where a subterminal, submarginal denticle is visible as a dark spot at the termination of a darkened line nearly parallel to the dorsal margin; ventral margin convex on basal 2/3, separated by a concavity from distal 1/3; scattered, darkened marginal denticles often present from slightly past middle of appendage to near its base, distal denticles largest.

Dorsal view (Fig. 9b). Anterior margin of IX broadly V-shaped, meeting at midline at 110°; posterior margin produced on middle 1/4, tip truncate, poorly differentiated from X, length at midline = 1/4 length of preanal appendages. Preanal appendages with inner and outer edges straight and parallel basally, inner margin rounded near tip, outer margin slightly out-curved near tip. Segment X with ventral arms convergent, meeting at mid-length at 40° angle, then divergent at same angle to terminal dorsal denticle; denticle at posteroventral corner of X barely visible as darkened, triangular area medial to dorsal denticle. Outer sides of X sclerotized, dorsal surface also sclerotized including a triangular area with base continuous with truncate posterior extension of segment IX; this area may actually be membranous.

Ventral view (Fig. 9c). Anterior margin of IX slightly concave; posterior margin forms 145° angle with bases of inferior appendages, which are slightly separated; a subcircular to subtriangular (apex directed anteriorly) depigmented area present, extending from inferior appendage bases forward 2/3 distance to anterior margin of IX; no fringe of setae associated with anterior margin of depigmented area. Inferior appendages with outer margin smoothly convex to rounded tip, with weak denticle forming posteromedial corner; inner ventral margin concave and with denticulate ridge from slightly past middle of appendage

to near its base. Inner dorsal margin of inferior appendage concave, distal 1/3 a narrow denticulate ridge with denticles tiny and irregular, terminating at posterio-medial corner of appendage. Ventral arms of X (not shown in Fig. 9c) with both terminal denticles visible.

**Larva.** Head and sclerites on IX and X brown, notal sclerites and sterna slightly paler, legs yellow. Frontoclypeus with a pair of elongate pale marks on anterior margin narrowly separated at midline; a pair of round, marginal pale spots at mid-length; a transverse arc of 3 pale muscle scars across middle of posterior 1/2. Genae with inconspicuous pale muscle scars below and behind circular, pale eye area; posterior third paler than anterior 2/3 on MMT sclerites. Pronotum with semicircular dark spot at margin where foreleg attaches; a few pale muscle scars in middle portion of sclerite. Other dark markings associated with sclerites typical for genus.

**Emergence dates.** 22 April-7 June.

**Distribution.** AL Florence, Lauderdale. IN Monroe (3). TN Hardin, Lawrence, Lewis, Sumner.

**Discussion.** We have taken *A. gelbae* with *A. aphallus* and *A. avitus*. Similarities of heavily sclerotized areas on X suggest an affinity with *A. crasmus* and *A. diacanthus*, while shape and denticulation of the inferior appendages suggest *A. pegram*/*A. stylifer* affinities.

**Etymology.** Named in honor of Miss Ruth Gelb, who first collected the species.

#### ***Agapetus harrisi* Etnier, Parker, and Baxter new species**

Fig. 10a, 10b, 10c. Map 10

**Type material.** Holotype, male, MMT pupa, EX UT 1.607, Chandler Branch 0.6 rd mi n of jct. co rd 593 on AL 79, 34.4680° N, 86.2270° W, Marshall Co., AL, 26 April 2000, preserved 23 May, DA Etnier. (NMNH)

Allotype, MMT female, 5.4 mm, collected with holotype, preserved 8 May. (NMNH)

Paratopotypes, all EX UT 1.607 and collected with holotype. CUAC, MMT male pupa, MMT female pupa, preserved 23 May, 1 larva; INHS, MMT female pupa preserved 23 May, 1 larva; ROME, MMT male pupa, MMT female pupa, preserved 11 May, 1 larva; SCHC, MMT male pupa, preserved 23 May; UMSP, MMT male pupa, MMT female pupa, preserved 23 May, 1 larva; 2 MMT female pupae (preserved 21 April), and 5 early pupae remain in UT 1.607.

Additional paratypes, AL 79 at co rd 377, 5.0 rd mi s of jct. AL 279, Jackson Co., AL, 10 April 1999-CASC; MMT male pupa preserved 3 May, MMT female preserved 26 April, 1 larva; INHS, MMT male pupa, preserved 6 May; 5 larvae, 2 early pupae; 5 MMT male pupae, 11 MMT male/female pupae, remain in UT 1.457; UT 1.1034, se side of co rd 67, 50 m ne of powerline, 2.3 rd mi ne of co rd 38 in Langston, Jackson Co., AL, 27 April 2006, 1 larvae 1 prepupa, 1 MMT male, 3 MMT female, emerged 30 April-1 June.

**Diagnosis.** Only two other species (*A. ibis*, *A. meridionalis*) of eastern and central North American *Agapetus* have the end of the ventral arms of X abruptly down-curved and pointed. Differs from both of these in having tip of inferior appendage with a deep posteroventral emargination (versus smoothly rounded). Also similar to *A. tomus*, in which tip of inferior appendage is weakly and symmetrically emarginate, and the ventral projection of the ventral arms of X is broadly rounded rather than pointed.

**Description. Male.** Length 5.4-6.1 mm (n = 2). Male genitalia: Lateral view (Fig. 10a), anterior margin of IX thickened, concave and sloped down and forward at 65° to midline, then down and back at 75° to convex ventral margin; dorsal margin horizontal, slightly depressed in middle, length = 3/4 length of ventral margin. Posterior margin of IX nearly vertical, slightly concave on dorsal 1/2, produced posteriorly at mid-depth, convex to ventral margin. Preanal appendage ovoid, 1/3 length of X, length = 1.5 times depth, about 10 dorsal setae. Length of X = 3/4 inferior appendage length, moderately sclerotized dorsal margin converges with ventral arm toward tip; ventral arm slender at base, gradually broader distad,

shaped like hockey stick with tip (acutely pointed, occasionally bifid) directed posteroventrad at 45°, “heel” expanded and pointed dorsad to merge with dorsal margin. Inferior appendage length = 1.6-2.0 times depth; dorsal and ventral margins slightly divergent, dorsal margin straight; ventral margin straight basad, convex distad, and continuing posteriad as finger-like extension; posterior margin angles down and forward at 65° from rounded posteriodorsal corner to base of finger-like ventral projection.

Dorsal view (Fig. 10b). Anterior margin of IX deeply concave, with median thickened ridge on anterior 1/2; posterior margin straight, moderately differentiated from X. Each preanal appendage with convex margins, diverging from body axis at 25°. Lateral margins of X straight, diverging from body axis at 10°, posterior margin in-curved to posteroventral points; inner margins joined near base, V-shaped, meeting at 30° angle, membranous area between lateral plates of X has V-shaped anterior and posterior border. Ventral arms of X dark on inner margin, mostly concealed by dorsal sclerotized area.

Ventral view (Fig. 10c). Anterior margin of IX thickened, nearly straight; posterior margin with obtuse (120°) angular projection between bases of inferior appendages; triangular depigmented area often apparent at posterior margin. Outer margin of inferior appendages with bulbous base, slightly concave middle 2/3, tips slightly in-curved; inner margin nearly straight to transverse denticle at tip; posterior emargination U- or V-shaped, extending forward 0.2 times length of appendage.

**Larva.** Head and notal sclerites glossy brown, darker than other sclerites, which are straw-yellow, with darker brown sutures and edges typical for genus. Sclerites of MMTs faintly marked, frontoclypeus with area behind arc from mid-lateral corners darker than anterior 3/4 of sclerite; two weak, dark muscle scars along line between lateral corners, each 3/4 distance from corner to midline; single weak, transverse muscle scar at midline just anterior to darkened posterior area. Genae with large, rectangular, pale eye spot; two irregular rows of pale, rounded to vertically elongate muscle scars angle down and back from eye area at 15-20° from horizontal, the upper row extending halfway from posterior border to pale eye area.

**Emergence dates.** 26 April-1 June.

**Distribution.** AL Jackson (2), Marshall.

**Discussion.** The 1999 Jackson County locality is tiny, with limited *Agapetus* substrate, and with discarded oil cans and other debris in the creek. The species is abundant at the type locality, which appears to be reasonably stable. In April 2006 we found a third population in a tiny southeastern tributary to Guntersville Reservoir, which is protected by TVA ownership. *Agapetus harrisi* appears to be one of the most geographically restricted *Agapetus* of eastern North America. We suggest that searches for additional populations be conducted, especially at the head ends of several embayments on the southeast side of Guntersville Reservoir south of Scottsboro, and on the northwest side of the reservoir north of Scottsboro. If these searches fail to yield additional populations, it should be considered for Alabama and Federal protected species status.

**Etymology.** Named in honor of Steven C. Harris, friend, colleague, trichopterist, and superb student of the microcaddisflies (family Hydroptilidae).

### ***Agapetus hesperus* Etnier, Baxter, and Parker new species**

Fig. 11a, 11b, 11c. Map 11

**Type material.** Holotype, male MMT, length 5.3 mm, EX UT 1.967. Tributary to Hubbard Cr. at Forest Service Road 210 bridge, Bankhead National Forest, 34.3052° N, 87.4995° W, Lawrence Co., AL, 15 April 2005, D.A. Etnier, P.L. Rakes, C.F. Saylor, J.R. and P.W. Shute. (NMNH)

Allotype, MMT female pupa, same data as for holotype, emerged 28 April. (NMNH)

Paratopotypes collected with holotype, all EX UT 1.967. CASC, 15 April MMT male pupa, 2 May MMT female pupa; CUAC, 18 April MMT male, 2 May MMT female pupa; INHS, 22 April MMT male, 20 April MMT female; ROME, MMT male, MMT female, both 9 May; SCHC, 15 April MMT male pupa, 27 April

MMT female pupa; UMSP, 15 May MMT male, 11 May MMT female; UT 1.967, 15 April MMT male, 2 MMT female pupae, 1 early pupa, all 15 April.

**Additional material examined. Alabama, Colbert Co.:** UT 1.824, Buzzard Roost Spring run off Natchez Trace Parkway at US 72, 12 April 2002, 1 prepupa, 1 mature female pupa; UT 1.965, nw side of Natchez Trace Parkway 1.0 rd mi ne of Bear Cr. exit, 15 April 2005, 3 larvae/prepupae, 8 male + 10 female mature pupae/adults; UT 1.966, same locality but se side of Parkway, 15 April 2005, 2 prepupae, 2 early pupae, 5 male + 5 female mature pupae/adults; UT 1.1012, Hurd Spring run 1.4 rd mi n of co rd 20 on co rd 1, Margerum, 12 April 2002, 1 larva, 3 female mature pupae.

**Diagnosis.** Very similar to the form of *A. avitus* that has two pairs of denticles posteriad on X, but differing in having sides of X sclerotized (membranous in posteriodorsal area in *A. avitus*), and in lateral view having a C-shaped notch between the terminal and subterminal denticle (no notch in *A. avitus*). Further differing from *A. avitus* in having inferior appendage rhomboid and with one pair of sharply pointed, transverse denticles and two pairs of blunt denticles (ovoid with two pairs of sharply pointed, transverse denticles in *A. avitus*). Similar to *A. alabamensis*, *A. crasmus*, *A. diacanthus*, *A. gelbae*, *A. kirchneri*, *A. medicus*, *A. meridionalis*, *A. tomus*, *A. tricornutus*, and *A. vireo* in having sides of X sclerotized and ventral edge more heavily sclerotized (more opaque); differing from all of these in the above described arrangement of the two pairs of posterior denticles on X.

**Description. Male.** Length 5.2-5.8 mm (n = 6). Male genitalia: Lateral view (Fig. 11a), anterior margin of IX slopes down and forward at 60° to midline, where smoothly recurved down and back at 60° to convex ventral margin; dorsal margin straight and sloping downward (20°) toward X, 3/4 length of ventral margin; posterior margin with lateral shoulder sloping down and back to dorsal margin of preanal appendage base, then straight and vertical to ventral margin. Preanal appendage slightly clavate, length about 5 times depth, extending 1/2 distance to tip of X; about 8 erect setae on posterior 3/4 of exposed dorsal margin. Segment X sclerotized throughout, more heavily so on ventral arms which terminate in a sharp, upward curved denticle that extends well past the inferior appendage tip, a tiny denticle occasionally present on posterior margin ventral to terminal denticle. Ventral margin of X slopes down and back 1/3 distance to tip; then straight to near base of terminal denticle where it is smoothly curved dorsad to tip of denticle; angle formed between basal 1/3 and distal 2/3 of ventral arm about 150°. Dorsal margin of X slightly concave on basal 1/3, then convex, terminating in sclerotized denticle at level of inferior appendage tip; a C-shaped notch between this denticle and the terminal denticle, neither denticle darker than ventral arms of X. Inferior appendage rhomboid, length = 3.2 times depth; concave dorsal edge and convex ventral edge diverge slightly to oblique and slightly concave posterior margin. Posterior margin slopes down and forward at 50°. Submarginal denticle near posteriodorsal corner and two blunt denticles on ventral margin (one at posteroventral corner, one more distal), all on inner surface, visible as darkened areas; the two ventral denticles connected by a darkened ridge.

Dorsal view (Fig. 11b). Anterior margin of IX broadly and deeply concave; posterior margin visible as narrow suture; dorsal midline slightly thickened. Dorsal aspect of X fused on midline near base, then separated by membranous area, inner edges divergent at 20-30° from each other to near dorsal pair of denticles; lateral margins of X parallel to body axis or slightly divergent; dorsal denticles diverge from body axis at 20°. Ventral arms of X convergent from bases, meeting at 0.1 times length of X, then divergent at 20° from each other and slightly and smoothly out-curved to posteroventral denticle. Posteriodorsal submarginal denticle on inferior appendage transverse, sharply pointed.

Ventral view (Fig. 11c). Anterior margin of IX slightly concave, posterior margin with angular posterior extension (100°) between inferior appendage bases, a triangular depigmented area present delimited anteriorly by a transverse band of setae. Inferior appendage base V-shaped, lateral and mesal sides at right angle. Outer margin nearly straight to bluntly pointed tip; inner margins in contact at base, divergent from each other at 30° angle to blunt denticle at 2/3 length; this denticle followed by darkened, concave ridge, each ridge diverges from body axis at 40° and terminates in a similar denticle. Submarginal posteriodorsal denticle as in dorsal view. Ventral arms of X conspicuous, smoothly curved outward from contact point at 1/4 length to non-darkened terminal denticle; posteriodorsal denticles barely visible laterally, 1/2 distance between end of membranous area and tip of X.

**Larva.** Head dark gray except for large, trapezoidal pale area that occupies nearly anterior 1/2 of genae, and a few pale, dark margined muscle scars behind eye visible on shed MMT sclerites. Frontoclypeus, pronotum, metanotal sclerites, and sclerites on IX and X concolorous, as dark as head. Mesonotal sclerites paler, with 3 darker freckles on outer margin. Prosternum with outer edge about 1.5 times length of median edge. Mesosternal sclerites black except for median yellow area. Legs pale. Legs, sterna, and sclerites on IX and X otherwise typical for genus.

**Emergence dates.** 18 April-17 May.

**Distribution.** AL Colbert (3), Lawrence.

**Discussion.** Occurs syntopically with the very similar *A. avitus*. Because *A. avitus* is an extremely variable species, it seems likely that additional records of *A. hesperus* are lurking in collections under the name *A. avitus*.

**Etymology.** *hesperus* = western, the most westerly distributed of species confined to the area east of the Mississippi River.

### ***Agapetus hessi* Leonard and Leonard**

Fig. 12a, 12b, 12c. Map 12

*Agapetus hessi* Leonard and Leonard 1949: 1

Type locality, South Branch Au Sable River, T25N, R2W, S21, Crawford Co., MI. (University of Michigan Museum of Zoology)

**Diagnosis.** The slender ventral arms of X that diverge distally to a transverse terminal denticle or group of denticles are shared by *A. kirchneri*, *A. spinosus*, and *A. walkeri*. Differs from *A. kirchneri* in lacking sclerotized posteriodorsal areas of X and a darkened ventral row of denticles on inferior appendages; and in having a lateral, horizontal carina on the inferior appendages. Differs from *A. spinosus* in having ventral arms of X with a single denticle, occasionally two (five or more denticles in *A. spinosus*). Differs from both *A. walkeri* and *A. spinosus* in having a pair of terminal denticles on inferior appendage (versus only one). Differs from all three species in having the ventral surface of the mid-ventral spine of VI non-sclerotized, a character shared only with *A. illini*.

**Description. Male.** Length 5.4-6.0 mm (n = 3). Male genitalia: Lateral view (Fig. 12a), anterior margin of IX vertical on dorsal 1/8, then sloping down and forward to below midline at 45°, then concave and sloping down and back at about 60° to irregular ventral margin; ventral margin 1/2 length of inferior appendages; anterior and posterior margins meet on dorsal midline, forming an upturned collar. Posterior margin of IX straight, down-sloped posteriad at 40° to base of preanal appendage, then convex to internal ridge, then nearly vertical to ventral margin. Preanal appendage rod-shaped, 1/2 length of inferior appendage, tip decurved and rounded, 12-18 setae on dorsal surface, basal 1/4 covered by IX. Dorsal margin of X sloping upward at 20-30° from base on anterior 2/3, forming 120° angle with distal 2/3, sclerotized on dorsal 1/2 to 3/4 length, otherwise membranous except for ventral arms. Ventral arms slender, thicker and horizontal on basal 3/8, distal 5/8 straight, angling posteriodorsad at 30-40° and continuous with darkened denticle (occasionally two denticles) at tip. Inferior appendage slightly shorter than X, length = 1.8 times depth, deepest near tip; dorsal and ventral margins divergent and straight to rounded dorsal and ventral corners. End of inferior appendage with two dark areas at mid-depth representing inward directed pair of denticles, tip of lower denticle exposed, margin concave and often irregular above and below these denticles.

Dorsal view (Fig. 12b). Anterior margin of IX with broad, deep, rectangular emargination; posterior margin broadly V-shaped and nearly contacting anterior margin on midline. Preanal appendages 1/2 length of X, margins nearly parallel, outer margins concave, slightly swollen near rounded tip. Dorsal,

sclerotized portions of X fused on midline on basal 1/2, not conspicuous (not shown in Fig. 12b), distal 1/2 of X membranous; outer margins of ventral arms smoothly and gently concave from base to tip of slender, darkened, terminal denticle or pair of denticles; inner margins straight, converging to swollen area near mid-length length, then diverging to rounded corner at base of terminal denticle. Large dorsal denticle at tip of inferior appendage a transverse equilateral triangle; underlying smaller denticle more slender, angling slightly posteriad, 1/2-2/3 length of dorsal denticle.

Ventral view (Fig. 12c). Anterior margin of IX broadly U-shaped, posterior margin forms 140° angle between inferior appendage bases; posterior depigmented area not apparent. Inferior appendages with outer margin straight and parallel, slightly divergent to abruptly incurved tips; inner margins in contact at base, diverging at 25° from each other to posteroventral corners. Slender, darker, ventral, more terminal denticle and larger dorsal denticle conspicuous.

**Larva.** We have not seen intact larvae, but sclerites from MMTs are distinctive. Sclerotized areas straw-yellow, with brown darker sutures and edges typical for genus. Frontoclypeus with pair of rounded brown muscle scars at 1/3 length, another pair a bit less conspicuous at posteromedial “corners” of a pair of pale areas near lateral margins at mid-length; then a row of three elongate muscle scars arcing from corner to corner on distal 1/2, then a pair of elongate muscle scars at 3/4 length. Genae like those of *A. walkeri*, except perhaps somewhat more prominently marked, rows of muscle scars ventral to eye spot less regular and less crowded, and two additional irregular rows along ventral suture of genae. Posteriolateral 1/2 of pronotal sclerites each with about 8-10 elongate, pale muscle scars with darker brown edges.

**Emergence dates.** 15 April-14 July.

**Distribution.** **AL** Bibb, Jackson, Lawrence (2), Madison, Winston. **KY** Pulaski (13), Wayne, Warren. **ME** Hancock, Penobscot (2). **MI** Crawford. **NB** Sunbury. **NC** Nash. **NS** Lunenburg. **ON** Hastings. **VA** Bath (2), Montgomery, Patrick. **WV** Hampshire, Wayne.

**Discussion.** The wide distribution but small number of collection localities is shared only by *A. gelbae*.

**Etymology.** Named in honor of the collector of the type material, C. L. Hess.

### ***Agapetus ibis* Etnier, Baxter, and Parker new species**

Fig. 13a, 13b, 13c. Map 13

**Type material.** Holotype, male, length 5.5 mm, Skyuka Spring, 34.9096° N, 85.3884° W, Chattanooga and Chickamauga National Military Park, Dade Co., GA, 8 May 2007 black light, C. R. Parker, J. L. Robinson. (NMNH)

Allotype, female 4.7 mm, same data as for holotype. (NMNH)

Paratopotypes taken with holotype, UT 1.1115 (2 males, 2 females); 1 male + 1 female to each of: CASC, CUAC, INHS, ROME, UMSP; 6 pinned males, 4 pinned females to NMNH.

**Additional material examined.** **Alabama, Jackson Co.:** UT 1.616, stream along co rd 91, 14.2 rd mi s of TN state line, 29 April 2000, 5 larvae/prepupae, 2 early pupae, 3 male + 9 female mature pupae/adults. **Georgia, Dade Co.:** UT 1.459, Pope Cr. at US 11, 7.8 rd mi n of GA 136, 13 April 1999, 8 male + 6 female mature pupae/adults; UT 1.611, Murphy Hollow Road 0.3 mi n of Hales Gap Road, e of I-59, 29 April 2000, 10 larvae/prepupae, 7 male + 4 female mature pupae/adults; UT 1.612, Murphy Spring at Murphy Hollow road, 1.2 rd mi n of jct. Hales Gap Road, 29 April 2000, 21 larvae/prepupae, 4 male + 5 female mature pupae/adults. **Tennessee, Hamilton Co.:** Raccoon Mountain, 27 April 2006, 1 prepupa, 7 male + 4 female mature pupae/adults. **Marion Co.:** UT 1.613, Harbin Spring run 0.7 rd mi from Murphy Hollow Road crossing of I-24, Whiteside, 29 April 2000, 8 male + 7 female mature pupae/adults; UT 1.482, Running Water Cr. adjacent to TN 134, just east of I-24 Mile Marker 3, 34.9879° N, 85.5040° W, Marion Co., TN, 6 April 1999, 4 males + 5 female mature pupae/adults; UT 1.1032, seep at 420 Wilcox Road, 1.0 rd mi ne of US 41/64 (north fork of loop).

**Diagnosis.** In lateral view, the long, nearly vertical, declivitous denticle on X combined with the banana-shaped inferior appendages are characters so divergent from those of other North American *Agapetus* as to render males of this species rather comical.

**Description. Male** (UT 1.459, 1.482). Length 4.1-6.3 mm (n = 5). Male genitalia: lateral view (Fig. 13a), anterior margin of IX thickened, sloping down and forward at 70° to midline, slightly concave; ventral 1/2 straight or nearly so, sloping down and back at 80° to convex ventral margin; dorsal margin slightly concave, down-sloped to base of X, 1/2 length of ventral margin; posterior margin slopes down and back at 70°, with projection at base of preanal appendage, to just above midline, then down and forward at 70° from vertical to upper base of inferior appendage, then concave to ventral margin. Preanal appendages oval, length = 2 times depth, 1/2 length of X; dorsal setae about 10, on distal 2/3. Length of X = less than 1/2 inferior appendage length; sides fully sclerotized, dorsal margin straight; ventral arms of X heavily sclerotized, sinuate, ventral margin convex on basal 1/3, distal 2/3 concave and terminating in long denticle that angles down and back at 10-20° from vertical; base of this denticle also heavily sclerotized to dorsal margin; a tiny denticle typically present at posteriodorsal corner of X; posterior margin slightly convex. Inferior appendage banana-shaped, dorsally with shallow emargination at mid-length, smoothly convex ventrally, rounded posteriad; length = 2.8-3.0 times depth; inner face with subterminal denticle visible as a small, darkened area near dorsal margin; posterior margin and distal 1/4 of ventral margin dark and roughened by denticulate ridge that is slightly submarginal.

Dorsal view (Fig. 13b). Anterior margin of IX broadly U-shaped, posterior margin weak, transverse, length at midline = length of preanal appendage. Preanal appendages with straight outer margin, inner margin swollen near middle, divergent from body axis at 15°. dorsal outer margins of X straight and parallel to body axis to base of downward sloped denticles; inner margins straight, meeting at 30° angle near base; X membranous between lateral plates. Posteriodorsal denticle on X apparent, angled medially. Inferior appendages with dorsal, terminal, incurved denticle and ventral denticulate ridge on posterior and ventral margins visible.

Ventral view (Fig. 13c). Anterior margin of IX nearly straight; posterior margin forming 90-100° angle between bases of inferior appendages, area from just anterior to inferior appendage bases to posterior margin of IX depigmented. Inferior appendages with bulbous base, then nearly straight to incurved tips, which end in a small, sharp, black, transverse denticle. Inner margin of inferior appendages straight, divergent from each other at 10° angle on basal 1/2; distal 1/4 more divergent, concave, with marginal row of irregular denticles, the one at posteroventral corner largest; posterior 1/4 of appendage irregularly dentate, more divergent (60° from each other), and slightly concave.

**Larva.** Head, posterior 2/3 of pronotum, metanotal sclerites, and anal claws brown; other sclerotized areas paler except for usual dark sutures/margins typical for genus. Posterior 2/3 of pronotum and outer edges of mesonotal sclerites with dark brown muscle scars with pale centers. In MMT sclerites, genae brown except for pale area around eye. Frontoclypeus with posterior 1/2 abruptly darker than anterior 1/2; a pair of dark, transverse, linear marks separated by their own length on middle 1/2 of sclerite near anterior margin of darkened posterior 1/2. Pronotum with small, semicircular dark smudge at site of foreleg articulation. The much darker larvae from UT 1.612 are marked the same, but large, pale muscle scars are visible on the genae behind and below the eye, in the middle of the posterior 1/2 of the frontoclypeus, and along the posterior margin of the pronotum.

**Emergence dates.** 17 April-28 May.

**Distribution.** AL Jackson (2). GA Dade (4). TN Hamilton, Marion (2).

**Discussion.** Taken with *A. aphallus* and *A. vireo*.

**Etymology.** *ibis* is in reference to the bird-like profile of segment X, which reminded us of the head of an ibis.

***Agapetus illini* Ross**

Fig. 14a, 14b, 14c. Map 14

*Agapetus illini* Ross 1938: 106

Type locality, Herod, Pope Co., IL. (INHS)

**Diagnosis.** Shares the upturned, spinose posterior margin of X with *A. alabamensis*, *A. minutus*, *A. ruiteri*, and *A. tricornutus*. Differs from *A. alabamensis* and *A. tricornutus* in having many similar denticles (8-10) versus only 3-9 and irregular in length and spacing in these two species. Differs from both *A. minutus* and *A. ruiteri* in having two prominent transverse denticles on each inferior appendage (versus only one prominent transverse denticle per appendage in *A. minutus* and *A. ruiteri*); in having a row of 2-5 darkened serrations at the anteriodorsal base of the lateral arms of X (versus a triangular lateral projection midway on the sides of X); in having the denticulate posterior margin of X not extending dorsally past the dorsal margin of X (extending well past dorsal margin of X in *A. minutus* and *A. ruiteri*); and in having the ventromedian process of VI non-sclerotized ventrally (a character shared only with *A. hessi*). Differs further from *A. ruiteri* in having the dorsal setae on the preanal appendage slender (as robust as the denticles on X in *A. ruiteri*).

**Description. Male.** Length 4.5-8.0 mm (n = 14). Male genitalia: Lateral view (Fig. 14a), anterior margin of IX slopes down and forward at 50° angle to midline, then down and back at 70° to straight or slightly convex ventral margin; dorsal margin slightly convex, length = 1/3 length of ventral margin; posterior margin angling posteriad at 10-20° from vertical to midline, then nearly vertical to lower base of inferior appendage. Preanal appendage clavate, maximum depth, near tip, is 1.5 times basal depth, length = 1/2 that of inferior appendage; about 10 long, erect setae on exposed distal 3/4. Segment X sclerotized at base, ventrally, and at posterior margin, with membranous area occupying dorsal 1/2 of segment. Sclerotized ventral arms of X angle down from near base of preanal appendage to form (125°) angle with remainder of ventral margin, then upturned at about 90° distally; hind margin convex, and with about 8 short, upturned denticles that are longer and more concentrated near recurved, pointed tip. Dorsal margin of sclerotized sides of X nearly parallel to ventral margin except at tip. Dorsal base of sclerotized portion of X with 2-5 closely spaced serrations. Inferior appendage 3/4 length of X, length = 3 times depth; forming a nearly perfect parallelogram, acute angles about 35°, basal and posterior edges 5/8 length of dorsal and ventral edges; denticle-bearing, darkened area near posterior margin arcs from posteroventral corner to near dorsal margin (convex distally and diverging from posterior margin); the two denticles prominent in ventral view appear as enlarged areas at each end of the linear darkened area.

Dorsal view (Fig. 14b). Anterior margin of IX deeply concave; posterior margin with V-shaped emargination, mid-dorsal suture apparent, mid-dorsal length 1/4 length of preanal appendages. Preanal appendages divergent from body axis at 25° angle, sinuate, most of inner margin convex, sides parallel, swollen on distal 1/2. Outer margins of ventral arms of X parallel to slightly divergent; mesal margins obscured by membranous area which occupies much of dorsum of X; basal cluster of 2-5 darkened serrations apparent; denticles along recurved distal margin conspicuous. Inferior appendages with pair of transverse denticles conspicuous.

Ventral view (Fig. 14c). Anterior margin of IX shallowly concave; posterior margin concave on each side of pointed (90° angle) projection between inferior appendage bases; depigmented area 1/3 length of IX apparent posteriad. Outer margins of inferior appendages with slight concavity at 2/3 length, tips rounded; inner margins slightly divergent on basal 3/8, then concave and divergent at about 90° from each other to transverse denticle at 3/4 length of appendage; a slightly smaller denticle at dorsal termination of darkened, denticle-bearing ridge on inner surface of appendage (visible in oblique view). Inner margins of sclerotized arms of X converge from base of preanal appendages, in near contact at basal 1/8, and smoothly divergent to tips.

**Larva.** Head, notal sclerites, and anal claws gray-brown; other sclerotized areas paler except for usual dark sutures/margins typical for genus. Frontoclypeus with two transverse pale areas at mid-length, each 1/3 width of sclerite and extending mesad from near lateral margin. Pale muscle scars on genae and pronotum visible on shed sclerites of MMTs, but not on larvae. Genae with a tight cluster of

about five horizontally elongate pale muscle scars at posterior margin behind eye. Posterior 1/4 of pronotum paler, and with 2 poorly developed rows of elongate muscle scars; anterior row with about three scars per side, posterior row with about 8.

**Emergence dates.** 28 March-20 July, 8 and 23 October.

**Distribution.** **AR** Benton, Crawford (3), Faulkner, Franklin (8), Garland, Independence, Johnson (2), Polk (2), Pope, Pulaski (3), Scott, Searcy, Van Buren (2), Washington (9). **ID** Lincoln. **IL** Hardin, Herod, Pope (11), Saline (3), Union (2). **IN** Lawrence. **KY** Bullitt, Christian (2), Clinton, Fayette (3), Jackson, Jessamine (2), Lincoln (2), Logan, Mercer (2), Pulaski (3), Wayne (2), Whitley, Woodford (2). **MO** Christian (6), Dade (3), Dent, Douglas (3), Franklin (3), Greene (14), Iron, Laclede, Lawrence, Madison (2), Maries (2), McDonald, Miller, Newton (4), Oregon (5), Polk, Reynolds, Shannon (4), Taney (4), Texas, Washington. **OK** McCurtain, Delaware (4), Le Flore, Pushmataha. **TN** Fentress (3), Montgomery (2), Overton (2), Pickett (2).

**Discussion.** Taken with *A. avitus* at numerous localities. This is the only *Agapetus* known to occur both east and west of the Mississippi River.

**Etymology.** Not given in original description, but surely “of Illinois”, the type locality, possibly with additional implications associated with the University of Illinois sports teams, the “Fighting Illini”.

### *Agapetus iridis* Ross

Fig. 15a, 15b, 15c. Map 15

*Agapetus iridis* Ross 1944: 269

Type locality, “small creek near Tahawus, Adirondack State Park, Essex Co., NY.” (INHS)

**Diagnosis.** The very elongate inferior appendages (length > 4.5 times depth) separate *A. iridis* from all North American *Agapetus* except *A. baueri*, *A. flinti*, *A. jocassee*, and *A. pinatus*. Differs from *A. baueri* and *A. jocassee* in having 3 denticles per inferior appendage (versus only 2). Differs from *A. pinatus* in having the lateral (ventral) denticle of X extending farther posteriad than the median (dorsal) denticle and in having the lateral denticles with more points (1-4 per denticle, visible at 50 diameters magnification) than the median denticle (usually with a single point, rarely with 2 points); in *A. pinatus* median denticle extends farther posteriad than lateral denticle, and median pair of denticles on X each with more points (2 or more) than lateral denticles (typically 1 point). In addition, non-terminal denticles on inferior appendage of *A. iridis* are widely spaced, at 0.5 and 0.8 times length of appendage, versus one dorsal to the other, both at about 2/3 length of appendage in *A. pinatus*; dorsal setae on preanal appendage of *A. iridis* are present only on the distal 3/4, but present along the entire exposed dorsal margin in *A. pinatus*. Most similar to *A. flinti*, from which it differs in having the middle denticle on the inferior appendage near the dorsal margin and the basal denticle on the ventral margin (both non-terminal denticles near mid-depth in *A. flinti*; also, in *A. iridis* the tip of the inferior appendage is truncate versus smoothly rounded in *A. flinti*).

**Description. Male.** Length 5.4-6.2 mm (n = 11). Male genitalia: Lateral view (Fig. 15a), anterior margin of IX slopes down and forward at 45° to midline, then smoothly down and back at 50° angle to ventral margin; dorsal margin short, 1/4 length of ventral margin; posteriodorsal shoulder of IX prominent, its dorsal margin horizontal, 1/4 length of IX, rounded at posterior corner, concealing basal fifth of preanal appendage; posterior margin convex, sloping (80°) down and back to midline, then down and forward (70°) to lower margin of inferior appendage. Ventral margin of IX convex, with transverse groove near anterior margin. Preanal appendage linear, occasionally expanded toward pointed tip, 1/2 length of inferior appendage, length = 7 times depth, 7-17 setae dorsally along distal 3/4. Segment X sclerotized only on ventral margin, sclerotized portion thickest on basal 1/3 (= preanal appendage depth), distal 2/3 forms

160° angle with basal 1/3; length of X subequal to that of inferior appendage; pointed denticle at tip of X horizontal to slightly angled dorsad; a second dark denticle, usually with a single point, straight to decurved, dorsal to other denticle. Inferior appendage length = 5.5 times depth at middle, dorsal and ventral margins nearly parallel. Dorsal margin sinuate, decurved at truncate tip; darkened terminal posteroventral denticle on inner face visible as a dark dot. An additional denticle on inner margin may be visible as a dark, oblique line at mid-length near ventral margin; a third inner denticle appears as a dark dot midway between these denticles, near dorsal margin.

Dorsal view (Fig. 15b). Anterior margin of IX deeply concave; posterior margin not apparent except laterad, projected mid-dorsal length subequal to width of preanal appendages. Preanal appendages with concave outer margin, convex inner margin, tip varying from pointed to expanded and rounded; inner base with triangular expansion extending toward midline of IX. Sclerotized arms of X with basal 1/3 convergent, meeting on midline at 65° angle from each other, then divergent at 20° angle to bases of dorsal denticles, then more divergent to tips of ventral denticles. Ventral denticles divergent from body axis at 60-90°, dorsal denticles less divergent; ventral denticles with tips often bifid or trifid. Segment X membranous dorsally from bases of dorsal denticles nearly to posterior margin of IX, sides (not shown) convergent from posterior margin to truncate anterior margin. Inferior appendages (not shown) with outer margin nearly straight, incurved at or near tip, all three pairs of denticles apparent.

Ventral view (Fig. 15c). Anterior margin of IX concave, posterior margin forms obtuse angle (110°) between inferior appendage bases; triangular area between outer bases of inferior appendages depigmented; a transverse row of setae at anterior margin of depigmented area. Inferior appendages slightly swollen at base, then straight or slightly convex to rounded tips; inner margin concave from base to broad median denticle, which varies from rounded or truncate and not black to sharply pointed and black, on narrow shelf on ventral edge, then equally concave from this denticle to terminal denticle; third pair of denticles visible, subequal to terminal denticles, and closer to median denticles than to terminal denticles.

**Larva.** All sclerotized areas straw yellow, except brown in areas typically dark for genus. Some larvae with only a transverse arc of 4 faint muscle scars on middle of frontoclypeus; well marked larvae with 9-10 muscle scars on middle 2/3 of frontoclypeus, 6-7 on genae on each side of vertex, in 3 rows (2-3 per row) behind eye, and with 3-4 on each side on posterior portion of pronotum.

**Emergence dates.** 20 April-13 August.

**Distribution.** AL Calhoun, Clay (2), Cleburne (3), Tallapoosa. CT Fairfield. MA Franklin (2), Hampshire. NC Buncombe, Caldwell (5), Jackson, Macon, McDowell (5), Moore, Swain (6), Transylvania (2). NH Coos (2), Grafton (2), Strafford (2). NY Essex (3), Hamilton. PA Monroe. PQ Brome. SC Cherokee, Pickens (2). TN Carter (5), Polk. VA Bath(2), Carroll, Washington.

**Discussion.** Taken with *A. jocassee*, *A. kirchneri*, *A. minutus*, *A. vireo*, and *A. walkeri*.

**Etymology.** Unknown.

### ***Agapetus jocassee* Morse**

Fig. 16a, 16b, 16c. Map 16

*Agapetus jocassee* Morse in Morse et al. 1989: 16

Type locality, Coley Creek at NC/SC border (Transylvania Co./Oconee Co.). (NMNH)

**Diagnosis.** The very elongate inferior appendages (length > 4.5 times depth) separate *A. jocassee* from all North American *Agapetus* except *A. baueri*, *A. flinti*, *A. iridis*, and *A. pinatus*. Differs from all of these except *A. baueri* in having each inferior appendage with only 2 denticles (lacking terminal denticle), versus 3 denticles per appendage (terminal denticle present) in *A. flinti*, *A. iridis*, and *A. pinatus*. Differs from *A. baueri* (ventral view) in having a broad, serrate, trapezoidal ridge with the largest denticle at posterior end (single denticle in middle of narrow, triangular ridge along internal margin of inferior

appendage in *A. baueri*). In ventral view inferior appendages of *A. jocassee* have the subterminal denticle only 1 “denticle length” from the tip of the appendage (subterminal denticle 1.5 to 2.0 “denticle lengths” from tip of appendage in *A. baueri*).

**Description. Male.** Length 4.6-6.2 mm (n = 29). Male genitalia: Lateral view (Fig. 16a), anterior margin of IX thickened, slightly concave near dorsal margin, then sloping down and forward at 40° angle to midline, then convex and sloping down and back at 60° angle to weakly sinuate ventral margin. Dorsal margin of IX a narrow bump, often concealed behind lateral shoulder; posteriodorsal margin of shoulder conceals basal 1/3-1/4 of preanal appendage. Dorsal margin of shoulder horizontal to sloping down and back at 25°. Posterior margin of IX nearly vertical, convex to ventral margin. Exposed portion of preanal appendage 1/2 length of inferior appendage, deepest at base (concealed by IX), dorsal and ventral margins convergent to narrowest point at posterior margin of IX, then slightly divergent nearly to pointed tip, maximum visible depth = 0.1 times visible length, 11 or 12 long dorsal setae along distal 3/4. Segment X membranous except for sclerotized ventral margin, sclerotized portion thickest on basal 1/3, distal 2/3 with sclerotized area 1/2 as thick as on basal 1/3 (= depth of preanal appendage), and forming 130° angle with basal 1/3. Distally, X extends past inferior appendage tip; each arm terminating in a pair of sharp, dark denticles. Outer denticle a straight continuation of dorsal edge of sclerotized area; more medial denticle dorsal to other denticle, tip decurved, and not extending as far posteriad as lateral denticle. Inferior appendage 0.8 times as long as X, length = 5 (Craft and Morse 1997) to 6 times depth; sclerotized dorsal margin with slight concavity at base, then convex to rounded tip. Ventral margin nearly straight, slightly concave near tip; mid-lateral subterminal black denticle visible as a dark dot. Lateral margin of inferior appendage visible as dark horizontal line near mid-depth, especially in middle 1/3-1/4 of appendage.

Dorsal view (Fig. 16b). Anterior and posterior margins of IX deeply concave, nearly in contact at midline. Preanal appendages with straight to slightly concave outer margin, inner margin convex, more so at tip, to form sharp point. Sclerotized lateral arms of X converge from base to 1/3 length, then slightly divergent (5° from body axis), then more divergent near swollen, denticle-bearing tips. Outer denticle a continuation of lateral margin of ventral arm, occasionally bifid; inner denticle a continuation of inner margin; both denticles parallel, diverging from body axis at 45°. Segment X with dorsal area membranous from base of inner denticle nearly to posterior margin of IX, sides of area diverging anteriad. Inferior appendages with both pairs of denticles visible.

Ventral view (Fig. 16c). Anterior margin of IX concave, posterior margin poorly differentiated, forming 130° angle between inferior appendage bases, area between outer inferior appendage bases depigmented, separated from anterior portion of IX by a conspicuous row of setae. Inferior appendages with outer margin sinuate, concave near base, convex distally. Inner margin of inferior appendages in contact at base, then divergent to serrate trapezoidal shelf, then slightly concave to subterminal denticle. Each inferior appendage with largest denticle on serrate ridge near posterior end of ridge; a single (rarely two) subterminal denticle on inner margin 1 “denticle-length” from end of inferior appendage.

**Larva.** Essentially identical to that of *A. baueri*, with the following characters possibly differing between the two species: Frontoclypeus lacking transverse row of darker muscle scars. Gena lacking paler posterior 1/3. Prosternal sclerites with outer edge 2 times length of inner edge. Sclerites on IX and X darker than head and thoracic sclerites. The larva and pupa were described by Craft and Morse (1997).

**Emergence dates.** 26 April-21 July, plus mature male pupae 12 and 27 September.

**Distribution.** GA Gilmer (3), Rabun. NC Buncombe, Cherokee (4), Clay, Graham (2), Haywood (2), Henderson, Jackson (3), Macon, Swain (5), Transylvania (15). SC Oconee (2). TN Monroe, Polk.

**Discussion.** See *A. baueri*. Taken with *A. flinti*, *A. iridis*, and *A. pinatus*.

**Etymology.** Named after Lake Jocassee, Oconee and Pickens counties, SC, and Transylvania Co., NC.

***Agapetus kirchneri* Parker, Etnier, and Baxter new species**

Fig. 17a, 17b, 17c. Map 17

**Type material.** Holotype, mature male pupa, Station Creek at horse barn, 36.6040°N, 83.6285°W, Cumberland Gap National Historical Park, Lee Co., VA, 5 April 2007, emerged 25 Apr-7 May, JL Robinson. (NMNH)

Allotype, mature female pupa, same data as for holotype. (NMNH)

Paratopotypes, mature male and female pupae, same data as for holotype CASC, male; CUAC, male MMT, female MMT; INHS, male MMT, female MMT; ROME, female, male MMT, UMSP, male, female; NMNH, male; UT 1.1117, 2 males.

Additional paratypes. SCHC, 1 male, 1 female, 1 mature male pupa, EX UT 1.604, Lone Mountain Cr. just above summer pool level of Norris Reservoir, along Lone Mountain Road, Claiborne Co. TN, 20 April 2000; 3 prepupae, 9 male + 6 female mature pupae/adults remain in UT 1.604.

**Additional material examined. Tennessee, Anderson Co.:** UT 1.355, Univ. Tenn. Arboretum trib. to Melton Hill Reservoir embayment n side of TN 170, about 1/2 mi e of TN 62, Solway, 31 March 1988, 12 larvae/ prepupae, 5 male + 8 female mature pupae/adults; UT 1.479, Clinch R. trib. 0.5 rd mi w of jct. Laurel Road/Hillcrest Road, w of Clinton, 24 April 1999, 3 larvae/prepupae, 3 male + 6 female mature pupae/adults; UT 1.480, jct. Old Dutch Valley Road and Shinliver Road, 24 April 1999, 2 prepupae, 4 pupae, 6 male + 6 female mature pupae/adults; UT 1.481, Sulphur Springs at Sulphur Springs Road, 24 April 1999, 11 larvae/prepupae, 17 pupae, 10 male + 6 female mature pupae/adults; UT 1.860, Sulphur Springs at Dutch Valley Road, n of Clinton, 8 April 2003, 2 prepupae, 6 male + 5 female mature pupae/adults. **Blount Co.:** UT 1.432, entrance to Laurel Valley Golf Course, 1.2 rd mi from TN 73 on Laurel Valley Road, Townsend, 16 May 1998, 1 mature male pupa. **Grainger Co.:** UT 1.383, Buffalo Springs, about 20 m below source, TWRA access rd, just n of TWRA Headquarters, 2 May 1998, 10 larvae/prepupae, 1 pupa, 7 male + 5 female mature pupae/adults. **Jefferson Co.:** UT 1.380, Indian Cr. at jct. US 411 and Bridges Chapel Road, 2.2 rd mi sw of US 70, 2 May 1998, 9 larvae/prepupae, 1 pupa, 1 male + 2 female mature pupae/adults. **Knox Co.:** UT 1.878, Pitts Spring, Campbell Station Road s of Hardin Valley Road, 8 May 2003, 1 prepupa, 1 male; UT 1.1200, same locality, 24 April 2010, 1 prepupa, 1 male pupa, 1 female pupa; UT 1.1039, spring run n of Gilbert Drive crossing, 0.2 rd mi w of Lovell Road, 20 m below lower end of concrete raceway near springhead, 3 May 2006, 2 larvae/prepupae, 1 male, 1 female; UT 1.1199, Conner Cr. and spring run, w side of East Gallaher Ferry Road at Rustic Bridge Road, 35.9230° N, 84.2193° W, 24 April 2010, 5 prepupae, 1 female pupa. **Roane Co.:** UT 1.448, White Oak Cr. km 6.8, 25 April 1989, 2 mm; UT 1.742, Keylon Hollow Road 0.4 rd mi above TN 304, 5 May 2001, 2 larvae, 1 pupa, 3 male + 4 female mature pupae/adults. **Virginia, Lee Co.:** UT 1.591, Sims Spring run above VA 662, 20 April 2000, 9 larvae, 1 pupa, 10 male + 7 female mature pupae/adults; UT 1.601, northern trib. to Hardy Cr. along US 58, 5.2 rd mi ne of Rose Hill, 20 April 2000, 13 larvae/prepupae, 8 male + 7 female mature pupae/adults. **Smyth Co.:** UT 1.873, Laurel Spring Road 0.6 rd mi s of I-81 Mile 43 overpass, 27 April 2003, 5 larvae, 2 pupae, 3 female mature pupae. **Washington Co.:** UT 1.876, Rockhouse Run at jct. VA 710 and VA 711, near Alvarado, 4 May 2003, 6 larvae/prepupae, 2 pupae, 17 male + 12 female mature pupae/adults.

**Diagnosis.** Similar to *A. hessi*, *A. spinosus*, and *A. walkeri* in having ventral arms of X out-turned and darkened at tip, and in having each inferior appendage with a single, transverse denticle near distal margin. Differs from all three of these in having tips of ventral arms of X shaped like a duck-head in dorsal and ventral views (versus straight denticle, pair of denticles, or cluster of denticles), and in having sides of X sclerotized and forming a notch distally at junction with ventral arms (versus membranous and smoothly merging with ventral arms). Inferior appendages of *A. kirchneri* differ from those of the three above species in having dorsal and ventral margins parallel (versus divergent toward tip), with terminal denticle at dorsal corner (versus at middle or at ventral corner); in having inferior appendage tip smoothly rounded (versus with angular projection near middle), and in having a darkened, denticulate ridge along the posteroventral portion (versus no denticulate ridge).

**Description. Male.** Length 4.0-5.9 mm (n = 6). Male genitalia: Lateral view (Fig. 17a), anterior margin of IX slopes down and forward at 45-50° to midline, then down and back at 65° and sinuate to convex ventral margin; dorsal margin straight, 1/2 length of ventral margin; posterior margin sloping down and back at 65° to base of preanal appendage, then straight to slightly convex, vertical or nearly so to ventral margin. Preanal appendage ovate, depth = 1/3 times exposed length, dorsal and ventral edges convex to rounded tip; 1/3 length of inferior appendage; 8-12 setae on distal 2/3 of exposed dorsal margin. Segment X sclerotized, more so on ventral arms; dorsally with basal concavity, then a convex dorsal margin, slightly down-sloped to 0.8 length, then decurved at 90° and smoothly merging with ventral arms. Ventral arms slightly less deep than preanal appendage, same depth throughout, basal 1/4 forms 140° angle with slightly concave, distal 3/4; tip with upturned, curved, black denticle. Inferior appendage length = 2.6 times depth, 3/4 length of X, dorsal and ventral margins nearly straight, parallel, tip bluntly rounded; posteriodorsal subterminal denticle visible as dark spot, posterior half of ventral margin with tuberculate ridge at or near edge, up-curved near posterior margin, and with small denticle at each end of ridge.

Dorsal view (Fig. 17b). Anterior margin of IX broadly concave, posterior margin faint to not apparent, mid-dorsal length 1/2 length of preanal appendage. Outer dorsal margins of X concave, convergent on basal 1/3, nearly parallel distally; dorsal inner margins fused near base, divergent (5° from body axis) to contact distal end of outer dorsal margin. Ventral arms of X distally shaped like a duck head, "beak" transverse, with tip slightly up-turned; inner margins convergent to nearly contact each other at 1/4 length, then slightly divergent to tips. Inferior appendages with terminal dorsal denticle, and ventral denticulate ridge prominent on distal 1/2.

Ventral view (Fig 17c). Anterior margin of IX concave; posterior margin forms 90° angle between inferior appendage bases; a triangular, depigmented area from slightly anterior to inferior appendage bases posteriad. Inferior appendages with outer margin beyond bulbous base convex to angular tip which bears a dark, in-pointed denticle; inner margins nearly in contact at base, ventral margins diverging from each other at 40° on basal 1/2; distal 1/2 more divergent, concave, denticulate ridge with a small denticle at each end.

**Larva.** Head and pronotum dark brown, other sclerites paler. Pale area around eye spot and dark markings on sclerites typical for genus, except mandibles same color as other head sclerites. Frontoclypeus and genae lacking apparent muscle scars except on shed sclerites of MMT; pronotum with about 10 large, elliptical, pale, dark-margined muscle scars on posterior 1/2, mostly near lateral and posterior margins. In MMT, a row of 3 transversely elliptical, pale, dark-margined muscle scars may be apparent at posterior fifth of frontoclypeus, along with scattered, less apparent muscle scars. Genae with 3 obscure rows of small, pale muscle scars behind eye, a few additional ones scattered elsewhere on posterior 1/2; a tight cluster of 3-4 more obvious muscle scars at posterior margin near ecdysial line.

**Emergence dates.** 25 April-26 July.

**Distribution.** KY Bell (larvae). TN Anderson (5), Blount, Claiborne, Grainger, Jefferson, Knox (2), Roane (2). VA Lee (2), Smyth, Washington.

**Discussion.** Taken with *A. iridis* and *A. minutus*. This species and *A. minutus* are the only two *Agapetus* known to persist in Knox Co., TN. Specimens in UT 1.1039 are from what appeared to be a pristine spring in a heavily wooded area, but pupae were very difficult to find, taken only from a very small area, and more heavily covered with silt (inside the case) than any others we have seen. *Glossosoma nigrior* Banks is abundant at the site, but the persistence of *A. kirchneri* there may be very tenuous. *Agapetus kirchneri* was abundant at the two additional localities (UT 1.1199, UT 1.1200) in the Hardin Valley area of western Knox County on 24 April 2010.

**Etymology.** Named in honor of Ralph F. Kirchner, prominent North American plecopterist who has contributed much to the study of Trichoptera in eastern North America through his collecting.

***Agapetus medicus* Ross**

Fig. 18a, 18b, 18c. Map 18

*Agapetus medicus* Ross 1938: 107

Type locality, McFadden Springs (Three Sisters Springs), Lake Ouachita State Park, Garland Co., AR. (INHS)

**Diagnosis.** The elongate, nearly rectangular, parallel-sided inferior appendage (lateral view) of *A. medicus* is shared only with *A. iridis*. In both these species the posteroventral corner of the appendage extends farther posteriad than the posteriodorsal corner. In other *Agapetus* species of the area covered that could be construed as having a subrectangular inferior appendage, the tip of the appendage is symmetrically rounded or the posteriodorsal corner extends farther posteriad than the posteroventral corner. Differs from *A. iridis* in having only a terminal denticle per inferior appendage (terminal and subterminal denticles in *A. iridis*), and in having length of inferior appendage less than 4 times depth (4.5 or more times depth in *A. iridis*).

**Description. Male.** Length 4.5-6.3 mm (n = 12). Male genitalia: Lateral view (Fig. 18a), segment IX anterior margin angles down and forward at 50° to mid-depth, then smoothly rounded and angling down and back at 60° to convex ventral margin; posterior margin angles down and back at 30° to slight shoulder above dorsal margin of preanal appendage, then vertical and smoothly convex to near ventral margin. Preanal appendage clavate, narrow at base, ventral tip produced; basal 1/4 concealed under posteriodorsal shoulder of IX, maximum depth 1/4 of exposed length, length 2/3 times length of X; dorsal edge with 10-15 erect setae. Ventral arms of X thickest at base, heavily sclerotized; basal 1/3 horizontal to sloping down and back, forming a 135° angle with thinner, upturned, distal 2/3. Posterior margin of X also heavily sclerotized, perpendicular to distal portion of ventral arm, often slightly serrate on its upper 1/3, and terminating in a denticle perpendicular to posterior margin. Remainder of sides of segment X lightly sclerotized except for membranous area along dorsal margin; length of X 3/4 length of inferior appendage. Length of inferior appendage 3.6 times depth; ventral and dorsal margins nearly straight, parallel; posterior margin slopes down and back from rounded posteriodorsal corner at 15° from vertical to more angular posteroventral corner; submarginal to marginal posteroventral denticle apparent as a darkened area, with darkened area continuing near posterior margin to just above mid-depth.

Dorsal view (Fig. 18b). Segment IX with both anterior and posterior margins concave, posterior margin not apparent near midline where continuous with X. Segment X widest at base; sides slightly convergent posteriad, separated by membrane about to level of distal denticle on inferior appendage; outer base of X often with patch of small, darkened denticles. Preanal appendages with margins nearly parallel, outer margin concave, inner margin convex, curved out and back at about 45° from body axis. Inferior appendage with transverse, sharply pointed, darkened denticle near tip.

Ventral view (Fig. 18c). Anterior base of IX slightly concave, posterior base produced between inferior appendage bases to form 140° angle; depigmented area anterior to angle occupies posterior 1/4 of IX, bounded anteriorly by transverse band of setae. Inferior appendages with lateral margin straight to bluntly pointed tip; inner margins nearly in contact on basal 1/2 to diverging from each other at about 30°, then diverging from each other at 90°, concave, and nearly parallel to body axis near base of prominent, transverse, subterminal denticle.

**Larva.** (Based on sclerites from INHS 27225, no larvae seen). Head and notal sclerites tan. Genae paler on posterior 1/2, with area behind eye covered with inconspicuous pale muscle scars, those near concavity of posterior margin larger, more conspicuous, and less circular. Frontoclypeus with 2 pale, transverse ovals at mid-length (just anterior to lateral angles of sclerite), each extends from lateral margin 1/3 distance to opposite margin; middle of posterior 1/2 of sclerite with about 3 large, pale muscle scars, and remainder of posterior 1/2 with additional, similar but smaller muscle scars. Pronotal sclerites slightly paler on posterior 1/4, with large but inconspicuous muscle scars along outer 2/3 of posterior margin.

**Emergence dates.** 15 April-5 June.

**Distribution.** AR Benton, Clark, Garland (11), Hot Spring, Montgomery (13), Polk (9), Saline (11).

**Discussion.** There appears to be considerable variation in inferior appendages in shape (ventral view) and in the position of the single denticle (terminal to markedly subterminal). In segment X we noted variation in the presence or absence of a patch of small denticles at the base of the segment (dorsal view), the degree of serration of the posterior margin, the orientation of the denticle at the posteriodorsal corner, and the sharpness of the posteroventral denticle of the inferior appendage.

**Etymology.** Not given in the original description, but likely from the Latin *medicus* = doctor or physician, in reference to the supposed curative powers of the Three Sisters Springs.

***Agapetus meridionalis* Etnier, Parker, and Baxter new species**

Fig. 19a, 19b, 19c. Map 19

**Type material.** Holotype, male MMT, length 5.0 mm, EX UT 1.453. spring run at Everett Springs Road 0.6 rd mi n of entrance to Boy Scouts of America Camp Sidney Dew, 34.5365° N, 85.1076° W, Floyd Co., GA, 6 April 1999, emerged 19 April, D. A. Etnier. (NMNH)

Allotype, female MMT. Taken with holotype, emerged 19 April 1999. (NMNH)

Paratopotypes, all EX UT 1.453. CUAC, male pupa emerged 14 April, MMT female pupa emerged 17 April, 1 prepupa; INHS, MMT male pupa emerged 17 April, female emerged 17 April, 1 prepupa; ROME, MMT male pupa emerged 12 April, female emerged 17 April, 1 prepupa; SCHC, male pupa emerged 14 April, 1 larva; UMSP, male pupa emerged 6 April, 1 larva; UT 1.453, male emerged 14 April, female MMT pupa emerged 1 May, 4 larvae, 1 prepupa.

**Diagnosis.** Shares with *A. crasmus*, *A. diacanthus*, *A. gelbae*, *A. tomus*, and *A. vireo* the heavily sclerotized ventral and posterior portions of segment X. Differs from all of these except *A. vireo* in having the preanal appendage nearly circular in lateral view, with length 1.5 times depth (versus digitiform, with length 2 or more times depth), and in having the inferior appendages ovoid (versus rhomboid in *A. crasmus* and *A. diacanthus*, with posteriodorsal projection in *A. gelbae*, and with concave or truncate tip in *A. tomus*). Posteroventral aspect of X is produced to form a denticle that angles down and back and has a very acute tip in *A. meridionalis*; (posteroventral area of X is rounded and extends dorsad in *A. crasmus*, is bluntly pointed and extends posteriodorsad in *A. diacanthus* and *A. gelbae*, has a rounded ventral lobe in *A. tomus*, and forms a right angle in *A. vireo*). Most similar to *A. vireo* (see **Discussion**), differing in having the posterior margin of X sloping down and back at 30° from vertical, extending below ventral margin of X, and extending past inferior appendage; in *A. vireo* posterior margin of X is vertical, with its posteroventral angle not produced, not extending below the ventral margin of X, and not extending to end of inferior appendage. In addition, there are only 3 (occasionally 4) denticles on the inferior appendage in *A. meridionalis* (see description), while in *A. vireo* there is an arc of 5-10 or more denticles occupying the same area as occupied by the individual denticles in *A. meridionalis*.

**Description. Male.** Length 4.9-5.1 mm (n = 3). Male genitalia: Lateral view (Fig. 19a), segment IX with anterior margin thickened, straight to concave, angling down and forward at 60° to midline, then straight to convex, angling down and back at 75° to convex ventral margin; dorsal margin straight, slightly longer than preanal appendage, 3/4 length of ventral margin; posterior margin convex, vertical. Preanal appendage with ventral margin slightly convex to slightly concave, dorsal margin convex, tip rounded or with ventral corner bluntly pointed, length 1.5 times depth, extending 1/3 distance to end of X, with 6-8 long setae dorsally. Sides of X sclerotized throughout, more heavily so along ventral and posterior margins; dorsal base of X slightly up-sloped. Posterior margin of X projected down and back at 30° from vertical, its dorsal continuation a sharp, protruding, vertical denticle; posteroventrally, X is produced down and back below the ventral margin of X, its sharply pointed tip extending past tip of inferior appendage. Membranous area between lateral plates of X protruding slightly above its concave dorsal margin. Inferior appendages ovoid, length = 2.2 times depth, posteriodorsal portion extending farther rearward than posteroventral portion, tip rounded, ventral and dorsal margins slightly convex; denticles on inner sur-

face visible as darkened areas near ventral margin at mid-length, and submarginally at posteriodorsal “corner”; a smaller, submarginal denticle near middle of posterior margin occasionally visible.

Dorsal view (Fig. 19b). Anterior margin of IX with broad, deep, U-shaped emargination; posterior margin concave between lateral margins of X and preanal appendages, straight, faint, transverse suture between IX and X; longitudinal ridge on midline of IX. Dorsal inner margins of lateral sclerotized areas of X with V-shaped junction near base of segment, outer margins slightly divergent to end of segment, area between sides of X membranous. Posteroventral angle of X with long, sharply pointed projection directed posteriolaterad at 30-45° from body axis; posteriodorsal denticle of X nearly erect, at about same angle as posteroventral denticle, sharply pointed. Subterminal dorsal denticle of inferior appendage (not shown) nearly transverse, angled slightly posteriad.

Ventral view (Fig. 19c). Anterior margin of IX barely concave; its posterior margin forming an obtuse (100-120°) angle between bases of inferior appendages; depigmented area on posterior 1/3 of segment bounded anteriorly by transverse row of setae. Inferior appendages angular, in contact at base, inner margins convex, diverging from each other at 30-50° to base of marginal denticle at mid-length, then more divergent and concave to second denticle at 3/4 length of appendage, these denticles connected by a nearly continuous, darkened ridge; subterminal, distal denticle about same size as other two, with a much smaller denticle occasionally apparent about midway between distal two denticles; outer margin of appendages convex and slightly divergent. Ventral arms of X (not shown) converge from base to mid-length where they nearly or actually meet, and then diverge in a smooth curve to tips.

**Larva.** Head uniformly dark brown except for oval pale area around eye, darker than other sclerites. Pale muscle scars visible on shed sclerites of MMT in 3-4 rows behind eye, and in 2 rows of 2 on middle of posterior 1/2 of frontoclypeus. Pronotum uniform tan, pale muscle scars in a row from middle of posterior margin to middle of mesal margin, and scattered near anteriolateral margin, on each sclerite. Muscle scars not apparent on intact larvae. Meso- and metanotal sclerites tan, darker than adjacent membranes, and easily visible. Legs amber. Prosternal sclerite with median side about 2/3 length of outer side. Mesosternal sclerites mostly black except for pale streak along midline. Legs, sterna, and sclerites on IX and X otherwise typical for genus.

**Emergence dates.** 6 April-1 May.

**Distribution.** GA, known only from the type locality.

**Discussion.** There is a possibility that this species is not valid, and represents a variant population of *A. vireo*. We choose to treat it as a valid species at this time because of its potentially precarious status and to stimulate additional research. See discussion under *A. vireo* for additional aspects of our rationale.

**Etymology.** *meridionalis* = of the south, in reference to its southerly distribution.

### ***Agapetus minutus* Sibley**

Fig. 20a, 20b, 20c. Map 20

*Agapetus minutus* Sibley 1926: 79

Type locality McLean, Tompkins Co., NY. (Cornell University Insect Collection)

**Diagnosis.** Shares the upturned, spinose posterior margin of X with *A. alabamensis*, *A. illini*, *A. ruiteri*, and *A. tricornutus*. Differs from *A. alabamensis* and *A. tricornutus* in having about 15 similar denticles, versus only 3 (*A. tricornutus*) or 5-9 (*A. alabamensis*) denticles irregular in length and spacing in these two species. Differs from *A. illini* in having only 1 prominent denticle on each inferior appendage (2 per appendage in *A. illini*). Differs from the very similar *A. ruiteri* in having the dorsal setae on the preanal appendage much more slender than the denticles on X (these setae as robust as denticles on X in *A. ruiteri*); in having the large, transverse denticle on the inferior appendage terminal and continuous with posteroventral margin of inferior appendage (at 2/3 length of appendage and on inner face not contacting

ventral margin of appendage in *A. ruiteri*), and in having the small, proximal denticle of the inferior appendage (ventral view) halfway between the ventral shoulder and the distal denticle (on the ventral shoulder in *A. ruiteri*). Also differs from *A. ruiteri* in having the denticulate, vertical, posterior process of X non-flexible, extending only slightly above the dorsal margin of X, and with denticles forming 2 irregular rows (posterior process of X flexible, about 1/2 of denticulate portion extending past dorsum of X, and with denticles arranged mostly in a single row in *A. ruiteri*). An additional character that may prove to consistently differ between *A. minutus* and *A. ruiteri* is the transverse band of ventral setae near distal margin of IX (triangular patch of setae, apex pointed forward, in *A. ruiteri*).

**Description. Male.** Length 4.5-6.0 mm (n = 16). Male genitalia: Lateral view (Fig. 20a), anterior margin of IX sinuate, concave near dorsal margin, sloping down and forward at 45° angle to below midline, then down and back at 10° from vertical to convex ventral margin; dorsal margin appears to have a pointed posterior projection, but, at 200X, there is a vertical boundary extending from the tip of the point to what appears to be the sclerotized anteriodorsal portion of X; dorsal margin length = 3/4 length of preanal appendage, 1/2 length of ventral margin; posterior margin slightly concave, nearly vertical. Preanal appendage 1/2 length of inferior appendage, slightly expanded at tip, ventral margin convex, dorsal margin concave near base, length 3 times maximum depth, about eight long, erect setae on distal 3/4. Dorsal base of preanal appendage with dorsal projection that extends to level of dorsal margin of X, and appears as a triangular, sclerotized area at the dorsal base of X. Segment X sclerotized along ventral margin, sclerotized area gradually more transparent dorsad and not clearly differentiated from membranous dorsal portion of X. Ventral arm of X not clearly defined; ventral margin curves down and back from base, nearly straight and horizontal to upturned at 30° for most of its length, then upturned at 90° or recurved at posterior margin; pointed tip of posterior margin extends slightly above dorsal margin of X, with about 15 darkened, upturned denticles along posterior and lateral margins. Inferior appendage same length as X, length = 2.5 times depth; dorsal margin horizontal, slightly concave near middle, a horizontal lateral carina extends from base nearly to tip along dorsal 1/4. Ventral margin of inferior appendage slightly concave on basal third, forming a rounded 140° angle with distal 2/3 which is also slightly concave. Tip of inferior appendage rounded, about 1/2 its maximum depth; tip of terminal denticle visible as a dark spot on inner surface of appendage at posteroventral margin; smaller denticle often visible on ventral margin halfway between terminal denticle and obtuse angle at 1/3 length.

Dorsal view (Fig. 20b). Anterior margin of IX deeply concave, U-shaped; mid-dorsal length 2/3 length of preanal appendage, posterior margin a faint, pale line just posterior to the tip of a triangular projection on midline. Preanal appendages with distal portion straight, divergent from body axis at 20° angle. Ventral arms of X nearly parallel, slightly concave laterally; denticles on upturned distal arms conspicuous. A darkened triangular projection extends laterad at about 1/2 length of X, from mid-depth of X, this projection shielded by the preanal appendage in lateral view; dorsal portion of X membranous between sclerotized sides.

Ventral view (Fig. 20c). Anterior margin of IX concave; posterior margin concave on each side of pointed projection (100° angle) between bases of inferior appendages; transverse linear array of setae present 1/3 distance from posterior margin, area posterior to this depigmented. Inferior appendages with outer margin nearly straight and slightly divergent from body axis to bluntly pointed tips; inner margins in contact at base, narrowly divergent from each other (30° angle) to shoulder at basal 1/4, then more divergent and concave to and continuous with base of large, transverse, subterminal denticle (posterior base of denticle is nearly terminal). A second smaller denticle on inner, ventral margin midway between subterminal denticle and shoulder of inferior appendage, this denticle occasionally vestigial. Inner margins of sclerotized arms of X (not shown) converge from base of preanal appendages, in contact at 1/3 length, and divergent to tips; outer margins parallel to inner margins; lateral denticle at mid-length on mid-sides of X not conspicuous.

**Larva.** Head, notal sclerites, and anal claws brown; other sclerotized areas paler except for usual dark sutures/margins typical for genus. Mesonotal sclerites with outer third darker than mesal 2/3. Frontoclypeus with a tight cluster of four pale muscle scars in middle of posterior 1/2 of sclerite, two small ones anterior and more noticeable than the larger, less conspicuous posterior pair, these visible on shed sclerites of MMTs, but not on larvae. Genae with about 10 pale muscle scars in posteriolateral corner, these more conspicuous than the about 30 pale muscle scars posterior to the pale eyespot. Pronotum with

about 15 pale muscle scars on posteriolateral 1/2 of each sclerite. At least some of the muscle scars on genae and pronotum visible on larvae.

**Emergence dates.** 22 May-5 July, 13-23 September.

**Distribution.** DE Newcastle. KY Bell, Breathitt (2), Edmonson (3), Lewis, Whitley. MA Worcester. NC Haywood (2). NY Colden, Tompkins. PA Chester (2), Crawford, Pike, Warren, Westmoreland. TN Blount (17), Campbell (2), Cocke (3), Fentress, Grainger, Knox, Sevier (13), Sullivan, Unicoi, Union. VA Giles, Tazewell. WV Preston.

**Discussion.** So similar to the allopatric and more southerly *A. ruiteri* that we felt compelled to compare the type of *A. minutus* with males of *A. ruiteri* to determine whether they represent one, two, or perhaps even three species (upstate New York type locality for *A. minutus* is far north of any other *A. minutus* material we were aware of at the time). In east Tennessee, *A. minutus* is widespread as far southwest as the Abrams Creek system and northern tributaries to Chilhowee Reservoir (north side of the Little Tennessee River); on the south side of the Little Tennessee River (Citico Creek system), the very similar *A. ruiteri* occurs, and it extends to the southwest through the Hiwassee and Conasauga river systems. The widespread *A. minutus* has been found to differ consistently from the localized *A. ruiteri* in numerous characters associated with male genitalia (see Diagnosis). Taken with *A. iridis* and *A. kirchneri*.

**Etymology.** Presumably in reference to the small size of this and all species of *Agapetus*.

#### ***Agapetus pegram* Etnier, Baxter, and Parker new species**

Fig. 21a, 21b, 21c. Map 21

**Type material.** Holotype, MMT male, length 4.3 mm, EX UT 1.362. Cave Spring, Pegram, 36.1070° N, 87.0462° W, Cheatham Co., TN, 27 March 1998, emerged 19 April, D.A. Etnier, C.J. Paxton, C.E. Skelton. (NMNH)

Allotype, MMT mature female pupa, taken with holotype, emerged 17 April 1998. (NMNH)

Paratypes taken with the holotype, EX UT 1.362. CASC, MMT male pupa emerged 9 April, 1 prepupa; CUAC, MMT male pupa emerged 26 April, 1 prepupa; INHS, MMT male pupa emerged 27 April, MMT female pupa emerged 17 April, 1 prepupa; ROME, MMT male emerged 20 April, 1 prepupa; SCHC, MMT male pupa emerged 19 April, 1 prepupa; NMNH, 1 larva, 1 prepupa. 2 MMT male pupae, 1 female, 2 early pupae, and 6 prepupae remain in UT 1.362.

Additional paratopotypes, 5 April 1997, EX UT 1.330. CASC, 1 MMT female pupa; CUAC, 1 MMT female pupa; ROME, 1 female, emerged 27 April; SCHC, 1 MMT female pupa, emerged 17 April; UMSP, 1 MMT male pupa, 1 MMT female pupa, 1 prepupa, 1 larva. Nine MMT male pupae, 2 MMT female pupae, 1 early pupa, and 5 larvae/prepupae remain in UT 1.330.

**Additional material examined. Tennessee, Cheatham Co.:** UT 1.568, spring run in northeast corner of jct. US 70 and TN 249, Pegram, 29 March 2000, 10 larvae/prepupae, 1 early pupa, 9 male + 5 female mature pupae/adults; UT 1.570, creek along TN 251 at Christ Community Church, 0.4 rd mi n of Glower Road, n of I-40, 29 March 1990, 7 larvae/prepupae, 8 male + 7 female mature pupae/adults; UT 1.572, type locality, 29 March 2000, 7 larvae/prepupae, 13 male + 14 female mature pupae/adults. **Davidson Co.:** UT 1.798, Little Cr. at Little Cr. Community Club, about 0.5 mi e of I-24 on TN 45, 17 April 2002, 6 larvae/prepupae, 2 male mature pupae/adults; UT 1.799, Little Cr. at Pioneer Christian Academy, dead end of Brick Church Road, e of I-24, 17 April 2002, 5 larvae/prepupae, 3 male + 5 female mature pupae/adults; UT 1.800, creek at Crocker Spring Road 0.2 rd mi above Lickton Road, e of I-24, 17 April 2002, 3 prepupae, 5 male + 3 female mature pupae/adults. **Williamson Co.:** UT 1.1113, Basin Spring, 35.9582° N, 87.0387° W, 9.5 air mi wnw of jct. US 31 and US 431 in Franklin, 4 May 2008, 1 male; UT 1.1193, same locality, 28 April 2008, 1 MMT male pupa, 1 MMT female pupa.

**Diagnosis.** Differs from all species treated herein except *A. stylifer* in having posteriodorsal and posteroventral corners of segment X well sclerotized, curved outward, and ending in a sharp point. Very similar to and probably closely related to *A. stylifer*, from which it differs most notably in having the posteriodorsal corner of X (lateral view) blunt, conspicuously darkened apically, and with only a shallow notch between it and the rounded posteroventral corner of X (tapering to a sharp point, not apically darkened, and forming a deep, U-shaped emargination between it and the distinct ventral projection in *A. stylifer*). In addition, in dorsal and ventral views of X both terminal denticles are bent outward at about 90° from their base, while in *A. stylifer* only the ventral denticle has this configuration, with the dorsal denticle a smooth continuation of its base.

**Description. Male.** Length 4.3-5.3 mm (n = 5). Male genitalia: Lateral view (Fig. 21a), anterior margin of IX thickened, slanting down and forward to midline at 40° angle, then nearly vertical to convex ventral margin; dorsal margin 1/3 length of ventral margin; posterior margin concave in dorsal 1/2, and nearly vertical in lower 1/2 to inferior appendage base; an elevated shoulder associated with base of preanal appendage. Preanal appendages subrectangular, length = 2.7 times maximum depth, tip bluntly rounded; dorsal margin convex with about 10 long, erect setae concentrated on distal 1/2; ventral margin concave. Segment X laterally well sclerotized, with ventral arms more opaque, darker area narrow at base and expanding distally to include terminal posteriodorsal projection and posterior 1/4 of dorsal margin. Dorsal margin depressed at base, then convex to tip of short, blunt, terminal projection. Both dorsal projection and posteroventral area with dark spot due to transverse, triangular denticle. A narrow membranous area often visible dorsal to dorsal margin of X. Ventral margin of X slightly concave near tip, its rounded termination forming a shallow notch with dorsal projection. Inferior appendages with length 2.5 times basal depth, dorsal margin slightly concave; ventral margin convex on basal 1/2, slightly concave distally and tapering smoothly to terminal, upturned denticle at bluntly pointed distal end; denticle vertical to slanting rearward at 30° from vertical and with a darkened line (denticulate ridge) visible extending forward from its base about 1/4 length of appendage; an additional, slightly shorter, darkened denticulate ridge barely visible on ventral margin at middle of appendage.

Dorsal view (Fig. 21b). Anterior margin of IX broadly and deeply emarginate; posterior margin not conspicuous, with V-shaped posterior projection; mid-dorsal length 1/2 exposed length of preanal appendage. Preanal appendages divergent from body axis at 30°, tips swollen and more divergent. Lateral margins of X gradually divergent from base to terminal pointed denticle that is directed laterad and slightly forward; inner dorsal margins not conspicuous, separated by membranous area, divergent from body axis (25° angle) and convex to tips of dorsal denticles. Ventral arms of X with inner margins convergent to nearly meet at 1/3 length, then convex and divergent at 25° from body axis to tip; darkened posteroventral denticle visible at 3/4 length of X. Inferior appendages (not shown) parallel sided, curved, with bases divergent; tips convergent, truncate, and slightly swollen, distal denticle not conspicuous.

Ventral view (Fig. 21c). Anterior margin of IX with broadly V-shaped concavity; posterior margin V-shaped (120° angle) between bases of inferior appendages. A diamond-shaped, depigmented area on IX mid-ventrally anterior to bases of inferior appendages. Inferior appendages basally each 1/3 width of IX, outer margin convex to truncate, slightly swollen tip; terminal denticle directed inward; inner margins in contact at base, convex and divergent from each other at increasing angle from base through darkened ridge of irregular denticles in middle 1/3 of length, then curved inward and parallel with outer margin on distal 1/3. Darkened row of irregular denticles often with slightly larger proximal denticle. Ventral arms of X (not shown) convex and convergent at basal third, divergent and straight to convex in distal 2/3, sharp subterminal and terminal denticles both visible, directed anteriolaterad.

**Larva.** Not separable from that of *A. stylifer*. Head with pale muscle scars on genae in area behind eye, and on frontoclypeus as a transverse band of 3-5 on posterior 1/2 of sclerite, visible in MMT sclerites but not in intact larvae or prepupae. Head (except for pale area around eye and muscle scars) and sclerites on IX and X dark brown; pronotal, mesonotal, and metanotal sclerites lighter brown, legs yellow. Mesosternal sclerite narrowly bordered with black. Legs, sterna, and sclerites on IX and X otherwise typical for genus.

**Emergence dates.** 7 April-23 May.

**Distribution.** TN Cheatham (3), Davidson (3), Williamson.

**Discussion.** All noted differences between males of *A. pegram* and *A. styliifer* are based on relative length, orientation, and degree of curvature of genital structures. In examination of males of all available material of both species, we have noted neither intermediate populations nor notable variation within populations. Cave Springs, Pegram, Cheatham Co., TN, type locality for *A. pegram*, is a locality collected by Sidney W. Edwards in the 1960s. He recorded two species of *Glossosoma* from the spring run, one of which was surely *Glossosoma nigrrior*, which is abundant there (but listed as *G. americanum* Banks by Edwards). Etnier et al. (1998) assumed that the second glossosomatid species in the spring run might represent *G. intermedium* (Klapalek), known from as far southeast as Meade Co., north central Kentucky. We now feel it more likely that Edwards' other Cave Springs glossosomatid (he listed only larvae and pupae) was *A. pegram*. Separation of *Agapetus* and *Glossosoma* larvae before Wiggins (1977) was quite subjective.

**Etymology.** *pegram* is used as a noun in apposition, in reference to the town of Pegram, very near the type locality.

### ***Agapetus pinatus* Ross**

Fig. 22a, 22b, 22c. Map 22

*Agapetus pinatus* Ross 1938: 107

Type locality, Elkmont, Great Smoky Mountains National Park, Sevier Co., TN. (INHS)

**Diagnosis.** *Agapetus pinatus* differs from all other *Agapetus* treated herein except *A. baueri*, *A. flinti*, *A. jocassee*, and *A. iridis* in having the length of the inferior appendages more than 4.5 times their depth. Differs from *A. baueri* and *A. jocassee* in having 3 (versus 2) denticles on each inferior appendage. Differs from both *A. flinti* and *A. iridis* in having the sub-terminal denticles on the inferior appendages closely approximated, one dorsal to the other (versus denticles rather evenly spaced).

**Description. Male.** Length = 4.6-6.2 mm (n = 30). Male genitalia: Lateral view (Fig. 22a), anterior margin of IX thickened, slightly convex, sloping down and forward at 45° from rounded mid-depth area, then down and back, nearly straight, at 60° to convex ventral margin; dorsal margin of IX essentially linear, just dorsal to prominent shoulder with horizontal to rounded dorsal margin that covers basal 1/8-1/4 of preanal appendage; posterior margin of IX straight, vertical. Preanal appendage with exposed area 1/2 as long as X, length = 7 times depth, ventral margin convex, curved upward at tip to posteriodorsal point; dorsal margin straight to slightly concave. Preanal appendage deepest at swollen base, constricted at posterior edge of IX; 15-20 dorsal setae on entire exposed area. Segment X with heavily sclerotized ventral arms, less sclerotized dorsally, posteriodorsal area membranous. Ventral arms of X nearly vertical from base of preanal appendage, then smoothly curved through 90° angle; nearly all of exposed portion slightly convex, sloping upward (10°), equally deep throughout except for thickened area near mid-length. Distally, X terminates in outer denticle continuous with ventral margin to sloping upward at 30°, this denticle with 1-3 points; a second denticle is medial and slightly posterior to this denticle and has a stellate cluster of 3-5 points. Inferior appendage nearly extending to tip of X, its length = 4.5 times depth; ventral margin straight and horizontal on basal 2/3, then upturned and concave to truncate tip; dorsal margin parallel to ventral margin on basal 2/3, then convex and slightly convergent with ventral margin to tip. A tiny, non-darkened, transverse denticle present at posteroventral angle, and a pair of darkened denticles on inner surface, one slightly above and slightly posterior to the other, on lower 1/2 at 2/3 length of inferior appendage; these denticles on basal edge of sclerotized area on posterior 1/3 of inner surface of appendage, basal inner surface of appendage non-sclerotized. Lateral edge of inferior appendage visible as faint horizontal line at mid-depth, especially in middle 1/3.

Dorsal view (Fig. 22b). Anterior margin of IX with deep, rounded concavity; posterior margin, if visible, with broadly V-shaped emargination, meeting at midline at 130° angle; mid-dorsal length essentially restricted to width of anterior margin. Preanal appendages with inner margin convex on distal half; outer margin nearly straight; divergent from body axis at 30° angle, with tip swollen and pointed. Seg-

ment X with lateral margins of ventral arms smoothly concave, convergent from bases of preanal appendages to contact each other near mid-length, then divergent distally to tips of outer denticles. Median margins of ventral arms parallel to lateral margins except slightly swollen in contact area; X sclerotized dorsally from base to junction of ventral arms; V-shaped membranous area distal to junction; median denticles extend farther posteriad than lateral denticles. Darkened pair of denticles on inferior appendage (not shown) prominent, transverse.

Ventral view (Fig. 22c). Anterior margin of IX with deep, bluntly V-shaped concavity; posterior margin forming 100° angle between inferior appendage bases; triangular area on posterior 1/4 depigmented posterior to transverse row of setae. Inferior appendages with lateral margin straight to slightly convex distal to swollen base; inner margins in contact at base, then diverging from each other at 20° as a thin, broad, straight-edged shelf that angles outward (45° from body axis) at 2/3 length of inferior appendage to base of dark, transverse, ventral denticle; a smaller dark transverse denticle posteriodorsal to larger denticle; inner margin continues to tip of inferior appendage, where non-darkened tiny denticle is not obvious.

**Larva.** Head, thoracic sclerites, and sclerites on IX and X dark gray; legs and prosternal sclerites dusky yellow. Head with circular pale area around eyespot. Prosternum with inner and outer margins of equal length. No muscle scars visible on larvae. In shed sclerites of MMT, small, pale muscle scars visible behind eye from lower level of eye to vertex, and behind pair of poorly defined pale spots at middle of frontoclypeus; each of these pale spots midway between outer edge and middle of sclerite. Pronotum with numerous larger pale muscle scars on posterior 2/3.

**Emergence dates.** 25 May-24 August.

**Distribution.** AL Cleburne. CT Middlesex. GA Fannin, Gilmer (2). ME Aroostook. MS Hampshire (4). NB Anagans. NC Buncombe (2), Cherokee (4), Clay (2), Graham (2), Haywood (5), Jackson, Macon (3), Swain (18), Transylvania (11). NH Carroll (2), Coos (2), Grafton, Hillsborough, Strafford (2), Sullivan, Worcester. NY Franklin. PQ Covey Hill, Knowlton, St-Fuygence, Route 33 to Rv. Montmorency. PA Carbon, Franklin, McKean, Monroe, Pike (3), Warren (3), Wayne. TN Blount, Sevier. VA Grayson, Rappahannock. VT Windsor.

**Discussion.** Taken with *A. baueri*, *A. flinti*, *A. jocassee*, *A. tomus*, and *A. walkeri*.

**Etymology.** Not given in description, but likely from the Latin *Pinus*, generic name of many pine trees, = of the pines.

### ***Agapetus ruiteri* Parker, Etnier, and Baxter new species**

Fig. 23a, 23b, 23c. Map 23

**Type material.** Holotype, mature male pupa, EX UT 1.104, spring run in US Forest Service Quinn Springs Campground, TN 30 1.7 rd mi se of US 411, 35.2290° N, 84.5460° W, Polk Co., TN, 12 May 1977, D. A. Etnier, G. A. Schuster. (NMNH)

Allotype, mature female pupa, taken with holotype. (NMNH)

Paratopotypes, EX UT 1.104: CASC, 1 larva, 1 prepupa; CUAC, 1 larva, 1 prepupa, 1 mature male pupa; INHS, 1 larva, 1 prepupa, 1 mature male pupa, 1 mature female pupa; ROME, 1 larva, 1 prepupa, 1 mature male pupa, 1 mature female pupa; SCHC, 1 larva, 1 prepupa; UMSP, 1 larva, 1 prepupa; NMNH, 1 larva, 1 prepupa. Eleven larvae, 3 prepupae, and 34 early pupae remain in UT 1.104.

Additional paratypes, **Polk Co., TN**, EX UT 1.440: Sheeds Cr. trib. at US Forest Service Road 221, 325 m n of Big Frog Loop Road, se Polk Co., TN, 8 June 1998, CASC, male pupa, female pupa, preserved late June; SCHC, male emerged 11 June, female emerged late June; UMSP, male emerged 11 June, female emerged late June; 1 MMT male pupa, 2 MMT female pupae remain in UT 1.440. **Monroe Co., TN**, UT 1.511, trib. to Citico Cr. at Citico Creek Road (= USFS Road 35-1), 1.9 rd mi s of Mt. Pleasant Road, 16 May 1999, 19 larvae/prepupae, 1 early pupa, 1 male MMT + 6 MMT male pupae, emerged 22 May-10 June, 1 female MMT + 6 MMT female pupae emerged 19 May-10 June.

**Additional material examined.** TN, Monroe Co.: UT 1.1158, Donnely Branch just above Indian Boundary Lake, 100 m w of boat ramp, 35.3943° N, 84.1127° W, 5 May 2009, 3 larvae, 1 male, 1 female, emerged 3-9 June 2009; UT 1.1162, Flats Creek just above Indian Boundary Lake, 1/4 mi w of boat ramp, 35.3922° N, 84.1221° W, 5 May 2009, 8 larvae/prepupae, 1 male + 2 female pupae, emerged 2-11 June. Polk Co.: UT 1.101, type locality, 22 April 1977, 6 larvae, 2 prepupae, 1 early pupa, 1 male pupa; UT 1.375, same locality as UT 1.440 (above), 3 larvae, 28 April 1998; UT 1.437, Conasauga R. trib. at USFS parking lot for Trail 61, off USFS Road 221, 6 June 1998, 6 female emerged late June; UT 1.682, stream 6.2 rd mi n of US 64 on TN 30, above bridge, 31 May 2000, emerged through 28 June, 6 prepupae, 12 MMT male + 8 MMT female pupae/adults.

**Diagnosis.** Shares the upturned, spinose posterior margin of X with *A. alabamensis*, *A. illini*, *A. minutus*, and *A. tricornutus*. Differs from *A. alabamensis* and *A. tricornutus* in having about 5 similar denticles (versus only 3 in *A. tricornutus*, 5-9 in *A. alabamensis*, denticles irregular in length and spacing in these two species). Differs from *A. illini* in having only 1 prominent denticle on each inferior appendage (2 per appendage in *A. illini*). Differs from the very similar *A. minutus* in having dorsal setae on preanal appendage as robust as denticles on X (much more slender than the denticles on X in *A. minutus* and all other *Agapetus* species discussed in this paper); in having the large, transverse denticle on the inferior appendage at 2/3 length of appendage and on inner face, not contacting ventral margin of appendage (terminal and continuous with posteroventral margin of inferior appendage in *A. minutus*); and in having the small, proximal denticle on the inferior appendage (ventral view) on the shoulder of the appendage (halfway between shoulder and terminal denticle in *A. minutus*). Also differs from *A. minutus* in having the denticulate, vertical, posterior process of X flexible, with about 1/2 of denticulate portion extending past dorsum of X, and with denticles arranged mostly in a single row (non-flexible, extending only slightly above the dorsal margin of X, and with denticles forming 2 irregular rows in *A. minutus*). An additional character that may prove to be diagnostic between *A. ruiteri* and *A. minutus* is mentioned under the diagnosis for *A. minutus*.

**Description. Male.** Length 5.2-5.8 mm (n = 3). Male genitalia: Lateral view (Fig. 23a), anterior margin of IX sinuous, trending down and forward at 45° angle to midline, then vertical to 15° back from vertical to convex ventral margin; dorsal margin 1/2 length of ventral margin, with up-sloped median elevation from anterior base extending posteriad nearly to end of IX; a transparent “window” often apparent near posteriodorsal corner of IX; posterior margin nearly vertical, slightly concave to base of preanal appendage, convex from preanal appendage to ventral margin. Preanal appendage clavate, exposed portion 0.6 times length of inferior appendage, 2.4 times maximum depth, ventral margin convex, distal 1/2 of dorsal margin convex, with about 12 long, very stout, vertical setae, these as thick as denticles on X. Base of preanal appendage with dorsal projection posterior to segment IX that extends to level of dorsal margin of X. Segment X sclerotized laterally, sclerotized area gradually more transparent dorsad and not clearly differentiated from membranous dorsal portion of X. Segment X steeply curved downward at ventral base to convex ventral margin, sclerotized ventral arms not well differentiated from sclerotized sides of X; posterior margin with filamentous, vertical projection that extends 1/3 its length above dorsal margin of X, denticulate portion mostly free from remainder of X, weakly sclerotized and flexible, denticles about 15, mostly lateral, some ventral denticles extend posteriad. Inferior appendage rhomboid, nearly as long as X, length = 2.3 times depth; dorsal margin concave, a concave horizontal carina on middle 1/3 of appendage parallels dorsal margin, extending above and slightly posterior to “shadow” of distal denticle. Ventral margin of inferior appendage slightly concave, especially distal to obtuse angle (150°) near middle of appendage; posterior margin rounded; the two denticles are visible as dark spots, at ventral angle, and the larger denticle at mid-depth about equally spaced between tip of appendage and proximal denticle.

Dorsal view (Fig. 23b). Anterior margin of IX deeply concave, U-shaped, with distinct rim; mid-dorsal length 2/3 length of preanal appendages; posterior margin of IX faint and transverse, posterior to tip of triangular elevation on midline. What appears to be the posterior margin of IX is interpreted as representing convergent dorsomedian extensions of the preanal appendages. Preanal appendages with exposed basal 1/3 transverse, less divergent distally (15° from body axis). Sides of X sclerotized; a triangular lateral projection typically present at 1/3 length; ventral arms difficult to see; posterior denticulate filament conspicuous, a vertical continuation of ventral arms; posterior portion of X membranous.

Ventral view (Fig. 23c). Anterior margin of IX concave; posterior margin concave on each side of obtuse projection (145°) between bases of inferior appendages; a triangular array of setae 1/4 distance from posterior margin; a narrow depigmented area often apparent posteriad. Inferior appendages with outer margin slightly sinuate, mostly convex, tip rounded; mesal margin with bases in contact, then divergent from each other at 20° angle to 2/3 length, then rounded shoulder forms obtuse (140°) angle with base, with a tiny, dark, triangular denticle at the angle; a second, larger, transverse denticle 1/2 distance from basal denticle to end of appendage, at mid-depth on inner face. Ventral arms of X (not shown) with inner margins smoothly convex, meeting at 1/3 length, then diverging, and continuing as filamentous, denticulate posterior margin; outer margins parallel to inner margins; lateral denticle at 1/3 length, easily seen in dorsal view of X, occasionally visible.

**Larva.** Head, notal sclerites, and anal claws brown; other sclerotized areas paler except for usual dark sutures/margins typical for genus. Frontoclypeus with a tight cluster of three pale, dark-edged muscle scars in middle of posterior 1/2 of sclerite. Genae with area posterior and dorsal to pale eye spot covered with poorly defined pale muscle scars, those in posteriolateral corner most conspicuous. Pronotum with inconspicuous pale muscle scars on posteriolateral 1/2 of each sclerite; muscle scars on head and pronotum typically apparent only on shed sclerites of MMTs, not on larvae.

**Emergence dates.** 11 May-28 June.

**Distribution.** TN Monroe, Polk (5).

**Discussion.** See Discussion for *A. minutus*. We have not taken *A. ruiteri* with the other five species of *Agapetus* that occur in Polk Co., TN; it tends to be found at higher elevations, nearer the Blue Ridge physiographic province, than the other Polk Co. *Agapetus*. All localities are in or adjacent to areas managed by the US Forest Service, an agency whose stewardship has proved to be highly correlated with survival of robust populations of *Agapetus*. In spite of its limited range, we feel that its future is currently secure.

**Etymology.** Named in honor of David E. Ruiter, colleague, friend, and trichopterist.

### *Agapetus spinosus* Etnier and Way

Fig. 24a, 24b, 24c. Map 24

*Agapetus spinosus* Etnier and Way 1973: 425

Type locality, University of Tennessee Plateau Experiment Station, 6 rd mi w of Crossville, US 70, Cumberland Co., TN. (NMNH)

**Diagnosis.** Similar to *A. hessi*, *A. kirchneri*, and *A. walkeri* in having ventral arms of X slender, out-curved at tip, and terminating in one to several denticles. Differs from *A. kirchneri* in lacking a ventral row of denticles on inferior appendage, and in having the terminal denticle ventral to mid-depth (inferior appendage with ventral row of denticles, terminal denticles dorsal and ventral in *A. kirchneri*). Most similar to *A. hessi* and *A. walkeri*, differing from both in having about 5 slender denticles at tip of each ventral arm of X (versus 1 or 2). Further differing from *A. hessi* in having a single denticle at tip of inferior appendage (2 in *A. hessi*). Further differing from *A. walkeri* in usually lacking a prominent sub-basal denticle laterally on each arm of X.

**Description. Male.** Length 5.5-6.6 mm (n = 7). Male genitalia: Lateral view (Fig. 24a), anterior margin of IX slopes down and forward to midline at 45°, then down and back at 30-40° to convex ventral margin, ventral 1/8 more vertical; dorsal margin straight, slightly longer than depth of preanal appendage, 1/4 length of ventral margin, down-sloped, forming obtuse angle with up-sloped dorsal base of X; posterior margin slopes gently down and back, covering basal 1/3 of preanal appendage, then vertical, straight to convex, to near ventral margin; ventral margin 1/2 length of inferior appendage. Preanal appendage rod-

shaped, length = 6 times depth, tip rounded, truncate, or pointed; length = 1/2 that of inferior appendage, dorsally with 10-15 erect setae on entire exposed area. Dorsal margin of X sloping upward, slightly sclerotized basally, distally membranous except for ventral arms. Ventral arms slender, ventral margin straight on basal 1/3, forming obtuse angle with distal portion which is also straight, then curved upward near tip to darkened terminal denticles. Inferior appendage length = 2 times depth, equal to X. End of inferior appendage with dark spot below mid-depth representing terminal denticle, upper and lower corners rounded. In ventrolateral view distal third of ventral margin swollen, and a horizontal carina conspicuous on ventral 1/2 of outer margin of inferior appendage from base to 3/4 length.

Dorsal view (Fig. 24b). Anterior margin of IX concave. Preanal appendages divergent from body axis at 30°, inner margin convex, sides parallel. Dorsal, sclerotized portion of X not apparent; ventral arms converge to contact at mid-length, then parallel or slightly divergent to near tips, which curve abruptly through 60-90°, tips darkened, each with about 5 slender, sharp denticles; a small pair of lateral denticles occasionally present near base (not shown). Darkened, in-turned denticle at end of each inferior appendage triangular.

Ventral view (Fig. 24c). Anterior and posterior margin of IX broadly concave, posterior margin apparently not projecting between inferior appendage bases, triangular area between posterior end of IX and bases of inferior appendages apparently membranous and depigmented, a transverse row of setae at anterior base of depigmented area. Inferior appendages with outer margins nearly straight, parallel to slightly convergent, tips rounded, dorsal tips flared out from lateral carina in slightly oblique views; terminal denticle transverse to directed slightly posteriad; inner margins in contact at base, divergent from each other at 75° on basal 1/8; sinuous but essentially parallel to distal 1/8 where divergent from each other at 90° and concave to base of terminal denticle.

**Larva.** Sclerites straw-yellow, with brown darker markings typical for genus. Very similar to the larva of *A. walkeri*, with the following characters possibly offering separation. In *A. spinosus*, muscle scars on the frontoclypeus are conspicuous only on the posterior 1/2, with an anterior transverse pair at the level of the marginal concavity and another pair just anterior to the lateral angles, all of these midway between the lateral margin and the midline; an additional pair of dark muscle scars occurs near the lateral margin, just posterior to the lateral angles; a cluster of 3 similar scars forms a triangle, "point" forward, near the posterior end of the sclerite. There are marginal dark areas at the lateral concavity just anterior to mid-length and at the lateral angles. Muscle scars on the pronotum are similar in size and color to those on the head, and confined to the posterior third. Metanotal sclerites are darker than adjacent membranes, as dark as the darkened posteriolateral corners of the mesonotal sclerites. In *A. walkeri*, muscle scars on anterior 1/2 of frontoclypeus are nearly as prominent as those on posterior 1/2, and the darkened area marginally at mid-length is absent.

**Emergence dates.** 3 May-early June.

**Distribution.** AL DeKalb, Jackson (2). TN Bledsoe, Cumberland (6), DeKalb (2), Franklin, Grundy, Roane, Scott.

**Discussion.** Taken with *A. crasmus*. This species appears to have a high fidelity to the Cumberland Plateau physiographic province.

**Etymology.** Not given in original description, but *spinosus* is in reference to the numerous denticles at the termination of the ventral arms of X.

### ***Agapetus stylifer* Etnier, Baxter, and Parker new species**

Fig. 25a, 25b, 25c. Map 25

**Type material.** Holotype, MMT male, length 5.0 mm, EX UT 1.596. Smith Fork trib. 0.5 rd mi w of US 70 on TN 96, 36.0140° N, 86.0021° W, DeKalb Co., TN, 18 April 2000, emerged 28 April 2000, D. A. Etnier. (NMNH)

Allotype, female, length 5.4 mm, taken with holotype, emerged 30 April 2000. (NMNH)

Paratypes taken with holotype, all EX UT 1.596. CASC, MMT male emerged 25 April, MMT female emerged 24 April; CUAC, MMT male pupa emerged 25 April, MMT female emerged 24 April; INHS, MMT male emerged 21 April, MMT female pupa emerged 30 April, 1 larva, 1 prepupa; ROME, MMT male emerged 23 April, MMT female pupa emerged 30 April; SCHC, MMT male emerged 23 April; MMT female emerged late April; UMSP, 1 MMT male, emerged 24 April; 1 MMT female pupa emerged late April, 1 prepupa; NMNH, 1 larva, 1 prepupa; 1 early pupa, 4 male pupae, 3 female, 3 female pupae remain in UT 1.596, adults emerged late April 2000.

**Additional material examined. Tennessee, Clay Co.:** UT 1.638, Little Proctor Cr. at Proctor Cr. Road & Old Watson Road, 13 May 2000, 3 larvae/prepupae, 1 early pupa, 7 male + 6 female mature pupae/adults; **Putnam Co.:** UT 1.369, creek 1.7 rd mi s of Overton Co. line on TN 84, 21 April 1998, 6 larvae/prepupae, 3 early pupae, 10 male + 2 female mature pupae/adults; **Smith Co.:** UT 1.594, upper Mulherrin Cr. along TN 53 1.9 rd mi n of jct. Brush Cr. Road, 18 April 2000, 3 larvae/prepupae, 10 male + 10 female mature pupae/adults; UT 1.595, spring run trib. to Mulherrin Cr. at 244 TN Hwy. 53, n of I-40, 18 April 2000, 1 larva, 5 male + 6 female mature pupae/adults; **Sumner Co.:** UT 1.598, Deshea Cr. at Bright Lane, 0.3 rd mi s of US 31E, 16 April 2000, 7 larvae/prepupae, 1 early pupa, 7 male + 5 female mature pupae/adults; UT 1.600, Lick Cr. at TN 25, 0.7 rd mi e of Rock Springs Road, 16 April 2000, 14 larvae/prepupae, 4 unopened pupae, 2 male + 1 female mature pupae/adults; UT 1.603, Jones Spring at Tyree Spring Road, White House, 16 April 2000, 1 prepupa, 1 male + 1 female; UT 1.621, Otter Fork at 801 Wolf Hill Road, 2.3 rd mi se of US 231/31E, 10 May 2000, 1 larva, 7 male + 6 female mature pupae/adults; **Trousdale Co.:** UT 1.592, Rocky Cr. trib. at US 231, 0.8 rd mi s of TN 25, 16 April 2000, 7 larvae/prepupae, 4 early pupae, 15 male + 14 female mature pupae/adults; **Wilson Co.:** UT 1.567, Shop Spring Br. trib. 0.2 rd mi n of jct. US 70/Shop Spring Road, 29 March 2000, 15 larvae/prepupae, 8 male + 2 female mature pupae/adults; UT 1.571, West Prong Jennings Cr. at Poplar Hill Road, s of I-40, 29 March 2000, 20 larvae/prepupae, 4 male + 3 female mature pupae/adults.

**Diagnosis.** Differs from all species treated herein except *A. pegram* in having the posteriodorsal and posteroventral corners of segment X well sclerotized, curved outward, and ending in a sharp point (dorsal and ventral views). Very similar to and probably closely related to *A. pegram*, from which it differs most notably in having the posteriodorsal corner of X (lateral view) tapering to a non-darkened sharp point, forming a deep, U-shaped emargination between it and the distinct ventral projection (versus blunt, conspicuously darkened apically, and with only a shallow notch between it and the rounded posteroventral corner of X in *A. pegram*). In addition, in dorsal and ventral views of X only the ventral terminal denticle is bent outward at about 90° from its base, with the dorsal denticle a smooth continuation of its base; in *A. pegram* both terminal denticles are sharply bent from their base.

**Description. Male.** Length 4.8-5.5 mm (n = 28). Male genitalia: Lateral view (Fig. 25a), anterior margin of IX thickened, slanting down and forward to midline at 45° angle, then vertical or angled slightly posteriad to convex ventral margin; dorsal margin 1/3 length of ventral margin; posterior margin vertical to just below lower edge of preanal appendage, then with a short shoulder that projects posteriad, then nearly vertical to lower articulation of inferior appendage. Preanal appendages subrectangular, exposed length = 2 times maximum depth, which occurs near truncate tip, dorsal margin convex, ventral margin straight to slightly concave; dorsal edge with about 10 long, erect setae on distal 3/4. Segment X laterally well sclerotized, with ventral margin more opaque, darker area narrow at base and expanding distally to include terminal denticle. Dorsal margin depressed at base, then convex to base of long, up-curved terminal denticle that extends nearly to tip of inferior appendage, with its tip extending slightly past posteroventral corner of X; ventral margin of X slightly concave, terminating in a blunt projection parallel to dorsal denticle; emargination between dorsal denticle and ventral projection U-shaped. Inferior appendages with length 3 times basal depth, margins concave dorsally and convex ventrally, tapering smoothly to terminal, upturned denticle at rounded distal end; denticle slants rearward at about 40° from vertical. Darkened ridge extending forward from base of terminal denticle visible as a dark line 1/4 length of appendage; darkened denticulate ridge on ventral margin barely visible, extending forward from middle of appendage.

Dorsal view (Fig. 25b). Anterior and posterior margins of IX broadly V-shaped, parallel, mid-dorsal length 1/2 length of exposed portion of preanal appendage. Preanal appendages divergent from body axis at 10°, tips swollen and more divergent. Lateral margins of X concave anterior and posterior to slight swelling at 1/3 length, increasingly divergent to tips of dorsal denticles; inner margins convex and divergent to tips of denticles, separated by inconspicuous membranous area, U-shaped separation at base. Ventral details of X not conspicuous in dorsal view. Inferior appendages parallel sided, curved, divergent on basal 1/2, distal 1/2 convergent, distal denticle hooked.

Ventral view (Fig. 25b). Anterior margin of IX concave, thickened; posterior margin broadly V-shaped (110° angle) between bases of inferior appendages. A diamond-shaped, depigmented area on IX mid-ventrally, anterior to bases of inferior appendages. Inferior appendages basally somewhat inflated, then outer margin convex to truncate tip; terminal denticle hooked; inner margins in contact at base, then convex to origin of darkened ridge of irregular denticles at basal 1/3 of length, then curved inward and parallel to outer margin to tip. Darkened row of irregular denticles extends about 1/3 length of inferior appendage, often with slightly larger proximal denticle; an additional but less conspicuous denticulate ridge on inner margin occupying distal 1/4 of appendage. Inner margins of ventral arms of X convex and convergent in basal third, straight and divergent in distal 2/3, and appearing widest where they nearly meet on the midline; terminating in sharp, laterally projected, posteroventral denticle; posteriodorsal denticle of X a smooth continuation of dorsal margin.

**Larva.** Not separable from that of *A. pegram*, see that description.

**Emergence dates.** 19 April-24 May.

**Distribution.** TN Clay, DeKalb, Putnam, Smith (2), Sumner (4), Trousdale, Wilson (2).

**Discussion.** See *A. pegram*. We have taken *A. aphallus* with *A. stylifer* at several localities.

**Etymology.** *stylifer* = style bearer, used as a noun in apposition.

### ***Agapetus tomus* Ross**

Fig. 26a, 26b, 26c. Map 26

*Agapetus tomus* Ross 1941: 44

Type locality, Swamp Cr. 7 mi s of Dalton, Whitfield Co., GA. (INHS)

**Diagnosis.** In lateral view neither the U-shaped ventral projection from the tip of the ventral arms of X nor the symmetrically concave (occasionally truncate) tip of the inferior appendage is shared by other North American *Agapetus*.

**Description. Male.** Length = 4.9-6.7 mm (n = 16). Male genitalia: Lateral view (Fig. 26a), anterior margin of IX with upper 1/2 convex, sloping down and forward to midline at 45°, then concave, down and back at 65° to convex ventral margin; ventral margin 6 times length of dorsal margin; lateral carina slopes from upper edge of preanal appendage up and forward at 10° from horizontal; posterior margin convex and essentially vertical below preanal appendage. Preanal appendage slender at posterior edge of IX, gradually deepening to tip; extending anteriorly under IX for about 1/3 its length, posteroventral corner slightly produced. Preanal appendage length = 0.6 times length of X, 1/2 length of inferior appendage, exposed portion with 10-15 erect setae near dorsal margin. Dorsal margin of X sclerotized on basal 3/8, distal 5/8 membranous and horizontal to sloping down and back to dorsal point of sclerotized ventral arms; ventral arms narrowest at base, a dark, lateral, external denticle apparent at 1/4 length, a U-shaped ventral projection occupies distal fifth; posterior margin vertical ± 20° and terminates dorsad in sharp, darkened point, with adjacent small, non-pointed, darkened areas occasionally present. Inferior appendage length = 2.4 times depth; dorsal margin straight to barely sinuous to rounded posteriodorsal corner where internal denticle visible as dark area; posterior margin vertical to sloping down and back at

about 20°, slightly to definitely concave; ventral margin biconcave with obtuse ventral projection near mid-length, distal concavity more pronounced than anterior concavity; posteroventral corner rounded and with dark mark representing posteroventral denticle. Lateral surface of inferior appendage with carina extending back and slightly up from anterior articulation 5/8 distance to tip.

Dorsal view (Fig. 26b). Anterior margin of IX broadly and deeply concave, right and left halves occasionally separated by suture; posterior margin concave or not apparent, nearly contacting anterior margin on midline. Preanal appendage with outer margin concave, inner margin sinuate, margins subparallel, tip bluntly pointed and diverging from body axis at 45°. Dorsal sclerotized base of X not differentiated from membranous remainder; lateral margins barely concave, parallel to body axis except pointed tips curved outward at 30° from body axis; a dark, broad-based, pointed, lateral denticle at 1/3 length of X; inner margins of ventral arms convergent from base, in apparent contact at 2/3 length, then gradually more divergent to terminal, darkened denticle, which may be bifid or adorned with a few tiny points laterally. Inner dorsal margin of inferior appendage concave, especially at tip where curved inward (60°) to form dorsal, terminal denticle; outer margins straight to smoothly and weakly convex; posteroventral denticle visible, much larger and more transverse than posteriodorsal denticle.

Ventral view (Fig. 26c). Anterior margin of IX with trapezoidal emargination; posterior margin forms obtuse (120°) angle between bases of inferior appendages; posterior 1/3 with depigmented area separated from anterior 2/3 by transverse patch of setae. Inferior appendages with outer margins nearly straight basally, becoming convex on distal 1/3 to transverse or slightly recurved, finger-like tip; inner margins straight to convex and divergent from basal contact to 2/3 length, then concave to finger-like tip; a darkened denticle present at posteroventral corner; posteriodorsal denticle often hidden.

**Larva.** Sclerites of head and pronotum pale, slightly darker than or as pale as other sclerotized areas. Frontoclypeus with three groups of transverse dark muscle scars, a pair just anterior to mid-length, four in a row from corner to corner, the larger two medial and more anterior, and two or three near the posterior end of the sclerite that form a triangle, point directed forward, or a line with the dark marks contiguous or nearly so. Posterior margins of frontoclypeus with darker brown border continuous with similar, slightly broader adjacent band on the genae. Genae with four large, round brown spots on each side of vertex and two rows of similar but less conspicuous brown spots behind eye, upper row with four spots, lower row with five or six spots. Pronotum with anterior 1/2 immaculate, area from and behind anterior base of foreleg with about ten brown spots per side. Mesonotum, metanotum, and tergite on IX lacking dark spots or margins, difficult to differentiate from adjacent membranous areas. Femora and tibiae freckled with brown spots. Except for dark anal claw, other sclerites straw-yellow, with brown darker markings typical for genus.

**Emergence dates.** 4 May-26 August.

**Distribution.** AL Bibb (2), Blount, Cherokee, Cleburne (3), Jefferson (2). GA Catoosa (3), Fannin, Gilmer (6), Murray, Whitfield. KY Bell (2), Breathitt (2), Green (2), Jackson, Laurel, Letcher, McCreary, Warren, Whitley. MI Livingston. MN Aitkin (2), Morrison, Pine (4). NC Cherokee. OH Portage (2). PA Somerset, Westmoreland. TN Blount (23), Bradley, Claiborne, Greene, Jefferson, Johnson (3), Morgan (3), Sevier (2). VA Smyth (6).

**Discussion.** We have taken *A. aphallus*, *A. baueri*, *A. jocasseae*, *A. pinatus*, *A. vireo*, and *A. walkeri* with *A. tomus*.

**Etymology.** Unknown.

### ***Agapetus tricornutus* Etnier, Parker, and Baxter new species**

Fig. 27a, 27b, 27c. Map 27

**Type material.** Holotype, male, length 4.7 mm, EX UT 1.464. stream 1.5 rd mi w of US 11 on continuation of St. Clair co rd 30, 33.7345° N, 86.5379° W, Jefferson Co., AL, 13 April 1999, emerged 17 April 1999, D. A. Etnier. (NMNH)

Allotype, female pupa, taken with holotype, emerged 17 April 1999. (NMNH)

Paratopotypes, EX UT 1.464: CASC, 1 male pupa, 1 larva, 1 prepupa; CUAC, 1 MMTmale, 1 MMT female, 1 larva, 1 prepupa; INHS, 1MMTmale, 1 MMT female, 1 larva, 1 prepupa; ROME, 1 MMTmale, 1 MMT female, 1 larva, 1 prepupa; SCHC, 1 MMT male pupa, 1 larva, 1 prepupa; UMSP, 1 MMTmale, 1 female pupa, 1 larva, 1 prepupa; NMNH, 1 male pupa, 1 larva, 1 prepupa. Remaining in UT 1.164 are 1 MMTmale, 1 MMT male pupa, 1 MMT female pupa, 1 larva, and 3 prepupae.

Additional paratypes, EX UT 1.500, Ohatchee Cr. trib. at Kays Ferry Road, 0.6 rd mi n of jct. Hollingsworth Road and New Liberty Road, access via Seven Springs Road, ne of AL 204, Calhoun Co., AL, 6 May 1999. CASC, 1 MMT female pupa; SCHC, 1 MMT female pupa. Remaining in UT 1.500 are 2 males, 2 MMT males, and 4 MMT female pupae.

**Additional material examined. Alabama, St. Clair Co.:** UT 1.463, spring run 2.4 rd mi n of co rd 30, s of Springville, 13 April 1999, 1 male + 2 female mature pupae/adults; UT 1.490, spring run at US 11 in Springville, 13 April 1999, 2 male + 1 female mature pupae/adults.

**Diagnosis.** The three prominent spines or denticles (2 dorsal and vertical, 1 ventral and horizontal, none between posteroventral and posteriodorsal corner) associated with the posterior margin of segment X (lateral view) separate this species from all others in central and eastern North America. Most similar to *A. alabamensis* (which has 4-9 prominent denticles on X, many on posterior border), and further differing in having ventral margin of X straight on distal 3/4 (distal 1/4 decurved in *A. alabamensis*).

**Description. Male.** Length 4.0-5.5 mm (n = 7). Male genitalia: Lateral view (Fig. 27a), segment IX anterior margin straight, slanting down and forward to middle at 45°, lower 1/2 slightly convex, sloping down and back at 60° to convex ventral margin; posterior margin convex and nearly vertical; dorsal margin 1/2 length of ventral margin, sloping down and back at 20°. Preanal appendage clavate, 1/2 length of inferior appendage, its maximum depth (posterior to mid-length) 1/3 length; distal 1/2 and end with about 12 long setae. Sides of X sclerotized, ventral arms more opaque; dorsal margin with slight concavity at base, then straight to second concavity anterior to anteriodorsal denticle, then more deeply concave to base of posteriodorsal denticle. Ventral margin horizontal to sloping downward to swelling at basal third, then upward (145° angle with base) to posteroventral denticle. Terminal denticles 3, one at posteroventral corner nearly horizontal, curved upward; largest denticle vertical, at posteriodorsal corner; third denticle also vertical, subequal to ventral denticle, and anterior to largest denticle. A few scattered serrations occasionally present along posterior border of X. Inferior appendage rhomboid, length = 3.0 times depth; upper margin straight, nearly parallel to convex lower margin, distal end angles down and forward at 55°; a submarginal black denticle apparent on inner surface at posteriodorsal corner, and heavily sclerotized ridge associated with posteroventral corner visible as a dark line.

Dorsal view (Fig. 27b). Segment IX with anterior margin broadly and deeply concave, thickened, its mid-length 0.4 times that of preanal appendage, posterior margin straight, poorly differentiated from X, and with triangular emargination barely visible on midline. Preanal appendages parallel to or slightly divergent from body axis, inner margin concave near base, convex distally, outer margin straight except may diverge slightly at pointed, distal end. Sclerotized inner margins of X narrowly separated by dorsal membranous area and convergent to U- or V-shaped (20° angle) basal fusion. Dorsolateral and ventrolateral margins of X nearly parallel; posteriodorsal denticles with tips incurved; posteroventral denticle with tip curved outward. Inferior appendages (not shown) with denticle near posteriodorsal margin pointed, transverse.

Ventral view (Fig. 27c). Anterior margin of IX concave, posterior margin with angular extension (90°) between inferior appendage bases; heart-shaped to triangular depigmented area on IX anterior to inferior appendage bases bordered anteriorly by transverse row of setae. Inferior appendages with bases slightly swollen, outer margins slightly concave near middle, slightly divergent to rounded tip; inner margins in contact at base, straight and divergent (30° from each other) to mid-length; at mid-length a tiny dark denticle marks the anterior end of a concave, heavily sclerotized ridge that diverges (30° angle from body axis) to posteroventral angle of inferior appendage where an additional weak denticle is present; the ridge then abruptly more concave, less darkly pigmented, and more divergent to base of submarginal posteriodorsal denticle. Ventral arms of X (not shown) converge from base to meet or nearly meet at

swelling at 1/3 length, forming an angle of about 80°, then nearly parallel to near each posteroventral tip and their denticle-like prolongations which diverge from body axis at about 30°.

**Larva.** Genae and frontoclypeus gray except for pale area around eye. Muscle scars on head of larva, if visible, are pale and occur in a patch of about 12 scars behind eye and extending ventrally to genal suture; frontoclypeus with 3 pale muscle scars near middle of sclerite just posterior to lateral angles. Pronotum with 1-2 large, circular, pale, submarginal muscle scars at the anterior base of each leg; 2 rows of 3 pale muscle scars diverge from each other at 40°, from middle of segment near midline; additional pale muscle scars near posterior margin of sclerite. Mesonotal and metanotal sclerites as dark as those of head and pronotum, easily differentiated from paler surrounding membranous area. Pale muscle scars on larval frontoclypeus not conspicuous in MMT, in a cluster of 3-5 as in larvae, 2 paler circular areas present transversely near middle of sclerite. Genae show additional pale muscle scars throughout area behind eye; posteroventral corner and deepest area of concavity on posterior margin are conspicuously darkened. Legs and sterna typical for genus; and sclerites on IX and X as dark as those on thoracic nota.

**Emergence dates.** 13 April-31 May.

**Distribution.** AL Calhoun, Jefferson, St. Clair (2).

**Discussion.** See comments under *A. alabamensis*.

**Etymology.** *tricornutus* = 3-horned, in reference to the 3 prominent denticles at the posterior end of segment X.

### ***Agapetus vireo* Ross**

Fig. 28a, 28b, 28c. Map 28

*Agapetus vireo* Ross 1941: 43

Type locality, Swamp Cr. 7 mi s of Dalton, Whitfield Co., GA. (INHS)

**Diagnosis.** Shares with *A. crasmus*, *A. diacanthus*, *A. gelbae*, *A. meridionalis*, and *A. tomus* the heavily sclerotized ventral and posterior portions of segment X. Differs from all of these except *A. meridionalis* in having the preanal appendage subcircular in lateral view, with length 1.5 times depth (versus digitiform, with length 2 or more times depth), and in having the inferior appendages ovoid (versus rhomboid in *A. crasmus* and *A. diacanthus*, with posteriodorsal projection in *A. gelbae*, and with concave or truncate tip in *A. tomus*). Posteroventral aspect of X (lateral view), which forms a right angle in *A. vireo*, is smoothly curved to form a hook in *A. crasmus*, has a bluntly pointed posteriodorsal projection in *A. diacanthus* and *A. gelbae*, and has a rounded ventral lobe in *A. tomus*. Most similar to *A. meridionalis* (see **Discussion**); in *A. vireo* (lateral view) posterior margin of X vertical and with its posteroventral angle not produced, not extending below the ventral margin of X, and not extending to posterior end of the inferior appendage; in *A. meridionalis* posterior margin of X sloping down and back at 30° from vertical, extending below ventral margin of X, and extending posteriad past end of inferior appendage. In addition, there is an arc of 5-10 or more denticles on the inferior appendage in *A. vireo*, while this same area is occupied by only 3 (occasionally 4) well separated denticles in *A. meridionalis*.

**Description. Male.** Length 4.2-5.7 mm (n = 11). Male genitalia: Lateral view (Fig. 28a), segment IX with anterior margin thickened, sloping down and forward at 60° to midline, then nearly straight to convex, sloping down and back at 75°, to convex ventral margin; dorsal margin straight, forming obtuse angle with upward sloped dorsal margin of X, 2/3 length of ventral margin; posterior margin convex and sloping down and forward at 85°. Preanal appendage with straight or concave ventral margin, convex dorsal margin, tip rounded, length 1.5 times depth, extending about halfway to end of X, with 6-8 long, erect setae dorsally. Segment X heavily sclerotized along ventral and posterior margins, sclerotized but less heavily so elsewhere. Posteroventral corner of X forming a right angle, transverse denticle projects

outward and visible only as a dark corner; posterior margin ends dorsally in a protruding sharp denticle; membranous area medial to lateral plates of X visible dorsally. Inferior appendage length = 2.1 times depth; ovoid, with ventral and dorsal margins slightly convex and tip symmetrically to slightly asymmetrically rounded, extending slightly past X. Denticles near tip of inferior appendage visible as darkened areas on distal 1/2 of ventral margin and extending dorsad submarginally along lower posterior margin; submarginal denticle at posteriodorsal "corner" most prominent.

Dorsal view (Fig. 28b). Anterior margin of IX with broad U-shaped emargination, posterior margin weakly separated from X, slightly concave between sides of X and preanal appendages; longitudinal ridge on midline. Preanal appendages parallel sided and nearly straight basally, slightly expanded distally, tips rounded. Segment X dorsally with sclerotized inner margins having narrowly U-shaped junction at base, then slightly divergent to posteriodorsal denticles; area between lateral sclerotized plates of X membranous. Posteroventral angle of X with short, sharp denticle directed laterad perpendicular to body axis; posteriodorsal denticle nearly vertical, protruding posteriad slightly. Distal denticle of the inferior appendages (not shown) sharply pointed, darkened, and transverse.

Ventral view (Fig. 28c). Anterior margin of IX barely concave; posterior margin forming 100-120° angle between bases of inferior appendages; transverse row of setae just anterior to bases of inferior appendages delimits triangular, depigmented area on posterior 1/3 of segment. Inferior appendages with bases angular, outer margins nearly straight, parallel; inner margins straight, nearly in contact at base, divergent from each other at about 40° to basal dark denticle at middle of appendage, then more divergent and concave to tip of appendage. From large basal denticle a darkened ridge, broken up into small denticles, continues along the ventral margin to posteroventral "corner" where 1 or 2 slightly larger denticles occur; smaller, more widely spaced denticles continue, submarginally, to near base of large denticle near posteriodorsal corner. Ventral arms of X (not shown) converge from base, nearly meeting at 1/3 length, where they are thickest, then diverge to denticle at posteroventral corner.

**Larva.** Currently not separable from that of *A. meridionalis*.

**Emergence dates.** 11 April-10 June, 9 September.

**Distribution.** AL DeKalb (4), Jackson (3). GA Catoosa (3), Dade, Floyd, Murray (2), Walker (2), Whitfield (2). TN Bledsoe (3), Bradley (4), Cumberland (2), Hamilton (4), Marion (2), Overton (2), Polk, Rhea (2).

**Discussion.** At two localities from near the *A. vireo* type locality, from Floyd Co. (UT 1.455, Pocket Cr. at Everett Springs Road 7.3 rd mi s of GA 136), and Walker Co. (UT 1.452, Everett Springs Road 2.7 rd mi s of GA 136) specimens collected were somewhat intermediate between *A. meridionalis* and typical *A. vireo*. In UT 1.455 the 5 males examined all have the posterior margin of X sloping down and back and acutely pointed at the posteroventral corner (in *A. vireo* vertical posterior margin of X forms blunt right angle with ventral margin of X); these differ from the *A. meridionalis* types in that the posteroventral corner does not extend below the level of the ventral margin of X and does not extend posteriad to the end of the inferior appendage. In UT 1.452 the 9 males examined vary from rather typical *A. vireo* (1), to resembling males in UT 1.455 (2), to having the posterior margin of X vertical but concave with the posteroventral corner produced into an acute point (2), to being rather intermediate between *A. vireo* and the two other morphs mentioned in this lot. In UT 1.450 (Walker Co., West Armuchee Cr. at Armuchee Road, 0.2 rd mi s of GA 136) the 4 males examined are typical of *A. vireo* except the right angle at the posteroventral corner of X is sharply rather than bluntly pointed. Examination of all males in the 4 lots involved indicates no variation in segment X in the 6 *A. meridionalis* males, and none of the 18 "*A. vireo*" males examined from UT 1.450, UT 1.452, and UT 1.455 approaches *A. meridionalis* in ventral projection and length of segment X. All 5 males examined from UT 1.484 (Whitfield Co., Vermeil Spring Branch at GA 2, Vermeil, 17 miles north of the *A. meridionalis* type locality) are typical *A. vireo*. What appears to be an additional character separating the two species (see Diagnosis) involves denticulation of the inferior appendages. Additional examination of specimens from this portion of Georgia is certainly warranted. We have taken *A. vireo* with *A. avitus*, *A. ibis*, *A. iridis*, *A. tomus*, and *A. walkeri*.

**Etymology.** Unknown.

***Agapetus walkeri* (Betten and Mosely)**

Fig. 29a, 29b, 29c. Map 29

*Synagapetus walkeri* Betten and Mosely 1940: 8

Type locality, St. Martin's Falls, Albany River, Hudson Bay, Ontario, Canada. (BMNH)

*Agapetus rossi* Denning 1941: 200 **new junior subjective synonym**

Type locality, Lake Superior at mouth of Gooseberry River, St. Louis Co., MN. (USMP)

**Diagnosis.** The slender ventral arms of X that diverge distally to a transverse terminal denticle or group of denticles are shared by *A. hessi*, *A. kirchneri*, and *A. spinosus*. Differs from *A. kirchneri* in lacking sclerotized posteriodorsal areas of X and a darkened ventral row of denticles on inferior appendages. Differs from *A. hessi* in having a single terminal denticle (2 in *A. hessi*) on inferior appendage. Differs from *A. spinosus* in having ventral arms of X with a single terminal denticle, occasionally two (five or more denticles in *A. spinosus*), and in having a prominent denticle laterally on each arm of X at 0.2 times length of X (these denticles usually lacking in *A. spinosus*).

**Description. Male.** Length 5.4-6.1 mm (n = 8). Male genitalia: Lateral view (Fig. 29a), segment IX with anterior margin thickened, sloping down and forward at 35° to midline, then sloping posteriad at about 10° from vertical to 3/4 depth, then sloping posteriad at 45° to convex ventral margin; dorsal margin very abbreviated, its posterior boundary not apparent; posterior margin slopes down and back at 30° from horizontal to upper base of preanal appendage, then sloped down and forward at 10° from vertical to ventral margin; anterior 1/4 of preanal appendage covered by IX. Preanal appendage with straight or concave ventral margin, convex dorsal margin, tip with ventral corner produced, length 4 times depth, extending about halfway to end of X, with about 15 long, erect setae dorsally on exposed portion. Segment X with ventral arms heavily sclerotized, thickest at base, distally about as thick as preanal appendage; abruptly bent near middle, with posterior 1/2 sloped upward at 20° from basal 1/2; tip with transverse black denticle with 1-2 points, perpendicular to body axis; a triangular denticle present on dorsal surface of ventral arm at level of posterior margin of IX. Remainder of X lightly sclerotized anteriorly, especially on dorsal margin, then gradually becoming membranous posteriad; dorsal margin a straight continuation of upper posterior margin of IX on basal 2/3, then abruptly (130°) sloping down and back to tip of ventral arm. Inferior appendage length = 1.8 times depth; deepest at 3/4 length; dorsal and ventral margins divergent, ventral margin slightly concave near mid-length, length = 0.8 times length of X. End of inferior appendage with triangular dark spot at mid-depth representing inward directed denticle, tip of denticle typically not visible in lateral view, margin slightly concave above denticle, convex below denticle, both dorsal and ventral "corners" rounded. A carina present at mid-depth on outer margin of inferior appendage from base to 3/4 length.

Dorsal view (Fig. 29b). Anterior margin of IX broadly concave and apparently contacting or nearly contacting obscure posterior margin. Preanal appendages concave on outer surface, smoothly curved laterad through angle of 45° to nearly 90°, margins parallel to convergent basally and distally, tip bluntly pointed. Dorsal, sclerotized portion of X scarcely apparent; ventral arms convergent on basal 1/2 and nearly in contact at mid-length, typically with dark, transverse denticle at 1/4 length; distal 1/3 curves increasingly outward through 60-90° to terminate in darkened denticle (occasionally bifid) with slightly bulbous base.

Ventral view (Fig. 29c). Anterior margin of IX broadly and shallowly concave; posterior margin forms obtuse angle (100°) between inferior appendage bases; depigmented triangle in area posterior to line slightly forward of inferior appendage bases; a transverse row of setae at anterior edge of depigmented area. Inferior appendages with bases swollen, outer margin slightly sinuous, convex and convergent on distal 1/3 to darkened, in-pointed, terminal denticle; inner margins nearly in contact at base, then slightly divergent to 2/3 length, then convex and more divergent to tip.

**Larva.** Sclerites straw-yellow with brown darker markings typical for genus. Frontoclypeus with four evenly spaced pairs of brown muscle scars arranged in two longitudinal rows on middle 1/3-1/2 of sclerite, anterior three pairs rounded, posterior pair transversely elongate; anterior pair at anterior mar-

gin, next pair between eye spots, third pair at widest part of sclerite, posterior pair at 3/4 length of sclerite; two additional rounded brown muscle scars laterally between posterior two pairs, and on midline between middle pairs; a crescent shaped brown mark on midline between posterior pairs of muscle scars. Genae with about 5 rows of 3-6 rounded, brown muscle scars behind eye from level of mandibles to near vertex, with 3 regular, closely spaced rows below eye (area immediately behind eye lacking muscle scars), and 2 irregular rows above eye. Pronotum with about 12 large brown muscle scars on each side, on posterior 1/3 of sclerite and laterally extending forward to area of leg articulation. Muscle scars easily visible on larvae and MMT sclerites. On MMT sclerites, linear brown area margining posterior 1/2 of frontoclypeus extends across suture to adjacent area of genae.

**Emergence dates.** 24 April-7 September.

**Distribution.** AL Bibb, Calhoun, Clay (4), Cleburne (8), Lawrence (6), Shelby, Talladega (2), Tallapoosa, Winston (4). CT Fairfield (2), Middlesex (2), Tolland, Windham. GA Dade, Murray (2). MA Franklin (2), Worcester. MD Harford. ME Penobscot, Aroostook. MN Cook (4), Lake (2), St. Louis. NB Charlotte (2), Northumberland, Victoria. NC Burke (3), Caldwell (3), Durham (2), Montgomery (2), Moore, Person, Rutherford, Transylvania (3). NH Carroll (2), Coos, Grafton (2), Hillsborough (3), Merrimack, Strafford (6). NS Inverness. ON Costello Lake, Algonquin Park. PA Cameron, Crawford, Lycoming, Potter, Tioga, Warren. SC Oconee. TN Anderson, Blount (8), Overton, Polk (4), Robertson. VA Bath, Bland (2), Botetourt, Fairfax (3), Hanover, Shenandoah (3), Tazewell. WV Braxton, Hampshire, Pocahontas (4).

**Discussion.** The female type of *A. rossi*, in the British Museum, was examined by Ross (1956), and he gave no indication of a generic misidentification, in spite of its occurrence well to the north of other *Agapetus* species of central North America. We were able to examine the type in 2006, and consider *Agapetus rossi* Denning, 1941 to be a junior synonym of *A. walkeri*. The larva illustrated in Wiggins (1977, 1996) very likely represents this species. We have examined adults from MN to eastern NC to AL, and larvae from AL, GA, NC, TN, and VA, and have not noted regional variation. Taken with *A. flinti*, *A. iridis*, *A. pinatus*, *A. tomus*, and *A. vireo*.

**Etymology.** Named in honor of Francis Walker, early trichopterist at the British Museum.

#### Key to *Agapetus* males of eastern and central North America.

(Males are unknown for *A. aphallus*.)

1. Segment X (Fig. 13a), shaped like head of an ibis, beak pointing downward; inferior appendage shaped like a banana, extending posteriorly approximately half its length beyond the end of segment X ..... ***Agapetus ibis* Etnier, Baxter, and Parker n. sp., p. 21**
- Segment X not like an ibis; inferior appendage not banana-shaped, shorter than length of X or extending only slightly posteriad of X ..... **2**
- 2(1). Inferior appendage with length at least 4.5 times maximum depth (Fig. 5, 8, 15, 16, 22) ..... **3**
- Inferior appendage with length at most 4 times maximum depth (Fig. 17, 18) ..... **7**
- 3(2). Each inferior appendage (ventral view) with 2 denticles on inner face, no terminal denticle (Fig. 5c, 16c) ..... **4**
- Each inferior appendage (ventral view) with 3 denticles on inner face, one of which is terminal (Fig. 8c, 15c, 22c) ..... **5**
- 4(3). Denticle near middle of inferior appendage (ventral view) in middle of narrow triangular shelf (Fig. 5c); preanal appendage (Fig. 5b) typically curved in dorsal view (concave outer margin) ..... ***Agapetus baueri* Etnier, Parker, and Baxter n. sp., p. 10**

- Denticle near middle of inferior appendage at posterior end of broad, serrate, trapezoidal shelf (Fig. 16c); preanal appendage nearly straight in dorsal view (Fig. 16a) ..... ***Agapetus jocassee* Morse, p. 25**
- 5(3). Inferior appendages markedly sinuate on outer margin, denticles approximately evenly spaced along inner margin (Fig. 8c) .... ***Agapetus flinti* Parker, Etnier, and Baxter n. sp., p. 14**
- Inferior appendages with outer margins nearly straight or with apex curved, denticles unequally spaced on inner margin (Figs 15c, 22c) ..... **6**
- 6(5). Inferior appendages (Fig. 22c) with proximal denticles close together, one slightly posterior and dorsal to the other; terminal denticle not darkly pigmented . ***Agapetus pinatus* Ross, p. 35**
- Inferior appendages (Fig. 15c) with proximal denticles rather widely spaced and all denticles darkly pigmented ..... ***Agapetus iridis* Ross, p. 24**
- 7(2). Posterior portion of segment X truncate and vertical or nearly so, and with 3-15 large denticles or spines directed posteriad or dorsad (Fig. 1, 14, 20, 23, 27) ..... **8**
- Posterior margin of segment X may have small serrae, but never with more than 2 large denticles or spines (Fig. 4, 24), or if so X is definitely not truncate ..... **12**
- 8(7). Ten to fifteen denticles on posterior margin of X, similar in size, orientation, and spacing (Fig. 14, 20, 23) ..... **9**
- Nine or fewer denticles on posterior margin of X, irregular in size, orientation, and spacing (Fig. 1, 27) ..... **11**
- 9(8). Denticles on posterior margin of X do not extend above dorsal margin of X (Fig. 14); inferior appendage (Fig. 14c) with two denticles connected by a darkened ridge ..... ***Agapetus illini* Ross, p. 23**
- Denticles on posterior margin of X extend well above dorsum of X (Fig. 20, 23); inferior appendage (Fig. 20c, 23c) with two denticles, not connected by darkened ridge ..... **10**
- 10(9). Dorsal setae of preanal appendage normal, not nearly as thick as denticles on posterior margin of X (Fig. 20a); distal denticle of inferior appendage (Fig. 20c) on ventral margin; denticulate posterior arms of X not flexible and with denticles in a double row ..... ***Agapetus minutus* Sibley, p. 31**
- Dorsal setae of preanal appendage as thick as denticles on posterior arms of X (Fig. 23a); distal denticle of inferior appendage (Fig. 23c) submarginal; denticulate posterior arms of X flexible and with denticles in a single row ..... ***Agapetus ruiteri* Parker, Etnier, and Baxter n. sp., p. 36**
- 11(8). Posterior margin of X with 4-9 denticles; ventral margin of X curved ventrad on distal 1/4 (Fig. 1a) ..... ***Agapetus alabamensis* Harris, p. 4**
- Posterior margin of X with only 3 denticles; ventral margin of X horizontal or curved dorsad on its distal 1/4 (Fig. 27a) ..... ***Agapetus tricornutus* Etnier, Parker, and Baxter n. sp., p. 42**
- 12(8). No denticles associated with segment X (Fig. 3); known only from Missouri ..... ***Agapetus artesus* Ross, p. 7**
- Denticles present on segment X ..... **13**
- 13(12). Inferior appendage with finger-like dorsal projection (Fig. 9a) ... ***Agapetus gelbae* Ross, p. 16**
- Inferior appendage not finger-like (Fig. 4a, 7a, 9a, 12a, 18a, 21a, 28a) ..... **14**
- 14(13). Greatest depth of inferior appendage at or beyond mid-length, not strongly tapered posteriad (Fig. 4a, 7a, 9a, 12a, 18a, 28a) ..... **15**
- Inferior appendage with greatest depth near base, strongly tapered (Fig. 21) ..... **27**

- 15(14). Inferior appendage with greatest depth near posterior end, not rhomboid (Fig. 12, 24, 26) .... 16  
 — Inferior appendage not as above; if slightly deeper near posterior end the appendage is rhomboid (Fig. 6a) ..... 20
- 16(15). Tip of inferior appendage concave to truncate (Fig. 26a), or deeply incised (Fig. 10a) ..... 17  
 — Tip of inferior appendage slightly produced near mid-depth (Fig. 12, 24) ..... 18
- 17(16). X with prominent rounded lobe apicoventrally; end of inferior appendage concave, occasionally nearly truncate (Fig. 26a) ..... *Agapetus tomus* Ross, p. 41  
 — X with narrow acute projection apicoventrally; end of inferior appendage deeply incised (Fig. 10a) ..... *Agapetus harrisi* Etnier, Parker, and Baxter n. sp., p. 17
- 18(16). Tip of inferior appendage concave both above and below median protrusion (Fig. 12); each inferior appendage with two terminal denticles ..... *Agapetus hessi* Leonard and Leonard, p. 20  
 — Tip of inferior appendage convex below median protuberance (Fig. 24, 29); each inferior appendage with a single terminal denticle ..... 19
- 19(18). Tip of each ventral arm of X with one (rarely two) denticles (Fig. 29a); base of X with a laterally directed triangular denticle on each side (Fig. 29c) .....  
 ..... *Agapetus walkeri* (Betten and Mosely), p. 46  
 — Tip of each ventral arm of X with a cluster of about 5 denticles (Fig. 24a); denticles typically absent near base of X (Fig. 24c) ..... *Agapetus spinosus* Etnier and Way, p. 38
- 20(15). Inferior appendage strongly rhomboid (Fig. 6a, 7a, 11a, 17a) ..... 21  
 — Inferior appendage with tip rounded (Fig. 4a, 28a), or truncate (Fig. 18a) ..... 24
- 21(20). Inferior appendage nearly a perfect rhombus (anterior, posterior, dorsal, and ventral margins subequal, Fig. 6a, 7a) ..... 22  
 — Inferior appendage with dorsal and ventral margins at least 1.5 times longer than anterior and posterior margins (Fig. 11, 17) ..... 23
- 22(21). Segment X with terminal denticle curved upward at posteroventral corner (Fig. 6a) .....  
 ..... *Agapetus crasmus* Ross, p. 12  
 — Segment X with blunt tooth at posteroventral corner, then posterior margin straight and sloping anteriad (Fig. 7) ..... *Agapetus diacanthus* Edwards, p. 13
- 23(21). Segment X (lateral) terminates in a darkened, long denticle, with a shorter, less darkened denticle above it (Fig. 11a) ..... *Agapetus hesperus* Etnier, Baxter, and Parker n. sp., p. 18  
 — Segment X (lateral) terminates in a single denticle (Fig. 17a) .....  
 ..... *Agapetus kirchneri* Parker, Etnier, and Baxter n. sp., p. 27
- 24(20). Inferior appendage smoothly and rather symmetrically rounded at tip (Fig. 4a, 19a, 28a) ..... 25  
 — Inferior appendage with tip obliquely truncate, sloping down and back from posteriodorsal corner (Fig. 18), known only from Arkansas ..... *Agapetus medicus* Ross, p. 29
- 25(24). Segment X (Fig. 28a) with posterior margin truncate, nearly vertical .....  
 ..... *Agapetus vireo* Ross, p. 44  
 — Segment X (Fig. 4a, 19a) sloping down and back ..... 26
- 26(25). Segment X (Fig. 19a) with posteriodorsal corner present; X terminating ventrally in a pointed projection ventral to ventral margin .....  
 ..... *Agapetus meridionalis* Etnier, Parker, and Baxter n. sp., p. 30  
 — Segment X (Fig. 4a) lacking posteriodorsal corner; X terminating ventrally in a pointed projection level with ventral margin ..... *Agapetus avitus* Edwards, p. 8

- 27(14). Tip of X with 2 sharp denticles, each with length subequal to depth of preanal appendage (Fig. 25)  
 ..... *Agapetus stylifer* Etnier, Baxter and Parker n. sp., p. 39  
 — Tip of X with 2 short, blunt protuberances (Fig. 21).....  
 ..... *Agapetus pegram* Etnier, Baxter and Parker n. sp., p. 33

## Discussion

The genus *Agapetus* appears to be one of the most sensitive Trichoptera taxa in the Southeast. We have not found the genus below even small impoundments (farm ponds, etc.), except for one location along the Blue Ridge Parkway. In Tennessee, the genus is virtually absent from Davidson and Knox counties, both rich in habitats that appear to be ideal for *Agapetus*, but both highly developed and containing the cities of Nashville and Knoxville, respectively. Dave Lenat (In Litt. 2000) sent us a list of North Carolina creeks where they had found *Agapetus*, and noted that all were in that state's highest two water quality rankings. In spring of 2005, four days of *Agapetus* "hunting" in Alabama, Mississippi, and North Carolina resulted in *Agapetus* being found at all five sites examined on public lands (Natchez Trace Parkway, Bankhead National Forest, Uwharrie National Forest), while about 50 additional, seemingly suitable sites, all on private property, produced no *Agapetus*.

The large spring run crossing AL 204 e of US 231 in the Seven Springs area (33.8486° N, 85.8569° W) contained only *Glossosoma* when visited on 8 April 2006; the late G. W. Folkerts, Auburn University, found abundant *Agapetus* at that site about 20 years earlier. The only apparent change — a new concrete public utility building had been constructed at the spring head. One of the three *A. kirchneri* sites in west Knox Co., TN (UT 1.1039) near the junction of Lovell Road and Gilbert Drive contained many *Glossosoma* when visited on 3 May 2006. A few *Agapetus* were located about 60 m below the spring head, 20 m below the lower end of an old concrete raceway. The pupae were more heavily covered with silt than any Etnier had ever seen, and it seems likely that this population will be extirpated within a decade or so. Conserving spring habitats and preventing excessive siltation in spring-fed streams appears to be mandatory in preventing continued loss of populations of these fascinating caddisflies, some species of which surely remain undiscovered.

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Thanks to the British Museum for allowing us to examine the unique female type of *Synagapetus walkeri*. Distributional information and/or specimens were kindly offered by Donald Chandler, University of New Hampshire; Ed DeWalt and Colin Favret (INHS); Brian Evans; Larry Everett; Oliver Flint (NMNH); Mike Floyd; Rich Harrington; Steve Harris; Barry Hart; Phillip Hollingsworth; Ralph Holzenthal, David Houghton, and Margot Monson, (UMSP); Ben Keck; Boris Kondratieff; James Liebherr, Cornell University; Ed Masteller; John Morse (CUAC); Dave Neely; Becky Nichols; Chris Paxton, Dave Ruiter; Andy Sheldon; John Smith, Oak Ridge National Laboratory; Don Tarter, West Virginia University; Milt Ward, University of Alabama; and Norm Penny (CASC). Steve Harris also provided a very useful unpublished illustrated key to North American *Agapetus*. Mark O'Brien confirmed the presence of the type of *Agapetus hessi* in the University of Michigan collection. Enthusiastic field help was provided by Bruce Bauer, Rick Bivens, Mark Campen, Liz Etnier, Dave Lenat, Todd Long, Pat MacPherson, Adrieen Mayor, Chris Paxton, Pat Rakes, John Richardson, Jason Robinson, Charley Saylor, Guenter Schuster, Peggy and Randy Shute, Chris Skelton, Hunter Terrell, Craig Walker, and Carl Williams. Jennifer Joice, UT collections manager, was most helpful in assembling the figures and maps. We are grateful to Bruce H. Bauer, Steve Harris, Steve Moulton, Dave Ruiter, and Bruce Taggart for their constructive reviews and improvement of an earlier version of the manuscript. Andy Rasmussen reviewed the final manuscript. We are grateful to Paul Skelley for his expert layout of the figures and the key, and for his patient work with us on editorial details.

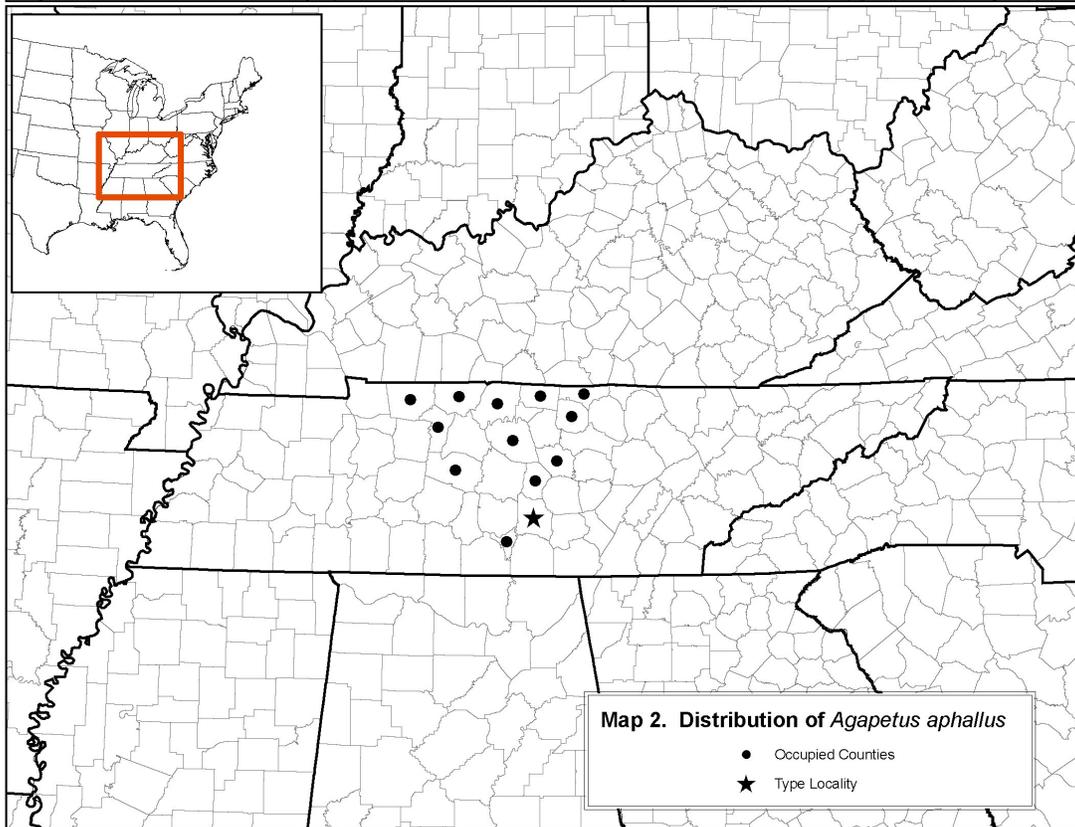
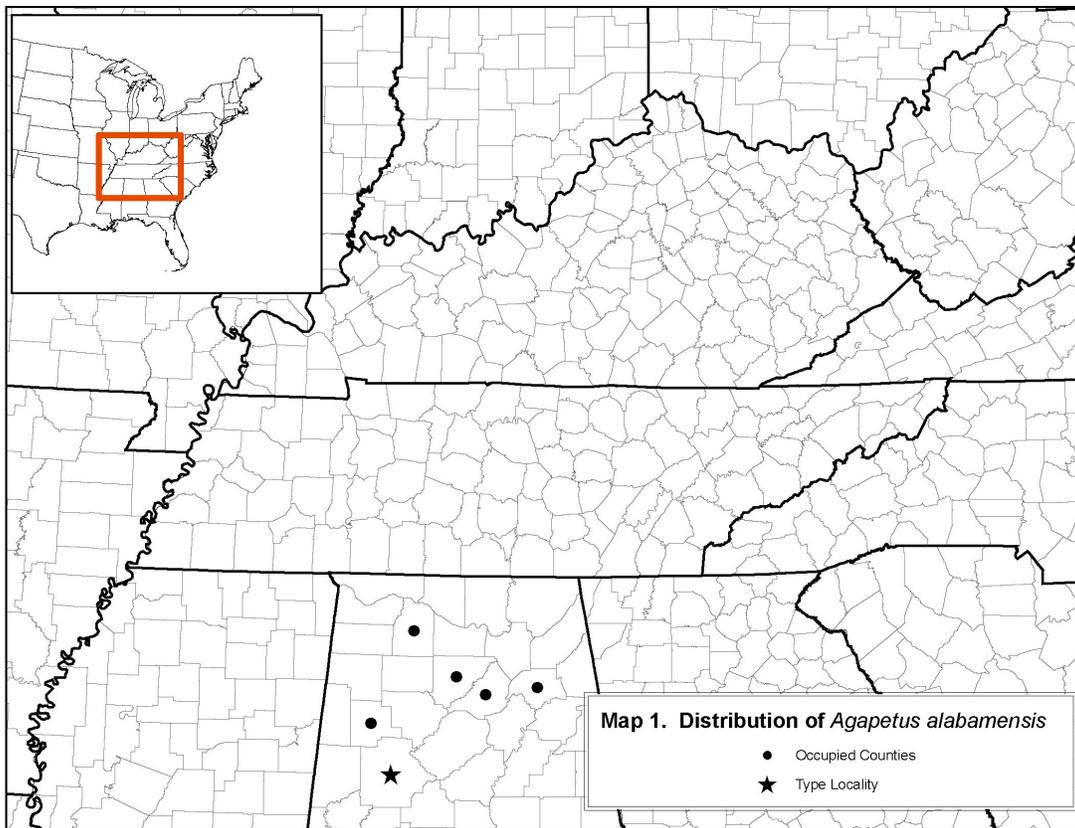
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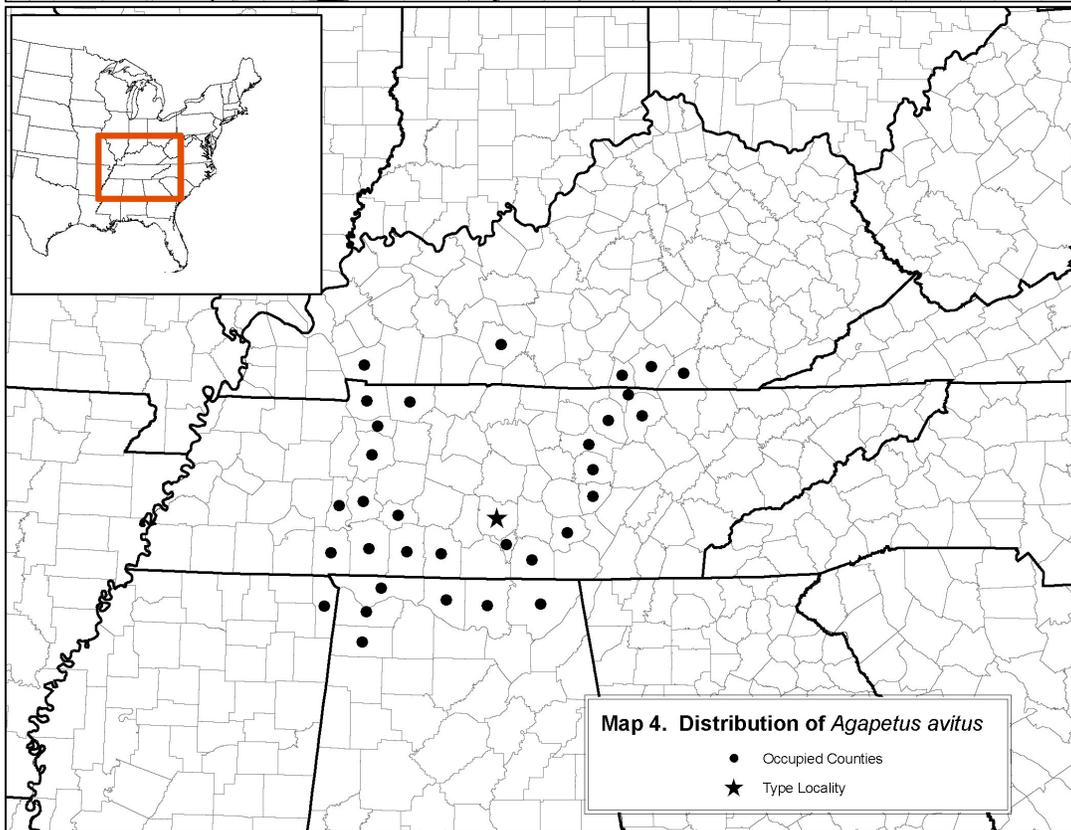
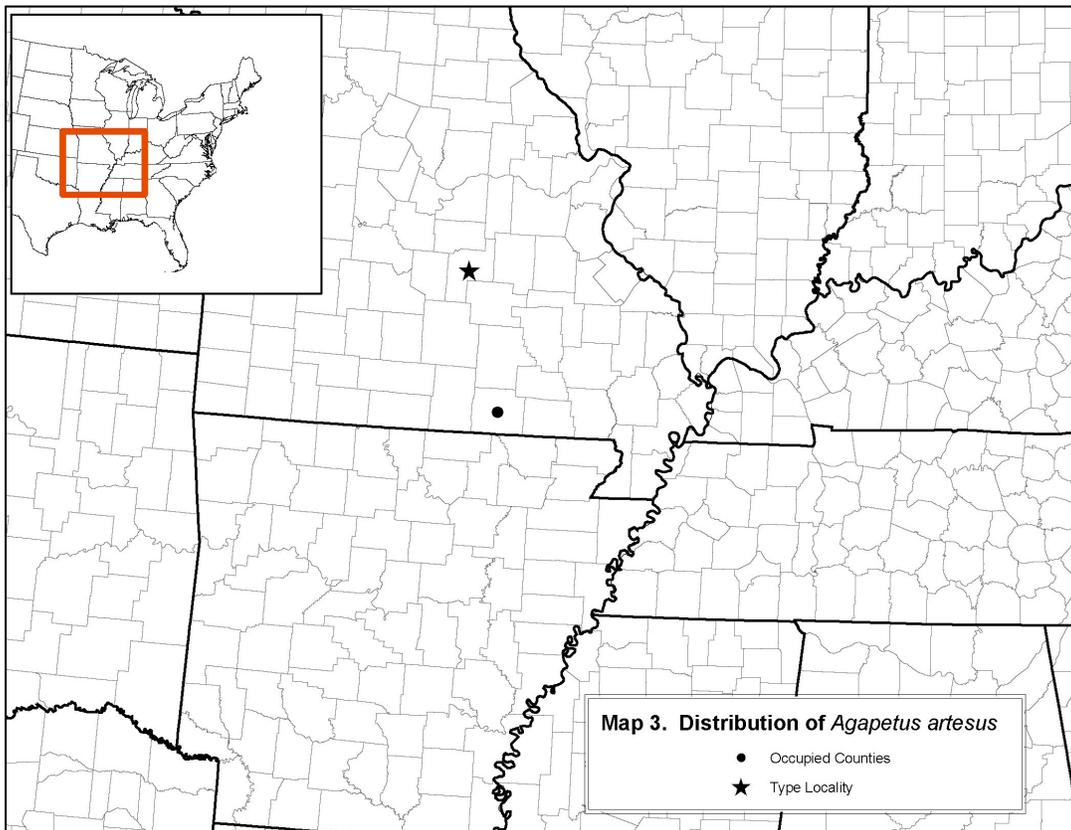
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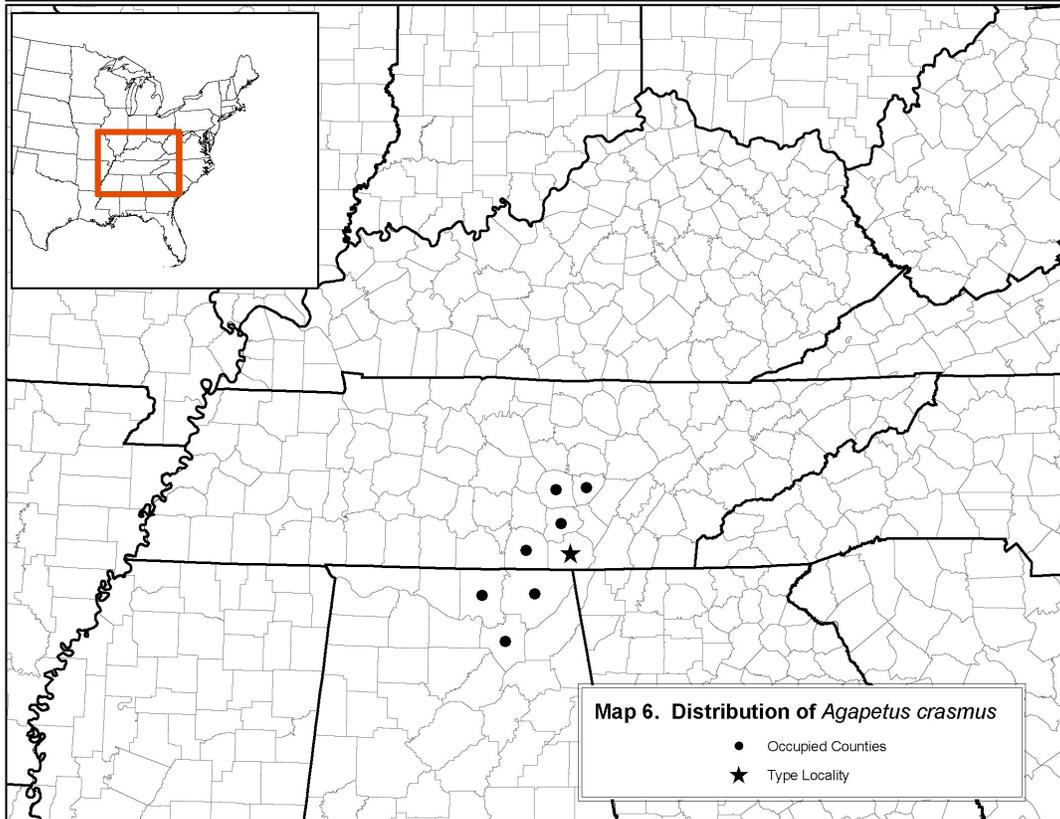
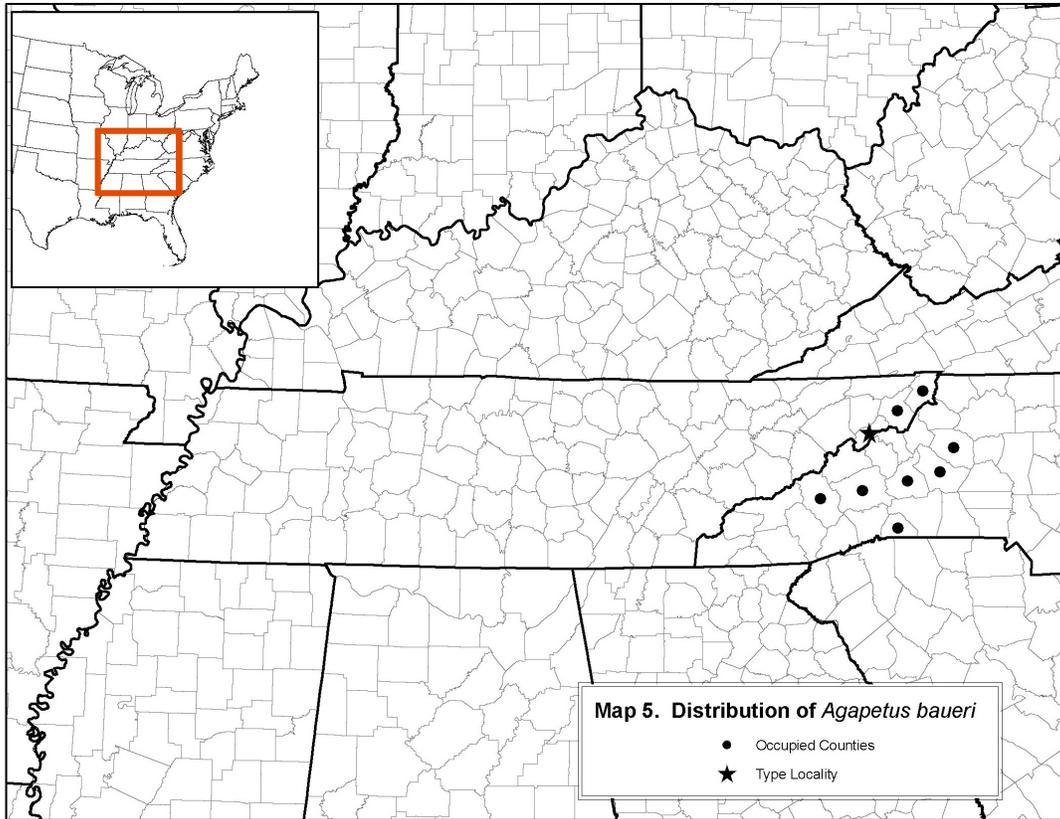
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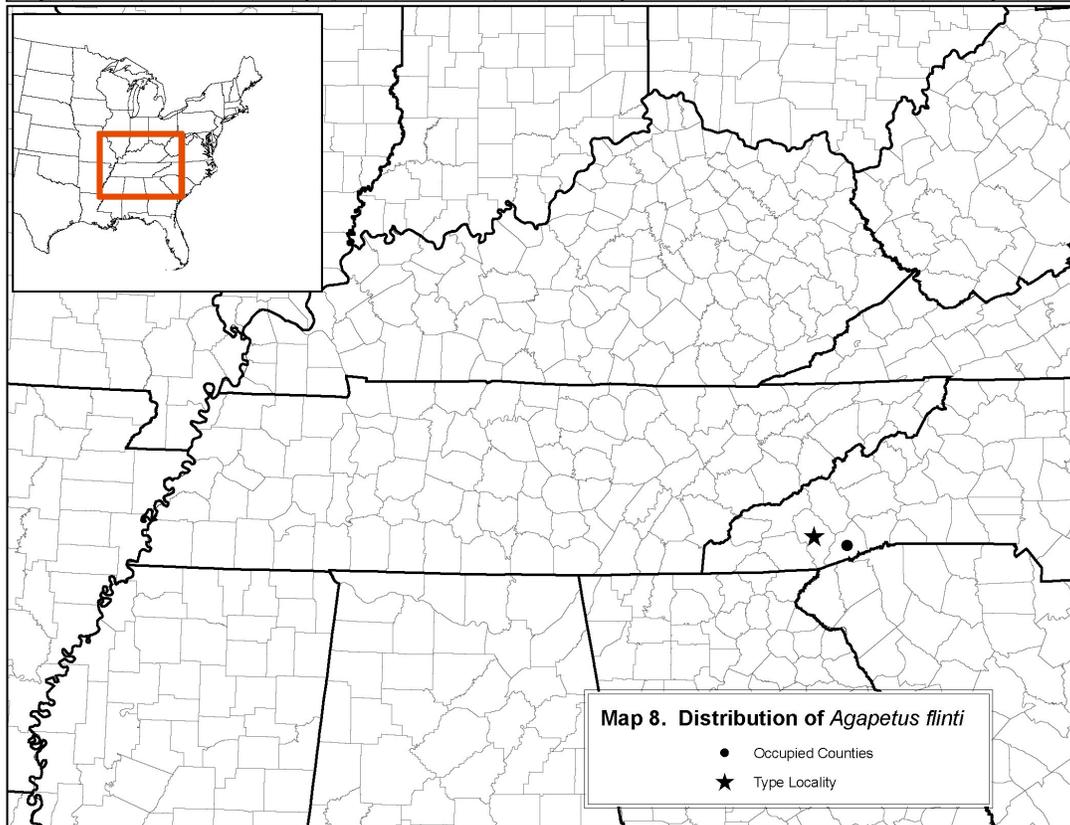
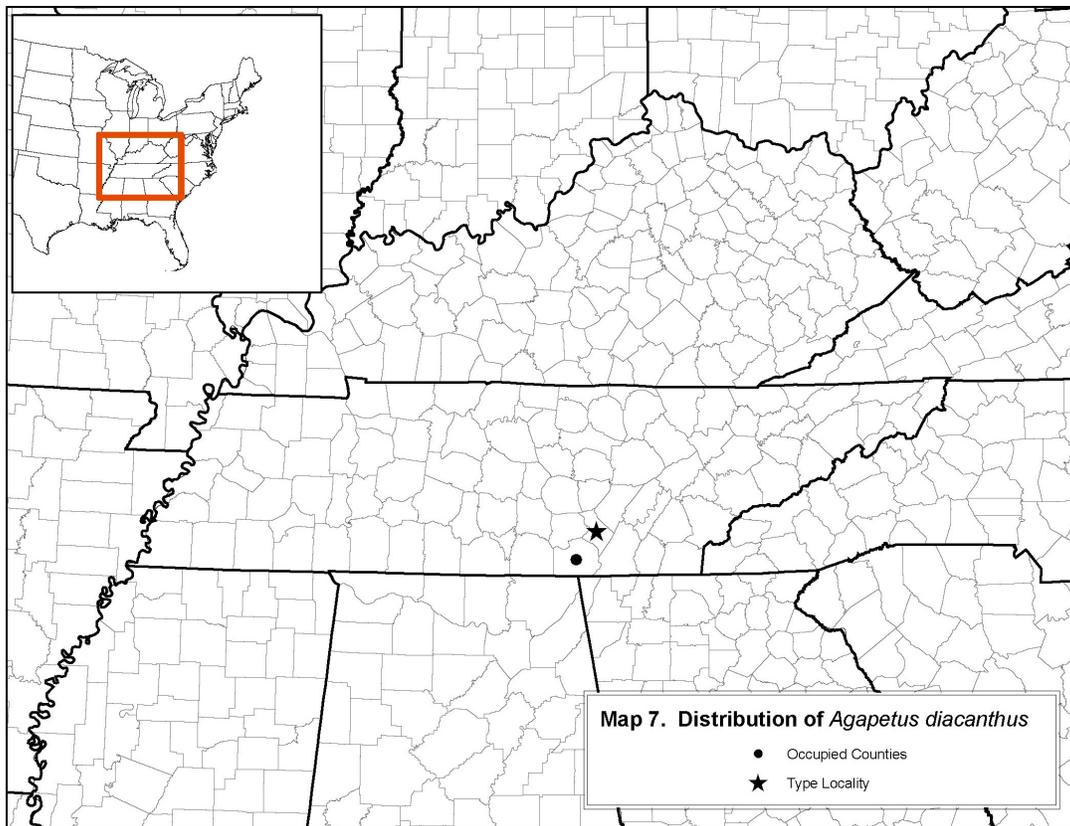
Map 1-2. *Agapetus alabamensis* Harris and *Agapetus aphallus* Etnier, Baxter, and Parker.



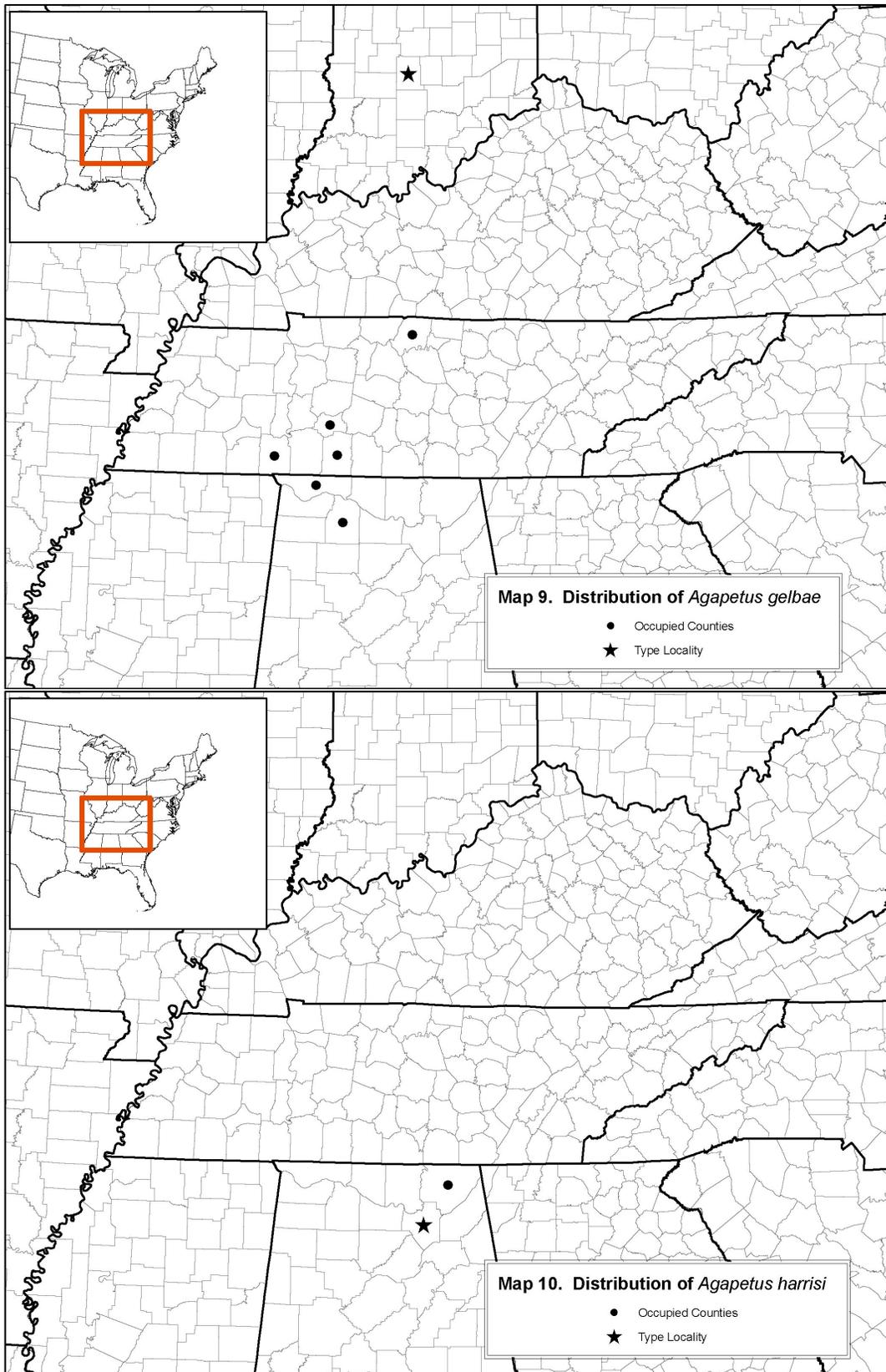
Map 3-4. *Agapetus artesus* Ross and *Agapetus avitus* Edwards.



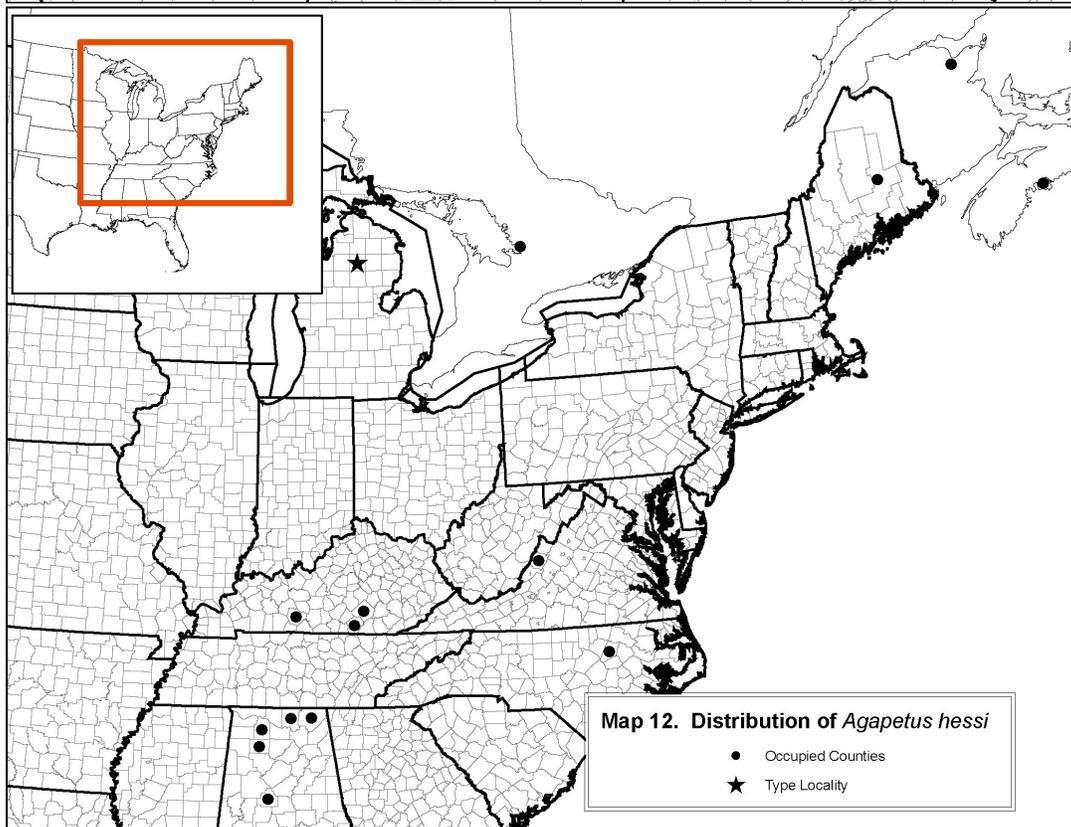
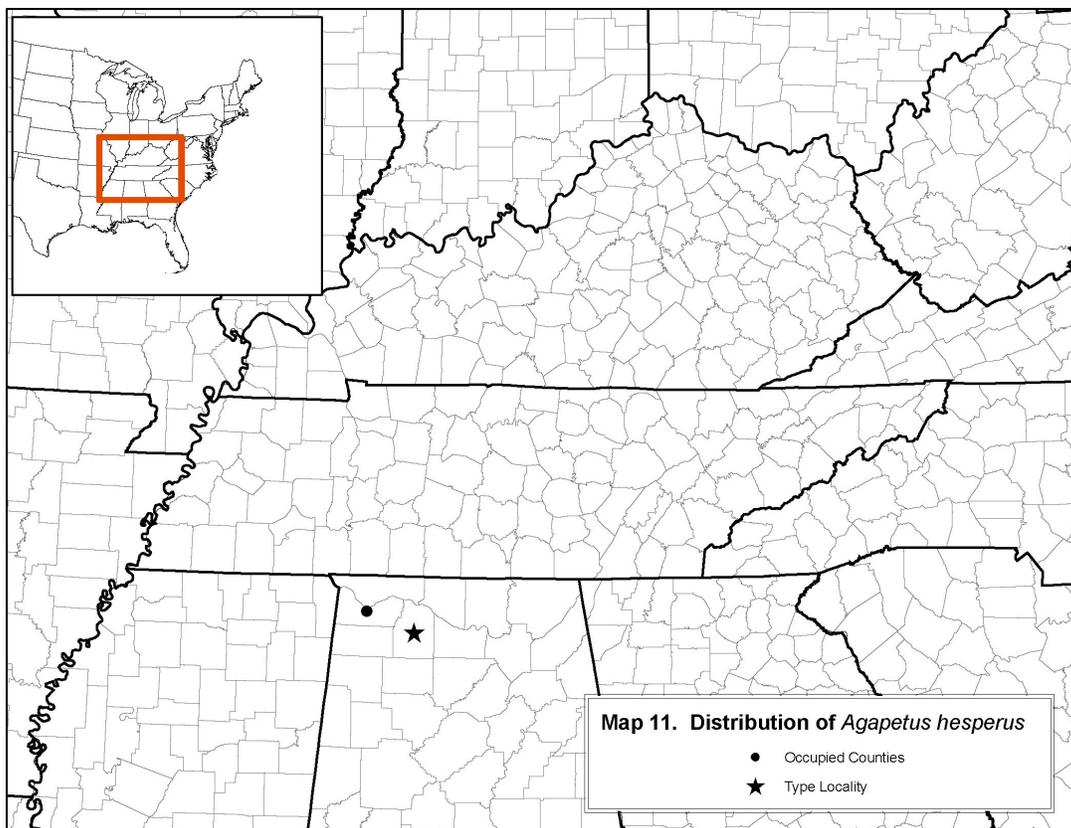
Map 5-6. *Agapetus baueri* Etnier, Parker, and Baxter and *Agapetus crasmus* Ross.



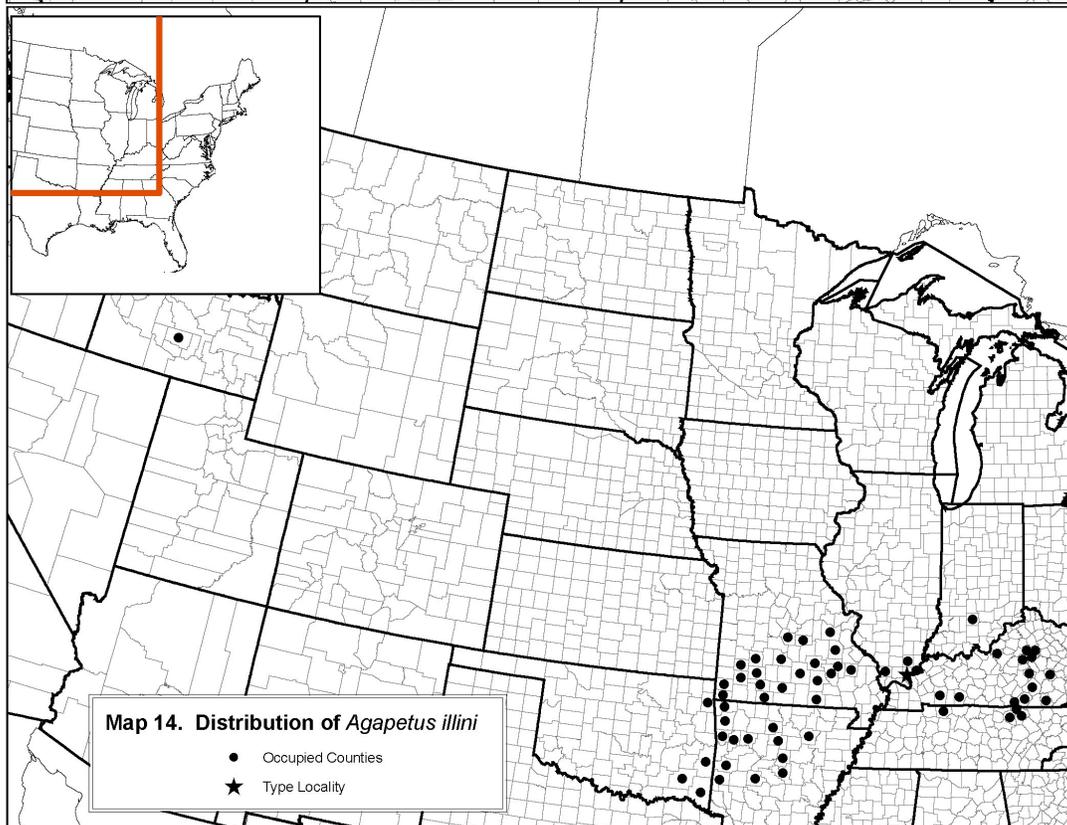
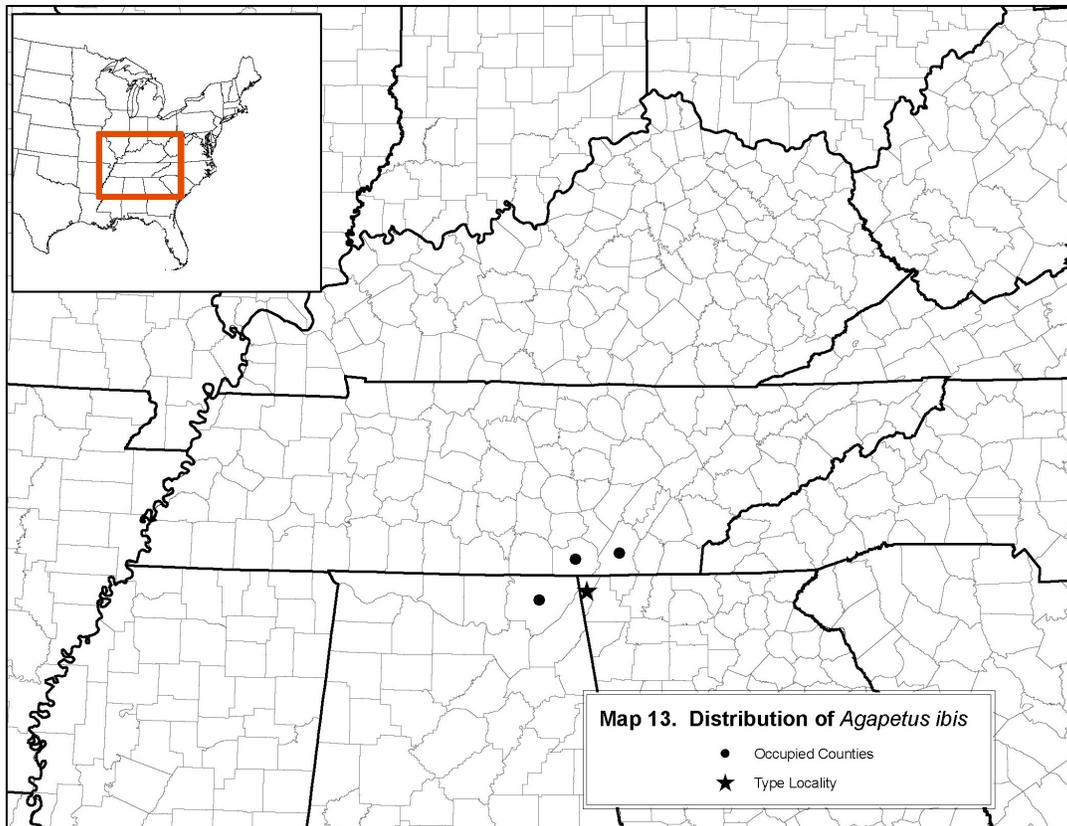
Map 7-8. *Agapetus diacanthus* Edwards and *Agapetus flinti* Parker, Etnier, and Baxter.



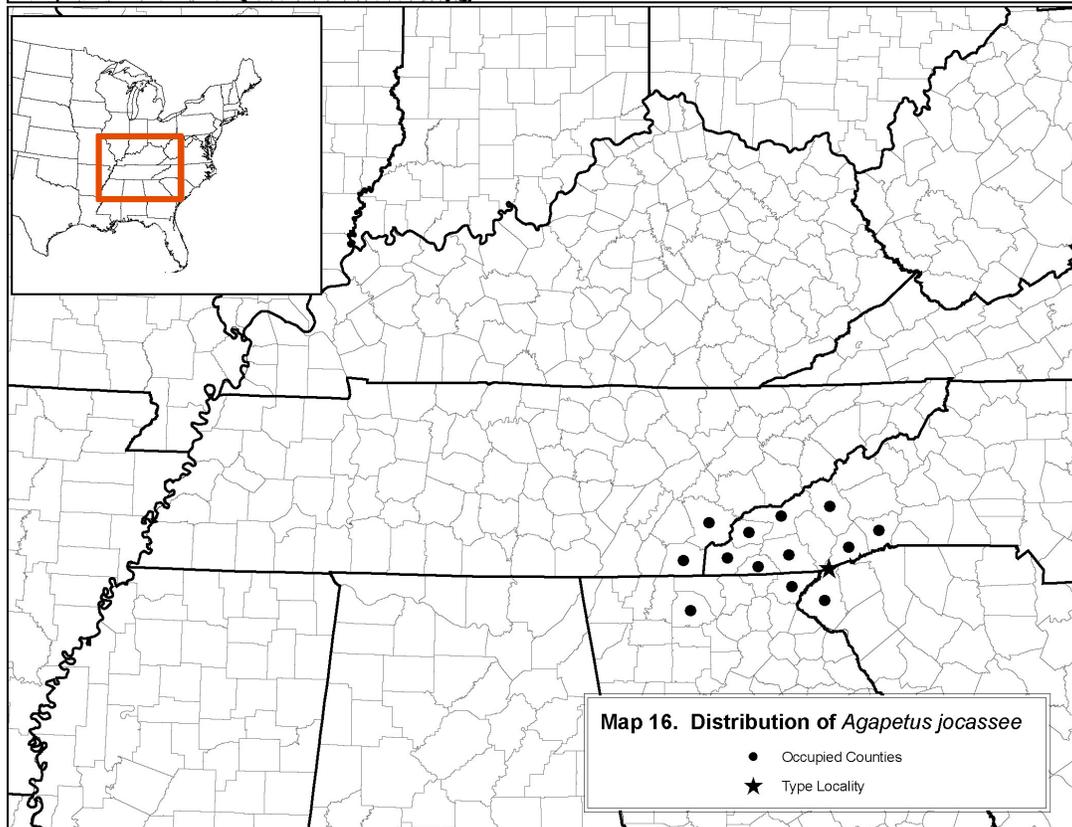
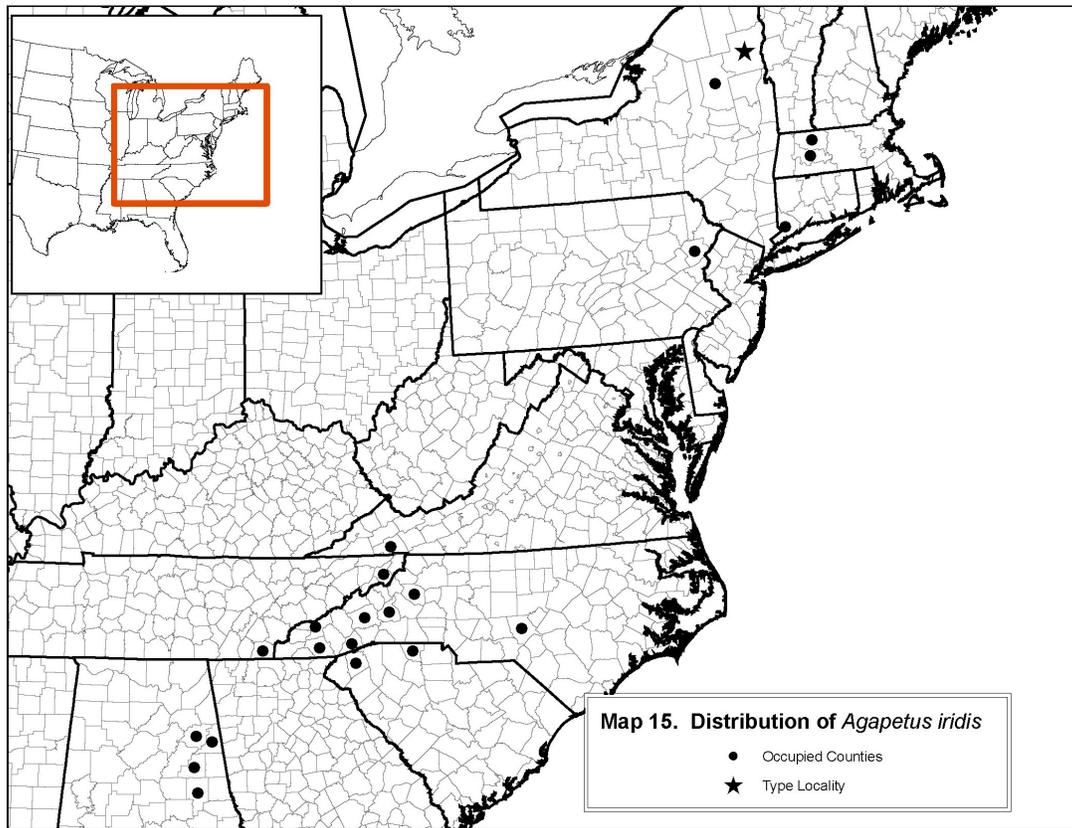
Map 9-10. *Agapetus gelbae* Ross and *Agapetus harrisi* Etnier, Parker, and Baxter.



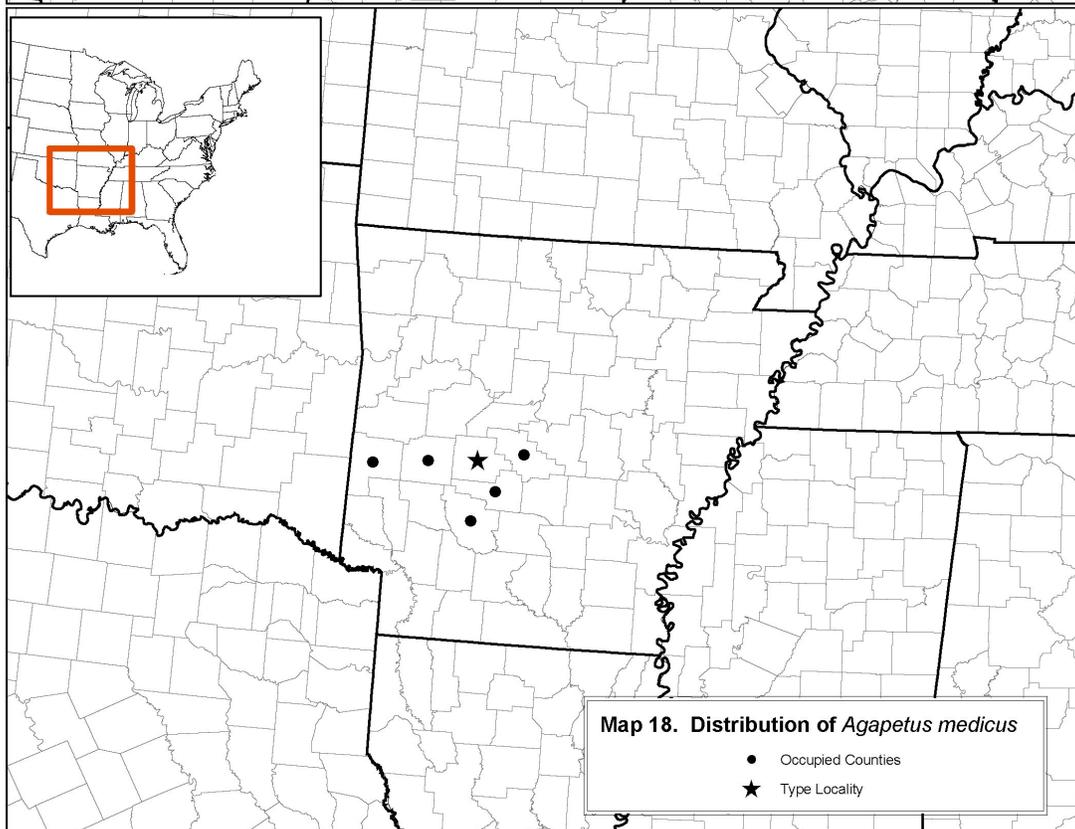
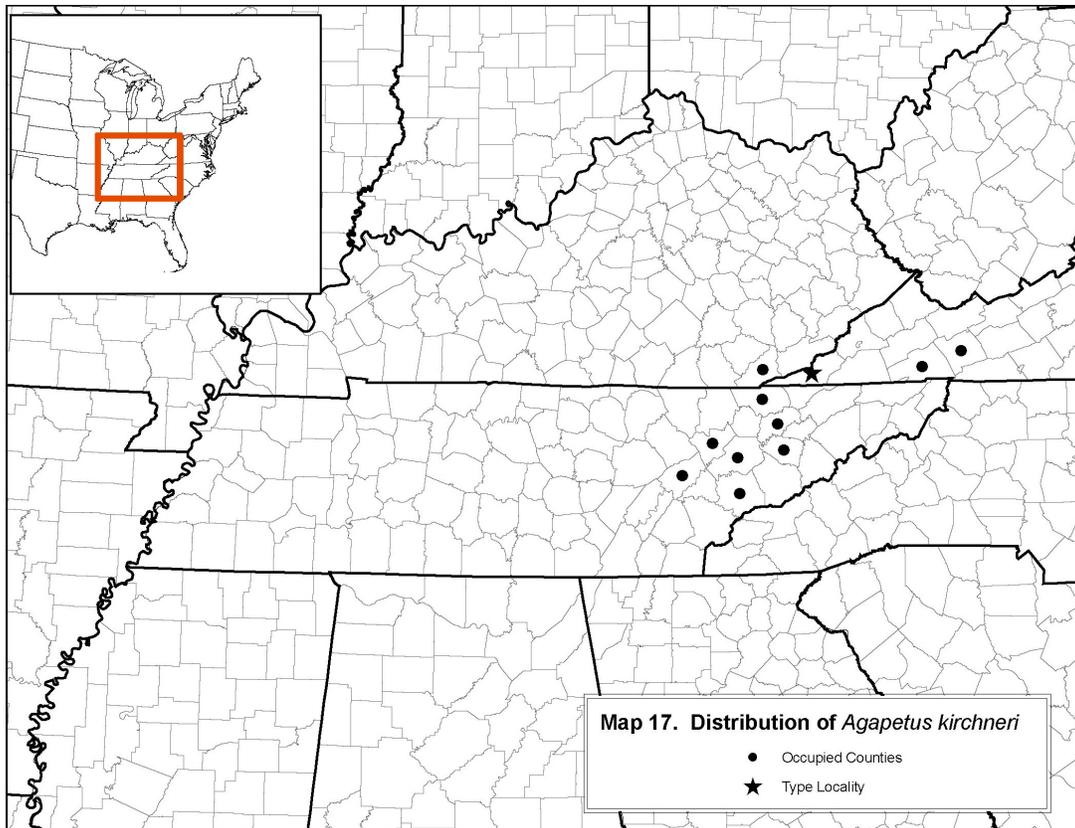
Map 11-12. *Agapetus hesperus* Etnier, Baxter, and Parker and *Agapetus hessi* Leonard and Leonard.



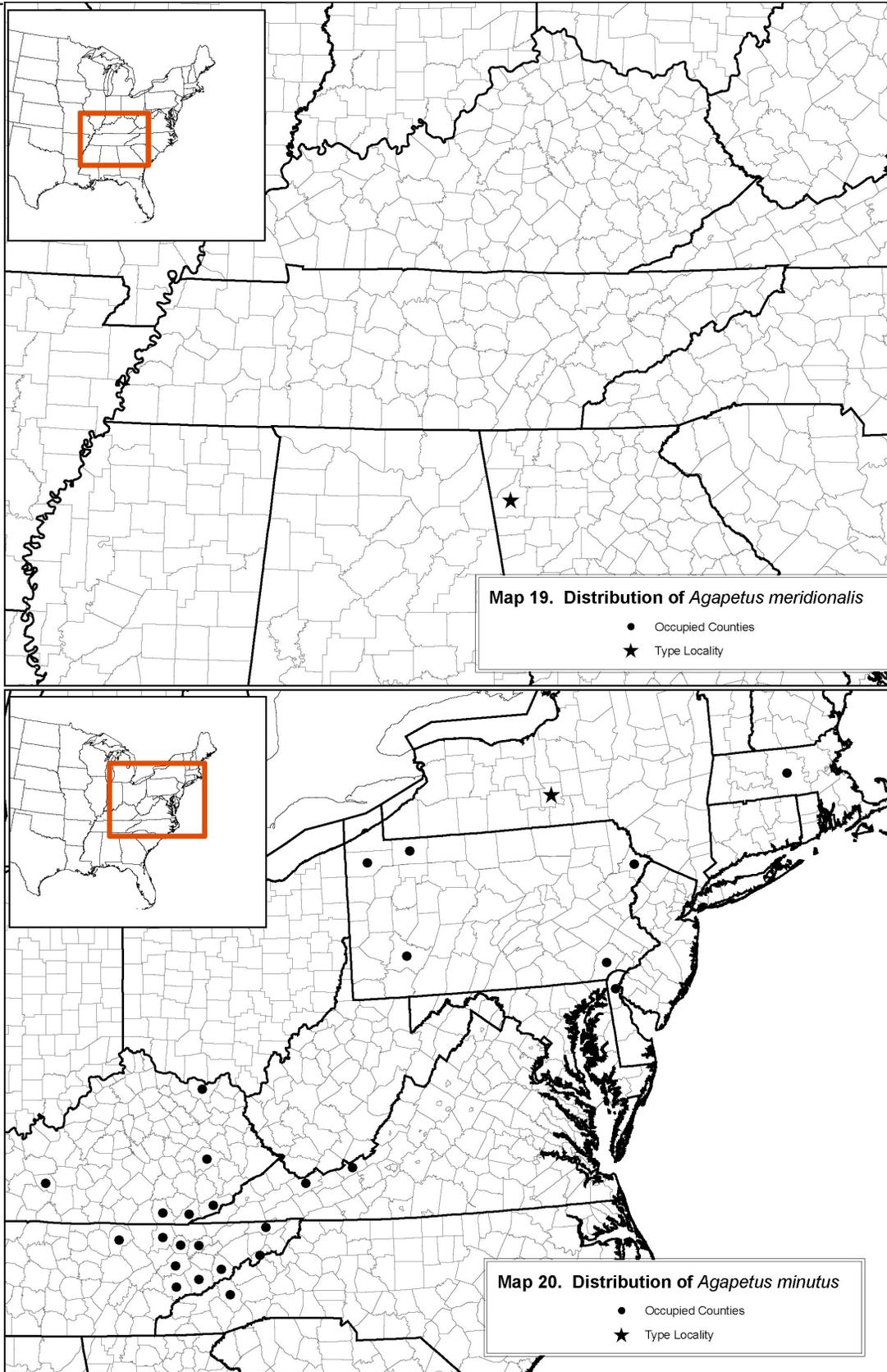
Map 13-14. *Agapetus ibis* Etnier, Baxter, and Parker and *Agapetus illini* Ross.



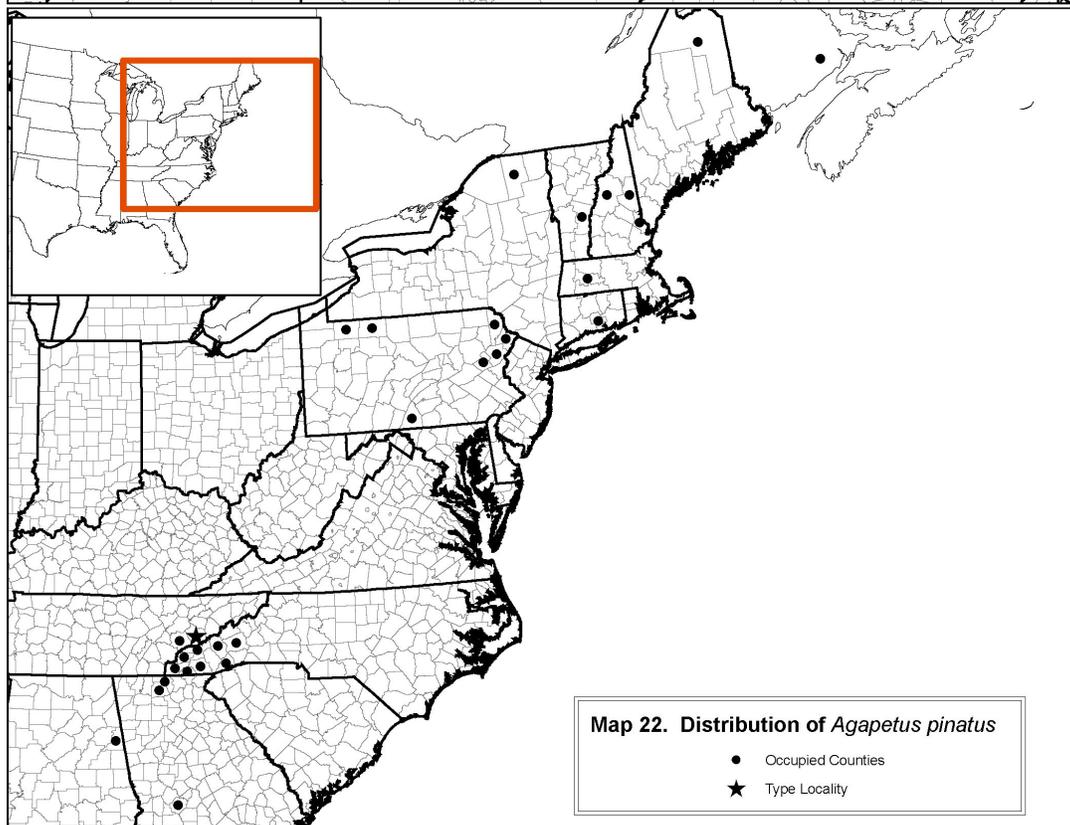
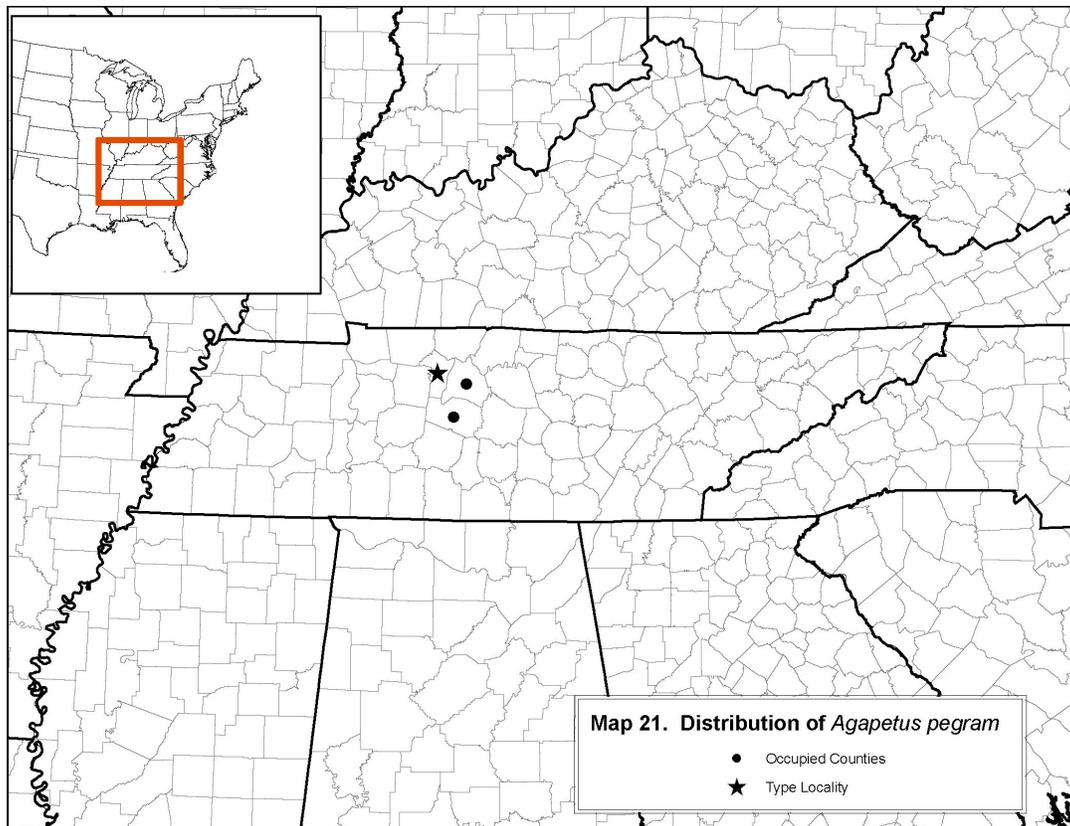
Map 15-16. *Agapetus iridis* Ross and *Agapetus jocassee* Morse.



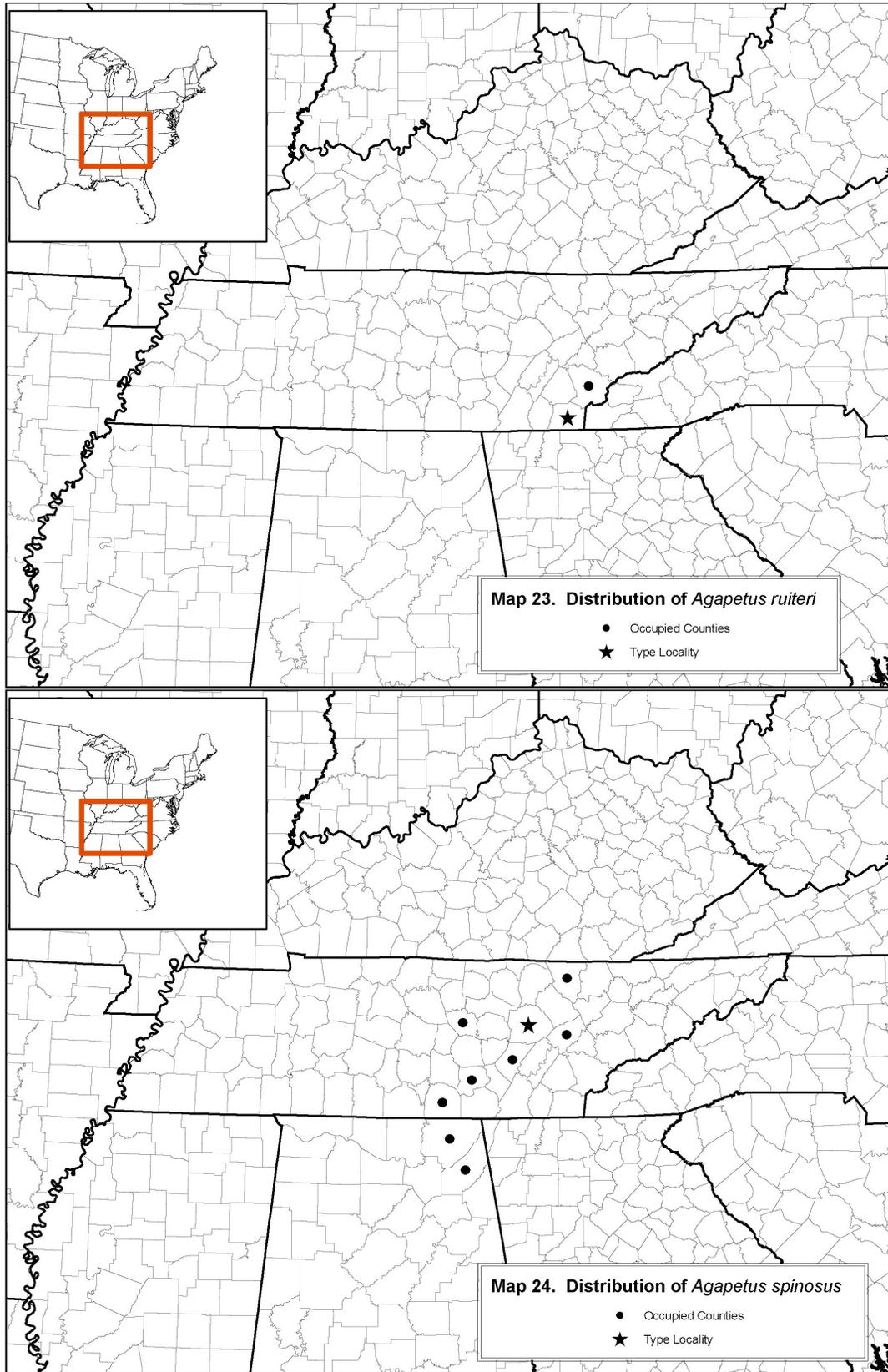
Map 17-18. *Agapetus kirchneri* Parker, Etnier, and Baxter and *Agapetus medicus* Ross.



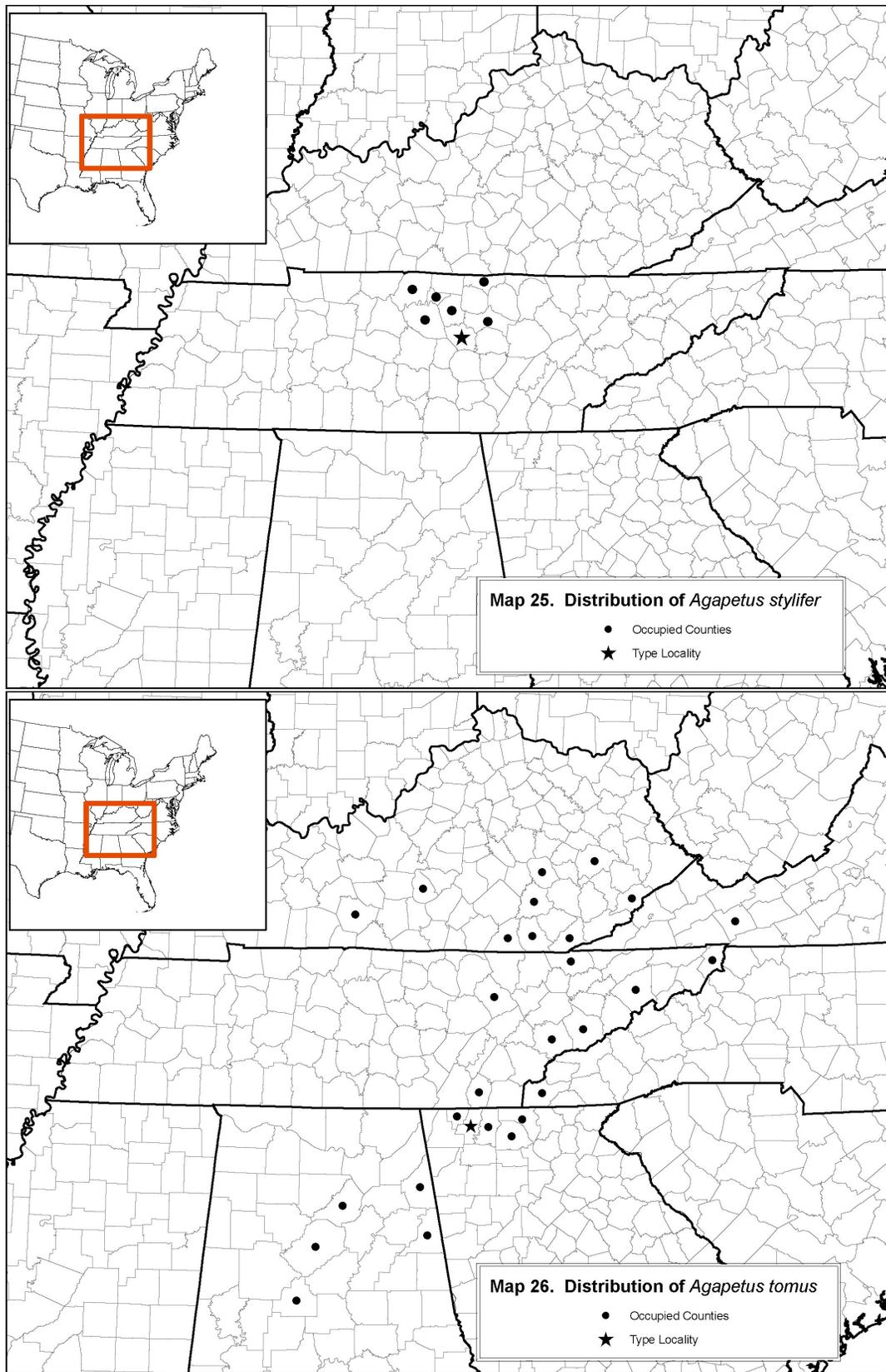
Map 19-20. *Agapetus meridionalis* Etnier, Parker, and Baxter and *Agapetus minutus* Sibley.



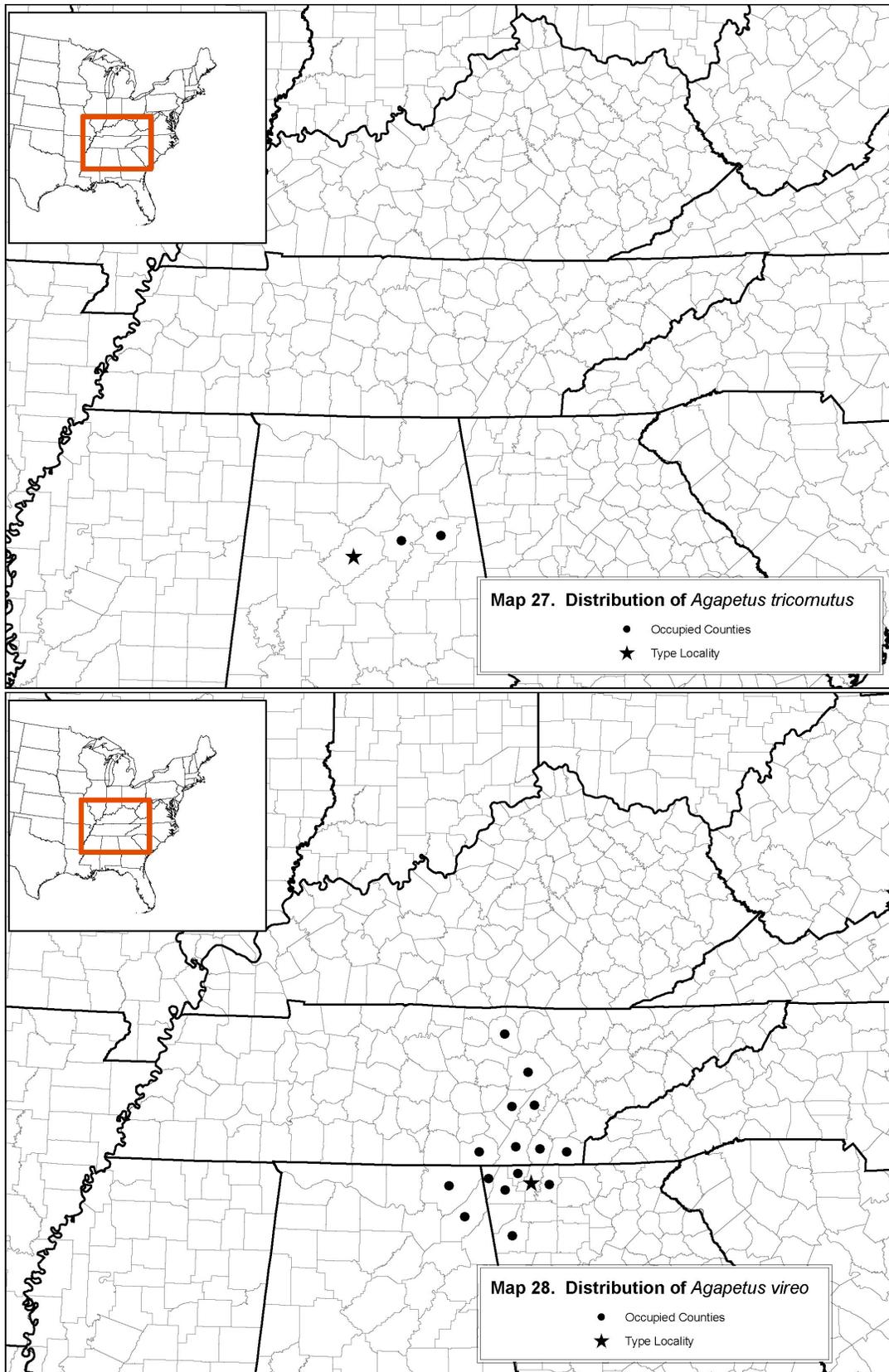
Map 21-22. *Agapetus pegram* Etnier, Baxter and Parker and *Agapetus pinatus* Ross.



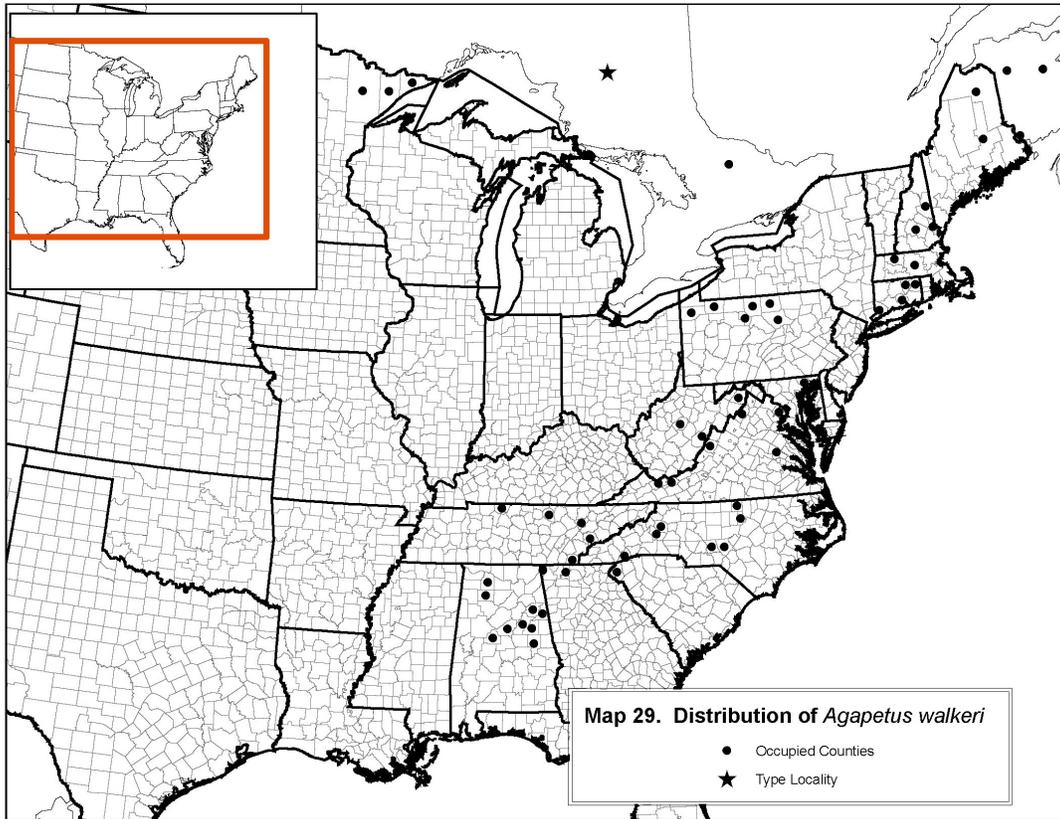
Map 23-24. *Agapetus ruiteri* Parker, Etnier, and Baxter and *Agapetus spinosus* Etnier and Way.



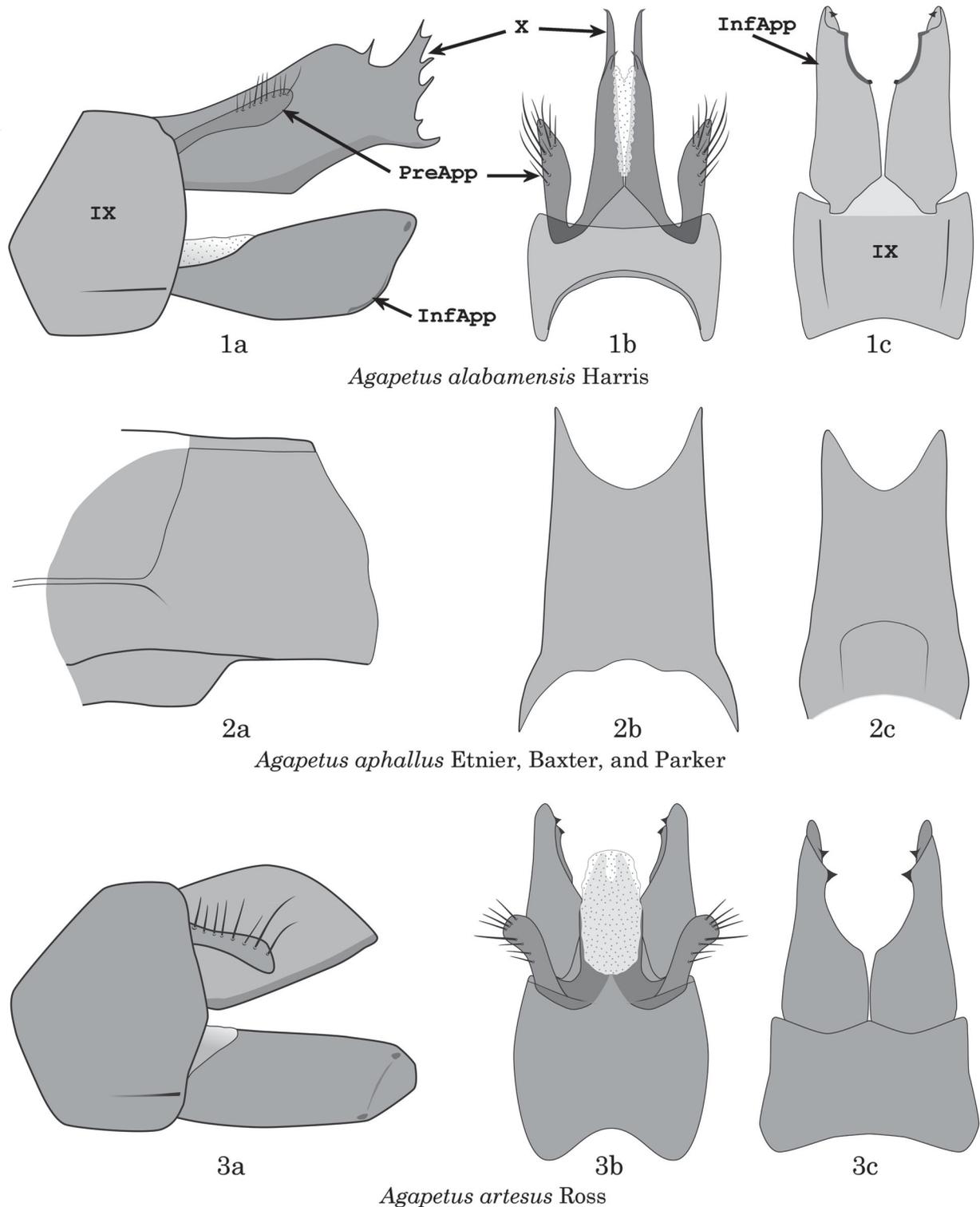
Map 25-26. *Agapetus stylifer* Etnier, Baxter, and Parker and *Agapetus tomus* Ross.



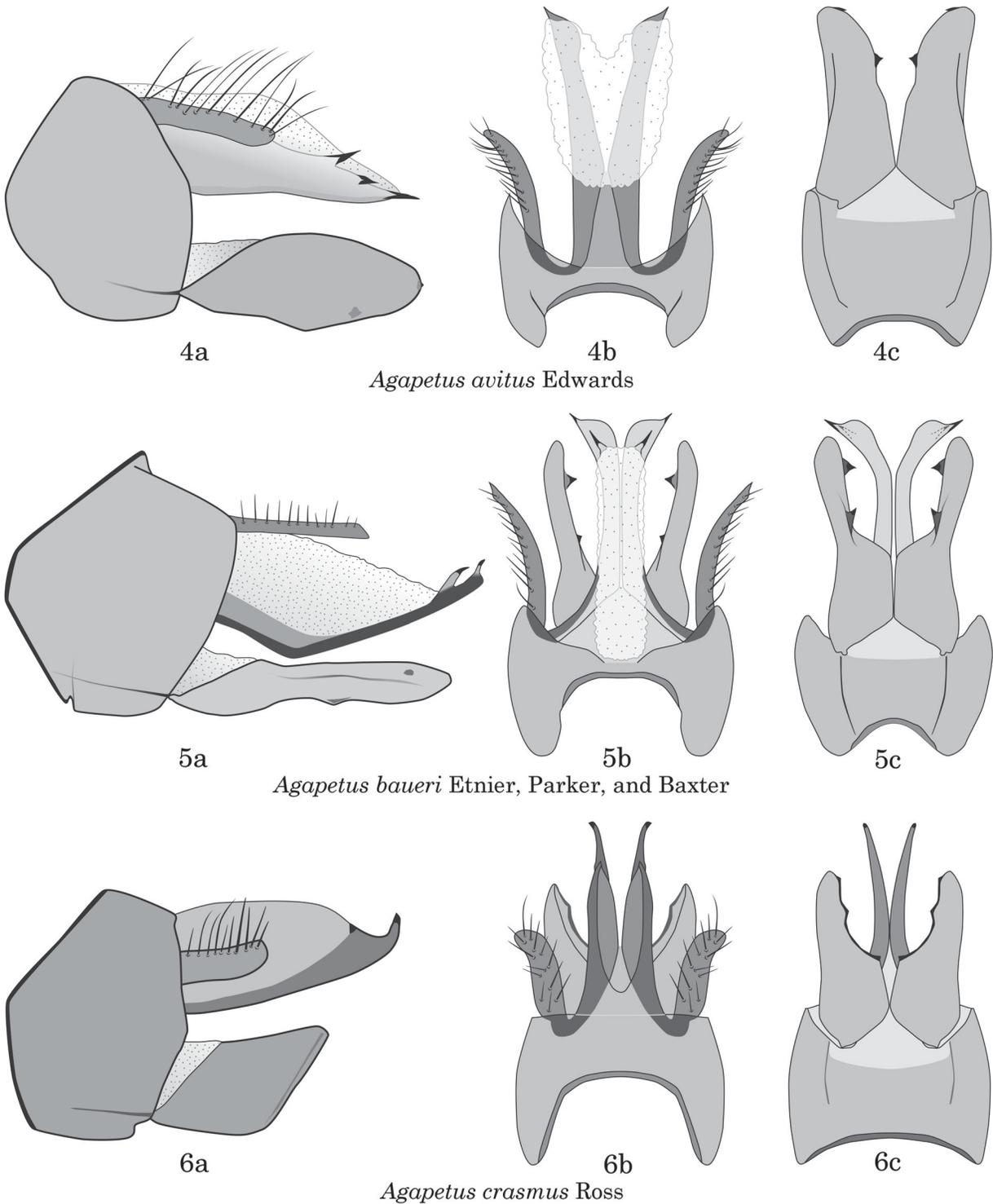
Map 27-28. *Agapetus tricornutus* Etnier, Parker, and Baxter and *Agapetus vireo* Ross.



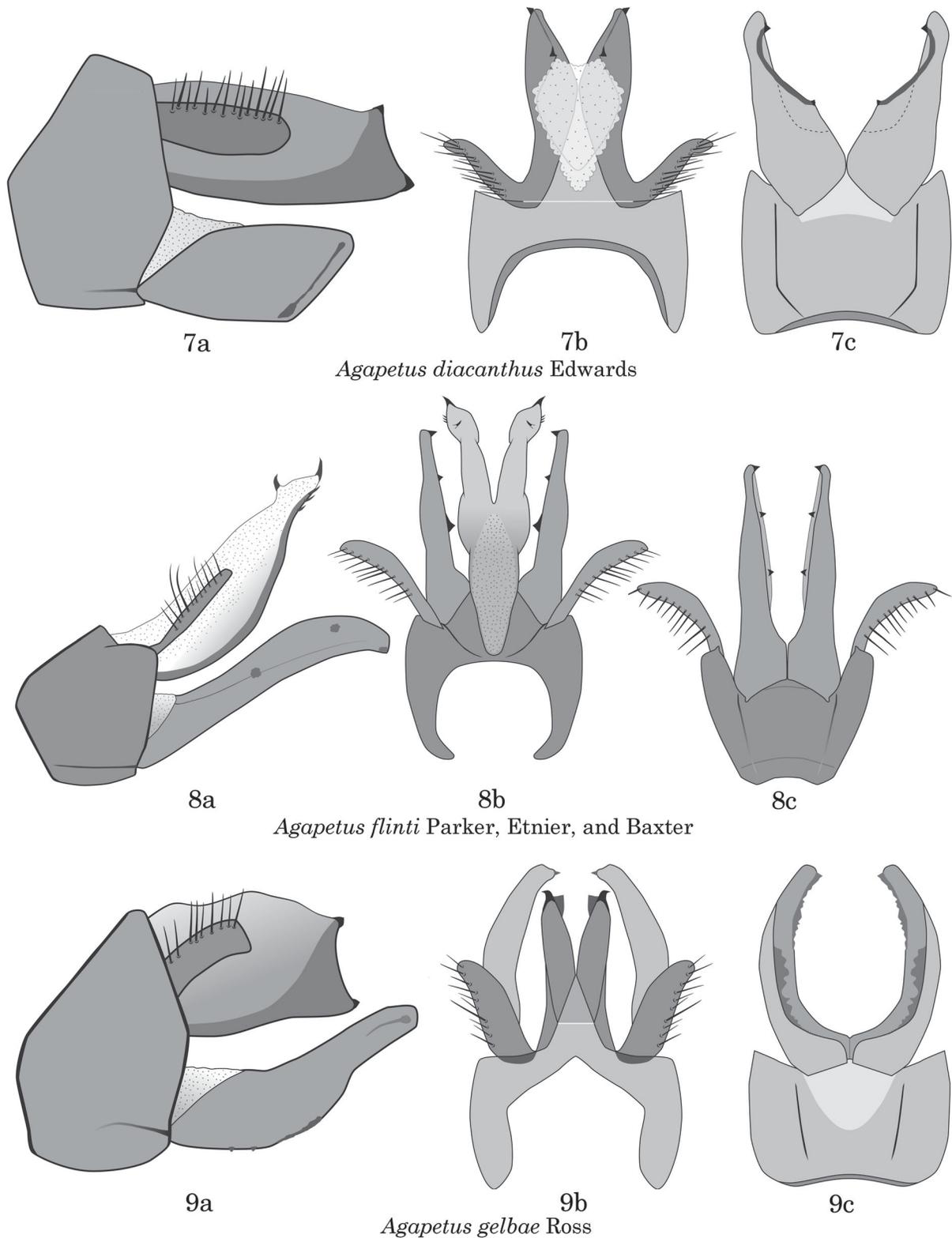
Map 29. *Agapetus walkeri* (Betten and Mosely).



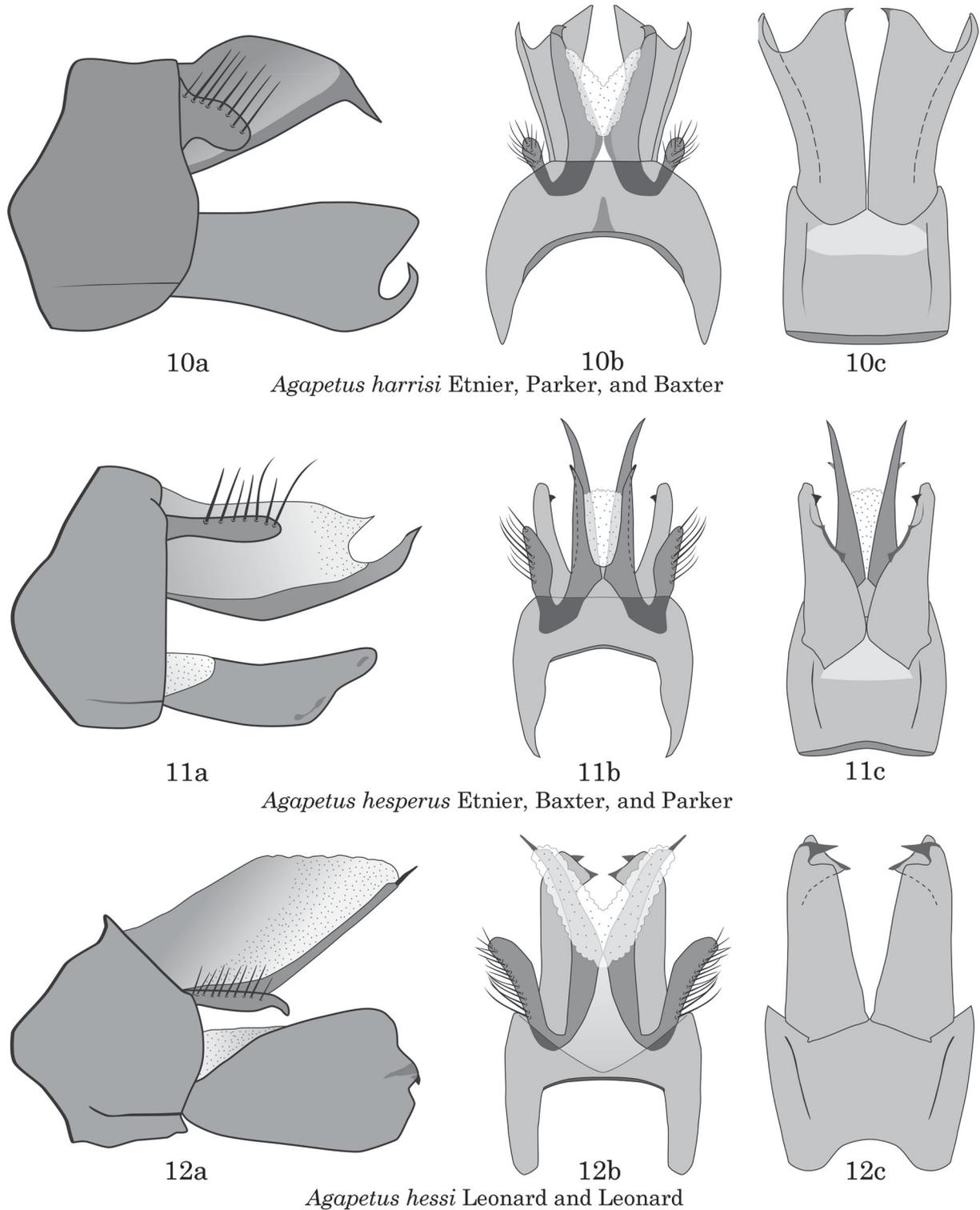
**Figure 1-3.** *Agapetus* spp. genitalia. **1)** *Agapetus alabamensis* Harris, male genitalia. 1a, lateral view; 1b, dorsal view, inferior appendages and ventral portion of X not shown; 1c, ventral view of IX and inferior appendages. InfApp = inferior appendage; PrApp = preanal appendage; IX = segment IX; X = segment X. **2)** *Agapetus aphallus* Etnier, Baxter, and Parker, female genitalia. 2a, lateral view; 2b, dorsal view; 2c, ventral view. **3)** *Agapetus artesus* Ross, male genitalia. 3a, lateral view; 3b, dorsal view; 3c, ventral view of IX and inferior appendages.



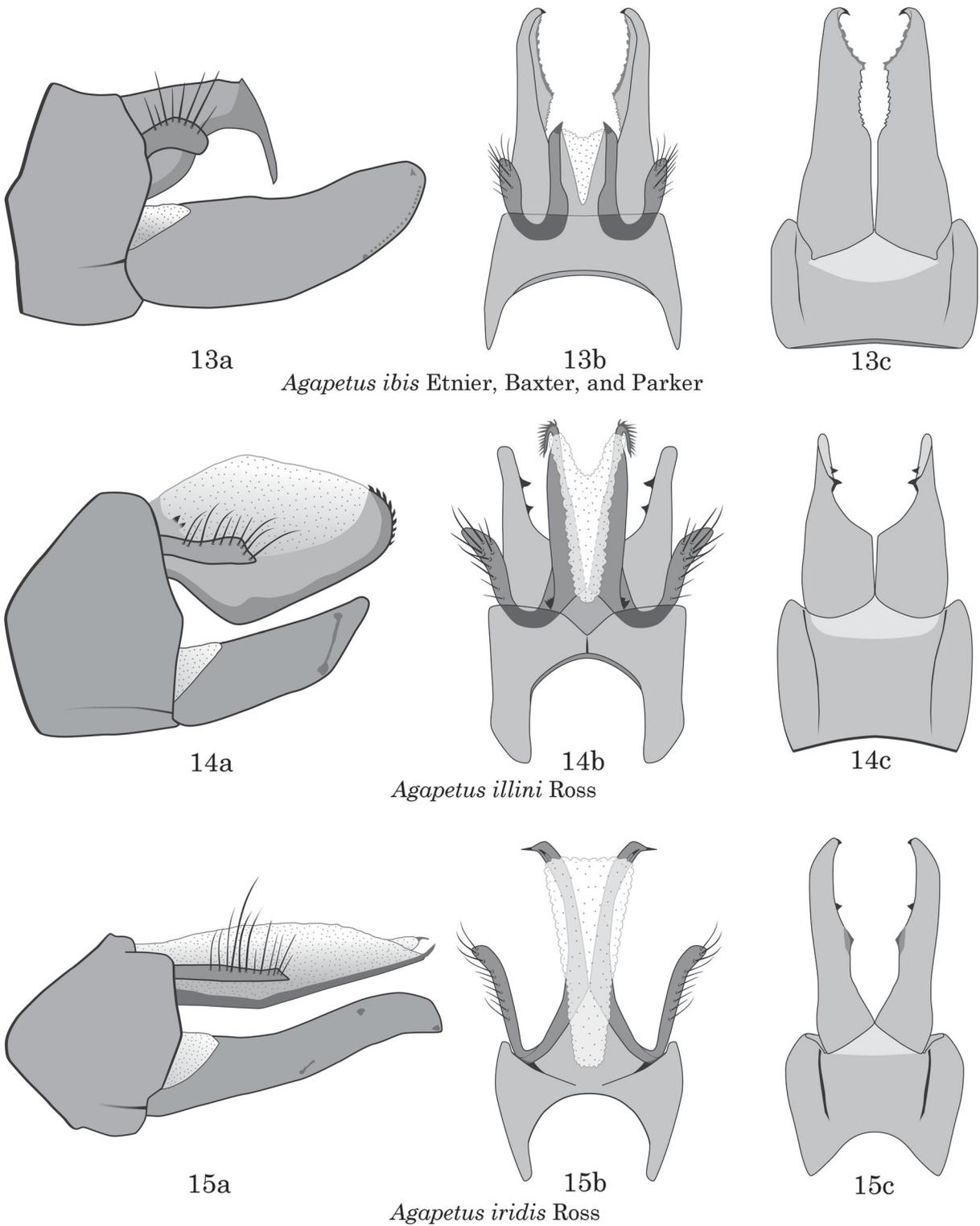
**Figure 4-6.** *Agapetus* spp. male genitalia. **4)** *Agapetus avitus* Edwards. 4a, lateral view; 4b, dorsal view, inferior appendages not shown; 4c, ventral view of IX and inferior appendages. **5)** *Agapetus baueri* Etnier, Parker, and Baxter. 5a, lateral view; 5b, dorsal view; 5c, ventral view, preanal appendages not shown. **6)** *Agapetus crasmus* Ross. 6a, lateral view; 6b, dorsal view; 6c, ventral view, preanal appendages not shown.



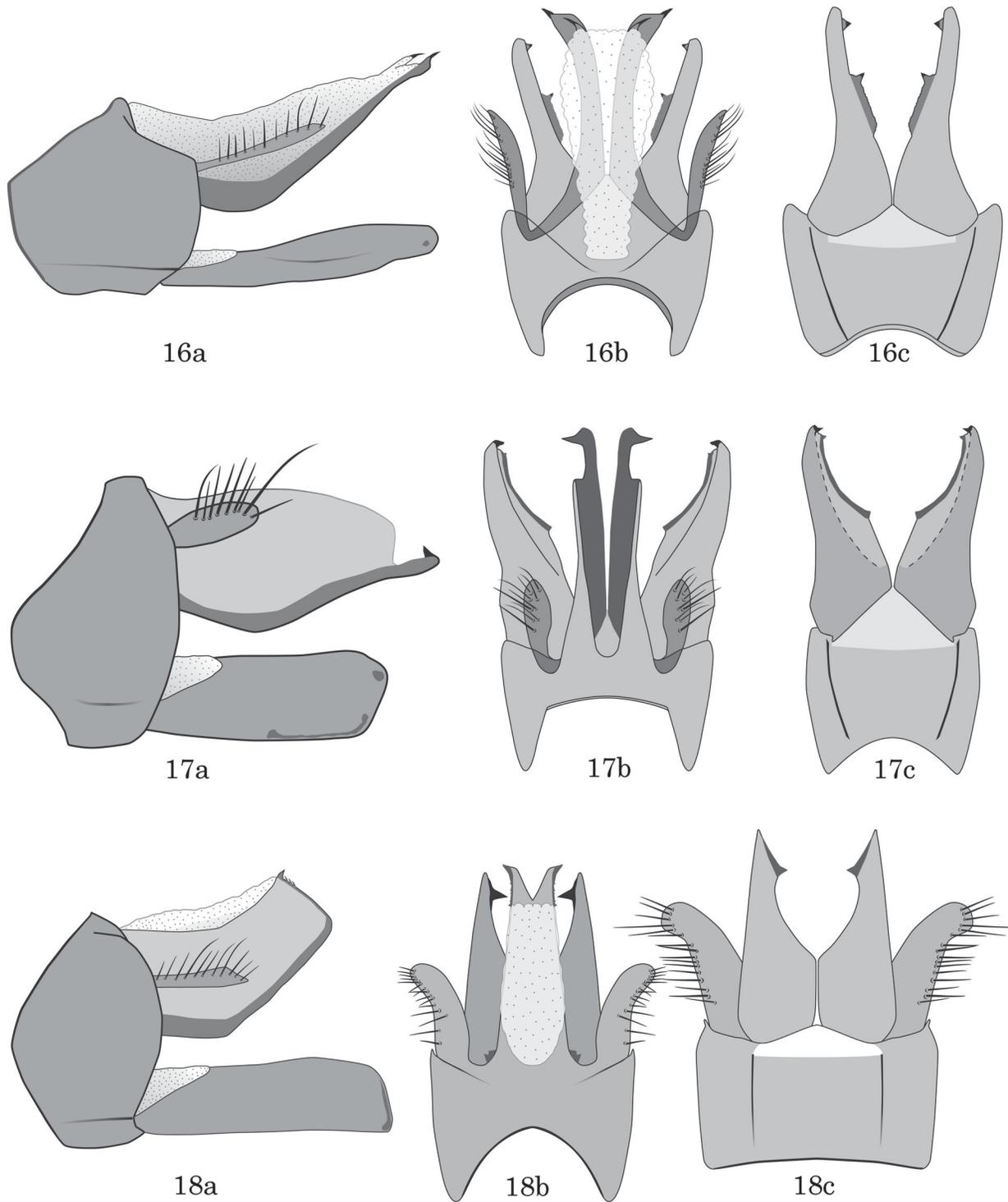
**Figure 7-9.** *Agapetus* spp. male genitalia. **7)** *Agapetus diacanthus* Edwards. 7a, lateral view; 7b, dorsal view; 7c, ventral view of IX and inferior appendages. **8)** *Agapetus flinti* Parker, Etnier, and Baxter. 8a, lateral view; 8b, dorsal view; 8c, ventral view, segment X not shown. **9)** *Agapetus gelbae* Ross. 9a, lateral view; 9b, dorsal view; 9c, ventral view of IX and inferior appendages.



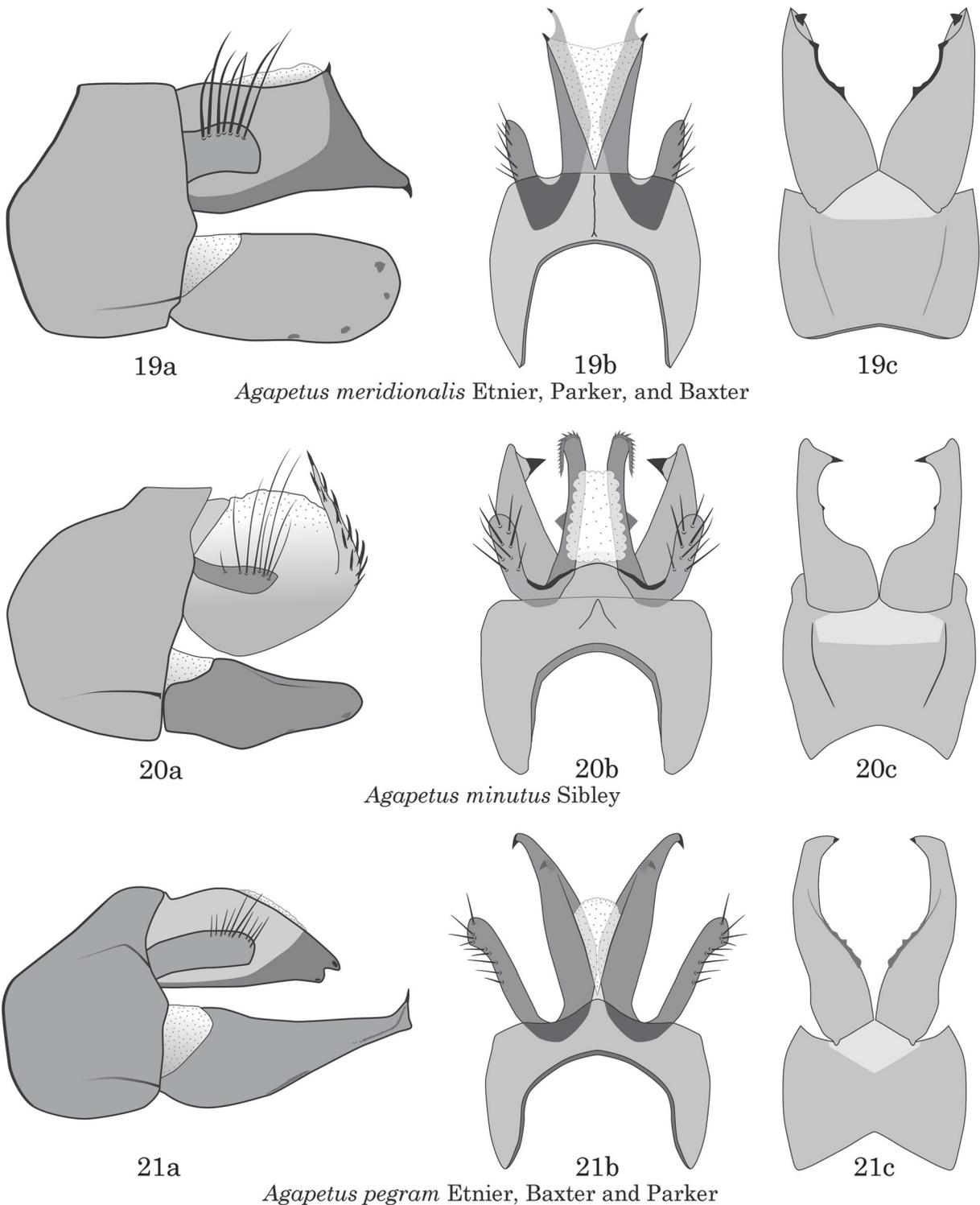
**Figure 10-12.** *Agapetus* spp. male genitalia. **10)** *Agapetus harrisi* Etnier, Parker, and Baxter. 10a, lateral view; 10b, dorsal view; 10c, ventral view of IX and inferior appendages. **11)** *Agapetus hesperus* Etnier, Baxter, and Parker. 11a, lateral view; 11b, dorsal view; 11c, ventral view, preanal appendages not shown. **12)** *Agapetus hessi* Leonard and Leonard. 12a, lateral view; 12b, dorsal view; 12c, ventral view of IX and inferior appendages.



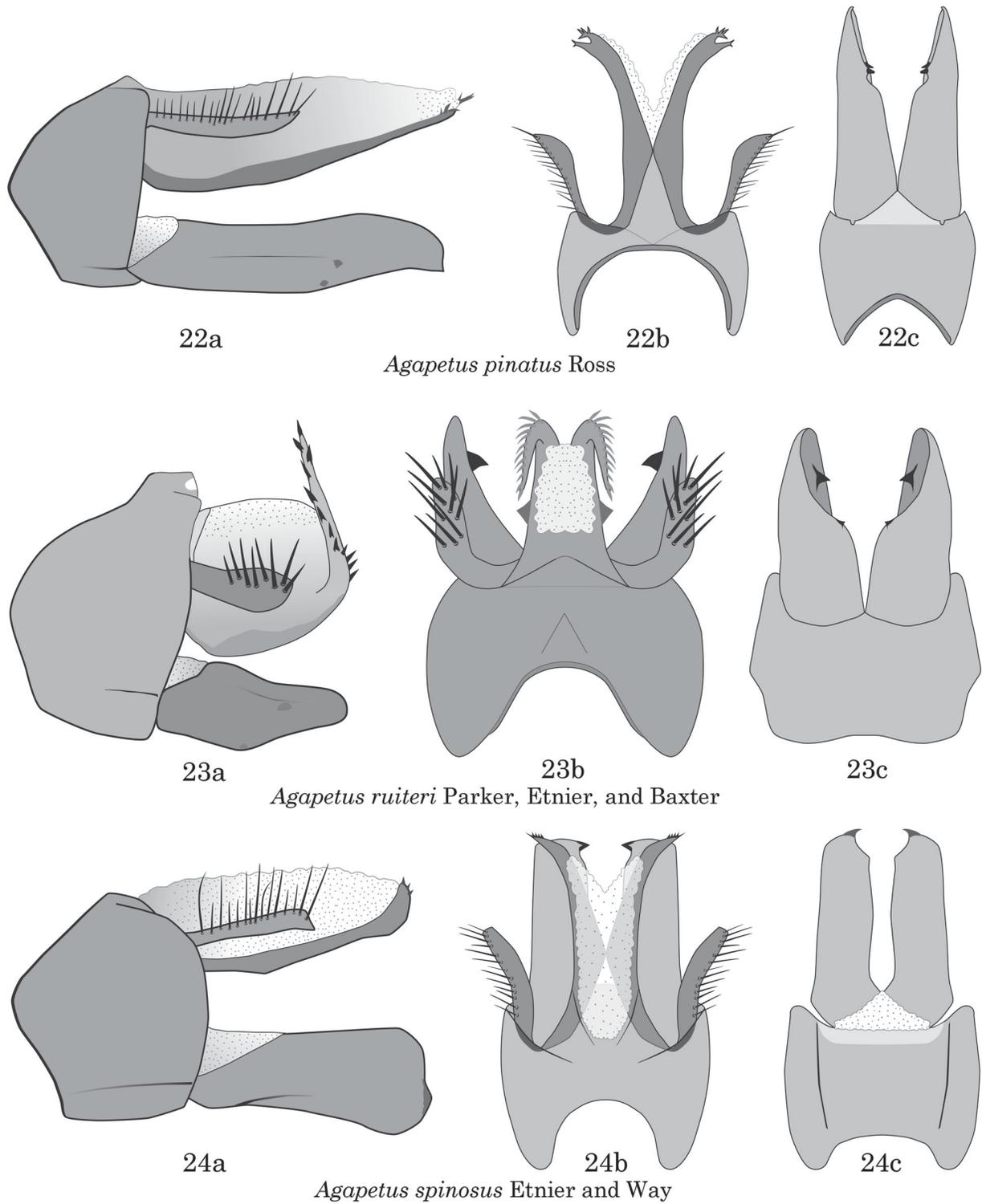
**Figure 13-15.** *Agapetus* spp. male genitalia. **13)** *Agapetus ibis* Etnier, Baxter, and Parker. 13a, lateral view; 13b, dorsal view; 13c, ventral view of IX and inferior appendages. **14)** *Agapetus illini* Ross. 14a, lateral view; 14b, dorsal view; 14c, ventral view of IX and inferior appendages. **15)** *Agapetus iridis* Ross. 15a, lateral view; 15b, dorsal view; 15c, ventral view of IX and inferior appendages.



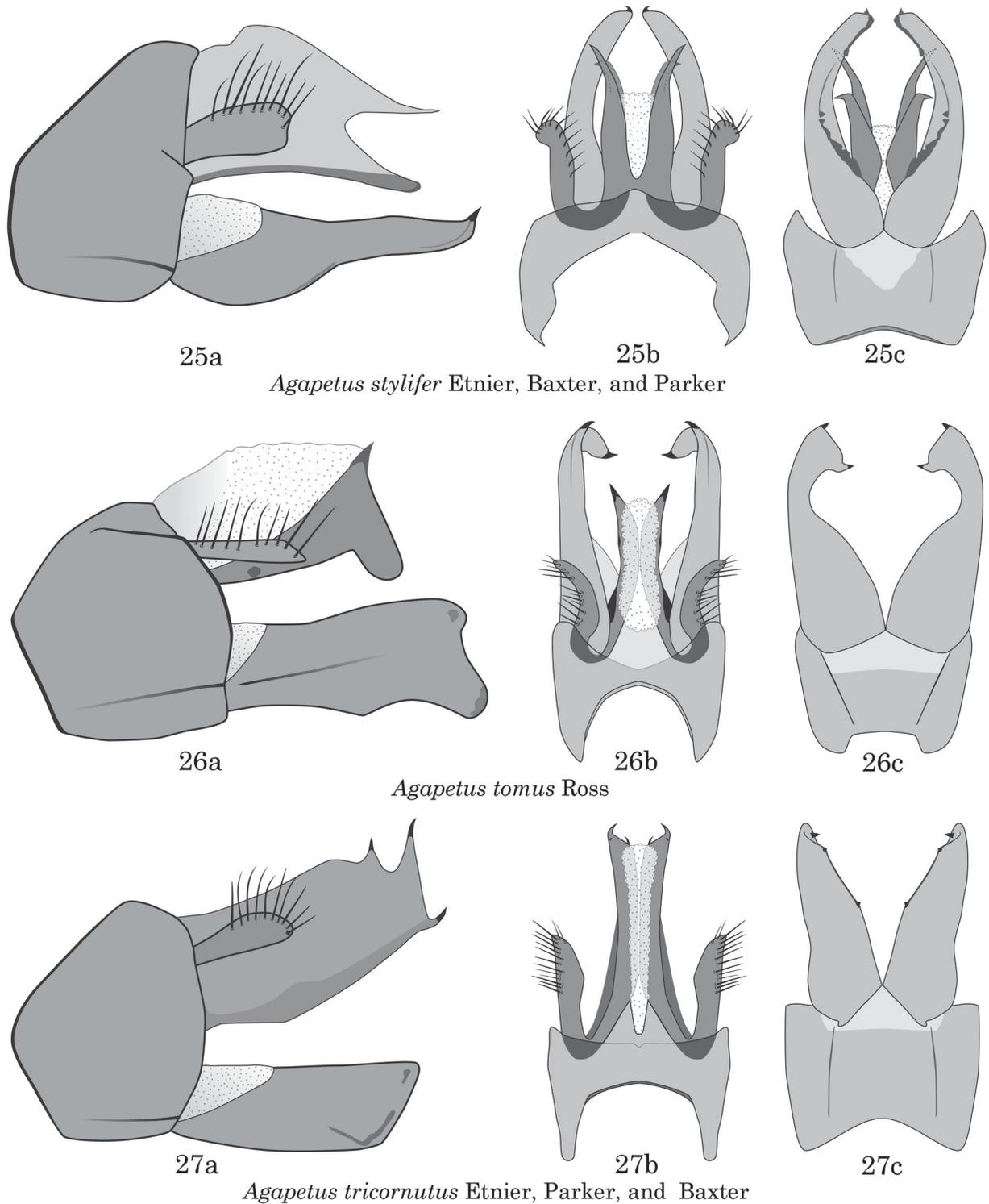
**Figure 16-18.** *Agapetus* spp. male genitalia. **16)** *Agapetus jocassee* Morse. 16a, lateral view; 16b, dorsal view; 16c, ventral view of IX and inferior appendages. **17)** *Agapetus kirchneri* Parker, Etnier, and Baxter. 17a, lateral view; 17b, dorsal view; 17c, ventral view of IX and inferior appendages. **18)** *Agapetus medicus* Ross. 18a, lateral view; 18b, dorsal view; 18c, ventral view of IX and inferior appendages.



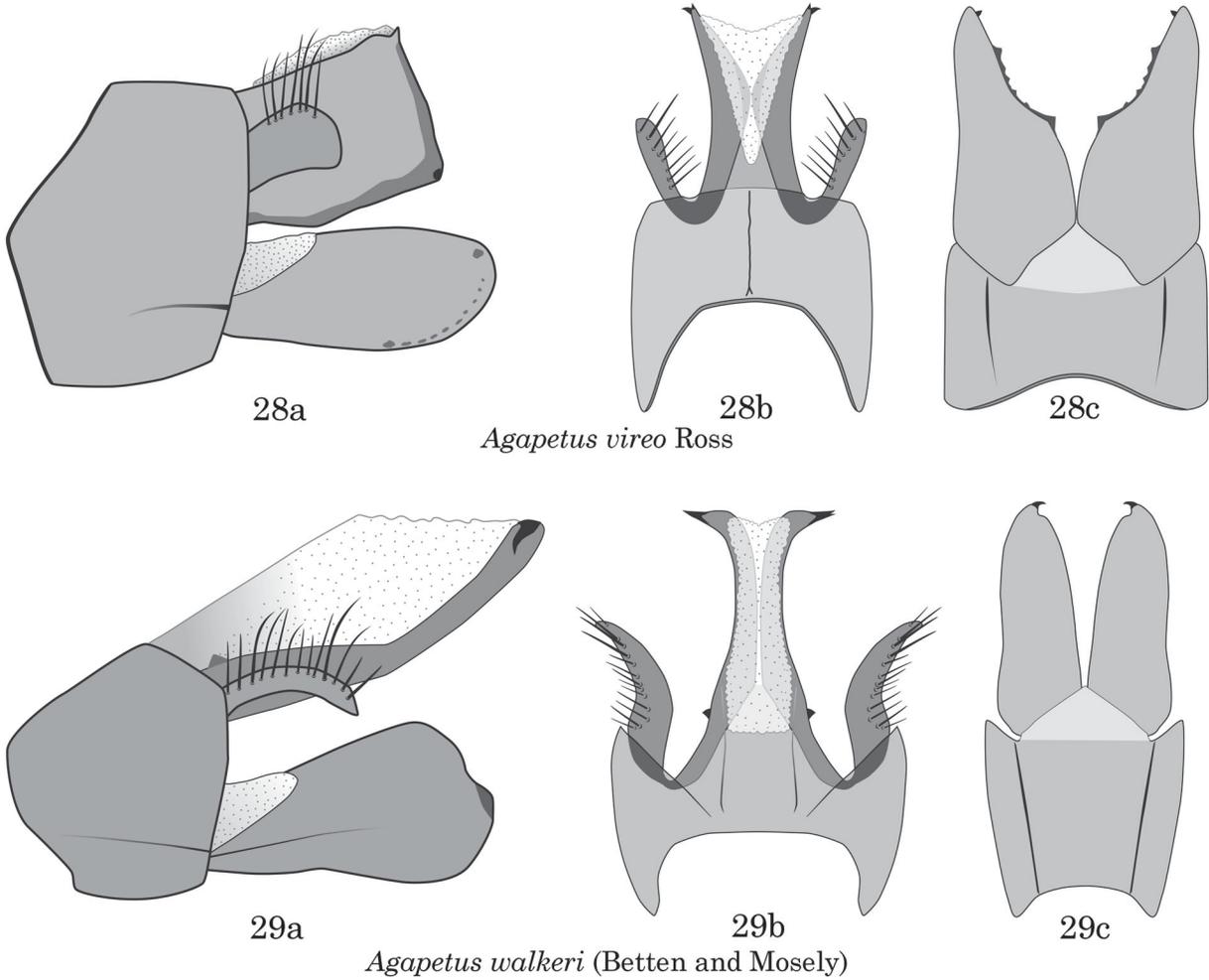
**Figure 19-21.** *Agapetus* spp. male genitalia. **19)** *Agapetus meridionalis* Etnier, Parker, and Baxter. 19a, lateral view; 19b, dorsal view, inferior appendages not shown; 19c, ventral view of IX and inferior appendages. **20)** *Agapetus minutus* Sibley. 20a, lateral view; 20b, dorsal view; 20c, ventral view of IX and inferior appendages. **21)** *Agapetus pegram* Etnier, Baxter and Parker. 21a, lateral view; 21b, dorsal view; inferior appendages not shown; 21c, ventral view of IX and inferior appendages.



**Figure 22-24.** *Agapetus* spp. male genitalia. **22)** *Agapetus pinatus* Ross. 22a, lateral view; 22b, dorsal view; inferior appendages not shown; 22c, ventral view of IX and inferior appendages. **23)** *Agapetus ruiteri* Parker, Etnier, and Baxter. 23a, lateral view; 23b, dorsal view; 23c, ventral view of IX and inferior appendages. **24)** *Agapetus spinosus* Etnier and Way. 24a, lateral view; 24b, dorsal view; 24c, ventral view of IX and inferior appendages.



**Figure 25-27.** *Agapetus* spp. male genitalia. **25)** *Agapetus stylifer* Etnier, Baxter, and Parker. 25a, lateral view; 25b, dorsal view; 25c, ventral view, preanal appendages not shown. **26)** *Agapetus tomus* Ross. 26a, lateral view; 26b, dorsal view; 26c, ventral view of IX and inferior appendages. **27)** *Agapetus tricornutus* Etnier, Parker, and Baxter. 27a, lateral view; 27b, dorsal view, inferior appendages not shown; 27c, ventral view of IX and inferior appendages.



**Figure 28-29.** *Agapetus* spp. male genitalia. **28)** *Agapetus vireo* Ross. 28a, lateral view; 28b, dorsal view, inferior appendages not shown; 28c, ventral view of IX and inferior appendages. **29)** *Agapetus walkeri* (Betten and Mosely). 29a, lateral view; 29b, dorsal view; inferior appendages not shown; 29c, ventral view of IX and inferior appendages.

