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## Scaphisomatini of Arizona (Coleoptera, Staphylinidae, Scaphidiinae) collected by V-Flight Intercept Traps

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**Abstract:** Records are given for 15 Scaphisomatini species captured by V-flight intercept traps in Arizona. *Baeocera hamata* Löbl & Stephan, *B. nana* Casey and *Toxidium gammaroides* LeConte are recorded for the first time from Arizona, *B. arizonensis* sp. nov., *B. obscura* sp. nov. *B. vintercepta* sp. nov. and *Scaphisoma declivum* sp. nov. are described as new. *Scaphisoma dakotanum* Fall is synonymized with *S. desertorum* Casey. The aedeagi of *Scaphisoma desertorum* Casey, *S. rufulum* LeConte, and *S. rubens* Casey are illustrated for the first time. A key to the Arizona species of *Scaphisoma* Leach is provided. A new iteration of the V-flight intercept trap is described and the diversity of Arizona Scaphisomatini is discussed.

**Keywords:** Insects - shining fungus beetles - new species - records - new efficient trap - USA.

### INTRODUCTION

Arizona is a biogeographically very heterogeneous area, consisting of deserts, high mountains, and riverine habitats. The ranges of some Neotropical biota have their northern edges in a narrow band mostly within about 100 km north of the state's southern border. Though relatively intensively collected, complete knowledge of the Arizona beetle fauna is lacking, and most groups are poorly documented. Thus, the catalogues of Leng (1920) with the subsequent supplements (Leng & Mutchler, 1927; Blackwelder, 1939) remain sources of information for many groups, however outdated these catalogues may be. This is true also for the rove beetle subfamily Scaphidiinae Latreille, 1806, which is only partly revised for North America (Newton *et al.*, 2001). While several modern authors significantly contributed to the knowledge of the biology, associated hosts, and larvae of scaphidiines (Ashe, 1984; Hanley, 1996; Lawrence & Newton, 1980; Leschen, 1988, 1994; Leschen *et al.*, 1990; Newton, 1984, 1991; Stephenson *et al.*, 1994), modern taxonomic work on species occurring north of Mexico is limited to the description of *Scaphisoma americanum* (Löbl, 1987), the review of the *Scaphisoma* of the Ozark Highland (Leschen *et al.*, 1990), and revision of *Baeocera* Erichson, 1845 (as *Eubaeocera*

new genus in Cornell, 1967, as *Sciatrophes* Blackburn, 1903 in Löbl, 1976; Löbl & Stephan, 1993). Of these, the three papers on *Baeocera* provided information on species occurring in Arizona.

Scaphisomatini can be very abundant when collected from their host fungi and sifted in leaf litter, including moist accumulations occurring in dry arroyos. They may also be collected in abundance using mass-trapping methods, with each collecting method producing different species assemblies (e.g. Ferro *et al.*, 2012), even though there is overlap. In this paper we record 15 species (four new) collected by WBW by V-form flight intercept traps (V-FIT). We describe the V-FIT, present new state records and provide a discussion about future research and the importance of implementing multiple collecting techniques for exploring further the Scaphisomatini diversity in Arizona.

### MATERIAL AND TECHNIQUES

The material studied is housed in the following collections:

MCZ: Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA

MHNG: Muséum d'histoire naturelle, Genève, Switzerland

NMNH: National Museum of Natural History, Washington, DC, USA

WBWC: Private collection of William B. Warner, Chandler, AZ, USA (deposited eventually in the Arizona State University collection, Tempe, AZ, USA)

The locality data of the type material are reproduced verbatim, dates from different labels are separated by a slash. This information is not repeated under the data of the non-typical material in the sections "Material examined". The body-length is measured from the anterior pronotal margin to the posterior inner angles of elytra. The length/width ratios of the antennomeres are measured on slide-mounted antennae. The sides of the aedeagi refer to their morphological side with the ostium situated dorsally, while it is in resting position rotated 90°. The dissected body-parts are embedded in Euparal and fixed on a separate card on the same pin as the respective specimen.

For the primary references to all taxa mentioned in the present paper see Löbl (2018), for the terminology see Leschen & Löbl (2005).

The Arizona specimens that form the basis of this study were collected by WBW in a new iteration of the V-form flight intercept trap (V-FIT, Figs 1, 2), initially described by Warner (2017), and further discussed below.

## TAXONOMY

### Genus *Baeocera* Erichson, 1845

**Remarks:** Thirty-nine species of *Baeocera* are distributed in North America (Newton *et al.*, 2001), one of them (*B. discolor* Casey, 1900) remains doubtful. Among these species, the following 12 have been described or reported from Arizona (Löbl & Stephan, 1993): *B. cerbera* (Cornell, 1967), *B. congener* Casey, 1893, *B. elongata* Löbl & Stephan, 1993, *B. eurydice* (Cornell, 1967), *B. flagellata* (Löbl, 1976), *B. hesperia* Löbl & Stephan, 1993, *B. humeralis* Fall, 1910, *B. impunctata* Löbl & Stephan, 1993, *B. lenczyi* Löbl & Stephan, 1993, *B. solida* Löbl & Stephan, 1993, *B. sticta* Löbl & Stephan, 1993 and *B. valida* (Löbl, 1976). The newly examined collection comprises ten species, with *B. hamata* Löbl & Stephan, 1993 and *B. nana* Casey, 1893 recorded here for the first time from Arizona, and three species described below as new to science.

#### *Baeocera cerbera* (Cornell, 1967)

**Material examined:** MHNG, WBWC; 4 females; Arizona, Cochise Co. Huachuca Mts.; 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, July 4-24, 2019.

**Remarks:** This species is known from Arizona and Texas and had been previously collected in Cochise County by sifting leaf litter in oak forests.

#### *Baeocera elongata* Löbl & Stephan, 1993

**Material examined:** MHNG, WBWC; 26 specimens; Arizona, Maricopa Co. along Sycamore Creek at Sunflower; 33.8651°N, 111.4657°W; July 16 - Aug. 4, 2019. – MHNG, WBWC; 5 specimens; Arizona, Santa Cruz Co. Old Ruby Rd., 0.9 km W of I-19; 31.4225°N, 110.9736°W, Aug. 6 - Sep. 18, 2019. – MHNG, WBWC; 11 specimens; Arizona, Santa Cruz Co. Palo Prado Rd., east side Santa Cruz R., 31.531°N, 111.016°W; July 11-16, 2018. – MHNG, WBWC; 52 specimens; Arizona, Santa Cruz Co. Duquesne Rd., 2.3 rd. mi E jct. Hwy 82, Santa Cruz R., 31.3757°N, 110.8406°W, Aug. 3-14, 2018. – MHNG, WBWC; 12 specimens; Arizona, Pima Co., 0.3 km W Hwy 83 on Gardner Cyn. Rd., 31.7367°N, 110.6663°W, 4722 ft., July 5 - Aug. 6, 2019. – MHNG, WBWC; 36 specimens; Arizona, Gila Co. Tonto Ck., 0.2 mi. S of Gisela, 34.0862°N, 111.2874°W, 2845 ft., July 6 - 21, 2018.

**Remarks:** As the previous species, *B. elongata* is known from Arizona and Texas only. It was based on a few specimens only, and new county records are Maricopa and Gila. It was previously collected by sifting leaf litter in oak forests and in sycamore litter.

#### *Baeocera hamata* Löbl & Stephan, 1993

**Material examined:** MHNG, WBWC; 4 specimens; Arizona, Cochise Co. Huachuca Mts., Carr Cyn. below Carr house, 31.4447°N, 110.2864°W, Aug. 15-31, 2018. – MHNG, WBWC; 14 specimens; Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, July 4 - 24, 2019. – MHNG; 1 specimen; Arizona, Pima Co., 0.3 km W Hwy 83 on Gardner Cyn. Rd., 31.7367°N, 110.6663°W, 4722 ft., July 5 - Aug. 6, 2019.

**Remarks:** This species was based on a single specimen from Texas without specified collecting method. While its aedeagus is distinctive, the elytral punctuation considered by Löbl & Stephan (1993) as diagnostic, is too variable and dissection of aedeagus is required to confirm its species identity. The examined specimens are 1.52-1.68 mm long, somewhat smaller than the holotype.

#### *Baeocera hesperia* Löbl & Stephan, 1993

**Material examined:** MHNG, WBWC; 10 specimens; Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, July 4-24, 2019.



Fig. 1. V-flight intercept trap, with metal frame.



Fig. 2. Travel version of V-flight intercept trap.

**Remarks:** The species was based on a few specimens from Arizona and Colorado and considered rare by Löbl & Stephan (1993). Prior specimens recorded by Löbl & Stephan (1993) were collected by coleopterists who routinely sifted litter.

***Baeocera humeralis* Fall, 1910**

**Material examined:** MHNG, WBWC; 9 specimens; Arizona, Cochise Co. Huachuca Mts.; 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, Aug. 31- Sept. 28, 2018.

**Remarks:** This species is widely distributed throughout North America and has been collected by sifting litter and by FIT (Löbl & Stephan 1993). Previous studies by Cornell (1967) and Löbl & Stephan (1993) do not provide county records.

***Baeocera impunctata* Löbl & Stephan, 1993**

**Material examined:** MHNG, WBWC; 4 specimens; Arizona, Maricopa Co. along Sycamore Creek at Sunflower, 33.8651°N, 111.4657°W, Jul. 16-Aug. 4, 2019. – MHNG, WBWC; 16 specimens; Arizona, Gila Co. along Tonto Ck., 0.2 mi. S of Gisela, 34.0862°N, 111.2874°W, 2845 ft., July 6-21, 2018. – MHNG, WBWC; 13 specimens; Arizona, Pima Co., 0.3 km W Hwy 83 on Gardner Cyn. Rd., 31.7367°N, 110.6663°W, 4722 ft., July 5- Aug. 6, 2019. – MHNG, WBWC; 7 specimens; Arizona, Santa Cruz Co. Duquesne Rd., 2.3 rd. Mi E jct. Hwy 82, Santa Cruz R., 31.3757°N, 110.8406°W, Aug. 3-14, 2018. – MHNG, WBWC; 6 specimens; Arizona, Santa Cruz Co. Palo Prado Rd., east side Santa Cruz R., 31.531°N, 111.016°W, July 11-16, 2018. – WBWC; 2 specimens; Arizona, Santa Cruz Co. 3.7 rd. mi. SE of Patagonia on Harshaw RD, 31.5163°N, 110.7043°W, July 24 - Aug. 6, 2019. – MHNG, WBWC; 26 specimens; Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, July 4-24, 2019. – WBWC; 3 specimens; Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, Aug. 31- Sept. 28, 2018. – WBWC; 1 specimen; Arizona, Cochise Co. Huachuca Mts., Carr Cyn. below Carr house, 31.4447°N, 110.2864°W, Aug. 15-31, 2018.

**Remarks:** The species was based on few specimens from Arizona and New Mexico and remains unknown from other states. It was collected previously in Pima County by sifting moist leaf litter (Löbl & Stephan, 1993) and new county records are: Cochise, Gila, Maricopa, and Santa Cruz.

***Baeocera nana* Casey, 1893**

**Material examined:** MHNG, WBWC; 4 specimens; Arizona, Cochise Co. Huachuca Mts.; 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, July 4-24, 2019.

**Remarks:** This species is widely distributed throughout North America and has been collected in many habitats by sifting as well as FIT and recorded from slime moulds (Cornell, 1967; Lawrence & Newton, 1980; Löbl & Stephan, 1993).

***Baeocera arizonensis* Löbl, sp. nov.**

Figs 3-5

**Material examined:**

*Holotype:* MHNG (# MHNG-ENTO-86101); male; USA: AZ: Cochise Co. Huachuca Mts.; 0.8 rd. mi. SW Reef; 31.4238° - 110.2991°; July 4-24.2019; V-flight intercept trap; W.B. Warner.

*Paratypes:* MHNG, WBWC; 2 males, 1 female; with the same data as the holotype. – WBWC; 1 male; with the same data but Aug. 31-Sept. 28, 2018.

**Etymology:** The species epithet refers to Arizona.

**Diagnosis:** The species is defined by the following characters in combination: body length about 1.20-1.30 mm, elytra lighter than most of pronotum, lateral margins of pronotum and elytra continuously arcuate, elytron with basal stria broadly separated from lateral stria, lateral parts of metaventricle finely punctate, ventrite I with basal striae, aedeagus symmetrical, with tapering apical process, parameres sinuate and narrowed posterior basal third, internal sac with complex sclerites, as in Figs 3, 4.

**Description:** Length 1.23-1.28 mm, width 0.75-0.85 mm. Head and most of pronotum dark brown, pronotum near lateral margins, hypomeres, elytra and appendages ochraceous, mesoventrite, mesanepisterna, metaventricle, metanepisterna and abdomen dark brown to blackish. Antennomere II twice as long as antennomere III. Length/width ratios of antennomeres as: III 15/7: IV 18/6: V 20/6: VI 17/7: VII 20/9: VIII 17/10: IX 30/15: X 27/16: XI 43/18. Pronotum and elytra continuously arcuate. Pronotal punctation hardly visible at 50 times magnification, microsculpture indistinct. Marginal carinae of pronotum not visible in dorsal view. Point of scutellum exposed. Elytron weakly narrowed apically, with lateral margin rounded near base and apex, oblique at middle, adsutural area flat and broad, sutural stria punctate, curved along base to form basal stria; basal stria extended slightly outward basal half of elytral width and broadly separated from lateral stria, gradually approximate to basal margin; lateral stria punctate. Elytral disc not microsculptured, with punctation less fine than that on pronotum. Hypomeron impunctate. Mesepimeron about twice to three times

as long as wide and about 1.5 times as long as distance to coxa. Median part of metaventrite flattened, with impunctate narrow central area delimited laterally and apically by dense patch of fine punctures. Remaining punctation on metaventrite hardly visible at 100 times magnification. Submesocoxal lines convex, with row of small, not elongate pits, not extended laterally. Submesocoxal areas 0.05-0.06 mm long, about as half to two-thirds of shortest distance to metacoxae. Exposed part of metanepisternum flat, about 0.08-0.09 mm wide, with suture finely punctate, straight or somewhat curved. Tibiae straight. Abdominal punctation finer than elytral punctation, microsculpture punctulate, hardly visible. Ventrite I with basolateral striae 0.08-0.12 mm long, row of fine basal pits interrupted at middle. Aedeagus (Figs 3-5) 0.47-0.52 mm long, weakly sclerotized.

**Distribution:** USA, Arizona.

**Type locality:** Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W.

**Remarks:** The species is a member of the *B. picea* group as defined in Löbl & Stephan (1993). Its aedeagal characters suggest relationship with *B. borealis* Löbl & Stephan, 1993 by having the same peculiar shape of the parameres. The shape of the median lobe is also similar though the apical process is in *B. arizonensis* narrower in lateral view. The new species may be easily distinguished from *B. borealis* by the bicolorous body, the long laterobasal striae of the ventrite I, and the shape of the sclerotized pieces of the internal sac. It falls in the key to the North American *Baeocera* (Löbl & Stephan, 1993) under the couplet 5, to *B. elongata* Löbl & Stephan, 1993. *B. elongata* is significantly larger and has the submesocoxal lines nearly parallel with the margin of coxal cavities, and deep striae at the base of the ventrite I.

***Baeocera obscura* Löbl, sp. nov.**

Figs 6-8

**Material examined:**

*Holotype:* MHNG (# MHNG-ENTO-86102); male; USA: AZ: Cochise Co. Huachuca Mts.; 0.8 rd. mi. SW Reef; 31.4238° - 110.2991°; Aug. 31 - Sept. 28, 2018; V-flight intercept trap; W.B. Warner.

*Paratypes:* WBWC, MHNG; 4 females, with the same data as the holotype. – MHNG; 1 female; with the same data but July 4-24.2019.

**Etymology:** The species epithet is a Latin adjective meaning dull.

**Diagnosis:** The species is defined by the following characters in combination: body length about 1.0-1.20 mm, body light brown, lateral margins of pronotum and elytra separately arcuate, elytron with basal stria

broadly separated from lateral stria, lateral parts of metaventrite with hardly visible punctation, ventrite I without basal striae, aedeagus as Figs 6-8, weakly sclerotized, symmetrical and narrow, parameres nearly throughout evenly narrow and weakly curved, internal sac lacking sclerites, with very thin, weakly sclerotized flagellum.

**Description:** Length 1.06-1.20 mm, width 0.73-0.84 mm. Body light brown, pronotum and elytra sometimes somewhat lighter than venter of thorax and abdomen. Femora, tibiae and antennomeres I and II about as light as venter of thorax, tarsi and antennomeres III to XI lighter, yellowish. Antennomere II slightly longer than antennomere III. Length/width ratios of antennomeres as: III 16/5: IV 16/5: V 23/5: VI 18/7: VII 24/11: VIII 23/10: IX 30/12: X 28/14: XI 28/15. Pronotum and elytra separately arcuate, both with punctation fine, hardly visible at 50 times magnification, pronotal microsculpture indistinct. Marginal carinae of pronotum not visible in dorsal view. Point of scutellum exposed. Elytron weakly narrowed apically, with lateral margin weakly rounded, adsutural area flat and broad, sutural stria impunctate, curved along base to form basal stria extended slightly outward basal half of elytral width and broadly separated from lateral stria, not approximate to basal margin; lateral stria appearing impunctate. Elytral disc with distinct punctulate microsculpture. Hypomeron impunctate. Mesepimeron about three times as long as wide and six times as long as distance to coxa. Median part of metaventrite flattened, with distinct U-shaped row of fine punctures. Remaining punctation on metaventrite hardly visible at 100 times magnification. Submesocoxal lines convex, with row of small, not elongate pits, not extended laterally. Submesocoxal areas 0.03 mm long, about as third to fourth of shortest distance to metacoxae. Exposed part of metanepisternum flat, 0.06 to 0.08 mm wide, with suture deep, impunctate, straight or somewhat curved. Protibiae and mesotibiae straight, metatibiae hardly curved. Abdominal punctation as fine as that on elytra, microsculpture punctulate, distinct. Ventrite I without basal striae, basal row of fine pits interrupted at middle. Aedeagus (Figs 6-8) 0.29 mm long, weakly sclerotized.

**Distribution:** USA, Arizona.

**Type locality:** Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W.

**Remarks:** The sole available male has the tip of the median lobe broken off and the basal bulb deformed, though the distinguishing characteristics are retained for naming this species. The shape of the median lobe and parameres of this species are similar with those in members of the *B. picea* group as defined by Löbl & Stephan (1993) while the presence of a flagellum and the internal sac lacking proximal sclerotized structures

suggest relationship with members of the *B. apicalis* group. Notable is the very thin flagellum much narrower than that in its North American congeners. The new species falls in the key to the North American *Baeocera* under the couplet 12, to *B. similaris* Löbl & Stephan, 1993. It differs drastically from *B. similaris* by the elytral and abdominal microsculpture, and by the ventrite I margined by round, not elongate, pits.

***Baeocera vintercepta* Löbl, sp. nov.**

Figs 9, 10

**Material examined:**

*Holotype*: MHNG (# MHNG-ENTO-86103); male; USA: AZ: Gila Co. along Tonto Ck., 0.2 mi. S of Gisela; elev. 2845 ft.; 34.0862°, -111.2874°; July 6-21, 2018, V-flight intercept trap; W.B. Warner.

*Paratypes*: MHNG; 3 males, 2 females; USA: AZ: Santa Cruz Co. Duquesne Rd., 2.3 rd. mi E jct. Hwy 82; Santa Cruz R.; 31.3757°, -110.8406° Aug. 3-14, 2018; V-flight intercept trap; W.B. Warner. – MHNG; 1 male; USA: AZ: Santa Cruz Co. Palo Prado Rd., east side Santa Cruz R.; 31.531°, 111.016°; July 11-16, 2018; V-flight intercept trap; W.B. Warner (MHNG); – WBWC; 1 male; USA: AZ: Maricopa Co. along Sycamore Creek at Sunflower; 33.8651°, -111.4657°; Jul.16-Aug.4.2019; V-flight intercept trap; W.B. Warner.

**Etymology:** The species epithet is a Latin adjective referring to the mode of collection, the v-flight intercept traps providing remarkable results.

**Diagnosis:** The species is defined by the following characters in combination: body length about 1.10-1.25 mm, body dark brown, lateral margins of pronotum and elytra separately arcuate, elytron with basal stria broadly separated from lateral stria, lateral parts of metaventrite with hardly visible punctation, ventrite I with basal striae, aedeagus as Figs 9, 10, symmetrical and narrow, median lobe tapering in lateral view, with obtuse tip in dorsal view, parameres abruptly narrowed near apices, internal sac with complex sclerites.

**Description:** Length 1.10-1.23 mm, width 0.77-0.80 mm. Body dark brown. Legs lighter, reddish to yellowish, tibiae and tarsi lighter than femora. Antennomeres I to VI about as light as tarsi. Antennomere II about twice as long as antennomere III. Length/width ratios of antennomeres as: III 12/7: IV 17/6: V 18/6: VI 18/6: VII 24/9: VIII 19/10: IX 26/13: X 28/14: XI 40/16. Pronotum and elytra separately arcuate, pronotum with punctation fine, hardly visible at 50 times magnification, pronotal microsculpture indistinct, elytra not microsculptured. Marginal carinae of pronotum not visible in dorsal view. Point of scutellum exposed. Elytron weakly narrowed apically, with lateral margin rounded near base and apex, oblique in middle third, adsutural area

flat and narrow, sutural stria impunctate, curved along base to form basal stria extended slightly outward basal half of elytral width and broadly separated from lateral stria, somewhat approximate to basal margin; lateral stria appearing impunctate. Discal punctation less fine than that on pronotum, distinct at 50 times magnification. Hypomeron impunctate. Mesepimeron hardly three times as long as wide and about 1.5 times as long as distance to coxa. Median part of metaventrite flattened, with distinct, dense punctation laterally centre. Remaining punctation on metaventrite hardly visible at 100 times magnification. Submesocoxal lines convex, with row of small, not elongate pits, not extended laterally. Submesocoxal areas 0.04-0.05 mm long, nearly as half of shortest distance to metacoxae. Exposed part of metanepisternum flat, 0.05-0.07 mm wide, suture of metanepisternum deep, impunctate, straight. Tibiae straight. Abdominal punctation as fine as that on elytra, microsculpture punctulate, distinct. Ventrite I with basal row of fine pits interrupted at middle and extended by fine, 0.08-0.12 mm long striae. Aedeagus (Figs 3, 4) 0.39-0.42 mm long, weakly sclerotized.

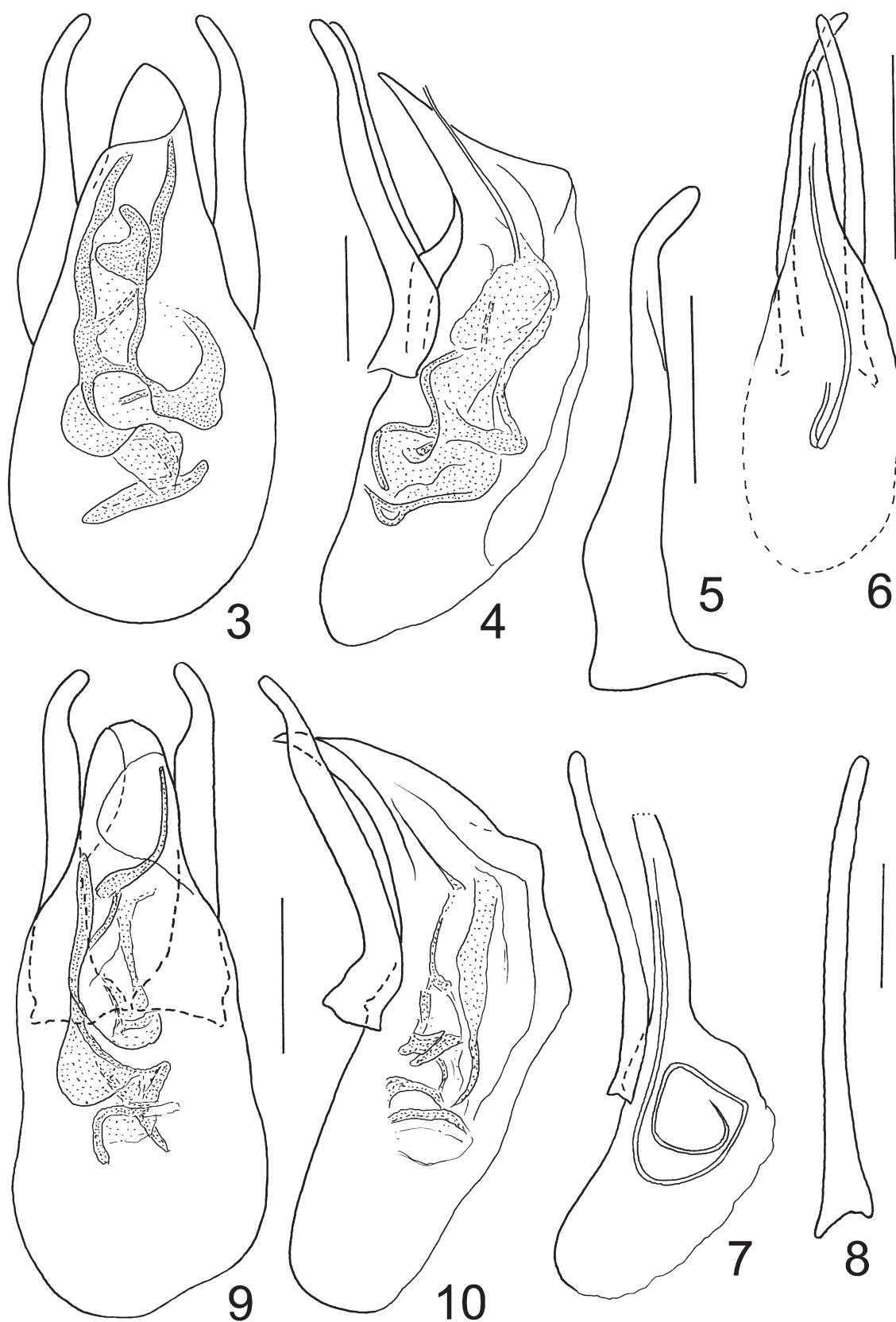
**Distribution:** USA, Arizona.

**Type locality:** Arizona, Gila Co. along Tonto Ck., 0.2 mi. S of Gisela, 34.0862°N, 111.2874°W, 2845 ft.

**Remarks:** This new species is clearly a member of the *B. picea* group (see Löbl & Stephan, 1993). The median lobe and parameres are similar with those in *B. scylla* (Cornell, 1967), while the shape of the sclerites of the internal sac are distinctive, and the presence of a proximal subtriangular plate is diagnostic for this new species. *Baeocera vintercepta* is readily distinguished from *B. scylla* by the longitudinal striae at the base of the ventrite I. It may be separated also by the comparatively shorter antennomere XI which is in *B. scylla* nearly twice as long as the antennomere X, the submesocoxal lines being not parabolic and having the submesocoxal areas much shorter. The new species falls in the key to the North American *Baeocera* (Löbl & Stephan, 1993) under the couplet 5, to *B. elongata* Löbl & Stephan, 1993, as *B. arizonensis*. These two species possess very distinctive aedeagi, in addition *B. vintercepta* may be easily distinguished by the uniformly dark body and the antennomeres XI larger, more than twice as long as wide.

**Genus *Scaphisoma* Leach, 1815**

**Remarks:** This genus comprises less species in North America than *Baeocera*, while the opposite is in the Old World. To date, 23 species of *Scaphisoma* have been reported from the USA (Newton *et al.*, 2001), including *S. americanum* (Löbl, 1987) originally placed in the subsequently synonymized *Caryoscapa* (see Leschen



Figs 3-10. Aedeagi in *Baeocera*. (3 - 4) *B. arizonensis* Löbl, sp. nov., in dorsal and lateral views, scale = 0.1 mm. (5) Ditto, paramere in ventral view, scale = 0.1 mm. (6-7) *B. obscura* Löbl, sp. nov., in dorsal and lateral views, scale = 0.1 mm (basal bulb deformed, tip of apical process broken). (8.) Ditto, paramere in ventral view, scale = 0.05 mm. (9-10) *B. vintercepta* Löbl, sp. nov., in dorsal and lateral views, scale = 0.1 mm.



& Löbl, 2005). The following four species have been listed from Arizona in Löbl (2018): *S. commune* Löbl, 1997 based on probably a mislabelled specimen of *S. convexum* Say, 1825 (see Casey, 1893), *S. desertorum* Casey, 1893, *S. pusillum* LeConte, 1860, and *S. rufulum* LeConte, 1860.

#### *Scaphisoma convexum* Say, 1825

**Material examined:** WBWC; 1 female; Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W, July 4-24, 2019.

**Remarks:** The species is in external characters similar with *S. commune* Löbl, 1997 [a replacement name for the homonymous *S. castaneum* (Motschulsky, 1845)]. The puncture pattern of the metaventricle and ventrite I enables reliable identification. In addition, the aedeagi of these species differ drastically: *S. commune* possesses a long, thin flagellum extruded in repose while *S. convexum* has a robust rod as illustrated in Leschen *et al.* (1990). *Scaphisoma convexum* can be collected in numbers from basidiomycete fungi (Newton, 1984; Leschen *et al.*, 1990).

#### *Scaphisoma desertorum* Casey, 1893

Figs 13-14

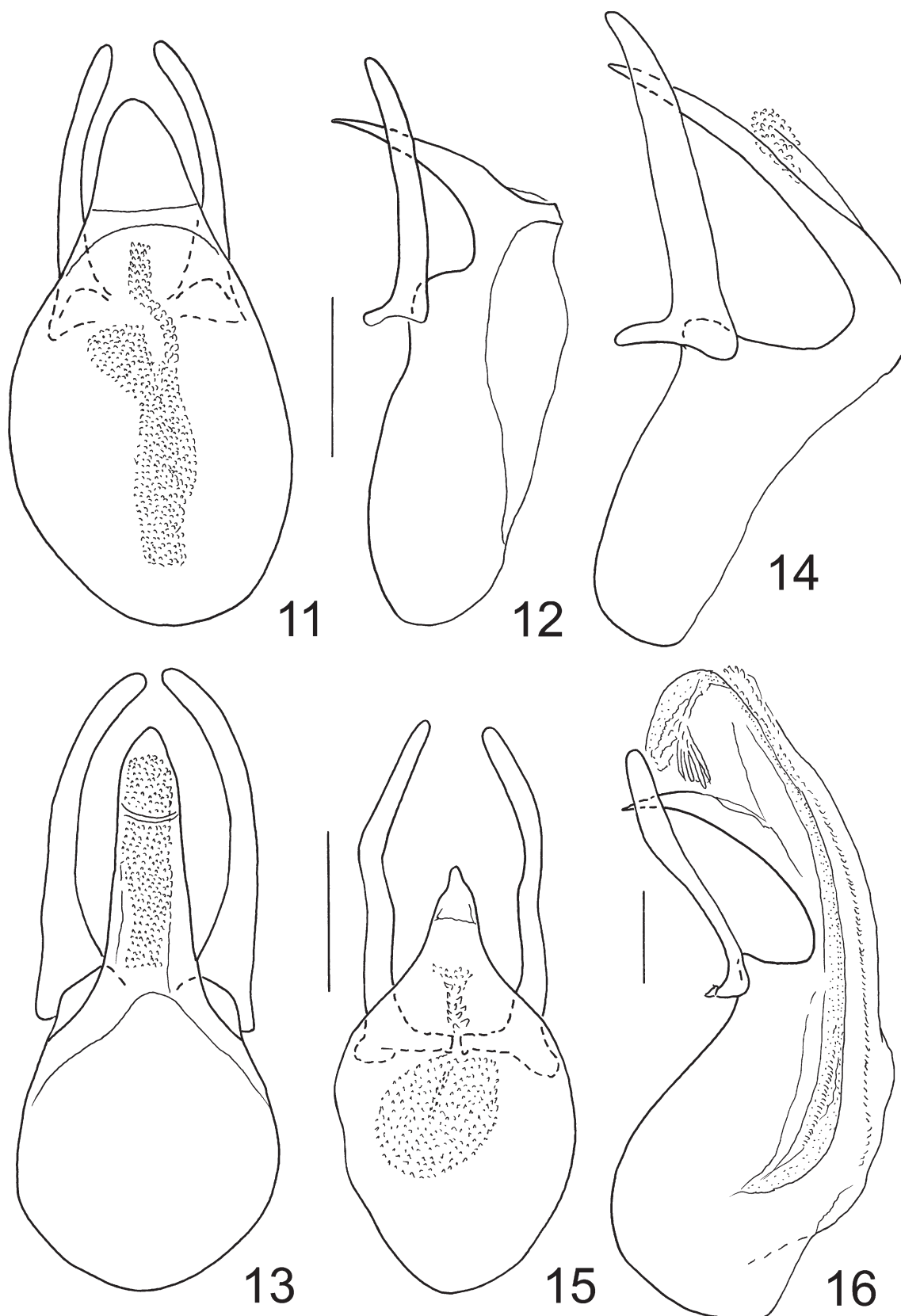
**Material examined:** MHNG, WBWC; 16 specimens; Arizona, Maricopa Co. along Sycamore Creek at Sunflower; 33.8651°N, 111.4657°W, July 16 - Aug.

4, 2019. – WBWC; 2 specimens; Arizona, Santa Cruz Co. 3.7 rd. mi. SE of Patagonia on Harshaw RD; 31.5163°N, 110.7043°W; July 24 - Aug. 6, 2019. – MHNG, WBWC; 32 specimens; Arizona, Santa Cruz Co. Palo Prado Rd., east side Santa Cruz R.; 31.531°N, 111.016°W; July 11-16, 2018. – WBWC; 5 specimens; Arizona, Gila Co. along Tonto Ck., 0.2 mi. S of Gisela; 2845 ft., 34.0862°N, 111.2874°W, July 6-21, 2018. – MHNG, WBWC; 25 specimens; Arizona, Santa Cruz Co. Duquesne Rd., 2.3 rd. Mi E jct. Hwy 82; Santa Cruz R.; 31.3757°N, 110.8406°W, Aug. 3-14, 2018. – MHNG, WBWC; 13 specimens; Arizona, Cochise Co. Huachuca Mts., 0.8 rd. mi. SW Reef; 31.4238°N, 110.2991°W, Aug. 31 - Sept. 28, 2018. – WBWC; 7 specimens; Arizona, Cochise Co. Huachuca Mts.; 0.8 rd. mi. SW Reef; 31.4238°N, 110.2991°W, July 4-24, 2019. – WBWC; 2 specimens; Arizona, Pima Co.; 0.3 km W Hwy 83 on Gardner Cyn. Rd., 4722 ft., 31.7367°N, 110.6663°W, July 5 - Aug. 6, 2019.

**Remarks:** The species was based on an unknown number of specimens from Arizona and Texas (Casey, 1893: 530). The senior author has examined a male syntype labelled “Williams Ariz” / “TYPE USNM 48161” / “desertorum” (handwritten). As its aedeagal characters have not yet been published, respective illustrations are given here (Figs 13, 14). An examined male syntype of *Scaphisoma dakotatum* Fall, 1910, originally spelled *dakotana*, labelled “Wickham, Bismarck, N. Dak.” / “dakotana TYPE” / “M.C.Z. Type 24119” / “H.C.Fall collection” / “Scaphisoma dakotana Fall” is found conspecific with *S. desertorum*. It is here

#### Key to the Arizona species of *Scaphisoma*

- |   |   |                             |
|---|---|-----------------------------|
| 1 | Body length 1.0-1.20 mm. Submetacoxal area large, extending to or nearly to mid-length of ventrite I, not margined by punctures.....                      | <i>S. pusillum</i> LeConte  |
| - | Body length 1.50 to 2.80 mm. Submetacoxal area small, much shorter than mid-length of ventrite I, margined by punctures .....                             | 2                           |
| 2 | Mesepimeron completely or to partly fused with mesanepisternum. Antennomeres IV and V similar. Metaventricle and abdomen very finely punctate .....       | <i>S. rufulum</i> LeConte   |
| - | Mesepimeron distinct. Antennomere V much larger than antennomere IV. Metaventricle and/or abdomen entirely or in part distinctly punctate .....           | 3                           |
| 3 | Metaventricle posterior submesocoxal lines and on centre much more coarsely punctate than on lateral area. Internal sac of aedeagus with robust rod ..... | <i>S. convexum</i> Say      |
| - | Metaventricle with punctation similar on centre, posterior submesocoxal lines and on lateral areas. Internal sac of aedeagus without rod .....            | 4                           |
| 4 | Internal sac of aedeagus with long, thin flagellum extruded in repos .....  | [ <i>S. commune</i> Löbl]   |
| - | Internal sac of aedeagus lacking flagellum .....  | 5                           |
| 5 | Body dark reddish-brown to blackish. Antennomere VI longer than antennomeres IV and V combined. Aedeagus with basal capsule shorter than parameres .....  | <i>S. desertorum</i> Casey  |
| - | Body light reddish-brown. Antennomere VI shorter than antennomeres IV and V combined. Aedeagus with basal capsule longer than parameres .....             | <i>S. declivum</i> sp. nov. |



Figs 11-16. Aedeagi in *Scaphisoma*. (11-12) *S. declivum* Löbl, sp. nov., in dorsal and lateral views, scale = 0.1 mm. (13-14) *S. desertorum* Casey, in dorsal and lateral views, scale = 0.2 mm. (15) *S. rufulum* LeConte, in dorsal view, scale = 0.2 mm. (16) *S. rubens* Casey, in lateral view, internal sac extruded, scale = 0.1 mm.

designated as lectotype, and bears respective label, dated 1987.

Hence, *Scaphisoma dakotatum* Fall, 1910, **syn. nov.** = *S. desertorum* Casey, 1893.

This species is reported from Arizona, North Dakota and Texas, the vouchers from Texas were not examined.

#### *Scaphisoma pusillum* LeConte, 1860

**Material examined:** MHNG; 1 female; Arizona, Cochise Co. Huachuca Mts.; 0.8 rd. mi. SW Reef; 31.4238°N, 110.2991°W; July 4-24, 2019.

**Remarks:** The species is widely distributed throughout the United States but does not occur in Canada. It has been collected by sifting hay (Leschen *et al.*, 1990).

#### *Scaphisoma rufulum* LeConte, 1860

Fig. 15

**Material examined:** MHNG, WBWC; 1 male, 1 female; Arizona, Santa Cruz Co. Duquesne Rd., 2.3 rd. Mi E jct. Hwy 82; Santa Cruz R., 31.3757°N, 110.8406°W, Aug. 3-14, 2018. – MHNG, WBWC; 1 male, 1 female; Arizona, Santa Cruz Co. Palo Prado Rd., east side Santa Cruz R.; 31.531°N, 111.016°W, July 11-16, 2018.

**Remarks:** This species was based on a single specimen (LeConte, 1860: 323). It is a male examined by the senior author in 1987, bearing the following labels: small, round golden-colour label, "TYPE 6639" (red) / "S. rufulum Lec. Cal." (handwritten) and my determination label dated 1987. The aedeagus is illustrated for the first time in the present paper (Fig. 15). It is similar with that of *S. impunctatum* Reitter, 1879 (see Leschen *et al.*, 1990), suggesting close relationships. It differs from that of *S. impunctatum* by the apical process of the median lobe less inclined, and the parameres more sinuate in dorsal view and narrowed apically in lateral view. *Scaphisoma rufulum* may be distinguished from *S. impunctatum* also by its lighter body and completely or to large part fused mesepimera, as in those of *S. carolinae* Casey, 1893.

This species is reported from California, Arizona and North Carolina (Löbl, 2018).

#### *Scaphisoma declivum* Löbl, sp. nov.

Figs 11-12

##### **Material examined:**

**Holotype:** MHNG (# MHNG-ENTO-86104); male; USA: AZ: Santa Cruz Co. Palo Prado Rd., east side Santa Cruz R.; 31.531°, 111.016°; July 11-16, 2018; V-flight intercept trap; W.B. Warner.

**Paratypes:** MHNG, WBWC; 2 males, 4 females with

the same data as the holotype; – WBWC, MHNG, 8 males, 13 females, USA: AZ: Santa Cruz Co. Duquesne Rd., 2.3 rd. Mi E jct. Hwy. 82; Santa Cruz R.; 31.3757°, -110.8406° Aug. 3-14, 2018; V-flight intercept trap; W.B. Warner

**Etymology:** The species epithet is a Latin adjective meaning inclined.

**Diagnosis:** The species is defined by the following characters in combination: body length about 1.70-2.10 mm, body light reddish-brown, antennomere VI about 1.5 times as long as antennomere V and twice as long as antennomere IV, elytron with basal stria broadly separated from lateral stria, elytral disc with punctures well delimited, dense and fine, submesocoxal areas about as long as third of shortest intervals to metacoxae, abdominal microsculpture punctulate, aedeagus as Figs 11, 12, symmetrical and narrow, median lobe shorter than basal bulb, strongly inflexed and tapering, with narrow dorsal bridge, parameres narrowed at middle section, internal sac membranous.

**Description:** Length 1.70-2.05 mm, width 1.16-1.55 mm. Head, most of body and femora evenly light reddish-brown. Apex of abdomen, antennae, tibiae, and tarsi lighter. Antennomeres I to VI about as light as tarsi. Antennomere II about twice as long as antennomere III. Length/width ratios of antennomeres as: III 13/10: IV 23/8: V 34/10: VI 48/12: VII 52/16: VIII 42/13: IX 49/16: X 50/17: XI 65/16. Pronotum with lateral margins rounded, lateral margin carinae usually visible in dorsal view, discal punctation dense and fine, consisting of well delimited punctures. Tip of scutellum exposed. Elytra moderately narrowed apically, lateral margin rounded, lateral margin carina exposed in dorsal view, inner apical angle about in level with outer apical angle, sutural margin not raised, adsutural area flat, narrowed apically, with irregular, very fine puncture row; sutural striae curved at base and extended laterally to form basal striae reaching about mid-width of basal margin, discal punctation very fine near base, dense and fine on prevailing surface, punctures well-delimited, puncture intervals on apical half of disc about twice to as large as puncture diameters. Exposed tergites very finely punctate, with distinct punctulate microsculpture. Hypomeron smooth. Mesepimeron distinctly shorter than distance between its tip and mesocoxa. Metaventricle finely, very densely punctate, not microsculptured, flattened at middle. Submesocoxal lines convex, densely margined with punctures; submesocoxal area about 0.05-0.06 mm long, as third of shortest distance to metacoxa. Metanepiternum narrowed anteriorly. Ventricle I with punctation similar as metaventricle, microsculpture punctulate, sometimes obsolete or hardly visible, submetaxocoxal lines convex, densely margined with punctures; submetaxocoxal area 0.06-0.08 mm long, about as fourth to third of shortest

distance to apical margin. Following ventrites with conspicuous punctulate microsculpture. Male ventrite VI with small mesal process about 0.03 mm long. Male protarsomeres I to III distinctly widened, with tenant setae. Aedeagus (Figs 11, 12) 0.68-0.75 mm long, strongly sclerotized.

**Distribution:** USA: Arizona.

**Type locality:** Arizona, Santa Cruz Co. Palo Prado Rd., east side Santa Cruz R., 31.531°N, 111.016°W.

**Remarks:** The aedeagus of *S. declivum* is rather similar with that of *S. carolinae* Casey, 1893 and *S. rubens* Casey, 1893, but the apical process of the median lobe is much wider and comparatively shorter, and the parameres are evenly arcuate in dorsal view. The species may be easily distinguished from *S. carolinae* by the larger and lighter body and the distinct mesepimera, and from *S. rubens* by the elytra with basal striae. The aedeagus of *S. rubens* (Fig. 16) is distinctive in lateral view and illustrated for the first time in the present paper.

#### Genus *Toxidium* LeConte, 1860

**Remarks:** Two widely distributed species are known from the USA (Newton *et al.*, 2001): *T. compressum* Zimmermann, 1869 and *T. gammaroides* LeConte, 1860. They may be distinguished by the punctation of the metaventrite, as given in Casey (1893).

#### *Toxidium gammaroides* LeConte, 1860

**Material examined:** MHNG, WBWC; 9 specimens; Arizona, Cochise Co., Huachuca Mts., 0.8 rd. mi. SW Reef, 31.4238°N, 110.2991°W; Aug. 31 - Sept. 28, 2018. – MHNG, WBWC; 5 specimens, same data but July 4-24, 2019.

**Remarks:** The species is widely distributed throughout the USA and has been reported also from Canada, Mexico and Guatemala. The state record is new.

#### THE V-FIT AND NOTES ON ARIZONA SCAPHISOMATINI

The trap design (Fig. 1) used to collect the specimens discussed in this paper is a new iteration of the V-FIT described by Warner (2017). Each trap used end supports bent from a single 3 m (10 ft) long piece of 1.25 cm (0.5 inch) steel EMT conduit (electrical metallic tubing), and two 1.5 m long horizontal supports made from half of a length of the same conduit; the corners were connected by EMT conduit elbows. A 1.5 m (5 ft) by 2.4 m (8 ft) sheet of 0.1524 mm (6 mil), sometimes 0.1016 mm (4 mil) “natural” (semi-transparent) polyethylene film

was attached to the frame with large binder clips, and a 1.5 m (5 ft) length of 10 mm (3/8 inch) diameter mild steel rebar was attached to the centre of the film, parallel to the horizontal supports to keep the film tight, but allow for movement to reduce the trap profile in winds (generally, winds up to 50 km/hr do not damage the trap). Large rocks or sand bags were placed over each corner of the “U-shaped” end supports, and four aluminium “half sized steamer trays” (single-use food service trays, about 32 cm x 25 cm x 6 cm deep) served as catchments and were filled with 4-5 L of propylene glycol as a non-toxic preservative. The trays were placed and centred about 3-4 cm below the centreline of the polyethylene “V” film and were covered with steel “chicken-wire” mesh as protection from vertebrate disturbance. Typically, insects impinging on the film slide down the surface and are caught in the preservative. Hovering insects may repeatedly fly against the film and descent until finally falling into the liquid. Some taxa with direct flight ricochet off the oblique surface into the catchment.

The “V” film provides a rain shield over the catchment, and the reflective aluminium pans may be attractive to some insects. During preliminary trials of different materials, using a black polyethylene garbage bag placed over the horizontal supports, like “rain shields” used on standard vertical netting FITs (SVN-FIT), noticeably decreased catch, especially of diurnal Hymenoptera. Without such cover, sunlight penetrates through the film “V” and reflects off the shiny aluminium trays, and then off the outside of the film perhaps acting as a daytime “light trap.”

Propylene glycol preserves specimens well and allows for traps to be left for several weeks in the field between checks and servicing. Also, the specimens are available for DNA work (Moreau *et al.*, 2013). Specimens were sieved out using 0.5 mm stainless steel mesh sieve, placed into labelled containers without any other preservative, and then stored in that condition for up to a year or more before sorting.

Though not used for specimens in this study, lightweight “travel” versions (Fig. 2) have been developed and used in Neotropics using cord wrapped around trees, film attached to the cord with paper clips, and locally cut saplings for the centre weight and “spreader bars” to provide distance across the top of the film “V.” For this “travel version,” soapy water was used, with insects removed daily into containers of preservative.

Quantitative testing of capture rates between V-FIT and SNV-FITs would be invaluable. Especially important would be the determination of what taxa are more effectively caught between each. In a 10 pseudo-replicate pair-wise comparison (two contiguous traps, position of intercept portion exchanged daily for 10 days) against the same profile size of a SNV-FIT, the V-FIT caught over 2.5 times the number of insects (WBW hitherto unpublished data). Although increases in catch were generally seen for all flying taxa in the V-FITs compared to SNV-

FITs, species that tend to land on, then fly away from standard FIT netting (e.g. Chrysomelidae) are caught 10-30 times more in V-FITs than in FITs. How this relates to capture rates for scaphisomatines is uncertain, but intense sampling of any beetle group would lead to new discoveries.

Prior to this study, 16 species of Scaphisomatini were known from Arizona. We have increased the number of *Baeocera* species to 17, with an additional three new species together with four previously considered endemic (*B. sticta*, *B. elongata*, *B. lenczyi*, and *B. solida*; see Löbl & Stephan, 1993), to seven possibly endemics. With respect to *Scaphisoma*, we have increased the number of species occurring in Arizona from four to five, one of which is possibly endemic to Arizona. Likewise, one of the two widespread species of *Toxidium* is newly recorded from Arizona.

No members of the Scaphidiinae tribes Cypariini Achard, 1924, Scaphidiini Latreille, 1806, or Scaphiini Achard, 1924 were collected in V-FITs in Arizona. This is not surprising since none of these groups have been reported from Arizona, though we would expect members of Cypariini (*Cyparium* Erichson) to eventually be captured because Neotropical species are readily collected in SNV-FITs (e.g., specimens from Mexico collected by S. B. Peck are in the MHNG and from elsewhere in the Americas are in the Snow Entomological Museum, Lawrence, Kansas). Furthermore, Fierros-López (2005) listed intercept traps as one of the methods used to collect Mexican and Central American Scaphidiini (*Scaphidium* Olivier), and the nearest state record to Arizona for this genus may be Colorado (Newton *et al.*, 2001).

Scaphisomatini are effectively collected by sifting leaf litter, hand collecting from fungi, and in FIT's, and to a lesser extent by light trapping. To fully appreciate the diversity of Arizona Scaphisomatini, we would recommend using all collecting methods, in several different habitats, from lush forested ravines to desert arroyos. We would expect by further leaf litter sampling to produce additional species, especially flightless *Baeocera* species. Further collecting may also confirm the state record of *Scaphisoma commune*, currently based on a probably mislabelled specimen.

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