

# Revision of the genus *Optioservus* SANDERSON, part 1: Generic redescription and revision of the Nearctic species (*O. fastiditus* and *O. quadrimaculatus* species groups) (Coleoptera: Elmidae)

Y. KAMITE

## Abstract

The genus *Optioservus* SANDERSON, 1954 (Coleoptera: Elmidae) is redescribed. All Nearctic species are redescribed and two species groups (*O. fastiditus* group and *O. quadrimaculatus* group) are newly proposed for them. The larvae of five species, *O. canus* CHANDLER, *O. castanipennis* (FALL), *O. fastiditus* (LECONTE), *O. phaeus* WHITE and *O. sandersoni* COLLIER, are newly described.

**Key words:** Coleoptera, Elmidae, *Optioservus*, *Optioservus fastiditus* species group, *O. quadrimaculatus* species group, taxonomy, Nearctic.

## Introduction

The elmid genus *Optioservus* was established by SANDERSON (1954) and based on 11 species from the Nearctic Region. He distinguished *Optioservus* from the very closely related genus *Heterlimnius* HINTON, 1935 by larval characters.

Subsequently, CHANDLER (1954), NOMURA (1958, 1960), BROWN (1972), WHITE (1978), JÄCH et al. (2006), KAMITE (2009, 2012) and JUNG et al. (2011) treated this genus.

At present, a total of 19 species is known, all from the Holarctic Region: 13 from the Nearctic (*O. browni* WHITE, 1978, *O. canus* CHANDLER, 1954, *O. castanipennis* (FALL, 1925), *O. divergens* (LECONTE, 1875), *O. fastiditus* (LECONTE, 1850), *O. heteroclitus* WHITE, 1978, *O. immnis* (FALL, 1925), *O. ovalis* (LECONTE, 1863), *O. phaeus* WHITE, 1978, *O. quadrimaculatus* (HORN, 1870), *O. sandersoni* COLLIER, 1972, *O. seriatus* (LECONTE, 1874), *O. trivittatus* (BROWN, 1930)); five from Japan (*O. hagai* NOMURA, 1958, *O. maculatus* NOMURA, 1958, *O. nitidus* NOMURA, 1958, *O. rugulosus* NOMURA, 1958, *O. variabilis* NOMURA 1958); and one, *O. gapyeongensis* JUNG, KAMITE & BAE, 2011, from Russian Far East, China and Korea.

Keys to the genera of Nearctic Elmidae were published by BROWN (1972), SHEPARD (2002) and WHITE & ROUGHLEY (2008), the Japanese genera were treated by SATÔ & YOSHITOMI (2005).

Recently, KAMITE (2009, 2011, 2012) revised *Heterlimnius* and provided some adult characters to distinguish these two genera. In adult specimens, only the veins in the hind wing clearly distinguish both genera. But unfortunately, most specimens of *Heterlimnius* are brachypterous. Therefore, the adult characters remain ambiguous. Hence the only reliable character to distinguish the two genera is provided by the ventral sclerites of the larval meso- and metathorax.

In this revision, all 13 Nearctic species are redescribed, and two new species groups are proposed. The larvae of five of these species are described. Data about the geographical distribution, as well as new states of morphological characters, are provided.

## Material and methods

Material was examined with a stereoscopic microscope (Olympus SZH10), a biological microscope (Olympus BX51, Nikon OPTIPHOT-2) and a scanning electron microscope (SEM; JEOL LTD. JSM-T20). The SEM material was sputter coated with gold. The genitalia were cleaned in 10% KOH solution for about one hour at 60°C in automatic ovens (AS ONE, ON-450). The cleaned parts were mounted on slides with gum-chloral medium. After the observation, some genitalia were remounted in Canada balsam.

### Abbreviations:

BF	brachypterous form
MF	macropterous form
BW	maximum width of body (metathorax of larva)
EL	elytral length along suture from scutellar base to elytral apices
EW	maximum width of elytra
HW	maximum width of head
PL	pronotal length along midline in dorsal view
PW	maximum width of pronotum
TL	total length of PL and EL

The elytral color patterns of most of the species of *Optioservus* are remarkably variable. Nine different color patterns are defined:

- F<sub>1</sub> elytra almost yellowish, except blackish along the outer margins
- F<sub>2</sub> elytra almost yellowish, except blackish along the sutural and outer margins
- F<sub>3</sub> elytra dark brown to black, with yellowish patches at humeral and apical areas
- F<sub>4</sub> elytra dark brown to black, with very small yellowish patches at humeral areas and yellowish patches at apical areas or yellowish patches at apical areas only
- F<sub>5</sub> elytra dark brown to black, with yellowish bands from humeral to apical areas
- F<sub>6</sub> elytra dark brown to black, with yellowish patches at humeral areas
- F<sub>7</sub> elytra entirely dark brown to black or very small yellowish patches at humeral areas
- F<sub>8</sub> elytra dark brown to black, with yellowish band along the suture and yellowish patches at humeral and apical area
- F<sub>9</sub> elytra dark brown to black, with three yellowish bands along the suture and around 4<sup>th</sup> to 5<sup>th</sup> striae

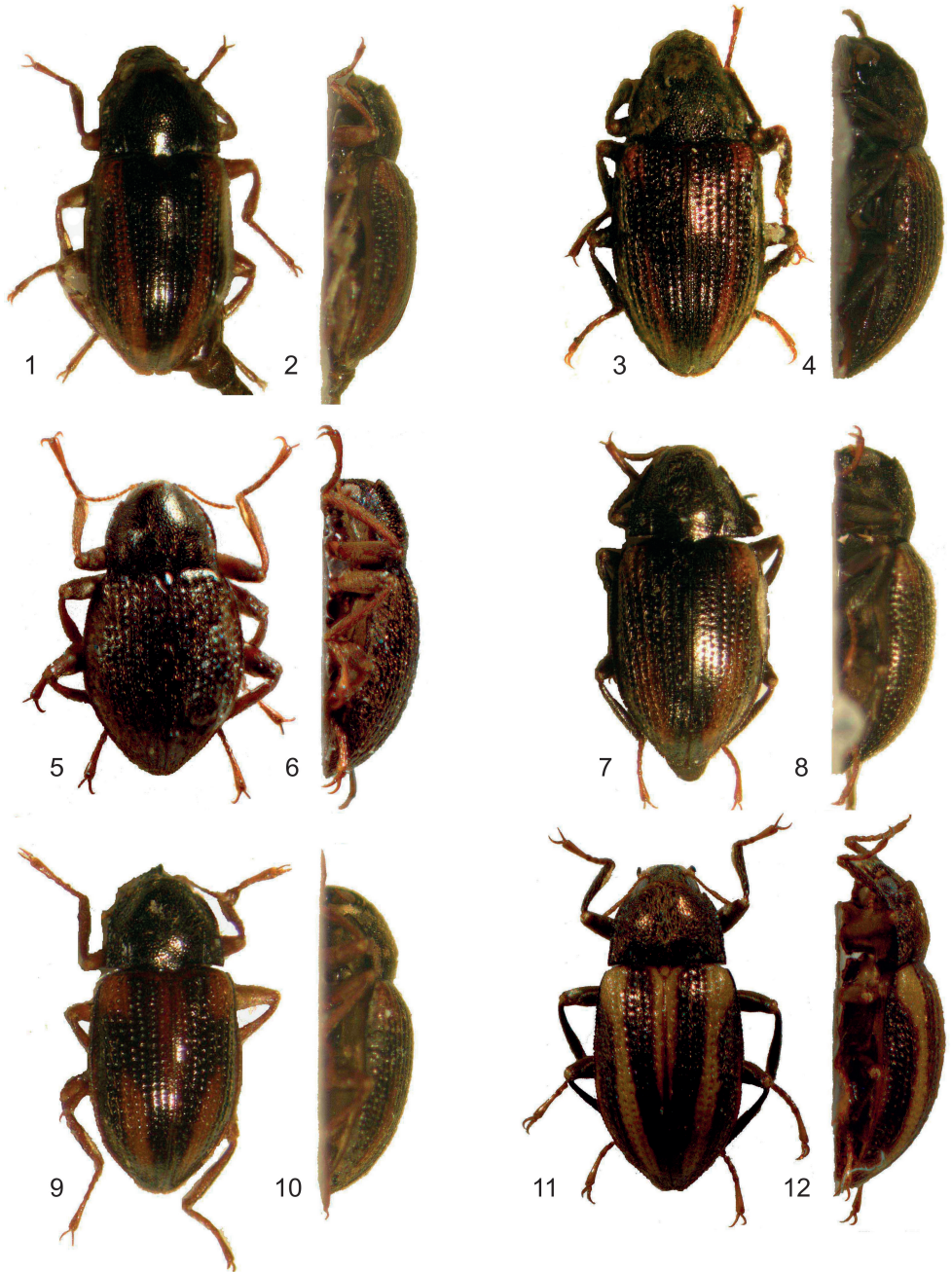
Four of these, F<sub>1</sub>, F<sub>2</sub>, F<sub>4</sub>, F<sub>7</sub>, are not represented in the Nearctic species. They are found only in the Asian fauna. Some of the specimens examined were not checked for color patterns, because they have been sputter coated with gold.

Type specimens and the material examined are deposited in the following collections:

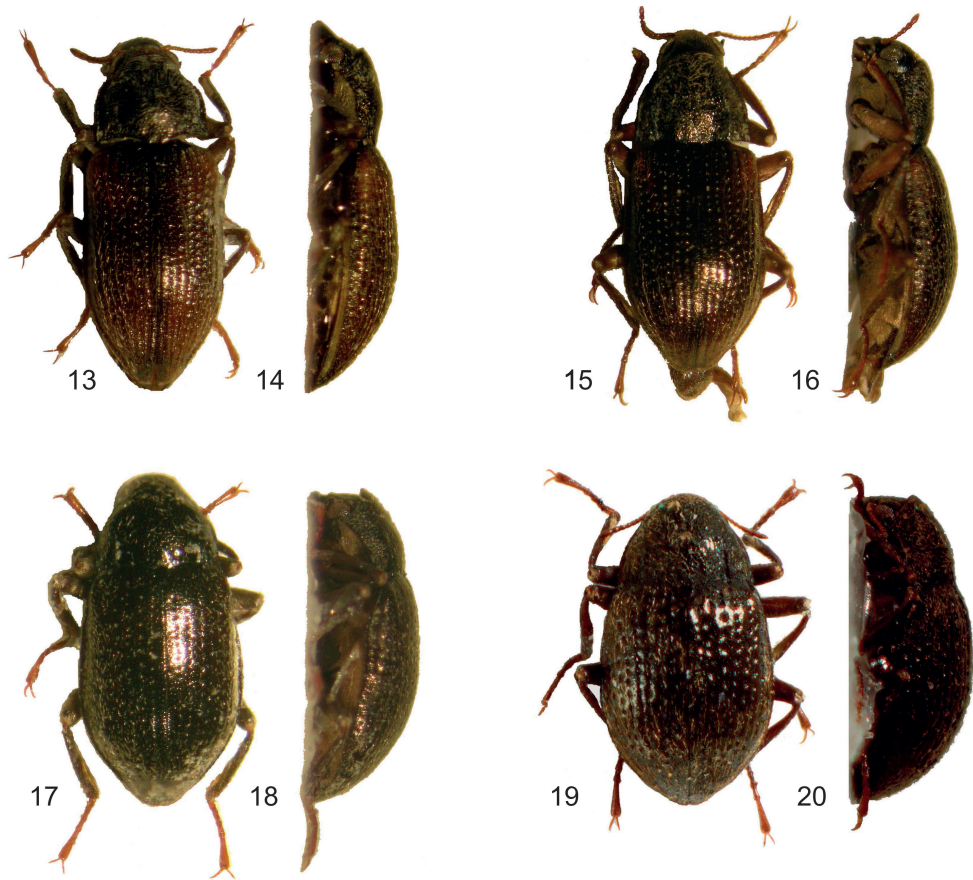
ANSP	Academy of Natural Sciences, Philadelphia, Pennsylvania, USA
CASC	California Academy of Sciences, San Francisco, California, USA
CKN	collection of Yuuki Kamite, Nagoya, Japan
CNCI	Canadian National Collection, Ottawa, Canada
EUMJ	Ehime University Museum, Matsuyama, Japan
INHS	The Illinois Natural History Survey, Illinois, USA
MCZC	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA
SMSH	Stovall Museum of Science and History, University of Oklahoma, Norman, USA
UM	Department of Entomology, University of Minnesota, St Paul, USA
USNM	U.S. National Museum of Natural History, Washington D.C., USA

Photographs of the type specimens deposited in the MCZC can be seen at <http://mcz-28168.oeb.harvard.edu/mcz/FMPro?-db=Species.fm&-lay=web&-format=search.htm&-view>.

The terminology generally follows KODADA & JÄCH (2005). The mean of the measurements is indicated in parenthesis after the ranges.



Figs. 1–12: Habitus of *Optioservus fastiditus* species group (adults); 1–2) *O. browni*; 1) dorsal view; 2) lateral view; 3–4) *O. fastiditus*; 3) dorsal view; 4) lateral view; 5–6) *O. immunis*; 5) dorsal view; 6) lateral view; 7–8) *O. ovalis*; 7) dorsal view; 8) lateral view; 9–10) *O. sandersoni*; 9) dorsal view; 10) lateral view; 11–12) *O. trivittatus*; 11) dorsal view; 12) lateral view.



Figs. 13–20: Habitus of *Optioservus quadrimaculatus* species group (adults); 13–14) *O. canus*; 13) dorsal view; 14) lateral view; 15–16) *O. castanipennis*; 15) dorsal view; 16) lateral view; 17–18) *O. divergens*; 17) dorsal view; 18) lateral view; 19–20) *O. heteroclitus*; 19) dorsal view; 20) lateral view.

### *Optioservus* SANDERSON, 1954

*Optioservus* SANDERSON 1953: 155 (key to Nearctic genera by adults, nomen nudum), 158 (key to Nearctic genera by larvae, nomen nudum), 1954: 8 (original description); COLLIER 1969: 19; BERTRAND 1972: 500; BROWN 1972: 43 (key to North American genera and species by adults), 63 (key to North American genera by larvae); BROWN & WHITE 1978: 1; WHITE 1978: 63; SATŌ 1992: 177; SHEPARD 1993: 5, 2002: 119 (key to American genera by adults); SATŌ & YOSHITOMI 2005: 637 (key to Japanese genera by larvae), 638 (key to Japanese genera by adults); WHITE & ROUGHLEY 2008: 636 (key to North American genera by larvae), 644 (key to North American genera by adults).

TYPE SPECIES: *Limnius trivittatus* BROWN, 1930 (by original designation).

REDESCRIPTION: **Adult.** Body elongate oval to oblong, convex dorsally. Plastron setae on gnae, hypomera, epipleura, lateral parts of prosternum, meso- and metaventrites and abdominal sterna except for a bare medial area.

Head slightly convex, retracted into prothorax. Clypeus and labrum separated, transverse, somewhat pubescent; antero-lateral corners of labrum densely pubescent. Antenna filiform (Fig. 37),

with 11 antennomeres; antennomeres 1 and 2 somewhat swollen. Mandible with three apical teeth (Fig. 38); mola dentate. Maxillary palpus with four palpomeres (Fig. 39), sparsely pubescent; 1<sup>st</sup>–3<sup>rd</sup> short, 4<sup>th</sup> long and slender; galea with two parts, sparsely pubescent; basigalea short. Labial palpus with three palpomeres (Fig. 41), sparsely pubescent; terminal palpomere large, longer than preceding segments combined; ligula umbrella-shaped, wider than mentum.



Figs. 21–26: Habitus of *Optioservus quadrimaculatus* species group (adults); 21–22) *O. phaeus*; 21) dorsal view; 22) lateral view; 23–24) *O. quadrimaculatus*; 23) dorsal view; 24) lateral view; 25–26) *O. seriatus*; 25) dorsal view; 26) lateral view.

Pronotum convex, wider than long, widest at base, narrower than elytra; anterior angles produced; lateral and posterior margins more or less sinuate, with sublateral carinae. Scutellum visible (Fig. 42), subtriangular, somewhat rounded at apex, but sometimes acute, devoid of punctures and setae.

Elytra convex dorsally, widest near middle, sparsely punctate and pubescent; with 10 punctate striae. Epipleura well developed, gradually narrowing from base to apex. Hind wings fully developed (MF, Fig. 43) or not fully developed (BF); in MF, radial cell incomplete, radius anterior (RA<sub>3+4</sub>) short, radius posterior long; radial cross-vein (r4) neither reaching RA<sub>3+4</sub> nor radius posterior (RP), RP connected with radio-medial cross-vein (rp-mp2), media posterior (MP<sub>1+2</sub>) distinct and long, medial spur long, nearly reaching margins, cubitus anterior (CuA) and anal anterior (AA) forming elongate cubito-anal cell, medial field with three free veins nearly

reaching margins (medial spur not included),  $MP_3$  and  $MP_4$  sometimes vestigial, cubitus anterior ( $CuA_{1+2}$ ) indistinct, anal posterior ( $AP_{3+4}$ ) unbranched, short, and apical field with two pigmented stripes (transformed  $RP_1$  and  $RP_2$ ).

Prosternum broad (Fig. 44), sparsely and finely punctate and pubescent; lateral carinae not reaching anterior margin; prosternal process almost as long as wide.

Mesoventrite transverse, sparsely and finely punctate and pubescent; middle of anterior part grooved, with a row of coarse punctures in front of mesocoxae, sometimes indistinct.

Metaventrite long and broad, sparsely and finely punctate and pubescent, longitudinal medial depression shallow or indistinct, with a row of coarse punctures posterior of mesocoxae and anterior of metacoxae.

Legs moderately long; pro- and mesocoxae nearly globular; metacoxae transverse; trochanters small, subtriangular; femora clavate, widest near the middle; tibiae gradually widening to apex, with setal fringe in ventral part; tarsomeres 1–4 short, subequal in length; tarsomere 5 almost as long as preceding tarsomeres combined; claws simple, with one subbasal tooth.

Abdomen with five ventrites (Fig. 45); medial bare area of ventrites 1–4 sparsely and finely punctate and pubescent; abdominal ventrite 1 with a row of coarse punctures posterior of metacoxae, sometimes indistinct; posterior margin of abdominal ventrite 3 and ventrite 4 with tooth. Tergite 8 pubescent with dense microtrichia.

Males. Sternite 8 with long and narrow apodeme (Fig. 47). Spiculum gastrale and segment 9 as in Fig. 46. Aedeagus trilobate type; penis symmetrical, longer than parameres, curved ventrad in lateral view; basolateral apophyse present; corona and fibula indistinct; endophallus developed, membranous; parameres developed, without projecting hooks; phallobase moderately large.

Females. Sternite 8 with long and broad apodome (Fig. 48). Ovipositor slender; valvifer longer than coxite; apico-lateral part of coxite produced outward; stylus short and curved outward.

**Larva.** Body elongate, subtriangular in cross section, surface with setiferous tubercles (Figs. 56–58).

Head subquadrate (Fig. 49), visible from above, with short front tooth. Antenna slender (Fig. 50), with three antennomeres; antennomere 1 short, wide; antennomere 2 longest, with sensorial appendage; antennomere 3 slender, almost as long as antennomere 1 or sensorial appendage. Labrum transverse (Fig. 51); with longer sensory hairs and tufted scales on dorsal surface. Mandible falciform or subtriangular, with three oblique apical teeth; prosthema well developed; mola absent. Maxilla slender (Fig. 52); cardo small, transverse; galea oval, shorter than lacinia; maxillary palpus with four palpomeres, almost as long as lacinia; palpomeres 1 and 2 short; palpomere 3 almost as long as preceding segments combined; terminal palpomere almost as long as palpomere 3. Labium slender (Fig. 52); prementum transverse; labial palpus with two palpomeres, short; basal palpomere almost as long as apical palpomere; ligula densely setose.

Thoraces wider than long, widest at base. Prothorax with seven ventral sclerites (Fig. 53); two anterior sclerites largest, transverse; two antero-lateral sclerites triangular; two postero-lateral sclerites subquadrate; one sclerite between coxae very small, arrowhead-shaped; postero-medial sclerite absent. Meso- and metathorax with three ventral sclerites (Fig. 54).

Legs robust; coxa largest, trapezoid; trochanter smallest, subtriangular; femur and tibia transverse, subequal in length.

Abdomen with pleural sclerites on segments 1–7 (Fig. 55); sclerites on segments 1–3 rectangular, subparallel; sclerites on segments 4–6 trapezoid, gradually narrowed to apex; sclerites on segment 7 subtriangular. Operculum pentagonal, reaching posterior margin.



Figs. 27–36: Habitus of *Optioservus* (larvae); 27–28) *O. fastiditus*; 27) dorsal view; 28) lateral view; 29–30) *O. sandersoni*; 29) dorsal view; 30) lateral view; 31–32) *O. canus*; 31) dorsal view; 32) lateral view; 33–34) *O. castanipennis*; 33) dorsal view; 34) lateral view; 35–36) *O. phaeus*; 35) dorsal view; 36) lateral view.

REMARKS: In adult features, this genus closely resembles *Heterlimnius* in general appearance, but is distinguishable from the latter by the following characteristics: radius posterior (RP) long (Fig. 43), only brachypterous form examined in *H. ater* (NOMURA), *O. castanipennis* (FALL) and *O. phaeus* WHITE; last three antennomeres relatively slender (Fig. 37); dorsal surface of head granulate or rugose except for the *O. fastiditus* species group where they are punctate as in *Heterlimnius*; ventrite 5 granulate or smooth except for the *O. fastiditus* species group where they are rugose as in *Heterlimnius*.

In larval features, this genus closely resembles *Heterlimnius* in general appearance, but is easily distinguishable by the number of ventral sclerites of meso- and metathorax. There are three sclerites in *Optioservus* (Fig. 54), while there are five in *Heterlimnius*.

### ***Optioservus fastiditus* species group**

*Optioservus browni* WHITE, *O. fastiditus* (LECONTE), *O. immunis* (FALL), *O. ovalis* (LECONTE), *O. sandersoni* COLLIER and *O. trivittatus* (BROWN).

This species group is characterized by the following features: head punctate (Fig. 61); abdominal ventrite 1 round; ventrite 5 rugose (Fig. 63); phallobase smooth at lateral and ventral surface.

#### **Key to the species (adults) of the *Optioservus fastiditus* species group**

- |   |  |                    |
|---|--|--------------------|
| 1 | Apical part of penis slender in lateral view (Fig. 80). Body larger, TL more than 2.90 mm.....   | <i>fastiditus</i>  |
| – | Apical part of penis somewhat dilated in lateral view. Body smaller, TL less than 2.75 mm.....   | 2                  |
| 2 | Elytra immaculate (Fig. 5). Apex of intercoxal process of abdominal ventrite 1 clearly rounded...  | <i>immunis</i>     |
| – | Elytra maculate. Apex of intercoxal process of abdominal ventrite 1 less rounded.....  | 3                  |
| 3 | Legs reddish brown .....   | 4                  |
| – | Legs blackish brown, except reddish brown at tarsi.....  | 5                  |
| 4 | Elytra without sutural yellowish band (Fig. 1); strial punctures of 1 <sup>st</sup> and 2 <sup>nd</sup> striae relatively small and shallow (Fig. 65).....   | <i>browni</i>      |
| – | Elytra usually with sutural yellowish band (Fig. 9); strial punctures of 1 <sup>st</sup> and 2 <sup>nd</sup> striae relatively large and deep (Fig. 69)..... | <i>sandersoni</i>  |
| 5 | Elytra without sutural yellowish band (Fig. 7). Apex of abdominal ventrite 5 without spinulate setae. Body larger, TL 2.40–2.75 mm .....                     | <i>ovalis</i>      |
| – | Elytra with sutural yellowish band (Fig. 11). Apex of abdominal ventrite 5 with spinulate setae. Body smaller, TL 2.16–2.42 mm.....                          | <i>trivittatus</i> |

### ***Optioservus browni* WHITE, 1978** (Figs. 1–2, 65, 77–78)

*Optioservus browni* WHITE 1978: 64 (type locality: USA, Arkansas, Montgomery County, above Albert Pike Campground; type material: Holotype ♂, USNM, and 30 paratypes, INHS, MCZC, SSMH, USNM, not examined); BROWN 1983: 7.

MATERIAL EXAMINED: USA: 3 exs. (CKN): “Arkansas, Polk county, Board Camp Creek, R29W, T3S, SE, Sec. 22, 5–IX–1983, C. B. Barr, *Optioservus browni* C. B. Barr 1985”.



**REDESCRIPTION: Adult.** TL/EW 2.03–2.07 (2.05). Dorsal surface black, but elytra dark brown to black, with yellowish humeral patches connected to apical patches. Ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and legs paler.

Head almost flat on dorsal surface, punctate and pubescent. Eyes moderate in size; the distance between eyes about 1.25 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.8 : 2.0 : 1.8 : 1.0 : 1.0 : 1.0 : 1.0 : 1.7 : 1.7 : 3.5. Labrum transverse, about 1.91 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners moderately produced anteriorly. PW/PL 1.37; sublateral carinae 0.30 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin clearly serrate; intervals less rugose, not convex; punctate striae oblique; strial punctures of 1<sup>st</sup> and 2<sup>nd</sup> striae relatively small and shallow; 3<sup>rd</sup> stria with scattered large and small punctures, large punctures deep; 4<sup>th</sup> to 10<sup>th</sup> striae with large and deep punctures; basal part of 4<sup>th</sup> interval wider than 3<sup>rd</sup> or subequal in width (Fig. 65); EL/EW 1.46–1.49 (1.48); EL/PL 2.54–2.55 (2.55); EW/PW 1.25–1.28 (1.27).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Abdominal ventrite 5 rugose; slightly emarginated and with spinulate setae.

Aedeagus as illustrated (Figs. 77–78); phallobase smooth at lateral and ventral surface; penis about 1.31 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 78); parameres slender, about 0.82 times as long as penis.

**MEASUREMENTS** (n = 2): TL 2.30 and 2.31 mm; PL 0.65 mm; PW 0.89 mm; EL 1.65 and 1.66 mm; EW 1.11 and 1.14 mm.

**DISTRIBUTION:** USA (Arkansas).

**DIFFERENTIAL DIAGNOSIS:** This species resembles *O. sandersoni* in general appearance, but is distinguishable from the latter by the following characteristics: elytra without yellowish sutural band (Fig. 1); punctures of elytral 1<sup>st</sup> and 2<sup>nd</sup> striae relatively small and shallow (Fig. 65).

### ***Optioservus fastiditus* (LECONTE, 1850)**

(Figs. 3–4, 27–28, 66, 79–80, 101)

*Limnius fastiditus* LECONTE 1850: 217 (type locality: Canada, Ontario, Lake Superior, Maple Island; type material: Holotype ♂, MCZC, type number 2275, only photograph examined).

*Elmis fastiditus*: HORN 1870: 36.

*Optioservus fastiditus*: SANDERSON 1954: 11; COLLIER 1969: 37; BROWN 1972: 45 (key to genera and species by adults); WHITE 1978: 67; BROWN 1983: 8.

**MATERIAL EXAMINED: Adults.** USA: 2 exs. (1 F<sub>3</sub>, 1 F<sub>5</sub>; CKN, EUMJ): “Minn: Otter Tail Co., 6 mi SW Wadena, 14.V.1978, In stream, On submerged stones, William D. Shepard, leg., *Optioservus fastiditus* W. D. Shepard 1978”; 3 exs. (1 F<sub>5</sub>; CKN): “Illinois, Winnebago Co., 12 mi N Rockford, 23.V.1982, unnamed stream, WDS–A–118, William D. Shepard, leg., *Optioservus fastiditus* W. D. Shepard”. CANADA: 10 exs. (2 F<sub>5</sub>; CKN): “near Guelph, Ontario, 27.V.2006, M. Hayashi leg.”. **Larvae.** USA: 2 mature larvae and 1 immature larva (CKN): “Illinois, Winnebago Co., 12 mi N Rockford, 23.V.1982, unnamed stream, WDS–A–118, William D. Shepard, leg., *Optioservus fastiditus* W. D. Shepard”.

**REDESCRIPTION: Adult.** TL/EW 2.05–2.15 (2.10). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and tarsi paler. Color variation of elytra showing F<sub>3</sub> or F<sub>5</sub>.

Head almost flat on dorsal surface, punctate and pubescent. Eyes moderate in size; the distance between eyes about 1.29 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.6 : 2.0 : 1.8 : 1.0 : 1.0 : 1.0 : 1.0 : 1.6 : 1.8 : 3.0. Clypeus transverse, about 2.49 times as wide as long. Labrum transverse, about 1.88 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners moderately produced anteriad. PW/PL 1.25–1.59 (1.39); sublateral carinae 0.26–0.34 (n = 2) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; stria punctures of each stria relatively large and deep; basal part of 4<sup>th</sup> interval slightly wider than 3<sup>rd</sup> (Fig. 66); EL/EW 1.48–1.57 (1.53); EL/PL 2.46–3.20 (2.74); EW/PW 1.27–1.31 (1.29).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Abdominal ventrite 5 rugose; apex evenly rounded and with long hairs.

Aedeagus as illustrated (Figs. 79–80); phallobase smooth at lateral and ventral surface; penis about 1.55 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat pointed, lateral view of apical part slender and slightly curved ventrad (Fig. 80); parameres slender, about 0.77 times as long as penis.

MEASUREMENTS (n = 4): TL 2.90–3.08 (3.02) mm; PL 0.69–0.89 (0.81) mm; PW 1.10–1.13 (1.12) mm; EL 2.19–2.23 (2.21) mm; EW 1.41–1.48 (1.44) mm.

DESCRIPTION: **Larva.** Body cylindrical; TL/BW 6.08. Color dark brown. Head about 1.16 times as wide as long; dorsal surface with widely setiferous tubercles; each tubercle relatively large. Mandible (Fig. 101) subtriangular, 1.33 times as long as wide. Lacinia elongate oval. Labrum about 2.03 times as wide as long. Lateral margin of each thoracic segment with developed setae. Pronotum slightly wider than long; PW/PL 1.45, not humped in mid-dorsal view. Abdomen not humped in mid-dorsal view; abdominal segment 9 not keeled in sublateral view.

MEASUREMENTS (n = 1): TL 6.63 mm; HW 0.49 mm; PL 0.67 mm; PW 0.97 mm; BW 1.09 mm.

DISTRIBUTION: USA (eastern states), Canada (eastern provinces).

DIFFERENTIAL DIAGNOSIS: In adult features, this species resembles *O. ovalis* in general appearance, but is distinguishable from the latter by the following characteristics: body large; apical part of penis slender in lateral view (Fig. 80). In larval features, this species resembles *O. sandersoni* in general appearance, but is distinguishable from the latter by the larger body and head.

***Optioservus immunis* (FALL, 1925)**  
(Figs. 5–6, 67, 81–82)

*Helmis immunis* FALL 1925: 178 (type locality: Stratford, Connecticut, USA; type material: Holotype ♂, MCZC, type number 24461, only photograph examined).

*Optioservus immunis*: SANDERSON 1954: 11; COLLIER 1969: 42; BROWN 1972: 44 (key to genera and species by adults); WHITE 1978: 69; BROWN 1983: 8.

*Limnius cryophilus* MUSGRAVE 1932: 78 (type locality: Tennessee, Greenbriar, Great Smoky Mountains, USA; type material: Holotype ♂, USNM, not examined); COLLIER 1969: 39; BROWN 1972: 44 (key to genera and species by adults); WHITE 1978: 69 (synonymy).

**MATERIAL EXAMINED:** **Adults.** USA: 2 exs. (CKN, EUMJ): “GA: Habersham Co., 4 mi E Punnerville, 26.V.1984, unnamed creek, WDS–A–266, William D. Shepard, leg., *Optioservus immunis* W. D. Shepard 1985”; 4 exs. (EUMJ): “South of Brevard, Williamson Creek, Transylvania Co., N. Carolina, U.S.A., Aug., 17, 1976, M. Sato leg.”

**REDESCRIPTION:** **Adult.** TL/EW 1.85–1.91 (1.88). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae, tibiae and tarsi paler.

Head almost flat on dorsal surface, punctate and pubescent. Eyes somewhat small in size; the distance between eyes about 1.30 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.7 : 2.0 : 1.8 : 1.0 : 1.0 : 1.0 : 1.1 : 1.0 : 1.6 : 1.6 : 3.1. Clypeus transverse, about 2.83 times as wide as long. Labrum transverse, about 2.09 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners moderately produced anteriorly. PW/PL 1.23–1.43 (1.35); sublateral carinae 0.28 (n = 1) times as long as PL.

Elytra oval; slightly convex; lateral margin clearly serrate; intervals less rugose, not convex; punctate striae oblique; strial punctures of basal part large and apical part small; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width (Fig. 67); EL/EW 1.31–1.36 (1.34); EL/PL 2.22–2.61 (2.48); EW/PW 1.32–1.47 (1.37).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Apex of intercoxal process of abdominal ventrite 1 clearly rounded. Abdominal ventrite 5 rugose; apex evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 81–82); phallobase smooth at lateral and ventral surface; penis relatively slender, about 1.80 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat pointed, curved ventrad in lateral view (Fig. 82); parameres slender, about 0.70 times as long as penis.

**MEASUREMENTS** (n = 6): TL 1.69–2.16 (1.92) mm; PL 0.50–0.64 (0.55) mm; PW 0.65–0.79 (0.74) mm; EL 1.19–1.56 (1.37) mm; EW 0.89–1.16 (1.02) mm.

**DISTRIBUTION:** USA (eastern states).

**DIFFERENTIAL DIAGNOSIS:** This species resembles *O. trivittatus* in general appearance, but is distinguishable from the latter by the following characteristics: body small; elytra immaculate (Fig. 5); apex of intercoxal process of abdominal ventrite 1 clearly rounded.

### ***Optioservus ovalis* (LECONTE, 1863)**

(Figs. 7–8, 68, 83–84)

*Limnius ovalis* LECONTE 1863: 74 (type locality: USA, Pennsylvania; type material: Holotype ♂, MCZC, type number 2276, only photograph examined).

*Heterlimnius ovalis*: HINTON 1935: 178.

*Optioservus ovalis*: SANDERSON 1954: 11; COLLIER 1969: 44; BROWN 1972: 45 (key to genera and species by adults); WHITE 1978: 69; BROWN 1983: 8.

*Helmis ampliatus* FALL 1925: 179 (type locality: Massachusetts, Lowell, USA; type material: Holotype ♀, MCZC, type number 24456, only photograph examined); COLLIER 1969: 28; BROWN 1972: 45 (key to genera and species by adults); WHITE 1978: 69 (synonymy).

**MATERIAL EXAMINED:** **Adults.** USA: 4 exs. (1 F<sub>3</sub>, CKN): “Alabama: Blount Co., 1 mi W Blount Springs, 29.V.1984, Murphy Creek, William D. Shepard, leg., *Optioservus ovalis* W. D. Shepard”; 3 exs. (1 F<sub>3</sub>; CKN): ditto but: “16.V.2006 530”, WDS–A–1668, William D. Shepard, leg., *Optioservus ovalis* W. D. Shepard”; 1 ex. (F<sub>3</sub>; CKN): “MD: Frederick Co., Walkersville, 28.IX.1973, Muddy Run, William D. Shepard, leg., *Optioservus ovalis*

W. D. Shepard"; 1 ex. (F<sub>3</sub>; EUMJ): ditto but: "8.X.1973, William D. Shepard, leg., *Optioservus ovalis* W. D. Shepard"; 2 exs., "ILLINOIS, Pope Co., 3 mi S Glendale, 18.V.2006 650', unnamed stream, William D. Shepard, leg., *Optioservus ovalis* W. D. Shepard"; 22 exs. (10 F<sub>3</sub>, 12 F<sub>5</sub>; EUMJ): "North of Unicoi, Unicoi Co., Tennessi, U. S. A., Aug, 18, 1976, M. Sato leg."; 1 ex. (F<sub>3</sub>; EUMJ): "South of Flag Pond, Cherokee Nat. Park, Unicoi Co., Tennessi, U. S. A., Aug, 18, 1976, M. Sato leg."; 11 exs. (10 F<sub>3</sub>; EUMJ): "South of Brevard, Williamson Creek, Transylvania Co., N. Carolina, U. S. A., Aug, 17, 1976, M. Sato leg."; 9 exs. (F<sub>3</sub>; EUMJ): "Trimble, Cullman Co., Alabama, USA, 14–VIII–1976, M. Sato leg.".

**REDESCRIPTION: Adult.** TL/EW 1.89–2.10 (2.00). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and tarsi paler. Color variation of elytra showing F<sub>3</sub> or F<sub>5</sub>.

Head almost flat on dorsal surface, punctate and pubescent. Eyes moderate in size; the distance between eyes about 1.21 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.7 : 1.9 : 1.7 : 1.0 : 1.0 : 1.0 : 1.0 : 1.7 : 1.7 : 3.1. Clypeus transverse, about 2.71 times as wide as long. Labrum transverse, about 2.03 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners moderately produced anteriorly. PW/PL 1.33–1.63 (1.45); sublateral carinae 0.30 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin clearly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; stria punctures of each stria relatively large and deep; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width (Fig. 68); EL/EW 1.41–1.53 (1.46); EL/PL 2.46–2.98 (2.69); EW/PW 1.23–1.38 (1.28).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of meso-ventral groove relatively narrow. Abdominal ventrite 5 rugose; slightly emarginated and with long hairs.

Aedeagus as illustrated (Figs. 83–84); phallobase smooth at lateral and ventral surface; penis about 1.61 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat pointed, curved ventrad in lateral view (Fig. 84); parameres slender, about 0.83 times as long as penis.

**MEASUREMENTS** (n = 21): TL 2.40–2.75 (2.53) mm; PL 0.64–0.73 (0.69) mm; PW 0.89–1.06 (0.99) mm; EL 1.75–2.02 (1.85) mm; EW 1.17–1.37 (1.27) mm.

**DISTRIBUTION:** USA (eastern states), Canada (eastern provinces).

**DIFFERENTIAL DIAGNOSIS:** This species resembles *O. trivittatus* in general appearance, but is distinguishable from the latter by the following characteristics: body large; elytra without sutural band yellowish (Fig. 7); apex of abdominal ventrite 5 without spinulate setae.

***Optioservus sandersoni* COLLIER, 1972**  
(Figs. 9–10, 29–30, 69, 85–86, 102, 106, 110)

*Optioservus sandersoni* COLLIER in BROWN 1972: 18 (type locality: Washington Co., USA, Arkansas; type material: Holotype ♂ and 3 paratypes, INHS, not examined); BROWN 1972: 44 (key to genera and species by adults); WHITE 1978: 71.

*Optioservus ozarkensis* COLLIER in BROWN 1972: 17 (type locality: Missouri, Roaring River State Park, USA; type material: Holotype ♂ UM, not examined); BROWN 1972: 44 (key to genera and species by adults); WHITE 1978: 71 (synonymy); BROWN 1983: 8.

**MATERIAL EXAMINED: Adults.** USA: 1 ex. (1 F<sub>8</sub>; CKN): "OK: Cherokee Co., 5 mi S Peggs, 8.X.1977, Blackbird Creek, On submerged stones, William D. Shepard, leg., *Optioservus sandersoni* W. D. Shepard"; 3 exs. (1 F<sub>3</sub>; CKN): "OK: Adair Co., Bitting Springs, 5.IX.1975, William D. Shepard, leg., *Optioservus sandersoni* W. D.

Shepard"; 1 ex. (1 F<sub>8</sub>; CKN): "Oklahoma, 6 mi W Oaks, 26.V.1986, E. A. Bergey, *Optioservus sandersoni* W. D. Shepard 1986". **Larvae.** USA: 3 mature larvae (CKN), "OK: Adair Co., Biting Springs, 5.IX.1975, William D. Shepard, leg., *Optioservus sandersoni* W. D. Shepard".

**REDESCRIPTION: Adult.** TL/EW 2.04–2.08 (2.06). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and legs paler. Color variation of elytra showing F<sub>3</sub>, F<sub>8</sub> or F<sub>9</sub>.

Head almost flat on dorsal surface, punctate and pubescent. Eyes moderate in size; the distance between eyes about 1.25 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.6 : 2.0 : 1.8 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.5 : 1.5 : 2.9. Clypeus transverse, about 2.47 times as wide as long. Labrum transverse, about 1.94 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners moderately produced anteriad. PW/PL 1.33–1.44 (1.38); sublateral carinae 0.33 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin weakly serrate; intervals less rugose, not convex; punctate striae oblique; strial punctures of each stria relatively large and deep; basal part of 4<sup>th</sup> interval wider than 3<sup>rd</sup> or subequal in width (Fig. 69); EL/EW 1.47–1.50 (1.49); EL/PL 2.59–2.69 (2.63); EW/PW 1.25–1.29 (1.28).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Abdominal ventrite 5 rugose; slightly emarginated and with spinulate setae.

Aedeagus as illustrated (Figs. 85–86); phallobase smooth at lateral and ventral surface; penis about 1.42 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 86); parameres slender, about 0.69 times as long as penis.

**MEASUREMENTS** (n = 3): TL 2.48–2.63 (2.58) mm; PL 0.69–0.73 (0.71) mm; PW 0.92–1.02 (0.98) mm; EL 1.79–1.91 (1.87) mm; EW 1.19–1.29 (1.25) mm.

**DESCRIPTION: Larva.** Body cylindrical; TL/BW 5.37–6.19 (5.78). Color dark brown, antennae, mouth parts and legs somewhat paler. Head about 1.04 times as wide as long; dorsal surface with widely spaced setiferous tubercles; each tubercle relatively large. Mandible (Fig. 102) subtriangular, 1.39 times as long as wide. Lacinia elongate oval. Lateral margin of each thoracic segment with developed setae. Pronotum slightly wider than long; PW/PL 1.43–1.49 (1.46), not humped in mid-dorsal view. Abdomen not humped in mid-dorsal view; abdominal segment 9 not keeled in sublateral view and posterior margin slightly concave (Figs. 106, 110).

**MEASUREMENTS** (n = 2): TL 5.42 and 6.00 mm; HW 0.43 mm; PL 0.59 and 0.60 mm; PW 0.86 and 0.88 mm; BW 0.97 and 1.01 mm.

**DISTRIBUTION:** USA (eastern states).

**DIFFERENTIAL DIAGNOSIS:** In adult features, this species resembles *O. browni* in general appearance, but is distinguishable from the latter by the following characteristics: elytra usually with sutural band yellowish (Fig. 9); punctures of 1<sup>st</sup> and 2<sup>nd</sup> elytral striae relatively large and deep (Fig. 69). In larval features, this species resembles *O. fastiditus* in general appearance, but is distinguishable from the latter by the smaller size of body and head.

***Optioservus trivittatus* (BROWN, 1930)**  
(Figs. 11–12, 59, 61, 63, 70, 87–88)

*Limnius trivittatus* BROWN 1930: 91 (type locality: Knowlton, Quebec, Canada; type material: Holotype ♂, CNCI, type number 3077, not examined).

*Heterlimnius trivittatus*: HINTON 1935: 178.

*Optioservus trivittatus*: SANDERSON 1954: 11; COLLIER 1969: 26; BROWN 1972: 44 (key to genera and species by adults); WHITE 1978: 72; BROWN 1983: 9.

MATERIAL EXAMINED: **Adults.** USA: 42 exs. (CKN): "OHIO, Jefferson County, Richmond, small run entering lake in Jefferson St. Pk., Aug., 30, 1941, P. N. Musgrave leg., COLL'N P. N. Musgrave [INHS] (Illinois Natural History Survey), *Optioservus trivittatus* (W. J. Bro.) det. H. G. Nelson 1975"; 2 exs. (CKN): "MD: Frederick Co., Walkersville, 8.X.1973, Muddy Run, On submerged gravel, William D. Shepard, leg., *Optioservus trivittatus* W. D. Shepard"; 1 ex. (CKN): "MD: Fred Co., Creagerstown, 27.VI.1973, Hunting Crk., On aquatic vegetation, William D. Shepard, leg., *Optioservus trivittatus* W. D. Shepard"; 1 ex. (CKN), "MD: Fred Co., Middletown, 7.V.1974, Catoctin Crk., On submerged stone, William D. Shepard, leg., *Optioservus trivittatus* W. D. Shepard"; 1 ex. (EUMJ): "South of Brevard, Williamson Creek, Transylvania Co., N. Carolina, U.S.A., Aug., 17, 1976, M. Sato leg."; 2 exs. (EUMJ): "S. of Dixie Caverns, Roanoke Co., Virginia, U.S.A., Aug., 19, 1976, M. Sato leg."; 12 exs. (CKN): "USA: New York: Tompkins County, nr. Ithaca, Rt. 13 at Fall Creek, 16.vi.2007, A. E. Z. Short, leg."; 17 exs. (CKN), ditto but: "30.vi.2007, A. E. Z. Short, leg.".

REDESCRIPTION: **Adult.** TL/EW 1.96–2.04 (2.00). Dorsal surface black, but elytra dark brown to black, with three yellowish bands along the suture and around 4<sup>th</sup> to 5<sup>th</sup> striae. Ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and tarsi paler.

Head almost flat on dorsal surface, punctate and pubescent. Eyes moderate in size; the distance between eyes about 1.23 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.7 : 2.0 : 1.8 : 1.0 : 1.0 : 1.0 : 1.0 : 1.6 : 1.6 : 3.1. Clypeus transverse, about 2.60 times as wide as long. Labrum transverse, about 2.08 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without longitudinal median impression; without prescutellar pits; antero-lateral corners moderately produced anteriad. PW/PL 1.40–1.51 (1.47); sublateral carinae 0.32–0.34 (n = 2) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin clearly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; strial punctures of each stria relatively large and deep; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width (Fig. 70); EL/EW 1.43–1.49 (1.46); EL/PL 2.68–2.78 (2.72); EW/PW 1.25–1.29 (1.27).

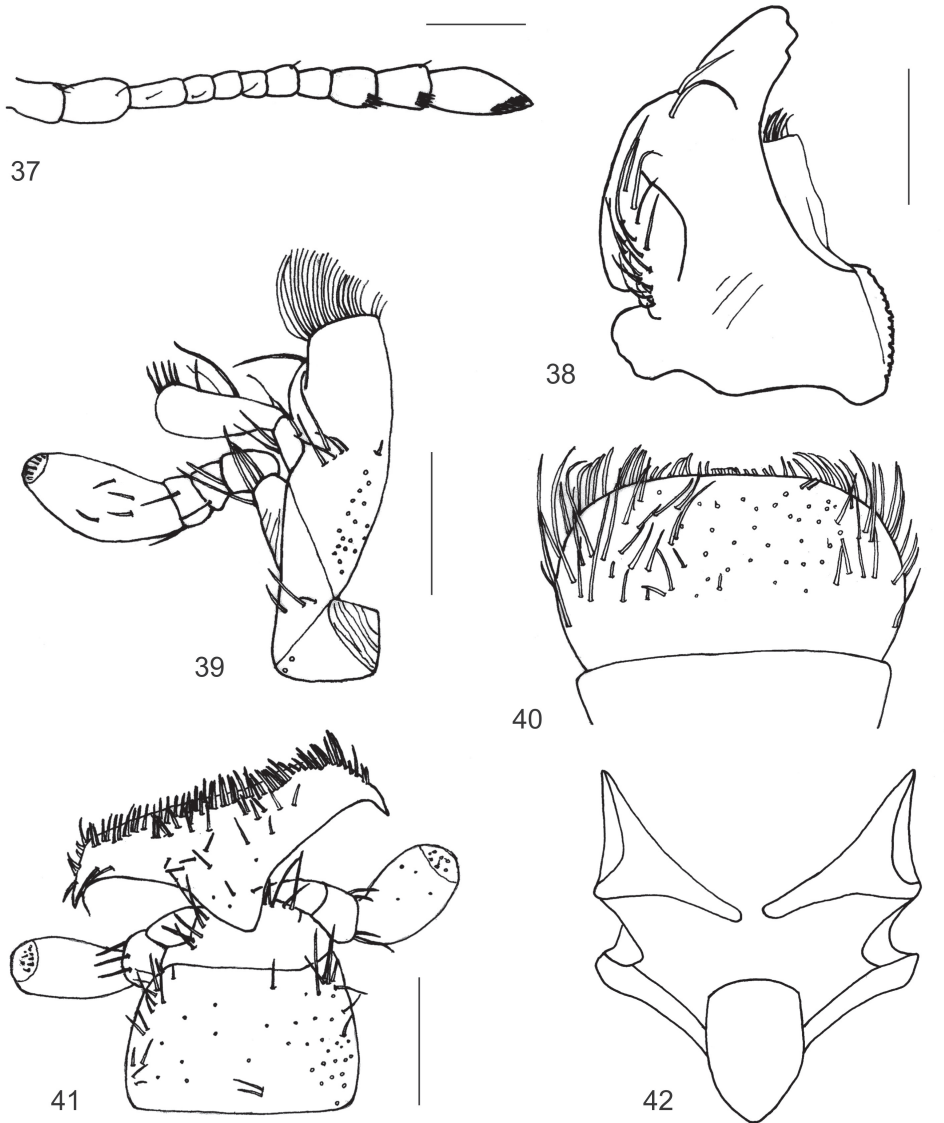
Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Abdominal ventrite 5 rugose; slightly emarginated and with spinulate setae (Fig. 63).

Aedeagus as illustrated (Figs. 87–88); phallobase smooth at lateral and ventral surface; penis about 1.35 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 88); parameres slender, about 0.74 times as long as penis.

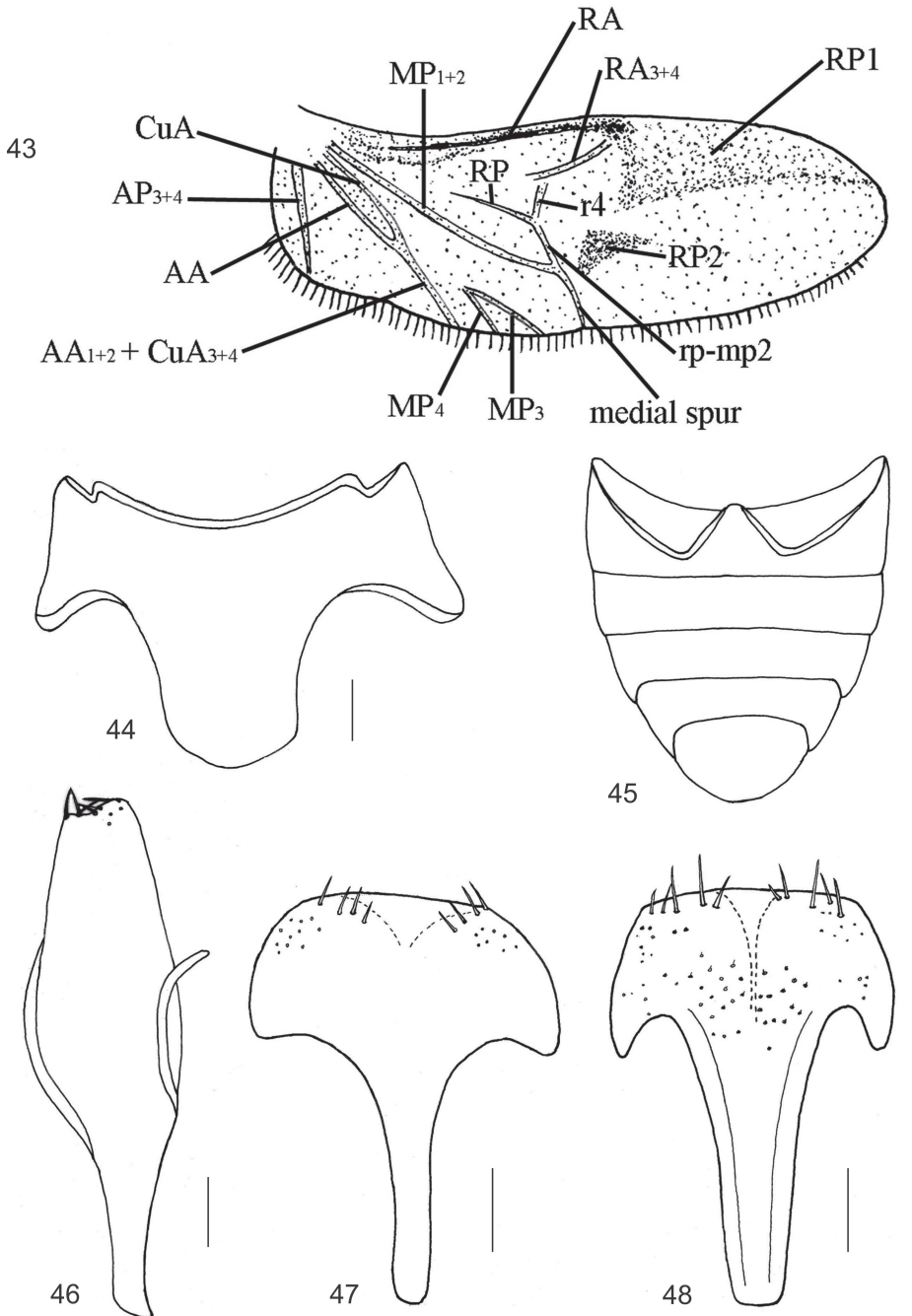
MEASUREMENTS (n = 5): TL 2.16–2.42 (2.26) mm; PL 0.58–0.64 (0.61) mm; PW 0.85–0.96 (0.89) mm; EL 1.58–1.78 (1.65) mm; EW 1.06–1.23 (1.13) mm.

DISTRIBUTION: USA (eastern states), Canada (eastern provinces).

DIFFERENTIAL DIAGNOSIS: This species resembles *O. ovalis* in general appearance, but is distinguishable from the latter by the following characteristics: body small; elytra with yellowish sutural band (Fig. 11); apex of abdominal ventrite 5 with spinulate setae (Fig. 63).

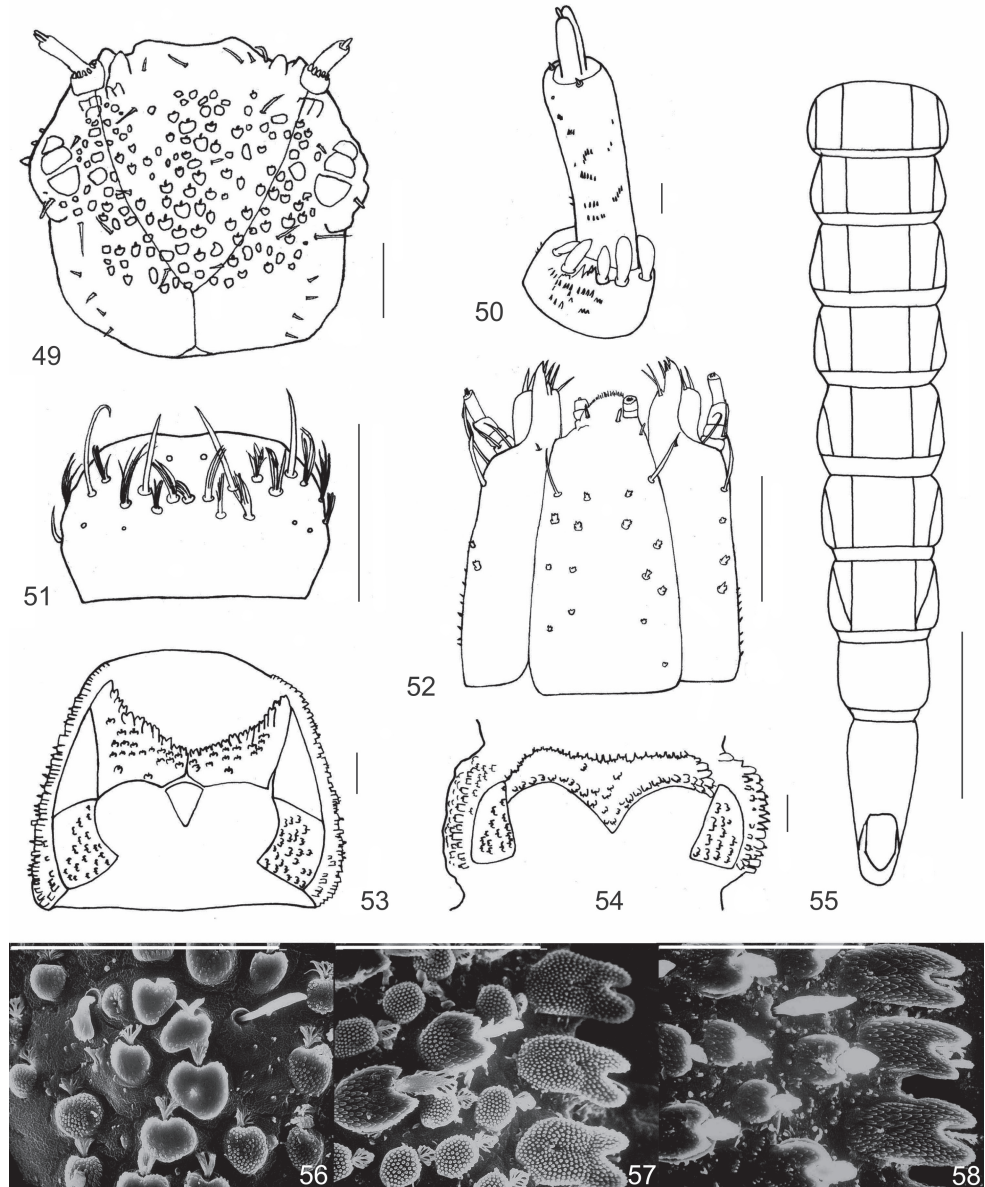


Figs. 37–42: *Optioservus* sp. (adults); 37) antenna; 38) mandible; 39) maxilla; 40) labrum; 41) labium; 42) mesonotum. Scales: 100  $\mu$ m.

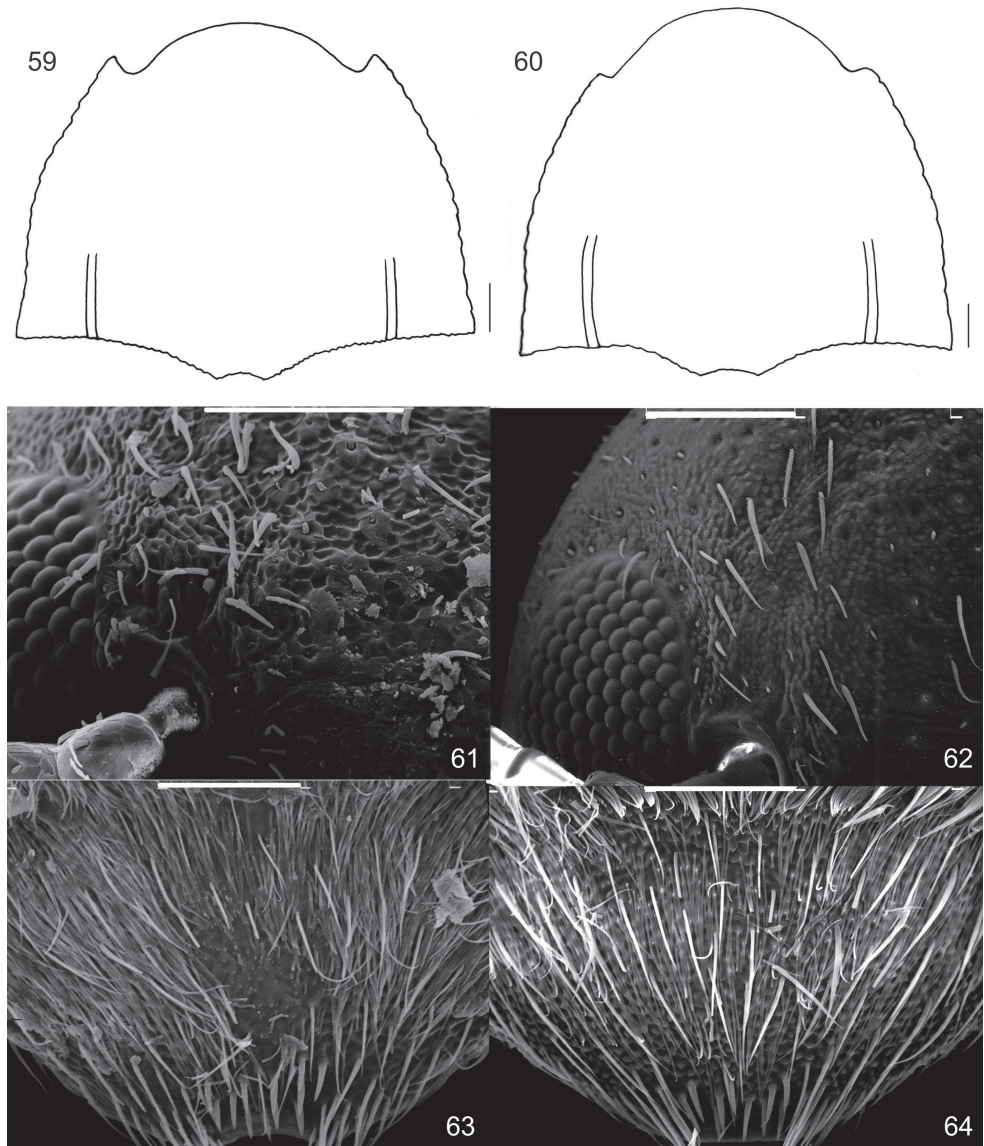


Figs. 43–48: *Optioservus* sp. (adults); 43) hind wing; AA: Anal anterior; AP: Anal posterior; CuA: Cubitus anterior; MP: Media posterior; r4: radial cross-vein; rp-mp2: radio-medial cross-vein; RA: Radius anterior; RP: Radius posterior; 44) prosternum; 45) abdomen; 46) spiculum gastrale and segment 9; 47) sternite 8, male; 48) sternite 8, female. Scales: 44, 46–48: 100  $\mu$ m; 43, 45: 1.0 mm.

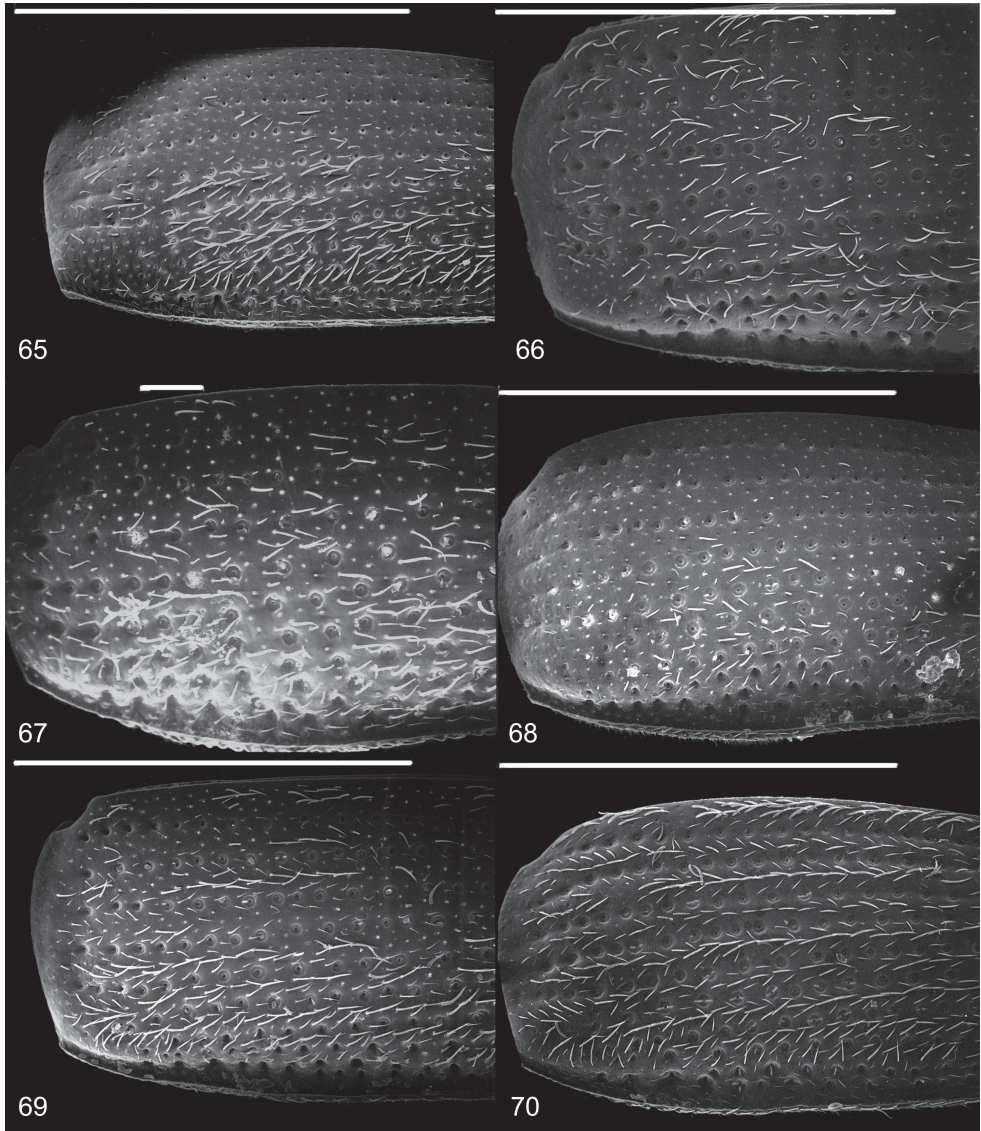




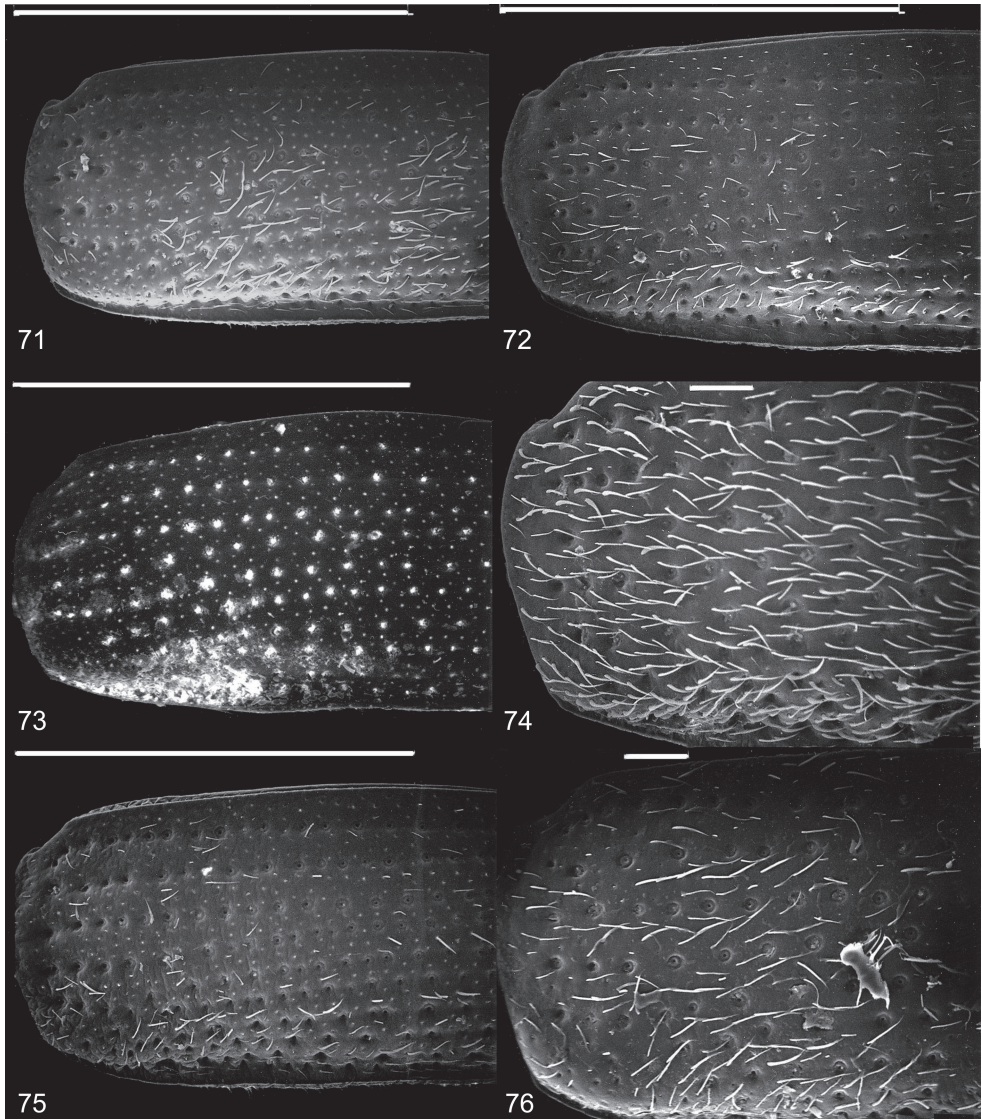
Figs. 49–58: *Optioservus variabilis* (larvae); 49) head; 50) antenna; 51) labrum; 52) maxilla and labium; 53) prothorax, ventral view; 54) mesothorax, ventral view; 55) abdomen, ventral view; 56) head, detail of central area; 57) abdominal tergite 4, detail of apical area; 58) abdominal sternite 4, detail of apical area. Scales: 50: 10  $\mu$ m; 49, 51–54, 56–58: 100  $\mu$ m; 55: 1.0 mm.



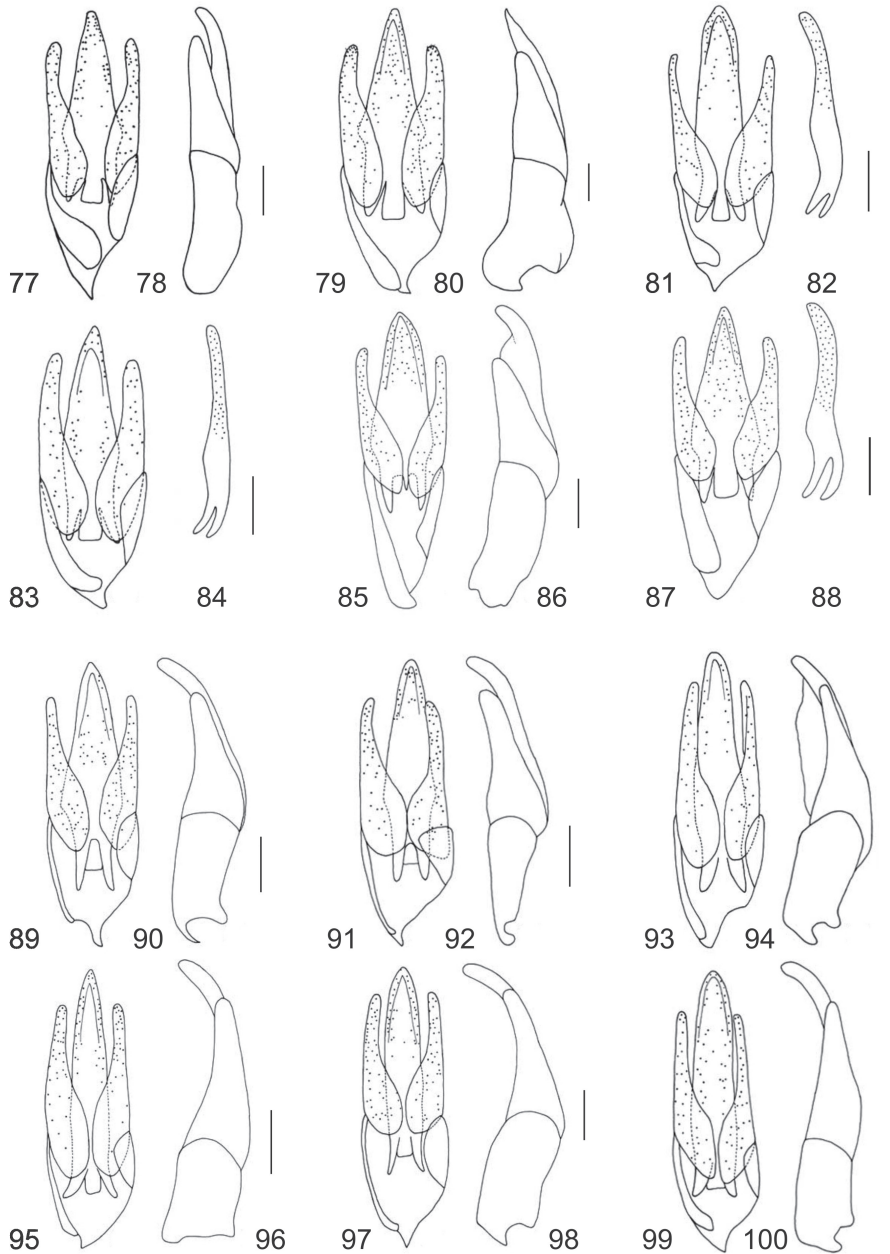
Figs. 59–64: Pronotum (59–60), head (61–62) and abdominal ventrite 5 (63–64) (adults); 59, 61, 63) *O. trivittatus*; 60) *O. castanipennis*; 62) *O. phaeus*; 64) *O. heteroclitus*. Scales: 100  $\mu$ m.



Figs. 65–70: Left elytron, anterior; 65) *O. browni*; 66) *O. fastiditus*; 67) *O. immunis*; 68) *O. ovalis*; 69) *O. sandersoni*; 70) *O. trivittatus*. Scales: 67: 100  $\mu$ m; 65–66, 68–70: 1.0 mm.

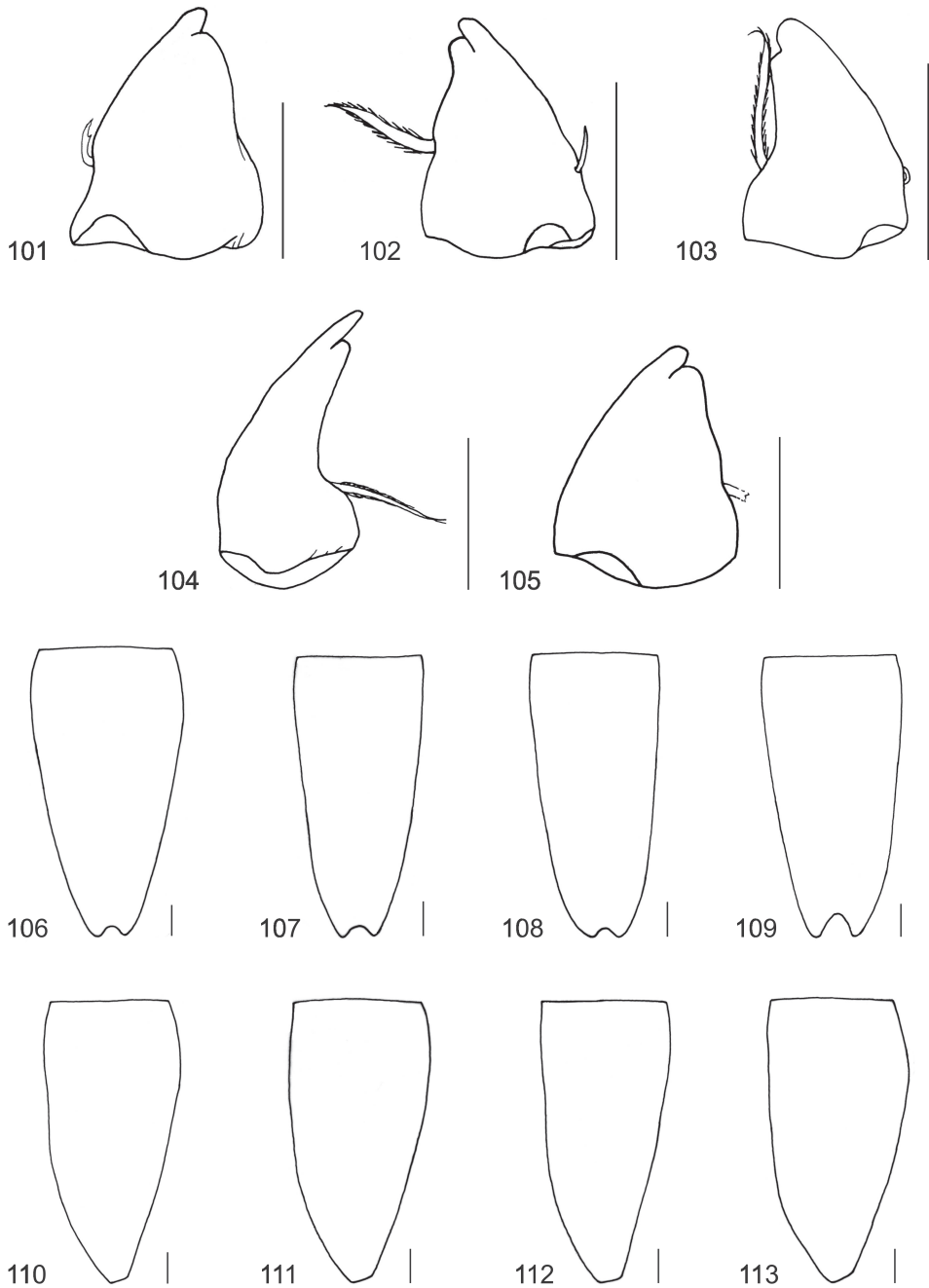


Figs. 71–76: Left elytron, anterior; 71) *O. canus*; 72) *O. castanipennis*; 73) *O. divergens*; 74) *O. heteroclitus*; 75) *O. phaeus*; 76) *O. seriatus*. Scales: 74, 76: 100  $\mu\text{m}$ ; 71–73, 75: 1.0 mm.



Figs. 77–88: *Optioservus fastiditus* species group, aedeagus in dorsal view (77, 79, 81, 83, 85, 87), aedeagus in lateral view (78, 80, 86), penis in lateral view (82, 84, 88); 77–78) *O. browni*; 79–80) *O. fastiditus*; 81–82) *O. immunis*; 83–84) *O. ovalis*; 85–86) *O. sandersoni*; 87–88) *O. trivittatus*. Scales: 100  $\mu$ m.

Figs. 89–100: *Optioservus quadrimaculatus* species group, aedeagus in dorsal view (89, 91, 93, 95, 97, 99), aedeagus in lateral view (90, 92, 94, 96, 98, 100); 89–90) *O. canus*; 91–92) *O. castanipennis*; 93–94) *O. divergens*; 95–96) *O. heteroclitus*; 97–98) *O. phaeus*; 99–100) *O. seriatus*. Scales: 100  $\mu$ m.



Figs. 101–105: Mandibles (larvae); 101) *O. fastiditus*; 102) *O. sandersoni*; 103) *O. canus*; 104) *O. castanipennis*; 105) *O. phaeus*. Scales: 100  $\mu\text{m}$ .

Figs. 106–113: Abdominal segment 9 (larvae), in dorsal view (106–109), in lateral view (110–113); 106, 110) *O. sandersoni*; 107, 111) *O. canus*; 108, 112) *O. castanipennis*; 109, 113) *O. phaeus*. Scales: 100  $\mu\text{m}$ .

***Optioservus quadrimaculatus* species group**

*Optioservus canus* CHANDLER, *O. castanipennis* (FALL), *O. divergens* (LECONTE), *O. heteroclitus* WHITE, *O. phaeus* WHITE, *O. quadrimaculatus* (HORN), *O. seriatus* (LECONTE).

This species group is characterized by the following features: head not punctate (Fig. 62); basal part of 4<sup>th</sup> interval wider than 3<sup>rd</sup> or subequal in width; abdominal ventrite 1 relatively pointed; ventrite 5 granulate (Fig. 64); phallobase smooth at lateral and ventral surface.

**Key to the species (adults) of the *Optioservus quadrimaculatus* species group**

- |   |   |                        |
|---|---|------------------------|
| 1 | Dorsal surface of head strongly rugose. Pronotum and elytra less convex. Elytral yellowish patches from humerus to apical half (Fig. 13)..... | <i>canus</i>           |
| – | Dorsal surface of head not rugose. Pronotum and elytra more convex. Elytra immaculate or humeral patches not reaching to apical half.....     | 2                      |
| 2 | Elytra immaculate.....  | 3                      |
| – | Elytra maculate.....  | 4                      |
| 3 | Elytra less wide (Fig. 17), EL/EW 1.49–1.61 (1.56). Body larger, TL 2.41–2.75 (2.59) mm.....  | <i>divergens</i>       |
| – | Elytra wide (Fig. 19), EL/EW 1.21–1.31 (1.27). Body smaller, TL 1.91–2.06 (2.00) mm.....  | <i>heteroclitus</i>    |
| 4 | Pronotum with shallow median longitudinal impression. Elytra not clearly maculate (Fig. 21).....  | <i>phaeus</i>          |
| – | Pronotum without median longitudinal impression. Elytra clearly maculate.....   | 5                      |
| 5 | Tibiae reddish brown. Body larger, TL 2.43–2.78 (2.57) mm.....  | <i>castanipennis</i>   |
| – | Tibiae black. Body smaller, TL 2.08–2.28 mm.....  | 6                      |
| 6 | Humeral yellowish patches of elytra large, extending to 2 <sup>nd</sup> stria (Fig. 23). Elytra wide, EL/EW 1.46.....                         | <i>quadrimaculatus</i> |
| – | Humeral yellowish patches of elytra small, not extending to 2 <sup>nd</sup> stria (Fig. 25). Elytra less wide, EL/EW 1.61–1.67 (1.65).....    | <i>seriatus</i>        |

***Optioservus canus* CHANDLER, 1954**

(Figs. 13–14, 31–32, 71, 89–90, 103, 107, 111)

*Optioservus canus* CHANDLER 1954: 130 (type locality: Chalone Creek, Pinnacles National Monument, San Benito County, California, USA, elev. 1,000 feet; type material: Holotype ♂ and three paratypes (allotype, 1 ♂, 1 ♀) (CASC), one paratype ♀ (INHS), not examined); COLLIER 1969: 30; BROWN 1972: 45 (key to genera and species by adults); WHITE 1978: 65; BROWN 1983: 8.

**MATERIAL EXAMINED: Adults.** USA: 2 exs. (EUMJ): “CA: San Benito Co., 4 mi S Tres Pinos, 24.VIII.1985, WDS–A–348, William D. Shepard, leg., *Optioservus canus* Chandler W. D. Shepard”; 2 exs. (CKN): “CA: San Benito Co., 4 mi S Tres Pinos, 24.VIII.1985, WDS–A–348, William D. Shepard, leg., *Optioservus canus* W. D. Shepard 1986”; 2 exs. (CKN): “CA: San Benito Co., Pinnacles Nat. Mon., 7.XII.1985, Chalone Creek, WDS–A–374, William D. Shepard, leg., *Optioservus canus* Chandler W. D. Shepard”. **Larvae.** USA: 2 mature larvae and 1 immature larva (CKN): “CA: San Benito Co., Pinnacles Nat. Mon., 7.XII.1985, Chalone Creek, WDS–A–374, William D. Shepard, leg., *Optioservus canus* Chandler W. D. Shepard”.

**REDESCRIPTION: Adult.** TL/EW 2.20–2.32 (2.26). Dorsal surface black, but elytra with yellowish patches from humerus to apical half. Ventral surface, antennae, mouth parts and legs reddish brown to blackish brown, but antennae and tarsi paler.

Head almost flat on dorsal surface, strongly rugose and pubescent. Eyes somewhat small in size; the distance between eyes about 1.41 times as long as the maximum diameter of an eye.

Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.7 : 1.9 : 1.8 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.8 : 1.8 : 3.1. Clypeus transverse, about 2.60 times as wide as long. Labrum transverse, about 1.91 times as wide as long.

Pronotum transverse, less convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners moderately produced anteriorly. PW/PL 1.29–1.38 (1.33); sublateral carinae 0.35 (n = 1) times as long as PL.

Elytra elongate oval; less convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; stria punctures of each stria relatively large and deep; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width (Fig. 71); EL/EW 1.57–1.70 (1.64); EL/PL 2.50–2.85 (2.66); EW/PW 1.20–1.25 (1.22).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Abdominal ventrite 5 clearly granulate in male; apex evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 89–90); phallobase smooth at lateral and ventral surface; penis about 1.67 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 90); parameres slender, about 0.68 times as long as penis.

MEASUREMENTS (n = 4): TL 2.30–2.38 (2.34) mm; PL 0.60–0.68 (0.64) mm; PW 0.83–0.88 (0.85) mm; EL 1.66–1.73 (1.70) mm; EW 1.00–1.08 (1.04) mm.

DESCRIPTION: **Larva.** Body cylindrical; TL/BW 6.05–6.37 (6.21). Color yellowish brown to brown, antennae, mouth parts and legs somewhat paler, apical area of abdominal segment 9 somewhat darker. Head about 1.19 times as wide as long; dorsal surface with widely spaced setiferous tubercles; each tubercle relatively large. Mandible (Fig. 103) subtriangular, 1.39 times as long as wide. Lacinia elongate oval. Labrum about 2.17 times as wide as long. Lateral margin of each thoracic segment with short setae. Pronotum slightly wider than long; PW/PL 1.49–1.53 (1.51), not humped in mid-dorsal view. Abdomen not humped in mid-dorsal view; abdominal segment 9 not keeled in sublateral view and posterior margin slightly concave (Figs. 107, 111).

MEASUREMENTS (n = 2): TL 5.02 and 5.03 mm; HW 0.41 mm; PL 0.49 mm; PW 0.73 and 0.75 mm; BW 0.79 and 0.83 mm.

DISTRIBUTION: USA (California).

DIFFERENTIAL DIAGNOSIS: In adult features, this species resembles *O. castanipennis* in general appearance, but is distinguishable from the latter by the following characteristics: dorsal surface of head strongly rugose; pronotum and elytra less convex; elytral yellowish patches from humerus to apical half (Fig. 13); apical area of elytra more slender. In larval features, this species resembles *O. phaeus* in general appearance, but is distinguishable from the latter by the following characteristics: color almost yellowish brown to brown (Figs. 31–32); body and head small; posterior margin of abdominal segment 9 slightly concave (Fig. 107).

### ***Optioservus castanipennis* (FALL, 1925)**

(Figs. 15–16, 33–34, 60, 72, 91–92, 104, 108, 112)

*Helmis castanipennis* FALL 1925: 177 (type locality: Wyoming, USA; type material: Holotype ♂, MCZC, type number 24459, only photograph examined).

*Optioservus castanipennis*: SANDERSON 1954: 11; WHITE 1978: 66; BROWN 1983: 8.

*Optioservus divergens*: COLLIER 1969: 33 (misidentification).



**MATERIAL EXAMINED:** **Adults.** USA: 7 exs. (1 F<sub>6</sub>; CKN, EUMJ): “SD: Lawrence Co., 4 mi S Spearfish, 21.VII.1981, Spearfish Creek, WDS–A–87, William D. Shepard, leg., *Optioservus castanipennis* W. D. Shepard”; 1 ex. (F<sub>6</sub>; EUMJ): “Piedmont S Dak, 7–17–37, H. T. Peters., *Optioservus castanipennis* (Fall)”. **Larvae.** USA: 2 mature larvae and 2 immature larvae (CKN): “SD: Lawrence Co., 4 mi S Spearfish, 21.VII.1981, Spearfish Creek, WDS–A–87, William D. Shepard, leg., *Optioservus castanipennis* W. D. Shepard”.

**REDESCRIPTION:** **Adult.** TL/EW 2.07–2.15 (2.11). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae, tibiae and tarsi paler. Color variation of elytra showing F<sub>3</sub> or F<sub>6</sub>.

Head almost flat on dorsal surface, densely granulate and pubescent. Eyes somewhat small in size; the distance between eyes about 1.39 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.6 : 1.9 : 1.7 : 1.0 : 1.0 : 1.0 : 1.0 : 1.5 : 1.5 : 2.8. Clypeus transverse, about 2.53 times as wide as long. Labrum transverse, about 1.76 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners weakly produced anteriad. PW/PL 1.24–1.37 (1.31); sublateral carinae 0.31–0.34 (n = 2) times as long as PL.

Elytra elongate oval; somewhat strongly convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; strial punctures of each stria somewhat large and deep; basal part of 4<sup>th</sup> interval wider than 3<sup>rd</sup> (Fig. 72); EL/EW 1.49–1.59 (1.54); EL/PL 2.39–2.92 (2.67); EW/PW 1.27–1.36 (1.32).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove narrow. Abdominal ventrite 5 clearly granulate in male; apex evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 91–92); phallobase smooth at lateral and ventral surface; penis about 1.81 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 92); parameres slender, about 0.71 times as long as penis.

**MEASUREMENTS** (n = 5): TL 2.43–2.78 (2.57) mm; PL 0.62–0.82 (0.70) mm; PW 0.85–1.02 (0.92) mm; EL 1.81–1.96 (1.87) mm; EW 1.16–1.31 (1.22) mm.

**DESCRIPTION:** **Larva.** Body cylindrical; TL/BW 5.94. Color dark brown, antennae, mouth parts and legs somewhat paler. Head about 1.29 times as wide as long; dorsal surface with widely spaced setiferous tubercles; each tubercle relatively large. Mandible (Fig. 104) falciform, 1.96 times as long as wide. Lacinia elongate oval. Labrum about 1.88 times as wide as long. Lateral margin of each thoracic segment with short setae. Pronotum slightly wider than long; PW/PL 1.53, not humped in mid-dorsal view. Abdomen not humped in mid-dorsal view; abdominal segment 9 slender in lateral view (Fig. 112); not keeled in sublateral view and posterior margin slightly concave (Fig. 108).

**MEASUREMENTS** (n = 1): TL 5.29 mm; HW 0.45 mm; PL 0.55 mm; PW 0.84 mm; BW 0.89 mm.

**DISTRIBUTION:** USA (western states).

**DIFFERENTIAL DIAGNOSIS:** In adult features, this species resembles *O. canus* in general appearance, but is distinguishable from the latter by the following characteristics: dorsal surface of head not rugose; pronotum and elytra more convex; elytral humeral patches not reaching apical half (Fig. 15); apical area of elytra somewhat ovate. In larval features, this species is distinguishable from the other species by the following characteristics: mandible falciform (Fig. 104); abdominal segment 9 slender in lateral view (Fig. 112).

***Optioservus divergens* (LECONTE, 1874)**  
(Figs. 17–18, 73, 93–94)

*Elmis divergens* LECONTE 1874: 52 (type locality: California, USA; type material: Holotype ♀, MCZC, type number 2278, only photograph examined).

*Heterolimnius divergens*: HINTON 1935: 178.

*Optioservus divergens*: SANDERSON 1954: 11; COLLIER 1969: 33; BROWN 1972: 44 (key to genera and species by adults); WHITE 1978: 66; BROWN 1983: 8.

*Elmis pecosensis* FALL 1907: 226 (type locality: New Mexico, Pecos, USA; type material: Holotype ♀, MCZC, type number 24462, only photograph examined); WHITE 1978: 66 (synonymy).

MATERIAL EXAMINED: **Adults**. USA: 2 exs. (CKN, EUMJ): “CO: Pueblo Co., 5 mi E Rye, 19.V.1986, Greenhorn Creek, WDS–A–404, William D. Shepard, leg., *Optioservus divergens* (LeC.) W. D. Shepard”; 1 ex. (EUMJ): “SD: Custer Co., 6 mi NE Custer, 22.VII.1981, Upper Iron Cr., WDS–A–92, William D. Shepard, leg., *Optioservus divergens* (LeC.) W. D. Shepard”; 2 exs. (CKN): “SD: Lawrence Co., 4 mi S Spearfish, 21.VII.1981, Spearfish Creek, WDS–A–87, William D. Shepard, leg., *Optioservus divergens* W. D. Shepard”; 2 exs. (CKN): “AZ: Coconino Co., 20 mi S Flagstaff, 8.VI.1984, Oak Creek, WDS–A–303, William D. Shepard, leg., *Optioservus divergens* W. D. Shepard”.

**REDESCRIPTION: Adult**. TL/EW 2.08–2.24 (2.14). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and tarsi paler.

Head almost flat on dorsal surface, densely granulate and pubescent. Eyes somewhat small in size; the distance between eyes about 1.35 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.4 : 1.9 : 1.7 : 1.0 : 1.0 : 1.0 : 1.0 : 1.5 : 1.6 : 3.0. Clypeus transverse, about 2.48 times as wide as long. Labrum transverse, about 1.90 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners moderately produced anteriad. PW/PL 1.22–1.44 (1.31); sublateral carinae 0.28 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow; strial punctures of each stria somewhat large and deep; basal part of 4<sup>th</sup> interval wider than 3<sup>rd</sup> (Fig. 73); EL/EW 1.49–1.61 (1.56); EL/PL 2.44–2.89 (2.68); EW/PW 1.29–1.38 (1.32).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove narrow. Abdominal ventrite 5 clearly granulate in male; apex evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 93–94); phallobase smooth at lateral and ventral surface; penis about 1.75 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 94); parameres slender, about 0.76 times as long as penis.

MEASUREMENTS (n = 5): TL 2.41–2.75 (2.59) mm; PL 0.62–0.77 (0.70) mm; PW 0.89–0.94 (0.91) mm; EL 1.79–2.04 (1.88) mm; EW 1.16–1.27 (1.21) mm.

DISTRIBUTION: USA (western states), Canada (western provinces).

DIFFERENTIAL DIAGNOSIS: This species resembles *O. heteroclitus* in general appearance, but is distinguishable from the latter by the following characteristics: body large; elytra less wide (Fig. 17).

***Optioservus heteroclitus* WHITE, 1978**  
(Figs. 19–20, 64, 74, 95–96)

*Optioservus heteroclitus* WHITE 1978: 68 (type locality: USA, California, Mosquito Creek north of Wawona, ca. 1524 m a.s.l.; type material: Holotype ♂, USNM, and 20 paratypes, INHS, MCZC, SSMH, USNM, not examined); BROWN 1983: 8.

MATERIAL EXAMINED: **Adults.** USA: 1 ex. (CKN): “CA: Madera Co., 5 mi E Fish Camp, 28.VIII.1985, Big Creek, WDS–A–364, William D. Shepard, leg., *Optioservus heteroclitus* W. D. Shepard 1985”; 1 ex. (EUMJ): ditto but: “*Optioservus heteroclitus* W. D. Shepard 1994”; 2 exs. (CKN): “CA: Mariposa Co., 1 mi N Fish Camp, 31.VIII.1986, Big Creek, WDS–A–420, William D. Shepard, leg., *Optioservus heteroclitus* White W. D. Shepard”.

REDESCRIPTION: **Adult.** TL/EW 1.77–1.89 (1.83). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and tarsi paler.

Head almost flat on dorsal surface, densely granulate and pubescent. Eyes somewhat small in size; the distance between eyes about 1.44 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.7 : 2.1 : 1.6 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.6 : 1.6 : 2.8. Clypeus transverse, about 2.81 times as wide as long. Labrum transverse, about 1.94 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners weakly produced anteriad. PW/PL 1.37–1.42 (1.39); sublateral carinae 0.30 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; strial punctures of each stria somewhat large and deep; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width (Fig. 74); EL/EW 1.21–1.31 (1.27); EL/PL 2.18–2.38 (2.28); EW/PW 1.27–1.35 (1.30).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove small and narrow. Abdominal ventrite 5 clearly granulate in male; apex evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 95–96); phallobase smooth at lateral and ventral surface; penis about 1.86 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 96); parameres slender, about 0.75 times as long as penis.

MEASUREMENTS (n = 3): TL 1.91–2.06 (2.00) mm; PL 0.60–0.62 (0.61) mm; PW 0.84–0.85 (0.85) mm; EL 1.31–1.45 (1.39) mm; EW 1.08–1.13 (1.10) mm.

DISTRIBUTION: USA (California).

DIFFERENTIAL DIAGNOSIS: This species resembles *O. divergens* in general appearance, but is distinguishable from the latter by the following characteristics: body small; elytra wide (Fig. 19).

***Optioservus phaeus* WHITE, 1978**  
(Figs. 21–22, 35–36, 62, 75, 97–98, 105, 109, 113)

*Optioservus phaeus* WHITE 1978: 70 (type locality: USA, Kansas, Scott County State Park, springs at 1006 m a.s.l.; type material: Holotype ♂, USNM, and 48 paratypes, CASC, INHS, MCZC, SSMH, USNM, not examined); BROWN 1983: 8.

MATERIAL EXAMINED: **Adults.** USA: 3 exs. (CKN): “KS: Scott Co., Lake Scott St. Pk., 29.VII.1987, Big Spring, WDS–A–487, William D. Shepard, leg., *Optioservus phaeus* W. D. Shepard”; 2 exs. (CKN): ditto but: “13.V.2006 2850”, unnamed spring, WDS–A–1666, William D. Shepard, leg., *Optioservus phaeus* W. D. Shepard”.

**Larvae.** USA: 4 mature larvae and 2 immature larvae (CKN): "KS: Scott Co., Lake Scott St. Pk., 29.VII.1987, Big Spring, WDS-A-487, William D. Shepard, leg., *Optioservus phaeus* W. D. Shepard"; 4 mature larvae (CKN): ditto but: "13.V.2006 2850", unnamed spring, WDS-A-1666, William D. Shepard, leg., *Optioservus phaeus* W. D. Shepard".

**REDESCRIPTION: Adult.** TL/EW 2.20–2.25 (2.23). Dorsal surface black, but elytra with yellowish patches at humeral and apical area. Ventral surface, antennae, mouth parts and legs reddish brown to blackish brown, but antennomeres 1–8 and tarsi paler.

Head almost flat on dorsal surface, densely granulate and pubescent. Eyes somewhat small in size; the distance between eyes about 1.39 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of antennomere 11; approximate ratio of each antennomere as 2.6 : 2.0 : 1.8 : 1.0 : 1.0 : 1.0 : 1.1 : 1.0 : 1.8 : 1.8 : 3.2. Clypeus transverse, about 2.63 times as wide as long. Labrum transverse, about 1.70 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; with shallow median longitudinal impression; without prescutellar pits; antero-lateral corners weakly produced anteriad. PW/PL 1.19–1.31 (1.24); sublateral carinae 0.31 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; strial punctures of each stria relatively large and deep; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width (Fig. 75); EL/EW 1.58–1.59 (1.58); EL/PL 2.35–2.55 (2.44); EW/PW 1.23–1.25 (1.24).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Abdominal ventrite 5 clearly granulate in male; apex evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 97–98); phallobase smooth at lateral and ventral surface; penis about 1.51 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 98); parameres slender, about 0.69 times as long as penis.

**MEASUREMENTS** (n = 3): TL 2.61–2.77 (2.68) mm; PL 0.75–0.81 (0.78) mm; PW 0.93–1.00 (0.97) mm; EL 1.83–1.96 (1.90) mm; EW 1.16–1.23 (1.20) mm.

**DESCRIPTION: Larva.** Body cylindrical; TL/BW 5.48. Color dark brown, antennae, mouth parts and legs somewhat paler. Head about 1.13 times as wide as long; dorsal surface with widely spaced setiferous tubercles; each tubercle relatively large. Mandible (Fig. 105) subtriangular, 1.32 times as long as wide. Lacinia elongate oval. Labrum about 2.10 times as wide as long. Lateral margin of each thoracic segment with short setae. Pronotum slightly wider than long; PW/PL 1.40, not humped in mid-dorsal view. Abdomen not humped in mid-dorsal view; abdominal segment 9 not keeled in sublateral view and posterior margin deeply concave (Figs. 109, 113).

**MEASUREMENTS** (n = 1): TL 5.32 mm; HW 0.47 mm; PL 0.62 mm; PW 0.87 mm; BW 0.97 mm.

**DISTRIBUTION:** USA (Kansas).

**DIFFERENTIAL DIAGNOSIS:** This species resembles *O. castanipennis* in general appearance, but is distinguishable from the latter by the following characteristics: [adult] pronotum with shallow median longitudinal impression; elytra not clearly maculate (Fig. 21); [larva] mandible subtriangular (Fig. 105); posterior margin of abdominal segment 9 deeply concave (Fig. 109).

***Optioservus quadrimaculatus* (HORN, 1870)**  
(Figs. 23–24)

*Elmis quadrimaculatus* HORN 1870: 37 (type locality: near Fort Crook, California, USA; type material: Holotype ♀, ANSP, type number 3262, only photograph of one type specimen (MCZC, type number 32119) examined at [http://mcz-28168.oeb.harvard.edu/mcz/FMPro?-DB=Image.fm&-Lay=web&-Format=images.htm&Species\\_ID=32119&-Find](http://mcz-28168.oeb.harvard.edu/mcz/FMPro?-DB=Image.fm&-Lay=web&-Format=images.htm&Species_ID=32119&-Find)).

*Heterlimnius quadrimaculatus*: HINTON 1935: 178.

*Optioservus quadrimaculatus*: SANDERSON 1954: 11; COLLIER 1969: 50; BROWN 1972: 45 (key to genera and species by adults); WHITE 1978: 70; BROWN 1983: 8.

MATERIAL EXAMINED: **Adult.** USA: 1 ex. (EUMJ): “Utah: Pinte Co., Hwy4W of Seviex, 1.VI.1977, K. W. Steubust, *Optioservus quadrimaculatus* (Horn) W. D. Shepard”.

**REDESCRIPTION: Adult.** TL/EW 2.04. Dorsal surface black, but elytra with yellowish patches at humeral and apical area. Ventral surface, antennae, mouth parts and legs reddish brown to blackish brown, but antennomeres 1–8 and tarsi paler.

Head almost flat on dorsal surface. Pronotum transverse, slightly convex; without median longitudinal impression; without prescutellar pits; antero-lateral corners weakly produced anteriorly. PW/PL 1.33; sublateral carinae 0.34 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; stria punctures of each stria relatively large and deep; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width; EL/EW 1.46; EL/PL 2.56; EW/PW 1.32.

Prosternal process narrowing posteriorly and broadly rounded at apex.

MEASUREMENTS (n = 1): TL 2.28 mm; PL 0.64 mm; PW 0.85 mm; EL 1.64 mm; EW 1.12 mm.

DISTRIBUTION: USA (western states), Canada (western provinces).

DIFFERENTIAL DIAGNOSIS: This species resembles *O. seriatus* in general appearance, but is distinguishable from the latter by the following characteristics: humeral yellowish patches of elytra large, extending to 2<sup>nd</sup> stria; elytra wide (Fig. 23).

***Optioservus seriatus* (LECONTE, 1874)**  
(Figs. 25–26, 76, 99–100)

*Elmis seriatus* LECONTE 1874: 52 (type locality: California, USA; type material: Holotype ♀, MCZC, type number 2279, only photograph examined).

*Optioservus seriatus*: SANDERSON 1954: 11; COLLIER 1969: 55; BROWN 1972: 45 (key to genera and species by adults); WHITE 1978: 72; BROWN 1983: 9.

MATERIAL EXAMINED: **Adults.** USA: 6 exs. (CKN, EUMJ): “CA: Colusa Co., 5 mi W Stonyford, 16.VI.1985, Mill Creek, WDS-A–332, William D. Shepard, leg., *Optioservus seriatus* W. D. Shepard 1985”; 14 exs. (CKN): ditto but: “15.X.2005, William D. Shepard, leg.”; 1 ex. (EUMJ): “Navarro River, 8 mi W. Navarro, Mendocino Co., Calif., 4–IX–50, H. B. Leech collection, *Optioservus seriatus* (LeConte) det. H. B. Leech 1960”; 2 exs. (EUMJ): ditto but: “Sep.4.1950, H. B. Leech”; 3 exs. (EUMJ): “Calif., Siskiyou, Sugar Creek, 2.3 mi NW Callahan, 7.IX.1976, H. B. Leech”; 1 ex. (EUMJ): “CA: Siskiyou Co., 3 mi SE Cecilville, 21.VII.1990, S Fk Salmon River, Light trap, C. B. Barr & W. D. Shepard”.

**REDESCRIPTION: Adult.** TL/EW 2.18–2.28 (2.22). Dorsal surface black, but elytra with yellowish patches at humeral and apical area. Ventral surface, antennae, mouth parts and legs reddish brown to blackish brown, but antennomeres 1–8 and tarsi paler.

Head almost flat on dorsal surface, densely granulate and pubescent. Eyes moderate in size; the distance between eyes about 1.23 times as long as the maximum diameter of an eye. Antennae with dense setae at antero-lateral corners of antennomeres 9 and 10 and apical part of

antennomere 11; approximate ratio of each antennomere as 2.8 : 2.0 : 1.7 : 1.0 : 1.0 : 1.0 : 1.1 : 1.0 : 1.7 : 1.7 : 3.1. Clypeus transverse, about 2.56 times as wide as long. Labrum transverse, about 1.67 times as wide as long.

Pronotum transverse, slightly convex; lateral part moderately granulate; without median longitudinal impression; without prescutellar pits; antero-lateral corners weakly produced anteriorly. PW/PL 1.27–1.48 (1.36); sublateral carinae 0.31 (n = 1) times as long as PL.

Elytra elongate oval; moderately convex; lateral margin weakly serrate; intervals less rugose, slightly convex; punctate striae shallow or oblique; stria punctures of each stria relatively large and deep; basal part of 3<sup>rd</sup> and 4<sup>th</sup> intervals subequal in width (Fig. 76); EL/EW 1.61–1.67 (1.65); EL/PL 2.63–3.04 (2.85); EW/PW 1.24–1.32 (1.27).

Prosternal process narrowing posteriorly and broadly rounded at apex. Anterior part of mesoventral groove relatively narrow. Abdominal ventrite 5 clearly granulate in male; apex evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 99–100); phallobase smooth at lateral and ventral surface; penis about 1.81 times as long as phallobase, dilated at base, gradually narrowed and apical part somewhat rounded, curved ventrad in lateral view (Fig. 100); parameres slender, about 0.75 times as long as penis.

MEASUREMENTS (n = 8): TL 2.08–2.27 (2.16) mm; PL 0.52–0.60 (0.56) mm; PW 0.71–0.79 (0.77) mm; EL 1.54–1.67 (1.60) mm; EW 0.92–1.04 (0.97) mm.

DISTRIBUTION: USA (western states), Canada (western provinces).

DIFFERENTIAL DIAGNOSIS: This species resembles *O. quadrimaculatus* in general appearance, but is distinguishable from the latter by the following characteristics: humeral yellowish patches of elytra small, not extending to 2<sup>nd</sup> stria; elytra less wide (Fig. 25).

### Acknowledgements

I wish to express my sincere gratitude to Dr. Masahiro Sakai and Dr. Hiroyuki Yoshitomi (EUMJ) for their continuous encouragement. I would also like to thank Dr. William D. Shepard (Essig Museum of Entomology, California, USA) for sending identified material, providing useful advice during my study and reading the manuscript. Thanks are also due to Dr. Masakazu Hayashi (Hoshizaki Institute for Wildlife Protection, Izumo, Japan), Dr. Manfred A. Jäch (NMW), the late Mr. Takeshi Ogata and the late Dr. Masataka Satô for providing useful advice during my study, and Dr. Andrew E.Z. Short (University of Kansas, Kansas, USA) and Dr. David S. White (Hancock Biological Station, Kentucky, USA) for sending material.

### References

- BERTRAND, H.P.I. 1972: Larves et nymphes des Coléoptères aquatiques du Globe. – Paris: Imprimerie F. Paillart, 804 pp.
- BROWN, H.P. 1972: Aquatic Dryopoid Beetles (Coleoptera) of the United States. Biota of Freshwater Ecosystems identification Manual No. 6. – Water Pollution Control Research Series, Environmental Protection Agency, Washington, D.C., 82 pp.
- BROWN, H.P. 1983: A Catalog of the Coleoptera of America north of Mexico. – United States Department of Agriculture, Agricultural Research Service, Washington, D.C., Agriculture Handbook No. 529-50, 23 pp.
- BROWN, H.P. & WHITE, D.S. 1978: Notes on separation and identification of North American riffle beetles (Coleoptera: Dryopoidea: Elmidae). – Entomological News 89 (1 & 2): 1–13.

- BROWN, W.J. 1930: New species of Coleoptera. I. – The Canadian Entomologist LXII: 87–92.
- CHANDLER, C.H.P. 1954: New genera and species of Elmidae (Coleoptera) from California. – The Pan-Pacific Entomologist XXX (2): 125–131.
- COLLIER, J.E. 1969: A taxonomic revision of the genus *Optioservus* (Coleoptera: Elmidae) in the Nearctic Region. – Doctoral thesis, University of Minnesota, 59 pp., 5 pls.
- FALL, H.C. 1925: New species of *Helmis* (Coleoptera). – Journal of the New York Entomological Society 33: 177–181.
- HINTON, H.E. 1935: Notes on the Dryopidae. – Stylops 4: 169–179.
- HORN, G.H. 1870: Synopsis of the Parnidae of the United States. – Transactions of the American Entomological Society 3: 29–42.
- JÄCH, M.A., KODADA, J. & ÇIAMPOR, F. 2006: Elmidae, pp. 432–440. – In Löbl, I. & Smetana, A. (eds.): Catalogue of Palaearctic Coleoptera, Vol. III. Scarabaeoidea, Scirtoidea, Dascilloidea, Buprestioidea and Byrrhoidea. – Stenstrup: Apollo Books, 690 pp.
- JUNG, S.W., KAMITE, Y. & BAE, Y.J. 2011: Description of *Optioservus gapyeongensis* new species and *Heterlimnius hasegawai* (Nomura) (Coleoptera: Elmidae) new to Korea. – Entomological Research 41: 178–184.
- KAMITE, Y. 2009: A revision of the genus *Heterlimnius* Hinton (Coleoptera, Elmidae). – Japanese Journal of Systematic Entomology 15 (1): 199–226.
- KAMITE, Y. 2011: Three new species of the genus *Heterlimnius* (Coleoptera, Elmidae) from Asia. – Japanese Journal of Systematic Entomology 17 (2): 409–414.
- KAMITE, Y. 2012: Three new species and a new combination of the genus *Heterlimnius* Hinton from Asia (Coleoptera: Elmidae). – Koleopterologische Rundschau 82: 291–299.
- KODADA, J. & JÄCH, M.A. 2005: Elmidae, pp. 471–496. – In Beutel, R.G. & Leschen, R.A.B. (eds.): Handbook of Zoology IV (Part 38): Coleoptera, Beetles, 1. Morphology and Systematics (Archostemata, Adephaga, Myxophaga, Polyphaga partim). – Berlin/New York, Walter de Gruyter, XI + 567 pp.
- LECONTE, J.L. 1850: General remarks upon the Coleoptera of Lake Superior, pp. 201–242. – In Agassiz, L. (ed.): Lake Superior: Its physical character, vegetation, and animals, compared with those of other and similar regions (With a narrative of the tour by J. Elliot Cabot). – Gould, Kendall and Lincoln, Boston, 428 pp., 17 pls.
- LECONTE, J.L. 1863: New species of North American Coleoptera. Part 1. – Smithsonian Miscellaneous Collections 167: 1–86.
- LECONTE, J.L. 1874: Descriptions of new Coleoptera chiefly from the Pacific slope of North America. – Transactions of the American Entomological Society 5: 43–72.
- MUSGRAVE, P.N. 1932: Notes on Helmididae taken in the Tennessee Great Smoky Mountains, with description of a new species. – Proceedings of the Entomological Society of Washington 34: 78–81.
- NOMURA, S. 1958: Notes on the Japanese Dryopoidea (Coleoptera), with two species from Saghalien. – Tôhō-Gakuhô 8: 45–60, 2 pls.
- NOMURA, S. 1960: Notes on the Japanese Dryopoidea (Coleoptera) III. – AKITU Transactions of the Kyoto Entomological Society IX: 34–36.
- SANDERSON, M.W. 1953: A revision of the Nearctic genera of Elmidae (Coleoptera). – Journal of the Kansas Entomological Society 26 (4): 148–163.
- SANDERSON, M.W. 1954: A revision of the Nearctic genera of Elmidae (Coleoptera). – Journal of the Kansas Entomological Society 27 (1): 1–13.

- SATÔ, M. 1992: A revisional study on the superfamily Dryopoidea (Coleoptera) of Japan. – Doctoral thesis, Kyoto University, 239 pp. + 12 tables + 52 figs.
- SATÔ, M. & YOSHITOMI, H. 2005: Coleoptera, pp. 591–658. – In Kawai, T. & Tanida, K. (eds.): Aquatic Insects of Japan: Manual with Keys and Illustrations, Tokai University Press, Tokyo, 1342 pp. [In Japanese, with English book title]
- SHEPARD, W.D. 1993: An annotated checklist of the aquatic and semiaquatic dryopoid Coleoptera of California. – *The Pan-Pacific Entomologist* 69 (1): 1–11.
- SHEPARD, W.D. 2002: Family 43. Elmidae, pp. 117–120. – In Arnett, R.H. et al. (eds.): American beetles 2. – Boca Raton, Florida: CRC Press, 861 pp.
- WHITE, D.S. 1978: A revision of the Nearctic *Optioservus* (Coleoptera: Elmidae) with description of new species. – *Systematic Entomology* 3: 59–74.
- WHITE, D.S. & ROUGHLEY, R.E. 2008: Chapter 20. Aquatic Coleoptera, pp. 571–671. – In Merritt, R.W. et al. (eds.): An Introduction to the Aquatic Insects of North America (Fourth edition). – Dubuque, Iowa: Kendall/Hunt Publishing Company, 1158 pp.

Dr. Yuuki KAMITE

Laboratory of Environmental Entomology, Nagoya City Public Health Research Institute, Hagiyama-cho 1–11, Mizuhoku, Nagoya, 467–8615 Japan (optioservus@yahoo.co.jp)



# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Koleopterologische Rundschau](#)

Jahr/Year: 2013

Band/Volume: [83\\_2013](#)

Autor(en)/Author(s): Kamite Yuuki

Artikel/Article: [Revision of the genus \*Optioservus\* SANDERSON, part 1: Generic redescription and revision of the Nearctic species \(\*O. fastiditus\* and \*O. quadrimaculatus\* species groups\) \(Coleoptera: Elmidae\). 133-164](#)