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Three new species and a new combination of the genus *Heterlimnius* HINTON from Asia (Coleoptera: Elmidae)

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Abstract

Three new species of the genus *Heterlimnius* HINTON (Coleoptera: Elmidae) are described from Asia: *H. horii*, *H. quadrigibbus* and *H. yokoii*. *Optioservus trachys* (JANSSENS) is transferred to *Heterlimnius*. The *H. trachys* species group is newly proposed for these four species. Keys to all species of the *H. trachys* species group and a world check list of the genus *Heterlimnius* are provided.

Key words: Coleoptera, Elmidae, *Heterlimnius*, *Heterlimnius trachys* species group, Asia, new species, new combination, taxonomy.

Introduction

The taxonomy of the genus *Heterlimnius* HINTON was recently revised by KAMITE (2009, 2011), who proposed two species groups, and recognized a total of 10 species from the Holarctic and Oriental Regions.

In this paper, a third species group is proposed, three new species are described, and one species is transferred to *Heterlimnius* from the very closely related genus *Optioservus* SANDERSON.

Abbreviations:

BF	brachypterous form
MF	macropterous form
EL	elytral length along suture from scutellar base to elytral apices
EW	maximum width of elytra
PL	pronotal length along midline in dorsal view
PW	maximum width of pronotum
TL	total length of PL and EL
EUMJ	Ehime University Museum, Matsuyama, Japan
NMW	Naturhistorisches Museum Wien, Austria

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

Heterlimnius horii sp.n.

(Figs. 1–4, 16, 19–21)

TYPE MATERIAL: **Holotype** ♂ (EUMJ): "Huanglonggou, Sichuan, China, 1–IX–1998, M. Sato leg.". **Paratypes** (EUMJ, NMW): 4 exs., same data as for the holotype; 7 exs.: "Jiuzhigou, Sichuan, China, 29–VIII–1998, M. Sato leg."; 16 exs.: "Gongga Ling, Jiuzhaigou, Songpan Xian, 3450 m, Sichuan, China, 29.VIII.1998, M. Satô leg."; 10 exs.: "Munigou, Songpan Xian, 3150–3290 m, Sichuan, China, 2.IX.1998, M. Satô leg."; 9 exs.: "Kalong Gou, Sichuan, China, 3–IX–1998, M. Sato leg.".

DESCRIPTION: TL/EW 2.11–2.26 (2.18) in BF; TL/EW 2.26 in MF. 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, punctate and pubescent. Eyes distinctly small in size; the distance between eyes about 1.79 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 : 2.0 : 1.5 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.8 : 1.8 : 3.1. Clypeus transverse, about 2.67 times as wide as long. Labrum transverse, about 1.84 times as wide as long. Pronotum transverse, slightly convex, neither median longitudinal impression nor prescutellar pits present; lateral part weakly granulate; antero-lateral corners moderately produced anteriad. PW/PL 1.14–1.26 (1.21) in BF; sublateral carinae 0.30 (n = 1) times as long as PL; PW/PL 1.23 in MF. Elytra elongate oval (BF) or subparallel-sided (MF); moderately convex; intervals not strongly rugose, slightly convex; punctate striae shallow; strial punctures of each stria relatively small and shallow; basal part of third interval wider than fourth (Fig. 16); in BF EL/EW 1.45–1.60 (1.52); EL/PL 2.15–2.52 (2.33); EW/PW 1.19–1.37 (1.27); in MF EL/EW 1.63; EL/PL 2.59; EW/PW 1.30.

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

Aedeagus (Figs. 19–20): phallobase smooth at lateral and ventral surface; penis about 1.42 times as long as phallobase, widely dilated at apical 1/4 and apical part rounded, slightly curved ventrad in lateral view (Fig. 20); basolateral apophyse not developed; parameres slightly wide, about 0.9 times as long as penis; mesal margins of ventral aspect sinuate; apex truncate and slightly curved outward.

Ovipositor (Fig. 21): coxite about 6.63 times as long as stylus; valvifer about 9.90 times as long as stylus.

MEASUREMENTS: BF (n = 7): TL 2.90–3.52 (3.17) mm; PL 0.87–1.02 (0.95) mm; PW 1.04–1.22 (1.15) mm; EL 1.98–2.50 (2.22) mm; EW 1.32–1.56 (1.45) mm. MF (n = 1): TL 3.34 mm; PL 0.93 mm; PW 1.14 mm; EL 2.41 mm; EW 1.48 mm.

DISTRIBUTION (Fig. 30): China (Sichuan).

ETYMOLOGY: The specific name is dedicated to Mr. Yoshihiro Hori for his kind help in my study.

REMARKS: This new species resembles *H. quadrigibbus* in general appearance, but is distinguishable from the latter by the following characteristics: body large; pronotum without median longitudinal impression; basolateral apophyse of penis not developed; apex of parameres truncate (Fig. 19).

***Heterlimnius quadrigibbus* sp.n.**
(Figs. 5–8, 22–23)

TYPE MATERIAL: **Holotype** ♂ (NMW): "CHINA: Tibet, 9.9.1996, Linzhi Co., Linzhi, 94°42'19"E, 29°40'18"N, 3000m, leg. M. L. Jeng". **Paratype** (NMW): 1 ♂, "CHINA: Tibet, 15.9.1996, Basu Co., Bangda, 97°05'04"E, 30°29'57"N, 4100m, leg. M. L. Jeng".

DESCRIPTION: TL/EW 2.05 in BF; TL/EW 2.09 in MF. 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. 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 2.0 : 1.8 : 1.4 : 1.0 : 1.0 : 1.0 : 1.0 : 1.0 : 1.5 : 1.5 : 2.4. Clypeus transverse, about 2.71 times as wide as long. Labrum transverse, about 1.64 times as wide as long. Pronotum transverse, slightly convex, with deep and wide median longitudinal impression extending from basal 1/3 to apex, and without prescutellar pits; lateral part weakly granulate; antero-lateral corners weakly produced anteriad. PW/PL 1.31 in BF; sublateral carinae 0.30 (n = 1) times as long as PL; PW/PL 1.23 in MF. Elytra elongate oval (BF) or subparallel-sided (MF); moderately convex; intervals not strongly rugose, slightly convex; punctuate striae deep; strial punctures of each striae relatively small and deep; basal part of third interval wider than fourth; in BF EL/EW 1.46; EL/PL 2.45; EW/PW 1.28; in MF EL/EW 1.51; EL/PL 2.64; EW/PW 1.42.

Prosternal process narrowing posteriorly and broadly rounded at apex. Apex of abdominal ventrite 5 evenly rounded and with spinulate setae.

Aedeagus as illustrated (Figs. 22–23); phallobase smooth at lateral and ventral surface; penis about 1.84 times as long as phallobase, abruptly dilated at basal 1/3, gradually narrowed and apical part somewhat pointed, curved ventrad in lateral view (Fig. 23); parameres slender, about 0.9 times as long as penis.

MEASUREMENTS: BF (n = 1): TL 2.69 mm; PL 0.78 mm; PW 1.02 mm; EL 1.91 mm; EW 1.31 mm. MF (n = 1): TL 2.84 mm; PL 0.78 mm; PW 0.96 mm; EL 2.06 mm; EW 1.36 mm.

DISTRIBUTION (Fig. 30): China (Tibet).

ETYMOLOGY: The specific name refers to the four tubercles on the pronotum of the *Heterlimnius trachys* species group.

REMARKS: This new species resembles *H. horii* in general appearance, but is distinguishable from the latter by the following characteristics: body small; pronotum with median longitudinal impression; basolateral apophyse of penis developed; apex of parameres rounded (Fig. 22).

***Heterlimnius trachys* (JANSSENS, 1959), comb.n.**
(Figs. 9–10, 15, 17, 24–26)

Stenelmis trachys JANSSENS 1959: 5 (type locality: Afghanistan, Grotte Nayak; type not examined).
Optioservus trachys: JÄCH et al. 2006: 436.

SPECIMENS EXAMINED: 4 ♂♂, 1 ♀ (NMW): "Hindukusch, O • Afghanistan, J. Klapperich, Do-Schak, 2500 m, Khinjantal, 1.10.52"; 1 ♂ (NMW): "J. Klapperich, Achmede, Dewane, 2700 m, Bashgultal, Nuristan, 25.7.52, O• Afghanistan".

DESCRIPTION: TL/EW 2.14–2.20 (2.16). 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, punctuate and pubescent. Eyes distinctly small in size; the distance between eyes about 1.61 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 : 2.4 : 2.0 : 1.0 : 1.0 : 1.0 : 1.1 : 1.0 : 1.6 : 1.6 : 3.2. Clypeus transverse, about 2.56 times as wide as long. Labrum transverse, about 1.98 times as wide as long. Pronotum transverse, slightly convex, with deep and wide median longitudinal impression extending from base to apex, and without prescutellar pits; lateral part moderately granulate; antero-lateral corners weakly produced anteriad. PW/PL 1.23–1.24 (1.24); sublateral carinae 0.31–0.32 (n = 2, 0.32) times as long as PL. Elytra elongate oval; moderately convex; intervals not strongly rugose, slightly convex; punctate striae shallow; strial punctures of each stria somewhat large and deep; basal part of elytral third interval slightly wider

than fourth or subequal in width (Fig. 17); EL/EW 1.51–1.55 (1.52); EL/PL 2.34–2.41 (2.37); EW/PW 1.23–1.28 (1.26).

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

Aedeagus as illustrated (Figs. 24–25); phallobase smooth at lateral and ventral surface; penis about 1.52 times as long as phallobase, gradually dilated at basal 1/3, gradually narrowed to basal 5/8 and apical part somewhat rounded, curved ventrad in lateral view (Fig. 25); parameres slender, about 0.86 times as long as penis.

Ovipositor as illustrated (Fig. 26); coxite about 5.25 times as long as stylus; valvifer about 9.42 times as long as stylus.

MEASUREMENTS: BF (n = 3): TL 2.80–2.92 (2.88) mm; PL 0.82–0.87 (0.85) mm; PW 1.02–1.08 (1.06) mm; EL 1.98–2.05 (2.02) mm; EW 1.31–1.36 (1.33) mm.

DISTRIBUTION (Fig. 30): Afghanistan.

REMARKS: This species resembles *H. quadrigibbus* in general appearance, but is distinguishable from the latter by the following characteristics: pronotal median longitudinal impression long, extending from base to apex; aedeagus as in Fig. 24.

Heterlimnius yokoii **sp.n.**
(Figs. 11–12, 18, 27–29)

TYPE MATERIAL: **Holotype** ♂ (NMW): "CHINA, YUNNAN, 23.6–2.7.1996, 28°20'N 99°03'E, HENGDUAN mts., 4300m, O. Semela leg.". **Paratypes** (NMW, EUMJ): 20 exs., same data as for the holotype.

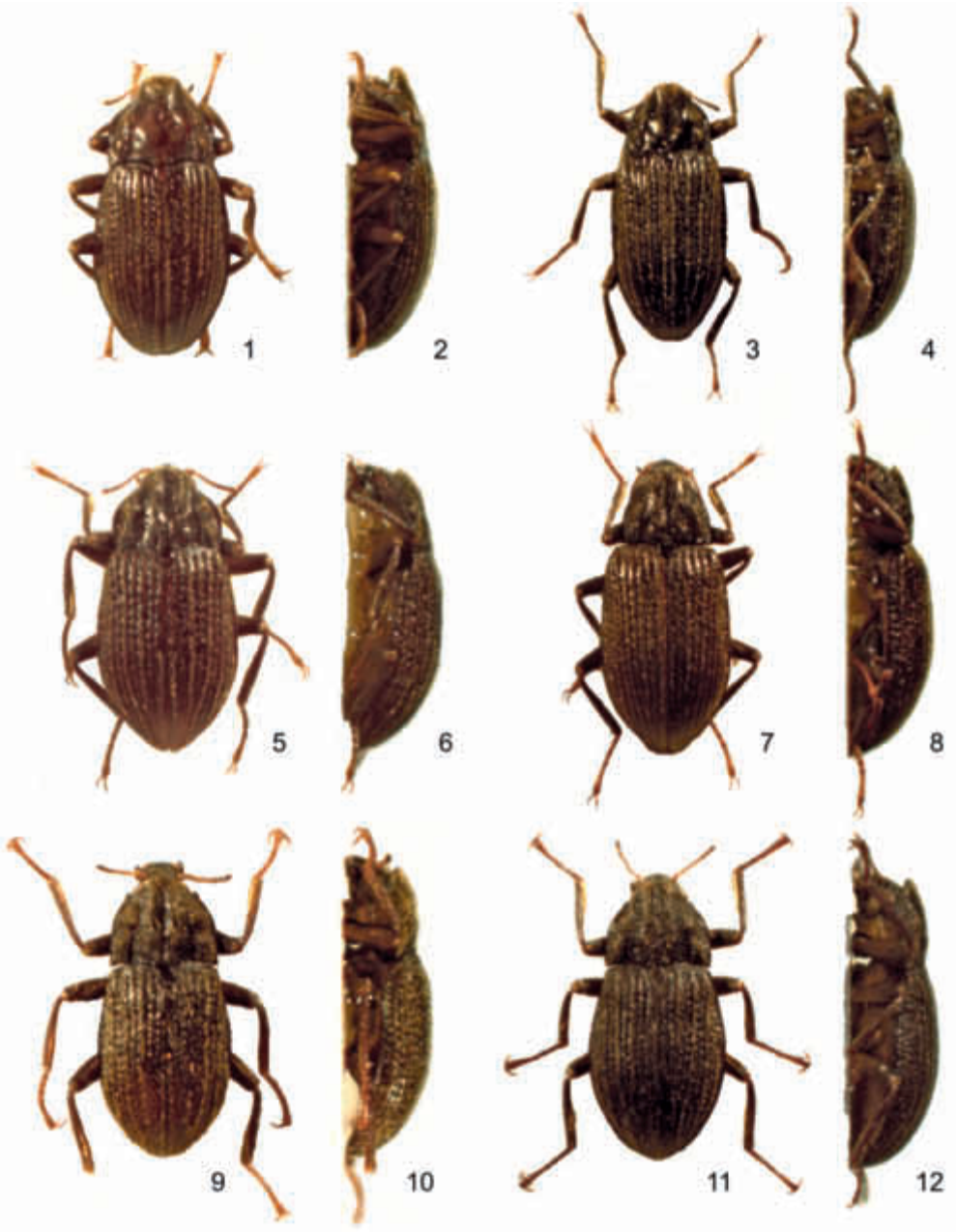
DESCRIPTION: TL/EW 1.96–2.13 (2.07). Coloration of body black, but ventral surface, antennae, mouth parts and legs reddish brown to blackish brown; antennae and tarsi paler.

Head almost flat on dorsal surface, punctuate and pubescent. Eyes distinctly small in size; the distance between eyes about 1.98 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 : 2.4 : 1.6 : 1.0 : 1.0 : 1.0 : 1.1 : 1.0 : 1.6 : 1.6 : 3.1. Clypeus transverse, about 2.87 times as wide as long. Labrum transverse, about 2.00 times as wide as long. Pronotum transverse, slightly convex, with deep and wide median longitudinal impression extending from base to apex, and without prescutellar pits; lateral part densely granulate; antero-lateral corners moderately produced anteriad. PW/PL 1.20–1.27 (1.23); sublateral carinae 0.35 (n = 1) times as long as PL. Elytra elongate oval; moderately convex; intervals distinctly rugose, moderately convex; punctate striae deep; strial punctures of each stria relatively small and deep; basal part of third interval wider than fourth (Fig. 18); EL/EW 1.37–1.49 (1.45); EL/PL 2.25–2.36 (2.31); EW/PW 1.27–1.33 (1.30).

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

Aedeagus as illustrated (Figs. 27–28); phallobase smooth at lateral and ventral surface; penis about 1.38 times as long as phallobase, dilated at base, gradually narrowed to basal 1/2, widely dilated at apical 1/2 and apical part somewhat rounded, curved ventrad in lateral view (Fig. 28); parameres slender, about 0.78 times as long as penis.

Ovipositor as illustrated (Fig. 29); coxite about 6.12 times as long as stylus; valvifer about 11.22 times as long as stylus.



Figs. 1–12: Habitus of *Heterlimnius trachys* species group. 1–4) *H. horii*; 1) BF female, paratype, dorsal view; 2) same, lateral view; 3) MF female, paratype, dorsal view; 4) same, lateral view; 5–8) *H. quadrigibbus*; 5) BF male, holotype, dorsal view; 6) same, lateral view; 7) MF male, paratype, dorsal view; 8) same, lateral view; 9–10) *H. trachys*; 9) BF male, dorsal view; 10) same, lateral view; 11–12) *H. yokoii*; 11) BF female, paratype, dorsal view; 12) same, lateral view.

MEASUREMENTS: BF (n = 10): TL 2.70–2.94 (2.80) mm; PL 0.81–0.90 (0.85) mm; PW 0.99–1.08 (1.04) mm; EL 1.87–2.04 (1.95) mm; EW 1.28–1.42 (1.35) mm.

DISTRIBUTION (Fig. 30): China (Yünnan).

ETYMOLOGY: The specific name is dedicated to Mr. Hiroaki Yokoi for his kind help in my study.

REMARKS: This new species is easily distinguishable from the other species by the following characteristics: lateral part of pronotum densely granulate; intervals of elytra strongly rugose (Fig. 18); aedeagus as in Fig. 27.

Discussion

According to SANDERSON (1954) *Heterlimnius* is distinguished from *Optioservus* SANDERSON by the number of larval ventral sclerites of meso- and metathorax: in *Heterlimnius* there are five sclerites, while there are three in *Optioservus*. Unfortunately, the larvae of some species of *Heterlimnius* are still unknown. In addition to the larval characteristics KAMITE (2009) provided some adult features to distinguish these two genera. However, most of these adult characters are ambiguous. So far, no phylogenetic analysis has been carried out, and therefore the relationship between *Heterlimnius* and *Optioservus* remains unclear.

The four species discussed in this paper should be included in *Heterlimnius* due to the following adult features: radius posterior short (only BF known in *H. trachys* and *H. yokoii*); head punctate; basal part of third elytral interval wider than fourth or subequal in width; ventrite 5 rugose.

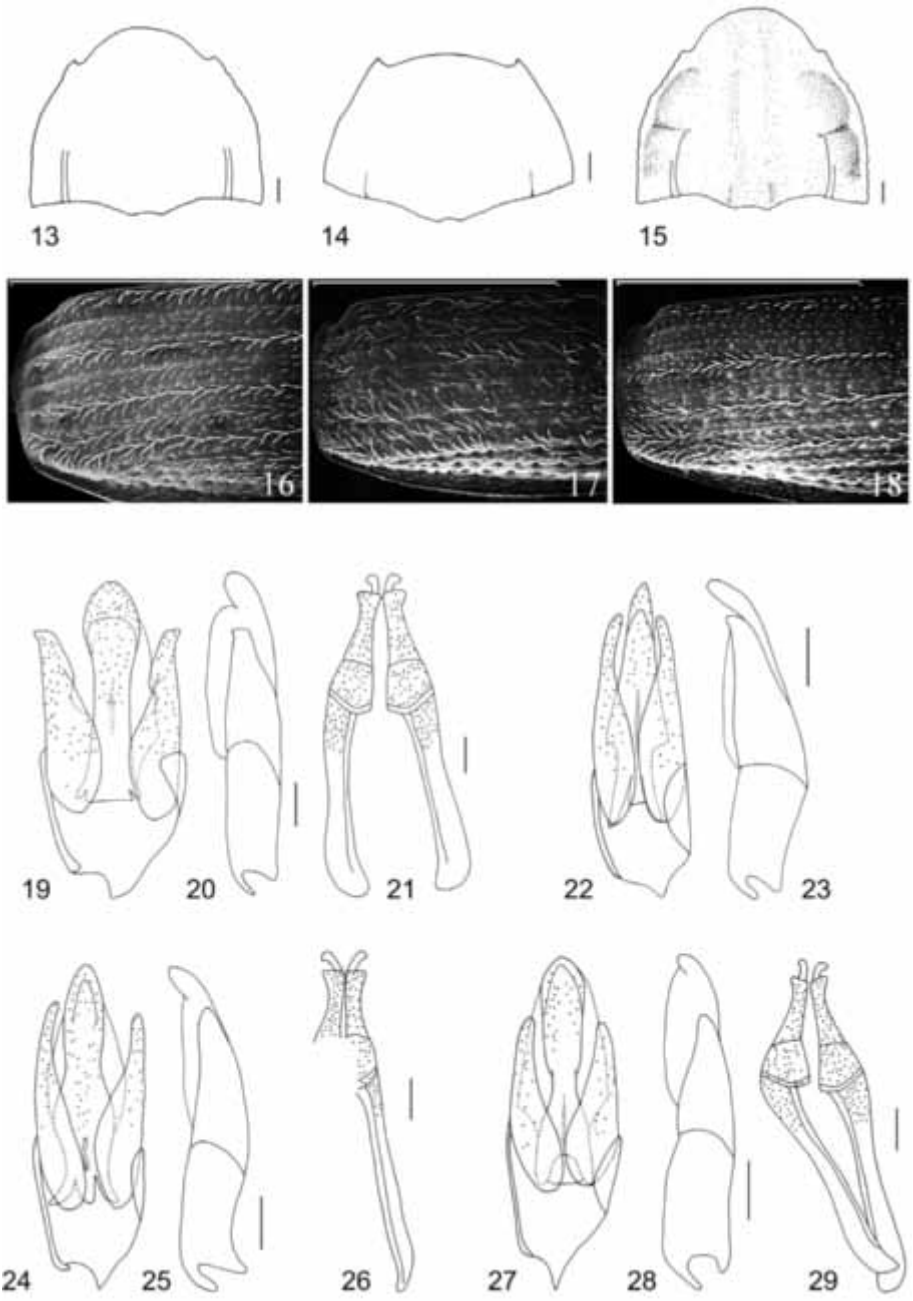
The four species of the *Heterlimnius trachys* group share unique pronotal characteristics, and are easily distinguishable from the previously known two species groups of the genus *Heterlimnius* by the following characteristics: anterior pronotal margin strongly produced anteriad; lateral area with tubercles in basal 1/3 and 2/3; sublateral carinae fine in anterior half (Fig. 15).

The three species groups can be distinguished as follows:

Heterlimnius corpulentus species group: Pronotum as in Fig. 13, without tubercles; anterior margin moderately produced anteriad; sublateral carinae long. Elytra with clearly defined striae. Mesoventrite and anterior part of mesoventral groove long. Presently, this group includes seven species from North America and Asia.

Heterlimnius amabilis species group: Pronotum as in Fig. 14, without tubercles; anterior margin weakly produced anteriad, sublateral carinae obliterated. Elytral striae not clearly defined. Mesoventrite and anterior part of mesoventral groove wide and short. Three species are known from China and Vietnam.

Heterlimnius trachys species group: Pronotum as in Fig. 15; anterior margin strongly produced anteriad; sublateral carinae long, but fine at anterior half; lateral area with tubercles in basal 1/3 and 2/3. Elytra with clearly defined striae. Mesoventrite and anterior part of mesoventral groove long. Four species are known from China and Afghanistan.



Figs. 13–15: Pronotum. 13) *H. corpulentus*; 14) *H. amabilis*; 15) *H. trachys*. Scales = 100 µm.
Figs. 16–18: Left elytron, anterior. 16) *H. horii*; 17) *H. trachys*; 18) *H. yokoii* Scales = 1.0 mm.
Figs. 19–29: *Heterlimnius trachys* species group, aedeagus in dorsal view (19, 22, 24, 27), aedeagus in lateral view (20, 23, 25, 28), and ovipositor (21, 26, 29). 19–21) *H. horii*; 22–23) *H. quadrigibbus*; 24–26) *H. trachys*; 27–29) *H. yokoii.* Scales = 100 µm.

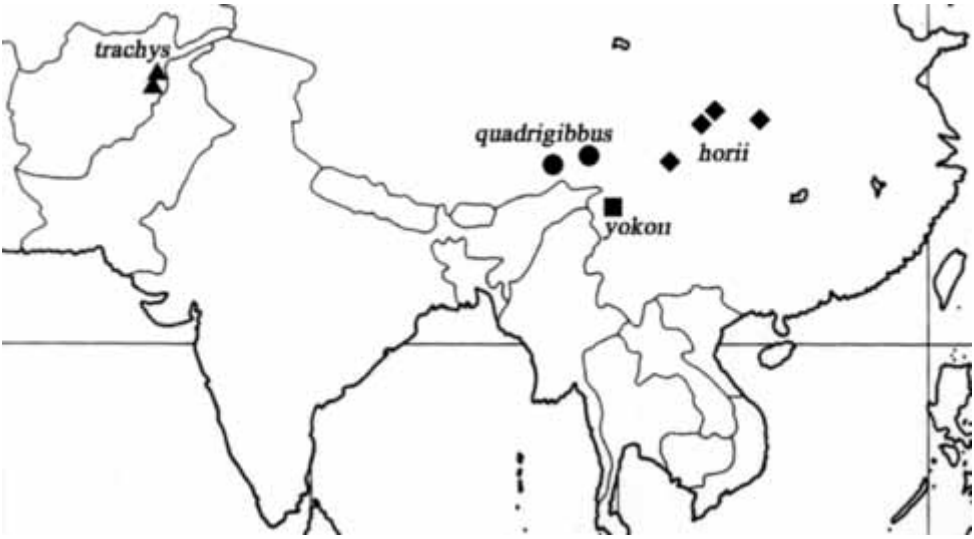


Fig. 30: Distribution map of *Heterlimnius trachys* species group.

Key to the species of the *Heterlimnius trachys* species group

1 Lateral part of pronotum densely granulate. Intervals of elytra strongly rugose (Fig. 18). Aedeagus as in Fig. 27; penis dilated at base, gradually narrowed to basal 1/2, widely dilated in apical half ..... ***yokoii* sp.n.**

– Lateral part of pronotum more sparsely and weakly granulate. Intervals of elytra less rugose..... 2

2 Pronotum without median longitudinal impression. Aedeagus as in Fig. 19; basolateral apophyse of penis not developed; apex of parameres truncate. Body larger, TL 2.90–3.52 mm ..... ***horii* sp.n.**

– Pronotum with median longitudinal impression. Basolateral apophyse of penis developed; apex of parameres rounded. Body smaller, TL 2.69–2.92 mm 3

3 Pronotal median longitudinal impression extending from basal 1/3 to apex. Aedeagus as in Fig. 22; penis abruptly dilated at basal 1/3, then gradually narrowed and apical part somewhat pointed ..... ***quadrigibbus* sp.n.**

– Pronotal median longitudinal impression extending from base to apex. Aedeagus as in Fig. 24; penis gradually dilated at basal 1/3, gradually narrowed to basal 5/8 and apical part somewhat rounded ..... ***trachys* (JANSSENS)**

Check list of the genus *Heterlimnius* of the world

<u>*Heterlimnius corpulentus* species group</u>

ater (NOMURA, 1958)	Japan
corpulentus (LECONTE, 1874)	USA, Canada
ennearthrus KAMITE, 2009	Kazakhstan
hasegawai (NOMURA, 1958)	Japan, Russian Far East, China, Korea
hisamatsui KAMITE, 2009	China
jaechi KAMITE, 2009	Bhutan, India
shepardi KAMITE, 2009	China

<u>*Heterlimnius amabilis* species group</u>	
amabilis KAMITE, 2011	China
ikedai KAMITE, 2011	China
vietnamensis KAMITE, 2011	Vietnam
<u>*Heterlimnius trachys* species group</u>	
horii sp.n.	China
quadrigibbus sp.n.	China
trachys (JANSSENS, 1959) comb.n.	Afghanistan
yokoii sp.n.	China

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