

NEW MESOZOIC WATER SCAVENGER BEETLES FROM THE YIXIAN FORMATION IN CHINA (COLEOPTERA: HYDROPHILOIDEA)

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Abstract.— One new fossil genus and four new fossil species are described from the Late Tithonian-Berriasian Yixian Formation (Huangbanjigou) in China: *Sinosperchopsis silinae* gen. et sp. nov., *Hydrophilopsia shatrovskiyi* sp. nov., *H. hydraenoides* sp. nov. and *H. gracilis* sp. nov. (Coleoptera: Hydrophiloidea). The genus *Sinosperchopsis* is compared with all Mesozoic hydrophiloid genera known so far.



Key words.— Coleoptera, Hydrophiloidea, new genus, new species, fossil, Mesozoic, Jurassic-Cretaceous boundary, Tithonian, Berriasian, China.

INTRODUCTION

Ten genera of water scavenger beetles (superfamily Hydrophiloidea sensu Hansen 1991), including 21 species, have been described so far from the Mesozoic based on adult fossil specimens. The majority of these fossils comes from the Russian and Mongolian Lower Jurassic to Lower Cretaceous localities (Ponomarenko 1977, 1985a, 1986, 1987, 1990, Prokin 2009) and few others have been described from the German localities (Sohlnhofen: Ponomarenko 1985b; eastern Lower Saxony: Bode 1953, Ponomarenko 1992) and Israel (Tayasir volcanics: Dobruskina *et al.*, 1997). Only two species were recorded from the Mesozoic of China: *Cretohelophorus yanensis* Ren, Lu et Ji, 1995 from the Chongqing Resevior, Beijing Lushangfen Formation, Early Cretaceous) and *Orphnospercheus longjingensis* Hong, 1992 from the Dalazi,

Yanji County (Dalazi Formation, Early Cretaceous) (Ren *et al.* 1995; Hong 1992). The identity of both these species are currently unclear, pending a study of the type specimens which are not accessible at present.

During the studies of the fossil collection of Capital Normal University (Beijing, People's Republic of China), four undescribed species of the superfamily Hydrophiloidea sensu Hansen, 1991 belonging to two genera were found among the material from the locality of Huanbanjigou, Yixian Formation (Chaomidian Village, Shangyuan County, Beipiao City, Liaoning Province; Late Tithonian-Berriasian, ca. 140–145 of millions years ago) consists of mainly of lacustrine sediments intercalated with volcanoclastics. These hydrophiloid species are described below. A detailed characteristics of the locality and its stratigraphy is provided by Kirejtshuk *et al.* (2010).

The majority of the material examined is deposited in the collection of the Capital Normal University, Beijing, China; few specimens deposited in the Palaeontological Institute of the Russian Academy of Science, Moscow, Russia, are indicated by "PIN" at the end of their inventory numbers.

Fossils were examined using a Leica MZ12.5 dissecting microscope. Photographs were taken with a Nikon DXM1200C digital camera.

The paper was prepared by A. Prokin and M. Fikáček, D. Ren was responsible for management of collection at CNU and supported the preparation of the photographs.

TAXONOMY

Order **Coleoptera** Linnaeus, 1758

Superfamily **Hydrophiloidea** Latreille, 1802

Sinosperchopsis gen. nov.

Etymology. The generic name is formed from the Latin name of China and the generic name *Sperchopsis*, a representative of the hydrophilid tribe Sperchopsini. Gender feminine.

Type species. *Sinosperchopsis silinae* sp. nov.

Description. Rather small, broadly oval brown beetle. Head transverse, frontoclypeal suture developed, angle between branches of the suture very obtuse. Labrum not exposed in dorsal view. Eyes small. Antenna with loosely segmented club consisting of three antennomers. Maxillary palpi as long as or shorter than antennae, visible part of palpus with 3 palpomeres; palpomeres symmetrical, palpomere 4 as long as palpomeres 2 and 3 combined. Gula moderately wide, gular sutures separated throughout. Length of head subequal (0.8–1.0×) to length of pronotum. Pronotum transverse, 1.7–2.0 times as wide as long, with rounded lateral margins and nearly rectangular posterolateral corners. Anapleural sutures of mesothorax well developed, convergent anteriorly. Mesoventrite not contacting metaventrite laterally of mesocoxal cavities. Elytra widest in anterior half; anterior margin of each elytron crenulate, lateral margin serrate in anterior third; elytral disc with ten regular grooves. Procoxae contiguous medially. Length of protibia equal to length of femur, with rows of denticles and hairs and two curved spurs at distal apex. Meso- and metatibia with denticulate margins similar to that of protibia. Protarsus with long tarsomere 5, equal in length to tarsomeres 1–4 combined. Claws of all legs arcuately curved. Mesocoxae large, rounded, contiguous medially. Mesotibia longer than mesofemur. Mesotarsomere 5 about 0.6 times as long as mesotarsomeres 1–4

combined. Metacoxae narrowly separated, reaching lateral body margin and completely dividing metaventrite from abdomen. Metatibia slightly longer than metafemur. Metatarsomere 1 much shorter than tarsomere 2–5 each, metatarsomere 2 about 3 times as long as metatarsomere 1 and equal to combined length of tarsomeres 3 and 4. Metatarsomere 5 about as long as metatarsomeres 1, 3 and 4 combined. For body measurements see Table 1.

Species composition. One species from Late Tithon-Berrias of China (Huanbanjigou of Yixian Formation).

Diagnosis. The following characters justify the placement of the genus in the Hydrophiloidea and distinguish it from scarabaeoid taxa: frontoclypeal suture on the head clearly visible (as in some Glaphyridae), but antenna clubbed and not lamellate, legs without carinae, 5-segmented tarsi with short first and long last tarsomere; abdomen with five ventrites, longer than metaventrite; mesocoxae rather small, rounded; anapleural sutures of mesothorax present.

The most important character which indicates the new genus as a member of the Hydrophiloidea and distinguishes it from the Histeroidea (and another Staphiliniformia) is the mesoventrite strongly narrowing anteriorly.

Among Hydrophiloidea, the representatives of Georissidae, Epimetopidae and several groups of the hydrophilid subfamily Sphaeridiinae differ from *Sinosperchopsis* by compact antennal club. The new genus also differs from most Georissidae and all Epimetopidae as well as from the Helophoridae, Hydrochidae and the Mesozoic genera *Cretohelophorus* Ponomarenko, 1987 and *Mesohelophorus* Ponomarenko, 1977 in the absence of granulate sculpture on the dorsal side of the head and pronotum. It differs from the "derived" Sphaeridiinae also by the presence of the anapleural sutures of the mesothorax.

The new genus differs from recent Spercheidae in the absence of medially emarginate anterior margin of clypeus, and long second metatarsomere. Based on the general body shape and crenulate lateral margins of elytra and rather long metatarsomere 2, *Sinosperchopsis* resembles the recent representatives of the hydrophilid tribe Sperchopsini; it differs from them by labrum not exposed in dorsal view.

The new genus is most similar to the Mesozoic *Zetemnos* Bode, 1953 (= *Mesosperchus* Ponomarenko, 1977), from which it differs by pronotum widest posteriorly, not so long tarsomeres 5 and the presence of the crenulation on the anterior margin of elytron and serrate lateral margins of each elytron. The latter characters distinguish *Sinosperchopsis* also from all other Mesozoic hydrophiloid genera. In addition, following diagnostic characters may be mentioned to distinguish other Mesozoic hydrophiloid genera from *Sinosperchopsis*:

- *Cretohelophorus* and *Prospercheus* Prokin, 2009: frontoclypeal suture absent (present in *Sinosperchopsis*);
- *Mesydra* Ponomarenko, 1977: abdomen with six ventrites (five ventrites in *Sinosperchopsis*), sides of pronotum and last abdominal ventrite with long hairs (without hairs in *Sinosperchopsis*);
- *Paraspercheus* Ponomarenko, 1977, *Cretospercheus* Ponomarenko in Dobruskina *et al.*, 1997 and *Prospercheus*: metaventrite short, i.e. meso- and metacoxae rather close to each other (mesoventrite longer in *Sinosperchopsis*); body larger than *Sinosperchopsis* (5.0 mm in *Cretospercheus*, 8.4 mm in *Prospercheus*, 13.0–15.0 mm in *Paraspercheus*);
- *Hydrophilopsia* Ponomarenko, 1987: elytra with dark longitudinal striae along elytral series (elytra unicolored in *Sinosperchopsis*), legs with natatory setae (without such setae in *Sinosperchopsis*), labrum exposed dorsally (not exposed in dorsal view in *Sinosperchopsis*);
- *Aposphinctus* Bode, 1953: mesocoxae widely separated (contiguous medially in *Sinosperchopsis*).

Sinosperchopsis silinae sp. nov.
(Figs 1–3, 10–12)

Etymology. This species is named after the hydroentomologist Alla Ye. Silina.

Material examined. Holotype: CNU COL LB 2010003, negative print of beetle (print of ventral side). Paratype: CNU COL LB 2010001, positive print of beetle. Additional specimens: CNU COL LB 2010002 (2010010): print of complete beetle; CNU COL LB 2010028 (PIN): negative print of beetle.

Description. See generic description. Body twice as long as wide. Pronotum 1.7–2.0 times as wide as long. Metaventrite 1.2–1.4 times as long as mesoventrite, with well-developed metaventral lines.

Size in mm. Length 4.1–4.6; width 2.1–2.2; length of elytra 3.1–3.4.

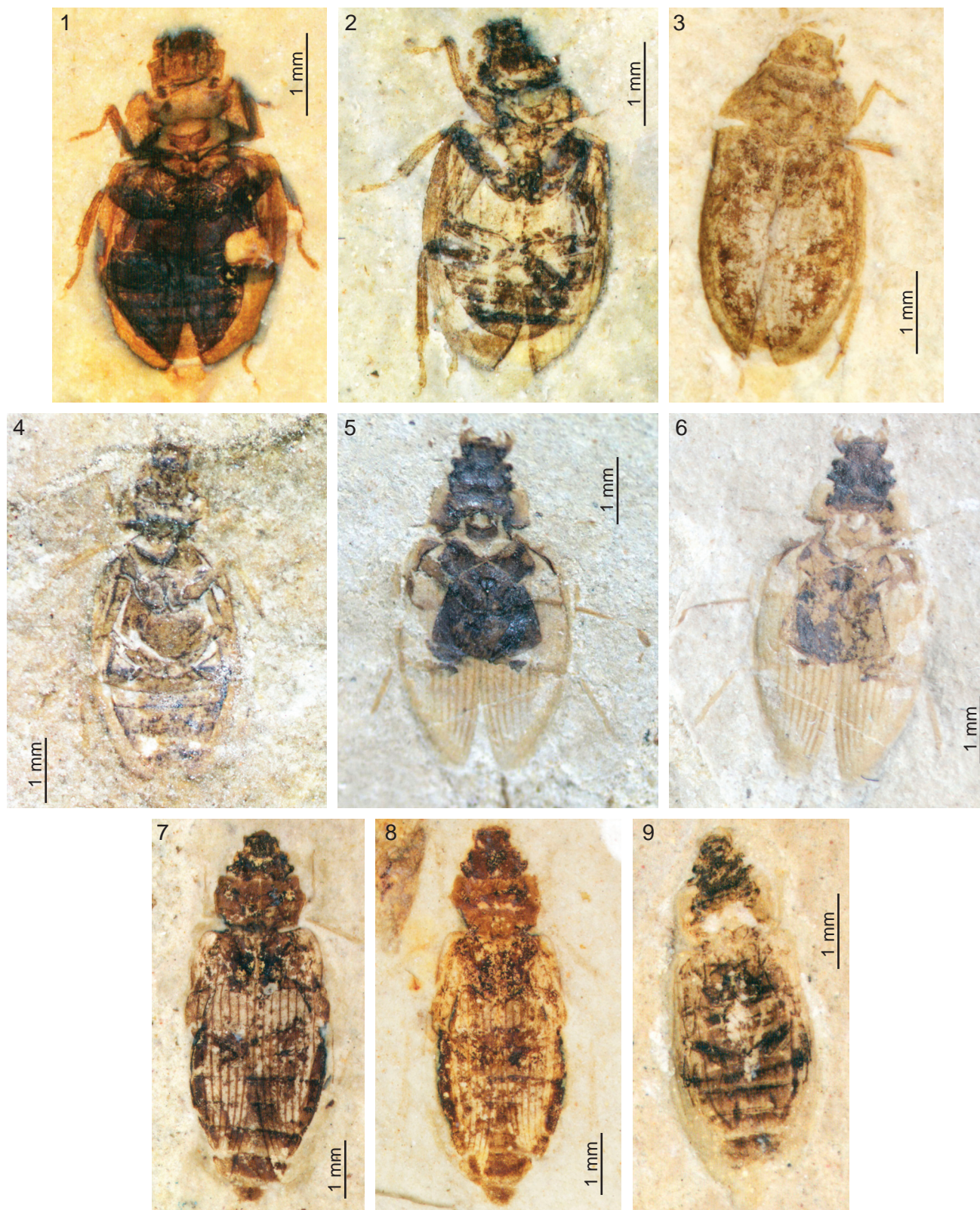
Hydrophilopsia Ponomarenko, 1987

Genus *Hydrophilopsia* was described by Ponomarenko (1987) to accommodate three Mesozoic hydrophiloid species from Upper Jurassic to Lower Cretaceous, *H. longitarsalis* Ponomarenko, 1987, *H. baisensis* Ponomarenko, 1987 and *H. mongolica* Ponomarenko, 1987. An additional species, *H. bontsganica* Prokin, 2009, was described recently from the Lower Cretaceous locality of Bon-Tsagan (Mongolia).

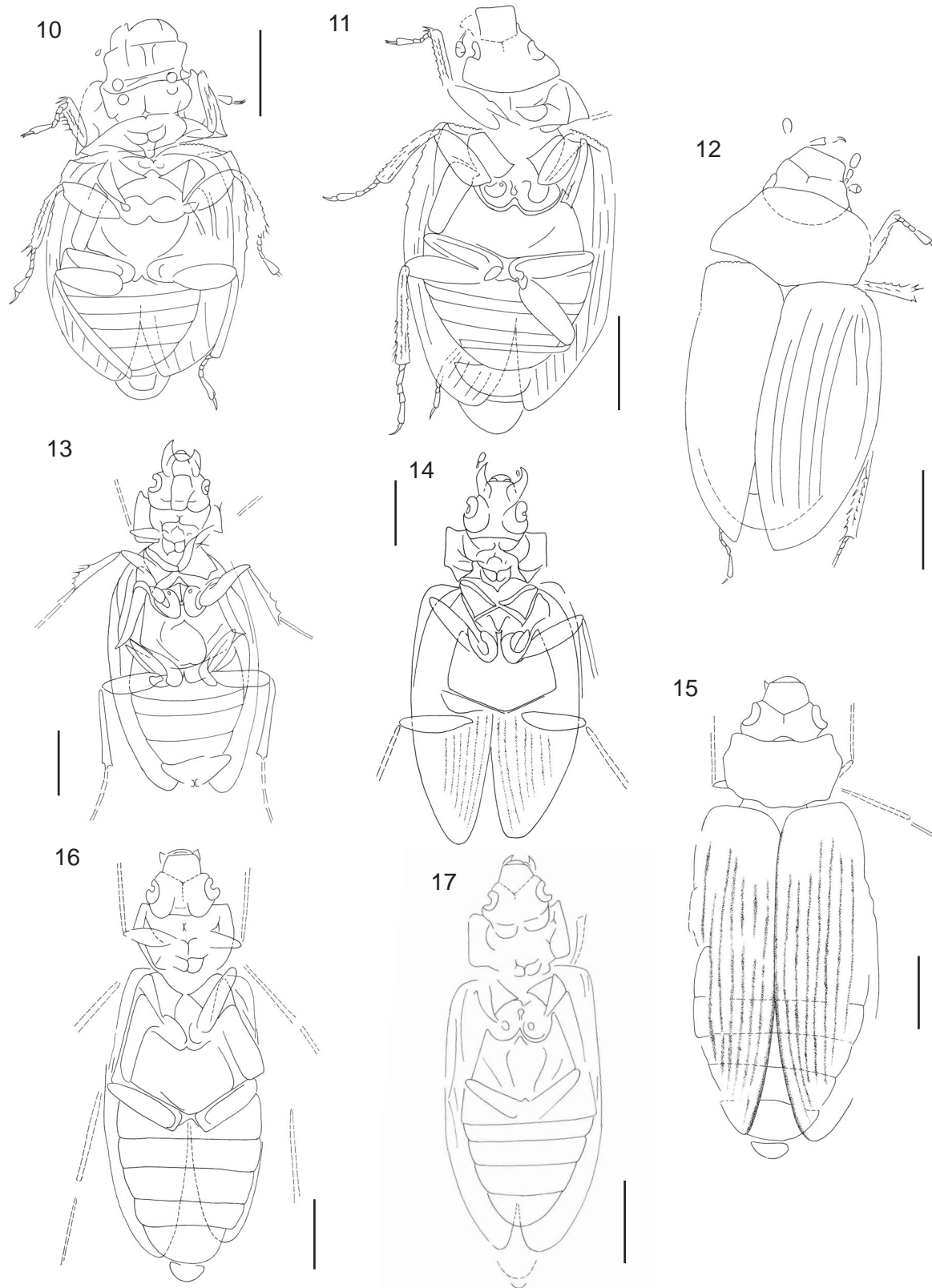
Three species described below seem to fit well the previously described species by the following characters: head with protruding eyes, frontoclypeal suture developed, labrum exposed and visible in dorsal view; prosternal bridge anterior to procoxae wide;

Table 1. Measurements of the fossils examined (mm). Abbreviations: TL (total body length), EL (length of elytron), TW (maximum body width), HL (length of head at middle), PL (length of pronotum at midline), PW (maximum width of pronotum), MSL (length of mesoventrite at midline), MTL (length of metaventrite at middle).

	TL	EL	TW	HL	PL	PW	MSL	MTL	PW/PL	HL/PL	MSL/MTL
<i>Sinosperchopsis silinae</i> gen. et sp. nov.											
2010003	4.60	2.60	2.22	0.70	0.84	1.72	0.60	0.70	2.05	0.83	0.86
2010001	4.13	3.08	2.21	0.81	0.77	1.35	0.48	0.67	1.75	1.05	0.72
2010028	4.16	2.86	2.06	0.78	0.98	1.67	–	–	1.70	0.80	–
2010002(2010010)	3.62	2.43	1.75	0.72	0.75	1.50	–	–	2.00	0.96	–
<i>Hydrophilopsia shatrovskiyi</i> sp. nov.											
2010242	5.40	3.78	2.38	0.94	0.81	1.46	0.68	0.97	1.80	1.16	0.70
2010004	5.61	3.71	2.61	1.05	0.80	1.63	0.61	1.02	2.04	1.31	0.60
2010016(2009199)	5.00	3.50	2.56	0.76	0.88	1.50	0.68	0.82	1.70	0.86	0.83
2010012	5.46	3.53	2.33	1.05	–	–	–	–	–	–	–
<i>Hydrophilopsia hydraenoides</i> sp. nov.											
2010021	6.15	4.51	2.56	0.90	0.88	1.63	0.73	0.98	1.85	1.02	0.75
2010026	5.82	4.10	2.26	0.97	0.97	1.49	0.77	0.97	1.54	1.00	0.79
2009089	5.32	3.83	2.55	0.91	0.87	1.49	0.64	0.85	1.71	1.04	0.75
<i>Hydrophilopsia gracilis</i> sp. nov.											
2010018	4.90	3.51	2.02	0.79	0.74	1.28	0.42	0.92	1.73	1.07	0.46
2010067	4.44	3.24	2.04	0.68	–	–	0.56	0.78	–	–	0.72
2010068	4.61	3.26	1.90	0.82	0.61	1.29	0.41	0.65	2.11	1.34	0.63
2010030	4.23	3.33	1.54	0.69	0.58	0.96	0.42	0.90	1.65	1.19	0.47



Figures 1–9. Habitus of (1–3) *Sinosperchopsis silinae*, (4–6) *Hydrophilopsia shatrovskiyi*, (7–8) *Hydrophilopsia hydraenoides*, (9) *Hydrophilopsia gracilis*. (1) Holotype CNU COL LB 2010003, (2) paratype CNU COL LB 2010001, (3) additional specimen CNU COL LB 2010028; (4) holotype CNU COL LB 2010242, (5) paratype CNU COL LB 2009199, (6) paratype CNU COL LB 2010016; (7) holotype CNU COL LB 2010021, (8) paratype CNU COL LB 2010026, (9) holotype CNU COL LB 2010018. Photographs by A. Prokin.



Figures 10–17. Details of the structure of: (10–12) *Sinosperchopsis silinae*, (13–14) *Hydrophilopsia shatrovskiyi*, (15–16) *Hydrophilopsia hydraenoides*, (17) *Hydrophilopsia gracilis*. (10) Holotype CNU COL LB 2010003, (11) paratype CNU COL LB 2010001, (12) additional specimen CNU COL LB 2010028; (13) holotype CNU COL LB 2010242, (14) paratype CNU COL LB 2009199; (15) holotype CNU COL LB 2010021, (16) paratype CNU COL LB 2010026; (17) holotype CNU COL LB 2010018. Scale bar 1.0 mm.

anapleural sutures converging anteriad, meeting at anterior margin of mesothorax; abdomen with five ventrites, elytra pale with longitudinal dark stripes. We therefore place all three new species to the genus *Hydrophilopsia* for the time being, even through some of the species bear characters unusual for the aforementioned *Hydrophilopsia* species from Russian and Mongolian localities (see Discussion for details).

Hydrophilopsia shatrovskiyi sp. nov.
(Figs 4–6, 13, 14)

Etymology. The species is named after the entomologist Alexander G. Shatrovskiy, a specialist on hydrophiloid beetles.

Material examined. Holotype: CNU COL LB 2010242, negative print of beetle. Paratypes: CNU COL LB 2010004, positive print of beetle; CNU COL LB 2010016 (2009199): complete print of beetle; CNU COL LB 2010012 (PIN): negative print of beetle.

Description. Head dark. Pronotum pale, quadrangular, with slightly rounded angles. Mesoventrite with rhomboid structure and with median keel on postero-median portion. Striae on elytra regular, slightly darkened. Epipleura broad at shoulders, narrowing posteriad, reaching level of abdominal ventrite 3.

Size in mm. Length 5.0–5.6; width 2.3–2.6; length of elytra 3.5–3.8.

Diagnosis. *Hydrophilopsia shatrovskiyi* sp. nov. is similar to *H. hydraenoides* sp. nov. in body size and proportions, but differs from it by the shape of the pronotum (lateral margins nearly straight in *H. shatrovskiyi*, angulate in *H. hydraenoides*); the shape of the pronotum does not vary between sexes within the Hydrophiloidea. It differs from *H. gracilis* sp. nov. by the much bigger body size and the presence of dark striae on elytra.

Hydrophilopsia hydraenoides sp. nov.
(Figs 7, 8, 15, 16)

Etymology. The specific epithet is derived from the generic name *Hydraena* (Coleoptera: Hydraenidae) which has a similar shape of the pronotum.

Material examined. Holotype: CNU COL LB 2010021, positive print of beetle. Paratype: CNU COL LB 2010026, negative print of the beetle. Additional specimen: CNU COL LB 2009089: a negative print of the beetle.

Description. Head black. Pronotum brown, with distinctly angulate lateral margins. Mesoventrite with weakly developed longitudinal keel. Elytral series and sutural margin distinctly dark. Epipleura broad at shoulders.

Size in mm. Length 5.8–6.1; width 2.3–2.6; length of elytra 3.8–4.5.

Diagnosis. *Hydrophilopsia hydraenoides* differs from all other species of the genus by the angulate lateral margins of pronotum.

Hydrophilopsia gracilis sp. nov.
(Figs 9, 17)

Etymology. *Gracilis*, Latin, means slender, reflecting the body shape of this species.

Material examined. Holotype: CNU COL LB 2010018, negative print of beetle. Paratype: CNU COL LB 2010067, negative print of beetle. Additional specimens: CNU COL LB 2010068: negative print of beetle; CNU COL LB 2010030: negative print of beetle (PIN).

Description. Head brown. Pronotum pale, quadrangular, with slightly rounded angles. Mesoventrite with weakly developed longitudinal keel. Striae on elytra regular, not coloured. Epipleura narrow.

Size in mm. Length 4.2–4.9; width 1.5–2.4; length of elytra 3.2–3.5.

Diagnosis. *Hydrophilopsia gracilis* differs from the other species of the genus by its small body size and from most species (possibly except *H. longitarsalis*) by the absence of dark stripes of elytra.

DISCUSSION

Although the fossil history of the superfamily Hydrophiloidea is far from well understood, the number of known species as well as the morphological heterogeneity of the Jurassic and Cretaceous taxa suggests that the group was already rather diverse in the Mesozoic. The recent findings from the Chinese localities dated to the Jurassic-Cretaceous boundary and surprisingly containing numerous undescribed hydrophiloid taxa (both on generic and species level) seem to support this presumption. This paper is the first of the series of studies focused on the valuable Chinese material, which will be hopefully very helpful for understanding the fossil history as well as the phylogenetic relationships within the superfamily Hydrophiloidea.

The phylogenetic placement of the above described Mesozoic hydrophiloid taxa remains unclear for the time being. The genus *Sinosperchopsis* seems to bear some characters typical for the hydrophilid tribe Sperchopsini (serrate lateral elytral margins, shape of anapleural sutures of mesothorax, rather long metatarsomere 2), but differs from them clearly by the concealed labrum. In some aspects (body proportions,

shape of anapleural sutures of mesothorax, short and stout legs) it also resembles Spercheidae, but the differences in antennal morphology and proportions of gula seem to exclude this placement as well. A similar problem, also caused by the combination of characters unusual for recent hydrophiloid taxa, is found in *Hydrophilopsia*, which resembles recent *Berosini* in the general appearance, body shape and the morphology of the head and mesothorax, but seems to differ drastically from them by the morphology of the prothorax (especially by a rather long prosternum). Therefore, we are currently placing both genera as Hydrophiloidae *incertae sedis*. Their position will be hopefully at least partially solved after a detailed morphological revision of the previously described taxa and after finishing the studies of the fossils from Chinese localities, both of which are in preparation by the first two authors. For that reason, we have also placed three of the new species described within this paper into the genus *Hydrophilopsia*, even though the Chinese species exhibit some differences from the previously known representatives from Russian and Mongolian, e.g. the presence of the rhomboid structure with the median keel on the posteromedian portion of the mesoventrite in *H. shatrovskiyi* and the angulate lateral margins of pronotum in *H. hydraenoides*.

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