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Description of *Diaulota submarina* sp. nov. (Coleoptera: Staphylinidae: Aleocharinae) on Korean coasts

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Abstract

Taxonomy of the intertidal *Diaulota* Casey is briefly reviewed and 12 species are listed including a new species. *Diaulota submarina* **sp. nov.** is described with illustrations of diagnostic characters and a revised key to the species of *Diaulota* is provided. The new species is remarkably similar to *D. uenoi* (Sawada) and indistinguishable by external morphological characters. They can be regarded as cryptic species.

Key words: *Diaulota*, taxonomy, new species, cryptic, intertidal

Introduction

The intertidal genus *Diaulota* Casey contains 11 species and occurs on the rocky shores along the Pacific coasts of Northern Hemisphere (Frank and Ahn, 2011). Since the genus was established by Casey (1893), they were revised (Ahn, 1996) and three additional species were described on the East Asian coasts (Song *et al.*, 2018; Yoo and Ahn, 2021). Song *et al.* (2018) suggested that *D. aokii* Sawada and *D. hokkaidona* Ahn and Ôhara were cryptic species. While working on the phylogeny of *Diaulota*, I recognized that there were two lineages, each with a long branch within *D. uenoi* (Sawada) clade, which implied that there might be cryptic species (unpublished data). They were indistinguishable by external morphological characters. Therefore, I examined the external shape and internal structure of male genitalia of those specimens more in detail.

As a result of this study, I found that *D. uenoi* published by Ahn (1996) was a misidentification and it should be treated as *Diaulota submarina* **sp. nov.** *Diaulota uenoi* and *D. submarina* **sp. nov.** could be another example of cryptic species in the coastal staphylinids.

In this paper, I compare *D. submarina* **sp. nov.** with *D. uenoi* and describe the new species with illustrations of diagnostic characters. Also, I provide an updated key and checklist of *Diaulota* from the world.

Material and methods

All the examined specimens including type series are deposited in the Chungnam National University Insect Collection (CNUIC), Daejeon, Korea. Terms used here generally followed Sawada (1972), but I followed Ashe (1984) in some cases, especially for the aedeagus and mouthparts.

Taxonomy

Diaulota submarina sp. nov.

(Figs. 1–4)

Diaulota uenoi: Ahn, 1996: 284; Frank and Ahn, 2011: 26; Ahn *et al.*, 2017: 306; Park and Lee, 2021: 240 [misidentification].

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Description. Small, body length 2.5–2.9 mm. Body more or less narrow but robust, long setae densely pubescent (Fig. 1). Body reddish brown with blackish brown abdominal tergites VI–VII. Head slightly deflexed, 1.2 times as long as wide (Fig. 2A), sculpture reticulate, about 3 pairs of long filiform setae present on each side, infraorbital carina present (Fig. 2B). Antennomeres 4–5 more or less subquadrate, 6–10 transverse. Eye small, 0.2 times as long as head (Fig. 2A), minute setae present between facets. Labrum (Fig. 3A) large, semicircular, 12 long and macrosetae and 4–5 short and microsetae present on each side of midline. Mandibles (Fig. 3B) narrow and elongate, more or less symmetrical, small median tooth present. Maxilla (Fig. 3C) with galea and lacinia elongate, almost equal in length; galea corneous, apex and internal surface densely pubescent with long filiform setae; lacinia more or less acute, internal surface with comb of single row of about 8 well separated spines followed by several setae, a distinctive row of several setae present on mesal half of lacinial surface; maxillary palpus with 4 articles, robust, article 3 incrassate distally and longer than article 2, article 4 narrowed distally. Labial palpi (Fig. 3D) with 3 distinct articles, palpomere 1 slightly longer than wide, palpomere 2 narrower than 1 and almost 2.0 times as long as 1, palpomere 3 narrower than 2 and slightly longer than 1; ligula simple and elongate with 2 minute setae; twin pores, median pore, and distal pore indistinctly present; medial setae absent on prementum, real pores and setal pores present, basal pores absent, pseudopores absent in very narrow median area, about 4 pseudopores present on each side; a pair of indistinct comb-like hypoglossae present. Mentum (Fig. 3D) without v setae, anterior margin shallowly emarginate, several setae present, many punctures present. Submentum with numerous punctures and setae. Neck absent. Pronotum 0.9 times as long as wide, narrowest at base and widest near one third, basal margin almost straight but slightly prolonged posteriorly on median region, apical margin slightly prolonged anteriorly; long setae subparallel, uniformly distributed and apical half directed anteriorly, basal half directed posteriorly in a narrow median strip, others curve correspondingly; about 3 pairs of long filiform setae present, 1 on disc, 1 on lateral margin, and 1 on apico-lateral margin. Hypomeron entirely visible in lateral aspect, with longitudinal carina. Scutellum more or less diamond-shaped. Elytron 1.2 times as long as wide; 0.7 times as long as pronotum; long setae uniformly distributed and directed posteriorly; about 2 pairs of long filiform setae present, 1 on disc and 1 on lateral margin. Hind wings absent. Mesocoxal cavities contiguous; mesoventral process short and pointed (Fig. 2C). Metaventrite shorter than width of mesocoxa, expanded apico-basally (Fig. 2C). Metendosternite Y-shaped (Fig. 2C). Tibiae with two thick setae on hind margin. Tarsal formula 4-4-4, tarsus with long setae but spatulate seta absent. Claws narrow, long, sickle-shaped. Abdomen gradually broadening to rounded apex; relatively long numerous setae uniformly distributed, directed posteriorly. Tergites III–VI strongly impressed at base. Sternites not impressed at base. Male sternite VIII (Fig. 4A) prolonged posteriorly as broad triangular projection but female unmodified. Male tergite X slightly truncated at posterior margin (Fig. 4B). Female tergite X rounded at posterior margin (Fig. 4C). Median lobe with complex internal sclerites (Fig. 4D). Paramere (Fig. 4E). Spermatheca (Fig. 4F).

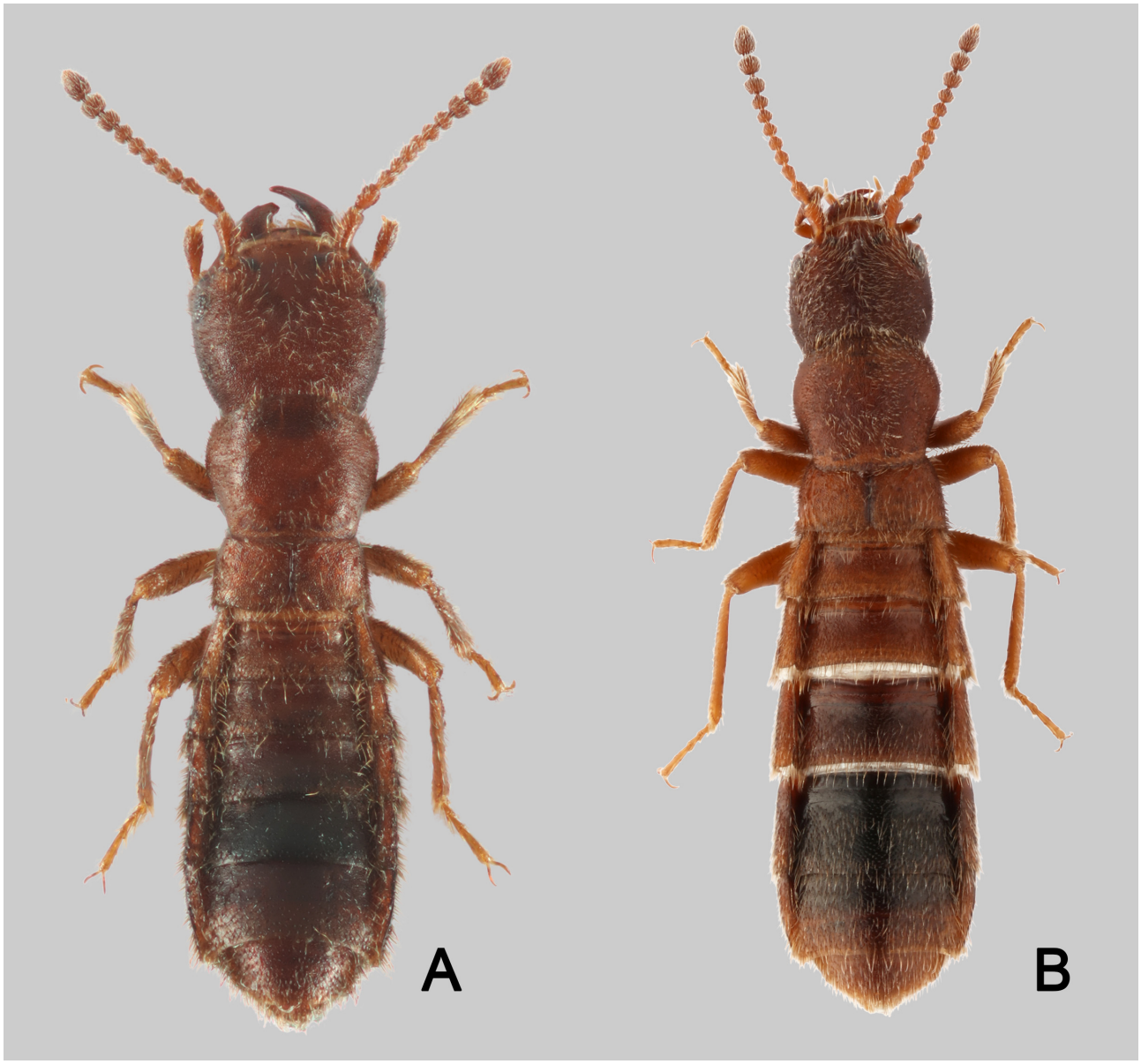
Specimens Examined. Holotype: 1♂ (CNUIC), with labels as follows: "KOREA: Chungnam: Anmyeon Isl., Bangpo Beach, 8 VI 1994, K. J. Ahn, *ex* rocks in low tide | Holotype *Diaulota submarina* Ahn, 2023". Paratypes: 7 exx. (4 on slides), same data as holotype; 15 exx., KOREA: Chungnam Prov., Muchangpo, 28 III 1998, K.-J. Ahn, *ex* inside empty barnacles in low tide. Other specimens: 13 exx. (alcohol collection), Chungnam: Anmyeon Isl., Bangpo Beach, 7 VI 1994, K. J. Ahn, *ex* rocks in low tide; 10 exx. (alcohol collection, 1 on slide), Jeju Prov., Udo-myeon, Yeonpyeong-ri, Udo island, 1 III 2007, KJ Ahn; 1 ex., Gyengnam Prov., Geoje City, Gabae-ri, 1 VII 2000, K.-J. Ahn, H.-J. Kim M.-J. Jeon, *ex* barnacles.

Distribution. Korea (South).

Etymology. The adjective *submarina* refers to the microhabitat of the species.

Remarks. There is sexual dimorphism in size (bigger in male) and shape of head (broadening anteriorly in male but more or less parallel in female) in this new species as other *Diaulota* species (Fig. 1A).

This species is similar to *D. uenoi* and almost indistinguishable by the external morphological characters (see key couplet below). However, it is different from the latter in mouthparts and the external shape and internal structure of the median lobe. Apical process of *D. uenoi* is broader and more abruptly bent upward (fig. 10L in Sawada, 1971) compared to the new species, narrower and slightly bent upward (Fig. 4D; fig. 40 in Ahn, 1996). Especially, the form of internal sclerites of median lobe are different: apical one larger and polygonal in *D. submarina* (Fig. 4D; fig. 40 in Ahn, 1996) but smaller and rounded in *D. uenoi* (fig. 10L in Sawada, 1971). They can be regarded as cryptic species.



FIGUER 1. Habitus of *Diaulota submarina* **sp. nov.** **A** Male **B** Female. Body length = 2.45 mm.

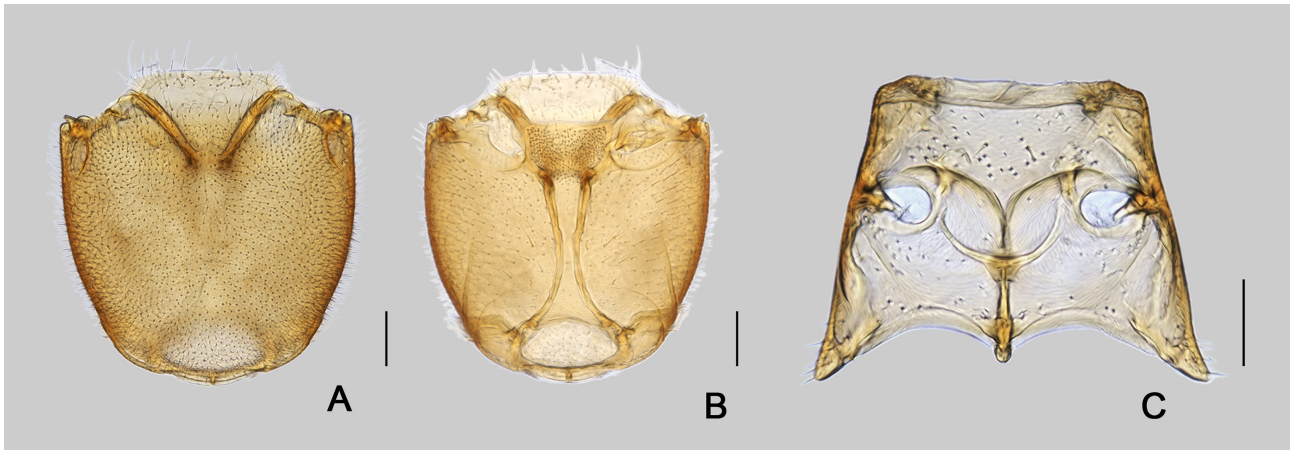


FIGURE 2. *Diaulota submarina* **sp. nov.** **A** Male head, dorsal aspect; **B** Male head, ventral aspect; **C** Meso- and Metaventrites, ventral aspect. Scale bars = 0.1 mm.

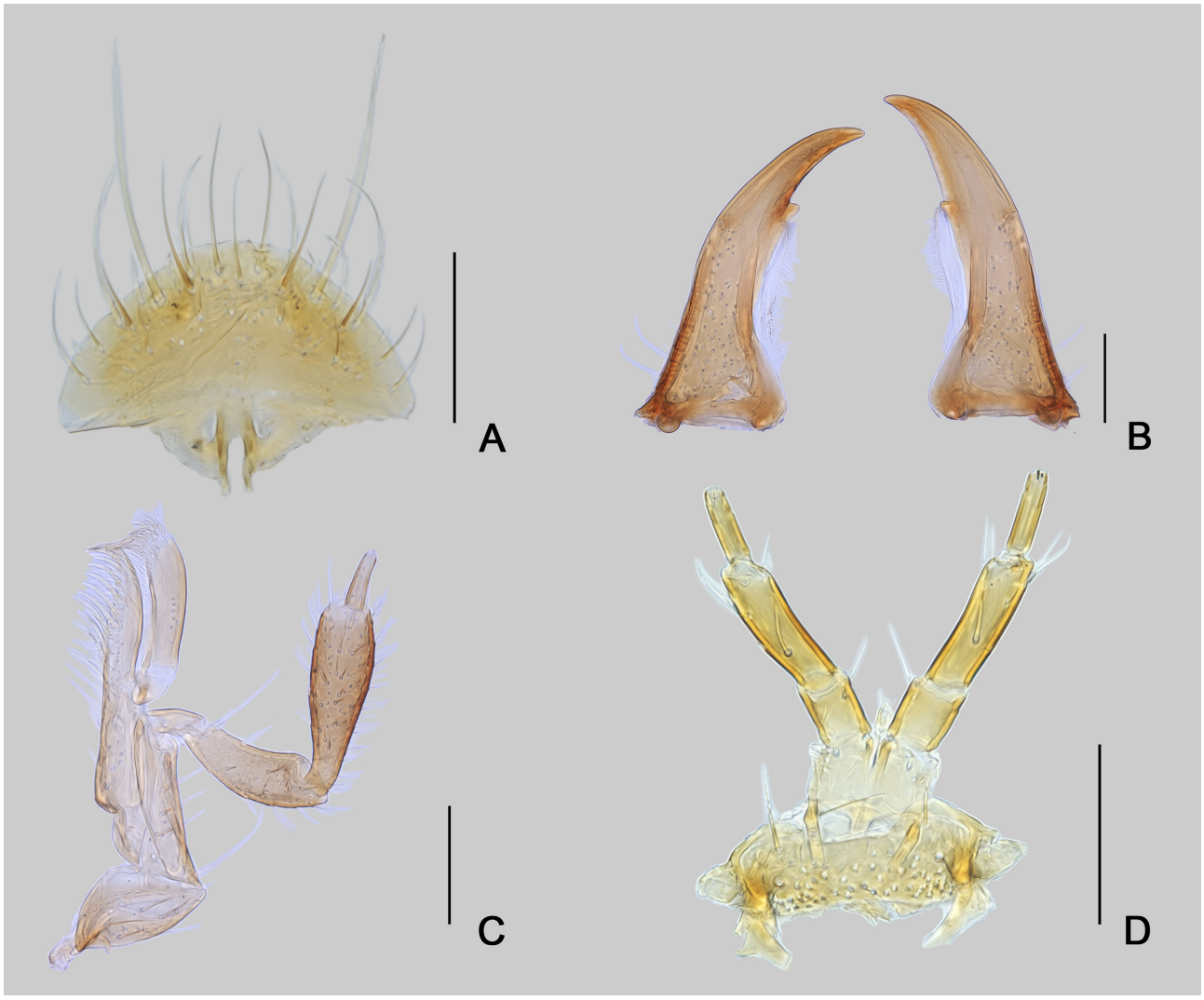


FIG. 3. *Diaulota submarina* **sp. nov. A** Labrum, dorsal aspect; **B** Mandibles, ventral aspect; **C** Maxilla, ventral aspect; **D** Labium, ventral aspect. Scale bars = 0.1 mm.

Key to the species of *Diaulota* from the world

(Updated and revised from Ahn, 1996; Song *et al.*, 2018; Yoo and Ahn, 2021. Note that dissections of the male genitalia are essential for correct species identification.)

1. Body black, rarely dark reddish brown 2
– Body brown to reddish brown 7
2. Hypomeron without longitudinal carina, more angulated posteriorly; mentum with deeper anterior emargination; median lobe (fig. 36 in Ahn, 1996) . . . . . *D. pacifica*
– Hypomeron with longitudinal carina, less angulated posteriorly; mentum with shallower anterior emargiantion 3
3. Elytron wider than long; posterior margin of male sternite VIII crenate; median lobe (fig. 26 in Ahn, 1996) . . . . *D. fulviventris*
– Elytron longer than wide; posterior margin of male sternite VIII smooth 4
4. Anterior margin of labrum not truncated; median lobe (fig. 7 in Ahn, 1996); distributed in the NE Pacific coasts . . . . . *D. densissima*
– Anterior margin of labrum truncated; distributed in the NW Pacific coats and Alaska 5
5. Pronotum and elytra without distinctively long filiform setae; mandible not pointed; median lobe (fig. 22 in Ahn, 1996) . . . . . *D. alaskana*
– Pronotum and elytra with distinctively long filiform setae; mandible more or less pointed 6
6. Median lobe (fig. 21 in Ahn, 1996); distributed in Korea and Honshu (Japan) . . . . . *D. aokii*
– Median lobe (figs. 3–4 in Song *et al.*, 2018); distributed in Hokkaido (Japan), Kamchatka (Russia), and USA (Alaska) . . . . . *D. hokkaidona*

7. Labrum large and robust; mandible more elongate; labial palpi with 3 distinct articles; ligula with 2 minute setae; metum with shallower anterior emargination; tarsal formula 4-4-4 8
– Labrum not large and robust; mandible less elongate; labial palpi with 3 indistinct articles; ligula without minute setae; metum with deeper anterior emargination; tarsal formula 3-3-4 or 4-4-5 9
8. Antennomeres 6–10 subquadrate; anterior margin of labrum truncated; labial palpomere 1 as wide as 2; median lobe smaller; apical process of median lobe broader; apical internal sclerite rounded (fig. 10L in Sawada, 1971); distributed in Japan . . . . . *D. uenoi*
– Antennomeres 6–10 transverse; anterior margin of labrum rounded (Fig. 3A); labial palpomere 1 wider than 2; median lobe bigger; apical process of median lobe narrower; apical internal sclerite larger and polygonal (Fig. 4D); distributed in Korea . . . . . *D. submarina*
9. Elytron wider than long . . . . . *D. harteri*
– Elytron longer than wide 10
10. Head rounded, as long as wide; antennomeres 8–10 subquadrate; tarsal formula 3-3-4; median lobe (fig. 6 in Yoo and Ahn, 2021) . . . . . *D. koreana*
-– Head oblong, longer than wide; antennomeres 8–10 trransverse; tarsal formula 4-4-5. 11
11. Infraorbital carina incomplete, reaching to half of head; median lobe (fig. 42 in Ahn, 1996); distributed in California . . . . . *D. vandykei*
– Infraorbital carina complete, reaching to eye; median lobe (fig. 12 in Song *et al.*, 2018); distributed in Hokkaido . . *D. oharai*

FIG. 4. *Diaulota submarina* **sp. nov. A** Male sternite VIII, ventral aspect; **B** Male tergites IX–X, dorsal aspect; **C** Female tergites IX–X, dorsal aspect; **D** Median lobe, lateral aspect; **E** Paramere, lateral aspect; **F** Spermatheca. Scale bars = 0.1 mm.

Checklist of *Diaulota* Casey, 1893 from the world

Diaulota Casey

Diaulota Casey, 1893: 354.
Genoplectes Sawada, 1955: 81.

1. *Diaulota alaskana* Ahn (USA: Alaska)
Diaulota alaskana Ahn, 1996: 278; Frank and Ahn, 2011: 25.

2. *Diaulota aokii* Sawada (Japan: Honshu; Korea)
Diaulota aokii Sawada, 1971: 104; Ahn, 1996: 279; Frank and Ahn, 2011: 25; Shibata, 2013: 118; Ahn *et al.*, 2017: 306; Park and Lee, 2021: 240.

3. *Diaulota densissima* Casey (Canada: British Columbia; USA: Alaska, California, Oregon, Washington)
Diaulota densissima Casey, 1893: 354; Ahn, 1996: 276; Frank and Ahn, 2011: 25.
= *Diaulota insolita* Casey, 1893: 355.

4. *Diaulota fulviventris* Moore (USA: California; Mexico: Baja California)
Diaulota fulviventris Moore, 1956: 120; Ahn, 1996: 281; Frank and Ahn, 2011: 25.

5. *Diaulota harteri* Moore (USA: California; Mexico: Baja California)
Diaulota harteri Moore, 1956: 123; Ahn, 1996: 282; Frank and Ahn, 2011: 25.
= *Diaulota megacephala* Moore, 1956: 124.

6. *Diaulota hokkaidona* Ahn and Ohara (Japan: Hokkaido; Russia: Kamchatka; USA: Alaska)
Diaulota hokkaidona Ahn and Ohara in Song *et al.*, 2018: 932.

7. *Diaulota koreana* Yoo and Ahn (Korea)
Diaulota koreana Yoo and Ahn 2021: 551.

8. *Diaulota oharai* Ahn and Yoo (Japan: Hokkaido)
Diaulota oharai Ahn and Yoo in Song *et al.*, 2018: 933.

9. *Diaulota pacifica* Sawada (Japan: Honshu, Shikoku; Korea)
Diaulota pacifica Sawada, 1971: 101; Ahn, 1996: 284; Frank and Ahn, 2011: 26; Shibata, 2013: 118; Ahn *et al.*, 2017: 306; Park and Lee, 2021: 240.

10. *Diaulota submarina* sp. nov. (Korea)
Diaulota submarina **sp. nov.**

11. *Diaulota uenoi* (Sawada) (Japan: Honshu, Shikoku, Ryukyu)
Genoplectes uenoi Sawada, 1955: 82; 1971: 106; Shibata, 2013: 118.
Diaulota uenoi: Ahn, 1996: 284; Frank and Ahn, 2011: 26; Ahn *et al.*, 2017: 306; Park and Lee, 2021: 240 [misidentification of *D. submarina*].

12. *Diaulota vandykei* Moore (USA: California)
Diaulota vandykei Moore, 1956: 125; Ahn, 1996: 284; Frank and Ahn, 2011: 26.

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