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PENSOFT

First records of a blind centipede, *Cryptops navis* Chamberlin, 1930 (Chilopoda, Scolopendromorpha, Cryptopidae), from Japan

Taro Jonishi[1], Takafumi Nakano[2]

1 Faculty of Agriculture, Kyoto University, Kyoto 606-8502, Japan. **2** Department of Zoology, Graduate School of Science, Kyoto University, Kyoto 606-8502, Japan.
Corresponding author: Taro Jonishi, ykn347635@gmail.com

Abstract
Eight specimens of a scolopendromorph centipede collected in Tokashiki Island and Minamidaito Island (both in the Ryukyu Islands, Japan) represent the first record of *Cryptops* (*Cryptops*) *navis* Chamberlin, 1930 from the islands of the Far East (i.e., Japanese Archipelago, Ryukyu Islands and Taiwan). This material also provides new details of the morphological variability of *C.* (*C.*) *navis* and the first data on natural habitats of *C.* (*C.*) *navis*, which previously was known only from soil samples from Singapore and China.

Keywords
Cryptops s. str., Daito Islands, *doriae* group, Kerama Island, Ryukyu Islands.

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Introduction

The scolopendromorph genus *Cryptops* Leach, 1814 comprises more than 170 species described worldwide (Bonato et al. 2016) that have been classified into four or five subgenera (Vahtera et al. 2013; Lewis 2016). Lewis (2011) has divided *Cryptops* sensu stricto into two groups based on the presence of an anterior transverse suture on tergite 1. Subsequently, this author also divided the group lacking this suture into two species groups, *doriae* and *hortensis,* based on the presence of one or more saw teeth on the ultimate leg femur.

To date, three species of *Cryptops* sensu stricto have been recorded from the Japanese Archipelago, the Ryukyu Islands, and Taiwan (islands of the Far East): *C.* (*C.*) *nigropictus* Takakuwa, 1936, *C.* (*C.*) *japonicus* Takakuwa, 1934 and *C.* (*C.*) *striatus* Takakuwa, 1936 (Chao and Chang 2003, 2008; Shinohara et al. 2015). *Cryptops* (*C.*) *nigropictus* belongs to the *hortensis* group (Lewis 2011), and *C.* (*C.*) *japonicus* to the *doriae* group (Lewis 2013) (both having tergite 1 without sutures), while *C.* (*C.*) *striatus* belongs to the group that possesses an anterior transverse suture on tergite 1. In the Ryukyu Islands, all three species were recorded from a montane region of the Okinawa Island (Ômine and Itô 1998).

We recently collected individuals of *Cryptops* sensu stricto from two islands in the Ryukyu Islands, Japan. Morphological examination indicated that these newly collected specimens certainly belong to the *doriae* group, and they were identified as *C.* (*C.*) *navis* Chamberlin, 1930, which has never been recorded from the islands of the Far East. Data on the natural habitats of *C.* (*C.*) *navis* are also provided for the first time; previously this species was only found in two soil samples transported to Honolulu (Hawaii) from Singapore (the type locality) and China (without precise location) (Chamberlin 1930, 1940; Lewis 2013) (Fig. 1).

Methods

Six specimens were collected from around a paddy field in Tokashiki Island (Fig. 2A, B), in the Kerama Islands (Okinawa Prefecture), and two specimens were obtained near the seashore in Minamidaito Island (Fig. 2C), in the Daito Islands (Okinawa Prefecture), Japan. The material was fixed and preserved in absolute ethanol. All eight specimens were examined using a Leica M125C stereoscopic microscope (Leica Microsystems, Wetzlar, Germany). Images were captured with the aid of a Leica MC170 HD digital camera mounted on the Leica M125C, and prepared using Leica Application Suite v. 4.12 software. Examined specimens are deposited in the Zoological Collection of Kyoto University (KUZ). Terminology of morphological characters follows Lewis et al. (2005) and Bonato et al. (2010).

Results

Order Scolopendromorpha
Family Cryptopidae Kohlrausch, 1881
Genus *Cryptops* Leach, 1814

***Cryptops* (*Cryptops*) *navis* Chamberlin, 1930**
Figures 1–4
[New Japanese name: Futamata-menashimukade, フタマタメナシムカデ]

Cryptops navis Chamberlin 1930: 65.
Cryptops sinesicus Chamberlin 1940: 49.
Cryptops (*Cryptops*) *navis*—Lewis 2013: 19, figs 50–54.
Cryptops (*Cryptops*) *sinesicus*—Lewis 2013: 25–26, figs 67–69.

New records. JAPAN • 1 specimen; Ryukyu Islands, Kerama Islands, Tokashiki Island; 26°11.77′N, 127°21.66′E; alt. 13 m; 13 Mar. 2019; Taro Jonishi leg.; under straws near a paddy field; KUZ Z2974. • 5 specimens; same collection data as for KUZ Z2974; 14 Mar. 2019; KUZ Z2975 to Z2979. • 2 specimens; Ryukyu Islands, Daito Islands, Minamidaito Island, Shioya Beach; 25°49.64′N, 131°12.97′E; alt. 17 m; 29 Oct. 2019; Takafumi Nakano leg.; under fallen leaves along a road; KUZ Z2980 to Z2981.

Identification. Body length 12–17 mm. Color brownish yellow (Fig. 3A). Antennae of 17 articles; basal 3–4 articles with long setae, number of long setae decreasing toward distal articles, subsequent articles pilose (Fig. 3B, E). Cephalic plate without sutures, posterior margin overlapped by tergite 1 (Fig. 3B, C). Clypeus with 2 + 1 + 2 setae and 5–6 prelabral setae (Fig. 3D). Anterior margin of forcipular coxosternite weakly bilobed, with 3 + 3 submarginal setae of which lateral ones smallest (absent in smaller specimens: KUZ Z2975, Z2977) (Fig. 3E). Calyx of poison gland ovoid, located in anterior part

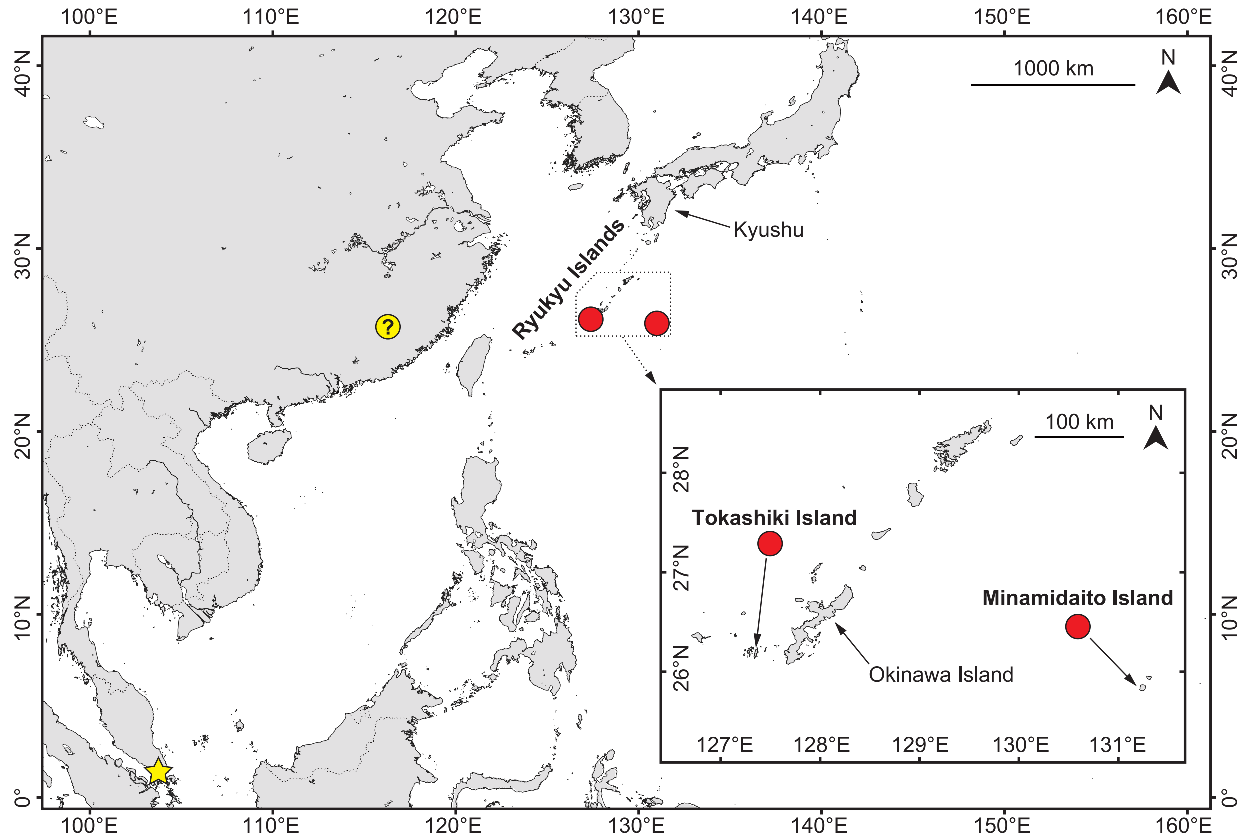

Figure 1. Map showing the collection localities of *Cryptops* (*C.*) *navis* Chamberlin, 1930. Red circles denote the new locations; a yellow star and circle represent the type locality and previously known locality, respectively. Shoreline data based on Wessel and Smith (1996).

Figure 2. Habitats of *Cryptops* (*C.*) *navis* Chamberlin, 1930 in Tokashiki (**A, B**) and Minamidaito (**C**) islands. **A.** A paddy field. **B.** Vegetation and straw near a paddy field, where specimens were collected. **C.** Vegetation along a road near the seacoast.

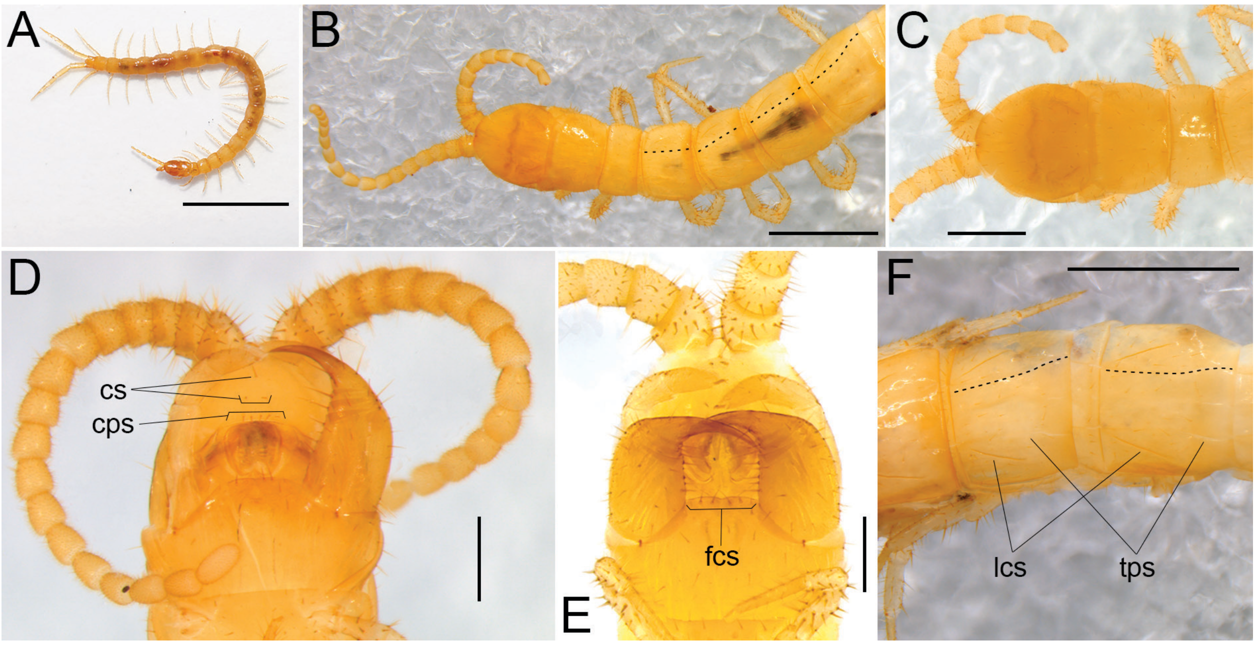

Figure 3. *Cryptops* (*C.*) *navis* Chamberlin, 1930, KUZ Z2974 (**A–C, E, F**) from Tokashiki Island, and KUZ Z2980 (**D**) from Minamidaito Island. **A.** Live specimen, dorsal view. **B.** Cephalic plate, tergites 1–7, dorsal view. **C.** Cephalic plate and tergite 1, dorsal view. **D.** Head (right forcipule removed), ventral view; anteriormost two clypeal setae overlapped by second maxillae. **E.** Head, ventral view. **F.** Tergites 9–10, dorsal view. Dashed lines denote right tergital paramedian sutures. Abbreviations: cps, clypeal prelabral seta; cs, clypeal seta; fcs, forcipular coxosternite submarginal seta; lcs, lateral crescentic sulcus of tergite; tps, tergital paramedian suture. Scale bars: 5 mm (**A**); 1 mm (**B, F**); 0.5 mm (**C**); 0.25 mm (**D, E**).

of trochanteroprefemur. Tergites 1 and 2 without sutures; paramedian sutures complete on tergites 3–20; lateral crescentic sulci present on tergites 3–20 (Fig. 3B, F). Sternites with cruciform sutures of which transverse suture curved and median longitudinal suture shorter than transverse one; sternite 21 with sides slightly converging posteriorly, corners broadly rounded (Fig. 4A). Coxopleuron with 12–23 coxal pores, dorsal area with 0–2 minute and 2–3 enlarged setae, posterior margin with a few minute and 3–5 enlarged ones, and 0–2 enlarged ones between pore field and posterior margin; pore-field covering anterior half of coxopleuron, with a few minute setae and enlarged ones (Fig. 4B). Ultimate legs with fine setae, plus numerous enlarged setae on prefemur (laterally, ventrally and medially) and femur (ventrally and medially) (Fig. 4C, D); prefemur with longitudinal glabrous area medially (sparsely setose in KUZ Z2980) (Fig. 4D, E); femur, tibia and tarsus 1, respectively, with 1, 5–7 and 2 saw teeth, distal one on tibia bifid (Fig. 4F). Legs 1–19 with undivided tarsus, and single pretarsal accessory spine nearly half as long as pretarsus (Fig. 4G). Prefemur, femur and tibia of leg 20 with dense short setae ventrally (Fig. 4H).

Discussion

The examined specimens were identified as *Cryptops* (*Cryptops*) *navis* based on the following features: 2 + 1 + 2 clypeal setae, one saw tooth on ultimate leg femur and ultimate leg tibia with bifid distal saw tooth, and locomotory legs with a single and comparatively long (nearly half as long as corresponding pretarsus) pretarsal accessory spine (Chamberlin 1930, 1940; Lewis 2013). Although the present specimens possess forcipular coxosternite with 3 + 3 submarginal setae and sternite 21 with broadly rounded corners, which are concordant with the descriptions of both Chamberlin (1930) and Lewis (2013), both the setal arrangement of forcipular

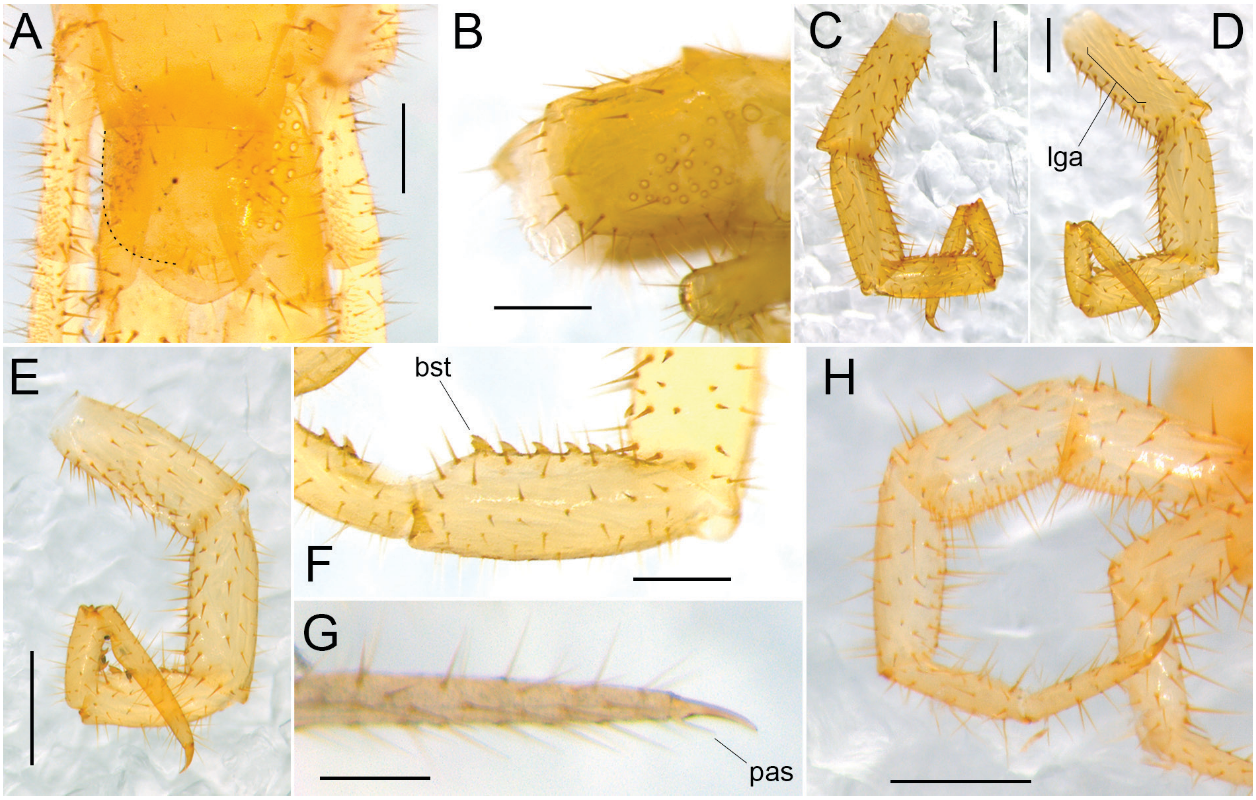

Figure 4. *Cryptops* (*C.*) *navis* Chamberlin, 1930, KUZ Z2974 (**A, F, G**) and Z2978 (**B–D**) from Tokashiki Island, and KUZ Z2980 (**E, H**) from Minamidaito Island. **A.** Sternite 21, ventral view; the dashed line indicates its right margin. **B.** Right coxopleuron (ultimate legs removed), lateral view. **C.** Right ultimate leg, lateral view. **D.** Right ultimate leg, medial view. **E.** Right ultimate leg, medial view. **F.** Saw teeth on tibia of right ultimate leg, medial view. **G.** Pretarsus of leg 12, medial view. **H.** Leg 20, lateral view. Abbreviations: bst, bifid saw tooth; lga, longitudinal glabrous area; pas, pretarsal accessory spine. Scale bars: 0.2 mm (**A, B, F**); 0.25 mm (**C–E, H**); 0.1 mm (**G**).

coxosternite and shape of sternite 21 are variable in some *Cryptops* species (Lewis 2009, 2013; Schileyko and Stoev 2016).

The Ryukyu specimens differ from previous descriptions (Chamberlin 1930, 1940; Lewis 2013) in the following characteristics: 5–6 (vs 9) prelabral setae on clypeus, 12–23 (vs 32–60) coxal pores, and a longitudinal glabrous (vs setose) area on the ultimate leg prefemur. However, the number of prelabral setae was reported as a variable character in *C.* (*C.*) *parisi* Brolemann, 1920 (Iorio and Geoffroy 2003), and the number of coxal pores is highly variable even intraspecifically (Lewis 1999; Schileyko 2008). The specimens from Tokashiki Island also possess the longitudinal glabrous area on the ultimate leg prefemur, which has been treated as a diagnostic characteristic for some *Cryptops* species (Lewis 2013, 2016). Nevertheless, the ultimate leg prefemur is sparsely setose in the specimen from Minamidaito Island, and the glabrous area was not observable in the holotype (Lewis 2013). Given the fact that the discordant details listed above are known to be variable in the other *Cryptops* species (even varying among the Ryukyu populations), we consider the present specimens to be *C.* (*C.*) *navis*. The number of prelabral setae and coxal pores, as well as the presence of a longitudinal glabrous area on the ultimate leg prefemur, may represent intraspecific variations of *C.* (*C.*) *navis*.

Only two specimens of *C.* (*C.*) *navis* have been previously reported, and the precise distribution of this species was uncertain (Chamberlin 1930, 1940; Lewis 2013). The studied material, collected under straw close to paddy fields and under fallen leaves near the seashore in Tokashiki Island and Minamidaito Island, respectively, therefore provides the first data on the natural habitats of *C.* (*C.*) *navis*. According to Chamberlin (1930, 1940) and the present results, the northern border of the range of this species is Tokashiki and Minamidaito islands, and the southernmost is Singapore (the type locality) (Fig. 1). Because only the holotype of *C. sinesicus* Chamberlin, 1940 (= *C.* (*C.*) *navis*; see Lewis 2013) was recorded from China (see Song et al. 2010), the precise distribution of *C.* (*C.*) *navis* in China cannot be determined. However, it is possible that the type locality of *C. sinesicus* is located along the coastline of Southern China, because this species was collected from the small islands within the Ryukyu Islands, and was found in the soil from Singapore.

The present findings revealed morphological variations among the two populations in the Ryukyu Islands, and suggest that these characteristics could be intraspecific variations of *C.* (*C.*) *navis*. However, a detailed understanding of the intraspecific variations of this species remains hampered by a lack of sufficient material from other localities. With the aid of the habitat information of *C.* (*C.*) *navis* in the Ryukyu Islands, further faunal surveys in Southeast and East Asia are necessary to clarify the true range of this species. Then, additional specimens obtained in future surveys will help elucidate the precise intraspecific morphological variations of *C.* (*C.*) *navis*.

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Authors' Contributions

TJ conceived the study, examined and photographed specimens, and drafted the manuscript. TN drew the map and improved the manuscript and figures. Both authors read and approved the final manuscript.

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