Heterocotyle chinensis (Monogenea: Monocotylidae) from the Whip Stingray Dasyatis akajei in the Seto Inland Sea, Japan

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Heterocotyle chinensis Timofeeva, 1983 (Monogenea: Monocotylidae) is reported from the gills of the whip stingray Dasyatis akajei (Müller and Henle, 1841) in the Seto Inland Sea, Hiroshima Prefecture, Japan, as a new country record. A morphological description and illustrations are provided, along with an emended key to the species of Heterocotyle. The present monogenean most likely has some tolerance for low salinity because one of the two infected fish examined was collected in brackish water.

Key Words: Heterocotyle chinensis, Monogenea, Dasyatis akajei, brackish water, new country record, redescription, Seto Inland Sea, Hiroshima, Japan, taxonomic key.

Introduction

Heterocotyle chinensis Timofeeva, 1983 (Monogenea: Monocotylidae) was originally described from the whip stingray Dasyatis akajei (Müller and Henle, 1841) (Myliobatiformes: Dasyatidae) in the Yellow Sea, China (Timofeeva 1983). Subsequently, H. chinensis has been reported from the estuary stingray D. fluviorum Ogilby, 1908 and the honeycomb stingray Himantura uarnak (Gmelin, 1789) (Myliobatiformes: Dasyatidae) in Moreton Bay, Australia (Chisholm and Whittington 1996) and from the blue-spotted stingray D. kuhli (Müller and Henle, 1841) and the blackish stingray D. navarrae (Steindacher, 1892) in Fujian Province, China (Zhang et al. 2001). In this paper we report H. chinensis parasitic on D. akajei in the Seto Inland Sea, Japan, as a new country record, with a morphological description of the specimens and a revised key to the species of Heterocotyle.

Materials and Methods

Two whip stingrays were collected at two sites in the Seto Inland Sea, Hiroshima Prefecture, Japan: the mouth of the Kamo River (34°19′34.8″N, 132°53′50.9″E) by hand net at the lowest tide on 28 May 2014, and off Ōsaki-kami-jima island (33°14′N, 132°48′E) by trawl fishing on 14 July 2014. The rays were brought alive to the laboratory and examined for parasites under a dissecting microscope. Monogeneans were picked from the gills using small needles and forceps and flattened on glass slides under slight coverslip pressure. The glands and ducts of the head and the posterior glands were observed in living specimens. Some monogeneans were fixed in ammonium picrate glycerin (Lim 1991) for observation of sclerotized structures, while others were fixed in 70% ethanol and stained in Heidenhain’s iron hematoxylin. All specimens were dehydrated through a graded ethanol series, cleared in xylene, and mounted in Canada balsam. Drawings were made with the aid of a drawing tube fitted on an Olympus BX51 light microscope. Measurements, in micrometers, are expressed as the mean ± standard deviation followed in parentheses by the range and the number (n) of specimens examined. Fish identification was based on Yamaguchi et al. (2013), and common names of fishes used in this paper follow Froese and Pauly (2014). Specimens are deposited in the Platyhelminthes collection of the National Museum of Nature and Science, in Tsukuba, Ibaraki Prefecture, Japan (NSMT-Pl).

Heterocotyle chinensis Timofeeva, 1983

(Fig. 1)


Material examined. Twenty-five specimens (NSMT-Pl 6164) from the mouth of the Kamo River on 28 May 2014, and 6 specimens (NSMT-Pl 6165) from off Ōsaki-kami-jima island on 14 July 2014.

Description. Body (Fig. 1A) including haptor length 865±132.7 (671–1073; n=17), width at mid-body 326±56.1 (194–406; n=17). Two ducts from point of anterolateral glands exiting medial to two ducts from anteromedian gland present in anterior part of head. Trio of other ducts...
Fig. 1. *Heterocotyle chinensis* Timofeeva, 1983. NMST-Pl 6164. A, whole mount (ventral view); B, hamulus; C, hooklet; D, male copulatory organ. Scale bars: A, 200 µm; B–D, 10 µm. Abbreviations: alg, anterolateral gland; amg, anteromedian gland; d, duct; dh, dorsal haptoral accessory structure; ej, ejaculatory bulb; ey, eyespots; h, hamulus; ho, hooklet; in, intestine; m, mouth; mag, male accessory gland; mco, male copulatory organ; mg, Mehlis’ gland; o, oötype; od, oviduct; ov, ovary; ph, pharynx; pg, posterior gland; phg, pharyngeal glands; r, sinuous ridge; sr, seminal receptacle; sv, seminal vesicle; t, testis; tv, transverse vitelline duct; u, uterus; vi, vitellaria; v, vagina; vp, vaginal pore; vd, vas deferens.
opening on either side of front of head. Eyespots dispersed over dorsal body surface between mouth and pharynx. 

Mouth muscular, round to elliptical, length 62±11.6 (48–87; 
n=14), width 71±18.1 (34–108; n=14). Pharynx muscular, 
spherical to oval, with muscular fibers attached to both sides 
of its anterior part, length 138±36.2 (65–185; n=17), width  
110±31.9 (46–113; n=17). Esophagus not present, bifurcate 
testis, posterior to ovary. Vas deferens arising from left anterior 
testis, extending along dorsal side of left intestine. 

Seminiferous testis located beneath branching point of intestines, extending to ejaculatory bulb, and connected to posterior part of ejaculatory bulb. Ejaculatory bulb muscular, oval to pyriform, length 97±9.0 (82–113; n=17), width 75±12.6 (37–98; n=17). Male accessory glands entering posterior part of ejaculatory bulb. Male copulatory organ (Fig. 1D) lacking accessory piece, sclerotized slightly curved tube, tip twisted slightly, length 78±4.9 (73–92; n=30) in chord straight line from base to tip. Ovary in mid-body, elongate, wrapping around right intestine. Oviduct arising from anterior part of ovary, continuing on as ootype. Mehlis’ gland connected to middle of ootype. Vagina, without sclerotized structure, connecting between posterior part of ootype and seminal receptacle. Vaginal pore opening on left side of ventral body surface. Vitellaria approximately co-extensive with intestine. Transverse vitelline duct lying at level of oviduct. 

Pair of posterior glands located near either tip of intestine. 

Haptor elliptical, length 232±24.1 (172–269; n=15), width 319±39.3 (223–383; n=15), ventral surface of haptor with 1 central and 8 peripheral loculi. Pair of hamuli (Fig. 1B), length 41±2.1 (38–46; n=31). Sinuous ridge single on 3 posterior radial septa, double on 2 lateral septa, triple on 3 anterior septa. Fourteen hooklets (Fig. 1C), length 9±0.7 (8–10; n=31), located in marginal valve as illustrated (Fig. 1A). Dorsal haptoral accessory structure U-shaped, located on dorsal surface of 4 posterior loculi. 

Host. Whip stingray Dasyatis akajei (Myliobatiformes: Dasyatidae). 

**Localities.** Mouth of the Kamo River, Takehara city, and off Osaki-kami-jima island, Osaki-kami-jima town, both in the Seto Inland Sea, Hiroshima Prefecture, Japan. 

**Site of infection.** Gill. 

**Intensity.** Two hundred and thirty-two individuals were found infecting the whip stingray (173 mm in disk width) collected at the mouth of the Kamo River, and 50 individuals were collected from the other whip stingray (323 mm in disk width) caught off Osaki-kami-jima island. 

**Remarks.** Heterocotyle chinensis was originally described by Timofeeva (1983) and later redescribed by Chisholm and Whittington (1996). The morphology of the specimens collected in this study corresponds to the description by Chisholm and Whittington (1996) and measurements by Timofeeva (1983) and Zhang et al. (2001).

Discrimination of the genus *Heterocotyle* (after Chisholm and Whittington 1996; Neifar et al. 1999)

1. Haplor with single sclerotized ridge on all septa........... 2
2. Sinuous sclerotized ridge single on inner and outer ring septa and 3 posterior radial septa, double on 2 lateral radial septa, and triple on 3 anterior radial septa ................................................................. 7
3. Male copulatory organ long (77–106 µm); testis with 3 posteriorly-directed finger-like lobes .............................................. 8
4. Accessory piece of male copulatory organ absent.......... 3
5. Accessory piece of male copulatory organ present .......... 4
6. Male copulatory organ long (77–106 µm); testis with 3 posteriorly-directed finger-like lobes .............................................. 8

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References
