Hysterothylacium gibsoni sp. nov. and H. tetrapteri (Bruce et Cannon, 1989) (Nematoda: Ascaridida) from the Chinese marine fishes

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Abstract
A new species of ascaridoid nematode, Hysterothylacium gibsoni sp. nov., is described based on specimens collected from the intestine of the slender lizardfish Saurida elongata (Temminck et Schlegel) (Aulopiformes: Synodontidae) in the Yellow Sea, China. The new species differs from its congeners by its small body size (12.8–13.2 mm), the absence of cervical alae, a very short intestinal caecum (representing 8.86–9.52% of oesophageal length) and a long ventricular appendix (intestinal caecum to ventricular appendix ratio 1:15.3–20.0), short spicules (0.38–0.41 mm, representing 2.97–3.11% of body length), the number and arrangement of the caudal papillae (25–28 pairs arranged as follows: 18–22 pairs precloacal, 3 pairs paracloacal, and 3–4 pairs postcloacal). In addition, Hysterothylacium tetrapteri (Bruce et Cannon, 1989) is also redescribed based on the material collected from the striped marlin Kajikia audax (Philippi) (Perciformes: Istiophoridae) in the South China Sea.

Keywords
Ascaridida, Hysterothylacium, taxonomy, new species, marine fishes

Introduction
Hysterothylacium nematodes commonly parasitize various marine, estuarine and freshwater fishes (Bruce et al. 1994; Torres et al. 1998; Torres and Soto 2004; Rossin et al. 2011). According to Moravec et al. (2012), there were 66 valid species of Hysterothylacium reported worldwide. Since then, 4 more species have been described: H. deardorffoverstreetorum Knoff, Felizardo, Iniguez, Torres, Pinto et Gomes, 2013 from Paralichthys isosceles Jordan (Pleuronectiformes: Paralichthyidae) in the Brazilian waters, H. longilabrum Li, Liu et Zhang, 2012 from Siganus fusescens (Houttuyn) and S. canaliculatus (Park) (Perciformes: Siganidae), H. zhoushanense Guo, Xu, Zhang, Hu et Li, 2014 from Pseudorhombus oligodon (Bleeker) (Pleuronectiformes: Paralichthyidae) and H. simile Li, Zhang et Liu, 2013 from Lateolabrax japonicus (Cuvier) (Perciformes: Lateolabracidae) in the Chinese waters, respectively (Knoff et al. 2012; Li et al. 2012a,b, 2013; Guo et al. 2014). In the present paper, a new species of Hysterothylacium, collected from the slender lizardfish Saurida elongata (Temminck et Schlegel) (Aulopiformes: Synodontidae) in the Yellow Sea, China, is described using both light and scanning electron microscopy. In addition, Hysterothylacium tetrapteri (Bruce et Cannon, 1989) is also redescribed based on the material collected from the striped marlin Kajikia audax (Philippi) (Perciformes: Istiophoridae) in the South China Sea.

Materials and Methods
Fishes caught by commercial trawlers from the Yellow Sea and South China Sea, respectively, were examined for parasites. Nematodes recovered from the digestive tract of various fishes were washed in physiological saline and then fixed and stored in 80% ethanol until studied. Light and scanning electron microscopic studies were prepared following the methods used by Li et al. (2012c). Drawings were made with the aid of Nikon microscope drawing attachment. Measurements (the range, followed by the mean in parentheses) are given in micrometres unless otherwise stated. Type-specimens are deposited in College of Life Science, Hebei Normal University, Hebei Province, China.
Results

*Hysterothylacium gibsoni* sp. nov. (Figs 1, 2)

General: small, whitish nematodes with finely transversely striated cuticle. Maximum width of body at about mid-body. Cervical alae absent (Figs 1A, 2G). Caudal alae conspicuous, extending from level of cloaca to base of tail tip (Fig. 2C). Anterior end with three lips, approximately equal in size, with deep postlabial grooves and prominent lateral flanges. Proximal part of each lip with four lobes (Fig. 2A). Dorsal lip with 2 double papillae, ventrolateral lips each with 1 lateral amphid, 1 single papilla and 1 double papilla (Figs 1A,B; 2A,E). Interlabia well-developed, about 1/2 length of lips (Fig. 2B,G). Oesophagus short, slightly broader posteriorly than anteriorly. Nerve ring at about 2/5 of oesophageal length. Excretory pore just posterior to nerve-ring (Fig. 1E). Cervical papillae not observed. Ventriculus nearly oval, almost as wide as posterior region of oesophagus. Intestinal caecum very short, as long as or slightly longer than ventriculus; ventricular appendix very long (Fig. 1E). Tail of male conical, tip with a number of small nodular protuberances (Figs 1E, 2C,F).

Fig. 1. *Hysterothylacium gibsoni* sp. nov. from *Saurida elongata* (Temminck et Schlegel) in the Yellow Sea, China, male: **A.** cephalic end, dorsal view; **B.** cephalic end, ventrolateral view; **C.** tip of tail, dorsal view; **D.** posterior end of body, lateral view; **E.** anterior part of body, lateral view. Scale-bars: A,B, 100 µm; C, 50 µm; D, 300 µm; E, 200 µm.
Male (based on 2 mature specimens). Body 12.8–13.2 (13.0) mm long; maximum width 340–390 (365). Dorsal and ventrolateral lips almost equal in size, 60–82 (71.0) long, 58–74 (65.7) wide. Interlabia 29–39 (34.0) long, 49–52 (50.5) wide. Oesophagus 830–942 (931) long, 78–98 (88) in maximum width, representing 6.48–7.14 (6.81)% of body length. Nerve-ring and excretory pore 380–401 (392) and 410–441 (426), respectively, from anterior extremity (Fig. 1E). Ventriculus 79–98 (88.5) long, 98–108 (103) wide. Ventricular appendix 1.58–1.79 (1.69) mm long, 108–125 (117) in maximum width. Intestinal caecum 79–117 (98.0) long, 69–87 (78.0) wide, representing 8.86–9.52 (9.19)% of oesophageal length. Ratio of intestinal caecum to ventricular appendix 1: 15.3–20.0 (1:17.7) (Fig. 1E). Posterior end of body curves ventrally. Ejaculatory duct 1.17–1.32 (1.25) mm long. Spicules slender, alate, pointed apically, of almost equal length, 380–410 (395) long, representing 31.1–32.5 (31.8)% of ejaculatory duct and 2.97–3.11 (3.04)% of body length (Figs 1D, 2C). Gubernaculum absent. Caudal papillae very small, 25–28 pairs in total, arranged as follows: 18–22 pairs of precloacal, 3 pairs of paracloacal and 3–4 pairs of postcloacal (Figs 1D, 2D). Tail 115–140 (128) long.

Female. Unknown.

Type-host and type-locality: Slender lizardfish Saurida elongata (Temminck et Schlegel) (Aulopiformes: Synodontidae); Yellow Sea (off Shidao, Shandong Province), China.

Site of infection: Intestine.

Type-material: Holotype: male (HBNU-F13048L); paratype: 1 male (HBNU-F13049L), deposited in the College of Life Science, Hebei Normal University, Hebei Province, China.

Prevalence and intensity of infection: 4.35% (1 out of 23 fishes) were infected with intensity of 2 specimens.

Etymology: The species is named for Dr. David I. Gibson (Department of Life Sciences, Natural History Museum, London, UK).

Comments

Within Hysterothylacium, only the following 5 species possess a very short caecum (as long as or slightly longer than ventriculus) and a long ventricular appendix, short spicules (not over 0.8 mm), and the tail tip of male covered with a number of nodular protuberances or spines as in the new species: H. winteri Torres et Soto, 2004 from Eleginopus maclovinus (Cuvier) (Perciformes: Eleginopidae) in the Chilean waters; H. physicali Moravec and Nagasawa, 2000 from Physicus maximowiczii (Herzenstein) (now as Physicus japonicus Hilgendorf) (Gadiformes: Moridae) in the Japanese waters; H. scomberoides (Cuvier et Cannon) 1899 from Scomberoides commersonianus Lacepède (Perciformes: Carangidae) in the Australian waters; H. fortalezae (Klein, 1973) from Scomber-
Fig. 2. Scanning electron micrographs of *Hysterothylacium gibsoni* sp. nov. from *Saurida elongata* (Temminck et Schlegel) in the Yellow Sea, China, male: A. cephalic end, apical view; B. cephalic end, ventral view; C. posterior end of body (caudal ala arrowed), lateral view; D. magnified image of paracoacal papillae (arrowed); E. cephalic end, dorsal view; F. tip of tail; G. anterior part of body, ventral view. 

*Abbreviations:* d, dorsal lip; i, interlabium; s, spicule
Fig. 3. *Hysterothylacium tetrapteri* (Bruce et Cannon, 1989) from *Kajikia audax* (Philippi) in the South China Sea, male. A. cephalic end, dorsal view; B. cephalic end, ventral view; C. region of ventriculus, dorsal view; D. anterior part of body, ventrolateral view; E. tip of tail, lateral view; F. posterior end of body, lateral view; G. distal end of spicule. Scale-bars: A,E, 120 µm; B,G, 100 µm; C,F, 500 µm; D, 250 µm.
Notwithstanding the inadequate original descriptions of *H. pseudotumbili*, the new species can be readily distinguished from *H. pseudotumbili* by possessing a smaller number of precloacal papillae (18–22 vs 32 pairs in the latter).

The authors are aware of the fact that a description of a new nematode species should be based on at least several specimens, preferably including both sexes. However, considering the presence of remarkable morphological and morphometric difference between *H. gibsoni* sp. nov. and its congeners, and the impossibility of obtaining the conspecific nematodes in the near future, we think that it is reasonable to establish a new species based on the presently available material.

**Hysterothylacium tetrapteri** (Bruce et Cannon, 1989) (Figs 3, 4)

General: Medium to large, whitish nematodes with finely transversely striated cuticle. Maximum width of body at about mid-body. Cervical alae well developed, extending from base of lateral interlabia to about the region of ventriculus (Figs 3A,B, 4A–C). Caudal alae inconspicuous (Fig. 4F). Anterior end with three lips, approximately equal in size, with deep postlabial grooves and prominent lateral flanges (Figs 3A,B,D, 4B,C). Proximal part of each lip with four lobes and two large upheaved structures adjacent to median lobes (Fig. 4A,B). Dorsal lip with 2 double papillae, ventrolateral lips each with 1 lateral amphid, 1 single papilla and 1 double papilla (Figs 3A,D, 4B,C). Interlabia well-developed, about 1/4 length of lips (Fig. 3B). Oesophagus long, slightly broader posteriorly than anteriorly. Nerve ring at 1/4–1/5 of oesophageal length. Excretory pore just posterior to nerve-ring (Figs 3D, 4C). Cervical papillae present, at about level of nerve-ring (Fig. 4C,D). Ventriculus oval, slightly narrower than posterior region of oesophagus. Intestinal caecum long, about 4/5 length of oesophagus, slightly shorter than ventricular appendix (Fig. 3C). Tail of male conical, tip pointed, without small nodular protuberances (Figs 3E, 4F).

**Male** (based on 1 mature specimens). Body 43.2 mm long; maximum width 735. Dorsal lip 117 long, 197 wide. Ventrolateral lips 141 long, 158 wide. Interlabia 37 long, 95 wide. Oesophagus 3.23 mm long, 147 in maximum width, representing 7.48% of body length. Nerve ring and excretory pore 637 and 656, respectively, from anterior extremity (Figs 3D, 4C). Ventriculus 137 long, 118 wide. Ventricular appendix 2.46 mm long, 39 in maximum width. Intestinal caecum 2.55 mm long, 59 wide, representing 78.9% oesophageal length. Ratio of intestinal caecum to ventricular appendix 1:0.97 (Fig. 3C). Posterior end of body curves ventrally. Ejaculatory duct 5.05 mm long. Spicules slender, alate, very pointed apically, of almost equal length, 5.54 mm long, representing 110% of ejaculatory duct and 12.8% of body length (Figs 3F,G, 4E,H). Gubernaculum absent. Ventral, longitudinal stockade-like ornamentation of cuticle well developed (Fig. 4E,G), beginning at short distance before first pair of precloacal papillae. Caudal papillae small, 21 pairs in total, arranged as follows: 16 pairs of precloacal, 1 pairs of double paracloacal and 4 pairs of postcloacal (Fig. 3E,F). Medioventral precloacal papilla present. Tail 196 long. Lateral phasmids situated at about 1/2 distance from cloaca to tip of tail.

**Host and locality of type-material:** Striped marlin *Tetrapurus audax* (Philippi) [now as *Kajikia audax* (Philippi)] (Perciformes: Istiophoridae) off East of Newcastle, Australia.

**Host of present material:** Striped marlin *Kajikia audax* (Philippi) (Perciformes: Istiophoridae).

**Locality of present material:** South China Sea, off Shantou, Guangdong Province, China; 23.IV.2010.

**Site of infection:** Intestine.

**Prevalence and intensity:** Single fish examined with intensity 1 specimen.

**Voucher specimens:** 1 male (HBNU-F13050L).

**Comments**

Bruce and Cannon (1989) established the genus *Maricostula* and designated *M. makairi* Bruce et Cannon, 1989 from the black marlin *Makaira indica* Cuvier [now as *Istiompax indica* (Cuvier)] (Perciformes: Istiophoridae) in the Australian waters as the type species. However, Moravec and Justine (2005) considered that the morphological characters used for defining *Maricostula* are questionable and incredible, and placed the genus *Maricostula* as a synonym of *Hysterothylacium*. Thus, the species *Maricostula tetrapteri* Bruce et Cannon, 1989 collected from the striped marlin *Tetrapurus audax* (Philippi) [now as *Kajikia audax* (Philippi)] (Perciformes: Istiophoridae) off East of Newcastle, Australia was also transferred to *Hysterothylacium*. The morphology of our present specimen collected from the South China Sea, is almost identical to the original description of *H. tetrapteri* with regard to many features, such as the shape of lips, the length of body, ventricular appendix, intestinal caecum and tail in the male, the number and arrangement of caudal papillae and the morphology of the male tail. Furthermore, it should also be noted that the present material was collected from the conspecific host as *H. tetrapteri* and from a neighbouring region of the Pacific Ocean. Therefore, we considered the present material to be conspecific with *H. tetrapteri*. However, the length of the oesophagus and spicules of present material is slightly shorter than the original description by Bruce and Cannon (1989) [oesophageal length 3.23 mm and spicules 5.54 mm in the present material vs 3.48–3.91 mm and 6.0–9.5 mm, respectively, in Bruce and Cannon (1989)’s material]. This morphometric difference should be considered as intraspecific variability. In addition, in our present material, we also observed paired, upheaved structures on each lip using SEM, which were not mentioned in the original description of *H. tetrapteri*. We can not confirm that this feature should be considered as intraspecific variability or probably artefacts because of the very limited specimen. To our knowledge, ours is only the second record of *H. tetrapteri* and this species is reported in Chinese waters for the first time.
Fig. 4. Scanning electron micrographs of *Hysterothylacium tetapteri* (Bruce et Cannon, 1989) from *Kajikia audax* (Philippi) in the South China Sea, male. A. anterior part of body (cervical ala and upheaved structures of lips arrowed), apical view; B. cephalic end (upheaved structures of dorsal lip arrowed), dorsal view; C. anterior part of body (excretory pore and cervical papilla arrowed), ventrolateral view; D. magnified image of cervical papilla; E. posterior end of body, lateral view; F. tip of tail, lateral view; G. magnified image of ventral, longitudinal stockade-like ornamentation of cuticle; H. distal end of spicule.
References


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