

## Two new species of free-living nematodes from the East China Sea

SUN Yan<sup>1</sup>, HUANG Mian<sup>1</sup>, HUANG Yong<sup>1\*</sup>

<sup>1</sup> College of Life Sciences, Liaocheng University, Liaocheng 252059, China

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### Abstract

Two new species of free-living marine nematodes of the genera *Hopperia* and *Nemanema* are described from the sublittoral sediment of the East China Sea. *Hopperia macramphida* sp. nov. is characterized by having large amphidial fovea with five turns; arcuate spicules with enlarged proximal end and central internal lamella extending one third of spicule length from proximal end; gubernaculum with bent apophyses, six papilliform precloacal supplements; and conico-cylindrical tail with swollen tip and terminal setae. *Nemanema minutum* sp. nov. is characterized by relatively smaller body size in the genus; large oval amphidial fovea; conical tail; slender spicules with alae and hooked proximal end; ring-like gubernaculum; and papilliform precloacal supplements with three short setae. An updated dichotomous key is provided for the 17 species of *Hopperia*.

**Key words:** *Hopperia macramphida* sp. nov., *Nemanema minutum* sp. nov., marine nematode, taxonomy

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### 1 Introduction

The genus *Hopperia* was set up by Vitiello (1969) based on the type species of *Hopperia massiliensis* Vitiello, 1969. To date, the genus contains 16 species recorded worldwide (Leduc, 2012; Guo et al., 2015; Campinas Bezerra et al., 2017). *Hopperia* species have characters of cuticle with lateral differentiation of irregularly arranged larger dots but not longitudinal rows; posterior portion of buccal cavity cylindrical, with three thorn-like teeth at border to anterior portion; spicules short; gubernaculum with caudal or dorso-caudal apophyses (Jensen, 1979; Platt and Warwick, 1988).

The genus *Nemanema* was described by Cobb (1920) with the type species of *Nemanema simplex* Cobb, 1920. Currently, 11 species have been recorded from all around the world. The characteristic feature of *Nemanema* is the strongly attenuated anterior end; no buccal cavity; oval-shaped amphidial fovea; six outer labial setae and four cephalic setae; prominent oval cells scattered throughout the body cavity; tail conical to rounded. It is similar to genus *Oxystomina* excepting the rounded tail (Platt and Warwick, 1983).

In order to study the biodiversity of free-living nematodes in the East China Sea, sediment samples were collected in many sites from the intertidal to the sublittoral region in the past few years. More than 300 species have been found from these habitats (Jiang et al., 2016). Of these, two species are new to science and are described as *Hopperia macramphida* sp. nov. and *Nemanema minutum* sp. nov., respectively.

### 2 Materials and methods

In October 2012, undisturbed sediment samples were obtained using a 0.1 m<sup>2</sup> improved Gray-O'Hara box from a grid of

33 sampling stations between 25°21'N to 30°00'N, 120°50'E to 126°00'E in the East China Sea during the Open Research Cruise of National Natural Science Foundation of China by the R/V *Dongfanghong 3*. Sampling, sorting and slide mounting followed those described in Jiang and Huang (2015). Description and measurements were made from glycerin mounts using a differential interference contrast microscope (Olympus BX53). Line drawings were made with the aid of a camera lucida. All measurements are given using Olympus software of cellSens Standard 1.12, and all curved structures were measured along the arc. Type specimens have been deposited in the Marine Biological Museum of Chinese Academy of Sciences, Qingdao, China.

### 3 Description of *Hopperia macramphida* sp. nov. (Figs 1 and 2)

Order Chromadorida Filipjev, 1929

Family Comesomatidae Filipjev, 1918

Genus *Hopperia* Vitiello, 1969

#### 3.1 Type material

Only one male was obtained and measured. Holotype male on slide DH 5-1-3-7.

#### 3.2 Type locality and habitat

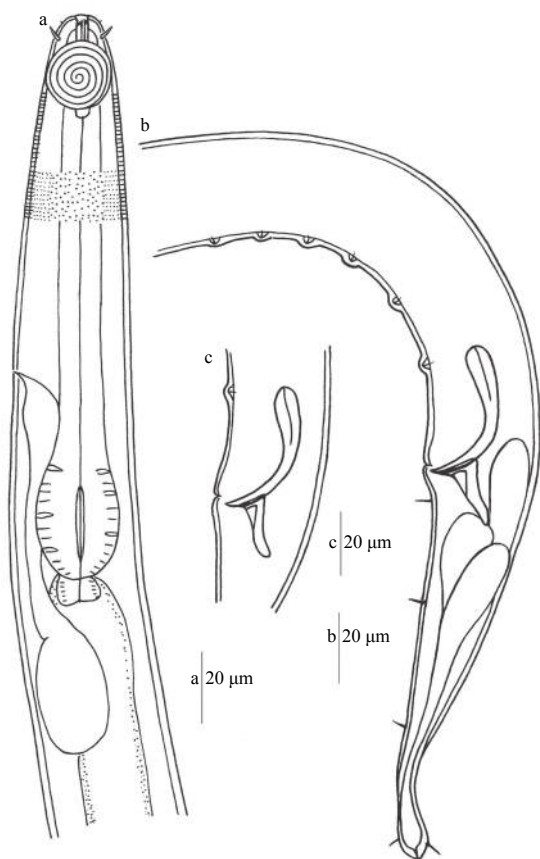
Sublittoral in the East China Sea. Station DH 5-1: 28°27'N, 122°10.4'E, water depth 43 m, muddy with a little sand sediment fraction.

#### 3.3 Etymology

The species name is derived from the Greek macro, in reference to the large amphidial fovea.

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\*Corresponding author, E-mail: huangy@lcu.edu.cn



**Fig. 1.** *Hopperia macramphida* sp. nov.. a. Lateral view of male anterior end, showing buccal cavity, cephalic setae, amphidial fovea and pharyngeal bulb; b. lateral view of male posterior end, showing spicules, gubernaculum, preloacal supplements and caudal glands; and c. male cloacal region.

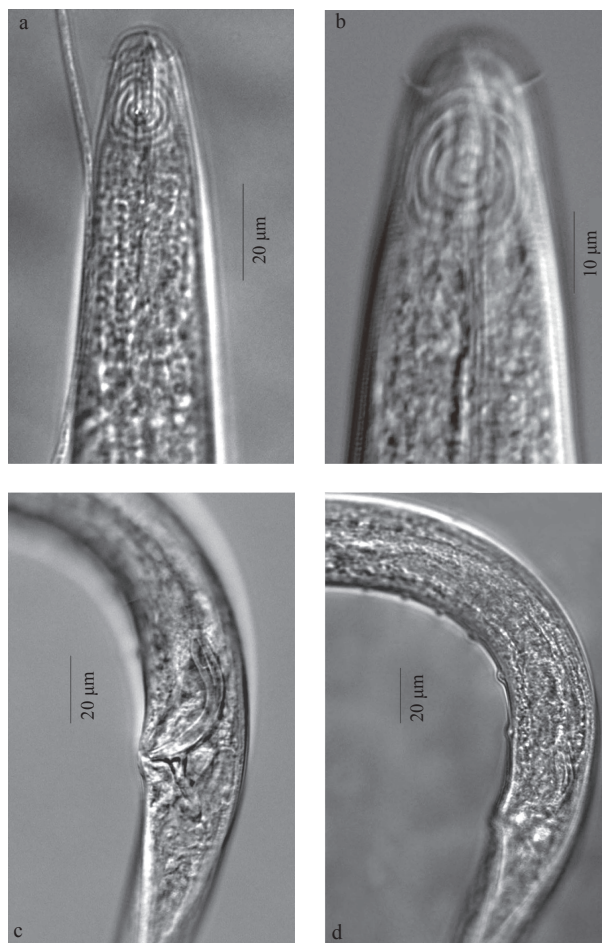
### 3.4 Measurements

$$\text{Holotype } \delta: \frac{-170 \quad M \quad 1 \quad 099}{15 \quad 38 \quad 39 \quad 33} \quad 1 \, 220 \, \mu\text{m}; a=32.1, b=7.2, c=10, \\ \text{Spic}=47.5,$$

where  $a$  is the ration of body length to maximum body diameter;  $b$  is the ration of body length to pharynx length;  $c$  is the ration of body length to tail length;  $M$  is the maximum body diameter; and  $\text{Spic}$  is the spicule length along arc.

### 3.5 Description

Body length 1 220  $\mu\text{m}$ , maximum diameter 38  $\mu\text{m}$ . Body cylindrical, tapering slightly towards anterior extremity. Cuticle punctated from level of amphidial fovea to near tail tip, with lateral differentiation consisting of irregularly-spaced larger dots. Head set-off by depression at level of cephalic setae. Inner labial sensilla not visible, six outer labial papillae and four cephalic setae in two distinct circles. Cephalic setae 4  $\mu\text{m}$  long. Amphidial fovea spiral, five turns, 22  $\mu\text{m}$  in diameter or 96% of c.b.d. wide, located immediately posterior to cephalic setae, 6  $\mu\text{m}$  from anterior edge to the head end. Anterior portion of buccal cavity cup-shaped. Posterior portion of buccal cavity cylindrical, cuticularised, 5  $\mu\text{m}$  wide, 30  $\mu\text{m}$  deep, with three strongly cuticularised teeth at border to anterior portion. Pharynx 170  $\mu\text{m}$  long, cylindrical with a terminal bulb. Cardia short. Nerve ring not observed. Ventral gland large, situated posterior to cardia. Excretory pore located at the ventral side, 110  $\mu\text{m}$  from anterior



**Fig. 2.** *Hopperia macramphida* sp. nov.. a. Lateral view of male anterior end, showing buccal cavity and teeth; b. lateral view of male anterior end, showing cephalic setae and amphidial fovea; c. male cloacal region, showing spicules and gubernaculum; and d. lateral view of male posterior end, showing preloacal supplements.

end.

Reproductive system diorchic, opposed, outstretched. Anterior testis to left of intestine and posterior testis to right of intestine. Spicules paired, equal, arcuate, 1.4 a.b.d. long, with swollen proximal end and central internal cuticularised lamella extending one third of spicule length from proximal end. Gubernaculum with bent dorso-caudal apophyses, 14.5  $\mu\text{m}$  long. Six papilliform preloacal supplements, from 32  $\mu\text{m}$  to 130  $\mu\text{m}$  in front of cloaca, and the distance between them more and more close. Tail 122  $\mu\text{m}$  long, conico-cylindrical with clavate end, bearing several short caudal setae and three terminal setae. Three caudal glands obvious.

### 3.6 Diagnosis and discussion

*Hopperia macramphida* sp. nov. is characterized by large amphidial fovea with five turns; arcuate spicules with enlarged proximal end and central internal lamella; gubernaculum with bent apophyses, six papilliform preloacal supplements; conico-cylindrical tail with swollen tip and three terminal setae. Most *Hopperia macramphida* sp. nov. closely resembles *H. patagonica* Pastor de Ward, 2004 in the body size, values of  $a$ ,  $b$  and  $c$ , size and shape of the spicules. However, it can be distinguished from the latter by having a much large amphidial fovea (five vs. three

turns); six papilliform preloacal supplements vs. 12 tiny tubular preloacal supplements; and a much longer spicules (1.4 vs. 0.5 a.b.d.). *Hopperia macramphida* sp. nov. differs from other congeneric species mainly in its very large amphidial fovea and the shape of spicule and preloacal supplement.

Updated dichotomous key to 17 species of *Hopperia* including the new species (Amended from [Leduc \(2012\)](#) and [Guo et al. \(2015\)](#)):

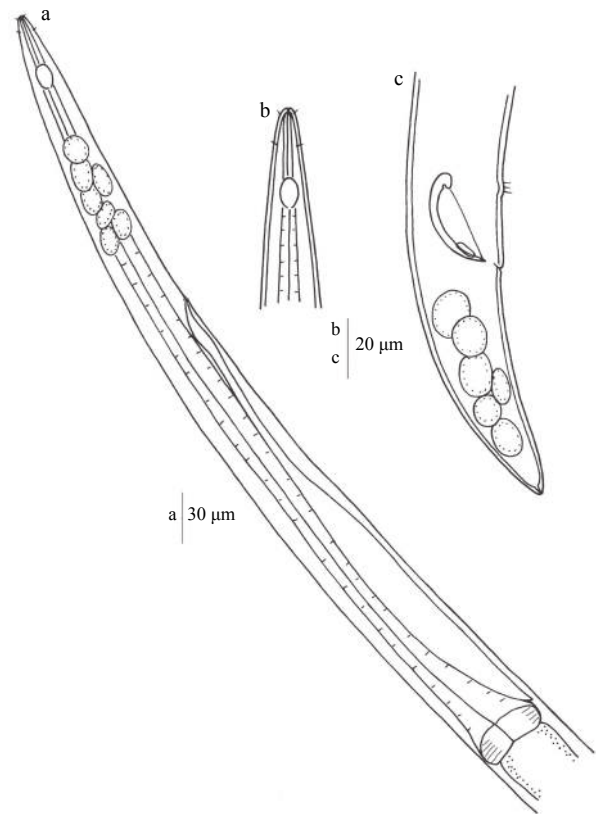
1. Cuticle with irregularly distributed dots in the lateral fields .....2
  - Cuticle with four longitudinal rows of coarse dots in lateral fields .....*H. communis* Gagarin and Thanh, 2006
2. Buccal cavity with three teeth .....3
  - Buccal cavity with six teeth .....*H. hexadentata* Hope and Zhang, 1995
3. Spicules not jointed ..... 4
  - Spicules jointed, more than 13 small preloacal supplements .....*H. metatypica* (Chitwood, 1936)
4. Spicules without distal hook ..... 5
  - Spicules with distal hook, tail without terminal setae.....*H. ancora* [Leduc, 2012](#)
5. Spicules without sharp proximal bend .....6
  - Spicules with sharp proximal bend.....*H. mira* Gagarin and Thanh, 2006
6. Tail conical, shorter than 3 a.b.d.....7
  - Tail conico-cylindrical, longer than 3 a.b.d.....8
7. Reflexed ovaries, 8 preloacal supplements .....9
  - Outstretched ovaries, 6–8 preloacal supplements.....*H. dorylaimopsoides* (Allgen, 1959)
  - Outstretched ovaries, 6–8 preloacal supplements.....*H. beaglense* Muthumbi et al., 1997
8. Tail with pointed tip..... 9
  - Tail tip not pointed.....10
9. Eight preloacal supplements,  $c'=4.7$ .....*H. australis* Jensen, 1992
  - 13–14 preloacal supplements,  $c'=5.2-5.7$ .....*H. sinensis* [Guo et al., 2015](#)
10. Tail longer than 5 a.b.d. ....11
  - Tail shorter than 5 a.b.d. ....13
11. Tail cylindrical portion < 50% of tail length, with terminal setae .....*H. massiliensis* [Vitiello, 1969](#)
  - Tail cylindrical portion >50% of tail length, without terminal setae. ....12
12. Amphidial diameter 51.5% of c.b.d., 20–21 preloacal supplements .....*H. indiana* Muthumbi et al., 1997
  - Amphidial diameter 75%–85% of c.b.d., 14–16 preloacal supplements .....*H. dolichura* Gagarin and Thanh, 2006
13. Spicules > 2 a.b.d., preloacal supplements indistinct.....*H. muscatensis* Warwick, 1973
  - Spicules < 2 a.b.d., preloacal supplements prominent.....14
14. 12 tubular preloacal supplements; spicules 0.5 a.b.d....*H. patagonica* Pastor de Ward, 2004
  - Six papilliform preloacal supplements.....15
15. Amphidial fovea with 5 turns, occupying 96% c.b.d. ....*H. macramphida* sp. nov.
  - Amphidial fovea with 3 turns, occupying about 50% c.b.d.....16
16. Tail 3.5 a.b.d., spicules 1.4 a.b.d.....*H. americana* Pastor de Ward, 1984
  - Tail 4.4 a.b.d., spicules 1.8 a.b.d.....*H. arntzi* Chen and Vincx, 1998

#### 4 Description of *Nemanema minutum* sp. nov. (Figs 3 and 4)

Order Enoplida Filipjev, 1929

Family Oxyostominidae Chitwood, 1935

Genus *Nemanema* [Cobb, 1920](#)



**Fig. 3.** *Nemanema minutum* sp. nov.. a. Lateral view of male pharyngeal region, showing amphidial fovea, pharynx and ventral gland cell; b. lateral view of male head end, showing cephalic setae, amphidial fovea; and c. lateral view of male posterior end, showing spicules, gubernaculum, preloacal supplements and oval cells of cavity.

#### 4.1 Type material

Only one male was discovered and measured. Holotype male on slide number 5-2-4-3

#### 4.2 Type locality and habitat

Sublittoral in the East China Sea. Station DH 5-2: 28°17.5'N, 122°25.3'E, water depth 67 m, muddy with a little sand sediment fraction.

#### 4.3 Etymology

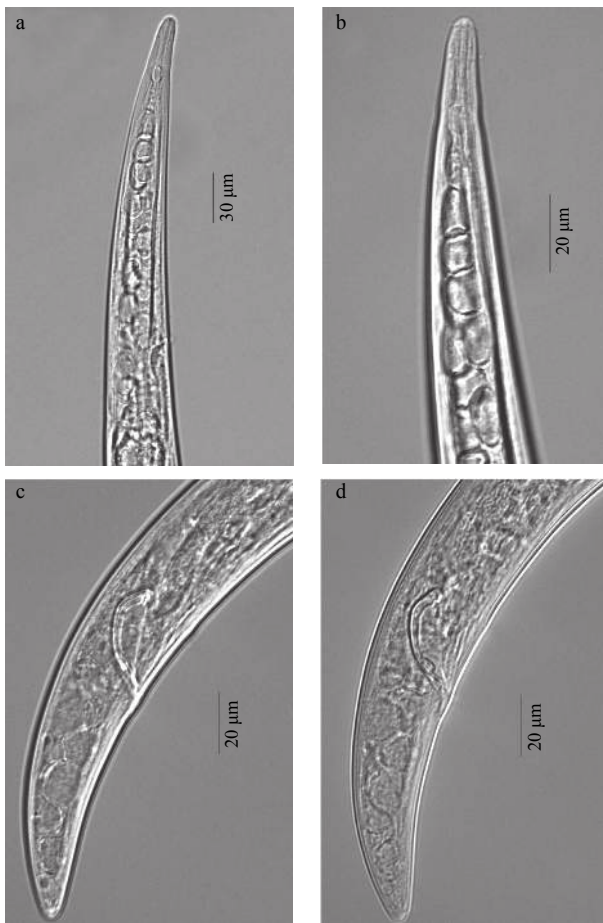
This species is named for its smaller body relative to similar congeners.

#### 4.4 Measurements

Holotype ♂:  $\frac{-436}{7}$   $\frac{M}{48}$   $\frac{1853}{50}$   $\frac{1}{31}$  1 939  $\mu\text{m}$ ;  $a=38.8$ ,  $b=4.5$ ,  $c=22.5$ ,  
 $\text{Spic}=41$ .

#### 4.5 Description

Body length 1 939  $\mu\text{m}$ . Maximum diameter 50  $\mu\text{m}$  ( $a=38.8$ ). Cuticle smooth. Prominent oval cells scattered throughout the body cavity. Six outer labial setae 1.5  $\mu\text{m}$ , four cephalic setae slightly shorter, 1.4 h.d. from anterior end. No buccal cavity. Amphidial foveae oval-shaped, 8  $\mu\text{m}$  long and 5.5  $\mu\text{m}$  wide, 3.4 times h.d. from anterior end. Pharynx slender, expanded at base, but not forming posterior bulb, 0.23 times body length. Cardia large, rectangle-shaped. Excretory pore surrounded by thickened cutic-



**Fig. 4.** *Nemanema minutum* sp. nov.. a. Lateral view of male anterior end, showing amphidial fovea; b. lateral view of male head end, showing cephalic setae and oval cells; c. lateral view of male tail end, showing spicules and preloacal supplements; and d. lateral view of male tail end, showing spicules and gubernaculum.

ular ring, 0.38 times pharyngeal length from anterior end. Ventral gland elongate, extending to near base of pharynx. Tail conical, 2.8 a.b.d. long.

Reproductive system diorchic, opposed, outstretched. Spicules 1.3 a.b.d. long, slender with hooked proximal end and tapered distal end, alae present. Gubernaculum with a ring-like appearance in lateral view. Preloacal supplements papilliform with three short setae (2–3  $\mu\text{m}$ ), located at the level of anterior end of spicule, 22  $\mu\text{m}$  from cloaca.

#### 4.6 Diagnosis and discussion

*Nemanema minutum* sp. nov. is characterized by relatively

smaller body size in the genus; larger oval amphidial fovea; conical tail; slender spicules with alae and hooked proximal end; ring-like gubernaculum; and papilliform preloacal supplements with three short setae. It is most similar to *Nemanema cylindricaudatum* (de Man, 1922) in most respects but differs by smaller body size (1.9 mm vs. 2.5–2.9 mm); larger amphidial fovea (0.5 vs. 0.3 times c.b.d.), more posterior in position (3.4 vs. 2–2.8 times h.d. from anterior); tail conical with tapered tip vs. cylindrical with rounded tip; spicules slender with hooked proximal end vs. broad with rounded proximal end; preloacal supplements present vs. absent. *Nemanema minutum* sp. nov. can be distinguished from most other congeners by its conical tail, slender spicules and papilliform preloacal supplements.

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