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Michael Türkay Memorial Issue

A NEW SPECIES OF THE GENUS *TYPHLAMPHIASCUS* (COPEPODA,
HARPACTICOIDA, MIRACIIDAE) FROM THE SOUTH CHINA SEA

BY

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ABSTRACT

A new species, *Typhlamphiascus tuerkayi* sp. nov. (Copepoda, Harpacticoida, Miraciiidae), is described from specimens collected in the South China Sea. This new species differs from its congeners by the combined characters of the number of chitinous lamellae on the male P1, the apomorphic setal formulae of the swimming legs, and the setal number on P5. The new species is most similar to *T. ovale* Wells & Rao, 1987 and *T. higginsii* Chullasorn, 2009. It differs from the latter two species by the following features: the caudal ramus about three times as long as broad, P2 exp-3 with three outer spines, P3 enp-3 with two inner setae, P5 basoendopod in the female with four setae, P5 exopod in the female about three times as long as its greatest width, antennule of male 9-segmented, the inner edge of the basis in male P1 with eight chitinous lamellae, P5 exopod in male with four setae.

Key words. — Crustacea, new species, taxonomy, meiobenthos

ZUSAMMENFASSUNG

Eine neue Art, *Typhlamphiascus tuerkayi* sp. nov. (Copepoda, Harpacticoida, Miraciiidae), wird hier anhand von im Südchinesischen Meer gesammelten Exemplaren beschrieben. Diese neue Art unterscheidet sich von ihren Verwandten durch eine Merkmalskombination der Anzahl chitinisierter Lamellen am männlichen P1, die apomorphischen Muster der Setae an den Schwimmbeinen und die Anzahl der Setae an P5. Die neue Art ähnelt *T. ovale* Wells & Rao, 1987 und *T. higginsii* Chullasorn, 2009 am stärksten. Sie unterscheidet sich von letzteren durch die folgenden Merkmale: der Kaudalramus ist ungefähr drei mal so lang wie breit, P2 exp-3 besitzt drei Außendornen, P3 enp-3 hat zwei innere Setae, P5 Basoendopod im Weibchen hat vier Setae, weiblicher P5 Exopod ist ungefähr dreimal so lang wie dessen größte Breite, männliche Antennule hat neun Segmente, der Innenrand der Basis des männlichen P1 hat acht chitinierte Lamellen, P5 Exopod des Männchens hat vier Setae.

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INTRODUCTION

The genus *Typhlamphiascus* Lang, 1944 belongs to the large family Miraciidae Dana, 1846. Miraciids inhabit a wide range of sediment types from flocculent mud to coralline debris, primarily in intertidal and shallow subtidal areas of continental shelves (Chullasorn, 2009). The genus *Typhlamphiascus* comprises 17 species, of which *T. confuses* (Scott T., 1902) and *T. lamellifer* (Sars G.O., 1911) contain two subspecies, respectively (Walter et al., 2016). Species of the genus *Typhlamphiascus* can inhabit deep, sublittoral muddy bottoms, the littoral zone, algal cover and surface layers of the northern Atlantic and Pacific coast (Por, 1963).

Early taxonomic studies on the benthic copepods in China have usually focused on freshwater species (Dai & Song, 1979), and the marine species were carried on very late, just a few species having been reported (Gee & Mu, 2000; Mu & Gee, 2000; Mu & Huys, 2002, 2004; Huys & Mu, 2008; Ma & Li, 2011). Most records of benthic copepods from the China seas are mainly from the Bohai Gulf and Yellow Sea. No *Typhlamphiascus* species has previously been reported from tropical waters in the China seas.

In 2007, several specimens of harpacticoid copepods were sorted from benthic samples collected off Hainan Island, South China Sea, by RV “Kexue-I” during the cruise of a project of Chinese offshore marine investigation and assessment. These specimens proved to belong to an unknown species of *Typhlamphiascus*, which is herein described as a new species.

MATERIAL AND METHODS

The type specimens were collected from the South China Sea, fixed in 10% formalin. The specimens were extracted from benthic samples using a 38 μm sieve and the colloidal silica Ludox TM-50 suspension centrifugation flotation method. Specimens were preserved in 75% alcohol. For their identification, the specimens were cleared in lactic acid and observed under a light microscope. Before dissection, the habitus was drawn and the whole body length was measured while being temporarily mounted in lactophenol. Specimens were dissected in lactic acid, mounted on slides in lactophenol, and subsequently sealed with nail polish. Observations, dissection and drawings were made using a compound microscope. The habitus was drawn at 400 \times magnification; appendages were drawn at 1000 \times magnification, with an oil immersion lens.

The terminology follows Huys et al. (1996). Abbreviations used in the text and figures are: aes, aesthetasc; exp, exopod; exp-1(-2-3), the first (second, third) segment of the exopod; enp, endopod; enp-1(-2-3), the first (second, third) segment of the endopod; P1-P6, swimming legs 1-6. Body length was measured from the

anterior margin of the rostrum to the posterior margin of the caudal rami. Type material is deposited in the Marine Biological Museum, Chinese Academy of Sciences, Qingdao, China (MBM, MBMCAS).

SYSTEMATIC PART

Order HARPACTICOIDA Sars, 1903

Family MIRACIIDAE Dana, 1846

Subfamily DIOSACCINAE Sars, 1906

Genus *Typhlamphiascus* Lang, 1944

***Typhlamphiascus tuerkayi* sp. nov.**

(figs. 1-7)

Material examined.— Holotype: female, dissected on four slides (MBM 189121), South China Sea, 18°35.8071'N 110°43.4366'E, soft mud, 30.1 m depth, 19 October 2007. Allotype: male, dissected on three slides (MBM 189222) same collection data as holotype. Paratypes: one female and one male, preserved in alcohol (MBM 189223), same collection data as holotype; one male (MBM 189224), 21°17.7426'N 110°51.1891'E, 15.5 m depth, soft mud, 9 October 2007; one male (MBM 189225), 20°01.2523'N 111°09.9323'E, 50.2 m depth, muddy sand, 15 October 2007; one female (MBM 189226), 19°34.8292'N 111°31.7719'E, 102 m depth, muddy sand, 17 October 2007; one female (MBM 189227), 18°33.2539'N 110°22.8292'E, 49.9 m depth, soft mud, 7 October 2007; two female, one male (MBM 189228), 21°01.9355'N 111°04.2526'E, 26.2 m depth, soft mud, 10 October 2007. Collectors: J.-B. Wang, L.-M. Shuai, J. Zhou, Q.-X. Han & L. Ma.

Etymology.— The species is named in honour of the German carcinologist, the late Professor Michael Türkay, for his great contributions to the knowledge of crustacean taxonomy.

Diagnosis.— Antennule 8-segmented in female, with one aesthetasc on the fourth segment and terminal segment each. Antennary basis without seta, exopod 3-segmented. Mandibular gnathobase with row of nine teeth and one spiniform seta, exopod 2-segmented with one seta, respectively, endopod 1-segmented with seven setae. Maxillary arthrite of praecoxa with nine spines at distal margin, coxal endite with three setae. Maxillary syncoxa bearing three endites with three, two, and three spinulose setae, respectively. Maxillipedal syncoxa with four setae. P1 exp-3 without inner seta, with three outer spines; P1 enp-3 with one inner seta, without outer spine. P2 and P3 exp-3 with one inner seta and three outer spines, respectively; P2 enp-3 with one inner seta and one outer spine; P3 enp-3 with two inner setae and one outer spine. P4 exp-3 with two inner setae and three outer spines; P4 enp-3 with one inner seta and one outer spine. Right and left legs of P5 separated; P5 basoendopod in female with four endopodal setae, in male with two setae. Inner edge of the basis of male P1 with eight chitinous lamellae. Caudal ramus about three times as long as broad.

Description.—Female (based on holotype and one paratype). Habitus (figs. 1A, 8A). Total length of holotype female (body plus caudal rami, excluding caudal setae): 920 μm . Body slender, almost linear, boundary between prosome and urosome inconspicuous, dorsal and lateral surfaces with scattered sensilla. Prosome 4-segmented: cephalothorax (including two thoracic somites bearing maxilliped and P1) and three articulated somites bearing P2 to P4. Urosome (fig. 1B) 5-segmented, comprising of posterior thoracic somite, genital double-somite, and three abdominal somites. Urosomites with rows of hyaline frills on dorsal edge respectively, excluding genital double-somite; urosomites ornamented with hyaline frills on ventral side except on first urosomite. Anal operculum large, furnished with rows of spinules dorsally and ventrally above the caudal edge. Caudal ramus (figs. 1A, 8B) about three times as long as broad, carrying seven setae: three outer setae, smooth; two medial setae, well developed, slightly pinnate; two inner setae, slender, all ramal setae located terminally.

Rostrum (fig. 2A) demarcated from cephalothorax, expanded at base, almost triangular with pair of sensilla positioned on either side about 1/5 the distance from acute tip.

Antennule (figs. 2B, 8C) with eight segments; the first segment and second segment longest; armature: 1, 11, 6, 4 + aes, 1, 4, 4, 5 + aes.

Antenna (fig. 2C) biramous, with small unornamented coxa. Allobasis with spinules near coxa. Exopod 3-segmented, with 1-0-(1 + 3) setae; exp-1 long, smooth; exp-2 clearly shorter than exp-1; exp-3 with row of spinules. Endopod 1-segmented, with eight spines on lateral edge; lateral armature comprising single spinulose seta; apical armature comprising seven elements: one pinnate spine, three geniculate setae, one spinulose seta and two slender setae.

Mandible (fig. 2D). Gnathobase with five large and strong teeth, seven small teeth and one seta. Basis with two rows of spinules and three setae. Exopod 2-segmented, with two and one setulose setae, respectively. Endopod 1-segmented, with two lateral and five terminal setae.

Maxillule (fig. 2E) with praecoxa and coxa demarcated. Arthrite with nine apical spines and two juxtaposed setae on surface. Coxal endite with three setae. Basis with row of spinules, six setae. Exopod 1-segmented, with two pinnate setae. Endopod 1-segmented, with four pinnate setae.

Maxilla (fig. 2F). Syncoxa with spinules along outer margin; with three endites bearing three, two, and three setae, respectively. Allobasis with one claw and two setae. Endopod 2-segmented, enp-1 with two setae, enp-2 with four setae.

Maxilliped (fig. 2G) subchelate. Syncoxa with four setae located at distal margin. Basis with two rows of spinules and two pinnate setae. Endopod 2-segmented; enp-1 with two setae, enp-2 with one strong claw.

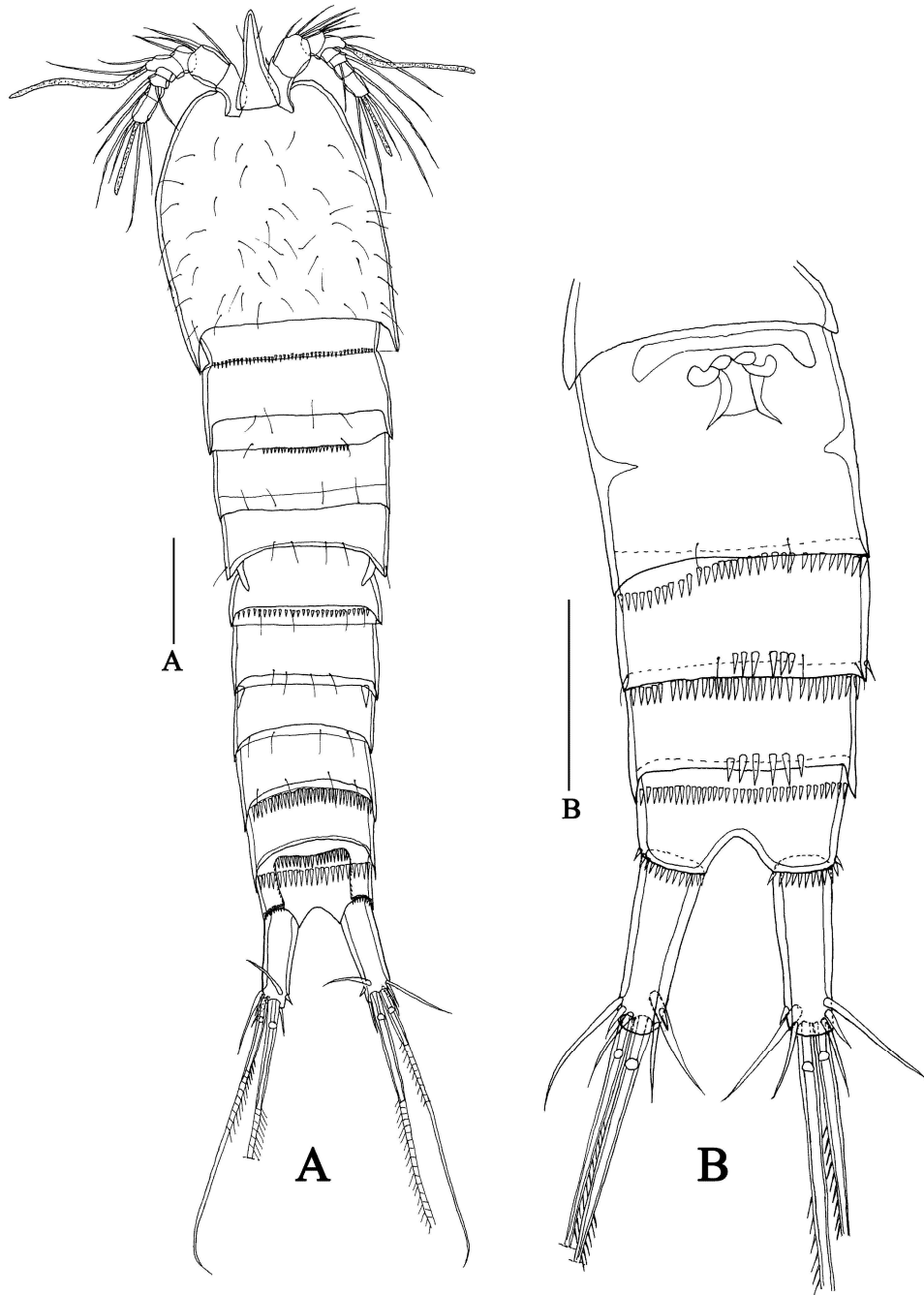


Fig. 1. *Typhlamphiascus tuerkayi* sp. nov., holotype (female, MBM 189121). A, habitus, dorsal; B, urosome, ventral. Scale bar = 100 μ m.

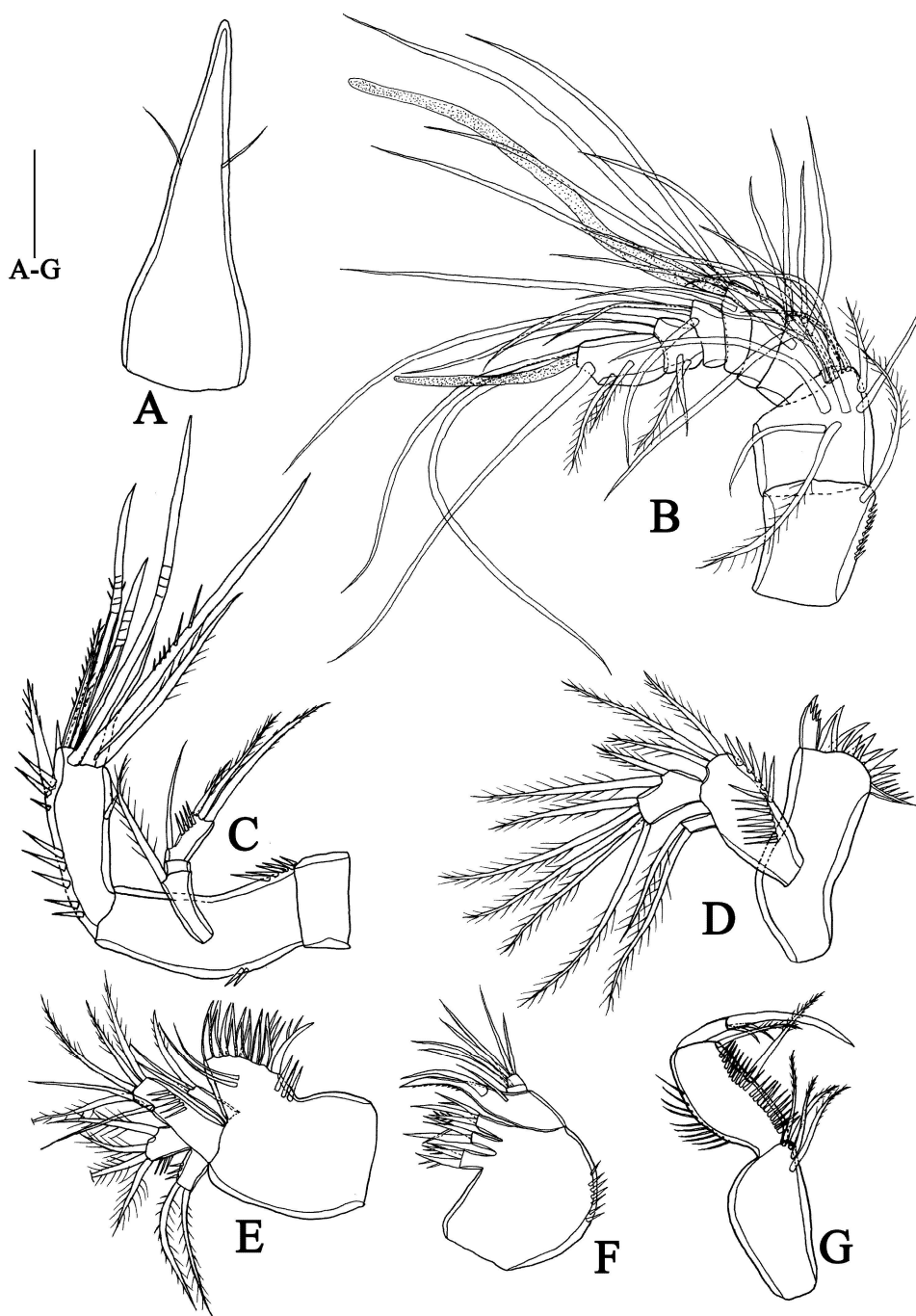


Fig. 2. *Typhlamphiascus tuerkayi* sp. nov., holotype. A, rostrum; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla; G, maxilliped. Scale bar = 50 μ m.

P1 (fig. 3A): Coxa with complex patterns of denticles on anterior surface, row of setules on inner margin. Basis bearing single outer and strong inner spinulose spines, terminal margin with spinules, inner margin with setules. Exopod and endopod 3-segmented, outer and distal margins with spinules, exopod short, about as long as enp-1.

P2-P4 (figs. 3B, 4A-B) with exopods and endopods 3-segmented, intercoxal sclerites with two lateral blunt projections. Coxae of almost rectangular shape with few rows of spinules on each. Basis with small and slender outer pinnate setae (spinulose seta in P2), without inner setae, ornamented with long spinules on anterior surface, distal margin with denticles; endopod about as long as exopod in P2 and P3, shorter in P4.

Setal formulae of female P1-P4 as follows:

	Exp	Enp
P1	0-1-0, 2, 3	1-1-1, 2, 0
P2	1-1-1, 2, 3	1-2-1, 2, 1
P3	1-1-1, 2, 3	1-1-2, 2, 1
P4	1-1-2, 2, 3	1-1-1, 2, 1

Right and left P5 (fig. 5A) not fused medially, baseoendopod and exopod separated. Endopodal lobe prominent, with two spinulose, one long and one slender setae. Exopod about three times as long as greatest width, ornamented with denticles and six bare setae.

Male (based on allotype and one paratype) differs from female as follows:

Body (figs. 6A, 8D) slightly shorter than female holotype, total length of allotype male (body plus caudal rami, excluding caudal setae): 660 μ m. Urosome (fig. 6B) 6-segmented, genital somite and the first abdominal somite separate, urosomite 4 with two rows of spinules ventrally. Caudal ramus (figs. 6A, 8E) about 1.5 times as long as broad. Spermatophore (fig. 6A) ovoid visible inside genital somite.

Antennule (figs. 5B, 8F) 9-segmented, haplocer. Armature: 1, 10, 6, 5 + aes, 1, 2, 2, 4, 6 + aes., geniculation between segments 6 and 7.

Antenna, mandible, maxillule, maxilla, maxilliped similar to female holotype.

P1 (fig. 7A). Basis bearing eight unequal chitinous lamellae on the inner edge. Other characters as in female holotype.

P2 (fig. 7B) with protopod and exopod as in female holotype. Endopod 2-segmented; enp-1 with one inner seta, long spinules on outer margin; enp-2 modified as common in the genus, with one inner seta, two terminal setae, one stout spine and one seta on outer margin.

P4 (fig. 7C) as in female holotype, except enp-3 with two inner setae.

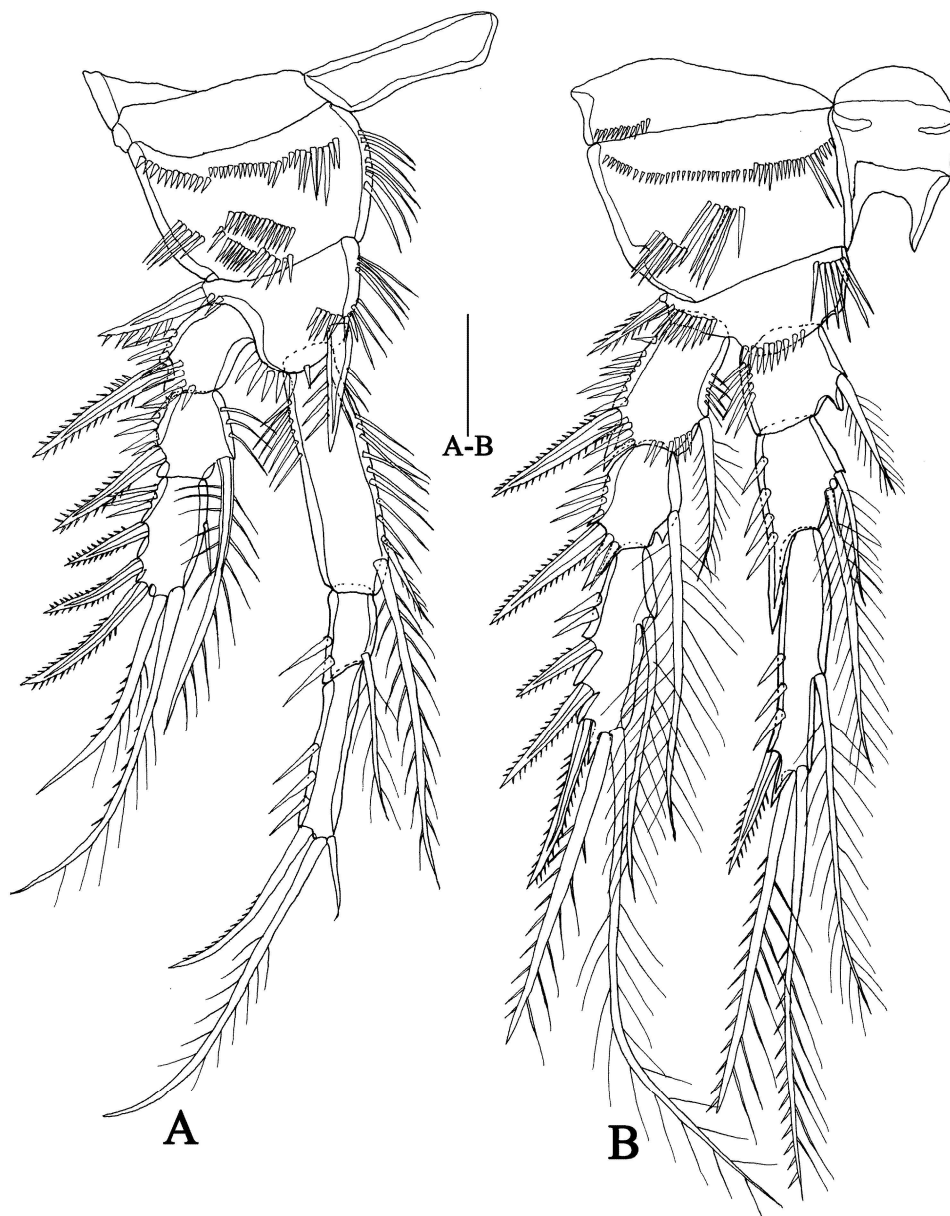


Fig. 3. *Typhlamphiascus tuerkayi* sp. nov., holotype. A, P1, anterior; B, P2, anterior. Scale bar = 50 μ m.

P5 (fig. 5C). Basoendopod with two bifid spines; exopod with denticles and four unequal setae.

P6 (fig. 6B) unconfuent, each with three setae.

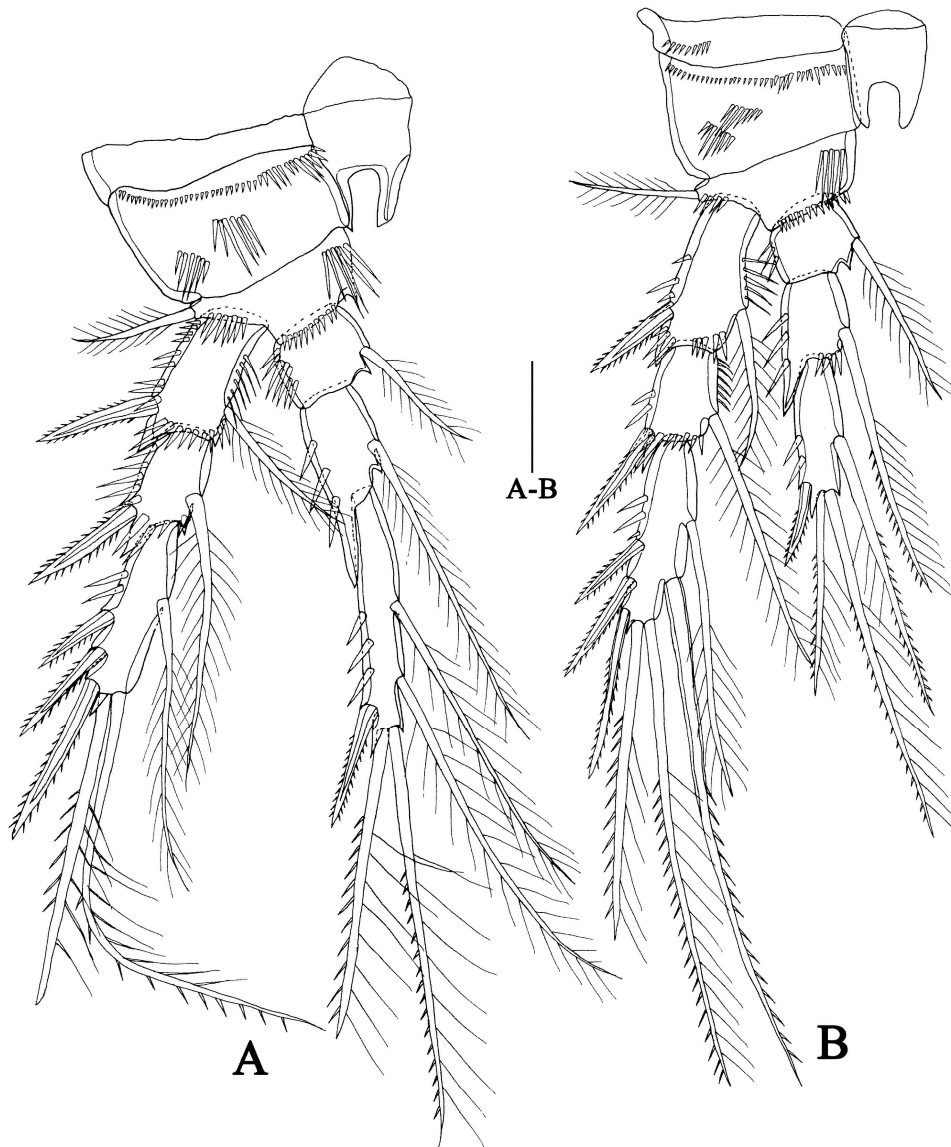


Fig. 4. *Typhlamphiascus tuerkayi* sp. nov., holotype. A, P3, anterior; B, P4, anterior. Scale bar = 50 μm .

Variability.— Most morphological features are conservative, except body length and the length/width ratio of caudal ramus. Body length of female varies from 518 to 920 μm and male from 497 to 660 μm . The length/width ratio of caudal ramus changes from 1.83 to 3 in female and 1.5 to 1.75 in male.

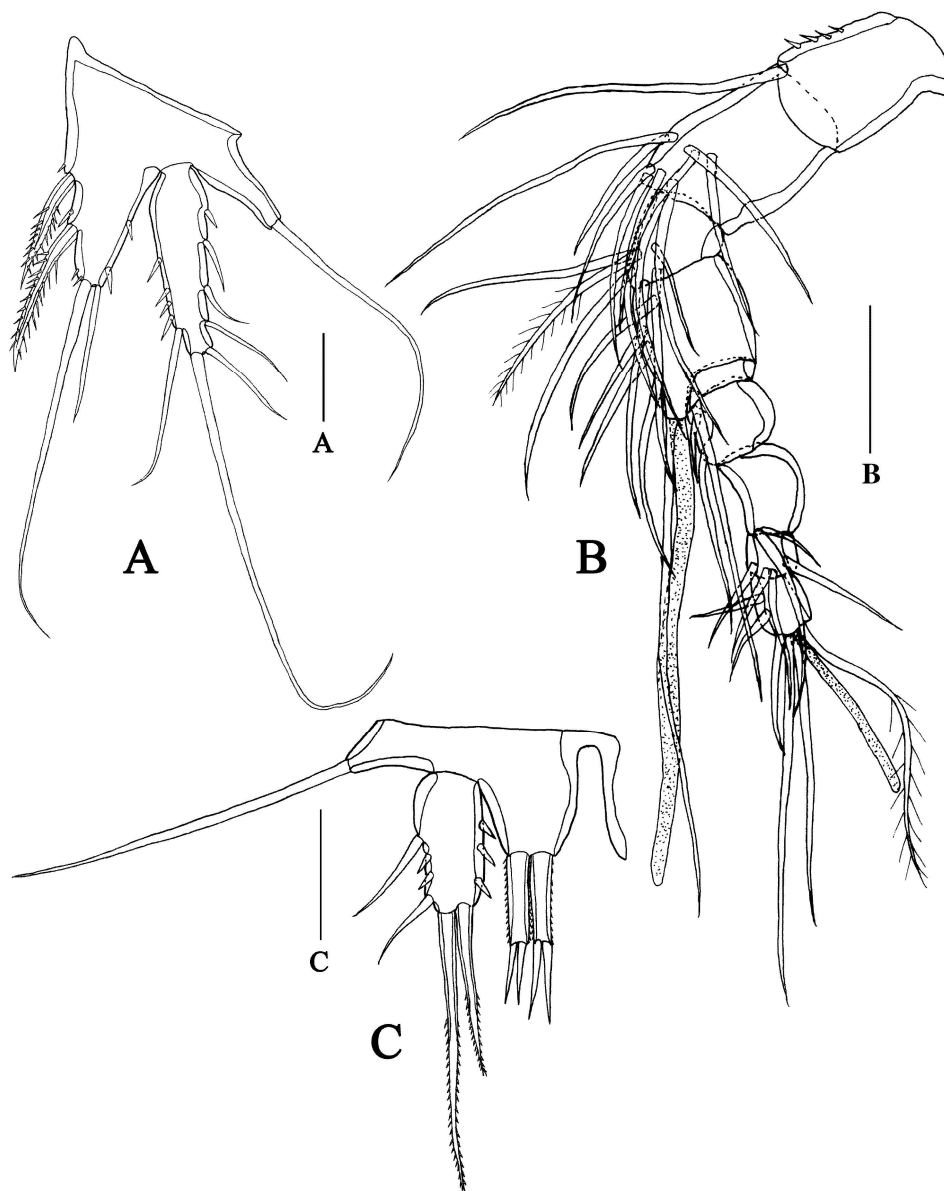


Fig. 5. *Typhlamphiascus tuerkayi* sp. nov., holotype. A, P5, anterior. Allotype (male, MBM 189222). B, antennule; C, P5, anterior. Scale bars = 50 μ m.

DISCUSSION

In a revision of *Typhlamphiascus*, Por (1963) recognized two groups of species, based on the presence of two or single setae on the inner side of P4 enp-3. Though one of these species, *Typhlamphiascus accraensis* Scott T., 1894, was

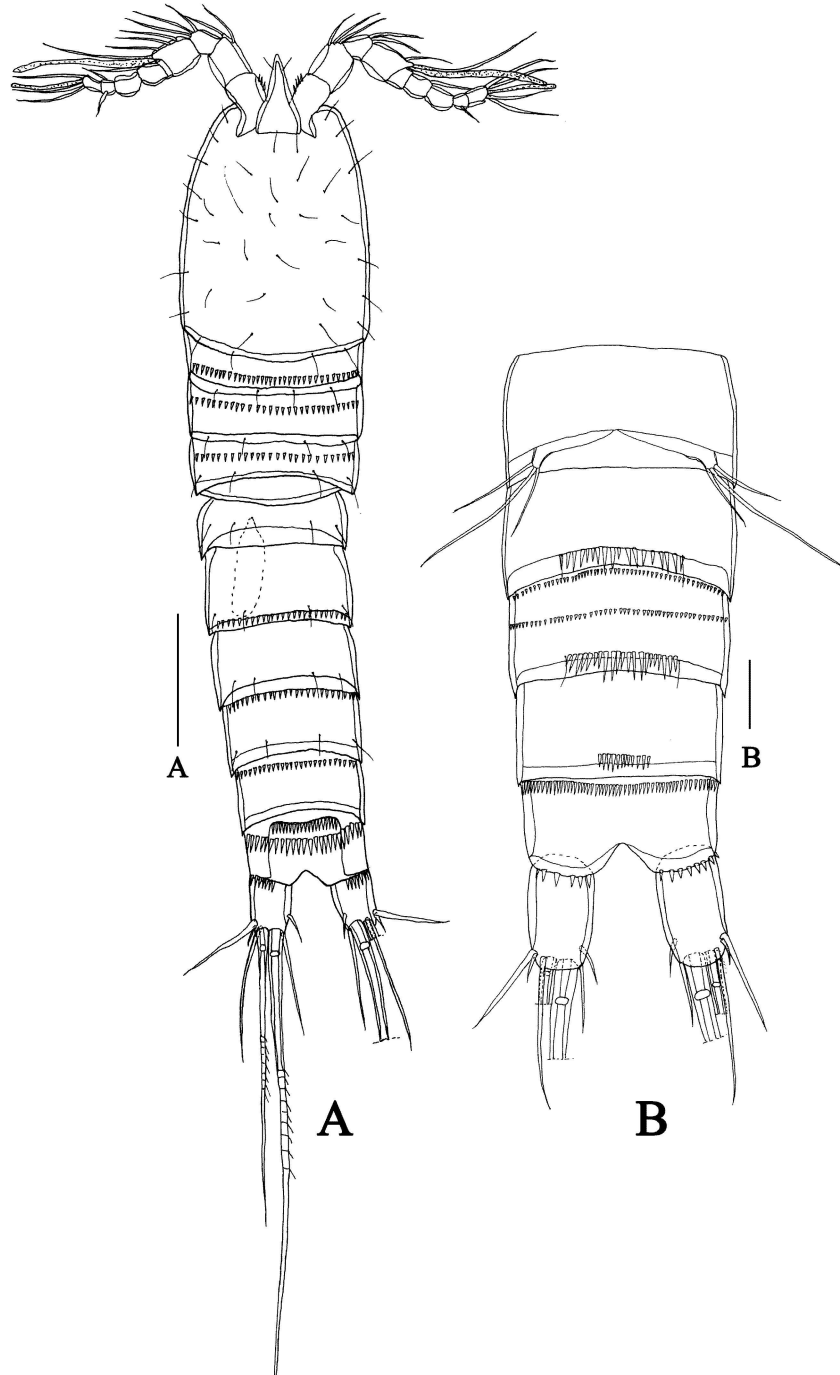


Fig. 6. *Typhlamphiascus tuerkayi* sp. nov., allotype. A, habitus, dorsal; B, urosome, ventral. Scale bars = 100 μ m (A), 50 μ m (B).

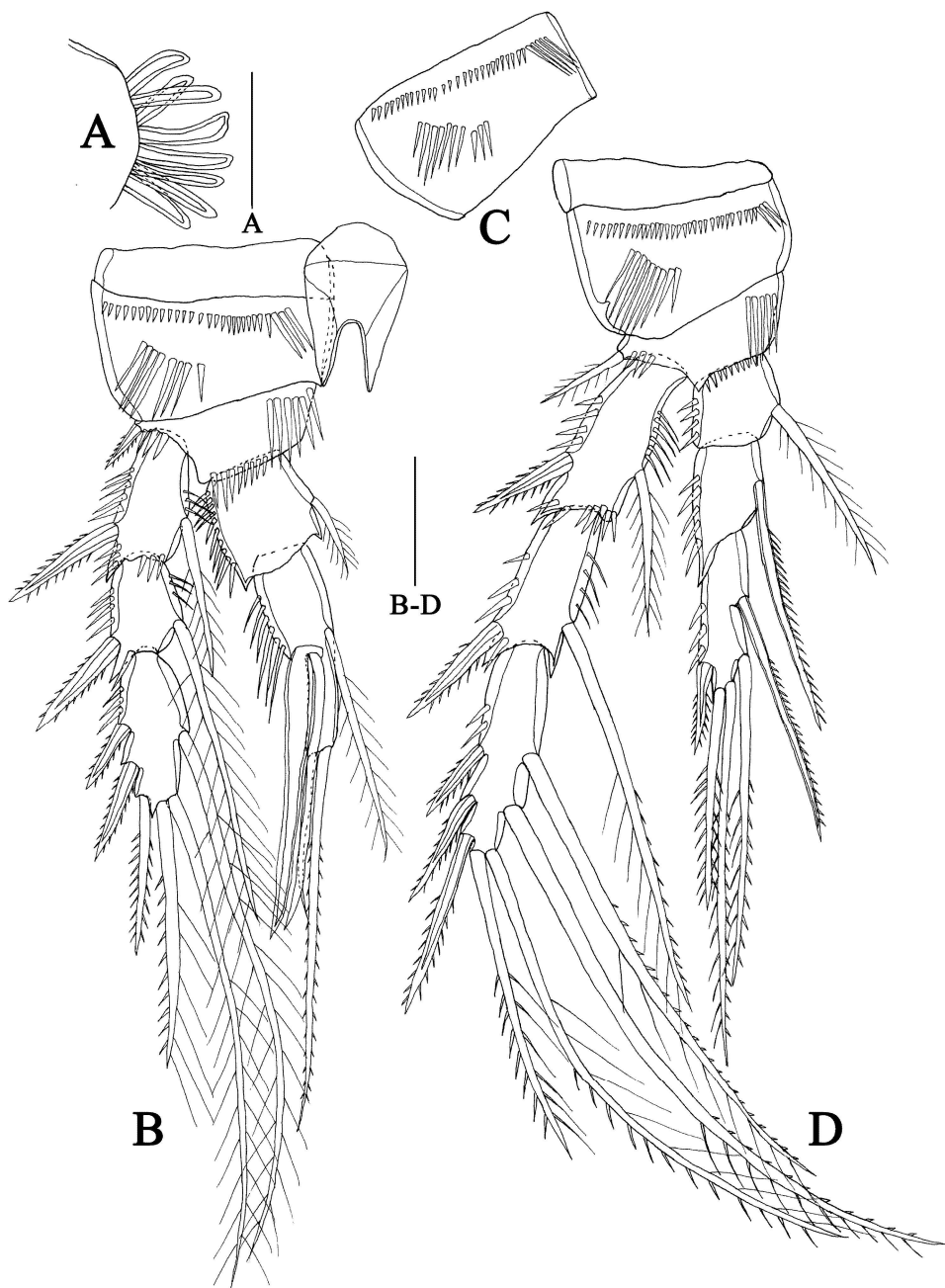


Fig. 7. *Typhlamphiascus tuerkayi* sp. nov., allotype. A, inner edge of P1 basis; B, P2, anterior; C, coxa of P3, anterior; D, P4, anterior. Scale bars = 50 μ m.



Fig. 8. *Typhlamphiascus tuerkayi* sp. nov., paratype (female, MBM 189222). A, habitus, dorsal; B, caudal ramus, dorsal; C, antennule, dorsal. Paratype (male, MBM 189228). D, habitus, dorsal; E, caudal ramus, dorsal; F, antennule, dorsal.

initially assigned to group 2 by Por (1963), the original description and figures (Scott T., 1984) describe and illustrate two setae on the inner side of P4 enp-3. Accordingly, we transfer *T. accraensis* to Por's group 1. Lang (1965) added *T. lutincola* Soyer, 1963 and *T. drachi* Soyer, 1964 to this group, and *T. pectinifer* Lang, 1965 and *T. unisetosus* Lang, 1965 to group 2. Therefore, group 1 now includes: *T. accraensis*, 1894, *T. blanchardi* (Scott T., 1895), *T. bouligandi* Soyer, 1971, *T. drachi*, *T. gracilicaudatus* (Thompson I.C. & Scott A., 1903), *T. gracilis* Por, 1963, *T. lamellifer capensis* Kunz, 1975, *T. lutincola*, *T. typhloides* (Sars G.O., 1911); while group 2 includes *T. confusus erythraeicus* Por, 1963, *T. confusus gullmaricus* Por, 1963, *T. higginsii* Chullasorn, 2009, *T. lamellifer lamellifer* (Sars G.O., 1911), *T. latifurca* Por, 1968, *T. longifurcatus* Rouch, 1962, *T. ovale* Wells & Rao, 1987, *T. pectinifer*, *T. typhlops* (Sars G.O., 1906) and *T. unisetosus*.

Typhlamphiascus tuerkayi sp. nov. bears only one setae on the inner side of P4 enp-3, so belongs to Por's (1963) group 2, wherein it most closely resembles *T. ovale* and *T. higginsii*. These three species share the following features: female

urosomites 2-4 ornamented with hyaline frills on their ventral side; P1-P4 exp-2 with one inner seta; P2-P4 exp-1 with one inner seta; P1-P4 enp-1 with one inner seta; P1 enp-3 with three setae; P2 enp-2 of female with two inner setae; P5 exopod of female with six setae; P5 basoendopod of male with two bifid spines.

However, *Typhlamphiascus tuerkayi* sp. nov. differs from *T. ovale* by the following characteristics: anal operculum furnished with rows of spinules above the caudal edge both dorsally and ventrally (anal operculum simple in *T. ovale*); the caudal ramus about three times as long as broad (almost as long as in *T. ovale*); maxilliped syncoxa with four setae (two setae in *T. ovale*); P5 basoendopod in female with four setae (five setae in *T. ovale*); P5 exopod in male about three times as long as greatest width (about two times as long as in *T. ovale*); P1 basis of male without knob at the inner proximal corner (with a chitin knob in *T. ovale*).

The new species can be distinguished from *T. higginsi* by the following characteristics: P2 exp-3 and P3 exp-3 with three inner setae (two setae in *T. higginsi*); P3 enp-3 with two inner setae (only one seta in *T. higginsi*); P5 basoendopod in female with four setae (five setae in *T. higginsi*); antennule of male 9-segmented (8-segmented in *T. higginsi*); P5 exopod in male with four setae (six setae in *T. higginsi*).

Typhlamphiascus tuerkayi sp. nov. differs from other species of the second group by bearing five setae on P3 enp-3 (four setae in *T. unisetosus*, *T. pectinifer*, *T. confusus erythraeicus*, *T. confusus gullmaricus*, *T. latifurca*, *T. lamellifer lamellifer*); and four setae on P5 basoendopod of female (five setae in *T. typhlops* and *T. longifurcatus*).

To date, 15 species and 4 subspecies are currently recognized as valid in the genus. *Typhlamphiascus* can be identified with the specific key suggested below (amended from Soyer, 1963, 1964; and Wells, 2007).

1. Caudal ramus with an aberrant inner seta *Typhlamphiascus typhloides* (Sars G.O., 1911)
 - Caudal ramus with normal inner seta 2
2. Distal end of exterior margin in P5 exopod forming into a hook-like process *Typhlamphiascus blanchardi* (Scott T., 1895)
 - Distal end of exterior margin in P5 exopod normal 3
3. Female P5 exopod with 4 setae *Typhlamphiascus longifurcatus* Rouch, 1962
 - Female P5 exopod with more than 4 setae 4
4. Female P5 exopod with 5 setae 5
 - Female P5 exopod with 6 setae 8
5. Female P5 baseoendopod with 4 setae 6
 - Female P5 baseoendopod with 5 setae 7
6. P4 enp-3 with 2 inner setae
 - *Typhlamphiascus gracilicaudatus* (Thompson I.C. & Scott A., 1903)
 - P4 enp-3 with single inner seta *Typhlamphiascus tuerkayi* sp. nov.
7. Male P1 basis with 3 chitinous lamellae on inner edge . . *Typhlamphiascus drachi* Soyer, 1964

- Male P1 basis with 7 chitinous lamellae on inner edge . . . *Typhlamphiascus gracilis* Por, 1963
- 8. Female A1 9-segmented *Typhlamphiascus accraensis* Scott T., 1894
- Female A1 8-segmented 9
- 9. P4 enp-3 with 2 inner setae 10
- P4 enp-3 with single inner seta 12
- 10. P1 exopod much shorter than P1 enp-1; male P1 without chitinous lamella
- *Typhlamphiascus bouligandi* Soyer, 1971
- P1 exopod extends to about the end of P1 enp-1 11
- 11. Caudal ramus at least two times as long as wide; fourth innermost seta of P5 baseoendopod as long as third innermost seta *Typhlamphiascus lutincola* Soyer, 1963
- Caudal ramus at most two times as long as wide; fourth innermost seta of P5 baseoendopod about half as long as third innermost seta . . . *Typhlamphiascus lamellifer capensis* Kunz, 1975
- 12. P3 enp-3 with 4 setae 13
- P3 enp-3 with 5 setae 14
- 13. P3 exp-3 with 5 setae *Typhlamphiascus higginsii* Chullasorn, 2009
- P3 exp-3 with 6 setae *Typhlamphiascus unisetosus* Lang, 1965
- 14. P4 enp-2 without inner seta *Typhlamphiascus typhlops* (Sars G.O., 1906)
- P4 enp-2 with single inner seta 15
- 15. P5 exopod oval, the outer two setae of P5 baseoendopod reduced
- *Typhlamphiascus ovale* Wells & Rao, 1987
- P5 exopod not of this form, the outer two setae of P5 baseoendopod not reduced 16
- 16. Caudal ramus lamelliform 17
- Caudal ramus sublinear or straight-rectangular 18
- 17. P5 exopod narrow oblong, the fifth innermost seta of P5 baseoendopod as long as the fourth innermost seta *Typhlamphiascus pectinifer* Lang, 1965
- P5 exopod oblong oval, the fifth innermost seta of P5 baseoendopod about half as long as the fourth innermost seta *Typhlamphiascus lamellifer lamellifer* (Sars G.O., 1911)
- 18. Caudal ramus at least two times as long as wide
- *Typhlamphiascus confusus gullmaricus* Por, 1963
- Caudal ramus at most 1.7 times as long as wide 19
- 19. Urosomite 4 without armature *Typhlamphiascus confusus erythraeicus* Por, 1963
- Urosomite 4 with armature *Typhlamphiascus latifurca* Por, 1968

ACKNOWLEDGEMENTS

This study was supported by the National Natural Science Foundation of China (No. 41206148) and the IOCAS Funding (No. 2012IO060104). This study was also funded partly by the Scientific and Technological Innovation Project Financially Supported by Qingdao National Laboratory for Marine Science and Technology (No. 2015ASKJ01). Thanks to the fellows in our team for their assistance in collecting samples.

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First received 12 May 2016.

Final version accepted 7 April 2017.