

## *Heteroconger mercyae*, a new species of garden eel (Congridae: Heterocongrinae) from West Papua, Indonesia

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### Abstract

A new species of heterocongrine garden eel is described from West Papua, Indonesia based on 13 specimens, 106.3–678.1 mm TL. It differs from other members of the genus by its distinct colour pattern, consisting of zebra-like black and white barring on the head grading to a complex black and white maze pattern on the body and a combination of features that include dorsal fin origin anterior to gill opening, pterygoid teeth present, body depth at gill opening 28.8–35.2 percent of head length, 62–71 (mean = 65) preanal vertebrae, 204–213 (mean = 207.4) total vertebrae, and 63–69 (mean = 65.7) preanal lateral-line pores. A key is provided for the Indo-west Pacific species of *Heteroconger*.

### Zusammenfassung

Beschrieben wird eine neue Art der Röhrenaele (Unterfamilie Heterocongrinae) von West-Papua, Indonesien, auf der Grundlage von 13 Exemplaren mit 106,3–678,1 mm TL. Sie unterscheidet sich von anderen Angehörigen der Gattung durch die unverkennbare Farbgebung: schwarz-weiße Zebrastrifen am Kopf, die übergehen in ein komplexes Netzmuster auf dem Rumpf, sowie durch eine Kombination weiterer Merkmale: u.a. Ansatz der Rückenflosse vor der Kiemenöffnung, vorhandene Pterygoidzähne, Körpertiefe an der Kiemenöffnung 28,8–35,2 Prozent der Kopflänge, 62–71 (Mittel 65) präanale Wirbel, Gesamtzahl der Wirbel 204–213 (Mittel 207,4), 63–69 (Mittel 65,7) präanale Seitenlinien-Poren. Angefügt ist ein Bestimmungsschlüssel für die indo-westpazifischen Arten der Gattung *Heteroconger*.

### Résumé

Une nouvelle espèce d'anguille jardinière hétérocongrine est décrite originaire de Papouasie occidentale, Indonésie, sur base de 13 spécimens, 106,3–678,1 mm de LT. Elle se distingue des autres membres du genre par son patron de coloration qui se compose de zébrures blanches et noires sur la tête passant à un patron complexe labyrinthique noir et blanc sur le corps et par une combinaison de caractéristiques qui comprennent une base de dorsale antérieure à l'ouïe, la présence de dents ptérygoïdes, la hauteur du corps à l'ouïe de 28,8 à 35,2 % de la longueur de la tête, de 62 à

71 (65 en moyenne) de vertèbres préanales, 204 à 213 (207,4 en moyenne) de vertèbres au total et 63 à 69 (65,7 en moyenne) de pores préanales sur la ligne latérale. Une clé est fournie pour les espèces d'*Heteroconger* de l'Indo-Pacifique ouest.

### Sommario

Una nuova specie di grongo di giardino (sottofamiglia Heterocongrinae) è descritta sulla base di 13 esemplari di 106.3–678.1 mm TL raccolti nelle acque di Papua Occidentale, Indonesia. Differisce dagli altri membri del genere per la caratteristica colorazione, costituita da una zebraatura bianca e nera sul capo che degrada verso un complesso labirinto di motivi neri e bianchi sul corpo, e per una combinazione di caratteristiche che comprendono l'origine della pinna dorsale anteriore all'apertura branchiale, presenza di denti pterigoidei, altezza del corpo a livello della fessura branchiale 28.8–35.2 percento della lunghezza della testa, 62–71 (valore medio = 65) vertebre preanali, 204–213 (valore medio = 207.4) vertebre totali and 63–69 (valore medio = 65.7) pori preanali della linea laterale. Si fornisce una chiave dicotomica per le specie di *Heteroconger* dell'Indo-Pacifico occidentale.

### INTRODUCTION

Heterocongrine garden eels are common inhabitants of sand-rubble areas, frequently in the vicinity of coral reefs. The group contains 32 species worldwide in two genera (Eschmeyer & Fricke 2009), *Gorgasia* Meek & Hildebrand, 1923 and *Heteroconger* Bleeker, 1868. The majority, with the exception of eight species from the eastern Pacific and Atlantic, are restricted to the Indo-Pacific region. They were reviewed by Castle & Randall (1999), who also provided descriptions of five new species. An additional species, *Gorgasia thamani* Greenfield & Niesz, 2004 was later described from Fiji. Earlier publications treating this group include those of Böhlke & Randall (1981) and Castle & Randall (1995).

Garden eels occur at depths between about 2-55 m. The eels construct permanent burrows in the sand, which they never leave. Mating occurs between members of the opposite sex that occupy adjacent burrows by intertwining their bodies while the tail tips remain in their respective burrows (personal observations). Zooplankton is the primary dietary item and the eels rise nearly to full extent out of their burrows when feeding in the passing current. When disturbed the eels retreat backward down their burrows. When a diver swims through an extensive colony a “wave effect” is often created – the eels directly ahead gradually disappear into the sand, while those in the divers wake slowly reappear. Randall & Castle (1999) provided further details of the biology and systematics of the group.

The present paper describes a strikingly-marked species of *Heteroconger* that was discovered at Papisol Bay (Fig. 1), on the southern Bird's Head

Peninsula of West Papua, Indonesia during March 2009. This general region has proved to be particularly rich for garden eels during our investigations over the past three years having previously collected and/or observed *Heteroconger enigmaticus* Castle & Randall, 1999, *H. bassi* (Klausewitz & Eibl-Eibesfeldt, 1959), *H. perissodon* Böhlke & Randall, 1981, *H. taylori* Castle & Randall, 1995, *Gorgasia barnesi* Robison & Lancraft, 1984, *G. maculata* Klausewitz & Eibl-Eibesfeldt, 1959, *G. naeocepaea* (Böhlke, 1951), and *G. preclara* Böhlke & Randall, 1981.

#### MATERIALS AND METHODS

Terminology and methods follow Castle and Randall (1999). Head pore terminology is from McCosker et al. (1989) and the following abbreviations are used: SO (supraorbital series), IO (infraorbital series), POM (preopercular-mandibular series), ST (supratemporal series). Total length and



**Fig. 1.** Satellite map of Bird's Head Peninsula region of West Papua, Indonesia, showing type locality (yellow star) of *Heteroconger mercyae*.

head length are abbreviated as TL and HL respectively. Vertebral counts were made from radiographs and include the hypural. Type specimens are deposited at Pusat Penelitian dan Pengembangan Oseanologi, Jakarta, Indonesia (NCIP), National Museum of Natural History, Washington, D.C. (USNM), and the Western Australian Museum, Perth (WAM).

***Heteroconger mercyae* n. sp.**

(Figs 2-4)

**Holotype:** NCIP 6352, male, 641.5 mm SL, Papisol Bay, 4°4.601'S 133°2.576'E, Papua Barat Province, Indonesia, 5-6 m depth, clove oil and hand net, M. Paine, M. Erdmann & G. Allen, 20 March 2009.

**Paratypes** (collected with holotype): NCIP 6353, 3 specimens, 560.7-653.9 mm TL; USNM 391795, 4 specimens, 385.1-678.1 mm TL; WAM 33088-001, 5 specimens, 106.3-677.4 mm TL.

**Diagnosis:** A relatively slender species of *Heteroconger* (Congridae) with dorsal-fin origin anterior to gill opening, pterygoid teeth present, body depth at gill opening 28.8-35.2 percent of HL, 62-71 (mean = 65) preanal vertebrae, 204-213 (mean = 207.4) total vertebrae, 63-69 preanal lateral-line pores, and body colouration consisting of zebra-like black and white barring on head grading to complex black and white maze pattern on body.

**Description:** Counts and proportions of holotype, followed by range and mean value for 9 paratypes (in parentheses). Vertebral formulae 6/67/205 (4-9/62-71/204-213); average total vertebrae for holotype and nine paratypes 207.4; lateral-line pores before pectoral fin 6 (6-7); lateral-line pores before anus 66 (63-69, mean = 65.7); total lateral-line pores 201 (198-210; mean = 205.8); pectoral-fin rays 10 (9-11; mean = 10.3); dorsal-fin rays before anus 190 (173-215; mean = 193.8); total dorsal rays 588 (578-629; mean = 591.6); anal rays 395 (390-432; mean = 412.5); head pores on left side, holotype (and 9 paratypes): SO 1+2, IO 2+2, POM 5+2, ST 1+1. As percent of total length: snout-anus length 29.7 (27.0-31.3; mean = 29.4); as percent of snout-anus length: HL 11.8 (10.9-14.7; mean = 11.9); predorsal length 11.0 (10.1-13.8; mean = 11.4); as percent of HL: snout 14.9 (13.5-15.7; mean = 14.7); eye 19.7 (20.0-23.9; mean = 21.2); fleshy interorbital 11.4 (10.2-14.1; mean = 10.9); mouth 21.9 (18.1-23.6;

mean = 21.3); gill opening 9.2 (6.6-10.1; mean = 8.6); branchial interspace 21.5 (18.9-24.7; mean = 21.6); pectoral-fin length 10.1 (7.3-10.6; mean = 9.0); depth at gill opening 32.9 (28.8-35.2; mean = 32.0); depth at anus 24.1 (23.5-28.4; mean = 25.7).

Body relatively elongate, slightly compressed along head, progressively more so to tail tip; greatest depth at pectoral fins; anus at about 30% TL; head little depressed, flexed downward at pectoral fins; lower jaw slightly protruding; snout short and rounded; upper and lower lips well developed, the upper confluent medially, enclosing anterior nostrils, and turned back on anterolateral face of snout; lower lip similarly turned back on lower jaw; anterior nostril a minute tube close to midline of



**Fig. 2.** *Heteroconger mercyae*, underwater photo of paratype, 641.4 mm TL, Papisol Bay, West Papua, Indonesia. Photo by M. Erdmann.



snout; posterior nostril a simple opening near anterodorsal corner of eye; mouth oblique, reaching to below anterior rim of eye; eye relatively large, oval, scarcely intruding into dorsal profile; throat with moderately developed folds extending to branchial aperture.

Gill opening before pectoral fins, slightly oblique with its ventral end more posterior than dorsal end; pectoral fins small rounded flaps; dorsal-fin origin about one-half eye diameter anterior to gill opening and low in preserved specimens; anal fin similarly low; caudal fin much reduced, tip of tail pointed.

Head pores inconspicuous, with very slightly raised rims; lateral-line pores minute and difficult to distinguish, especially on posterior one-fourth of body, approximately matching number of vertebrae.

Teeth small, although those of pterygoid and rear portion of vomer slightly enlarged; teeth in three

rows on maxilla, tapering to two rows posteriorly; teeth in about five irregular rows on dentary, tapering to a single row posteriorly; intermaxillary-vomerine patch with 3-4 rows of teeth anteriorly, the tooth patch tapering posteriorly and nearly as long as maxillary row; pterygoid teeth in single row.

Colour in life (Figs 2, 3): conspicuous black and white zebra-like bars, spots, and oblique bands on head, grading to bold maze of black and white vermiculations on body; dorsal fin translucent with occasional rays marked with alternating black and white bands, and alternating black and white spots along outer margin; a yellow-orange iris ring on eye; lips white.

Colour in alcohol (Fig. 4): Generally dark brown, but close inspection reveals dark markings as described in live colouration above; about posterior one-fifth of total length light brown with dense pattern of melanophores.



Fig. 3. *Heteroconger mercyae*, underwater photo of paratype, 641.4 mm TL, Papisol Bay, West Papua, Indonesia. Photo by M. Erdmann.

**Remarks:** The new species has one of the highest average number of vertebrae (207.4) for the genus. Other species with relatively high average counts include *H. cobra* Böhlke & Randall 1981 from the Solomon Islands (199.8), *H. tomberua* Castle & Randall, 1999 from Fiji (195.1), and *H. tricia* Castle & Randall, 1999 from Flores, Indonesia (210, based on a single specimen). However, these three species have very different colour patterns consisting of either numerous small round spots and trio of large u-shaped black saddles (with white central portion) on head and anterior body (*H. cobra*), 2-3 irregular rows of small dark spots above and below lateral-line (*H. tomberua*), or widely scattered large dark tan (possibly orange in life) spots, becoming more numerous on posterior half of body (*H. tricia*). The only species that has a colour pattern similar to *H. mercyae* is *H. taylori*, which ranges from Papua New Guinea westward to Bali, Indonesia. Although the usual pattern consists of

numerous, relatively large black spots with white interspaces (Fig. 5), some individuals (Fig. 6) exhibit a pattern that approaches that of *H. mercyae*. However, the head is marked with irregular spots and bands rather than zebra-like bars and the vermicular pattern of the body is less complex. Moreover, *H. taylori* has relatively large black spots on the dorsal fin and lacks the pattern of alternating black and white spots along the dorsal-fin margin. The two species also show significant differences in vertebral counts (204-213 for *H. mercyae* and 169-172 for *H. taylori*). The new species also appears to attain a larger size than most members of the genus, at least based on museum specimens. Castle & Randall (1999) reported maximum total lengths ranging from 331-537 mm TL, with most species under 450 mm.

**Etymology:** The new species is named *mercyae* in honour of Mercy Paine, who discovered the eel colony and helped us collect the type specimens.



Fig. 4. *Heteroconger mercyae*, preserved holotype, 641.4 mm TL, Papisol Bay, West Papua, Indonesia. Photo by G. Allen.

**Key to the Indo-west Pacific species of  
*Heteroconger***

(adapted from Castle & Randall 1999)

- 1a. Body white with numerous narrow black bars on head and trunk, some on trunk meeting opposite neighbour ventrally; no pectoral fins; total vertebrae 153-159 (central Indonesia to Japan and Vanuatu) .....  
.....*H. polyzona* Bleeker, 1868
- 1b. Colour not as in 1a; pectoral fins present .. 2
- 2a. Body plain brown, with or without light head markings ..... 3
- 2b. Body colour not as in 2a, variously spotted or mottled and/or with more prominent additional black blotches or marks ..... 5
- 3a. Body plain medium brown with a white-yellow patch on postorbital and white margins on median fins; pterygoid teeth present; lateral-line pores before anus 54-59; total vertebrae 173-176 (Philippines and Indonesia) ....  
..... *H. perissodon*
- 3b. Body dark brown without light head markings or white margins on median fins; pterygoid teeth present or absent; lateral-line pores before anus 47-55 ..... 4
- 4a. Pterygoid teeth present on most specimens; total vertebrae 154-163 (eastern Indonesia) ..  
..... *H. enigmaticus*
- 4b. No pterygoid teeth; total vertebrae 144 (Nicobar Islands) .....  
..... *H. obscurus* (Klausewitz & Eibl-Eibesfeldt, 1959)
- 5a. Body with relatively large, evenly spaced, round dark tan spots (orange in life in *H. balteatus*), with or without other markings ..... 6
- 5b. Body markings as small closely packed dark spots or freckles on a pale background; the spots may link together to form irregular mottling or a maze-like network, with or without several other prominent dark and/or light bars or patches ..... 7
- 6a. A wide oblique white bar on trunk and a less prominent white patch on postorbital head; lateral-line pores before anus 52-56; HL 15.0-18.0% of snout-anus length; total vertebrae 158-161 (Red Sea) .....  
.....*H. balteatus* Castle & Randall, 1999
- 6b. No white bar on trunk and no white patch on head; lateral-line pores before anus 64-68; HL 13.5-14.5% of snout-anus length; total vertebrae 210 (central Indonesia) .....  
.....*H. tricia* Castle & Randall, 1999
- 7a. Body markings as evenly distributed, rounded, small, discrete dark spots on a light background, but with no other markings; total vertebrae 186-208 (Fiji) .....  
..... *H. tomberua* Castle & Randall, 1999
- 7b. Body markings more intense, either consisting of closely packed dark spots or spots more closely packed and/or joining to form conspicuous mottling, or maze-like network, with or without additional, prominent and distinctive bars, bands or blotches; total vertebrae 164-213 ..... 8
- 8a. Dorsal-fin origin more or less over gill opening or a little behind it ..... 11
- 8b. Dorsal-fin origin clearly anterior of gill opening ..... 9
- 9a. Body colouration consisting of zebra-like black and white bars on head grading to complex black and white maze pattern on body; total vertebrae 204-213 ..... *H. mercyae* n. sp.
- 9b. Body colouration not as in 9a, usually spotted, although sometimes consisting of maze-like pattern on body without zebra-like bars on head; total vertebrae 169-176 ..... 10
- 10a. Body evenly spotted to mottled or occasionally with maze-like pattern, without other markings; total lateral-line pores 157-160; mouth 24-30% of HL; pterygoid teeth present; total vertebrae 169-172 (Indonesia and Papua New Guinea) ..... *H. taylori*
- 10b. Body evenly and closely spotted, with a blackish anterior head and light throat; total lateral-line pores 161-168; mouth 18.4-21.3% of HL; no pterygoid teeth; total vertebrae 173-176 (Marshall Islands and French Polynesia) .....  
..... *H. lentiginosus* Böhlke & Randall, 1981
- 11a. Three prominent black patches, one encompassing gill opening and pectoral fin, a second halfway along midlateral portion of trunk, and the third encompassing anus; total vertebrae 164-175 (Indo-Pacific) ..... *H. hassi*
- 11b. Three prominent dark and light (combined), u-shaped saddles, one on postorbital and two spaced along anterior trunk; vertebrae 198-204 (Solomon Islands) .....  
..... *H. cobra* Böhlke & Randall, 1981

**Zoogeography and habitat:** The new species is currently known for certain only from the type locality (Fig. 1), which is situated about 95 km southwest of the town of Kaimana, West Papua,





Fig. 5. *Heteroconger taylori*, underwater photo, approximately 450 mm TL, Bali, Indonesia. Photo by T. Tonozuka.

Indonesia. However, it likely ranges at least as far east as Rabaul, New Britain, based on an underwater photograph by R. Steene, showing a close-up view of the head of a garden eel that appears to be *H. mercyae*.

The type specimens were obtained from a single colony, occupying about 100 m<sup>2</sup> and containing approximately 50 eels in 5-6 m depth. The bottom consisted of fine, silty sand and was no doubt influenced by a freshwater stream along the adjacent shoreline, about 100 m distance. The nearest reef formation was about 50 m from the site.

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Fig. 6. *Heteroconger taylori*, underwater photo, approximately 400 mm TL, Bali, Indonesia. Photo by T. Tonozuka.

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#### REFERENCES

- BÖHLKE, J. E. & RANDALL, J. E. 1981. Four new garden eels (Congridae, Heterocongrinae) from the Pacific and Indian Oceans. *Bulletin of Marine Science* 31(2): 366-382.
- CASTLE, P. H. J & RANDALL, J. E. 1995. A new garden eel (Congridae, Heterocongrinae) from Papua New Guinea and Indonesia. *Revue française d'Aquariologie* 22 (1-2): 3-6.
- CASTLE, P. H. J & RANDALL, J. E. 1999. Revision of the Indo-Pacific garden eels (Congridae: Heterocongrinae), with descriptions of five new species. *Indo-Pacific Fishes* 30: 1-52.
- ESCHMEYER, W. N. & FRICKE, R. (eds.) Catalog of Fishes electronic version (updated 13 Mar. 2009). <http://research.calacademy.org/ichthyology/catalog/fishcatsearch.html>
- MCCOSKER, J. E., BÖHLKE, E. B. & BÖHLKE, J. E. 1989. Family Ophichthidae. In: *Fishes of the Western North Atlantic*. Part Nine. Volume 1: Orders Anguilliformes and Saccopharyngiformes. (Ed. E. B. Böhlke): 254-412. Sears Foundation for Marine Research, New Haven.