New record of the rare flounder *Bothus swio* (Pleuronectiformes: Bothidae) from the eastern Indian Ocean (northwestern Australia) with consideration on its generic affiliations

by

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ABSTRACT. - The second known specimen of *Bothus swio*, previously known only from the holotype from the western Indian Ocean (off Mozambique), is reported from the eastern Indian Ocean (northwestern Australia). Preliminary comparisons of morphological data between *Bothus swio*, other *Bothus* species and other Bothinae genera indicated a distant phylogenetic relationship of *B. swio* to other members of *Bothus*. The generic placement of *B. swio* needs further evaluation.

RÉSUMÉ. - Nouveau signalement de *Bothus swio* (Pleuronectiformes, Bothidae) dans l'océan Indien oriental (nord-ouest de l'Australie) et considérations sur ses affiliations génériques.

Un second spécimen de *Bothus swio*, uniquement connu auparavant par l'holotype récolté au large du Mozambique dans la partie occidentale de l'océan Indien, est reporté ici au nord-ouest de l'Australie dans la partie orientale de l'océan Indien. Les études préliminaires de la morphologie de *Bothus swio*, des autres espèces du genre *Bothus* et des autres genres de Bothinae indiquent une parenté éloignée entre *B. swio* et les autres membres du genre *Bothus*. L'attribution générique de *B. swio* nécessite des travaux complémentaires.

Key words. - Bothidae - *Bothus swio* - ISEW - Australia - Eastern Indian Ocean - New record - Taxonomy.

The bothid flounder *Bothus swio* Hensley, 1997 was described from a single specimen collected off the coast of Mozambique (southwestern Indian Ocean) (Hensley, 1997). A second specimen, collected in 1983 off the coast of northwestern Australia (eastern Indian Ocean), is identified as *Bothus swio* (Fig. 1) and examined in detail. Additional morphological data for the species are provided, and the generic affiliations of this taxon are reconsidered.

MATERIAL AND METHODS

Methods of counts and measurements follow those of Hubbs and Lagler (1958), although all dorsal and anal fin rays were counted individually. A radiograph was used for the osteological examination. Museum codes follow Leviton *et al*. (1985).

Specimens examined

Bothus swio. - CSIRO CA4252, 137.7 mm SL, male, off northwestern Australia, 19°09'S-118°02'E, 82 m, 16 Apr. 1983, R/V Soela. - SAM 33681, holotype, 154.5 mm SL, male, off coast of northern Mozambique, 19°28'S-36°37'E, 88 m, 14 Jun. 1994.

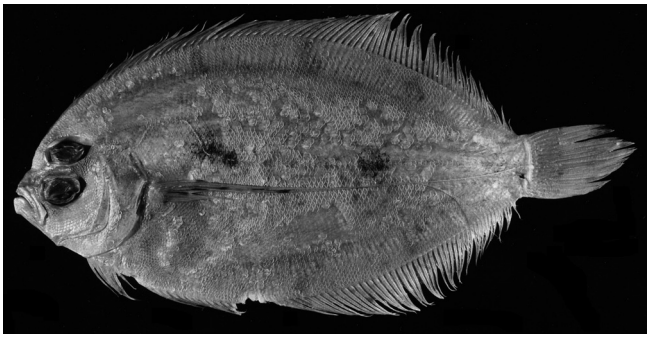

Figure 1. - *Bothus swio*, CSIRO CA4252 (137.7 mm SL, male; BMNH1938-11-15:54-55), northwestern Australia. *[*Bothus swio*, mâle, Australie nord-ouest.]*

Comparative material

Bothus podas. - BMNH 1938-11-15: 54-55 (107.0 mm SL); *B. ocellatus*. - USNM 282648 (3 of 7 specimens, 76.7-95.8 mm SL); *B. constellatus*. - USNM 321702 (2 of 5 spms, 84.0-89.7 mm SL); *Grammatobothus polyophthalmus*. - USNM 260481 (124.8 mm SL), USNM 362520 (1 of 4 spms, 143.9 mm SL); *G. pennatus*. - NSMT-P 60405, 60422, 60423 and 60424 (4 spms, 131.0-184.3 mm SL); *G. krempfi*. - MNHN 1947-19 (holotype, 147.0 mm SL).

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RESULTS

Description of additional characters

Counts and measurements are given in table I. The following description is based primarily on the northwestern Australian specimen, differing conditions in the holotype being given in parentheses. Most of characters were as described by Hensley (1997), with the following additions: anterior tip of isthmus at vertical through posterior end of lower eye (at vertical through middle of lower eye in holotype); first haemal spine not particularly expanded (Fig. 2A, left); haemapophyses ventrally tapered or triangular (Fig. 2A, left); urohyal fish-hook-like in shape, sciatic part expanded anteriorly and at vertical through anterior tip of main part (Fig. 2B, left); parhypural and hypural plates unbranched, with two shallow clefts distally in hypurals 3+4 (Fig. 2C, left) (no clefts in hypurals 3+4 of holotype).

Table I. - Counts and measurements of *Bothus swio*. * os = ocular side; bs = blind side. *[Comptages et mesures de* Bothus swio. * *os : côté oculaire ; bs = côté aveugle.]*

	CSIRO CA4252	SAM33681 (Holotype)
Counts		
Dorsal fin rays	88	90
Anal fn rays	70	72
P1 fin rays (os)*	10	10
P1 fin rays (bs)*	9	9
P2 fin rays (os)	6	6
P2 fin rays (bs)	6	6
Caudal fin rays	17	17
Abdominal vertebrae	10	10
Caudal vertebrae	28	28
Lateral line scales	92	92
Upper gill rakers	0	0
Lower gill rakers	9	9
Measurements		
SL (mm)	137.7	154.5
in SL		
Head length (HL)	3.8	3.59
Body depth	1.93	1.94
in HL		
Snout length	4.16	3.64
Upper eye diameter	3.66	3.52
Lower eye diameter	3.62	3.52
Interorbital width	11.68	16.54
Upper jaw length (os)	2.92	2.93
Upper jaw length (bs)	2.81	2.87
Lower jaw length (os)	2.05	2.06
Lower jaw length (bs)	1.92	1.95
Depth of caudal peduncle	2.17	2.47
Pl length (os)	0.37	0.42
P1 length (bs)	1.68	1.77
P2 length (os)	2.37	2.05
P2 length (bs)	2.55	2.97
P2 base length (os)	3.77	3.55
P2 base length (bs)	6.46	7.17

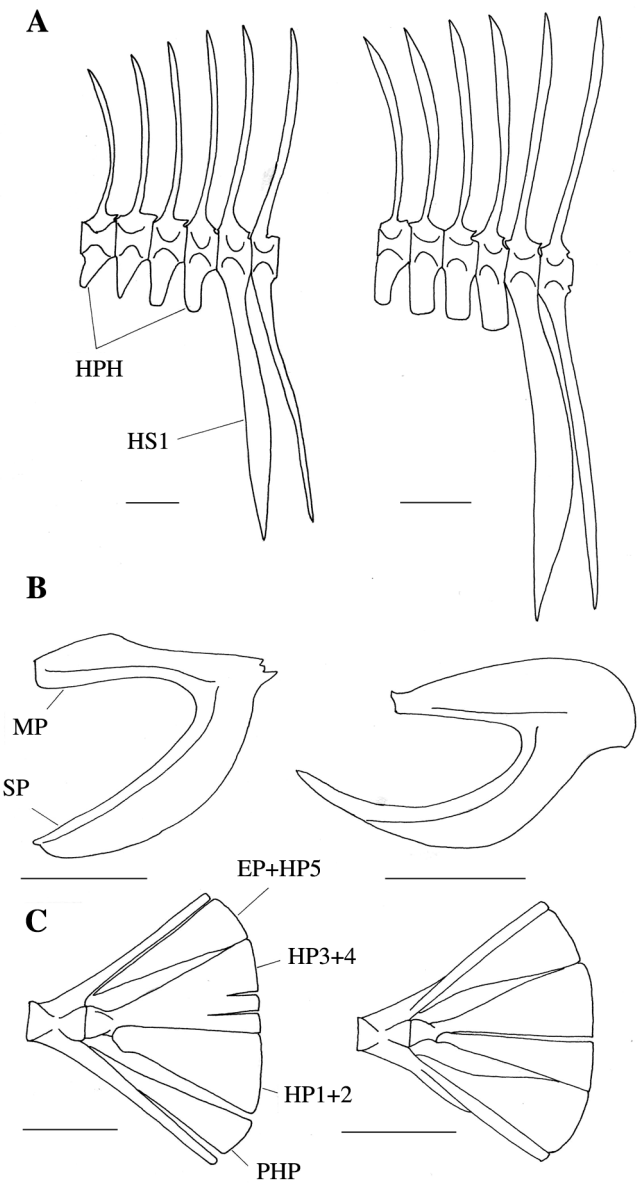

Figure 2. - Bony elements of *Bothus swio* (left; CSIRO CA4252) and *B. podas* (right; BMNH1938-11-15:54-55) observed by radiography. **A**: Posterior abdominal and anterior caudal vertebrae; **B**: Urohyal; **C**: Caudal skeleton. EP: epural; HP: hypural; HPH: haemapophyses; HS1: first haemal spine; MP: main part; PHP: parhypural; SP: sciatic part. Scale bars = 5 mm. *[Parties du squelette de* Bothus swio *(à gauche) et de* B. podas *(à droite) observées par radiographie. **A** : Vertèbres abdominales postérieures et caudales antérieures ; **B** : Urohyal ; **C** : Squelette caudal. Échelles = 5 mm.]*

Distribution

Bothus swio is known from off the coast of Mozambique (Hensley, 1997) and now from northwestern Australia, 82-88 m in depth.

DISCUSSION

Identification

The specimen was identified as *Bothus swio*, having a combination of characters unique to that species among the bothid subfamily Bothinae: concave interorbital space, absence of a series of white blotches along anterior margin of head, well developed rostral spine, anterior dorsal fin rays not elongated, ocular-side scales with short ctenii, relatively high lateral line scale count (92), dorsal and anal fin ray counts (within the ranges 88-90 and 70-72, respectively), and absence of blind-side lateral line (combination of all characters restricts to *Bothus*), relatively deep body (ca. 52% of SL), concave interorbital space much narrower than eye diameter in mature males, anterior margin of upper eye only slightly posterior to that of lower eye, ocular tentacles or flaps and orbital spines absent, prolongation of second to fourth pectoral fin rays on ocular side reaching caudal peduncle (at least in males) and lack of colour pattern on blind side (characters excluding all known species, except *B. swio*). The specimen also agreed with the holotype of *B. swio* in other features in table I and those reported in Hensley (1997).

However, unlike the holotype of *Bothus swio*, the tip of the sciatic part of the urohyal in the present specimen was essentially at the vertical through the posterior margin of the lower eye (equal to vertical through middle of lower eye in holotype). Furthermore, two shallow clefts were present on hypurals 3+4 (absent in the holotype). At present, we consider these differences to represent geographic or individual variation, rather than specific characters. The overwhelming similarities in other features and the lack of other significant differences between the present specimen and the holotype of *B. swio* support this conclusion. The significance of the above variations between these specimens will become more apparent when additional specimens from various locations are examined.

Remarks

Hensley (1997) described *Bothus swio* based on a single specimen from off Mozambique, southwestern Indian Ocean. The northwestern Australian (eastern Indian Ocean) capture of the present specimen indicates a wide distribution of the species across the Indian Ocean (ca. 8000 km), as reported in some other bothid species (e.g., *Bothus myriaster, B. pantherinus, Engyprosopon grandisquamum*: Hensley and Amaoka, 2001).

The generic affiliation of *B. swio* needs further clarification. Hensley (1997) noted that *Bothus swio* resembled species of *Grammatobothus*, but he did not mention any particular characters to support this statement (probably based on general appearance and narrow concave interorbital space). However, Hensley did not choose to include *B. swio* in *Grammatobothus*, probably because this species lacked certain diagnostic features of *Grammatobothus, viz*., presence of blind-side lateral line and elongate anterior dorsal fin rays (Norman, 1934; Hensley and Amaoka, 2001; Hoshino *et al*., 2004).

Although not discussed by Hensley (1997), *Bothus swio* is separable from all genera of Bothinae (*sensu* Amaoka, 1969; Ahlstrom *et al*., 1984), except *Bothus*. The concave interorbital space separates *B. swio* from the genera of Bothinae, except for *Asterorhombus, Parabothus, Crossorhombus, Engyprosopon* and *Tosarhombus*. *Bothus swio* is distinct from these latter genera, in having elongate pectoral fin rays reaching the caudal peduncle (species of *Asterorhombus* and *Parabothus* have much shorter pectoral fin rays: Norman, 1934; Chabanaud, 1942; Parin, 1983; Amaoka and Shen, 1993; Amaoka *et al*., 1994, 1997; Amaoka and Arai, 1998; Amaoka and Mihara, 2001; Hensley and Randall, 2003), in lacking any blind-side colour pattern in males and having short ctenii on the ocular-side scales (species of *Crossorhombus* with pale blotch on blind side in males, and long ctenii on ocular-side scales: Hensley and Randall, 1993), in having small scales and relatively high (92) lateral-line scale counts (species of *Engyprosopon* have larger scales and fewer [36-61] lateral-line scales: Amaoka *et al*., 1993), and in lacking white cephalic blotches (present in *Tosarhombus*: Amaoka and Rivaton, 1991; Amaoka *et al*., 1997). Accordingly, it is possible to provisionally place the present species in *Bothus* by the above series of eliminations.

However, the osteological characters revealed by the radiograph raise questions regarding the generic placement of *Bothus swio*. In several species of *Bothus* (*B. pantherinus, B. myriaster, B. mancus, B. podas, B. ocellatus* and *B. constellatus*), haemapophyses of the abdominal vertebrae are ventrally well expanded (Fig. 2A, right). Additionally, the sciatic part of urohyal is anteriorly extended beyond the anterior tip of the main part of the urohyal (Amaoka, 1969; present study: Fig. 2B, right). *Bothus swio* lacks such characters, having narrower haemapophyses (Fig. 2A, left), and a shorter sciatic part of the urohyal (Fig. 2B, left). The expanded haemapophyses, observed in the six species of *Bothus* (except *B. swio*), are probably apomorphic within the Bothidae, because in most of other bothid genera plus the paralichthyids and pleuronectids (considered to form a clade with the Bothidae, as diagrammed by Cooper and Chapleau (1998), but without showing a character, and substantiated by the analysis of Hoshino, 2001 with two synapomorphies),

the haemapophyses are less expanded, and sciatic part of the urohyal does not extend beyond the anterior tip of the main part except for *Engyprosopon* and *Crossorhombus* (Amaoka, 1969; Kim, 1973; Sakamoto, 1984; pers. obs.).

Expanded haemapophyses are unique to species of *Bothus* (excluding *B. swio*) within Bothidae (Amaoka, 1969), indicating that these species may form a monophyletic assemblage. If so, that hypothetical clade should bear the generic name *Bothus*, because it includes the type species of the genus, *B. podas* (Delaroche, 1809). The other apomorphic character, anterior extension of the sciatic part of the urohyal, is also known in *Engyprosopon* and *Crossorhombus* (Amaoka, 1969), suggesting that the latter two genera are more closely related to the hypothetical clade of *Bothus*, than *B. swio* is. Conversely, the elongated pectoral fin rays reaching the caudal fin base in male *B. swio* (known in many species of *Bothus*: Hensley, 1997) may suggest a closer relationship of this species with other species of *Bothus*. However, elongate pectoral fin rays are absent in some species of *Bothus* (e.g., *B. podas*: Norman, 1934), and this character must be considered equivocal at this stage of interpreting relationships within Bothidae. If *B. swio* is found to be phylogenetically distant from species now placed in *Bothus*, its generic affiliation should be changed, but such a decision necessitates stronger evidence than is presently available. A phylogenetic analysis of the bothids is needed to establish the systematic position of this species.

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