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Notes on the Moray Eels (Anguilliformes: Muraenidae) of Malaysia with Two New Records

(Nota Mengenai Belut Laut (Anguilliformes: Muraenidae)
di Malaysia dengan Dua Rekod Baru)

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ABSTRACT

Two new records of moray eels (Muraenidae), Gymnothorax margaritophorus Bleeker, 1864 and Strophidon sathete (Hamilton 1822), are reported for Malaysia. They are represented by two specimens each, all collected from Sabah waters. The present study also provides the current taxonomic and distributional information of the Malaysian moray eels. To date, there are 33 species belonging to six genera of the Muraenidae in Malaysian waters based on the published records.

Keywords: Anguilliformes; moray eels; Muraenidae; new records; taxonomic revision

ABSTRAK

Dua rekod baru belut laut (Muraenidae), Gymnothorax margaritophorus Bleeker, 1864 dan Strophidon sathete (Hamilton 1822), dilaporkan untuk Malaysia. Kedua-duanya diwakili oleh dua spesimen bagi setiap spesies dan semua spesimen diperolehi dari perairan Sabah. Kajian ini juga memberikan maklumat terkini mengenai taksonomi dan taburan belut laut di Malaysia. Setakat ini perairan Malaysia mempunyai 33 spesies daripada enam genus Muraenidae berdasarkan rekod-rekod yang telah diterbitkan.

Kata kunci: Anguilliformes; belut laut; Muraenidae; rekod baru; semakan taksonomi

INTRODUCTION

Moray eels belong to a diverse family of eels (Muraenidae) found around the world, with 15 genera and 197 species (Smith 2012). They are locally called *belut-laut*, *belin* or *malong* in Malay. This group of fishes is distinguished from other eel families by the absence of pectoral and pelvic fins. Some species of the moray eels are commercially exploited and contribute as food fish in fish markets worldwide, e.g. in Okinawa, Japan (Hatooka & Randall 1992), Taiwan (Tsai et al. 2009), Portugal and Vietnam (Loh et al. 2011), but these fish are not similarly used in Malaysia.

The past studies of muraenid fauna in Malaysia are sparse. The earliest records of moray eels from the Malay Archipelago are from Bleeker (1853) which included *Muraena dizona*, *M. venosa*, *M. prosopeion* and *Thaerodontis reticulata*. Maxwell (1921) listed *Muraena undulata* in his book 'Malayan Fishes'. Herre (1940) further added another species, *Uropterygius concolor* in his book 'Additions to the Fish Fauna of Malaya'. Mohsin and Ambak (1996) reported *Gymnothorax thyrsoideus* in their book 'Marine Fishes and Fisheries of Malaysia and Neighbouring Countries' (p. 697, figure 80). More recent records of the moray eels are reported by Atan et al. (2010) who listed three genera and 17 species of moray eels in their book 'Ikan Laut Malaysia, Glosari, Nama Sahih Spesies Ikan' and Ambak et al. (2010) who listed three genera and 18 species of muraenids in their book

'Fishes of Malaysia' (p. 35). However, five genera with 16 species of the family Muraenidae are listed as present in Malaysia by Chong et al. (2010).

Thus, the records from the sparse information suggest that the total number of moray eels in Malaysia is 16–18 species. However, given the recent taxonomic revisions of the moray eels of the world (Smith 2012), it is expected that the Malaysian species lists also include misidentifications and synonyms.

The present study aimed to describe two new records of moray eels and to update the current moray eel species list in Malaysia after correcting the scientific names of the moray eels so far recorded.

MATERIALS AND METHODS

A total of four moray eels were collected by long lines in Udar Island and Sepangar Island, Sabah. The specimens were fixed in 10% formalin, then transferred into 70% ethanol solution for long term preservation. The methods of measurements followed Böhlke and Randall (2000). Proportional measurements for the specimens of moray eels were expressed as percentage of the total length (TL) or the head length (HL). Body depth was measured at the gill openings (DGO) and at the anus (DA); both measurements did not include the fins. Preanal length (PAL), snout length (S), eye diameter (E) and upper jaw length (UI) were also measured. All specimens were deposited

in the Borneo Marine Research Institute, Universiti Malaysia Sabah (UMS). The collections of the Laboratory of Aquatic Ecology, Department of Aquaculture, National Taiwan Ocean University, Taiwan (NTOU-AE) were also examined for comparisons. The validity of the given scientific names of Malaysian moray eels thus far recorded were verified by comparisons with the current accepted classification of moray eels (Smith 2012) based on their descriptions, figures, photo plates and where possible, the voucher specimens. The re-examined materials included *Gymnothorax albimarginatus*, *G. dorsalis*, *G. fimbriatus*, *G. rervesii* and *G. thyrsoideus*.

RESULTS AND DISCUSSION

TWO NEW RECORDS OF MORAY EELS

Gymnothorax margaritophorus Bleeker, 1864

Turnkeyed moray (Figure 1(a), 1(b))

Gymnothorax margaritophorus Bleeker, 1864: 53
(Type locality: Amboina, Moluccas; Holotype BMNH 1867.11.28.268, 221 mm)

Lycodontis margaritophorus: Smith 1962: 434;

Gymnothorax margaritophorus: Böhlke & Smith 2002: 124: 282; Castle & McCosker 1986: 170; Chen et al. 1994: 51; Hatooka & Yoshino 1982: 89; Myers 1991: 44; Randall & Lim 2000: 585; Schultz et al. 1953: 136; Smith 2012: 19; Zhang et al. 2010: 282.

Description Reddish brown with diffuse pale pattern on body and fins; a conspicuous row of three elongate dark spots on head extending behind eye, a fourth diffuse spot behind gill opening and corner of mouth dusky. Anus a little before middle of total length. Teeth long and sharp, caniniform. Preanal length 2.22-2.32 (2.27 ± 0.07), head length 6.96-6.97 (6.97 ± 0.01), body depth at gill open 18.25-20.22 (19.24 ± 1.39) and body depth at anus 20.24-24.13 (22.19 ± 2.75) all in TL. Upper jaw length 2.25-2.56 (2.41 ± 0.22), interorbital width 7.35-8.97 (8.16 ± 1.14), snout length 5.45-5.91 (5.68 ± 0.32) and eye diameter 8.67-9.35 (9.01 ± 0.48) all in HL (Table 1). Five to six peripheral intermaxillary teeth on each side, 2-3 median teeth; maxillary teeth biserial, an outer row of 19-20 short triangular teeth and an inner row of 5-6 tall slender teeth; vomerine teeth uniserial 7-8 in number; dentary teeth



FIGURE 1. *Gymnothorax margaritophorus* (a) TOU-AE 4227, 395 mm TL, from Taiwan (b) UMS- uncatalogued, from Sabah

TABLE 1. Morphometric data of *Gymnothorax margaritophorus* and *Strophidon sathete* collected from Sabah waters, Malaysia

	<i>Gymnothorax margaritophorus</i>				<i>Strophidon sathete</i>			
	range (n=2)		Mean	SD.	range (n=2)		Mean	SD.
Total length (mm)	181	251			941	1267		
% of *total length								
Preanal length	43.09	45.02	44.06	1.36	41.12	41.45	41.28	0.23
Tail length	54.98	56.91	55.94	1.36	58.55	58.88	58.72	0.23
Trunk length	32.04	32.27	32.16	0.16	31.81	33.05	32.43	0.88
Body depth at gill opening	4.94	5.48	5.21	0.38	2.49	3.35	2.92	0.61
Body depth at anus	4.14	4.94	4.54	0.56	2.42	2.63	2.52	0.15
Predorsal length	9.56	10.50	10.03	0.66	6.91	7.81	7.36	0.64
Head length	14.34	14.36	14.35	0.02	8.71	9.08	8.90	0.26
Proportions in* total length								
Preanal length	2.22	2.32	2.27	0.07	2.41	2.43	2.42	0.01
Tail length	1.76	1.82	1.79	0.04	1.70	1.71	1.70	0.01
Trunk length	3.10	3.12	3.11	0.02	3.03	3.14	3.08	0.08
Body depth at gill opening	18.25	20.22	19.24	1.39	30.81	40.08	35.45	6.56
Body depth at anus	20.24	24.13	22.19	2.75	38.05	41.30	39.67	2.30
Predorsal length	9.53	10.46	9.99	0.66	12.80	14.48	13.64	1.19
Head length	6.96	6.97	6.97	0.01	11.02	11.48	11.25	0.32
% of *head length								
Length of upper jaw	39.04	44.44	41.74	3.82	36.05	36.39	36.22	0.24
Length of lower jaw	38.85	44.31	41.58	3.86	34.86	36.57	35.72	1.21
Interorbital width	11.15	13.61	12.38	1.74	6.21	6.51	6.36	0.21
Snout length	16.92	18.33	17.63	1.00	8.65	9.79	9.22	0.81
Eye diameter	10.69	11.54	11.12	0.60	5.44	5.95	5.70	0.36
Proportions in*head length								
Length of upper jaw	2.25	2.56	2.41	0.22	2.75	2.77	2.76	0.02
Length of lower jaw	2.26	2.57	2.42	0.22	2.73	2.87	2.80	0.09
Interorbital width	7.35	8.97	8.16	1.14	15.36	16.11	15.73	0.53
Snout length	5.45	5.91	5.68	0.32	10.21	11.56	10.88	0.95
Eye diameter	8.67	9.35	9.01	0.48	16.80	18.37	17.59	1.11

biserial, an anterior inner row of 4-5 large teeth and an outer row of 28-30 smaller teeth. Head pores typical, three superorbital pores, four infraorbital pores, six mandibular pores. Two to six branchial pores, branchial pores small before gill opening. Gill opening at or below mid-side. Anterior nostril tubular, posterior nostril behind front edge of eye. Eye wider than gill opening. Total vertebrae 128-132, mean vertebral formula 6-50-129; to 700 mm.

Distribution Indo Pacific: Australia, Cocos Islands, Hawaii, Indonesia, Japan, Madagascar, Maldives, New Caledonia, Ogasawara Islands, Palau, Philippines, Ryukyu Islands, Samoa, Seychelles, Taiwan, Vietnam and Malaysia - Sabah.

Habitat Marine, substrate rubble and rocks, depth 2 m.

Material examined UMS- uncatalogued (2) 181-251 mm, collected from Sabah Offshore, 06 02' 42"N, 116 06' 42" E.

Comparative material 4: (272-395 mm) TOU-AE 3780, 3786, 4227, 4273, all in Taiwan.

Remark This species is characterized by the row of elongate dark spots behind the eye. The spots had not faded after fixation in formalin or ethanol.

Strophidon sathete (Hamilton 1822)

Slender giant moray (Figure 2)

Muraenophis sathete Hamilton, 1822: 17 (Type locality: Ganges estuaries, India, Holotype not extant)

Muraena macrura Bleeker, 1854: 324 (Type locality: Anjer, Banten; Holotype BMNH 1867.11.28.212, 2250 mm)

Thyrsoidea macrura: Castle & McCosker 1986: 174;

Strophidon ui Chen & Weng 1967: 37; Tanaka 1918: 52;

Strophidon sathete: Myers 1991: 48; Böhlke 1997: 106;

Böhlke & Smith 2002: 123; Böhlke et al. 1999: 1647; Chen

et al. 1994: 54; Randall & Golani 1995: 871; Randall &

Lim 2000: 585; Smith 2012: 33; Zhang et al. 2010: 239

Description Body very elongated, cylindrical, slightly compressed behind anus. Dorsal and anal fins confluent with caudal fin; pectoral and pelvic fins absent. Uniformly brown head, body and fins with unpatterned colouration;



FIGURE 2. *Strophidon sathete*. UMS- uncatalogued 1267 mm TL, collected from Udar Island, Sabah

anus well before midbody, tail much longer than preanal length. Preanal length 2.41-2.43 (2.42 ± 0.01), head length 11.02-11.48 (11.25 ± 0.32), body depth at gill open 30.81-40.08 (35.45 ± 6.56), body depth at anus 38.05-41.30 (39.67 ± 2.30) all in TL. Upper jaw length 2.75-2.77 (2.76 ± 0.02), interorbital width 15.36-16.11 (15.73 ± 0.53), snouth length 10.21-11.56 (10.88 ± 0.95), eye diameter 16.80-18.37 (17.59 ± 1.11) all in HL (Table 1). Five to six peripheral intermaxillary teeth on each side, 2-4 median teeth; maxillary teeth biserial, an outer row of 19-27 short triangular teeth and an inner row of 4-9 tall depressible teeth; vomerine teeth uniserial 3-8 in number; dentary teeth biserial, an anterior inner row of 3-4 large teeth and an outer row of 23-33 smaller teeth. Head pores typical, three superorbital pores, four infraorbital pores, six mandibular pores. Two to six branchial pores, branchial pores small before gill opening. Gill opening at mid-side. Dorsal fin origin between rictus and gill opening, closer to gill opening and above anterior branchial pore. Total vertebrae 188-200, predorsal vertebrae 7-10, preanal vertebrae 78-83; mean vertebral formula 9-81-194; 602 and 1443 mm in total length.

Distribution Indo-West Pacific: Red Sea, Australia, Fiji, Hong Kong, India, Indonesia, Japan, Kenya, Madagascar, Maldives, New Caledonia, Palau, Philippines, Ryukyu Islands, Somalia, South Africa, Taiwan, Vietnam and Malaysia - Udar Island and Sepangar Island, Sabah.

Habitat Freshwater, brackish water, marine, substrate coral, rubble, depth 5-20 m.

Material examined UMS - uncatalogued (2) 941-1267 mm, collected from Udar Island (06 03' 30"N, 116 04' 05"E) and Sepangar Island (06 04' 50"N, 116 05' 18"E), Sabah, longline fishing, 03 August 2012.

Comparative material 5: (602-1443 mm) TOU-AE 4464, 4465, 4466, 4467, 4470, all in Taiwan.

Remark Ambak et al. (2010) listed 18 species and three genera in Muraenidae family in their book 'Fishes of Malaysia' (p. 35) and also included *Strophidon sathete* but was misidentified as *G. dorsalis*. This species is the longest moray, reaching 3940 mm (Myers 1991).

CURRENT RECORD OF MALAYSIAN MORAY EELS

Species names of past moray eel records are of suspect. The moray eels as named by Bleeker (1853), *Muraena dizona*, *M. venosa*, *M. prosopeion* and *Thaerodontis reticulata*, are now accepted as the junior synonyms of *Echidna polyzona* (Richardson 1845), *Gymnothorax richardsonii* (Bleeker 1852), *G. thyrsoides* (Richardson 1845) and *G. favagineus* (Bloch & Schneider 1801), respectively (Table 2). *Muraena undulata* in Maxell (1921) is now replaced by *Gymnothorax undulatus* (Lacépède 1803). *Gymnothorax thyrsoides* in Mohsin and Ambak (1996) is a misidentification of *Gymnothorax fimbriatus*. *Gymnothorax albimarginatus* is actually a misdesignation of *G. dorsalis* (Department of Fisheries Malaysia 2009). *Gymnothorax fimbriatus* is misidentified as *G. reevesii* in Atan et al. (2010) and Ambak et al. (2010). In addition, the latter record of *G. dorsalis* is a misidentification of *Strophidon sathete*. Chong et al. (2010) listing of the Malaysian Muraenidae included *Sideria prosopeion* which is actually a junior synonym of *G. thyrsoides* (Richardson 1845).

Gymnothorax moringa (Cuvier 1829) is actually an Atlantic species, it is virtually impossible for this species to be found in Malaysia. It must be a misidentified species (no specimen exists), which was listed in the book 'Valid Local Names of Malaysian Marine Fishes' (Department of Fisheries Malaysia 2009).

The taxonomic history and corrections of moray species used in several major Malaysian publications are summarized in Table 2. In the present study, two new

TABLE 2. The taxonomic history and corrections of moray species used in several major Malaysian publications

Species	Common Name	Bleeker (1819-2878)	Maxwell (1921)	Herre (1940)	Mohsin& Ambak (1996)	Department of fisheries Malaysia (2009)	Ambak et al. (2010)	Atan et al. (2010)	Chong et al. (2010)	This study
1. <i>Echidna delicatula</i>	Mottled moray					V		V		
2. <i>Echidna nebulosa</i>	Snowflake moray					V		V		
3. <i>Echidna polyzona</i>	Barred moray (<i>Muraena dzona</i>)								V	
4. <i>Enchelycore bayeri</i>	Bayer's moray								V	
5. <i>Gymnothorax albimarginatus</i>	Whitemargin moray					V		V	V	
6. <i>Gymnothorax buroensis</i>	Vagrant moray								V	
7. <i>Gymnothorax chilospilus</i>	Lipspot moray								V	
8. <i>Gymnothorax dorsalis</i>	moray eel		V				X <i>G. albimarginatus</i>	X <i>S. sathete</i>		
9. <i>Gymnothorax enigmaticus</i>	Enigmatic moray								V	
10. <i>Gymnothorax javagnieus</i>	Laced moray									
11. <i>Gymnothorax fimbriatus</i>	Fimbriated moray					V			V	
12. <i>Gymnothorax flavimarginatus</i>	Yellow-edged moray					V				
13. <i>Gymnothorax herrei</i>	Slendertail moray	V						V		
14. <i>Gymnothorax istingteena</i>	moray eel									V
15. <i>Gymnothorax javanicus</i>	Giant moray					V	V	V	V	
16. <i>Gymnothorax margaritophous</i>	Blotch-necked moray									
17. <i>Gymnothorax melatremus</i>	Dwarf moray	V								•
18. <i>Gymnothorax meleagris</i>	Turkey moray								V	
19. <i>Gymnothorax monochrous</i>	Drab moray					V	V			
X. <i>Gymnothorax moringa</i>	Giant moray						X			
20. <i>Gymnothorax pictus</i>	Spotted moray					V	V		V	
21. <i>Gymnothorax polysuadon</i>	Peppered moray					V	V			
22. <i>Gymnothorax pseudohyrsoides</i>	Highfin moray									0
23. <i>Gymnothorax punctatofasciatus</i>	Bars'n spots moray	V				V	V			
24. <i>Gymnothorax reevesii</i>	Reeve's moray					V	X <i>G. fimbriatus</i>	V; X <i>G. fimbriatus</i>		
25. <i>Gymnothorax richardsonii</i>	Richardson's moray									
26. <i>Gymnothorax reticularis</i>	moray eel						V		V	
27. <i>Gymnothorax thyrsoideus</i>	Greyface moray					V		V	V; (<i>S. prosopoeion</i>)	
28. <i>Gymnothorax tile</i>	moray eel		V				V		V	V
29. <i>Gymnothorax undulatus</i>	Undulated moray					V		V	V	
30. <i>Rhinomuraena quasita</i>	Ribbon moray					V		V		
31. <i>Strophidon sathete</i>	Slender giant moray									•
32. <i>Uropterygius concolor</i>	Unicolor snake moray			V					V	
33. <i>Uropterygius macrocephalus</i>	Needle-tooth moray	V								

species in parenthesis (): synonym; V: species reported; X: misidentified; •: new record in present paper; 0: correctly recorded for the first time

records are recorded and a previously reported species *G. pseudothyrsoides* (Bleeker 1853) is actually the first collected from Malaysia. Thus, the present tentative record of Malaysia's moray eel diversity is at a total of six genera with 33 species. This update, however, assumes that the moray eels have been correctly identified by the original authors. The corrections to species names in the present update are, however, necessary to stabilize the names so far listed by the published texts in order to prevent the perpetuation of wrong species names being used in future reports, publications and texts. The next step is to improve the list of Malaysian moray eels is to check the validity of the species given by these authors, either by re-examination of the voucher specimens or if unavailable, re-sampling of specimens in the said locality of collection.

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