



ONE NEW RECORD GENUS AND THREE NEW RECORD SPECIES OF SNAKE EELS (OPHICHTHIDAE:ANGUILLIFORMES) FROM TAIWAN

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Acknowledgements

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ONE NEW RECORD GENUS AND THREE NEW RECORD SPECIES OF SNAKE EELS (OPHICHTHIDAE: ANGUILLIFORMES) FROM TAIWAN

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Key words: new record, Ophichthidae, Anguilliformes, Taiwan.

ABSTRACT

The tropical and subtropical eel family Ophichthidae are the most diverse Anguilliformes fishes which occupy a variety of marine habitats such as reefs, sand and mud substrates. In Taiwan, we can often collect them from the capture of bottom-trawl fishery. In this study, we added two new recorded species *Ophichthus machidai* and *O. obtusus* of ophichthid eels collected from Da-xi fish market by comparing their morphological measurements, vertebral counts and head pores with the other six species of the genus *Ophichthus*: *O. apicalis*, *O. aphotistos*, *O. asakusae*, *O. erabo*, *O. tsuchidaei*, *O. urolophus*. We also obtained a unique specimen from Tong-gang fish market and we identified this specimen as *Skythrenchelys zabra*, it would be the new recorded genus and species in Taiwan as well.

I. INTRODUCTION

Snake eels, the tropical and subtropical eel family Ophichthidae are the most diverse Anguilliformes fishes comprising of as many as 58 genera and 315 species worldwide, and 14 genera and 35 species in Taiwan [17].

There are two major subfamilies: Ophichthinae and Myrophinae. Hatooka [6], Smith and McCosker [18] and McCosker [11] used the tail form to distinguish Ophichthinae and Myrophinae; the former has its caudal fin absent and in the latter it is present thus it can be easily recognized without any other

treatment to those specimens.

Ophichthids eels occupy a variety of marine habitats ranging from mid water to reefs, sand and mud substrates, usually at depth less than 100 m although some species of genus *Ophichthus* are found at a depth of 1,300 m [15]. They are often taken by bottom trawl fishery in Taiwan.

In this study, two new records of Ophichthinae eels, *Ophichthus machidai* and *O. obtusus*, collected from Da-xi fish market were added. A unique Myrophinae specimen from Dong-gang fish market was obtained, which was herein identified as *Skythrenchelys zabra* Castle and McCosker, 1999, as a new recorded genus and species in Taiwan.

II. MATERIALS AND METHODS

Counts and measurements follow Böhlke [3]. Measurements include a straight-line with a 300 mm ruler and 0.5 mm gradation for total length (TL), tail length (Tail), trunk length (TR), head length (HL), predorsal length (PD), and recorded to the nearest 0.5 mm and with a dial caliper for depth at gill opening (DGO), depth at anus (DA), interorbital width (IOW), eye diameter (E), snout length (S), gill opening (G) and pectoral fin length (P) recorded to the nearest 0.1 mm.

Head pore terminology follows McCosker *et al.* [13] such that the supraorbital pores (SO) are expressed as ethmoidal pore + pores in its supraorbital canal; infraorbital pores (IO) are expressed as pores along the upper jaw + those in vertical part of the canal behind the eye (the postorbital pores), however, the last pore included in the upper jaw is part of the postorbital pore series; the preoperculo-mandibular pores (POM) include the lower jaw and those on the preopercular canal (preopercular pores, POP); the supratemporal pores (ST) contain those on the dorsolateral side of the head pore before the lateral line pores. Frontal pore (F) is expressed as the pore in the position of transverse frontal commissure.

Vertebral counts were taken from radiographs. The mean vertebral formula (MVF) follows Böhlke [2] and it is expressed as the average of predorsal (PDV), preanal (PAV) and total vertebrae (TV).

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The terminology of dentition generally follows Hatooka [5]. All species belonging to Anguilliformes have a premaxillo-ethmo-prevomer complex where the premaxilla, ethmoid and prevomer is almost fused together, nonetheless, it is preferential to use the words premaxillary, middle-premaxillary and vomer.

All the specimens collected from Da-xi and Dong-gang fish market were labeled as TOU-AE XXXX (National Taiwan Ocean University, Aquatic Ecology laboratory) and preserved in 10% formalin then transferred to 75% ethyl alcohol after measuring and photographing.

III. TAXONOMY

Subfamily Myrophinae

Genus *Skythrenchelys* Castle and McCosker, 1999 (New record)

1. Type species

Skythrenchelys zabra Castle and McCosker, 1999: 114 [4]. Type by original designation.

2. Diagnosis

Body cylinder, laterally compressed posteriorly with weak tail and significant caudal fin; tail equal to or shorter than preanal length. Posterior nostril a hole with a small anterior flap. Jaws elongate and center of orbit in advance of middle upper jaw. Origin of dorsal fin along trunk or above anus. Pectoral fins absent or a minute remnant. Cephalic and lateral-line pores developed, lateral-line pores absent from posterior third of tail. Teeth conical and large, uniserial on jaws and vomer. Branchiostegal rays typically myrophine such that its branchiostegal rays are attached to the outer face of the epihyal usually only single ray on ceratohyal.

Skythrenchelys zabra Castle and McCosker, 1999 (New record)

Fig. 1A-B, Fig. 2; Table 1

1. Material examined

TOU-AE 6966, 1 specimen; 358 mm TL, immature female, Dong-gang (22°24'N, 120°21'E), Ping-tung, Taiwan, caught using a bottom trawler operated along the sand and mud substrate at 200 m in depth, collected by the second author on 19 Jul. 2013.

2. Diagnosis

Body elongated and anus behind mid body; laterally compressed tail with obviously caudal fin. Stout head; rictus beyond eye reach to about one third head length. Jaws elongated, uniserial dentition on both jaws and vomer with conical teeth. Pectoral fin absent. Gill opening below lateral-line, cavity with thick epidermis around. Very small eyes, before midway of upper jaw. Anterior nostrils tube-like located laterally directly behind the snout tip; posterior

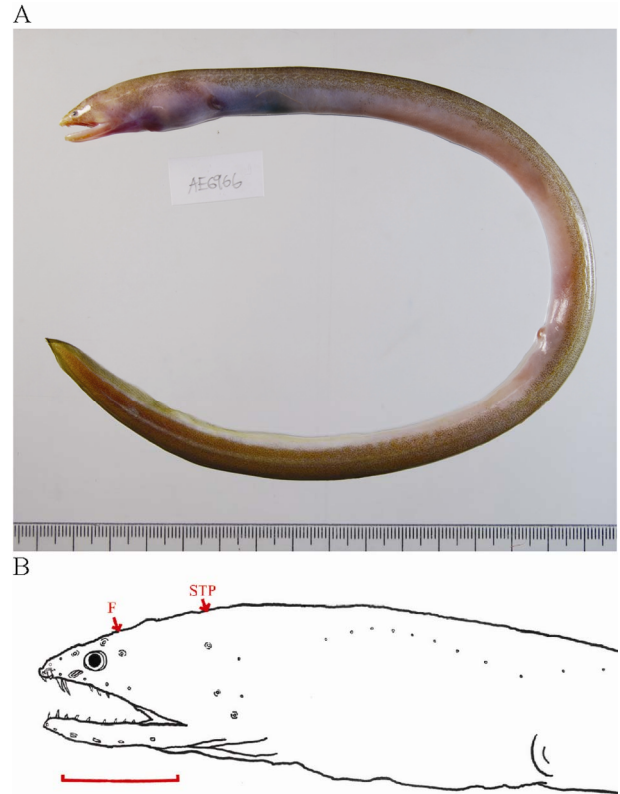


Fig. 1. *Skythrenchelys zabra*, TOU-AE 6966, 358 mm TL., immature female, Dong-gang fish market, Ping-tung, Taiwan. Bar = 10 mm. A. Lateral view of whole body. B. Lateral illustration of head, arrows shows frontal pore and supratemporal pore.

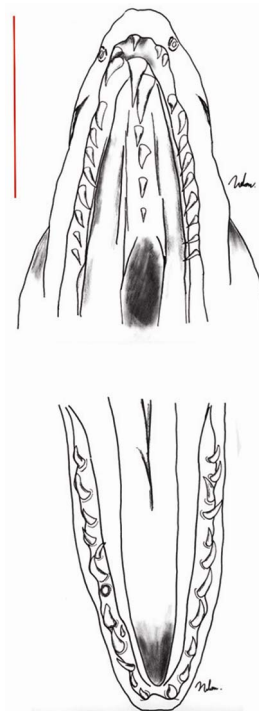


Fig. 2. Dentition of *Skythrenchelys zabra*. TOU-AE 6966, 358 mm TL. Bar = 10 mm.

Table 1. Proportions (in thousandths) and counts of the holotype, paratypes and the new record specimen collected from Taiwan of *Skythrenchelys zabra*.

	Holotype: NMNZ 35152	Mean of paratypes	Range of paratypes	TOU-AE6966
TL (mm)	239	-	119-296	358
Head/TL	133	132.4	127-137	122.9
Trunk/TL	421	423.6	406-468	4242.6
Tail/TL	446	444	405-457	460.9
DGO/TL	37	34.3	28-40	30.8
DA/TL	35	26.7	24-30	29.4
GO interspace/HL	141	135.7	100-162	166.6
Snout/HL	129	119.8	107-149	125.5
Upper jaw/HL	282	298.1	252-379	350.9
Eye/HL	31	30.5	26-38	38.6
IOW/HL	97	86.8	74-110	91.6
Predorsal vertebrae	34	33.4	31-36	37
Preanal vertebrae	57	56.7	55-58	57
Total vertebrae	116	118.6	112-122	121
SO	1 + 4	-	-	1 + 4
IO	4 + 1	-	-	4 + 1
POM	6 + 3	-	-	6 + 3
ST	2	-	-	2
F	1	-	-	1
Preanal dorsal-fin rays	69	72.4	64-80	71
Total dorsal-fin rays	230	233.3	217-250	231
Anal-fin rays	164	150.1	127-165	162
Predorsal lateral-line pores	35	33.9	32-36	38
Preanal lateral-line pores	58	56.4	55-57	60
Total lateral-line pores	105	92.8	90-99	96

nostrils open along lower edge of the upper lip. Dorsal fin begins before anus, above the midway of trunk. Lateral-line pores are incomplete; it ends from posterior tail about a head length. When fresh, body white to rice yellow coloration. Vertebral formula: 37-57-121. Head pores: SO = 1 + 4, IO = 4 + 1, POM = 6 + 3, ST = 2, F = 1. Teeth uniserial, conical, and recurved: five teeth on premaxillary, two large middle-premaxillary teeth, and four teeth on vomer (Fig. 2).

3. Distribution

From Indian Ocean to Western Central Pacific: southern India, Straits of Malacca, Philippines, Indonesia, north to southwestern Taiwan, and south to northern Australia.

4. Remarks

This specimen was identified as an ophichthid eel belonging to the subfamily Myrophinae for its significant caudal fin and it also clearly differs from other two similar genera *Scolecenchelys* and *Muraenichthys* in the relatively short tubular anterior nostrils; posterior nostrils are out of mouth with a small flap in anterior margin; unconstructed gill opening; the position of center of eyes is in advanced of mid-upper jaw; conical teeth and uniserial dentition; single infraorbital pore between anterior and posterior nostrils. Castle and McCosker [4] described two new species of genus *Skythrenchelys* in the original text, one of them *Skythrenchelys lentiginosa* had been considered as a junior synonym of

Muraenichthys macrostomus (now = *S. macrostomus* (Bleeker, 1864)) after Hibino *et al.* [7].

By the position of dorsal fin origin, we can easily distinguish *S. macrostomus* and *S. zabra*. This specimen has front dorsal fin origin, vertebral formula: 37-57-121, so we recognized it as *Skythrenchelys zabra* Castle and McCosker, 1999, a new record of genus and species in Taiwan as well. The Taiwanese specimen has similar proportions and counts that agree with the type specimens described in Castle and McCosker [4] (Table 1).

Subfamily Ophichthinae

Genus *Ophichthus* Ahl

1. Type species

Muraena ophis Linnaeus, 1758: 5 [9], Type designated by Bleeker 1864:43 [1].

2. Diagnosis

Caudal fin absent, dorsal fin and anal fin don't meet at tip of tail. Pectoral fin moderately to well developed. Moderately elongate body, but the body doesn't compress posteriorly. Tail usually longer than trunk and head.

3. Other material

Ophichthus erabo, 3 specimens. TOU-AE 6539, 735 mm

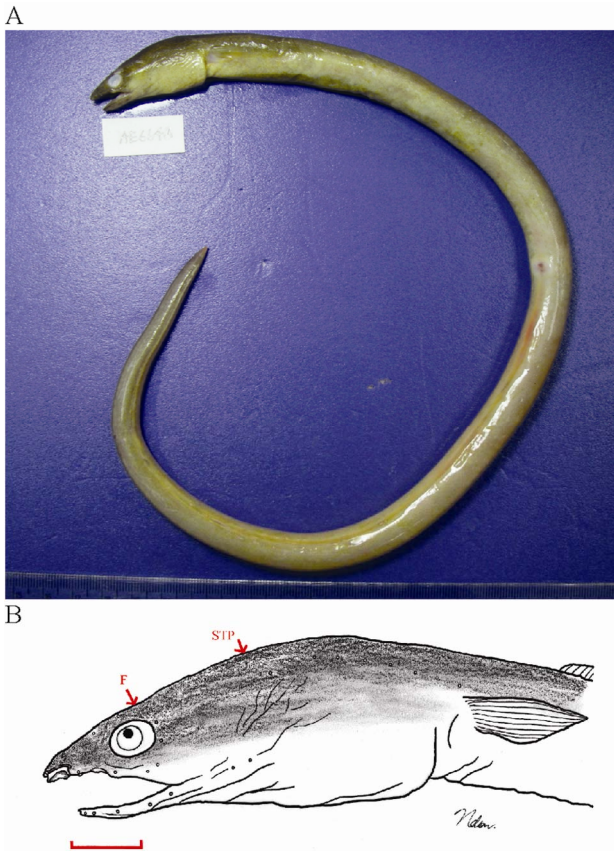


Fig. 3. *Ophichthus machidai*, TOU-AE 6501, 556 mm TL., mature female, Da-xi fish market, Yi-lan, Taiwan. Bar = 10 mm. A. Lateral view of whole body. B. Lateral illustration of head, arrows shows the position of frontal pore and supratemporal pore.

TL, mature female, Da-xi (24°50'N, 121°59'E), Yi-lan, Taiwan, caught using a bottom trawler operated along the sand and mud substrate at 114 m in depth, 16 Jul. 2010. TOU-AE 6540, 716 mm TL; TOU-AE 6541, 600 mm TL, same collecting data as TOU-AE 6539.

***Ophichthus machidai* McCosker, Ide and Endo, 2012 (New record)**

Fig. 3A-B, Fig. 4

1. Material examined

5 specimens: TOU-AE 6501, 556 mm TL, mature female, Da-xi (24°50'N, 121°59'E), Yi-lan, Taiwan, caught using a bottom trawler operated along the sand and mud substrate at 130 m in depth, 9 Jul. 2012. TOU-AE 6502, 570 mm TL, immature male; TOU-AE 6503, 143 mm TL, sexuality unknown, same collecting data as TOU-AE 6501. TOU-AE 6640, 471 mm TL, male, Da-xi (24°48'N, 121°58'E), Yi-lan, Taiwan, caught using a bottom trawler operated along the sand and mud substrate at 190 m in depth, 17 Oct. 2012. TOU-AE 7069, 465 mm TL, sexuality unknown, Da-xi (24°50'N, 122°00'E), Yi-lan, Taiwan, caught using a bottom

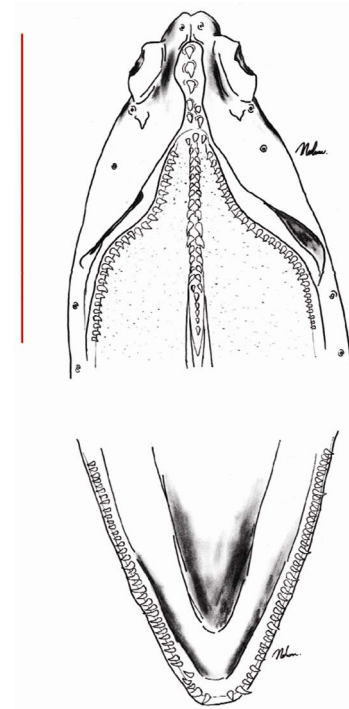


Fig. 4. Dentition of *Ophichthus machidai*, TOU-AE 6501, 556 mm TL. Bar = 10 mm.

trawler operated along the sand and mud substrate at 200 m in depth, 9 May 2010.

2. Diagnosis

Pectoral fins well developed. Dorsal fin begins after the middle of pectoral fin or slightly behind. Opening of posterior nostrils are within mouth. Teeth all small and conical; uniserial at anteriorly then become biserial on premaxilla, generally uniserial on maxilla and mandible, biserial front and uniserial posteriorly on vomer. MVF: 13-58-162, n = 5. Head pore: SO = 1 + 4, IO = 4 + 2, POM = 5 + 2, ST = 1, F = 1.

3. Distribution

Northwestern Pacific: Kuroshio-cho, Kochi Prefecture, the Kii-suido channel separating Honshu and Shikoku islands, and from Uchinour Bay, Kagoshima Prefecture, Japan; Da-xi, Yi-lan, northeastern Taiwan.

***Ophichthus obtusus* McCosker, Ide and Endo, 2012 (New record)**

Fig. 5A-B, Fig. 6

1. Material examined

5 specimens: TOU-AE 6576, 450 mm TL, mature female, Da-xi (24°48'N, 121°57'E), Yi-lan, Taiwan, caught using a bottom trawler operated along the sand and mud substrate at 130 m in depth, 21 Aug. 2012. TOU-AE 6637, 581 mm TL, mature female, Da-xi (24°48'N, 121°58'E), Yi-lan, Taiwan, caught using a bottom trawler operated along the sand and

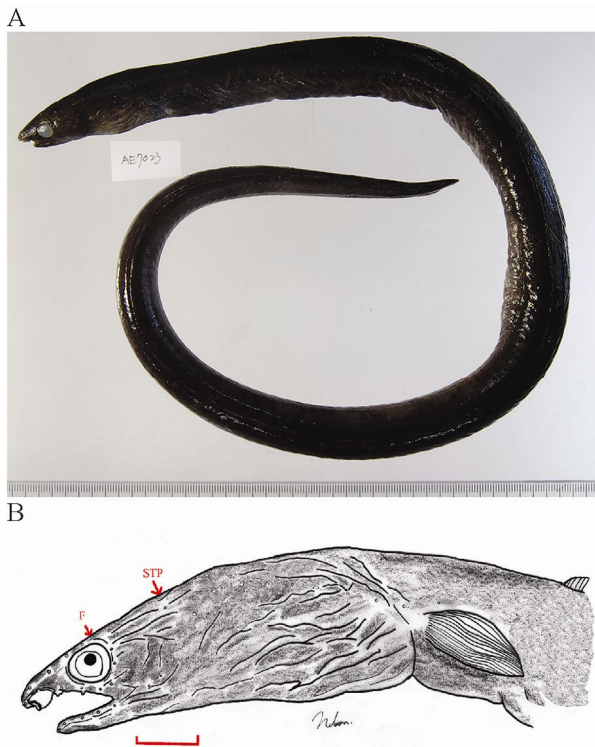


Fig. 5. *Ophichthus obtusus*, TOU-AE 7023, 599 mm TL., mature female, Da-xi fish market, Yi-lan, Taiwan. Bar = 10 mm. A. Lateral view of whole body. B. Lateral illustration of head, arrows shows the position of frontal pore and supratemporal pore.

mud substrate at 190 m in depth, 17 Oct. 2012. TOU-AE 7023, 599 mm TL, mature female, Da-xi (24°50'N, 122°00'E), Yi-lan, Taiwan, caught using a bottom trawler operated along the sand and mud substrate at 210 m in depth, 9 May 2012. TOU-AE 7024, 455 mm TL, same collecting data as TOU-AE 7023. TOU-AE 7051, 488 mm TL, same collecting data as TOU-AE 7023.

2. Diagnosis

Pectoral fins moderately developed. Origin of dorsal fin above pectoral fin. Opening posterior nostrils are within mouth. 1 pair of labial barbel placed just after anterior nostril. Small and conical teeth; 7 teeth on premaxillary (3 at first and 4 in 2 rows behind), uniserial on maxilla and mandible, biserial in middle part on vomer. (Fig. 4). MVF: 12-57-152, $n = 5$. Head pore: SO = 1 + 4, IO = 4 + 2, POM = 5 + 3. ST = 1, F = 1.

3. Distribution

Northwestern Pacific: Kuroshio-cho, Kochi Prefecture, and the Kii-suido channel separating Honshu and Shikoku islands, Japan; Da-xi, Yi-lan, northeastern Taiwan.

IV. DISCUSSION

Most of the *Ophichthus* eels off Taiwan Sea only have

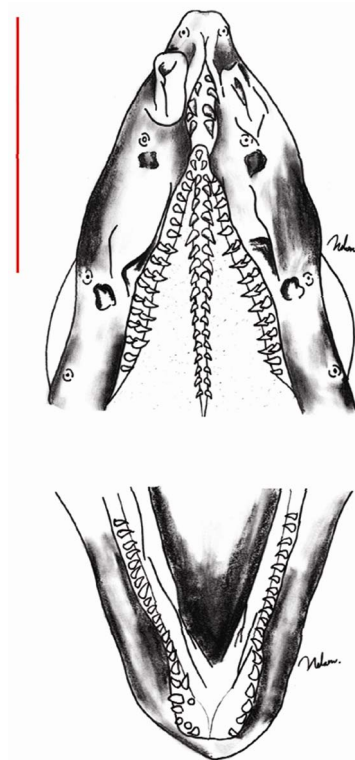


Fig. 6. Dentition of *Ophichthus obtusus*, TOU-AE 7023, 599 mm TL. Bar = 10 mm.

monotonous coloration and similar body measurements, hence, they are very similar to each other. It can be generally distinguished from their dentition form, upon patterns on skin or the relative position with pectoral fins or gill opening. This study, we compare eight *Ophichthus* species could be found in Taiwan Sea: *O. aphotistos*; *O. tsuchidae*; *O. erabo*; *O. urolophus*; *O. obtusus*; *O. asakusae*; *O. machidai*; and *O. apicalis*. Within, only *O. aphotistos* has biserial teeth in whole mouth; *O. tsuchidae* is biserial in maxillary. Within the rest of *Ophichthus* eels had uniserial maxillary teeth, only *O. erabo* has patterns on skin. *O. urolophus* can be separated by the origin of dorsal fin. *O. obtusus* is nearly all dark on body coloration with two flower-like mastoid within its mouth, rear margin of eyes just above rictus, many deep corrugation cover the head; 1 row maxillary with several teeth by the side, 8 teeth on premaxillary, 3 teeth on middle-premaxillary, orderly biserial teeth in vomer, and 1 row on mandibular, in some case biserial in the anterior part (Fig. 6). The last 3 species differs from their POP numbers, *O. asakusae* has 3 POP, *O. machidai* and *O. apicalis* has 2 POP. *O. apicalis* and *O. machidai* are very similar in many aspects, but *O. machidai*'s vomer teeth is small and interleaving uniserial in the anterior part, big biserial teeth on the central part and minute uniserial teeth in the posterior part; *O. apicalis* has a Y shape, uniformly small vomer teeth. The vertebrae formula comparison of these eight species can see in Table 2 (Comparison data from original description: McCosker and Chen [14]; Jordan and Snyder [8]; McCosker *et al.* [15].)

Table 2. A list of vertebral formula for the holotypes, mean vertebral formulae, and total vertebrae range for the eight Taiwanese *Ophichthus* species.

	Holotype	MVF	TV Range
<i>Ophichthus apicalis</i>	No data	12-52-144 ^c	143-145 ^c
<i>O. aphotistos</i>	18-59-161 ^b	18-59-160 ^b	158-162 ^b
<i>O. asakusae</i>	11-54-128 ^a	11-54-130 ^a	126-132 ^a
<i>O. erabo</i>	6-78-155 ^a	7-76-158 ^d	155-163 ^d
<i>O. machidai</i>	16-58-158 ^c	13-58-162 ^c	159-164 ^d
<i>O. obtusus</i>	11-55-151 ^c	12-57-152 ^c	150-153 ^d
<i>O. tsuchidae</i>	16-61-138 ^a	No data	No data
<i>O. urolophus</i>	16-54-136 ^a	16-54-136 ^a	134-139 ^a

Data source: a, Jordan and Snyder [8]; b, McCosker and Chen [14]; c, McCosker *et al.* [15]; d, from first author's specimen counts.

Key to *Ophichthus* species of Taiwan in this study

- 1a. Lower jaw teeth biserial *Ophichthus aphotistos*
- 1b. Lower jaw teeth uniserial 2
- 2a. Teeth 2 rows on upper jaw *Ophichthus tsuchidae*
- 2b. Teeth 1 row on upper jaw, or irregularly 2 rows in anterior part 3
- 3a. Body coloration spotted blotches *Ophichthus erabo*
- 3b. Body coloration monotonous, or covered with vague patterns 4
- 4a. Dorsal fin origin after pectoral fins slightly; all teeth uniserial, MVF: 16-54-136, TV: 134-139 *Ophichthus urolophus*
- 4b. Dorsal fin origin in advance of the trailing edge of pectoral fins 5
- 5a. Median fins black; rear margin of eyes just above rictus; MVF: 12-57-152, TV: 150-153 *Ophichthus obtusus*
- 5b. Median fins whitish or have dark margin; rear margin of eyes before rictus 6
- 6a. Pectoral fin shorter than jaw; 3 POP; teeth uniserial; MVF: 11-54-130, TV: 126-132 *Ophichthus asakusae*
- 6b. Pectoral fin even longer than jaw; 2 POP 7
- 7a. Vomerine teeth uniserial at anterior part; MVF: 13-58-162, TV: 158-162 *Ophichthus machidai*
- 7b. Vomerine teeth biserial at anterior part; MVF: 12-52-144, TV: 143-145 *Ophichthus apicalis*

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