



Description of a new species of deep-water snake eel, *Ophichthus mccoskeri* (Ophichthidae: Ophichthinae) from Andaman Sea, India

K. S. SUMOD^{1,4}, YUSUKE HIBINO², HASHIM MANJABRAYAKATH¹ & V. N. SANJEEVAN^{1,3}

¹Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences, Government of India, Kendriya Bhavan, Kakkanad, Kochi 682037, Kerala, India.

²Kitakyushu Museum of Natural History and Human History, Fukuoka 805-0071, Japan.

³Kerala University of Fisheries and Ocean Studies, Panangad, Kochi 682506, Kerala, India.

⁴Corresponding author. E-mail: sumodksaqua@gmail.com

Abstract

A deep-sea species of snake eel (family Ophichthidae, subfamily Ophichthinae) *Ophichthus mccoskeri* **sp. nov.** is described based on 6 specimens (331–447 mm total length) trawled at 314–363 m depth in Andaman waters, India. This species is differentiated from its deep-water congeners by a combination of characters such as its large eyes, dorsal-fin origin a short distance behind pectoral-fin tip, anal fin black posteriorly, three preopercular pores, maxillary and mandibular teeth ending as triserial, and in a vertebral formula of 20/55/153.

Key words: Anguilliformes, Ophichthidae, Andaman Sea, deep-sea

Introduction

Members of the family Ophichthidae, with two subfamilies, the Myrophinae (Worm eels) and the Ophichthinae (Snake eels), are the most diverse and speciose of the order Anguilliformes. Currently 345 valid species are recognized, Myrophinae (69) and Ophichthinae (276) (Fricke *et al.* 2019). Most inhabit depths of less than 200 m, but recent deep-sea explorations have uncovered many new species living at depths of more than 200 m (McCosker *et al.* 1989; McCosker 1999; McCosker & Chen 2000; McCosker 2010; McCosker & Ho 2015; Tashiro *et al.* 2015; McCosker & Psomadakis 2018; Hibino *et al.* 2019). They are rarely encountered in sampling because of their specialized burrowing nature. This is one reason why many are known only from their holotypes. They do not create permanent burrows but instead rapidly burrow into the substrate using the head or tail (McCosker & Rosenblatt 1993; McCosker 2002).

In Indian coastal waters, the family Ophichthidae is represented by 17 genera and 25 species (Biswas *et al.* 2010; Ray *et al.* 2015; Mohapatra *et al.* 2018).

The members of the family Ophichthidae share the following characters: snake-like or worm-like in appearance; body anteriorly cylindrical and laterally compressed posteriorly; snout pointed to blunt; mouth inferior to superior; nostrils widely separated; pectoral fins present or absent; gill opening mid-lateral to ventral and the presence of overlapping branchiostegal rays. The presence or absence of median fins at the tail tip separates the two subfamilies. In the subfamily Myrophinae the tail tip is flexible with continuous median fins, whereas the tail tip is hard and the median fins are generally absent in the subfamily Ophichthinae (McCosker *et al.* 1989; McCosker & Okamoto 2016). The subfamily Ophichthinae has 47 recognized genera (Mohapatra *et al.* 2018).

The genus *Ophichthus* Ahl, 1789 is the most species rich with more than 80 recognized species. Members of the genus are diagnosed by the tail length, body (head and trunk) length, dorsal-fin origin above or behind gill openings, development of the pectoral fins, moderate to well-developed eyes, tubular anterior nostrils, posterior nostrils open into the mouth or along lower edge of lip, teeth conical and numerous uniserial to multiserial on jaws and vomer, finless pointed tail tip, and generally uniform colour with a darker dorsal region (McCosker *et al.* 2012).

The new species that we describe here belongs to the subgenus *Coecilophis* Kaup, 1856. Nearly all deep-water

Indo-Pacific species of *Ophichthus* belonging to this subgenus are generally pale and weakly pigmented and some have a darkened snout, chin and anterior nostrils, whereas others have pale anterior nostril tubes that are much paler than the surrounding snout (McCosker 2010; McCosker *et al.* 2012). During the exploratory fishery surveys of FORV *Sagar Sampada* the first author discovered specimens of deep-water snake eels from the Andaman waters of the Indian EEZ. This is the first report of an ophichthid eel from deep-waters of India. These specimens differs from their congeners and we herein describe *O. mccoskeri* as a new species.

Materials and methods

Six specimens [331–447 mm total length (TL)] were collected during the deep-sea exploratory fishery surveys of the Fishery Oceanographic Research Vessel (FORV) *Sagar Sampada*, conducted by the Centre for Marine Living Resources and Ecology (CMLRE), Ministry of Earth Sciences (MoES), Government of India, along the continental slope in Andaman waters. Specimens were collected using demersal trawls such as High Speed Demersal Trawl Crustacean version HSDT(CV), EXPO model fish trawl and High Opening Trawl (HOT) operated at a depth ranging from (314–363 m) at a speed of 2–3 knots. Counts, measurements and abbreviations for cephalic sensory pores follow McCosker (2010). The specimens were photographed in fresh condition and later preserved in a 10% formaldehyde solution and deposited at CMLRE Referral Centre, Kochi, India.

Taxonomy

Ophichthus mccoskeri sp. nov.

Proposed common name: Black-tipped Andaman Snake eel, with reference to the colouration and type locality at which the specimens were collected.

(Figures 1–4, Table 1)

Holotype. CMLRE IO/SS/FIS/00449 A (346 mm TL), 321 m off South Great Nicobar, India (6°38'18" N; 93°41'4.81" E) collected on September 2010 onboard FORV *Sagar Sampada*.

Paratypes. Five specimens (331–415 mm TL) CMLRE IO/SS/FIS/00449 A, CMLRE IO/SS/FIS/00449 B, off South Great Nicobar (6°37'48.84"N; 93°41'11.47"E); CMLRE IO/SS/FIS/00449 C, West Little Andaman (10°51'32.21"N; 92°21'54.54"E); CMLRE IO/SS/FIS/00449 D, off South Nicobar (6°35'53.1"N; 93°11'12.01"E) & CMLRE IO/SS/FIS/00449 E, off North Andaman (12°29'53.11.98"N; 93°10'12.20"E); collected from a depth ranging from 314–363 m onboard FORV *Sagar Sampada*.

Diagnosis. A moderately elongate species of the genus *Ophichthus*, subgenus *Coecilophis*, with the following combination of characters: head 13.0–14.0%, tail 54.6–56.8 %, depth at gill opening 4.0–4.7 % and dorsal-fin origin 18.4–20.5 % of total length; eyes large, its diameter almost equal to snout; pectoral fins elongate but not lanceolate, with elongated middle most ray; rear margin of orbit in advance of rictus, with its center positioned after the mid-point of upper jaw; posterior nostril opens along upper lip, with a small anterior flap; preoperculomandibular pores 3 + 6; teeth numerous, small and conical, biserial on maxillary with triserial ending, uniserial anteriorly and biserial posteriorly on mandible with triserial ending, and biserial anteriorly and uniserial posteriorly on vomer; colouration pale brown on dorsal surface and whitish below, snout tip brown with lower jaw pale; median fins and pectoral fins colourless except anal-fin base blackened posteriorly and vertebral formula 20/55/153.

Description. Counts and measurements of the holotype (in mm): Total length 346; head 48.6; trunk 106; tail 191; predorsal distance 69.0; pectoral fin length 15.8; pectoral fin base 4.6; body depth at gill opening 16.2; body width at gill opening 12.4; body depth at anus 11.8; body width at anus 10.3; snout length 9.5; upper jaw length 21.3; lower jaw length 20.6; eye diameter 9.0; interorbital width 5.6; gill opening height 8.1; inter-gill width 10.2; vertebral count 19/53/150.

Body (Fig. 1) moderately elongate, cylindrical anteriorly and compressed in posterior tail region. Depth at gill opening 4.0–4.7% in total length. Head and trunk 44.2–45.4%, head 13.0–14.0% and tail 54.6–56.8% in total length. Snout tip moderately rounded and not elongated. Anterior nostril tubular, directed anteriorly, not reaching the snout tip. Snout not bisected on underside by a groove. Posterior nostril opens along upper lip with a short anterior flap,

extends beyond the edge of lip. Upper jaw slightly extended at its tip, upper and lower lips meet when mouth is closed. Eye large, approximately equal to snout, 17.1–19.4% of head length. Posterior margin of eye in advance of rictus. Center of eye placed slightly posterior to middle of upper jaw. Branchial basket slightly wider and deeper than body. Dorsal-fin origin 18.4–20.5% in total length. Dorsal and anal fins placed in a groove for their entire length. Dorsal and anal fins end before the tail tip by approximately half the snout length. Pectoral fin elongated but not lanceolate, its base positioned in upper half of the gill opening.

Head pores (Fig. 2) small but conspicuous. Single median interorbital and temporal pores, supraorbital pores (SO) 1 + 4, infraorbital pores (IO) 4 + 2, preoperculo-mandibular pores (POM) 3 + 6, supratemporal pores (ST) 3. Lateral-line pores before pectoral base 9–11, before dorsal-fin 20–21, before anus 54–59 (10, 21 and 56 in holotype).



FIGURE 1. Fresh specimen of *Ophichthus mccoskeri* **sp. nov.**, paratype, CMLRE IO/SS/FIS/0049 E, 447 mm TL.

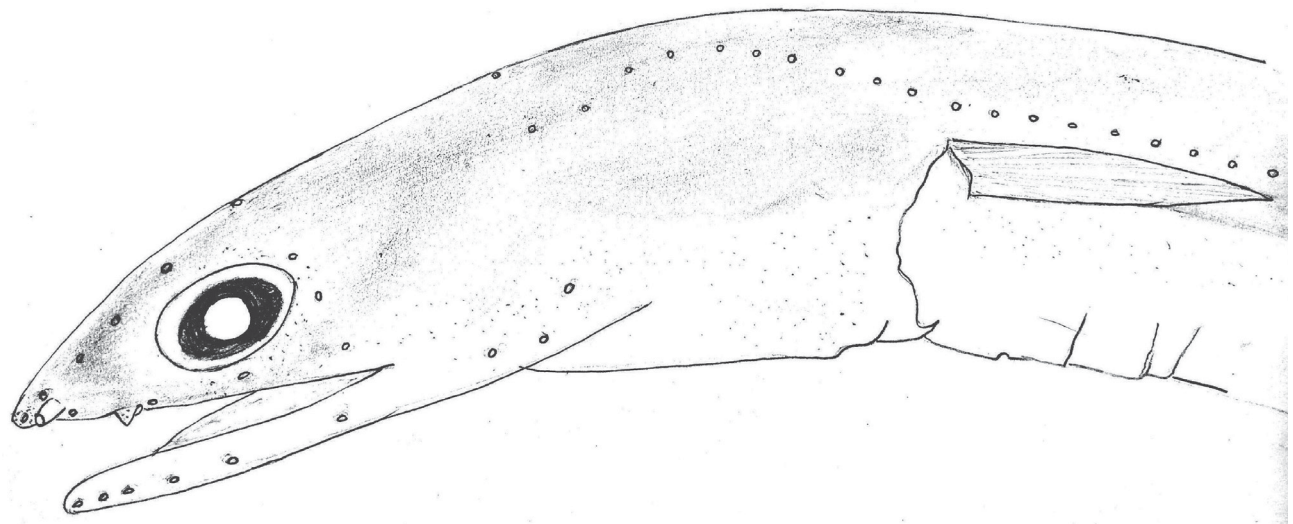


FIGURE 2. Head of holotype of *Ophichthus mccoskeri* **sp. nov.**, CMLRE IO/SS/FIS/00449 A, 346 mm TL.

Teeth (Fig. 3) small, conical, and numerous. Intermaxillary with a rosette of 6–9 teeth preceded by 4–6 teeth, followed by 2–7 biserial vomerine teeth continued by 15–17 uniserial teeth. Biserial maxillary teeth with triserial ending. Mandibular teeth uniserial anteriorly with few isolated pairs, biserial in last quarter and ending as triserial.

Body colouration when fresh light brown on dorsal surface and white ventrally, including lower jaw and branchial region; dorsal surface of the head and snout brown; posterior and anterior nostrils pale; median and pectoral fins pale white, except posterior region of anal- fin base which is black (Fig. 4). Colour after preservation in formaldehyde is darker brown dorsally, the remainder the same as in fresh specimens.

Distribution. Known only from the continental slope off Andaman waters, India (South Great Nicobar and West Little Andaman), depth ranging from 314–363 m.

Etymology. This species is named in honor of the well-known snake eel expert John E. McCosker for his immense contributions to ophichthid eel systematics and phylogeny.

TABLE 1. Comparison (Counts and proportions in thousands including some special characters) of holotype and paratypes of *Ophichthus mccoskeri* sp. nov., with similar deep-water congeners (based on Asano (1987), McCosker (1979), McCosker (1999), McCosker (2002), McCosker (2010) and present study).

Characters	<i>O. kunoloa</i> n = 5	<i>O. genie</i> n = 6	<i>O. mccoskeri</i> sp. nov. n = 6	<i>O. congroides</i> n = 2	<i>O. tonioi</i> n = 5	<i>O. megalops</i> n = 1
TL (mm)	383–473	196–337	331–447	472–522	334–447	322
Head length (HL) /TL	96–101	93–101	130–140	83–84	91–100	110
Head and trunk/TL	398–410	439	442–454	375–397	374–407	447
Trunk/TL	304–307	317–356	302–320	313–314	-	336
Tail/TL	590–602	552–582	546–568	603–625	592–626	554
Depth at gill opening /TL	32–37	24–32	40–47	27	32–40	40
Dorsal-fin origin/TL	132–144	126–155	184–205	136–138	126–138	250
Pectoral-fin length/HL	319–476	388–471	291–330	425	396–455	324
Upper jaw /HL	379–438	382–471	394–447	-	378–438	-
Snout/HL	168–223	197–266	182–205	197–205	175–211	213
Eye/HL	142–175	115–144	171–194	169–179	152–185	186
Interorbital width/HL	164	101–156	106–144	157–160	-	181
Predorsal vertebrae	15	12–16	19–22	20–22	16–18	29
Preal anal vertebrae	66–67	56–59	53–59	75–77	60–67	60
Total vertebrae	180–185	139–147	150–154	204–208	166–189	160
Mean vertebral formula	15-66-182	14-57-142	20-55-153	21-76-206	17-63-178	-
Cephalic pores	Small	Small	Small	Small	Small	Small
SO	1+4	1+4	1+4	1+4	1+4	1+4
IO	4+2	4+2	4+2	4+2-3	4+2	4+2
POM	2+5	2+6-7	3+6	2+6	2+6-7	3+6
Median ST pore	1	1	1	1	1	1
Interorbital pore	1	1	1	1	1	1
Eye	Large	Not large	Large	Large	Large	Large
Pectoral fin shape	Elongate, not lanceolate	Elongate, lanceolate	Elongate, not lanceolate	Elongate, lanceolate	Elongate, lanceolate	Elongate, not lanceolate
Posterior anal fin margin	Black	Pale	Black	Pale	Black	Black

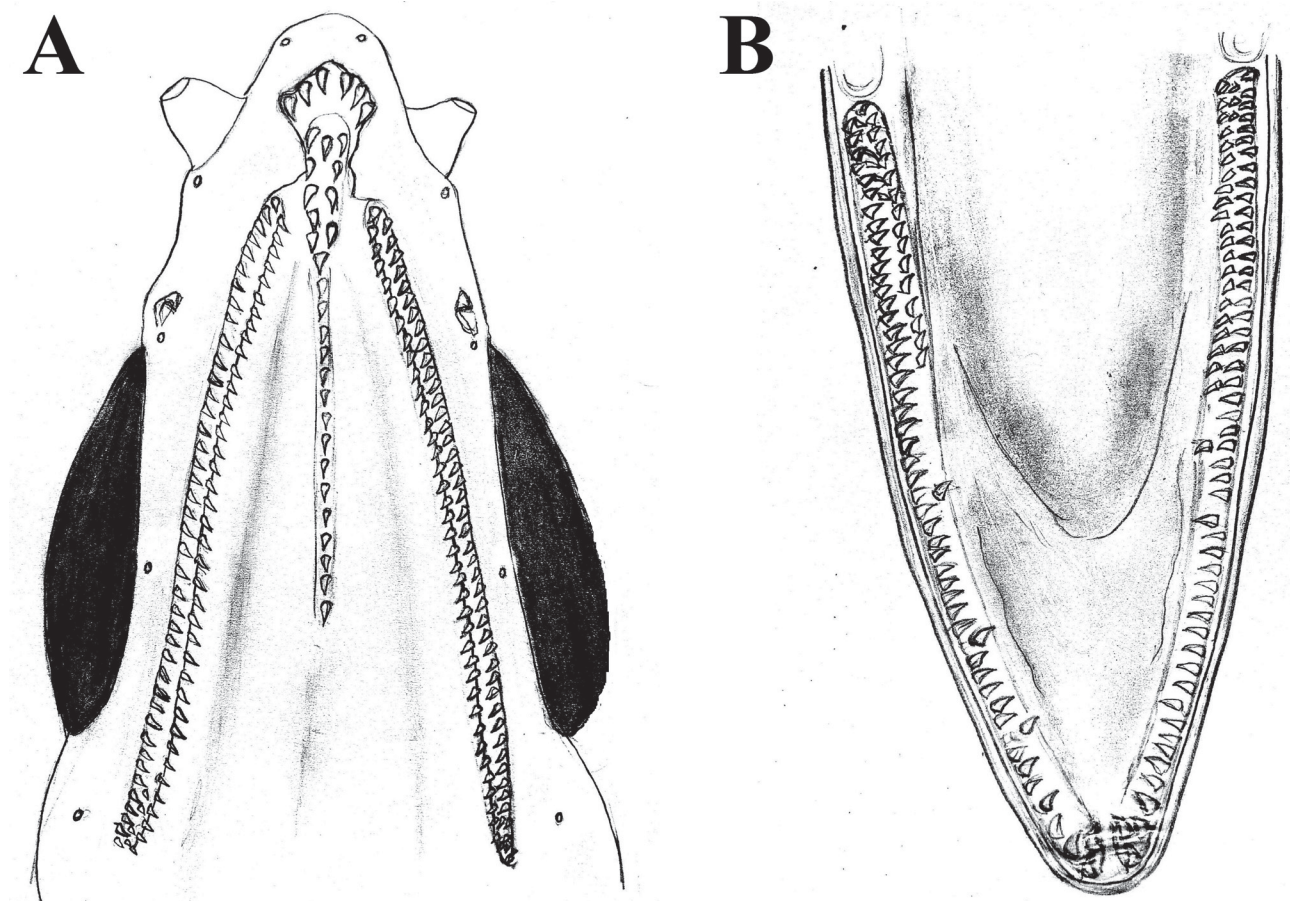


FIGURE 3. Dentition of holotype of *Ophichthus mccoskeri* **sp. nov.**, CMLRE IO/SS/FIS/00449A, 346 mm TL. A) Upper jaw B) Lower Jaw.



FIGURE 4. Enlarged view of posterior region of tail, holotype of *Ophichthus mccoskeri* **sp. nov.**, CMLRE IO/SS/FIS/00449 A, 346 mm TL.

Discussion

McCosker (2010) reviewed 19 species of the deep-water snake-eels of the genus *Ophichthus* from the Indo-Pacific region. Later, McCosker & Ho (2015) described two deep-water species, *O. bicolor* and *O. shaoi* from Taiwan waters. Subsequently McCosker & Psomadakis (2018) described a deep-water species, *O. naga* from Myanmar and most recently Hibino et al. (2019) described another four deep-water congeners *O. kusanagi*, *O. lupus*, *O. oligosteus* and *O. yamakawai*. The new species described herein increases the deep-water Indo-Pacific species of *Ophichthus* to 27. Comparison of *O. mccoskeri* **sp. nov.** with other similar deep-water congeners is given in the (Table 1).

The new species appears to be similar to *O. genie* McCosker, 1999, described from New Caledonia and the Maldives, in its general head and body proportions but differs in its preopercular mandibular pore condition (2 + 6 or

7 vs. 3 + 6 in *O. mccoskeri*), vertebral counts (12–16 predorsal, 56–59 preanal, and total 139–147 vs. 19–22, 53–59 and 150–154, respectively), the shape of its pectoral fin (lanceolate vs. not lanceolate) and the colour of its anal fin (colourless vs. anal-fin margin black posteriorly). The new species is also similar to *O. kunaloa* McCosker, 1979 from the central Pacific. It has similar head and body proportions and general colouration and a dark patch at its anal-fin base, but differs significantly in its preopercular mandibular pore condition (2 + 5 vs. 3 + 6 in *O. mccoskeri*), vertebral number (66–69 preanal and total 180–185 vs. 53–59 and 150–154), and mandibular tooth pattern (biserial vs. uniserial anteriorly and biserial posteriorly with triserial ending). The large eye (almost equal to snout length) is an important character of *O. mccoskeri* **sp. nov.**, which is similar to that of *O. congroides* McCosker, 2010 and *O. tomioi* McCosker, 2010, however, these species have an enlarged lanceolate pectoral fin and their dorsal-fin origin is before the tip of the pectoral fin. *Ophichthus megalops* Asano, 1987 also has large eyes, a black posterior margin on the anal fin, and 3 preopercular pores, similar to *O. mccoskeri* **sp. nov.**, but differs in head length (11.0% vs. 13.0–14.0% of total length), predorsal (29 vs. 19–22) and total vertebral counts (160 vs. 150–154). The discovery of our new species is the first ophichthid eel from deep-waters of the Indian EEZ. Further exploratory surveys using bottom trawl nets and dredges will certainly increase the species diversity.

Acknowledgements

This study was carried out under the Marine Living Resources programme of the Ministry of Earth Sciences, Government of India. The support of Dr. M. Sudhakar, Director of CMLRE, is sincerely acknowledged. We thank all the scientific and crew members of the FORV *Sagar Sampada* Cruises (280, 292, 334 & 367) for their support during the sampling. We also wish to thank John E. McCosker (California Academy of Sciences, San Francisco, California) and David G. Smith (Smithsonian Institution, Museum Support Center, Suitland, MD) for reading the draft of this manuscript and making valuable suggestions. This is CMLRE contribution number 105.

References

- Ahl, J.N. (1789) *Specimen ichthyologicum de Muraena et Ophichtho, quod venia exp. fac. Med. ups. Praeside Carol. Pet. Thunberg, etc.* J. Edman, Upsala, 14 pp.
- Asano, H. (1987) A new ophichthid eel, *Ophichthus megalops*, from the Kumano-nada, Japan. *Japanese Journal of Ichthyology*, 34, 135–137.
<https://doi.org/10.1007/BF02912407>
- Biswas, S., Mishra, S.S., Satpathy, K.K. & Selvanayagam, M. (2010) First record of stargazer snake eel *Brachysomophis cirrocheilos* (Osteichthyes: Ophichthidae) from India. *Marine Biodiversity Records*, 3, E85.
<https://doi.org/10.1017/S1755267210000795>
- Fricke, R., Eschmeyer, W.N. & Fong, J.D. (2019) Eschmeyer's Catalog of Fishes: Species by Family/Subfamily. Available from: <http://researcharchive.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp> (accessed 12 July 2019)
- Hibino, Y., McCosker, J.E. & Tashiro, F. (2019) Four new deepwater *Ophichthus* (Anguilliformes: Ophichthidae) from Japan with a redescription of *Ophichthus pallens* (Richardson 1848). *Ichthyological Research*, 66 (2), 289–306.
<https://doi.org/10.1007/s10228-018-00677-3>
- Kaup, J.J. (1856) Übersicht der Aale. *Archiv für Naturgeschichte*, 22, 41–77.
<https://doi.org/10.5962/bhl.part.11240>
- McCosker, J.E. (1979) The snake eels (Pisces, Ophichthidae) of the Hawaiian Islands, with the description of two new species. *Proceedings of the California Academy of Sciences*, 42, 57–67.
- McCosker, J.E. (1999) Pisces Anguilliformes: Deepwater snake eels (Ophichthidae) from the New Caledonia region, Southwest Pacific Ocean. In: Crosnier, A. (Ed.), Résultats des Campagnes MUSORSTOM Vol. 20. *Mémoires du Muséum national d'Histoire naturelle*, 180, 571–588.
- McCosker, J.E. (2002) Notes on Hawaiian snake eels (Pisces: Ophichthidae), with comments on *Ophichthus bonaparti*. *Pacific Science*, 56, 23–34.
<https://doi.org/10.1353/psc.2002.0005>
- McCosker, J.E. (2010) Deepwater Indo-Pacific species of the snake-eel genus *Ophichthus* (Anguilliformes: Ophichthidae), with the description of nine new species. *Zootaxa*, 2505 (1), 1–39.
<https://doi.org/10.11646/zootaxa.2505.1.1>
- McCosker, J.E., Böhlke, E.B. & Böhlke, J.E. (1989) Family Ophichthidae. In E.B. Böhlke (ed.), Fishes of the Western North Atlantic, Part Nine, Vol. One: Orders Anguilliformes and Saccopharyngiformes. *Memoir Sears Foundation for Marine Research*, 1 (9), 254–412.

- McCosker, J.E. & Chen, Y. (2000) A new species of deepwater snake-eel, *Ophichthus aphotistos*, with comments on *Neenchelys retropinna* (Anguilliformes: Ophichthidae) from Taiwan. *Ichthyological Research*, 47, 353–357.
<https://doi.org/10.1007/BF02674262>
- McCosker, J.E. & Ho, H.C. (2015) New species of the snake eels *Echelus* and *Ophichthus* (Anguilliformes: Ophichthidae) from Taiwan. *Zootaxa*, 4060 (1), 71–85.
<https://doi.org/10.11646/zootaxa.4060.1.11>
- McCosker, J.E., Ide, S. & Endo, H. (2012) Three new species of ophichthid eels (Anguilliformes: Ophichthidae) from Japan. *Bulletin of the National Museum of Nature and Science, Series A, Supplement 6*, 1–16.
- McCosker, J.E. & Okamoto, M. (2016) *Chauligenion camelopardalis*, a new genus and species of deepwater snake eel (Anguilliformes: Ophichthidae) from the East China Sea. *Proceedings of the California Academy of Sciences, Series 4*, 63, 321–328.
- McCosker, J.E. & Psomadakis, P.N. (2018) Snake eels of the genus *Ophichthus* (Anguilliformes: Ophichthidae) from Myanmar (Indian Ocean) with the description of two new species. *Zootaxa*, 4526 (1), 71–83.
<https://doi.org/10.11646/zootaxa.4526.1.5>
- McCosker, J.E. & Rosenblatt, R.H. (1993) A revision of the snake eel genus *Myrichthys* (Anguilliformes: Ophichthidae) with the description of a new eastern Pacific species. *Proceedings of the California Academy of Sciences*, 48, 153–169.
- Mohapatra, A., Ray, D., Mohanty, S.R. & Mishra, S.S. (2018) *Ophichthus johnmccoskeri* sp. nov. (Anguilliformes: Ophichthidae): a new snake eel from Indian waters, Bay of Bengal. *Zootaxa*, 4462 (2), 251–256.
<https://doi.org/10.11646/zootaxa.4462.2.7>
- Ray D., Mohapatra, A., Biswas, S., Satpathy, K.K. & Mishra, S.S. (2015) First record of the Evermann's snake eel, *Ophichthus lithinus* (Actinopterygii: Anguilliformes: Ophichthidae), from northern Indian Ocean. *Acta Ichthyologica et Piscatoria*, 45, 89–93.
<https://doi.org/10.3750/AIP2015.45.1.10>
- Tashiro, F., Hibino, Y. & Imamura, H. (2015) Description of a new species of the genus *Neenchelys* (Anguilliformes: Ophichthidae, Myrophinae) from the eastern Indian Ocean, with comments on the availability of three congeners. *Ichthyological Research*, 63, 53–58.
<https://doi.org/10.1007/s10228-015-0473-8>