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Gymnothorax phalarus, a new eastern Pacific moray eel (Pisces: Muraenidae)

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Abstract: *Gymnothorax phalarus* is described from 23 individuals taken in trawl and dredge collections made on the Pacific coast of Costa Rica. The new species is nearly always syntopic with a similar species, *Gymnothorax equatorialis*. The new moray is distinguished by its white-spotted pattern, uniserial, slightly serrated teeth in adults, four infraorbital pores and mean vertebral formula of 6-58-140. Of the total of 21 valid species of morays recorded from the Pacific coast of Costa Rica, only the new species and *G. equatorialis* form part of the trawl fishery as the remainder are almost entirely restricted to nearshore rocky habitats. The known range of *G. phalarus* is from Baja California to Peru.

Key words: New species, eastern Pacific, Pisces: Muraenidae, moray eel.

The moray eel fauna of the Pacific coast of Costa Rica is abundant and diverse. To date, 19 valid species of morays have been recorded from nearshore rocky habitats and another two species by trawling in deeper waters over soft substrata. Nine of these eels, including the two deep-water species, belong to the genus *Gymnothorax*. In addition, Böhlke et al. (1989:149;172) referred to the presence in the eastern Pacific of one or two unidentified species of *Gymnothorax* of the subgenus *Neomuraena* similar to several *Neomuraena* in the western Atlantic.

Trawl samples on the Pacific coast of Costa Rica routinely yield fair numbers of the white-spotted *Gymnothorax* (*Neomuraena*) *equatorialis* (Hildebrand) and a similar less-common, undescribed species (Fig. 1). Unlike members of *Neomuraena* which have three infraorbital pores, the new species, described herein, possesses four infraorbital pores and slightly serrated uniserial teeth and possibly belongs to another subgenus.

Methodology follows (Böhlke 1982 & Böhlke *et al.* 1989). Institutional acronyms follow Leviton *et al.* (1985). All measurements are expressed in millimeters (mm) and length is total length (TL) throughout. Specimens are deposited at LACM and UCR.

Gymnothorax phalarus, new species (Figs. 1-4)

Gymnothorax sp. nov. Bussing & López 1993 (figure legend and description inverted

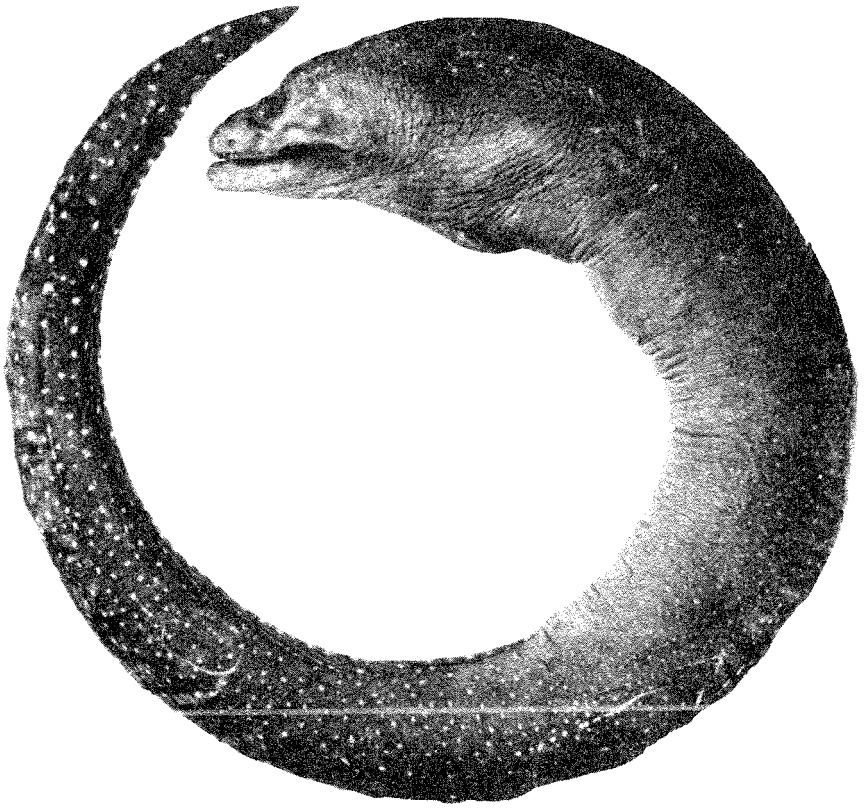

Fig. 1. *Gymnothorax phalarus*, n. sp., holotype, LACM 47317-1, 565 mm TL, Isla del Caño, Costa Rica.

with *G. equatorialis*); Bussing & López 1996 (listed).

Holotype: LACM 47317-1, an adult female of 565 mm total length (TL), W side of Isla del Caño off Osa Peninsula, Costa Rica. (8°47'00" N; 84°03'48" W). Collected with 3 m dredge at 136-237 m depth on 12 Feb. 1994 by M.I., W.A. Bussing and crew of R/V Victor Hensen, (ex UCR 2373-12).

Paratypes: Data is presented as follows: catalog number, number of specimens, length in mm TL and collection data. All specimens are from Costa Rica. Additional data are available on the Internet.

LACM 32560-13, 1 (485 mm), Isla del Caño, 55-73 m, 17 Mar. 1972. LACM 47318-1, 2 (468-620), SW of Cabo Blanco, Nicoya Peninsula, 275-339 m, 7-8 May 1970. LACM 47320-1, 5 (352-598), 8 km offshore of Bahía Herradura, 184 m, 10 Feb. 1984. LACM 47319-1, 1 (523), off Punta Coyote, Nicoya Peninsula, 83 m, 31 Oct. 1983. UCR 427-16, 1 (339), between Cabo Blanco and Punta Herradura, 220 m, 19-21 May 1970. UCR 489-17, 1 (570), Golfo de Nicoya, 23-25 m, 26-29 Oct. 1970. UCR 1242-4, 1 (660), coast N of Cabo Velas, 118-139 m, 5 Dec. 1977. UCR 1555-1, 3 (397-927),off Punta Coyote, Nicoya Peninsula, 80 m, 30 Oct. 1983. UCR 1711-2, 1 (283), 1.2 km offshore of Punta Leona, 54 m, 7 Dec. 1983. UCR 1730-6, 2 (420-437), 6 km offshore of Malpaís, Nicoya Peninsula, 295 m, 12 Feb. 1984. UCR 1963-4, 1 (603), off Punta Coyote, Nicoya Peninsula, 65 m, 23 May 1987. UCR 2353-14, 3 (505-755). Golfo

Dulce, at center of entrance to gulf, 130-268 m, 15 Dec. 1993. UCR 2366-1, 1 (402), Golfo Dulce, just outside entrance to gulf, 200 m, 10 Feb. 1994. UCR 2372-6, 1 (400), off mouth of Río Sierpe, 103 m, 12 Feb. 1994.

Comparative Material: *Gymnothorax equatorialis* from Mexico (3 specimens) and from Costa Rica (63 specimens) are deposited at LACM and UCR. *Gymnothorax castaneus* (13 specimens) and *G. dovii* (33 specimens) from Costa Rica and Isla del Coco are deposited at UCR. Additional data for UCR collections is available on Internet.

Diagnosis: A moderately deep-bodied moray of the genus *Gymnothorax*, with: medium to dark brown coloration overlain with white dots becoming larger posteriorly; jaw teeth uniserial and serrate; one or two vomerine teeth in adults; four infraorbital pores; and mean vertebral formula (MVF) 6-58-140.

Description: Measurements in percentage of TL appear in Table 1. In the following, proportions of the holotype are in parentheses following the range of 15 paratypes. Body depth at gill opening greatest in large specimens, 11.2-19.2 (11.9) times in TL, depth at anus 14.1-25.4 (15.2) in TL; tapering gradually and becoming more compressed posteriorly. Predorsal distance 7.2-11.1 in TL (determined on radiographs of 8 paratypes). Anus slightly before or after midbody, preanal distance 1.9-2.2 (2.2) in TL; tail length 1.9-2.2 (1.9) in TL.

TABLE 1

Proportional measurements in percentage of total length of holotype, 15 paratypes of Gymnothorax phalarus *from the Pacific coast of Costa Rica*

	Holotype	Paratypes N = 10	Paratypes N = 5
Total length (mm)	565	283-445	577-929
Head length	17.9	15.6-17.6	16.5-18.7
Eye diameter	1.3	1.0-1.6	0.9-1.3
Fleshy interorbital	2.0	1.4-2.2	1.7-2.6
Snout length	2.7	2.3-3.2	2.6-3.4
Jaw length	6.9	5.6-8.1	5.8-7.4
Body depth at gill open.	8.4	5.2-8.2	6.3-9.0
Body depth at anus	6.6	4.6-6.8	3.9-7.1
Predorsal distance	11.7	9.0-11.8	12.5-13.8
Preanal distance	46.6	46.0-53.1	49.2-53.1
Tail length	53.4	47.4-52.9	45.1-51.5

Head length 5.4-6.4 (5.6) in TL; eye slightly in advance of mid-jaw, 10.4-21.4 (13.7) in head length (HL). Fleshy interorbital space convex, width 7.2-11.2 (9.2) in HL. Snout length 5.1-6.9 (6.6) in HL. Anterior nostril tubular, near tip of snout; posterior nostril with a slightly raised margin, near anterodorsal margin of eye. Gill opening in form of an oblique slit slightly above or at mid-side.

Head pores (Fig. 2) usually rimmed with darker pigment. Four conspicuous infraorbital pores; three smaller supraorbital pores; mandibular pores 5-7, usually 6 (holotype with 6-7).

Jaws of equal length or lower jaw extending slightly, snout to rictus (upper jaw length) 2.1-2.9 (2.6) in HL. Teeth sharp, slender and uniserial with margins most strongly serrated on posterior edge. On upper jaw usually an anterior median fang, followed on each side by three or four widely-spaced long intermaxillary teeth, and followed by about eight maxillary teeth, the teeth evenly spaced and decreasing in size posteriorly (Fig. 3A). On lower jaw, a single row of 11-15 teeth,

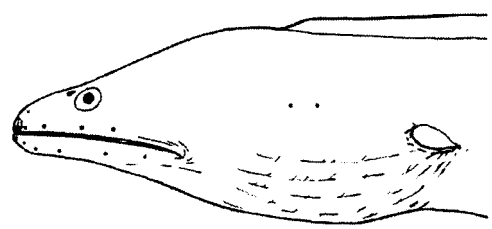

Fig. 2. *Gymnothorax phalarus*, n. sp., UCR 2353-14, 505 mm TL, head pore distribution.

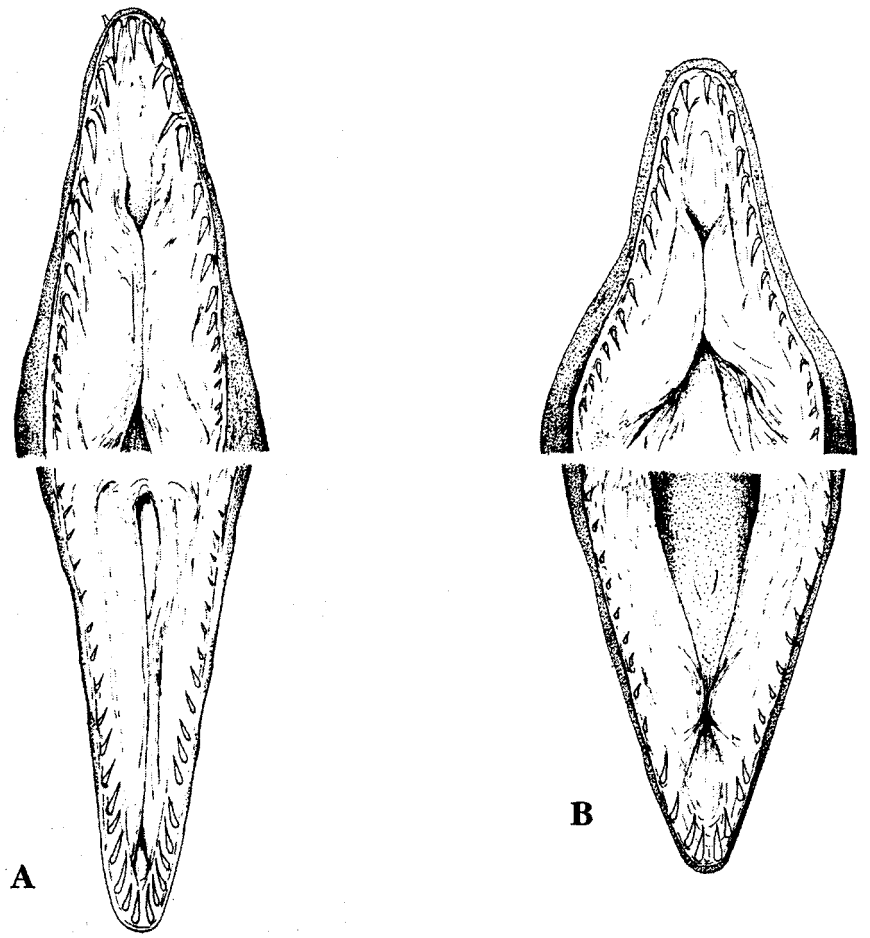

Fig. 3. Comparison of dentition of two deep-water morays from the same collection site, Peninsula de Nicoya, Costa Rica. A: *Gymnothorax phalarus*, n. sp., paratype LACM 47319-1, 462 mm TL. B: *Gymnothorax equatorialis*, UCR 1556-6, 460 mm TL.

the anterior three to five, similar in size and shape to intermaxillary teeth, the remainder decreasing gradually in size posteriorly, but less so than in upper jaw. Depressible replacement teeth present, in process of becoming functional. Median intermaxillary teeth absent. One or two conical vomerine teeth only on large specimens.

Vertebral counts (Table 2) based on radiographs of holotype and 13 paratypes (means in parentheses): predorsal vertebrae 5-8 (6.3); preanal vertebrae 56-61 (58.2); total vertebrae 138-144 (140.1). Holotype with VF value of 5-56-144.

Coloration: Color of live and preserved specimens the same. Head and trunk brown, becoming darker posteriorly to dusky chocolate brown or black on tail. Eye rimmed in darker pigment. Numerous small, pale, spots behind head, becoming fewer and larger (pupil to eye-diameter size) posteriorly; round or oval white spots very conspicuous on tail (Fig. 4A). Spots on trunk fewer and less distinct on some specimens, more numerous and distinctly

TABLE 2

Frequency distribution of numbers of vertebrae in Gymnothorax phalarus *and* G. equatorialis

	Predorsal vertebrae:												
			5			6			7			8			$\bar{x}$
G. phalarus			3			5			5			1			6.3
G. equatorialis						1			3			3			7.3
	Preanal vertebrae:														
	51	52	53	54	55	56	57	58	59	60	61	$\bar{x}$			
G. phalarus						4	2	1	1	3	2	58.2			
G. equatorialis	1	1	3	4				1?				53.1			
	Total vertebrae:														
	138	139	140	141	142	143	144	145	146	147	148	149	$\bar{x}$		
G. phalarus	3	2	2	3	1		1						140.1		
G. equatorialis						2	1		1	2		1	145.6		

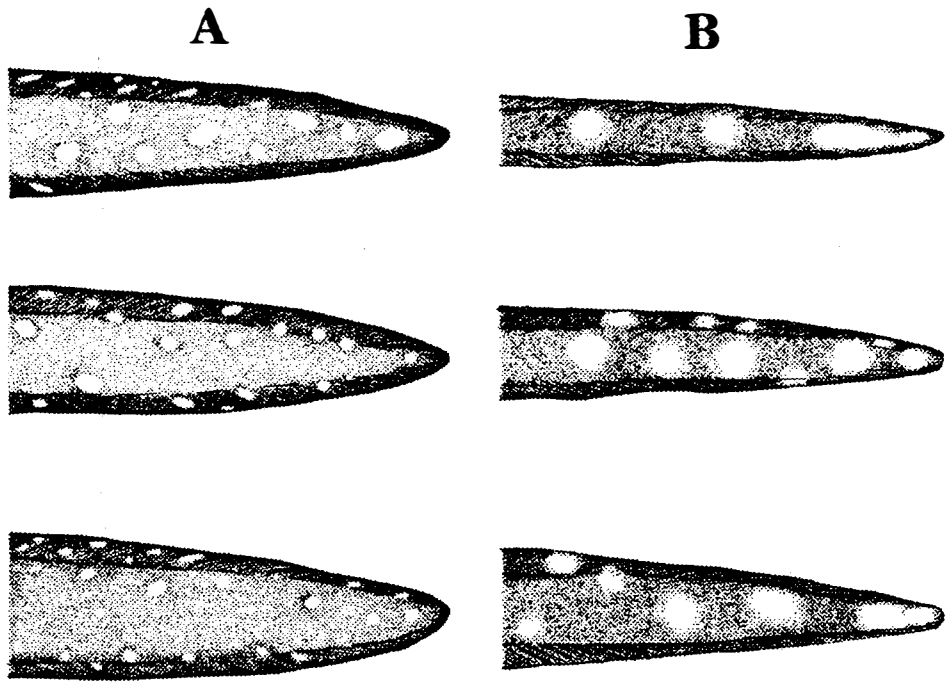

Fig. 4. Comparison of tail pigmentation of two deep-water morays from Costa Rica. A: *Gymnothorax phalarus*, n. sp., paratypes UCR 1711-2 and 1209-3. B: *Gymnothorax equatorialis*, UCR 2364-2, 1209-3 and 2023-6.

white on others; head and abdomen brown or straw-colored with few or no spots. Dorsal fin also white-spotted, becoming nearly black on tail; anal fin black with few or no white spots.

An immature specimen (283 mm) has small white spots commencing at snout tip; becoming larger ovals on branchial region; eye-sized white spots behind gill opening well-

separated and contrasting with nearly black tail. The largest specimen, a 927 mm adult male, is dark brown, nearly black on mid-dorsal line from snout to tail tip; head with a wide black ring around orbit; few well-separated white specks on trunk, becoming more numerous and larger (pupil-sized) round or oval spots on tail; dorsal fin black with white spots, anal fin black without spots.

Etymology: From the Greek *phalaros* meaning white-spotted; to be treated as an adjective.

Distribution: Known from Baja California, Mexico to Peru, (only Costa Rican material was utilized in the present study). Specimens of *G. phalarus* labeled "*Gymnothorax C*" or "*Gymnothorax* sp." were examined by the Böhlkes during their survey on the *Gymnothorax ocellatus-marginatus-saxicola* complex, and are deposited at several institutions including SIO, LACM and USNM (E. Böhlke, pers. comm.). Taken by trawl and dredge on soft substrata between 23 and at least 295 m depth in Costa Rican waters.

REMARKS

Although not necessarily closely related, in general appearance, body shape and habitat, *Gymnothorax phalarus* resembles *G. equatorialis*. Both species are dark, white-spotted eels with uniserial jaw teeth and few or no vomerine teeth. The anus is located near midbody and the tail tapers to a slender tip. *Gymnothorax equatorialis* is distinguished by its three infraorbital pores, different MVF values (Table 2), different jaw shape (Fig. 3B), often a median intermaxillary tooth, and by a narrower tail with very elongate (longer than eye diameter), widely-spaced, terminal spots (Fig. 4B). Terminal spots on the tail of *G. phalarus* (Fig. 4A) are round or oval, smaller than eye diameter, and more closely spaced.

The reef morays *Gymnothorax castaneus* Gilbert and *G. dovii* (Günther) may be related to and share several characteristics with *G. phalarus*. They also have four infraorbital pores, similar MVF values, uniserial teeth (but with an inner, median intermaxillary tooth) and anus near midbody. However the tail is more robust, ending in a blunt tip and the median fins are more elevated. The teeth are extremely finely serrated even on large specimens, whereas the teeth of *G. phalarus* are more conspicuously serrate. Both reef species are found in nearshore rocky habitats and have not been collected by trawls in deeper water.

Gymnothorax dovii is a dark brown or black eel covered with small (less than pupil size) white spots and can be more readily confused with *G. phalarus*, whereas *G. castaneus* is brown or brownish green with few white or yellow flecks mostly on the posterior half of body and dorsal fin (McCosker & Rosenblatt 1975).

Two other, somewhat similar species, *G. angusticeps* (Hildebrand) and *G. serratidens* (Hildebrand), reported only from Peru, have quite different MVF values: 5-73-170 and 8-68-156 respectively (Böhlke, 1982) and differ in a number of other respects (Hildebrand, 1949).

Three other spotted eels have been reported from the mid Pacific at Easter Island (Randall & McCosker, 1975). *Gymnothorax nasuta* De Buen has a dark reticulum overlaying white spotting, the anterior nostril is exceptionally long (6-7% of HL), several inner median intermaxillary fangs and a row of several vomerine teeth. *Gymnothorax eurostus* (Abbott), in addition to a dense covering of minute white spots, presents larger (pupil diameter) black spots on the anterior third of the body; biserial maxillary teeth, three rows of intermaxillary fangs, a row of several vomerine teeth and the Easter Island specimens have 124-128 total vertebrae. Randall & McCosker (1975) placed

Gymnothorax dentex De Buen in the synonymy of *G. eurostus* and described the deep-water (250 m) *Gymnothorax bathyphilus*. The latter species has similar dentition, but presents a light yellowish gray color with scattered dark brown blotches, mostly larger than eye and 145 total vertebrae.

No attempt is made to place *G. phalarus* in one of the provisional subgenera of Böhlke *et al.* (1989) until further study and comparison with Indo-Pacific species is carried out.

ACKNOWLEDGMENTS

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RESUMEN

Gymnothorax phalarus se describe con base en 23 individuos de colecciones hechas por redes de arrastre y dragas en la costa Pacífica de Costa Rica. La especie nueva es casi siempre sintópica con la especie similar, *Gymnothorax equatorialis*. La nueva morena se distingue por su patrón de puntos blancos, dientes ligeramente aserrados y uniseriales en adultos, cuatro poros infraorbitales y MVF (Fórmula de Vértebras) de 6-58-140. México a Perú.

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