Zootaxa 4066 (4): 493–500
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://doi.org/10.11646/zootaxa.4066.4.10
http://zoobank.org/urn:lsid:zoobank.org:pub:FA0AC613-5F3D-4A57-97B3-6684D7F28A77

A new species of *Leptoderma* Vaillant, 1886 (Osmeriformes: Alepocephalidae) from the Pacific coast of Central America

ARTURO ANGULO[1, 2, 3], CAROLE C. BALDWIN[4] & D. ROSS ROBERTSON[5, 6]

[1] *Museo de Zoología, Universidad de Costa Rica. 11501–2060, San Pedro de Montes de Oca, San José, Costa Rica*
[2] *Centro de Investigación en Ciencias del Mar y Limnologia (CIMAR), Universidad de Costa Rica. 11501–2060, San Pedro de Montes de Oca, San José, Costa Rica*
[3] *Current address: Laboratório de Ictiologia, Departamento de Zoologia e Botânica, Universidade Estadual Paulista "Júlio de Mesquita Filho". Rua Cristóvão Colombo, 2265, CEP 15054–000, São José do Rio Preto, SP, Brazil. E-mail: arturo.angs@gmail.com*
[4] *Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560. E-mail: baldwinc@si.edu*
[5] *Smithsonian Tropical Research Institute, Balboa, Republic of Panamá. E-mail: drr@stri.org*
[6] *Corresponding author*

Abstract

A new species of *Leptoderma* Vaillant, 1886 is described from a single specimen trawled at 1368–1406 m depth off El Salvador, Central America, tropical eastern Pacific. *Leptoderma ospesca* **n. sp.** can be readily distinguished from its congeners by the following combination of characters: dermal papillae absent along the lateral line, pectoral-fin rays 6, pelvic-fin rays 5, pre-dorsal length 54.9% of SL, both dorsal and anal fins separated from the caudal fin, dorsal- and anal-fin rays long, procurrent caudal-fin rays numerous and extending far forward on caudal peduncle, caudal-fin rays 16, and total pre-ural vertebrae 60. A key to the species of the genus is presented.

Key words: Deep sea, eel-slickheads, El Salvador, tropical eastern Pacific Ocean

Introduction

The family Alepocephalidae (Osmeriformes) comprises about 96 species, in 22 genera, of benthic and pelagic fishes found in the deep parts (usually below 1000 m) of all oceans (Byrkjedal *et al.* 2011, Eschmeyer 2015, Nelson 2006). Members of the family, commonly known as slick-heads or smooth-heads, share the following characteristics: body shape variable, moderately deep to elongate and eel-like; eyes large, lateral; mouth terminal, with one or two supramaxillae; teeth small and feeble, usually present on premaxilla and dentary; premaxilla lacking tusks; tongue present, usually without teeth; gill rakers moderate to long and numerous; gill membranes separated from isthmus; fins without spines; origin of single dorsal fin located posterior to midpoint of body; no adipose dorsal fin; pectoral fin located below mid-flank level, small to rudimentary, 4-18 rays; pelvic fins, if present, abdominal, origin before origin of dorsal fin; caudal fin forked; no dark tube above base of pectoral fin that connects to a luminous gland on shoulder girdle; scales present or absent, if present cycloid and easily shed, almost always lacking on head; no swim bladder; and lateral line present or absent (McEachran & Fechhelm 1998, Sazonov & Markle 1999, Carter & Hartel 2002, Nelson 2006).

The genus *Leptoderma* Vaillant (1886) comprises medium-sized alepocephalid fishes (ca. 260 mm in maximum standard length) in five valid species (Byrkjedal *et al.* 2011, Eschmeyer 2015). Species of the genus are widely distributed in the Atlantic, Indian and western Pacific Oceans: *L. affinis* Alcock 1899, from the Indo-West Pacific; *L. lubricum* Abe, Marumo & Kawaguchi 1965, from the western Pacific; *L. macrophthalmum* Byrkjedal, Poulsen & Galbraith 2011, from the Mid-Atlantic Ridge, North Atlantic; *L. macrops* Vaillant 1886, from the Atlantic; and *L. retropinna* Fowler 1943, from the Indo-West Pacific (Byrkjedal *et al.* 2011, Eschmeyer 2015). Species of *Leptoderma* are characterized by having elongate, almost eel-like, blackish or grayish-blue bodies;

Accepted by E. Hilton: 15 Dec. 2015; published: 18 Jan. 2016

large, almost circular eyes; an anal fin base longer than the dorsal fin base; the origin of the anal fin anterior to the origin of the dorsal fin; procurrent caudal-fin rays close to the vertical fin rays; and scales absent, except on the lateral line (Sazonov & Ivanov 1980, Markle & Quéro 1984, Sazonov & Markle 1999).

During a cruise of the Spanish research vessel *B/O Miguel Oliver* on the Pacific coast of Central America, in December of 2010, a specimen of *Leptoderma* of uncertain specific identification was captured by the ship's trawl. A detailed morphometric and meristic examination revealed that it represents a previously unknown species, which we describe herein as new.

Material and methods

Counts and measurements, the latter given as percentages of standard length (SL), were taken on the left side of the specimens and follow Hubbs & Lagler (1967) and Byrkjedal *et al.* (2011). Fin-ray and vertebral counts for the holotype of the new species were made from a digital radiograph. Comparative information on other collections and other valid species of *Leptoderma* was obtained from the literature (Alcock 1899, Abe *et al.* 1965, Markle 1976, Ye *et al.* 2006, Takami & Fukui 2010, Byrkjedal *et al.* 2011) and from museum specimens listed in the comparative material. Institutional abbreviations follow Sabaj Perez (2014).

Leptoderma ospesca n. sp.

(Fig. 1)

Holotype. USNM 421478, 197 mm SL; El Salvador, Central America, Eastern Pacific Ocean, research vessel *B/O Miguel Oliver* station MOP11–94, trawl on soft-bottom from 12º 53' 15.72" N, 90º 9' 30.6" W to 12º 53' 22.9194" N, 90º 7' 56.28" W, at 1368–1406 m; December 11, 2010; D. Ross Robertson.

Diagnosis. *Leptoderma ospesca* differs from *L. affinis*, *L. macrops* and *L. retropinna* by having a distinct gap between the posterior ends of the dorsal and anal fins and the origins of the upper and lower procurrent caudal-fin rays. From *L. lubricum*, the new species differs by lacking dermal papillae along the lateral line, by having pectoral fins low on body (vs. high) with 6 fin rays (vs. 7–8), and by having fewer caudal-fin rays (16, vs. 17–18). From *L. macrophthalmum*, the new species differs by having a longer pre-dorsal length (54.9% SL, vs. 49.3%), fewer pectoral-fin rays (6, vs. 8), fewer pelvic-fin rays (5, vs. 8) and longer dorsal- and anal-fin rays (vs. shorter). *Leptoderma ospesca* also differs from all congeneric species by having fewer pre-ural vertebrae (60, vs. 64–84).

Description. Measurements and counts of *L. ospesca* and comparative data are presented in Table 1. Body naked, relatively long, subcylindrical anteriorly and laterally compressed posteriorly, with greatest body depth at a distance of 24.3% SL from snout; dermal papillae absent from head, along lateral line and dorsum; lateral line pores inconspicuous.

Head length (HL) almost twice greatest body depth. Nostrils with large longitudinal openings, partly covered by a dermal flap, located nearer to eye than to snout tip. Mandibular pores 4, supraorbital pores 3, suborbital pores 4 and preopercular pores 3. Snout blunt, relatively large, its length 30.3% of HL, shorter than eye. Mouth subterminal. Teeth minute to small, conical and well separated, present in one row on premaxilla and one on dentary; no teeth on palate. Supramaxilla slender, curved. Upper jaw relatively short, barely reaching front border of eye, its length 33.0% of HL. Lower jaw ending under orbit. Eyes large, 37.5% of HL, directed outward and slightly upward, with upper margin protruding above dorsal profile of head. Interorbital space relatively large, 17.2% of HL. Postorbital length 32.2% of HL. Maximal head width (behind eyes) 34.5% of HL. Pseudobranchiae small. Pectoral fins inserted relatively low on body, uppermost fin ray at level of dorsal corner of gill opening, slightly below midbody. Pelvic fins abdominal, length 71.1% of pectoral-fin length. Pelvic-fin base located just in front of anus. Genital papilla short, located between anus and anal-fin origin. Anal-fin origin well in advance of dorsal-fin origin; length of dorsal-fin base 60.4% of length of anal-fin base. Dorsal- and anal-fin rays long, longer rays greater than half body depth at level of anus. Both dorsal and anal fins separated from caudal fin. Procurrent caudal-fin rays numerous, extending far forward on caudal peduncle. Dorsal and anal procurrent caudal sections about equal in length. Caudal fin small, forked, with 8 principal rays in each lobe.

Color in life. Head, eye, and anterior part of body bluish black, turning gradually lighter brownish towards posterior part of body (Fig. 1A).

TABLE. 1. Morphometric and meristic characters of six *Leptoderma* species. Measurements and counts not attainable (i.e. structure absent or inconspicuous) or unavailable are represented with an en–dash (–). When the number of examined specimens used to determine the respective measurement or count differs from the total, the number of examined specimens is indicated in parenthesis.

Character	***L. affinis***	***L. lubricum***	***L. macrops***	***L. macrophthalmum***	***L. ospesca***	***L. retropinna***
	n=1 [2, *]	**n=21** [3, *]	**n=52** [4]	**n=1** [5, *]	**n=1** [1, *]	**n=27** [6]
SL (mm)	222.5	29.7–210	141–210	151	197	28.4–152
Morphometric characters as % SL						
Pre–dorsal length	–	55.1–61.1	47.3–56.4 (49)	49.3	59.4	55.0–58.7 (6)
Pre–anal length	–	41.0–46.5 (20)	35.5–44.2 (49)	45.7	46.4	40.9–45.6 (6)
Pre–pelvic length	–	36.8–41.8 (20)	31.0–43.8 (49)	39.5	38.0	34.4–38.7 (6)
Dorsal-fin base, length	–	25.3–28.9 (5)	44.7–58.1 (14)	31.1	25.5	41.0–47.6 (6)
Dorsal procurrent caudal-fin section, length	–	15.0–16.6 (5)	3.2-3.6 (3)	15.5	14.1	4.5-4.7 (2)
Anal-fin base, length	–	36.6–41.0 (5)	58.6–73.6 (14)	40.7	42.2	50.0–59.0 (6)
Ventral procurrent caudal-fin section, length	–	14.0–16.9 (5)	3.4-4.2 (3)	15.1	14.0	4.1-5.3 (3)
Pectoral-fin length	–	5.0–11.4 (5)	6.0–8.4 (14)	7.3	7.0	4.9–5.8 (5)
Pelvic-fin length	–	1.8–6.9 (5)	3.9–5.8 (14)	4.8	5.0	4.0–4.9 (5)
Greatest body depth	c.11.1	11.1–14.7 (5)	9.8–12.3 (14)	12.8	13.4	7.8–9.2 (6)
Caudal-peduncle depth	–	2.0–2.8 (5)	0.9–1.5 (14)	2.1	1.8	1.1–1.3 (6)
Maximal head width (behind eyes)	–	8.6–14.9 (20)	7.8–9.2 (14)	11.3	8.4	6.6–8.6 (6)
Head length	c.22.2	22.8–25.7 (5)	16.7–24.4 (49)	23.2	24.3	18.7–21.7 (6)
Snout length	–	7.0–8.3 (5)	3.8–7.0 (49)	7	7.4	5.3–7.0 (6)
Horizontal orbital diameter	–	7.5–9.0 (5)	5.7–9.4 (49)	9.3	9.1	3.3–7.2 (6)
Postorbital length	–	–	–	6.9	7.8	–
Interorbital distance	–	3.1–5.1 (5)	1.6–5.6 (49)	3.4	4.2	3.3–5.7 (6)
Upper-jaw length	–	5.6–8.9 (5)	4.6–7.3 (49)	7.9	8.0	5.3–7.3 (6)

……*continued on the next page*

TABLE 1. (Continued)

Character	*L. affinis*	*L. lubricum*	*L. macrops*	*L. macrophthalmum*	*L. ospesca*	*L. retropinna*
	n=1 [2, *]	**n=21** [3, *]	**n=52** [4]	**n=1** [5, *]	**n=1** [1, *]	**n=27** [6]
Meristic characters						
Dorsal-fin rays	c.66	33–40	57–67 (49)	32	33	46–56 (26)
Dorsal procurrent caudal-fin rays	–	21–29	–	21	25	7–9 (21)
Anal-fin rays	c.85	45–56	74–85 (49)	47	48	65–72 (26)
Ventral procurrent caudal-fin rays	–	19–26	–	20	22	6–8 (21)
Pectoral-fin rays	–	7–8	8–9 (14)	8	6	6–8
Pelvic-fin rays	5	4–6	5–6 (14)	8	5	5–8
Principal caudal-fin rays	–	17–19	14–17 (14)	16	16	16–18 (26)
Gill rakers on first arch	–	15–18	11–15 (49)	19	16	10–18
Lateral-line pores	–	58–66 (5)	–	c.48	–	–
Branchiostegals	–	5	4–6 (49)	5	–	7 (6)
Vertebrae, visceral	–	15–17 (4)	–	15	–	–
Vertebrae, hemal (excl. urostyle)	–	49–55 (4)	–	51	–	–
Vertebrae, total (excl. urostyle)	–	64–77 (20)	79–84 (35)	66	60	77 (1)
Dermal papillae on lateral line	Yes	Yes (5)	Yes	No	No	No (5)

[1] USNM 421478, n=1. [2] Data from Alcock (1899). [3] Data from Abe *et al.* (1965), n=1; Takami & Fukui (2010), n=15; and USNM 135621, n=1. [4] Data from Markle (1976), n=35; USNM 215604, n=6; USNM 215606, n=3; USNM 290727, n=1; USNM 407283, n=1; USNM 407399, n=1; USNM 407400, n=1; USNM 407401, n=1; and USNM 435839 (OREGON 4562), n=3. [5] Data from Byrkjedal *et al*. (2011), n=1. [6] Data from Takami & Fukui (2010), n=21; USNM 150804, n=2; and USNM 150806, n=3. [*] Data from, or including, the Holotype.

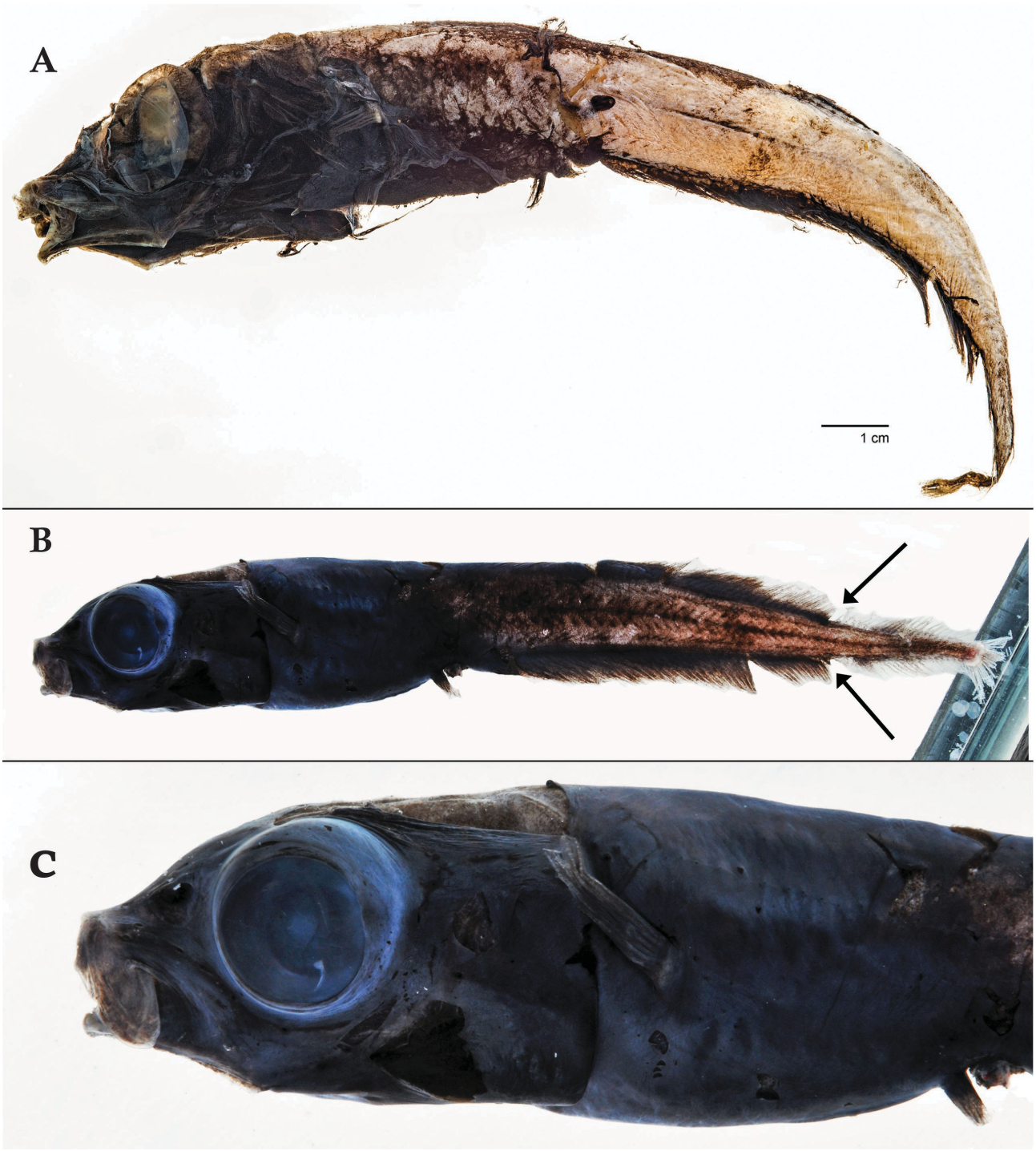

FIGURE. 1. *Leptoderma ospesca* **n. sp.**, holotype (USNM 421478), A: preserved entire specimen; B: newly caught entire specimen, arrows indicate position of gaps between dorsal and anal fin rays and upper and lower procurrent caudal rays, respectively; C close-up of head region of newly caught specimen. Note: The structure near the lateral midline above the anus that is visible in Fig. 1A (but not obvious in Figs. 1B or C), is a piece of loose skin adhered to the body.

Color in alcohol. Head and anterior part of body black, turning gradually lighter grayish towards posterior part of body (Fig. 1B).

Distribution. Known only from the holotype collected off El Salvador, between 12º 53' 15.72" N, 90º 9' 30.6" W and 12º 53' 22.9194" N, 90º 7' 56.28" W, Central America, eastern Pacific Ocean, at a depth of 1368–1406 m.

Etymology. The specific name "*ospesca*" recognizes the contribution of OSPESCA (Organización del Sector Pesquero y Acúicola de Centroamerica) to the discovery of deepwater marine fishes in Central America by

sponsoring research cruises of the Spanish research vessel *B/O Miguel Oliver* on both the Pacific (2010) and Atlantic (2011) coasts of Central America.

Suggested common names. Eastern eel-slickhead; Cabezalisa oriental.

Key to species of *Leptoderma*

1 Both dorsal and anal fins confluent with caudal fin; procurrent caudal-fin rays few (dorsal 7–9; ventral 6–8) not extending far forward on caudal peduncle; dorsal procurrent caudal-fin section about 3.2–4.2% of SL; ventral procurrent caudal-fin section about 3.4–5.3% of SL 2

\- Both dorsal and anal fins separated from caudal fin; procurrent caudal-fin rays numerous (dorsal 21–29; ventral 19–26) extending far forward on caudal peduncle; dorsal procurrent caudal-fin section 14.1–16.6% of SL; ventral procurrent caudal-fin section 14.0–16.9% of SL 4

2 Dermal papillae absent along lateral line (Indo-West Pacific Ocean) . . . . . *L. retropinna*

\- Dermal papillae present along lateral line. 3

3 Dorsal-fin rays about 66; anal-fin rays about 85 (Indo-West Pacific) . . . . . *L. affinis*

\- Dorsal-fin rays 57–67, usually less than 64; anal-fin rays 74–85, usually less than 82 (Atlantic) . . . . . *L. macrops*

4 Dermal papillae present along lateral line; lateral line pores 55–66; pectoral fin inserted high on body, central fin ray level with dorsal corner of gill opening, slightly above midline of body; length of anal-fin base 36.6–41.0% of SL (Western Pacific) . . . . . *L. lubricum*

\- Dermal papillae absent along lateral line; lateral line pores, if conspicuous, about 48; pectoral fin inserted low on body, uppermost fin ray level with dorsal corner of gill opening, slightly below midline of body; length of anal-fin base 40.7–42.2% of SL 5

5 Pre-dorsal region short, length about 49.3% SL; pectoral-fin rays 8; pelvic-fin rays 8; dorsal- and anal-fin rays short, longer rays less than half body depth at anus; pre-ural vertebrae about 66 (North Atlantic) . . . . . *L. macrophthalmum*

\- Pre-dorsal region long, length about 54.9% SL; pectoral-fin rays 6; pelvic-fin rays 5; dorsal- and anal-fin rays long, longer rays greater than half body depth at anus; pre-ural vertebrae about 60 (Eastern Pacific) . . . . . *L. ospesca*

Discussion

The taxonomy of *Leptoderma* is based mainly on the presence/absence of a distinctive gap between the posterior ends of the dorsal and anal fins and the beginning of the procurrent caudal-fin rays (i.e. if both dorsal and anal fins are or are not confluent with caudal fin), the presence/absence of dermal papillae along the lateral line, and a limited set of morphometric and meristic characters. Within the genus, two groups, here referred to as the "*Leptoderma macrops* species group" and the "*Leptoderma lubricum* species group," can be recognized. Members of the *Leptoderma macrops* species group (*L. affinis*, *L. macrops* and *L. retropinna*) are characterized by having both the dorsal and anal fins confluent with the procurrent rays of the caudal fin and the procurrent rays not extending far anteriorly on the caudal peduncle. Members of the *Leptoderma lubricum* species group (*L. lubricum*, *L. ospesca* and *L. macrophthalmum*) have the dorsal and anal fins separated from procurrent caudal rays by a gap and numerous procurrent rays that extend far forward on the caudal peduncle.

From the examined specimens of *L. ospesca* and *L. lubricum*, and from the data of Abe *et al.* (1965), Takami & Fukui (2010) and Byrkjedal *et al.* (2011), the following differences separate the new species from the other members of the *Leptoderma lubricum* species group: (1) *L. ospesca* differs from *L. lubricum* by lacking dermal papillae along the lateral line and by having pectoral fins lower on body (vs. high) with 6 fin rays (vs. 7–8), fewer caudal-fin rays (16, vs. 17–18), and fewer pre-ural vertebrae (60, vs. 64–77); (2) *L. ospesca* differs from *L. macrophthalmum* by having a longer pre-dorsal region (pre-dorsal length 54.9% of SL, vs. 49.3%), fewer pectoral-fin rays (6, vs. 8), fewer pelvic-fin rays (5, vs. 8), longer dorsal- and anal-fin rays (vs. short), and fewer pre-ural vertebrae (60, vs. 66). Although the examination of more specimens of all three species would be highly desirable, multiple morphological differences indicate that they are distinct.

In addition, unlike the broad and overlapping geographical distributions reported in the *Leptoderma macrops* species group, members of the *Leptoderma lubricum* species group appear to have more restricted and, as far as known, non-overlapping distributions. *Leptoderma lubricum*, described from the Suruga Bay, Japan, is known only from the western Pacific Ocean (Abe *et al.* 1965, Eschmeyer 2015); *L. macrophthalmum*, described from the Mid Atlantic Ridge, is known only from the North Atlantic Ocean (Byrkjedal *et al.* 2011, Eschmeyer 2015); and *L. ospesca,* herein described from El Salvador, Central America, is known only from the tropical eastern Pacific Ocean.

Finally, a 602-base-pair sequence of mitochondrial cytochrome *C* oxidase 1 (COI) from *L. ospesca* is 99.67% similar to a DNA barcode of *L. macrophthalmum* in the Barcode of Life Database from Byrkjedal *et al.* (2011). Other *Leptoderma* species in the BOLD database (*L. macrops, L. retropinna,* and *L. lubricum*—http://www.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxon=Leptoderma&searchTax=) are approximately 4% or more divergent. The single available sequence for *L. ospesca,* however, is shorter than the other sequences (655 base pairs or longer), and there is considerable ambiguity towards one end of that sequence. Due to its poor quality, we have elected not to publish the sequence and note that additional molecular data are needed to determine genetic relationships within the genus.

Comparative material examined

Leptoderma lubricum: 1 specimen. USNM 135621, n=1, 184 mm SL, collected from about 90 miles WSW of Kagoshima Gulf, Japan, Eastern Sea, 30º 34' 12" N, 129º 19' 29.9994" E, on August 13, 2006, at a depth of 805 m. ***Leptoderma macrops***: 17 specimens. USNM 215604, n=6, 186–204 mm SL, collected off Alabama, United States (US), Gulf of Mexico (Oregon Station 3217), 29º 19' 12" N, 87º 32' 59.9994" W, on February 9, 1961, at a depth of 494–585 m; USNM 215606, n=3, 162–202, collected off Louisiana, US, Gulf of Mexico, 28º 36' 0" N, 89º 0' 0"W , on September 29, 1971, at a depth of 622 m; USNM 290727, n=1, 148 mm SL, collected off Key West, Florida, US, Gulf of Mexico, 24º 31' 11.9994" N, 83º 45' 0"W, on August 29, 1987, by J. Janssen, at a depth of 908 m; USNM 407283, n=1, 199 mm SL, collected off Panama, Caribbean Sea, *Miguel Oliver* station 11–24, 9º 11' 56.3994" N, 81º 0' 3.6" W, 1,203 m; USNM 407399, n=1, 204 mm SL, collected off Costa Rica, Caribbean Sea, *Miguel Oliver* station 11-38, 10° 8' 13.2" N, 82° 53' 41.9994" W, 987-1046 m; USNM 407400, n=1, 187 mm SL (same collection data as USNM 407399); USNM 407401, n=1, 176 mm SL (same collection data as USNM 407399); USNM 435839 (OREGON 4562), n=3, ca 118-184 mm SL. ***Leptoderma retropinna***: 5 specimens. USNM 150804, n=2, 113–131 mm SL, collected off Tsurikake Saki Light, 10 to 30 miles SW of Koshika Islands, Japan, Eastern Sea, 31º 39' 29.88" N, 129º 24' 0" E, on August 11, 1906, at a depth of 742 m; USNM 150806, n=3, 119–129 mm SL, collected off Tsurikake Saki Light, 10 to 30 miles SW of Koshika Islands, Japan, Eastern Sea, 31º 40' 12" N, 129º 29' 38.3994" E, on August 11, 1906, at a depth of 794 m.

Acknowledgements

Ross Robertson, who collected the specimen of *L. ospesca* during the December 2010 survey along the Pacific coast of Central America by the *B/O Miguel Oliver,* participated in that survey at the invitation of Mario Gonzalez Recinos of OSPESCA. Acquisition of the *B/O Miguel Oliver Pacific* fish specimens to the USNM collection was made possible by a Smithsonian Institution Federal Barcode grant to Lee Weigt, Carole Baldwin, and Amy Driskell in 2011. Accessioning of this material into the USNM collection was facilitated by Diane Pitassy. Sandra Raredon made the digital radiographs and photos of the preserved holotype.

References

Abe, T., Marumo, R. & Kawaguchi, K. (1965) Description of a new alepocephalid fish from Suruga Bay. *Japanese Journal of Ichthyology*, 13, 69–72.

Alcock, A.W. (1899) *A descriptive catalogue of the Indian deep-sea fishes in the Indian Museum*. Baptist Mission Press, Calcutta, 211 pp.

Byrkjedal, I., Poulsen, J.Y. & Galbraith, J. (2011) *Leptoderma macrophthalmum* n.sp., a new species of smooth-head (Otocephala: Alepocephalidae) from the Mid Atlantic Ridge. *Zootaxa*, 2876, 49–56.

Carter, J.A. & Hartel, K.E. (2002) Alepocephalidae. *In*: Carpenter, K.E. (Ed.), *FAO species identification guide for fishery purposes and American Society of Ichthyologists and Herpetologists Special Publication No. 5. The living marine resources of the Western Central Atlantic. Vol 2.* Bony fishes part 1 (Acipenseridae to Grammatidae). FAO, Rome, pp. 601–1374.

Eschmeyer, W.N. (2015) Catalog of Fishes. Available from: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (accessed 19 May 2015)

Hubbs, C.L. & Lagler, K.F. (1967) *Fishes of the Great Lakes Region*. Universidad of Michigan Press, Ann Arbor, 276 pp.
Markle, D.F. (1976) *Preliminary studies on the systematics of deep-sea Alocephaoidea (Pisces: Salmoniformes)*. Ph.D. Dissertation, the Faculty of the School of Marine Science, the College of William and Mary in Virginia, 265 pp.
McEachran, J.D. & Fechhelm, J.D. (1998) Alepocephalidae. *In*: McEachran, J.D. & Fechhelm, J.D. (Eds), *Fish of the Gulf of Mexico*. *Vol. I*. University of Texas Press, Austin, pp. 381–402.
Nelson, J.S. (2006) *Fishes of the world*. *4th Edition.* Wiley, Hoboken, 601 pp.
Sabaj Perez, M.H. (2014) Standard symbolic codes for institutional resource collections in herpetology and ichthyology: an Online Reference. Version 5.0 (22 September 2014). Available from: http://www.asih.org (accessed 19 May 2015)
Sazonov, Y.I. & Markle, D.F. (1999) Alepocephalidae. *In*: Carpenter, K.E. & Niem, V.H. (Eds.), FAO species identification guide for fishery purposes. *The living marine resources of the Western Central Pacific. Vol 3. Batoid fishes, chimaeras and bony fish part 1 (Elopidae to Linophrynidae)*. FAO, Rome, pp. 1888–1893.
Takami, M. & Fukui, A. (2010) Larvae and juveniles of *Leptoderma lubricum* and *L. retropinnum* (Argentiformes: Alepocephalidae) collected from Suruga Bay, Japan. *Ichthyological Research*, 57, 406–415. http://dx.doi.org/10.1007/s10228-010-0176-0
Vaillant, L.L. (1886) Considérations sur les poissons des grandes profondeurs, en particulier sur ceux qui appartiennent au sous-ordre des Abdominales. *Comptes Rendus Hebdomadaires des séances de l'Académie des sciences*, 103, 1237–1239.
Yeh, H.-M., Lee, M.-Y. & Shao, K.-T. (2006) Ten Taiwanese new records of alepocephalid fishes (Pisces: Alepocephalidae) collected from the deep waters by the R/V Ocean Researcher I. *Journal of The Fisheries Society of Taiwan*, 33, 265–279.