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Four new soles (Pleuronectiformes: Soleidae) of the genus *Aseraggodes* from the western Indian Ocean

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Abstract

The soleid fish *Aseraggodes andersoni* is described as a new species from a 23.5-mm specimen collected in 1988 at North Malé Atoll, Republic of Maldives. It is differentiated from seven species with similar meristic data by color pattern and in lacking a caudal peduncle. Efforts to collect additional specimens failed, and the type locality of seaward reef is now land reclaimed from the sea. *Aseraggodes kruppi* is described from one small specimen from an island off the Red Sea coast of Saudi Arabia, distinct in having 32 vertebrae and 39 anal rays, the lowest numbers for the genus. *Aseraggodes macronasus*, represented by three specimens from the Gulf of Aqaba, Red Sea, is unique in having a very long tubular anterior nostril. *Aseraggodes martine*, described from two specimens from Lakshadweep (Laccadive Islands, India) and a juvenile from the Seychelles, is distinguished by having 15 or 16 dorsal pterygiophores anterior to the fourth neural spine (highest for the genus), 64–66 dorsal rays, 42 or 43 anal rays, and 66–71 lateral-line scales. A key is provided for the 12 species of *Aseraggodes* of the western Indian Ocean, and a table for the number of dorsal rays, anal rays, lateral-line scales, vertebrae, and anterior dorsal pterygiophores for the 53 known species of the genus.

Key words: taxonomy, Soleidae, *Aseraggodes*, new species, Maldives, Seychelles, Lakshadweep, western Indian Ocean, Red Sea, coral reef fishes

Introduction

In March of 1988, the first author, R.C. Anderson, and M.S. Adam collected a small specimen of a new species of sole of the genus *Aseraggodes* in the outer surge zone of the fringing reef of Malé Island, North Malé Atoll in the Republic of the Maldives at a depth of 1.5 m (Fig. 1). The specimen probably came from a sand bottom below a ledge. Anderson later tried to obtain additional specimens, but without success. We also enlisted the aid of Arie De Jong, an aquarium fish importer in the Netherlands with contacts in the Maldives, to try to obtain additional specimens of the unidentified sole.

Randall and Gon (2005) reviewed the soles of the genus *Aseraggodes* for the western Indian Ocean. They recognized eight species, three of which were described as new. They also published a photograph of a specimen of an unidentified species of *Aseraggodes* from Maskali Island, Djibouti, noting that the specimen was lost. Unfortunately, the wrong photograph was printed. The correct photograph is reproduced here as Fig. 10.

A small sole of the genus *Aseraggodes* was collected at Mahé, Seychelles in April 2005 by staff of the South African Institute for Biodiversity and deposited in the SAIAB fish collection. It was sent on loan to us, and determined to be new.

Ofer Gon of the SAIAB visited the Republic of the Maldives in November 2010. He was asked to try to collect the unidentified sole. He determined that the area where it was collected is now part of the land of the atoll reclaimed from the sea.

In March 2011, while conducting field research sponsored by King Abdulaziz University, the second author and Tilman J. Alpermann collected a small specimen of a species of *Aseraggodes* (Fig. 2) at an unnamed island in the Red Sea near Qunfudhah, Saudi Arabia. It was provisionally identified as *A. steinitzi* Joglekar 1970, type locality Dahlak Archipelago in the southern Red Sea, but later determined to be an undescribed species with the help of K.K. Bineesh and S.S. Mishra who examined the type specimens of *A. steinitzi* for us at the Indian Museum in Kolkata.

In November of 2012 the second author collected a juvenile and two adult specimens of a species of *Aseraggodes* in the Gulf of Aqaba at Dahab, Egypt that were unusual in having a very long, tubular anterior nostril.

In September 2013 Dr. Biju Kumar of the University of Kerala, India sent two adult specimens of a species of *Aseraggodes* that Mohammed Noushad collected at Andrott Atoll in Lakshadweep (Laccadive Islands, India). Surprisingly, they proved to be adult females of the juvenile specimen from the Seychelles.

The objective of the present paper is the description of these four new species and their addition to the key of the species of *Aseraggodes* of the western Indian Ocean published by Randall and Gon (2005).

The number of dorsal rays, anal rays, lateral-line scales, vertebrae, and dorsal pterygiophores anterior to the fourth neural spine of a specimen of *Aseraggodes* usually collectively narrows the possible identification of a specimen of the genus to only a few species, and sometimes provides the definitive species name. Table 1 provides these collective meristics for the 53 known species of the genus, including those described here. We have not been able to get viable x-rays for four species. It will be noted from the table that 17 species of *Aseraggodes* are presently known from only a single specimen.

Materials and Methods

Specimens of the new species described in this study are deposited in the Bernice P. Bishop Museum, Honolulu (BPBM); Senckenberg Museum, Frankfurt (SMF); South African Institute for Aquatic Biodiversity, Grahamstown, South Africa (SAIAB); Department of Aquatic Biology and Fisheries, University of Kerala, India (UOK).

Lengths of specimens are given as Standard Length (SL), measured horizontally from the front of the upper lip to the base of the caudal fin (end of hypural plate). Body depth is the maximum distance between the bases of the dorsal and anal fins; body width is the maximum thickness midlaterally between the ocular and blind surfaces (discounting abdomen, if distended). Head length is measured from the front of the upper lip to a vertical at the posterior end of the operculum. Preorbital length is the distance from the anterior edge of the upper eyeball (dark part of the eye, hereafter termed only as the eye) directly forward to the anterior edge of the dorsal fin (but not to tips of cirri, if present). Snout length is taken from the front of the upper lip to the nearest edge of the upper eye. Eye diameter is the greatest diameter of the lower eye (not the fleshy cutaneous part). Interorbital width is the vertical distance between horizontal lines at the lower edge of the upper eye and upper edge of the lower eye. Upper-jaw length is measured on the blind side from the front of the upper lip to the rear edge of the maxilla (it is often difficult to determine the posterior end of the maxilla on the ocular side). Caudal-peduncle depth is the least depth (if the caudal peduncle is absent, the depth is measured at the base of the caudal fin). Caudal-peduncle length is the horizontal distance between verticals at the rear base of the anal fin and the base of the lowermost

caudal ray. Predorsal, preanal, and prepelvic lengths are taken from the base of the first spine to the front of the upper lip. Lengths of fin rays of median fins are measured from the ray base (not from where the ray emerges from a basal scaly sheath) in a straight line to the tip. Pelvic-fin length is taken from the base of the first ray to the tip of the longest ray. Proportional measurements in the text of the description are rounded to the nearest 0.5. Lateral-line scales are counted on the ocular side from the most anterior on the head to the base of the caudal fin; scales above and below the lateral line are the maximum number counted in oblique rows.

The color pattern of soles of the genus *Aseraggodes* is often variable, generally matching the substratum on which they are found; therefore color is usually of limited diagnostic value. The most important morphometrics for species of the genus are body depth, head length, snout length, eye diameter, interorbital width, presence or absence of a caudal peduncle; and length of longest dorsal, caudal, and pelvic-fin rays. Meristic data, although variable, are also important in identification. X-rays were taken to record the vertebral count and the number of anterior dorsal pterygiophores anterior to the fourth neural spine. The most anterior dorsal pterygiophores are supported by the erisme, a slender median dermal bone articulating to the cranium beneath the second neural spine. For osteological terminology of soleid fishes, see Ochiai (1963) and Chapleau (1989). The collective counts of the dorsal rays, anal rays, lateral-line scales (counts include those anterior to upper end of gill opening), vertebrae, and the number of dorsal pterygiophores anterior to the fourth neural spine will narrow the identification of a specimen to only a few species, and they may be diagnostic for a single species. Table 1 provides the available counts of these five meristic characters for the 53 known species of the genus (including the four described below). X-rays are not available for *Aseraggodes beauforti*, *A. dubius*, and *A. herrei*, so counts of vertebrae and dorsal pterygiophores could not be included for these three species.

Key to Species of *Aseraggodes* in the western Indian Ocean

- 1a. Tubular anterior nostril very long, reaching posterior to middle of lower eye when laid back; color of ocular side yellowish gray, the scale centers light bluish gray, edged in brown, many forming clumps (mostly of four scales); two large irregular dark brown spots centered on lateral line in middle of standard length, separated by a distance equal to head length; a small white spot behind upper end of gill opening (Gulf of Aqaba, Red Sea).....*A. macronasus*, n. sp.
- 1b. Tubular anterior nostril not long, not reaching posterior to middle of lower eye; color not as in 1a.....2
- 2a. Head large, 2.9–3.4 in SL; eye very small, 8.7–11.7 in head length; light brown with three longitudinal rows of dark brown blotches on body 2 to 3 times larger than eye (Bay of Bengal and Arabian Sea, 70–270m).....*A. umbratilis*
- 2b. Head not as large, 3.45–4.6 in SL; eye not very small, 3.8–8.35 in head length; color not as in 2a.....3
- 3a. Lateral-line scales 84 (including those anterior to upper end of gill opening); caudal fin very short, 4.9 in SL; no cirri on ventral margin of head; gray with numerous white blotches less than half size of eye; dark brown blotches of about same size as white in three longitudinal rows on body (one specimen, Réunion)*A. guttulatus*
- 3b. Lateral-line scales 59–72; caudal fin not very short, 3.0–4.85 in SL; cirri present on ventral side of head; color not as in 4a.....4
- 4a. Anal rays 39–45.....5
- 4b. Anal rays 47–52.....8

- 5a. Caudal peduncle absent; vertebrae 35 or 36; pelvic fins short, not reaching beyond base of second anal ray; dorsal and anal fin rays unbranched; color of ocular side tan with no pale markings (northern Red Sea).....
.....*A. sinusarabici*
- 5b. Caudal peduncle present; vertebrae 32–34; pelvic fins not short, reaching base of third or fourth anal rays; dorsal and anal fin rays branched or unbranched; color of ocular side with or without pale markings.....6
- 6a. Anal rays 42 or 43; dorsal rays 65–67; vertebrae 33 or 34 (Seychelles & Lakshadweep)...*A. martine*, n. sp.
- 6b. Anal rays 39–41; dorsal rays 58–62; vertebrae 32.....7
- 7a. Caudal rays 14–16; rays of dorsal and anal fins not branched; ocular side without white markings (Dahlak Archipelago, Eritrea, Red Sea).....*A. steinitzi*
- 7b. Caudal rays 18; some rays of dorsal and anal fins branched; ocular side with prominent white markings (Red Sea).....*A. kruppi*, n. sp.
- 8a. Caudal fin long, 3.1–4.0 in SL.....9
- 8b. Caudal fin not long, 4.2–4.85 in SL.....11
- 9a. Lateral-line scales 75–87; caudal peduncle present; snout not very short, 2.6–2.75 in head length; dorsal pterygiophores anterior to fourth neural spine 13–15 (islands of W Indian Ocean and coast of Africa from Kenya to KwaZulu-Natal).....*A. diringeri*
- 9b. Lateral-line scales 69–71; caudal peduncle absent; snout very short, 2.95–3.15 in head length; dorsal pterygiophores anterior to fourth neural spine 9–11.....10
- 10a. Caudal fin 3.9–4.0 in SL; head length 4.45–4.5 in SL; eye 4.35–4.45 in head length; vertebrae 35–36; dorsal pterygiophores anterior to fourth neural spine 10 or 11; fins with gray rays and translucent membranes (two specimens, Comoro Islands).....*A. brevirostris*
- 10b. Caudal fin 3.6 in SL; head length 4.15 in SL; eye 5.85 in head length; vertebrae 37; dorsal pterygiophores anterior to fourth neural spine 9; fins strongly mottled with brown and bluish white (one specimen, Republic of Maldives).....*A. andersoni*, n. sp.
- 11a. Caudal peduncle absent; vertebrae 34; pelvic fins reaching base of second anal ray, their length 2.7 in head length; fins pale, dark-spotted only at base (one specimen, Mauritius).....*A. jenny*
- 11b. Caudal peduncle present, though very short, its length 10.2–17.7 in head length; vertebrae 36–38; pelvic fins reaching base of third anal ray, their length 1.7–2.0 in head length; fin rays strongly black-spotted (KwaZulu-Natal).....*A. heemstrai*

TABLE 1
Meristic Data of Species of *Aseraggodes*

	Dorsal Rays	Anal Rays	LL Scales	Vertebrae	Dorsal Pterygiophores
<i>albidus</i>	67	49	73	35	5
<i>andersoni</i>	68	49	71	37	9
<i>auroculus</i>	74–77	56–57	69–73	37–38	12
<i>bahamondei</i>	65–71	50–56	75–86	39–40	7–8
<i>beauforti</i>	73–82	53–57	73–80		
<i>borehami</i>	71–76	49–52	66–70	37	14
<i>brevirostris</i>	67–71	51	69–71	35–36	10–11
<i>chapleaui</i>	73	49	86	35	13
<i>cheni</i>	68–75	46–51	73–76	36–38	13–14
<i>corymbus</i>	72–75	52–59	70–75	38	9–10
<i>crypticus</i>	76–79	56–59	70–76	37	12–13
<i>cyaneus</i>	68–73	47–50	67–70	39	13
<i>cyclurus</i>	68–71	53	68–72	36–37	10–11
<i>diringeri</i>	71–74	50–52	81–85	36–38	13–15
<i>dubius</i>	67–70	46–51	66–70		
<i>firmisquamis</i>	66	49	74	36	12
<i>guttulatus</i>	64	42	84	34	14
<i>haackeanus</i>	59–68	43–50	68–77	36–37	7–9
<i>heemstrai</i>	68–75	48–52	70–79	36–38	11–13
<i>heraldi</i>	75	56–57	68–70	36	12
<i>herrei</i>	73–79	52–54	77–82		
<i>holcomi</i>	68–72	47–50	87–96	36–37	13–15
<i>jenny</i>	66	49	77	34	11
<i>kaianus</i>	68–71	49–50	73–76	36–37	10–12
<i>kimurai</i>	66–70	46–48	69–72	35–36	13–14
<i>kobensis</i>	69–74	48–53	74–80	37–38	12–13
<i>kruppi</i>	58	39	68	32	15
<i>lateralis</i>	76–78	58–59	78–83	37–38	12
<i>lenisquamis</i>	62–70	46–52	62–68	36–37	8–9
<i>longipinnis</i>	71	49	76	36	14
<i>macronasus</i>	63–69	45–50	66–72	35–36	11–12
<i>magnoculis</i>	67–72	49–53	67–76	35–36	9–10
<i>martine</i>	65–67	42–43	66–71	33–34	15–16
<i>matsuurai</i>	66–70	49–52	68–71	35–36	10–11
<i>melanostictus</i>	74–75	53–54	78–79	38	11–12
<i>microlepidotus</i>	70	53	93	39	11
<i>nigrocirratus</i>	63–69	47–53	59–67	36–38	8–9
<i>normani</i>	64–71	50–52	68–73	35–36	10–11
<i>orientalis</i>	67–72	45–47	81–86	35–36	14
<i>pelvicus</i>	71	49	81	36	14
<i>ramsaii</i>	69–72	47–50	86–88	36	13–14
<i>satapoomini</i>	67	48	68	35	11
<i>senoui</i>	67	49	73	36	10
<i>sinusarabici</i>	60–68	40–45	62–72	35–36	10–11
<i>steinitzii</i>	58–62	39–41	59–72	32?	
<i>suzumotoi</i>	66–72	46–50	66–71	34–35	11–13
<i>texturatus</i>	72	53	75	39	10
<i>therese</i>	72–79	54–61	60–66	35–36	12
<i>umbratilis</i>	67–73	47–51	76–84	37–38	11–13
<i>whitakeri</i>	71–76	48–53	77–85	36–38	14–15
<i>winterbottomi</i>	67–71	49–51	69–72	35	9–10
<i>xenicus</i>	57–69	39–47	53–64	32–33	14
<i>zizette</i>	66	47	64	36	11

Aseraggodes andersoni Randall & Bogorodsky, n. sp.

Figure 1

Holotype. BPBM 33022, male, 23.5 mm, Republic of Maldives, North Malé Atoll, North Malé Island, east end of island off building of Marine Research Section, Ministry of Fisheries, outer surge zone of seaward reef, 1–1.5 m, rotenone, J.E. Randall, R.C. Anderson, and M.S. Adam, March 21, 1988.

Diagnosis. Dorsal rays 68; anal rays 49; lateral-line scales 71; vertebrae 37; dorsal pterygiophores anterior to fourth neural spine 9; body depth 2.4 in SL; head length 4.1 in SL; no caudal peduncle; snout length 2.95 in head length; color in alcohol uniformly pale yellowish brown; color when fresh pale brown with numerous, irregular, bluish white blotches, scattered small dark brown spots, and three rows of large brown blotches, one at base of dorsal fin, one at base of anal fin, and one along lateral line; a large orange-red area over abdomen and posterior head; iris light yellow with spoke-like brown bands; median fins with a row of large dark brown spots at base, and smaller spots peripherally.

Description. Dorsal rays 68, all but the first 21 branched; anal rays 49, all but first 5 branched; pelvic rays 5, none branched; caudal rays 18, the median 14 branched; lateral-line scales 71; scales above lateral line 21; scales below lateral line 25; vertebrae 37; dorsal pterygiophores before the fourth neural spine 9; erisme and one dorsal pterygiophore anterior to second neural spine; 6 pterygiophores between second and third neural spines, and 2 between the third and fourth neural spines; ventroanterior margin of urohyal forming an angle of about 70°, the inner corner very broadly rounded.

Body depth 2.4 in SL; body width (thickness) 4.85 in body depth; snout length 2.95 in head length; preorbital length 3.2 in head length; ventral profile of head posterior to mouth slightly convex; eye diameter 5.85 in head length; upper eye a half upper-eye diameter anterior to lower eye; least vertical interorbital width 11.0 in head length; upper end of gill opening on a horizontal nearly an orbit diameter ventral to lower eye; no caudal peduncle (last anal-fin ray on a vertical with base of lower caudal-fin rays); depth of caudal-fin base 1.75 in head length.

Maxilla extending slightly posterior to anterior edge of lower eye, the upper-jaw length (measured on blind side) 3.85 in head length; a narrow band of close-set villiform teeth on blind side of upper and lower jaws; tubular



Figure 1. *Aseraggodes andersoni*, holotype, BPBM 33022, 23.5 mm, North Malé Atoll, Rep. of Maldives (J.E. Randall).

anterior nostril on ocular side nearly reaching lower eye when laid back, its length equal to eye diameter; posterior nostril a slit in labial groove anterior to lower eye; dorsal half of gill opening on ocular side with a broad opercular membrane, the ventral half with a row of slender cirri.

Scales strongly ctenoid on ocular and blind side, except those of lateral line, most with 5 to 7 cteni; cteni progressively shorter on head, absent on snout, but present on chin; front of snout on ocular side with numerous fine cirri; interorbital space with two rows of scales; scales extending broadly onto medial and anterior part of eyes; front of snout and chin of blind side with low fleshy papillae; lateral line straight on both sides of body, ending on ocular side about an eye diameter posterior to upper eye; scales extending out on anterior dorsal fin on both sides, progressively less posteriorly, ending at about 20th ray; scales on about basal fourth of caudal fin.

Origin of dorsal fin anterior to upper eye, the predorsal length 3.85 in head length; first dorsal ray 4.05 in head length; longest dorsal ray 1.65 in head length; first anal ray on a transverse line with base of 21st dorsal ray, the preanal length 3.35 in SL; length of first anal ray 4.85 in head length; longest anal ray 1.45 in head length; caudal fin strongly rounded, its length 3.6 in SL; pelvic fins adjacent on ventral edge of body, the ocular-side fin a little anterior, the prepelvic length 4.8 in SL; third and fourth pelvic rays longest, reaching base of third anal ray; anus anterodorsal and adjacent to first anal ray; genital papilla at dorsoposterior edge of anus.

Color in alcohol uniformly pale yellowish brown. Color when fresh described above in Diagnosis and shown in Fig. 1.

Etymology. This species is named for Dr. R. Charles Anderson, one of the collectors of the holotype, who assisted the first author during the latter's visits to the Republic of Maldives.

Remarks. It is regretted that there is only a single immature male on which to base the description of this species, but a span of 25 years has failed to yield any more specimens.

Based on the meristics of Table 1, *Aseraggodes andersoni* has potential relatives, at least marginally, in *A. cyclurus* Randall 2005, *A. haackeanus* (Steindachner 1883), *A. magnoculus* Randall 2005, *A. nigrocirratus* Randall 2005, *A. senoui* Randall & Desoutter-Meniger 2007, and *A. winterbottomi* Randall & Desoutter-Meniger 2007. All of these species lack a caudal peduncle. *Aseraggodes cyclurus* from Tahiti has a very similar color pattern to *A. andersoni*, but is easily distinguished by its deeper body and shorter caudal and pelvic fins. *Aseraggodes haackeanus* from South Australia is readily separated by its more slender body and pale dark-dotted color pattern. Also, its cool southern locality would rule out the possibility of being conspecific. *Aseraggodes magnoculus* from New Caledonia is similar in color and general morphology, but differs in having larger eyes (despite larger size) and shorter caudal fin. *Aseraggodes nigrocirratus* from New South Wales has a shorter head, shorter fins, and very different coloration. *Aseraggodes senoui* from Indonesia and the Philippines is similar in color, except for lacking any markings in the fins; it differs notably in having larger eyes and shorter caudal and pelvic fins. *Aseraggodes winterbottomi* from the Philippines is distinct in having a smaller eye, larger jaws, and shorter fins; the body coloration is similar, but the fins lack large dark spots.

Although presently considered endemic to the Republic of the Maldives, this species should be expected at other tropical localities in the western Indian Ocean.

***Aseraggodes kruppi* Randall & Bogorodsky, n. sp.**

Figure 2

Holotype. SMF 33620, 24 mm, Red Sea, Saudi Arabia, unnamed small island off Qunfudhah, east side, 19°16.813'N, 40°53.265'E, coral patch near outer edge of fringing reef, 2.5 m, rotenone, S.V. Bogorodsky and T.J. Alpermann, March 31, 2011.

Diagnosis. Dorsal rays 58; anal rays 39; caudal rays 18; lateral-line scales 68 (including 8 anterior to upper end of gill opening); vertebrae 32; dorsal pterygiophores anterior to fourth neural spine 15; body depth 2.6 in SL; head length 3.65 in SL; snout length 3.05 in head length; a row of 13 lappet-like cirri on ventral margin of head; caudal peduncle present, the peduncle depth 6.4 in head length; caudal fin rounded, 3.7 in SL; longest dorsal ray 1.6 in head length; color in alcohol pale beige, the scales narrowly rimmed with brown; three longitudinal rows



Figure 2. *Aseraggodes kruppi*, holotype, SMF 33620, 24 mm, off Qunfudhah, Saudi Arabia, Red Sea (S.V. Bogorodsky).

of diffuse dark brown blotches on body; fins unmarked; color when fresh pale yellow, the dark markings more heavily pigmented; head and body with large irregular white blotches, varying from nearly round (most larger than eye) to vermiculate; median fins with transparent membranes, the rays yellowish, spotted with dark brown and white; dorsal and anal fins with a row of large irregular white blotches on about basal half; pelvic fins white; lips and eyes whitish, the pupils rimmed in light yellow; cirri ventrally on head white.

Description. Dorsal rays 58; anal rays 39; pelvic rays 5, none branched; caudal rays 18, the median 13 branched; lateral-line scales 68 (including 8 anterior to upper end of gill opening); scales above lateral line 19; scales below lateral line 24; vertebrae 32; dorsal pterygiophores anterior to fourth neural spine 15; erismes and three dorsal pterygiophores anterior to second neural spine; 7 pterygiophores between second and third neural spines, and 2 between third and fourth neural spines; ventroanterior margin of urohyal forming an angle of about 70°, the inner corner very broadly rounded.

Body depth 2.6 in SL; body width (thickness) 4.45 in body depth; snout length 3.05 in head length; preorbital length 2.7 in head length; ventral profile of head posterior to mouth very slightly convex; eye diameter 4.15 in head length; upper eye four-tenths eye diameter anterior to lower eye; least vertical interorbital width 11.5 in head length; upper end of gill opening on a horizontal nearly an orbit diameter ventral to lower eye; caudal peduncle depth 2.3 in head length; caudal-peduncle length 6.35 in head length.

Jaws strongly curved; maxilla extending slightly posterior to anterior edge of lower eye, the upper-jaw length (measured on blind side) 3.85 in head length; a narrow band of very small villiform teeth on blind side of upper and lower jaws; tubular anterior nostril on ocular side vertical, conical, just above upper lip, anterior to upper fourth of lower eye, just reaching lower eye when laid back; posterior nostril a slit in labial groove anterior to lower eye; opercular membrane present on about dorsal half of gill opening on ocular side, less than half orbit diameter at widest point; no cirri at edge of gill opening on either side.

Scales strongly ctenoid on ocular and blind side, except those of lateral line, most with 6 to 9 cteni; scales extending only basally onto fins; scales continuing onto snout, progressively smaller anteriorly with fewer cteni; a broad zone of thick papillae above upper jaw and on chin of blind side; lateral line straight on both sides, ending on ocular side less than an eye diameter posterior to upper eye; six series of small sensory papillae converging onto snout on blind side, the one on base of dorsal fin extending well posterior to head.

Origin of dorsal fin on upper lip, the predorsal length from base of first dorsal ray 6.0 in head length; first

dorsal ray 3.2 in head length; longest dorsal ray 1.6 in head length; first anal ray on a transverse line with base of 22nd dorsal ray, the preanal length 3.1 in SL; first anal ray 3.05 in head length; longest anal ray 1.6 in head length; caudal fin rounded, 3.0 in SL; pelvic fins on ventral edge of body, the ocular-side fin a little anterior, the prepelvic length 4.55 in SL; second to fourth pelvic rays nearly equally long, the third slightly longest, the tip finely branched, reaching base of third anal ray when laid back, 2.1 in head length; distal end of rays of all fins slightly protruding free of membrane; anus directly anterior to origin of anal fin; genital papilla adjacent to base of first anal ray on blind side.

Color in alcohol pale beige, the scales on ocular side narrowly edged with dark brown, with three longitudinal rows of dark brown blotches on body, one dorsal, one midlateral, and one ventral, from heavier pigmentation on scales; fin rays pale yellowish, unmarked; membranes translucent; no trace of the large white blotches seen in the newly collected specimen.

Color when fresh as described in the Diagnosis and as shown in Fig. 2.

Etymology. We are pleased to name this species in honor of Dr. Fareed Krupp, in recognition of his research on fishes, especially in the Red Sea, and for his support of the second author's fieldwork in the Red Sea.

Remarks. This species is one of three of the genus *Aseraggodes* with specimens that may have fewer than 59 dorsal rays and fewer than 41 anal rays. The others are *A. xenicus* (Matsubara & Ochiai 1963), type locality Japan, that ranges south to Indonesia and east to the Marshall Islands, and *A. steinitzi* Joglekar 1970, collected from the Dahlak Archipelago, Red Sea.

Aseraggodes kruppi is very similar in color pattern to *A. xenicus*, but clearly differs in its more slender body (depth 2.6 in SL, compared to 2.35–2.5 for *A. xenicus*), larger head (head length 3.6 in SL, compared to 4.0–4.1 in *A. xenicus*), and longer caudal fin (caudal-fin length 3.0 in SL, vs. 3.3–4.3 in SL for *A. xenicus*). Also it has 32 vertebrae, vs. 33–35 for *A. xenicus*, and 6–9 cteni on the scales, compared to 10–14.

We first identified *Aseraggodes kruppi* as *A. steinitzi*, described in 1970 from three specimens, 24–36 mm SL, from the Dahlak Archipelago, Eritrea in 1962 and deposited in the Indian Museum, Kolkata, the holotype as ZSI F6280. The second paratype (illustrated here as Fig. 3 from a photo taken by K.K. Bineesh) was intended for the U.S. National Museum of Natural History, as indicated in Joglekar's paper, but it was never sent to Washington, D.C. Apparently it is forbidden to deposit Indian specimens in institutions outside India.

Aseraggodes kruppi differs from *A. steinitzi* by having 18 instead of 14–16 caudal rays, 6–9 instead of 10–15 cteni on the scales of the ocular side, and a more slender body, the depth 2.6 in SL, compared to 2.4–2.45 for *A. steinitzi*.



Figure 3. *Aseraggodes steinitzi*, paratype, ZSI uncat., 33 mm, Dahlak Archipelago, Eritrea, Red Sea (K.K. Bineesh).

The holotype of *Aseraggodes kruppi* was collected at a depth of 2.5 m from sand in an isolated patch reef about 3 m in diameter, an estimated 100 m from shore on the sheltered east side of a small island near the coast of Saudi Arabia. It was about 15 m from the steep outer-reef slope.

Aseraggodes macronasus Randall & Bogorodsky, n. sp.

Figures 4–6

Holotype. BPBM 41155, male, 61.5 mm, Red Sea, Gulf of Aqaba, Egypt, Dahab, dive site “lighthouse”, 28°29′54.94″N, 34°31′11.71″E, coral reef, 5 m, clove oil, S.V. Bogorodsky, Nov. 19, 2012.

Paratypes. SAIAB 190254, 57 mm, Red Sea, Gulf of Aqaba, Egypt, Dahab, dive site “caves”, 28°24′59.33″N, 34°27′11.47″E, sand and rubble, 5.5 m, clove oil, S.V. Bogorodsky, Nov. 20, 2012; BPBM 41156, 23 mm, Red Sea, Gulf of Aqaba, Egypt, Dahab, “lighthouse”, 28°29′54.69″N, 34°31′12.20″E, sand close to reef, 18 m, clove oil, S.V. Bogorodsky, Nov. 19, 2012.

Diagnosis. Dorsal rays 63–69; anal rays 45–50; dorsal and anal fin rays branched in adults, except for about first 20 rays of dorsal fin; caudal rays 18; lateral-line scales 66–72 (including 7 anterior to upper end of gill opening); vertebrae 35 or 36; dorsal pterygiophores anterior to fourth neural spine 11 or 12; body depth 2.7–2.75 in SL; head length 4.05–4.45 in SL; snout length 2.7–3.0 in head length; anterior nostril on ocular side tubular and very long, its length 3.6–4.1 in head length; ventral profile of head nearly straight, with very fine cirri on margin; caudal-peduncle length 13.0–14.5 in head length; caudal-fin length 2.8–3.9 in SL. Color of ocular side of adults in alcohol light gray-brown, finely mottled with whitish; many scales rimmed posteriorly with dark brown; two dark brown blotches slightly larger than eye centered on lateral line, separated by a distance equal to head length; a few lesser dark brown spots on or near lateral line; dorsal and anal fins with translucent membranes and yellowish rays, some with faint small dark spots; caudal fin similar, but with small dark brown spots on basal scaled part of fin; a series of well-spaced, dark blotches of about eye size below base of dorsal fin and above base of anal fin. Color of holotype in life (Fig. 4) yellowish gray, the scales narrowly dark-edged; many pale bluish gray spots,

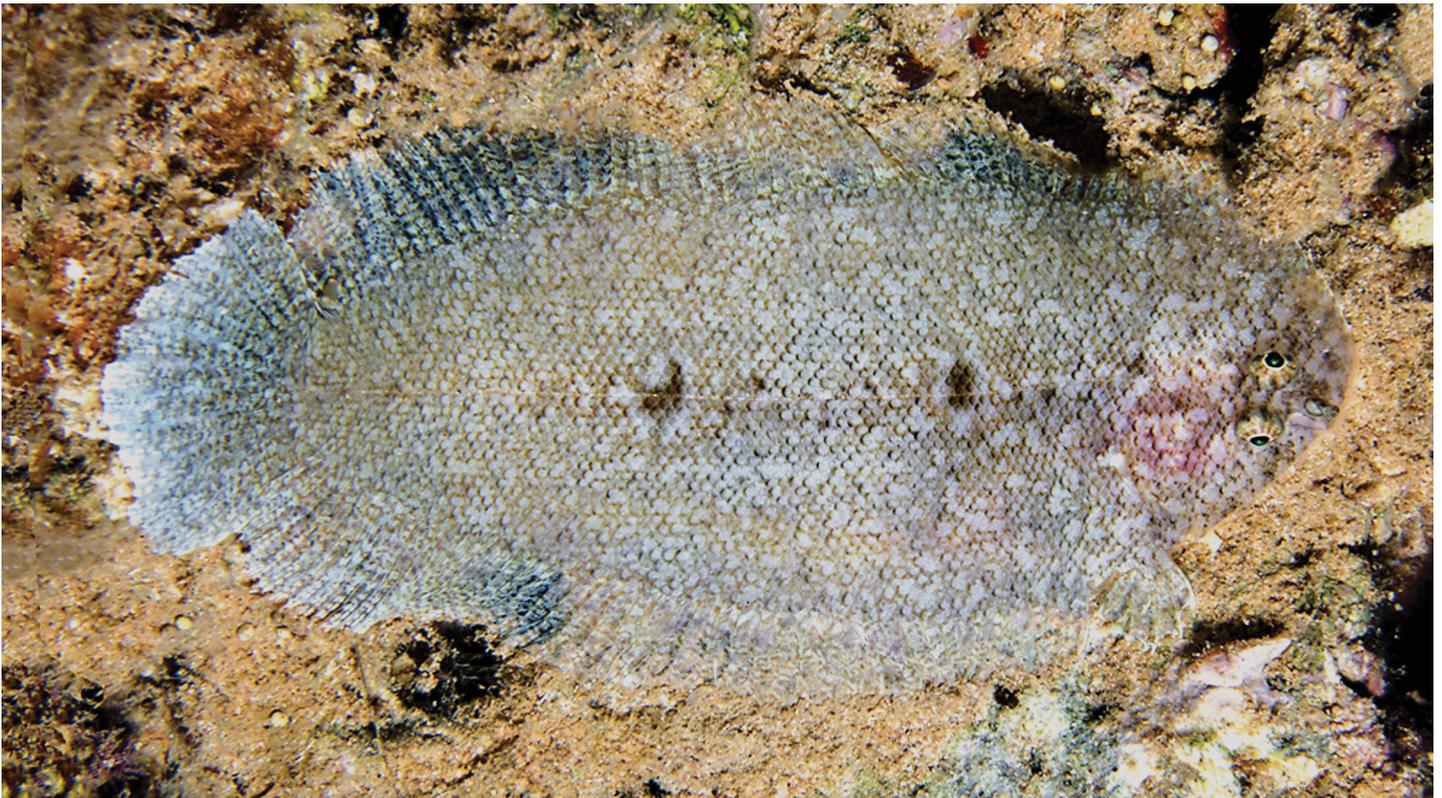


Figure 4. *Aseraggodes macronasus*, holotype, BPBM 41155, 61.5 mm, Dahab, Egypt, Red Sea (S.V. Bogorodsky).

some in clusters forming irregular blotches, especially on head and anterior half of body; red from gill filaments showing faintly through operculum; a small white spot on opercular flap; dark blotches as described in preserved specimen; iris of eyes brown with spoke-like yellow lines, the pupil dark green, narrowly rimmed in yellow.

Description. Dorsal rays 64 (63–69); anal rays 50 (45–50); dorsal and anal fin rays branched in adults except for about first 20 of dorsal fin; caudal rays 18; pelvic rays 5; lateral-line scales 71 (66–72), including 7 anterior to upper end of gill opening; scales above lateral line 23 (23); scales below lateral line 25 (24); vertebrae 35 or 36; dorsal pterygiophores anterior to fourth neural spine 11 or 12; erismes and 3 dorsal pterygiophores anterior to second neural spine; 4 pterygiophores between second and third neural spines, and between third and fourth neural spines; ventroanterior margin of urohyal forming an angle of about 80°, the inner corner broadly rounded.

Body depth 2.7 (2.7–2.75) in SL; body width (thickness) 5.7 (5.3–5.4) in body depth; head length 4.45 (4.05–4.3) in SL; snout length 2.85 (2.7–2.8) in head length; preorbital length 3.9 (3.5–3.6) in head length; ventral profile of head posterior to mouth straight, with very fine cirri on margin (as seen on paratype of Fig. 5; mostly lost or folded back on preserved specimens); eye diameter 4.4 (3.8–4.3) in head length; upper eye about one-third eye diameter anterior to lower eye; least vertical interorbital width 10.1 (13.8–14.5) in head length; upper end of gill opening on a horizontal about one-third orbit diameter ventral to lower eye; caudal-peduncle depth 2.05 (1.9–2.05) in head length; caudal-peduncle short, its length 14 (13–14.5) in head length.

Jaws strongly curved; maxilla extending slightly posterior to anterior edge of lower eye, the upper-jaw length (measured on blind side) 3.4 (3.35–3.5) in head length; a row of close-set, very small teeth on blind side of upper and lower jaws just inside fleshy lips; anterior nostril of ocular side a thin-walled tube on snout directly anterior to interorbital space, reaching to rear margin of lower eye when laid firmly back, its length 4.1 (3.6–4.0) in head length; posterior nostril a slit in labial groove anterior to lower eye; gill opening ending on ocular side at level of one-half orbit diameter below lower eye; opercular membrane well-developed; no cirri at edge of gill opening on either side.

Scales strongly ctenoid on ocular and blind sides, except those of lateral line; most scales on ocular side of adults with 10–14 cteni (only 3 on juveniles); blind side with at most 12 cteni; scales progressively smaller anteriorly on head, those at front of snout without cteni; anterior edge of snout above upper lip, and on chin below lower lip naked with a few small cirri; scales present on about anterior third of dorsal fin, progressively fewer posteriorly, the scales concentrated in a band anterior to each posterior ray that narrows distally; small scales on about basal fourth of caudal fin; a broad zone of short papillae around jaws on blind side; lateral line straight

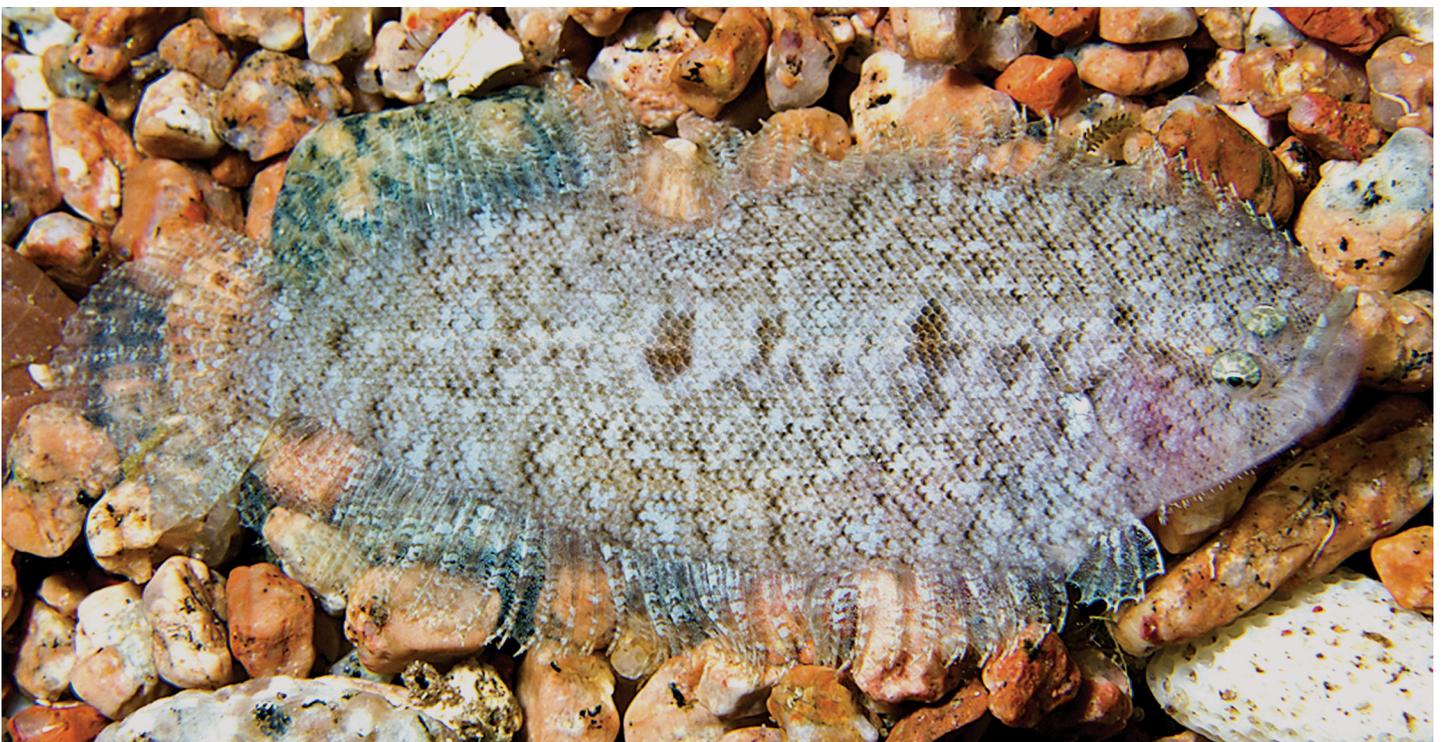


Figure 5. *Aseraggodes macronasus*, paratype, SAIAB 190254, 57 mm, Dahab, Egypt, Red Sea (S.V. Bogorodsky).



Figure 6. *Aseraggodes macronasus*, paratype, BPBM 41156, 23 mm, Dahab, Egypt, Red Sea (S.V. Bogorodsky).

on both sides, beginning on ocular side less than an eye diameter posterior to upper eye; about 6 series of small sensory papillae converging onto blind side of snout, the one on base of dorsal fin continuing more than half distance on body to base of caudal fin; a thin membranous ridge of variable length basally on each dorsal and anal ray, except anteriorly on dorsal fin.

Origin of dorsal fin on upper lip, the predorsal length from base of first dorsal ray 4.8 (3.5–4.9) in head length; first dorsal ray 4.2 (3.5–4.1) in head length; longest dorsal ray 1.35 (1.35–1.4) in head length; first anal ray on a transverse line with base of 20th (19th–20th) dorsal ray, the preanal length 3.5 (3.25–3.3) in SL; first anal ray 2.35 (2.1–2.45) in head length; longest anal ray 1.35 (1.3–1.6) in head length; caudal fin strongly rounded, 3.85 (2.8–3.9) in SL (fin progressively shorter with growth), the ray tips slightly exerted in juveniles; blind-side pelvic fin anterior in adults (nearly parallel in juveniles), the prepelvic length 4.3 (4.1–4.3) in SL; third pelvic ray slightly longest, reaching base of third anal ray when laid back, 2.3 (2.1–2.2) in head length; anus directly anterior to origin of anal fin; genital papilla adjacent to base of first anal ray on blind side.

Color of ocular side of holotype in alcohol pale beige, densely and finely mottled with gray; scattered scales rimmed in dark brown; two irregular dark brown blotches on lateral line, the first vertically elongate, covering 21st to 24th pored scales, the second irregular, covering 45th to 49th pored scales; lesser brown blotches on lateral line (one on fifth to seventh scales, and two between the main dark brown spots); dorsal and anal fins with translucent membranes and pale yellowish rays, most with one to four brown spots (rays unmarked in juveniles); color of blind side pale beige.

Color of holotype in life as shown in Fig. 4. Variation in color can be expected with habitat. However, the coloration of the second-largest paratype, photographed on a different colored substratum (Fig. 5), is remarkably similar to that of the holotype at rest on a substratum of very different color. The 23-mm juvenile can be linked in color (Fig. 6) to that of the adults by noting the position of the two dark brown spots, centered in the standard length on the lateral line, and the white spot at the upper end of the gill opening.

Etymology. This species is named *Aseraggodes macronasus* in reference to its unusually long anterior nostril.

Remarks. The disparity in some of the proportional measurements given above is the result of measuring a juvenile and two adults. The variation in color is at least in part due to size difference, but it might also be expected from the color of substrata on which these small soles are found.

Joglekar (1970) described the anterior nostril of *Aseraggodes steinitzi* as long, but did not quantify it, nor did she include it in any of her drawings. It can be seen in Fig. 3, the tip just touching the lower eye, clearly not as long as the nostril of *A. macronasus*. Another obvious difference of *Aseraggodes macronasus* from *A. steinitzi* is the more slender body, the depth 2.7–2.75 in SL, compared 2.4–2.45 in SL for *A. steinitzi*. There is also a difference in the number of dorsal and anal rays, 63–69 dorsal and 45–50 anal rays for *Aseraggodes macronasus* vs. 58–62 dorsal and 39–41 anal rays for *A. steinitzi*. S.S. Mishra of the Indian Museum took the holotype of *A. steinitzi* to a medical facility for an x-ray. He reported the number of vertebrae as “not more than 32”. As noted above, *A. macronasus* has 35 or 36 vertebrae.

Aseraggodes macronasus was collected from sand or sand and rubble substrata near or within coral reefs from depths of 5–18 m. It is typically hidden in sand by day, but active at night when it may move from sand to rock or coral; however, it quickly retires to sand if alarmed.

The specimen of Fig. 5 appears to have suffered a wound to its dorsal side, from which it is healing. The wound may have been inflicted by a predator, and the sole may have survived the attack because the presence of a repelling skin toxin. This is known for at least two species of the genus *Aseraggodes* (Randall & Meléndez 1987: 104; Randall 2007: 467).

Aseraggodes martine Randall & Bogorodsky, n. sp.

Figures 7–9

Holotype. UOK 132, female, 60 mm, India, Lakshadweep (Laccadive Islands), Andrott Island, lagoon, sand bottom, 1.5 m, scoop net, M. Noushad, April 30, 2013.

Paratype. SAIAB 80938, 20.5 mm, Seychelles, Mahé, Les Trois Dames, off Port Glaud, 4°40.75'S, 55°25.16'E, sand and gravel next to reef, 8–10 m, rotenone, P.C. Heemstra, E. Heemstra, K.A. Moots, and M.J. Smale, April 27, 2005; UOK 133, female, 64.5 mm, same data as holotype.

Diagnosis. Dorsal rays 65–67; anal rays 42 or 43; all fin rays branched, except first 14 of dorsal fin, first of

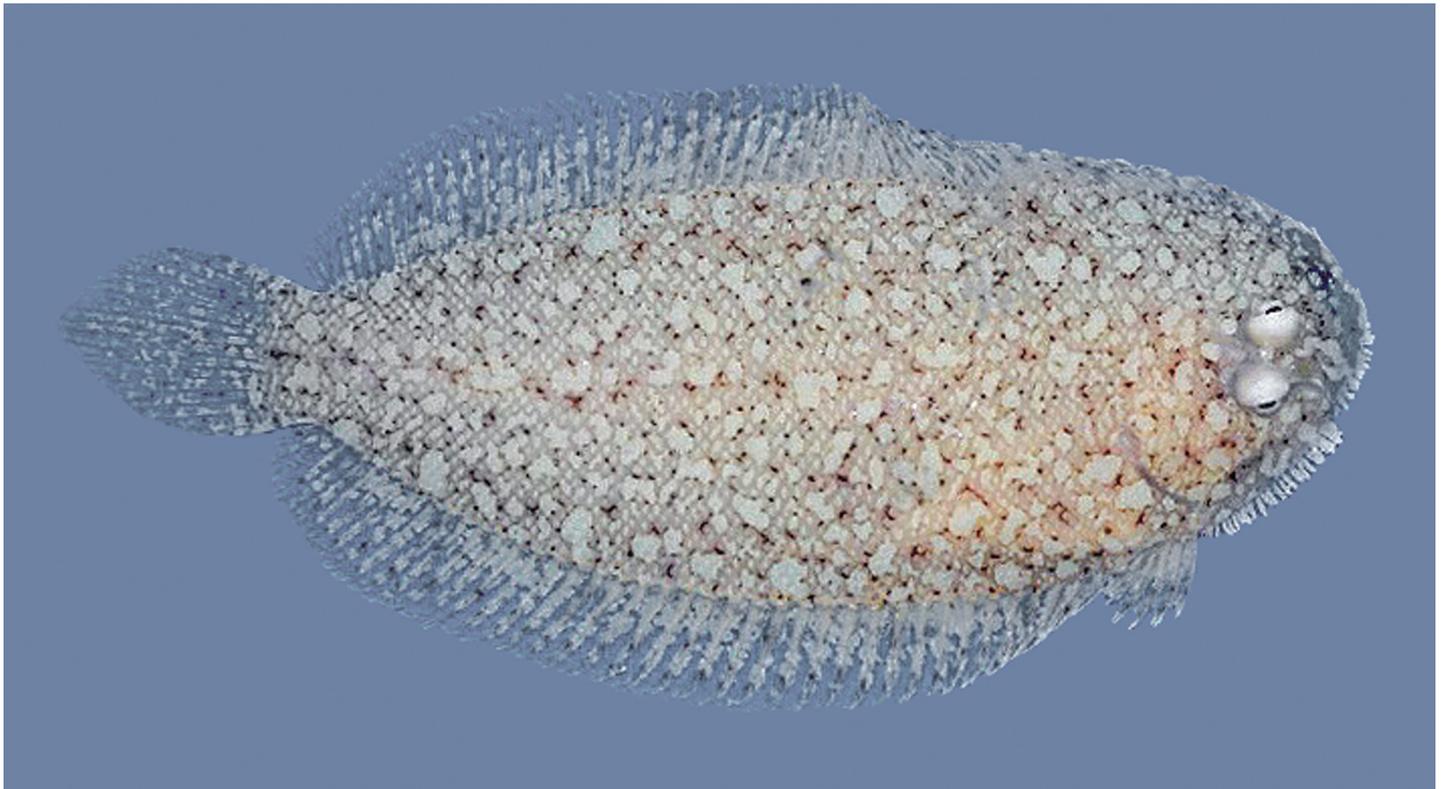


Figure 7. *Aseraggodes martine*, holotype, UOK 132, 60 mm, Andrott Island, Lakshadweep, India (M. Noushad).

anal fin, and lateral two of caudal fin; lateral-line scales 66–69; vertebrae 33 or 34; dorsal pterygiophores anterior to fourth neural spine 15 or 16; body depth 2.5 (2.35) in SL; head length 4.35 in SL; caudal peduncle short, 9–14 in head length; snout length 2.75 in head length; tubular anterior nostril conical, as long as diameter of upper eye; origin of dorsal fin at base of upper lip; color of ocular side in alcohol yellowish white with a faint longitudinal orangish band below base of dorsal and anal fins; an indistinct dusky spot about twice eye diameter on lateral line about two head lengths posterior to head; scattered small blackish flecks, most from dark outer edges of scales; color of ocular side when fresh light yellowish brown, the scale edges darker brown, except within numerous, dark-edged, pale spots that vary from nearly round to irregularly ovate, none larger than eye; fin membranes mainly transparent, the rays blotched and spotted with greenish yellow, especially basally; front of head translucent; lappet-like cirri anteriorly and ventrally on margin of head white.

Description. Dorsal rays 65 (67), all except first 14 (26) branched; anal rays 43 (42), all but first branched; pelvic rays 5, all branched; caudal rays 18, the median 14 branched; lateral-line scales 69 (66); scales above lateral line 21; scales below lateral line 23; vertebrae 33 or 34; dorsal pterygiophores before the fourth neural spine 15 or 16; erismes and 2 dorsal pterygiophores anterior to second neural spine; 7 pterygiophores between second and third neural spines, and 3 between the third and fourth neural spines; ventroanterior margin of urohyal forming an angle of about 80°, the inner corner very broadly rounded.

Body depth 2.5 (2.35) in SL (juvenile deeper bodied than adult); body width (thickness) 3.65 (4.1) in body depth; head length 4.35 in SL; snout length 2.7 (2.75) in head length; preorbital length 2.3 in head length; ventral profile of head posterior to mouth nearly straight; eye diameter 3.9 (3.8) in head length; upper eye four-tenths (three-tenths) eye length anterior to lower eye; least vertical interorbital width 13.7 (14.0) in head length; upper end of gill opening on a horizontal with upper edge of lower eye; caudal peduncle short, 9–14 in head length; caudal-peduncle depth 1.8 (1.9) in head length.

Maxilla strongly curved, the straight-line length 3.1 (2.9) in head length, the posterior end on a vertical with anterior edge of upper eye; upper-jaw length (measured on blind side) 3.45 in head length; a narrow band of very small, recurved, villiform teeth on blind side of jaws (difficult to see due to plicate fleshy lips); anterior nostril on ocular side conical, tubular, as long as diameter of upper eye, in horizontal alignment with and just anterior to lower eye; posterior nostril a slit in labial groove anterior to lower eye; a very short opercular membrane at medial end of gill opening on ocular side.

Scales ctenoid on ocular and blind sides of body, except those of lateral line, most with 14 to 16 cteni, a few

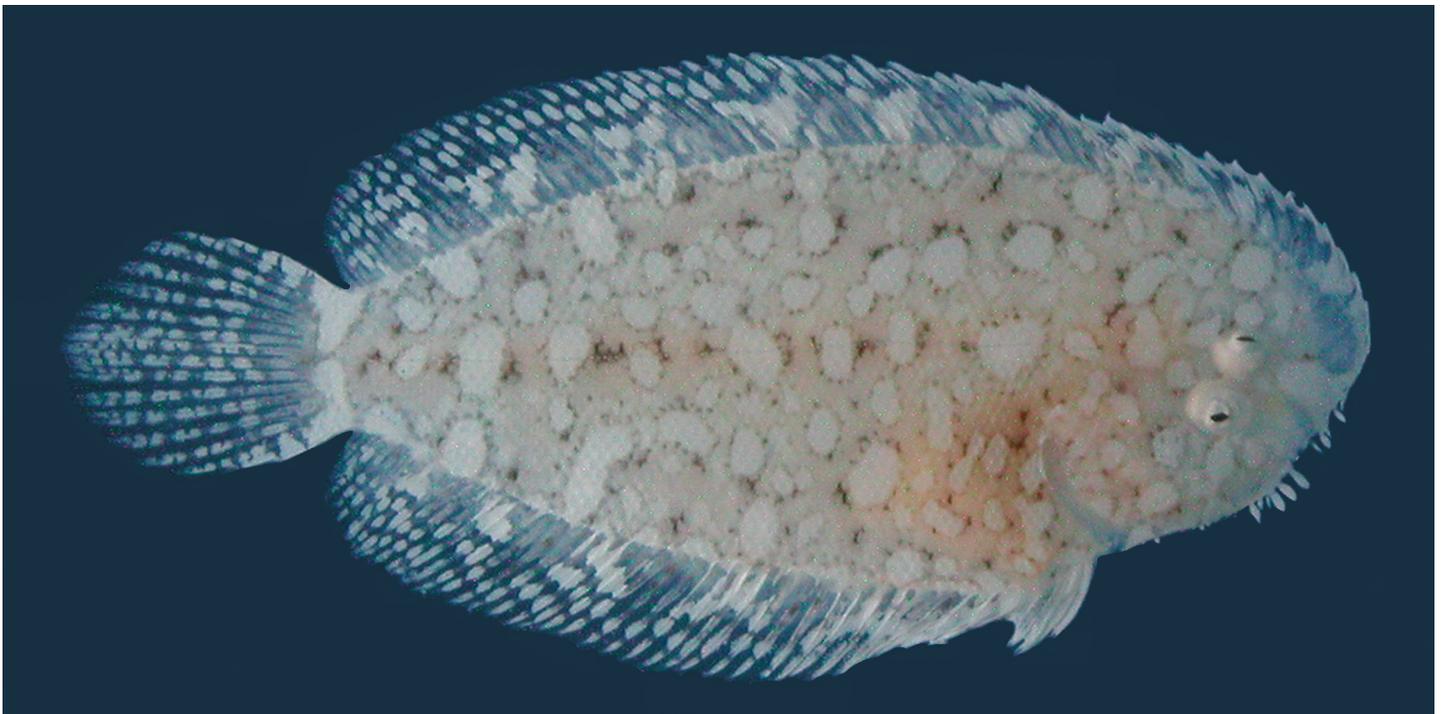


Figure 8. *Aseraggodes martine*, paratype, SAIAB 80938, 20.5 mm, Mahé, Seychelles (K.A. Moots).

with as many as 20; scales progressively smaller and with fewer cteni anteriorly on head; interorbital space with two rows of scales; scales extending medially and anteriorly onto sides and front of orbits; scales on blind side of head progressively smaller anteriorly as they converge onto snout and become papillae, ending in a triangular zone of dense papillae from anterior to upper lip to front of snout; ventral margin of head straight, with a row of 23 lappet-like cirri; lateral line on blind side curving laterally around edge of operculum and continuing to dense patch of papillae above upper lip; two lines of sensory scales parallel to base of anal fin converging at level of mouth and continuing to anterior patch of sensory papillae.

Origin of dorsal fin at base of upper lip, the first dorsal ray nearly equal to orbit diameter; longest dorsal ray nearly 1.45 head length; first anal ray on a transverse line with base of 21st dorsal ray, the preanal length 4.2 (4.25) in SL; length of first anal ray 2.1 in head length; longest dorsal and anal rays 1.45 in head length; caudal fin strongly rounded, its length 4.4 in SL; pelvic fins adjacent on ventral edge of body, the ocular-side fin a little anterior, the prepelvic length 5.4 (5.3) in SL; fourth pelvic ray longest, just reaching base of fourth anal ray; anus directly anterior to first anal ray; genital papilla small, at ventroposterior edge of anus.

Color when fresh as shown in Figures 7 and 8 and described in Diagnosis.

Etymology. We are pleased to name this species in honor of Martine Dessouter-Meniger in recognition of her research on soleid fishes. The species name is treated as a noun in apposition.

Remarks. Except for meristics, the description above is based on the two adult type specimens. The 20.5-mm juvenile differs mainly in lacking any branched dorsal, anal, or pelvic rays; a body depth of 2.6 in SL; head length 3.9 in SL; longer caudal fin, 3.3 in SL; only 12 lappet-like cirri on ventral margin of head, and 8 slender ones anteriorly on head.

Aseraggodes martine differs from all known species of the genus in having 15 or 16 dorsal pterygiophores anterior to the fourth neural spine (four other species may have as many as 15). Its remaining meristic data are the same as *A. sinusarabici* Chabanaud 1931, but it is easily distinguished from this species by having a caudal peduncle and by color. *Aseraggodes sinusarabici* is nearly uniform tan on the ocular side, with no white or dark brown spots.

There are many species of *Aseraggodes* with a white- or pale-spotted pattern on the ocular-side, but they all have even more irregular spots than *A. martine*.



Figure 9. *Aseraggodes martine*, paratype, UOK 133, 64.5 mm, Andrott Island, Lakshadweep, India (B. Kumar).

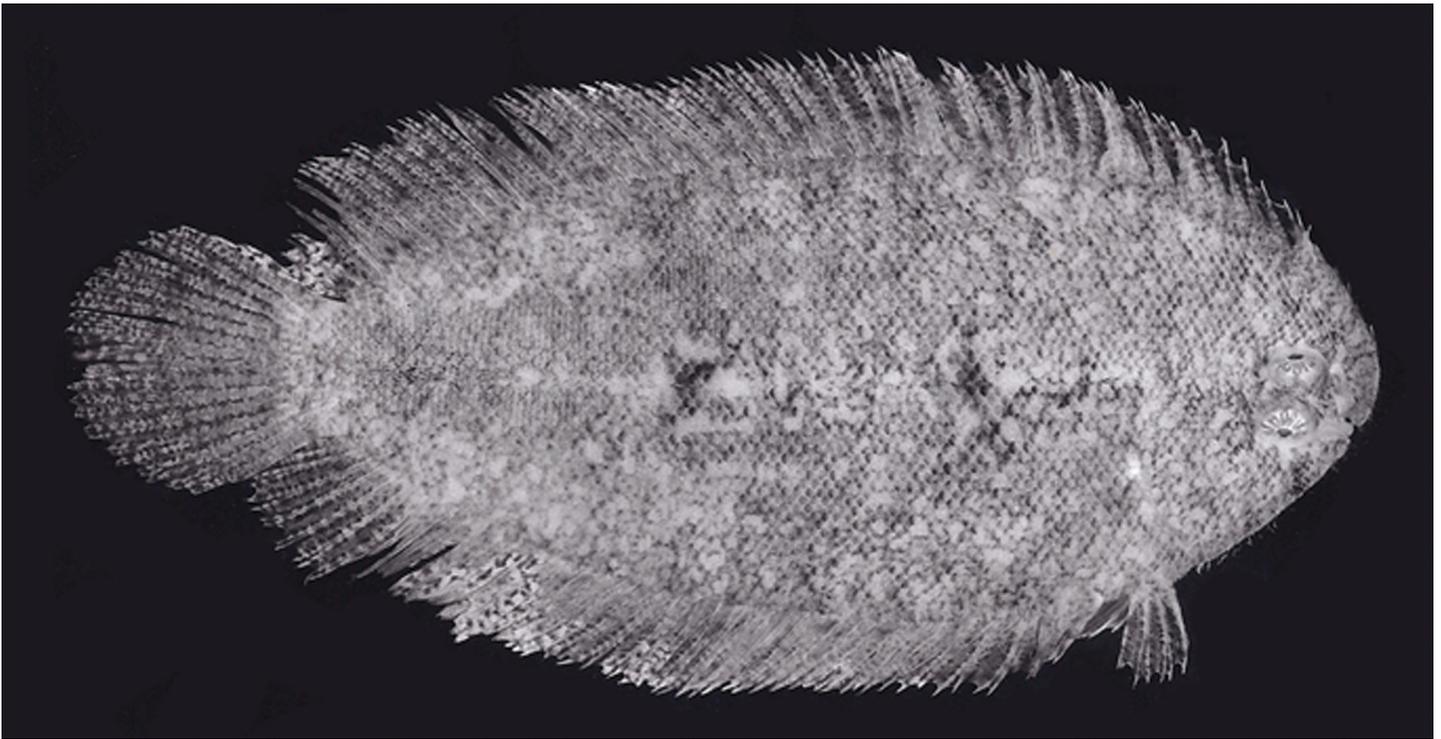


Figure 10. *Aseraggodes* sp., 56 mm, Maskali Island, Gulf of Tadjoura, Djibouti (J.E. Randall; specimen lost).

Aseraggodes sp.

Figure 10

Aseraggodes sp. Randall & Gon 2005: fig. 10 (Maskali Island, Djibouti).

Correction. Randall and Gon (2005: 187, fig. 10) used the wrong photograph to illustrate an unidentified species of sole of the genus *Aseraggodes* collected by the first author at Maskali Island, Gulf of Tadjoura, Djibouti in 1977. Their figure was one of *A. whitakeri* from New Caledonia taken by Richard Winterbottom. The correct photograph is reproduced here as Fig. 10.

Another mistake was made in the same paper with their figure on p. 174, identified as *A. diringeri* from the Comoro Islands, taken by Richard Winterbottom. The photograph instead is one of *A. whitakeri* taken by Dr. Winterbottom in New Caledonia.

It is easy to understand how the Indian Ocean *A. diringeri* (Quéro 1997) can be confused with the Pacific *A. whitakeri* Woods (in Schultz *et al.* 1966). Randall and Gon (2005: 175) wrote in reference to *A. diringeri*: “This species is very similar to *A. whitakeri* Woods of islands of Oceania, the two having essentially the same meristic data. It differs from *whitakeri* mainly in its larger size and the white markings on the body in life being mainly roundish instead of vermiculate”. The holotype of *A. diringeri* measures 104 mm SL. The largest of 39 specimens of *A. diringeri* reported by Randall and Gon is 78 mm in SL. The largest of a total of 13 specimens in 12 lots of *A. whitakeri* examined by Randall (2005) measures 43 mm SL.

Acknowledgments

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