

A New Sole of the Genus *Aseraggodes* from Easter Island and Lord Howe Island, with Comments on the Validity of *A. ramsaii*

John E. Randall¹ and Roberto Meléndez C.²

ABSTRACT

A new soleid fish, *Aseraggodes bahamondei*, is described from specimens from Easter Island and Lord Howe Island collected at depths of 2 to 25 m. It is distinctive in having 65-71 dorsal-fin rays, 50-56 anal-fin rays, 75-86 lateral-line scales, strongly ctenoid scales, 1-4 small pores beneath scales peripherally on body, and a body depth of 2.3-2.5 in SL. Its closest relative appears to be an undescribed species from New South Wales. It coexists at Lord Howe Island with *A. ramsaii*, a valid species easily distinguished from *A. haackeanus* of South Australian waters. A whitish secretion exuded from the body of *A. bahamondei* when under stress was shown to be toxic to the goby *Kelloggella oligolepis*.

INTRODUCTION

The fish fauna of Easter Island is very impoverished. Randall & Cea Egaña (1984) listed 130 fishes from the island, including pelagic species. Recent collecting by the senior author and associates has raised the total number of known species to 155. The fauna, however, is unique in that it is divisible into 7 components: tropical Indo-Pacific, pelagic, cosmopolitan (nonpelagic), southern subtropical, antitropical, eastern Pacific, and endemic. The largest component is the group of Indo-Pacific origin, accounting for 27.2% of the species. The second largest category is the endemic species, a surprising 26.4% of the total (when pelagic species are excluded). The soleid fish described below as a new species was initially believed to be one of these endemic species.

The first collection of the new sole at Easter Island was made in 1958 by Ramsey Parks and crew of the yacht *Chiriqui*. A total of 13 specimens was taken in a large rotenone station in Anakena Cove. The Parks collection was given to the University of California at Los Angeles; it was later transferred to the Natural History Museum of Los Angeles County. Three lots of this flatfish were obtained from the island by Ian E. Efford and Jack A. Mathias in 1965 during a Canadian medical expedition. These specimens were deposited in the collection of the University of British Columbia. The holotype, 2 other adults, and 1 small juvenile were collected by the senior author and Gerald R. Allen in 1969. Four additional Easter Island collections followed from 1972 to 1985.

We have classified this sole in *Aseraggodes* Kaup based on the following characters: no pectoral fins; straight lateral line midlaterally on both sides of body with a short anterodorsal branch on the blind side; eyes separated by a scaled space; margin of preopercle not exposed; pelvic fins short-based, free from anal fin; dorsal fin commencing on snout, the 1st ray not prolonged; mouth horizontal, strongly curved; tubular anterior nostril not reaching lower eye; posterior nostril a slit in labial groove; and a fringe of cirri along margins of head.

1. Bernice P. Bishop Museum, P.O. Box 19000-A, Honolulu, Hawai'i 96817-0916, USA.
2. Museo Nacional de Historia Natural, Casilla 787, Santiago, Chile.

Chabanaud (1930) reviewed *Aseraggodes*, recognizing 15 species. Chabanaud (1931) transferred *A. filiger* Weber to a new monotypic genus, *Coryphillus*, based on its contiguous eyes and elongate 1st dorsal ray. In the same paper he described a new *Aseraggodes* from the Red Sea and Djibouti. Many specimens have been collected since Chabanaud's review. This material has been obtained mainly with the use of rotenone and by trawling. Much of it is on museum shelves identified only as *Aseraggodes* sp.

Upon checking material of this genus in the collection of the Bishop Museum, 2 small specimens of the Easter Island species were found that had been collected at Lord Howe Island by the senior author and colleagues from the Australian Museum in 1973. They were labelled *A. ramsaii* (Ogilby). Hoese in Allen et al. (1976), however, had identified Lord Howe Island material as *A. haackeanus* (Steindachner), adding that "Lord Howe Island and New South Wales specimens have generally been recognized as belonging to the subspecies *A. haackeanus ramsayi*." The description of *Solea ramsaii* by Ogilby (1889) did not reveal any differences from the Easter Island-Lord Howe Island material of what had been regarded as an undescribed sole. Since the description of *Solea ramsaii* was brief, a request was made of John R. Paxton of the Australian Museum for a loan of specimens of *Aseraggodes* from Australia and Lord Howe Island, including the holotype of *S. ramsaii*. Our examination of the specimens sent by Paxton has revealed that *Aseraggodes ramsaii* is a valid species readily separated from *A. haackeanus* and that the Easter Island-Lord Howe Island sole is undescribed and clearly distinct from both *ramsaii* and *haackeanus*. The new species, therefore, falls in the group of southern subtropical species of the Pacific and not among those endemic to Easter Island.

Aseraggodes is related to *Pardachirus* Günther, a genus of 4 species reviewed by Clark & George (1979). A noteworthy difference between the 2 genera is the presence in species of *Pardachirus* of an external pore at the bases of most of the dorsal- and anal-fin rays; these pores are absent in species of *Aseraggodes*. In at least 2 species of *Pardachirus*, *P. marmoratus* (Lacepède) and *P. pavoninus* (Lacepède), a powerful toxin is exuded from these pores when the fish is under stress (Clark & Chao 1973). The new species of *Aseraggodes* from Easter and Lord Howe Island, however, has 1 to 4 small pores under the scales peripherally on the body. These are absent from most species now placed in *Aseraggodes*. It seems likely that not all species currently recognized in the genus will remain there when the group is studied throughout the Indo-Pacific region.

Type specimens of the new species have been deposited in the following institutions: Australian Museum, Sydney (AMS); Bernice Pauahi Bishop Museum, Honolulu (BPBM); Natural History Museum of Los Angeles County (LACM); Muséum National d'Histoire Naturelle, Paris (MNHN); Museo Nacional de Historia Natural, Santiago (MNHNC); Museo Zoológico Universidad de Concepción (MZUC); National Science Museum, Tokyo (NSMT); University of British Columbia, Vancouver (UBC); and U.S. National Museum of Natural History, Washington, D.C. (USNM).

Methods of counting and measuring. In the description below, data in parentheses refer to paratypes. Proportional measurements are presented in Table 1 as percentages of the standard length. Many of the same measurements are given in the text as quotients of the standard length or head length for convenience; these measurements are rounded to the nearest 0.05. Counts of the rays of the dorsal and anal fins and of the lateral-line scales of the ocular side are given in Tables 2 and 3.

Standard length (SL) is measured from the front of the upper lip to the base of the caudal fin (posterior end of hypural plate); body depth is the maximum distance between the bases of the dorsal- and anal-fin rays as they emerge from the scaled part of the body; body width is the maximum thickness between the ocular and blind surfaces; head length is measured

from the most anterior point of the head (disregarding cirri) to the posterior end of the opercular membrane (near upper end of gill opening); snout length is taken from the front of the upper lip to the anterior edge of the lower eye; eye diameter is the greatest diameter of the lower eye (the dark eyeball itself, not the fleshy cutaneous part; this is best detected by transmitting a bright light through the head); interorbital width is the least width between the dark edges of the 2 eyes (also best seen by holding the specimen to a bright light); upper jaw length is measured from the front of the upper lip to the rear edge of the maxilla; caudal peduncle depth is the least depth; caudal peduncle length is the horizontal distance from the posterior end of the anal-fin base to the caudal-fin base; predorsal, preanal, and prepelvic lengths are measured from the base of the 1st ray of these fins to the front of upper lip; lengths of the dorsal and anal rays are measured on the blind side in a straight line from base to tip; caudal fin and pelvic fin lengths are the measurements of the longest rays. Lateral-line scales are counted from the front of the straight part on the head to the base of the caudal fin; the number of scales above and below the lateral line are the highest counts obtained in a diagonal row between the lateral line and the bases of the dorsal- and anal-fin rays, respectively.

SYSTEMATICS

Aseraggodes bahamondei Randall & Meléndez C., **new species** Fig. 1–4, Tables 1–3

Aseraggodes haackeanus (not Steindachner, 1883) Hoese in Allen et al., 1976 (in part): 437 (Lord Howe Island).

Aseraggodes sp. Randall & Cea Egaña, 1984: 13 (Easter Island).

Type data. *Holotype*. BPBM 6610, 149.3 mm SL, EASTER I, off Mataveri O Tai (nr S end of W coast), 6 m, sand patch, rotenone (J.E. Randall & G.R. Allen) 2 Feb. 1969. *Paratypes*. LACM 6560, 13: 37–169 mm SL, EASTER I, Anakena Cove, E side, ca. 100 m NE of sand beach, 1–3 m, rotenone (Ramsey Parks and crew of *Chiriqui*) 1 Oct. 1958; AMS IB.6385, 145 mm SL, LORD HOWE I, Far Rocks area (31°33'S, 159°5'E) (J. Booth) 1962; UBC 65-452, 145 mm SL, EASTER I, Hanga Roa, spear (I.E. Efford & J.A. Mathias) 3 Feb. 1965; UBC 65-455, 56.3 mm SL, Hanga Roa, subtidal, rotenone (Efford & Mathias) 5 Feb. 1965; UBC 65-457, 3: 97.8–135.4 mm SL, same data as preceding but date not recorded (probably early Feb. 1965); AMS I.25700-001, 156 mm SL and USNM 274719, 125.8 mm SL, same data as holotype; BPBM 6611, 22.2 mm SL, EASTER I, W coast off S end of Hanga Roa, sand near rocks, 12 m, rotenone (Randall & Allen) 10 Feb. 1969; MNHC P.6142, 145.2 mm SL, EASTER I, Motu Nui (M. Codoceo) Feb. 1972; BPBM 14755, 49.3 mm SL, LORD HOWE I, outside reef W of Mt Lidgbird, sand near reef, 25 m, rotenone (Randall, Allen, B.C. Russell, D.F. Hoese & G.P. Whitley), 5 Feb. 1973; BPBM 14790, 68.3 mm SL, LORD HOWE I, reef W of Mt Lidgbird, surge channel, sand, 6 m, rotenone (Randall, Hoese, Russell, G. Goldman & Whitley) 7 Feb. 1973; MZUC 2096, 141 mm SL, EASTER I, Anakena, sand between rocks, spear (J. Fernandez & C. Villalba) Mar. 1984; BPBM 30554, 2: 59.5–140.2 mm SL, EASTER I, Anakena, E side of bay, sand at edge of rocky shore, 6 m, handnet and spear (Randall & J.L. Earle) 7 Feb. 1985; MNHN 1985-885, 143.6 mm SL and NSMT-P 44015, 120.6 mm SL, same data as preceding; BPBM 30851, 2: 42.7–46.9 mm SL, EASTER I, off Tahai, sand patch in reef, 18 m, rotenone (Randall & A. Cea Egaña) 15 Feb. 1985.

Diagnosis. Dorsal rays 65–71; anal rays 50–56; last dorsal and anal rays not joined by a membrane to caudal fin; lateral-line scales 75–86; scales strongly ctenoid; 1–4 small pores beneath scales peripherally on body; body depth 2.3–2.5 in SL; head extending anterior to mouth; pelvic fins short-based, symmetrical; caudal fin rounded, slightly shorter than head

Table 1. Proportional measurements of specimens of *Aseraggodes bahamondei* of the type series expressed as percentages of the standard length.

	Holotype		Paratypes							
	BPBM 6610	BPBM 30851	BPBM 30554	UBC 65-457	NSMT-P 44015	USNM 274719	BPBM 30554	MZUC 2096	MNHN 1985-885	AMS I.25700-001
Standard length (mm)	149.3	46.9	59.5	97.8	120.6	125.8	140.2	141.0	143.6	156.0
Body depth	41.7	40.6	39.7	41.6	41.5	42.6	41.3	43.6	42.5	40.7
Body width	9.9	8.5	7.6	9.0	8.2	9.6	8.0		9.5	10.2
Head length	22.8	26.2	25.6	22.7	23.0	23.6	22.9	23.3	22.5	21.9
Snout length	6.1	6.6	6.5	5.9	6.0	6.5	6.1	6.4	6.3	6.4
Eye diameter	3.4	4.4	4.4	3.9	3.4	3.5	3.4	3.5	3.5	3.3
Interorbital width	2.7	2.8	2.8	2.6	3.1	2.7	2.9	2.9	3.0	3.3
Upper jaw length	6.8	7.8	7.5	6.9	6.6	6.9	6.9	6.8	6.3	6.5
Caudal peduncle depth	14.1	13.2	12.8	13.9	14.3	15.3	14.8	13.9	15.2	13.0
Caudal peduncle length	1.7	1.8	1.9	1.5	2.0	1.8	2.0	2.1	1.7	1.7
Predorsal length	8.5	9.2	9.2	9.0	8.1	8.5	6.5	8.1	8.2	7.6
Preanal length	27.0	27.3	24.5	25.4	24.3	25.2	25.7	25.5	25.6	26.9
Prepelvic length	20.4	20.2	20.2	20.0	19.2	20.2	18.5	18.4	18.6	18.7
1st dorsal ray length	3.1	3.6	3.4	3.3	2.8	3.4	3.5	2.8	3.0	3.2
Longest dorsal ray length	11.5	12.3	11.9	11.8	11.3	11.9	10.8	11.7	11.2	11.8
Longest anal ray length	11.5	12.3	11.9	11.9	11.1	11.8	11.0	11.7	11.2	11.7
Caudal fin length	20.6	25.1	22.8	20.9	20.9	20.8	20.7	19.6	20.7	20.0
Pelvic fin length	8.2	8.9	8.4	8.4	8.1	8.3	7.1	7.2	7.7	7.8

Table 2. Counts of the dorsal- and anal-fin rays of *Aseraggodes bahamondei*.

	Dorsal rays							Anal rays							
	65	66	67	68	69	70	71	50	51	52	53	54	55	56	
Easter I	1	3	4	6	5	5	3	1	2	8	8	4	3	1	
Lord Howe I	1			1	1						2	1			

length; pale, finely mottled and blotched with dark brown and whitish, the fin rays spotted with blackish.

Description. Dorsal rays 70 (65–71); anal rays 53 (50–56); caudal rays 18; pectoral fins absent; pelvic rays 5; all fin rays branched in adults except uppermost and lowermost caudal rays (dorsal and anal rays of small juveniles simple, the posterior rays of 42.7–46.9-mm juveniles branching at tips); last dorsal and anal rays not connected by a membrane to caudal fin; lateral-line scales on ocular side 83 (75–86), on blind side 86 (83–88); scales above lateral line to top of body 29 (27–30); scales below lateral line to lower edge of body 31 (30–32); no developed gill rakers (2 rows of papillae on anterior edge of 1st gill arch, with very small papillae between); vertebrae 40.

Body an elongate oval, the depth 2.4 (2.3–2.5) in SL; head length 4.4 (3.8–4.55, relatively longer in small juveniles); snout length 3.75 (3.4–3.95) in head; eye diameter 6.7 (5.8–6.8) in head; upper eye slightly in advance of lower (in holotype and some paratypes) to as much as ½ of eye diameter anterior to lower eye in other paratypes; eyes close together, the interorbital space less than eye diameter, its least width 8.45 (6.6–9.55) in head; caudal peduncle depth 1.6 (1.5–2.0) in head; caudal peduncle very short, its length 13.5 (11.0–15.5) in head.

Mouth inferior, the gape horizontal but strongly curved; maxilla extending to below first ⅓ to ½ of lower eye, the upper jaw length 3.35 (3.3–3.6) in head; slender villiform teeth in a band in jaws. Tubular anterior nostril above middle of upper lip, moderately long, approaching but not reaching eyeball when laid back; posterior nostril a downward-directed slit posteriorly in labial groove.

A straight lateral line midlaterally on both sides of body; in addition, on blind side, a curved dorsoanterior branch on head extending a short distance onto body; lateral-line scales continuing onto base of caudal fin (but not included in counts above); scales strongly ctenoid; head (including interorbital space) and body fully scaled, the scales becoming smaller on head and still smaller on snout; scales extending out on fin rays ¾ or more of distance to distal ends; a fringe of cirri (many branched) on margins of head; 1 to 4 (usually 1 or 2) small pores under scales for 5 to 9 rows peripherally on body (pores not present anteriorly and ventrally on head and only a few may be found ventrally on thorax; pores more numerous on ocular than blind side).

Origin of dorsal fin nearly at most anterior point of head, the 1st ray short, about 60% length of 2nd ray, its length 7.35 (6.55–8.8) in head; dorsal and anal rays about equal in length, the longest dorsal ray 2.0 (1.9–2.15) in head; caudal fin rounded, slightly shorter

Table 3. Counts of the lateral-line scales of *Aseraggodes bahamondei*.

	Lateral-line scales (ocular side)											
	75	76	77	78	79	80	81	82	83	84	85	86
Easter I	2	1	2	3	2	3	4	1	4	3	1	1
Lord Howe I					2		1					

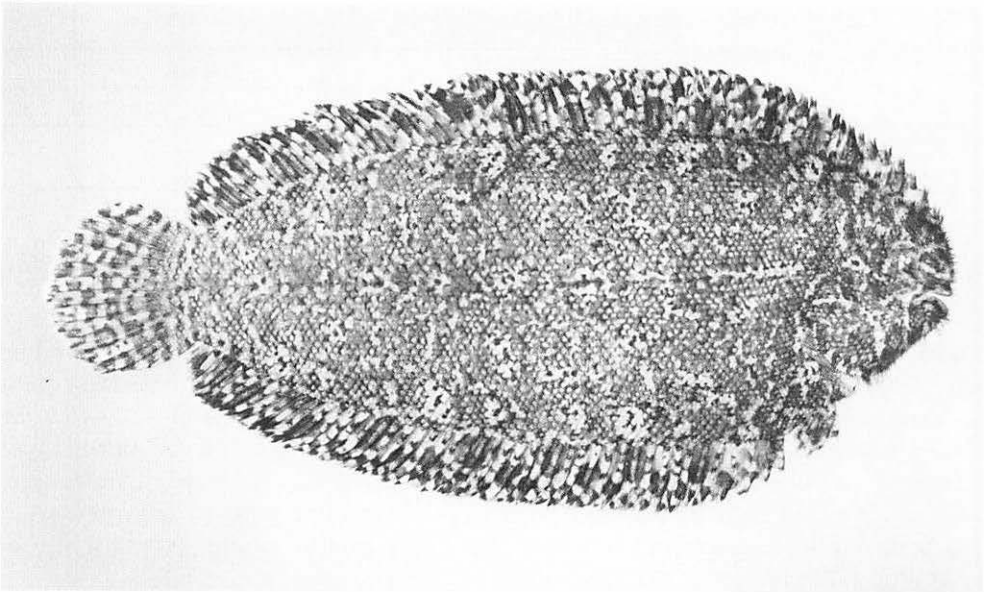


Fig. 1. Holotype of *Aseraggodes bahamondei*, BPBM 6610, 149.3 mm SL, Easter Island.

than head, the longest ray 4.85 (4.0–5.1) in SL; pelvic fins nearly symmetrical, completely separated from anal fin and one another, the bases approximately parallel and not broad (base of fin on ocular side a little broader and slightly anterior in origin to fin of blind side); 3rd ray of pelvic fins longest, 2.8 (2.8–3.2) in head.

Anus immediately anterior to anal fin, rimmed except posteriorly by a fleshy papillose ridge ending on ocular side at base of urinary papilla (papilla 3 mm long in holotype).

Color of holotype in alcohol: ocular side pale brown, densely mottled with brown (pigment concentrated more on scale edges than centers) and dotted with dark brown, the pale interspaces as small irregular spots and short, narrow, irregular bands (some on head extending from eyes); dorsal and anal fins pale with large brown blotches and small dark brown spots, the latter mostly on rays; caudal fin light brown with 6 curved transverse rows of brown blotches paralleling curved posterior margin of fin; blind side whitish; pelvic fins light brown, sparsely spotted with darker brown.

Color of the holotype when fresh (Fig. 1) similar to that in preservative, but pale brown ground color was whitish and dark brown spots nearly black.

Color of juveniles in alcohol (Fig. 2, 3): basically the same as adults but spots and blotches, both blackish and whitish, more contrasting, fewer in number, and relatively larger; whitish spots and short bands narrowly dark-edged, many of those on head radiating from eyes.

Etymology. This species of sole is named in honor of Nibaldo Bahamonde, first director of the Division of Hydrobiology of the Museo Nacional de Historia Natural and a pioneer in Chilean marine sciences.

Remarks. *Aseraggodes bahamondei* is presently known only from Easter Island and Lord Howe Island, which are separated by nearly 9,000 km (5,600 mi). It is expected, therefore, that the species also occurs at some intermediate islands in the southern subtropical zone, such as Pitcairn, Rapa, the Kermadec Islands, and Norfolk Island. It is a shallow-water fish (maximum depth of collection at Easter Island 18 m, and at Lord Howe Island 25 m). We found it common on sand-gravel bottom in Anakena Cove, Easter Island, near a sloping

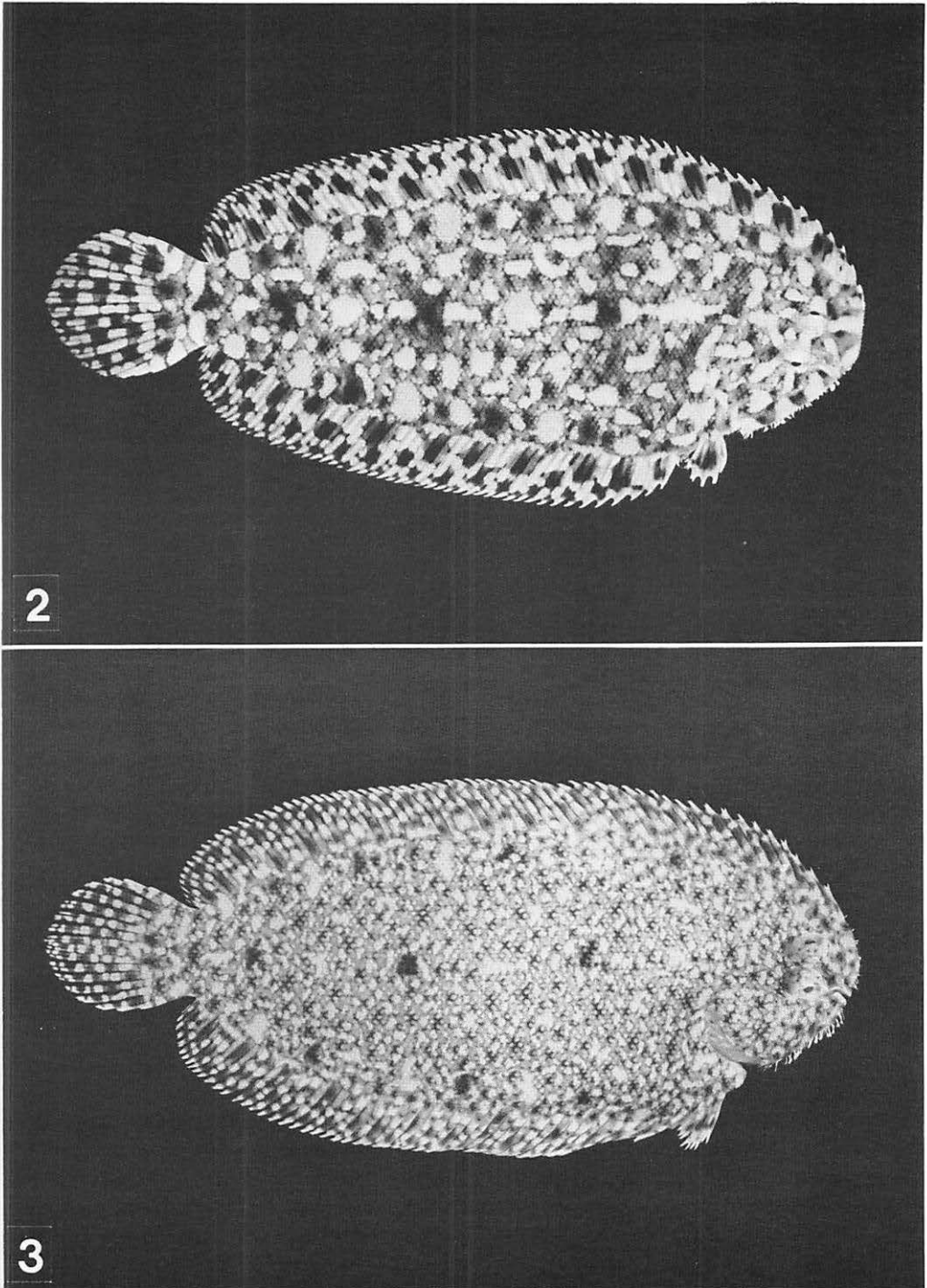


Fig. 2-3. Paratypes of *Aseraggodes bahamondei*: 2, BPBM 30851, 46.9 mm SL, Easter Island; 3, BPBM 14790, 68.3 mm SL, Lord Howe Island.

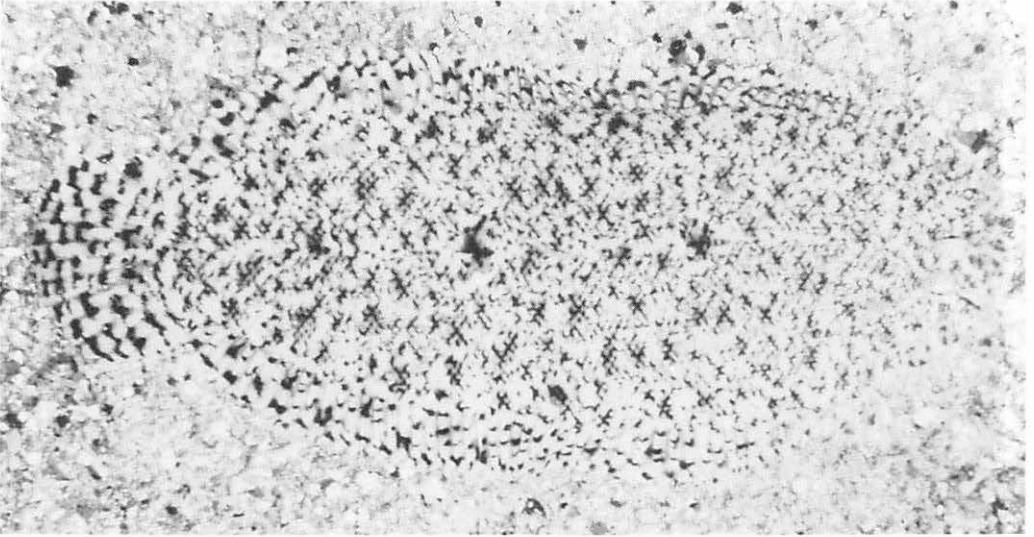


Fig. 4. Underwater photograph of *Aseraggodes bahamondei*, Anakena Cove, Easter Island, 4 m depth.

boulder substratum leading to shore. Individual soles were difficult to see because they matched the sand so well (Fig. 4). They were observed to move slowly by progressive waves of backward-directed action of rays of the dorsal and anal fins. When frightened, they darted quickly into the upper layer of the sediment, the sand stirred up by their burying movement obscuring their position. Usually they completely buried themselves or nearly so, the eyes and traces of the head showing. When closely approached while buried, they darted forward 30 cm or more and again dived into the sand. One individual repeatedly harrassed took refuge under a narrow ledge of a boulder. When a fish was handled after capture in a net or after spearing, a milky white secretion was noticed at the margin of the body.

In order to test possible toxicity of the white secretion, 5 adults of *A. bahamondei* were speared in Anakena Cove. Their mucus was washed into 6 liters of seawater in a plastic container. Three live gobies [*Kelloggella oligolepis* (Jenkins)] were collected from an isolated high tidepool (the usual habitat for this species) and placed in the container, along with 2 xanthid crabs. This fish was selected because it is very hardy, living as it does in pools in which the water varies greatly in temperature, salinity, and oxygen content. The fish reacted immediately upon placement in the container by swimming rapidly around the edges at the surface and trying to jump out. Within a minute they settled to the bottom of the container. Ten minutes after the experiment began all 3 fish were dead. The crabs, however, survived and showed no sign of distress. Although it is obvious that something in the mucus of the sole is toxic to the fish, this substance does not seem as virulent as that reported from 2 species of *Pardachirus* by Clark & Chao (1973).

Aseraggodes bahamondei coexists with *A. ramsaii* at Lord Howe Island. A direct comparison was made with 2 specimens of the latter species, the holotype (AMS I.1951, 57 mm SL) and AMS I.5387, 63.5 mm SL. *Aseraggodes ramsaii* differs in lacking pores beneath the peripheral scales of the body, in having fewer anal rays (47–49, compared to 50–56 for *bahamondei*), a higher average number of lateral-line scales (81–89, compared to 75–86 for *bahamondei*), in the more anterior extension of the straight portion of the lateral line (to less than an eye diameter of a vertical at the posterior edge of the lower eye), and in the

more anterior origin of the dorsal fin (the fin begins just above the base of the upper lip, directly anterior to the ventral edge of the upper eye).

The closest relative of *A. bahamondei* appears to be an undescribed species from New South Wales represented by 4 lots in the Australian Museum. That sole has pores under the peripheral scales (though fewer than *bahamondei*). It differs in having 63–69 dorsal rays, 47–53 anal rays, and 59–70 lateral-line scales. Also, it may not grow as large as *bahamondei*. The largest of 10 specimens is 90 mm SL. Our largest *bahamondei* measures 156 mm SL and 191 mm total length.

There is no basis for considering *A. ramsaii* a subspecies of *A. haackeanus* as proposed by Munro (1957). Two specimens of the latter species sent on loan from the Australian Museum, including the type of *Solea textilis* Ramsay & Ogilby (AMS I.1, 105.5 mm SL, regarded as a junior synonym of *A. haackeanus*), were compared with specimens of *A. ramsaii*. The counts of the dorsal and anal rays and of the lateral-line scales of the 2 specimens fall within the ranges given by Scott et al. (1980) for *haackeanus*: D 59–60; A 43–46; L. lat. 68–74. These counts alone readily separate *haackeanus* from *ramsaii* (and the other 2 species discussed above as well). Also, the eyes are in vertical alignment, or nearly so, and the caudal fin is short (ca. 14.5% SL). *Aseraggodes haackeanus* is a species of South Australian waters.

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LITERATURE CITED

- Allen, G.R., D.F. Hoese, J.R. Paxton, J.E. Randall, B.C. Russell, W.A. Starck II, F.H. Talbot & G.P. Whitley. 1976. Annotated checklist of the fishes of Lord Howe Island. Rec. Aust. Mus. 30(15): 365–454.
- Chabanaud, P. 1930. Revision du genre *Aseraggodes* Kaup. Zool. Meded. (Leiden) 13: 180–92.
- . 1931. Sur divers poissons soléiformes de la région Indo-Pacifique. Bull. Soc. Zool. Fr. 56: 291–305.
- Clark, E. & S. Chao. 1973. A toxic secretion from the Red Sea flatfish *Pardachirus marmoratus* (Lacépède). Bull. Sea. Fish. Res. Stn., Haifa 60: 53–56.
- Clark, E. & A. George. 1979. Two toxic soles, *Pardachirus marmoratus* from the Red Sea and *P. pavoninus* from Japan, with notes on other species. Environ. Biol. Fishes 4(2): 103–23.
- Munro, I.S.R. 1957. Handbook of Australian fishes, no. 17. Fish. Newsl. 16: 69–72.
- Ogilby, J.D. 1889. The reptiles and fishes of Lord Howe Island. p. 51–74. In: Lord Howe Island: Its zoology, geology, and physical characters. Aust. Mus. Sydney Mem. 2.
- Randall, J.E. & A. Cea Egaña. 1984. Native names of Easter Island fishes, with comments on the origin of the Rapanui people. Occas. Pap. Bernice P. Bishop Mus. 25(12): 1–16.
- Scott, T.D., C.J.M. Glover & R.V. Southcott. 1980. The marine and freshwater fishes of South Australia. 2nd ed. D.J. Woolman, South Australia. 392 p.