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Revision of the Family Samaridae (Pleuronectiformes: Actinopterygii)

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This thesis is dedicated to the memory of Don E. McAllister, seminal Canadian ichthyologist, dedicated conservationist, advocate for global biodiversity, photographer, artist, naturalist, mentor to many; a caring man with heart and soul and a good friend.

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Abstract

The family Samaridae has 28 nominal species or subspecies, 22 of which are recognized in this study. Four new species (*Samariscus* sp., *Samaris* sp., *Samaris* sp.1 and *S.* sp. 2) are described, two species names resurrected (*S. cacatuae* and *S. ornatus*) and two species (*S. filipectoralis* and *S. sunieri*) and one subspecies (*Samaris cristatus erythraeus*) are synonymized. An artificial key was constructed for all species. The family is shown to be monophyletic, as are the three genera comprising the family; *Plagiopsetta* being the most plesiomorphic. *Samaris* and *Samariscus* are sister groups. Numerous apomorphies corroborate the monophyly of the *S. cristatus* complex (*Samaris cristatus*, *S. cacatuae*, *S. ornatus* and *S. sp*). In *Samariscus*, *S. nielseni*, *S. corallinus* and *S. triocellatus* form a monophyletic group. The family is restricted to the Indo-West Pacific. Species numbers are highest in the Indo-Malaysian region, drop off with increasing distance and are not found in the extreme eastern Pacific due to the eastern Pacific barrier.

Résumé

La famille Samaridae est formée 28 espèces ou sous-espèces nominales dont 22 sont jugées valides dans cette étude. Quatre nouvelles espèces (*Samariscus* sp., *Samaris* sp., *Samaris* sp.1 et *S.* sp2) sont décrites, deux espèces mises en synonymie sont maintenant considérées valides (*S. cacatuae* et *S. ornatus*) alors que deux espèces nominales (*S. filipectoralis* et *S. sunieri*) et une sous-espèce nominale (*Samaris cristatus erythraeus*) sont mises en synonymie. Une clé artificielle fut créée pour les espèces. La famille, formée de trois genres, est monophylétique. *Plagiopsetta* est le genre le plus primitif. *Samaris* et *Samariscus* sont des genres-frères. Plusieurs apomorphies confirment la monophylie du complexe *S. cristatus* (*Samaris cristatus*, *S. cacatuae*, *S. ornatus* et *S. sp*). Dans le genre *Samariscus*, *S. nielseni, S. corallinus* et *S. triocellatus* forment un groupe monophylétique. Toutes les espèces sont retrouvées dans la partie ouest de l'Indo-Pacifique. On retrouve plusieurs espèces dans la région Indo-Malésienne. Plus on s'éloigne de cette région plus le nombre d'espèces diminue graduellement et aucune espèce n'est retrouvée au-delà de la barrière du Pacifique-Est.

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Introduction

The family Samaridae is a tropical and sub-tropical Indo-Pacific group consisting of three genera, *Plagiopsetta*, *Samariscus* and *Samaris*, with 28 nominal extant species and subspecies and 2 nominal fossil species. The genus *Plagiopsetta* is monotypic, comprising *Plagiopsetta glossa*. The genus *Samariscus* has 17 nominal species and *Samaris* has 8 nominal species and subspecies (see Table 1 for list of nominal and synonymized species). Individual species accounts will provide a chronology of name changes and validity. The Samaridae can be distinguished in a general sense from other Pleuronectoidei by their lack of a blind side (b.s.) pectoral fin, straight lateral line, small mouth, short gill rakers, asymmetrical pelvic fins, small scales, minute b.s. nostrils and dextral eyes. The nostrils on the eyed side (e.s.) are invariably paired, forming short tubes that in some species make contact with the premaxilla. They arise from a flap of skin over a round olfactory pit always located between and in front of the eyes.

Species and subspecies	**Revised to**	**Author**	**Year** (of publication)
Samaris cristatus		Gray	1831
Samaris maculatus	*Samariscus maculatus*	Günther	1880
Samariscus corallinus		Gilbert	1905
Samaris inornata	*Samariscus inornatus*	Lloyd	1910
Arnoglossus cacatuae	*Samaris cacatuae*	Ogilby	1910
Plagiopsetta glossa		Franz	1910
Samariscus huysmani		Weber	1913
Samaris ornatus		Von Bonde	1922
Samaris delagoensis		Von Bonde	1925
Samaris macrolepis		Norman	1927
Samariscus longimanus		Norman	1927
Samariscus sunieri		Weber & De Beaufort	1929
Samariscus fasciatus	*Plagiopsetta glossa*	Fowler	1934
Samariscus macrognathus		Fowler	1934
Samariscus luzonensis		Fowler	1934
Samariscus japonicus		Kamohara	1936
Samariscus latus		Matsubara & Takamuki	1951
Samariscus asanoi		Ochiai & Amaoka	1962
Samariscus xenicus		Ochiai & Amaoka	1962
Samariscus triocellatus		Woods	1966
Samaris cristatus erythraeus		Chabanaud	1969
Samariscus filipectoralis		Shen	1982
Samariscus nielseni		Quéro, Hensley & Maugé	1989
Samariscus desoutterae		Quéro, Hensley & Maugé	1989
Samaris costae		Quéro, Hensley & Maugé	1989
Samaris sp.		Quéro, Hensley & Maugé	1989
Samariscus sp.		Amaoka, Hoshino & Parin	1997
Samaris validus (fossil)		Schwarzhans	1999
Samaris verus (fossil)		Schwarzhans	1999

Table 1. Chronological list of nominal species, both recent and fossil, for the Samaridae. See individual species accounts for details of revisions.

Taxonomic History

The Samarinae were erected as a subfamily of Pleuronectidae by Jordan & Goss (1889). In their study, they characterized the subfamily as having: a small, nearly symmetrical mouth, ventral fins with elongated bases, minute gill rakers and in most of the species in the group, filamentous and simple dorsal fin rays. The following genera were included in Samarinae; *Samaris*, *Lophonectes*, *Poecilopsetta* and *Nematops*. The latter two genera are now placed in Poecilopsettidae (Norman, 1934) and *Lophonectes* placed in Bothidae (Norman, 1934). Regan (1910) divided the Pleuronectidae into three subfamilies: Pleuronectinae, Samarinae (*Samaris*, *Brachypleura* and *Paralichthodes*) and Rhombosoleinae. The Samarinae were defined (ibid) as follows; dorsal fin extending forward on snout either above or below the nasal organ of blind side, pelvic fins supported by the pelvic bones behind or below the cleithra, asymmetrical, that of the eyed side median and somewhat advanced, pectoral radials present, hypocoracoids expanded, vertebrae 31 (10+21); precaudal parapophyses united to form closed haemal arches bearing the slender ribs at their extremities, mouth symmetrical, with the jaws and dentition nearly equally developed on both sides.

Regan (1920) removed *Paralichthodes* from the Samarinae by erecting the new family Paralichthodidae and included four genera in the Samarinae; *Brachypleura*, *Lepidoblepharon*, *Samaris* and *Samariscus*, including *Plagiopsetta glossa* as a doubtful *Samariscus glossa*. Chabanaud (1937) erected the subfamily Brachypleurinae, including *Brachypleura* and *Lepidoblepharon*, as a subfamily of the Samaridae. Chabanaud (1939) elevated the Samarinae to the family level, listing 15 species and omitting *Brachypleura* and *Lepidoblepharon*. The latter two species were moved to the new family Citharidae by Hubbs (1945). Chabanaud (1949) again referred to the family Samaridae without listing genera or species. Nelson (1984) included *Paralichthodes algoensis* in Samarinae, but in a later edition (Nelson 1994) agreed with the recommendations of Chapleau & Keast (1988) and Chapleau (1993) in recognizing the family Samaridae.

Chronology of species description

Thirty nominal species of extant and fossil samarids have been described, beginning with *Samaris cristatus* Gray, 1831 which in turn is the type genus for the family. *Samariscus corallinus*, the type species for *Samariscus*, was described by Gilbert in 1905. *Plagiopsetta glossa* Franz, the monotypic species comprising *Plagiopsetta*, was described in 1910. Additional species in the genera *Samaris* and *Samariscus* were described by Norman (1927), Fowler (1934), Matsuhara & Takamuki (1951), Ochiai & Amaoka (1962). The most recent species descriptions were made by Quéro et al. (1989). Even more recently, a specimen identified to the level of genus was described as a juvenile *Samariscus* (Amaoka et al.. 1997).

Ochiai & Amaoka (1962) reviewed Japanese representatives of the genus *Samariscus*, describing *S. xenicus* and *S. asanoi* and providing a key to species in the genus. Matsuhara & Takamuki (1951) reviewed Japanese *Samariscus* species, describing *S. latus*. Quéro et al. (1989) provided a key for 18 species of samarids, omitting *Samaris*. These included three new species, *Samariscus nielseni*, *Samariscus desoutterae*, *Samaris costae* and a specimen closely resembling *S. costae* which they provisionally labelled *Samaris* sp. In noting a range extension of *S. inornatus*, Hensley (1993) also provided a key for 17 species of samarids, also omitting *Samaris*.

Phylogenetic placement

A cladistic analysis of the order Pleuronectiformes (Chapleau 1993) showed the Samaridae to be monophyletic and the sister group of the Achiridae-Soleidae-Cynoglossidae clade. Autapomorphies of the group are: eyed side frontal broadly attached to the parasphenoid, small metapterygoid, first preural centrum fused with second, third and fourth hypural plates and second, third and fourth hypurals are fused while hypurals 1 and 5 are autogenous (hypural pattern 5). This and another study (Chapleau & Keast 1988) suggested that the subfamilies Pleuronectinae, Samarinae, Rhombosoleinae and Poecilopsettinae should be raised to familial level. This was recognized for Samaridae by Hensley (1993) and by Nelson (1994). The phenetic analysis of Sakamoto (1984) showed that on the basis of similarity of 78 morphological characters, *Samaris*, *Samariscus* and *Plagiopsetta* formed a group distinct from other groups in OTU (Operational Taxonomic Unit) clusters. A phylogenetic study of *Paralichthodes* by Cooper & Chapleau (1998) showed that *P. algoensis* was neither a samarid nor a pleuronectid, but formed the sister group to a larger clade uniting the Poecilopsettidae, Rhombosoleidae, Samaridae, Achiridae, Soleidae and Cynoglossidae (see Fig. 1). The monophyletic status of the Samaridae and its ranking at the family level was reinforced by that study.

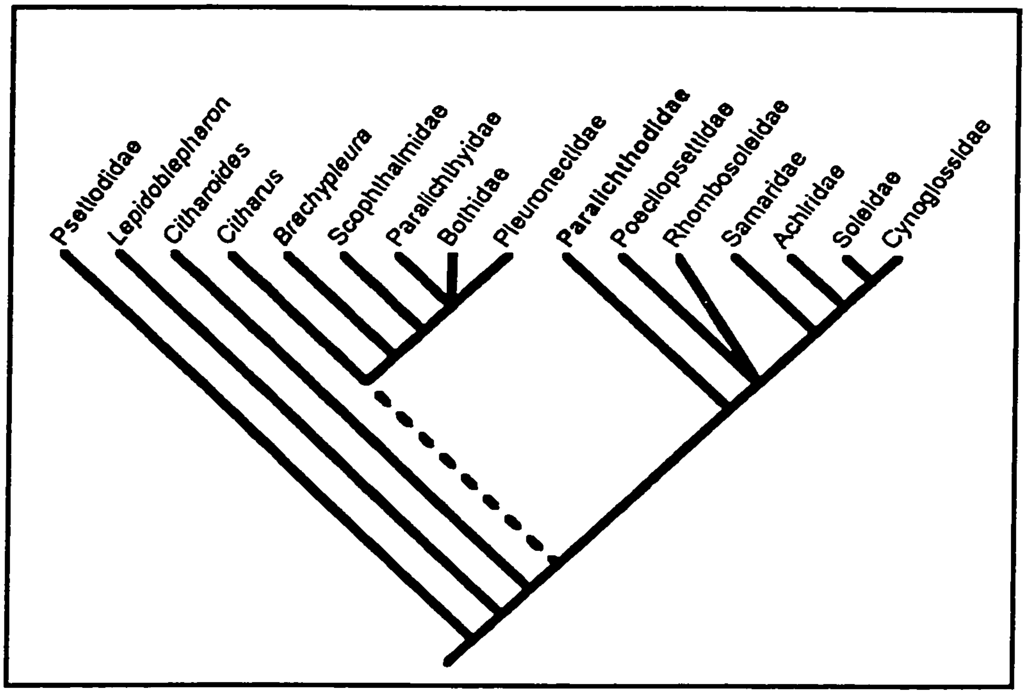

Figure 1. Consensus tree representing flatfish relationships from Cooper & Chapleau (1998)

The status of the family Samaridae as a natural or monophyletic group has been established by Chapleau (1993). In that study, interrelationships of the group were not investigated. The alpha taxonomy has not been established and no formal description of the family has been made. *S. fasciatus* was formally synonymized with *P. glossa* by Mihara & Amaoka (1995). *S. ornatus*, *S. cacatuae* and *S. delagoensis* were synonymized by Heemstra (1995) with *S. cristatus* who gave no evidence to support this action.

Cooper & Chapleau (1994) questioned the monophyletic status of *Plagiopsetta* and hence its rank as genus. The monophyly of the genus *Samariscus* had also been previously questioned (Amaoka et al. 1997). This study has three primary aims: first, to determine the interrelationships of the genera of the family; second, to define recognizable species of samarids; and third, to determine and discuss the geographic distribution of these species.

Placement of *Psammodiscus ocellatus*

Chapleau (1993) noted that *Psammodiscus ocellatus* (classified as a rhombosoleid by Norman 1934) shares hypural plate pattern 5 with members of the Samaridae. It should be noted that while the pattern of hypural grouping is identical, *Psammodiscus* has dissected hypurals that are distinct from the distinctive and uniformly fused hypurals exhibited by all samarids (see Fig. 2). Additionally, *P. ocellatus* shares 16 caudal fin rays and the possession of teeth on the 3rd epibranchial with samarids. The placement of *Psammodiscus ocellatus* is problematic. A phylogenetic analysis of the family and its interrelationships (A.-C. Guibord, University of Ottawa, pers. comm. 2000) showed that the species is not a member of the rhombosoleid clade.

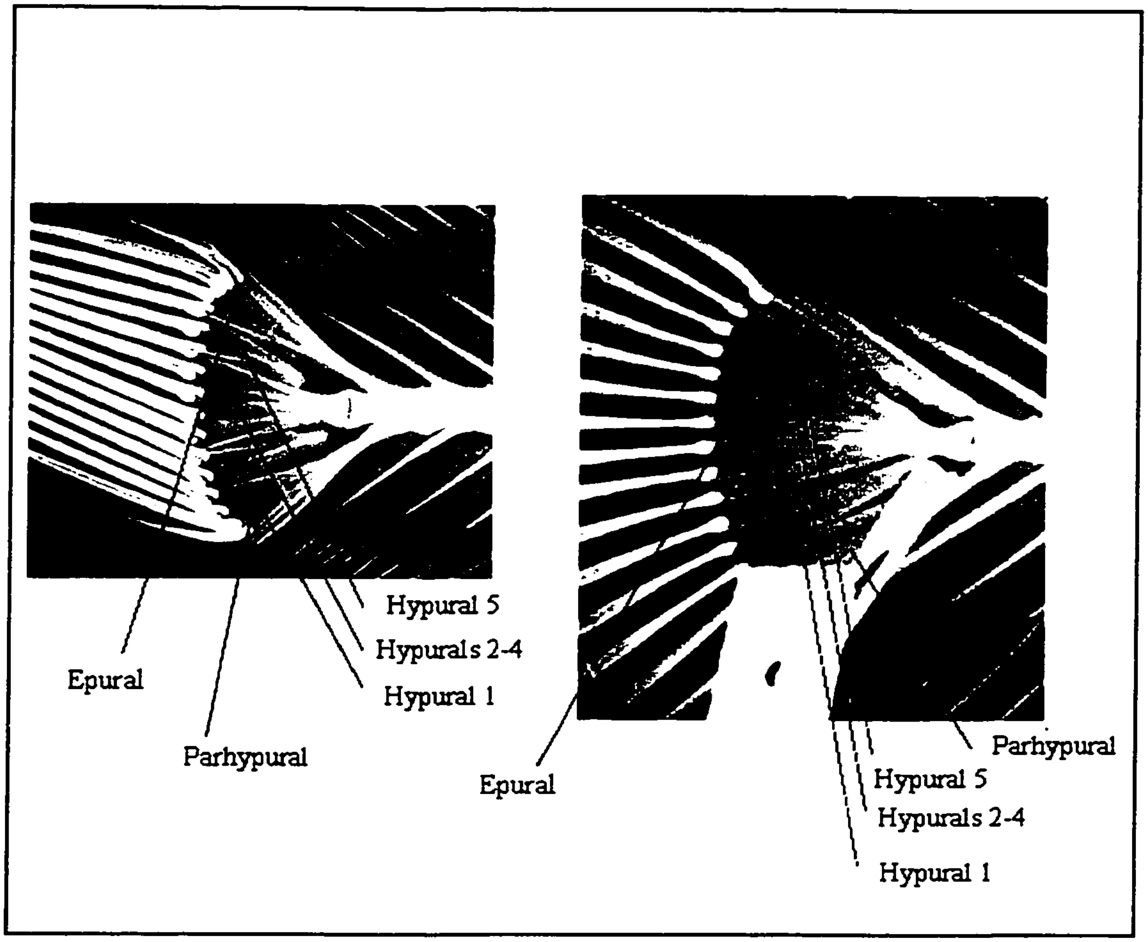

Figure 2. Hypural plate patterns of *S. cristatus*, left; *P. ocellatus*, right.

Objectives of this study

This study has two main objectives; 1) to determine the monophyletic status of each genus within the Samaridae and 2) to determine the interrelationships of those genera. To establish the monophyly of each genus, all species within each genus were examined (with the exception of *S. asanoi*) for synapomorphies. If each samarid genus is shown to be monophyletic, a phylogenetic study to determine generic interrelationships within the Samaridae and to assess the status of *Psammodiscus ocellatus* can be done.

In addition to the samarid genera and *Psammodiscus ocellatus*, the cladistic analysis will include the following outgroups (see Fig.1): Rhombosoleidae (*Azygopus*), Poecilopsettidae (*Poecilopsetta*), and the Achiridae (*Achirus*). The representative for each family represents, to the best of our knowledge, the most plesiomorphic taxon of each clade. *Psammodiscus* was included in the ingroup with *Plagiopsetta*, *Samariscus* and *Samaris*. Characters used in the analysis are listed in Appendix 1. Characters 3,5-7,9-10, 15-19 and 27-28 were unordered; all others were ordered. The character matrix (shown in Appendix 2) was subjected to an exhaustive search using PAUP ver. 3.1.1, D.L. Swofford, 1991, unpubl. Character optimization was set for accelerated transformation (ACCTRAN). Paraphyletic outgroups were permitted.

Results

All 3 samarid genera were found to be monophyletic and are included in the phylogenetic analysis. Synapomorphies for each are: *Plagiopsetta* has an unpigmented snout (15), 7 –9 pectoral rays (17), the and the b.s has some degree of pigmentation (26). *Samariscus* species all have 5 abdominal parapophyses (10). All species in *Samaris* have prolonged dorsal rays (2), prolonged ocular pelvic rays (4) and simple caudal rays (9). This study has corroborated the monophyly of *Plagiopsetta* and consequently this taxon should be recognized as a good genus. Additionally, this study for the first time has recognized a synapomorphy for *Samariscus*. Therefore, all genera in the Samaridae are good monophyletic taxa, and thus can be used as such in the phylogenetic analysis of the family.

In the analysis of the inter-relationships of the samarid genera, the exhaustive search resulted in two equally parsimonious cladograms of 39 steps [consistency index (CI), excluding uninformative characters = 0.79 , retention index (RI) = 0.80], differing only in the arrangement of the outgroup. In both cladograms, an unresolved trichotomy of *Poecilopsetta*, *Azygopus* and *Psammodiscus* formed the sister group of the Samaridae and *Achirus* (Fig. 3). Within the Samaridae, *Plagiopsetta* was seen to be the most plesiomorphic clade. The character supporting the monophyly of the species of *Samariscus* (abdominal parapophyses 5) is an equivocal character, as it is shared by *Achirus*, but within the Samaridae, it is interpreted as an autapomorphy for the genus. Based on this study, *Psammodiscus ocellatus* cannot be included in the Samaridae as it does not share all the autapomorphies of the clade. A study using a much expanded suite of characters and possibly including additional taxa such as *Tephrinectes* should be done to determine the phylogenetic placement of *Psammodiscus ocellatus*.

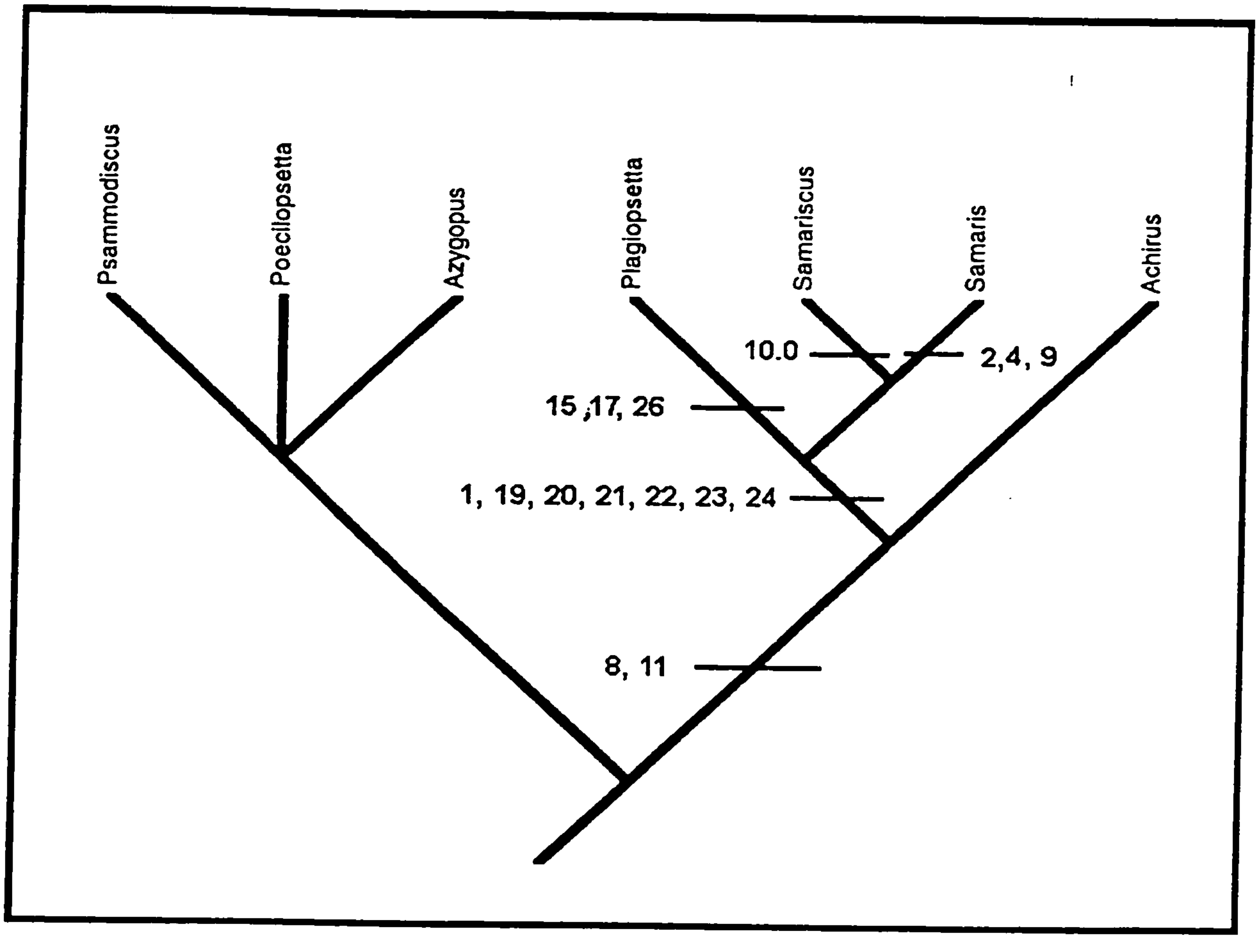

Figure 3. Strict consensus of two equally parsimonious cladograms (39 steps, CI = 0.79, RI = 0.80) resolved by exhaustive search using a matrix of 7 taxa and 28 characters. Decimal numbers indicate the order of apomorphic states.

Ecology

The literature on ecological aspects of samarids is virtually non-existent. In the course of this study, data on depth distribution and habitat were compiled from museum labels. In an ongoing study, hard part food items visible in radiographs are being identified and listed. Species in the family Samaridae are found at a mean depth of 131 m. One species, *Samariscus triocellatus*, is reef-dwelling and is found at a mean depth of 9 m. The depth of the most shallow non-reef-dwelling samarid, *Samariscus sp.* is 14 m; the deepest is *Samariscus desoutterae* at 325 m. Only three species are found deeper than 200 m. Thus, samarids can generally be classified as nearshore fishes (Helfman et al. 1997); fishes living down to 200 m. This depth distribution generally follows the extent of continental shelf and upper slope areas.

The diet of samarids has never been investigated. In examining radiographs of specimens in this study, intact shells of gastropods as well as intact portions of other invertebrates were observed. The small teeth and rudimentary gill rakers of samarids mean that they are likely to feed on small invertebrates and perhaps be nippers of mollusc siphons. Some clearly swallow whole gastropods and other molluscs. Food items that have been identified in stomach contents from radiographs include: Foraminifera, larval and adult gastropods (*Nassarius* sp. (Family Nauticidae), Teretelidae and Buccinidae), scaphopods (tusk or tooth shells), cumaceans (Crustacea). Of all stomach contents examined, only specimens of *S. triocellatus* were seen to have ingested other fishes. The habitat at the capture sites is generally listed as sandy or muddy bottoms and flats, with reef habitats listed for *Samariscus triocellatus*. The muddy or sandy shore biome constantly receives a supply of mud or sand, forming an unstable substrate. This benthic habitat forms an ideal environment for burrowing worms, crustaceans, molluscs and gastropods; all typical food items for flatfishes.

Fossil samarid species

In his study of otolith morphology in Pleuronectiformes, Schwarzhans (1999) defined the Samarinae as including *Samaris*, *Samariscus*, *Plagiopsetta* and *Azygopus* (the latter genus is generally accepted as being included in the Rhombosoleidae). This classification scheme based on a single character conflicts with other classifications based on numerous characters (see Sakamoto (1984), Chapleau (1993); Cooper & Chapleau (1998)). There are numerous factual errors in the section on samarids. Schwarzhans erroneously cited Norman in asserting that all samarids possess 4 pectoral fin rays. He stated that "several species are adapted to living in a reefoidal environment" and a page later that all *Samariscus* species are found on or near coral reefs. This is true only of *S. triocellatus* and possibly *S. corallinus*. Additionally, *S. triocellatus* is listed as Woods 1984 rather than Woods 1966.

Otoliths of the Samaridae *sensu* Schwarzhans (*ibid*) are small and thick-set, with an extremely deepened V-shaped sulcus, the deepest of all pleuronectiformes. Schwarzhans (1999) described the fossil samarid species *S. validus* (Holotype BSP 1984 X 116, type locality New Zealand). However, in his illustration of the otolith of this new species, there is an apparent typographic error and the otolith is labelled *Samaris verus*. According to the International Code of Zoological Nomenclature (1985, 3rd edition, Article 24a and Recommendation 24) this constitutes the simultaneous publication of names. The first reviser may select the name rather than using line or page precedence. As this study has not examined otoliths, it remains for a formal study of samarid otoliths to clarify this issue.

Materials and Methods

Four hundred and seventy-seven specimens from 17 museums were loaned. Museum acronyms follow Leviton et al.. (1985) and Leviton and Gibbs (1988). These specimens were measured, radiographs made and counts taken. Methods used for making counts and measurements follow those of Hubbs and Lagler (1964) and Holčík (1991) with the following additions or exceptions; orbital width, abdominal parapophyses, supracranial pterygiophores, interdigitation pattern following Munroe (1998) and proximal reduced anal pterygiophores. All measurements (see Table 2) were made using dial calipers and data recorded to tenths of a millimetre. Counts (see Table 3) and measurements were made on the right side of specimens. Vertebra, fin ray and pterygiophore counts were made from radiographs. The first caudal vertebra was defined as the centrum bearing the first elongate haemal spine. In species descriptions, modal meristic counts are given. Where specimens were too few to summarize using modal values, mean values were used; ranges can be found in the tables. Descriptions of pigmentation are based on formalin-fixed fishes stored in alcohol. Material examined for each species is listed at the beginning of each account. Major divisions on scale bars in photographs represent one centimeter, minor divisions represent one millimetre.

Table 2: Acronyms and methods of morphometric measurements.

SL	Length of axial skeleton	Eye_fixed	Distance from interorbital bones on a long axis
HL	Length of head	Intorb	Distance from lower margin of orbit of migrated eye to the upper margin of the fixed eye
H_depth	Depth of head at the posterior extent of the most posterior orbit (generally that of the fixed eye)	B_depth	Greatest depth of body
		Caud_ped	Depth of caudal peduncle
Snout	Length of snout	Pre_anal	Distance from snout to origin of first anal fin ray
Orb_width	Distance from most distal dorsal portion of orbit of migrated eye to the most distal ventral portion of the fixed eye	Pelvic_l	Basal articulation to tip of longest ray
		Pectoral_l	Basal articulation to tip of longest ray
		Dorsal_l	Basal articulation to tip of longest ray, most often third or fourth ray
U_jaw_O	Length of pre-maxilla plus maxilla on the eyed side	Caud_l	Basal articulation to distal tip of longest ray, most often middle rays
L_jaw_O	Length of dentary plus angulo-articular on the eyed side	Dorht	Basal articulation to distal tip of a dorsal fin ray taken at the same line where body depth taken
U_jaw_O	Length of pre-maxilla plus maxilla on the blind side	Anlht	Basal articulation to distal tip of an anal fin ray taken at the same line where body depth taken
L_jaw_O	Length of dentary plus angulo-articular on the blind side		

Table 3: List of Meristics

Dorsal, Anal and Pectoral fin rays	All rays counted
Prolonged dorsal fin rays	All rays counted
Vertebral counts	Caudal and abdominal rays counted
Ll scales	See Hubbs & Lagler (1964)
Interdigitation pattern	Patterns of interdigitation of proximal dorsal pterygiophores and neural spines according to the methods of Munroe (1992). Fig. 5 illustrates a 1-2-2 pattern
Supracranial pterygiophores	Number of pterygiophores over the cranium anterior to a line following the most posterior portion of the cranium. See Fig. 5 for illustration
Abdominal parapophyses	Count of abdominal vertebrae bearing paired parapophyses.
Proximal reduced anal pterygiophores (PRAP)	Count of pterygiophores not including the first highly enlarged one, to the first pterygiophore preceding the haemal spine of the first caudal vertebra. See Fig. 4 for illustration of a specimen with 4 proximal reduced anal pterygiophores

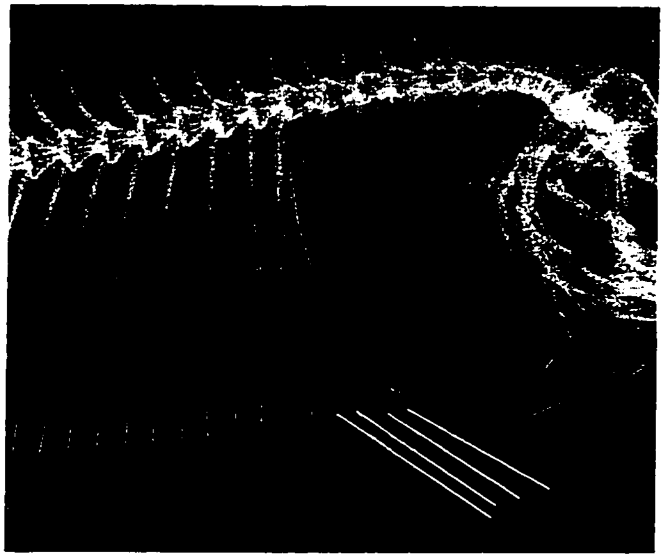

Figure 4. Illustration of proximal reduced anal pterygiophores.

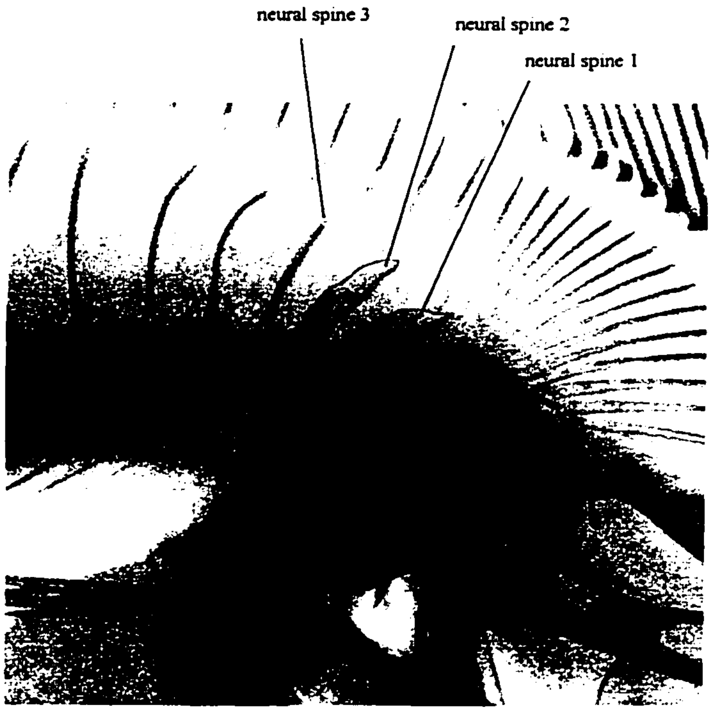

Figure 5. Radiograph illustrating supracranial pterygiophores and interdigitation pattern

In this study, recognition of species follows the phylogenetic species concept of Cracraft (1983): "A species is the smallest diagnosable cluster of individual organisms within which there is a parental pattern of ancestry and descent". In this view, populations or individuals from those populations are recognized as species if they exhibit a single diagnosable difference from other populations. Another definition of species incorporated into this study (Eldredge & Cracraft 1980) is that of minimal monophyletic groups (populations for which no further subdivision can be made by observing unique characters). After data gathering, body measurements were plotted against standard length to check for outliers and irregularities or other patterns in the data and those errors rectified. Ratios of body part measurements were calculated and those ratios were plotted (generally against standard length) in order to visualize differences in characters between taxa. For meristic variation, histograms of counts were plotted and frequency distribution tables generated.

In cases where there were many specimens and potentially more than two groups, other means of differentiating divergent taxa were required. In morphometric studies, fish populations should be compared in terms of shape variates free from the effects of size variation (Reist 1985, 1986). In this study, size effects in the data were minimized using the regression-related technique of calculating residuals from the pooled groups regression line of logged (base 10) body part and logged standard length. These residuals are orthogonal to the regression line and hence reflect the shape of the body part independent of size. Standardized residuals were used in a principal components analysis (PCA) in order to summarize variation in the dataset, as a diagnostic procedure and to reduce the number of variables for further statistical analyses. A classification procedure, discriminant function analysis (DFA), was used on size-free factors summarizing variation in the dataset.

Latitude and longitude data were taken from collection data as supplied by museums or taken from specimen labels. Where only a general locality was given, latitude and longitude were taken from a gazetteer or approximated for mapping purposes.

Artificial key to Family Samaridae

1a Pectoral fin rays 4 or 5 .... **2**

1b Pectoral fin rays 7-10 .... *Plagiopsetta glossa* Franz 1910

2a Pectoral fin rays 4, caudal fin rays simple, first 6-15 dorsal and all e.s. pelvic fin rays prolonged .... *Samaris* **3**

2b Pectoral fin rays 4 or 5, caudal fin rays branched............................ *Samariscus* **10**

3a Prolonged dorsal fin rays 10-15, b.s. cephalic skin extending from base of 1st dorsal fin ray to posterior end of articular, no membrane between the first and second e.s. pelvic fin, 7 abdominal parapophyses .... *S. cristatus* complex **4**

3b Prolonged dorsal fin rays 4-8, b.s. cephalic skin flap absent or extending from base of 1st dorsal fin ray to midpoint of b.s. of head, membrane between the first and second e.s. pelvic fin, 6 abdominal parapophyses **7**

4a B.s. cephalic skin flap robust, often scalloped and variably yellow, generally inserting at or posterior to the posterior and ventral extent of the b.s. articular **5**

4b B.s. cephalic skin flap weak and translucent, generally inserting at or posterior to the posterio-ventral extent of the b.s. articular **6**

5a Cream-coloured to whitish spots on the pectoral fin, HL in SL > 4.3 .... *Samaris ornatus* (Von Bonde 1922)

5b Cream-coloured to whitish spots on the pectoral fin not present, HL in SL ≤4.3.. *Samaris* sp.

6a Pigmentation on body quite uniform, little to no obvious blotching or spotting, pelvic fin uniform in colouration .... *Samaris cristatus* Gray 1831

6b Pigmentation on body variable, obvious blotching and spotting, pelvic fin with distinct banded pattern .... *Samaris cacatuae* (Ogilby 1910)

7a Robust ctenii on posteriormost scales of dorsal and anal margins .. .. *Samaris* sp1.

7b Robust ctenii on any scales absent **8**

8a E.s. pelvic fin rays long (< 2.8 in SL) .... *Samaris macrolepis* Norman 1927

8b E.s. pelvic fin rays short (> 2.8 in SL) **9**

9a Colour light, light spotting on body, anal fin rays 52-59 ....*Samaris costae* Quéro et al. 1989

9b Colour dark, anal fin rays 50 ....*Samaris* sp2.

10a Anterior dorsal fin rays longer than the following rays; snout length greater than eye...... .... **11**

10a Anterior dorsal fin rays not longer than the following rays; snout length less than eye...... .... **13**

11a 75 to 77 dorsal fin rays, 63 to 65 anal fin rays; 98 - 100 ll scales .... *S. corallinus* Gilbert 1905

11b 62-70 dorsal fin rays, 47-57 anal fin rays; 71-78 ll scales....................................... **12**

12a Ornamentation characterized by 2 or 3 dark rings, about as large as the eye, on the lateral line or just below .... *S. triocellatus* Woods, 1966

12b Markings consist of 4 large dark spots, along the base of the dorsal, and 2 or 3 along the base of the anal, the more posterior being larger and most visible .... *S. nielseni* Quéro et al. 1989.

13a Pectoral longer than half the body, excepting the head and tail **14**

13b Pectoral equal to half or less than half of body length excepting the head and tail **16**

14a Maxillary elongated, twice in head, ending posteriorly under the middle of the lower eye; pectoral with 4 rays (about 0.6 times in head). D 67; A 51, ll 60 .... *S. macrognathus* Fowler, 1934

14b Maxillary 2.2 times or more in head; pectoral with 5 rays (0.5 or less in head) pectoral blackish, about 0.5 times in HL, D 66 - 71, A 50 – 54.............................. ....*S. longimanus* Norman, 1927

15a 69-76 ll scales **16**

15b 45 - 68 ll scales **17**

16a 68-78 dorsal fin rays, 55 - 59 anal fin rays, maxillary 2 to 2.5 times in head length. E.s. lower jaw 1.8 times in HL .... *S. huysmani* Weber, 1913

16b 78-80 dorsal fin rays, 61-63 anal fin rays. Maxillary 2.9 to 3 times in HL. E.s. lower jaw 2.1 to 2.3 times in HL. ....*S. desoutterae* Quéro et al. 1989

17a Pectoral at most a little longer than the head (0.7 to 1.3 times in head length) **18**

17b Pectoral ≤0.7 in HL ....*S. latus* Matsuhara & Takamuki,1951

18a 4 pectoral fin rays **19**

18b 5 pectoral fin rays **21**

19a Body quite deep, 2.2 to 2.6 times in SL; D 62 – 70, A 46-53, ll 45 to 52. Snout very short, 4.5 to 6.4 times in HL .... *S. xenicus* Ochiai & Amaoka, 1962

19b Depth of body 2.8 times in SL. A 54 or 55, snout 4.0 to 4.5 times in HL............. **20**

20a Head 5.2 times in SL. Pectoral at least as long as the head, eye 3.7 times in HL...*S. luzonensis* Fowler, 1934

20b Head 5.4 times in SL. Pectoral almost as long as the head, eye 3.0 to 3.3 times in HL ....*S. asanoi* Ochiai & Amaoka, 1962

21a Anterior dorsal fin rays more widely spaced than those following; no gill-rakers; body depth 3 to 3.2 times in SL, pectoral 1.2 to 1.3 in head length ....*S. maculatus* Günther 1880

21b Anterior dorsal fin rays no more widely spaced as the following; body depth 2.3 to 3.1 times in SL, pectoral 0.8 to 1.3 in head length **22**

22a Dorsal fin rays 77, A 62, dark spots on body, at base of e.s. lower jaw, posterior margins of dorsal and anal fins ....*Samariscus sp.*

22b Dorsal fin rays 67-70, A 52, few dark spots on body, none at base of e.s. lower jaw or posterior margins of dorsal and anal fins **23**

23a Maxillary 3.5 to 3.6 times in HL. E.s. lower jaw 2.5 times in head length. ....*S. inornatus* Lloyd, 1909

23b Maxillary 2.9 to 3.3 times in HL. E.s. lower jaw 1.9 to 2.1 times in head length ....*S. japonicus* Kamohara, 1934

Genus *Plagiopsetta* Franz, 1910

Plagiopsetta glossa was described by Franz from a locality listed as Yagoshima; this locality is inland in Japan. Mihara & Amaoka (1995) suggested that the locality was in fact Yaku Is. (Yaku-shima), Japan. The type is not extant. Norman (1932) listed the species as a doubtful *Samariscus glossa*. Mihara & Amaoka (1995) synonymized *S. fasciatus* with *P. glossa*. Kuronuma (1940) listed the following characters to support the validity of the genus: high number of pectoral fin rays, low caudal peduncle and small b.s. nostrils. The last two characters were rejected by Ochiai & Amaoka (1962) as they were shared with *S. fasciatus*. Small b.s. nostrils are shared with all samarids, and a low caudal peduncle is shared by many members of *Samaris*cus.

In this study, the genus *Plagiopsetta* is defined as follows: straight lateral line with a supratemporal curve, without a branch leading down toward the postopercle; pectoral fin rays 7-10, medial dark spot on mandibles and intermandibular area, snout feebly pigmented, pigment present on b.s., distinctive dark bar at base of caudal peduncle, hypomerals not extending onto caudal vertebrae and abdominal parapophyses 6.

N=24

Table 4. Variation in dorsal fin ray number in *Plagiopsetta*

Dorsal fin rays	66	67	68	69	70	71	72	73	74	75	x	sd
	2	0	1	5	7	1	3	0	1	1	70.0	2.18

Table 5. Variation in anal fin ray number in *Plagiopsetta*

Anal fin rays	50	51	52	53	54	55	56	57	58	x	sd
	2	0	2	4	6	4	0	1	1	54.1	2.47

Table 6. Variation in numbers of total vertebrae in *Plagiopsetta*

Total vertebrae	37	38	x	sd
	7	14	37.6	0.50

Table 7. Variation in numbers of supracranial pterygiophores in *Plagiopsetta*

Supracranial Pterygiophores	6	7	8	x	sd
	4	12	4	7.0	0.63

Table 8. Variation in numbers of proximal reduced anal pterygiophores (PRAP) in *Plagiopsetta*

PRAP	4	5	6	x	sd
	1	16	3	5.1	0.49

Table 9. Frequency distribution of interdigitation pattern in *Plagiopsetta*

Interdigitation pattern	0-1-2	0-2-1	0-2-2	0-3-1	1-1-2	1-2-1
	2	2	13	1	1	1

Table 10. Frequency distribution of lateral line scales in *Plagiopsetta*.

Lateral line Scales	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	x	sd
	1	0	1	4	3	2	1	1	2	2	1	0	0	0	1	1	66.5	4.18

Plagiopsetta glossa Franz, 1910

Samariscus glossa Norman, 1931
Samariscus fasciatus Fowler 1934

Material examined

BMNH (not catalogued) 1(69.0 mm SL), no locational data, BMNH 1995.4.12; 2(90.8-99.0 mm SL), no locational data, CAS 123481 1(101.3 mm SL) 39°7' N, 139°52' E, HUMZ 79905 1(121.3 mm SL) 34°7' N, 136°5' E, HUMZ 79906 1(144.9 mm SL) 34°7' N, 136°5' E, HUMZ 79908 1(113.7 mm SL) 34°7' N, 136°5' E, HUMZ 79909 1(104.9 mm SL) 34°7' N, 136°5' E, HUMZ 79910 1(77.8 mm SL) 34°7' N, 136°5' E, AMS I.24490-002 1(70.3 mm SL) 24°23' S, 153°17' E, AMS I.26828-001 1(140.2 mm SL) 28°6' S, 153°48' E, , AMS I.30409-006 1(101.6 mm SL) 29°49' S, 153°38' E, AMS I.31557-002 1(82.2 mm SL) 29°27' S, 153°34' E, AMS I.32142-009 1(152.0 mm SL) 28°25' S, 153°50' E, AMS I.33599-002 1(83.4 mm SL) 29°25' S, 153°34' E, , NTUM 05340 2(122.1-147 mm SL) 25°38' N, 122°4' E, NTUM 05341 1(123.5 mm SL) 24°46' N, 121°45' E, NTUM 07090 3(109.4-119.9 mm SL) 24°46' N, 121°45' E, USNM 093090 1(53.8 mm SL) 21°30' N, 115°0' E.

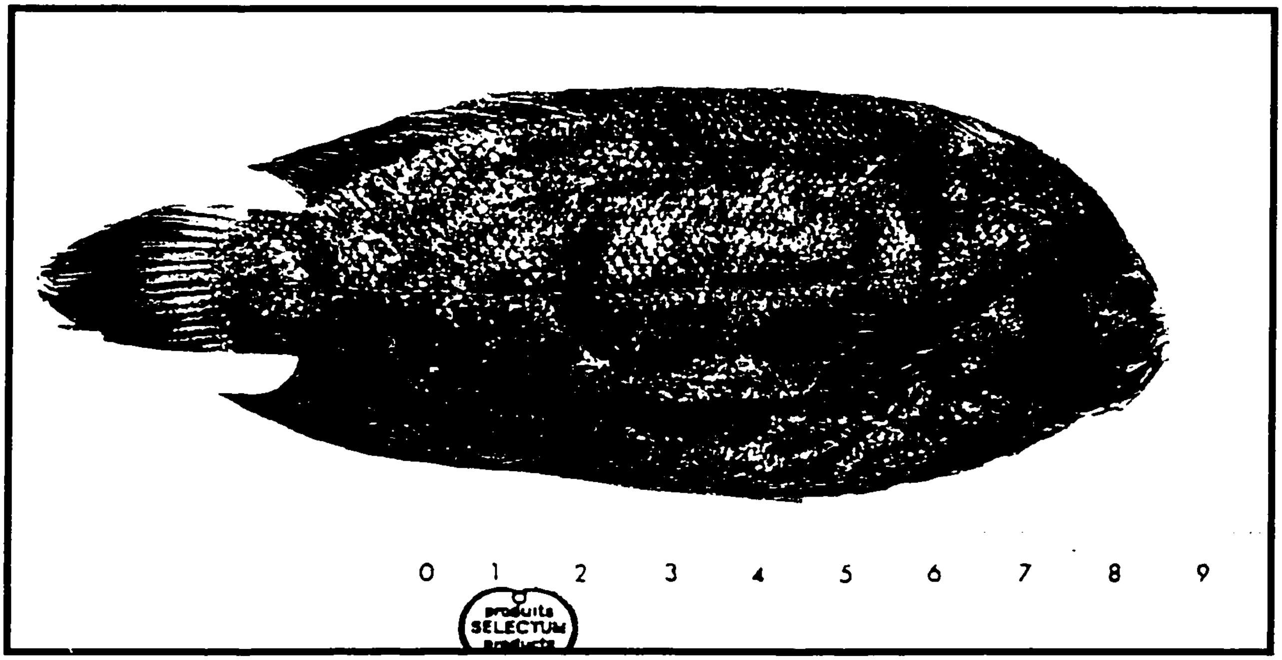

Figure 6. Illustration of *P. glossa*

Common names

Tongue flatfish (Cooper & Chapleau 1994), berogarei (Masuda et al. 1984).

Diagnosis

P. glossa can be distinguished from all other samarid species by the number of pectoral fin rays (≥7) and the presence of a supratemporal branch of the lateral line. Not all the diagnostic characters listed by Cooper & Chapleau (1994) are apparent in smaller individuals (less than or equal to ca. 55 mm). A feebly pigmented snout and dark pigmentation on mandibles and intermandibular area is not visible on the holotype of *Samariscus fasciatus*, however, it is not visible on smaller specimens of *P. glossa* examined in this study.

Description

Head very deep, with dorsal profile descending steeply over eyes to snout (see Fig. 6). Ventral margin of the body shows a comparatively gentle curve. Head noticeably deflected towards ventral side from midline of body. Short snout and head deep. Eyes large, closely set together close to mouth, crowded into anterior portion of the head. Morphometric characters are listed in Table 11. Modal meristic counts D(70), A(54), P1(9), total vertebrae (38) and lateral line scales (63) . Eyes separated by a scaled interorbital space. Mouth small. Scales ctenoid on both sides but lacking on snout, mouth parts and eyes. Small villiform teeth. Pectoral fin triangular, longer than head and robust, with a strong, dark brown to almost back membrane uniting the rays. Last few rays of dorsal and anal fins shaped into posterior-directed points.

Table 11. Morphometrics for *P. glossa*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

	Character	Mean, Range
1.	HL	4.4 (3.4-5.3)
2.	H_depth	1.0 (0.8-1.3)
3.	Snout	5.5 (3.8-7.5)
4.	Orb_width	1.9 (1.5-2.7)
5.	U_jaw_o	3.3 (2.7-4.5)
6.	L_ jaw_o	2.3 (2.0-3.3)
7.	U_jaw_b	3.8 (3.3-5.3)
8.	L_jaw_b	2.4 (2.2-3.6)
9.	Eye_fixed	3.2 (2.7-4.3)
10.	Intorb	23.3 (9.9-49.3)
11.	B_depth	2.3 (1.6-2.8)
12.	Caud_ped	7.6 (6.6-8.5)
13.	Pre_anal	4.2 (2.8-6.8)
14	Pelvic_l	7.4 (5.4-9.3)
15.	Pectoral_l	4.5 (3.3-6.8)
16.	Caud_l	4.0 (3.3-4.8)
17.	Dorht	8.8 (7.3-10.7)
18.	Anlht	8.3 (7.3-10.7)

Colour in alcohol

Generally a dark chocolate brown with a series of irregular brown blotches on margins of dorsal, anal, caudal fins. Pectoral fin with distinct blotching without being barred or banded. Caudal fin with distinct dark brown to black bars on the dorsal and anal markings close to the caudal peduncle. Distinct dark spots on the dorsal and anal margins of the caudal peduncle match with similar spots on the dorsal and anal fins. Dark blotch on mandibles and intermandibular area. Snout lacking pigment and blind side often partially pigmented on the posterior half of body. These characteristic pigmentation patterns are not apparent until a certain size is reached (over ca 55 mm).

Geographic distribution

P. glossa is found from Japan in the north east, south of the Queensland coast in the southeast (see Fig. 7). This is apparently a disjunct distribution, assuming that the area has been sufficiently sampled. Specimens labelled as *P. glossa* from New Caledonia will be requested from MNHM. If these specimens do indeed represent *P. glossa*, the range will be somewhat more continuous.

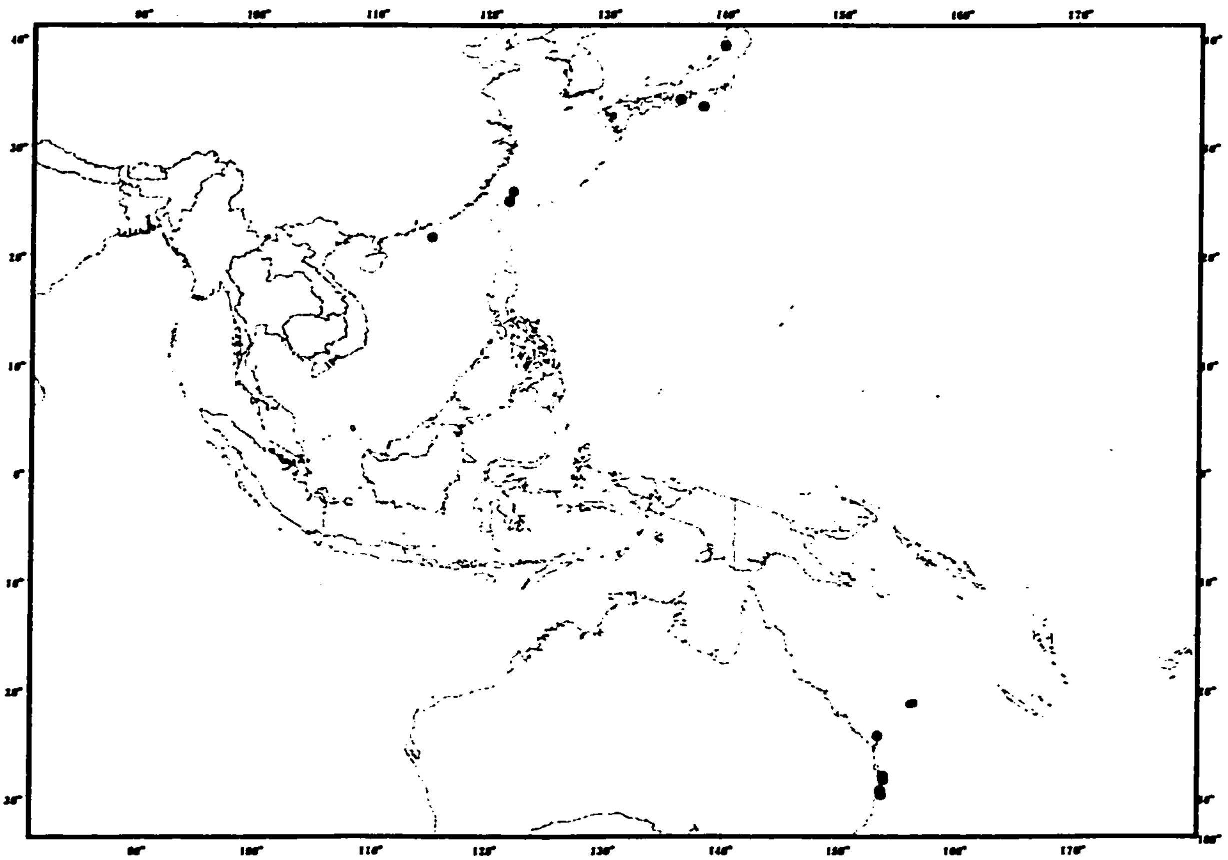

Figure 7. Distribution of *Plagiopsetta glossa*.

Remarks

Norman (1934) and Kuronuma (1940) noted similarities between *Plagiopsetta glossa* and *Samariscus fasciatus*. Ochiai & Amaoka (1962) noted that the number of pectoral fin rays was the only character distinguishing *Plagiopsetta* and *Samariscus fasciatus*. In their synonymy of *Samariscus fasciatus* and *Plagiopsetta glossa*, Mihara and Amaoka (1995) noted differences in counts and measurements from Fowler's description which they "considered to be Fowler's mistakes". They also stated that the recognition of a neotype is unnecessary according to Article 75 (b) of the International Code of Zoological Nomenclature (1985) because *P. glossa* represents the only species in the genus, which is clearly distinguishable from species in related genera.

The mean size of 104 mm for specimens surveyed makes *P. glossa* the largest samarid species.

Comparisons

P. glossa most closely resembles *Samariscus sp.*, but can be distinguished from that species in having 7 or more pectoral fin rays, a supratemporal lateral line and hypomerals not extending onto the caudal vertebrae. Some *Samariscus* species such as *S. latus* and *S. inornatus* share the deep head and steep dorsal slope over the eyes with *P. glossa*. Small specimens of *P. glossa* could be mistaken for *Samariscus* species, but may be identified by a count of pectoral fin rays.

Samaridae genus incertae sedis

Material examined

ANSP 145613 1(53.9 mm SL) 2°42' S, 40°53' E.

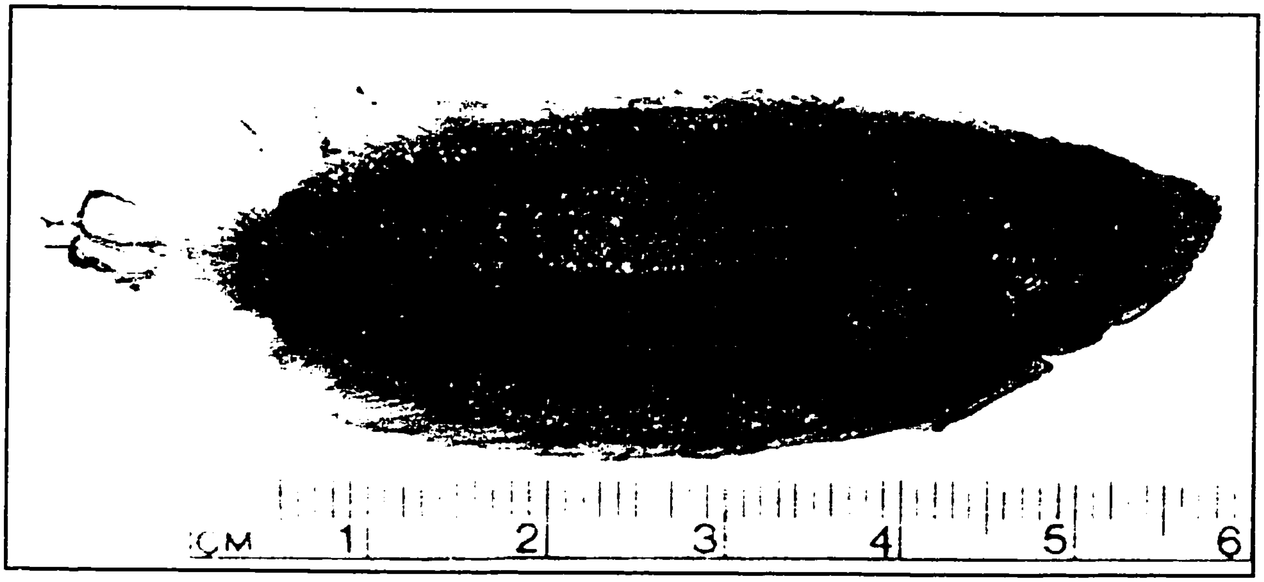

Figure 8. Illustration of ANSP 145613.

The specimen, from the Kenyan coast, cannot be placed either in *Plagiopsetta* or in *Samariscus*. Its meristics are D(75), A(61), P1(7), total vertebrae(43) and LL(74). These meristics are at the extreme range for *Plagiopsetta*. It is not referable to *Plagiopsetta* as the hypomerals extend to posterior caudal vertebrae, abdominal parapophyses number 5 (both characters shared with *Samariscus*) and the very long pectoral fin ray is straplike as opposed to fan-shaped. The specimen shares seven pectoral fin rays with *Plagiopsetta*, but visually appears similar to *S. maculatus* (see Fig. 8). This specimen cannot be placed in either genus and will await more specimens from the region and further taxonomic revision of the family.

Genus *Samariscus* Gilbert, 1905

***Samariscus* Gilbert, 1905** [type species *Samariscus corallinus*]

Gilbert (1905) described the new genus *Samariscus* as having anterior dorsal and pelvic rays not greatly produced, b.s. scales strongly ciliated, e.s. integument having many cup-shaped organs "possibly glandular in origin", eyes dextral, pelvic fins symmetrical, mouth small, teeth in villiform bands; lateral line rising anteriorly but without arch, present on e.s. only. Scales very small, strongly ciliated on both sides, opercle becoming adnate shortly above base of pectoral, gill rakers extremely feeble, right pectoral with four rays, left pectoral absent, all fins except caudal scaleless.

This genus is characterized by having caudal fin rays branched, pectoral fin rays simple and either 4 or 5 pectoral fin rays and 5 abdominal parapophyses. Until this study, the genus *Samariscus* served as a "garbage group" for the Samaridae. New species that were not obviously *Plagiopsetta* or *Samaris* were, by default, classified as *Samariscus*. The phylogenetic analysis in this study has shown that the genus *Samariscus* is monophyletic.

Meristic variation in *Samariscus*

Some counts for *S. triocellatus* will be truncated in the frequency table but displayed in an abbreviated manner below.

Numbers of specimens surveyed are listed in Table 12 and are not repeated in subsequent tables.

Table 12. Variation in dorsal fin ray number in *Samariscus*

Dorsal fin rays	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	N	x	sd
S. asanoi								1												1		
S. corallinus												1	2							3	75.7	0.58
S. desoutterae														1		1				2	78.0	1.41
S. huysmani								2	1	0	2	0	0	2	1	0	1	1	1	11	75.3	1.58
S. inornatus							1													1		
S. japonicus	1	1	2	3	1	0	1													9	66.7	1.73
S. latus								2	2	1	3	1	1	1						11	72.5	1.97
S. longimanus						2	1	0	1	1	0	1								6	71.3	2.42
S. luzonensis				1																1		
S. macrognathus				1																1		
S. maculatus				1																1		
S. sp.				1																1		
S. nielseni	1				1															2	66.0	2.80
S. sunieri							1				1	2								4	73.5	2.40
S .triocellatus	12	17	29	30	33	13	14	7	3	2	0	1	0	0	0	1				162	66.8	3.01
S. xenicus	2	2	0	2	1															7	65.3	3.60

The full range and values for *S. triocellatus* are summarized here:
60(1),61(2),62(6),63(22),64(12),65(17),66(29),67(30),68(33),69(13),70(14),71(7),72(3),73(2),74(0)75(1),76(0),77(0),78(0),79(1),80(0),81 (0),82(0),83(1)

Table 13. Variation in anal fin ray number in *Samariscus*

Anal fin rays	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	x	sd
S. asanoi								1								1	1			1	63.7	2.10
S. corallinus															1		1				62.0	1.41
S. desoutterae									2	1	0	1	2	2	0	2	1				59.0	2.79
S. huysmani						1																
S. inornatus			1	1	1	4	2														51.6	1.33
S. japonicus							2	1	2	1	2	3									55.8	1.94
S. latus						2	1	1	0	0	1	1									54.3	2.60
S. longimanus									1													
S. luzonensis									1													
S. macrognathus									1													
S. maculatus					1																	
S. sp.								1		1											55.0	1.40
S. nielseni								1		1	1				1						57.0	2.90
S. sunieri			3	6	14	20	34	32	40	19	16	4	3								54.0	2.06
S .triocellatus	1	2	2	2																	48.7	1.11
S. xenicus																						

Table 14. Variation in numbers of total vertebrae in *Samariscus*

Total vertebrae	35	36	37	38	39	40	41	42	43	44	45	46	47	x	sd
S. corallinus											2		1	45.7	1.15
S. desoutterae							2							41.0	0.00
S. huysmani			1	0	2	6	2							39.7	1.10
S. inornatus			1												
S. japonicus			3	5	1									37.8	0.67
S. latus			1	6	4									38.3	0.65
S. longimanus			1	3	1									38.2	0.75
S. luzonensis			1												
S. macrognathus							1								
S. maculatus					1										
S. sp.		1													
S. nielseni					1	1								40.0	1.41
S. sunieri					1	2		1						40.3	1.26
S .triocellatus			1	1	32	69	67	21						40.4	0.94
S. xenicus	5	2												35.3	0.49

(Only one count is listed for *S. nielseni* as the other specimen was damaged in the cranial area)

Table 15. Variation in numbers of supracranial pterygiophores in *Samariscus*

Supracranial pterygiophores	4	5	6	7	8	9	x	sd
S. corallinus		1	2				5.7	0.76
S. desoutterae				1	1		7.5	0.71
S. huysmani			3	6	2		6.8	0.87
S. inornatus				1				
S. japonicus			1	4	4		7.3	0.71
S. latus				1	10		7.9	0.30
S. longimanus				3	3		7.5	0.50
S. luzonensis					1			
S. macrognathus					1			
S. maculatus				1				
S. sp.				1				
S. nielseni			1					
S. sunieri				4				
S. triocellatus		12	139	35			6.1	0.49
S. xenicus				1	6		7.9	0.38

Table 16. Variation in numbers of proximal reduced anal pterygiophores in *Samariscus*

PRAP	3	4	5	6	x	sd
S. asanoi						
S. corallinus		3				
S. desoutterae		2				
S. huysmani	1	9	1		4.0	0.45
S. inornatus		1				
S. japonicus			8	1	5.1	0.33
S. latus		11				
S. longimanus		6				
S. luzonensis			1			
S. macrognathus		1				
S. maculatus		1				
S. sp.		1				
S. nielseni		2				
S. sunieri		4				
S. triocellatus	5	164	14		4.1	0.35
S. xenicus		1	6			

Table 17. Frequency distribution of interdigitation pattern for species in *Samariscus*. There is no entry for *S. asanoi* as no radiograph was made or obtained

Interdigitation pattern	0-1-0	0-1-1	0-1-2	0-2-0	0-2-1	0-2-2	0-2-3	0-3-1	0-3-2	1-1-1	1-1-2	1-2-1
S. corallinus					3							
S. desoutterae					1	1						
S. huysmani		1			4	1		2				3
S. inornatus						1						
S. japonicus					7			1			1	
S. latus			1		1	5					2	2
S. longimanus					2	3						1
S. luzonensis					1							
S. macrognathus					1							
S. maculatus					1							
S. sp.					1							
S. nielseni					1							
S. sunieri					4							
S. triocellatus	1	35	21	1	114	8	1			6	2	1
S. xenicus			1		3	2					1	

Table 18. Frequency distribution of lateral line scales for *Samariscus*.

Lateral line Scales	
S. asanoi	55(1)
S. corallinus	92(2), 93(1)
S. desoutterae	58(1), 64(1)
S. huysmani	60(1), 61(0), 62(0), 63(1), 64(0), 65(1), 66(0), 67(2), 68(2), 69(0), 70(1), 71(0), 72(1), 73(0), 74(0), 75(0), 76(1), 77(0), 78(1)
S. inornatus	60(1)
S. japonicus	56(1), 57(0), 58(2), 59(1), 61(2), 61(0), 62(2), 63(1)
S. latus	54(1), 55(2), 56(1), 57(2), 58(1), 59(2), 60(1), 61(0), 62(0), 63(1)
S. longimanus	58(1), 59(0), 60(0), 61(0), 62(0), 63(0), 64(2), 65(0), 66(0), 67(1), 68(2)
S. luzonensis	56(1)
S. macrognathus	67(1)
S. maculatus	66(1)
S. sp.	58(1)
S. nielseni	72(1), 76(1)
S. sunieri	59(1), 60(1), 63 (1), 71(1)
S. triocellatus	61(2), 62(1), 63(5), 64(3), 65(7), 66(7), 67(16), 68(13), 69(16), 70(25), 71(10), 72(16), 73(14), 74(14), 75(9), 76(11), 77(3), 78(7)
S. xenicus	45(1), 46(0), 47(4), 48(1), 49(0), 50(1)

Samariscus asanoi Ochiai & Amaoka (1962)

Material examined
Based on literature sources. Specimens were unavailable for loan.

Diagnosis
S. asanoi can be differentiated from its congeners by the following combination of characters: 4 pectoral fin rays, snout length 4.1 in HL, head length 5.4 in SL, body depth 2.8 in SL, eye diameter 3.3 in HL and anal fin rays 54.

Common names
None

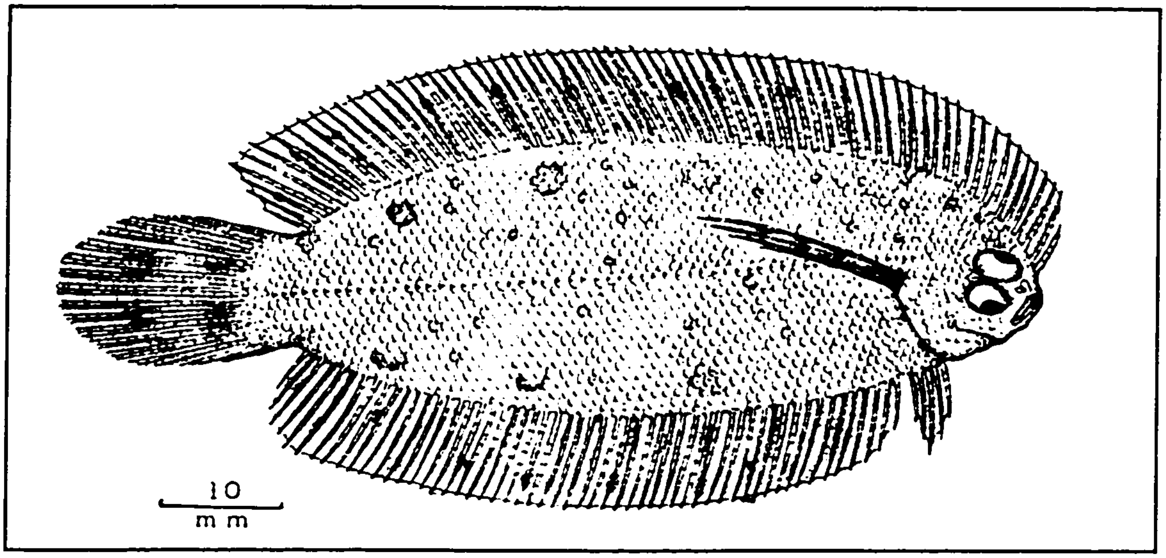

Figure 9. Illustration of *Samariscus asanoi* taken from Ochiai & Amaoka (1962)

Description
A small species of *Samariscus*. Dorsal fin rays 71 , anal fin rays 54, pectoral fin rays 4, lateral line scales 55. Proportions of morphometric features from the species description are presented in Table 19. Body long and slender, with dorsal contour rounded (see Fig. 9). Head small. Mouth small eyes large, occupying half the head depth. Lower eye same size as migrated eye. Posterior end of lower jaw anterior to fixed eye and projects in advance of the tip of the upper. Teeth villiform. Pectoral fin short.

Table 19. Morphometrics for holotype S297 of *Samariscus asanoi*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL. Eleven measurements taken from the original description are listed here as no specimens could be obtained for the study.

Character		
1.	HL	5.4
2.	Snout	4.1
3.	U_jaw_o	3.4
4.	U_jaw_b	3.7
5.	Eye_fixed	3.3
6.	B_depth	2.8
7.	Caud_ped	7.0
8.	Pelvic_l	8.6
9.	Pectoral_l	3.2
10.	Dorht	7.0
11.	Anlht	7.0

Colour in alcohol
Body brownish with five dorsal and four ventral spots. Scattered smaller spots on body. Pectoral pale, with three dark vertical bars. Vertical fins pale, with scattered small black spots.

Geographic distribution
S. asanoi was listed by Ochiai & Amaoka (1962) as being captured in Tonking Bay, but no entry for that name in gazetteers for Japan were found. It is possible that the locality is the Gulf of Tonking in southern China.

Comparisons
Close to *S. xenicus*, but differs in body depth (2.8 in SL for *S. asanoi* vs. 2.2-2.6 in SL for *S. xenicus*). Can be distinguished from other species of *Samariscus* by the following characters: pectoral rays 4, pectoral length 3.2 in SL, eye 3.0-3.3 in HL, body depth 2.8 in SL, anal fin rays 54.

Samariscus corallinus Gilbert, 1905

Material examined
USNM 51596, 1(85.8 mm SL), 1°21' N," 20° 1' E, holotype; USNM 51676, 2(68.9-69.5 mm SL), 1°21' N," 20° 1' E, paratypes.

Diagnosis
S. *corallinus* can be differentiated from its congeners by the following combination of characters: first few dorsal fin rays slightly prolonged, membrane attached to first dorsal fin ray, number of dorsal fin rays (75-77) and lateral line scales (92-93).

Common names
Coralline-red flounder (Tinker 1982)

Figure 10. Illustration of holotype USNM 51596 *Samariscus corallinus*

Description
A medium-sized species of *Samariscus*. Modal (with counts for holotype in parentheses) dorsal fin ray count 76(75), anal fin rays 62.5(mean (66), pectoral fin rays 4, lateral line scales 92(92), total vertebrae 45(47), supracranial pterygiophores 6(5) and proximal reduced anal pterygiophores 4(4). Proportions of morphometric features are presented in Table 20. Body long and slender, with upper and lower body outlines somewhat parallel (see Fig. 10). Mouth large. Head short, maxillary and mandibular areas free of scales. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower eye same size as

migrated eye; both small and in same vertical line. Posterior end of lower jaw anterior to fixed eye. Short membrane joining the first dorsal fin ray to blind side of head. Pectoral fin small. Pelvic fin short. Posterior margins of dorsal and anal fins pointed. Minute round saucer-like fleshy structures found near the focus of most scales on the e.s.

Table 20. Morphometrics for holotype USNM 51596 and 2 additional specimens (paratypes) of *Samariscus corallinus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

Character		Holotype	Mean, Range
1.	HL	5.2	4.4 (4.2-4.7)
2.	H_depth	4.6	4.3 (4.1-4.5)
3.	Snout	3.3	3.4 (3.0-3.7)
4.	Orb_width	2.0	2.3 (2.2-2.4)
5.	U_jaw_o	2.4	2.5 (2.4-2.6)
6.	L_jaw_o	1.5	1.6 (1.6-1.6)
7.	U_jaw_b	2.5	2.7 (2.6-2.8)
8.	L_jaw_b	1.6	1.7 (1.7-1.7)
9.	Eye_fixed	4.2	5.2 (4.5-5.9)
10.	Intorb	15.1	16.6 (12.4-20.8)
11.	B_depth	2.8	2.5 (2.4-2.5)
12.	Caud_ped	7.9	7.9 (7.7-8.2)
13.	Pre_anal	4.3	4.3 (3.5-5.1)
14	Pelvic_l	5.9	4.4 (3.8-5.0)
15.	Pectoral_l	5.7	4.0 (3.5-4.5)
16.	Caud_l	3.9	4.4 (4.4-4.5)
17.	Dorht	7.3	8.1 (7.7-8.4)
18.	Anlht	6.5	7.3 (6.2-8.4)

Colour in alcohol
Body mottled with indistinct scattered spots. Distal edges of pectoral, pelvic, dorsal, anal and caudal fins with small but distinct spots. Two obvious spots on body, each almost twice as large as eye, at posterior quarter of body.

Colour in life: body coralline red above and irregularly mottled and spotted with pinkish hues, pearl gray, and black. Two round black spots (as noted above) with orange centres mark the rear margin of the body (Gilbert 1905). Fig. 11 is an illustration of the holotype USNM 51596. The two ocelli shown at the tip of the pectoral fin are not visible in the holotype, having faded with time.

Figure 11. Illustration of holotype of *S. corallinus* taken from Gilbert (1905)

Geographic distribution

S. corallinus is a Hawaiian endemic (see Fig. 12).

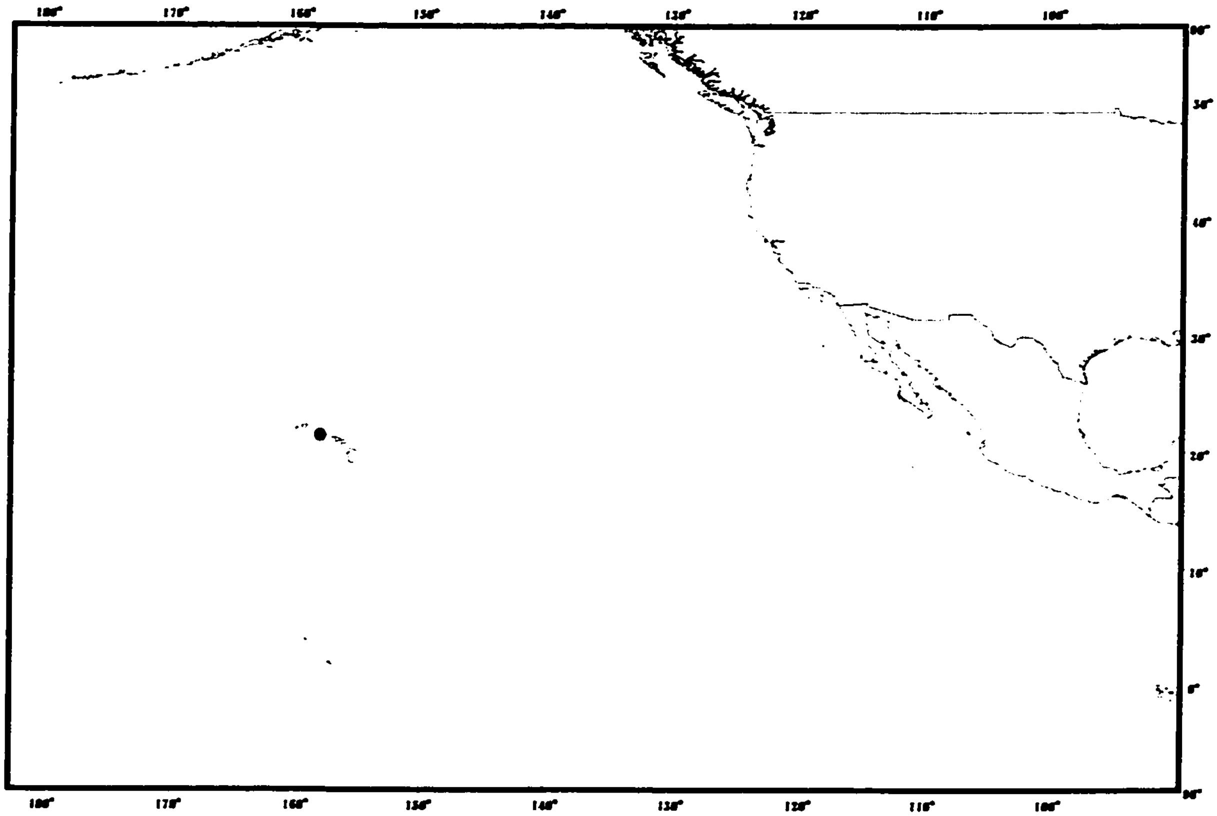

Figure 12. Distribution of *S. corallinus*.

Remarks
This species is based on only three specimens captured in 1902 from the Albatross off southern Molokai. Additional larval specimens (uncatalogued LACM collections) were collected in 1967 and 1972.

Comparisons
One of 3 species in *Samariscus* having 4 pectoral fin rays and a b.s. membrane at the base of the first dorsal fin ray. Also, only these three (*S. corallinus*, *S. neilseni* and *S. triocellatus*) species have ocelli (spots with a distinct central area that is differentially pigmented from the margin). *S. corallinus* can be distinguished from *S. neilseni* and *S. triocellatus* by its high dorsal fin ray count (75-77 vs 62-70 in the latter 2 species) and the high lateral line scale count (92-93), the highest in the family.

Samariscus desoutterae Quéro, Hensley & Maugé 1989

Material examined
MNHN 1984-0368, 1(74.0 mm SL), 15° 20'S, 46° 09'E, holotype. MNHN 1984-0369, 1(79.5 mm SL), 15° 20'S, 46° 09'E, paratype.

Diagnosis
S. desoutterae can be differentiated from its congeners by the following combination of characters: lateral line scales 92-93, anal fin rays 61-63, preanal distance 0.9-1.0 in SL, length of caudal and pelvic fin rays (9.1-12.6 in SL and 2.8-3.4 in SL respectively).

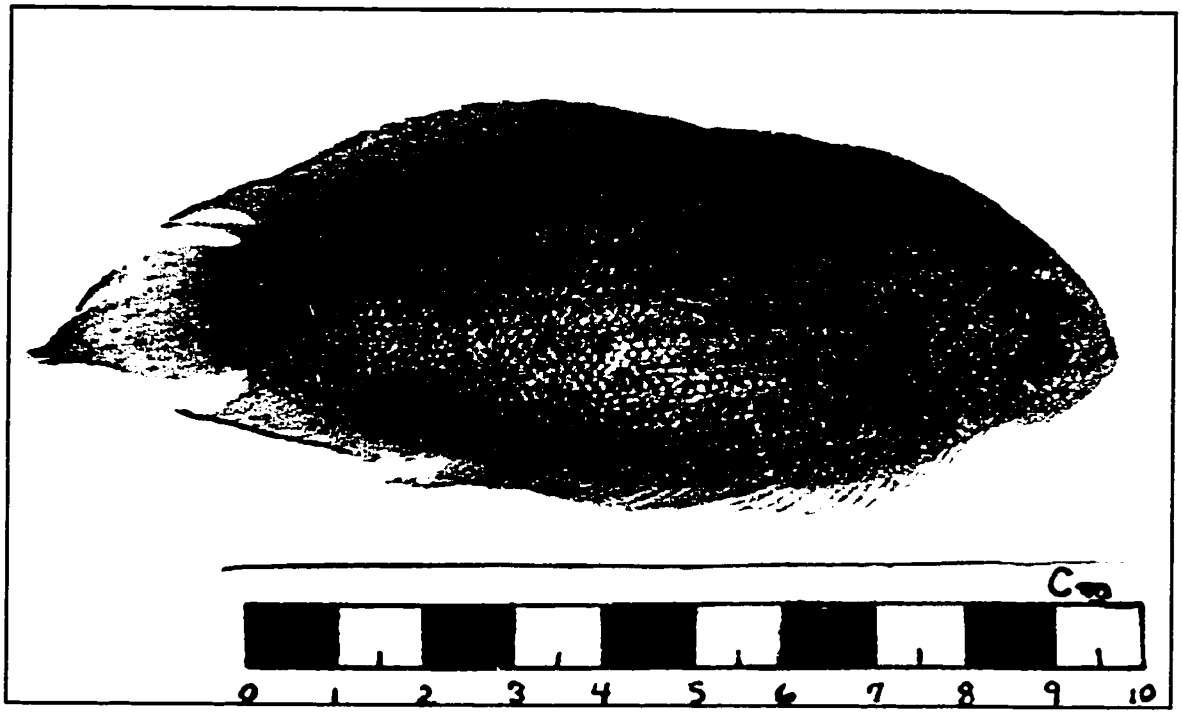

Figure 13. Illustration of *Samariscus desoutterae*

Description
A mid-sized species of *Samariscus*. Dorsal fin ray count (for paratype, with counts for holotype in parentheses) 77(79), anal fin rays 63(61), pectoral fin rays 4, lateral line scales 64(58), total vertebrae 41(41), supracranial pterygiophores 8(7) and proximal reduced anal pterygiophores 4(4). Proportions of morphometric features are presented in Table 21. Body oval, reaching maximum depth at halfway point of body; distinctly rounded outline (see Fig. 13). Head short, body outlines over eyes and below head sloping evenly to form a smooth conical shape. Maxillary and mandibular areas free of

scales, interorbital space scaled. Mouth small and oblique. Lower jaw ends anterior to the fixed eye. Teeth poorly developed in 2-3 bands on upper and lower jaws. Eyes large, lower same size as migrated one, both on same vertical line. Pectoral fin long, at least one third body length less the head, threadlike and prominent. Pelvic on e.s. very short. Posteriormost portions of dorsal and anal fins pointed. Small weakly ctenoid scales on both e.s and b.s.

Table 21. Morphometrics for holotype MNHN 1984-0368 and paratype MNHN 1984-0369 of *Samariscus desoutterae*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

Character		Holotype	Paratype
1.	HL	4.2	4.5
2.	H_depth	1.0	1.0
3.	Snout	4.9	4.8
4.	Orb_width	1.8	1.9
5.	U_jaw_o	2.8	3.0
6.	L_ jaw_o	2.0	2.1
7.	U_jaw_b	3.2	3.5
8.	L_jaw_b	2.2	2.4
9.	Eye_fixed	3.0	2.8
10.	Intorb	22.3	22.8
11.	B_depth	2.6	2.7
12.	Caud_ped	8.3	7.3
13.	Pre_anal	0.9	1.0
14	Pelvic_l	4.2	4.3
15.	Pectoral_l	2.8	3.4
16.	Caud_l	12.6	9.1
17.	Dorht	8.6	9.6
18.	Anlht	9.9	8.5

Colour in alcohol

Body clear brown with five distinct blotches on dorsal margin, four on the ventral margin. Two axial spots visible. Pectoral fin darker than body with distinct spots. Dorsal and anal fin rays with small sparse brownish spots. Distal margins of dorsal, anal and caudal fin rays tinged with dark brown. B.s. uniformly light greyish brown; caudal distal margin dark grey brown.

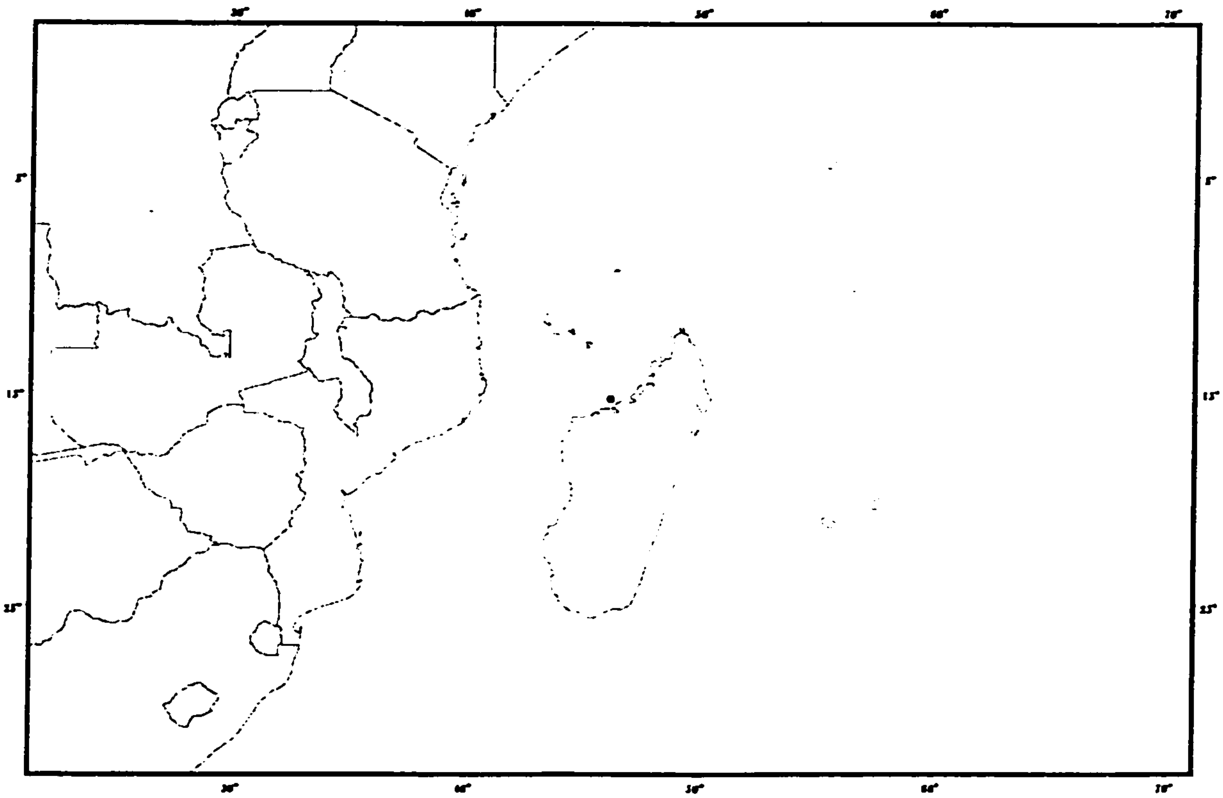

Figure 14. Distribution of *Samariscus desoutterae*.

Geographic distribution
This species is known only from Madagascar (Fig. 14).

Comparisons
Close to *S. huysmani*, but can be distinguished from that species by comparison of preanal distance (0.6-0.8 in SL vs 3.6-6.1 in SL in *S. huysmani*), the length of the pelvic and caudal fin rays (2.8-3.4 in SL vs 9.1-12.6 in SL in *S. huysmani*). *S. desoutterae* can be distinguished from other species of *Samariscus* by the number of pectoral fin rays (4) its relatively high number of lateral line scales (69-76).

Samariscus huysmani Weber 1913

Samariscus sunieri Weber & De Beaufort 1929

Material examined

AMS I.22807-018, 6(55.4-109.0 mm SL), 18° 32' S, 118°17' E, AMS I.24855-007 1(48.9 mm SL) 19° 28' S, 116°29' E, AMS I.25825-006 1(126.7 mm SL), 18° 0' S, 147°6' E, AMS I.25835-005 3(132.0-99.5), 18° 30' S, 117°6' E.

Common names

None

Diagnosis

S. *huysmani* can be differentiated from its congeners by the following combination of characters: length of pectoral fin 5.4-9.7 in SL, lateral line scales 60-78, anal fin rays 55-63, preanal distance 3.6-6.1 in SL, length of caudal (5.4-10.8 in SL) and pelvic fin rays (1.8-5.1 in SL).

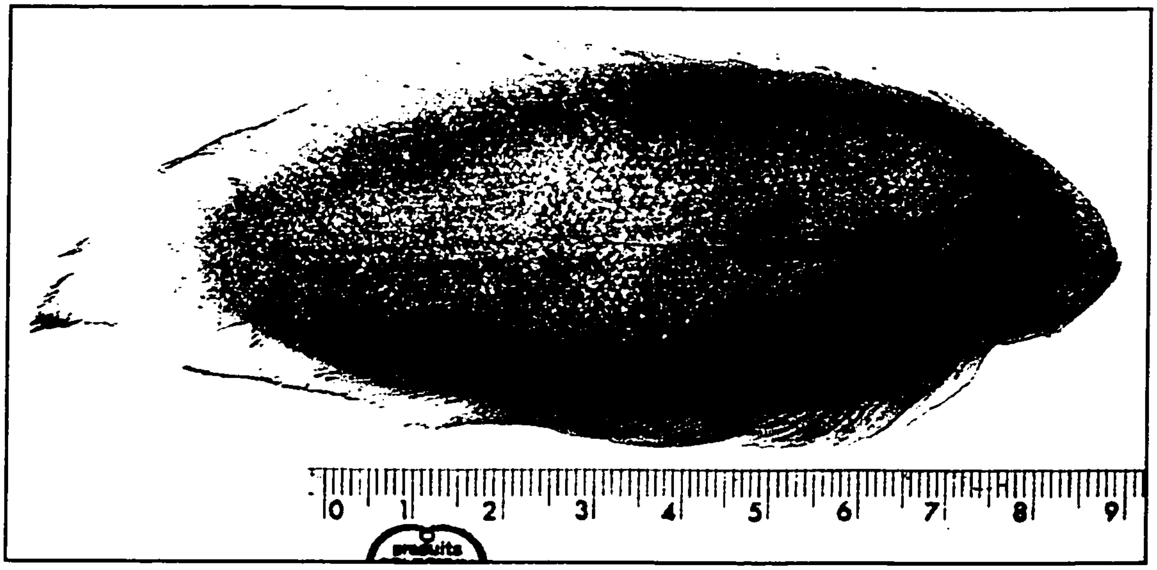

Figure 15. Illustration of *Samariscus huysmani*

Description

A large species of *Samariscus*. Dorsal fin ray count (with counts for paratype in parentheses) 77(67), anal fin rays 62(51), pectoral fin rays 5, lateral line scales 78(61), total vertebrae 40(36), supracranial pterygiophores 7(7) and proximal reduced anal pterygiophores 4(4). Proportions of morphometric features are presented in Table 22. Body long and slender, reaching maximum depth at halfway point of body, with body outlines somewhat parallel (see Fig. 15). Dorsal profile slopes downward steeply. Head short, upper profile smooth and with moderate slope. Maxillary and lower jaw areas free of scales, but interorbital space scaled. Mouth large and oblique. Numerous small teeth in 2-3 bands on upper and lower jaws. Lower eye close in size to and in slightly in advance of migrated eye, both large and prominent. Lower jaw ends anterior to the fixed eye. Pectoral fin longer than head, with third ray longest. E.s pelvic as long as head. Posteriormost portions of dorsal and anal fins pointed. Caudal rounded. Scales ctenoid on both sides. Gillrakers few, short and of unequal size.

Table 22. Morphometrics for eleven specimens of *Samariscus huysmani* and four specimens of *S. sunieri*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

		S. huysmani	*S. sunieri*
	Character	Mean (Range)	Mean (Range)
1.	HL	4.6 (4.1-5.3)	4.7 (4.5-4.8)
2.	H_depth	0.9 (0.8-1.0)	1.0 (0.9-1.1)
3.	Snout	4.7 (4.2-5.0)	4.9 (4.3-5.8)
4.	Orb_width	1.8 (1.7-2.0)	1.9 (1.8-2.0)
5.	U_jaw_o	2.4 (2.0-3.5)	2.8 (2.7-3.0)
6.	L_jaw_o	2.5 (1.9-3.3)	2.0 (2.0-2.1)
7.	U_jaw_b	2.9 (2.1-5.3)	3.3 (3.1-3.4)
8.	L_jaw_b	2.2 (2.1-2.5)	2.3 (2.1-2.6)
9.	Eye_fixed	3.1 (2.9-3.4)	2.9 (2.6-3.1)
10.	Intorb	25.4 (14.9-35.3)	29.1 (24.6-35.0)
11.	B_depth	2.7 (2.4-3.1)	3.1 (2.7-3.3)
12.	Caud_ped	7.5 (6.4-8.4)	8.3 (7.4-8.9)
13.	Pre_anal	4.4 (3.6-5.1)	4.9 (4.3-6.1)
14	Pelvic_l	7.8 (5.7-9.7)	6.5 (5.4-7.6)
15.	Pectoral_l	3.6 (2.0-5.1)	2.5 (1.8-3.0)
16.	Caud_l	3.5 (2.7-4.1)	3.1 (2.7-3.5)
17.	Dorht	9.4 (5.4-10.8)	8.6 (7.6-9.7)
18.	Anlht	8.8 (6.0-9.9)	7.9 (7.4-8.2)

Colour in alcohol

Body pale yellowish brown. Five dark spots on dorsal margin, four on ventral margin. Smaller spots and rings on body, similar spots on fins. Pectoral fin pale with distinct dark spots. Areas of dark brown on inside of dorsal and anal margins, as well as abdominal area. Blind side uniform light yellow.

Geographic distribution

S. *huysmani* is distributed from the Bay of Bengal, through the Indo-Malaysian region and south to both eastern and western Australia (see Fig. 16).

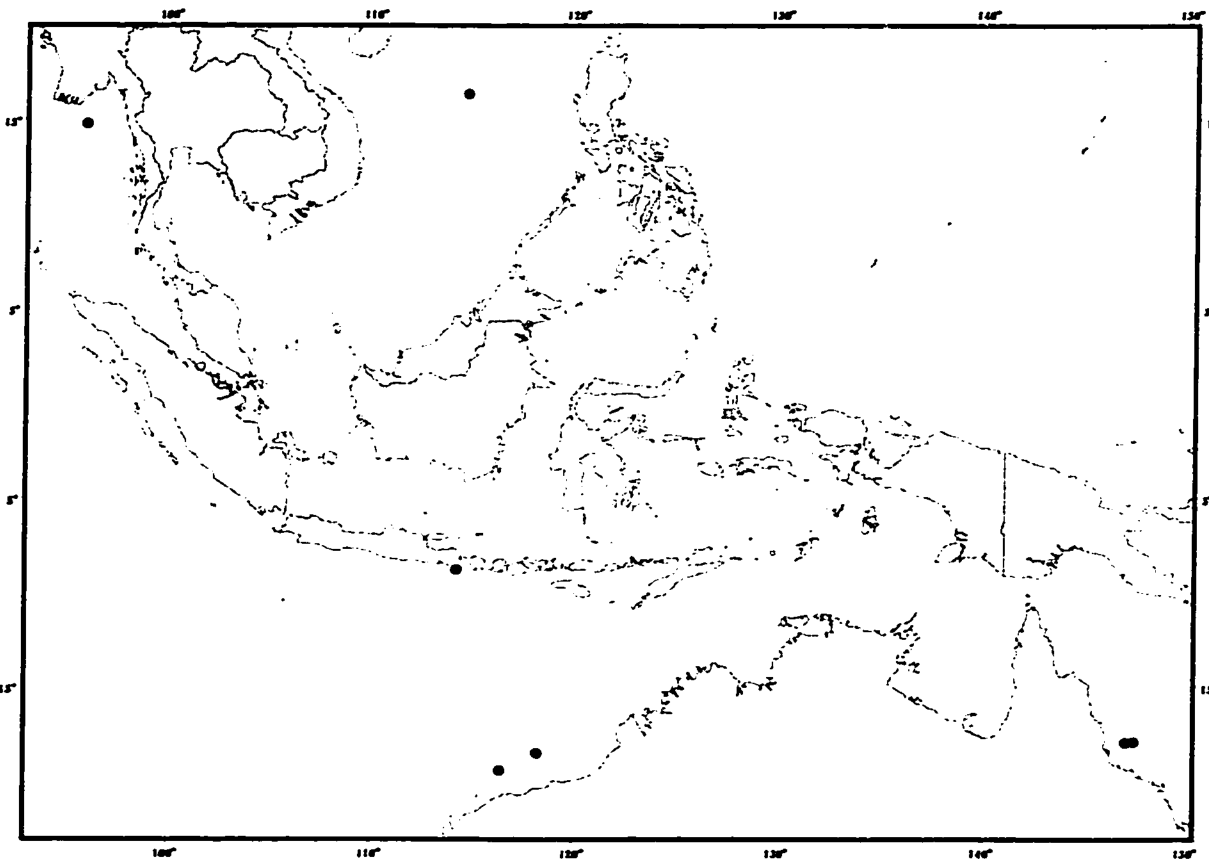

Figure 16. Distribution of S. *huysmani*.

Remarks

S. sunieri is herein synonymized with *S. huysmani*. As can be seen from Tables 22-28, there are no characters that separate the two species. The holotypes of both *S. sunieri* and *S. huysmani* were not examined.

Table 23. Variation in numbers of dorsal fin rays for *S. huysmani* and *S. sunieri*.

Dorsal fin rays	70	71	72	73	74	75	76	77	78	79	80	81	82
S. huysmani		2	1	0	2	0	0	2	1	0	1	1	1
S. sunieri	1				1	2							

Table 24. Variation in numbers of anal fin rays for *S. huysmani* and *S. sunieri*.

Anal fin rays	54	55	56	57	58	59	60	61	62	63
S. huysmani		2	1	0	1	2	2	0	2	1
S. sunieri	1		1	1				1		

Table 25. Variation in numbers of lateral line scales for *S. huysmani* and *S. sunieri*.

Lateral line scales	
S. huysmani	60 (1), 61(0), 63(1), 65(1), 67(2), 68(2), 70(1), 72(1), 74(0), 76(1), 78(1)
S. sunieri	59(1), 60(1), 63 (1), 71(1)

Table 26. Variation in numbers of total vertebrae for *S. huysmani* and *S. sunieri*.

Total vertebrae	37	38	39	40	41	42
S. huysmani	1	0	2	6	2	
S. sunieri			1	2		1

Table 27. Variation in numbers of supracranial pterygiophores for *S. huysmani* and *S. sunieri*.

Supracranial pterygiophores	6	7	8	9
S. huysmani	3	6	2	
S. sunieri		4		

Table 28. Variation in numbers of proximal reduced anal pterygiophores for *S. huysmani* and *S. sunieri*.

PRAP	3	4	5
S. huysmani	1	9	1
S. sunieri		4	

Comparisons

Close to *S. desoutterae*, but can be distinguished from that species by comparison of preanal distance (3.6-6.1 in SL vs 0.9-1.0 in SL in *S. desoutterae*), the length of the pelvic and caudal fin rays (1.8-5.1 vs 2.8-3.4 in SL and 5.4-10.8 vs 9.1-12.6 in SL in *S. desoutterae* respectively). *S. huysmani* can be distinguished from other species of *Samariscus* by the number of pectoral fin rays (5) and its higher number of lateral line scales (59-78).

Samariscus inornatus Lloyd 1909

Samaris inornata Lloyd 1909
Samariscus inornatus Norman 1927

Material examined
BMNH 1927.1.6.67, 1(79.4 mm SL), Gulf of Aden.

Common names
None

Diagnosis
S. inornatus can be differentiated from its congeners by the following combination of characters: eyed side upper jaw 2.6 in HL, eyed side lower jaw 4.3 in HL, body depth 2.4 in SL and length of pectoral 12.8 in SL.

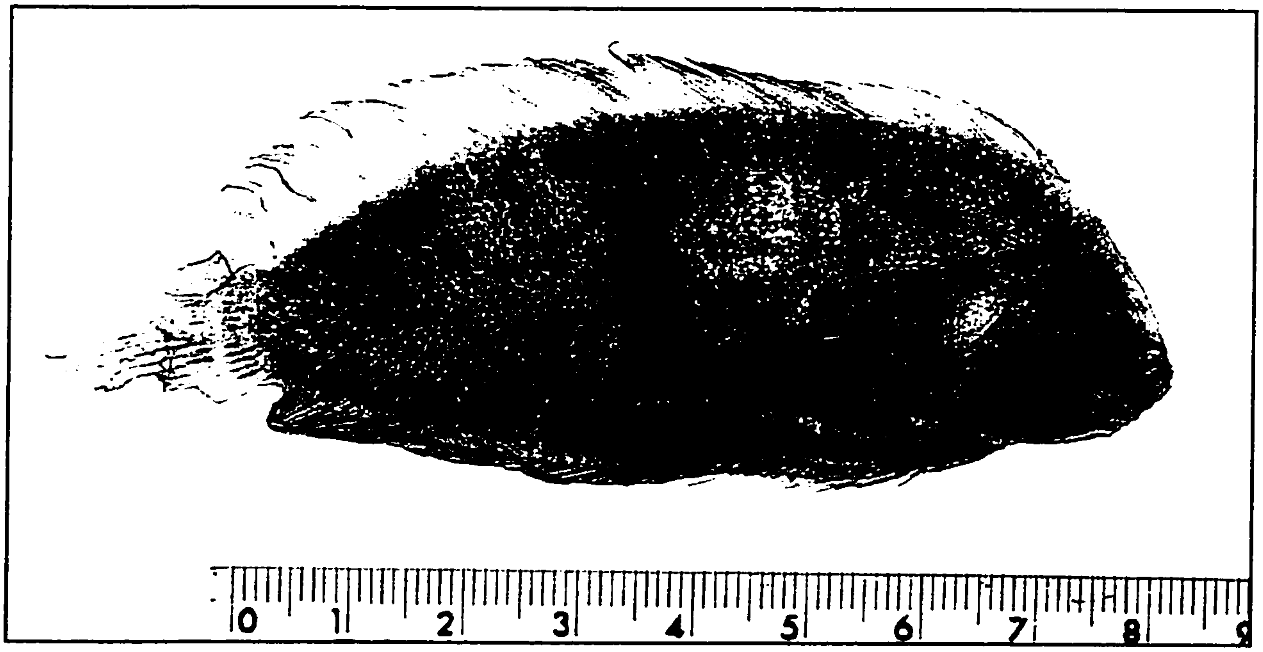

Fig 17. Illustration of BMNH 1927.1.6.67 *Samariscus inornatus*

Description
A mid-sized species of *Samariscus*. Dorsal fin ray count for specimen reported by Hensley (1993) with counts for the holotype in parentheses; 68(70), anal fin rays 53(52), pectoral fin rays 5, lateral line scales 62(60), total vertebrae (38), supracranial pterygiophores (7) and proximal reduced anal pterygiophores (4). Proportions of

morphometric features are presented in Table 29. Body long and slender, reaching maximum depth at halfway point of body, with body outlines somewhat parallel (see Fig. 17). Dorsal profile steep. Head noticeably displaced to ventral side of body. Head short, mouth small and oblique. Eyes large, equal in size, on same vertical line and close to mouth. Teeth poorly developed in 2-3 bands on upper and lower jaws. Snout distinctly triangular. Lower jaw ends under anterior portion of fixed eye. Pectoral fin prominent; long and threadlike. Pelvic very small.

Table 29. Morphometrics for holotype BMNH 1927.1.6.67 of *Samariscus inornatus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

Character		Holotype
1.	HL	3.7
2.	H_depth	0.9
3.	Snout	6.1
4.	Orb_width	2.3
5.	U_jaw_o	2.6
6.	L_jaw_o	4.3
7.	U_jaw_b	2.8
8.	L_jaw_b	2.8
9.	Eye_fixed	3.8
10.	Intorb	21.2
11.	B_depth	2.4
12.	Caud_ped	7.9
13.	Pre_anal	5.3
14	Pelvic_l	12.8
15.	Pectoral_l	3.3
16.	Caud_l	5.0
17.	Dorht	7.7
18.	Anlht	13.2

Colour in alcohol

Body uniform light brown. Five dorsal spots and four ventral spots weakly visible. Axial spots very faint. Opercular area paler than body. Pectoral fin slightly darker than body without noticeable spotting. Edges of dorsal, anal and caudal fins edged with brown. Blind side uniformly grey-brown.

Geographic distribution

Gulf of Aden and Red Sea (see Fig. 18).

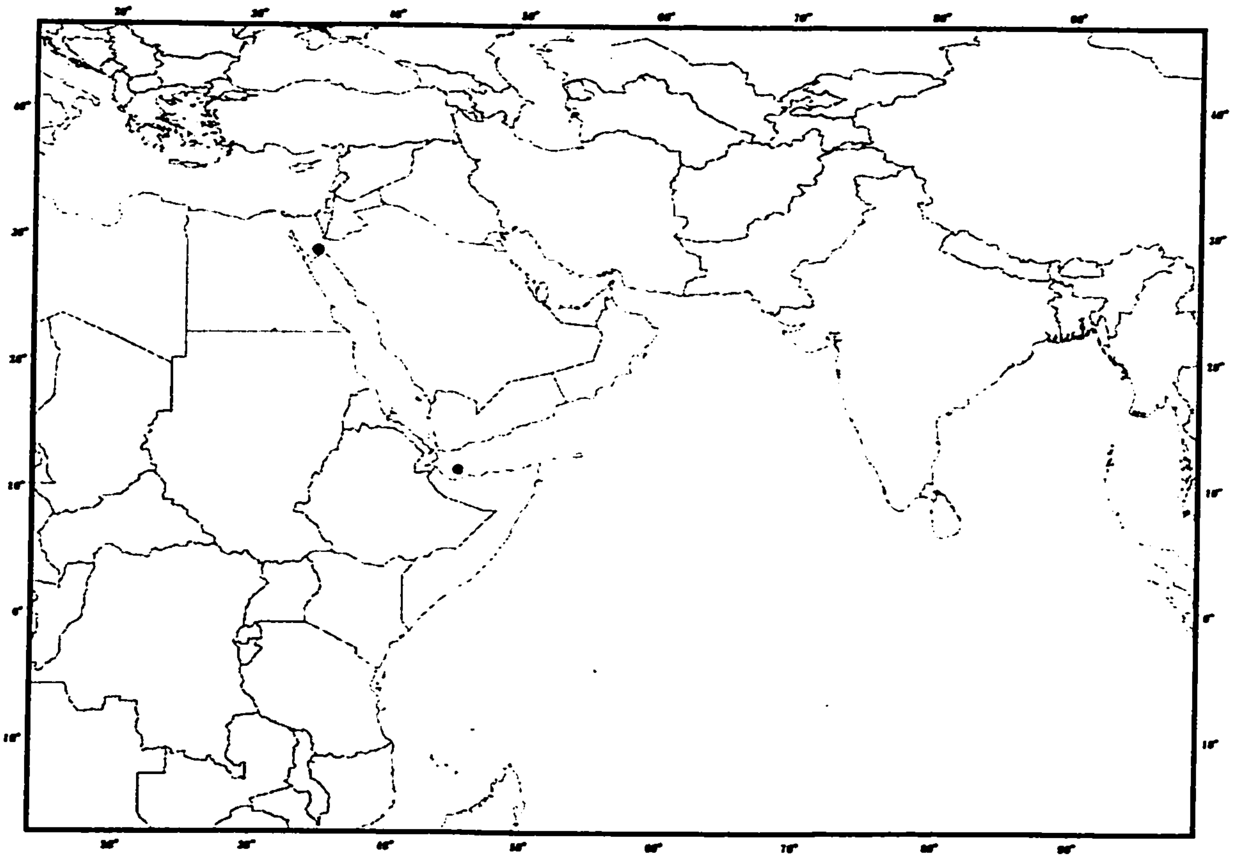

Figure 18. Distribution of *Samariscus inornatus*.

Comparisons

Close to *S. japonicus* and *S. latus* but can be distinguished from the former by the length of the e.s. maxillary (3.5-3.6 in HL vs 2.9-3.3 in HL in *S. japonicus*). Can be distinguished from all other species of *Samariscus* by the number of pectoral rays (5), dorsal fin rays (67-70) and the number of anal fin rays (52).

Samariscus japonicus Kamohara 1936b

Material examined
BMNH 1995.4.12:8-14 , 7(74.0-83.9 mm SL), no locational data; MNHN 1992-936, 2(52.2-54.1 mm SL), 33° 30' N, 133°30' E.

Common names
Tsukinowa-garei (Kamohara 1936b)

Diagnosis
Samariscus japonicus can be differentiated from its congeners by the following combination of characters: e.s. maxillary 3-3.5 in HL, e.s. mandible 2-2.3 in HL, body depth 1.6-2.7 in SL and pectoral length 5.4-10.9 in SL.

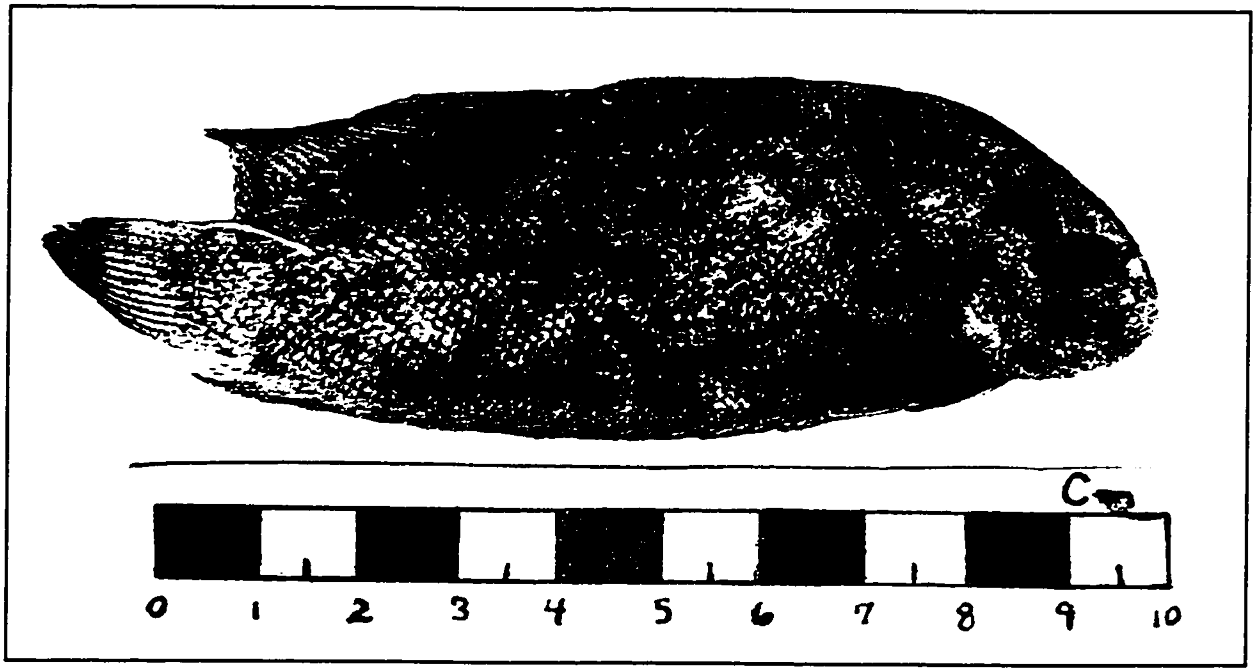

Fig 19. Illustration of MNHN 1992-936 *Samariscus japonicus*

Description
A small species of *Samariscus*. Dorsal fin ray count 67, anal fin rays 52, pectoral fin rays 5, lateral line scales 60, total vertebrae 38, supracranial pterygiophores 7 and proximal reduced anal pterygiophores 4. Proportions of morphometric features are presented in Table 30. Body long and slender, reaching maximum depth at halfway point of body, with body outlines somewhat parallel, but dorsal profile slopes steeply

down over eyes, unlike ventral profile, which is gently and uniformly curved (see Fig. 19). Head short and displaced below midline of body. Maxillary and lower jaw areas free of scales, but interorbital space scaled. Mouth small and shallow angled, snout rounded. Lower jaw ends under the anterior portion of the fixed eye. Teeth poorly developed in 2-3 bands on upper and lower jaws. Eyes large and on same vertical line. Pectoral fin long, straplike, with first ray the longest. Pelvic short. Scales moderately ctenoid on both sides.

Table 30. Morphometrics for *Samariscus japonicus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

	Character	Mean, Range
1.	HL	4.1 (2.7-4.7)
2.	H_depth	1.0 (0.9-1.1)
3.	Snout	4.9 (4.1-5.4)
4.	Orb_width	1.9 (1.8-2.0)
5.	U_jaw_o	3.2 (3.0-3.5)
6.	L_ jaw_o	2.1 (2.0-2.3)
7.	U_jaw_b	3.5 (3.3-4.0)
8.	L_jaw_b	2.2 (2.1-2.4)
9.	Eye_fixed	3.1 (2.9-3.5)
10.	Intorb	27.9 (19.9-39.8)
11.	B_depth	2.3 (1.6-2.7)
12.	Caud_ped	7.2 (4.7-8.2)
13.	Pre_anal	4.1 (2.5-6.5)
14	Pelvic_l	8.2 (5.4-10.9)
15.	Pectoral_l	4.0 (2.4-5.3)
16.	Caud_l	3.6 (2.5-4.8)
17.	Dorht	8.6 (5.9-10.6)
18.	Anlht	7.9 (4.5-11.2)

Colour in alcohol

Body light gray-brown. Five dorsal and four ventral marginal spots with one or two central axial spots visible. Scattered blotches on dorsal and anal fin margins. Pectoral fin black. Proximal edges of dorsal, anal and caudal fins with scattered spots; these spots increase in density to form solid dark grey at the margins. Indistinct dark grey smudge or stripe toward the most posterior extent of mandible. Blind side yellow cream colour with some dark pigment in two stripes along dorsal and anal pterygiophores. Tip of caudal fin black, as is the posterior margin of the dorsal fin, less so for the anal fin. Scales somewhat outlined by chromatophores to give the body a stippled appearance.

Geographic distribution
Samariscus japonicus is a Japanese endemic (see Fig. 20).

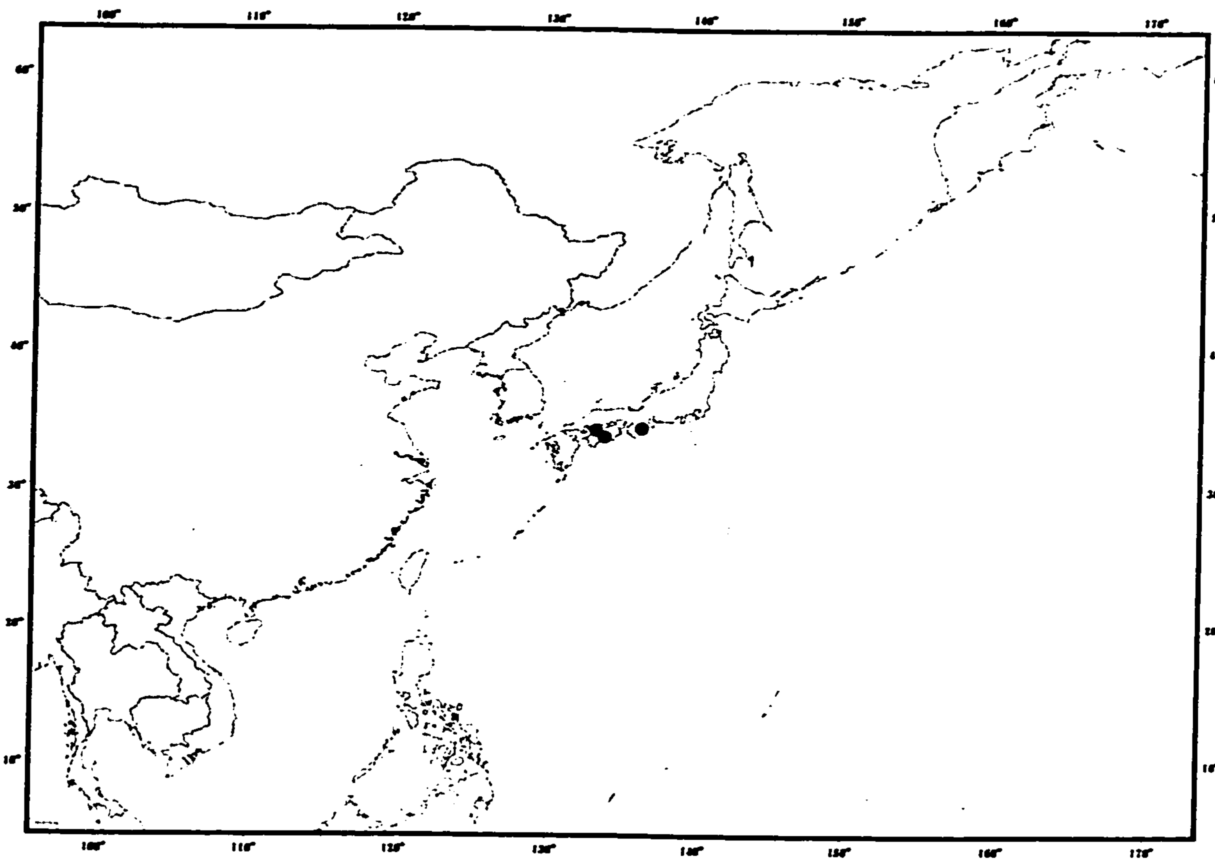

Figure 20. Distribution of *Samariscus japonicus.*

Remarks
Holotype not examined

Comparisons
Close to *S. asanoi* and *S. xenicus*, but can be distinguished from those Japanese species of *Samariscus* by a count of pectoral fin rays; 5 for *S. japonicus* vs 4 for the others. Can be distinguished from all other species of *Samariscus* by the number of pectoral rays (5), dorsal fin rays (67-70) and the number of anal fin rays (52).

Samariscus latus Matsubara & Takamuki 1951
Samariscus filipectoralis Shen 1982

Material examined
NTUM 05334, 1(79.1 mm SL), 24°0' N," 122°0' E, UMMZ 159741, 2(97.8-98.1 mm SL), 33°0' N," 134°0' E, NTUM 4840, 1(47.5 mm SL), 23°0' N," 121°0' E, paratype. NTUM 5335, 1(73.9 mm SL), 23°20' N," 121°15' E, paratype. NTUM 5484, 2(64.6-69 mm SL), 22°30' N," 120°10' E, paratypes; NTUM 5485 3(66.2-72.5 mm SL), 23°0' N," 121°0' E; NTUM 5486, 1(71.8 mm SL), 24°0' N," 122°0' E.

Common name
Tsumari-tsukinowagerei (Masuda et al.. 1984)

Diagnosis
S. latus can be differentiated from its congeners by the following combination of characters: lateral line scales 54-63 and length of pectoral fin 1.9-3.4 in SL.

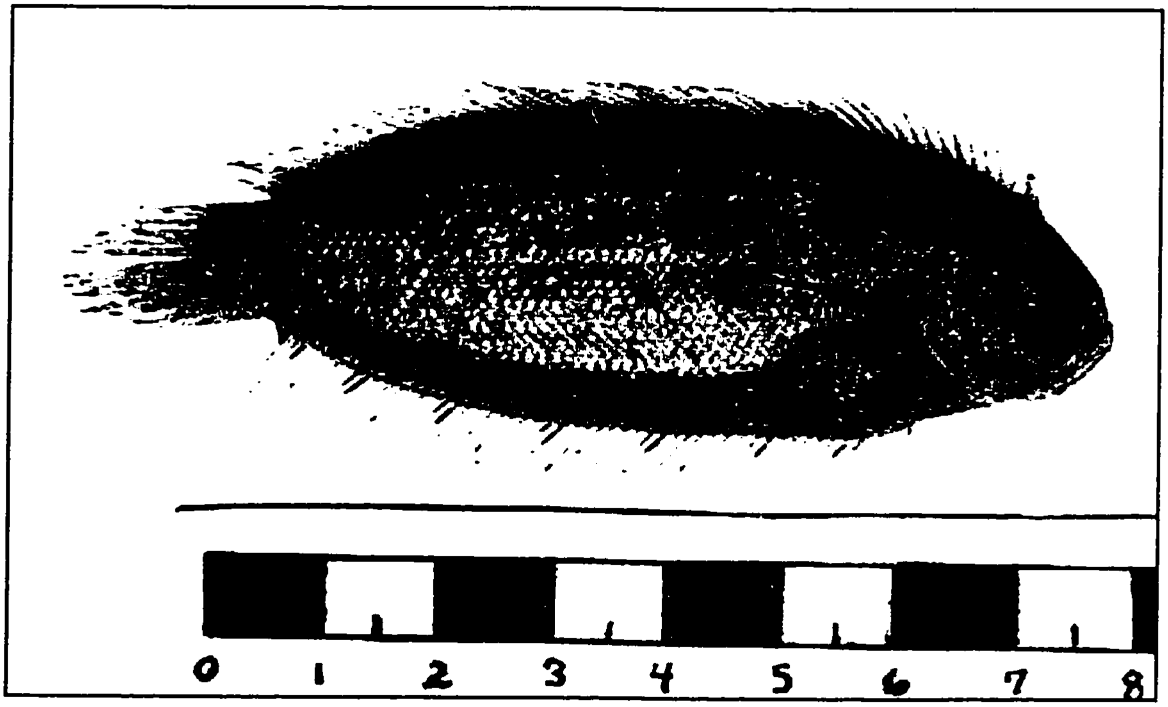

Fig 21. Illustration of *Samariscus latus*

Description
A mid-sized species of *Samariscus*. Modal dorsal fin ray 73, anal fin rays 58, pectoral fin rays 5, lateral line scales 57 , total vertebrae 39, supracranial pterygiophores 8 and proximal reduced anal pterygiophores 4. Proportions of morphometric features are

presented in Table 31. Body deep, reaching maximum depth at halfway point of body, with body oval in outline, but dorsal profile slopes steeply down over eyes, unlike ventral profile, which is gently and uniformly curved (see Fig. 22). Head on midline of body, outline conical and short, maxillary and lower jaw areas free of scales, but interorbital space scaled. Mouth small and oblique, snout short. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower jaw ends under the anterior portion of the fixed eye, both very large. Pectoral fin long and threadlike. Pelvic fin on e.s. extremely small. Caudal rounded.

Table 31. Morphometrics for *Samariscus latus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

	Character	Mean, Range
1.	HL	4.6 (3.1-5.4)
2.	H_depth	0.8 (0.7-0.9)
3.	Snout	4.9 (4.6-5.4)
4.	Orb_width	1.6 (1.5-1.8)
5.	U_jaw_o	2.9 (2.7-3.0)
6.	L_ jaw_o	2.0 (1.9-2.1)
7.	U_jaw_b	3.3 (3.1-3.5)
8.	L_jaw_b	2.2 (2.0-2.3)
9.	Eye_fixed	2.7 (2.4-3.0)
10.	Intorb	34.3 (18.2-78.5)
11.	B_depth	2.1 (1.6-2.5)
12.	Caud_ped	7.0 (4.4-7.7)
13.	Pre_anal	4.0 (2.4-4.6)
14	Pelvic_l	7.2 (2.2-12.8)
15.	Pectoral_l	2.8 (1.9-3.4)
16.	Caud_l	4.1 (2.7-5.0)
17.	Dorht	9.8 (6.3-10.7)
18.	Anlht	9.6 (6.0-11.7)

Colour in alcohol

Body very pale. Five dorsal and four ventral margin spots. Pectoral, which is light brown, is indistinct and filamentous. Fins with scattered small spots on distal margins, larger rod-shaped black markings somewhat regularly spaced on midpoint of anal fin rays. B.s. uniformly pale sandy colour.

Geographic distribution

This species is found in Japan and Taiwan (see Fig. 22).

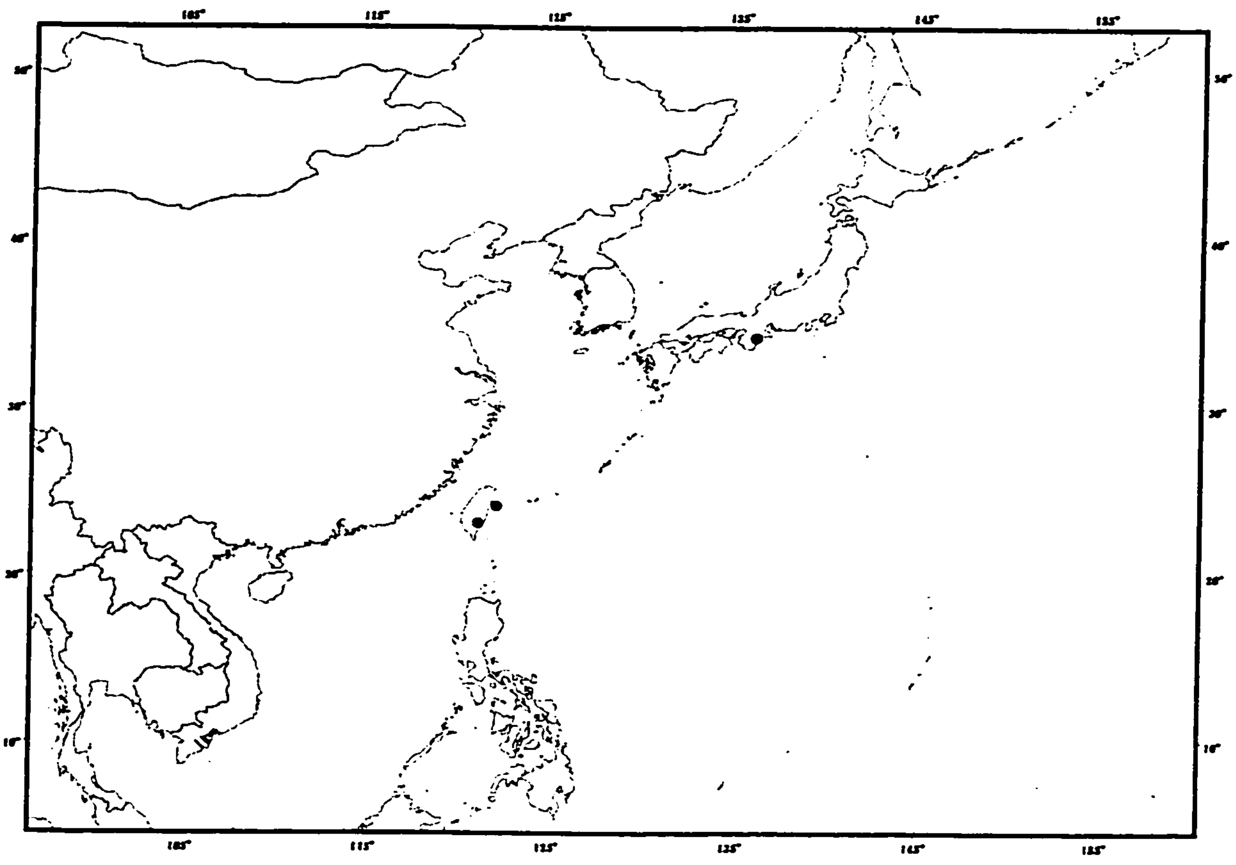

Figure 22. Distribution of *S. latus*.

Remarks

Samariscus filipectoralis is herein synonymized with *Samariscus latus*. Shen (1982) gave defining characters as lower number of lateral line scales and more elongate body, but data presented in that paper and that of Ochiai & Amaoka (1962) as well as data gathered in this study do not support that separation.

Characters listed by Shen (1982) to differentiate *S. filipectoralis* from *S. latus* were body depth in SL, head length in SL and lateral line scales. In this study, no such differences were observed (see Table 32).

Table 32. Body depth and head length in standard length and distribution of lateral scale counts for *S. latus* and *S. filipectoralis*.

	BD in SL	HL in SL	Lateral line scales									
			54	55	56	57	58	59	60	61	62	63
S. latus	2.2 (2.0-2.4)	2.2 (2.1-2.3)						2				1
S. filipectoralis	2.1 (1.6-2.5)	2.1 (1.8-2.7)	1	1	1	2	1		1			

Kamohara (1967) noted that *S. latus* is "rather delicious but rare".

Comparisons

Close to *S. desoutterae* and *S. huysmani*, but can be distinguished from those species by the length of the pectoral fin rays; < 0.7 in HL for *S. latus* vs 0.72 in HL for *S. desoutterae* and 0.8 in HL for *S. huysmani*. Can be distinguished from all other species of *Samariscus* by the number of pectoral rays (5), dorsal fin rays (67-70) and the number of lateral line scales (45-68).

Samariscus longimanus Norman 1927

Material examined
BMNH 1927.1.6.68, 1(80.7 mm SL), 7°48'N, 76° 44'E, paratype. USNM 137386, 3(66.4-94.8 mm SL), 10°9'N, 123° 52'E. USNM 137387, 1(99.0 mm SL), 8°47'N, 123° 31'E. USNM 137388, 1(84.5 mm SL), 13°52'N, 120° 46'E.

Common name
Longfinned flounder (de Bruin et al. 1994)

Diagnosis
S. longimanus can be differentiated from its congeners by the following combination of characters: Head length 3.3-4.4 in SL, ll scales 58-68, dorsal and anal fin rays 69-72 and 52-58 respectively, pectoral fin large and black.

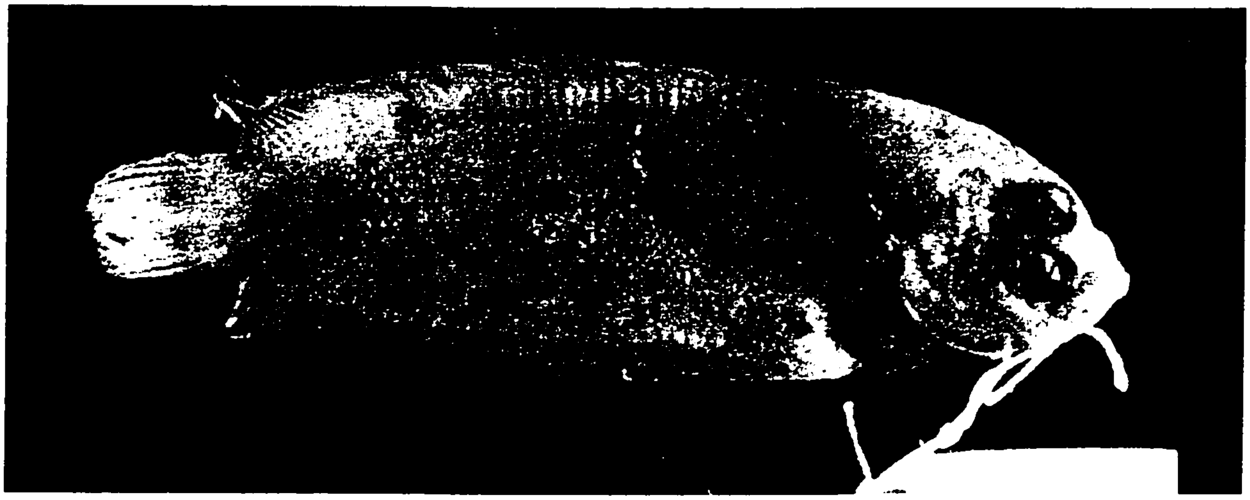

Fig 23. Illustration of *Samariscus longimanus*

Description
A medium sized species of *Samariscus*. Modal dorsal fin ray count (with counts for paratype in parentheses) 69(72), anal fin rays 52(52), pectoral fin rays 4, lateral line scales 68(58), total vertebrae 37(37), supracranial pterygiophores 7(7) and proximal reduced anal pterygiophores 4(4). Proportions of morphometric features are presented in Table 33. Body long and slender, reaching maximum depth at halfway point of body, with body outlines parallel; most elongate of all samarids (see Fig. 23). Head short,

maxillary and lower jaw areas free of scales, but interorbital space scaled. Scales ctenoid on both sides. Gillrakers short or rudimentary, knoblike. Mouth small and oblique, snout pointed. Mandible protrudes past snout. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower jaw ends under the anterior portion of the fixed eye. Eyes extremely large, occupying almost all head depth. Pectoral fin very long and wide; over half the body length excluding the head. Pelvic moderate in length. Caudal fin is wide and blunt.

Table 33. Morphometrics for paratype BMNH 1927.1.6.67 and 5 additional specimens of *Samariscus longimanus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

Character		Paratype	Mean, Range
1.	HL	3.3	4.0 (3.8-4.4)
2.	H_depth	1.2	1.1 (0.9-1.2)
3.	Snout	5.3	4.4 (3.9-4.8)
4.	Orb_width	3.3	2.9 (2.7-3.4)
5.	U_jaw_o	2.3	2.0 (1.9-2.4)
6.	L_ jaw_o	3.9	3.4 (3.1-3.7)
7.	U_jaw_b	2.6	2.2 (2.1-2.3)
8.	L_jaw_b	3.2	3.5 (3.0-3.9)
9.	Eye_fixed	3.2	3.5 (3.0-3.9)
10.	Intorb	48.8	51.0 (38.4-76.0)
11.	B_depth	2.6	3.2 (2.9-3.5)
12.	Caud_ped	7.5	8.3 (8.0-8.6)
13.	Pre_anal	2.7	3.9 (2.5-5.7)
14	Pelvic_l	9.7	8.9 (4.6-13.2)
15.	Pectoral_l	2.1	2.8 (2.3-3.5)
16.	Caud_l	4.9	4.4 (3.9-5.2)
17.	Dorht	9.2	8.7 (8.0-10.3)
18.	Anlht	8.0	8.9 (7.4-12.4)

Colour in alcohol

Three prominent paired spots the size of the eye on dorsal and anal margins on a pale sandy brown background. Pectoral fin dark, almost black, faintly banded near the origin, more uniformly dark at the distal extent. Little pigmentation on the fins, which are generally clear. On the b.s., the body is a uniform light sandy brown.

Geographic distribution

Samariscus longimanus is found off southern India, Sri Lanka and the Philippines (see Fig. 24)

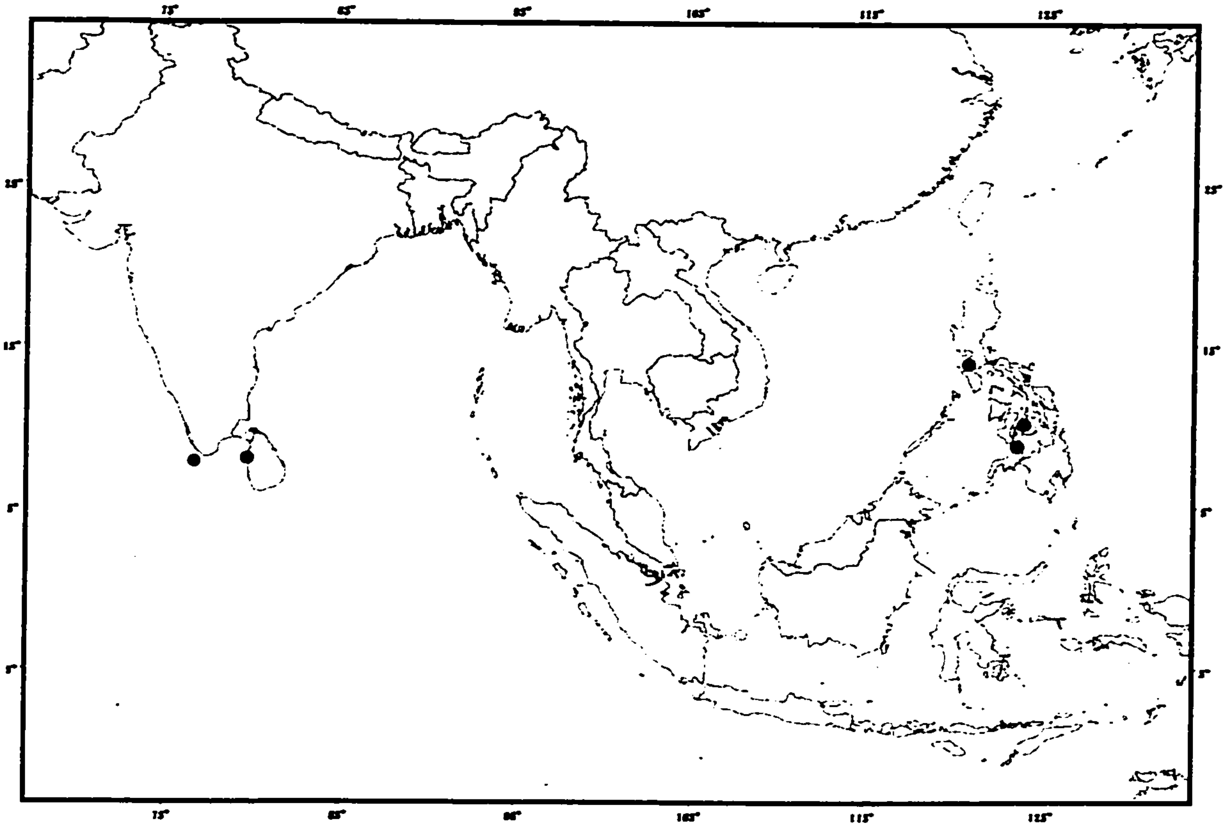

Figure 24. Distribution of *Samariscus longimanus.*

Remarks

The holotype ZSI F10846/1 was not examined.

Comparisons

Close to *S. macrognathus* but *S. longimanus* has a different pattern of pigmentation and a black and robust pectoral fin. Can be distinguished from all other species of *Samariscus* by the length of the pectoral fin (2.3-3.5 in SL), the number of lateral line scales (55-60) and its unique large black pectoral fin and pigmentation pattern.

Samariscus luzonensis Fowler 1934

Material examined
USNM 093089, 1(55.7 mm SL), 16°30'N, 120° 11'E, holotype.

Common name
None

Diagnosis
S. luzonensis can be differentiated from its congeners by the following combination of characters: head 5.2 in SL, pectoral fin length 4.3 in SL and eye diameter 3.7 in HL.

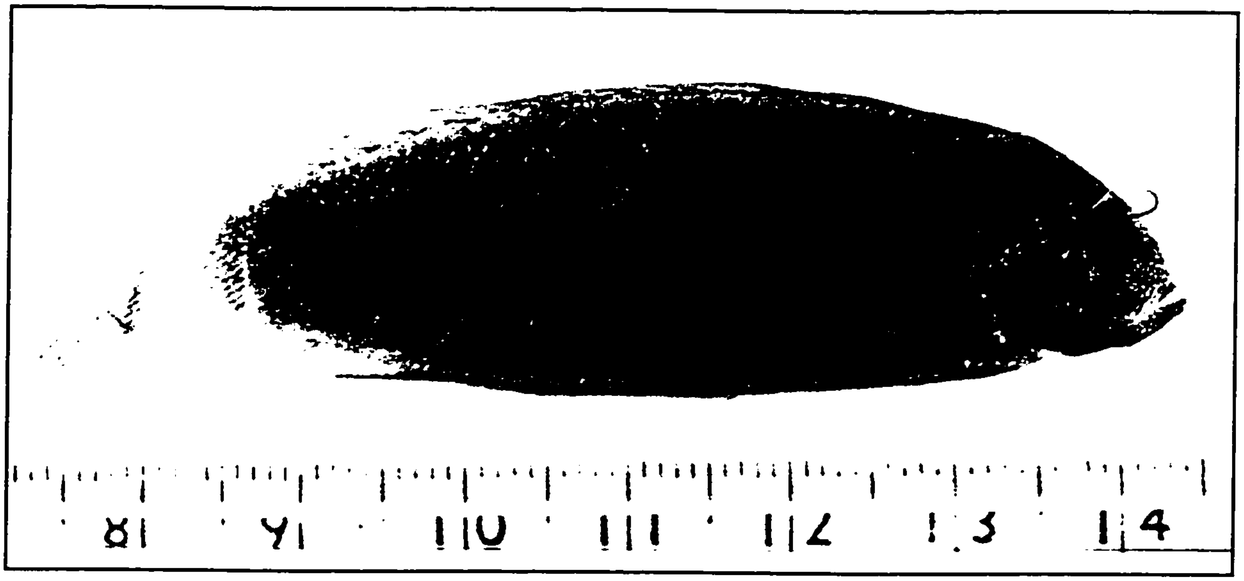

Fig 25. Illustration of *Samariscus luzonensis*

Description
Dorsal fin ray count 67, anal fin rays 55, pectoral fin rays 4, lateral line scales 56, total vertebrae 37, supracranial pterygiophores 8 and proximal reduced anal pterygiophores 5. Proportions of morphometric features are presented in Table 34. Body long and slender, with body outlines somewhat parallel (see Fig. 25). Dorsal profile steep. Head small, maxillary and lower jaw areas free of scales, but interorbital space slightly elevated and scaled. Mouth small and oblique. Teeth poorly developed in 2-3 bands on upper and lower jaws. Snout large. Lower eye close in size to and not in advance of migrated eye, both large. Lower jaw ends anterior to the fixed eye. Pectoral long and threadlike. E.s.

pelvic shorter than head. b.s pelvic much shorter than e.s. one. Scales ctenoid on both sides. Caudal delta-shaped, gillrakers short or rudimentary, knoblike.

Table 34. Morphometrics for holotype USNM 093089 of *Samariscus luzonensis*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 18 are expressed in hundredths of SL.

Character		Holotype
1.	HL	5.2
2.	H_depth	1.0
3.	Snout	5.1
4.	Orb_width	2.2
5.	U_jaw_o	3.5
6.	L_ jaw_o	2.3
7.	U_jaw_b	3.9
8.	L_jaw_b	2.5
9.	Eye_fixed	3.7
10.	Intorb	3.6
11.	B_depth	2.8
12.	Caud_ped	7.7
13.	Pre_anal	8.5
14	Pelvic_l	7.3
15.	Pectoral_l	4.3
16.	Caud_l	3.8
17.	Dorht	3.1
18.	Anlht	3.4

Colour in alcohol
Colour in alcohol dark greyish-brown. Five dorsal and four ventral spots barely visible. Fins dull brown with scattered small spots, pectoral fin dark brown with 5 or 6 black bars. Fowler (1934) noted that the body was "marked with many obscure variable small dark rings". These markings may have faded with time as they are not visible in the holotype.

Geographic distribution
Known from Luzon Island in the Philippines (see Fig. 26).

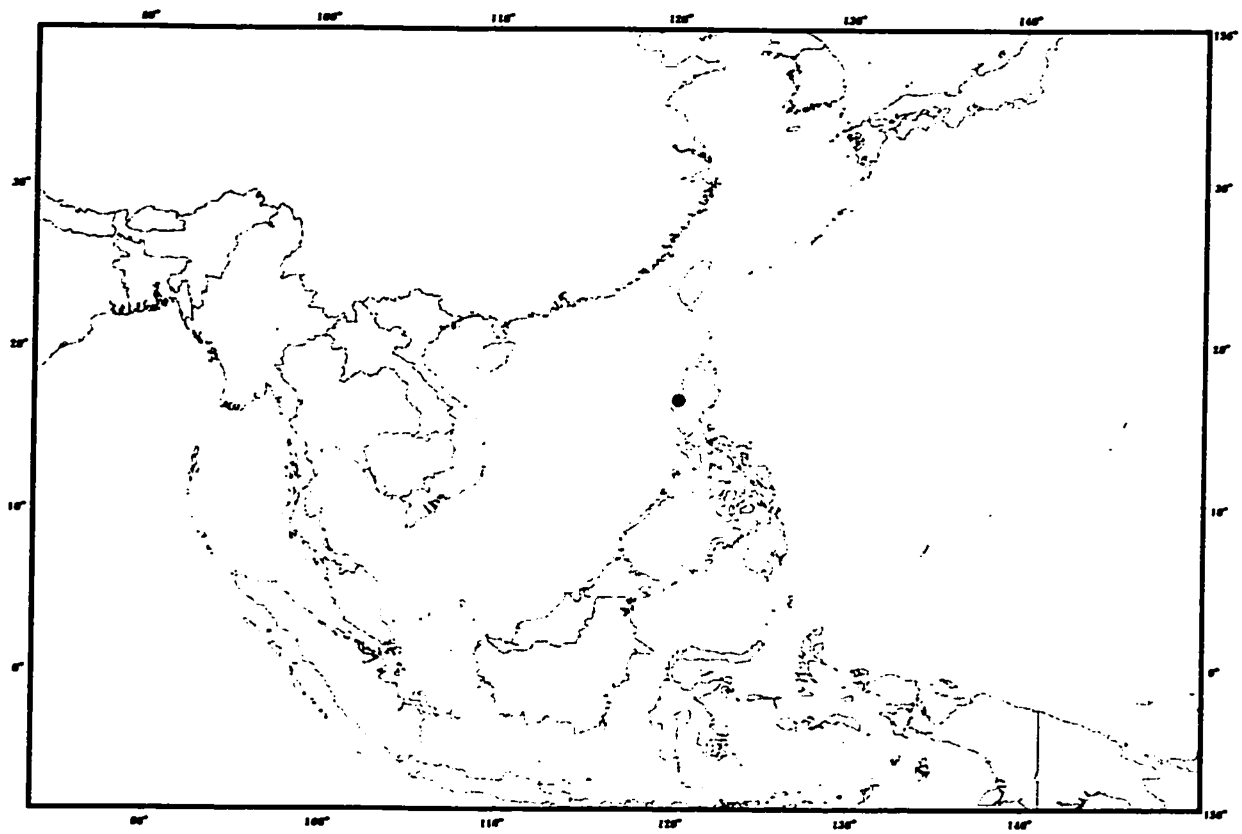

Figure 26. Distribution of *Samariscus luzonensis*.

Comparisons

Similar to *S. asanoi*, but differs in eye diameter (3.7 in HL vs 3.0-3.3 in HL for *S. asanoi*). Can be distinguished from all other species of *Samariscus* by body depth (2.8 in SL, in anal fin ray count (45) and in snout length (4.0-4.5 in HL).

Samariscus maculatus Günther 1880

Material examined
BMNH 1879.5.14.84, 1(84.4 mm SL) 8°30'S, 133° 11'E, holotype

Common name
None

Diagnosis
S. maculatus can be differentiated from its congeners by the following combination of characters: anterior dorsal fin rays more widely spaced than the following, body depth 3.1 in SL and length of pectoral 5.6 in SL.

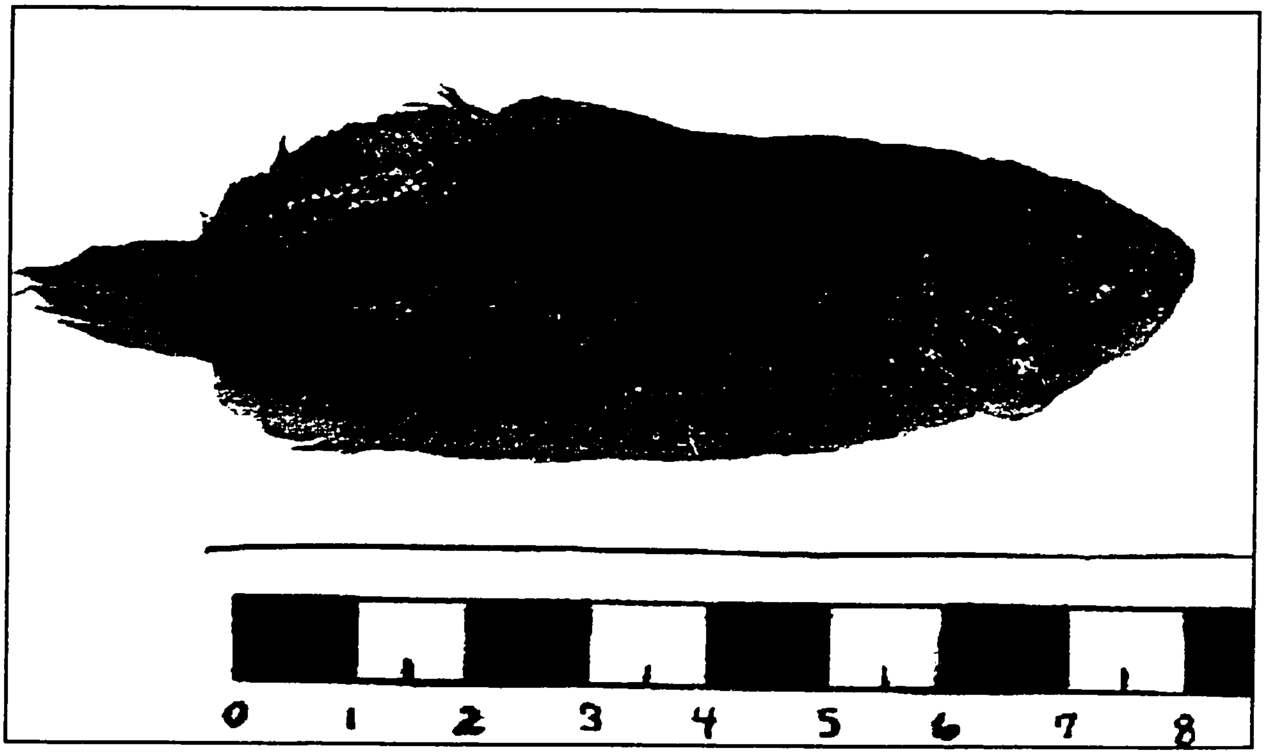

Fig 27. Illustration of *Samariscus maculatus*

Description
Dorsal fin ray count 67, anal fin rays 55, pectoral fin rays 5, lateral line scales 66, total vertebrae 39, supracranial pterygiophores 7 and proximal reduced anal pterygiophores 4. Proportions of morphometric features are presented in Table 35. Body long and slender, with body outlines somewhat parallel, not elliptical (see Fig. 27). Dorsal profile gentle.

Head short, maxillary and lower jaw areas free of scales, but interorbital space slightly elevated and scaled. Mouth small and oblique. Teeth poorly developed in 2-3 bands on upper and lower jaws. Snout large. Lower eye close in size to and noticeably in advance of migrated eye, both extremely large. Lower jaw ends anterior to the fixed eye. Pectoral short and inconspicuous; straplike. E.s. pelvic shorter than head, b.s pelvic fin much shorter than e.s. pelvic fin. Scales ctenoid on both sides. caudal rounded, gillrakers short or rudimentary, knoblike.

Table 35. Morphometrics for holotype BMNH 1879.5.14 of *Samariscus maculatus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype
1.	HL	4.0
2.	H_depth	1.2
3.	Snout	4.2
4.	Orb_width	2.1
5.	U_jaw_o	3.2
6.	L_jaw_o	2.1
7.	U_jaw_b	3.4
8.	L_jaw_b	2.3
9.	Eye_fixed	3.2
10.	Intorb	53.0
11.	B_depth	3.1
12.	Caud_ped	8.4
13.	Pre_anal	3.0
14	Pelvic_l	14.8
15.	Pectoral_l	5.6
16.	Caud_l	5.3
17.	Dorht	11.3
18.	Anlht	11.6

Colour in alcohol

Pigmentation light, with four dorsal and four ventral spots. Pectoral fin pigmented only on most distal half. Dorsal, anal and caudal fins clear, with very slight darkening at the margins. Blind side amber brown, slight pigmentation on the caudal.

Geographic distribution

Von Bonde (1922) listed *S. maculatus* as occurring in South Africa, but gave no measurements nor listed a museum specimen. The described range will be limited to the Arafura Sea in the Indo-Malaysian region, pending further specimens (see Fig. 28).

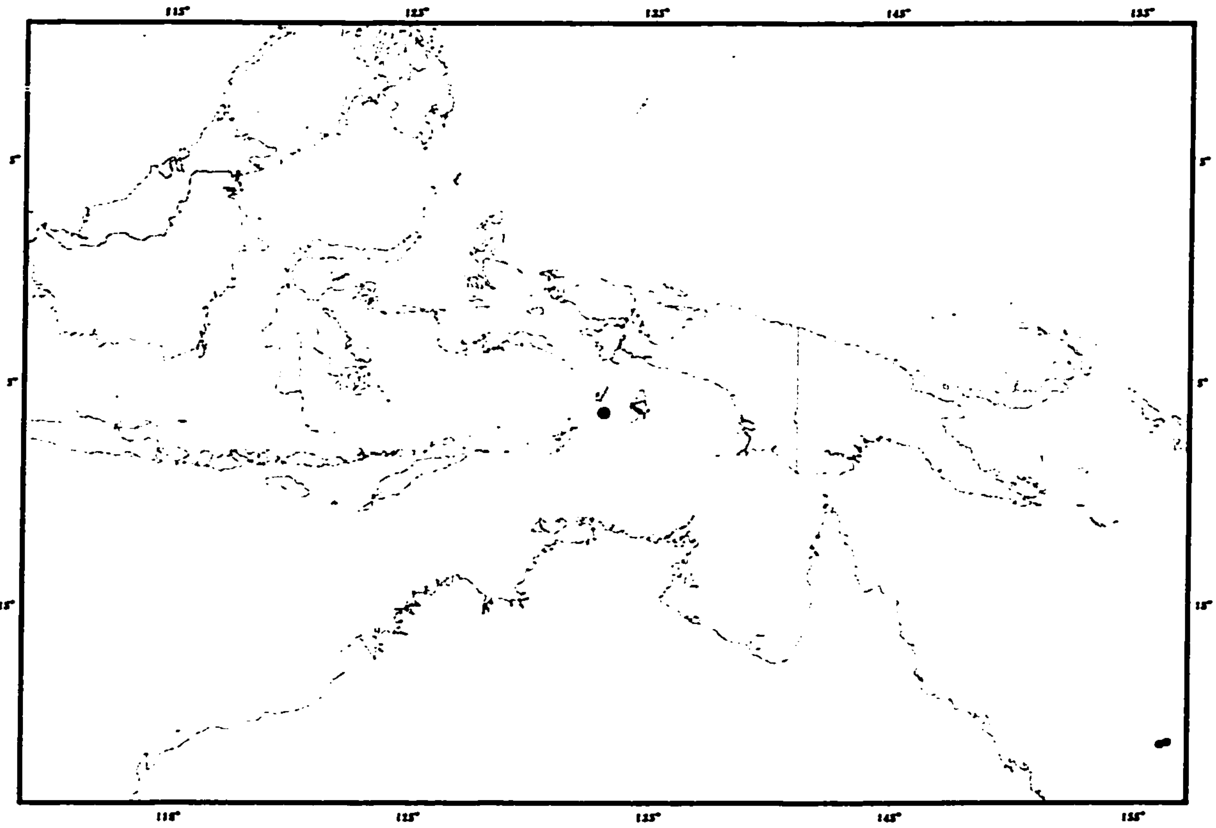

Figure 28. Distribution of *S. maculatus*.

Comparisons

Closest to *Samariscus sp.*, *S. inornatus* and *S. japonicus* but can be distinguished from those species by the following combination of characters; body depth 3.0-3.2 in SL, pectoral 1.2-1.3 in HL and anterior dorsal fin rays more widely spaced than posterior ones. Can be distinguished from all other species of *Samariscus* by possession of 5 pectoral rays, pectoral fin longer than head and 66 lateral line scales.

Samariscus macrognathus Fowler 1934

Material examined
USNM 93088; 1(43.2 mm SL)14 0 N, 122 0 E

Common name
None

Diagnosis
Can be differentiated from its congeners by the following combination of characters; pectoral fin rays 4, pectoral fin 0.6 in HL, dorsal and anal fin rays 67 and 51 respectively, lateral line scales 60.

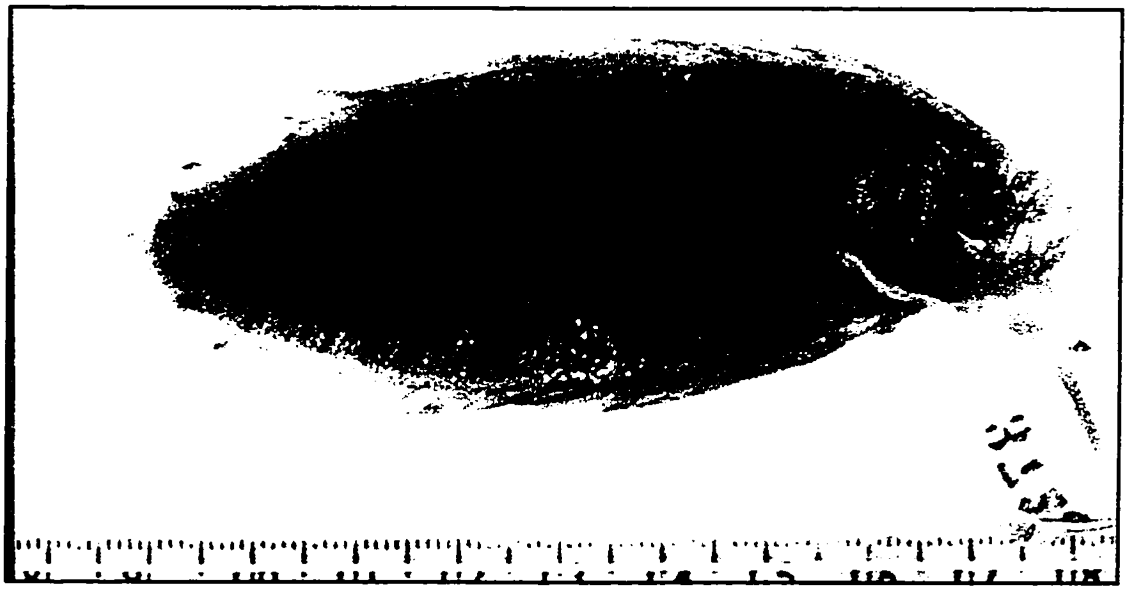

Fig 29. Illustration of *Samariscus macrognathus*

Description
Dorsal fin ray count 67, anal fin rays 55, pectoral fin rays 5, lateral line scales 67, total vertebrae 41, supracranial pterygiophores 8 and proximal reduced anal pterygiophores 4. Proportions of morphometric features are presented in Table 36. Body broad and robust (see Fig. 29). Dorsal profile gentle, with distinct notch at origin of first dorsal fin ray just anterior to the eye. Head large, maxillary and lower jaw areas free of scales, but interorbital space slightly elevated and scaled. Mouth small and oblique. Teeth poorly developed in 2-3 bands on upper and lower jaws. Snout large. Lower eye close in size

to and on the same line as the migrated eye, both very large. Lower jaw ends at midpoint of the lower eye. Pectoral long and robust. Wide e.s. pelvic shorter than head. B.s pelvic fin much shorter than e.s. pelvic fin. Scales ctenoid on both sides.

Table 36. Morphometrics for holotype USNM 93088 of *Samariscus macrognathus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype
1.	HL	3.9
2.	H_depth	0.9
3.	Snout	4.0
4.	Orb_width	2.0
5.	U_jaw_o	2.1
6.	L_jaw_o	1.7
7.	U_jaw_b	1.9
8.	L_jaw_b	1.9
9.	Eye_fixed	3.7
10.	Intorb	22.4
11.	B_depth	2.4
12.	Caud_ped	7.6
13.	Pre_anal	6.6
14	Pelvic_l	5.7
15.	Pectoral_l	2.7
16.	Caud_l	3.7
17.	Dorht	9.3
18.	Anlht	4.8

Colour in alcohol

Body lightly coloured, with five dorsal and four ventral spots. Pectoral fin slightly darker than body. Dorsal, anal and caudal fins clear, with a few small scattered brown spots at the margins. Blind side amber brown, slight pigmentation on the caudal fin.

Geographic distribution

Known from Luzon Island in the Philippines (see Fig. 30).

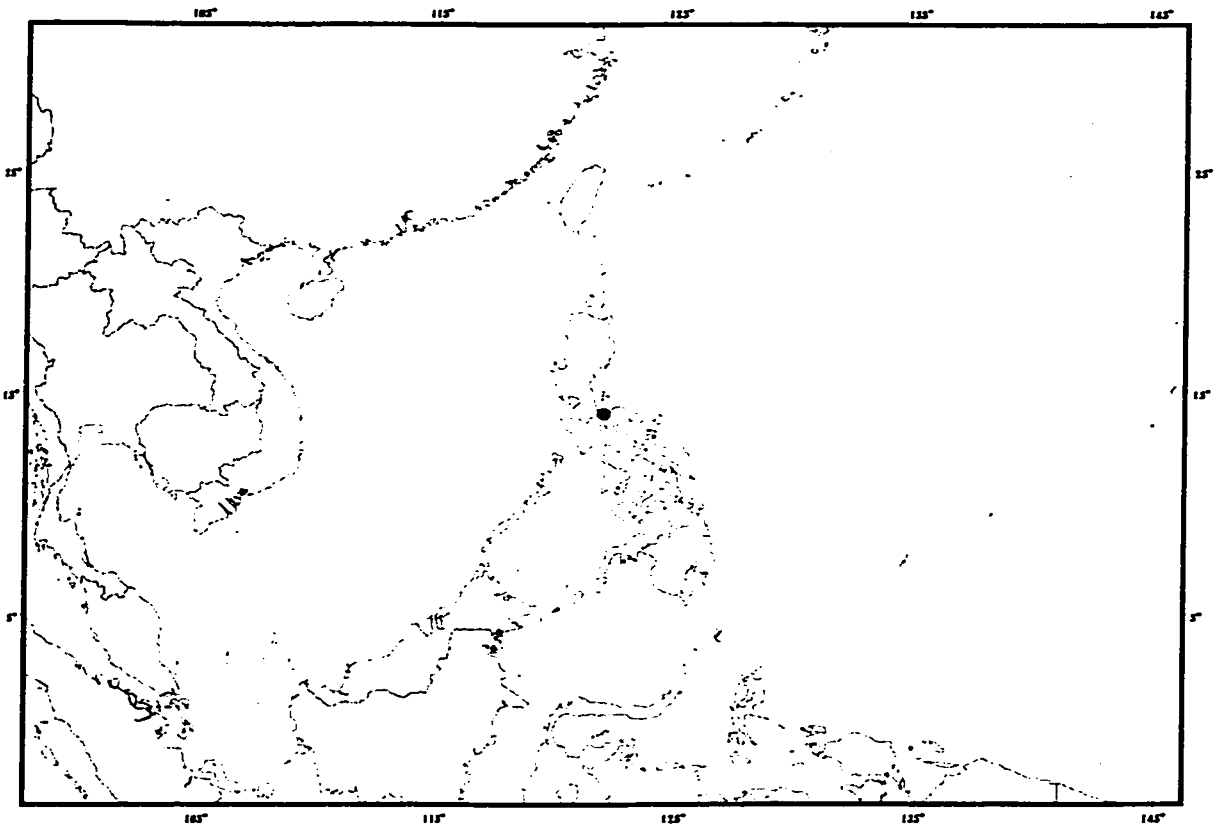

Figure 30. Distribution of *Samariscus macrognathus*.

Comparisons

Closest to *S. longimanus* but can be distinguished from that species by the different pattern of pigmentation and the black and robust pectoral fin. Can be distinguished from all other species of *Samariscus* by possession of 4 pectoral rays, length of pectoral fin slightly longer than half the length of the head and 60 lateral line scales.

Samariscus sp.

Material examined
BMNH 1984.1.1.108, 1(90.6 mm SL), 8°50' S, 114°14' E.

Common name

Diagnosis
S. sp. can be differentiated from its congeners by the following combination of characters: 5 pectoral fin rays, length of pectoral fin 5.0 in SL, D67, A51, ll 58.

Fig 31. Illustration of *Samariscus sp.*

Description
Dorsal fin ray count 67, anal fin rays 51, pectoral fin rays 5, lateral line scales 58, total vertebrae 36, supracranial pterygiophores 7 and proximal reduced anal pterygiophores 4. Proportions of morphometric features are presented in Table 37. Body oval , reaching the greatest depth just posterior to pectoral fin (see Fig. 31). Ventral margin shows little curvature, almost linear. Dorsal margin slightly more curved. Eyes very large, almost filling head depth. Head and snout evenly conical in outline. Mouth oblique and small, mandible ending anterior to fixed eye. Teeth poorly developed in 2-3 bands on upper and

lower jaws. Scales ctenoid on both sides. Gillrakers short or rudimentary, knoblike. Eyes and mouth very close together. Pectoral fin large and triangular.

Table 37. Morphometrics for BMNH 1984.1.1.108 of *Samariscus sp.*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype
1.	HL	3.9
2.	H_depth	1.0
3.	Snout	5.3
4.	Orb_width	1.8
5.	U_jaw_o	3.2
6.	L_ jaw_o	2.2
7.	U_jaw_b	3.6
8.	L_jaw_b	2.4
9.	Eye_fixed	3.4
10.	Intorb	28.8
11.	B_depth	2.4
12.	Caud_ped	7.1
13.	Pre_anal	3.1
14	Pelvic_l	11.3
15.	Pectoral_l	5.0
16.	Caud_l	4.2
17.	Dorht	11.0
18.	Anlht	9.1

Colour in alcohol

Body uniform brown with 5 dorsal and 4 ventral dark brown spots on margins. One central axial spot visible. Obvious dark spot at the base of the lower jaw. Dorsal and anal fins with blotches on proximal portion of fins. Two vertical linear spots at the posterior margin of the dorsal and anal fins match spots just anterior to the caudal peduncle. Three distinct spots on the on the anterior third of the caudal fin. Medial dark spot on mandibles and intermandibular area. Pectoral with distinct alternating light and dark areas on the rays and membrane. B.s. clear yellowish

Geographic distribution
Found off Bali, Indonesia (see Fig. 32).

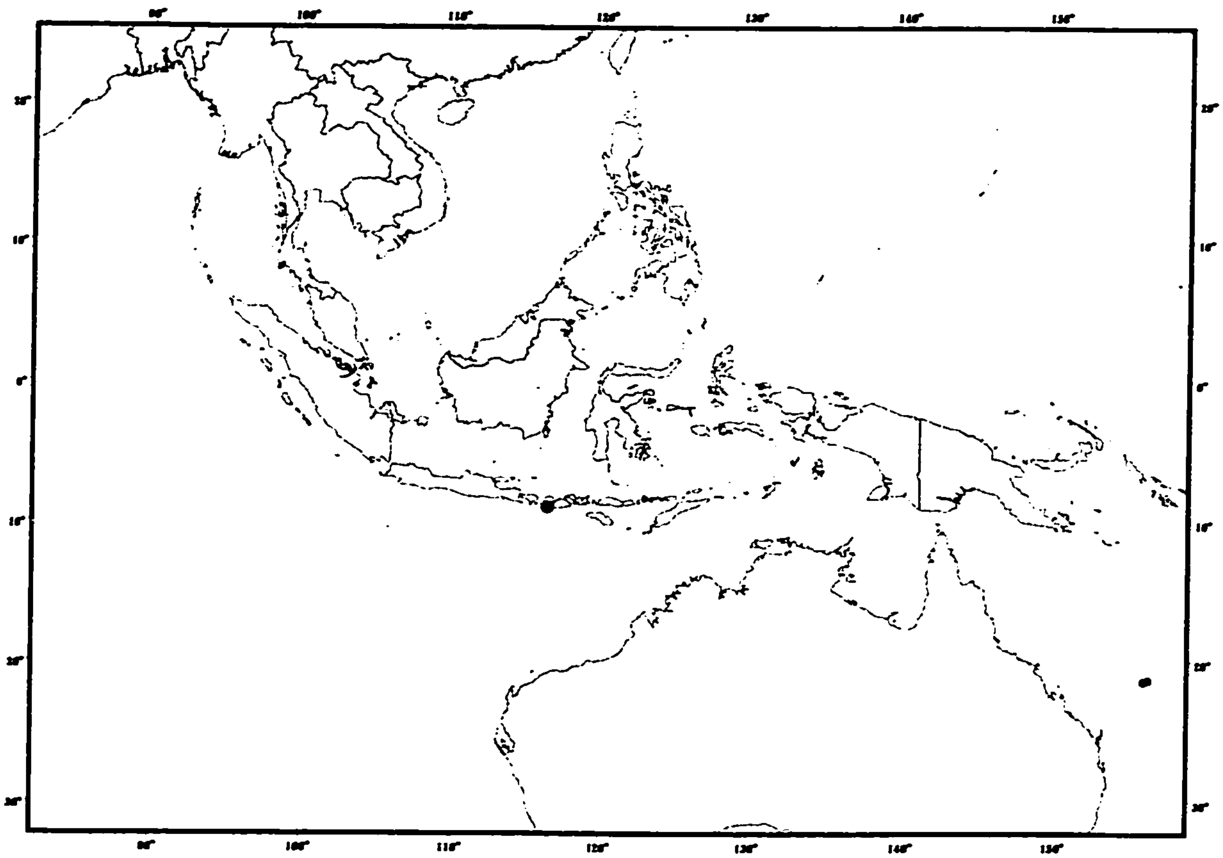

Figure 32. Distribution of *Samariscus sp.*.

Remarks
The BMNH label identified the specimen as *S. huysmani*, but the meristics are very different. Meristic for *S. huysmani* are D 77, A 62, LL 68. Counts for this specimen are D 67 A 51 LL 58. Also, caudal vertebrae for *S. huysmani* are 31 vs. 27 for *S. sp.*

The pigmentation patterns are very similar to those of *P. glossa*, especially the dark colouration, dark, almost black pectoral fin and the distinctive barring pattern at the base of the caudal fin. In appearance close to *P. glossa*, but in all other characters a good *Samariscus*, but differs from other *Samariscus* spp. in having hypomerals prolonged slightly onto caudal vertebrae as opposed to hypomerals extending to halfway point of caudal vertebrae.

Comparisons
Can be distinguished from all other species of *Samariscus* by possession of 5 pectoral rays, having hypomerals prolonged slightly onto caudal vertebrae, unique pigmentation pattern and the shape and pigmentation of the pectoral fin.

Samariscus nielseni Quéro, Hensley & Maugé 1989

Material examined
MNHN 1984-367, 1(52.5 mm SL), 20°0'S, 46° 12'E, holotype. RUSI 46456 , 1(79.9 mm SL), 15°21'S, 46° 12'E.

Diagnosis
Samariscus nielseni can be differentiated from its congeners by the following combination of characters: 70 dorsal fin rays, 56 anal fin rays, 72-76 lateral line scales.

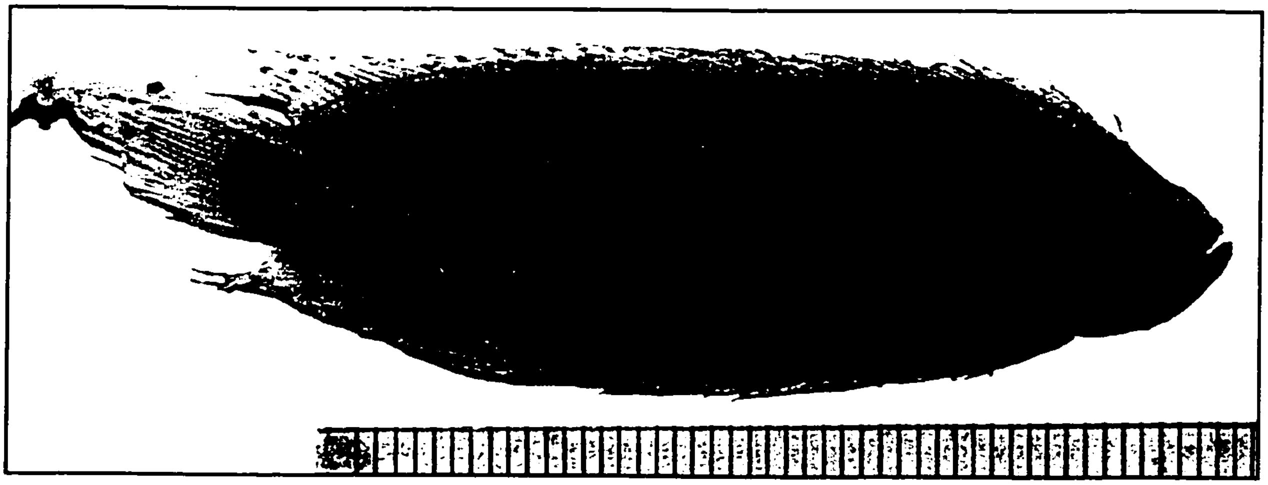

Fig 33. Illustration of holotype MNHN 1984-367 *Samariscus nielseni*

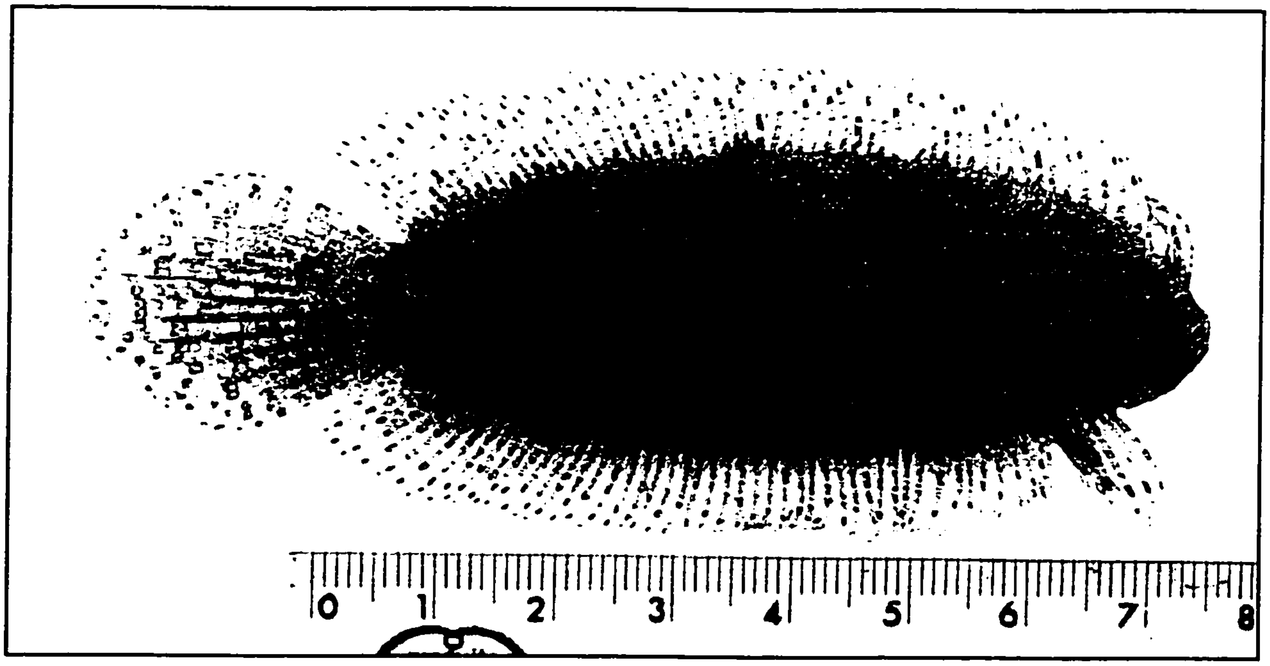

Fig 34. Illustration of RUSI 46456 *Samariscus nielseni*

Description

A small species of *Samariscus*. Dorsal fin ray count for RUSI 46456 (with counts for holotype MNHN 1984-367 in parentheses) 64(68), anal fin rays 54(56), pectoral fin rays 4, lateral line scales 72(76), total vertebrae 39(41), supracranial pterygiophores (6) and proximal reduced anal pterygiophores 4(4). Proportions of morphometric features are presented in Table 38. Body oval, reaching maximum depth at halfway point of body, with body outlines somewhat parallel (see Figs. 33 & 34). Head short, sharply triangular in outline. Mouth large, oblique and prominent. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower eye close in size to migrated eye; both eyes small. Lower jaw ends anterior to the fixed eye. RUSI 46456 shows a body outline more oval than the holotype. Most posterior margins of dorsal and anal fins rounded. Scales ctenoid on both sides. Gillrakers short or rudimentary, knoblike. Membrane joining base of first dorsal fin ray to head on b.s. Caudal large, prominent dorsal and anal fins.

Table 38. Morphometrics for holotype MNHN 1984-367 and 1 additional specimen of *Samariscus nielseni*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype	RUSI 46456
1.	HL	4.3	5.6
2.	H_depth	1.0	0.9
3.	Snout	3.6	3.7
4.	Orb_width	2.1	2.0
5.	U_jaw_o	2.6	2.6
6.	L_jaw_o	1.8	1.7
7.	U_jaw_b	2.9	3.0
8.	L_jaw_b	1.8	1.9
9.	Eye_fixed	3.3	3.6
10.	Intorb	40.0	13.0
11.	B_depth	2.8	3.0
12.	Caud_ped	8.4	8.3
13.	Pre_anal	3.7	5.1
14	Pelvic_l	6.9	6.7
15.	Pectoral_l	4.4	5.4
16.	Caud_l	4.4	3.4
17.	Dorht	9.3	10.2
18.	Anlht	8.5	8.7

Colour in alcohol
Holotype pale sandy brown, with paired ocelli at posterior margin of body. Pectoral banded, slightly darker than the body. B.s. uniform light brown. For RUSI 46456, scattered spots and blotches all over body. Two large prominent ocelli at posterior margin of body and two pairs of smaller dorsal and anal marginal spots. Small uniformly distributed dark spots on all fins, but faintly banded on caudal. B.s. uniformly creamy yellow.

Geographic distribution
The two known specimens listed above are from South Africa and Madagascar (see Fig. 35). Hensley (1993) gave the range of *S. nielseni* as Madagascar and north coast of Papua New Guinea but did not list measurements nor cite a museum specimen for the latter locality.

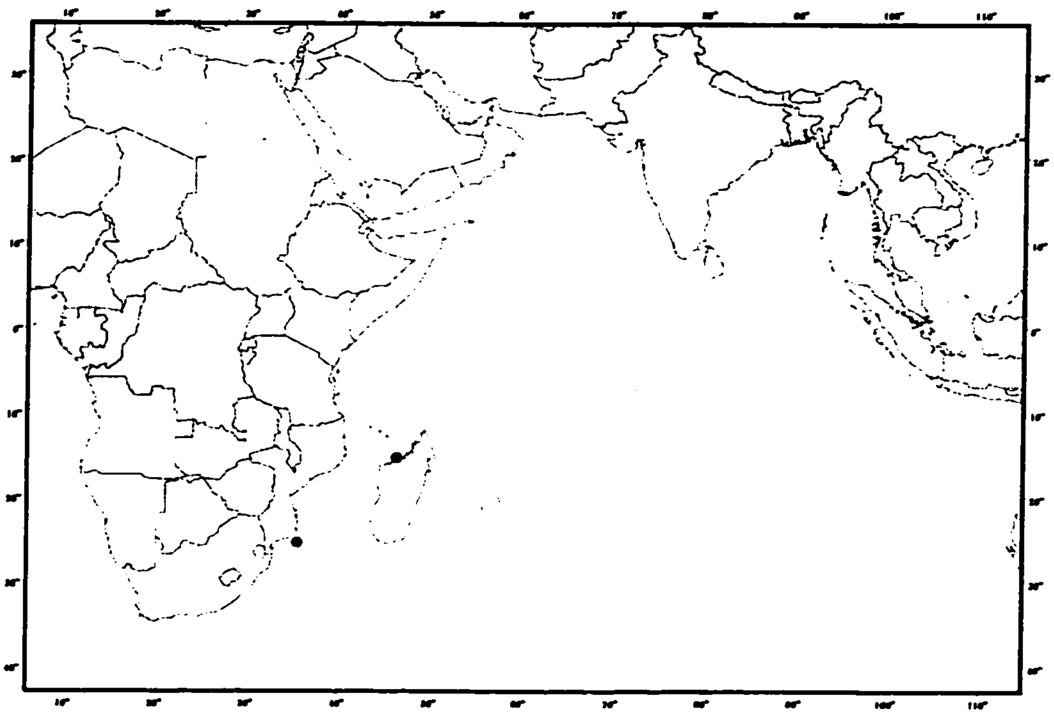

Figure 35. Distribution of *S. nielseni*.

Comparisons

S. nielseni is closest to *S. corallinus* and *S. triocellatus.* The three species share the following characteristics: the first few dorsal fin rays free of the membrane, possession of ocelli and a b.s. tissue flap at the base of the first dorsal fin ray. The three species are also united in having the snout longer than the eye (Quéro et al. 1989). *S. neilseni* can be distinguished from *S. corallinus* and *S. triocellatus* by comparison of dorsal fin ray count (62-70 in *S. nielseni* and *S. triocellatus* vs 75-77 in *S. corallinus*) and the pigmentation pattern (3 ocelli in *S. triocellatus vs* 2 in *S. nielseni*).

S. nielseni can be distinguished from all other species of *Samariscus* by possession of 4 pectoral rays, a unique pigmentation pattern and a membrane joining the base of the first dorsal fin ray to the b.s. of the head.

Samariscus triocellatus Woods 1966

Material examined

ANSP 107776; 4(24.6-45.8 mm SL) 1°6' N, 0°1' E; ANSP 107786; 1(24.7 mm SL) 1°4' N, 15°1' E; ANSP 153411; 2(25.4-38.5 mm SL), 1°9' N, 23°1' E; ANSP145614; 3(39.5-57.1 mm SL) 1°19' N, 38°1' E; BPBM 9776; 6(35.5-51.4 mm SL) 1°21' N, 30°1' E; CAS 210832; 3(19.0-43.6 mm SL) 1°21' N, 28°1' E; CAS 210833; 1(45.8 mm SL) 1°21' N, 28°1' E; CAS 210837; 5(23.8-56.4 mm SL) 1°21' N, 28°1' E; CAS 210839; 3(41.1-62.1 mm SL) 1°21' N, 28°1' E; CAS 210840; 1(16.0 mm SL) 1°25' N, 30°1' E; CAS 210843; 1(36.9 mm SL) 1°21' N, 25°1' E; CAS 210843; 2(24.4-36.9 mm SL) 1°21' N, 25°1' E; CAS 210844; 1(47.8 mm SL) 1°25' N, 28°1' E; CAS 210867; 1(29.3 mm SL) 1°25' N, 30°1' E; CAS 210868; 1(23.5 mm SL) 1°25' N, 28°1' E; CAS 24983; 2(44.4-53.4 mm SL) 1°21' N, 28°1' E; CAS 43058; 1(33.0 mm SL) 1°11' N, 30°1' E; CAS 43314; 1(23.4 mm SL) 1°11' N, 30°1' E; CAS 43406; 1(23.3 mm SL) 1°11' N, 30°1' E; CAS 57742; 3(22.7-33.4 mm SL) 1°8' N, 52°1' E; CAS 77438; 1 of 2(19.0-24.8 mm SL) 1°25' N, 30°1' E; CAS 77439; 1(25.0 mm SL) 1°25' N, 30°1' E; CAS 77440; 1(26.5 mm SL) 1°25' N, 30°1' E; CAS 82913; 1 of 2(59.6-63.8 mm SL) 1°1' N, 2°1' E; CAS 82914; 1(57.0 mm SL) 1°1' N, 30°1' E; AMS I.18360-002; 1(20.1 mm SL), 1°18' N, 25°0' E; AMS I.19456-039; 3(26.8-36.2 mm SL), 1°14' N, 35°0' E; AMS I.20757-092; 1(48.4 mm SL), 1°11' N, 36°0' E; AMS I.20957-001; 1 of 2(61.2-42 mm SL), 1°5' N, 10°1' E; AMS I.20965-037; 1(35.7 mm SL), 1°17' N, 56°0' E; AMS I.21914-048; 1(18.2 mm SL) 1°13' N, 35°0' E; AMS I.27152-030; 1(59.0 mm SL), 1°29' N, 58°0' E; AMS I.28947-045; 1(27.7 mm SL), 1°17' N, 30°0' E; AMS I.28952-012; 1(38.7 mm SL), 1°17' N, 29°0' E; AMS I.30465-051; 1(42.6 mm SL), 1°16' N, 30°0' E; AMS I.33721-003; 1(46.2 mm SL), 1°10' N, 23°0' E; AMS I.34500-011; 1(31.5 mm SL), 1°8' N, 26°0' E; AMS I.34502-006; 1(44.0 mm SL), 1°8' N, 30°0' E; AMS I.39011-068; 1(35.5 mm SL), 1°10' N, 16°0' E; AMS I.39040-008; 1(25.0 mm SL), 1°10' N, 40°0' E; MNHN 1975,1093; 8(42.5-31.8 mm SL) 1°23' N, 0°1' E; MNHN 1975,1094; 1(33.6 mm SL) 1°23' N, 0°1' E; MNHN 1984-241; 1(46.5 mm SL), 1°17' N, 30°1' E; P26087-017; 1(35.8 mm SL), 1°10' N, 29°1' E; P27467-005; 1(44.1 mm SL), 1°15' N, 50°1' E; P27663-026; 1(23.0 mm SL), 1°17' N, 15°1' E; P28191-018; 1(49.4 mm SL), 1°4' N, 51°1' E; P30627 005; 1(25.5 mm SL), 1°5' N, 9°1' E; P26090-009; 1(45.0 mm SL), 1°10' N, 29°1' E; P26106-023; 1(36.3 mm SL), 1°10' N, 29°1' E; P26930-002; 2(31.4-32.8 mm SL), 1°16' N, 57°1' E; P28031-033; 1(44.8 mm SL), 1°17' N, 18°1' E; P29051-018; 3(57.0-45.6 mm SL), 1°12' N, 10°1' E; P29630-002; 1 of 2(32.7-31.0 mm SL), 1°16' N, 57°1' E; P30626-002; 1(24.8 mm SL), 1°5' N, 9°1' E; P30960-008; 1(41.1 mm SL), 1°8' N, 44°1' E; ROM 40485; 1(17.8 mm SL), 1°5' N, 21°1' E; ROM 43434; 3(53.0-44.8 mm SL), 1°18' N, 45°1' E; ROM 43435; 1(58.2 mm SL), 1°18' N, 45°1' E; ROM 43436; 1(38.5 mm SL), 1°18' N, 45°1' E; ROM 43437; 1(40.5 mm SL), 1°18' N, 44°1' E; ROM 43438; 1(41.2 mm SL), 1°18' N, 10°1' E; ROM 55044; 1 of 2(53.4-37.9 mm SL) 1°9' N, 38°1' E; ROM 55045; 1(50.8 mm SL) 1°9' N, 37°1' E; ROM 55046; 3(44.2-30.1 mm SL) 1°9' N, 26°1' E; ROM 56922; 3(57.1-20.5 mm SL), 1°12' N, 57°1' E; ROM 56923; 1 of 2(22.5,17.5 mm SL), 1°12' N, 5°1' E; ROM 56924; 1(48.7 mm SL), 1°12' N, 10°1' E; ROM 56925; 1 of 7(43.2-20.9 mm SL), 1°12' N, 11°1' E; ROM 57410; 8(44.2-31.8 mm SL), 1°12' N, 11°1' E; ROM 57411; 1(41.4 mm SL), 1°12' N, 24°1' E; ROM 57412; 3(76.9-27.7 mm SL), 1°12' N, 24°1' E; ROM 61678; 1(36.8 mm SL), 1°17' N, 29°1' E; ROM 61679; 1(31.4 mm SL), 1°17' N, 32°1' E; ROM 61680; 1(20.6 mm SL), 1°17' N, 29°1' E; ROM 61681; 1(21.5 mm SL), 1°17' N, 29°1' E; ROM 61682; 1 of 2(42.3-22.0 mm SL), 1°17' N, 28°1' E; ROM 61683; 1 of 4(25.0,19.4 mm SL), 1°17' N, 29°1' E; ROM 61684; 1 of 2(34.6-21.9 mm SL), 1°17' N, 29°1' E; ROM 61684; 2 of 2(21.9 mm SL), 1°17' N, 29°1' E; ROM 64822; 1(44.0 mm SL), 1°22' N, 20°1' E; ROM 64823; 1 of 4(47.2,18.3 mm SL), 1°22' N, 23°1' E; ROM 64872; 1(30.4 mm SL), 1°22' N, 20°1' E; ROM 64873; 1 of 2(22.5,17.5 mm SL) 0°0' N, 0°0' E; RUSI 50629; 3(71.7-44.9 mm SL), 1°26' N, 50°1' E; RUSI 52077; 1(35.7-20.3 mm SL), 1°10' N, 45°1' E; RUSI 57373; 1(41.6 mm SL), 1°30' N, 18°1' E; S.12884-067; 1(37.4 mm SL), 1°12' N, 33°1' E; USNM 141767; 1(52.3 mm SL) (Holotype)1°11' N, 30°1' E; USNM 141768; 3(57.5-41.9 mm SL) (Paratypes)1°11' N, 20°1' E; USNM 164421; 1(63.2 mm SL) 1°21' N, 15°1' E; USNM 167246; 1(32.4 mm SL), 1°8' N, 0°1' E; USNM 209679; 3(56.5-34.9 mm SL), 1°3' N, 30°1' E; USNM 210526; 1(51.0 mm SL), 1°3' N, 20°1' E; USNM 259758; 1(49.5 mm SL), 1°20' N, 37°1' E; USNM 259761; 3(38.6-31.7 mm SL), 1°19' N, 4°0' E; USNM 259764; 1(40.4 mm SL), 1°19' N, 10°1' E; USNM 259771; 3(45.6-40.4 mm SL), 1°18' N, 8°1' E; USNM 259773; 1(34.7 mm SL), 1°21' N, 38°1' E; USNM 268536; 1(29.0 mm SL) 1°9' N, 50°1' E; USNM 268538; 1(30.4 mm SL) 1°9' N, 47°1' E; USNM 276005; 2(39.1-33.7 mm SL) 1°7' N, 0°1' E; USNM 286581; 3(25.0,19.6 mm SL), 1°10' N, 19°1' E; USNM 286582; 1(35.8 mm SL), 1°7' N, 15°1' E; USNM 286583; 1(38.7 mm SL), 1°3' N, 47°1' E; USNM 286584; 1(64.5 mm SL) 1°21' N, 55°1' E; USNM 286585; 8(57.4-22.5 mm SL), 1°5' N, 24°1' E.

Diagnosis
The only species of *Samariscus* with an axial series of ocelli. Also possesses 4 pectoral rays, and a membrane joining the base of the first dorsal fin ray to the b.s. of the head.

Common names
Three-spot flounder (Tinker 1982); Driekol-botvis (Heemstra 1986).

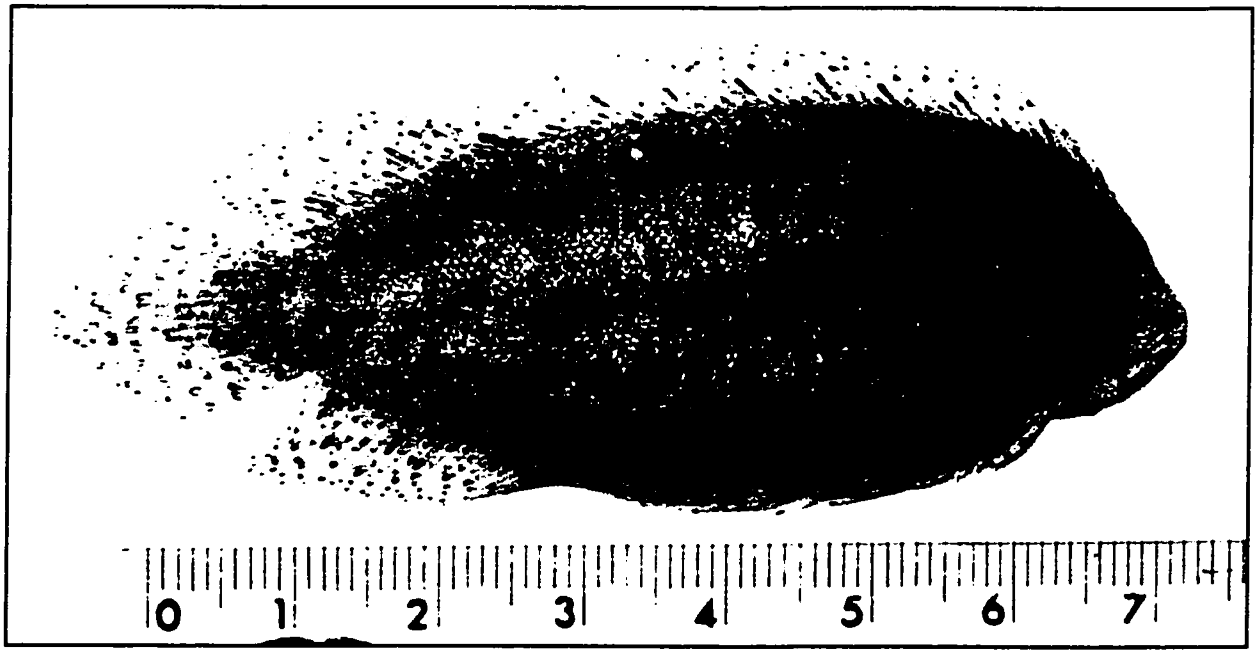

Fig 36. Illustration of *Samariscus triocellatus*

Description
The smallest species of *Samariscus*. Modal (with counts for holotype in parentheses) dorsal fin ray count 76(75), anal fin rays 62(66), pectoral fin rays 4, lateral line scales 92(92), total vertebrae 45(47), supracranial pterygiophores 6(5) and proximal reduced

anal pterygiophores 4(4). Proportions of morphometric features are presented in Table 39. Body long and slender, reaching maximum depth at or posterior to halfway point of body, with body outlines somewhat parallel (see Fig. 36). Larger individuals tend to have a pronounced and steeply descending dorsal profile. Head short, with a distinct triangular profile, maxillary and lower jaw areas free of scales. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower eye close in size to migrated eye. Lower jaw ends in anterior portion of the fixed eye. Posteriormost portions of dorsal and anal fins rounded. Scales ctenoid on both sides. Gillrakers short or rudimentary, knoblike. Membrane joining base of first dorsal fin ray to head on b.s. Lateral line slopes upward just posterior to the pectoral fin, usually at lateral line scale 14. First ocellus often at lateral line scale 20.

Table 39. Morphometrics for holotype USNM 141767 and additional specimens of *Samariscus triocellatus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype	Mean, Range
1.	HL	4.2	4.0 (3.3-21.9)
2.	H_depth	1.0	1.1 (0.8-7.7)
3.	Snout	3.3	3.7 (0.8-6.4)
4.	Orb_width	3.9	2.1 (0.4-2.8)
5.	U_jaw_o	2.4	2.7 (0.6-4.8)
6.	L_ jaw_o	1.7	1.8 (0.4-3.3)
7.	U_jaw_b	2.5	2.8 (0.6-3.8)
8.	L_jaw_b	1.8	2.0 (0.4-29.3)
9.	Eye_fixed	4.0	3.9 (0.8-7.3)
10.	Intorb	13.9	25.2 (4.7-96.3)
11.	B_depth	2.9	2.7 (2.3-3.5)
12.	Caud_ped	7.4	8.6 (6.8-74.7)
13.	Pre_anal	4.0	3.7 (2.7-7.9)
14	Pelvic_l	5.1	5.2 (3.6-13.3)
15.	Pectoral_l	3.2	4.5 (3.1-15.8)
16.	Caud_l	7.5	8.5 (3.3-73.3)
17.	Dorht	6.6	7.9 (5.3-14.6)
18.	Anlht	5.9	7.4 (5.2-11.1)

Colour in alcohol

Body with scattered blotches and spots on a light background. Three distinct ocelli each larger than the eye along midline of body. The posterior third to half of pectoral fin dark to black. Scattered small spots on fins and extending onto snout.

Geographic distribution

S. triocellatus has the largest range within the genus, found from South Africa to the Society Islands (see Fig. 37).

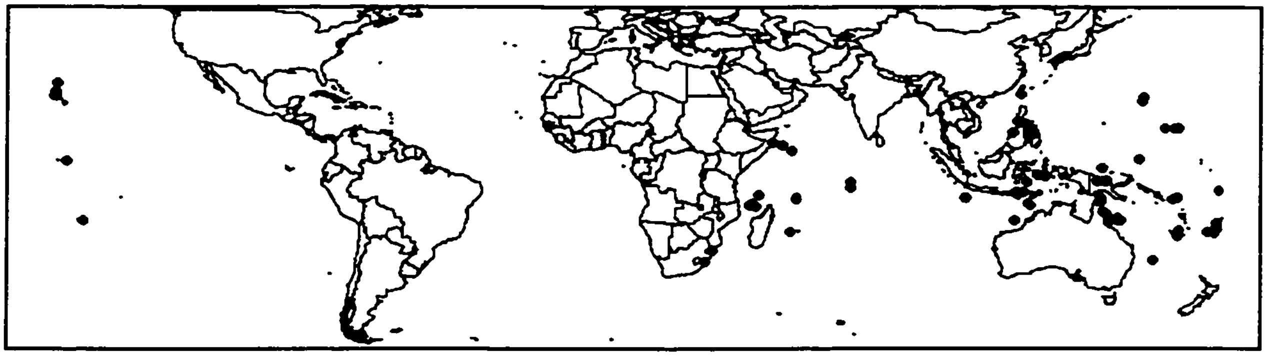

Figure 37. Distribution of *S. triocellatus*.

Comparisons

S. triocellatus is closest to *S. corallinus* and *S. nielseni*, sharing with those species a distinct membrane joining the base of the first dorsal fin ray with the head on the b.s., four pectoral fin rays and distinct patterns of ocelli. The species may be distinguished from other species of *Samariscus* by the number of pectoral fin rays and the presence of three ocelli on the body.

Remarks

This species is notable in the Samaridae for a number of reasons; it is the smallest member of the family, it is the only reef-dwelling species and it has the only non-endemic, non-marginal presence on the Pacific Plate (see Biogeography section for more details).

S. triocellatus was described on the basis of specimens from Bikini, Rongelap and Onotoa Atolls, and from Oahu (Woods 1966). Winterbottom (1978) observed that the Kwazulu specimens "appear to have more lateral line scales, a wider interorbital and to have more elongate dorsal and anal fin rays." Theses differences were likely due to small sample size.

The average depth distribution of samarids (131 m, based on the specimens used in this study) generally precludes direct observation of behaviour. However, *S. triocellatus* is found in the most shallow waters of all samarid species. Anderson et al.. (1998) provided a fascinating description of behaviour exhibited by *S. triocellatus*, referring to the movement of the pectoral fin:

"The fish typically waves this fin with a slow anticlockwise motion, spreading the distal portion out and up as it passes over the eyes. The fin may play some role in courtship or intraspecific competition, although specimens observed underwater wave their pectoral fins even when no other individuals of the same species appear to be present."

A very clear photograph of *S. triocellatus* (Plate 39-3, Allen & Steene 1987) shows a specimen with a spread, black pectoral fin above its body. The fin may be a lure as in the case of *Asterorhombus* (Amaoka et al.. 1994). This bothid has the tip of the first dorsal fin ray enlarged into a large leaflike membrane, which it waves in front of its head to lure prey. The common sole (*Solea solea*) is reported to raise its black-tipped pectoral fin when disturbed – an action mimicking the raising of the venomous dorsal fin of the weeverfish (Helfman et al. 1997), a member of the family Trachinidae, found in the inshore waters of Europe and West Africa.

To assess population differences, specimens of *S. triocellatus* were assigned to one of 6 groups based on geographic area. These groups / areas were: TA - Taiwan, WIO - Western Indian Ocean, , IM - Indo-Malaysia including the Philippines, HI - Hawaii, E_AUSTR – Eastern Australia and western Micronesia and Melanesia , PAC – Polynesia including the Society Islands and Fiji. Fifteen pairwise comparisons were made and no differences were found in any of the morphometric ratios. Meristics (dorsal, anal fin rays; lateral line scales and total vertebrae) were examined. No non-overlapping differences were found.

In order to assess discrete variation in populations of *S. triocellatus*, a PCA on residuals of logged (base 10) data was done. This procedure yielded 9 factors accounting for 70.4% of the total variation in the dataset (see Table 40). A DFA on those 9 factors resulted in Wilks' λ p = 0.000, an overall classification rate of 39 % and a jacknifed classification rate of 31 %. These low classification rates indicate a relatively homogeneous data set.

Table 40. Loadings for first 5 factors for PCA

Variable	Factors				
	1	2	3	4	5
U_jaw_o	0.815	0.047	0.206	-0.048	0.064
L_jaw_b	0.813	0.041	0.256	0.054	0.063
L_jaw_o	0.778	0.051	0.227	0.060	0.090
Snout	0.707	0.021	0.244	-0.085	-0.170
U_jaw_b	0.663	-0.031	-0.062	0.080	0.104
Eye_fixed	0.636	0.092	0.016	-0.235	0.281
Caud_ped	0.575	0.021	0.117	-0.010	-0.300
Pelvic_l	0.526	0.054	0.388	0.006	0.069
HL	0.503	0.125	-0.036	0.394	-0.429
Anlht	-0.173	-0.630	0.566	0.091	0.054
Dorht	-0.315	-0.618	0.488	0.146	0.006
ANAL	-0.366	0.569	0.337	0.324	0.312
DORSAL	-0.279	0.518	0.353	0.465	0.331
Caud_l	-0.210	-0.463	0.508	0.040	0.046
VERT_A	0.127	-0.008	0.007	0.147	0.110
LL_SCALES	-0.145	0.427	0.224	-0.185	-0.159
Caud_ped	0.187	-0.133	-0.272	0.131	0.189
Pectoral_l	0.178	-0.111	0.094	-0.234	0.366
H_depth	0.426	0.022	0.008	0.480	-0.327
Intorb	-0.067	-0.275	-0.361	0.472	0.221
Orb_width	0.480	-0.001	-0.117	-0.269	0.383
VERT_C	-0.370	0.455	0.373	-0.057	-0.010
B_depth	0.365	-0.186	-0.369	0.371	0.298

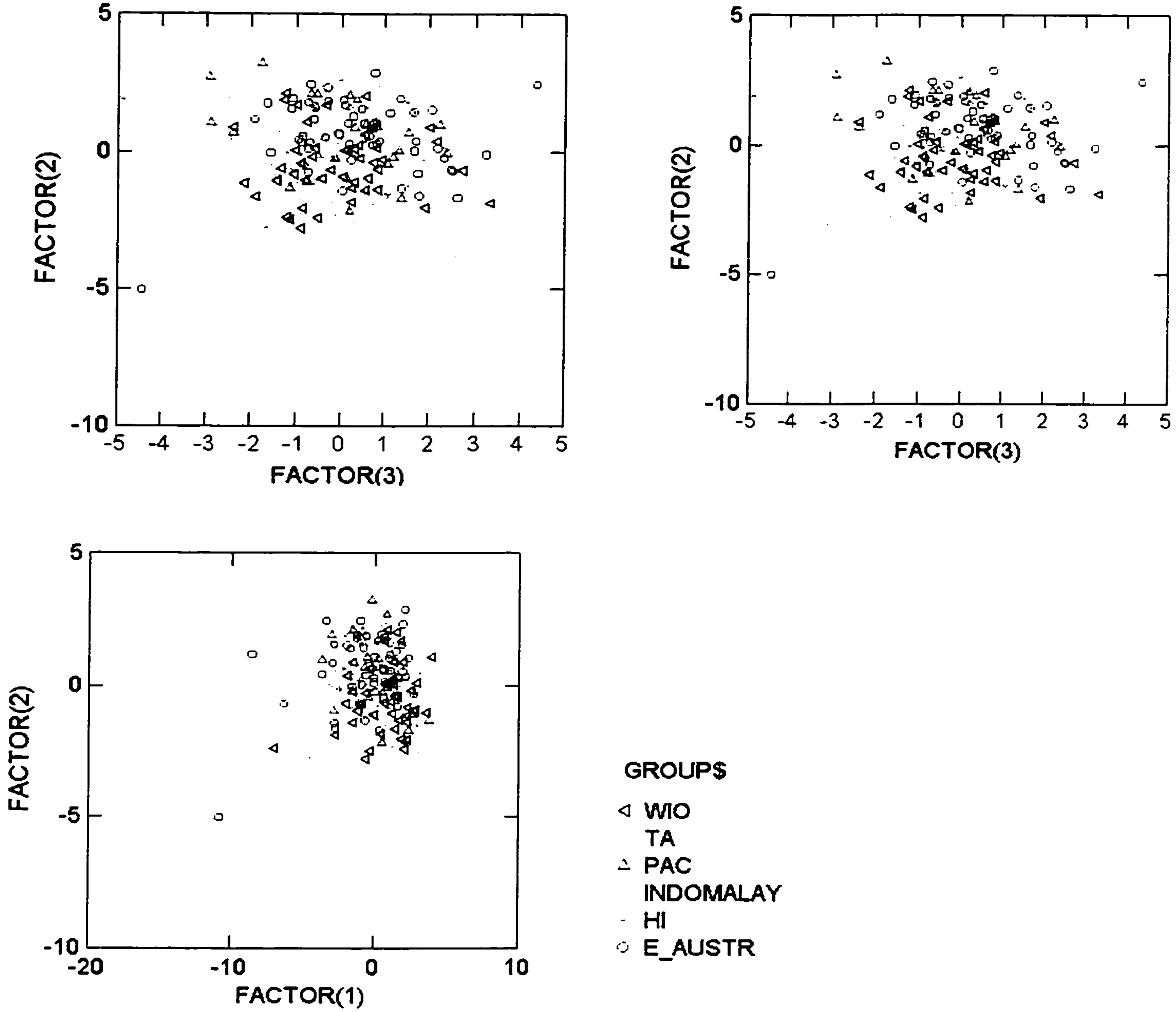

Figure 38. Bivariate plots of factors 1 to 3. Top left, factor 1 vs 3, top right, factor 2 vs 3, bottom left, factor 1 vs 2.

Samariscus xenicus Ochiai & Amaoka 1962

Material examined

HUMZ 111595, 1(51.9 mm SL), off Kochi, Japan, HUMZ 111596, 1(56.0 mm SL), off Kochi, Japan, HUMZ 111597, 1(46.4 mm SL), off Kochi, Japan, HUMZ 111598, 1(46.9 mm SL), off Kochi, Japan, HUMZ 111599, 1(41.7 mm SL), off Kochi, Japan, MNHN 1992-937, 2(47.1- 55.6mm SL), Tosa Bay (Kochi pref).

Common name

Ko-tsukinowagerei (Masuda et al. 1984)

Diagnosis

S. xenicus can be differentiated from its congeners by the following combination of characters: 4 pectoral fin rays, D 64-68, A 47-50, snout length 4.7-5.6 in HL.

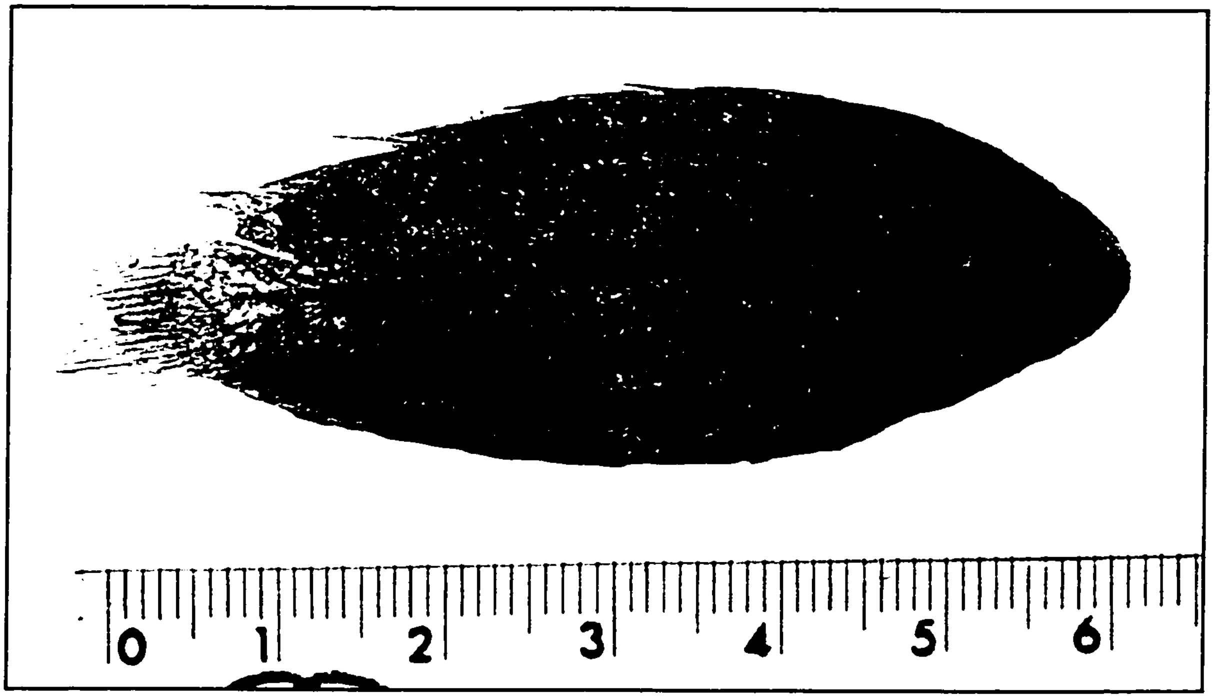

Fig 39. Illustration of *Samariscus xenicus*

Description

Dorsal fin ray count 64-68, anal fin rays 47-50, pectoral fin rays 4, lateral line scales 45-50, total vertebrae 35-36, supracranial pterygiophores 7-8 and proximal reduced anal pterygiophores 4. Proportions of morphometric features are presented in Table 41. Body outline oval, reaching deepest point in anterior third of body (see Fig. 39). Head small, placed below axis of lateral line. Head and snout form smooth conical outline. Dorsal profile above head smooth. Eyes small but dark and prominent. Mouth small and moderately oblique. Teeth poorly developed in 2-3 bands on upper and lower jaws. Scales ctenoid on both sides. Gillrakers short or rudimentary, knoblike. Eyes same size, snout rounded. Pectoral short, threadlike and dark. Pelvic short and inconspicuous. Dorsal and anal posterior fins pointed posteriorly.

Table 41. Morphometrics for seven specimens of *Samariscus xenicus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

Character		Mean, Range
1.	HL	4.8 (4.3-5.2)
2.	H_depth	0.9 (0.9-1.0)
3.	Snout	5.0 (4.7-5.6)
4.	Orb_width	2.0 (1.9-2.2)
5.	U_jaw_o	3.4 (3.1-3.5)
6.	L_jaw_o	2.3 (2.3-2.5)
7.	U_jaw_b	3.8 (3.5-4.2)
8.	L_jaw_b	2.5 (2.4-2.6)
9.	Eye_fixed	3.2 (3.1-3.4)
10.	Intorb	47.4 (25.8-54.5)
11.	B_depth	2.3 (2.2-2.5)
12.	Caud_ped	7.7 (6.4-8.4)
13.	Pre_anal	4.8 (4.1-6.5)
14	Pelvic_l	9.6 (8.7-11.3)
15.	Pectoral_l	4.0 (3.6-4.5)
16.	Caud_l	5.1 (4.1-6.7)
17.	Dorht	9.8 (8.7-11.9)
18.	Anlht	9.4 (8.8-9.9)

Colour in alcohol

Body greyish brown. Concentration of chromatophores around e.s. scales gives body a stippled appearance. Dorsal and ventral marginal spots very small and indistinct. B.s. uniformly yellow. Pectoral with a series of dark bands. Abdominal area on e.s. dark. Characteristic rectangular band of dark colour on anal margin of head immediately below eyes.

Geographic distribution

Samariscus xenicus is found in Japanese waters (see Fig. 40).

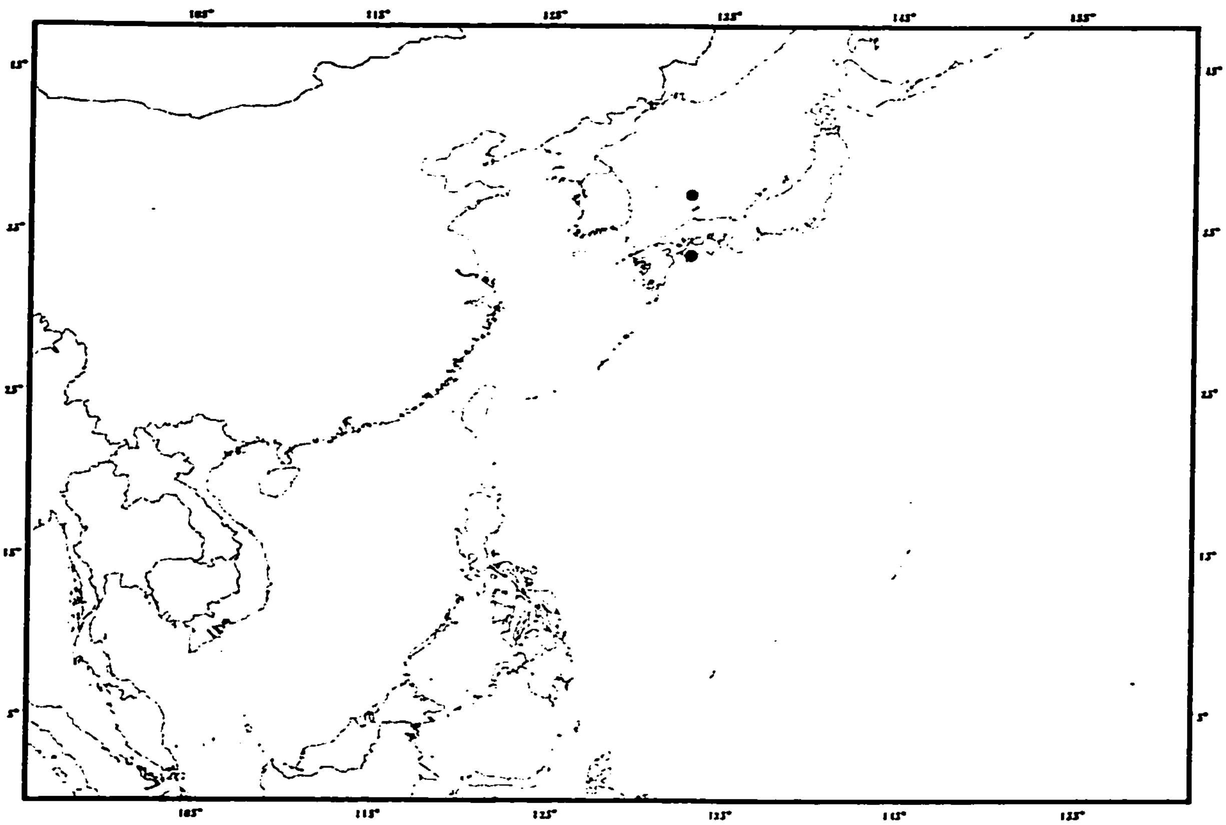

Figure 40. Distribution of *Samariscus xenicus*.

Comparisons

Close to *S. asanoi*, but differs in body depth (2.2-2.6 in SL for *S. xenicus* vs. 2.8 in SL for that species). Can be distinguished from other species of *Samariscus* by the following characters: pectoral rays 4, eye 3.1-3.4 in HL, body depth 2.2-2.5 in SL, anal fin rays 47-50.

Samaridae genus incertae sedis

Material examined
P28711.004 1(33.4 mm SL), 19° 3' S, 118° 50' E.

Diagnosis
Like *Samaris* sp1, this specimen has large robust ctenii on scales along the posterior margins of the dorsal and anal curves, but lacks prolonged dorsal fin rays and has short pelvic fins. This specimen has two ocelli on the posterior portion of the midline of the body.

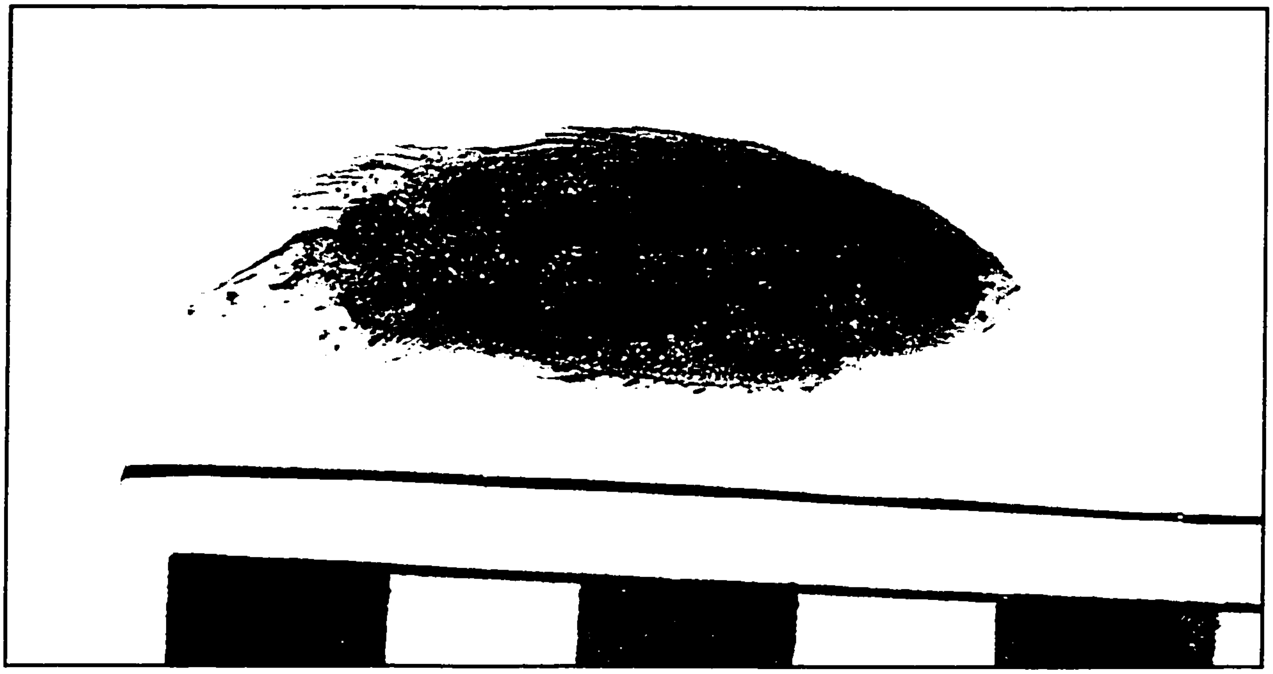

Figure 41. Illustration of P28711.004.

Description
Dorsal fin rays 67, anal fin rays 52, lateral line scales 56, total vertebrae 38, supracranial pterygiophores 8, and proximal reduced anal pterygiophores 5. Proportions of all morphometric features are presented in Table 42. Body oval, reaching greatest depth in the anterior third of the body (see Fig. 41). Head sharply conical, eyes large, mouth large and oblique. Anterior dorsal fin rays not prolonged. Pectoral fin large, pelvic short. Caudal fin rays branched. B.s. cephalic flap reaches to midpoint of head.

Table 42. Morphometrics for P28711.004. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	
1.	HL	4.2
2.	H_depth	0.9
3.	Snout	4.2
4.	Orb_width	2.0
5.	U_jaw_o	2.9
6.	L_jaw_o	2.0
7.	U_jaw_b	3.5
8.	L_jaw_b	2.2
9.	Eye_fixed	2.9
10.	Intorb	28.0
11.	B_depth	2.7
12.	Caud_ped	9.5
13.	Pre_anal	3.4
14	Pelvic_l	6.7
15.	Pectoral_l	3.8
16.	Dorsal_l	12.8
17.	Caud_l	4.0
18.	Dorht	8.6
19.	Anlht	7.6

Colour in alcohol

Scattered indistinct blotches on the body. Five dorsal and four vental spots. Two central ocelli almost as large as the eye. Scattered small spots on dorsal, anal and caudal fins, which are generally clear. Pectoral dark, b.s. uniformly yellowish beige.

Geographic distribution

P28711.004 is known from northwestern Australia (see Fig. 42)

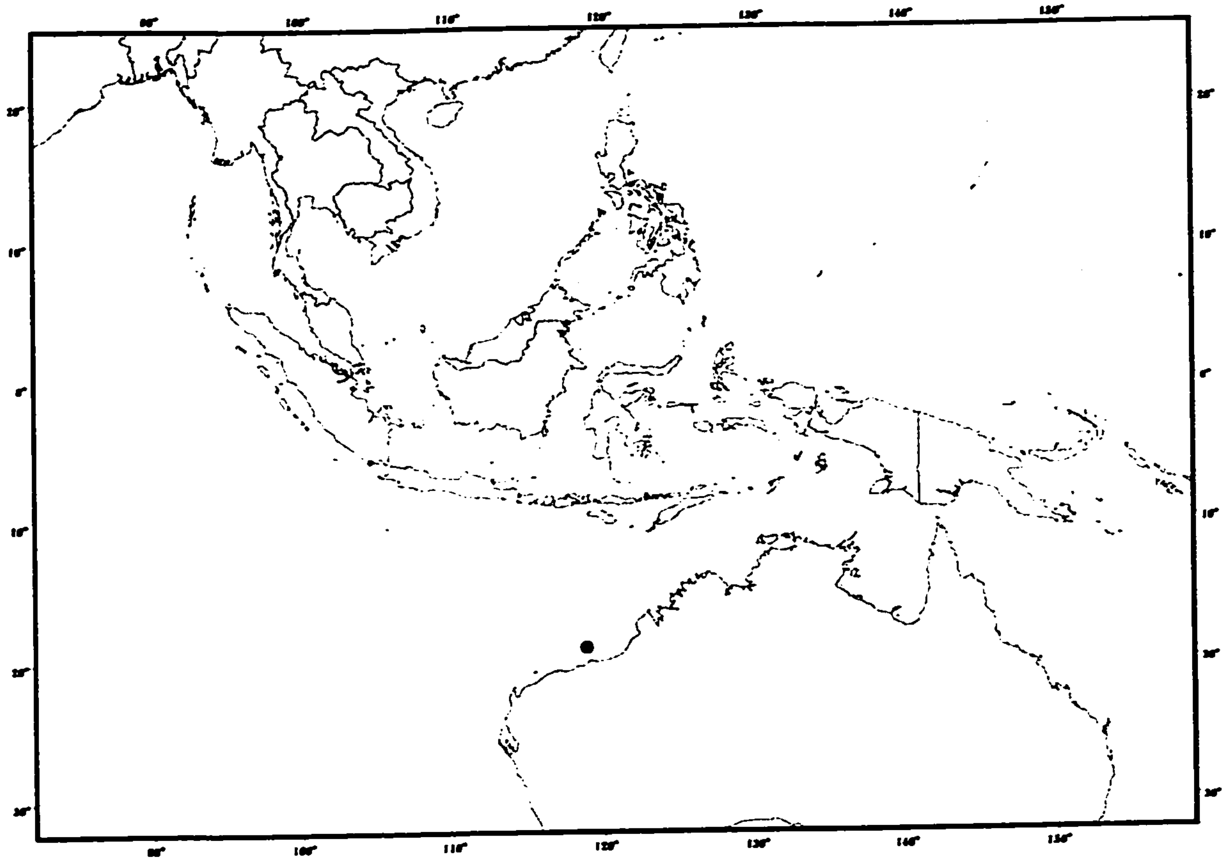

Figure 42. Distribution of P28711.004.

Remarks
This specimen possesses enlarged ctenii but no prolonged anterior dorsal rays, branched caudal fin rays, 6 abdominal parapophyses and a short e.s. pelvic fin (6.7 in SL). It agrees closely with *S.* sp1. in meristics such as dorsal and anal fin rays, supracranial pterygiophores and lateral line scales. The absence of prolonged anterior dorsal rays and presence of a b.s. cephalic flap as well as branched caudal fin rays means that the specimen has a mixture of characteristics of *Samaris* and *Samariscus*. The size at which anterior dorsal fin rays begin to lengthen in P28711.004 is unknown, but in *S. cristatus*, larvae of 6.4 to 10.0 mm show short dorsal fin rays. There are a number of possibilities; one is that the specimen represents a new genus, one that is intermediate between the two aforementioned genera, or that it is a hybrid between *S.* sp1. and a *Samariscus* species. It could also be an aberrant individual of *S.* sp1. The specimen is from the Northwestern Shelf of Australia, an area midway between the two known specimens of *S.* sp1. and within the range of several species of *Samariscus*, so that it is conceivable that it is a

hybrid. As there have been no studies done or observations made on the reproduction of samarid flatfishes, there is little basis for refutation or support of an hypothesized hybridization event.

Genus *Samaris* Gray, 1831 [type species by monotypy - *Samaris cristatus*]

Gray (1831) defined the genus *Samaris* as having a small pectoral fin, ventral (= pelvic) fins separate, unequal, the e.s. fin larger, dorsal fin commencing over the middle of the upper eye; the first rays long and free at the end. Eyes on the right side close together, separated by a ridge, mouth regular; teeth small. In this study, the genus is defined by the presence of prolonged dorsal fin rays, numbering from 6-15, prolonged ocular side pelvic fin rays, all fin rays simple, 4 pectoral rays, and 6-7 abdominal parapophyses.

Description

Eyes moderate, narrowly separated. Mouth small, teeth small in narrow bands on both sides. Gill rakers rudimentary. Dorsal originating on snout, anterior rays greatly prolonged. Pelvics asymmetrical, right longer than left. Pectoral fin long. Scales small, ctenoid. Straight lateral line, with supratemporal branch bifurcating behind upper eye. Nostrils with a bifurcate tubular flap of skin. Where scales have not been worn away, numerous scales with numerous clustered robust ctenii emerging at an oblique angle are found on the b.s. of the head (see figs. 46 and 47)

Taxonomy

Eschmeyer (1998) listed three species in this genus; *S. cristatus*, *S. macrolepis* and *S. costae*. Four species or subspecies were described that were close to *S. cristatus*; *S. cacatuae*, *S. ornatus*, *S. delagoensis* and *S. cristatus erythraeus* (Norman 1934, Chabanaud 1969). Heemstra (1986) synonymized *S. delagoensis* and *S. ornatus*. The type for *S. delagoensis* is not extant. Winterbottom (1974) noted that much of the material collected in the Government Marine Survey collections housed in the Department of Zoology at the University of Cape Town was disposed of. Barnard (1925) in a key noted that *S. ornatus* had D84, A57, while *S. delagoensis* had D78, A55. More importantly, in the same key he differentiated *S. ornatus* from *S. delagoensis* by the former having the pectoral mottled with white, the pectoral of the latter species mottled with black. This character, at least for *S. ornatus*, is reinforced in the present study.

In examining specimens labelled as *S. cristatus*, it was obvious from looking at all specimens that there was geographic meristic and morphometric variation. Norman noted similarities between *S. cristatus*, *S. delagoensis*, *S. ornatus* and *S. cacatuae*.

To detect patterns of morphological variation in all specimens identified as *Samaris cristatus*, residuals were extracted from regressions of body parts on standard length to create size-free shape variates. Those standardized variates were used in a principal components analysis (PCA) that summarized most of the variation in the dataset. Factors from that PCA were used in a discriminant function analysis (DFA) in order to classify individuals .

Specimens were initially assigned to one of nine groups based on geographic area. These groups / areas were: TH - Thailand, TA - Taiwan, SA, South Africa, RS - Red Sea, PI - Philippines, IM - Indo-Malaysia, BB - Bay of Bengal, AU - Australia and AR - Arabian Sea (see table 43). A discriminant function analysis was done on 8 size free factors representing 75% of the variation in the dataset. The p value for Wilk's λ was 0.014 and the overall classification rate 69%, the jacknifed classification rate 62%.. Canonical scores of group means were then used in hierarchical cluster analysis (see Fig. 43)

Table 43. Classification rate for DFA on 9 groups of *Samaris cristatus*.

Geographic label	%correct
AR	97
AU	87
BB	43
IM	14
PI	67
RS	64
SA	33
TA	78
TH	88

Taking an arbitrary level of 75% correct classification, AR, AU and TH and TA are correctly classified. The others will be reclassified. Numerous pairwise comparisons were done (examination of ratios of morphometric measurements): AR with RS, BB with IM, BB with TH, TH with IM, IM and PI, TA with PI, SA with AR. Rather than doing all pairwise comparisons, comparisons were limited to adjacent geographic areas.

```
Distances
 0.000                                                          1.000
 AU          -----------------------------\
                                          +-------\
 TH          ----\                        |       |
                 +------------------------/       |
 IM          ----/                                |
                                                  +-----\
 AR          -------------------------------------/     |
                                                        +-----\
 PI          ------\                                    |     |
                   +------------------------------------/     |
 TA          ------/                                          |
                                                              |--
---------------
 BB          --------------------------------\                |
                                             +----------------/
 RS          -----\                          |
                  +--------------------------/
 SA          -----/
```

Figure 43. Cluster tree using discriminant scores of nine groups of nominal *S. cristatus*

In pairwise comparisons, where no differences in meristic or morphometric characters were seen, the specimens from those groups were combined. Even if there were overlapping ratios, but some separation visually, the groups were kept separate. PI was combined with TA to form the new identifier PITA, RS and SA combined to WIO (western Indian Ocean) and IM and BB combined to MALAY (Indo-Malaysia). See Fig 44 and Table 44.

Wilk's λ p = 0.0000, overall classification rate 89%, jacknifed classification rate 88%.

```
0.000                                                        2.000

 AU        ---------------------------------------\
                                                   |--------
--------------
 AR        -------------------------------\                   |
                                           +----\             |
 MALAY     -------\                        |     |            |
                   +-----------------------/     |            |
 WIO       -------/                              |            |
                                                 +--/
 PITA      -------------------------------------/
```

Figure 44. Cluster tree using discriminant scores of five groups of nominal *S. cristatus*

Table 44. Ten pairwise comparisons with five groups and characters showing the greatest differences.

Pair	Characters
AU-AR	Extended_D, CAUDLS, HL
AU-MALAY	LJOS, UJOS, HD
AU-WIO	Extended_D, Pecl
AU-PITA	HD, LJOS, UJBS
AR-MALAY	Extended_D, CAUDL,EYE, LJB, HL
AR-WIO	HL, PECL
AR-PITA	HL and HD, DORL, CAUDL, EXTENDED_D
MALAY-WIO	PECL, SUPRACRAN
MALAY-PITA	little separation
WIO-PITA	Pecl, XDOR

As there are no apparent differences between the MALAY-PITA groups, they are combined into MALPIT. In another DFA using these new groups, Wilk's λ p = 0.0000, overall classification rate was 95%, jacknifed classification rate was 92%.

Table 45. Six pairwise comparisons with four groups and characters showing the greatest differences.

Pair	Characters
AU-AR	Extended_D, CAUDLS, HL
AU-MALPIT	HD, DORSAL, XDOR
AU-WIO	Extended_D, Pecl
AR- MALPIT	ANALHT, DORSHT, CAUDL, HL, CRANPT
AR-WIO	HL, PECL
MALPIT -WIO	PECL, CRANPT

There are now four well defined forms, AU, AR, MALPIT and WIO (see Table 45). These four forms are distinguishable from what is currently defined as a widely-ranging species, *Samaris cristatus* correspond to four species, *S. cacatuae*, *S. arabiensis*, *S. cristatus* and *S. ornatus*. The two species most difficult to quantitatively separate are S. *cacatuae* and *S. cristatus*. A discriminant function using four meristics (dorsal and anal fin rays, lateral scales and prolonged dorsal fin rays) was used to generate discriminant scores that showed separation of 88% (see Fig. 45). The two species, however, may be distinguished using pigmentation patterns (see individual species accounts for details). The *S. cristatus* complex is defined by the following characters: first pelvic fin ray free and not united with the rest, b.s. cephalic flap, 7 abdominal parapophyses, flaps over the insertion of dorsal and anal fin rays, ≥ 10 (10-16) prolonged dorsal fin rays, base of 4th to 7th anterior dorsal fin rays tinged with black.

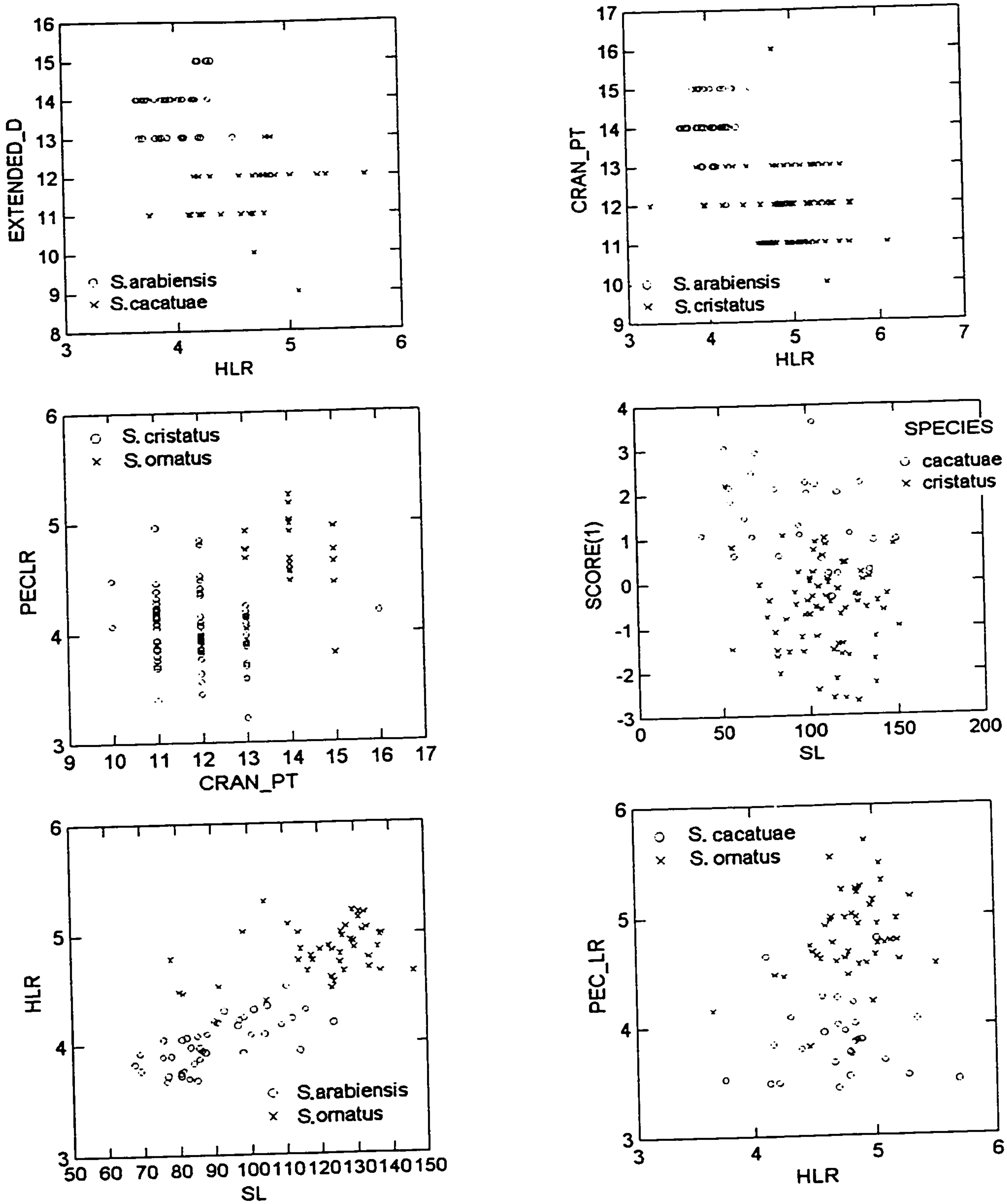

Figure 45. Pairwise comparisons of the best separating characters for each pair of the four species in the *S. cristatus* complex.

Unique scales in the *S. cristatus* complex

During the course of this study, tufts or fine sharp protrusions on the b.s. of the head in several specimens were observed. On further examination, they proved to be ctenii, but emerging perpendicular from the body. Some of these scales were removed and photographed (Figs. 46 & 47). These scales were not documented by Roberts (1993) and may be new to ichthyology.

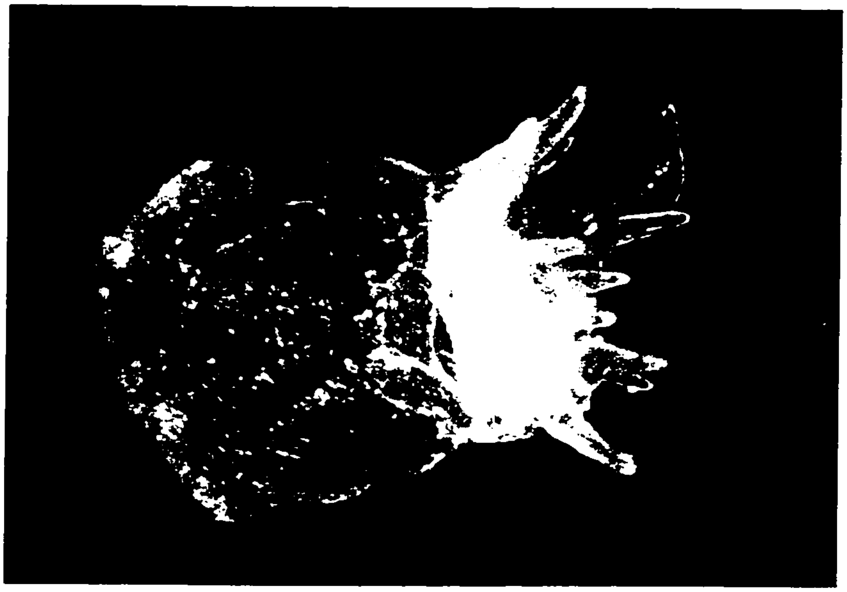

Figure 46. Dorsal view of ctenoid scale from b.s. of the head.

Figure 47. Lateral view of ctenoid scale from b.s. of the head. Bend in scale body is an artifact of handling.

Meristic variation in the *S. cristatus* complex

Table 46. Frequency distribution of dorsal fin rays for species in the *S. cristatus* complex

Dorsal fin rays	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	x	sd
sp.	1	0	0	1	2	3	1	7	8	5	4	6	2	0	1				79.1	2.74
cacatuae									1	4	4	4	6	4	5	0	1	1	82.9	2.20
cristatus				2	0	7	12	7	9	12	10	6	7	2					79.3	2.40
ornatus									3	4	9	5	6	5	4	4	2		82.6	2.25

Table 47. Frequency distribution of anal fin rays for species in the *S. cristatus* complex

Anal fin rays	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	N	x	sd
sp.	1	1	0	0	6	3	15	6	5	3	0	1					41	54.0	2.00
cacatuae								2	5	1	6	11	2	1	0	2	30	58.3	2.00
cristatus					1	3	11	8	17	13	10	7	3	0	1		74	56.4	1.98
ornatus							2	2	11	14	7	3	2	1			42	57.0	1.47

Table 48. Frequency distribution of total vertebrae for species in the *S. cristatus* complex

Total vertebrae	38	39	40	41	42	x	sd
sp.		2	29	10		40.2	0.51
cacatuae			1	23	6	41.1	0.44
cristatus	1	1	33	37	2	40.5	0.65
ornatus		4	20	16	2	40.4	0.73

Table 49. Frequency distribution of supracranial pterygiophores for species in the *S. cristatus* complex

Supracranial pterygiophores	10	11	12	13	14	15	16	x	sd
sp.			1	5	22	13		14.1	0.73
cacatuae		2	6	19	3	0		12.8	0.74
cristatus	2	26	28	17	0	0	1	11.9	0.96
ornatus				7	24	10	1	14.0	0.76

Table 50. Frequency distribution of proximal reduced anal pterygiophores for species in the *S. cristatus* complex

PRAP	4	5	6	7	x	sd
sp.	6	32	2	1	5.0	0.55
cacatuae		17	9	4	5.0	0.61
cristatus	2	21	50	1	5.7	0.56
ornatus		20	22		6.0	0.73

Table 51. Frequency distribution of prolonged dorsal fin rays for species in the *S. cristatus* complex

Prolonged dorsal fin rays	10	11	12	13	14	15	16	x	sd
sp.				12	24	5		13.8	0.63
cacatuae	1	12	15	2				11.5	0.82
cristatus	1	6	41	24	2			12.3	0.71
ornatus				4	19	17	2	14.4	0.76

Table 52. Frequency distribution of interdigitation pattern for species in the *S. cristatus* complex

Interdigitation pattern	0-1-2	0-2-1	0-2-2	0-2-3	0-3-1	0-3-2	1-1-1	1-1-2	1-2-1	1-2-2	1-3-1	1-3-2	2-1-2	2-2-1	2-2-2	3-2-2
sp.	1	2	18	1	3	1	0	0	4	11	0	0	1	0	0	0
cacatuae	0	6	11	0	0	0	0	1	2	7	1	0	1	0	0	0
cristatus	0	1	10	0	1	3	0	8	12	22	3	2	0	3	6	1
ornatus	1	5	5	0	1	4	1	3	4	11	2	0	0	2	1	2

Table 53. Frequency distribution of lateral line scales for species in the *S. cristatus* complex

Lateral line scales	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	x	sd
sp.				2	1	0	4	2	3	5	1	4	3	3	4	5	1	2	0	1	0				70.8	4.11
cacatuae	1	0	0	2	1	1	2	5	7	3	4	1	2	0	0	0	0	0	0	0	1				68.2	3.49
cristatus				3	0	5	3	5	6	5	3	4	11	4	9	1	6	6	1	1	1				71.4	4.39
ornatus							1	2	2	2	0	2	10	2	3	6	4	1	2	0	2	2	0	1	73.8	4.06

Samaris sp.

Samaris cristatus Gray 1831

Material examined

Samaris sp - ANSP 145366, 2 (92.9-104.1 mm SL), Arabian Sea, 17°41°N, 71°33° E; ANSP 145379, 38 (67.5-123.7 mm SL), Arabian Sea, 17°25°N, 71°39° E.

Diagnosis

S. sp. can be differentiated from *S. cacatuae* by the following combination of characters: *cacatuae* has 12 prolonged dorsal fin rays (modal count); *S. sp.* has a modal count of 14. There is a 96% percent separation between *S. cristatus* and *S. sp.* on the basis of *cristatus* having less than or equal to 12 supracranial pterygiophores and SL/HL greater than or equal to 0.23. *S. sp.* is separated from *S. ornatus* by the combination of SL/HL and SL/PECL distinguishing 97.6% of specimens. Specimens of *S. ornatus* have cream-coloured to whitish spots on the pectoral fin, while specimens of *S. sp.* lack obvious spots.

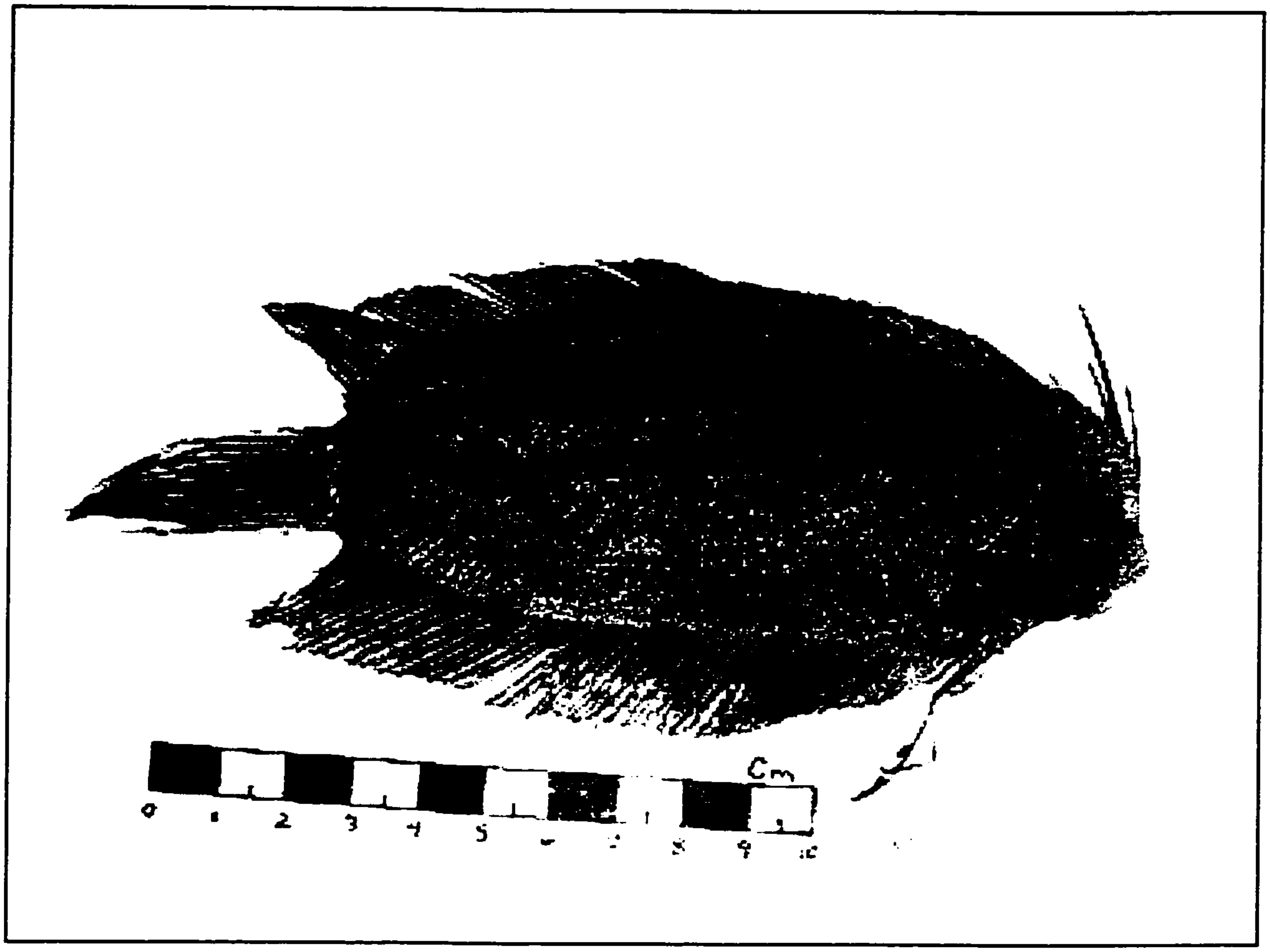

Fig 48. Illustration of *Samaris* sp.

Description

A large species in the *S. cristatus* complex. Modal dorsal fin ray count 79, anal fin rays 54, lateral line scales 75, total vertebrae 40, supracranial pterygiophores 14, prolonged dorsal fin rays 14 and proximal reduced anal pterygiophores 5. Proportions of morphometric features are presented in Table 54. Depth of body 2.6 (2.5-2.9) in standard length, head length 4.0 (3.7-4.5) pectoral fin length 4.1 (3.1-4.8). Body elongate, reaching maximum depth before halfway point of body, but very uniformly ovate, somewhat parallel sided (see Fig. 48). Head moderate in length, snout short, maxillary and lower jaw areas free of scales. B.s. cephalic area has scales with ctenii at right angles to scale body. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower eye close in size to and not advanced from migrated eye. Lower jaw ends at centre of fixed eye. Dorsal fin origin ahead of migrated eye, notch anterior to migrated eye not well developed. Lower jaw ends below the fixed eye. Dorsal body profile immediately posterior to head smooth, not noticeably altered by supracranial pterygiophores. Pectoral prominent and long. First 13-15 dorsal fin rays prolonged, almost as long as body. E.s. pelvic with paddle-like extension. On b.s., a skin fold runs from the base of the first dorsal fin ray down to the posterior portion of the angular.

Table 54. Morphometrics for 41 specimens of *Samaris sp.* Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

Character		Mean, Range
1.	HL	4.0 (3.7-4.5)
2.	H_depth	0.9 (0.9-1.1)
3.	Snout	5.1 (4.0-5.9)
4.	Orb_width	2.4 (2.2-2.8)
5.	U_jaw_o	3.5 (3.1-5.0)
6.	L_ jaw_o	2.3 (2.1-2.6)
7.	U_jaw_b	4.1 (3.5-5.3)
8.	L_jaw_b	2.4 (2.2-2.8)
9.	Eye_fixed	3.6 (3.0-4.6)
10.	Intorb	47.9 (19.4-78.3)
11.	B_depth	2.7 (2.5-2.9)
12.	Caud_ped	8.7 (7.8-9.7)
13.	Pre_anal	3.6 (2.4-4.0)
14	Pelvic_l	3.1 (2.3-3.9)
15.	Dorsal_l	1.1 (1.0-1.3)
16.	Pectoral_l	4.0 (2.8-4.8)
17.	Caud_l	2.9 (2.4-3.4)
18.	Dorht	7.0 (5.0-8.3)
19.	Anlht	6.8 (5.6-8.1)

Colour in alcohol

Ocular side light brown tinged with yellow. Five equally spaced spots on dorsal margin, the most posterior spot at the most posterior extent of dorsal fin base. Four equally spaced spots on the anal margin, the most posterior spot at the most posterior anal fin base. The base of each dorsal and ventral spot is weakly expanded to form almost continuous brownish bands running parallel to the dorsal and anal fin margins. Scattered brown spots are barely visible on a yellowish brown background. The pectoral fin is darker than the body being chocolate brown with no obvious variation in pigmentation. The blind side has a noticeably yellow colour. The b.s. dorsal and ventral pterygiophores are distinct. Fins on b.s. darker than the body, their distal portions darker than the proximal portion of the rays. Pelvic fin rays not banded. Caudal fin lacks spots. Chromatophores distributed randomly over body. Tip of 3rd pectoral fin ray with an indistinct, often oval dark spot.

Geographic distribution
S. sp. is known from three localities (see Fig.49) in the Arabian Sea.

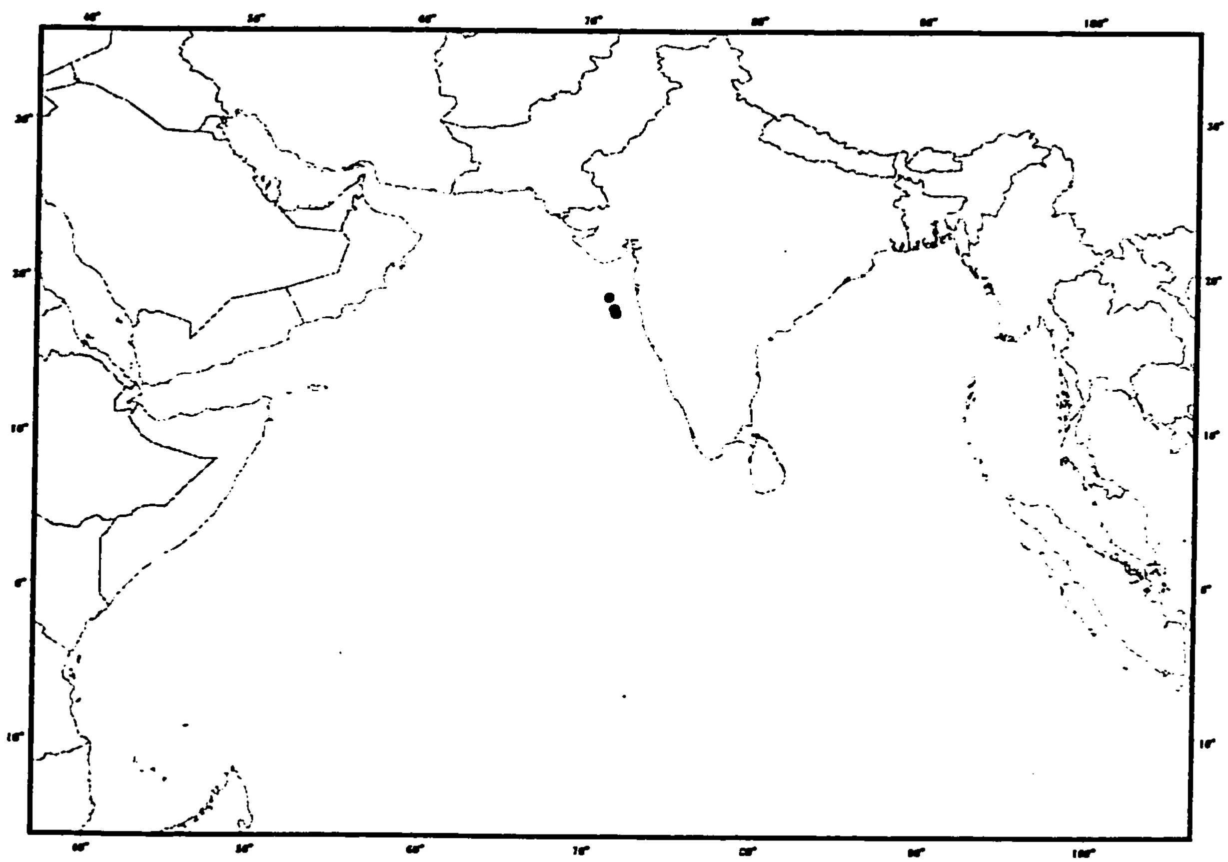

Figure 49. Distribution of *Samaris sp.*

Remarks
Samaris sp. is a medium to large species, with a mean length of 90.2 mm and attaining a maximum length of 123.7 mm. Some of the smallest specimens were females with mature ovaries. This is not the *Samaris sp.* referred to by Quéro et al. 1989.

Comparisons

Within the *S. cristatus* complex, *S. sp.* is most similar to *S. ornatus*, sharing a well-developed b.s. cephalic skin flap and high dorsal, anal and lateral line counts, as well as generally similar pigmentation patterns. This species can be distinguished from *S. cristatus* and *S. cacatuae* by body shape, pigmentation pattern and the strength of the b.s. cephalic flap. *S. sp.*, like *S. cristatus*, S. *ornatus* and S. *cacatuae*, can readily be distinguished from other *Samaris* species by the number of prolonged dorsal fin rays (10-16), first pelvic fin ray free and not united with the rest, b.s. cephalic flap, 7 abdominal parapophyses, flap over the insertion of dorsal and anal fin rays, base of 4th to 7th anterior dorsal fin rays tinged with black.

Samaris cacatuae (Ogilby 1910)

Arnoglossus cacatuae Ogilby 1910
Samaris cacatuae (McCullough & Whitley 1935)
Samaris cristatus; Heemstra 1995

Material examined

E.2969, 1 (129.9 mm SL), 19° 45′ S 148° 40′ E.; holotype; AMS I.15557-057, 2 (123.4-134.5 mm SL), 19° 45′ S 148° 40′ E. AMS I.21641-002, 1 (107.8 mm SL), 19° 45′ S, 148° 40′ E. AMS I.22831-026, 1 (111.4 mm SL), 19° S, 117 °16′ E. AMS I.24342-001, 1 (87.0 mm SL), 19° 28′ S, 116° 29′ E. AMS I.37496-001, 29 25 S, 153 36 E, 1 (95.6 mm SL), AMS I.38468-002, 1 (87.0 mm SL), . NMV A.3153, 1 (112.9 mm SL), NTM S.11673-024, 1 (116.4 mm SL), WAM P.26200-007, 1 (103.6 mm SL), WAM P.28674-004, 1 (57.5 mm SL), WAM P.28688-002, 10 (37.8-99.8 mm SL), NTM S.1180-006, 1 (116.6 mm SL), NTM S.2474-001, 1 (137.0 mm SL), NTM S.2945-001, 1 (150.2 mm SL), NTM S.3311-013, 2 (99.2-104.4 mm SL), NTM S.4279-001, 1 (113.3 mm SL), NTM S.4279-002, 1 (81.4 mm SL), NTM S.4721-001, 1 (95.1 mm SL) .

Diagnosis

This species can be distinguished from all its congeners by the following combination of characters: body with irregular blotching on faintly blue and light brown background, e.s. pelvic fin with distinct bands along length as well as on paddle, numbers of prolonged dorsal fin rays 11-12 (rarely 10 or 13), D 79-88, A 55-63, length of pectoral fin 2.8-4.8 in SL, head length 3.7-4.5 in SL.

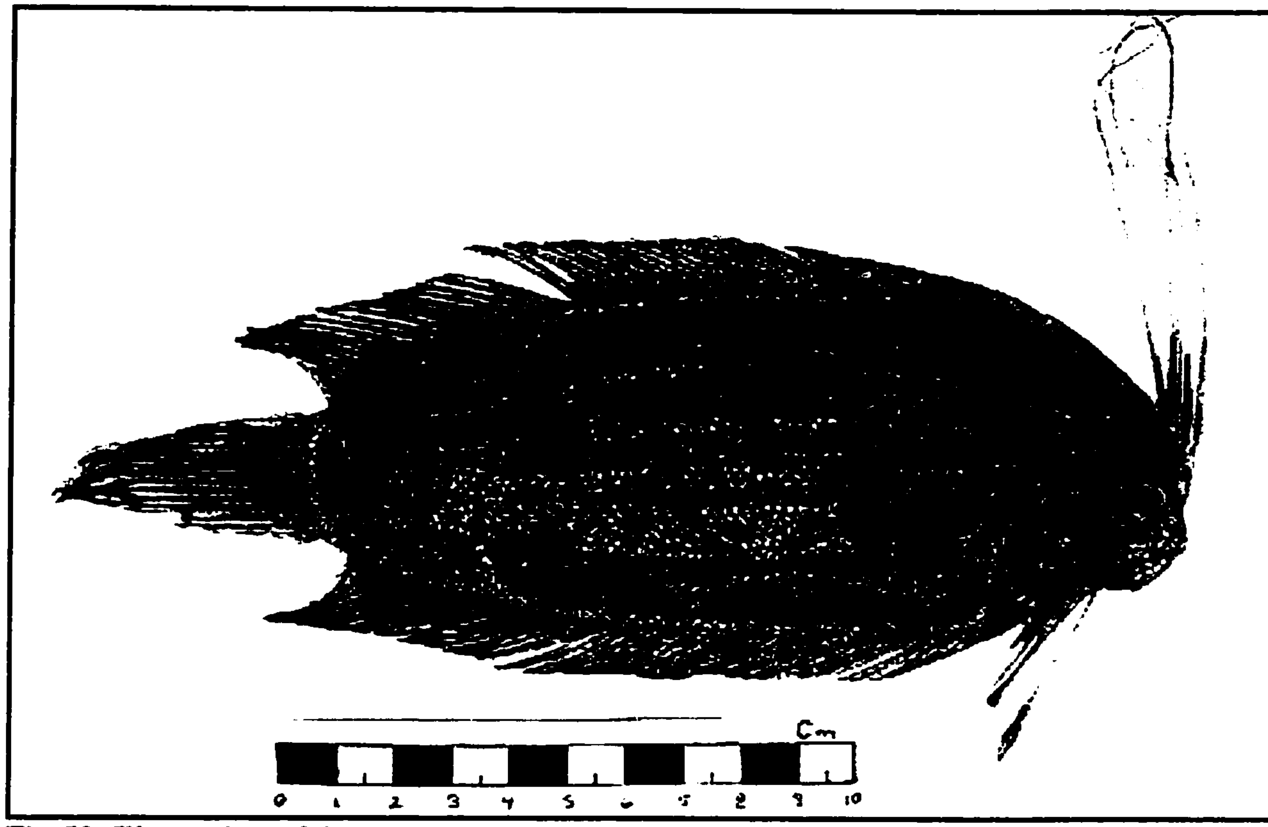

Fig 50. Illustration of *Samaris cacatuae*

Description

The smallest species in the *S. cristatus* complex. Modal (with count for holotype in parentheses) dorsal fin ray count 85 (83), anal fin rays 59 (59), lateral line scales 60 (68), total vertebrae 31 (30), supracranial pterygiophores 13 (13), prolonged dorsal fin rays 12 (12) and proximal reduced anal pterygiophores 5 (5). Proportions of all morphometric features are presented in Table 55. Body relatively deep, reaching maximum depth at halfway point of body (see Fig. 50). Head moderate in length, snout short; maxillary and lower jaw areas free of scales. B.s. cephalic area has scales with ctenii at right angles to scale body. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower eye close in size to migrated eye. Dorsal fin origin ahead of migrated eye, notch anterior to migrated eye hardly visible. Lower jaw ends under the first third of the fixed eye. Dorsal body profile immediately posterior to head smooth, not noticeably altered by supracranial pterygiophores. First 10-14 dorsal fin rays prolonged, almost as long as body. Pectoral large. E.s. pelvic with well-developed paddle-like extension. On b.s., a skin fold runs from the base of the first dorsal fin ray down to the posterior portion of the angular.

Table 55. Morphometrics for holotype E.2969 and 30 additional specimens of *Samaris cacatuae*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype	Mean, Range
1.	HL	5.3	4.6 (3.8-5.7)
2.	H_depth	0.7	0.8 (0.5-1.0)
3.	Snout	4.2	4.2 (3.7-5.2)
4.	Orb_width	2.0	2.1 (1.8-2.8)
5.	U_jaw_o	2.8	2.9 (2.5-3.7)
6.	L_jaw_o	1.9	2.0 (1.8-2.3)
7.	U_jaw_b	3.4	3.4 (3.0-4.1)
8.	L_jaw_b	1.9	2.1 (1.9-2.4)
9.	Eye_fixed	3.4	3.3 (2.8-4.1)
10.	Intorb	24.3	30.3 (17.2-52.7)
11.	B_depth	2.5	2.5 (2.3-3.1)
12.	Caud_ped	8.0	8.3 (6.9-11.0)
13.	Pre_anal	4.6	4.2 (3.0-7.4)
14	Pelvic_l	3.9	3.7 (0.8-7.2)
15.	Pectoral_l	4.0	1.3 (1.0-1.6)
16.	Dorsal_l	1.4	4.2 (3.4-9.6)
17.	Caud_l	3.6	3.9 (1.0-8.2)
18.	Dorht	7.4	7.3 (3.4-10.0)
19.	Anlht	7.9	7.4 (5.8-13.2)

Colour in alcohol

Ocular side light grey background. Five equally spaced indistinct spots on dorsal margin, the most posterior spot at the most posterior dorsal fin base. Four equally spaced spots on the anal margin, the most posterior spot at the most posterior anal fin base. Dorsal and ventral spots with bases barely expanded. Central spot on body visible, posterior and anterior spots not discernible. Scattered brown spots are visible on a faintly blue and brown background, but chocolate brown vermiculations are more obvious. The strongly banded pectoral fin is darker than the body having irregular greyish or chocolate brown crossbands alternating with a cream colour. Some specimens exhibit a membrane on the pectoral fin that is enlarged and scalloped. The e.s. pelvic fin is noticeably banded along its length as well as on the paddle. The blind side is uniformly dull yellow to cream. The b.s. dorsal and ventral pterygiophores are visible but not distinct. Fins on b.s. darker than the body, their distal portions not darker than the proximal portion of the rays. Pelvic fin rays banded. Caudal fin spotted and banded. Chromatophores distributed randomly over body. A variable character defining the *S. cristatus* complex is the possession of an ocellus on the distal tip of the pectoral fin. *S. cacatuae* shows this ocellus in the majority of specimens. This ocellus is not readily apparent on small (< 50 mm.) specimens, nor is it apparent on specimens that have been poorly preserved. Colour in life lavender (Ogilby 1910).

Geographic distribution
S. cacatuae is found along the north-western, north and north-eastern coast of Australia (see Fig. 51). See Biogeography section for further discussion.

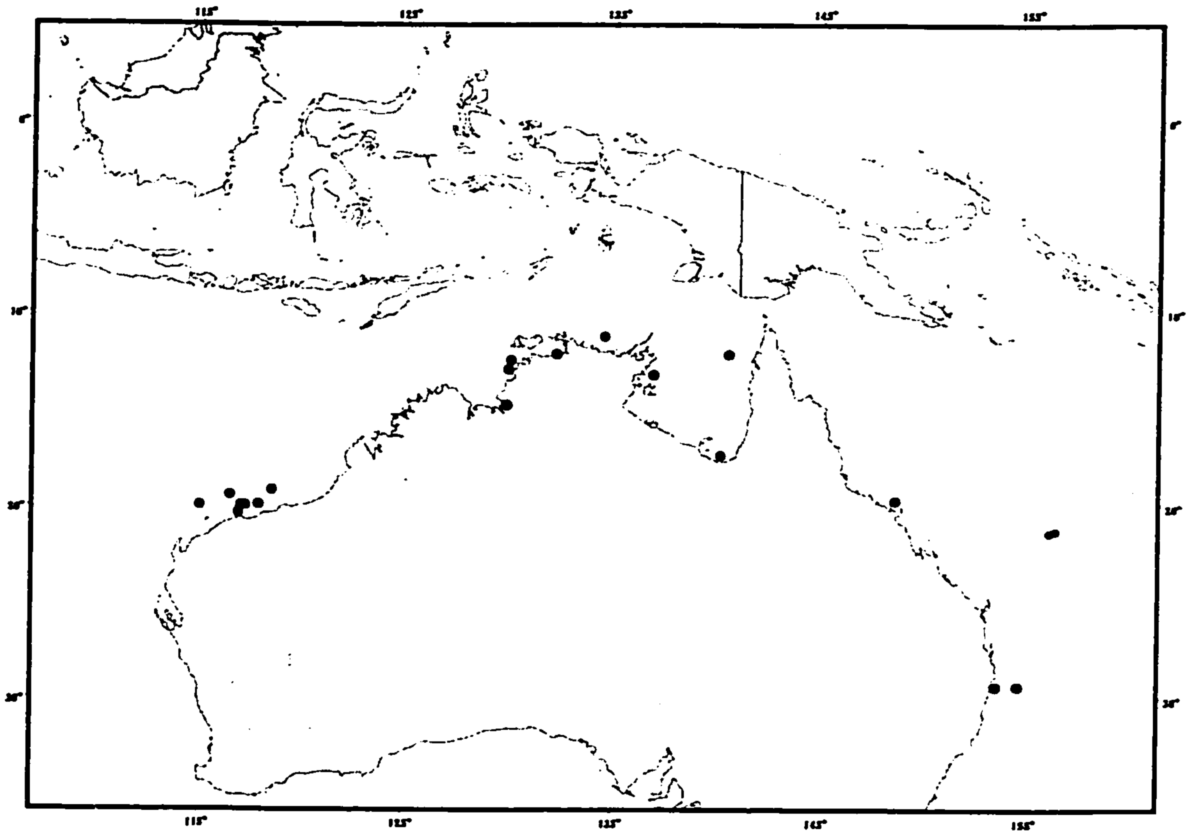

Figure 51. Distribution of *Samaris cacatuae.*

Remarks
Samaris cacatuae is a medium to large species, with a mean length of 94.0 mm and attaining a maximum length of 150.2 mm.

Comparisons

Closest to *S. cristatus*. The present species differs little from *S. cristatus* morphologically. A discriminant function combining four meristics (dorsal, anal fin rays, lateral line scales and numbers of prolonged dorsal fin rays) successfully classifies 93 individuals or 88% (Fig 52). Qualitatively, the two species can readily be distinguished by differences in pigmentation. *S. cristatus* has the most sombre colouration of all members of the *S. cristatus* complex. *S. cacatuae*, by contrast, has quite ornate and distinctive colouration. One key diagnostic character is pigmentation of the e.s. pelvic fin, which is distinctly banded on all specimens of S. *cacatuae*, and uniform on all specimens of *S. cristatus*. . This species can be distinguished from S. *ornatus* and *S. sp.* by body shape, pigmentation pattern and the strength of the b.s. cephalic flap.

This species, like *S. cristatus*, *S. ornatus* and *S.* sp., can readily be distinguished from other *Samaris* species by the number of prolonged dorsal fin rays (10-16), first pelvic fin ray free, b.s. cephalic flap, 7 abdominal parapophyses, flap over the insertion of dorsal and anal fin rays, base of 4th to 7th anterior dorsal fin rays tinged with black.

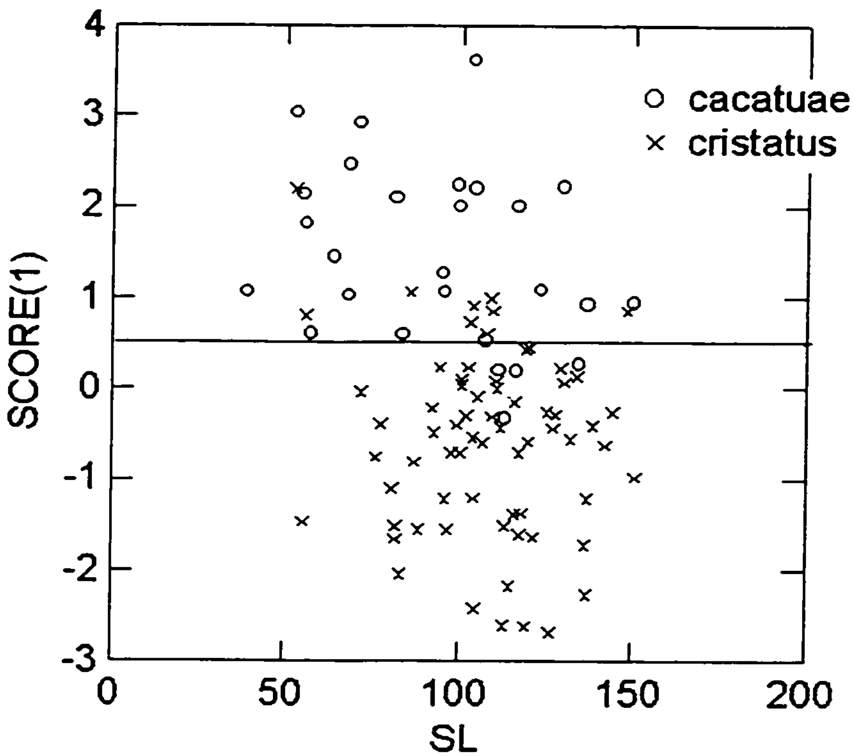

Figure 52. Plot of discriminant function scores against standard length for *S. cristatus* and *S. cacatuae*.

Samaris cristatus Gray, 1831

Common names: Crested Samaris (Gray 1831), Hatatategarei (Masuda et al. 1984), alternatively Hatatate-Garei (Kyushin et al. 1982), Gray's crested flounder (de Bruin et al. 1994) crested flounder (Barnard 1925)

Material examined

BMNH 1848.3.16; 1 (55.8) 7°6' N, 1°21' E; BMNH 1931.2.27:1-2; 2 (96.2- 125.9) 7°6' N, 0°7' E; BMNH 1931.4.23.27; 1 (92.0) 7°5' N, -1°4' E; BMNH 1931.4.23.28; 1 (110.2) 7°6' N, -1°4' E; CAS 130331; 3 (81.6- 136.6) 7°6' N, 1°25' E; CAS 160850; 1 (142.1) 7°5' N, 1°21' E; CAS 162243; 5 (102.6- 142.1) 7°6' N, 1°12' E; CAS 162244; 2 (100.6-109.5) 6°5' N, 1°11' E; CAS 162245; 1 (108.8) 7°6' N, 1°12' E; CAS 162246; 4 (80.6-102.9) 7°5' N, 1°12' E; CAS 162247; 1 (102.9) 7°5' N, 1°12' E; CAS 28338; 3 (114.6 -119.8) 7°6' N, 1°23' E; CAS 32043; 1 (71.8) 7°6' N, 1°12' E; CAS 35874; 1 (55.3) 7°5' N, -1°3' E; CAS 45842; 3 (99.4- 104.6) 7°5' N, 1°15' E; NTUM 2507; 3 (82.9-92.5) 7°6' N, 1°25' E; NTUM 5331; 2 (126.5-137.0) 7°6' N, 1°22' E; NTUM 5332; 1 (100.6) 7°6' N, 1°24' E; NTUM 5333; 1 (100.4) 7°5' N, 1°21' E; NTUM 5344; 1 (116.0) 7°5' N, 1°25' E; NTUM 5345; 1 (95.8) 6°4' N, 1°26' E; NTUM 5346; 1 (136.9) 7°5' N, 1°26' E; NTUM 5347; 1 (119.4) 7°6' N, 1°26' E; NTUM 5482; 1 (96.6) 8°6' N, 1°26' E; ROM 39367; 16 (88.4-148.2) 7°6' N, 1°25' E; S.11335-002; 2 (72.4-90.8) 7°6' N, 0°8' E;UMMZ 226114; 2 97.6-(110.8) 7°6' N, 1°10' E;UMMZ 227063; 1 (112.1) 7°5' N, 1°11' E; USNM 137649; 1 (81.5) 7°4' N, 1°10' E; USNM 137650; 1 (52.6) 7°5' N, -1°4' E; USNM 228532; 1 (130.4) 7°5' N, 1°11' E; USNM 286568; 1 (117.3) 7°6' N, 1°11' E; USNM 286569; 1 (127.9) 7°6' N, 1°11' E; USNM 286570; 2 (111.9-121.6) 7°6' N, 1°11' E.

Diagnosis

This species can be distinguished from all its congeners by the following combination of characters: body lacking distinct brown spots and vermiculations, prolonged dorsal fin rays 11-13 (rarely 10 or 14), head length 3.8-5.7 in SL, D 74-84, A 52-62, length of pectoral fin 3.4-9.6 in SL and supracranial pterygiophores 11-13 (rarely 10 or 16).

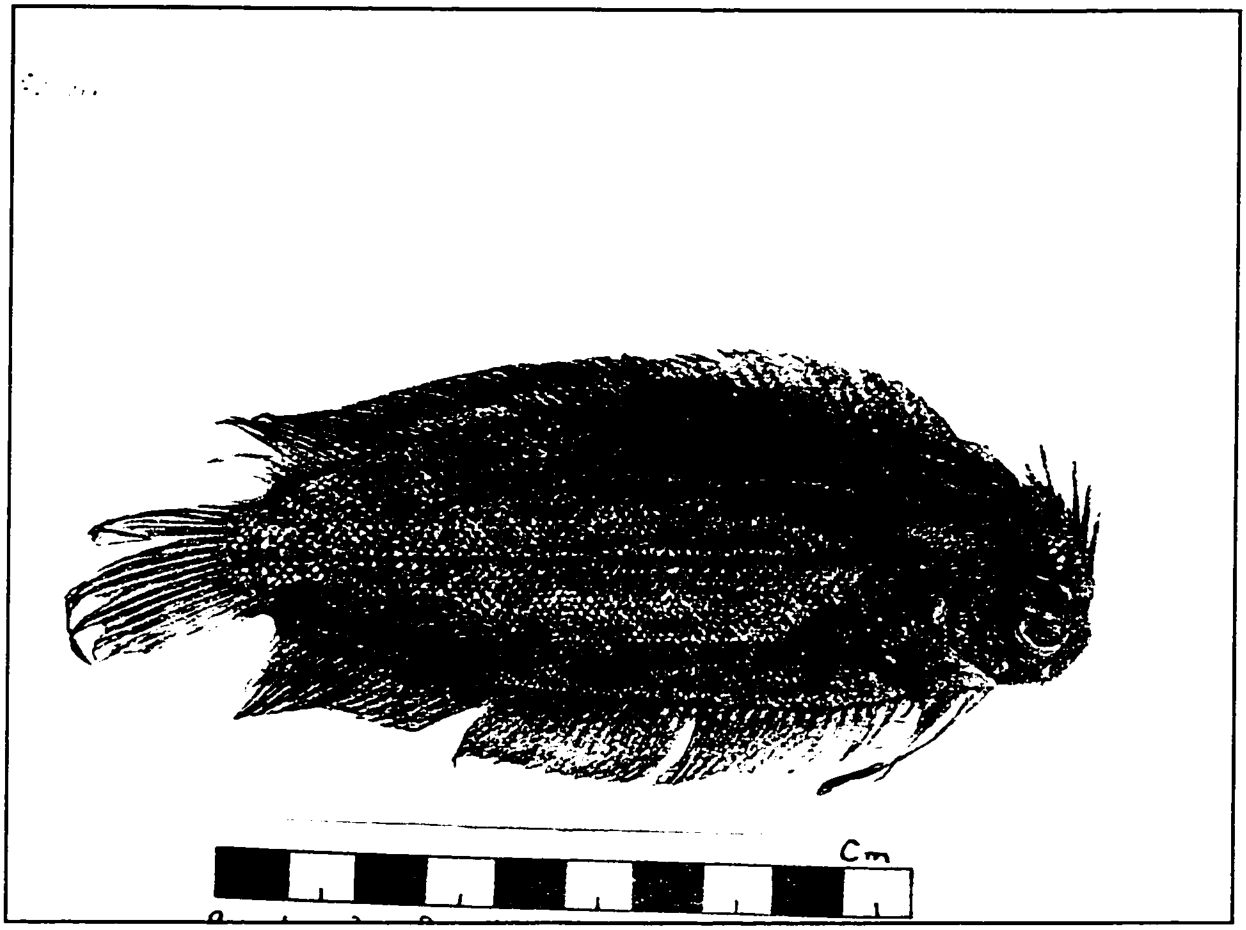

Figure 53. Illustration of *Samaris cristatus*

Description
The smallest species in the *S. cristatus* complex. Modal dorsal fin ray count 80, anal fin rays 56, lateral line scales 72, total vertebrae 41, supracranial pterygiophores 12, prolonged dorsal fin rays 12 and proximal reduced anal pterygiophores 5. Proportions of all morphometric features are presented in Table 56. Body generally oval in outline, reaching maximum depth posterior to the head (see Fig. 53). Ventral side of body often has a more pronounced curve posterior to halfway point than the dorsal. Head moderate in length and displaced below midline of body, snout short; maxillary and lower jaw areas free of scales. Lower jaw ends under the first third of the fixed eye. Dorsal body profile rounded, emphatically convex. B.s. cephalic area has scales with ctenii at right angles to scale body. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower eye close in size to and not advanced relative to migrated eye. Dorsal fin origin ahead of migrated eye, notch anterior to migrated eye well developed. Pectoral fin large.

First 10-15 dorsal fin rays prolonged, almost as long as body. E.s. pelvic with paddle-like extension. On b.s., a skin fold runs from the base of the first dorsal fin ray down to the posterior portion of the angular.

Table 56. Morphometrics for holotype BMNH 1977.4.22:8 and 30 additional specimens of *Samaris cristatus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype	Mean, Range
1.	HL	5.3	4.6 (3.8-5.7)
2.	H_depth	0.8	0.8 (0.5-1.0)
3.	Snout	4.4	4.2 (3.7-5.2)
4.	Orb_width	1.9	2.1 (1.8-2.8)
5.	U_jaw_o	3.1	2.9 (2.5-3.7)
6.	L_jaw_o	2.1	2.0 (1.8-2.3)
7.	U_jaw_b	3.8	3.4 (3.0-4.1)
8.	L_jaw_b	2.2	2.1 (1.9-2.4)
9.	Eye_fixed	3.4	3.3 (2.8-4.1)
10.	Intorb	40.0	30.3 (17.2-52.7)
11.	B_depth	2.4	2.5 (2.3-3.1)
12.	Caud_ped	8.4	8.3 (6.9-11.0)
13.	Pre_anal	7.3	4.2 (3.0-7.4)
14	Pelvic_l	3.7	3.7 (0.8-7.2)
15.	Pectoral_l	3.9	4.2 (3.4-9.6)
16.	Dorsal_l	1.1	1.3 (1.0-1.6)
17.	Caud_l	3.7	3.9 (1.0-8.2)
18.	Dorht	7.4	7.3 (3.4-10.0)
19.	Anlht	7.9	7.4 (5.8-13.2)

Colour in alcohol

Body colouration ranges from light greyish brown, brown to dark brown with indistinct scattered brown spots. Five dorsal margin and four anal marginal spots barely visible. Central spot of axial spots occasionally apparent. Scattered brown spots with light brown vermiculations are visible on a brown background. Some specimens are uniformly mid- to dark brown. The pectoral fin is little darker than the body being chocolate brown with no obvious variation in pigmentation. The blind side has a muddy beige colour. The b.s. dorsal and ventral pterygiophores are not distinct. Fins on b.s. not darker than the body, their distal portions not darker than the proximal portion of the rays. Dorsal and anal fin rays mottled. Pelvic fin rays uniform brown or very weakly banded. Paddle-like extension weakly developed, often dark brown or black. Caudal fin has weak spots. Dorsal and anal fins have some weak blotching at the base of the fins. Chromatophores distributed randomly over body.

Geographic distribution

S. cristatus is found throughout the Indo-Malaysian archipelago and north to Taiwan (see Fig. 54).

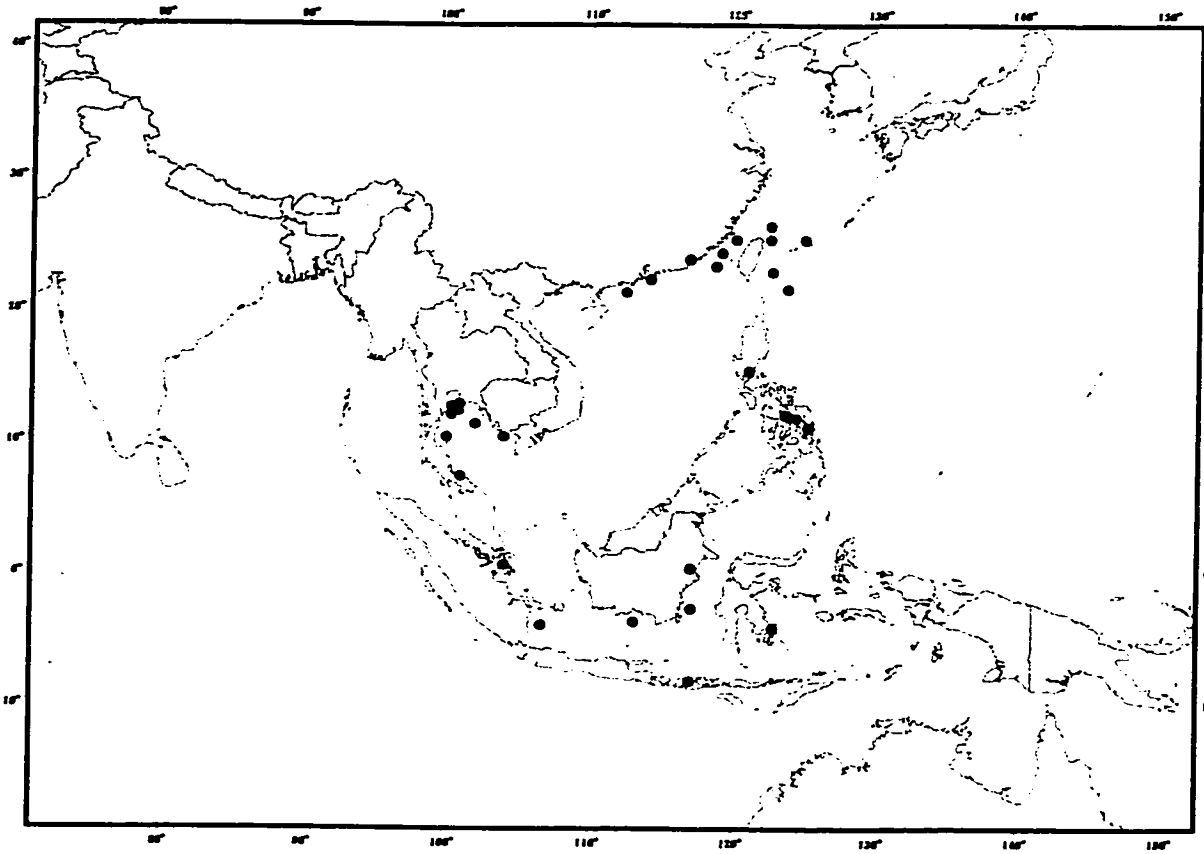

Figure 54. Distribution of *Samaris cristatus*.

Remarks

Samaris cristatus is a medium to large species, with a mean length of 104.7 mm and attaining a maximum length of 150.7 mm. This species has the least distinctive pigmentation pattern of all species in the *S. cristatus* complex.

Comparisons

Closest to *S. cacatuae*. The present species differs little from *S. cacatuae* morphologically, but can readily distinguished by differences in pigmentation. *S.* cristatus has the most sombre colouration of all members of the *S. cristatus* complex. *S. cacatuae*, by contrast, has quite ornate and distinctive colouration. One key diagnostic character is pigmentation of the e.s. pelvic fin, which is distinctly banded on all specimens of *S. cacatuae* and uniform on all specimens of *S. cristatus*. This species can be distinguished from S. *ornatus* and *S. sp.* by its smaller head and more oval body, darker and more uniform e.s. pigmentation, lacking a yellow or cream colour on the b.s. and much weaker b.s. cephalic flap.

This species, like *S. cacatuae*, *S. ornatus* and *S.* sp., can readily be distinguished from other *Samaris* species by the number of prolonged dorsal fin rays (10-16), first pelvic fin ray free, b.s. cephalic flap, 7 abdominal parapophyses, flap over the insertion of dorsal and anal fin rays, base of 4th to 7th anterior dorsal fin rays tinged with black.

Samaris ornatus (Von Bonde 1922)

Samaris cristatus erythraeus Chabanaud 1969
Samaris cristatus; Heemstra 1995

Material examined

ANSP 145377, 2(104.5-126.1 mm SL), 9° 54° N, 97° 42° E; ANSP 145378, 1(126.9 mm SL), 19 51 S, 36 21E, ANSP 145380, 20(114.6-137.4 mm SL), 19 51 S, 36 21, ANSP 145611,1(81.2 mm SL), 14 7 N, 97 5 E, ANSP 145612,1(80.2 mm SL), 8 40 N, 97 46 E, BMNH 1922.3.27.8, 1(77.9 mm SL), 28 30 S, 30 30 E, holotype, MNHN 1966-54 (91.4 mm SL), MNHN 1967-62, 6(111.1-146.2 mm SL), MNHN 1989-629, 2(123.2-128.7 mm SL), MNHN 2115, 2(98.4-10.43 mm SL), MNHN 59-589, 3(113.8-120 mm SL), RUSI 55792, 2(116.1-117.5 mm SL), 28 48 S, 36 6 E

Diagnosis

This species can be distinguished from all its congeners by the following combination of characters: few, if any, distinct brown spots or vermiculations on the body away from the dorsal and ventral margins, numbers of prolonged dorsal fin rays 14-15 (rarely 13 or 16), D 79-87, A 54-61, pectoral fin 3.8-5.7 in SL, head length 3.7-5.5 in SL and supracranial pterygiophores 14-15 (rarely 13 or 16).

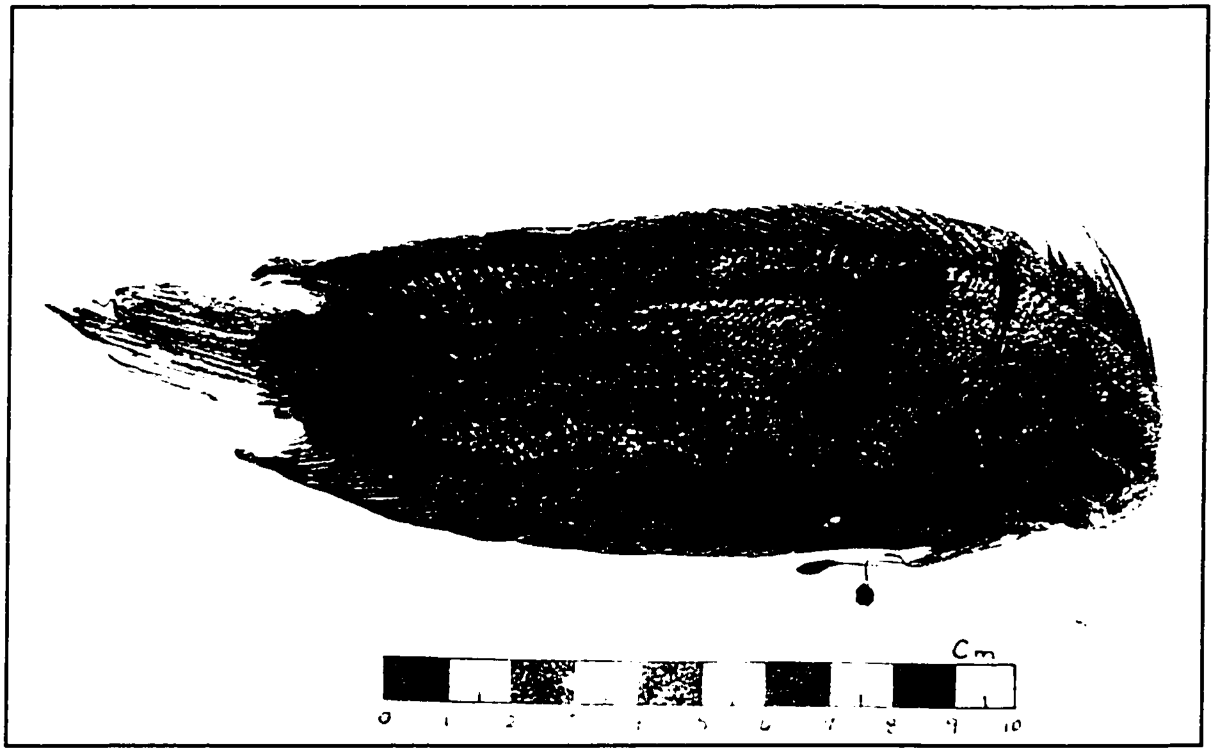

Fig 55. Illustration of *Samaris ornatus*

Description

The smallest species in the *S. cristatus* complex. Modal dorsal fin ray count 81, anal fin rays 57, lateral line scales 72, total vertebrae 40, supracranial pterygiophores 14, prolonged dorsal fin rays 14 and proximal reduced anal pterygiophores 5. Proportions of all morphometric features are presented in Table 57. Body ovate and elongate, sides parallel (see Fig. 55). B.s. cephalic flap robust and often scalloped. Head small, snout short, maxillary and lower jaw areas free of scales. B.s. cephalic area has scales with ctenii at right angles to scale body. Teeth poorly developed in 2-3 bands on upper and lower jaws. Lower eye same size as migrated eye. Dorsal fin origin ahead of migrated eye, notch anterior to migrated eye not well developed. Lower jaw ends under the first third of the fixed eye. Dorsal body profile over eyes descends abruptly.

Table 57. Morphometrics for holotype and 30 additional specimens of *Samaris ornatus*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype	Mean, Range
1.	HL	4.8	4.8 (3.7-5.5)
2.	H_depth	0.9	0.9 (0.6-1.2)
3.	Snout	4.4	4.2 (2.8-5.5)
4.	Orb_width	2.0	2.3 (2.0-2.7)
5.	U_jaw_o	3.3	3.4 (2.8-4.0)
6.	L_jaw_o	2.2	2.2 (1.4-3.5)
7.	U_jaw_b	3.8	3.9 (2.2-5.7)
8.	L_jaw_b	2.4	2.4 (2.1-4.6)
9.	Eye_fixed	3.2	3.4 (2.7-4.5)
10.	Intorb	51.5	36.7 (24.1-61.9)
11.	B_depth	2.8	2.8 (2.4-3.0)
12.	Caud_ped	8.7	8.3 (7.3-10.2)
13.	Pre_anal	3.7	4.6 (3.0-13.2)
14	Pelvic_l	3.6	3.8 (2.9-7.4)
15.	Pectoral_l	4.7	4.8 (3.8-5.7)
16.	Dorsal_l	1.0	1.2 (1.0-3.8)
17.	Caud_l	3.3	3.4 (2.7-5.9)
18.	Dorht	8.4	8.4 (6.6-9.8)
19.	Anlht	9.4	8.3 (6.9-11.1)

Colour in alcohol

Body light yellowish brown on the ocular side. Five equally spaced spots on dorsal margin, the most posterior spot at the most posterior dorsal fin base. Four equally spaced spots on the anal margin, the most posterior spot at the most posterior anal fin base. Each dorsal and ventral spot trapezoid-shaped, with the shorter side toward the centre of the body. The base of each spot joins almost continuous brownish bands running parallel to the dorsal and anal fin margins. Axial spots are barely visible. Scattered brown spots are visible on a yellowish brown background. The pectoral fin is darker than the body with distinct alternating light and dark areas. The blind side has a noticeably light brownish yellow colour. The b.s. dorsal and ventral pterygiophores are indistinct. Fins on b.s. darker than the body, their distal portions barely darker than the proximal portion of the rays. Pelvic fin rays banded. Caudal fin lacks spots.

Geographic distribution

S. ornatus has a complex distribution. The species is found from the Red Sea, South Africa and Mozambique and the Bay of Bengal (see Fig. 56).

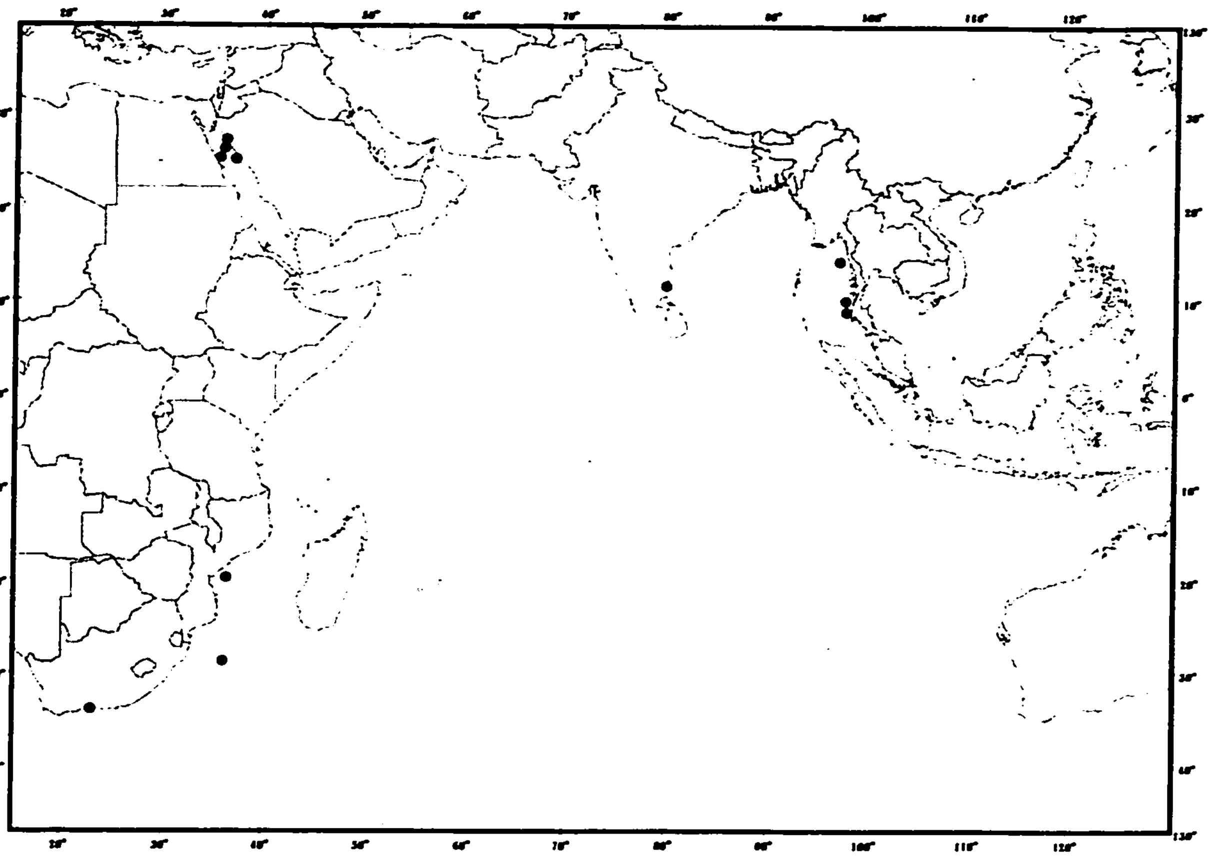

Figure 56. Distribution of *Samaris ornatus*.

Remarks

Chabanaud described *S. cristatus erythraeus* on the basis of differences in the length of the prolonged dorsal fin rays, body size and numbers of dorsal fin rays. Those differences may have been due to comparisons with the *S. cristatus* of this study, but as Table 58 shows, *S. cristatus erythraeus* cannot be distinguished morphologically from other populations of *S. ornatus*.

Table 58. Morphometrics for *S. ornatus* and *S. cristatus erythraeus*

	Other areas	Red Sea
HL	4.8 (3.7-5.5)	4.8 (4.5-5.3)
H_depth	0.9 (0.8-1.2)	0.8 (0.6-0.9)
Snout	4.2 (2.8-5.5)	4.2 (3.6-4.8)
Orb_width	2.3 (2.0-2.7)	2.3 (2.0-2.5)
U_jaw_o	3.4 (2.8-4.0)	3.3 (3.1-3.6)
L_ jaw_o	2.3 (1.4-3.5)	2.1 (2.0-2.3)
U_jaw_b	3.9 (2.2-4.9)	3.9 (3.5-5.7)
L_jaw_b	2.4 (2.2-2.9)	2.4 (2.1-4.6)
Eye_fixed	3.3 (2.7-3.9)	3.5 (3.0-4.5)
Intorb	36.1 (24.1-81.5)	41.2 (25.3-61.9)
B_depth	2.8 (2.6-3.0)	2.6 (2.4-2.9)
Caud_ped	8.3 (7.6-10.2)	8.3 (7.3-9.1)
Pre_anal	4.1 (3.0-4.7)	5.7 (3.7-13.2)
Pelvic_l	3.7 (2.9-7.4)	3.8 (3.5-4.6)
Pectoral_l	4.8 (3.8-5.7)	4.8 (4.6-5.2)
Dorsal_l	1.2 (1.0-3.8)	1.3 (1.0-2.5)
Caud_l	3.4 (2.7-5.9)	3.3 (3.0-3.5)
Dorht	8.3 (6.6-9.8)	8.5 (7.4-9.4)
Anlht	8.2 (6.9-11.1)	8.5 (7.0-10.5)

Comparisons

Close to *S. sp*, but can be distinguished by head length in standard length and presence of white blotches on the pectoral fin. *S. ornatus* can be distinguished from *S. cristatus* and *S. cacatuae* by body shape, pigmentation pattern and in having a strongly developed b.s. cephalic flap. This species, like *S. cristatus*, *S. cacatuae* and *S. sp.*, can readily be distinguished from other *Samaris* species by the number of prolonged dorsal fin rays (10-16), first pelvic fin ray free, b.s. cephalic flap, 7 abdominal parapophyses, flap over the insertion of dorsal and anal fin rays, base of 4th to 7th anterior dorsal fin rays tinged with black.

***Samaris* species exclusive of the *S. cristatus* complex**

Meristic variation in species of *Samaris* species exclusive of the *S. cristatus* complex

Table 59. Frequency distribution of dorsal fin rays for *Samaris* exclusive of the *S. cristatus* complex

Dorsal fin rays	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	x	sd
S. costae												1				2			1	74.8	2.87
S. sp1							1	1												66.5	0.71
S. macrolepis	1			1																61.5	2.12
S. sp2												1									

Table 60. Frequency distribution of anal fin rays for *Samaris* species exclusive of the *S. cristatus* complex

Anal fin rays	47	48	49	50	51	52	53	54	55	56	57	58	59	N	x	sd
S. costae						1			1			1	1	4	56.0	3.16
S. sp1				1	1									2	50.5	0.71
S. macrolepis	2													2		
S. sp2				1										1		

Table 61. Frequency distribution of total vertebrae for *Samaris* species exclusive of the *S. cristatus* complex

Total vertebrae	36	37	38	39	40	x	sd
S. costae				2	2	39.5	0.58
S. sp1	1		1			37.0	1.41
S. macrolepis		2					
S. sp2			1				

Table 62. Frequency distribution of supracranial pterygiophores for *Samaris* species exclusive of the *S. cristatus* complex

Supracranial pterygiophores	8	9	10	x	sd
S. costae		2	2	9.5	0.58
S. sp1	2				
S. macrolepis	2				
S. sp2	1				

Table 63. Frequency distribution of proximal reduced anal pterygiophores for *Samaris* species exclusive of the *S. cristatus* complex

PRAP	4	5	6	x	sd
S. costae	1	2	1	5.0	0.82
S. sp1		1	1	5.5	0.71
S. macrolepis		2			
S. sp2			1		

Table 64. Frequency distribution of prolonged dorsal fin rays for *Samaris* species exclusive of the *S. cristatus* complex

Prolonged dorsal fin rays	6	7	8	x	sd
S. costae	4			6.0	0.0
S. sp1	1	1		6.5	0.71
S. macrolepis			1		
S. sp2			1		

Table 65. Frequency distribution of interdigitation pattern for *Samaris* species exclusive of the *S. cristatus* complex

Interdigitation pattern	0-2-1	0-2-2	0-2-3	0-3-1	0-3-2	1-1-1	1-1-2	1-2-1	1-2-2
S. costae		2			1		1		
S. sp1	1	1							
S. macrolepis							1		1
S. sp2									1

Table 66. Frequency distribution of lateral line scales for Samaris species exclusive of the *S. cristatus* complex

Lateral line scales		x	sd
S. costae	1(53), 1(64), 1(67), 1(68)	63.0	6.88
S. sp1	1(57), 1(56)	56.5	0.71
S. macrolepis	2(49)		
S. sp2	1(61)		

Samaris costae Quéro, Hensley & Maugé 1989

Material examined
MNHN 1986-654, 1(90.7 mm SL), 21° 4'S, 55° 11'E, holotype. MNHN 1986-655, 1(73.3 mm SL), 21° 4'S, 55° 11'E, paratype. MNHN 1986-656, 1(68.7 mm SL), 21° 4'S, 55° 11'E, paratype. MNHN 1986-657, 1(39.2 mm SL), 15° 21'S, 46° 12'E.

Diagnosis
This species can be distinguished from all its congeners by the following combination of characters: numerous small scattered spots on body and fins, prolonged dorsal fin rays 6, head length 3.8-4.4 in SL, D(71-78), A(52-59) and pectoral fin 3.7-4.0 in SL.

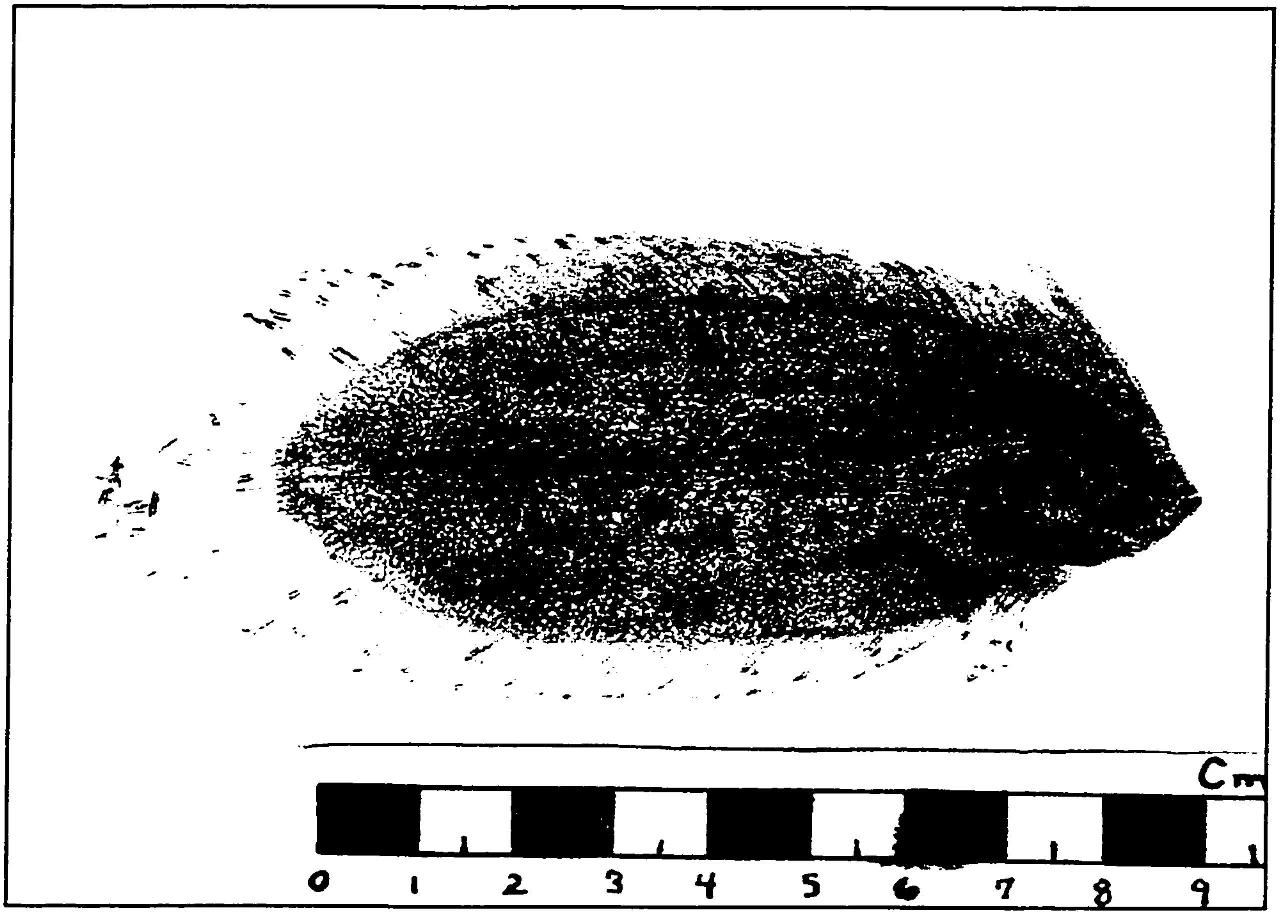

Fig 57. Illustration of *Samaris costae*

Description
Mean dorsal fin ray count 75, anal fin rays 56, lateral line scales 66, total vertebrae 40, supracranial pterygiophores 10, prolonged dorsal fin rays 6, and proximal reduced anal

pterygiophores 6. Proportions of all morphometric features are presented in Table 67. Body oval, somewhat parallel sided (see Fig. 57). Head small. Dorsal profile gently sloping. Eyes large and prominent. Snout pointed. Fixed eye slightly advanced relative to migrated eye. Lower jaw protrudes ahead of upper. Teeth poorly developed in 2-3 bands on upper and lower jaws. Scales ctenoid on both sides. Gillrakers short or rudimentary, knoblike. Dorsal and anal fins large; pectoral prominent, extending almost to halfway point of body. Pelvic broad and long. Prolonged dorsal fin ray two-thirds the length of the body, without recess on b.s. of the head. B.s. cephalic flap very small, not extending to midpoint of head.

Table 67. Morphometrics for holotype and 30 additional specimens of *Samaris costae*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

	Character	Holotype	Mean, Range
1.	HL	4.5	4.2 (3.8-4.4)
2.	H_depth	1.0	1.0 (1.0-1.1)
3.	Snout	4.8	4.7 (4.4-4.9)
4.	Orb_width	2.4	2.3 (1.9-2.8)
5.	U_jaw_o	3.7	3.4 (3.0-3.6)
6.	L_ jaw_o	2.2	2.1 (2.0-2.2)
7.	U_jaw_b	4.1	3.8 (3.4-4.1)
8.	L_jaw_b	2.5	2.3 (2.2-2.3)
9.	Eye_fixed	3.3	3.1 (3.0-3.2)
10.	Intorb	40.7	46.5 (31.0-57.5)
11.	B_depth	2.4	2.4 (2.4-2.5)
12.	Caud_ped	7.8	8.4 (8.0-8.7)
13.	Pre_anal	4.0	3.4 (3.2-3.6)
14	Pelvic_l	4.5	4.0 (3.8-4.2)
15.	Pectoral_l	4.0	3.9 (3.7-4.0)
16.	Dorsal_l	1.5	2.6 (1.6-4.3)
17.	Caud_l	3.5	4.7 (1.7-8.5)
18.	Dorht	8.9	6.5 (3.2-8.7)
19.	Anlht	7.8	7.6 (6.5-8.8)

Colour in alcohol
Body very light brown with scattered brown spots. Five dorsal and four ventral spots along margin of body. Two central spots visible. Scattered brown spots on the fins, generally at the distal margin. A central brown spot half the size of the eye visible on the

third of the caudal fin. Pectoral fin shows only slight barring so obvious in species of the *S. cristatus* complex. B.s. uniform light yellow, myomeres readily visible.

Geographic distribution

S. costae is found off Madagascar and Réunion Islands (see Fig. 58).

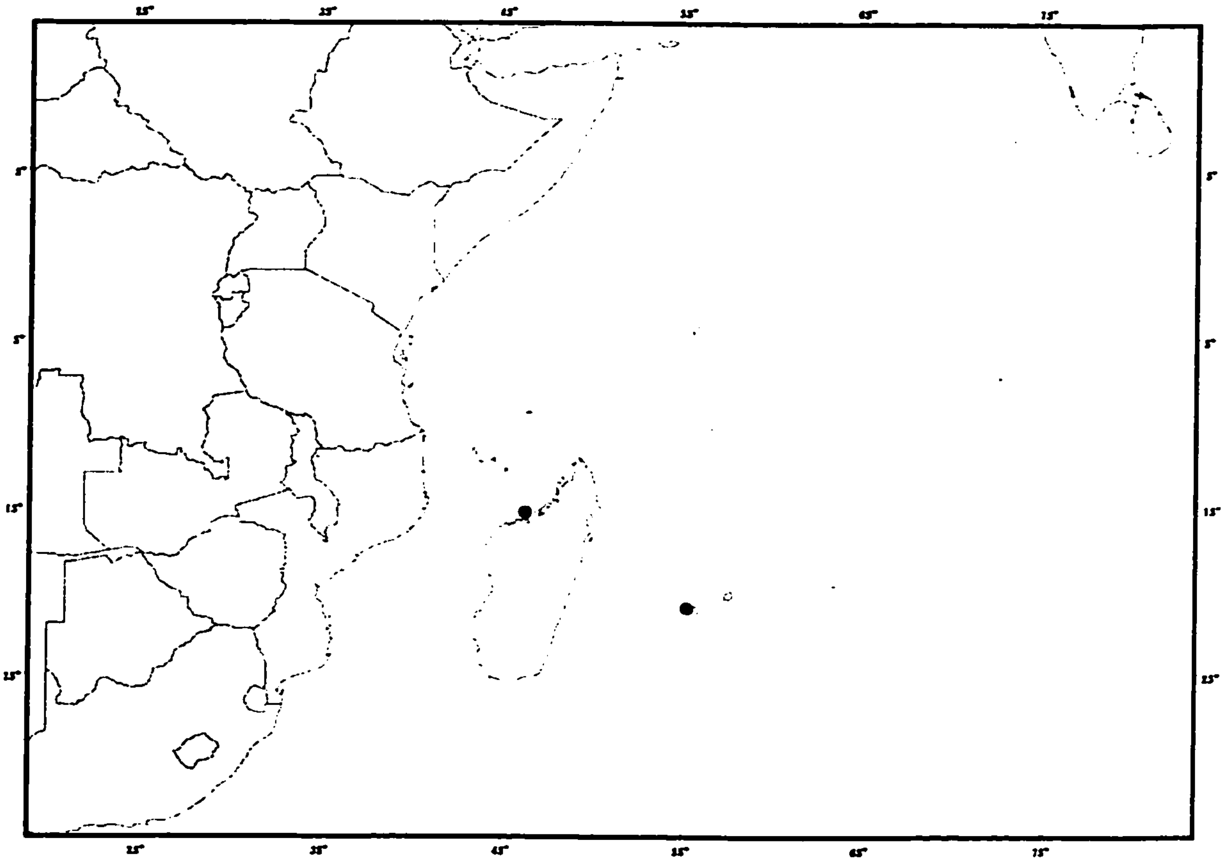

Figure 58. Distribution of *Samaris costae.*

Remarks

Quéro et al. (1989) listed a specimen, MNHN 1986-657, as *Samaris* sp. because of the discrepancies in meristics and in the length of the pelvic fin between that specimen and the specimens of S. *costae* that had counts that clustered more closely together. In this study, MNHN 1986-657 is identified as *Samaris costae.*

Table 68. Meristic differences between specimens of *S. costae* and *S. sp* - study of Quéro et al. (1989).

	Dorsal fin rays	Anal fin rays	Lateral line scales	Pelvic ratio (SL/pelvic length)
S. costae	75-78	55-59	64-68	3.9
S. sp.	71	52	53	6.5

The purpose of this analysis is to use statistical inference to determine the likelihood of the identity of *Samaris* sp. Meristic variation in populations of *Samaris cristatus* is assumed to be similar to variation in *S. costae*. The mean plus one standard deviation (SD) includes 68.27% of a population (Mayr 1991) and the mean plus two standard deviations will include 95.45% of a population if the character is normally distributed. For dorsal fin rays, using a standard deviation of 3.3 derived from *S. cristatus* (*S. cristatus* of this study) and a mean of 76 for specimens of *S. costae*, the mean less one SD is 72.7, close to the dorsal fin ray value of 71 for MNHN 1986-657. Similar results for anal fin rays and lateral line scales show that MNHN 1986-657 can readily be classified as *Samaris costae*. As for the very different relative pelvic lengths, allometric effects may be more pronounced at that size for this species. More specimens of *Samaris costae* will clarify variation in the species.

Comparisons

Close to *Samaris* sp2, but differing in pigmentation patterns and in the numbers of prolonged dorsal fin rays (6 in *S. costae* vs 8 in *Samaris* sp2). *S. costae* is light in colour with dark spots; *S.* sp2 is dark with characteristic blotches. *S. costae* lacks the characteristic spinuous ctenii of *Samaris* sp1 and *Samaris* sp2, as well as not having the long pelvic fin of *S. macrolepis.*

Samaris sp1.

Material examined

MNHN 1996-1516, 1(38.8 mm SL), 20° 0'S, 165° 0'E, USNM 286579 1(53.8 mm SL), 16° 4'N, 114° 42'E.

Diagnosis

Samaris sp1. can be distinguished by the presence of large robust ctenii on scales along the posterior margins of the dorsal and anal curves and an extremely long e.s. pelvic fin (1.9-2.2 in SL). No other samarid species has these characters.

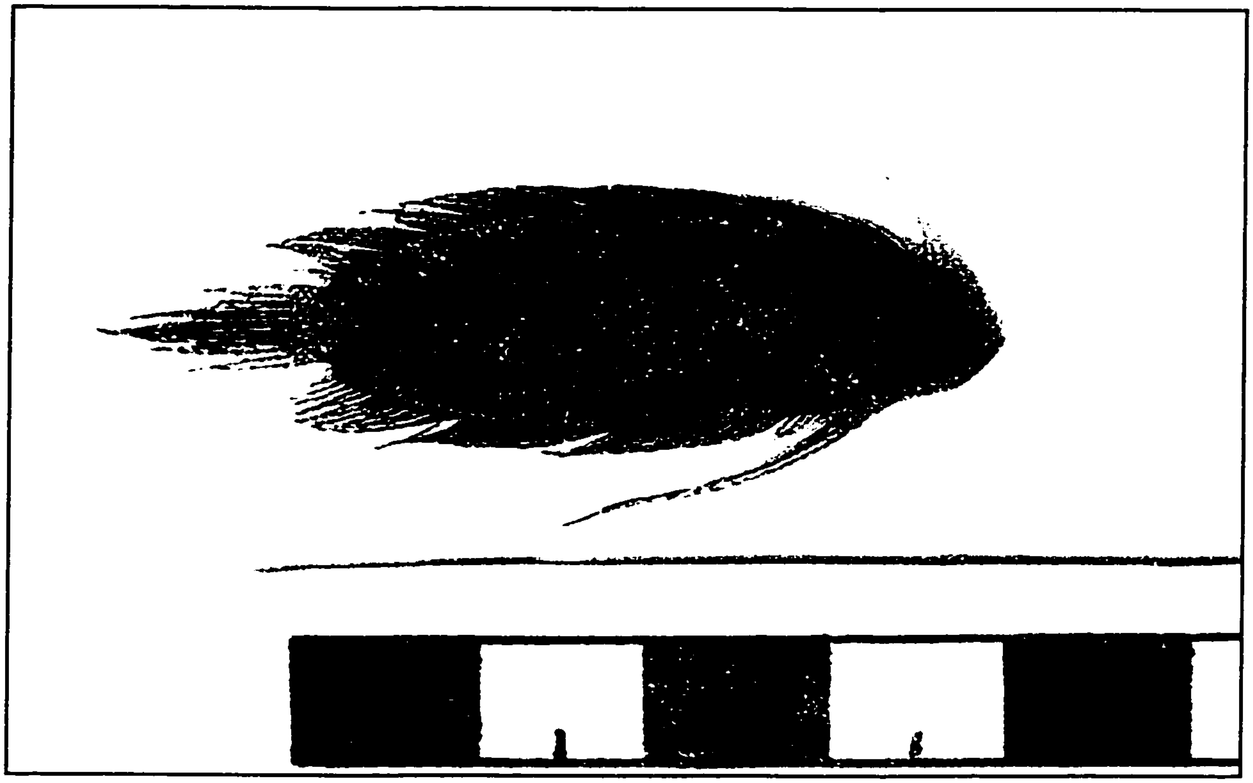

Fig 59. Illustration of *Samaris* sp1

Description

Dorsal fin ray count 67, anal fin rays 51, lateral line scales 57, total vertebrae 38, supracranial pterygiophores 8, prolonged dorsal fin rays 8 and proximal reduced anal pterygiophores 5. Proportions of all morphometric features are presented in Table 69. Body elongate and parallel sided, dorsal profile gentle (see Fig. 59). Eyes large, snout small. Pectoral fin threadlike. E.s. pelvic very long. B.s. cephalic flap extends to halfway point of head. At the posterior portion of each dorsal and anal fin where they meet the caudal peduncle, there are three large spines visible on each side on the e.s. The spines start as four enlarged ctenii, then more posterior scales have fewer and larger ctenii until the last three or so scales have a single, robust ctenus, approximately three times as long as the scale body (see Figs 60-62).

Figure 60. Spinuous ctenii on the posterior ventral margin of *S. sp1*. Note scale on lower right bearing four distinct ctenii.

Figure 61. Spinuous ctenii on the posterior ventral margin of *S.* sp1.

Figure 62. Spinuous ctenii on the posterior dorsal margin of *S.* sp1.

Table 69. Morphometrics for holotype BMNH 1977.4.22:8 and 30 additional specimens of *Samaris* sp1. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

Character		Holotype	USNM 286579
1.	HL	4.5	4.3
2.	H_depth	1.0	1.0
3.	Snout	4.6	5.2
4.	Orb_width	2.4	2.3
5.	U_jaw_o	3.0	3.2
6.	L_jaw_o	2.0	2.1
7.	U_jaw_b	3.6	3.8
8.	L_jaw_b	2.3	2.4
9.	Eye_fixed	2.9	3.5
10.	Intorb	45.5	40.0
11.	B_depth	2.9	2.7
12.	Caud_ped	9.2	8.5
13.	Pre_anal	3.7	4.2
14	Pelvic_l	1.9	2.2
15.	Pectoral_l	4.6	4.9
16.	Dorsal_l	1.9	2.1
17.	Caud_l	3.0	4.3
18.	Dorht	7.1	6.1
19.	Anlht	6.6	6.4

Colour in alcohol

USNM 286579 has a pale body with scattered indistinct spots. Slightly more distinct small spots are visible on the proximal portion of the dorsal and anal fins. Five dorsal spots and four ventral spots on body margin visible. MNHN 1996-1516 has a darker body with patchy blotches and very small but distinct spots. There is a dark patch on the abdominal area. Dorsal, anal and caudal fins heavily spotted with small distinct spots.

Geographic distribution

Found in two localities, Macclesfield Bank in the South China Sea and in New Caledonia (see Fig. 63).

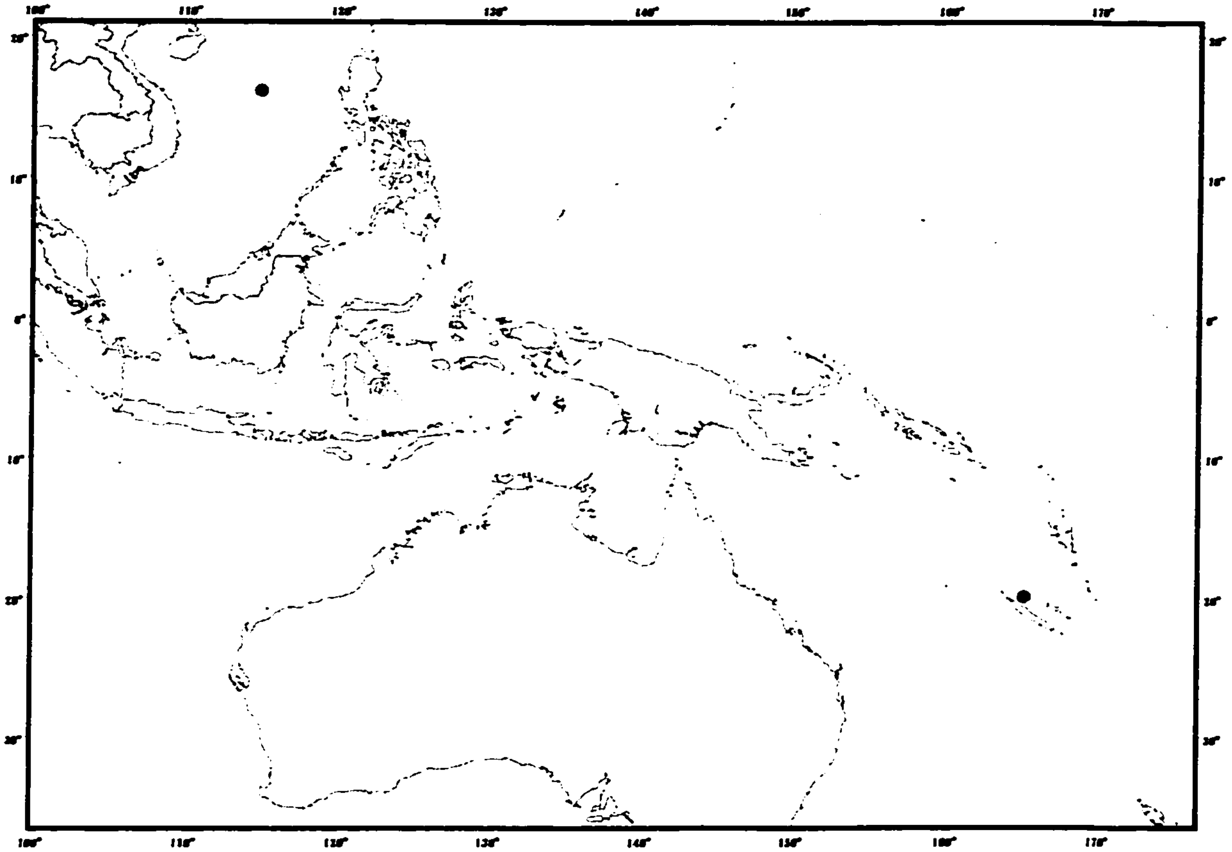

Figure 63. Distribution of *Samaris* sp1.

Remarks

Posterior scales with extremely large and robust spinules are unique in the family Samaridae and are unknown in other pleuronectoid species. One diagnostic character of the bothid genus *Psettina* is the possession of peripheral scales with slender, long ctenii (Norman 1934). Dorsal margin scales posses one spinule, lateral line and body scales have two spinules, with the lateral line spinules being stronger than those of the body scale spinules. *Psettina senta*, described by Amaoka & Larson (1999), has very strong single and double spinules. In his survey of teleost spined scales, Roberts (1993) did not document either the L-shaped scales and ctenii of the *S. cristatus* complex, nor the robust claw-shaped scales of *S.* sp1.

Comparisons

Samaris sp1 is close to *S. macrolepis*, but with higher dorsal and anal fin ray counts, as well as lateral line scale counts. *S. costae* and *S.* sp2 have shorter pelvic fins . *S.* sp1 lacks all of the characters that distinguish the *S. cristatus* complex, such as the number of prolonged dorsal fin rays (10-16), first pelvic fin ray free, b.s. cephalic flap, 7 abdominal parapophyses, flap over the insertion of dorsal and anal fin rays, base of 4th to 7th anterior dorsal fin rays tinged with black.

Samaris macrolepis Norman 1927

Material examined

BMNH 1888.12.1:32, Holotype, 1(34.5 mm SL), 16° 36' N, 96° 00' E, BMNH 1927.1.6:66, 1(18.9 mm SL), 4° 16' S 106° 41' E.

Diagnosis

S. *macrolepis* can be differentiated from its congeners by possession of a long e.s. pelvic, low counts for lateral line (49), dorsal and anal fin rays (63 and 47 respectively).

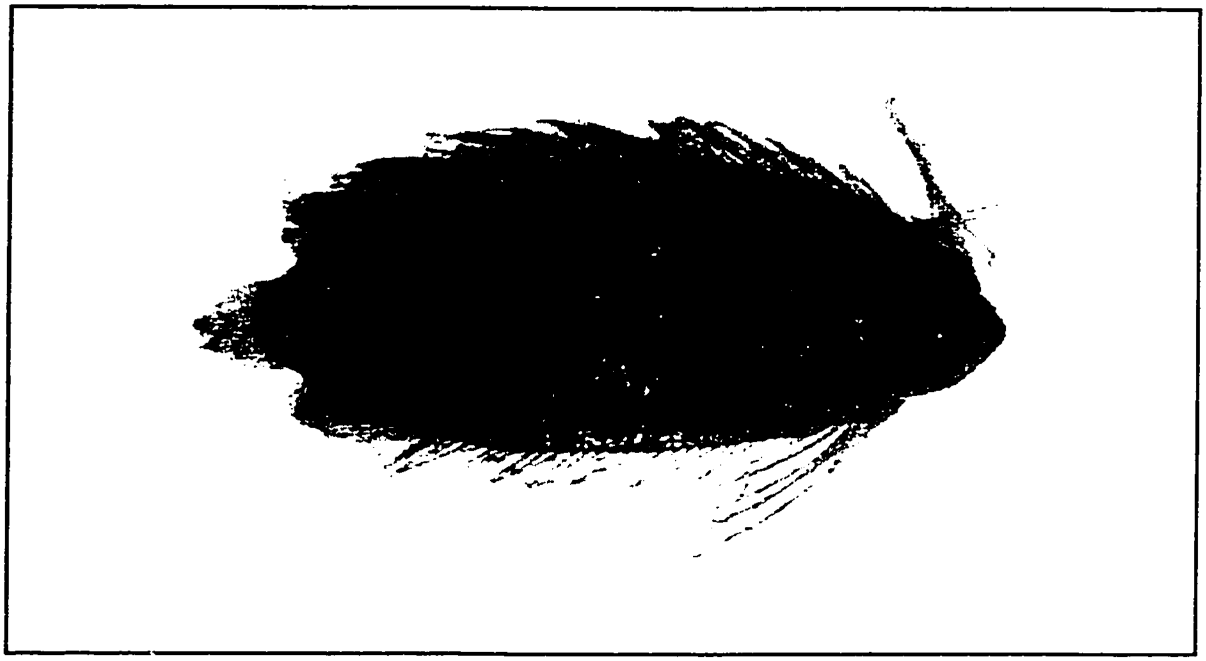

Figure 64. Illustration of *Samaris macrolepis*

Description

Dorsal fin rays 60-63, anal fin rays 47, lateral line scales 49, total vertebrae 37, supracranial pterygiophores 8, prolonged dorsal fin rays 8 in the holotype and proximal reduced anal pterygiophores 5. Proportions of all morphometric features are presented in Table 70. Body oval (see Fig. 64). Head small, eyes large, occupying more than half of head depth. Head has sharply conical profile. First 8 dorsal fin rays moderately prolonged in holotype, not prolonged in the smaller specimen BMNH 1927.1.6:66. E.s. pelvic very long. Pectoral fin long. B.s. cephalic flap extends to halfway point of head.

Table 70. Morphometrics for holotype BMNH 1888.12.1:32 and 1 additional specimen of *Samaris macrolepis*. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

Character		Holotype	BMNH 1927.1.6:66
1.	HL	4.2	3.4
2.	H_depth	1.0	1.2
3.	Snout	4.4	4.0
4.	Orb_width	2.4	2.5
5.	U_jaw_o	3.3	3.1
6.	L_ jaw_o	2.0	1.9
7.	U_jaw_b	4.0	3.5
8.	L_jaw_b	2.2	1.9
9.	Eye_fixed	3.5	3.5
10.	Intorb	16.6	28.0
11.	B_depth	2.4	1.5
12.	Caud_ped	7.5	9.5
13.	Pre_anal	3.8	2.7
14	Pelvic_l	2.7	fin missing
15.	Pectoral_l	3.1	8.6
16.	Dorsal_l	2.0	fin undeveloped
17.	Caud_l	6.4	14.5
18.	Dorht	8.4	9.9
19.	Anlht	6.8	8.6

Colour in alcohol

Body of the holotype pale sandy brown with a few scattered indistinct spots. Fins unpigmented. B.s. uniformly muddy brown. Norman (1927) noted that the e.s. pelvic had three narrow cross-bars, which are not now visible on the preserved specimen.

Geographic distribution

S. macrolepis is found through the Indo-Malaysian region and has been reported from South Africa (Heemstra 1995), but as no measurements were given nor a museum specimen referred to, the occurrence of that specimen will not be mapped until its identity can be confirmed (see Fig. 65).

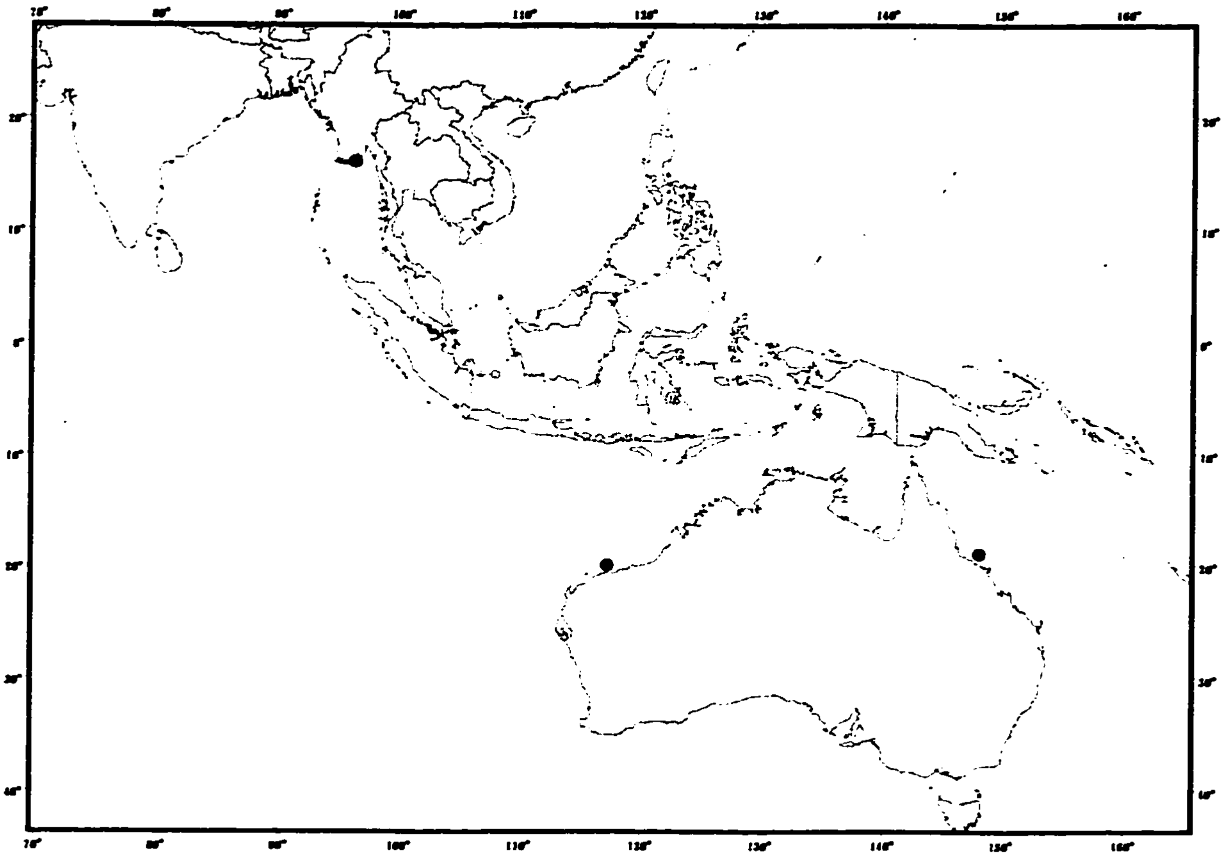

Figure 65. Distribution of S. *macrolepis*.

Remarks

Hoshino & Amaoka (1998) described a juvenile specimen of S. *macrolepis* from Northwest Australia. This species is known from the holotype collected in the Gulf of Martaban, a South African specimen (Heemstra 1995) and two northwest shelf Australian specimens (Leis and Trnski 1989; Hoshino & Amaoka 1998). BMNH 1927.1.6:66, identified during this study, is the fifth record of this species.

Comparisons

S. macrolepis is close to *S. sp1*, but lacks the spines characteristic of that species. Both *S. sp2.* and *S. costae* have much different colouration patterns and higher counts of dorsal and anal fin rays, as well as lateral line scale and caudal vertebral counts.

Samaris sp2.

Material examined

NTM S.0752-017, 1(70.8 mm SL), 21° 4'S, 55° 11'E.

Diagnosis

Samaris sp2 can be distinguished from its congeners by the following characters: prolonged dorsal rays 8, anal fin rays 50 and the presence of numerous small scattered spots on body and fins.

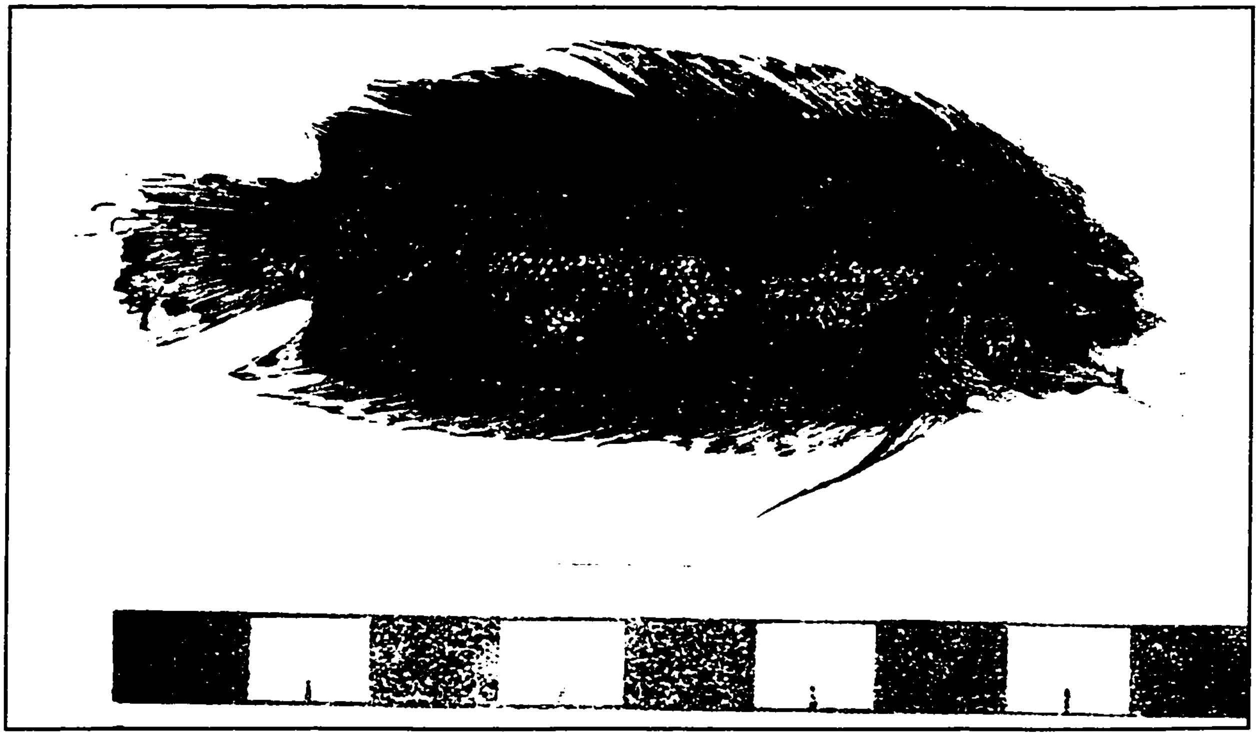

Figure 66. Illustration of *Samaris* sp2

Description

Dorsal fin rays 71, anal fin rays 50, lateral line scales 61, total vertebrae 38, supracranial pterygiophores 8, prolonged dorsal fin rays 8 and proximal reduced anal pterygiophores 5. Proportions of all morphometric features are presented in Table 71. A large species of *Samaris* (excluding the *S. cristatus* complex). Body elongate, dorsal and ventral outlines quite straight (see Fig. 66). Dorsal profile smooth over eye, which are large. Lower eye advanced relative to the upper. Teeth poorly developed in 2-3 bands on upper and lower jaws. Posteriormost portions of dorsal and anal fins pointed. Scales ctenoid on both sides. Gillrakers short or rudimentary, knoblike. Eight anterior dorsal fin rays prolonged. Pectoral fin long. Pelvic fin long. B.s. cephalic flap short, not reaching midpoint of head.

Table 71. Morphometrics for holotype BMNH 1977.4.22:8 *Samaris* sp2. Abbreviations are defined in Methods section; characters 2 to 10 are expressed in hundredths of HL, characters 1, 11 to 19 are expressed in hundredths of SL.

Character		Holotype
1.	HL	4.2
2.	H_depth	1.0
3.	Snout	1.0
4.	Orb_width	2.1
5.	U_jaw_o	4.1
6.	L_jaw_o	2.2
7.	U_jaw_b	3.7
8.	L_jaw_b	2.4
9.	Eye_fixed	3.7
10.	Intorb	2.7
11.	B_depth	2.7
12.	Caud_ped	7.2
13.	Pre_anal	3.8
14	Pelvic_l	3.4
15.	Pectoral_l	3.9
16.	Dorsal_l	2.1
17.	Caud_l	3.3
18.	Dorht	7.8
19.	Anlht	8.2

Colour in alcohol

Body distinctively dark chocolate brown. Five dorsal and four ventral spots with scattered dusky blotches over body. Pectoral dark brown, almost black. Prolonged dorsal fin rays without pigment. Dorsal, anal and caudal fins with many small scattered spots. Dark spot the size of the eye at the base of the caudal fin. B.s. a muddy beige colour. Dark brown pigmentation on the fins prominent.

Geographic distribution

S. sp2 is found south of Bali (see Fig. 67).

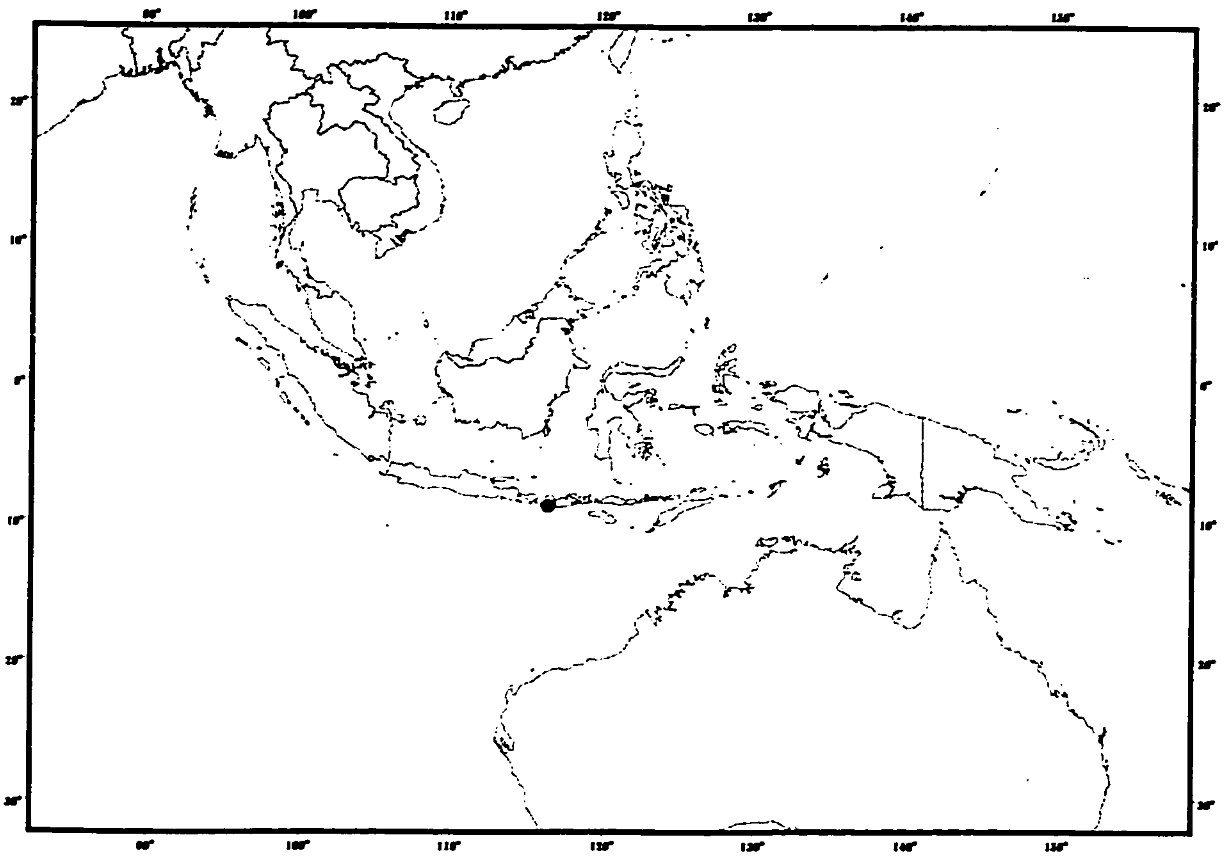

Figure 67. Distribution of *Samaris* sp2.

Comparisons

S. sp2. is very close to *S. costae*, but differs in pelvic length (3.4 in SL vs. 3.8-4.2 in *S. costae*) and numbers of anal fin rays (50 vs. 52-59). Both *S. sp2.* and S. *costae* have much different colouration patterns and higher counts of dorsal and anal fin rays, as well as lateral line scale and caudal vertebral counts than other *Samaris* species exclusive of the *S. cristatus* complex.

Biogeography

Biogeography is the study of the distribution of species in space and time (Myers & Giller 1990). There are two main divisions: historical and ecological biogeography. The former focuses on the sequences of origin, dispersal and extinction of taxa and explains how geological events such as continental drift and Pleistocene glaciations have shaped present day biotic distribution patterns. Historical biogeography is itself split into two areas; dispersal and vicariance biogeography. Dispersal biogeography looks at centres of origin and the movement of species in jump dispersal across pre-existing barriers. Vicariance biogeography observes distributional patterns to elucidate geological and physical events such as continental drift that contribute to geographic isolation and permit speciation. The methodology of vicariography i.e. cladistic analysis, allows for falsification of hypotheses. Ecological biogeography accounts for distribution patterns by examining the interactions between organisms and their physical and biotic environments (Myers & Giller 1990).

Dispersal and vicariance are not mutually exclusive processes. Dispersal can extend the range of species and may be interrupted. That interruption is the vicariance event. For example, the emergence of the Panama land bridge allowed the dispersal of northern mammals into South America while at the same time dividing marine biota into Caribbean and East Pacific populations (Cox & Moore 1993).

In, ecological biogeography, distribution patterns, interactions between biota and their physical and biotic environment are examined. Species richness, temperature and dispersal are studied in this field. Patterns of tropical diversity are affected by factors such as climatic stability and area effects. The study of dispersal in marine fishes includes physical oceanography such as the extent and nature of continental shelves, ocean currents and temperature variations. Briggs (1974) postulated the centre of dispersal concept, in which speciation occurs predominantly in one region and more plesiomorphic species are pushed out to the peripheral areas. In this model, apomorphic species will be concentrated in the area where they presumably evolved.

In this study, the first step of biogeographical analysis, that of delineating species distributions, will be made. Some biophysical aspects of the Indo-West Pacific as they pertain to samarids will be discussed. The development of a full cladistic analysis of the interrelationships of the Samaridae is a prerequisite to a vicariant biogoegraphic analysis and will not be done in this study.

The family Samaridae has a distribution extending from South Africa, north through Madagascar and the Kenyan coast to the Gulf of Aden and the Red Sea, across the Indian Ocean to the Indo-Malaysian peninsula, north through the Philippines, Taiwan and southern Japan (see Fig.68). To the south-east, the family is found through New Guinea, the northern portion of Australia on both the east and west coasts, out to New Caledonia, Fiji, the Society Islands, Hawaii and reaches its eastern extent at the Sala y Gomez ridge in the eastern Pacific. This is a very broad distribution, spanning approximately 90° of longitude and 65° of latitude. The depth distribution of samarid flatfishes appears to follow that of continental shelves. Light penetrates well beyond the 200 m that was formerly accepted as a limit (Briggs 1974) to as deep as 800 m.

Plagiopsetta glossa is found from southeastern Japan to Australia. As previously noted, the distribution based on specimens from this study as well as those gleaned from the literature shows a disjunct distribution (see Fig. 7). There are no known biogeographic barriers between the South China Sea and Australia's Queensland coast. The gap in the range of *P. glossa* may be due to insufficient sampling, some ecological effect or possibly a vicariant event in the history of the species.

The genus *Samariscus* has the broadest distribution within the family, spanning the maximum longitudinal width and occupying approximately 60° of latitude (see Fig. 69). The identification of a juvenile specimen of *Samariscus* (Amaoka et al. 1997) from the Sala y Gomez Submarine Ridge, eastern Pacific Ocean, extended the longitudinal limit of that

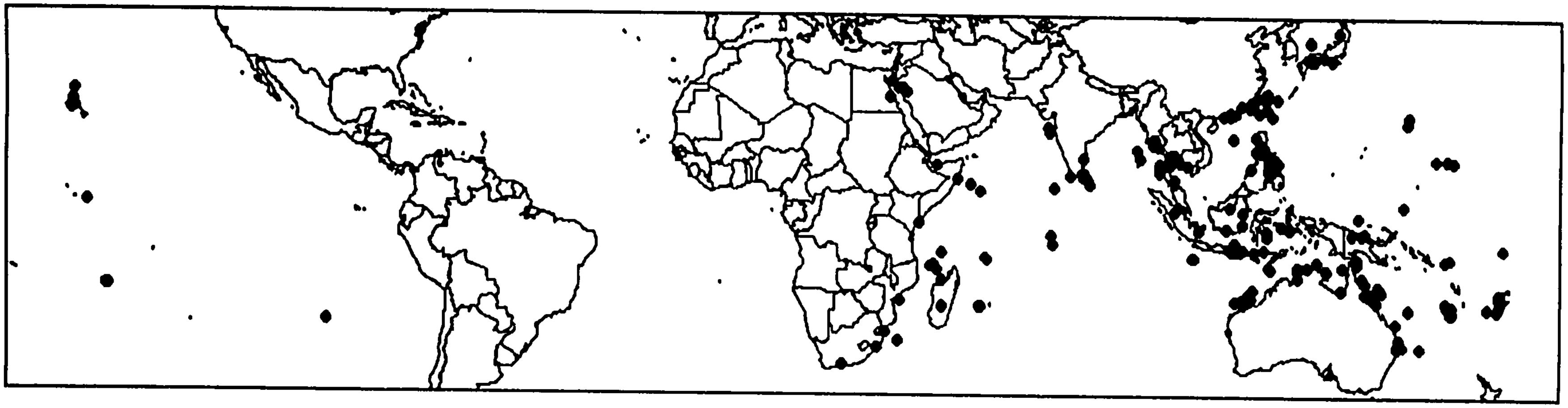

Figure 68. Distribution of the Samaridae

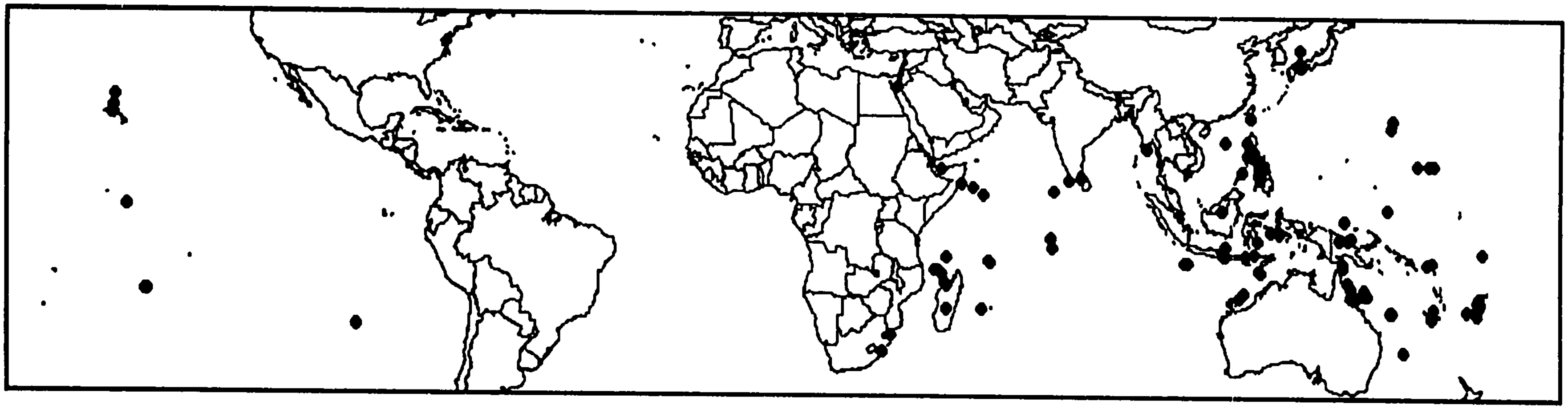

Figure 69. Distribution of *Samariscus*.

genus eastward by 60 degrees. *S. triocellatus* has the largest range within the genus, found from South Africa to the Society Islands. Many species of *Samariscus* have a limited range simply by virtue of having unique or a handful of specimens known; these include *S. luzonensis* and *S. maculatus*. *S. corallinus* appears to be a Hawaiian Islands endemic. Norman (1927) reported four species of *Samariscus* in Indian waters, *S. inornatus*, *S. longimanus*, *S. maculatus* and *S. huysmani*. de Bruin et al. (1994) confirmed the presence of *S. longimanus* in Sri Lankan waters.

Species in the *Samaris cristatus* complex have allopatric distributions. *S. sp.* appears to be endemic to the Arabian Gulf. *S. cacatuae* is found from the northwest coast to the east coast of Australia. *S. cristatus* is found in the Gulf of Thailand, the Java and Banda Seas, South and East China Seas, the Sulu Sea and the eastern Pacific east of Taiwan and southeast of Japan. *S. ornatus* has the largest range of all the species of this complex. Allen & Swainson (1988) reported that *S. cristatus* (*S. cacatuae* of this study) was found from Port Hedland northward in north-western Australia. That is reinforced by this study. Dor (1984) listed only one species, *S. cristatus* from the Red Sea. De Silva (1956) listed *S. cristatus* as occurring off the south and east coast of Ceylon.

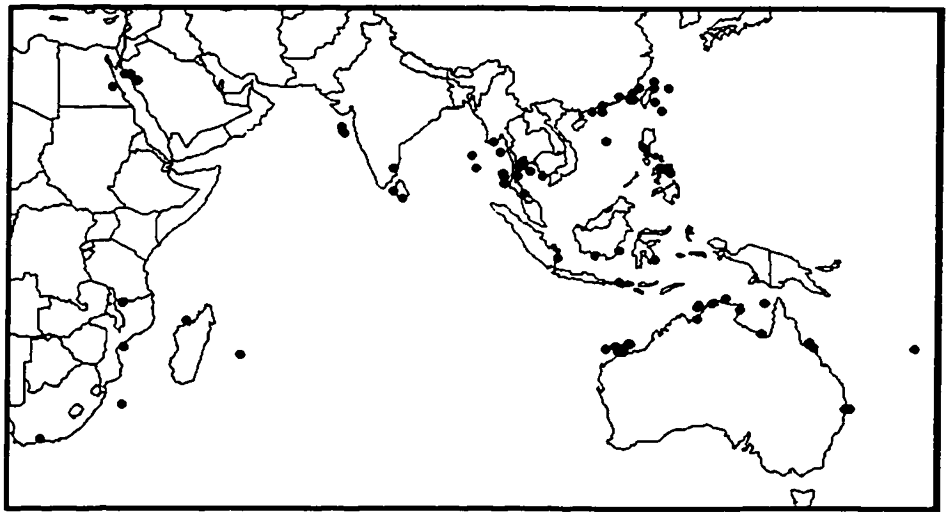

Figure 70. Distribution of *Samaris*.

The distribution exhibited by the Samaridae lies almost entirely within the world's largest marine zoogeographic zone, the Indo-West Pacific. This zone is the most biodiverse of all marine areas, not only for fishes (containing approximately a third, ca. 3000 spp., of all shallow water fishes), but for many other taxa such as molluscs and Crustacea (Briggs 1974). It extends from South Africa and the Red Sea through Indonesia and Australia to Hawaii and the South Pacific Islands to Easter Island.

Within this huge region, there are several divisions or provinces; the western Indian Ocean, the Red Sea and the Indo-Polynesian region. The Pacific Plate is a subdivision of the Indo-Polynesian province. It is the largest lithospheric plate, underlies the majority of the Pacific Ocean and defines a major biogeographic region (Springer 1981). Briggs (1987) summarized three notable characteristics in biogeographic patterns of the islands of the Pacific Plate: 1) Flora and fauna exhibit western Pacific relationships; 2) There is a west to east diversity gradient; and 3) some groups show abrupt elimination from west to east. The Hawaiian Islands are exceptional in the Pacific Plate as they have a high degree of endemism and a notably higher number of species than the general west to east declining trend (Springer 1981).

The distribution of shorefishes (defined as warm-temperate to tropical fishes dwelling to about 100 m depth close to shore) was mapped and discussed by Springer (1981). Some flatfish families were included in the study. The Psettodidae showed no nonmarginal presence; that is, they were not found on the central portion of the Pacific Plate but were found where the Plate intersects with other tectonic plates. For Springer's Pleuronectidae (which included the present family Samaridae), two genera, *Samariscus* and *Poecilopsetta* were listed; the former noted as a common, widely distributed genus of small fishes and the latter, a Hawaiian endemic. The reference to the genus *Samariscus* appeared to apply only to *S. triocellatus* and not to any other species of *Samariscus*. The existence of a Hawaiian endemic, *S. corallinus* was not reported. For Cynoglossidae, *Symphurus* had a circumglobal distribution, but was only found nonmarginally. Soleidae has only two genera occurring on the Pacific Plate. A juvenile specimen of *Samariscus* (Amaoka et al. 1997) was collected on the Nazca, not the Pacific Plate, but very close to the edges of the two plates.

Oceanography

Salinity, currents and the extent and nature of continental shelves influence the distribution of fishes. Ahlstrom et al. (1984) reported that *Samariscus* species have large pelagic larvae; *S. corallinus* larvae can reach the size of 26 mm. This implies that the larval stage is long. If that is the case, samarids should be able to disperse effectively using surface currents. The Western Indian Ocean is under the influence of the South Equatorial current (see Figs 71-72), which approaches Madagascar and divides into northern and southern branches. The southern branch, the Agulhas Current, brings warm water south to the southern extent of South Africa. Fricke (1999) referred to a "dispersal track" in that species recorded from South Africa, southern Madagascar and Mauritius are expected to occur at Réunion, presumably having been dispersed by the Agulhas Current.

The northern part of the West Indian Ocean has a current pattern that varies widely on an annual basis. Trade winds during the monsoon season cause a clockwise movement in East Africa and the Arabian Sea (Fig 72). From November to March, trade winds reverse and the general surface current movement is counter clockwise (Fig 71). Chagos and to a lesser degree, the southern Maldives are under the influence of the eastward flowing Equatorial Counter Current, as well as the intermonsoonal Equatorial Jet, while areas to the north are not (Anderson et al. 1998). The Red Sea is an evaporative basin with a sill at 110 m at its southern end. Highly saline water flows out at that sill, bringing in Arabian Sea surface water.

In the western Pacific, the warm Kuroshio current brings Indo-Pacific region species northwards to southern Japan. The Yellow sea, immediately west of the South Korean Peninsula but at the same latitude as Shikoku, has a more characteristically cool-water fauna because it is more influenced by the North Pacific Oyashio current. There are no records of samarids from that area, nor are there any records of samarids from the Sea of

Japan. The Sea of Japan and Yellow Sea can therefore be predicted to have a more characteristic temperate pleuronectiform fauna. The Queensland region of Australia is under the influence of the tropical Eastern Australia current. The Western Australian current brings up cool temperate water from the south, thus limiting tropical faunas to north of the Exmouth Gulf.

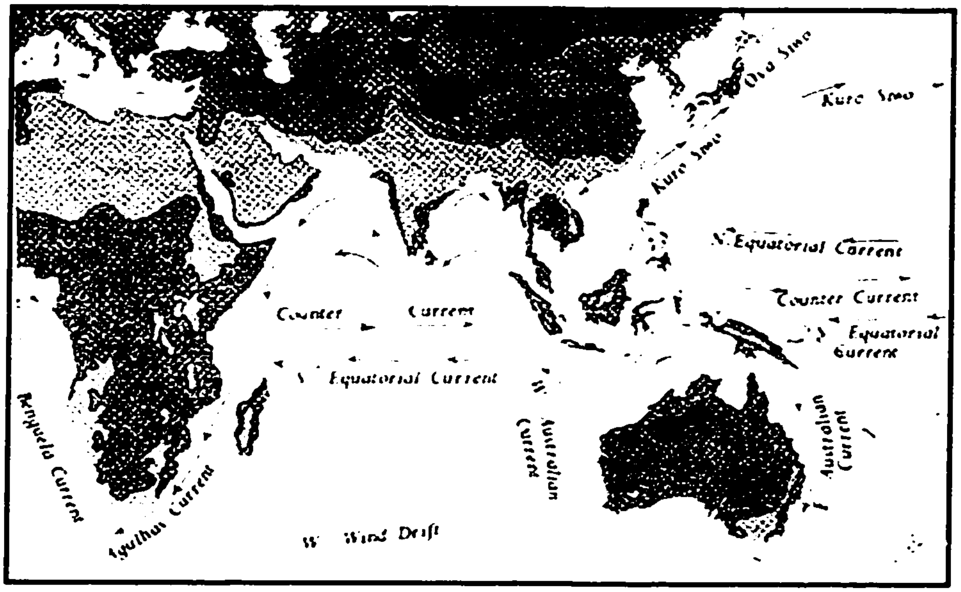

Figure 71. January surface currents in the Western Indian Ocean

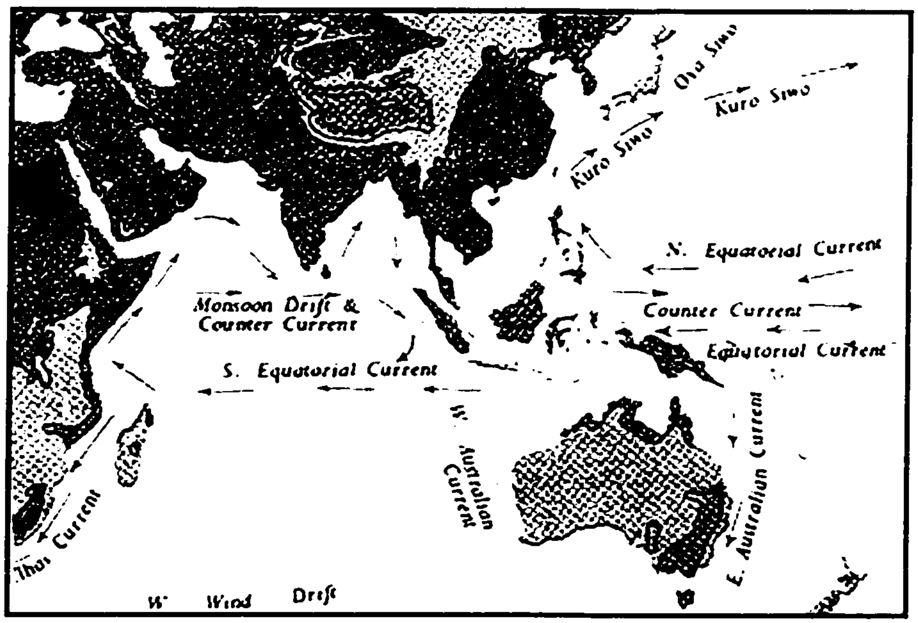

Fig 72. July surface currents in the Western Indian Ocean

The Eastern Pacific barrier is a huge expanse of open water between the central and South Pacific Islands and the American mainland, which acts as a distance barrier to almost all shore fishes from the central Pacific (Briggs 1974; see Fig 73). Parin (1991) listed 173 species of fishes from Nazca and Sala y Gomez of Indo-West Pacific origin, demonstrating that the Indo-West Pacific ichthyofauna extends very slightly beyond the Pacific Plate. Another factor limiting the distribution of Indo-Pacific fishes to the far eastern Pacific is the northward movement of the cold Humboldt current.

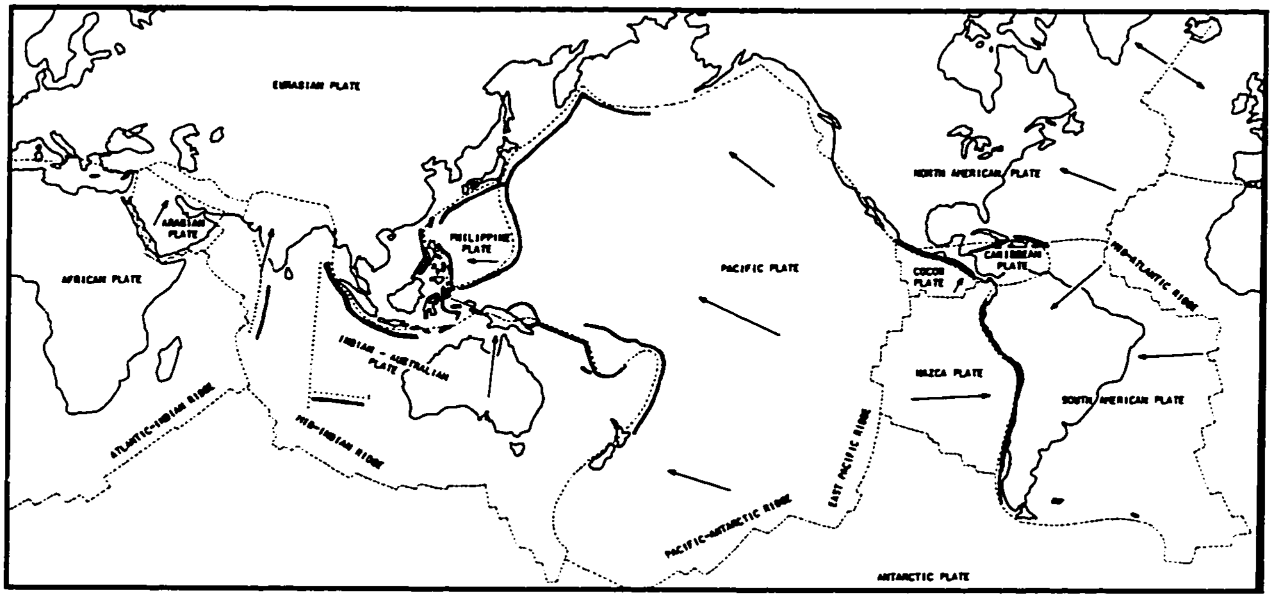

Fig 73. Pacific and other tectonic plates. Modified from Springer(1981).

The western Pacific is a geologically extremely complex region, containing by far the most important continental shelves in the tropics (Longhurst & Pauly 1987). This complexity is due to previous movements of the Australian Plate and small isolated continental blocks, but also the extensive coral reefs and large river discharges.
From Taiwan, the shelf widens southward until it reaches a width of 480 km off the Gulf of Tonkin. Deposits are a mix of sand, carbonate debris from coral reefs and coralline algae; in the south muds and muddy sands predominate. Silts and muddy sands are found on the narrow Vietnam shelf; in the large Gulf of Thailand deposits are more

muddy. The Sunda shelf of the South China Sea, extends to the Sahul Shelf of Northern Australia, averaging less than 100 m in depth, and between Sumatra and Kalimantan (Borneo) is10-40 m deep.

In the Indian Ocean, the west coast of Malaysia, Thailand and Burma including the Andaman Sea has a shelf that widens northward and becomes very wide in the Bay of Bengal, although deltaic muds cover the region so that coral reefs are almost entirely absent. The shelf off western India increase to the Arabian Sea, where it becomes more than 300 km wide. From the northwest Arabian Sea, to Madagascar, the shelf is narrow and only widens significantly in Delagoa Bay, Mozambique, with soft sandy-mud deposits.

Patterns of diversity in nearshore fishes of the Indo-West Pacific are generally agreed upon, but with some observed differences. The highest number of genera is reported by Springer(1981) to be 163 in Queensland. Briggs (1974) stated that the Indo-Malaysian triangle had the highest number of species and genera. There is a sharp break in numbers of families at the Philippine-Western Pacific Plate margin. The East Pacific barrier marks the edge of the Indo-West Pacific (Ekman 1953, Briggs 1961).

Springer and Williams (1990) suggested that glacial sea level lowerings resulted in extensive loss of marine habitats and cooler seawater temperatures. These factors, in turn caused the extinction or extirpation of continuously distributed Indo-Malaysian species during the Pliocene-Pleistocene.

Briggs (1987) referred to an East Indies evolutionary centre located primarily on the continental shelf of the mainland and adjacent large islands including New Guinea. The area having the most species in a given group was likely to be the area where the group dispersed from. In this model, species arise in the centre and are displaced by newer species, so that plesiomorphic species would be found on the periphery of the range and derived species at the centre.

Patterns of distribution of the family Samaridae closely generally mirror those of Indo-West Pacific nearshore fishes. There is a peak of species numbers in the Indo-Malaysian triangle, an endemic species in Hawaii, and different distributions of genera throughout the range of the family. The centre of evolution concept is not borne out by the distribution of the Samaridae. The most plesiomorphic genus, *Plagiopsetta*, is found centrally.

The range of Samaridae has been extended by warm tropical currents such as the South Equatorial current in The Western Indian Ocean, the warm Kuroshio bringing species northwards to southern Japan and the tropical current Eastern Australia current bringing tropical fauna south along the Queensland coast. The Eastern Pacific barrier, which has prevented 90% of all Indo-Pacific fishes from reaching the west coasts of south and central America has also prevented samarids from establishing themselves there, although the identification of a juvenile specimen of *Samariscus* (Amaoka et al. 1997) from the Sala y Gomez Submarine Ridge is close to the eastern Pacific Ocean. *Samaris ornatus* has the only disjunct distribution observed in this study; from the Red Sea, South Africa and in the Bay of Bengal. The South Equatorial current may be responsible for this distribution, by moving larvae westward along the equator. *Samariscus triocellatus* has the most widespread distribution of all the samarids. It is the only shallow reef dwelling member of the family.

Summary and Conclusions

Taxonomy

Of 28 nominal species or subspecies in the family Samaridae, 22 are recognized in this study (see Table 72). Four new species (*Samaris sp.*, *Samaris sp1*, *Samaris sp2.* and *Samaris sp3*) were described, 2 species names resurrected (*S. cacatuae* and *S. ornatus*) and 2 species (*S. filipectoralis* and *S. sunieri*) and one subspecies (*Samaris cristatus erythraeus*) synonymized.

Table 72. Species recognized in this study

Plagiopsetta glossa
Samariscus asanoi
Samariscus corallinus
Samariscus desoutterae
Samariscus huysmani
Samariscus inornatus
Samariscus japonicus
Samariscus latus
Samariscus longimanus
Samariscus luzonensis
Samariscus macrognathus
Samariscus maculatus
Samariscus sp.
Samariscus nielseni
Samariscus triocellatus
Samariscus xenicus
Samaris cacatuae
Samaris costae
Samaris cristatus
Samaris macrolepis
Samaris sp
Samaris ornatus
Samaris sp 1
Samaris sp 2

Interdigitation pattern and number of supracranial pterygiophores

In *P. glossa*, 65% of all specimens showed a strong modal interdigitation pattern of 0-2-2 (Table 9). All *Samariscus* species showed a strong modal value of 0-2-1 (see table 17).

The *Samaris cristatus* complex was variable and notably bimodal compared to *Samariscus* (see table 52). *S. sp.*had bimodal values of 0-2-2 and 1-2-2, *S. cacatuae* showed trimodal values at 0-2-1, 0-2-2 and 1-2-2; *S. cristatus* trimodal at 0-2-2, 1-2-1 and 1-2-2 and *S. ornatus* had a weak mode of 1-2-2. Species of *Samaris* exclusive of the *S. cristatus* complex had variable interdigitation patterns of 0-2-2, 0-2-1, 1-1-2 and 1-2-2 (see table 65).

Supracranial pterygiophores in the *Samaris cristatus* complex numbered 10-16 (most commonly 11-15), all species of *Samaris* exclusive of the *S. cristatus* complex had 8 supracranial pterygiophores except *S. costae* at 9 and 10. *Samariscus* species had 5-8, *Plagiopsetta* 6-8, with a mode at 7.

Interrelationships of the Samaridae

The three genera comprising the Samaridae were shown to be monophyletic. *Plagiopsetta* was shown to be the most plesiomorphic. *Samaris* and *Samariscus* are sister groups. *Psammodiscus ocellatus* was shown on the basis of this study not to be a samarid.

Samaris cristatus, *S. cacatuae*, *S. ornatus* and *S. sp.* are valid species and constitute a monophyletic group, with numerous apomorphies (b.s. cephalic flap, flaps at the posterior dorsal and anal fin junctions, first pelvic fin ray free, abdominal parapophyses 7 and presence of scales with angled ctenii) corroborating the monophyly of the *S. cristatus* complex. A complete phylogenetic analysis of interrelationships within the family will establish the taxonomic status of the complex.

In *Samariscus*, *S. nielseni*, *S. corallinus* and *S. triocellatus* form a monophyletic group. The three species share characteristics of having the first few dorsal fin rays free of the membrane, in possessing ocelli, in having the snout longer than the eye and in having a b.s. tissue flap at the base of the first dorsal fin ray.

Biogeography

The family Samaridae is restricted to the Indo-West Pacific. This distribution mirrors that of Indo-west Pacific shorefishes in that species numbers are highest in the Indo-Malaysian region, drop off with increasing distance and are not found in the extreme eastern Pacific due to the eastern Pacific barrier. The peripheries of the range of the family in South Africa, south-eastern Japan, east and west Australia appear to be primarily influenced by temperature and currents.

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Appendix 1. List of characters used in the phylogenetic analysis of the family Samaridae

This section includes a list of characters for which the polarity was established using outgroup comparison (see Chapleau 1993). The following descriptions list the plesiomorphic condition first (state 0) followed by the apomorphic conditions (states 1,2, or 3). (1) Pectoral fin present on blind side (0); pectoral fin absent on blind side (1). (2) Dorsal fin rays not prolonged(0); dorsal fin rays prolonged(1). (3) Pelvic fins asymmetrical (0); pelvic fins symmetrical (1). (4) Ocular pelvic fin rays not prolonged(0); ocular pelvic fin rays prolonged(1). (5) Hypural plate pattern not 5 (0); hypural plate pattern 5 (1). (6) Eyed side lateral line not straight (0); eyed side lateral line straight (1). (7) Supratemporal branch of lateral line absent (0); supratemporal branch of lateral line present (1). (8) Pectoral fin rays branched (0); Pectoral fin rays simple (1). (9) Caudal fin rays branched (0); caudal fin rays simple (1). (10) Number of abdominal parapophyses 5,6 or 7 (0,1,2). (11) Pleural ribs absent (0); pleural ribs present (1). (12) Epipleural absent (0); epipleural present (1). (13) Epimeral absent (0); epimeral present (1). (14) Hypomerals absent (0); hypomerals found on caudal vertebrae (1); hypomerals found on all vertebrae (2). (15) Mandibular area pigmented (0); mandibular area unpigmented (1). (16) Blind side lateral line present (0); blind side lateral line absent (1). (17) Number of Pectoral fin rays >5, 4/5, 4 (0,1,2). (18) Haemal spine of first caudal vertebra thin and curved (0); haemal spine of first caudal vertebra stout and straight (1). (19) Epural absent (0); epural present (1). (20) Blind side lateral ethmoid not attached to the eyed side frontal (0); blind side lateral ethmoid attached to the eyed side (1). (21) Lateral ethmoids not attached to each other on the dorsal part of the anterior portion of the eyed-side frontal (0); lateral ethmoids attached to each other on the dorsal part of the anterior portion of the eyed-side frontal (1). (22) Eyed side frontal not broadly attached to the parasphenoid in the interorbital region (0); eyed side frontal broadly attached to the parasphenoid in the interorbital region (1). (23) Metapterygoid large (0); metapterygoid small (1). (24) Postcleithrum present on one or both sides (0); postcleithrum absent on both sides (1). (25) Nasal organ on b.s. large (0); nasal organ on b.s. much reduced (1). (26) B.s. not pigmented (0); b.s. partially pigmented (1). (27) Caudal fin rays not numbering 16 (0); caudal fin rays numbering 16 (1). (28) Teeth not present on 3rd epibranchial (0); teeth present on 3rd epibranchial (1).

Appendix 2. Character matrix for cladistic analysis of interrelationships of the Samaridae and placement of *P. ocellatus*.

Character	*Samaris*	*Samariscus*	*Plagiopsetta*	*Psammodiscus*	*Achirus*	*Poecilopsetta*	*Azygopus*
1	1	1	1	0	0	0	0
2	1	0	0	0	0	0	0
3	1	1	1	0	1	1	0
4	1	0	0	0	0	0	0
5	1	1	1	1	0	0	0
6	1	1	1	0	1	0	1
7	1	0	1	1	1	0	1
8	1	1	1	0	1	0/1	0
9	1	0	0	0	1	0	0
10	0	2	1	1	2	1	0
11	1	1	1	0	1	0	0
12	1	1	0	0	0	0	0
13	1	1	1	0	0	0	0
14	2	2	1	0	0	0	0
15	0	0	1	0	0	0	0
16	1	1	1	0	0	1	0
17	2	2	1	0	0	1	0
18	0	0	0	1	0	0	0
19	1	1	1	0	0	0	0
20	1	1	1	0	0	0	0
21	1	1	1	0	0	0	0
22	1	1	1	0	0	0	0
23	1	1	1	0	0	0	0
24	1	1	1	0	0	0	0
25	1	1	1	0	0	0	0
26	0	0	1	0	0	0	0
27	1	1	1	1	0	0	0
28	1	1	1	1	0	0	0