

A Review of the Fish Genus *Dibranchus* with Descriptions of New Species and a New Genus, *Solocisquama* (Lophiiformes, Ogcocephalidae)

by

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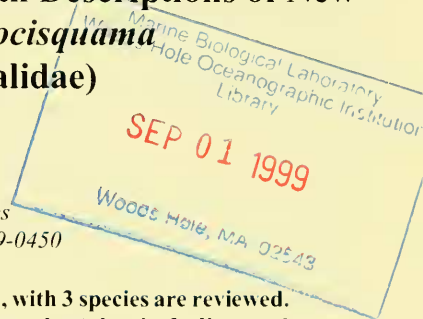
Dibranchus Peters, with 13 species, and *Solocisquama*, n. gen., with 3 species are reviewed. Three new species of *Dibranchus* are described, one each from the Atlantic, Indian, and east Pacific oceans. *Dibranchus scaber* Garman 1899 is a junior synonym of *D. hystrix* Garman 1899. *Dibranchus alberti* Nuñez 1967 is a junior synonym of *D. spinosus* (Garman) 1899. *Solocisquama* includes 2 species formerly referred to *Dibranchus* and 1 species described as new. A key to eastern Pacific species of *Dibranchus* and a key to species of *Solocisquama* are presented.

Although *Dibranchus atlanticus* is known from hundreds of specimens, 5 species of *Dibranchus* and the 3 species of *Solocisquama* are rare, known from one or a few specimens. All species are uncommon. The material of *Dibranchus* from the eastern Pacific represents 9 species, many more than from any other biogeographic region.

Like most ogcocephalids, members of the genus *Dibranchus* are bottom fishes with large, strongly depressed heads reminiscent of skates. Present in the Atlantic, Pacific, and Indian oceans, *Dibranchus* occurs at tropical and subtropical latitudes in depths from 200 to over 2200 meters. The little available data suggest that the majority of species have characteristic bathymetric ranges; for example, the two Atlantic species appear to be bathymetrically well separated, with *D. atlanticus* distributed above 800–1000 m and *D. tremendus* below.

I have examined 407 specimens from the eastern Pacific representing 9 species, of which 1 is new and 2 recently described (Bradbury et al. 1999), and 465 specimens from the Atlantic Ocean representing 2 species. Most Atlantic specimens may be assigned to the type species of the genus, *Dibranchus atlanticus* Peters, but 34 specimens represent a new Atlantic species from deeper water. I have seen only a handful of specimens from the western Pacific and Indian Oceans, but of these, a unique specimen from the Mozambique Channel is undescribed. One specimen of *Dibranchus japonicus* Amaoka and Toyoshima 1981, described from the Japanese archipelago, is herein reported from off Cape Town, South Africa, a significant range extension.

One result of this review has been the determination that several forms originally designated *Dibranchus* do not agree with the generic diagnosis proposed by Bradbury (1967) and discussed below. The two Hawaiian forms, *Dibranchus erythrinus* and *D. stellulatus* described by Gilbert (1905), are here referred to a new genus, *Solocisquama*, on the grounds of differences in the illicial skeleton, the peculiar squamation, and the shape of the upper jaw. A unique specimen from Sala y Gomez Ridge is found to be undescribed and is assigned to the new genus. The genus *Dibranchus*



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was proposed by Peters (1876) to include ogocephalids with only 2 gills on each side; that is, only the second and third arches bear gill filaments, a unique character for lophiiform fishes. At the time, only 2 other ogocephalid genera were known to Peters, *Halieutaea* Valenciennes 1837 from the Orient and *Ogocephalus* Fischer 1813 (known to Peters as *Malthé* Cuvier 1816) from the New World; both have gill filaments on the second and third arches plus the anterior side of the fourth arch, referred to as gills 2½. [A third genus with gills 2½, *Halieutichthys* Poey (in Gill 1863), had been described about a dozen years before Peters proposed *Dibranchus*, but was evidently unknown to him.]

Fifteen years later Alcock (in Wood-Mason and Alcock 1891) proposed *Malthopsis*, another genus with only 2 gills on each side. *Malthopsis* was said to resemble *Ogocephalus* in having a hornlike rostrum and the head depressed and formed as a “triangular wedge,” but these statements about characters were too general or imprecise to separate *Malthopsis* from *Dibranchus* as new species were discovered, with the result that *Malthopsis* had assigned to it species which later were reassigned to *Dibranchus* on the basis of additional characters including the illicial skeleton and features of squamation (Bradbury 1967). Eventually there were 11 nominal genera of ogocephalids described, 7 of these characterized by having gills only on the second and third arches. One of these was *Halieutopsis* Garman 1899, which also came to be confused with *Dibranchus* (summarized in Bradbury 1967).

Attempting to redefine the limits of ogocephalid genera, Bradbury (1967) showed that *Dibranchus* differed from *Malthopsis* in having simple tubercles, not bucklers as seen in *Malthopsis*, and in having the frontal bones of the cranium forming a groove for the illicium instead of the tubular canal seen in *Malthopsis*. *Halieutopsis* was shown to share with *Dibranchus* the character of tubercles, but *Halieutopsis* has a flat cranial roof, no groove or canal. *Halieutopsis* was further shown to have extra lateral line scales on the ventral surface of the body at or anterior to the anus, lacking in *Dibranchus*, while *Halieutopsis* lacked the well-developed pads of teeth on the ceratobranchial V bones seen in *Dibranchus*. Finally, the morphology of the illicial bone was found to be autapomorphic for each genus, and the implication was that the illicial bone morphology, as far as it was studied, established monophyly for each genus (*Coelophrys* excepted because no material of that genus had been available for study).

Although not all species were available for study of the illicial morphology at that time, the illicial bone in *Dibranchus* was shown to differ strongly from that in *Halieutopsis* in having two large foramina located ventrally, one in each of the two lateral processes which form the articulation of the illicial bone with the pterygiophore (Bradbury 1967, fig. 1). Further, *Dibranchus* lacks the median dorsal process prominent in both *Halieutopsis* and *Malthopsis*. Employing these characters, the following species originally described as belonging to *Dibranchus* were reassigned to *Halieutopsis*: *D. micropus* Alcock 1891, *D. stelliferus* Smith and Radcliffe and *D. simulus* Smith and Radcliffe (both in Radcliffe 1912) (see also Bradbury 1988). Similarly, the following species originally assigned to *Malthopsis* by Garman 1899 were reassigned to *Dibranchus*: *D. sparsa*, *D. erinacea*, *D. spinosa*, and *D. spinulosa* (*spinulosa* was treated as a junior synonym of *spinosa*). Finally, two monotypic genera described by Garman 1899 were treated as junior synonyms of *Dibranchus*: *Dibranchichthys*, with one species, *D. nudivomer*, and *Dibranchopsis* with one species, *D. spongiosa* (Bradbury 1967). Characters of the illicial bone are further assessed herein because of availability of new material.

I have not been able to study all nominal species of *Dibranchus*. I herein place *D. alberti* Nuñez 1967 in the synonymy of *D. spinosus* (Garman) 1899 on the basis of photographs published with the original description. Listed below are 3 nominal species that may more correctly be assigned to *Halieutopsis* and a fourth one that I cannot assign without examining the holotype.

(1) I have had an opportunity to examine specimens at the Zoological Society of India including ZSI 13028, the published number for the type specimen of *Dibranchus nasutus* Alcock (also listed in Menon and Yazdani 1968). I found the remains of two specimens in the jar. The specimens were largely disintegrated, but there was a fragment of cranium containing the esca of one, and frontal

bones and esca of the second, enough to establish that it is incorrect to assign them to *Dibranchus*. The remains of the frontal bones showed them to be flat, not forming a median groove in the roof of the cranium as in *Dibranchus*, and the escas had the two ventral lobes each spherical and separated from one another, not joined as in *Dibranchus*. Both characters are consistent with *Halieutopsis*, but I could not ascertain the species; the escas were most like *H. vermicularis*.

(2) *Dibranchus nudiventer* Lloyd, 1909 was described from a single specimen "75 mm in length" from the Bay of Bengal. This specimen had the rostrum projecting beyond the mouth and the esca in the form of "a pair of fleshy balls with a pair of filaments above and between them." Neither of these features agree with *Dibranchus*; they agree with *Halieutopsis*. The description of the esca suggests *H. vermicularis*.

(3) *Dibranchus infranudus* de Beaufort, 1962 (in de Beaufort and Briggs 1962) is based upon a single specimen, 80 mm, from the Flores Sea. Without having seen the holotype, I tentatively assigned this name to the synonymy of *Halieutopsis simulus* (Smith and Radcliffe, 1912) in a review of *Halieutopsis* (Bradbury 1988).

The holotype of *Dibranchus infranudus* de Beaufort is in the Institute of Taxonomic Zoology, ZMA 101.877 (Nijssen et al. 1982).

(4) *Dibranchus obscurus* Brauer, 1908 was based on a single, 12-centimeter specimen from the Gulf of Aden. Not having seen this specimen and lacking information on diagnostic characters, I am unable to place it.

METHODS

Methods are those developed for a study of the related genus *Ogcocephalus* (Bradbury 1980) and modified for a study of *Halieutopsis* (Bradbury 1988). Length of disk margin is the distance taken on the right side from the front of the posterior swelling of the mandible just at the corner of the mouth to the distal end of the subopercle excluding the subopercular spine. Skull length is the distance from the upper lip to the slight pit that can be felt with the tip of the calipers between the cranium and the anteriormost vertebra. Cranium width is the distance between the points of greatest concavity just behind the orbits. Eye width is greatest width of orbit. Other measurements are standard measurements: distance from jaw to anus, distance from jaw to anal fin, distance from snout to dorsal fin, interorbital width, jaw length, and mouth width. Meristic characters studied include numbers of rays in the pectoral and dorsal fins and numbers of neuromasts in certain lateral-line series. Neuromasts are free neuromasts (lie on the surface of the skin) but are cupped in modified tubercles (seen in Fig. 4c; Fig. 5c, d).

In *Dibranchus*, the lateral line is interrupted at the transition from dorsal surface of disk to lateral sides of tail, resulting in 2 separate series, a disk lateral line and a tail lateral line. Disk lateral line elements were too difficult to count accurately so were not used. The tail lateral line commences just posterior to anus and runs onto the base of caudal fin. (A free neuromast without lateral-line scale often occurs about half way out on the caudal fin, but is omitted from the count because it may be difficult to see and its presence cannot be verified by the presence of the modified lateralis scale.) The other lateral-line series used in this study are the preopercular series, the subopercular series, and the dorsolateral branch of the subopercular series.

In lophiiform fishes, the first vertebra is fused to the skull; it is not included in the vertebral count in this study. Counts begin with the first free vertebra and include the hypural fan. All vertebral counts were made from radiographs.

In *Dibranchus* the surface sculpturing of tubercles and pattern of squamation are useful characters for discriminating species, but to a large extent the characters are difficult to convey descriptively. It was finally determined to restrict detailed description to the ventral surface of the tail, the portion of the integument that shows in the least bewildering way the kinds of variation seen (Figs. 9, 10). The

ventral surface of the tail is relatively flat with a clear boundary row of tubercles on each lateral edge, herein called principal rows.

Museum collections are indicated by standard symbolic codes (Leviton et al. 1985; Leviton and Gibbs 1988).

Dibranchus Peters

Dibranchus Peters, 1876:736 [type species *Dibranchus atlanticus* Peters, 1876, by monotypy; gender masculine]; Bradbury, 1967:413 [diagnosis].

DIAGNOSIS. — Gills 2; holobranchs present on 2nd and 3rd arches only. Scales in the form of tubercles, not bucklers. Frontal bones of skull modified to form a median groove for the illicium. Illicial bone with each lateral process pierced by a large foramen; no long dorsal median process. Tooth patches on ceratobranchial V bones contiguous with one another, meeting all along midline. Tail lateral line commences posterior to anus; no lateral-line organs beside, or anterior to, the anus as in *Halieutopsis*.

DESCRIPTION. — Disk variable in size and shape depending upon preservation, from oval or bell-shaped when subopercular bones (which form lateral margins of disk) and pectoral pedicels collapsed against trunk, to strongly triangular when subopercles and pectoral pedicels flared away from trunk. Most species with prominent posteriorly directed, medially-curved spines at posterior ends of subopercles, these subopercular spines multifid, often with largest spinelets curving dorsally.

Body depressed but cranium elevated above general surface of disk so eyes are directed laterally and anteriorly. Rostrum composed of an array of closely-spaced tubercles forming a short shelf over esca; no median horn, although median tubercle may be larger or longer than those to the sides. Illicial cavity small, not cavernous as in some *Halieutopsis*. Esca (Fig. 1a) broader than high, consisting of a median dorsal lobe continuous with 2 ventral lobes which are continuous with one another across the midline and flared out laterally, subtended by a ridgelike edging, sometimes membranous. On posterior side of esca, ventral lobes strongly separated, spherical (can be seen in Fig. 6a). Olfactory organs sexually dimorphic: in females, organs relatively small and containing a few small lamellae, the nostrils small and round; in males, olfactory organ large, swollen by enlarged lamellae within, posterior nostril a wide gaping slit (see analysis below). Dorsal rays 5 or 6, rarely 4 or 7; pectoral rays usually 13–15, range 12–16 (Table 1). Anal rays always 4, caudal rays always 9. Preopercular lateral line series 1–4, subopercular series 4–7, dorsolateral branch of the subopercular series nearly invariably 3. Lateral line interrupted just as it descends from the disk onto the tail. The lateral line organs on the disk are difficult to see and count, so these were not studied. Tail lateral line commences on the ventral side of tail just posterior to the anus, thence continuing along lateral sides of tail onto base of caudal; tail lateral line 8–15 (Table 4).

Vertebral count 17–20, usually 18 in *D. atlanticus*, usually 19 in other species (Table 3).

Teeth in oral and gill cavities simple, small, recurved, posteriorly hinged Type 4 teeth as described by Fink (1981, table 1) for *Dibranchus hystrix* (his *Dibranchus scaber*) with a single exception. That is the new species *D. velutinus* described herein as having bristlelike teeth (the true nature of teeth in *D. velutinus* has not been studied for lack of material). Teeth in bands on jaws, visible when mouth closed. Scanning electron micrographs of premaxillary teeth of 4 specimens of *D. atlanticus* varying in size from 39.5 to 131.5 mm SL (Fig. 2) show that numbers of rows of teeth and numbers of teeth within each row increase with size of fish; a similar pattern was seen in *D. spongiosus* and in *D. spinosus* (not pictured). Palatal teeth present only in 5 species. Each ceratobranchial V with a broad patch of teeth, the two patches always completely contiguous along midline.

Figures 3a and b show the general structure of gill rakers for most species of *Dibranchus* (exceptions are *velutinus* and *spongiosus*). Pictured is *D. atlanticus* with relatively stout pedicels and

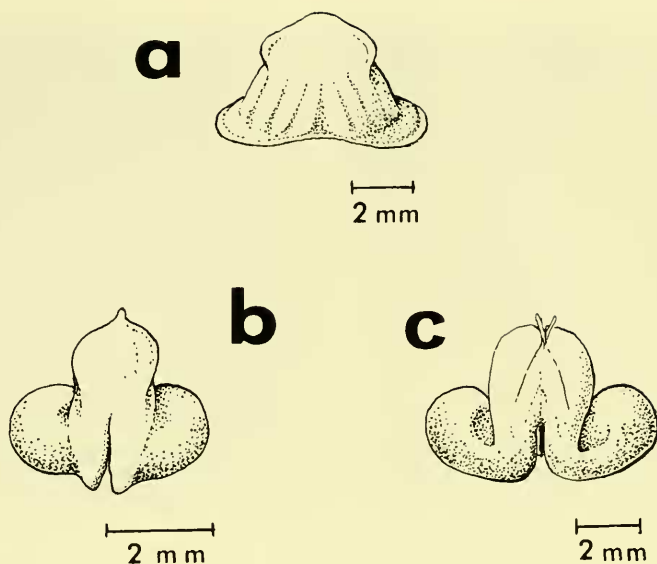


FIGURE 1. Frontal views of escas. (a) *Dibranchius spinosus*, 133.0 mm SL (ZMUC, GALATHEA Sta. 739). The esca in most species of *Dibranchius* looks like this as long as the gland has not become distorted in the preservation process. The two ventral lobes are less differentiated than in most other genera (although well-differentiated spherical lobes are visible from the posterior view as seen in Fig. 6a). There is often a fringe or membrane along ventral margin. (b) *Solocisquama stellulata* (Gilbert), holotype USNM 51595, 47.8 mm SL. (c) *Solocisquama erythrina* (Gilbert), holotype USNM 51642, 133.5 mm SL.

broad tooth plates with numerous teeth in a subspherical cluster. In some eastern Pacific species, pedicels are slender with fewer teeth. In *D. velutinus*, teeth appear absent. In *D. spongiosus* (Figs. 3c, d), the dome-shaped tooth plate appears to cover the pedicel and spreads out on the gill arch. The gill rakers in the following species were studied only by gross examination — no SEM or clearing/staining: *D. accinctus*, *D. cracens*, *D. discors*, *D. japonicus* and *D. velutinus*.

Modified scales known as tubercles are, in *Dibranchius*, typically pyramid-shaped with 8–14 ridges radiating from a central spine and separating facetlike surfaces. Examples shown are *atlanticus* (Figs. 4a, b) with pronounced ridges decorated by spinules, *D. tremendus* (Figs. 4c, d) with barely-defined facets and thick terminal spines, and *D. nudivomer* (Fig. 5d). Lateralis scales are crescent-shaped (Fig. 5c) with a central foramen for the protruding neuromast. An individual lateralis scale usually lies between two good-sized tubercles, visible in the near background in both Figs. 4c and 5d.

Illicial bone. In *D. atlanticus*, *D. tremendus*, *D. hystrix*, *D. sparsus*, *D. spinosus*, *D. erinaceus*, *D. nudivomer*, *D. cracens*, and *D. spongiosus*, illicial bone with a large foramen on each side ventrally, piercing on each side the lateral processes that articulate with pterygiophore (Fig. 6b). Lateral processes separated by a broad high median space. Dorsal median process completely absent, but a very short, blunt dorsal process on each side of central mass. *Dibranchius discors* shows this same conformation but is compressed from side to side (Fig. 7a). (This feature was not studied in *D. accinctus*, *D. japonicus*, and *D. velutinus*.)

Sexual Dimorphism in Olfactory Organs. Sexual dimorphism in olfactory organs has been reported in lophiiform groups. Bertelsen (1951) reported that males in most ceratioid anglerfishes have larger olfactory organs with more and larger lamellae than females. Bertelsen, Pietsch, and Lavenberg (1981) later determined that metamorphosed males are macrosomatic in all ceratioids except Ceratiidae and Neoceratiidae. Caruso (1975) reported for Lophiidae that *Lophius* has sexual dimorphism in the olfactory organ, but slight and “easily overlooked,” while in *Lophiodes* and

TABLE 1. Relationship of standard lengths and sex in *Dibranchius atlanticus* to numbers of olfactory lamellae. Specimens with large flag-shaped lamellae always had testes. Specimens with small nub-like lamellae or no identifiable lamellae (signified by —) always had ovaries. Specimens from the Gulf of Guinea are from 2 lots: ZMUC *Atlantidae* Sta. 120, 18 examples, and ZMUC *Atlantidae* Sta. 135, 20 examples; total, 38 examples. Of these the gonad was indeterminable in 12 (not shown in Table). Specimens from the Atlantic coast of NE South America are from seven lots all from *Oregon* stations, as follows. (Numbers in parentheses are numbers of examples.) CAS 42661 (3), Sta. 2005; CAS 42662 (10), Sta. 2007; CAS 42663 (3), Sta. 2008; CAS 42671 (4), Sta. 2026; CAS 43673 (4), Sta. 2029; CAS 42674 (13), Sta. 2028; CAS 42690 (3), Sta. 2025; total, 40 examples.

Gulf of Guinea				NE South America			
Testes Present		Ovaries Present		Testes Present		Ovaries Present	
SL	Lamellae	SL	Lamellae	SL	Lamellae	SL	Lamellae
102.0	14	91.0	—	96.4	20	141.8	4
93.0	18	89.0	4	89.2	18	120.0	6
83.5	15	82.0	4	86.3	16	115.6	8
68.0	14	82.0	4	84.4	15	109.3	6
53.5	11	81.5	4	83.0	17	103.0	—
47.5	6	81.0	3	82.0	14	102.7	—
		80.5	4	75.8	17	93.4	—
		80.5	—	74.0	15	82.1	—
		80.0	—	71.8	18	79.8	—
		78.5	—	71.8	17	76.8	—
		78.0	4	71.2	15	72.7	—
		76.0	—	70.0	17	70.0	—
		75.0	4	69.1	14	68.0	—
		73.5	0	64.0	12	65.7	—
		71.5	5	63.2	10	59.1	—
		61.0	—	61.7	12	53.0	—
		56.5	—	56.2	7	51.5	—
		51.5	—	49.2	0		
				45.1	0		

Lophiomus, sexual dimorphism of olfactory organs is well developed. Bradbury (1988) reported that males were macrosomic in the ogocephalid genus *Halieutopsis*. Since variation in size of olfactory organs was noted in *D. atlanticus* and other species of *Dibranchius*, a test was made to determine relationship between size variation and sex.

Two samples of *D. atlanticus* were chosen, 40 from off the Atlantic coast of northeastern South America, and 38 from the Gulf of Guinea. Each sample was sorted into two groups: those with large and those with small olfactory organs. The sample from the Gulf of Guinea yielded 6 specimens, 47.5–102.0 mm SL, with large olfactory organs, and 32 specimens, 35.0–91.0 mm SL, with small olfactory organs. All specimens with large olfactory organs, upon dissection, proved to have testes. Of the other group, 20 specimens, 51.5–91.0 mm SL, had ovaries, and 12, 35.0–59.0 mm SL, were indeterminable by gross dissection. For the sample from off northeastern South America, 19 specimens, 56.2–96.4 mm SL, had large olfactory organs as well as testes; 2 others, 45.1 and 49.2 mm SL, also had testes but did not yet show enlarged olfactory organs; 19 specimens, 51.5–141.8 mm SL, that had small olfactory organs had ovaries. We may conclude that mature males are macrosomic, as has been found in Lophiidae and most ceratioids (Caruso 1975; Bertelsen et al. 1981).

In large olfactory organs of males, the posterior nostrils are long horizontal slits, the lips of the slit generally gaping so the opening appears large; within can be seen enormous, overlapping, flag-shaped olfactory lamellae in the center of the organ, tapering to smaller leaf-shaped lamellae at

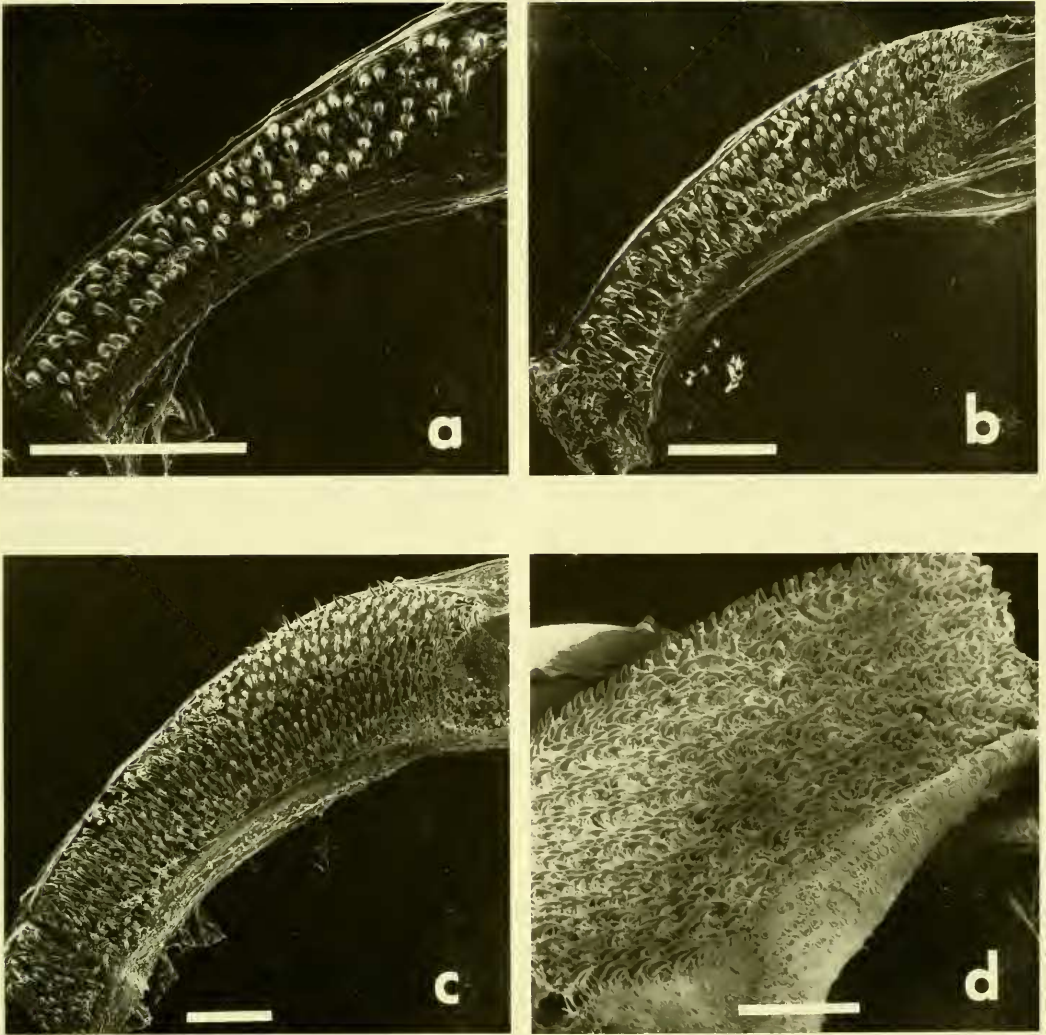


FIGURE 2. Scanning electron micrographs showing that premaxillary teeth in *Dibranchius atlanticus* increase in numbers of rows and numbers of teeth within rows with increasing standard length. Standard lengths as follows: (a) 39.5 mm; (b) 72.5 mm; (c) 81.0 mm, all from CAS 76446; (d) 131.5 mm, CAS 76452. Scale bars = 1 mm.

either end. The skin covering the olfactory capsule bulges to accommodate the enormous lamellae. The olfactory lamellae were inspected and counted by simply looking into the posterior nares when large, but, in small olfactory organs, the relatively small rounded posterior nares sometimes made it difficult to count lamellae. The opening was enlarged by a cut in these cases, but even so, it could be difficult to determine whether the material within was lamellar epithelium or mucous or other material. Simple methods such as forcefully irrigating, scraping, or drying the structure seldom clarified whether or not lamellae were present. It was clear, however, that none of the specimens with ovaries has large, overlapping, flag-shaped olfactory lamellae as seen in males. Rather, the females had small lamellae or only nubbins of epithelium.

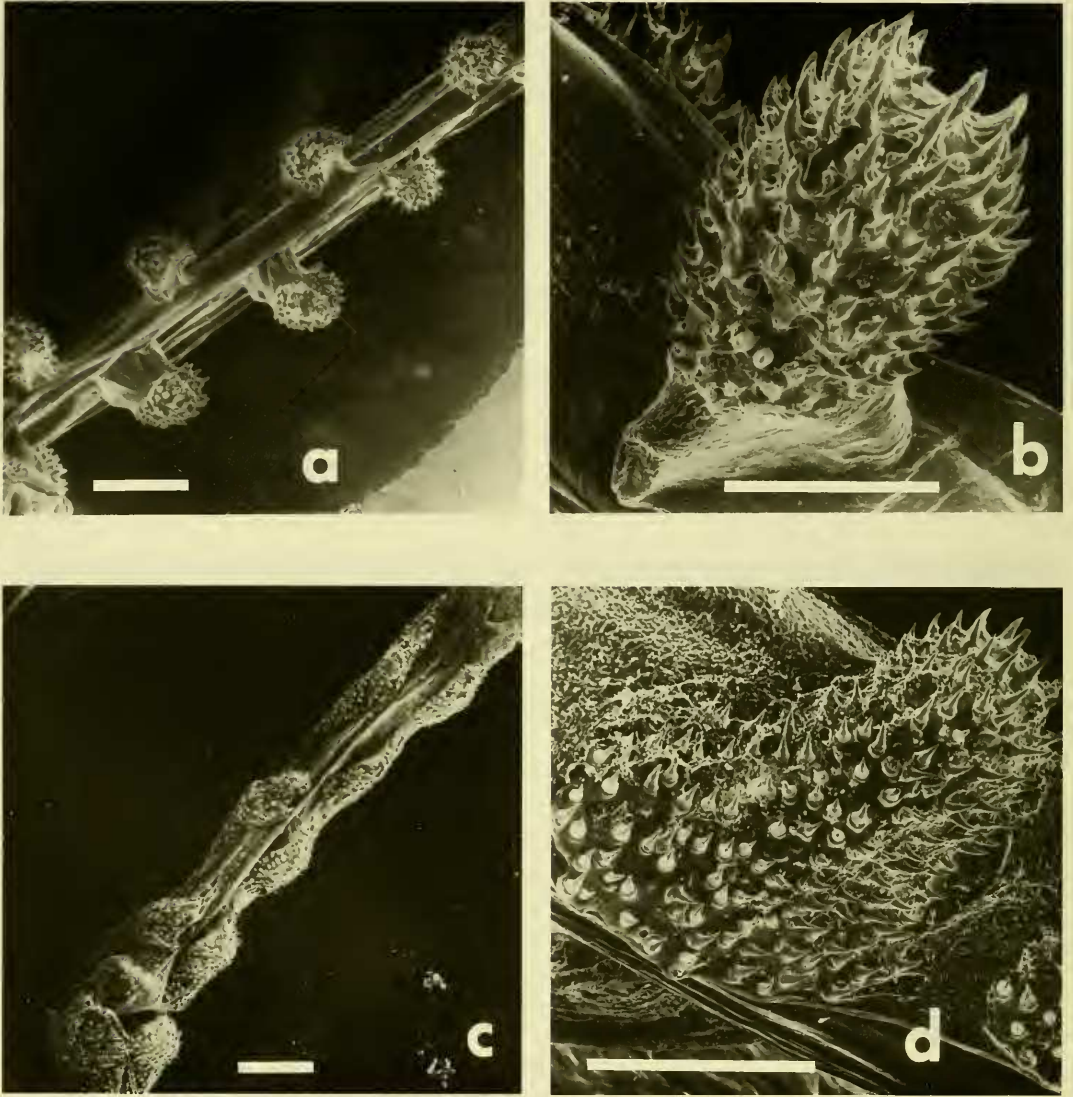


FIGURE 3. Scanning electron micrographs showing (a) second gill bar with gill rakers and (b) individual gill raker in *Dibranchius atlanticus*, 131.5 mm SL, CAS 76452, and the same (c and d) for *D. spongiosus*, 115.0 mm SL, CAS 82252. Scale bars for a and c = 1 mm, for b and d = 0.5 mm.

As can be seen in Table 1, not only do males have larger lamellae than females, they have many more of them. Males show an increase in number of lamellae with increase in standard length; females do not show this pattern although data for females is admittedly incomplete. In any event, although small size fish 50–60 mm SL or smaller may not show it, mature males in *Dibranchius atlanticus* are shown to have far more extensive nasal epithelia than females and seem to increase the area of these epithelia with growth. Similar observations in species of *Dibranchius* of which large samples were available (*D. spinosus*, *D. nudivomer*, *D. tremendus*, and *D. spongiosus*) showed the same pattern, and all specimens with enlarged olfactory organs of other species proved to have testes with one exception. The exception is the new species *D. discors*, in which males have enlarged olfactory organs,

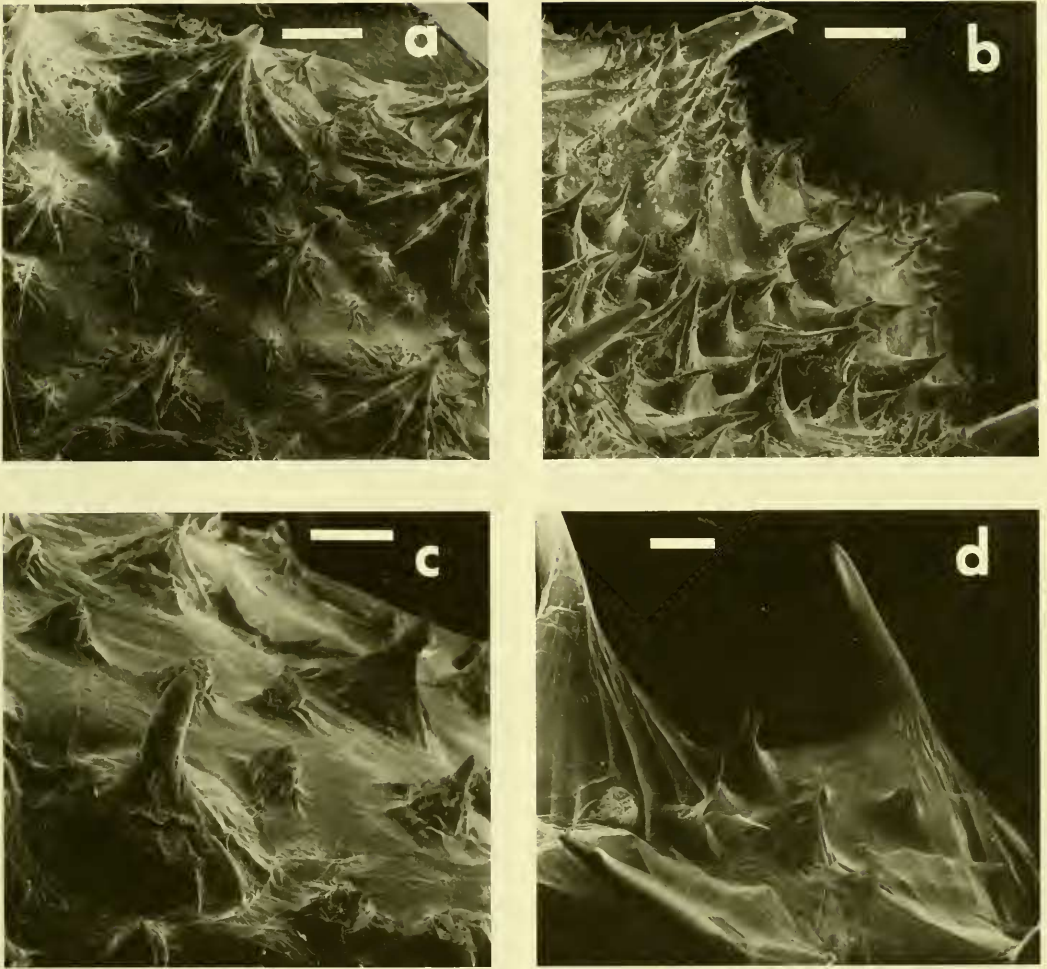


FIGURE 4. Scanning electron micrographs showing (a) tubercles from a section of skin posterior to eye and (b) principal tubercles of the tail in *Dibranchus atlanticus*, 131.5 mm SL, CAS 76452, and the same (c and d) for *D. tremendus*, 155 mm SL, USNM 320332. Tubercles are decorated with spinules in *D. atlanticus* but not in *D. tremendus*; spines of tubercles are far longer in *D. tremendus* than in *D. atlanticus*. Scale bars = 1 mm. In the near background in (c) is seen a specialized crescent-shaped lateralis scale, placed as usual between two tubercles that mark the poles of the long axis of the scale. The neuromast protrudes through a pore in the middle of the scale.

but much less pronounced than in congeners, so that it is difficult to be sure one has a male without identifying testes.

Bioluminescence. No light organs have been observed in *Dibranchus*, but bioluminescence nevertheless may play a role in the life of *Dibranchus atlanticus*. Crane (1968) reported that the skin of the dorsal surface of freshly-caught specimens from 366 m off Brunswick, Georgia, showed fluorescence, suggesting a luciferin might be present. Adrenalin hydrochloride injected into the heart of one fish induced it to emit a low level glow over the entire dorsal surface, although neither the esca nor ventral surface of the fish emitted light. Later, skin and esca from frozen fish were tested for spontaneous light emission as well as stimulated by various reagents, resulting in the determination that the esca and the skin from both the dorsal and ventral surface have bioluminescence capability. The function of this feature is as yet obscure.

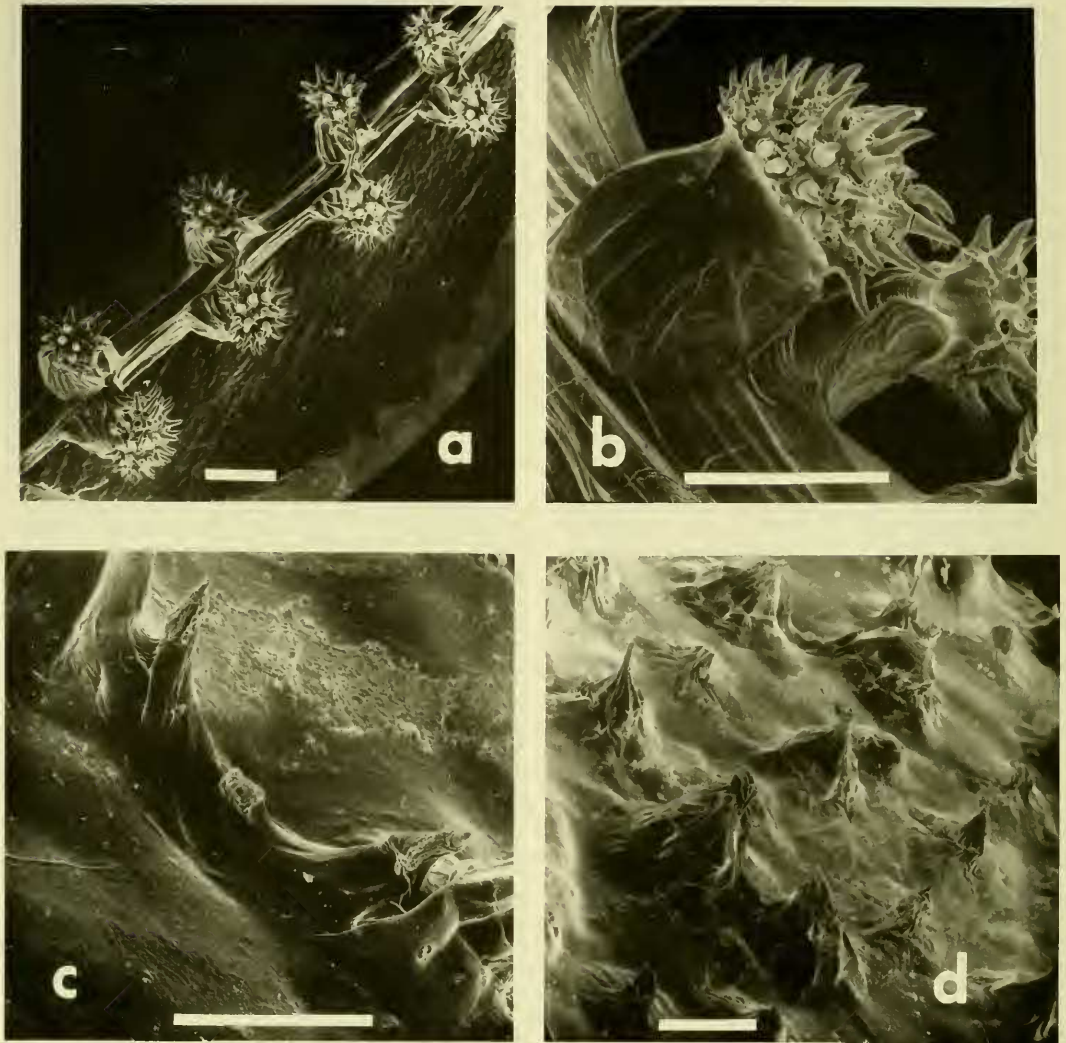


FIGURE 5. Scanning electron micrographs. (a) second gill bar with gill rakers and (b) individual gill raker in *Solocisquama erythrina*, 135.5 mm SL, BPBM 29270; in this species and in *S. stellulata*, the pedicels are stouter and longer than in *Dibranchius*. (c) crescent-shaped lateralis scale with neuromast at center and (d) tubercles in skin of disk posterior to eye in *Dibranchius nudivomer*, 98.5 mm SL, CAS 82261. A specialized lateralis scale in near background in (d) lies between its two associated tubercles. Scale bars for a, b, and d = 1 mm, for c = 0.5 mm.

DISTRIBUTION. — Two species in the Atlantic, both occurring in the eastern as well as western Atlantic and Gulf of Mexico. Nine species in the eastern Pacific, from the coasts of Mexico to Peru and west to the Galapagos; of the nine, two are known only from the Galapagos archipelago, and one is trans-Pacific. One other species is known from the western Pacific, but its range is shown herein to extend to the western Indian Ocean. One species, described herein from a single specimen, is known only from the western Indian Ocean.

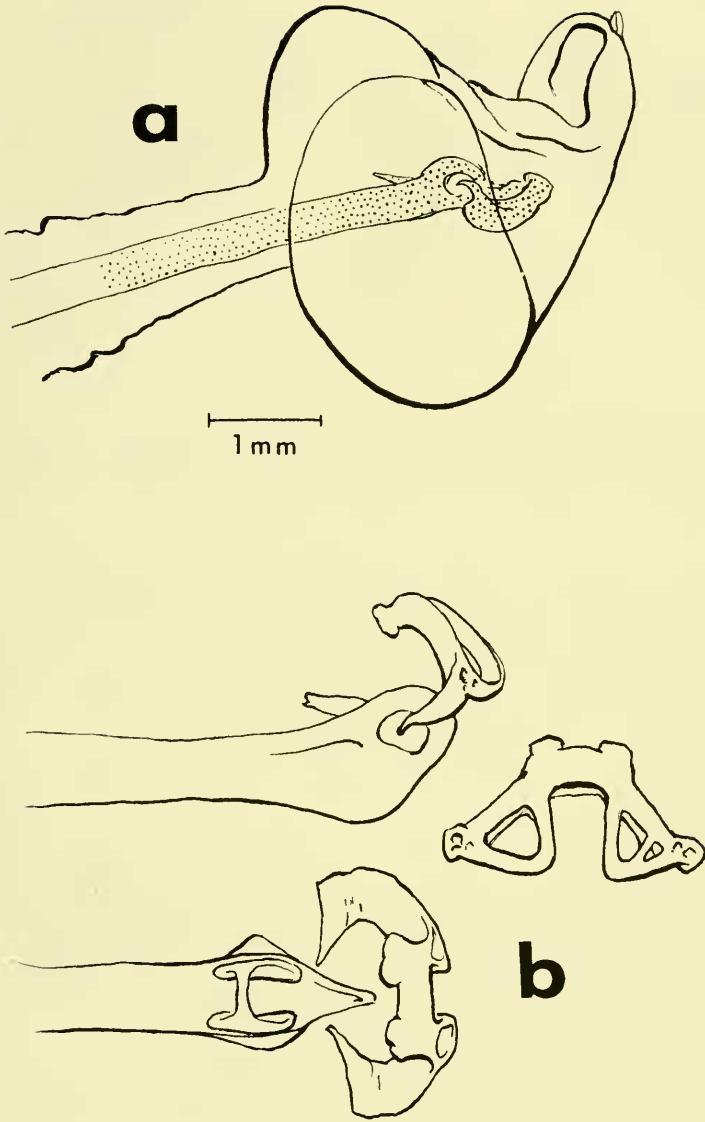


FIGURE 6. (a) Postero-lateral view of cleared and stained illicium of *Dibranchius tremendus*, 96.5 mm SL, UF 25923. Internal structures (stippled) are the elongate pterygiophore, left, and illicial bone, right. The dorsal lobe of the esca appears to the right instead of dorsad because the esca has been bent down relative to the pterygiophore; note at its distal tip a large opening for discharge of gland's secretion. Scale bar = 1 mm. (b) Three views of distal end of pterygiophore and illicial bone in *Dibranchius* (generalized; from Bradbury 1967) as follows: side view (upper left), dorsal view (lower left), and frontal view of illicial bone (right). Note on the illicial bone the very short dorso-lateral process on each side and the large ventro-lateral lobe pierced by a foramen on each side. Each ventro-lateral lobe extends laterally and posteriorly to form the articulating processes of the illicial bone.

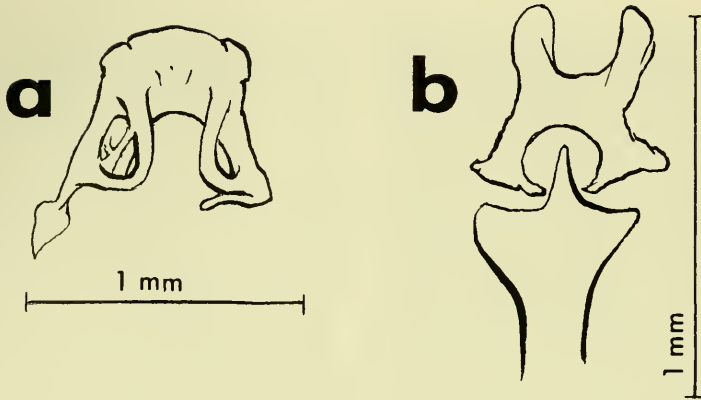


FIGURE 7. Frontal views of illicial bones. (a) *Dibranchius discors*, 87.2 mm SL (CAS 47195); (b) *Solocisquama stellulata*, 76.0 mm SL (BPBM 17941). Bone spicules occasionally occur within the foramen of the lateral process in *Dibranchius* as seen on the left in this specimen. On the left it can also be seen that the lateral process is malformed.

KEY TO ADULTS OF EASTERN PACIFIC SPECIES OF *DIBRANCHUS*

A key to only the eastern Pacific species of *Dibranchius* is offered here because the species from other regions are few and easily separable. The two Atlantic species, *D. atlanticus* and *D. tremendus*, are easily separated by their squamation (Fig. 4). The two species found in the western Pacific, *D. hystrix* and *D. japonicus* (Fig. 9b, f), can also be distinguished from one another by their squamation, as can *D. accinctus* and *D. japonicus* in the Indian Ocean (Fig. 9c, f).

- 1a. Teeth present on palate 2
- 1b. No teeth on palate 6
- 2a. Teeth on palatines but none on vomer *D. nudivomer*
- 2b. Teeth on both palatines and vomer 3
- 3a. Tubercles present in skin of eyeballs and on ventral surface of disk. Mouth width 14% or more of SL 4
- 3b. No tubercles in skin of eyeballs, or on ventral surface of disk (except a few around pelvic bases). Mouth very narrow, its width 11.5% or less of SL *D. discors*
- 4a. Preopercular lateral-line count usually 2. A reticulate color pattern often discernable on dorsal surface (Fig. 15a). A small species reaching less than 85 mm SL *D. sparsus*
- 4b. Preopercular lateral-line count usually 3. No reticulate color pattern on dorsal surface. Larger species, reaching nearly 150 mm SL 5
- 5a. Very small tubercles with slender spines covering body; enlarged tubercles are present, but these covered by the small ones so effect is of uniformly small tubercles (Fig. 15c). Subopercular spine little developed *D. spinosus*
- 5b. Tubercles moderate size interspersed with small ones (Fig. 15b). Subopercular spine broad, moderately long *D. erinaceus*
- 6a. Tubercles so tiny that the texture of the skin resembles velvet (Fig. 14). Mouth very wide, the width 27.5% of SL. Jaws covered with papillae, burying the bristlelike teeth *D. velutinus*
- 6b. Tubercles moderate to large size, skin not velvetlike. Mouth width less than 25% of SL. Small conical teeth in bands visible on jaws 7
- 7a. Large tubercles decorated with spinules radiating in lines from central spine (Fig. 9e). Subopercular lateral-line count 6 *D. cracens*
- 7b. Tubercles plain; no spinules. Subopercular lateral-line count usually 5 8
- 8a. Spines of tubercles long (Fig. 9b) *D. hystrix*
- 8b. Spines of tubercles short (Fig. 10f) *D. spongiosus*

***Dibranchus atlanticus* Peters, 1876**

Figs. 2, 3a–b, 4a–b, 8, 9d

Dibranchus atlanticus Peters, 1876:738 (original description, 1 specimen, the type, off West Africa; 675 m; holotype not seen); Gunther, 1887:59 (W coast of Africa, 658 m); Vaillant, 1888:343 (off Cape Verde I., 405 m); Goode and Bean, 1896:501; Beebe, 1937:207 (off Bermuda; pelagic specimens from depths to 600 m); Cadenat, 1937 (9°32'N, 16°25'W, 250 m); Arnold, 1949:299 (off New England, 117 m); Rees, 1963:1513 (continental slope of Canadian Atlantic); Crane, 1968:410 (off Georgia from 366 m; bioluminescence); Hoese and Moore, 1977:144 (Gulf of Mexico off Texas and Louisiana; key; partial description); Golovan, 1978:231 (northwestern Africa; benthic zonation); Pietsch, 1981:387 (osteology; phylogeny); Uyeno et al., 1983:250 (off Surinam and French Guiana, 180–910 m; description; photograph); Matallanas, 1987:121 (off Guinea-Bissau, NW Africa).

Halieutaea senticosa Goode, 1881:467 (holotype USNM 26175; coast of southern New England, 412 m).

REMARKS. — I am indebted to C. Karrer, Zoologisches Museum Hamburg, who informs me that “nearly all the material of Peters is in the Zoologisches Museum, Berlin” (pers. commun. 1991). Presumably the holotype of *Dibranchus atlanticus* is among this material. In any event, figures accompanying the original description give an exceptionally clear picture of the species including the diagnostic spinules on tubercles.

DIAGNOSIS. — Tubercles have ridges radiating from the apical spine; these ridges heavily edged with spinules, especially the largest tubercles (Figs. 4, 9d); thus, tubercles in this species appear multi-spined. Vertebral count usually 18 (Table 3). Subopercular lateral-line count usually 5 (Table 4). No palatal teeth.

DESCRIPTION. — Based on 432 specimens 30.0–138.0 mm SL. Counts and body proportions given in Tables 3–5. Skeleton firm; skin tough, studded with shagreenlike tubercles among which protrude numerous enlarged tubercles with hard sharp spines. Rostrum short, median tubercle slightly overhanging illicial cavity (juveniles have rostrum more elongated). Esca and nasal capsules as in generic description.

Teeth as in generic description. No palatal teeth. Gill rakers as in generic description; usually 6 gill rakers on each side of second arch.

Tubercles mainly of 2 sizes; relatively small simple tubercles evenly distributed over entire body so skin resembles shagreen. Interspersed are large tubercles featuring prominent facets, the ridges between facets studded with rows of spinules forming a radiating pattern from the long central spine (Fig. 4a). Largest of these occur on the sides of the disk, where terminal spines are bifid, and on the dorsal and lateral sides of the tail. Spinules on edges of tubercle facets well developed in specimens about 35 mm SL or more; in specimens about 30–35 mm SL, only largest tubercles have spinules developed; tubercles in specimens under about 30 mm SL lack spinules. Subopercular spine prominently long with 6–8 spinelets. Only small tubercles occur on the ventral surface of the disk, where the skin is uniformly shagreenlike; this type of squamation also occurs in the skin on the eyeballs.

Ventral surface of tail with principal tubercles wide, low, covered with radiating spinules as elsewhere on body, terminating in short stout recurved spines (compare Fig. 9d with others pictured in Figs. 9 and 10). Similar tubercles lie between the principal rows in 2 longitudinal rows from the anus to the anal fin base. Small tubercles thickly distributed between bases of large tubercles.

Fins, except dorsal, usually with tubercles on bases of rays.

Dermal cirri associated with channels for lateralis organs, especially around neuromasts.

Pectoral fins slender, sturdy relative to most other species; pelvic fins slender.

Color. Fresh specimens tinged with pink on light bluish gray or brown background. Fins very pale to brilliant rose red. Pinks and reds disappear completely in preservative; preserved specimens uniformly pale gray or light brown. Eastern Atlantic specimens frequently with a reticular pattern on the dorsal surface of the disk that is darker than the ground color. Fins the same color as the body in



FIGURE 8. Dorsal views of similar-sized specimens of *Dibranchius tremendus*, 116.0 mm SL, USNM 320326 (left) and *D. atlanticus*, 113.0 mm SL, USNM 186337 (right).

preserved specimens. Peritoneum black. Dark brown specimens occur, but rarely; in these, cirri associated with lateral line organs on subopercle and tail dark brown or black, fins dark or with dark blotches.

DISTRIBUTION. — Atlantic coasts of Canada and United States, Gulf of Mexico, Caribbean, and coast of South America to Rio de Janeiro, Brazil; in the eastern Atlantic, the Gulf of Guinea to Angola. Bathymetric range: the vast majority of collections from 300–700 m. Two lots that I have seen came from depths less than 100 m off French Guiana. A few lots have come from 700–1000 m, including samples from the Gulf of Mexico, Straits of Florida, off Surinam, and off Angola; there is one record from 1260 m from off Angola.

GEOGRAPHIC VARIATION. — Intraspecific variation occurs in this wide-ranging species. Color differences between eastern and western Atlantic populations are observable: specimens from the Gulf of Guinea often have reticulate markings on the dorsal surface of the body, usually vague, occasionally strong, which are not seen in western Atlantic material.

There was also a difference in pectoral fin ray count between eastern and western Atlantic populations (Table 2); note that the western Atlantic material was handled as five populations based on geographic regions, as follows: Gulf of Guinea, Atlantic coast of the United States (US), Gulf of Mexico, Caribbean, and coast of NE South America.

MATERIAL. — Numbers in parentheses give number of specimens; for lots used in morphometric analyses, standard lengths follow the number of specimens. Method of capture, when known, is by bottom trawls or dredges unless otherwise noted.

Atlantic Coast of United States: ARC 8600689 (1, 112.4), 43°07'N, 61°28'W, 500 m. ARC 8600690 (2, 65.0–125.3), 42°52'N, 62°35'W, 326 m. ARC 8600691 (1, 129.2), St. Pierre Bank. ARC 8600693 (1, 91.1), 42°47'N, 63°30'W, 600 m. ARC 8600694 (2, 94.0–97.7), 44°35'N, 58°44'W, 81 m. ARC 8600695 (1, 87.7), 42°46'N, 63°30'W, 417 m. ARC 8600696 (1, 90.2), Nova Scotia Banks, 6' Issacs Kidd. ARC 8600697 (1, 85.4), 43°56'N, 58°40'W, 373 m. CAS 3200 (5, 27.8–56.9), ISELIN Cruise 7310, Sta. 45, 36°42.6'N, 74°38.2'W, 390 m. CAS-SU 9519 (4, 45.7–108.6), off Newport, R. I. CAS 42667 (2, 76.0–92.0), COMBAT Sta. 362, 34°18'N, 75°51'W, 402 m. CAS 42669 (1, 71.0), SILVER BAY Sta. 2070, 29°13'N, 79°59'W, 375 m. CAS 76452 (1, 131.5), DELAWARE Cr. 60-1, Sta. 8, 41°54'N, 68°13'W–41°54'N, 68°17.5'W, 220–238 m. CAS 42670 (1, 77.5), PELICAN Sta. 58, 29°59'N, 80°10'W, 296–305 m. CAS 42700 (2, 45.6–82.0), SILVER BAY Sta. 469, 29°36'N, 80°10'W, 348–366 m. CAS 42701 (1, 105.0), SILVER BAY Sta. 445, 28°03'N, 78°44'W, 914–951 m. CAS 42702 (1, 42.0), COMBAT Sta. 499, 29°50'N, 80°10'W, 366 m. CAS 42704 (3, 48.0–123.0), DELAWARE Sta. 59-10, Tow 3, 39°57'N, 70°58'W, 320–366 m. CAS 42705 (1, 76.0), COMBAT Sta. 445, 25°15'N, 79°13'W, 366 m. CAS 51206 (1, 90.0), COMBAT Sta. 436, 24°13'N, 81°42'W, 549 m. CAS 63251 (2, 68.7–90.4), COMBAT Sta. 431, 29°57'N 80°08'W, 384 m. UF 25980 (2, 79.5–83.0), PELICAN P-70, 29°32'N, 80°08'W, 274–348 m. UF 25981 (4, 54.0–106.0), SILVER BAY Sta. 220, 29°29'N, 80°09'W, 329–348 m. USNM 186335 (1, 77.8), DELAWARE Cr. 59-7, Sta. 8B, 36°42'N, 74°41'W, 366 m. USNM 186337 (5, 75.3–113.0), DELAWARE Cr. 59-7, Sta. 4B, 36°05'N, 74°43'W, 366 m.

Gulf of Mexico: CAS-SU 17442 (4, 66.2–79.9), OREGON Sta. 501, 27°55.5'N, 91°32.5'W, 402 m. CAS 42668 (4, 80.2–92.1), OREGON Sta. 126, 29°02'N, 88°34.5'W, 357 m. CAS 42689 (1), OREGON Sta. 1019, 24°16'N, 83°22'W, 686 m. CAS 42692 (1), OREGON Sta. 319, 29°20'N, 87°25'W, 576–622 m. CAS 42695 (4, 88.0–95.5), OREGON Sta. 270, 29°23'N, 87°25'W, 402 m. CAS 42697 (13), OREGON Sta. 480-484, 28°56.5'–28°58'N, 88°39'–88°42.5'W, 366–439 m. CAS 42698 (4, 37.0–79.5), SILVER BAY Sta. 1197, 24°15'N, 83°36'W, 914 m. CAS 42699 (2, 76.5–87.0), SILVER BAY Sta. 1196, 24°11'N, 83°21.5'W, 732 m. CAS 42706 (1), OREGON Sta. 307, 29°00'N, 88°35'W, 402 m. CAS 76453 (1, 105.1), OREGON Sta. 279, 29°11'N, 86°11'W, 558 m. FMNH 45748 (1), OREGON Sta. 795, 29°15'N, 87°49'W, 421–549 m. FMNH 46730 (16, 51.7–97.0), OREGON Sta. 472-484, 29°06'N, 88°27'W–28°57'N, 88°42.5'W, 348–439 m. FMNH 46732 (2), OREGON Sta. 272, 29°16'N, 86°39'W, 395 m. FMNH 59915 (1), OREGON Sta. 726, 22°41.9'N, 86°41.2'W, 412 m. FMNH 64020 (1), OREGON Sta. 640, 29°01'N, 88°24'W, 649–869 m. USNM 158230 (4) OREGON Sta. 489, 27°44'N, 85°09'W, 465 m. USNM 158536 (2), OREGON Sta. 127, 29°02'N, 88°34'W, 424–472 m. USNM 158837 (3, 63.4–93.7), OREGON Sta. 1389, 29°00'N, 88°33'W, 408 m. USNM 158839 (1, 95.8), OREGON Sta. 1400, 29°30'N, 87°08'W, 384 m. USNM 159150 (1), OREGON Sta. 1283, 29°06'N, 88°19'W, 476 m. USNM 159160 (3, 45.6–71.0), OREGON Sta. 1282, 29°10'N, 88°03'W, 476 m. USNM 159181 (5, one measured 86.8), OREGON Sta. 1238, 28°53'N, 88°48'W, 366 m. USNM 219120 (1, 165.0), OREGON II Sta. 11469, 28°59'N, 86°49'W, 521 m.

TABLE 2. Frequency distributions for pectoral fin ray counts in specimens of *Dibranchius atlanticus* from five geographic regions of the Atlantic Ocean. Counts were made on both sides.

	Pectoral Fin Ray Count					N	x
	12	13	14	15	16		
Gulf of Guinea	1	93	71	3	—	168	13.5
Off NE South America	—	1	47	50	1	99	14.5
Caribbean	—	2	52	70	2	126	14.5
Gulf of Mexico	—	1	54	60	1	116	14.5
Atlantic off United States	—	5	46	49	—	100	14.4

TABLE 3. Frequency distributions for dorsal and pectoral fin ray counts and vertebral counts in species of *Dibranchius*.

Species	Dorsal fin				Pectoral Fin						Vertebrae			
	4	5	6	7	11	12	13	14	15	16	17	18	19	20
<i>atlanticus</i>	—	9	74	1	—	1	102	270	232	4	4	104	4	—
<i>tremendus</i>	1	11	19	3	—	2	8	27	—	—	—	5	25	1
<i>nudivomer</i>	—	5	11	1	—	14	20	—	—	—	—	3	45	2
<i>discors</i>	—	—	3	2	—	3	2	5	—	—	—	2	2	1
<i>sparsus</i>	—	12	9	—	—	7	37	—	—	—	—	—	17	1
<i>spinus</i>	4	22	9	—	7	55	29	1	—	—	—	9	42	7
<i>erinaeus</i>	1	7	9	—	—	7	23	4	—	—	—	3	8	—
<i>velutinus</i>	—	—	1	—	—	—	—	2	—	—	—	—	1	—
<i>cracens</i>	—	—	3	—	—	2	4	—	—	—	—	2	1	—
<i>hystrix</i>	1	14	15	—	—	2	30	4	—	—	—	2	10	—
<i>spongiosus</i>	—	8	16	—	3	14	28	3	—	—	—	6	18	—
<i>japonicus*</i>	—	1	8	—	—	—	3	6	1	—	—	1	7	—
<i>accinctus</i>	—	—	1	—	—	—	2	—	—	—	—	—	1	—

Caribbean: CAS 42658 (2, 34.0–50.6), OREGON Sta. 2637, 17°37'N, 63°36'W, 512 m. CAS 42660 (12, 37.0–104.5), OREGON Sta. 3599, 9°00'N, 81°23'W, 457 m. CAS 42665 (6, 60.5–90.2), OREGON Sta. 3616, 14°23'N, 81°45'W, 457 m. CAS 42666 (2, 36.3–66.6), OREGON Sta. 2353, 11°35'N, 62°41'W, 388–457 m. CAS 42693 (1, 48.7), OREGON Sta. 1911, 12°44'N, 82°14'W, 640 m. CAS 42696 (32, 31.5–81.5), OREGON Sta. 3635, 16°58'N, 87°53'W, 457–732 m.

Atlantic Coast of South America: CAS 42661 (3, 80.0–105.0), OREGON Sta. 2005, 07°34'N, 54°50'W, 366 m. CAS 42662 (10, 49.0–81.5), OREGON Sta. 2007, 07°34'N, 54°49'W, 412 m. CAS 42663 (3, 52.6–85.2), OREGON Sta. 2008, 07°38'N, 54°43'W, 457 m. CAS 42664 (5, 67.5–90.9) OREGON Sta. 2012, 07°34'N, 54°19'W, 274 m. CAS 42671 (4, 63.5–115.5), OREGON Sta. 2026, 07°10'N, 53°07'W, 366 m. CAS 42672 (8, 65.1–95.7), OREGON Sta. 2320, 07°05'N, 52°47'W, 366 m. CAS 42673 (4, 95.0–143), OREGON Sta. 2029, 07°11'N, 52°56'W, 503 m. CAS 42674 (13, 61.5–111.0), OREGON Sta. 2028, 07°11'N, 52°58'W, 457 m. CAS 42685 (1, 95.0), OREGON Sta. 2006, 07°36'N, 54°42'W, 412 m. CAS 42686 (1, 95.0), OREGON Sta. 2009, 07°40'N, 54°47'W, 549 m. CAS 42687 (4, 71.5–85.5), OREGON Sta. 2010, 07°44'N, 54°40'W, 640 m. CAS 42688 (1, 79.5), OREGON Sta. 2011, 07°46'N, 54°36'W, 732 m. CAS 42690 (3, 71.0–76.5), OREGON Sta. 2025, 07°12'N, 53°11'W, 329 m. CAS 42691 (1, 57.3), 06°39'N, 52°53'W, 91 m. CAS 42694 (1, 37.0),

TABLE 4. Frequency distributions for cephalic and tail lateral-line counts of species of *Dibranchus*.

Species	Cephalic Lateral-line Counts															
	Subopercular				Preopercular				Tail Lateral-line Counts							
	4	5	6	7	1	2	3	4	8	9	10	11	12	13	14	15
<i>atlanticus</i>	7	18	15	—	1	78	2	—	2	25	14	24	15	43	7	—
<i>tremendus</i>	2	34	—	—	1	65	—	—	2	17	23	16	3	2	—	—
<i>nudivomer</i>	—	7	29	—	—	36	—	—	—	—	5	5	10	12	1	1
<i>discors</i>	—	—	10	—	—	10	—	—	—	1	2	3	3	1	—	—
<i>sparsus</i>	—	1	40	7	—	43	—	—	—	1	13	19	7	3	1	—
<i>spinus</i>	—	3	63	9	1	9	75	7	1	1	1	14	31	20	15	3
<i>erinaceus</i>	—	4	28	2	—	4	29	1	—	—	1	8	11	7	4	1
<i>velutinus</i>	—	—	2	—	—	2	—	—	—	—	—	—	—	2	—	—
<i>cracens</i>	—	—	6	—	—	6	—	—	—	—	—	—	2	2	2	2
<i>hystrix</i>	—	36	4	—	—	27	1	—	1	5	13	13	7	1	—	—
<i>spongiosus</i>	—	42	6	—	—	46	—	—	8	16	17	2	—	—	—	—
<i>japonicus</i>	—	2	—	—	—	2	—	—	—	—	—	2	—	—	—	—
<i>accinctus</i>	—	2	—	—	—	2	—	—	—	—	—	2	—	—	—	—

OREGON Sta. 2084, 01°45'N, 46°46'W, 503 m. CAS 42703 (1), 23°01'S, 40°43'W, off Rio de Janeiro, Brazil.

Gulf of Guinea to Angola: CAS 76446 (101, 35.9–79.2), UNDAUNTED Cr. 6801, Sta. 111, 10°36'S, 13°12'E, 361 m. CAS 76454 (3, 51.0–72.0), GERONIMO Cr. 2, Sta. 221, 03°02'S, 09°16'E, 400 m. ZMMSU P14050 (2, 102.2–109.2), FIOLENT Cr. FAO-1, trawl 29, 03°30'S, 09°41'E, 1000 m. ZMMSU P14051 (1, 66.0), FIOLENT Cr. FAO-1, 08°33'S, 12°35'E, 1260 m. ZMMSU P14053 (1, 101.7), FIOLENT Cr. FAO-1, trawl 79, 10°54'S, 13°22'E, 520 m. ZMUC (2, 79.2–83.6), GALATHEA Sta. 110, 12°05'S, 13°08'E, 1000 m. ZMUC (1, 32.2), GALATHEA Sta. 137, 20°04'S, 11°56'E, 550–585 m. ZMUC (50, 33 measured 35.5–73.3) ATLANTIDE Sta. 120, 02°09'N, 09°27'E, 530–850 and 650–260 m. ZMUC (24, 35.0–102.0), ATLANTIDE Sta. 135, 07°55'S, 12°38'E, 440–360 and 460–235 m.

Dibranchus tremendus new species

Figs. 4c, d; 6a; 8; 9a; 11

Dibranchus atlanticus, Roule, 1916 (not of Peters, 1876):26 and 1919 (Cape Verde Islands, 1300 m; description; lithographic drawings)

Probable reference: Haedrich and Horn, 1970:393 (New York Bight, 1280 m)

NOTES ON SYNONYMY. — Roule (1916, 1919) had two specimens from the Cape Verde Islands, one taken at 1300 m and one at 875 m. Which was used for the fine illustrations is not given, but the specimen drawn is the new species, *Dibranchus tremendus*, not *D. atlanticus*.

DIAGNOSIS. — A very large *Dibranchus* reaching over 190 mm SL. Tubercles without the radiating rows of spinules seen in *D. atlanticus*, spines of tubercles extremely long and stout, especially along sides of tail. Tubercles cover ventral surface of disk. Principal tubercles of ventral surface of tail (Fig. 9a) very large and occupying entire ventral surface except for a few small tubercles in the median portion between anus and anal fin base. No palatal teeth. Subopercular lateral-line count usually 5 (Table 4).

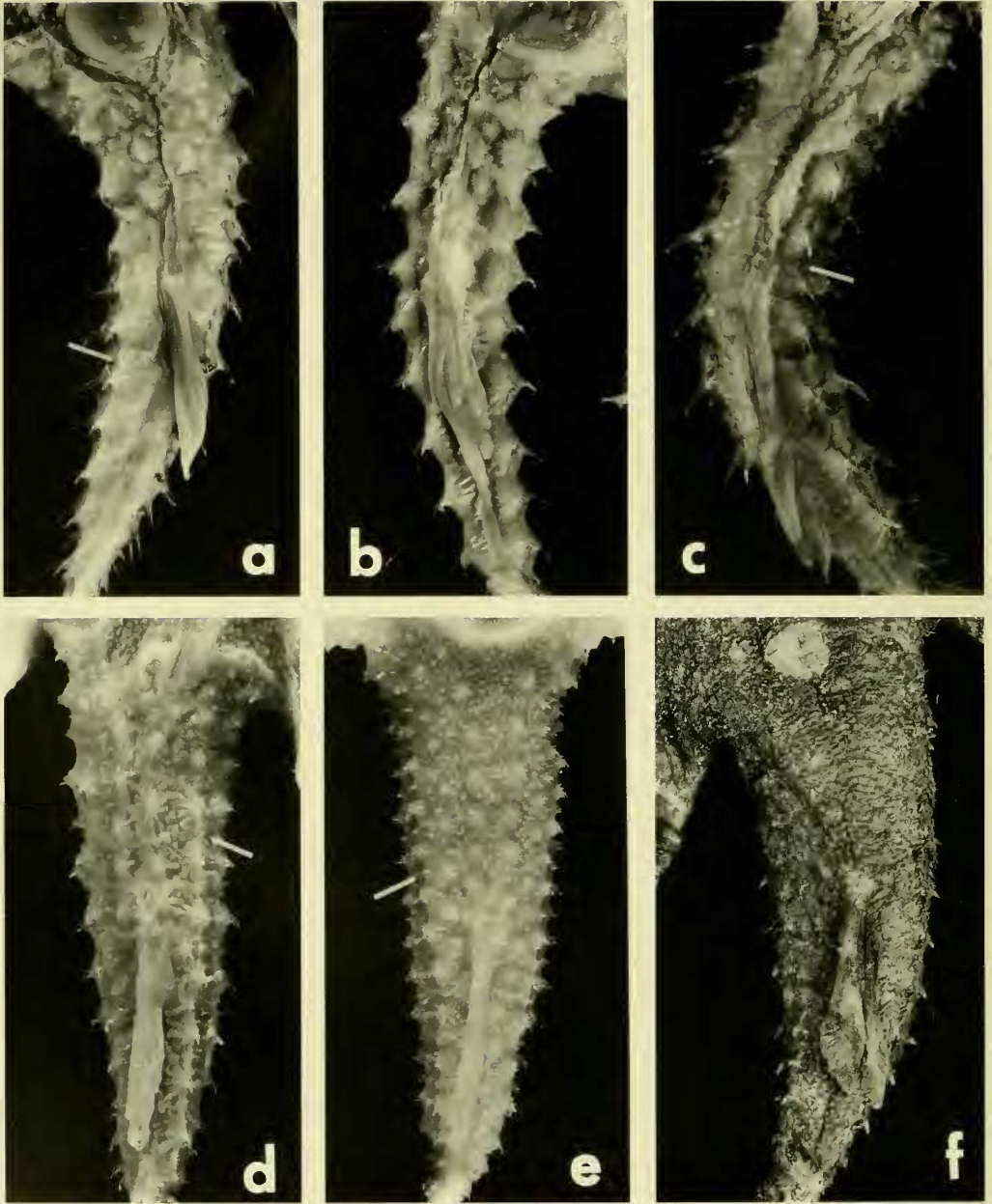


FIGURE 9. Ventral views of tails of species of *Dibranchius* to show patterns of squamation. Pointers indicate lateral-line channels on the sides of the tail. A principal row of tubercles is defined as forming the ventral edge of this channel. (a) *Dibranchius tremendus*, 192.0 mm SL (holotype), UF 25923; (b) *D. hystrix*, 125.0 mm SL, CAS-SU 46657; (c) *D. accinctus*, 175.0 mm SL (holotype), CAS 82221; (d) *D. atlanticus*, 92.8 mm SL, CAS 42695; (e) *D. cracens*, 102.0 mm SL (holotype), CAS 82222; (f) *D. japonicus*, 151.5 mm SL, ZMMSU 20360. Long-spined species (a, b, and c) occur around the world, with *D. tremendus* in the eastern and western Atlantic, *D. hystrix* in the eastern and western Pacific, and *D. accinctus* in the western Indian Ocean. Two species have tubercles decorated with spinules: *D. atlanticus* (d) and *D. cracens* (e). (*D. discors*, not shown, has tubercles decorated with spinules, but these are barely macroscopic and sparse.) The fine-tubercled species, *D. japonicus* (f), has uniquely leathery skin and prominent stout spines on the principal tubercles.

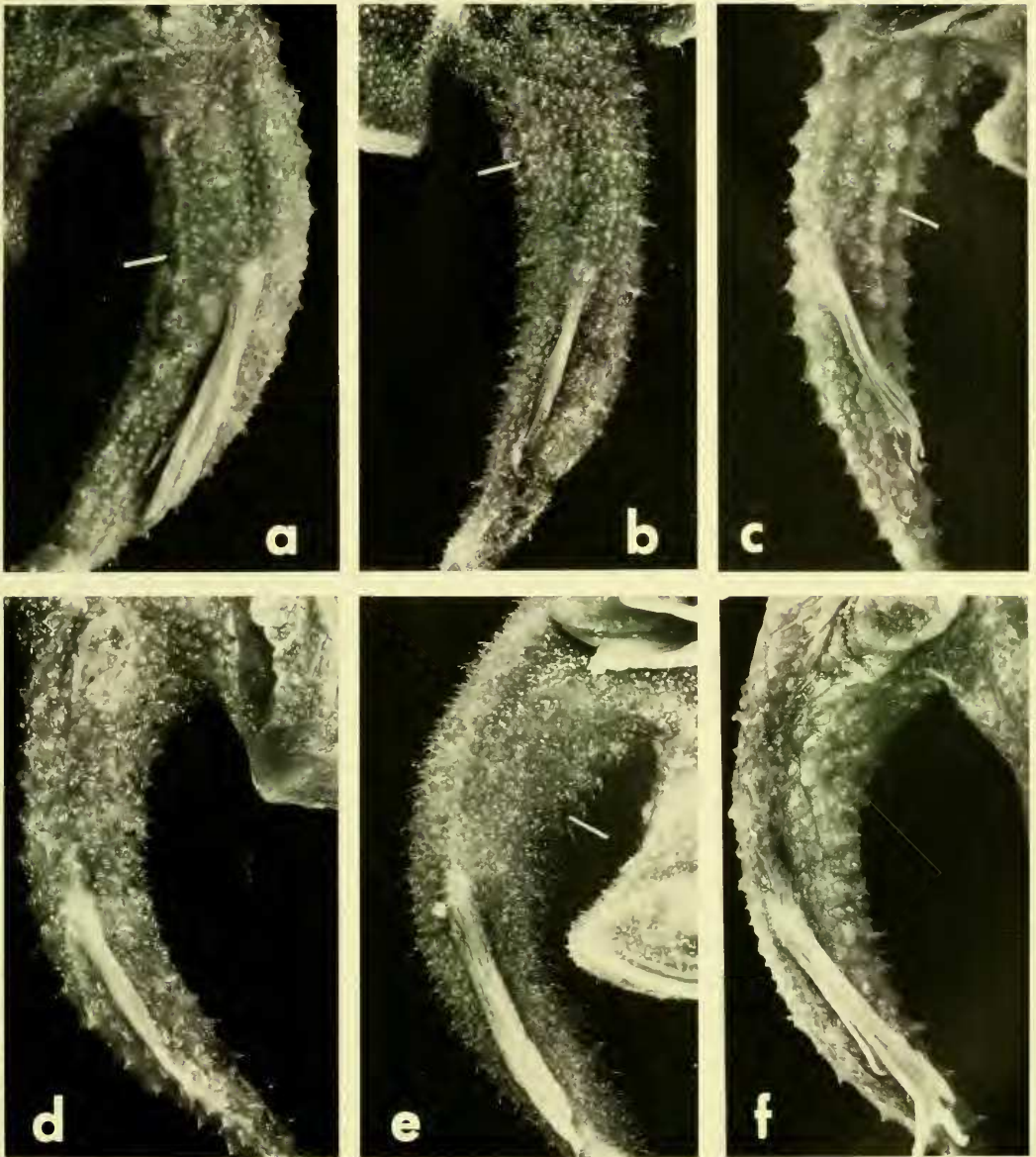


FIGURE 10. Ventral views of tails of species of *Dibranchus* to show patterns of squamation. Pointers indicate lateral-line channels on the sides of the tail. A principal row of tubercles is defined as forming the ventral edge of this channel. Note that neuromasts may be seen in the channel posteriorly in specimen c. (a) *D. sparsus*, 81.2 mm SL, MCZ 28716; (b) *D. spinosus*, 91.0 mm SL, CAS 39921; (c) *D. erinaceus*, 114.0 mm SL (lectotype), MCZ 28712; (d) *D. nudivomer*, 101.2 mm SL, CAS 82225; (e) *D. velutinus*, 99.0 mm SL (holotype), CAS 82223; (f) *D. spongiosus*, 133.2 mm SL, CAS 82252. *Dibranchus sparsus*, *D. spinosus*, *D. erinaceus* and *D. nudivomer* (a-d) are four of the five species in the genus with palatal teeth (the fifth, *Dibranchus discors*, is not pictured). *Dibranchus sparsus* and *D. spinosus* are fine-tubercled species with principal tubercles little enlarged. *D. erinaceus* has prominent principal tubercles, and *D. nudivomer* has uniformly moderate-sized tubercles. Species lacking palatal teeth include *D. velutinus* (e), which has the smallest tubercles of any species in the genus, and *D. spongiosus* (f), with approximately uniform moderate-sized but short-spined tubercles.

TABLE 5. Range and mean for body measurements as thousandths of standard length in species of *Dibranchius*.

	N	Disk margin length	Skull length	Jaw to anal fin length	Jaw to anus distance	Snout to dorsal distance	Inter-orbital width	Cranium width	Jaw length	Mouth width	Eye width
<i>D. atlanticus</i>	290	367-480 x = 424	247-319 x = 282	702-791 x = 758	488-611 x = 535	582-671 x = 627	67-111 x = 84	185-256 x = 217	100-145 x = 125	136-239 x = 198	97-151 x = 123
<i>D. tremendus</i>	34	374-467 x = 418	259-336 x = 294	686-831 x = 765	508-626 x = 554	601-720 x = 638	85-111 x = 96	181-254 x = 210	119-164 x = 138	194-258 x = 227	99-146 x = 119
<i>D. midvomer</i>	18	340-441 x = 401	271-319 x = 287	678-768 x = 709	490-583 x = 522	582-634 x = 610	73-83 x = 77	173-236 x = 203	88-122 x = 108	160-197 x = 170	112-143 x = 129
<i>D. discors</i>	5	441-496 x = 471	272-281 x = 276	766-799 x = 785	505-556 x = 533	592-651 x = 620	35-51 x = 46	201-243 x = 223	52-83 x = 69	102-115 x = 108	120-138 x = 129
<i>D. sparsus</i>	21	419-498 x = 457	263-291 x = 281	741-796 x = 774	556-611 x = 576	616-671 x = 652	77-95 x = 86	195-222 x = 208	109-130 x = 118	168-209 x = 188	110-130 x = 121
<i>D. spinosus</i>	46	382-462 x = 423	264-294 x = 276	737-808 x = 767	503-601 x = 553	590-687 x = 640	64-89 x = 74	167-205 x = 190	92-116 x = 101	140-181 x = 161	89-142 x = 119
<i>D. erinaceus</i>	18	416-485 x = 447	264-295 x = 278	742-774 x = 767	522-568 x = 540	625-661 x = 638	80-93 x = 86	187-206 x = 199	96-117 x = 109	153-184 x = 172	96-136 x = 118
<i>D. velutinus</i>	1	448	282	734	578	620	97	210	115	275	112
<i>D. cracens</i>	3	432-459 x = 450	294-304 x = 300	734-809 x = 772	532-578 x = 553	624-664 x = 650	97-99 x = 98	212-261 x = 235	106-146 x = 131	212-232 x = 221	106-124 x = 116
<i>D. hystrix</i>	22	399-473 x = 428	287-329 x = 309	732-805 x = 768	520-598 x = 562	607-669 x = 640	91-113 x = 102	203-251 x = 226	134-164 x = 149	188-253 x = 222	115-148 x = 124
<i>D. spongiosus</i>	27	388-506 x = 445	298-348 x = 325	711-810 x = 773	509-598 x = 557	604-697 x = 648	82-121 x = 106	199-255 x = 230	137-170 x = 154	183-249 x = 220	125-157 x = 140
<i>D. japonicus</i>	1	424	242	730	564	583	90	230	125	215	105
<i>D. accinctus</i>	1	422	297	764	567	643	91	267	141	214	120

DESCRIPTION.—Based on 34 specimens 36.2–192.0 mm SL. Counts and body proportions given in Tables 3–5. Skeleton firm; skin pliant, especially on ventral surface of disk. Rostrum broadly triangular viewed from above, slightly overhanging mouth. Esca and nasal capsules as in generic description. Illicium of one specimen, FSM 25923, cleared and stained (Fig. 6a); illicial bone agrees with *Dibranchus* as pictured in Figure 6b.

Teeth as in generic description. No palatal teeth. Gill rakers as in generic description, pedicels relatively short; 5 gill rakers on each side of second arch.

Tubercles on dorsal surface of disk relatively widely spaced (Figs. 8, 11), medium to large in size (no background of small tubercles forming a shagreen as in *D. atlanticus*). Tubercles on ventral surface of disk similarly widely spaced but smaller, as are the tubercles on skin surrounding eyeballs. Tubercles of edge of disk very large, closely spaced, with prominent bifid spines. Subopercular spine conspicuously long in small specimens, becoming nearly the same size as other disk margin tubercles in large specimens; usually 4 spinelets. A few enlarged tubercles along dorsal edge of each orbit. Very large tubercles with extremely long sharp spines occur down the posterior midline of head, continuing onto tail, and on lateral sides of tail.

Ventral surface of tail (Fig. 9a) with the huge heavily-spined tubercles of the principal rows occupying most of the space. Between anus and base of anal fin occur 2 irregular rows of lesser tubercles, with a sprinkling of small tubercles in between, but no small tubercles covering bases of large tubercles as in *D. accinctus*.

Fins without tubercles except at the extreme bases of the pectorals and caudal.

Dermal cirri associated with channels of lateralis system, especially neuromasts.

Pectoral and pelvic fins relatively long and slender in small individuals, shorter and broader with rays very fleshy in large ones.

Color. Ground color of body pale to medium brown; ventral surface in one specimen darker than dorsal surface, but otherwise dorsal and ventral surfaces about the same. Cirri associated with lateral-line scales and excavations of ventral surface often dark brown or black. In a few specimens, each tubercle of dorsal surface of disk with skin at apex colored dark brown, giving effect of evenly distributed tiny dark spots. Fins the same color as ground color of body, sometimes darker, or sometimes fin membranes dark.

ETYMOLOGY.—The name *tremendus* means a *Dibranchus* to be trembled at, in reference to its giant size and terrific spines.

DISTRIBUTION.—Caribbean Sea, Gulf of Mexico, western North Atlantic, eastern Atlantic from Gulf of Guinea to Namibia. Bathymetric range from about 1000–2300 m, with one record 750–896 m; separated bathymetrically from *D. atlanticus* which usually occurs at depths less than 1000 m.

MATERIAL.—34 specimens 36.2–192.0 mm SL. **HOLOTYPE:** UF 25923 (192.0), OREGON II Sta. 11239, 9°32'N, 76°38'W, 1463 m. **PARATYPES:** **Atlantic Coast United States:** MCZ 37822 (3, 143.5–158.0), CAPT. BILL II Sta. 59, 39°59'N, 69°09'W, 750–896 m. **VIMS 03504** (1, 174.0), slope south of Hudson Canyon, 38°51'N, 72°44.1'W, 1333 m. **Gulf of Mexico:** USNM 320332 (1, 158.0), OREGON II Sta. 10876, 28°55.2'N, 87°23'W, 1463 m. **Caribbean:** UF 25924 (3, 104.6–150.0), OREGON II Sta. 11242, 10°10'N, 76°14'W, 1097 m. UF 25925 (5, 64.2–149.2), OREGON II Sta. 11240, 9°58'N, 76°29'W, 1271 m. UF 104889 (1, 96.5) same data as for holotype. UF 229293 (1, 53.4), PILLSBURY Sta. 748, 11°24.8'–36'N, 67°10.1'–06'W, 1865–1783 m. UF 232001 (2, 106.9–116.4), PILLSBURY Sta. 747, 11°46'–54.7'N, 67°05.7'–05.0'W, 1174–1097 m. UF 232820 (1, 113.5), 12°55'–13°04'N, 71°46.5'–42.0'W, 1317–1298 m. USNM 320325 (1, 132.5), OREGON Sta. 5639, 11°44'N, 68°43'W, 1006 m. USNM 320326 (2, 43.3–116.0), OREGON Sta. 4449, 10°56'N, 67°38'W, 1079 m. USNM 320327 (1, 144.0), OREGON II Sta. 11242, 10°10'N, 76°14'W, 1097 m. **Eastern Atlantic, Gulf of Guinea to Namibia:** IOAN (1, 32.1), FIOLENT Cr. FAO-1, Trawl 81, 10°56'S, 13°13'E, 960 m. UF 221621 (1, 82.7), PILLSBURY Sta. 314, 4°58'–52'N, 3°48'E,

2268–2332 m. UF 221672 (6, 36.2–134.2), PILLSBURY Sta. 309, 4°15'–12'N, 4°27'–28'E, 1280–1317 m. UF 223274 (3, 49.1–130.2), PILLSBURY Sta. 76, 4°32'–40'N, 9°42'–49'W, 1555–1463 m.

One other paratype, UF 232665 (1, 111.0), GILLIS GS-21, cannot be assigned locality data. Catalog data, specimen label, and GILLIS data sheets at the Florida Museum of Natural History all agree on the following: 7°11'–7°12.5'N, 79°16'–79°18.5'W, erroneously placing the locality in the Pacific rather than in the Caribbean where the ship was cruising at the time.

Dibranchus hystrix Garman, 1899

Figs. 9b, 12a

Dibranchus hystrix Garman, 1899:92 (original description, 3 specimens from eastern tropical Pacific, illustrations); Bradbury 1962:2 (lectotype selected, MCZ 28776, from off northern Ecuador, 2196 m).

Dibranchus scaber Garman, 1899:94 (original description, 2 specimens from eastern tropical Pacific, illustration); Bradbury, 1962:2 (lectotype selected, MCZ 28724, from mouth of Gulf of California, 1820 m).

Dibranchus asper Garman, 1899:101 (original description, holotype from off Acapulco de Juarez, Mexico, 1207 m); Bradbury, 1962:2 (*D. asper* placed in synonymy of *D. hystrix*).

DIAGNOSIS. — Tubercles on sides of tail with extremely long spines (Fig. 9b). On ventral surface of disk, tubercles small, widely spaced so skin seems naked, the effect intensifying with increase in standard length; in larger specimens, these tubercles sometimes truly absent. Except for 2 short longitudinal rows of tubercles anterior to anal fin base, principal tubercles occupy most of the ventral surface of tail (Fig. 9b); no small tubercles in skin covering bases of principal tubercles. Subopercular lateral-line count usually 5 (this count usually 6 in most eastern Pacific *Dibranchus* except *D. spongiosus* (Table 4). No palatal teeth.

DESCRIPTION. — Based on 22 specimens 40.0–125.0 mm SL. Counts and body proportions given in Tables 3–5. Skeleton pliant, body often flabby depending on preservation; subopercles weakly calcified so lateral sides of disk have tendency to roll up in preservative. Skin thin, flabby, especially soft on ventral surface of disk. Rostrum triangular, slightly overhanging mouth, relatively small in small individuals, largest in largest specimens (usually in ogocephalids the relationship is an inverse one); a deep notch at either side of base of rostrum, which is the channel of the supraorbital lateral line series. Esca and nasal capsules as in generic description.

Teeth as in generic description. No palatal teeth. Gill rakers as in generic description; usually 6 gill rakers on each side of second arch.

Tubercles widely spaced, varied in size but spines always relatively stout and long, bifid on edge of disk, recurved on tail. Skin covering eyeballs with small widely-spaced tubercles. Largest tubercles occur on face, edges of disk, and dorsal and lateral sides of tail. Elsewhere tubercles uneven in size, not closely spaced so considerable bare skin in intervals, sprinkled over dorsal surface of disk and pectoral fin pedicels. Subopercular spines extremely large with 4–5 spinelets. On ventral surface of disk, small widely-spaced tubercles present in small specimens but becoming inconspicuous with increase in body size, sometimes absent in large specimens; the skin thin and flaccid.

Ventral surface of tail (Fig. 9b) with principal tubercles large, close-set, terminating in long recurved spines. Anterior to anal fin base, between the 2 rows of principal tubercles, lie 2 rows of slightly smaller tubercles, also close-set; no small tubercles in intervening spaces or in skin covering bases of large tubercles. Fins devoid of tubercles, except a few sometimes present at base of pectoral.

Dermal cirri relatively sparse, present around margins of disk and lateral sides of tail. Cirri associated with neuromasts formed as fringed flaps.

Pectoral fins slender. Pelvic fins with thickened skin on rays.

Color. Garman [1899:91, 94–96] stated, “Color a rich dark chestnut to chocolate brown; fins black.” For *D. asper*, (here placed in synonymy of *D. hystrix*) Garman said, “Blackish externally and on the linings of the body cavity.” For *D. scaber* (here placed in the synonymy of *D. hystrix*) Garman said, “Greyish black, apparently reddish or purplish in life, fins blackish; lower surface darker.” The above specimens now faded. All specimens I have examined lack pigment externally, but several have linings of buccal and gill cavities and the peritoneum covered with melanophores, giving a medium brown effect.

DISTRIBUTION. — A disjunct distribution, with 11 localities recorded in the eastern Pacific and one from the South China Sea. Occurs in eastern Pacific from mouth of Gulf of California to Gulf of Guayaquil and west nearly to Galapagos Is. There are in addition two problematic lots, CAS-SU 46656 from about 150 mi ESE of Cocos I. and CAS-SU 57662 from the Galapagos archipelago. Hard to identify because specimens are small and must have once dried out, they most likely represent *D. hystrix*, and therefore provisionally are included here. Bathymetric range: 914–2323 m.

MATERIAL. — 22 specimens 40.0–125.0 mm SL. LECTOTYPE: MCZ 28726 (83.0 mm SL), ALBATROSS sta. 3375, 2°34'N, 82°29'W, 2196 m.

CAS-SU 46287 (5, 41.0–75.0 mm SL) and CAS-SU 46657 (125.0 mm SL), ARCTURUS 74–D-1, 4°50'N, 87°00'W, 1543 m. CAS 82242 (4, 41.1–83.1 mm SL), ANTON BRUUN Cr. 18B, sta. 766, 4°10'S, 81°27'W, 1815–1860 m. CAS 82256 (43.3 mm SL), NAGA exp. 60-219, sta. 60-67, South China Sea, 1234–1264 m, m.V. STRANGER. LACM 33588-5 (64.0 mm SL), VELERO 18932, Costa Rica, 14 mi off Punta Guiones. MCZ 28723 (40.0 mm SL, holotype of *Dibranchus asper* Garman), ALBATROSS sta. 3418, 16°33'N, 99°52'30"W, 1207 m. MCZ 28724 (101.0 mm SL, lectotype of *Dibranchus scaber* Garman), ALBATROSS Sta. 3431, 23°59'N, 108°40'W, 1820 m; MCZ 28725 (58.0 mm SL, lectoparatype of *Dibranchus scaber* Garman), ALBATROSS sta. 3364, 5°30'N, 86°08'30"W, 1650 m. MCZ 28727 (63.5 mm SL), ALBATROSS sta. 3392, 7°05'30"N, 79°40'W, 2323 m. MCZ 28728 (56.0 mm SL), ALBATROSS sta. 3362, 5°56'N, 85°10'30"W, 2149 m. USNM 135364 (2, 53.2–80.0 mm SL), 0°24'S, 89°06'W, 1485 m. ZMUC (2, 40.0–53.0 mm SL), GALATHEA sta. 739, 7°22'N, 79°32'W, 938 m.

Two lots provisionally identified as *D. hystrix*: CAS-SU 46656 (1), ARCTURUS 61-T-4, 4°56'N, 84°35'W, 914 m, and CAS-SU 57662 (2), ARCTURUS 84–T-20, 0°17'S, 91°34'W, 914 m.

Dibranchus spongiosus (Gilbert), 1891

Figs. 3c, d; 10f; 12b

Halientaea spongiosa Gilbert, 1891:124 (original description, holotype from eastern tropical Pacific, 841 m).

Dibranchopsis spongiosa, Garman, 1899:96 (description; illustrations; eastern tropical Pacific).

Dibranchus spongiosus, Bradbury, 1967:414 (diagnosis of *Dibranchus*).

DIAGNOSIS. — Body flabby, skin thin and translucent. Subopercular lateral-line count usually 5 (compared to 6 for most eastern Pacific *Dibranchus*, Table 4). Skull relatively long, 30 percent or more of SL (Table 5). Lower lip with membranous fringe of fingerlike papillae. No palatal teeth. Gill rakers in the form of broad tooth plates attached directly to gill arch; no pedicels evident (Fig. 3c, d).

DESCRIPTION. — Based on 30 specimens 43.6–118.5 mm SL. Counts and body proportions given in Tables 3–5. Body and skeleton flabby, bones easily bent, tubercles weakly ossified. Cranium relatively high posteriorly, sloping sharply down to rostrum; rostrum very abbreviated, merely a rounded, narrow shelf. Illicial cavity very shallow. Esca and nasal capsules as in generic description. Fringe of fingerlike papillae on membrane hanging from lower lip; oral valves covered with small short papillae.

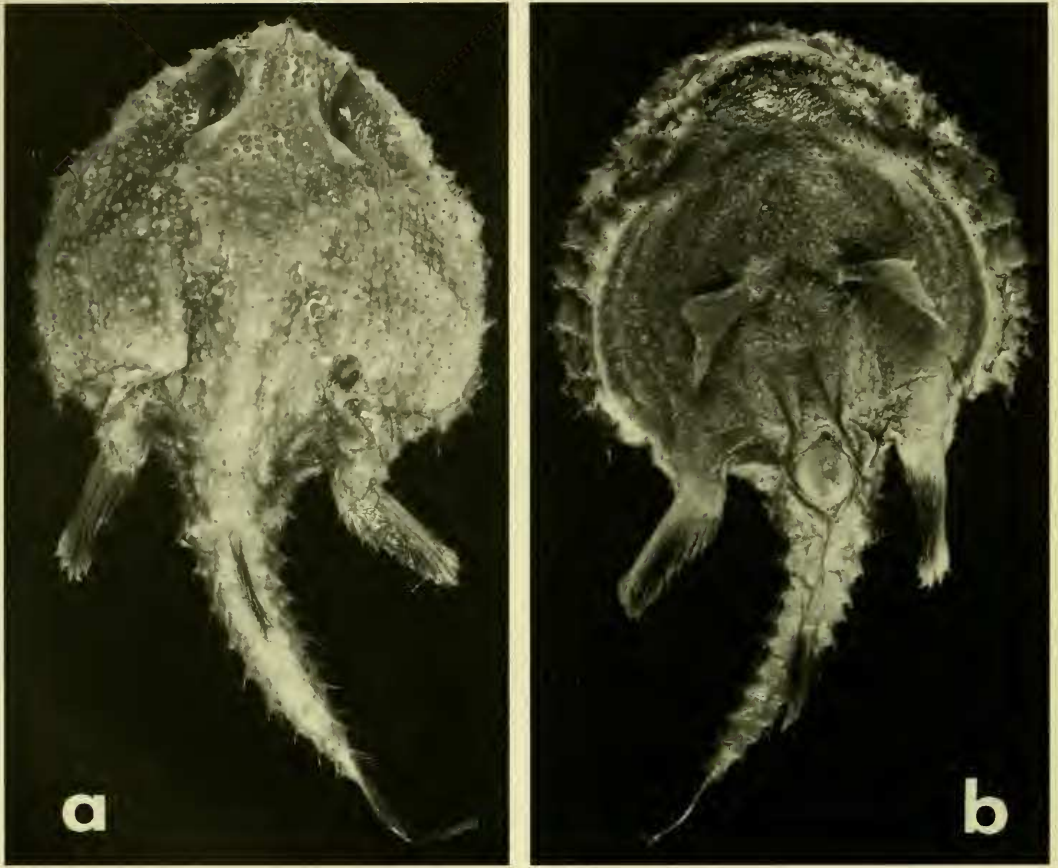


FIGURE 11. *Dibranchius tremendus* new species, holotype, 192.0 mm SL, UF 25923, from the Caribbean Ocean. (a) dorsal view, (b) ventral view.

Teeth as in generic description. No palatal teeth. Gill rakers evidently without pedicels; low dome-shaped tooth plates bearing tiny teeth extend broadly onto gill arch (Fig. 3c), 6 or 7 on each side of second arch.

Tubercles on dorsal surface of body moderate and uniform in size with short spines, widely spaced but evenly distributed. Tubercles on edges of disk and lateral sides of tail slightly larger, sometimes bifid or trifid, but spines very short. Subopercular spines developed in small specimens, in large specimens relatively very small and encroached upon by skin. Small tubercles evenly distributed in skin covering eyeballs. Tubercles on ventral surface of disk smaller, widely but evenly spaced except sparse on lateral sides disk.

Ventral surface of tail (Fig. 10f) with principal tubercles broad, low, terminating in very short spines. Intervening space with small tubercles both anterior and posterior to anal fin base, these spaced apart leaving bare skin between.

Pedicels of paired fins covered with tubercles but fins free of tubercles except for a few near bases of pectoral and caudal fin rays.

Dermal cirri in the form of fringed flaps associated with neuromasts.

Fins moderate length, slender; membranes thin, transparent.

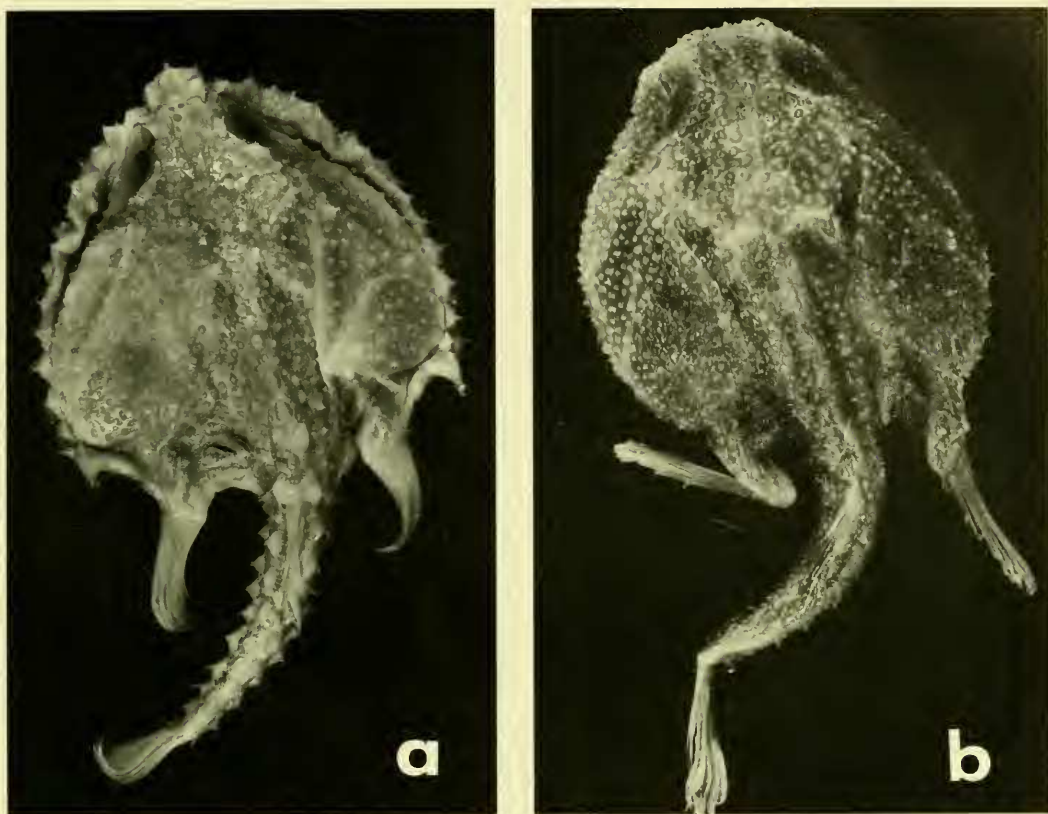


FIGURE 12. Dorsal views of (a) *Dibranchius hystrix*, 125.0 mm SL, CAS-SU 46657, and (b) *D. spongiosus*, 133.2 mm SL, CAS 82252, both from the eastern tropical Pacific Ocean.

Color. In original description, Gilbert (1891:125) wrote, "Uniform dusky, the tail sometimes lighter; fins blackish, more or less edged with white." In a black-and-white photograph of a fresh specimen kindly sent by staff of Scripps Institution of Oceanography, the skin is translucent with dark blotches over the top of the eyeballs, the posterior two-thirds of the disk, and on the tail; each tubercle is darkly pigmented, and these contrast with the pale portions of skin around the face and tail. Preserved specimens uniformly pale, including linings of gill cavities; peritoneum spotted with black. One relatively fresh specimen with epithelium of gill bars and branchial cavities very dark, peritoneum very dark.

DISTRIBUTION. — Recorded here from 10 localities off Mexico, from Bahia Magdalena to Gulf of Tehuantepec, and 1 locality off Revillagigedo I. Bathymetric range: 700–1244 m.

MATERIAL. — 92 specimens, 39.2–133.2 mm SL. HOLOTYPE: USNM 44284 (89.5 mm SL). PARATYPES: USNM 44392 (14, 49.0–75.5 mm SL.), ALBATROSS sta. 2992, 18°17'30"N, 114°43'15"W, 841 m.

CAS 57834 (2, 76.1–78.1 mm SL), TE VEGA Cr. 19, Sta. 19, 17°24'N, 101°31'W, 940–1000 m. CAS 82252 (51, 32.9–133.2 mm SL), TE VEGA Cr. 19, sta. 17, 19°43.5'N, 105°35.5'W, 700–900 m. MCZ 28720 (9, 51.0–118.5 mm SL), ALBATROSS sta. 3417, 16°32'N, 99°48'W, 902 m. MCZ 28721 (2, 46.0–66.5 mm SL), ALBATROSS sta. 3425, 21°19'N, 106°24'W, 1244 m. MCZ 28722 (43.6 mm SL), ALBATROSS sta. 3418, 16°33'N, 99°52'30"W, 1207 m. SIO 58-419 (2,

82.0–96.5 mm SL), Mexico, Salina Cruz, Gulf of Tehuantepec. SIO 59-266 (1 specimen), 23°55'N, 108°11.5'–23°51'N, 108°07.5'W. SIO 64-14 (3, 48.8–67.1 mm SL), 24°59'N, 113°00.5'W–24°49.3'N, 113°14.2'W. UAZ (6, 58.6–72.0 mm SL), Lugar 50 m SW Baluarte, Sinaloa, 800 m.

***Dibranchius cracens* Bradbury, McCosker, and Long, 1999**

Figs. 9e, 13

DIAGNOSIS. — Large tubercles decorated with rows of bosslike spinules radiating out from the central spine along the ridges between facets (only *D. atlanticus* has a similar feature). Jaw relatively long compared to *D. atlanticus*, 14.6 percent of SL (Table 5). No palatal teeth. Illicial skeleton as in *Dibranchius* as shown in cleared and stained illicium from CAS 88034.

DESCRIPTION. — Based on 3 specimens, all males, 102.0–128.3 mm SL. Counts and body proportions given in Tables 3–5. Skeleton relatively firm, skin tough. Rostrum bluntly triangular, short, scarcely overhanging mouth; when viewed from above, appears notched on either side near base owing to excavations for supraorbital lateral-line. Esca with ventral lobes well separated at midline. All specimens, which are males, with large swollen nasal capsules and the posterior nostril a long vertical gaping slit.

Teeth as in generic description. No palatal teeth. Gill rakers as in generic description, 6 on posterior side of second arch.

Dorsal surface of body sprinkled with large tubercles spaced apart, except those of dorsal surface of tail in 2 longitudinal rows. Intervening spaces like shagreen, packed with tiny simple tubercles. Large tubercles with short stout center spines and rows of bosslike spinules radiating out from center spine. Subopercular spines moderate size. Ventral surface of disk and pectoral pedicels covered with small tubercles.

Ventral surface of tail (Fig. 9e) with principal tubercles broad, low, their central spines short; prominent spinules radiate from central spines. An orderly row of similar tubercles on each side of midline anterior to anal base, with small tubercles packed in intervening spaces.

Skin covering eyeballs thickly covered with fine tubercles. Fine tubercles also present on fin rays of dorsal and caudal fins and dorsal side of pectoral fins, running out for about half the length of the fin ray; ventral surface of pelvic fin rays have tubercles near fin base.

Dermal cirri present but not abundant; those associated with neuromasts formed as flaps.

Paired fins relatively slender, fin membranes transparent.

Color. In life, holotype with dorsal surface of body salmon colored, tubercles white; dorsal, caudal and pectoral fins salmon to orange (Bradbury et al. 1999). Faint dark saddle across tail at base of dorsal fin. Ventral surface of body white, pelvic and anal fins pink. Lower jaw and tip of snout white, esca red-orange, eyes blue. Paratype, CAS 88034, with dorsal surface brown, tubercles white; orange around ventral body margin, tail, and fins; dorsal fin brown basally, orange distally; esca brown, mouth and anus white. In preservative, one specimen (CAS 82222) faded white, but others light brown with tubercles pale so they seem like pale spots. Olfactory capsule dark or pale. Dark saddle across tail at base of dorsal fin. Dorsal dark basally, pale distally. Caudal dusky on dorsal half, otherwise pale. Paired fins and anal fin pale. Ventral surface of body pale. Internal membranes pigmentless except peritoneum, which is spotted with brown melanophores.

DISTRIBUTION. — All three specimens come from the Galápagos Islands.

ETYMOLOGY. — The name *Dibranchius cracens* means a neat or tidy *Dibranchius*, in reference to the firm, trim body and regularity of size and distribution of tubercles.

MATERIAL. — 3 specimens 102.0–128.3 mm SL. HOLOTYPE: CAS 86516 (119.1 mm SL, male), JSL 3947, off Cabo San Rosa, Isla Isabella, 01°04.7'S, 91°11.9'W, 152–480 m, 10 Nov. 1995, J. E. McCosker and party. PARATYPES: CAS 82222 (102.0 mm SL, male), between Islas Santa Cruz and Floreana, 350 m, dredge, collected by A. deRoy and J. deRoy, 1978. CAS 88034 (128.3 mm SL,

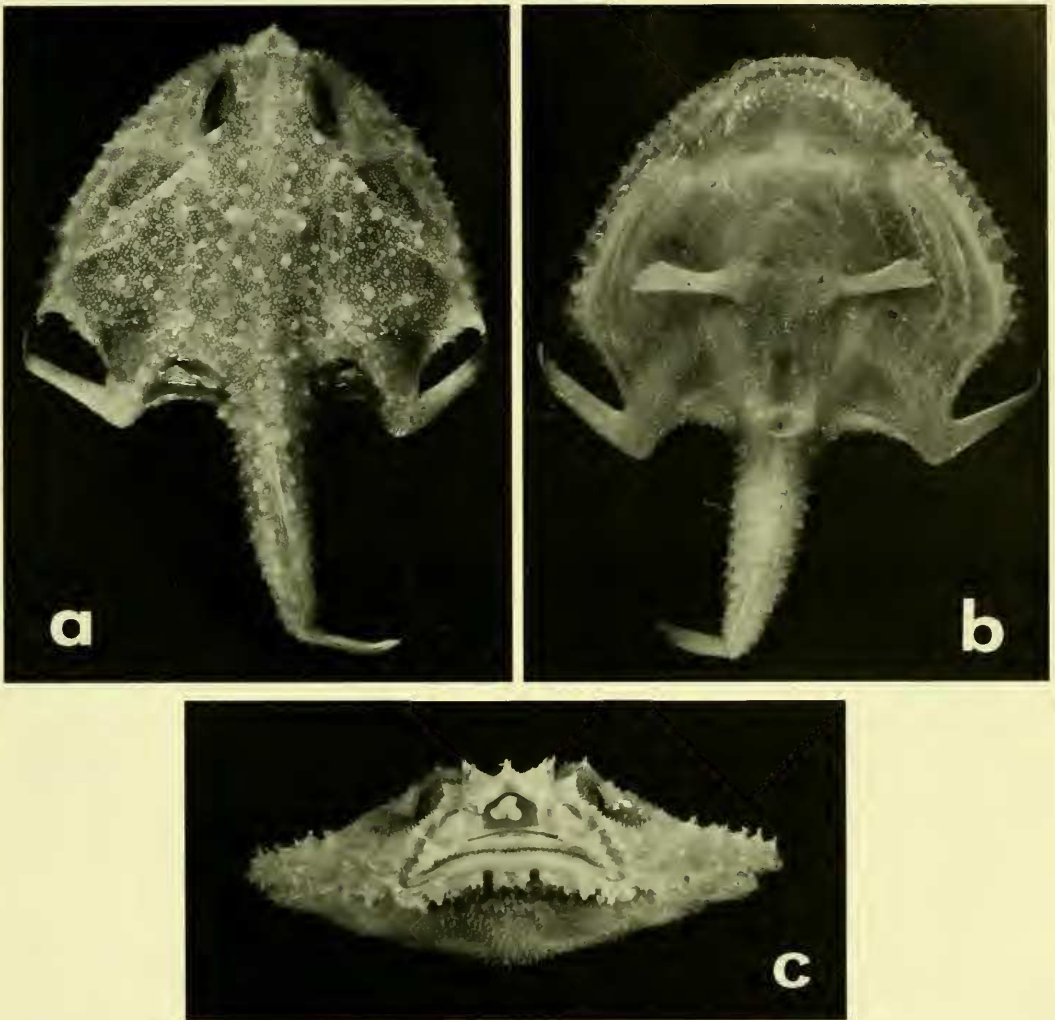


FIGURE 13. *Dibranchius cracens* new species, holotype, 102.0 mm SL, CAS 82222, from the Galapagos Islands. (a) dorsal view, (b) ventral view, (c) frontal view.

male), JSL 3957, off Cabo Douglas, Isla Fernandina, 00°17.5'S, 91°38.9'W, 354 m, 16 Nov. 1995, J. E. McCosker and party.

***Dibranchius velutinus* new species**

Figs. 10e, 14

DIAGNOSIS. — Entire body covered with extremely fine tubercles, giving skin a velvety appearance. No palatal teeth. Jaw teeth fine, bristlelike, buried among papillae that cover the jaws. Mouth very wide, 27.5 percent of SL (Table 5).

DESCRIPTION. — Based on a single specimen 99.0 mm SL. Counts and body proportions given in Tables 3–5. Skeleton flabby (but specimen shown by radiographs to have been decalcified, probably owing to having been held too long in formalin, so it is possible the skeleton is normally sturdier).

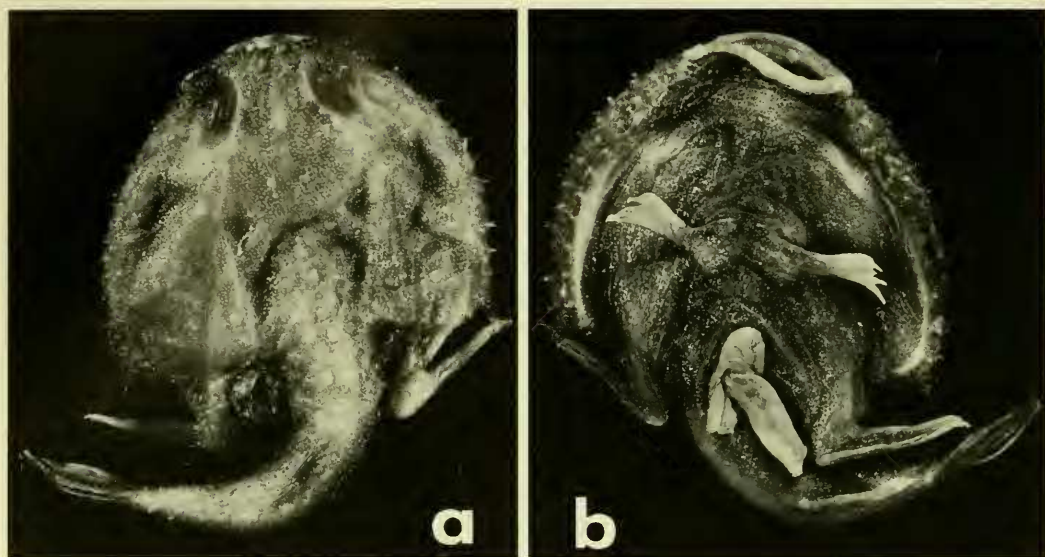


FIGURE 14. *Dibranchus velutinus* new species, holotype, 99.0 mm SL, CAS 82223, from the Peru-Chile Trench. (a) dorsal view, (b) ventral view.

Anterior margin of disk blunt, so there is virtually no rostrum, the spines small but sharply upturned. Esca as in generic description. Specimen a female with small nasal capsules and nostrils.

Pads of papillae prominent on jaws and within oral cavity including oral valves. On jaws and each ceratobranchial V, slender, translucent teeth lie concealed among papillae, the papillae-teeth pads of the jaws occurring as bands; each ceratobranchial V with suboval-shaped pad, the two contiguous along midline their entire lengths. Papillae present on palate, but teeth are not.

Gill rakers finger-shaped, covered with relatively tiny papillae but no tooth plates evident; 5 gill rakers on each side of second arch.

Skin soft, somewhat puffy, covered everywhere (including skin covering eyeballs) with extremely fine tubercles giving skin velvety appearance. Large tubercles occur on lateral edges of disk, dorsal surface of trunk and dorsal and lateral surfaces of tail, and sprinkled over dorsal surface of disk and pectoral pedicels, but always overlain by fine tubercles so velvety surface uniform throughout. Large tubercles terminate in modest recurved spines, these bifid or trifid along disk margin. Subopercular spines moderate size.

Ventral surface of tail (Fig. 10e) uniformly thickly covered with extremely fine tubercles, tubercles of principal rows scarcely differentiated from the others except for slightly thicker spines.

Extremely fine tubercles in skin thickly covering paired fin pedicels, running out on the fin rays for about half their length; fine tubercles also occur on fin rays of caudal.

Dermal cirri moderately developed, those associated with neuromasts flaplike.

Paired fins slender, weak; skin of fin rays slightly puffy but fin membranes thin, translucent.

Color. Body and fins tan color, somewhat darker on snout and anterior end of disk, contrasting with pale lips and esca. Spines of tubercles on face and chin tipped with black, giving effect of skin being peppered with fine black spots. Lining of gill cavities pale, peritoneum brown.

ETYMOLOGY. — The name *velutinus* is an adjective meaning velvety, in reference to the fine tubercles that give the skin the look of velvet.

MATERIAL. — HOLOTYPE: CAS 82223 (99.0 mm SL), IMARPE, 4°59'S, 81°24.5'W. Depth unknown, but *D. sparsus* taken in the same haul suggests *D. velutinus* will be found at depths at which *D. sparsus* occurs, about 450–525 m.

***Dibranchus sparsus* (Garman), 1899**

Figs. 10a, 15a

Malthopsis sparsa Garman, 1899:101 (original description, 19 specimens from eastern tropical Pacific);

Bradbury, 1962:3 (lectotype selected, MCZ 28717, from Gulf of Panama, 443 m).

Dibranchus sparsus, Bradbury, 1967:414 (diagnosis of *Dibranchus*).

DIAGNOSIS. — Teeth present on vomer and palatines. Subopercular lateral-line count usually 6, preopercular lateral-line count usually 2 (Table 4). Tubercles simple, very small, thickly distributed over entire body. Subopercular spines small, inconspicuous. A small species reaching just over 80 mm SL.

DESCRIPTION. — Based on 23 specimens 21.9–83.7 mm SL. Counts and body proportions given in Tables 3–5. Skeleton relatively firm. Rostrum not developed, anterior end of disk rounded. Illicial cavity very shallow. Esca and nasal capsules as in generic description.

Teeth as in generic description. Teeth present on vomer and palatines. Gill rakers as in generic description; second gill arch with 6 or 7 gill rakers on each side.

Tubercles small with very short spines uniformly distributed over dorsal and ventral surfaces of body including skin covering eyeballs. Larger tubercles in several longitudinal series dorsally on trunk and tail, around edges of disk, and lateral sides of disk, their spines stronger but still short, some multifid, particularly of edge of disk. Subopercular spines inconspicuous, short, 5–6 spinelets.

Ventral surface of tail (Fig. 10a) covered by the same small, close-packed, slender-spined tubercles as the rest of body; principal tubercles scarcely larger than intervening ones, but some with short blunt spines.

Pedicles of paired fins covered with small tubercles; paired fins and caudal with tubercles running out along fin supports for 1/2 to 2/3 their length. Dorsal and anal sometimes with a few prickles, especially near bases.

Dermal cirri well-developed on lateral margins of disk and tail; cirri associated with neuromasts take the form of fringed flaps.

Fins moderate length, relatively stout.

Color. Garman (1899:102) stated: "Fresh specimens brownish, more or less gray, with rather faint and ill defined spots of light brown somewhat closely placed over the disk; or in cases with white vermiculations in the brown, or in others with whitish spots over a brownish surface; ventral surface uniform light; orbits darker." In one relatively fresh specimen from Peru-Chile Trench: a discernable reticulum on a relatively darker background; cirri blackish, associated with the lateralis channels on face and ventral surface of disk. Gill, buccal, and gut cavities with brownish linings; individual melanophores present, giving wash effect. Some specimens have peritoneum darker brown. Fins colorless.

DISTRIBUTION. — Recorded here from 6 localities in the eastern Pacific, 3 off the Gulf of Panama and 3 off the coast of Peru. Bathymetric range: 443–528 m.

MATERIAL. — 23 specimens 21.9–83.7 mm SL. LECTOTYPE: MCZ 28717 (71.5 mm SL) and lectoparatypes MCZ 41595 (7, 53.0–70.5 mm SL), ALBATROSS sta. 3386, 7°33'12"N, 79°17'15"W, 443 m.

CAS 82227 (74.8 mm SL), IMARPE, 4°59'S, 81°24.5'W, 528 m, 2 Jul 1980. CAS 82240 (46.1 mm SL), IMARPE, 8°42'S, 78°49'W, 24 Nov 1970. CAS 82236 (2, 29.1–48.7 mm SL), IMARPE, Bonco de Moncora, Dec 1970. MCZ 28715 (6, 52.4–68.7 mm SL), ALBATROSS sta. 3385, 7°32'N,

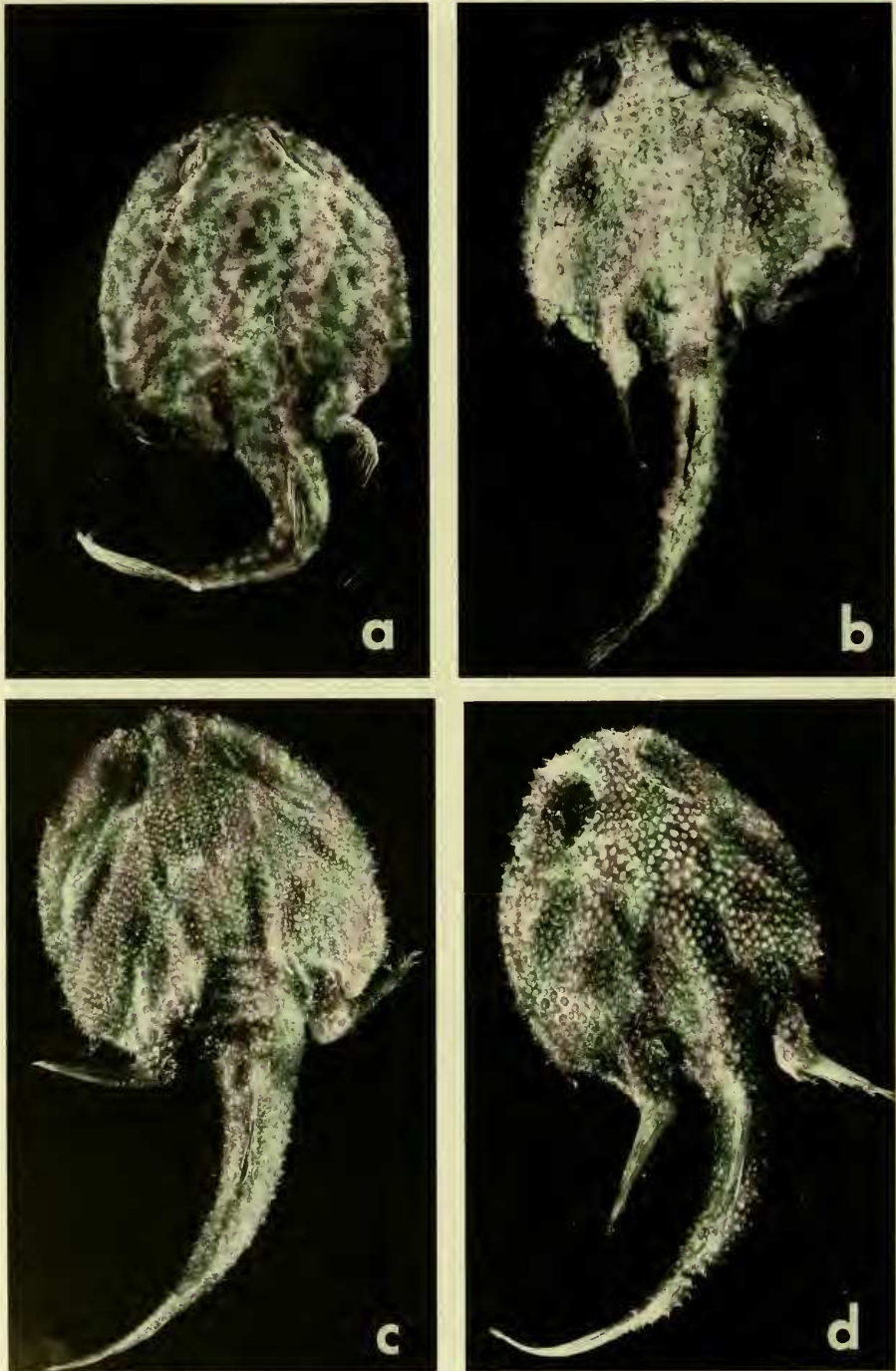


FIGURE 15. Dorsal views of 4 species of *Dibranchius* with palatal teeth, all from the eastern tropical Pacific Ocean (the 5th species with palatal teeth, *D. discors*, is pictured in Fig. 17). (a) *D. sparsus*, 74.8 mm SL, CAS 82227, showing the reticulated color pattern apparently unique for Pacific species; (b) *D. erinaceus*, 110.0 mm SL, SIO 90-71; (c) *D. spinosus*, 87.9 mm SL, CAS 82238; (d) *D. nudivomer*, 98.1 mm SL, CAS 82261. *D. spinosus* and *D. nudivomer* sometimes co-occur and, in sorting, are easily confused, but absence of teeth from the vomer in *D. nudivomer* separates the two.

78°36'30"W, 474 m. MCZ 28716 (4, 67.5–83.7 mm SL), ALBATROSS sta. 3385, 7°32'36"N, 79°16'W, 523 m.

***Dibranchus spinosus* (Garman), 1899**

Figs. 10b, 15c

Malthopsis spinosa Garman, 1899:104 (original description, 2 specimens from Gulf of Panama, illustrations); Bradbury, 1962:4 (lectotype selected, MCZ 28710, Gulf of Panama, 2323 m).

Dibranchus spinosus, Bradbury, 1967:414 (diagnosis of *Dibranchus*).

Malthopsis spinulosa Garman, 1899:106 (original description, 21 specimens from Gulf of Panama); Bradbury, 1962:4 (lectotype selected, MCZ 28709, 935 m; synonymized with *D. spinosus*).

Dibranchus alberti Nuñez, 1967:43 (original description, 5 specimens from off Arica, Chile, 366 m; photographs; no museum or museum numbers given).

DIAGNOSIS. — Teeth on vomer and palatines. Subopercular lateral-line count usually 6, preopercular lateral-line count usually 3 (Table 4). Tubercles simple, very small, thickly covering entire body. Subopercular spines small, inconspicuous.

DESCRIPTION. — Based on 58 specimens 32.9–149.0 mm SL. Counts and body proportions given in Tables 3–5. Skeleton somewhat rubbery, subopercles (lateral margins of disk) flabby, often rolled inward in preserved specimens. Rostrum variable when viewed from above, from bluntly rounded to triangular but always very short, appearing notched at the base owing to excavation of supraorbital lateral line channel on either side. Similarly prominent notches formed by lateralis system channels on margins of disk opposite posterior end of orbits and near base of subopercular spine. Esca and nasal capsules as in generic description.

Teeth as in generic description. Pads of teeth on palatines, these contiguous with pad of teeth on vomer. Gill rakers as in generic description, usually 6 rakers on each side of second arch.

Tubercles very small and slender with relatively long weak spines, about uniform in size in smaller examples, but, in larger specimens, many tubercles on dorsal surface of body slightly enlarged, these sprinkled thinly but evenly over dorsal surface of disk, denser along margins of disk; in either case, tubercles thickly distributed over dorsal surface of body including skin covering eyeballs; tubercles of edge of disk and lateral sides of tail with longer, stouter spines. Tubercles of edge of disk and lateral sides of tail with slightly stouter longer spines. Subopercular spines large and prominent in smallest specimens, but the larger the specimen, the smaller the spine, until it can hardly be noticed; 5–6 spinelets. Fine tubercles cover entire ventral surface of body.

Ventral surface of tail (Fig. 10b) covered with very small densely-packed fine-spined tubercles. Principal tubercles slightly larger than intervening ones, the spines long and delicate.

Paired fins with tubercles covering pedicels and occurring along both dorsal and ventral surfaces of fin rays. Caudal also with tubercles running out along fin rays, dorsal with a few prickles at base, anal sometimes with prickles but usually none.

Dermal cirri numerous, conspicuous because of black color, on chin and lateral margins of disk and tail. Cirri associated with neuromasts take the form of fringed flaps, also black.

Fins slender, relatively weak.

Color. Garman (1899:106, 107) wrote of *D. spinosus*: “Uniform dark brown; fins black” and of *D. spinulosa* (here placed in synonymy of *D. spinosus*): “Translucent whitish to brown, with or without cloudings or spots Traces of brilliant red colors appear on light colored individuals and . . . some of the lateral lobes of the illicium are deep red, while the median lobe is of cream color; the illicium varies from light color to dark brown.” Newer material has some specimens faded to extremely pale, otherwise tan to brown, spines of tubercles appearing as points of pigment darker than background. Nasal capsule blotched to entirely dark, esca variously pale or blotched, a tinge of red-orange visible in some. Sometimes membranes around gill pores and/or anus-urogenital region

relatively dark, contrasting with rest of body. Cirri associated with lateralis channels on face on ventral surface of disk usually conspicuously darker than body color. Fins about same color as body, often darker distally; dorsal and caudal sometimes barred or blotched with darker color. In freshest specimens, skin covering gill bars dark brown with gill rakers white, contrasting strikingly. Peritoneum light to medium brown.

DISTRIBUTION. — Recorded here from numerous localities off Mexico and Central and South America in the eastern Pacific, from the mouth of the Gulf of California to off the southern tip of Peru. Bathymetric range: the majority from 528–1439 m, but 3 lots from 1815–2323 m, one of these the lectotype. One lot with little data recorded as being from 100 m. One literature record from off Arica, Chile, 19°08'09"S, 70°20'02"W, 366 m (Nuñez, 1967).

MATERIAL. — 140 specimens 32.9–149.0 mm SL. **LECTOTYPE:** MCZ 28710 (129.5 mm SL), ALBATROSS sta. 3392, 7°05'30"N, 79°40'W, 2323 m.

CAS-SU 25242 (14), ALBATROSS sta 2792, 0°37'S, 81°W, 733 m. CAS 39919 (2, 138.8–149.0 mm SL), ANTON BRUUN Cr. 18B, sta. 766, 4°10'S, 81°27'W, 1815–1860 m. CAS 39920 (17, 37.2–81.2 mm SL), ANTON BRUUN Cr. 18B, sta. 754, 7°49'S, 80°38'W, 605–735 m. CAS 39921 (16, 49.4–97.1 mm SL), ANTON BRUUN Cr. 18B, sta. 770, 3°15'S, 80°55'W, 945–960 m. CAS 42708 (46.2 mm SL), ANTON BRUUN Cr. 18B, sta. 755, 7°43'S, 80°43'W, 700–1110 m. CAS-SU 46656 (1 specimen, poor condition), ARCTURUS 61-T-4, 4°56'N, 84°35'W, 914 m. CAS 57853 (94.0 mm SL), TE VEGA Cr. 19, Sta. 144, 2°10'S, 81°13'W, 800–1000 m. CAS 57862 (3, 35.2–102.5 mm SL), TE VEGA Cr. 19, Sta. 148, 2°25'S, 81°10'W, 700–1000 m. CAS 82228 (109.2 mm SL), IMARPE, 18°17.7'S, 71°11.3'W, 600 m. CAS 82229 (135.2 mm SL), IMARPE, 18°10'S, 71°29'W, 610 m. CAS 82230 (94.6 mm SL), IMARPE, 16°29'S, 73°33'W, 1300 m. CAS 82231 (96.2 mm SL), IMARPE, 16°30.5'S, 73°27.5'W. CAS 82232 (115.5 mm SL), IMARPE, 10°51.8'S, 78°30.7'W, 800 m. CAS 82233 (2, 117.8–122.8 mm SL), IMARPE, 18°19'S, 71°12'W, 810 m. CAS 82234 (2, 68.2–106.9 mm SL), IMARPE, 7°46'S, 80°31'W, 800 m. CAS 82235 (139.2 mm SL), IMARPE, 17°41'S, 71°42'W, 650 m. CAS 82237 (101.8 mm SL), IMARPE, 100 m, no other data. CAS 82238 (90.5 mm SL), IMARPE, 16°30.9'S, 73°26'W, 800 m. CAS 82239 (135.2 mm SL), IMARPE, 4°59'S, 81°24.5'W, 528 m. CAS 82241 (96.7 mm SL), IMARPE, 3°48.2'S, 81°22'W, 695 m. CAS 82260 (36, 34.5–96.9), ANTON BRUUN Cr. 18B, sta. 754, 7°49'S, 80°38'W, 605–735 m. GCRL (3, 83.3–109.0 mm SL), CANOPUS sta. 1291, 7°13'N, 79°18'W, 805–841 m. LACM 10098 (32.9 mm SL), ELTANIN sta. 34, 7°47.5'S, 81°23'W, 677 m. LACM 31124-6 (1 specimen, damaged), VELERO 13770, 21°52'30"N, 106°47'36"W, Middle American Trench. LACM 33699-2 (2, 103.0–129.7 mm SL), VELERO 19128, off Cabo Matapalo, Costa Rica, 22 Jun 1973. MCZ 28709 (101.0 mm SL, lectotype of *Malthopsis spinulosa* Garman) and MCZ 41600 (19, 87.0–97.5 mm SL). ALBATROSS sta. 3394, 7°21'N, 79°35'W, 935 m. MCZ 28714 (4, 55.0–77.0 mm SL), ALBATROSS sta. 3418, 16°33'N, 99°52'30"W, 1207 m. MCZ 41597 (62.5 mm SL), ALBATROSS sta. 3354, 7°09'45"N, 80°50'W, 589 m. MCZ 41599 (130.5 mm SL), ALBATROSS sta. 3393, 7°15'N, 79°36'W, 1865 m. SIO 59-265 (4 specimens), 23°40.5'N, 107°38.5–23°37.0'N, 107°51.8'W, 1366–1439 m. USNM 135365 (131.0 mm SL), ALBATROSS sta. 3418, 16°33'N, 99°52'30"W, 1207 m. ZMUC (15, 52.5–134.0 mm SL), GALATHEA sta. 739, 7°22'N, 79°32'W, 938 m.

Dibranchus erinaceus (Garman), 1899

Figs. 10c, 15b

Malthopsis erinacea Garman, 1899:103 (original description, 8 specimens from eastern tropical Pacific); Bradbury, 1962:3 (lectotype selected, MCZ 28712, from Galapagos Is., 770 m).

Dibranchius erinaceus, Bradbury, 1967:414 (diagnosis of *Dibranchius*); Bradbury, et al. 1999 (6 specimens from Galápagos Is.).

DIAGNOSIS. — Teeth on vomer and palatines. Subopercular lateral-line count usually 6, preopercular lateral-line count usually 3 (Table 4). Tubercles distributed over entire body, consisting of moderate sized tubercles interspersed with very small tubercles (Fig. 10c and 15b). Subopercular spines long.

DESCRIPTION. — Based on 18 specimens 37.0–110.0 mm SL. Counts and body proportions given in Tables 3–5. Skeleton relatively rigid. Rostrum prominent, triangular in shape when viewed from above, overhanging mouth in small specimens, becoming relatively shorter in large specimens; when viewed from above, a conspicuous notch present on either side at the base of the rostrum where the supraorbital lateralis channel on each side passes from the face to the roof of the cranium. Esca and nasal capsules as in generic description.

Teeth as in generic description. Teeth present on vomer and palatines. Gill rakers as in generic description; usually 6 gill rakers on each side of second arch.

Tubercles on dorsal surface of disk moderate size with relatively short stout spines, fairly uniform size except as noted below, evenly distributed. Larger tubercles occur in several longitudinal series along dorsal side of trunk and tail; large tubercles also along edges of disk and sides of tail, these often with extra spinules that are much smaller than terminal spines. Subopercular spines relatively long, 6–8 spinelets. Tiny tubercles evenly distributed in skin covering eyeballs. Tubercles of ventral surface of disk much smaller than those of dorsal surface, closely spaced, evenly distributed.

Principal tubercles of ventral surface of tail (Fig. 10c) moderate size with short spines. In the intervening space just posterior to the anus is a short series of similar moderate-sized tubercles; remainder of the intervening space filled by small tubercles both anterior and posterior to anal fin base.

Paired fins and caudal with sparse tubercles running out on fin rays a short distance.

Dermal cirri usually present along disk margins and sides of tail; not abundant. Cirri in form of fringed flaps associated with neuromasts.

Fins moderate size, pectorals slender, pelvic rays with thickened skin.

Color. Garman (1899:104) stated, “Brownish, with traces indicating a rose color in life; young individuals blackish; fins blackish.” These specimens and most others at my disposal now faded pale. One specimen, a male, (SIO 90-71) has fins, nasal capsules, and esca blotched with dark pigment; cirri associated with lateralis channels on face and ventral surface of disk also blackish; lining of gill cavities dark brown, epithelium of gill bars also dark brown, contrasting sharply with white gill rakers; peritoneum blotched with dark spots.

DISTRIBUTION. — Recorded here from only 5 localities in the eastern Pacific, from the vicinities of Galapagos Is., Cocos I., and Peninsula de Azuero, Panama. Bathymetric range: 700–1150 m.

MATERIAL. — 19 specimens 37.0–110.0 mm SL. **LECTOTYPE:** MCZ 28712 (114.0 mm SL) and lectoparatype MCZ 41598 (81.0 mm SL), ALBATROSS sta. 3402, 0°57'30"S, 89°03'30"W, 770 m.

CAS 60476 (8, 37.0–97.0 mm SL), ARCTURUS 74 OT-4, 60 mi. S of Cocos Id., 4°50'N, 87°00'W, 1143 m. CAS 86503 (3, 83.8–105.2 mm SL), JSL 3977, James Bay, Isla San Salvadore, 914 m, J. E. McCosker and party. CAS 86529 (2, 98.0–105.8 mm SL), JSL 3949, off Cabo Rosa, Isla Isabella, 744 m, J. E. McCosker and party. CAS 86533 (1, 105.5 mm SL), JSL 3976, James Bay, Isla San Salvadore, 914 m, J. E. McCosker and party. MCZ 28711 (102.0 mm SL), ALBATROSS sta. 3358, 6°30'N, 81°44'W, 1015 m. SIO 90-71 (110.0 mm SL), Galapagos Is., 1°37.73'S, 90°10.7'W, 965–310 m. USNM 135579 (90.0 mm SL), ALBATROSS, 0°29'S, 89°54'30"W, 715 m.

***Dibranchus nudivomer* (Garman), 1899**

Figs. 5c, d; 10d, 15d

Dibranchichthys nudivomer Garman, 1899:99 (original description, 8 specimens from eastern tropical Pacific, 1271–1335 m); Bradbury, 1962:2 (lectotype selected, MCZ 28719, eastern tropical Pacific, 1271 m).

Dibranchus nudivomer, Bradbury, 1967:414 (diagnosis of *Dibranchus*); Castro-Aguirre and Moncayo-Lopez, 1976:307 (41 specimens from off Sinaloa, México; photograph, osteology, figures).

DIAGNOSIS. — Palatal dentition unique for family: teeth on palatines but none on vomer. Subopercular lateral-line count usually 6, preopercular lateral-line count usually 2 (Table 4).

DESCRIPTION. — Based on 50 specimens 61.0–102.5 mm SL. Counts and body proportions given in Tables 3–5. Skeleton somewhat rubbery. Rostrum very short. Skin thin, semi-transparent, soft. Esca and nasal capsules as in generic description.

Teeth as in generic description. Palatal dentition unique in having pads of teeth on each palatine bone but none on vomer. Gill rakers as in generic description, relatively short; 6 gill rakers on each side of second arch.

Tubercles moderately small with short spines, uniform in size, evenly distributed over dorsal surface of disk and tail. Tubercles on edges of disk slightly larger, their spines sometimes bifid but short; tubercles of lateral sides of tail also larger, the spines in these stout, relatively long, recurved. Subopercular spine moderate, 5–6 spinelets. Smaller tubercles evenly distributed over ventral surface of disk, on pedicels of paired fins, and on skin covering eyeballs.

Ventral surface of tail (Fig. 10d) evenly covered by tubercles, tubercles of principal rows only slightly larger than intervening ones, their spines retrosely curved.

Caudal with tiny tubercles running out short distance along fin rays, pectorals with only a few tubercles on dorsal surface at base, other fins devoid of tubercles.

Dermal cirri well developed on disk margins and sides of tail. Cirri associated with neuromasts formed as fringed flaps.

Fins small, slender.

Color. — Garman (1899) stated that his specimens were brown to black. Material available to me varied from pale tan to dark tan; in many, cirri associated with the lateralis excavations on face and disk dark brown. Some specimens with dark pectorals, particularly tips. Linings of gill cavities pigmented but light colored; peritoneum often medium brown.

DISTRIBUTION. — Present material is from the Gulf of Panama, Gulf of Guayaquil, and from off Peru. Bathymetric range: 605–1400 m. Reported also from off the Rio Baluarte, Sinaloa, México, 900 m (Castro-Aguirre and Moncayo-Lopes 1976).

MATERIAL. — 102 specimens 36.5–112.0 mm SL. LECTOTYPE: MCZ 28719 (94.0 mm SL), and lectoparatype MCZ 41595 (84.0 mm SL), ALBATROSS sta. 3353, 7°06'15"N, 80°34'W, 1271 m.

CAS 35339 (3, 78.4–112.0 mm SL), TE VEGA Cr. 19, Sta. 84, 2°20'S, 81°16'W, 850–1400 m. CAS 82225 (31, 36.5–104.7 mm SL), ANTON BRUUN Cr. 18B, Sta. 770, 3°15'S, 80°55'W, 945–960 m. CAS 82261 (59, 47.0–99.1 mm SL), ANTON BRUUN Cr. 18B, sta. 754, 7°49'S, 80°38'W, 605–735 m. MCZ 28718 (5, 61.0–87.5 mm SL), ALBATROSS sta. 3395, 7°30'36"N, 78°39'W, 1335 m. USNM 57867 (75.0 mm SL), ALBATROSS sta. 3395, 7°30'36"N, 78°39'W, 1335 m.

***Dibranchus discors* Bradbury, McCosker, and Long, 1999**

Figs. 7a, 16

DIAGNOSIS. — Teeth present on palatines and vomer. Interorbital and mouth both exceptionally narrow (Table 5). No tubercles in skin covering eyeballs. No tubercles on ventral surface of disk except a few near bases of pelvics. Conspicuous chalk-white oval marking on midline of lower jaw.

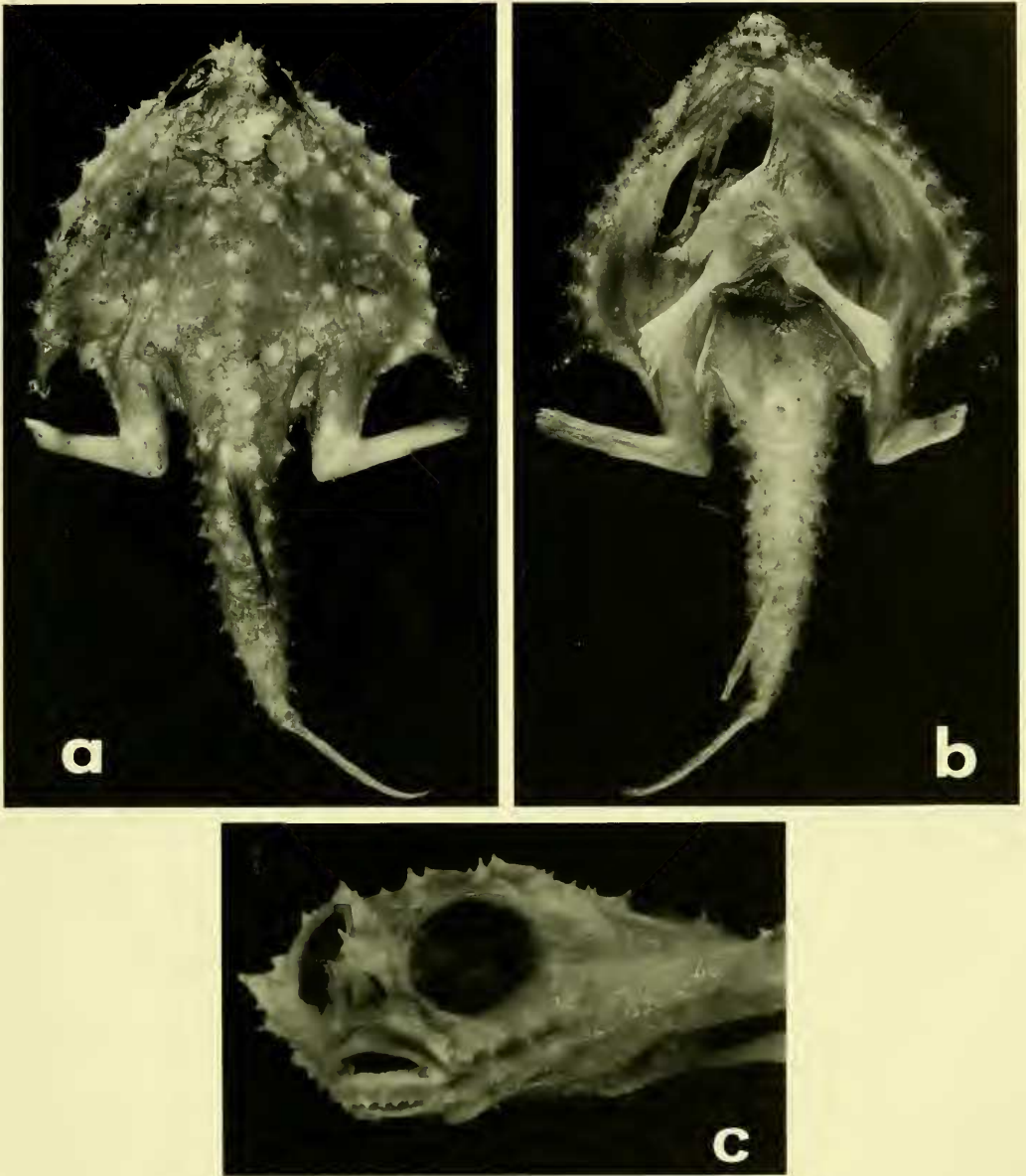


FIGURE 16. *Dibranchus discors* Bradbury, McCosker, and Long.. (a) dorsal view, and (b) ventral view of holotype, 80.2 mm SL, SIO 90-71; (c) frontal-oblique view of paratype, 87.2 mm SL, CAS 47195. Both from the Galapagos Islands.

DESCRIPTION. — Based on 5 specimens 80.2–107.9 mm SL. Counts and body proportions given in Tables 3–5. Skeleton relatively firm. Rostrum short, narrow, upturned, about even with jaws, not overhanging mouth. Esca higher than wide, otherwise not differing from other *Dibranchus*; ventral margin with membranous fringe. Illicium of one specimen (CAS 47195) cleared and stained, agrees with *Dibranchus* in lacking a long median dorsal process and in having the lateral processes each with a foramen (Fig. 7a). Olfactory organs in males somewhat larger than in females, the posterior

nostril slit-shaped, but this dimorphism less pronounced in *D. discors* than in other *Dibranchus*. Females, as usual, show no swelling of the olfactory organ and have both nostrils small and round. A unique chalk-white oval patch on midline of chin with surface appearing pitted or sculptured, that appearance due to the presence lateral line organs and cirri that are all absolutely white but otherwise normal. The patch does not appear to be a light organ; the skin is tough as elsewhere on the body, not glandular.

Teeth as in generic description. Teeth present on vomer and palatines. Gill rakers as in generic description, 5 on each side of second arch.

Tubercles relatively large, widely spaced, each with a short, stout spine, the largest with minute spinules radiating from the central spine. Tubercles of edge of disk multifid. Prominent tubercles present in longitudinal rows on dorsal side of trunk and dorsal and lateral sides of tail, and sprinkled over dorsal surface of disk and pectoral pedicels with intervening skin bare of tubercles. No tubercles on skin covering eyeballs. Subopercular spines long, thick, covered with rows of minute spinules. Skin of ventral surface of disk devoid of tubercles except for patch of very small tubercles between and anterior to pelvics.

Ventral surface of tail with large principal tubercles, their spines moderate, recurved. A few small tubercles scattered among the bases of the principal tubercles.

Dermal cirri not developed.

Paired fins slender, moderately strong, fin membranes transparent; tips of pectoral rays fleshy. No tubercles on fins.

Color. In life, dorsal surface light brown with pale tubercles making whitish spots (Bradbury et al. 1999). Dark margins around anterior nostrils give effect of dark moustache; esca brown, fins pink except dorsal brown. Brownish saddle over tail beneath dorsal fin. Ventral surface pale except for chalk-white oval marking on midline of lower jaw which is ringed by black cirri. In preservative, ALBATROSS specimen (CAS-SU 47195) faded white. Other specimens medium brown dorsally with pale tubercles making pale spots. Dark margins around anterior nostrils give effect of dark moustache. A dark saddle on tail beneath dorsal fin, the dark color continuing onto dorsal fin. Ventral surface pale; pectorals, pelvics, and anal pale. A conspicuous patch on chin colored chalk-white, the effect intensified by black edging composed of black cirri.

DISTRIBUTION. — All specimens taken in the Galápagos archipelago.

ETYMOLOGY. — The name *discors* means unlike or different, in reference to the aberrant shape of the head and illicial bone in this *Dibranchus*.

MATERIAL. — Five specimens 80.2–107.9 mm SL. HOLOTYPE: CAS 86502 (107.9 mm SL, female), JSL 3957, 00°17.5'S, 91°38.9'W, Isla Fernandina off Cabo Douglas, 340 m, 16 Nov. 1995, J. E. McCosker and party. PARATYPES: CAS-SU 47195 (87.2 mm SL, female), ALBATROSS sta. 4642, 1°30'30"S, 89°35'W, 549 m, 7 Nov 1904. CAS 86542 (88.2 mm SL, male), JSL 3974, N shore of Tower Island, 00°21.6'S, 89°58.3'W, 373 m, J. E. McCosker and party. SIO 90-71 (80.2 mm SL, female), Galapagos Is., 1°37.73'S, 90°10.7'W, between 310–965 m, 1 Feb 1990. USNM 344535 (84.1 m SL, male), JSL 3957, 00°17.5'S, 91°38.9'W, Isla Fernandina off Cabo Douglas, 415 m, J. E. McCosker and party.

Dibranchus japonicus Amaoka and Toyoshima, 1981

Fig. 19f

Dibranchus japonicus Amaoka and Toyoshima, 1981:115 (original description, holotype and 7 other specimens from off Iwate Prefecture, Pacific coast of Japan, 1180–1230 m; photographs); Yamakawa (in Okamura and Kitajima, ed. 1984:380 (Pacific coast of Japan, 900–1000 m).

DIAGNOSIS. — Skull relatively short, the length 24.2 percent of SL (Table 5) compared to 26 percent or more in other *Dibranchus*. Skin extremely thick and leathery, studded over entire body with small tubercles; principal tubercles of ventral surface of tail very stout but relatively short (Fig. 9f). No palatal teeth.

DESCRIPTION. — Based on 1 male specimen 154.5 mm SL and on original description (Amaoka and Toyoshima 1981). Counts and body proportions given in Tables 3–5. Skeleton firm. Skin very thick, fairly tough, with tubercles forming a coarse leathery shagreen. Rostrum short and broad. Esca wider than high, the ventral lobes in this specimen flared out and distended so that each appears two-parted, but is essentially as in generic description. Nasal capsule with enlarged lamellae within, and the posterior nostril a gaping slit.

Teeth as in generic description. No palatal teeth. Gill rakers as in generic description; 5 gill rakers on each side of second arch.

Small tubercles abundantly scattered in the thick skin, forming a coarse leathery shagreen over entire body including skin covering eyeballs. Large tubercles with strong short spines occur on dorsal margins of orbits, along disk margins and lateral sides of tail, and sprinkled irregularly on dorsal surface of disk. These large tubercles have their bases covered with skin bearing small tubercles. Subopercular spine thick with 4–5 spinelets. Ventral surface of disk covered with the same small tubercles as seen on dorsal side. No tubercles on fin rays.

Ventral surface of tail with tubercles of principal rows somewhat larger than nearby tubercles and terminating in strong short spines (Fig. 9f). A few large tubercles occur between the principal rows, but the noticeable feature is the thick covering of numerous small tubercles between the principal rows, encroaching on the bases of the large tubercles as described for the dorsal surface of the body.

Pectoral and pelvic fins both relatively short, broad, the covering skin extremely fleshy, the membranes thick.

Color. The specimen agrees with those in original description in its very dark coloration, including fins, and blackish linings of oral, gill, and peritoneal cavities.

DISTRIBUTION. — Known from the Japanese archipelago from 620–1270 m (Amaoka and Toyoshima 1981) and from off eastern Australia, from off Raine Is. (11°35'S) and off Sidney to Shoalhaven (33°50'S–34°55'S), (Paxton et al. 1989:284). A disjunct locality reported here from off Cape Town, South Africa at 855–900 m.

MATERIAL. — IOAN (154.5 mm SL), FIOLENT Cr. 3, trawl 305, 35°26'S, 18°45'E, 855–900 m, 21 Nov 1973.

***Dibranchus accinctus* new species**

Figs. 9c, 17

Possible reference: *Dibranchus obscurus*, Norman, 1939:113 (3 specimens from Gulf of Aden and Indian Ocean off Zanzibar, 1022–1789 m; illustration).

DIAGNOSIS. — A large *Dibranchus* (175 mm SL) with tubercles covering ventral surface of disk. Ventral surface of tail with principal tubercles occupying entire ventral surface, but with numerous small tubercles in skin thickly covering bases of principal tubercles (Fig. 9c). Cranium relatively wide, the width 26.7 percent of SL compared to a range of 16.7–25.6 for the genus (Table 5). No palatal teeth.

DESCRIPTION. — Counts and body proportions given in Tables 3–5. Skeleton firm. Skin tough, like coarse shagreen on dorsal surface of disk; on ventral side of disk, skin somewhat flabby, especially on belly. Rostrum short, only slightly overhanging mouth. Esca as in generic description. The single specimen a female, its nasal capsule small with small round nostrils.



FIGURE 17. *Dibranchius accinctus* new species, holotype, 175.0 mm SL, CAS 82221, from the western Indian Ocean. (a) dorsal view, (b) ventral view.

Teeth as in generic description. No palatal teeth. Gill rakers in the form of low pedicels each capped by a tooth plate bearing a semi-spherical cluster of teeth. 5 gill rakers on each side of second arch.

Tubercles on dorsal surface of disk grading in size from small on the face, interorbital, and skin covering eyeballs, and sides of disk to moderate (and variable) in size posteriorly on the disk. Large tubercles with long spines occur on dorsal margins of orbits, down the midline posteriorly on the disk and onto the tail, and all around the disk margin, these last with bifid spines. Subopercular spine longer than other spines of disk margin, with 4 spinelets. Ventral surface of disk covered with small tubercles.

Ventral surface of tail with tubercles of principle rows large, long-spined and close-set (Fig. 9c). Small tubercles fairly evenly distributed between and over the bases of the large tubercles both anterior and posterior to the anal fin base.

Paired fins with small, widely spaced tubercles running out in the thick skin of the rays nearly 2/3 the way to the fin tip. Caudal fin with a few tubercles along rays near their bases.

Dermal cirri abundant on face, ventral edges of disk margin, and lateral sides of tail, readily visible because darkly pigmented; flaplike cirri associated with neuromasts. On dorsal surface of disk, darkly-pigmented cirri associated with neuromasts which in this location are not housed in channels.

Paired fins relatively short, broad, fleshy; fin membranes translucent.

Color. The specimen has ground color uniform tan. Tubercles of face, interorbital space, and to some extent the pectoral pedicels and sides of disk, have dark pigment around tips of spines, giving dorsal surface a dotted pattern. Dorsal fin dark, pectorals and caudal darkly blotched. Cirri dark brown or black.

ETYMOLOGY. — The name *accinctus* means a well-armed *Dibranchus*, in reference to its long tough spines.

MATERIAL. — HOLOTYPE: CAS 82221 (175.0 mm SL), ANTON BRUUN Cr. 6, sta. 399C, 21°16'S, 38°18'E, 1510–1600 m.

Solocisquama new genus

TYPE SPECIES. — *Dibranchus stellulatus* Gilbert, 1905, is here designated as the type species of the new genus *Solocisquama*.

DIAGNOSIS. — Gills 2; holobranchs present on 2nd and 3rd arches only. Upper jaw with a marked cleft in midline, unique for family. Scales in the form of tubercles, not bucklers, but spines highly modified (Fig. 18). Tooth patches on fifth ceratobranchial bones relatively small, not meeting, or barely meeting, in midline, unlike broad tooth patches meeting broadly in midline seen in *Dibranchus*. Illicial bone (Fig. 7b) with two well-developed laterodorsal processes somewhat resembling those found in *Halicometus* (Bradbury 1967:401); no foramina in lateral processes as seen in *Dibranchus*. Tail lateral line commences posterior to anus; unlike *Halioutopsis*, no lateral-line organs beside, or anterior to, anus.

DESCRIPTION. — Disk triangular in outline unless pectoral pedicels collapsed against body, which gives disk an oval or bell-shaped outline. Subopercular spines short, stout, multifid.

Body depressed but cranium elevated above general surface of disk so that eyes are directed laterally and anteriorly. Rostrum composed of closely-spaced tubercles forming a short shelf above esca; one species, *S. stellulata*, with a prominent median tubercle larger and longer than those to the sides. Illicial cavity small, not cavernous as in *Coelophrys* or some *Halioutopsis*. Esca consisting of a dorsal semi-leaf-shaped lobe with a median furrow which ventrally separates two semi-spherical ventral lobes (Figs. 1b, c; 19). Olfactory organs sexually dimorphic in the one species (*S. erythrina*) with sufficient material to assess: in females, olfactory organs relatively small and containing a few small lamellae, the nostrils small and round; in males, olfactory organ large, swollen by numerous enlarged lamellae within, posterior nostril a wide, gaping slit. Status of sexual dimorphism in olfactory organ in *S. stellulata* and *S. carinata* unknown.

Vertebral count 18, dorsal rays 6–7, pectoral rays 13–16 (Table 6), anal rays always 4, caudal rays always 9. As in *Dibranchus*, lateral line interrupted just as it descends from the disk onto the tail. The lateral-line organs on the disk are too difficult to count, so these were not studied. Tail lateral line commences on the ventral side of tail just posterior to anus, thence continuing along lateral sides of tail onto base of caudal fin; tail lateral-line count 6–12 (Table 6). Subopercular lateral-line series usually 5, range 4–5 (Table 6). The dorsolateral branch of the subopercular series shows no variation in the specimens at hand, the count always 3. Likewise, the preopercular series does not vary, the count always 2.

Teeth in oral and gill cavities small and recurved as described for *Dibranchus*. Teeth in bands on jaws, visible when mouth closed. No palatal teeth. Patches of teeth on ceratobranchial V small, not meeting, or barely meeting, in midline. Gill rakers in the form of pedicels capped by tooth plates (Fig. 5a, b); pedicels relatively long and stout compared to *Dibranchus*. (Except for gross examination, this feature in *S. carinata* was not studied.)

Dermal cirri appear to be absent in this genus.

Illicial Bone. Illicial bone known for *S. stellulata* (Fig. 7b) and *S. erythrina*; the two agree in lacking the median dorsal process seen in the majority of ogocephalid genera and in having, instead,

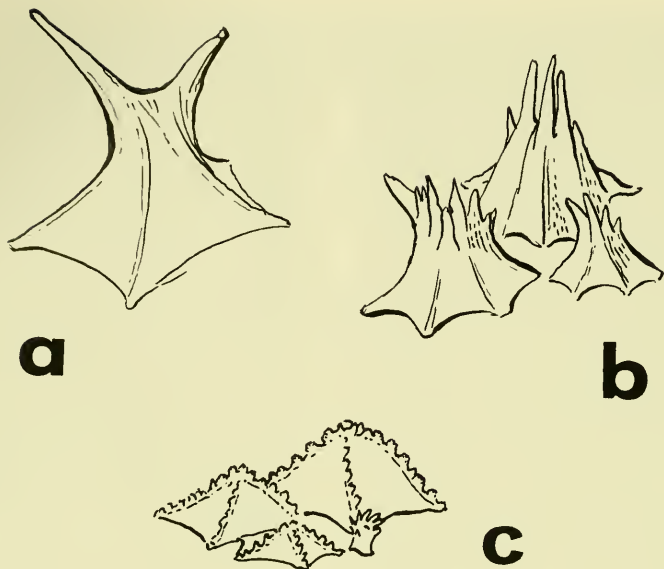


FIGURE 18. Sketches of tubercles from the dorsal surface of the disk in species of *Solocisquama*. (a) *S. stellulata*, 88.8 mm SL, ZMMSU P.20352; (b) *S. erythrina*, 135.5 mm SL, BPBM 29270; (c) *S. carinata*, 73.2 mm SL, ZMMSU P.20359, holotype. The tubercles in *S. erythrina* and *S. carinata* are very different from one another, and each is unique for the family. Multi-spined tubercles seen in *S. stellulata* occur in many species just on the edges of the disk, but *S. stellulata* is alone in having them nearly all over the body.

two long dorsolateral processes, resembling those in *Halicmetus* (Bradbury 1967:401). They further agree in lacking foramina in the lateral processes that articulate with the pterygiophore, unlike *Dibranchus*. Since *S. carinata* is known only from the holotype, clearing and staining was not performed on that specimen, so the nature of its illicial bone is unknown.

DISTRIBUTION. — From Sala y Gomez Ridge near Easter Island in the eastern Pacific, Hawaiian archipelago, Philippine Sea, South China Sea, and western Indian Ocean off South Africa.

ETYMOLOGY. — *Solocisquama* means bristly or coarsely scaled.

KEY TO THE SPECIES OF *SOLOCISQUAMA*

- 1a. When disk viewed from the front or side, dorsal surface of disk seen to be thickly covered by tubercles with simple but relatively long spines (Fig. 19), true even for specimens as small as 37 mm SL *S. stellulata*
 1b. Dorsal surface of disk covered by low tubercles without long spines 2
 2a. Tubercles along sides of tail (herein called principle tubercles) each with 2–4 long, irregularly sized, somewhat flaring spines (Fig. 20c, d) *S. erythrina*
 2b. Principle tubercles shaped like toothed scutes (Fig. 20a), aligned in keellike series on each side of tail *S. carinata*

Solocisquama stellulata (Gilbert), 1905

Figs. 1b, 18a, 19a, 20b

Dibranchus stellulatus Gilbert, 1905:698 (original description, holotype from Hawaiian Is., 326–369 m); Bradbury, 1967:414 (diagnosis of *Dibranchus*); Mochizuki, in Okamura, Amaoka, and Mitani 1982:361 (Kyushu-Palau Ridge, Japan, 550 m); Bradbury, in Smith and Heemstra, 1986:371 (off Natal, South Africa, 475 m).

DIAGNOSIS. — Tubercles on dorsal surface of disk with simple spines (Fig. 19a), but elsewhere on body tubercles multi-spined (Fig. 18a), these especially prominent on principal tubercles of tail

TABLE 6. Frequency distribution for dorsal and pectoral fin ray counts, vertebral counts and subopercular and tail lateral-line counts in species of *Solocisquama*.

	Dorsal Fin		Pectoral Fin				Verte- brae	Lateral-line Count								
								Subopercular		Tail						
	6	7	13	14	15	16	18	4	5	6	7	8	9	10	11	12
<i>erythrina</i>	3	1	—	2	5	1	6	—	8	—	—	—	—	2	3	1
<i>stellulata</i>	4	—	1	3	6	—	3	1	9	1	—	1	4	2	—	—
<i>carinata</i>	1	—	—	—	2	—	1	—	2	—	—	—	1	1	—	—

(Fig. 20b). Rostrum with a large multifid median spine protruding beyond its neighbors, terminating in 5 or more flaring spinelets.

DESCRIPTION. — Based on 7 specimens including holotype, USNM 51595; counts and body proportions given in Tables 6 and 7. Skeleton firm, skin tough. Rostrum short but with a jaunty, upturned, thick, median tubercle protruding further than its neighbors with 5 or more spinelets near tip flaring outward. Upper jaw with median cleft. Esca composed of large central lobe with a median furrow and two smaller ventral lobes, one on each side (Fig. 1b, 19a). Sexual dimorphism of nasal capsules problematic; 2 specimens (including holotype) have small round posterior nostrils and also have ovaries, but other specimens too small or too poorly preserved, or both, to see nature of capsules and/or gonads.

Teeth in bands on jaws, visible when mouth closed. Small elongate tooth pad on each ceratobranchial V, set at 90° angle to one another but not meeting at midline. (In the original description, Gilbert recorded "tongue without teeth," but this is an error.) No palatal teeth. (Mochizuki [Okamura et al. 1982:361] stated that palatine teeth were present for 4 specimens from the Kyushi-Palau Ridge, although no vomerine teeth. I have checked my material in this regard and can find no palatine teeth.) Gill rakers as in generic description; 6 gill rakers on each side of second arch.

Tubercles with long, strong sharp spines evenly distributed over entire dorsal surface (in contrast to *S. erythrina*, with far shorter spines (Fig. 19) and *S. carinata* with none. On ventral side of disk, tubercles small, evenly distributed down center of disk but thinning laterally. Except for dorsal surface of disk, most tubercles are the peculiar multi-spined tubercles (Fig. 18a), occurring on face, edges of disk, pectoral pedicels, and all over tail, arranged so that small tubercles crowd among large ones. Tubercles present in skin covering eyeballs. Subopercular spines moderate length but thick with 5–6 spinelets.

Ventral surface of tail covered with multi-spined tubercles, these especially large and prominent on principal tubercles (Fig. 20b).

Fins without tubercles. Paired fins sturdy. Fin membranes translucent.

No dermal cirri.

Color. Gilbert recorded for the holotype, "light olive-brown above, white below; 2 small black spots behind each eye, a second pair on each side the middle of disk, and a third pair above and in front of each gill-opening; a vertical dark shade immediately behind dorsal fin; a faint dark bar on terminal portion of dorsal and one on caudal." A color photograph of a specimen from Japan (Okamura et al. 1982:196) shows ground color medium tan with orange-tinged blotches on pectorals and caudal; the dark spots are as described by Gilbert for the holotype (above). Preserved specimens, including holotype, pale creamy or pale brown; internal membranes colorless, or peritoneum sometimes with a few scattered melanophores.

DISTRIBUTION. — Hawaiian archipelago, Philippine Sea, South China Sea, and western Indian Ocean off South Africa. Bathymetric range: 274–530 (possibly to 900) m.

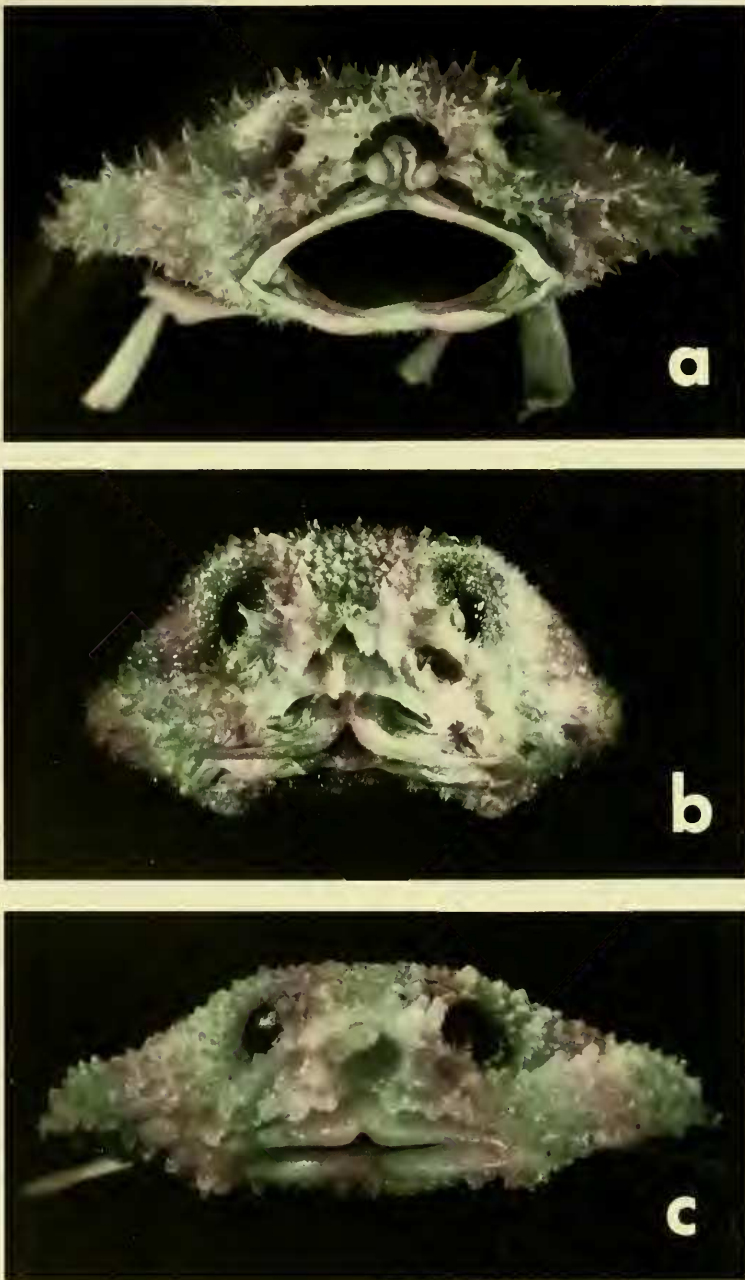


FIGURE 19. Frontal views of species of *Solocisquama* to show contrast between tall single spines on dorsal surface of disk in *S. stellulata* (a) and the low complex tubercles in *S. erythrina* (b) and *S. carinata* (c). (Note that the esca of the *S. erythrina* is nearly gone; ordinarily it would be the same relative size as in the *S. stellulata* specimen.)

MATERIAL. — 7 specimens 37.4–101.6 mm SL. HOLOTYPE: USNM 51595 (47.8 mm SL), ALBATROSS sta. 4080, off N coast Maui, 326–369 m. BPBM 17941 (76.0 mm SL), Hawaiian Is., Molokai Channel, 21°02'N, 157°32'W. CAS 42709 (37.4 mm SL), TOWNSEND CROMWELL Cr. 33, sta. 34, 20°01.6'N, 156°54.2'W–20°02.7'N, 156°53.9'W, 344–356 m. CAS 42710 (48.9 mm SL), TOWNSEND CROMWELL 40-92, 21°04'N, 156°29'W, 274–318 m. IOAN (1, 88.8 mm SL), 28°05'N, 134°40'E, 530–900 m. RUSI 14046 (77.8 mm SL), 3°49'S, 40°00'E. ZMMSU P15841 (101.6 mm SL), PROFESSOR MESIATSEV Cr. 6, trawl 124, 4°43'S, 110°56'E, 4 00–430 m.

***Solocisquama erythrina* (Gilbert), 1905**

Figs. 1c; 5a, b; 18b; 19b; 20c, d

Dibranchus erythrinus Gilbert, 1905:697 (original description, holotype from Hawaiian Is., 786–872 m); Bradbury, 1967:414 (diagnosis of *Dibranchus*).

DIAGNOSIS. — Unique tubercles multi-spined, that is, with numerous spines clustered in center of each tubercle instead of single spine (Fig. 18b). No large rostral spine as in *S. stellulata*, nor long simple spines on dorsal surface of disk; no toothed scutes on tubercles as in *S. carinata*.

DESCRIPTION. — Based on 6 specimens including holotype, USNM 51642. Counts and body proportions for the 4 largest specimens plus vertebral counts for all 6 specimens are given in Tables 6 and 7. Skeleton moderately firm. Rostrum short, rounded when viewed from above, slightly overhanging jaws. Esca with dorsal median lobe and 2 ventral lateral lobes, a strong vertical median furrow down the dorsal lobe and separating the lateral lobes (Fig. 1c). Lower jaw included in cleft upper jaw. Nasal capsules exhibit sexual dimorphism: in females, capsule small with round nostrils; in males, nasal capsules large, swollen because of enlarged lamellae within, with long vertical slitlike posterior nostril.

Teeth as in generic description. Each ceratobranchial V with a relatively small leaf-shaped patch of teeth, these patches set at 90° to one another so ensemble resembles a pair of wings in outline. (In the original description, Gilbert recorded “tongue edentulous,” but this is an error.) No palatal teeth. Gill rakers finger-shaped with relatively long pedicels, each with distal tooth plate bearing cluster of tiny teeth. Second gill arch with 6 or 7 gill rakers on each side.

Skin thickly covered with tubercles. Tubercles unique; rather than each with a single central spine as generally seen in this family, there are 2–6 or more spines clustered (conjoined) in center of each tubercle (= multi-spined). In holotype and one other large specimen (BPBM 29270), each shows a variety of sizes of tubercles: large tubercles in several longitudinal rows on dorsal surface of trunk and fairly evenly distributed over rest of dorsal surface of body; much smaller tubercles fill intervening spaces; largest tubercles of all, with relatively stronger, longer spines, occur along sides of disk and tail, those of face modified somewhat to form toothed ridges over lips and excavations of the lateralis system. Small specimens have many fewer tubercles, these about uniform in size; presumably these increase in number and differentiate with growth. Skin covering eyeballs densely set with small tubercles. Subopercular spines long in small specimens, but relatively short and far less prominent in large specimens. Ventral surface of disk densely covered with small tubercles.

Ventral surface of tail, in small as well as large specimens, covered with multi-spined tubercles, small and close-set except for principal tubercles, which are relatively large with long prominent spines (Fig. 20c, d)

No dermal cirri.

Paired and caudal fins with tubercles at their bases; in largest specimens, tubercles occur along proximal half of fin rays. Dorsal fin rays with a few tubercles, none on anal fin.

TABLE 7. Range and mean for body measurements as thousandths of standard length in species of *Solocisquama*.

	N	Disk margin length	Skull length	Jaw to anal fin distance	Jaw to anus distance	Snout to dorsal distance	Interorbital width	Cranium width	Jaw length	Mouth width	Eye width
<i>S. erythrina</i>	4	329-405 $x = 353$	308-316 $x = 313$	741-805 $x = 785$	550-590 $x = 566$	624-673 $x = 656$	110-122 $x = 115$	234-255 $x = 253$	187-216 $x = 199$	274-318 $x = 303$	110-133 $x = 120$
<i>S. stellulata</i>	7	337-436 $x = 397$	297-340 $x = 313$	773-824 $x = 803$	563-641 $x = 608$	667-708 $x = 697$	96-142 $x = 125$	256-323 $x = 281$	179-197 $x = 190$	275-346 $x = 308$	110-135 $x = 121$
<i>S. carinata</i>	1	353	316	794	564	638	103	254	191	305	112

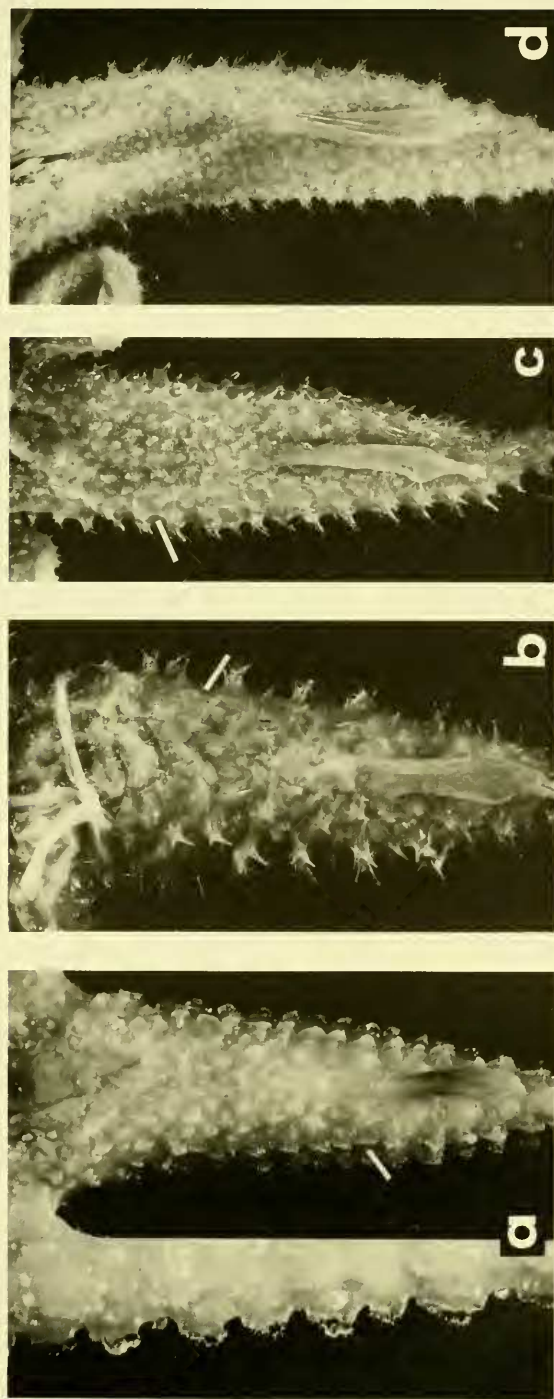


FIGURE 20. Ventral views of tails of species of *Solocisquamia* to show spines of principal tubercles. Principal tubercles are defined as the row of tubercles ventral to the channel for the lateralis system. Pointers indicate the channel for the lateralis system. (a) *S. carinata* new species, 73.2 mm SL, ZMMSU P.20359, holotype. Image on the left is an enlargement to show the toothed edges of the principle tubercles; (b) *S. stethilata*, 88.8 mm SL, ZMIMISU P.20362; (c) *S. erythrina*, 65.7 mm SL, BPBM 24729; (d) *S. erythrina*, 135.5 mm SL, BPBM 29270.

Paired fins relatively long and broad, paddle-shaped, tips of pectoral rays fleshy, skin of pelvics thick, somewhat puffy.

Color. Gilbert (1905:698) described the holotype as “light carmine-red” with the ventral surface “suffused with purple” and the fins deeper red. He found the lining of the gill cavities and peritoneum both “blackish.” In preserved specimens, body and fins completely pigmentless. Lining of gill cavities, buccal cavity, pale; peritoneum black or brown or pale with black spots.

MATERIAL. — 6 specimens 28.0–135.5 mm SL, all from Hawaiian Is. HOLOTYPE: USNM 51642 (133.5 mm SL), ALBATROSS sta. 3985, vicinity of Kauai, 786–872 m. BPBM 24729 (3, 26.1–65.7 mm SL), TOWNSEND CROMWELL Cr. 59, sta. 20, 21°09'N, 156°11'W, 100–800 m. BPBM 29270 (135.5 mm SL), off N shore of Kauai, 622 m. CAS 42707 (74.4 mm SL), TOWNSEND CROMWELL Cr. 61, sta. 66, 21°01'–05.7'N, 156°08.4–10.2'W, 786 m.

***Solocisquama carinata* new species**

Figs. 18c, 19c, 20a, 21

Dibranchius sp. nova Bradbury; Parin 1990:18 (Sala y Gomez Ridge).

DIAGNOSIS. — Tubercles unique in family, low, without spines, having only 3 or 4 facets, the ridges between facet surfaces drawn out into scutes, each scute bordered by a comb of fine teeth (Figs. 18c, 20a). Disk margin short, 35% of SL (40% in *S. erythrina* and *S. stellulata* of equal size or larger).

DESCRIPTION. — Based on holotype, 73.2 mm SL. Counts and body proportions given in Tables 6 and 7. Skeleton rigid, integument relatively tough. Rostrum very short, only slightly overhanging mouth, slightly upturned. Upper jaw with median cleft. Esca relatively wide, leaf-shaped median dorsal lobe very short, two ventral lobes subspherical. This specimen a female with small nasal capsules and nasal openings.

Teeth in bands on jaws; teeth visible on upper jaw when jaws closed; small oval pad of teeth anteriorly placed on each ceratobranchial V, pads widely separated at midline. No palatal teeth. Gill rakers finger-shaped, 7 on each side of second arch, pedicles relatively long as in *S. erythrina*, distal end of each with tooth plate bearing cluster of tiny teeth.

Strong, extraordinarily shaped tubercles everywhere over body except fins, each with only 3 or 4 facets, the ridge between facet surfaces drawn out into scutes, each scute bordered with comb of fine teeth. Tubercles of dorsal surface of disk fairly uniform in size, evenly spaced; tubercles of ventral surface of disk smaller but uniform size, widely spaced. Tubercles on skin of eyeballs arranged around iris in concentric rows. Subopercular spines prominent although relatively short. Scutes of tubercles on edges of disk and sides of tail forming keeled edges for excavations housing lateralis organs.

Ventral surface of tail (Fig. 20a) covered with close-set tubercles uniform in size. Principal tubercles somewhat enlarged, aligned so carinated scutes form strong keels.

No dermal cirri.

Paired fins relatively large, strong, paddle-shaped, pelvics with skin thickened and puffy, membranes not emarginate, ray tips not free. Fin membranes translucent.

Color. Specimen totally devoid of pigment externally and in gill cavity; peritoneum with black blotches.

ETYMOLOGY. — The specific name *carinata* is a Latin adjective meaning keeled, in reference to the alignment of tubercles forming keels along the disk edge and sides of tail.

MATERIAL. — HOLOTYPE: ZMMSU P.20359 (female 73.2 mm SL), Sala y Gomez Ridge, 25°08.2'S, 99°25'W, 750–800 m, PROFESSOR SHTOKMAN sta. 1996, bottom otter-trawl, 5 May 1987.

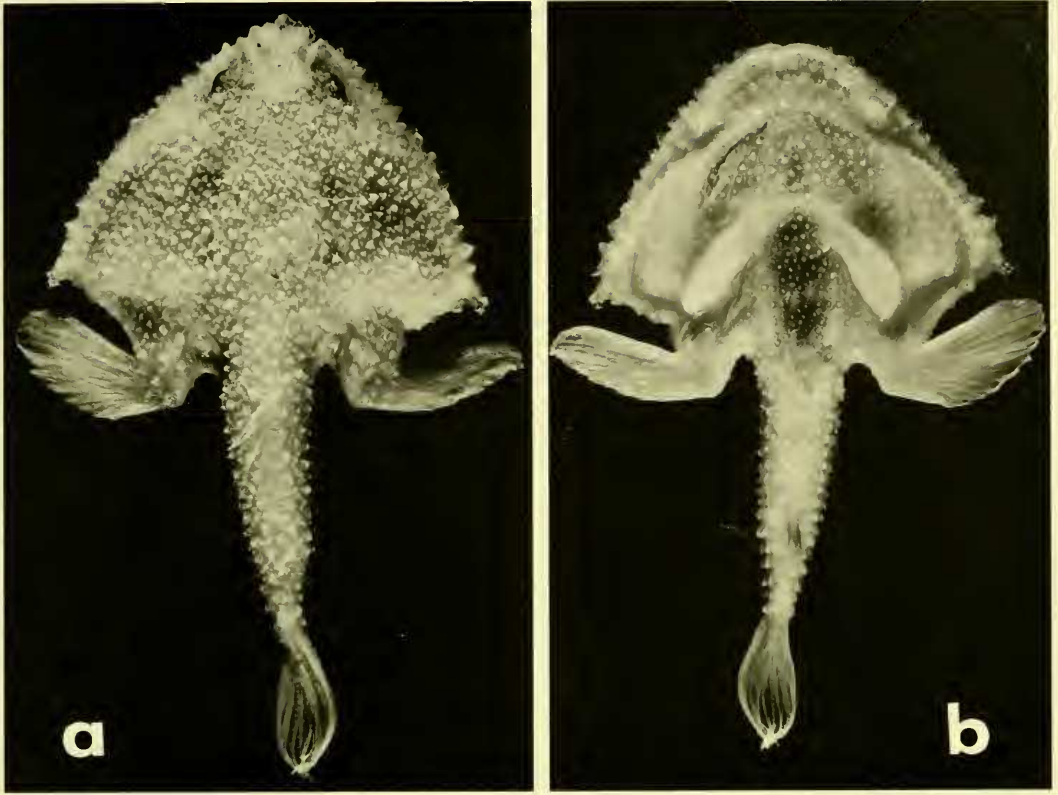


FIGURE 21. *Solocisquama carinata* new species, holotype, 73.2 mm SL, ZMMSU P.20359, from Sala y Gomez Ridge. (a) dorsal view; (b) ventral view.

DISCUSSION

The majority of species of *Dibranchus* reside in the eastern Pacific Ocean, a peculiar distribution for ogcocephalid genera and uncommon in other fish groups. I adduce the argument that *Dibranchus* evolved in the eastern Pacific and offer the following justifications.

Relationships Within the Family. In a survey of the cranium and illicium of many species of Ogcocephalidae, Bradbury (1967:401, 405) implicitly identified in the Indo-Pacific genus *Halieutopsis* two characters plesiomorphic for the family. First, the frontal bones on the dorsal surface of the cranium were found to be relatively flat and scalelike, not modified to form a groove for the illicium (as seen in *Dibranchus*, *Halieutaea*, *Halieutichthys*, and *Halicmetus*) or a tube housing the illicium (as seen in the remaining genera *Malthopsis*, *Zalieutes*, and *Ogcocephalus*). Second, the illicial bone was found to be spinelike and relatively simple, not perforated, thickened and rounded, pitted, or split as seen in other genera (conditions which, in fact, constituted autapomorphies defining these other genera). Only one genus, *Coelophrys*, another Indo-Pacific genus, was omitted from the survey because no material had been available for clearing and staining.

Subsequently, I examined a cleared and stained specimen of *Coelophrys brevicaudata*, BSKU 26847. It resembles *Halieutopsis*. The frontal bones of the cranium, although poorly ossified, show no deformation to form a groove, and the illicial bone is elongate, slender, and sub-spinelike, not perforated or split or thickened and rounded. If *C. brevicaudata* is representative of the genus, perhaps

future work will indicate that *Coelophrys* and *Halieutopsis* ought to be combined in a single genus. Meanwhile, it is fair to consider that the *Coelophrys/Halieutopsis* complex is the closest to an ancestral ogocephalid that we have, because it is difficult to think that it can be derived from taxa with grooved or tube-bearing skulls. *Coelophrys* and *Halieutopsis micropa* differ markedly from other ogocephalids in having globose or sub-globose bodies, and they, plus several other species of *Halieutopsis*, have markedly loose skin with subdermal gelatinous layers. I take the view (below) that these are plesiomorphic characters within the Ogocephalidae.

In two comprehensive papers, which were landmarks for lophiiform systematics, Pietsch (1981, 1994) presented two different hypotheses for sister-group relationships of the Ogocephalidae. The earlier hypothesis (1981) proposed that Chaunacidae and Ogocephalidae were sister-groups, but this was superseded (1994) by the hypothesis that the sister-group of Ogocephalidae is the suborder Ceratioidei (with Chaunacidae the sister-group of combined Ceratioidei and Ogocephalidae; see the Pietsch papers for discussion). In either case, the implicated taxa are pelagic forms with (usually) globose or sub-globose bodies and, in the main, soft loose skin, sometimes with subdermal gelatinous tissue. When scales occur in the skin, they are small, simple tubercles occurring over the entire body, little or not at all differentiated on different parts of the body. *Coelophrys* and *Halieutopsis micropa* appear to be benthopelagic and have globose or sub-globose bodies, soft loose skin, subdermal gelatinous tissue and simple, undifferentiated tubercles completely covering the body. The pelagic postlarval stages now known among ogocephalids are all globose with loose skin, extensive subdermal gelatinous tissue and (usually) simple, small tubercles covering the body. It is worth considering that these are plesiomorphies for the family, that pelagic life is the ancestral condition for the Ogocephalidae, and that *Coelophrys* and similar species of *Halieutopsis* are pedomorphic. Forms with benthic adults would, then, all be derived. These would include all the genera with frontal bones forming a groove or tube, that is, all other known genera of Ogocephalidae.

There is one more point of interest having to do with the condition of the lateral line canals and neuromasts. Pelagic forms like *Coelophrys* have excavations in the skin which may be interpreted to be open lateralis canals. Lying within the canals are large prominent free neuromasts, a condition common in bathypelagics. All other species of ogocephalids have versions of this condition even though they are benthic forms, some of which live as far inshore as to be nearly subtidal. In benthic deepwater forms like *Halieutopsis* and *Dibranchus*, the free neuromasts on the ventral surface of the disk and lateral sides of the tail still lie in canals, but are sheltered by modified scales and cirri, the cirri sometimes in thick mats. On the dorsal surface of the bodies in these forms, the neuromasts are reduced in size and nestled in and among specialized scales, for the open canals have disappeared. In forms like *Ogocephalus* and *Malthopsis*, found at continental shelf depths where, presumably, waters are more turbulent, all canals are lost, but the neuromasts *remain free on the body surface*, where they are greatly reduced in size but still protected by specialized scales and cirri and situated in depressions among strongly calcified bucklers. The loss of canals and tiny size of neuromasts are derived character states, modifications for benthic life. The open lateralis canals and large free neuromasts as seen in *Coelophrys* are characters suited to pelagic life, the hypothesized ancestral condition for ogocephalids.

Of the genera with frontal bones forming a groove, *Dibranchus* is probably the one closest to *Coelophrys/Halieutopsis*. I have found two synapomorphies. One is the reduction of gills to 2. The other is the peculiarity of the lateral line such that the lateral line is interrupted just where it passes from the disk to the tail and the anterior part of the tail lateral line runs instead onto the ventral surface of the tail towards, or in advance of, the anus. *Halicmetus* shares these characters, but has been very poorly studied; it is set apart by having scales in the form of bucklers, an apomorphy it shares with all the genera with a cranial tube for the illicium. That is, *Dibranchus* is probably more closely related to *Halieutopsis* than to *Halicmetus*.

Relationships Within the Genus *Dibranchus*. Most species of *Dibranchus* have tubercles showing derived character states including enlargement of some tubercles with loss of others, strong differentiation on different body parts, tubercles ankylosed to underlying skeletal parts, patterns of spinules overlaying tubercles, small tubercles overlaying the bases of large tubercles, and so on. The majority of dibranchids also have lost the palatal teeth, and most show loss in one or another of meristic characters. The two Atlantic species and the three Indo-Western Pacific species have all lost the palatal teeth and show other apomorphies, as follows. *Dibranchus atlanticus* has a radiating pattern of spinules on the tubercles and has a reduced number of vertebrae, 18 instead of 19. *Dibranchus tremendus*, *D. hystrix*, and *D. accinctus* all have tubercles very reduced in number, with many remaining tubercles greatly enlarged and bearing enormous spines, especially on the tail. These three species also have lost one neuromast from the subopercular series. Finally, *D. japonicus*, although retaining simple tubercles all over the body, where they are relatively undifferentiated on different parts of the body, has peculiar leathery skin, an autapomorphy.

All dibranchids that retain palatal teeth are eastern Pacific species: *D. spinosus*, *D. sparsus*, *D. erinaceus*, and *D. discors*, but *D. discors* is removed from candidacy for being most like an ancestral *Dibranchus* by these derived characters: loss of tubercles from portions of the body and minute spinules on large tubercles. Also, its laterally compressed illicial bone, narrow mouth and interorbital, and large eye, all unique for *Dibranchus*, make *D. discors* a highly derived *Dibranchus*.

Of the remaining three species with palatal teeth, the widespread *D. spinosus* has small simple tubercles without giant spines, evenly distributed over the body, without much differentiation on different parts of the body, in skin that is relatively somewhat soft and loose. It may be the closest we have to an ancestral *Dibranchus*. The other two species, *D. sparsa* and *D. erinaceus*, are very similar to *D. spinosus*, but *D. sparsa* has lost one neuromast from the preopercular lateral line series, and *D. erinaceus* has moderately enlarged tubercles interspersed in a regular pattern among small simple tubercles.

All these observations and guesses taken together suggest that *Dibranchus*, while descended from Indo-Pacific forms, first radiated in the eastern Pacific, with descendants of that radiation populating the Atlantic, western Pacific, and Indian Oceans.

Relationships of the Genus *Solocisquama*. With ogocephalids still so poorly known, hypotheses about relationships, of course, await revision, especially in the case of *Solocisquama*. Characters so far known suggest two different hypotheses. One is that *Halicmetus* is the primitive sister-group of *Solocisquama*. One suspected synapomorphy is the conformation of the illicial bone, with two dorsolateral processes replacing (derived from?) the median dorsal process. The two genera share two other derived characters, an interrupted lateral line with one neuromast on the ventral surface of the tail on each side, near the anus, and loss of palatal teeth. However, these latter two characters are also shared with *Dibranchus*. If *Solocisquama* instead shares a common ancestor with *Dibranchus*, it would mean that an eastern Pacific genus has given rise to a distinctive eastern Pacific genus.

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APPENDIX

Specimens Used for Scanning Electron Micrography of Gill Rakers, Premaxillae, and Tubercles. *Dibranchius atlanticus*, 131.5 mm SL, CAS 76452; the following all from CAS 76446: 39.5 mm SL, 72.5 mm SL, 81.0 mm SL. *Dibranchius erinaceus*, 94.0 mm SL, CAS-SU 60476. *Dibranchius hystrix*, 82.0 mm SL, CAS 82242. *Dibranchius nudivomer*, 83.5 mm SL, CAS 82261. *Dibranchius sparsus*, 75 mm SL, CAS 82227. *Dibranchius spinosus*, 139.0 mm SL, ZMUC GALATHEA sta. 739; 140.0 mm SL, CAS 82235. *Dibranchius spongiosus*, 71.0 mm SL and 115.0 mm SL, both CAS 82252. *Dibranchius tremendus*, 158.0 mm SL, USNM 320332. *Solocisquama erythrina*, 135.0 mm SL, BPBM 29270.

Specimens Used for Clearing/Staining. *Dibranchius cracens*, 128.3 mm SL, CAS 88034 (illicium). *Dibranchius discors*, 87.2 mm SL, CAS-SU 47195 (illicium). *Dibranchius erinaceus*, 94.0 mm SL, CAS-SU 60476 (gill arch). *Dibranchius hystrix*, 82.0 mm SL, CAS 82242 (gill arch). *Dibranchius nudivomer*, 82.3 mm SL, CAS 82261 (entire). *Dibranchius spongiosus*, 115.0 mm SL, CAS 82252 (entire). *Dibranchius tremendus*, 96.5 mm SL, UF 25923 (illicium). *Solocisquama erythrina*, 135.0 mm SL, BPBM 29270 (gill arch), and 65.7 mm SL, BPBM 24729 (illicium). *Solocisquama stellulata*, 76.0 mm SL, BPBM 17941 (illicium), and 101.6 mm SL, ZMMSU P.15841 (gill arch). *Coelophrys brevicandata*, BSKU 26847 (entire).

LITERATURE CITED

- ALCOCK, A. (in WOOD-MASON AND ALCOCK). 1891. Natural history notes from H. M. Indian survey steamer 'Investigator,' Commander R. F. Hoskyn, R. N., commanding—Series II, No. 1. On the results of deep-sea dredging during the season 1890–91. *Ann. Mag. Nat. Hist.*, series 6, 8:16–34, 119–138.
- . 1899. Illustrations of the zoology of the royal marine surveying steamer Investigator, Fishes. Calcutta.
- . 1902. A naturalist in Indian seas, or, four years with the royal Indian marine survey ship "Investigator." London.
- AMAOKA, K. AND M. TOYOSHIMA. 1981. A new ogocephalid fish, *Dibranchius japonicus*, from Japan. *Japanese J. Ichthyology* 28(2):115–121.
- ARNOLD, E. L. 1949. Unusual occurrence of fish on New England Banks. *Copeia* 1949(4):299–300.
- BEEBE, W. 1937. Preliminary list of Bermuda deep-sea fish. Based on the collections from fifteen hundred metre-net hauls, made in an eight-mile circle south of Nonsuch I., Bermuda. *Zoologica* 22:197–208.
- BERTELSEN, E. 1951. The ceratioid fishes. Dana Report No. 39, 276 pp.
- BERTELSEN, E., T. W. PIETSCH, AND R. J. LAVENBERG. 1981. Ceratioid anglerfishes of the family Gigantactinidae: morphology, systematics and distribution. *Contributions in Science, Natural History Museum of Los Angeles County* 332:1–74.
- BRADBURY, M. G. 1962. Lectotypes of species of Ogocephalidae selected from syntypes in the Museum of Comparative Zoology. *Breviora* No. 166, 4 pp.
- . 1967. The genera of batfishes (Family Ogocephalidae). *Copeia* 1967(2):399–422.
- . 1980. A revision of the fish genus *Ogocephalus* with descriptions of new species from the western Atlantic Ocean (Ogocephalidae; Lophiiformes). *Proc. Calif. Acad. Sci.* 42:229–285.
- . 1988. Rare fishes of the deep-sea genus *Halieutopsis*: a review with descriptions of four new species (Lophiiformes: Ogocephalidae). *Fieldiana: Zoology (new series)* No. 44, 22 pp.
- BRADBURY, M. G., McCOSKER, J. E., AND D. J. LONG. 1999. Batfishes of the Galápagos Islands with descriptions of two new species of *Dibranchius* (Teleostei; Ogocephalidae). *Review Francaise d'Aquariologie* 25(1998):79–88.

- BRAUER, A. 1908. Die Tiefseefische. I. Systematischer Teil. Wiss. Ergebn. Deutschen Tiefsee-Exped. VALDIVIA 1898–99, 15(1):1–432.
- CADENAT, J. 1937. Recherches systématiques sur les poissons littoraux de la côte occidentale d'Afrique. Liste des poissons littoraux recoltés par le Naivre PRESIDENT THEODORE-TISSIER au cours de sa cinquième croisière. Revue des Travaux de l'Office des Pêches Maritimes, Paris 10(4):425–562.
- CARUSO, J. H. 1975. Sexual dimorphism of the olfactory organs of lophiids. *Copeia* 1975(2):380–381.
- CASTRO-AGUIRRE, J. L. AND M. E. MONCAYO-LÓPEZ. 1976. Sobre la presencia de *Dibranchius nudivomer* (Garman) (Pisces: Ogocephalidae), en la costa occidental de México, con notas y observaciones biológicas. *Revista de la Sociedad Mexicana de Historia Natural* 37:307–321.
- CRANE, J. 1968. Bioluminescence in the batfish *Dibranchius atlanticus*. *Copeia* 1968:410–411.
- CUVIER, G. 1816. Le règne animal distribué d'après son organisation . . . Poissons, vol. 2. Paris. 532 pp.
- CUVIER, G. AND A. VALENCIENNES. 1837. Histoire Naturelle des poissons, v. 12. Bertrand, Paris.
- DE BEAUFORT, L. F. AND J. C. BRIGGS. 1962. The fishes of the Indo-Australian archipelago. XI. Scleroperi, Hypostomides, Pediculati, Plectognathi, Opisthomi, Discocephali, Xenopterygii. E. J. Brill, Leiden, 11:1–481.
- FINK, W. L. 1981. Ontogeny and phylogeny of tooth attachment modes in actinopterygian fishes. *J. Morph.* 167:167–184.
- FISCHER, G. V. W. 1813. Zoognosia, tabulis synopticus illustrata in usum praelectionum Academiae Imperialis Medico-Chirurgicae Mosquensis. 3rd edition. Mosquae.
- GARMAN, S. 1899. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U. S. Fish Commission steamer ALBATROSS, during 1891, Lieut. Commander Z. L. Tanner, U. S. N., commanding. XXVI. The fishes. *Mem. Harvard Mus. Comp. Zool.* No. 24, 431 pp.
- GILBERT, C. H. 1891. A preliminary report on the fishes collected by the steamer ALBATROSS on the Pacific Coast of North America during the year 1889, with descriptions of twelve new genera and ninety-two new species. *Proc. U. S. Nat. Mus.* 13:49–126.
- . 1905. The deep-sea fishes of the Hawaiian Islands. *Bull. U. S. Fish. Comm.* 23[1903](2):575–713.
- GILL, T. 1863. Descriptions of some new species of Pediculati, and on the classification of the group. *Proc. Acad. Nat. Sci. Philadelphia* 15(2):88–92.
- GOLOVAN, G. A. 1978. Composition and distribution of the ichthyofauna of the continental slope of north-western Africa *Trudy Inst. Okeanol. Akad. Nauka SSSR* 111:195–258. [In Russian with English summary].
- GOODE, G. B. 1881. Fishes from the deep water on the south coast of New England obtained by the United States Fish Commission in the summer of 1880. *Proc. U. S. Nat. Mus.* 3:467–486.
- GOODE, G. B. AND T. H. BEAN. 1896. Oceanic Ichthyology. *Spec. Bull. U. S. Nat. Mus.* No. 2. 555 pp., plus atlas of plates.
- GUNTHER, A. 1887. Report on the deep-sea fishes collected by H. M. S. Challenger during the years 1873–76. *Report Scientific Results voyage H. M. S. Challenger 1873–76, Zoology*, 22(pt. 57), 268 pp.
- HAEDRICH, R. L. AND M. H. HORN. 1970. The morid fish *Halargyreus johnsonii* from the New York Bight. *J. Fish. Res. Bd. Canada* 27(2):391–393.
- HOESE, H. D. AND R. H. MOORE. 1977. Fishes of the Gulf of Mexico. Texas, Louisiana, and adjacent waters. Texas A&M Univ. Press. 327 pp.
- KOEFOD, E. 1927. Fishes from the sea-bottom. *Scient. Results Michael Sars No. Atlantic deep-sea Exped.* 1910, v. 4, pt. 2, no. 1:1–18.
- LEVITON, A. E., R. H. GIBBS, JR., E. HEAL, AND C. E. DAWSON. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia*, 1985(3):802–832.
- LEVITON, A. E. AND R. H. GIBBS, JR. 1988. Standards in herpetology and ichthyology. Standard symbolic codes for institution resource collections in herpetology and ichthyology. *Copeia* 88(1):280–282.
- LLOYD, R. E. 1909. A description of the deep-sea fish caught by the R. I. M. S. ship INVESTIGATOR since the year 1900, with supposed evidence of mutation in *Malthopsis*. *Mem. Indian Mus.* 2(3):139–180.
- MATALLANAS, J. 1987. Peces Marinos de Guinea-Bissau (Africa Noroccidental) capturados por el motopesquero LULU. Analisis zoogeografico. *Thalassas* 5(1):115–124.
- MENON, A. G. K. AND G. M. YAZDANI. 1968. Catalogue of type-specimens in the Zoological Survey of India, Part 2: Fishes. *Records of the Zoological Survey of India* 61, Parts 1, 2:91–190.

- NIJSSEN, H., L. VAN TUIJL, AND J. H. ISBRUCKER. 1982. A catalogue of the type-specimens of recent fishes in the Institute of Taxonomic Zoology (Zoologische Museum), University of Amsterdam, The Netherlands. Verslagen en technische gegevens, Instituut voor Taxonomische Zoologie (Zoologisch Museum) Universiteit van Amsterdam No. 33, 173 pp.
- NORMAN, J. R. 1939. Fishes. The John Murray Expedition 1933–34. Sci. Reports, John Murray Exped. 7(1):1–116.
- NUÑEZ, B. 1967. Sobre la presencia de una especie nueva de la familia Ogcocephalidae (Lophiiformes) en la costa Chilena. Revista Universidad del Norte, Chile 4:43–48.
- OKAMURA, O., K. AMAOKA, AND F. MITANI, eds. 1982. Fishes of the Kyushu-Palau Ridge and Tosa Bay. Japan Fisheries Resource Conservation Association. 435 pp.
- OKAMURA, O. AND T. KITAJIMA, eds. 1984. Fishes of the Okinawa Trough and the adjacent waters. Japan Fisheries Resource Conservation Association. 414 pp.
- PARIN, N. V. 1990. Preliminary review of fish fauna of the Nazca and Sala y Gomez submarine ridges (southern East Pacific Ocean). Tr. Inst. Okeanol. Akad. Nauka SSSR 125:6–36. [In Russian with English summary.]
- PAXTON, J. R., D. F. HOESE, G. R. ALLEN, AND J. E. HANLEY. 1989. Zoological catalogue of Australia. Vol. 7. PISCES. Petromyzontidae to Carangidae.
- PETERS, W. C. H. 1876. Ueber eine neue mit *Halieutaea* verwandete Fischgattung, *Dibranchus*, aus dem atlantischen Ocean. Monats. Konig. Acad. Wiss. Berlin (1875)736–742.
- PIETSCH, T. W. 1981. The osteology and relationships of the anglerfish genus *Tetrabrachium* with comments on lophiiform classification. Fishery Bull. 79(3):387–419.
- POLL, M. 1959. Expédition océanographique Belge dans les eaux côtières Africaines de l'Atlantique sud. (1948–1949). Résultats scientifiques 4(3B), Poissons, V. Téléostéens Acanthopterygiens Pt. 2. Inst. Roy. Sci. Nat. Belgique, Brussels.
- RADCLIFFE, L. 1912. New pediculate fishes from the Philippine Islands and contiguous waters. Proc. U. S. Nat. Mus. 42:199–214, pls. 22–31.
- REES, E. I. S. 1963. The batfish, *Dibranchus atlanticus* Peters, on the Canadian Atlantic slopes. J. Fish. Res. Bd. Canada 20(6):1513–1517.
- ROULE, L. 1916. Notice préliminaire sur quelques espèces nouvelles ou rares des Poissons provenant des croisières de S.A.S. le Prince de Monaco. Bull. de l'Inst. Océanographique No. 320. 32 pp.
- . 1919. Poissons provenant des campagnes du yacht PRINCESS-ALICE (1891–1913) et du yacht HIRONDELLE II (1914). Résultats des campagnes scientifiques Monaco 52:1–190.
- SMITH, M. M. AND P. C. HEEMSTRA, eds. 1986. Smith's Sea Fishes. Macmillan, South Africa. 1047 pp.
- UYENO, T., K. MATSUURA, AND E. FUJII, eds. 1983. Fishes trawled off Suriname and French Guiana. Japan Marine Fishery Research Center, National Science Museum, Tokyo, Japan. 519 pp.
- VAILLANT, L. 1888. Expéditions Scientifiques du "Travailleur" et de "Talisman" pendant les années 1880, 1881, 1882, 1883. Poissons. Paris. 406 pp.