

Record of the Bothid Flounder *Asterorhombus fijiensis* from the Western Pacific, with Observations on the Use of the First Dorsal-fin Ray as a Lure

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Abstract In the Indo-West Pacific bothid flounder *Asterorhombus fijiensis*, the first dorsal-fin ray is completely separated from the other rays and bears a membranous distal structure resembling a small fish or crustacean, both in morphology and coloration. A live specimen, the fourth known example of the species, was observed in its natural habitat and in an aquarium, and seen to repeatedly vibrate the membranous structure near its mouth. Although actual attraction of prey species was not observed, the first dorsal-fin ray and membranous structure are interpreted as an illicium and esca, structures used in aggressive mimicry for attracting prey. This is the only pleuronectiform species known to apparently lure prey with a modified first dorsal-fin ray. The species is redescribed in detail and generic characters presented. Its distribution is now known to be Fiji Islands, northern Mozambique, Western Australia and southern Japan. *Asterorhombus fijiensis* and *A. intermedius* are the only described species in the genus.

A bothid flounder was observed actively moving its first dorsal-fin ray, which bore an expanded membranous tip, on a coral-sand bottom off the Kerama Islands, Okinawa Prefecture. The specimen was collected alive for identification and behavioral observations (Fig. 1).

The first dorsal-fin ray lacked the membrane and pigmentation of the following rays, being entirely separated from them and resembling a movable illicium. Distally the ray had a membranous orange flap bearing tiny filaments and a pair of black, eye-like pigment spots near its proximal end. The structure resembled a small fish or crustacean, being very similar to the esca (bait) of the Indo-Pacific warty frogfish, *Antennarius maculatus* (Pietsch and Grobcker, 1978, 1987). An illicium and esca have never before been reported for a flatfish.

The fish was identified as *Asterorhombus fijiensis*, known previously from three specimens. In this paper, the species is redescribed in detail and generic characters presented, in addition to observations on the use and morphology of the illicium and esca.

Materials and Methods

The live specimen of *Asterorhombus fijiensis* was a male, 109.9 mm SL, captured on the north side of Gahi-to Island, Kerama Islands, Okinawa Prefecture, at a depth of 3 m on 21 March 1993. After the specimen was observed and photographed in an aquarium, it was fixed and preserved in formalin, and deposited in the collection at Izu Oceanic Park (IOP-3303).

The following comparative material was examined:

Asterorhombus fijiensis: BMNH 1879.5.14.89, holotype, sex unknown, 68.1 mm SL, Levuka, Fiji Islands, collected by H. M. S. "Challenger"; WAM P28028-013, female, 62.5 mm SL, Rowley Shoals, Clecke Reef, lagoon edge 2 km SE of Bedwell Island (17°18'S, 119°22'E), 1-2 m depth, August 8, 1983. *Asterorhombus intermedius*: BSKU 8376, male, 122.0 mm SL, Mimase, Kochi Pref., July 1, 1958; FAKU 17541, female, 103.5 mm SL, Miya, Aichi Pref., March 15, 1952; CSIRO CA3606, male, 91.7 mm SL, 20°31'S, 116°05'E, east of Monte Bello Islands, January 22, 1983; CSIRO CA3826, female, 98.9 mm SL, 19°40'S, 119°01'E, November 18, 1982.

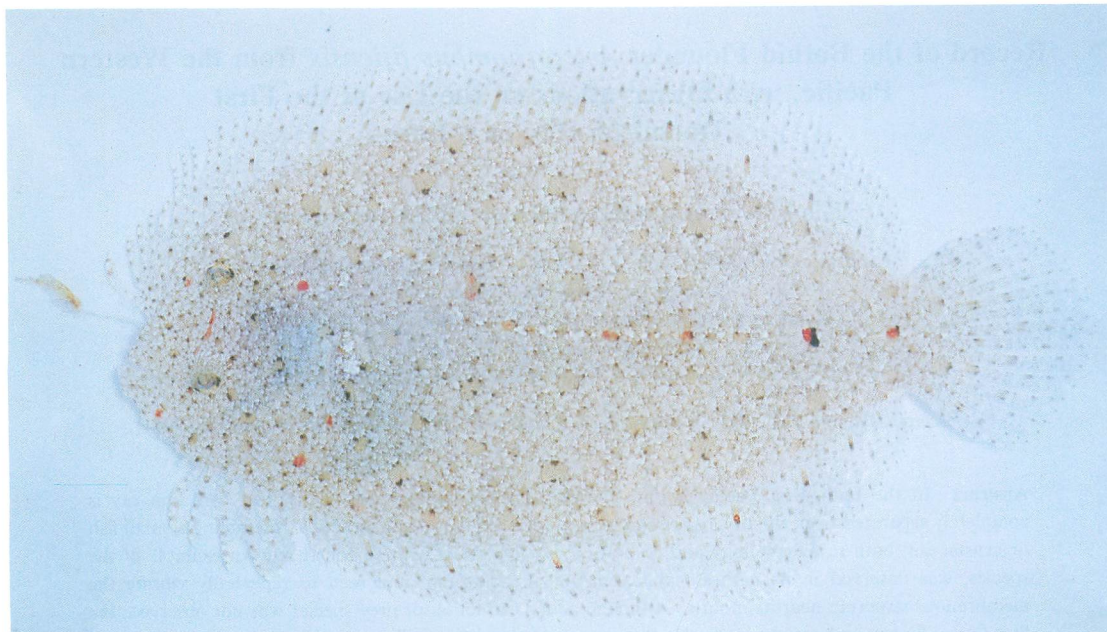


Fig. 1. Photographs of living specimen of *Astero rhombus fijiensis*. Top—IOP-3303, male, 109.9 mm SL, from Kerama Islands, Okinawa Prefecture; left—close-up of head with lure.

base to the last-ray base. The caudal skeleton and vertebral counts were examined by radiographs. Institutional abbreviations follow Leviton et al. (1985), except for IOP (Izu Oceanic Park).

Description

Body ovate, deepest at middle, depth somewhat more than half length of body; dorsal and ventral contours gently arched. Caudal peduncle deep, depth slightly more than 1/4 of body depth. Head rather large, length more than about 1/4 of SL; upper profile rather steep, with a slight notch at dorsal-fin origin. Snout long, length about twice eye diameter; somewhat enlarged at tip and deeply concave in front of interorbital area. Rostral and orbital spines absent. Eyes very small, diameter a little less than half upper-jaw length; lower eye in advance of upper. Interorbital region wide, deeply concave, width slightly less than twice eye diameter. Nostrils on

Counts and measurements follow those of Hubbs and Lagler (1958) with the exception that the pelvic-fin base lengths were measured from the first-ray

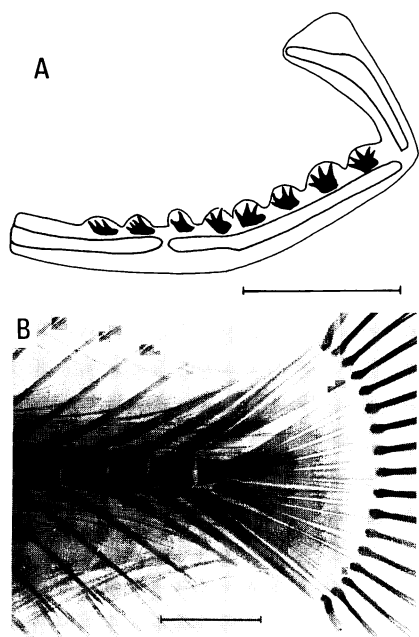


Fig. 2. A) Gill rakers of first gill arch; B) caudal skeleton of *Asterorhombus fijiensis*. Each scale bar indicates 5 mm.

ocular side above horizontal line through upper margin of lower eye, anterior nostril tubular with a flap posteriorly, posterior nostril more or less tubular; nostrils on blind side small, below 2nd dorsal ray, similar in shape to those on ocular side.

Mouth rather large, oblique and gently arched; maxilla extending almost to below anterior part of lower eye; anterior tip of lower jaw projecting slightly beyond tip of upper jaw when mouth closed. Some flaps on ventral margin of posterior half of lower jaw, anterior- and posteriormost larger than others. Teeth uniserial on both jaws; teeth on upper jaw somewhat enlarged anteriorly, becoming smaller, short and close-set posteriorly; teeth on lower jaw similar in size and space to anterior teeth on upper jaw. Gill rakers on 1st arch palmate, with 2 to 5 spines on each margin; no gill rakers on upper limb (Fig. 2A). Scales on ocular side moderate in size, with moderate ctenii; snout tip, both jaws, anterior dorsal-fin ray, and pectoral and pelvic fins naked; cycloid scales on blind side. Lateral line curved above pectoral fin on ocular side; length of curved portion about 2/3 and height about 1/3 of head length; lateral line absent on blind side.

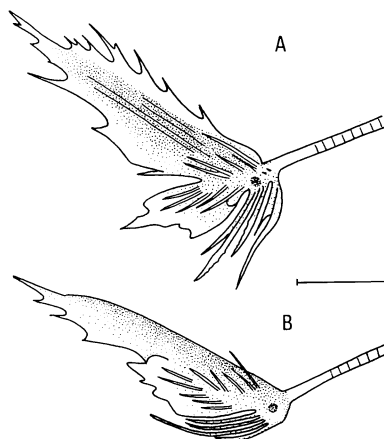


Fig. 3. Lure of first dorsal-fin ray of *Asterorhombus fijiensis*. A) Expanded; B) natural condition. Scale bar indicates 5 mm.

Dorsal fin originating on blind side, on horizontal line through middle of interorbital space; fin rays 2–10 increasing in length, subsequently decreasing in length to 25th fin ray, increasing in length to posterior 1/3 of body, and decreasing in length to last fin ray. First dorsal-fin ray (illicium) completely free from remaining rays, without usual fin-membrane or flaps; distal 1/10 of 1st ray supporting a large, laterally compressed leaf-like membrane (esca) (Fig. 3A), anterior 2/3 of margin of membrane folded posteroventrally (Fig. 3B); many tiny, compressed filamentous and membranous projections on ventral margin and lateral surface of esca (Fig. 3). Several following dorsal rays with membranes deeply incised, i.e. pinniform; free portions of these rays with many tiny filaments. Anal fin originating on vertical line along posterior margin of preopercular bone, similar in shape and structure to dorsal fin, except for anterior rays. Pectoral fin on ocular side small, subequal to half of head length; 1st ray shortest, 2nd ray longest; fin on blind side more feeble than that on ocular side, middle ray longest. Pelvic fins with 6 rays; fin on ocular side starting at tip of isthmus, anterior 3 rays pinniform with many tiny flaps on distal portion; fin on blind side starting next to 3rd ray of ocular side. Tip of isthmus on vertical line through anterior margin of lower eye. Caudal fin round, all rays branched, except for 2 upper- and lowermost rays. Vent opening on blind side, above origin of anal fin. Genital papilla on opposite side of vent.

Coloration in formalin.—Ground color on ocular

side whitish-gray, mottled with indistinct darker ocelli and numerous small, dark spots scattered on body; a distinct black spot on lateral line in front of caudal peduncle; median fins with many pale and dark spots. Blind side white, without markings.

Coloration in life (Fig. 1).—Ground color on ocular side light brown, mottled with brownish blotches and black spots; a distinct black spot on lateral line in front of caudal peduncle; 7 red spots on lateral line, 2 along opercular margin, 1 in front of upper eye, and 1 on middle of lower jaw; a vertical red band on interorbital concavity; a series of paler red spots on dorsal, anal, caudal and pelvic fins on ocular side. First dorsal ray (illicium) white; lateral side of esca, except for marginal portion, yellowish-red; a pair of tiny black spots at base of esca.

Distribution.—Fiji Islands (Günther, 1880; Norman, 1931), northern Mozambique (Hensley, 1984, 1986), Bedwell Island, Western Australia and Kerama Islands, Okinawa, Japan.

New Japanese name.—Taikoubou-daruma, meaning angler flounder.

Habitat and Behavioral Observations

The specimen was found in clear water at a depth of 3 m on a coral-sand bottom near many small, scattered reefs. Gobiid fishes (*Fusigobius* and *Gnatholepis* spp.) were observed near the flatfish. Fragments of sea-weeds collected by tidal currents were drifting near the bottom. When the flatfish was first seen on the bottom, its entire body was exposed on the sand. It repeatedly made short (ca. 1 cm) swimming advances, at the same time bringing the esca near its mouth and vibrating it, before depressing the illicium, thus moving the esca back onto the head. The fish repeated such movements of the illicium and esca many times. When approached closely by a diver, the fish swam rapidly, raising a cloud of sand.

Table 1. Morphometric proportions expressed as percent of SL and counts of *Asterorhombus fijiensis*

	Present specimen IOP-3303	Holotype BMNH 1879.5.14.89	WAM P28028-013
SL (mm)	109.9	68.1	62.5
Head length	28.3	28.2	30.2
Body depth	54.1	51.5	53.2
Snout length	9.3	8.7	8.8
Upper-eye diameter	4.5	5.1	6.4
Lower-eye diameter	4.5	5.0	6.4
Interorbital width	7.4	3.5	4.0
Upper-jaw length (o)	11.2	11.9	12.2
Upper-jaw length (b)	10.9	11.7	12.0
Lower-jaw length (o)	15.7	16.7	17.9
Lower-jaw length (b)	16.5	17.3	17.8
Caudal-peduncle depth	14.6	12.9	14.2
Pectoral-fin length (o)	15.0	14.8	16.2
Pectoral-fin length (b)	14.0	—	14.6
Pelvic-fin length (o)	14.6	15.4	16.0
Pelvic-fin length (b)	10.0	10.4	11.0
Pelvic-fin base length (o)	10.9	9.1	11.2
Pelvic-fin base length (b)	6.5	5.7	6.4
Longest dorsal-fin ray	13.9	—	15.7
Longest anal-fin ray	14.6	—	16.0
Dorsal-fin ray	81	82	82
Anal-fin rays	61	62	61
Pectoral-fin rays (o)	11	11	12
Pectoral-fin rays (b)	10	—	10
Scales in lateral line	54	58	52
Gill rakers on 1st arch	0+8	0+8	0+9
Vertebrae	10+26=36	10+26=36	10+26=36

o, ocular side; b, blind side.

It then stopped and swam backward for about 15 cm into the sand, becoming completely hidden, although its body outline was still slightly visible. Such behavior is very similar to that of *Bothus pantherinus* and *B. mancus*, two of the more common bothids living near coral reefs.

Discussion

Comparison of the present specimen with the holotype of *Asterorhombus fijiensis* (BMNH 1879.5.14.89; Norman, 1931) indicated no substantial differences, except for the interorbital width (Table 1). Like most bothids, this species probably shows positive allometric growth of the interorbital region.

Norman (1931, 1934) suggested that the species resembled *Arnoglossus intermedius* (= *Asterorhombus intermedius*, see Amaoka, 1969: 111) in the peculiar form of the gill rakers. Hensley (1984, 1986) moved the species from *Engyprosopon* to *Asterorhombus*, but gave no reason. Our examination of *A. fijiensis* and *A. intermedius*, has enabled a definition of the genus based on the following characters: no noticeable sexual dimorphism in interorbital width, fins, or rostral and orbital spines; palmate gill rakers (Fig. 2A); first dorsal-fin ray separated from other fin rays; no sexual differences in body coloration on blind side; and parhypural and hypural plates with deep clefts (Fig. 2B).

Following the species initial report as "*Rhomboidichthys* sp. (?)" by Günther (1880), based on one specimen from near the Fiji Islands, further examples were unknown until Hensley (1984, 1986) reported a single specimen from northern Mozambique. During this study, a specimen from Western Australia was also identified as *A. fijiensis*. Thus, the specimen discussed in this paper is the fourth known example of the species and the first record from the Western Pacific and Japan. However, *A. fijiensis* probably has a much wider distribution in the tropical and subtropical waters of the Indian and Pacific oceans. Because it is a relatively small species, living in sandy areas between and around coral reefs, it is likely that any future collections will be made by divers, rather than by trawls or seines.

The esca of *A. fijiensis* is a compressed, membranous, leaflike structure, resembling a small fish or crustacean. In its normal state (i.e. not artificially unfolded) the dorsal portion of the esca is folded,

causing the dorsal surface to be thicker than the ventral membranous area (Fig. 3B). Many small, compressed filaments are located along the ventral margin and sides, appearing to mimic the pectoral and pelvic fins of a small fish or the appendages of a small crustacean. The distal end of the esca is somewhat tapered, resembling the tail of a crustacean or fish. The coloration of the esca, yellowish-red dorsally and becoming much paler ventrally, follows the general pattern of coloration in marine animals. Spots, resembling a pair of dark eyespots, are present on the proximal portion.

Although the specimen was at no time observed to actually attract prey in its natural habitat or in the aquarium, judging from its movements, and the morphology and coloration of the esca, there seems to be no doubt that the species uses the latter structure in aggressive mimicry.

Among cases of aggressive mimicry utilizing a lure to attract prey, the evolutionary origins of the lures are very diverse (Randall and Kuitert, 1989), the following examples having been reported: dorsal fin of the scorpaenid, *Iracundus signifer* (Shallenberger and Madden, 1973), tongue of the ophichthid, *Glenoglossa wassi* (McCosker, 1982), first dorsal-fin ray of many families of lophiiform fishes (Norman, 1963: 40; Pietsch and Grobecker, 1978, 1987), a flap of skin in front of the mouth of the uranoscopid, *Uranoscopus oligolepis* (Norman, 1963: 95), and pectoral fin of various flatfishes (Randall, pers. comm. in Shallenberger and Madden, 1973). However, as far as we know, a lure formed from a modified first dorsal-fin ray is known only in the anglerfishes and *A. fijiensis*.

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ダルマガレイ科のタイコウボウダルマ（新称）の西部太平洋からの初記録とルアーとしての背鰭第1軟条の役割

尼岡邦夫・瀬能 宏・小野篤司

沖縄県慶良間諸島嘉比島北側、水深 3 m のサンゴ砂底で背鰭第1軟条を活発に動かし、口に引き寄せたり、離したりしているダルマガレイ科魚類が発見され、捕獲された。この個体はフィジー諸島、モザンビーク北部、西オーストラリアから知られていたタイコウボウダルマ（新称）*Asterorhombus fijiensis* に査定された。この個体は西部太平洋からの初めての記録であり、本種の4番目の標本である。本個体は詳しく再記載された。本種の背鰭第1軟条は他の鰭条のような鰭膜や色素を欠き、完全に他のものから分離していた。この軟条は先端部に小魚または小型の甲殻類に似たオレンジ色の膜状の皮弁を持ち、皮弁の基部近くに眼のような1対の小黒斑及び胸鰭・腹鰭または遊泳肢のように見える多くの小さい糸状物を備えていた。誘引突起（イリシウム）と擬餌状体（エスカ）を持った攻撃擬態をするカレイ目魚類はいままでに報告されたことはない。本種の帰属について、この種は両眼間隔、吻棘、眼棘および鰭に二次性徴を発現しないこと、鰓耙は手のひら状であること、背鰭第1軟条は他の鰭条から分離すること、無眼側の体色に二次性徴が発現しないこと、下尾骨と準下尾骨が分枝することなどの特徴によって、セイテンビラメ *A. intermedius* と共にセイテンビラメ属を構成すると考えるのが妥当である。

（尼岡：〒041 函館市港町 3-1-1 北海道大学水産学部水産動物学講座；瀬能：〒231 横浜市中区山下町 54 神奈川県立博物館；小野：〒901-34 沖縄県島尻郡座間味村字座間味 153）