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Redescription of *Diplogrammus xenicus* (Teleostei: Callionymidae) from Miyake-jima, Japan, with Ecological Notes

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Abstract *Diplogrammus xenicus* (Jordan et Thompson) was described in 1914 on the basis of a single specimen. Existing descriptions of the species are lacking in detail. In this paper, *D. xenicus* is redescribed with comments on its ecology and the extension of its known geographical range.

Jordan and Thompson (1914) described *Calymmichthys xenicus* on the basis of a single specimen from Sagami Bay, obtained in a Tokyo market in 1911. Later, Schultz (1960) synonymized this species with *Callionymus goramensis* Bleeker, but followed Gill (1865) referring *C. goramensis* to the genus *Diplogrammus*. He further stressed the necessity of examination of a series of specimens from Japan and other areas in order to clarify the relationships within this group. Ochiai (1963) treated *Diplogrammus xenicus* as a valid species. Kuroda (1951) reported the occurrence of this species in Suruga Bay. Nakabo (in press) gives in part a short description and illustrations of specimens from Sagami Bay and from Shirahama, Wakayama Prefecture.

As existing descriptions of *Diplogrammus xenicus* are incomplete, the species is redescribed in the present paper. Details of its known geographical distribution and ecology are included, as well as illustrations of both sexes and comparisons with other members of the genus.

Methods follow those used in Fricke (1980, 1981a). Repositories of materials examined are abbreviated as follows:
BM(NH)—British Museum (Natural History), London; FMNH—Field Museum of Natural History, Chicago; NMB—Staatliches Naturhistorisches Museum, Braunschweig; RMNH—Rijksmuseum van Natuurlijke Historie, Leiden; TMBS—Tatsuo Tanaka Memorial Biological Station, Miyake-jima, Tokyo.

Diplogrammus xenicus
(Jordan et Thompson, 1914)
(Japanese name: Kobu-numeri)
(Figs. 1～5)

Calymmichthys xenicus Jordan et Thompson, 1914: 296～297, pl. 36, fig. 2, Sagami Bay; Tanaka, 1931: 40; Kuroda, 1951: 386, Suruga Bay; Matsubara, 1955: 711; Lindberg and Krasyukova, 1975: 208, fig. 162 (after Jordan and Thompson, 1914).

Diplogrammus goramensis (part: non Bleeker, 1858): Schultz, 1960: 400 (compiled).

Diplogrammus xenicus: Ochiai, 1963: 70; Masuda et al., 1975: 260, pl. 84 A; Nakabo, 1982: 80 (listed); Nakabo (in press) (part: Sagami Bay and Shirahama material): description and illustration.

Material examined. NMB 37645, 2 males and 1 female, 61.2～94.9 mm SL (standard length), Igaya Bay, Miyake-jima, 34°05′N, 139°30°E, 16 m, M. J. Zaiser, Y. Yogo and J. T. Moyer, July 1981. TMBS 810716-1, 1 female, 61.5 mm SL, with same data as NMB 37645. TMBS 770813, 1 male, 105.5 mm SL, Igaya Bay, J. W. Shepard, Aug. 1977. TMBS 810824-1, 1 male, 30.75 mm SL, Igaya Bay, Miyake-jima, 13.5 m, M. J. Zaiser, Aug. 1981. TMBS 811017, 1 female, 66.0 mm SL, Igaya Bay, Miyake-jima, 13.5 m, M. J. Zaiser and J. T. Moyer, Oct. 1981. FMNH 57089 (formerly Carnegie Museum No. 6027), holotype, 103 mm SL, Tokyo market, from Sagami Bay, D. S. Jordan; this specimen was kindly examined by D. J. Stewart (FMNH, Chicago).

Description. D_1 IV; D_2 vii, 1; A vi, 1 (in one specimen iv, 1, i, 1); P_1 i～iii, 14～16 ii (total 18～20); P_2 I, 5; C (i) i, 7, ii (i). See Table 1 for proportions of the Miyake-jima specimens.

Body elongate and slightly depressed. Head slightly depressed, 4.0～4.5 in SL. Eye 2.4～4.3 in head, in young specimens relatively larger than in old specimens. Branchial opening oval, sublateral in position. Occipital region with a large bony plate. Maxilla in males with a large knob-like process. Preopercular spine with a small slightly upcurved main point, four to nine curved points on its dorsal side, a smooth ventral side, and a small antrorse spine at its base (formula $1\overset{4\text{-}9}{\underline{\ \ }}1$; see figs. 1B, 2B). Anal papilla in males elongate, in females small or not visible. Lateral line reaching from postorbital region to end of fourth branched caudal fin ray (counted from above); in postorbital region with one long ventral branch, along the side of the body with many large dorsal branches which may be interconnected by a further branch, and with many small ventral branches. Ventrolateral fold of skin present below the lateral line, reaching from above base of first anal fin ray to caudal fin base. Caudal peduncle length 4.3～5.0 in SL, caudal peduncle depth 13.0～15.4 in SL.

Table 1. Proportions of Miyake-jima specimens of *Diplogrammus xenicus*.

	In SL	% of SL
Predorsal (1) length	3.32～ 3.78	26.46～30.12
Predorsal (2) length	2.16～ 2.40	41.67～46.30
Preanal fin length	2.02～ 2.21	45.25～49.50
Prepelvic fin length	3.92～ 4.27	23.42～25.51
Head length	4.07～ 4.44	22.52～24.57
Body depth	6.28～ 8.54	11.71～15.92
Caudal peduncle length	4.36～ 4.96	20.16～22.94
Caudal peduncle depth	13.19～15.38	6.50～ 7.58
Caudal fin length	3.53～ 4.25	23.53～28.33
	In head length	% of head length
Eye diameter	2.45～ 4.28	23.36～ 40.82
Maxillary length	2.29～ 2.76	36.23～ 43.67
First D_1 spine (males)	0.58～ 1.04	96.15～172.41
First D_1 spine (females)	1.32～ 1.59	62.89～ 75.76
Second D_1 spine (males)	1.74～ 2.53	39.53～ 57.47
Second D_1 spine (females)	1.97～ 2.03	49.26～ 50.76
First D_2 ray (males)	1.27～ 1.42	70.42～ 78.74
First D_2 ray (females)	1.19～ 1.32	75.76～ 84.03
Last D_2 ray (males)	0.95～ 1.14	87.72～105.26
Last D_2 ray (females)	1.33～ 1.39	71.94～ 75.19

First spine of first dorsal fin elongate, with a long filament in males, a filament lacking or very short in females. First spine in males 0.55～1.05 in head, in females 1.3～1.6 in head. Second spine in males 1.7～2.6 in head, in females 1.9～2.1 in head. Predorsal (1) length 3.3～3.8 in SL. First ray of second dorsal fin in males lower than first dorsal fin spine, in females higher. Distal margin of second dorsal fin in males mostly straight, in females slightly concave. All rays unbranched, last divided at its base. Predorsal (2) length 2.1～2.4 in SL. Anal fin beginning on a vertical through second ray of second dorsal fin. Rays usually unbranched, last divided at its base. Preanal fin length 2.0～2.25 in SL. A large membrane connects the fifth pelvic fin ray with the mid of the pectoral fin base. Pectoral fin reaching back to base of second or third anal fin ray. Caudal fin distally convex, in males more elongate than in females. Caudal fin length 3.5～4.3 in SL.

Color in life: see figs. 4, 5.

Color in alcohol: Head and body light brown, with many whitish and dark spots and blotches. Ventral parts of body in females and young males light, in adult males brown, with blackish spots and lines. Lower parts of head and proximal parts of pelvic fins in large males also with blackish, white-edged spots and lines. Eye dark brown or grey, with black spots. First dorsal fin in males light brown, with indistinct darker lines; in females brown, with whitish blotches. Second dorsal fin of females translucent, each ray with a number of brown spots; in males with three narrow horizontal distal lines, on the anterior four membranes with large indistinct dark brown areas and black spots on the rays, and on the posterior membranes with small white blotches and larger dark spots on the rays. Anal fin in females translucent, in males dark brown, distally lighter with dark brown spots and lines. Pelvic fin in females with many dark spots, in males distally darkish and with dark areas on the membranes. Pectoral

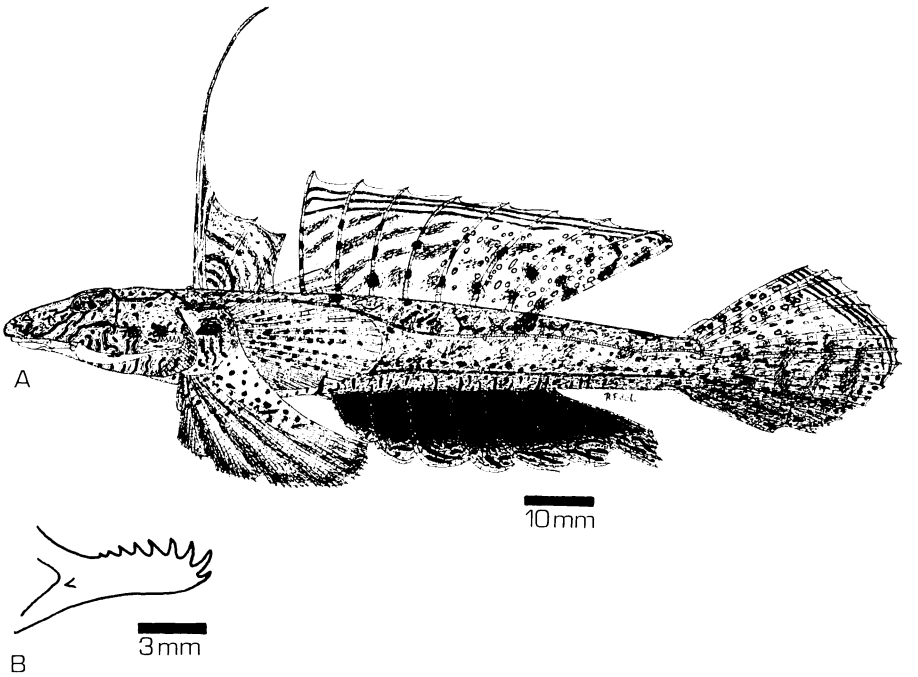

Fig. 1. *Diplogrammus xenicus* (Jordan et Thompson, 1914), TMBS 770813-5, male, 105.5 mm SL, Miyake-jima. A: Lateral view. B: Left preopercular spine.

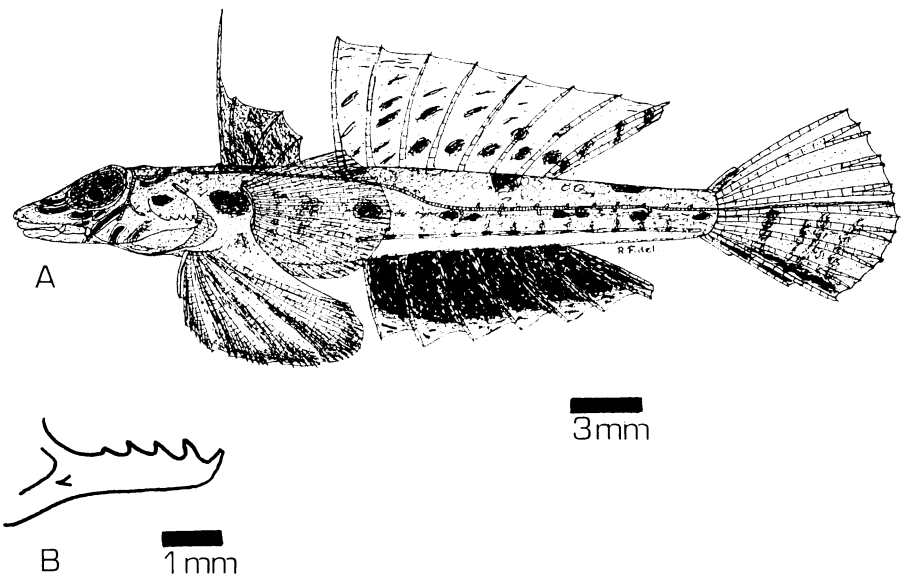

Fig. 2. *Diplogrammus xenicus* (Jordan et Thompson, 1914), TMBS 810824-1, male, 30.75 mm SL, Miyake-jima. A: Lateral view. B: Left preopercular spine.

fin translucent, occasionally with small blackish spots in the central part. Lower part of caudal fin dark, median part with four vertical darkish lines; in large males distal part of the upper half of the caudal fin narrow dark lines, and the upper one-third with small white and dark brown spots.

Sexual dimorphism: Size, shape and colora-

tion of the caudal fin, and shape and coloration of the first dorsal and pelvic fins are different in males and females. The anal fin is translucent in females, but very dark in males. Males also have white-edged dark brown spots and lines on the lower parts of the head. The anal papilla is more elongate in males.

Distribution and ecological notes

Diplogrammus xenicus is known from a few localities along the Japanese Pacific coast: it was previously reported only from Sagami and Suruga Bays. Its occurrence at Miyake-jima slightly extends the known geographical range southward to the Izu Islands. At Miyake-jima, the species was found between depths of 9～27 m, but areas below 27 m were not carefully surveyed. Probably, according to Nakabo (in press), the species also occurs further south, at Shirahama and in the Ryukyu Islands.

Diplogrammus xenicus is a benthic species, inhabiting substrates of mixed volcanic sand, broken shells, and coral fragments. Individual home ranges always include algae covered rocks or rubble, a small boulder, coral, or other types of low relief. Under normal conditions, it does not occur on broad unbroken stretches of bare sand. *D. xenicus* feeds on a wide variety of mysids and benthic organisms, which are abundant in this habitat. It is an isolate species (see Itzkowitz, 1974), normally foraging solitarily. It displays a variety of color patterns; each is cryptic on backgrounds within its habitat. *D. xenicus* is a pelagic spawner, breeding daily at dusk from June to October at Miyake-jima. Unlike *Callionymus*, it is frequently visible at midday during the breeding season. However, it is seldom seen from November, when it seems to spend most of the time buried in the sand. There appears to be heavy predation (mainly by the lizardfish *Synodus ulae*) on the species at Miyake-jima, the mortality rate being particularly high in males. The behavioral ecology of *D. xenicus* is described in detail in Zaiser (MS).

Comparison with allied species

Diplogrammus xenicus can be distinguished from the nearest allied species, *D. goramensis* (Bleeker) (Bleeker, 1858: 214, *Callionymus goramensis*; Beaufort & Chapman, 1951: 69～70, fig. 13; Schultz, 1960: 400～402, fig. 130) by its longer preopercular spine, its larger pectoral fin, its larger maximal body size, a bifurcate infraorbital lateral line canal (according to Nakabo, in press), the snout being not concave (lateral view), the broader head and body (seen from above), and various color markings (e.g. the characteristic blackish brown spots occuring on head, trunk, tail and some fins; presence of a large darkish blotch at the pectoral fin base).

From the Western Indian Ocean species, *D. gruveli* Smith (Smith, 1963: 551～552, fig. 2, pl. 86 G, Suez) and *D. pygmaeus* Fricke (Fricke, 1981 b: 685～692, figs. 1～2, South Arabian coast), *D. xenicus* differs by the shape of the first dorsal fin (three elongated rays without long filaments instead of only one elongated ray with a long filament), by a usually lower number of points at the dorsal side of the preopercular spine, and by a completely different color pattern. It is distinguishable from *D. infulatus* Smith (Smith, 1963: 550～551, pl. 83 E～I, Inhaca) by different shapes of the first dorsal fin and of the preopercular spine, different proportions and a completely different color pattern.

Callionymus cooki Günther (Günther, 1871: 665, Rarotonga; Günther, 1877: 192, pl. 113 B) is regarded by Nakabo (1982: 80, listed, *Diplogrammus cooki*) as a valid species distinguishable from *D. goramensis*. The first author of the present paper has, however, examined the type specimen of *C. cooki* (BM(NH) 1871.9.13.230) and found that Günther's original description was incorrect in some details. The holotype of *C. cooki* does not have branched rays in the second dorsal and anal fins (they are unbranched except the last which is divided at its base) but has an antrorse point at the base of its preopercular spine. Therefore, *Callionymus cooki* lacks features which distinguish it from *Diplogrammus goramensis* (2 syntypes, RMNH 4812, were also examined by the first author of the present paper), and is a junior synonym of that species.

Discussion

Schultz (1960: 400) regarded *Diplogrammus xenicus* as a junior synonym of *Diplogrammus goramensis*, but we are treating them as different species since they can be easily distinguished by

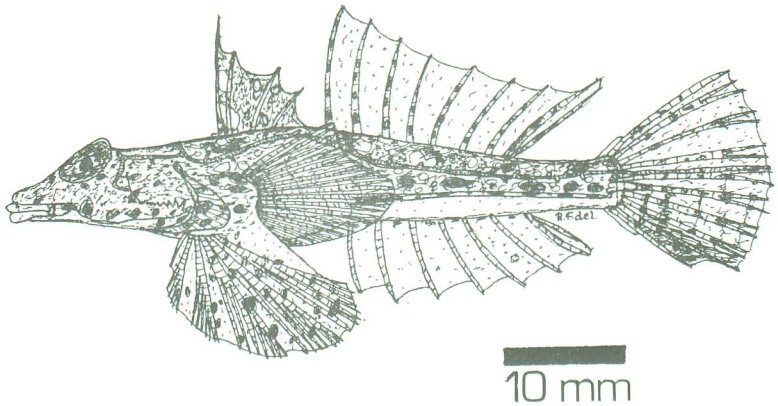

Fig. 3. *Diplogrammus xenicus* (Jordan et Thompson, 1914), TMBS 810716-1, female, 61.5 mm SL, Miyake-jima. Lateral view.

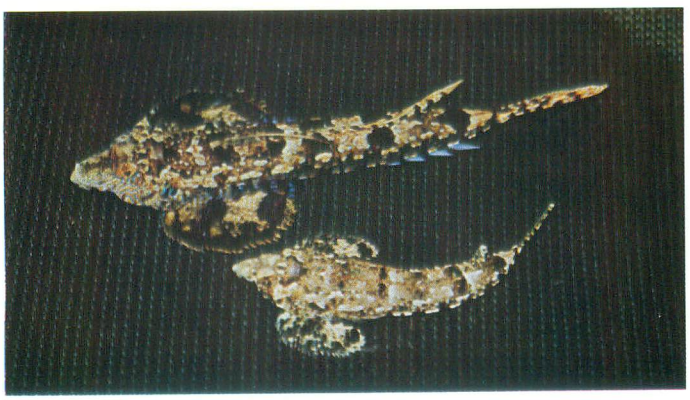

Fig. 4. *Diplogrammus xenicus* (Jordan et Thompson, 1914), male (above), female (below), Miyake-jima. Color in life, immediately after collection.

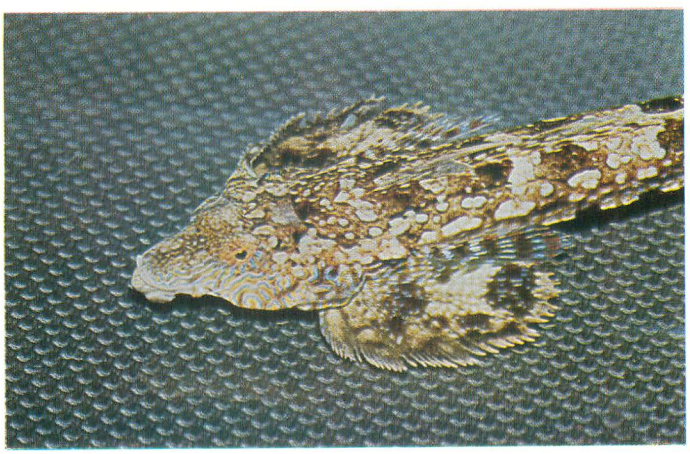

Fig. 5. *Diplogrammus xenicus* (Jordan et Thompson, 1914), male, Miyake-jima. View of head in living coloration, immediately after collection.

the features discussed above.

The "*D. goramensis*" specimens described by Ochiai (1963: 64～70, figs. 1, 3～6) and by Masuda et al. (1975: 260, pl. 84 B) may also belong to *Diplogrammus xenicus*, as indicated by Nakabo (in press). That would extend the known distribution range of *D. xenicus* southward to the Ryukyu Islands.

However, the "juvenile *Diplogrammus goramensis*" illustrated by Ochiai (1963: fig. 2) is not a juvenile *Diplogrammus* but an adult female of a *Synchiropus* of the *postulus* species group. As far as is known, juvenile *Diplogrammus* specimens possess the ventrolateral fold of skin and the free opercular flap of skin at a size of at least 12 mm SL.

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三宅島から採集されたネズッポ科 *Diplogrammus xenicus*

Ronald Fricke • Martha J. Zaiser

Jordan and Thompson (1914) により1個体に基づいて記載された *Diplogrammus xenicus* を三宅島から採集し，詳細な再記載をおこなった．また，本種の生態，分布についても論及した．

(Fricke: ドイツ連邦共和国; Zaiser: 100–12 東京都三宅島阿古　田中達男記念生物実験所)