Japanese Journal of Ichthyology
Vol. 23, No. 3 1976

魚類学雑誌
23巻3号 1976年

Sexual Dimorphism in a Triggerfish, *Balistapus undulatus*

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(Received June 3, 1976)

A triggerfish, *Balistapus undulatus* (Mungo Park), common in the Indo-Pacific, is characterized by having a number of more or less undulated orange bands on its dark body and two longitudinal rows of stout antrorse spines on the caudal peduncle. Among 71 specimens collected at Ishigaki-jima, Ryukyu Islands, in 1973 and 1974, and a juvenile from Rabaul, in New Britain, on February 27, 1972, the present author found two types in the species with regard to coloration and body form. In this paper, these types are checked in relation to sex and growth.

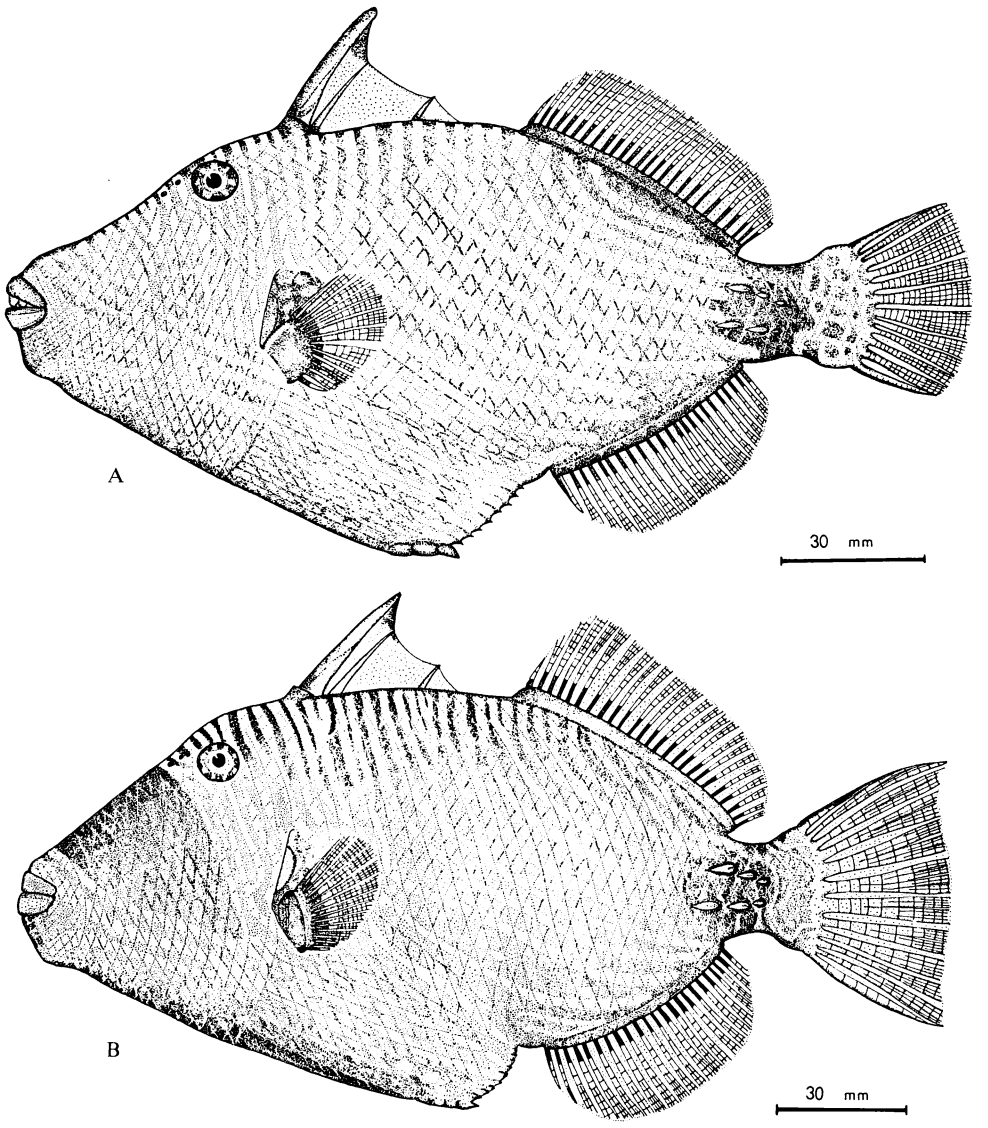

Fig. 1. *Balistapus undulatus* from Ishigaki-jima, Ryukyu Islands.
A: a female, 158.2 mm, August 17, 1974 (HUMZ 40619), showing the features of female and smaller male. B: a male, 177.6 mm, August 24, 1974 (HUMZ 40633), showing the features of larger male.

72 specimens used for the present study are deposited at the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ). Methods of measurements and counts followed the manner used for the family Balistidae by Berry and Baldwin (1966). The sex of each specimen was primarily determined through the gross examination of the gonad, and general histological study was made for the specimens in which the gonads were not developed enough to distinguish the sex.

Two types are first distinguished by the color pattern. One type has undulated orange bands on the snout and body (Fig. 1, A), and in an other bands are shown only on the body (Fig. 1, B). Further examination shows that two types are subdivided into following four groups associating with both size of body and sex:

A. 44 specimens, 150.6～226.5 mm in standard length, have no bands on the snout which is dark brown and straight or slightly convex in profile (Fig. 1, B). The diameter of the orbit is 4.7～6.8% of the standard length. All specimens were males as their gonads indicated.

B. 5 specimens, 133.5～158.7 mm in standard length, show the same features on the snout as the females (C), however, the diameter of the orbit ranges 5.7～7.0%. These specimens showed to be males in histological examination.

C. 22 specimens, 124.0～175.5 mm in standard length, have the concave profile of the snout with undulated orange bands (Fig. 1,A). The diameter of the orbit is 6.0～7.7%. These specimens proved to be females as their gonads indicated.

D. A juvenile, 41.8 mm in standard length, shows the same features on the snout as the females (C). The diameter of the orbit is 12.0%. The sex could not be determined even through histological examination.

It was found that males grow larger than females (Fig. 2), and the proportional diameter of the orbit in males becomes smaller with the growth of fish (Fig. 3).

In the present study, a juvenile shows the same features on the snout as females. Smaller males (group B) stand at the intermediate position between females (group C) and larger males (group A) in proportional diameter of the orbit (Fig. 3). However, smaller males show the same features in the coloration and form of the snout as females. The evidence of sex reversal

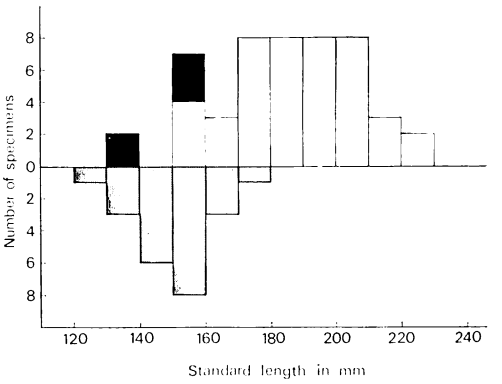

Fig. 1. Frequency polygons in size of adult *Balistapus undulatus* by sexes and sizes. Dark columns, smaller males (Group B); shaded, females (Group C); blank, larger males (Group A). A juvenile is excluded.

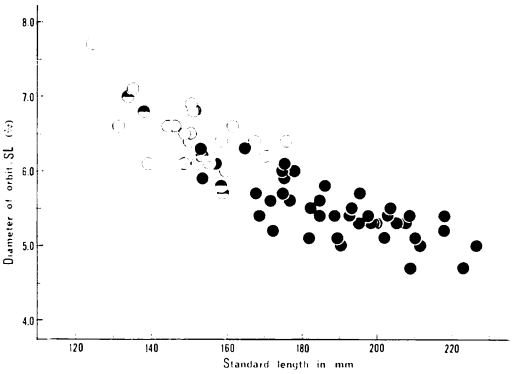

Fig. 3. Relationship between the diameter of orbit and the size of fish in *Balistapus undulatus* by sexes and sizes. Open circles indicating females (Group C), half solid circles smaller males (Group B), solid circles larger males (Group A). A juvenile is excluded.

was not found through the histological examination of the gonads in the present specimens. On the basis of these facts, it is clear that the juveniles of both sexes have a snout which is slightly concave in profile bearing the undulated orange bands. The changes of these characters in males are possibly associated with the growth of fish. At about 160 mm in standard length, the snout of males may become straight or slightly convex in profile and dark brown as the undulated orange bands tend to disappear; the snout of females retains the characteristics of the juvenile.

Kamohara (1940), Smith (1953), de Beaufort (1962), Abe (1963), Schultz (1966), and Axelrod and Emmens (1969) described or figured the coloration of the present species which corresponded to that of the larger males (group A). On the other hand, Fowler (1959) and Masuda et al. (1975) presented the figure of the species which shows the features of the smaller males and the females (groups B and C). Bagnis et al. (1972) and Burgess and Axelrod (1973) figured both types. Burgess and Axelrod (1973) also showed that the young differs from the adult in the coloration. However, these authors overlooked the species shows sexual dimorphism in the coloration and the body form.

The sexual dimorphism in the order Tetraodontiformes has been described in the various species belonging to the different families. In the family Balistidae, sexual dimorphism is observed in only four species, *Xanthichthys lineopunctatus* (=*X. mento*), *Sufflamen verres, Sufflamen fraenatus,* and *Melichthys niger* (Tanaka, 1931; Berry and Baldwin, 1966; Zama and Hattori, 1975; Moore, 1967). Three former species show distinct differences in the coloration, however, in the last species sexual dimorphism is found in the form of the lower jaw only. The juveniles of *S. verres* are rather similar to adult females in the coloration (Berry and Baldwin, 1966).

Acknowledgments

The author is indebted to Professor Takao Igarashi and Assistant Professor Kunio Amaoka of the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University for their valuable advice. He also wishes to express his thanks to Dr. Hitoshi Ida of the School of Fishery Sciences, Kitasato University who supplied him a juvenile specimen.

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クマドリの性的二形

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琉球諸島の石垣島から採集した 71 個体のクマドリの成魚とラバウルから得た 1 個体の幼魚の外部形態および生殖巣を調査した．これらの個体は，(1) 体側および吻部にオレンジ色の波状の色帯を持ち，吻部の背部外郭線が，やや凹状のもの，(2) 体側のみに色帯を持ち吻部は茶褐色で背部外郭線が，直線的かやや凸状のものに分けられた．(1) には，すべての雌，小形の雄および幼魚が含まれ，(2) には大形の雄が含まれた．また (1) の小形の雄の体長に対する眼径の割合は，大形の雄と雌のそれの中間の値を示した．これらのことからクマドリの斑紋と体形は，性と成長に関連して変化する事が明らかになった．即ち，雄では成長にとも

なって吻部の色帯が消失して茶褐色を呈し背部外郭線は，直線的かやや凸状となり，雌では幼魚の吻部の特徴は，成魚まで保持される。

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