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A Revision of Japanese Balistoid Fishes

I. Family Balistidae

By

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Balistoid fishes are widely distributed throughout the seas in the tropical and temperate regions, and are easily distinguishable from other teleostean fishes by having a single pelvic fin (MATSUURA, 1979).

With regard to the taxonomy of the balistoid fishes found around Japan, the first revisional work was made by JORDAN and FOWLER (1902). Subsequently, several authors (TANAKA, 1918; KAMOHARA, 1939, 1940; AOYAGI, 1950 a, b) added many balistoid species to the ichthyofauna of Japan. MATSUBARA (1955) gave a key to all these balistoid fishes which had been reported from the waters around Japan up to that time. This system, however, includes several mistakes, because it followed FRASER-BRUNNER's (1935, 1941) works in which he made errors in describing the characters used in the key to genera, and also in recognizing the genera. These errors have not been completely emended by any of the authors, although several papers were published to review some balistid and monacanthid genera (BERRY & VOGELE, 1961; RANDALL, 1964; BERRY & BALDWIN, 1966; RANDALL & KLAUSEWITZ, 1973; RANDALL *et al.*, 1978).

In order to clear up this situation, the taxonomic study on the Japanese balistoid fishes was made on the basis of specimens collected from the southern half of Japan and its adjacent waters. The present paper deals with the taxonomic problems on the fishes belonging to the family Balistidae. The fishes of the family Monacanthidae will be reported in the paper which is now in preparation.

Material and Methods

The specimens used for the present study are deposited at the following institutions: Department of Zoology, National Science Museum (Natural History), Tokyo (NSMT–P); Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ); Marine Science Museum, Tokai University (MSM); Ichthyological Laboratory, Tokyo University of Fisheries (TUFO). The data of the specimens are listed at the end of each species account.

Measurements were made with a needlepoint caliper and defined as follows (see also Fig. 1).

Standard length: From the tip of the snout to the caudal fin base.

Head length: From the tip of the snout to the upper end of the gill opening.

Snout length: From the tip of the snout to the nearest point of the orbit.

Depth of body: The vertical measurement at the origin of the anal fin which excludes the scaly sheath at the base of the second dorsal fin.

Greatest depth of body: The greatest vertical measurement, usually through the end of the incasing scales.

Width of body: The maximum width on body axis.

Snout to origins of first dorsal, second dorsal, and anal fins: From the tip of the snout to the anterior edge of each fin (excluding the basal scaly sheath).

Interdorsal space: Distance from the posterior edge of the first dorsal spine at its base to the origin of the first ray of the second dorsal fin (excluding the basal scaly sheath).

Bases of second dorsal and anal fins: From the anterior edge of the base of the first ray to the posterior edge of the base of the last ray (excluding the basal scaly sheath).

Length of gill opening: Distance between the upper and lower ends of the gill opening.

Eye diameter: The greatest width of the orbit, not of the eye itself.

Depth of caudal peduncle: The shortest vertical measurement of the peduncle.

Length of caudal peduncle: From the posterior edge of the base of the last ray of the anal fin to the caudal fin base.

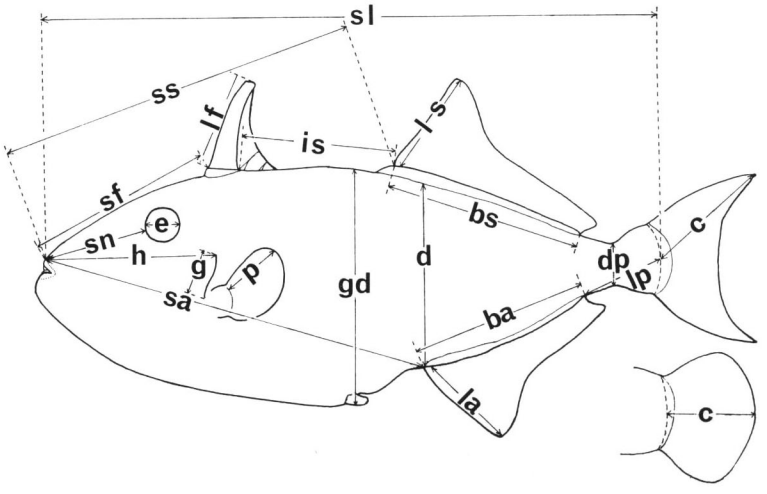

Fig. 1. Diagram showing measurements of the balistoids. ba, base of anal fin; bs, base of second dorsal fin; c, length of caudal fin; d, depth of body; dp, depth of caudal peduncle; e, eye diameter; g, length of gill opening; gd, greatest depth of body; h, head length; is, interdorsal space; la, length of longest anal fin ray; lf, length of first dorsal spine; lp, length of caudal peduncle; ls, length of longest second dorsal fin ray; p, length of pectoral fin; sa, snout to origin of anal fin; sf, snout to origin of first dorsal fin; sl, standard length; sn, snout length; ss, snout to origin of second dorsal fin.

Length of first dorsal spine: From the anterior edge of the base of the first dorsal spine (excluding the basal scaly sheath) to its distal tip.

Length of longest second dorsal and anal fin rays: From the upper edge of the basal scaly sheath of the longest ray to the distal tip of the ray.

Length of pectoral fin: From the anterior base of the longest ray to its distal tip.

Length of caudal fin: From the caudal fin base to the distal tip of the longest ray.

Counts were taken from the following characters.

Body scale rows: Counted from the upper end of the gill opening to the caudal fin base. The count includes the diagonal rows of small scales just behind the gill opening.

Head scale rows: Counted from the corner of the mouth to the lower end of the gill opening.

Pectoral fin rays: The count does not include the small rudimentary element at the uppermost base of the fin.

Second dorsal and anal fin rays: The total count of the fin rays.

The gill raker count is not given in the present paper, because it is impossible to obtain the count without causing great damage to specimens.

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YOSHINO of the University of the Ryukyus. To my wife, Yoko, I extend my heartfelt gratitude for translating papers on balistoids from Chinese to Japanese.

Key to the Families of Balistoidea

1(2) Body covered with more or less imbricate plate-like scales. First dorsal fin with three spines. Second dorsal and anal fins with branched rays. Incasing scales composed of four segments (Fig. 3). Seven teeth on each upper jaw, four in an outer row and three in an inner row. Four teeth on each lower jaw in a single row ..... Balistidae

2(1) Body covered with minute scales which are not arranged regularly. First dorsal fin with two spines, second spine very small (absent in the genus *Anacanthus*). Second dorsal and anal fins with unbranched rays. Incasing scales composed of one to three segments, or absent. Five teeth on each upper jaw, three in an outer row and two in an inner row. Two or three teeth on each lower jaw in a single row ..... Monacanthidae

Family **Balistidae**

Diagnosis. Body compressed, covered with more or less imbricate plate-like scales. Each scale with numerous small nodules and short longitudinal ridges (Fig. 2). First dorsal fin with three spines: the first spine long and stout; the second spine shorter than the first, locking the first when erect; the third spine short, sometimes not extending above the dorsal edge of body. Second dorsal and anal fins with branched rays. Incasing scales composed of four segments (Fig. 3), more or less movable dorso-ventrally. Teeth not coalesced: seven on each upper jaw, four in an outer row more or less pointed or notched, and three in an inner row plate-like; four on each lower jaw in a single row (Fig. 4). Vertebrae 7+11=18.

Remarks. FRASER-BRUNNER (1935) divided the balistid members into 13 genera, *Abalistes*, *Balistapus*, *Balistes*, *Balistoides*, *Canthidermis*, *Melichthys*, *Nematobalistes*,

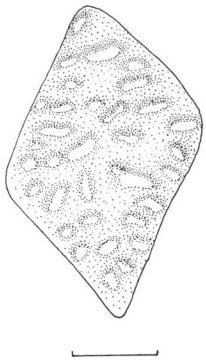

Fig. 2. Scale of *Sufflamen bursa* from below origin of second dorsal fin. Scale bar indicates 1 mm.

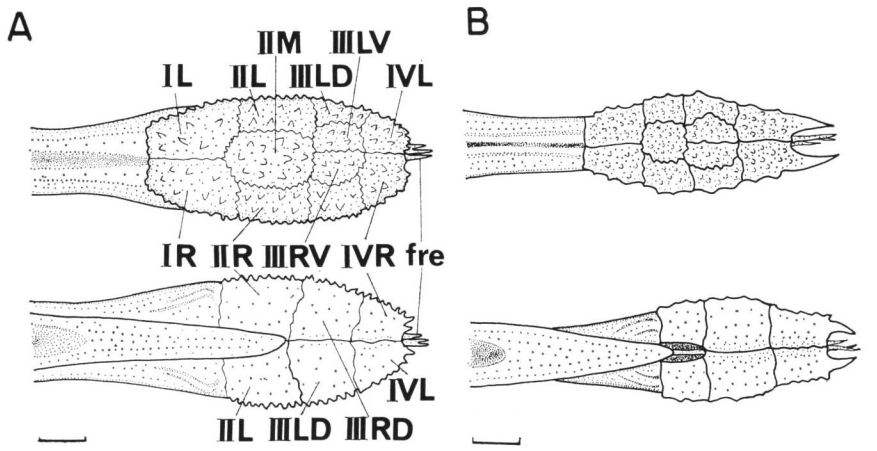

Fig. 3. Posterior end of the pelvis and incasing scales of: A, *Balistapus undulatus*; B, *Abalistes stellatus*. IL, I Left; IR, I Right; IIL, II Left; IIM, II Medial; IIR, II Right; IIILD, III Left Dorsal; IIILV, III Left Ventral; IIIRD, III Right Dorsal; IIIRV, III Right Ventral; IVL, IV Left; IVR, IV Right; fre, rudimentary fin ray element. Top, ventral view; bottom, dorsal view. Scale bars indicate 2 mm.

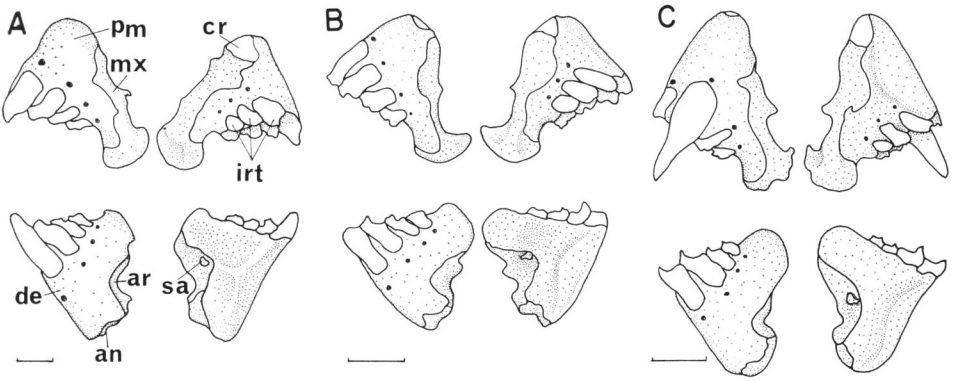

Fig. 4. Jaws of three balistid species. A, *Pseudobalistes flavimarginatus*; B, *Melichthys vidua*; C, *Odonus niger*. an, angular; ar, articular; cr, cartilage; de, dentary; irt, inner row of teeth; mx, maxillary; pm, premaxillary; sa, sesamoid articular. Left, lateral view; right, medial view; top upper jaw; bottom, lower jaw. Scale bars indicate 5 mm.

Odonus, *Pseudobalistes*, *Rhinecanthus*, *Sufflamen*, *Verrunculus* and *Xanthichthys*. DE BEAUFORT (1962) studied the Indo-Australian balistid species belonging to 11 genera by FRASER-BRUNNER's classification, and lumped them into a single genus *Balistes*. He accepted 11 generic names as subgenera seemingly in his key to the Indo-Australian

species of the family. BERRY and BALDWIN (1966), dealing with six balistid species found in the eastern Pacific, reviewed the part of FRASER-BRUNNER's classification, and found that the diagnostic characters for the genera *Nematobalistes* and *Verrunculus* are not sufficient to separate them from the other 11 genera. They concluded that both the generic names should be considered junior synonyms of the genus *Balistes*. Consequently, they accepted six of the 13 genera proposed by FRASER-BRUNNER, *Balistes*, *Canthidermis*, *Melichthys*, *Pseudobalistes*, *Sufflamen* and *Xanthichthys*, whereas they left the remaining five genera for future study because of the lack of materials. I accept the five genera, *Abalistes*, *Balistapus*, *Balistoides*, *Odonus* and *Rhinecanthus*, on the basis of a taxonomic study of materials collected from the waters around Japan and its adjacent regions. Thus, there are 11 genera in the family as described below.

Key to the Genera of Balistidae

1 (18) Enlarged osseous scales behind gill opening (Fig. 5).
2 (15) A deep groove before eye (Fig. 6).
3 (4) Teeth red, two upper lateral ones produced and canine-like (Fig. 4 C)..... *Odonus*
4 (3) Teeth white, not greatly produced.
5 (6) Anterior part of cheek largely naked, its posterior part covered with scales smaller than those of body..... *Pseudobalistes*
6 (5) Cheek entirely or except for a fold at the corner of mouth covered with scales.
7 (8) Caudal peduncle depressed, broader than depth..... *Abalistes*
8 (7) Caudal peduncle compressed, deeper than width.
9 (10) Teeth, at least anterior most ones, even and incisor-like..... *Melichthys*
10 (9) Teeth uneven, each one notched.
11 (12) Scales of body and tail without spines or large tubercles..... *Balistes* (not found in the waters around Japan and the Pacific)
12 (11) Scales, at least of tail, with spines or large tubercles.
13 (14) Large tubercles not extending forward beyond posterior portion of second dorsal fin. Caudal fin rounded..... *Balistoides*
14 (13) Large tubercles or small spines extending well forward on body. Caudal fin truncate or slightly emarginate..... *Sufflamen*
15 (2) No deep groove before eye.
16 (17) Third dorsal spine developed, extending above dorsal edge of body. Caudal peduncle with two longitudinal rows of large antrorse spines. Body dark with many undulated bands..... *Balistapus*
17 (16) Third dorsal spine minute, slightly extending above dorsal edge of body. Caudal peduncle with three to five longitudinal rows of small spines..... *Rhinecanthus*
18 (1) No enlarged osseous scales behind gill opening.
19 (20) Three to six longitudinal, somewhat diagonal grooves on cheek. Third dorsal

spine minute, not extending above dorsal edge of body.....*Xanthichthys*

20 (19) No grooves on cheek. Third dorsal spine developed, extending above dorsal edge of body .....*Canthidermis*

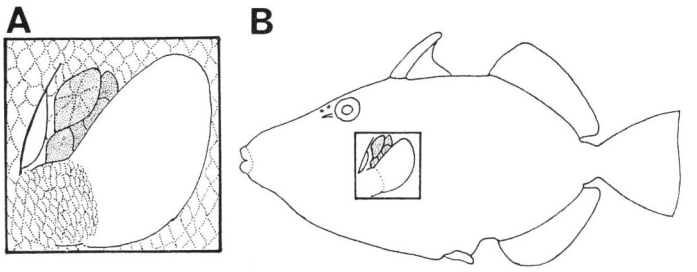

Fig. 5. Diagrams showing: A, size difference between enlarged osseous scales and normal body scales; B, position of enlarged osseous scales.

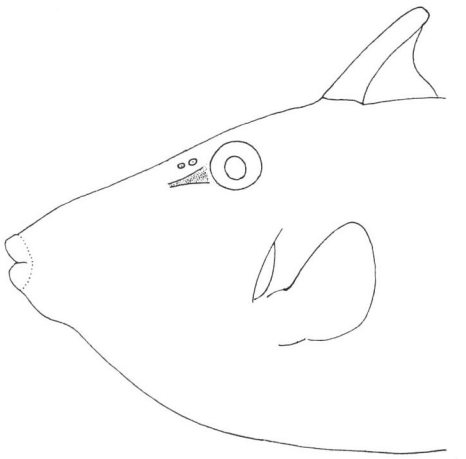

Fig. 6. Diagram showing position of a deep groove before eye represented by dotted area.

Genus ***Odonus*** GISTEL, 1848

Xenodon RÜPPELL, 1835, Neue Wirbelthiere, Fische des rothen Meeres, p. 52.
Zenodon SWAINSON, 1839, Nat. Hist .... Monocard. Anim., **2**, pp. 194, 325.
Odonus GISTEL, 1848, Naturg. des Thierreichs, **11** (type-species, *Xenodon niger* RÜPPELL, 1835).
Erythrodon RÜPPELL, 1852, Verz. Samml. Senckenb. Mus. Fische, p. 34.

Diagnosis, counts and proportional measurements, and *coloration*. See account of the single species, *O. niger*.

Remarks. A difficult problem concerning the generic name was clarified by HERRE (1924, pp. 447–448). His conclusion is as follows: The genus was first recognized in 1835 by RÜPPELL, who called it *Xenodon*, a name preoccupied in reptiles. SWAINSON's

misprint of it in 1839 as *Zenodon* cannot be accepted as a valid substitute, while RÜPPELL's appropriate name of *Erythrodon*, proposed in 1852, is preceded by the name *Odonus*.

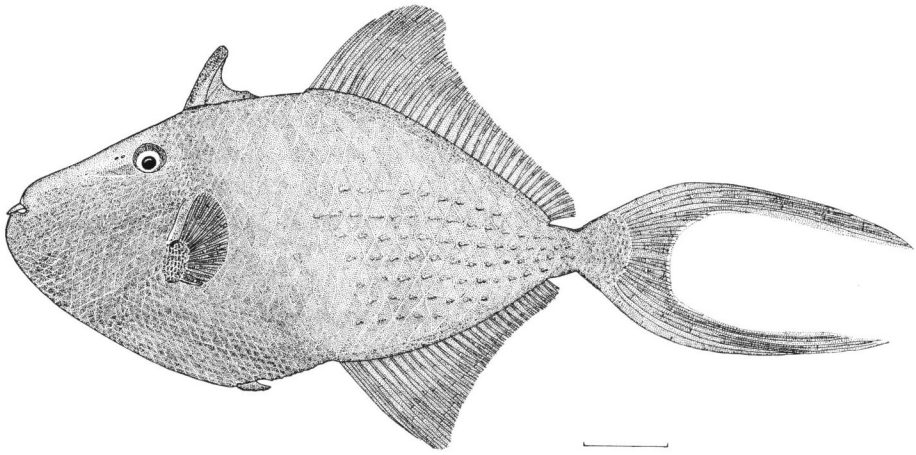

Fig. 7. *Odonus niger*, 207.7 mm SL, Okinawa Island, HUMZ 40583. Scale bar indicates 30 mm.

Odonus niger (RÜPPELL, 1835)

[Japanese name: Aka-mongara]

(Fig. 7)

Baliste noir LACEPÈDE, 1798, Hist. Nat. Poissons, **1**, pp. 335, 378, pl. 15, fig. 2 (varnacular name only).
Xenodon niger RÜPPELL, 1835, Neue Wirbelthiere, Fische des rothen Meeres, p. 53, pl. 14, fig. 3.
Erythrodon niger: RÜPPELL, 1852, Verz. Samml. Senckenb. Mus. Fische, p. 34.
Balistes erythrodon GÜNTHER, 1870, Cat. Brit. Mus., **8**, p. 228.
Zenodon caeruleorum FOWLER, 1904, J. Acad. nat. Sci. Phila., (2), **12**, p. 456, pl. 43.
Odonus niger: HERRE, 1924, Philip. J. Sci., **25**, p. 448, pl. 1, fig. 2.
Odonus erythrodon: FOWLER, 1928, Mem. Bishop Mus., **10**, p. 455.

Diagnosis. A species of the balistids with the following combination of characters: mouth somewhat superior, chin prominent; teeth red, two upper lateral ones produced, canine-like; enlarged osseous scales behind gill opening; a deep groove before eye, below nostrils; caudal fin lunate, upper and lower marginal lobes greatly produced into filaments; ground color of body bluish black.

Counts and proportional measurements. D. III, 33–35; A. 28–31; P. 14 (rarely 15); body scale rows 29–34; head scale rows 19–23; vertebrae 7+11=18. Greatest depth of body 1.81–2.16; depth of body 2.17–3.22; width of body 4.78–6.54; head length 3.27–3.48; snout length 4.23–4.80; snout to origin of first dorsal fin 2.94–3.30; snout to origin of second dorsal fin 1.81–2.00; snout to origin of anal fin 1.49–1.66; base of second dorsal fin 2.06–2.26; base of anal fin 2.58–3.22; length of caudal fin 1.54–

2.73 — all in standard length (SL).

Eye diameter 4.21–6.37; interorbital width 2.80–3.14; length of gill opening 2.51–3.29; length of caudal peduncle 2.14–2.48; depth of caudal peduncle 3.81–4.72; length of first dorsal spine 1.74–2.24; length of longest (third to fifth) second dorsal fin ray 1.08–1.76; length of longest (third to fifth) anal fin ray 1.27–1.52; interdorsal space 1.55–1.89; length of pectoral fin 2.86–3.67 — all in head length (HL).

Coloration. Ground color of body bluish black; posterior margin of caudal fin white or sky blue; teeth red.

Distribution. South of Sagami Bay. Rather common in the Indo-western Pacific.

Material examined. 15 specimens, 107.2–226.4 mm SL. HUMZ 38670, Naha, Okinawa Is., Ryukyu Isls., 18 March 1974; HUMZ 38726, Ishigaki Is. (24°25′N, 124° 10′E), Ryukyu Isls., 4 May 1974; HUMZ 40574, 40575, Okinawa Is., Ryukyu Isls., date unknown; HUMZ 40576, 40577, Ishigaki Is., Ryukyu Isls., March 1974; HUMZ 40578, 40579, Naha, Okinawa Is., Ryukyu Isls., 13 April 1973; HUMZ 40580, 40582, 40583, Ishigaki Is., Ryukyu Isls., March 1974; HUMZ 40584, Naha, Okinawa Is., Ryukyu Isls., 17 April 1974; HUMZ 40585, Chinen, Okinawa Is., Ryukyu Isls., 6 March 1974; HUMZ 46136, Ishigaki Is., Ryukyu Isls., 1975; HUMZ 48749, Naha, Okinawa Is., Ryukyu Isls., 13 April 1973.

Genus ***Pseudobalistes*** BLEEKER, 1866

Pseudobalistes BLEEKER, 1866, Ned. Tijdschr. Dierk., **3**, p. 11 (type-species, *Balistes flavimarginatus* RÜPPELL, 1828).

Diagnosis. A genus of the balistids with the following combination of characters: mouth terminal; teeth white, uneven, each one notched; enlarged osseous scales behind gill opening; a shallow or deep groove before eye, below nostrils; cheek naked anteriorly, posteriorly covered with scales smaller than those of body; second dorsal and anal fins rounded or elevated anteriorly.

Remarks. This genus is represented by three species, *P. flavimarginatus*, *P. fuscus* and *P. naufragium*. The former two species are found in the Indo-western Pacific, while the last species is confined to the eastern Pacific (BERRY & BALDWIN, 1966).

Key to the Japanese Species of *Pseudobalistes*

1 (2) Small spines forming five or six longitudinal rows on caudal peduncle. Second dorsal and anal fins rounded, not elevated anteriorly..... *P. flavimarginatus*

2 (1) No spines on caudal peduncle. Second dorsal and anal fins elevated anteriorly ..... *P. fuscus*

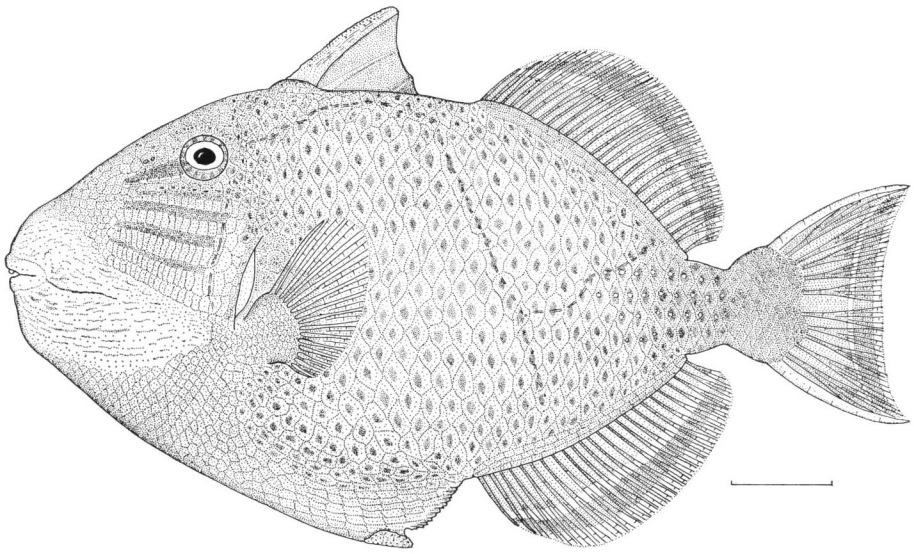

Fig. 8. *Pseudobalistes flavimarginatus*, 220.7 mm SL, Ishigaki Island, HUMZ 39203. Scale bar indicates 30 mm.

Pseudobalistes flavimarginatus (RÜPPELL, 1828)

[Japanese name: Kiheri-mongara]

(Fig. 8)

Balistes flavimarginatus RÜPPELL, 1828, Atlas Reise N. Afrika, p. 33.
Balistes Beeri BLEEKER, 1860, Acta. Soc. Sci. Indo-Neerl., **8**, Dertiende bijdr. kennis vischfauna Celebes, p. 53.
Balistes (*Pseudobalistes*) *flavomarginatus*: BLEEKER, 1865, Altas Ichth., **5**, p. 113, pl. 218, fig. 3, pl. 224, fig. 3.
Balistes papuensis MACLEAY, 1884, Proc. Linn. Soc. N. S. Wales, **8**, p. 279.
Pseudobalistes flavimarginatus: JORDOAN & FOWLER, 1902, Proc. U. S. Natn. Mus., **25** (1287), p. 257.
Balistes flavomarginatus: JORDAN & SEALE, 1906, Bull. Bur. Fish., **25**, p. 362.
Rhinecanthus papuensis: FOWLER, 1949, Mem. Bishop Mus., **12**, p. 154.
Pseudobalistes flavomarginatus: SMITH, 1949, Sea Fishes of S. Africa, p. 409.

Diagnosis. A species of *Pseudobalistes* with the following combination of characters: small spines forming five or six longitudinal rows on caudal peduncle; shallow horizontal grooves on upper part of cheek; second dorsal and anal fins rounded, not elevated anteriorly.

Counts and proportional measurements. D. III, 24–26; A. 24; P. 15; body scale rows 28–33; vertebrae 7+11=18. Greatest depth of body 1.63–1.80; depth of body 2.05–2.15; width of body 4.62–5.79; head length 2.55–2.81; snout length 3.40–3.60; snout to origin of first dorsal fin 2.21–2.37; snout to origin of second dorsal fin 1.43–

1.52; snout to origin of anal fin 1.36–1.47; base of second dorsal fin 2.84–2.91; base of anal fin 3.03–3.18; length of caudal fin 3.83–4.13 — all in SL.

Eye diameter 5.42–6.09; interorbital width 2.96–3.05; length of gill opening 2.59–2.74; length of caudal peduncle 2.57–2.84; depth of caudal peduncle 3.50–3.93; length of first dorsal spine 1.77–1.95; length of longest (fourth) second dorsal fin ray 2.06–2.20; length of longest (third or fourth) anal fin ray 2.01–2.19; interdorsal space 1.55–1.69; length of pectoral fin 2.63–2.68 — all in HL.

Coloration. Ground color of body yellowish light brown; each scale of body and tail with a dark green spot; first dorsal fin yellowish light brown; second dorsal and anal fins dark green with a marginal orange band; pectoral fin green with a marginal orange band; caudal fin dark green with a marginal orange band.

Distribution. South of Sagami Bay. Widespread in the Indo-western Pacific.

Material examined. Four specimens, 180.8–220.7 mm SL. HUMZ 38656, 40557, Ishigaki Is., Ryukyu Isls., 29 July 1973; HUMZ 39203, Ishigaki Is., Ryukyu Isls., 23 August 1974; HUMZ 41325, Ishigaki Is., Ryukyu Isls., 28 April 1975.

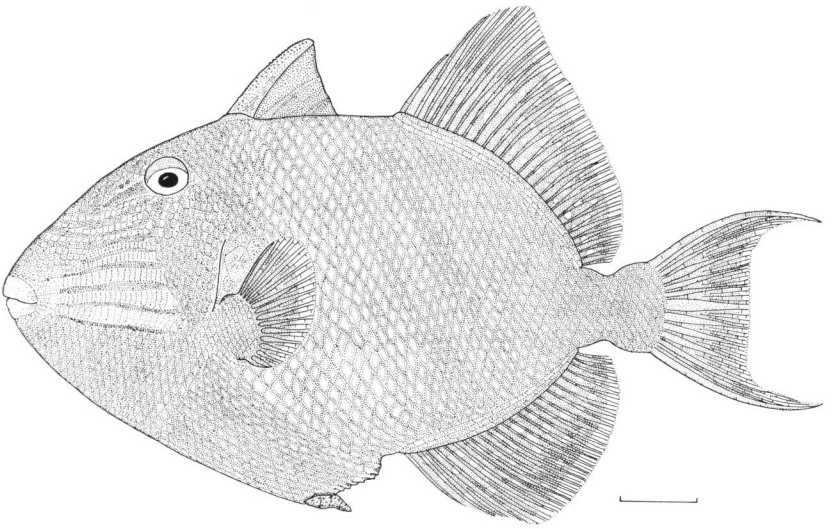

Fig. 9. *Pseudobalistes fuscus*, 231.1 mm SL, Ishigaki Island, HUMZ 38699. Scale bar indicates 30 mm.

Pseudobalistes fuscus (BLOCH et SCHNEIDER, 1801)

[Japanese name: Iso-mongara]

(Fig. 9)

Balistes fuscus BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 471.
Balistes chrysopilus BLEEKER, 1853, Nat. Tijdschr. Ned. Indië., **5**, p. 94.
Balistes reticulatus HOLLARD, 1854, Ann. Sci. nat., (Zool.), (4), **1**, p. 312.

Balistes (Parabalistes) chrysopilus: BLEEKER, 1865, Atlas Ichth., **5**, p. 111, pl. 225, fig. 3.
Xanthichthys fuscus: FOWLER, 1949, Mem. Bishop Mus., **12**, p. 154.
Pseudobalistes fuscus: SMITH, 1949, Sea Fishes of S. Africa, p. 410, pl. 91.

Diagnosis. A species of *Pseudobalistes* with the following combination of characters: no spines on caudal peduncle; second dorsal and anal fins much elevated anteriorly; shallow horizontal grooves on lower part of cheek.

Counts and proportional measurements. D. III, 25–27; A. 19–24; P. 14; body scale rows 35–46; vertebrae 7+11=18. Greatest depth of body 1.52–1.92; depth of body 1.77–2.16; width of body 4.01–5.20; head length 2.30–2.67; snout length 2.96–3.53; snout to origin of first dorsal fin 2.04–2.44; snout to origin of second dorsal fin 1.31–1.50; snout to origin of anal fin 1.24–1.45; base of second dorsal fin 2.43–3.00; base of anal fin 2.92–3.84; length of caudal fin 2.59–4.23 — all in SL.

Eye diameter 5.06–6.14; interorbital width 3.12–3.70; length of gill opening 2.87–3.27; length of caudal peduncle 2.46–3.34; depth of caudal peduncle 3.47–3.74; length of first dorsal spine 1.78–2.08; length of longest (fourth or fifth) second dorsal fin ray 1.50–1.78; length of longest (third to fifth) anal fin ray 1.66–1.98; interdorsal space 1.48–1.64; length of pectoral fin 2.52–3.18 — all in HL.

Coloration. Ground color of body dark brown, scales with a dusky yellow spot; pectoral, second dorsal, anal, and caudal fins dark with a marginal yellow band.

Distribution. South of Wakayama Prefecture. Widespread in the Indo-western Pacific.

Material examined. 10 specimens, 175.3–337.5 mm SL. HUMZ 38651, Yonagusuku, Okinawa Is., Ryukyu Isls., 6 April 1974; HUMZ 38663, 38699, 38743, Ishigaki Is., Ryukyu Isls., 14 March 1974; HUMZ 38711, Ishigaki Is., Ryukyu Isls., 4 May 1974; HUMZ 38719, Nakaoji, Okinawa Is., Ryukyu Isls., August 1973; HUMZ 38725, 40560, Yonagusuku, Okinawa Is., Ryukyu Isls., 10 March 1974; HUMZ 40559, Ishigaki Is., Ryukyu Isls., 27 July 1973; HUMZ 46129, Ishigaki Is., Ryukyu Isls., 1975.

Genus ***Abalistes*** JORDAN et SEALE, 1906

Leiurus SWAINSON, 1839, Nat. Hist . . . . Monocard. Anim., **2**, p. 326.
Abalistes JORDAN et SEALE, 1906, Bull. Bur. Fish., **25**, p. 364 (type-species, *Balistes stellaris* BLOCH et SCHNEIDER, 1801=*Balistes stellatus* [LACEPÈDE], 1798).

Diagnosis, counts and proportional measurements, and *coloration.* See account of the single species, *A. stellatus.*

Remarks. SWAINSON (1839, p. 326) recognized the genus *Leiurus* based on *Lama yellakah* RUSSELL, 1803=*Abalistes stellatus* ([LACEPÈDE], 1798). However, he also used the same generic name *Leiurus* for the fishes of the Gasterosteidae on p. 242 of the same article. In other words, the generic name *Leiurus* for the present species was preoccupied by the gasterosteids.

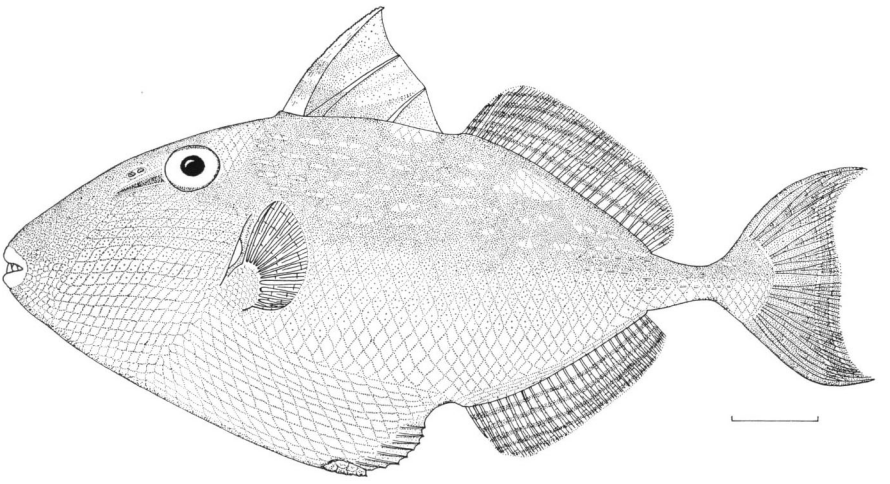

Fig. 10. *Abalistes stellatus*, 247.2 mm SL, South China Sea, HUMZ 38305. Scale bar indicates 30 mm.

Abalistes stellatus ([LACEPÈDE], 1798)

[Japanese name: Oki-hagi]

(Fig. 10)

Balistes stellatus [LACEPÈDE], 1798, Allgemeine Literature-Zeitung, **3** (288), p. 682 (based on vernacular name "Baliste étoilé" LACEPÈDE, 1798, Hist. Nat. Poissons, **1**, pp. 333, 350, pl. 15, fig. 1).
Balistes stellaris BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 476.
Balistes Vachellii RICHARDSON, 1844, Zool. Voyage Sulphur, Fishes, p. 129.
Balistes phalreatus RICHARDSON, 1846, *in* STOKES, Discover. Australia, **1**, p. 484, pl. 1, figs. 4–5.
Balistes forcipatus BLEEKER, 1859, Act. Soc. Sci. Indo-Neerl., **6**, Enumeratio specierum piscium, p. 191.
Leiurus stellatus: BLEEKER, 1865, Atlas Ichth., **5**, p. 105.
Abalistes stellaris: JORDAN & SEALE, 1906, Bull. Bur. Fish., **25**, p. 364.
Abalistes stellatus: WHITLEY, 1941, Austr. Zool., **10** (1), p. 48.

Diagnosis. A species of the balistids with the following combination of characters: mouth terminal; teeth white, uneven, each one notched; enlarged osseous scales behind gill opening; a deep groove before eye, below nostrils; caudal peduncle depressed, broader than depth; caudal fin double-emarginate, in large specimens upper and lower marginal lobes produced into filaments.

Counts and proportional measurements. D. III, 25–27; A. 24–25; P. 14 (rarely 15); body scale rows 33–41; head scale rows 27–32; vertebrae 7+11=18. Greatest depth of body 2.03–2.53; depth of body 2.21–3.17; width of body 5.64–6.69; head length 2.72–3.03; snout length 3.96–4.48; snout to origin of first dorsal fin 2.49–2.78; snout to origin of second dorsal fin 1.56–1.67; snout to origin of anal fin 1.55–1.70; base of second dorsal fin 3.06–3.46; base of anal fin 3.37–3.70; length of caudal fin 2.67–4.83 — all in SL.

Eye diameter 3.55–5.10; interorbital width 2.70–3.40; length of gill opening 2.96–3.62; length of caudal peduncle 1.91–2.49; depth of caudal peduncle 7.89–9.57; length of first dorsal spine 1.59–1.91; length of longest (third or fourth) second dorsal fin ray 2.63–3.50; length of longest (third) anal fin ray 2.97–3.79; interdorsal space 1.39–1.65; length of pectoral fin 2.67–4.83 — all in HL.

Coloration. Body brown, lighter below; many small blue spots on back, scales on ventral part of body with a light blue line; at least in young specimens three white blotches on back, the first below first dorsal spine, the second below inter-space between third spine and second dorsal fin, the third below middle of second dorsal fin; first dorsal fin brown with white lines, second dorsal and anal fins brown with several longitudinal white lines; caudal fin dark brown with some narrow white lines; pectoral fin yellow.

Distribution. South of Suruga Bay. Widespread in the Indo–western Pacific.

Material examined. 19 specimens, 193.0–391.0 mm SL. HUMZ 38301, 38302, 38304–38307, 38309, 38311, 38312, 38314, 03°40′N, 109°08′E, 16 November 1973; HUMZ 38303, 38313, 38322, 03°34′N, 109°20′E, 16 November 1973; HUMZ 38706, Naha, Okinawa Is., Ryukyu Isls., 5 April 1974; HUMZ 50123, 03°13′N, 109°09′E, 12 November 1975; HUMZ 68923–68926, Itoman, Okinawa Is., Ryukyu Isls., 9 March 1974.

Genus *Melichthys* SWAINSON, 1839

Melichthys SWAINSON, 1839, Nat. Hist . . . . Monocard. Anim., **2**, p. 325 (type-species, *Balistes ringens* OSBECK, 1765 = *Balistes niger* BLOCH, 1786).
Melanichthys GÜNTHER, 1870, Cat. Brit. Mus., **8**, pp. 212, 227.
Oncobalistes FOWLER, 1946, Proc. Acad. nat. Sci. Phila., **98**, p. 213.

Diagnosis. A genus of the balistids with the following combination of characters: mouth terminal; teeth white, at least anterior most ones even and incisor-like; enlarged osseous scales behind gill opening; a deep groove before eye, below nostrils; third dorsal spine minute, slightly extending above dorsal edge of body; ground color of body dark brown or black.

Remarks. This genus is represented by three species, *M. vidua*, *M. niger* and *M. indicus*. The first is found in the Indo-Pacific area, the second in the circumtropical regions, but the last is confined to the Indian Ocean (RANDALL & KLAUSEWITZ, 1973).

Key to the Japanese Species of *Melichthys*

1 (2) Second dorsal and anal fins pale with a prominent black margin. Caudal fin pale, slightly emarginate or slightly rounded. Pectoral rays 14 (rarely 15). . . . . *M. vidua*

2 (1) Second dorsal and anal fins black with a longitudinal light blue line at base. Caudal fin black, deeply emarginate or lunate. Pectoral rays 15 or 16. . *M. niger*

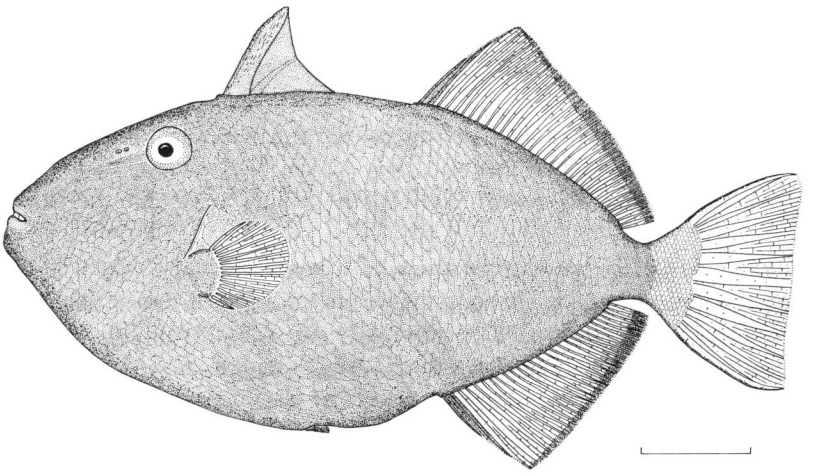

Fig. 11. *Melichthys vidua*, 171.9 mm SL, Ishigaki Island, HUMZ 41472. Scale bar indicates 30 mm.

Melichthys vidua (SOLANDER, 1844)

[Japanese name: Kuro-mongara]

(Fig. 11)

Balistes vidua SOLANDER in RICHARDSON, 1844, Zool. Voyage Sulphur, Fishes, p. 128, pl. 59, figs. 9–10.
Pachynathus nycteris JORDAN et EVERMANN, 1903, Bull. U. S. Fish Comm., **22**, p. 199.
Oncobalistes erythropterus FOWLER, 1946, Proc. Acad. nat. Sci. Phila., **98**, p. 213, fig. 73.
Balistes vidua kamoharai ABE, 1958, Rec. Oceanogr. Works Japan, **12**, p. 178.
Melichthys vidua: SMITH, 1949, Sea Fishes of S. Africa, p. 408, pl. 88.

Diagnosis. A species of *Melichthys* with the following combination of characters: second dorsal and anal fins pale with a prominent black margin (in young specimens, fins with dark brown or black longitudinal lines); caudal fin pale, slightly emarginate or slightly rounded; pectoral rays 14; head scale rows 26–29.

Counts and proportional measurements. D. III, 31–33; A. 27–30; P. 14 (rarely 15); body scale rows 50–59; head scale rows 26–29; vertebrae 7+11=18. Greatest depth of body 1.86–2.01; depth of body 2.40–2.59; width of body 4.35–5.32; head length 3.09–3.28; snout length 4.19–5.57; snout to origin of first dorsal fin 2.91–3.12; snout to origin of second dorsal fin 1.57–1.64; snout to origin of anal fin 1.43–1.48; base of second dorsal fin 2.76–2.89; base of anal fin 3.15–3.35 — all in SL.

Eye diameter 4.71–6.19; interorbital width 2.50–2.84; length of gill opening 3.10–3.51; length of caudal peduncle 2.51–3.22; depth of caudal peduncle 3.69–4.06; length of first dorsal spine 1.82–2.26; length of longest (third to fifth) second dorsal fin ray 1.56–1.78; length of longest (third or fourth) anal fin ray 1.77–2.20; interdorsal space 1.04–1.18; length of pectoral fin 3.08–3.54; length of caudal fin 1.54–1.66 — all in HL.

Coloration. Ground color of body dark brown or black; second dorsal and anal fins pale with a prominent narrow black margin; basal portion of caudal fin white, posterior half of fin light pink, upper and lower marginal rays narrowly black; pectoral fin yellow.

In young specimens, dark lines radiating from eye; three or four longitudinal dark lines on second dorsal and anal fins.

Distribution. South of Iwate Prefecture. Widespread in the Indo-western Pacific.

Remarks. Since the prejuvenile stage of this species is prominently different in color from the juvenile and adult stages, it was described as a distinct species by some authors (JORDAN & EVERMANN, 1903; FOWLER, 1946; ABE, 1958). Based on the detail examination of many specimens, RANDALL (1971) and RANDALL and KLAUSEWITZ (1973) showed that these distinct forms are to be accepted as different stages of the present species.

Material examined. Seven specimens, 171.9–207.5 mm SL. HUMZ 39210, 39260, Ishigaki Is., Ryukyu Isls., 25 August 1974; HUMZ 40588, Ishigaki Is., Ryukyu Isls., 30 July 1973; HUMZ 40589, Kita-daito Is., Ryukyu Isls., 14 July 1973; HUMZ 41332, Ishigaki Is., Ryukyu Isls., 19 April 1975; HUMZ 41438, Ishigaki Is., Ryukyu Isls., 4 May 1975; HUMZ 41472, Ishigaki Is., Ryukyu Isls., 11 May 1975.

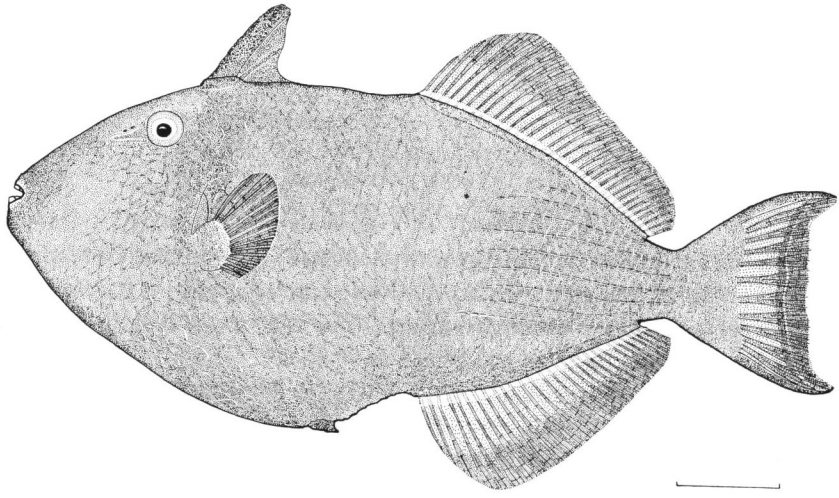

Fig. 12. *Melichthys niger*, 212.5 mm SL, Guam Island, MSM 75-32. Scale bar indicates 30 mm.

Melichthys niger (BLOCH, 1786)

[Japanese name: Soroi-mongara]

(Fig. 12)

Balistes niger BLOCH, 1786, Naturg. ausländ. Fische, **2**, p. 27, pl. 152, fig. 2 (plate incorrectly labeled

Balistes ringens).

Baliste sillonné LACEPÈDE, 1798, Hist. Nat. Poissons, **1**, pp. 334, 370, pl. 18, flg. 1 (vernacular name only).

Balistes radula SOLANDER in RICHARDSON, 1848, Zool. Voyage Samarang, Fishes, p. 21, pl. 6, figs. 1–4.

Balistes kibitar THIOLLIÈRE, 1857, Partie ichth . . . l'île Woodlark, p. 216.

Balistes piceus POEY, 1863, Proc. Acad. nat. Sci. Phila., **15**, p. 180.

Melichthys bispinosus GILBERT, 1890, Proc. U. S. Natn. Mus., **13**, p. 125.

Balistes fuscolineatus SEALE, 1901, Occ. Pap. Bishop Mus., **1**, p. 9, fig. 4.

Melichthys niger: BERRY & BALDWIN, 1966, Proc. Calif. Acad. Sci., (4), **34**, p. 447, figs. 9–11.

Diagnosis. A species of *Melichthys* with the following combination of characters: second dorsal and anal fins black with a longitudinal light blue line at base; caudal fin black, deeply emarginate or lunate; pectoral rays 15 or 16; head scale rows 22–23.

Counts and proportional measurements. D. III, 32–34; A. 29–30; P. 15–16; body scale rows 54–57; head scale rows 22–23; vertebrae 7+11=18. Greatest depth of body 2.04–2.07; depth of body 2.46–2.53; width of body 5.35–6.01; head length 3.29–3.53; snout length 4.76–5.01; snout to origin of first dorsal fin 3.18–3.30; snout to origin of second dorsal fin 1.70–1.75; snout to origin of anal fin 1.54–1.58; base of second dorsal fin 2.53–2.71; base of anal fin 2.88–3.01 — all in SL.

Eye diameter 5.28–5.71; interorbital width 2.67–2.87; length of gill opening 3.36–3.75; length of caudal peduncle 2.22–2.61; depth of caudal peduncle 3.29–3.34; length of first dorsal spine 1.81–1.88; length of longest (third to fifth) second dorsal fin ray 1.36–1.65; length of longest (third or fourth) anal fin ray 1.49–1.69; interdorsal space 1.04–1.19; length of pectoral fin 3.03–3.26; length of caudal fin 1.20–1.41 — all in HL.

Coloration. Ground color of body bluish black; second dorsal and anal fins black with a longitudinal light blue line at base; caudal fin black with a marginal light blue line; pectoral fin black.

Distribution. South of Ryukyu Islands. Distributed in the circumtropical regions.

Remarks. There has been great confusion in the nomenclature of this species which has been frequently identified with *M. ringens* (OSBECK), *M. radula* (SOLANDER), *M. buniva* (LACEPÈDE), or *M. piceus* (POEY). Moreover, the name *niger* has caused an additional confusion, since it has been used for four different triggerfishes: *Balistes niger* BLOCH, 1786, now treated as *M. niger* (BLOCH, 1786); *Balistes niger* MUNGO PARK, 1797, a senior synonym of *Sufflamen chrysopterus* (BLOCH et SCHNEIDER, 1801); *Balistes niger* BONNATERRE, 1788, a senior synonym of *Balistoides conspicillum* (BLOCH et SCHNEIDER, 1801); and *Xenodon niger* RÜPPELL, 1835, now recognized as *Odonus niger* (RÜPPELL, 1835). BERRY and BALDWIN (1966) studied in detail this confused situation, and concluded that *Melichthys niger* (BLOCH, 1786) is the earliset available and valid name for this species.

Material examined. Four specimens, 212.5–281.2 mm SL. MSM 75-32, Guam Is., Mariana Isls., 21 September 1974; TUFO 1151, 1158, Minami-tori-shima Is., (24° 16.9′N, 155°58.5′E), Ogasawara Isls., 28 August 1973; HUMZ 48724, locality and date unknown.

Genus *Balistoides* FRASER-BRUNNER, 1935

Balistoides FRASER-BRUNNER, 1935, Ann. Mag. nat. Hist., (10), **15**, p. 662 (type-species *Balistes viridescens* BLOCH et SCHNEIDER, 1801).

Diagnosis. A genus of the balistids with the following combination of characters: mouth terminal; teeth white, uneven, each one notched; enlarged osseous scales behind gill opening; a deep groove before eye, below nostrils; large tubercles forming several longitudinal rows on posterior part of tail and caudal peduncle, but not extending forward beyond posterior portion of second dorsal fin; caudal fin rounded.

Counts and proportional measurements. D. III, 25–26; A. 22–24; P. 14; body scale rows 29–50; vertebrae 7+11=18. Greatest depth of body 1.77–2.07; depth of body 2.11–2.88; width of body 4.42–6.09; head length 2.51–3.03; snout length 3.40–4.05; snout to origin of first dorsal fin 2.19–2.65; snout to origin of second dorsal fin 1.42–1.52; snout to origin of anal fin 1.29–1.41; base of second dorsal fin 2.95–3.39; base of anal fin 3.44–4.28 — all in SL.

Eye diameter 5.18–6.30; interorbital width 2.87–3.50; length of gill opening 2.56–3.51; depth of caudal peduncle 3.76–4.58; length of first dorsal spine 1.73–2.97; length of longest (third to sixth) second dorsal fin ray 2.22–3.17; length of longest (third to sixth) anal fin ray 2.22–3.29; interdorsal space 1.18–1.73; length of pectoral fin 2.69–3.27; length of caudal fin 1.63–2.06 — all in HL.

Remarks. This genus is represented by only two species, *B. conspicillum* and *B. viridescens*. They are widely distributed in the Indo–western Pacific, but are not found in the Atlantic.

Key to the Species of *Balistoides*

1 (2) Cheek entirely covered with scales. Ventral part of body with large rounded white blotches. Body scale rows 39–50 ..... *B. conspicillum*

2 (1) A naked longitudinal fold behind corner of mouth. Ventral part of body without white blotches. Body scale rows 29–32 ..... *B. viridescens*

Balistoides conspicillum (BLOCH et SCHNEIDER, 1801)

[Japanese name: Mongara-kawahagi]

(Fig. 13)

Balistes niger BONNATERRE, 1788, Table. Encyc. Ichth., p. 19.
Balistes conspicillum BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 474.
Pachynathus conspicillum: JORDAN & FOWLER, 1902, Proc. U. S. Natn Mus., **25** (1287), p. 256.
Balistoides conspicillum: WHITLEY, 1937, Mem. Queensland Mus., **11**, p. 145.

Diagnosis. A species of *Balistoides* with the following combination of characters: body elliptical, depth of body 2.33–2.88 in SL; cheek entirely covered with scales; scales on body small, body scale rows 39–50; ventral part of body with large rounded

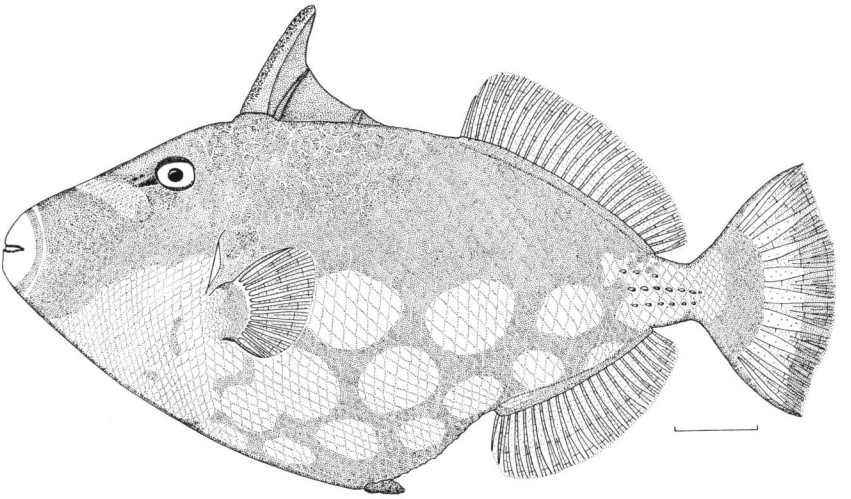

Fig. 13. *Balistoides conspicillum*, 241.6 mm SL, Okinawa Island, HUMZ 62830. Scale bar indicates 30 mm.

white blotches; three or four longitudinal rows of antrorse small spines or large tubercles on caudal peduncle and posterior part of tail.

Counts and proportional measurements. D. III, 25–26; A. 22; P. 14; body scale rows 39–50; head scale rows 33–37; vertebrae 7+11=18. Depth of body 2.33–2.88; head length 2.65–3.03; snout length 3.49–4.05; snout to origin of first dorsal fin 2.46–2.65; snout to origin of anal fin 1.29–1.34 — all in SL.

Eye diameter 5.18–5.98; interorbital width 2.87–3.23; length of gill opening 3.30–3.92; depth of caudal peduncle 4.17–4.58; interdorsal space 1.18–1.39 — all in HL.

Coloration. Body dark with three or four longitudinal rows of very large rounded white blotches on ventral half; dorsal part of body between eye and second dorsal fin covered with yellow vermiculations; a yellow band from below anterior border of eye to middle of snout, where it meets that of the opposite side; lips yellowish orange with a narrow black marginal line; a narrow yellowish orange line encircling mouth just behind lips; caudal peduncle with yellowish orange vermiculations; first dorsal fin black; second dorsal and anal fins pale with a yellowish orange band at base; caudal fin yellow with a black marginal band; pectoral fin pale with a yellow band at base.

Distribution. South of Urakawa, Hokkaido. Common in the Indo-western Pacific.

Material examined. Nine specimens, 191.0–254.0 mm SL. HUMZ 38664, Yonagusuku, Okinawa Is., Ryukyu Isls., 10 April 1974; HUMZ 38668, Chinen, Okinawa Is., Ryukyu Isls., 18 March 1974; HUMZ 38712, Ishigaki Is., Ryukyu Isls., 25 August 1974; HUMZ 38735, Ishigaki Is., Ryukyu Isls., 16 August 1974; HUMZ 39206, Ishigaki Is., Ryukyu Isls., 1 September 1974; HUMZ 41336, Ishigaki Is., Ryukyu Isls., 29 April 1975; HUMZ 62830, Yonagusuku, Okinawa Is., Ryukyu Isls.,

12 April 1977; HUMZ 69516, Minamihara, Okinawa Is., Ryukyu Isls., 27 July 1973; HUMZ 69517, Ishigaki Is., Ryukyu Isls., March 1974.

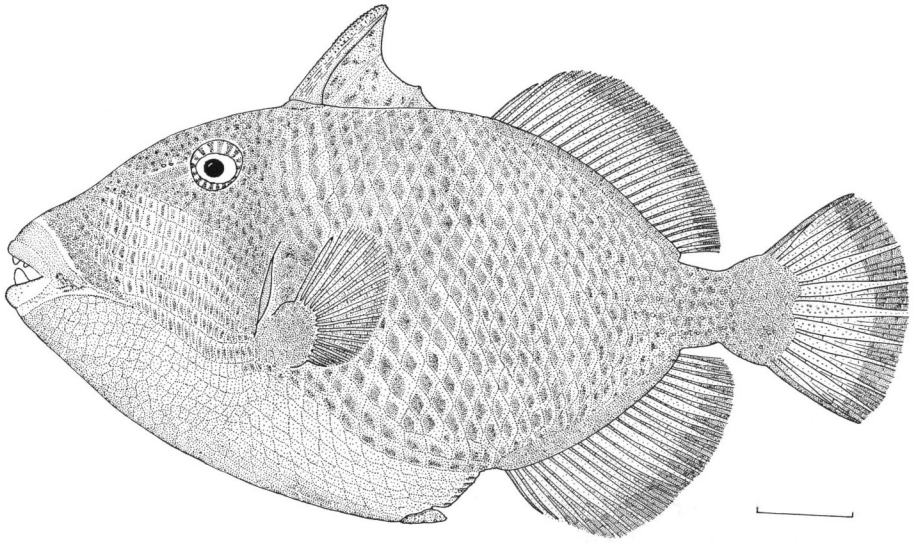

Fig. 14. *Balistoides viridescens*, 222.7 mm SL, Ishigaki Island, HUMZ 38739. Scale bar indicates 30 mm.

Balistoides viridescens (BLOCH et SCHNEIDER, 1801)

[Japanese name: Goma-mongara]

(Fig. 14)

Balistes viridescens BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 477.
Balistes (Pseudobalistes) viridescens: BLEEKER, 1865, Atlas Ichth., **5**, p. 112, pl. 231, fig. 2.
Pachynathus nigromarginatus TANAKA, 1908, J. Coll. Sci. Imp. Univ. Tokyo, **23** (7), p. 39, pl. 1, fig. 4.
Balistoides viridescens: FRASER-BRUNNER, 1935, Ann. Mag. nat. Hist., (10), **15**, p. 662.

Diagnosis. A species of *Balistoides* with the following combination of characters: body ovate, depth of body 2.11–2.25 in SL; a naked longitudinal fold behind corner of mouth; scales on body large, body scale rows 29–32; ground color of body yellowish grey, without white blotches; small spines forming four to six longitudinal rows on caudal peduncle.

Counts and proportional measurements. D. III, 25–26; A. 23–24; P. 14; body scale rows 29–32; vertebrae 7+11=18. Depth of body 2.11–2.25; head length 2.51–2.67; snout length 3.40–3.74; snout to origin of first dorsal fin 2.19–2.37; snout to origin of anal fin 1.35–1.41 — all in SL.

Eye diameter 5.57–6.30; interorbital width 3.26–3.50; length of gill opening 2.56–2.77; depth of caudal peduncle 3.76–4.12; interdorsal space 1.55–1.73 — all in HL.

Coloration. Ground color of body yellowish grey; scales with a dark green spot; a broad dark green band connecting eye over interorbital space, continued below eye over gill opening to base of pectoral fin; cheek yellowish brown; upper lip and corner of mouth dark green; membrane of first dorsal fin with dark green stripes and spots; second dorsal and anal fins yellowish brown with a broad dark green band at margin; pectoral fin yellowish brown; caudal fin yellowish brown with a broad marginal dark green band.

Distribution. South of Misaki, Kanagawa Prefecture. Widespread in the Indo-western Pacific.

Remarks. TANAKA (1908, pp. 39–42) described *Pachynathus nigromarginatus* based on a single specimen collected at Misaki, Kanagawa Prefecture, Japan in 1905. Since the characteristics of this species as found in the original description and figure coincide with those of *B. viridescens*, I conclude that the former is a junior synonym of the latter. The holotype of TANAKA's species cannot be found in the Department of Zoology, University Museum, University of Tokyo.

Material examined. Eight specimens, 163.0–245.3 mm SL. HUMZ 38739, Ishigaki Is., Ryukyu Isls., 16 August 1974; HUMZ 39220, Ishigaki Is., Ryukyu Isls., 30 August 1974; HUMZ 40561, 40562, Ishigaki Is., Ryukyu Isls., 29 April 1975; HUMZ 41349, Ishigaki Is., Ryukyu Isls., 29 April 1975; HUMZ 41424, 41425, Ishigaki Is., Ryukyu Isls., 3 May 1975; HUMZ 46128, Ishigaki Is., Ryukyu Isls., 1975.

Genus ***Sufflamen*** JORDAN, 1916

Sufflamen JORDAN, 1916, Copeia, **1916** (29), p. 27 (type-species, *Balistes capistratus* SHAW, 1804= *Balistes fraenatus* LATREILLE, 1804).

Hemibalistes FRASER-BRUNNER, 1935, Ann. Mag. nat. Hist., (10), **15**, p. 662.

Diagnosis. A genus of the balistids with the following combination of characters: mouth terminal; teeth white, uneven, each one notched; enlarged osseous scales behind gill opening; a deep groove before eye, below nostrils; large tubercles or small spines extending well forward on body; caudal fin truncate or slightly emarginate.

Counts and proportional measurements. D. III, 26–30; A. 23–27; P. 12–14 (usually 13); body scale rows 41–54; head scale rows 23–32; vertebrae 7+11=18. Greatest depth of body 1.71–2.15; depth of body 2.23–2.70; width of body 4.58–5.66; head length 2.35–2.94; snout length 3.03–3.70; snout to origin of first dorsal fin 2.05–2.46; snout to origin of second dorsal fin 1.27–1.65; snout to origin of anal fin 1.26–1.54; base of second dorsal fin 2.91–3.50; base of anal fin 3.34–3.95 — all in SL.

Eye diameter 4.94–8.11; interorbital width 3.34–4.70; length of gill opening 2.83–4.47; length of caudal peduncle 2.75–3.52; depth of caudal peduncle 3.80–4.80; length of first dorsal spine 1.86–2.93; length of longest (third to fifth) second dorsal fin ray 2.45–3.28; length of longest (third to fifth) anal fin ray 2.61–3.57; interdorsal space 1.48–1.87; length of pectoral fin 2.66–3.80; length of caudal fin 1.55–2.30 — all in HL.

Remarks. The generic name *Pachynathus* established by SWAINSON (1839) was

frequently used for this genus. However, it should be treated as a misprint of *Pachygnathus*, which is not valid, since *Pachygnathus* had already been preoccupied by a genus of spiders in 1834 (JORDAN, 1916). Thus, JORDAN (1916) proposed a new generic name *Sufflamen* typified by *Balistes capistratus* SHAW for the genus. On the other hand, WHITLEY (1937) showed that *B. capistratus* SHAW is a junior synonym of *B. fraenatus* LATREILLE, because the former was published on November 8, 1804 and the latter on March 7, 1804.

FRASER-BRUNNER (1935) accepted the name *Sufflamen* and subdivided it into two subgenera *Sufflamen* and *Hemibalistes*. He described the diagnostic characters as "a patch of large rectangular scales on cheek, larger than those on body" in *Sufflamen*, and "all scales on cheek smaller than those on body" in *Hemibalistes* (FRASER-BRUNNER, 1935, p. 662). SMITH (1949, p. 409) elevated the subgenus *Hemibalistes* to the generic rank and designated *Balistes bursa* BLOCH et SCHNEIDER as the type-species. However, squamation on the cheek of *Sufflamen* and *Hemibalistes* is rather variable; in some specimens of *Hemibalistes chrysopterus*, the scales on the cheek are almost equal in size to those on the body. Therefore, I conclude that it is not reasonable to divide the genus *Sufflamen* into two subgenera or to accept the genus *Hemibalistes*.

The genus *Sufflamen* is represented by four species: *S. bursa*, *S. chrysopterus*, *S. fraenatus* and *S. verres*. The former three species are distributed in the Indo–western Pacific and the last one is restricted to the eastern Pacific. *S. fraenatus* and *S. verres* are closely related with each other in the morphological characteristics and coloration. The former is distinguishable from the latter by only the low number of rays in the second dorsal and anal fins (BERRY & BALDWIN, 1966, pp. 445–446). Thus, further studies are needed to clarify the relationships between these two species, although I tentatively accept both of them.

Key to the Japanese Species of *Sufflamen*

1 (2) Two vertical curved black bands present: the anterior one from above and through eye downward to lower part of pectoral base; the posterior one from upper part of pectoral base upward and backward to middle of, not reaching, first dorsal fin ..... *S. bursa*

2 (1) No vertical curved black bands present.

3 (4) Caudal fin dark with a broad white marginal band, upper and lower marginal rays also white ..... *S. chrysopterus*

4 (3) Caudal fin uniformly dark ..... *S. fraenatus*

Sufflamen bursa (BLOCH et SCHNEIDER, 1801)

[Japanese name: Musume-hagi]

(Fig. 15)

Balistes bursa BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 476.
Balistes (*Balistapus*) *bursa*: BLEEKER, 1865, Atlas Ichth., **5**, p. 11, pl. 223, fig. 3.

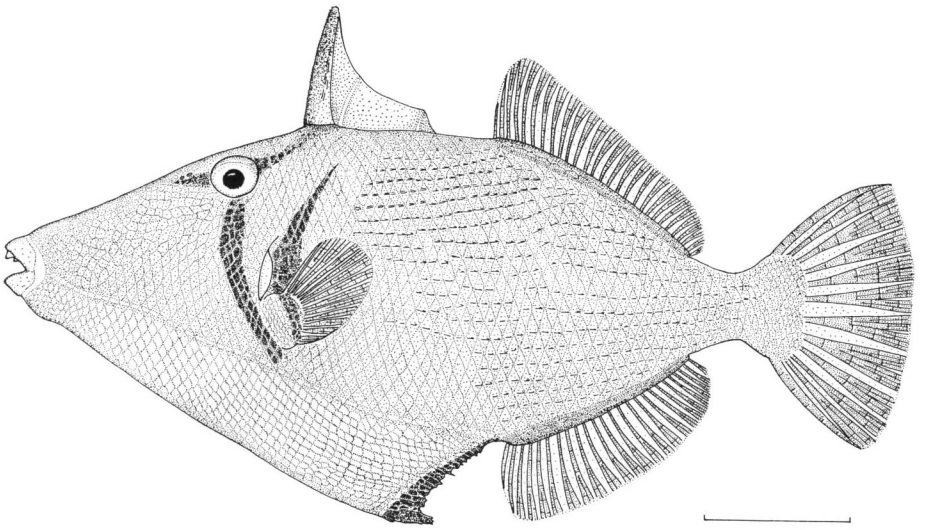

Fig. 15. *Sufflamen bursa*, 157.0 mm SL, Okinawa Island, HUMZ 63090. Scale bar indicates 30 mm.

Pachynathus bursa: JENKINS, 1904, Bull. U. S. Fish Comm., **23**, p. 483.
Hemibalistes bursa: SMITH, 1949, Sea Fishes of S. Africa, p. 409, pl. 90.
Sufflamen bursa: MASUDA *et al.*, 1975, Coastal Fishes of Southern Japan, p. 327, pl. 133J.

Diagnosis. A species of *Sufflamen* with the following combination of characters: a median part of each scale on posterior part of body with spinous tubercle being sharp posteriorly and weak anteriorly, these spinous tubercles form elevated longitudinal ridges on body extending forward to pectoral region; pectoral rays 13–14; two vertical curved black bands present, the anterior one from above and through eye downward and backward to lower part of pectoral base, the posterior one from upper part of pectoral base upward and backward to middle of, but not reaching, first dorsal fin.

Counts and proportional measurements. D. III, 28–29; A. 25–26; P. 13–14; body scale rows 43–50; head scale rows 27–30; vertebrae 7+11=18. Head length 2.63–2.84; snout length 3.43–3.59 in SL. Eye diameter 5.89; depth of caudal peduncle 3.84–4.26 in HL.

Coloration. Ground color of body light brown; two vertical curved brown or black bands on body, the anterior one from above and through eye downward and backward to lower part of pectoral base, the posterior one from upper part of pectoral base upward and backward to middle of, but not reaching, first dorsal fin; a narrow distinct white line from near corner of mouth to near origin of anal fin, which returns forward along ventral edge of body to origin of incasing scales; throat and belly below this white line lighter than the other part of body; incasing scales and origin of anal fin dark brown; first dorsal fin light brown; second dorsal, anal, and pectoral fins pale; caudal

fin dark brown.

Distribution. South of Suruga Bay. Widespread in the Indo-western Pacific.

Material examined. Four specimens, 144.6–199.9 mm SL. HUMZ 40657, Nase, Amami-oshima Is., Satsunan Isls., 21 July–7 August 1971; HUMZ 46748, Naha, Okinawa Is., Ryukyu Isls., 29 October 1975; HUMZ 49779, Chichi-jima Is., Ogasawara Isls., 24 November 1975; HUMZ 63090, Naha, Okinawa Is., Ryukyu Isls., 3 May 1977.

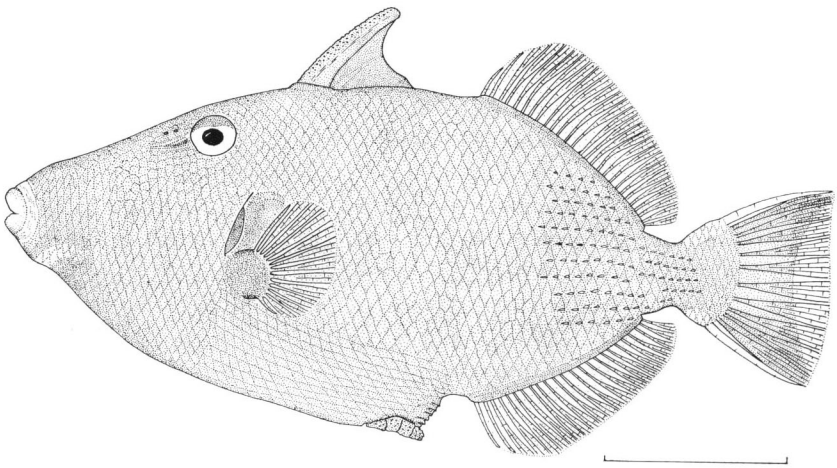

Fig. 16. *Sufflamen chrysopterus*, 118.0 mm SL, Ishigaki Island, HUMZ 46132. Scale bar indicates 30 mm.

Sufflamen chrysopterus (BLOCH et SCHNEIDER, 1801)

[Japanese name: Tsumajiro-mongara]

(Fig. 16)

Balistes niger MUNGO PARK, 1797, Trans. Linn. Soc., **3**, p. 37.
Balistes chrysopterus BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 466.
Balistes subarmatus GRAY, 1830–1835, Illustr. Indian Zool., pl. 90, fig. 3.
Balistes albicaudatus RÜPPELL, 1835, Neue Wirbelthiere, Fische des rothen Meeres, p. 54, pl. 16, fig. 1.
Balistes armatus BLEEKER, 1851, Nat. Tijdschr. Ned Indië, **2**, p. 224.
Balistes (*Balistapus*) *armatus*: BLEEKER, 1865, Atlas Ichth., **5**, p. 115, pl. 241, fig. 1.
Hemibalistes chrysopterus: SMITH, 1949, Sea Fishes of S. Africa, p. 409, pl. 90.
Sufflamen chrysoptera: RANDALL, 1955, Atoll Res. Bull., (47), pp. 219, 223.

Diagnosis. A species of *Sufflamen* with the following combination of characters: scales of posterior part of body with small spines forming longitudinal lines on body, extending forward to level of middle part of second dorsal fin; pectoral rays usually 13; caudal fin dark with a broad white marginal band, upper and lower rays edged with a narrow white line.

Counts and proportional measurements. D. III, 26–28; A. 23–26; P. 12–14 (usually

13); body scale rows 41–47; head scale rows 23–28; vertebrae 7+11=18. Head length 2.57–2.94; snout length 3.32–3.70 in SL. Eye diameter 4.94–7.14; depth of caudal peduncle 3.80–4.58 in HL.

Coloration. Ground color of body brown; throat and belly bluish purple; a short white band on chin; first dorsal fin brown; second dorsal, anal, and pectoral fins light reddish hyaline; caudal fin dark brown with a broad white marginal band; upper and lower marginal rays edged with a narrow white line.

Distribution. South of Shimoda, Izu Peninsula, Shizuoka Prefecture. Common in the Indo–western Pacific.

Material examined. 19 specimens, 47.4–166.4 mm SL. NSMT–P 18267, Yaku-shima Is., Satsunan Isls., 28 September 1974; NSMT–P 18268, Yaku-shima Is., Satsunan Isls., 27 September 1974; HUMZ 39223, Ishigaki Is., Ryukyu Isls., 24 August 1974; HUMZ 40551, 40556, 48271, Ishigaki Is., Ryukyu Isls., 14 March 1974; HUMZ 40552, 40553, Ishigaki Is., Ryukyu Isls., 1974; HUMZ 40554, Ishigaki Is., Ryukyu Isls., 31 July 1973; HUMZ 40555, Yonagusuku, Okinawa Is., Ryukyu Isls., 12 April 1974; HUMZ 40608, Chinen, Okinawa Is., Ryukyu Isls., 7 March 1974; HUMZ 41431, Ishigaki Is., Ryukyu Isls., 3 May 1975; HUMZ 41468, Kuroshima Is., Ryukyu Isls., 10 May 1975; HUMZ 46120, Ishigaki Is., Ryukyu Isls., 1 May 1974; HUMZ 46132–46135, Ishigaki Is., Ryukyu Isls., 1975; HUMZ 48271, Ishigaki Is., Ryukyu Isls., 14 March 1974.

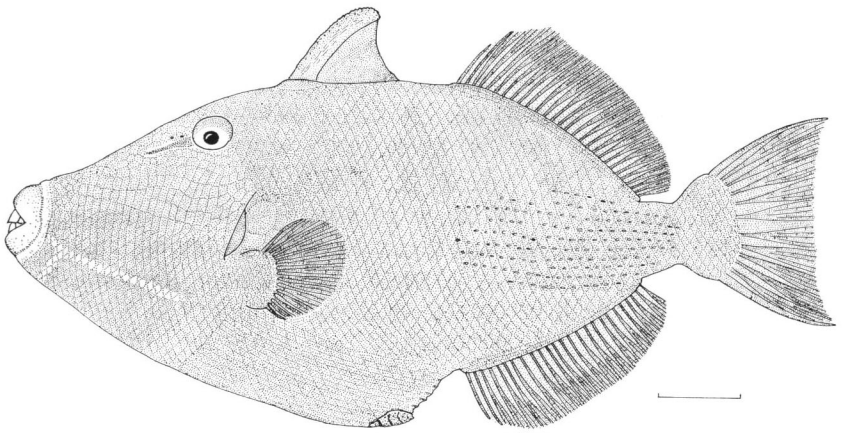

Fig. 17. *Sufflamen fraenatus*, 236.9 mm SL, Ishigaki Island, HUMZ 38728. Scale bar indicates 30 mm.

Sufflamen fraenatus (LATREILLE, 1804)

[Japanese name: Megane-hagi]

(Fig. 17)

Balistes fraenatus LATREILLE, 1804 (March), Nouv, Dict. Hist. Nat., ed. 1, **24**, Poissons, p. 74.

Balistes capistratus SHAW, 1804 (November), Gen. Zool., **5**, p. 417.
Balistes mitis BENNETT, 1831, Proc. Comm. zool. Soc. London, **1**, p. 169.
Balistes hiphe RICHARDSON, 1844, Zool. Voyage Sulphur, Fishes, p. 127, pl. 60, fig. 2.
Balistes frenatus: RICHARDSON, 1844, ibid., p. 129, pl. 62, fig. 1.
Balistes Schmittii BLEEKER, 1852, Verh. Bat. Gen., **24**, Bijidr. kennis Balistini, p. 37.
Balistes (*Balistapus*) *frenatus*: BLEEKER, 1865, Atlas Ichth., **5**, p. 114, pl. 223, fig. 2.
Pachynathus capistratus: JORDAN & FOWLER, 1902, Proc. U. S. Natn. Mus., **25** (1287), p. 255.
Sufflamen fraenatus: WHITLEY, 1937, Mem. Queensland Mus., **11**, p. 146.
Sufflamen capistratus: SMITH, 1949, Sea Fishes of S. Africa, p. 408, pl. 90.

Diagnosis. A species of *Sufflamen* with the following combination of characters: scales of posterior part of body with large tubercles forming longitudinal ridges extending forward to level of origin of second dorsal fin; pectoral rays 14; no vertical black bands on body; caudal fin uniformly dark without a white marginal band.

Counts and proportional measurements. D. III, 27–30; A. 24–27; P. 14; body scale rows 43–54; head scale rows 25–32; vertebrae 7+11=18. Head length 2.35–2.85; snout length 3.03–3.70 in SL. Eye diameter 6.03–8.11; depth of caudal peduncle 4.80–5.05 in HL.

Coloration. Ground color of body dark brown; in male a rosy white band from corner of mouth to below posterior edge of eye, it meets the opposite one through a transverse band over chin, while in female these bands are absent; vertical fins dark brown; pectoral fin brown.

Distribution. South of Sagami Bay. Common in the Indo–western Pacific.

Material examined. 22 specimens, 170.6–280.0 mm SL. HUMZ 38660, Ishigaki Is., Ryukyu Isls., April–June, 1974; HUMZ 38693, Yonagusuku, Okinawa Is., Ryukyu Isls., 10 April 1974; HUMZ 38697, Naha, Okinawa Is., Ryukyu Isls., 5 April 1974; HUMZ 38728, Ishigaki Is., Ryukyu Isls., 27 August 1974; HUMZ 38729, Ishigaki Is., Ryukyu Isls., 28 August 1974; HUMZ 39196, 39207, 39215, Ishigaki Is., Ryukyu Isls., 23 August 1974; HUMZ 39199, Ishigaki Is., Ryukyu Isls., 18 August 1974; HUMZ 39258, Ishigaki Is., Ryukyu Isls., 25 August 1974; HUMZ 39345, Ishigaki Is., Ryukyu Isls., May–July 1974; HUMZ 40544, Chinen, Okinawa Is., Ryukyu Isls., 18 March 1974; HUMZ 40545, data unknown; HUMZ 40546, Chinen, Okinawa Is., Ryukyu Isls., 6 March 1974; HUMZ 40547, 40549, off Borneo, South China Sea, 1963; HUMZ 40548, 40550, Itoman, Okinawa Is., Ryukyu Isls., 9 March 1974; HUMZ 41385, Ishigaki Is., Ryukyu Isls., 1 May 1975; HUMZ 41415, Ishigaki Is., Ryukyu Isls., 2 May 1975; HUMZ 41459, Ishigaki Is., Ryukyu Isls., 7 May 1975; HUMZ 46131, Ishigaki Is., Ryukyu Isls., 1 September 1973.

Genus ***Balistapus*** TILESIUS, 1820

Balistapus TILESIUS, 1820, Mem. Acad. Imp. Sci. St. Petersburg, **7**, p. 306 (type-species, *Balistapus capistratus* TILESIUS, 1820=*Balistes undulatus* MUNGO PARK, 1797).

Diagnosis, counts and proportional measurements, and *coloration.* See account of the single species, *B. undulatus*.

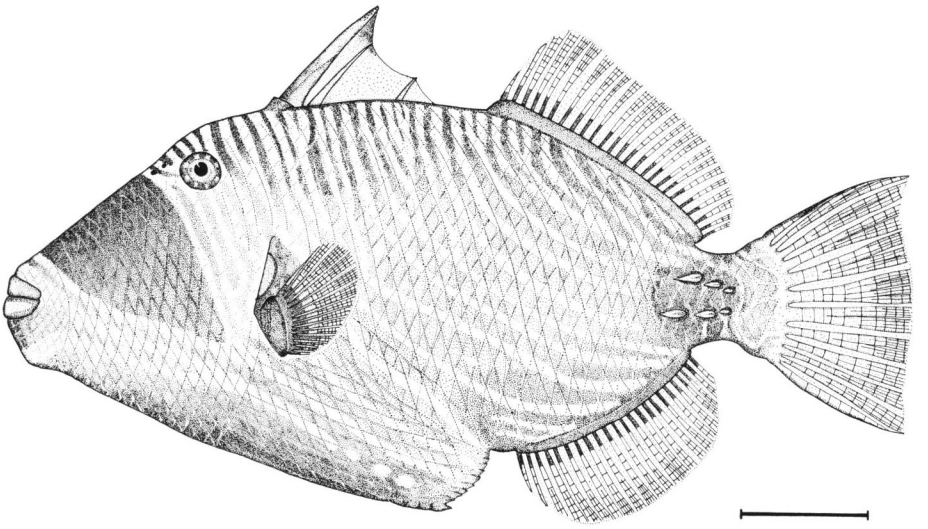

Fig. 18. *Balistapus undulatus*, 177.6 mm SL, Ishigaki Island, HUMZ 40633. Scale bar indicates 30 mm.

Balistapus undulatus (MUNGO PARK, 1797)

[Japanese name: Kumadori]

(Fig. 18)

Balistes undulatus MUNGO PARK 1797, Trans. Linn. Soc., **3**, p. 37.
Balistes lineatus BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 466.
Balistes Lamourouxii QUOY et GAIMARD, 1824, Voyage Uranie et Physiciénne, Zool., p. 208.
Balistes aculeatus β *viridis* J. W. BENNETT, 1830, A Selection . . . Fishes . . . Ceylon. pl. 10.
Balistes sesquilineatus LAY et E. T. BENNETT, 1839, Zool. Captain BEECHEY's Voyage, Fishes, p. 69.
Balistes Zeylanicus LAY et E. T. BENNETT, 1839, 1. c.
Balistes porcatus GRAY, 1854, Cat. Fish . . . Gronow . . . Brit. Mus., p. 32.
Balistes (*Balistapus*) *lineatus*: BLEEKER, 1865, Atlas Ichth., **5**, p. 118, pl. 229, fig. 2.
Balistapus undulatus: JORDAN & FOWLER, 1902, Proc. U. S. Natn. Mus., **25** (1287), p. 258.
Balistapus lineatus: FOWLER & BEAN, 1922, Proc. U. S. Natn. Mus., **62** (2448), p. 59.
Balistapus undulatus: HARRY, 1953, Atoll Res. Bull., (18), p. 161.

Diagnosis. A species of the balistids with the following combination of characters: mouth terminal; teeth white, uneven, each one notched; enlarged osseous scales behind gill opening; no groove before eye; six large antrorse spines forming two longitudinal rows on caudal peduncle; body dark with more or less undulated bands.

Counts and proportional measurements. D. III, 25–27; A. 20–24; P. 12–14 (usually 13); body scale rows 36–40; vertebrae 7+11=18. Greatest depth of body 1.71–2.13; depth of body 2.30–2.57; width of body 4.54–5.86; head length 2.64–2.87; snout length 3.32–3.66; snout to origin of first dorsal fin 2.27–2.49; snout to origin of second dorsal fin 1.46–1.55; snout to origin of anal fin 1.32–1.46; base of second dorsal fin 2.92–

3.21; base of anal fin 3.46–3.94 — all in SL.

Eye diameter 3.05–3.50; length of caudal peduncle 2.63–3.58; depth of caudal peduncle 2.05–3.27; length of first dorsal spine 1.72–2.38; length of longest (fourth to sixth) second dorsal fin ray 2.73–3.42; length of longest (fourth to sixth) anal fin ray 2.83–3.61; interdorsal space 1.38–1.58; length of pectoral fin 2.82–3.46; length of caudal fin 1.47–1.96 — all in HL.

Coloration. Ground color of body dark green or dark brown; in female and young male a number of more or less undulated orange bands on snout and body, in adult male body with these undulated bands but snout dark green or dark brown without bands; first dorsal fin dark green or dark brown; second dorsal, anal, pectoral, and caudal fins orange; a large rounded black blotch on caudal peduncle.

Distribution. South of Wakayama Prefecture. Common in the Indo–western Pacific.

Material examined. 24 specimens, 150.0–211.0 mm SL. HUMZ 38661, Chinen, Okinawa Is., Ryukyu Isls., 11 April 1974; HUMZ 40614, 40634, 40636, 40637, Ishigaki Is., Ryukyu Isls., 23 August 1974; HUMZ 40621, 40622, 40633, Ishigaki Is., Ryukyu Isls., 24 August 1974; HUMZ 40632, 40641, Ishigaki Is., Ryukyu Isls., 22 August 1974; HUMZ 40638, Ishigaki Is., Ryukyu Isls., 1 September 1974; HUMZ 41329, Ishigaki Is., Ryukyu Isls., 28 April 1975; HUMZ 41339, Ishigaki Is., Ryukyu Isls., 29 April 1975; HUMZ 46101, 46114, 46115, 46118, Ishigaki Is., Ryukyu Isls., 24 August 1973; HUMZ 46102, 46108, 46109, 46119, Ishigaki Is., Ryukyu Isls., 23 August 1973; HUMZ 46110, Ishigaki Is., Ryukyu Isls., 18 August 1973; HUMZ 46113, Ishigaki Is., Ryukyu Isls., 22 August 1973; HUMZ 46116, Ishigaki Is., Ryukyu Isls., 17 August 1973.

Genus ***Rhinecanthus*** SWAINSON, 1839

Rhinecanthus SWAINSON, 1839, Nat. Hist . . . . Monocard. Anim., **2**, pp. 194, 325 (type-species, *Balistes aculeatus* LINNAEUS, 1758).

Diagnosis. A genus of the balistids with the following combination of characters: mouth terminal; teeth white, unequal, each one notched; enlarged osseous scales behind gill opening; no groove before eye; caudal peduncle much constricted, having many small spines forming longitudinal three to five rows.

Counts and proportional measurements. D. III, 23–26; A. 20–23; P. 13 (rarely 14); body scale rows 32–39; vertebrae 7+11=18. Greatest depth of body 1.88–2.53; depth of body 2.13–3.23; width of body 4.47–6.05; head length 2.16–2.71; snout length 2.77–3.37; snout to origin of first dorsal fin 2.05–2.41; snout to origin of second dorsal fin 1.38–1.61; snout to origin of anal fin 1.30–1.52; base of second dorsal fin 3.36–4.27; base of anal fin 3.97–5.10 — all in SL.

Eye diameter 4.57–8.95; interorbital width 3.82–5.08; length of gill opening 3.35–5.30; length of caudal peduncle 2.93–4.24; depth of caudal peduncle 4.45–6.89; length of first dorsal spine 2.18–3.18; length of longest (fourth or fifth) second dorsal fin ray 2.98–4.38; length of longest (third to fifth) anal fin ray 2.72–4.04; interdorsal space

1.81–2.95; length of pectoral fin 2.91–3.83; length of caudal fin 1.87–3.58 — all in HL.

Remarks. This genus is represented by three species, *R. aculeatus*, *R. echarpe* and *R. verrucosus*, which are widely distributed in the Indo-western Pacific but are not found in the Atlantic.

Key to the Species of *Rhinecanthus*

1 (2) Four, rarely five, longitudinal rows of small antrorse spines on caudal peduncle. A black band from eye to gill opening and base of pectoral fin, continued as a very broad black band to anus and base of anal fin; caudal peduncle with a black triangular blotch produced into a point below middle of second dorsal fin ..... *R. echarpe*

2 (1) Three longitudinal rows of small antrorse spines on caudal peduncle.

3 (4) Lowermost row of small antrorse spines much shorter than upper two rows. A large black blotch on upper part of body; several narrow black bands extending from the blotch to base of anal fin; two broad black bands also running from the blotch upward to second dorsal fin ..... *R. aculeatus*

4 (3) Uppermost row of small antrorse spines much shorter than lower two rows. A large, somewhat elliptical, black blotch on ventral side of body; a small black saddle on caudal peduncle ..... *R. verrucosus*

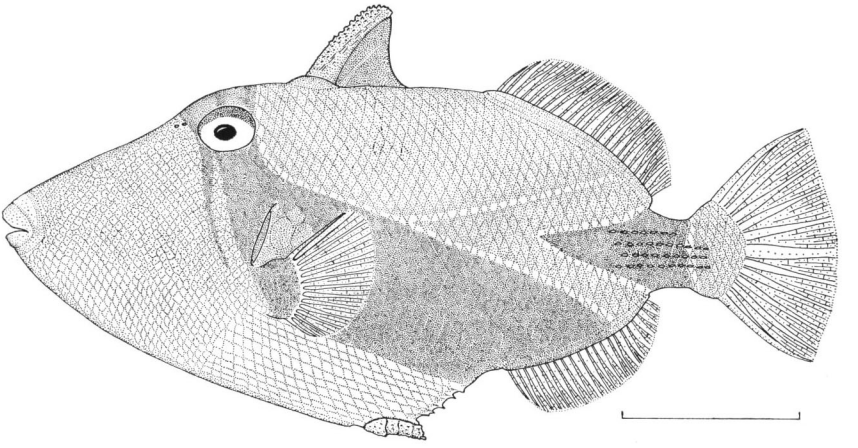

Fig. 19. *Rhinecanthus echarpe*, 117.4 mm SL, Okinawa Island, HUMZ 40609. Scale bar indicates 30 mm.

Rhinecanthus echarpe ([LACEPÈDE], 1798)

[Japanese name: Tasuki-mongara]

(Fig. 19)

Balistes echarpe [LACEPÈDE], 1798, Allgemeine Literature-Zeitung, **3** (288), p. 682 (based on vernac-

ular name "Baliste écharpe" LACEPÈDE, 1798, Hist. Nat. Poissons, **1**, pp. 333, 352).
Balistes rectangulus BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 465.
Balistes medinilla QUOY et GAIMARD, 1824, Voyage Uranie et Physiciénne, Poissons, p. 206.
Balistes erythropterus LESSON, 1830, Voyage Coquille, Zool., **2**, p. 123.
Balistes cinctus BLEEKER, 1857, Act. Soc. Sci., Indo-Neerl., **2**, Achtste bijdr. kennis vischfauna Amboina, p. 96.
Balistes (Balistapus) cinctus: BLEEKER, 1865, Atlas Ichth., **5**, p. 119, pl. 228, fig. 1.
Rhinecanthus echarpe: WHITLEY, 1959, Austr. Zool., **12**, p. 322.

Diagnosis. A species of *Rhinecanthus* with the following combination of characters: four, rarely five, longitudinal rows of small antrorse spines on caudal peduncle extending below posterior part of second dorsal fin. A black band from eye to gill opening and base of pectoral fin, continued as a very broad black band to anus and base of anal fin; caudal peduncle covered with a black triangular blotch produced into a point below middle of second dorsal fin.

Counts and proportional measurements. D. III, 23–24; A. 20–21; P. 13; body scale rows 33–39; vertebrae 7+11=18. Head length 2.29–2.71; snout length 2.99–3.37 in SL. Eye diameter 4.57—6.75 in HL.

Coloration. Ground color of body brown dorsally, white ventrally; a black band from eye to gill opening and base of pectoral fin, continuing as a very broad black band to anus and base of anal fin; this band bordered postero-dorsally with a narrow golden line which bifurcates below posterior edge of first dorsal fin, the lower one extending to base of anal fin and the upper one running to posterior part of second dorsal fin; a broad blue band across interorbital space containing three black lines; three blue lines extending downward from eye to pectoral region, posterior two of three lines forming borders of a broad black band; a narrow blue line on upper lip; caudal peduncle with a triangular black blotch bordered with narrow golden lines; a narrow red line at base of pectoral fin; first dorsal fin dusky; second dorsal, anal, and pectoral fins pale; caudal fin dusky.

Distribution. South of Ryukyu Islands. Widespread in the Indo–western Pacific.

Material examined. Six specimens, 73.3–177.1 mm SL. HUMZ 3526, Okinawa Is., Ryukyu Isls., date unknown; HUMZ 40609, Heshikiya, Okinawa Is., Ryukyu Isls., 20 April 1974; HUMZ 40610, Ishigaki Is., Ryukyu Isls., 31 July 1973; HUMZ 41310, Itoman, Okinawa Is., Ryukyu Isls., 26 April 1975; HUMZ 41470, 48273, Kuroshima, Is. Ryukyu Isls., 10 May 1975.

Rhinecanthus aculeatus (LINNAEUS, 1758)

[Japanese name: Murasame-mongara]

(Fig. 20)

Balistes aculeatus LINNAEUS, 1758, Syst. Nat., ed. 10, p. 328.
Balistes ornatissimus LESSON, 1830, Voyage Coquille, Zool., **2**, p. 119.

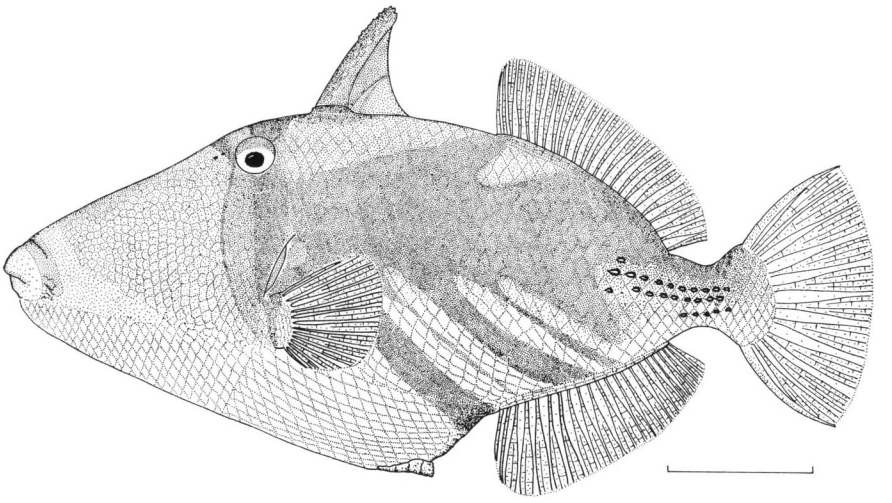

Fig. 20. *Rhinecanthus aculeatus*, 143.0 mm SL, Okinawa Island, HUMZ 62766. Scale bar indicates 30 mm.

Balistes (*Balistapus*) *aculeatus*: BLEEKER, 1865, Atlas Ichth., **5**, p. 120, pl. 241, fig. 3.
Balistapus aculeatus: KNER, 1865–1867, Novara-Exped. Fische, **1**, p. 399.
Monacanthus Cheverti ALLEYNE et MACLEAY, 1877, Proc. Linn. Soc. N. S. Wales, **2**, p. 69.
Balistapus (*Rhinecanthus*) *aculeatus*: WHITLEY, 1932, Great Barrier Reef Exped. Sci. Rept. Brit. Mus., **4** (9), p. 310.
Rhinecanthus aculeatus: FRASER-BRUNNER, 1935, Ann. Mag. nat. Hist., (10), **15**, p. 662.

Diagnosis. A species of *Rhinecanthus* with the following combination of characters: three longitudinal rows of small antrorse spines on caudal peduncle, upper two rows extending forward below posterior part of second dorsal fin, lowermost one short and restricted to caudal peduncle; a large black blotch on upper part of body; several narrow black bands extending from the blotch to base of anal fin; two broad black bands also running from the blotch upward to second dorsal fin.

Counts and proportional measurements. D. III, 23–26; A. 21–22; P. 13; body scale rows 32–39; vertebrae 7+11=18. Head length 2.16–2.46; snout length 2.77–3.02 in SL. Eye diameter 6.28–8.95 in HL.

Coloration. Ground color of body brown dorsally and white ventrally; a black band bordered by narrow blue lines extending from eye to base of pectoral fin; a narrow blue line, just in front of blue-bordered black band, running from eye to base of pectoral fin; interorbital space blue with three black lines connecting eyes; a blue band encircling upper lip; an orange band extending from lips to lower base of pectoral fin; a large black blotch on upper part of body; several narrow black bands extending from the blotch to base of anal fin, separated by white bands, two broad black bands also running from the blotch upward to second dorsal fin; small antrorse spines on caudal

peduncle black; an elongated elliptical light blue blotch on caudal peduncle; first dorsal fin black; second dorsal, anal, and pectoral fins pale; caudal fin dusky.

Distribution. South of Kominato, Chiba Prefecture. Common in the Indo–western Pacific.

Material examined. 25 specimens, 57.4–199.8 mm SL. NSMT–P 18269, Ishigaki Is., Ryukyu Isls., 13 May 1975; HUMZ 41311–41317, Itoman, Okinawa Is., Ryukyu Isls., 26 April 1975; HUMZ 41318, Ishigaki Is., Ryukyu Isls., 26 April 1975; HUMZ 41352, 41359, Ishigaki Is., Ryukyu Isls., 29 April 1975; HUMZ 41386, Ishigaki Is., Ryukyu Isls., 1 May 1975; HUMZ 41389, Ishigaki Is., Ryukyu Isls., 30 April 1975; HUMZ 41432, 41433, Ishigaki Is., Ryukyu Isls., 3 May 1975; HUMZ 41434–41436, Ishigaki Is., Ryukyu Isls., 4 May 1975; HUMZ 41446–41448, Ishigaki Is., Ryukyu Isls., 5 May 1975; HUMZ 46124–46127, Ishigaki Is., Ryukyu Isls., 1975.

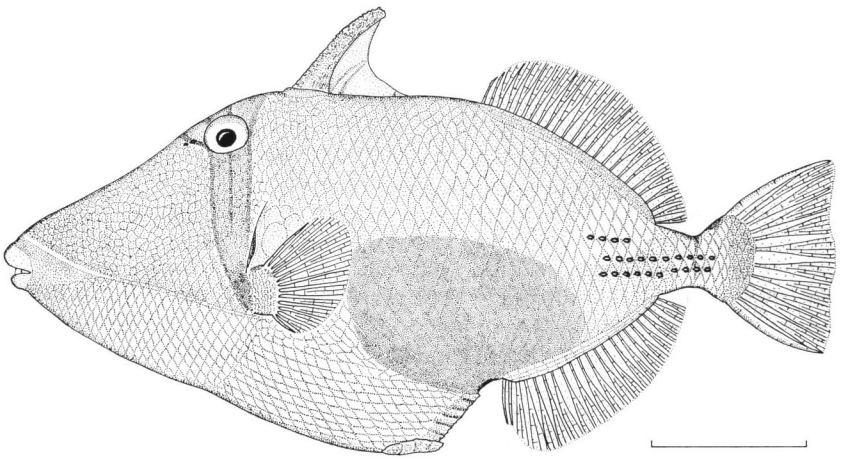

Fig. 21. *Rhinecanthus verrucosus*, 132.8 mm SL, Iriomote Island, HUMZ 72161. Scale bar indicates 30 mm.

Rhinecanthus verrucosus (LINNAEUS, 1758)

[Japanese name: Kurakake-mongara]

(Fig. 21)

Balistes verrucosus LINNAEUS, 1758, Syst. Nat., ed. 10, p. 328.
Balistes cinereus BONNATERRE, 1788, Table. Encycl. Ichth., p. 20.
Balistes viridis BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 46.
Balistes praslineatus QUOY et GAIMARD, 1824, Voyage Uranie et Physiciénne, Zool., p. 205.
Balistes melanopleura BLEEKER, 1849, J. Ind. Arch., **3**, pp. 71, 73.
Balistes praslinus: BLEEKER, 1852, Verh. Bat., **24**, Bijdr. kennis Balistini, p. 14.
Balistes heteracanthus BLEEKER, 1859, Act. Soc. Sci., Indo-Neerl., **6**, 22.
Balistes (*Balistapus*) *heteracanthus*: BLEEKER, 1865, Atlas Ichth., **5**, p. 117, pl. 218, fig. 1.
Balistes (*Balistapus*) *verrucosus*: BLEEKER, 1865, ibid., p. 120, pl. 216, fig. 2.

Balistapus verrucosus: KNER, 1865–1867, Novara-Exped. Fische, **1**, p. 399.
Balistes (*Balistapus*) (*cinereus*?): M. WEBER, 1913, Siboga-Exped., **57**, p. 576.
Rhinecanthus verrucosus: MUNRO, 1967, Fishes of New Guinea, p. 564, pl. 75, fig. 1055.

Diagnosis. A species of *Rhinecanthus* with the following combination of characters: three longitudinal rows of small antrorse spines on posterior part of tail and caudal peduncle, lower two rows rather elongated but uppermost one very short; a large, somewhat elliptical, black blotch on ventral side of body; a small black saddle on caudal peduncle.

Counts and proportional measurements. D. III, 23–26; A. 21–23; P. 13–14; body scale rows 34–37; vertebrae 7+11=18. Head length 2.35–2.47; snout length 2.80–3.02 in SL. Eye diameter 6.02–8.25 in HL.

Coloration. Ground color of body dark brown on upper side and white on lower side; a black band bordered by narrow blue lines extending from eye to base of pectoral fin; a narrow blue line running through middle of blue-bordered black band; corner of mouth light blue; a narrow red line over snout immediately behind upper lip running to lower base of pectoral fin; a large, somewhat elliptical, black blotch on ventral side of body; a narrow black saddle on caudal peduncle; small antrorse spines on caudal peduncle black; first dorsal fin dark; second dorsal, anal, and pectoral fins pale; caudal fin dusky.

Distribution. South of Kominato, Chiba Prefecture. Widespread in the Indo–western Pacific.

Material examined. 10 specimens, 44.7–187.0 mm SL. NSMT–P 18264, 18265, Tanegashima Is., Satsunan Isls., 1 October 1974; NSMT–P 18266, Tanegashima Is., Satsunan Isls., 2 October 1974; HUMZ 48641, 48642, Ishigaki Is., Ryukyu Isls., 1 September 1974; HUMZ 72158–72161, Amitori, Iriomote Is., Ryukyu Isls., 5 May 1977; MSM 71–128, Ryukyu Isls., 26 September 1970.

Genus ***Xanthichthys*** KAUP, 1856

Xanthichthys KAUP in RICHARDSON, 1856, Ichth. Encycl. Britanica, ed. 8, 313 (type-species, *Balistes curassavicus* GMELIN, 1788=*Balistes ringens* LINNAEUS, 1758).

Diagnosis. A genus of the balistids with the following combination of characters: no enlarged osseous scales behind gill opening; three to six longitudinal, somewhat diagonal, grooves on cheek; third dorsal spine minute, not extending above dorsal edge of body.

Remarks. This genus is represented by five species, *X. auromarginatus*, *X. caeruleolineatus*, *X. lineopunctatus*, *X. mento* and *X. ringens*. The former three species are distributed in the Indo–western Pacific, the fourth in the Pacific, and the last in the Atlantic.

Key to the Japanese Species of *Xanthichthys*

1 (2) Cheek with three prominent slightly diagonal dark brown grooves, extending

from just behind and below corner of mouth nearly to gill opening. Upper half of body with longitudinal dark brown lines..... *X. lineopunctatus*

2 (1) Cheek with five or six slightly diagonal grooves. Body without longitudinal dark brown lines.

3 (4) Second dorsal rays 26–27, anal rays 23–25. An irregular longitudinal blue line on body from pectoral axil to upper part of caudal peduncle..... ..... *X. caeruleolineatus*

4 (3) Second dorsal rays 28–32, anal rays 25–28. No longitudinal blue line on body.

5 (6) Grooves on cheek developed and darkly pigmented. Depth of body 2.84–3.34 in SL. Scales on posterior part of body with slight median ridges..... ..... *X. mento*

6 (5) Grooves on cheek poorly developed and without pigmentation. Depth of body 2.45 in SL. Scales of body with a prominent elevation forming longitudinal ridges ..... *X. auromarginatus*

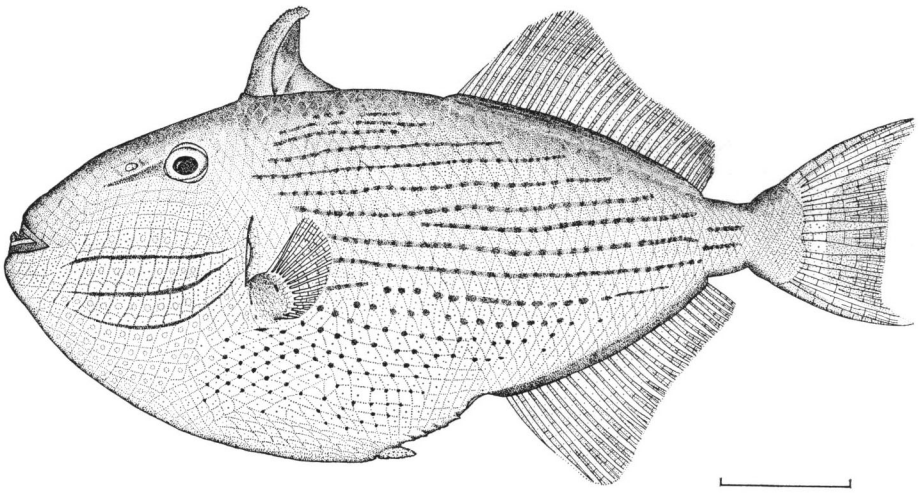

Fig. 22. *Xanthichthys lineopunctatus*, 169.7 mm SL, Okinawa Island, HUMZ 40642. Scale bar indicates 30 mm.

Xanthichthys lineopunctatus (HOLLARD, 1854)

[Japanese name: Sujiname-mongara]

(Fig. 22)

Balistes lineopunctatus HOLLARD, 1854, Ann. Sci. Nat. (Zool.), (4), **1**, p. 65.
Balistes ringens GÜNTHER, 1870 (in part), Cat. Brit. Mus., **8**, p. 221.
Xanthichthys lineopunctatus: BERRY & BALDWIN, 1966, Proc. Calif. Acad. Sci., (4)., **34**, p. 459, figs. 12–13.

Diagnosis. A species of *Xanthichthys* with the following combination of charac-

ters: cheek with three prominent slightly diagonal dark brown grooves, extending from just behind and below corner of mouth nearly to gill opening; upper half of body with longitudinal dark brown lines; depth of body 2.59–2.67 in SL.

Counts and proportional measurements. D. III, 28; A. 25–26; P. 13–14; body scale rows 44–46; head scale rows 17–19; vertebrae 7+11=18. Greatest depth of body 1.83–2.11; depth of body 2.59–2.67; width of body 5.03–5.58; head length 3.03–3.13; snout length 4.79–4.80; snout to origin of first dorsal fin 2.94–3.05; snout to origin of second dorsal fin 1.66–1.69; snout to origin of anal fin 1.48–1.50; base of second dorsal fin 2.87–2.95; base of anal fin 3.20–3.27 — all in SL.

Eye diameter 5.92–6.16; interorbital width 2.63–2.65; length of gill opening 3.20–3.43; length of caudal peduncle 2.56–2.91; depth of caudal peduncle 3.98–4.23; length of first dorsal spine 2.07–2.15; length of longest (sixth) second dorsal ray 1.74–1.95; length of longest (third) anal ray 1.89–2.04; interdorsal space 1.31–1.40; length of pectoral fin 3.29–3.54; length of caudal fin 1.38–1.80 — all in HL.

Coloration. Ground color of body brownish grey, lighter below; upper half of body with many longitudinal dark brown lines, sometimes interrupted; anterior apex of each scale on ventral third of body with a dark brown spot; grooves on cheek dark brown; first dorsal fin and basal sheaths of second dorsal and anal fins dark brown; second dorsal and anal fins brown; pectoral fin pale; caudal fin brown with reddish orange upper and lower borders and a large reddish orange crescent posteriorly.

Distribution. South of Satsunan Islands. Widespread in the Indo-western Pacific.

Remarks. This species closely resembles the Atlantic *X. ringens*, and some authors erroneously regarded it as the latter species (GÜNTHER, 1870; SMITH, 1949). However the former is clearly separated from the latter in having many longitudinal dark brown lines on the upper half of body (RANDALL *et al.*, 1978).

Material examined. Two specimens, 152.5–169.7 mm SL. HUMZ 40642, Okinawa Is., Ryukyu Isls., September 1973; YAMAKAWA's collection 11606, Koniya, Amami-oshima Is., Satsunan Isls., February 1971.

Xanthichthys caeruleolineatus RANDALL, MATSUURA et ZAMA, 1978

[Japanese name: Aosuji-mongara]

(Fig. 23)

Xanthichthys sp. BAGNIS *et al.*, 1972, Fishes of Polynesia, p. 216, fig. (not numbered); MASUDA *et al.*, 1975, Coastal Fishes of Southern Japan, p. 328, pl. 134 M.

Xanthichthys lineopunctatus GUSHIKEN, 1973 (*non* HOLLARD), Fishes of Okinawa Isls., p. 16, fig. 51.

Xanthichthys caeruleolineatus RANDALL, MATSUURA et ZAMA, 1978, Bull. mar. Sci., **28**, pp. 691, 701, figs. 2D, 7.

Diagnosis. A species of *Xanthichthys* with the following combination of characters: cheek with six slightly diagonal grooves; second dorsal rays 26–27, anal rays 23–25; an irregular longitudinal blue line on body from pectoral axil to upper part of

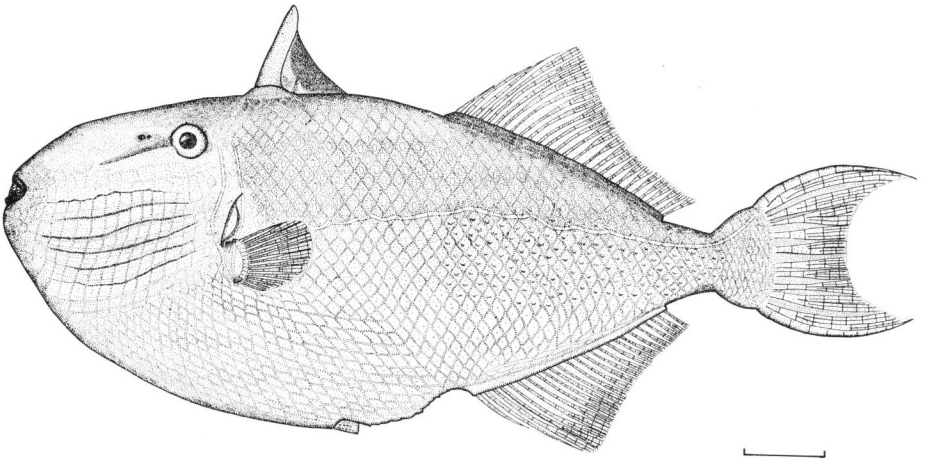

Fig. 23. *Xanthichthys caeruleolineatus*, 265.8 mm SL, Okinawa Island, HUMZ 40586. Scale bar indicates 30 mm.

caudal peduncle; head scale rows 22–23.

Counts and proportional measurements. D. III, 26–27; A. 23–25; P. 13; body scale rows 40–43; head scale rows 22–23; vertebrae 7+11=18. Greatest depth of body 2.09–2.43; depth of body 2.70–3.21; width of body 5.39–6.20; head length 3.07–3.34; snout length 4.29–4.85; snout to origin of first dorsal fin 2.74–3.23; snout to origin of second dorsal fin 1.60–1.83; snout to origin of anal fin 1.42–1.61; base of second dorsal fin 3.14–3.56; base of anal fin 3.55–3.83 — all in SL.

Eye diameter 4.96–5.75; interorbital width 2.33–2.71; length of gill opening 3.98–5.12; length of caudal peduncle 2.17–2.43; depth of caudal peduncle 3.83–4.41; length of first dorsal spine 1.88–2.48; length of longest (third or fourth) second dorsal fin ray 1.58–1.88; length of longest (third or fourth) anal fin ray 1.73–2.12; interdorsal space 1.13–1.35; length of pectoral fin 2.89–3.51; length of caudal fin 1.10–1.29 — all in HL.

Coloration. Upper half of body olive brown, each scale with a vertically elongated irregular light blue line or a group of light blue dots, lower half of body light grey; these areas separated by an irregular light blue line extending from pectoral axil to upper part of caudal peduncle; an orangish brown band adjacent to upper edge of longitudinal blue line on side of body; a vertical orangish brown band bordered with narrow blue lines running from just behind eye, passing through gill opening, to lower part of pectoral base; diagonal grooves on cheek light blue, intervening scale rows brownish yellow; a groove in front of eye brownish yellow; first dorsal spine olive brown anteriorly, light grey laterally; membrane of first dorsal fin light grey with black margin; second dorsal and anal fins with dark brown rays and pale membranes; pectoral fin pale with dusky rays; caudal fin dusky with a broad reddish brown band posteriorly, upper and lower marginal rays red.

Distribution. South of Izu Islands. Widespread in the Indo-western Pacific.

Material examined. Nine specimens, 181.0–307.0 mm SL. HUMZ 35534, Naha, Okinawa Is., Ryukyu Isls., 18 April 1974; HUMZ 40586, Naha, Okinawa Is., Ryukyu Isls., 5 April 1974; HUMZ 40587, Naha, Okinawa Is., Ryukyu Isls., 20 April 1974; HUMZ 41474, 41475, Naha, Okinawa Is., Ryukyu Isls., 12 May 1975; HUMZ 42302, Naha, Okinawa Is., Ryukyu Isls., 26 April 1975; TUFO 958, 24°16.9′N, 153° 58.5′E, 28 August 1973; TUFO 1268, Tori-shima Is., Izu Isls., 19 December 1973; TUFO 1269, data unknown.

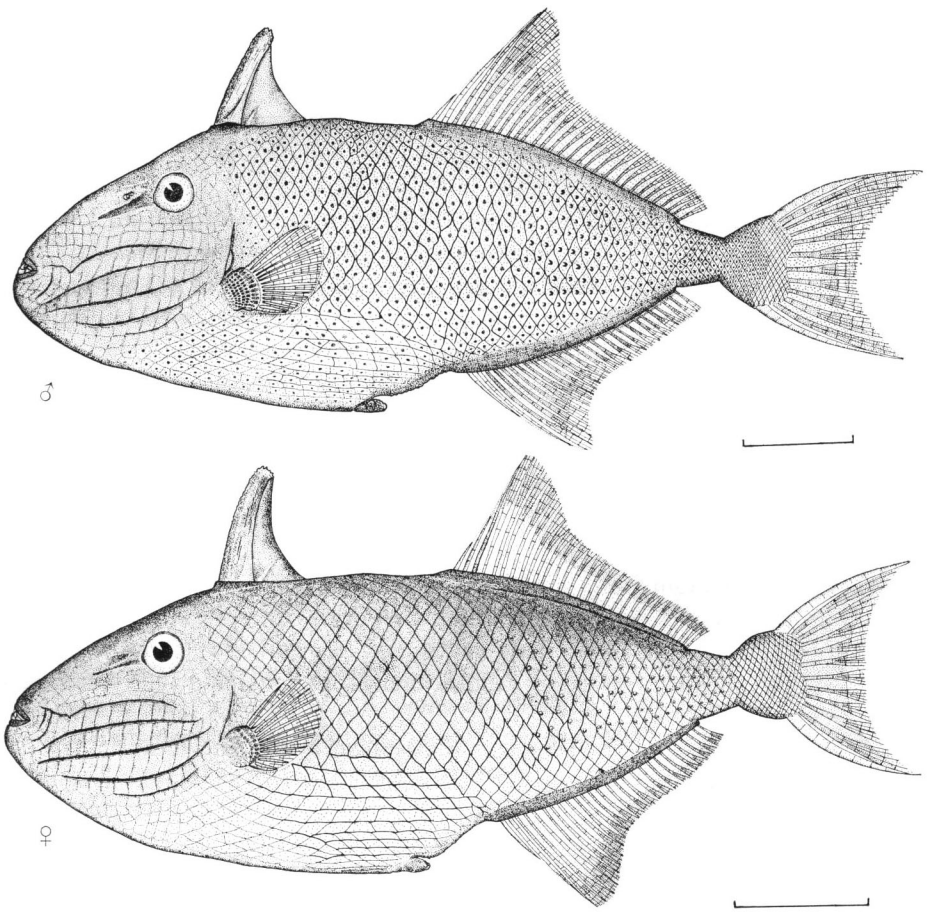

Fig. 24. *Xanthichthys mento*: above, male, 200.0 mm SL, Ogasawara Islands, TUFO 956; below, female, 165.0 mm SL, Ogasawara Islands, TUFO 1184. Scale bars indicate 30 mm.

Xanthichthys mento (JORDAN et GILBERT, 1882)

[Japanese name: Name-mongara]

(Fig. 24)

Balistes mento JORDAN et GILBERT, 1882, Proc. U. S. Natn. Mus., (1881), **4** (221), p. 228.

Xanthichthys mento: JORDAN & EVERMANN, 1898, Bull. U. S. Natn. Mus., **47** (2), p. 1710.
Balistes ringens: GÜNTHER, 1910 (in part), Andrew GARRETT's Fische der Südsee, J. Mus. Godeffroy, **17**, p. 441.
Xanthichthys gotonis TANAKA, 1918, Figures . . . Fishes of Japan, **27**, p. 481, pl. 131, fig. 372.
Xanthichthys purus TANAKA, 1918, ibid., p. 484, pl. 133, fig. 374.
Xanthichthys surcatus DE BUEN, 1963, Bol. Soc. Biol. Concepción, **35–36**, p. 63, fig. 30.

Diagnosis. A species of *Xanthichthys* with the following combination of characters: cheek with five longitudinal slightly diagonal dark grooves; second dorsal rays 29–31, anal rays 27–28; depth of body 2.84–3.34 in SL; scales on posterior part of body with slight median ridges.

Counts and proportional measurements. D. III, 29–31; A. 27–28; P. 12–14 (usually 13); body scale rows 43–48; head scale rows 19–21; vertebrae 7+11=18. Greatest depth of body 2.11–2.53; depth of body 2.84–3.26; width of body 4.38–6.54; head length 3.02–3.34; snout length 4.58–5.32; snout to origin of first dorsal fin 2.95–3.37; snout to origin of second dorsal fin 1.57–1.77; snout to origin of anal fin 1.46–1.64; base of second dorsal fin 2.71–3.21; base of anal fin 2.96–3.56 — all in SL.

Eye diameter 4.07–5.21; interorbital width 2.78–3.21; length of gill opening 3.10–4.47; length of caudal peduncle 2.23–2.66; depth of caudal peduncle 4.07–5.08; length of first dorsal spine 1.55–2.37; length of longest (third or fourth) second dorsal fin ray 1.52–2.03; length of longest (third) anal fin ray 1.69–2.29; interdorsal space 1.04–1.17; length of pectoral fin 2.74–3.32; length of caudal fin 1.32–1.67 — all in HL.

Coloration. In male, body brown with a more yellowish cast than that found in female, especially ventrally; a blue spot on each scale; head and grooves on cheek dark blue; first dorsal fin dark brown with reddish brown membrane; second dorsal and anal fins with a broad marginal bright yellow band; pectoral fin olive; caudal fin purplish red, with red marginal and light blue submarginal lines. In female, head and body dark brown; grooves on cheek dark blue; first dorsal fin same as in male; second dorsal and anal fins with a broad marginal reddish brown band; pectoral fin olive; caudal fin reddish brown, with bright reddish orange marginal and blue submarginal lines.

Distribution. South of Izu Islands. Widespread in the Pacific.

Material examined. 13 specimens, 106.0–209.0 mm SL. HUMZ 42303, Tori-shima Is., Ogasawara Isls., date unknown; HUMZ 42304, Minami-tori-shima Is., Ogasawara Isls., date unknown; TUFO 213, Chichi-jima Is., Ogasawara Isls., 19 August 1968; TUFO 956, 957, 980–982, 1184, 24°16.9′N, 153°58.5′E, 28 August 1973; TUFO 1270, 1271, date unknown; TUFO 1272, 1273, Hachijo-jima Is., Izu Isls., date unknown.

Xanthichthys auromarginatus (BENNETT, 1831)

[Japanese name: Hoshi-mongara]

(Fig. 25)

Balistes auromarginatus BENNETT, 1831, Proc. Comm. Sci. zool. Soc. London, **1** (14), p. 168.
Balistes carolepis HOLLARD, 1854, Ann. Sci. nat., (Zool.), (4), **1**, p. 67, pl. 3, fig. 5.

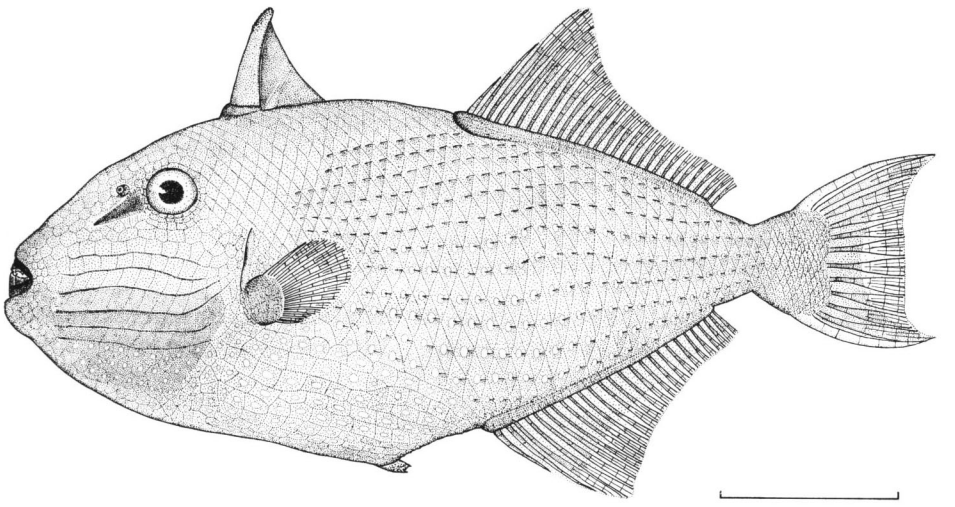

Fig. 25. *Xanthichthys auromarginatus*, 128.0 mm SL, Okinawa Island, HUMZ 40670. Scale bar indicates 30 mm.

Xanthichthys auromarginatus: KLAUSEWITZ, 1974, Senckenb. Biol., **55**, p. 62, fig. 17.

Diagnosis. A species of *Xanthichthys* with the following combination of characters: five slightly diagonal grooves on cheek poorly developed and without pigmentation; second dorsal rays 29, anal rays 26; depth of body 2.45 in SL; scales of body with a prominent elevation forming longitudinal ridges.

Counts and proportional measurements. D. III, 29; A. 26; P. 13; body scale rows 43; head scale rows 17; vertebrae 7+11=18. Greatest depth of body 2.21; depth of body 2.45; width of body 5.74; head length 3.05; snout length 4.85; snout to origin of first dorsal fin 3.05; snout to origin of second dorsal fin 1.69; snout to origin of anal fin 1.49; base of second dorsal fin 2.83; base of anal fin 3.03 — all in SL.

Eye diameter 4.66; interorbital width 2.79; length of gill opening 4.28; length of caudal peduncle 2.85; depth of caudal peduncle 3.74; length of first dorsal spine 2.28; length of longest (fourth) second dorsal fin ray 1.73; length of longest (third) anal fin ray 1.81; interdorsal space 1.32; length of pectoral fin 2.91; length of caudal fin 1.43 — all in HL.

Coloration. Body brownish grey with blue or lavender cast: each scale with a pale spot; cheek brown with bluish cast; five grooves on cheek pale; second dorsal and anal fins brown with a bright yellow margin; pectoral fin brown; caudal fin brown with bright yellow upper and lower margins and a large bright yellow crescent posteriorly.

Distribution. South of Ryukyu Islands. Widespread in the Indo–western Pacific.

Remarks. RANDALL and others (1978) reported the sexual dichromatism of the species as follows: The margins of the second dorsal, anal, and caudal fins are dark

brown or dark reddish brown in female and bright yellow in male; male has a large bright blue patch on the head below the level of the mouth.

Material examined. One specimen, 128.0 mm SL. HUMZ 40670, Okinawa Is., Ryukyu Isls., September 1973.

Genus ***Canthidermis*** SWAINSON, 1839

Canthidermis SWAINSON, 1839, Nat. Hist . . . . Monocard. Anim., **2**, p. 325 (type-species, *Balistes angulosus* QUOY et GAIMARD, 1824=*Balistes maculatus* BLOCH, 1786).

Diagnosis. A genus of the balistids with the following combination of characters: no enlarged osseous scales behind gill opening; mouth terminal; teeth white, uneven, each one notched; a deep groove before eye, below nostrils; no grooves on cheek; third dorsal spine developed, extending above dorsal edge of body.

Remarks. This genus is represented by two species, *C. maculatus* and *C. sufflamen*. The former, world-wide species, is distinguished from the latter, Atlantic species, in having the small number of second dorsal, anal, and pectoral fin rays (Berry & Baldwin, 1966; Moore, 1967).

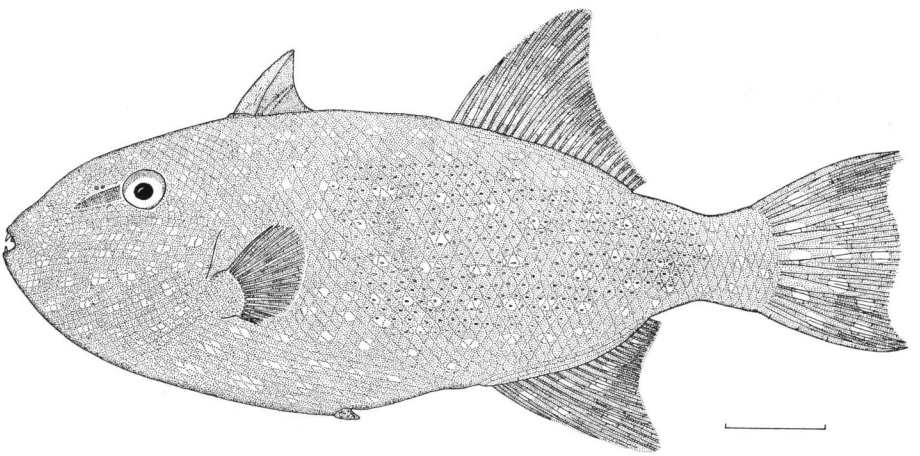

Fig. 26. *Canthidermis maculatus*, 219.2 mm SL, Ogasawara Islands, HUMZ 21116. Scale bar indicates 30 mm.

Canthidermis maculatus (BLOCH, 1786)

[Japanese name: Ami-mongara]

(Fig. 26)

Balistes maculatus BLOCH, 1786, Natur. Fische . . . Zweiter Theil., p. 25, pl. 151.
Balistes americanus GMELIN, 1788, Caroli a Linné Syst. Nat., Pisces, **1** (3), p. 1473.
Balistes macropterus WALBAUM, 1792, Petri Artedi . . . Ant. Ferdin, p. 465.

Balistes rotundatus PROCÉ, 1822, Bull. Soc. philmatique Paris, p. 130.
Balistes angulosus QUOY et GAIMARD, 1824, Voyage Uranie et Physiciénne, Zool., p. 210.
Balistes azureus LESSON, 1830, Voyage Coquille, Zool., p. 212, pl. 10, fig. 2.
Balistes oculatus GRAY, 1830–1835, Illustr. Ind. Zool., pl. 90, fig. 1.
Balistes willughbeii LAY et BENNETT, 1839, Zool. Captain BEECHEY's Voyage, Fishes, p. 68, pl. 21, fig. 2.
Balistes adspersus TSCHUDI, 1845, Untersuchungen Fauna peruana, Ichth., p. 31.
Balistes senticosus RICHARDSON, 1848, Zool. Voyage Samarang, Fishes, p. 23, pl. 9, figs. 5–8.
Balistes brevissimus HOLLARD, 1854, Ann. Sci. nat., (Zool.), (4), **1**, p. 56, pl. 3, fig. 1.
Balistes longissimus HOLLARD, 1854, ibid., p. 60, pl. 3, fig. 3.
Balistes rufus GRONOVIUS in GRAY, 1854, Catalogue of Collected . . . by Laurence Theodore GRONOW . . . London, p. 36.
Balistes longus GRONOVIUS in GRAY, 1854, ibid., p. 37.
Balistes um THIOLLIÈRE, 1857, Partie ichth . . . l'île Woodlark, p. 217.
Balistes melanopterus COPE, 1926, Trans. Amer. phil. Soc., (N. S.), **14**, p. 478.
Balistes viola HERRE, 1926, Philip. J. Sci., **31**, p. 534, pl. 1.
Canthidermis longirostris TORTONESE, 1954, Revista "Biologia Coloniale", **14**, p. 77, fig. 1.
Canthidermis maculatus: BERRY & BALDWIN, 1966, Proc. Calif. Acad. Sci., (4), **34**, p. 460, figs. 14–16.

Diagnosis. A species of *Canthidermis* with the following combination of characters: second dorsal rays 23–25, anal rays 20–22, and pectoral rays 14–15 (usually 14); depth of body 2.27–2.91 in SL.

Counts and proportional measurements. D. III, 23–25; A. 20–22; P. 14–15 (usually 14); body scale rows 37–46; head scale rows 28–32; vertebrae 7+11=18. Greatest depth of body 1.94–2.62; depth of body 2.27–2.91; width of body 4.70–6.25; head length 2.86–3.33; snout length 4.49–5.61; snout to origin of first dorsal fin 2.53–2.94; snout to origin of second dorsal fin 1.41–2.26; snout to origin of anal fin 1.31–1.51; base of second dorsal fin 2.95–4.07; base of anal fin 3.42–4.15 — all in SL.

Eye diameter 4.34–5.90; interorbital width 2.19–2.49; length of gill opening 2.83–4.42; length of caudal peduncle 1.64–2.48; depth of caudal peduncle 2.57–3.01; length of first dorsal spine 2.13–2.65; length of longest (fourth to sixth) second dorsal fin ray 1.13–1.70; length of longest (third to sixth) anal fin ray 1.25–1.71; interdorsal space 1.14–1.51; length of pectoral fin 2.76–3.08; length of caudal fin 1.13–1.71 — all in HL.

Coloration. Body and head dark, lighter below, with many elongated white spots; these spots less prominent or missing from large adult specimens; all fins dark.

Distribution. South of Otaru, Hokkaido. Distributed in the world-wide regions of warm and tropical seas.

Material examined. Nine specimens, 95.4–289.5 mm SL. HUMZ 21114–21116, 22°10′N, 142°14′E, 18 January 1966; HUMZ 40572, Naha, Okinawa Is., Ryukyu Isls., 7 May 1974; HUMZ 40573, Naha, Okinawa Is., Ryukyu Isls., 20 July 1973; HUMZ 40590, data unknown; HUMZ 41923, Otaru, Hokkaido, 30 August 1973; HUMZ 48272, Kôchi Prefecture, date unknown; MSM 71–6000, Ogasawara Isls., 1 November 1970.

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ABE, T., 1958. Two new subspecies of fishes from the path of the "Kuro-shiwo". *Res. Oceanogr.*

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