

# First records of *Giganthias immaculatus* (Perciformes: Giganthiidae) from the Osumi and Tokara islands, Kagoshima Prefecture, Japan, with notes on sexual dimorphism

Emmanuel S. Delloro Jr.<sup>1,2,3</sup> and Hiroyuki Motomura<sup>3</sup>

<sup>1</sup>Institute of Marine Fisheries and Oceanology, College of Fisheries and Ocean Sciences, University of the Philippines Visayas, 5023 Miagao, Iloilo, Philippines

<sup>2</sup>Graduate School of Fisheries, Kagoshima University, 4–50–20 Shimoarata, Kagoshima 890–0056, Japan

<sup>3</sup>The Kagoshima University Museum, 1–21–30 Korimoto, Kagoshima 890–0065, Japan

## ■ Abstract

Thirteen specimens (205.0–284.0 mm standard length) of *Giganthias immaculatus* Katayama, 1954, previously recorded from the Izu-oshima island, Sagami Bay, Mie and Wakayama prefectures, Amami-oshima island, Okinawa, and the Yaeyama Islands in Japanese waters, were collected from the Osumi (Yaku-shima and Tanega-shima islands) and Tokara islands. Thereby continuous distribution of the species in the Ryukyu Islands is confirmed. The Osumi and Tokara specimens are described here in detail. Sexual dimorphism of the species is also discussed.

## ■ Introduction

The genus *Giganthias* Katayama, 1954, regarded as the unique member of family Giganthiidae (Katayama, 1954, 1960; Johnson, 1984), is characterized by having nine dorsal-fin spines, tips of the third dorsal-fin and pelvic-fin spine with serration, patches of large conical teeth on the anterior jaws, and a highly arched lateral line (Katayama, 1954). Two species have currently been regarded as valid in the genus: *Giganthias immaculatus* Katayama, 1954 and *Giganthias serratospinosus* White and Dharmadi, 2012. *Giganthias immaculatus* has been recorded from Japan (Katayama, 1954; Senou, 2002, 2013), Taiwan (Lee, 1990), and Indonesia (Peristiwady et al., 2014), while *G. serratospinosus* has been known only from Indonesia (White and Dharmadi, 2012).

During ichthyofaunal surveys in the northern Ryukyu Islands, Kagoshima Prefecture, Japan, 13 specimens of

*Giganthias immaculatus* were collected from Tanega-shima and Yaku-shima islands in the Osumi Islands, and the Tokara Islands. In Japanese waters, this species has previously been reported from Sagami Bay (Senou, 2013), Izu-Oshima (Katayama, 1954), Mie Prefecture (Suzuki and Kataoka, 1997), Wakayama Prefecture (Fukui, 1999), Amami-oshima island (Mochida, 2018), and the Yaeyama Islands (Senou, 2013). Therefore, the specimens from the Osumi and Tokara islands, herein described in detail, represent the first records from the northern Ryukyu Islands.

## ■ Materials and Methods

Counts and measurements followed Randall and Heemstra (2006) and Peristiwady et al. (2014) with additional measurements: dorsal-fin base length from first dorsal-fin spine base to last dorsal-fin soft ray base; anal-fin base from first anal-fin spine base to last anal-fin soft ray base. Measurements were made to the nearest 0.1 mm with a digital caliper. Standard and head lengths are abbreviated as SL and HL, respectively. Curatorial procedures followed Motomura and Ishikawa (2013). Sex was confirmed by dissection of the abdomen on the right side of the body. The specimens examined in this study were deposited at the Kagoshima University Museum, Kagoshima (KAUM). Specimen photographs of the species referred to in this study are registered at the Image Database of Fishes in Kanagawa Prefectural Museum of Natural History, Odawara (KPM-NR).

## ■ Results and Discussion

*Giganthias immaculatus* Katayama, 1954

Japanese name: Mihara-hanadai (Figs. 1–3; Table 1)

**Material examined. OSUMI ISLANDS (3 specimens):** KAUM–I. 104769, 277.8 mm SL, off Yaku-

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✉ HM: e-mail: motomura@kaum.kagoshima-u.ac.jp

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Fig. 1. Fresh specimen of *Giganthias immaculatus* (KAUM-I. 104769, 277.8 mm SL, Yaku-shima island, Osumi Islands, Kagoshima Prefecture, Japan).

shima island, T. Yoshida et al., 21 July 2017; KAUM-I. 63619, 246.3 mm SL, south of Tanega-shima island, 30°16'N, 130°54'E, 180 m, line-fishing, H. Hata, 1 Sept. 2014; KAUM-I. 67902, 205 mm SL, off Kumano, Nakatane, Tanega-shima island, 30°28'N, 130°58'E, long-line, Y. Kakoi, 29 Dec. 2014. **TOKARA ISLANDS (10):** KAUM-I. 51148, 260.9 mm SL, off Kodakara-jima island, 29°13'N, 129°19'E, line-fishing, M. Matsunuma, 29 Oct. 2012; KAUM-I. 54133, 282 mm SL, KAUM-I. 54144, 283.3 mm SL, KAUM-I. 54145, 249.5 mm SL, off Tokara Islands, 29°34'N, 129°38'E, line-fishing, M. Matsunuma, 23 Apr. 2013; KAUM-I. 54482, 284 mm SL, KAUM-I. 54485, 220.9 mm SL, KAUM-I. 54486, 264 mm SL, off Takara-jima island, 29°08'N, 129°12'E, deeper than 100 m, line-fishing, M. Matsunuma, 18 May 2013; KAUM-I. 77357, 231.6 mm SL, KAUM-I. 77358, 251.4 mm SL, north of Kuchino-shima island (south of Yaku-shima island), 30°01'N, 130°11'E, line-fishing, H. Hata, 3 Aug. 2015; KAUM-I. 89491, 258.4 mm SL, Yaku-shin-sone Bank (east of Nakano-shima island), 29°45'N, 130°21'E, 260 m, line-fishing, H. Hata, 21 July 2016.

**Description.** Body oblong, compressed and moderately elongated, deepest between origins of 3rd and 7th dorsal-fin spines. Dorsal and ventral profile body convex from tip of snout toward caudal-fin base. Mouth terminal, large; posterior tip of maxilla extending

beyond vertical through posterior margin of pupil. Interorbital space slightly convex, without scales. Nostrils paired, close together, directly positioned diagonally at anterior of eyes; anterior nostril small with posterior flap; posterior nostril, large, elliptical. Upper end of pectoral-fin base anterior to vertical through opercular margin; lower end of fin base vertical through opercular margin. Pectoral-fin pointed, asymmetrical, its posterior tip reaching to vertical through between anus and second anal-fin spine base. Pelvic-fin origin slightly anterior to vertical through dorsal-fin origin. Last pelvic-fin soft ray base just below 2nd dorsal-fin spine base; pelvic-fin spine serrated; posterior tip of depressed pelvic fin reaching vertical through midpoint between bases of 8th and 9th dorsal-fin spines. Dorsal-fin origin slightly posterior to vertical through pelvic-fin origin. Dorsal-fin spines strong; 4th spine longest, 3rd spine serrated (1st to 4th spines sometimes serrated); bases of 4 anterior dorsal-fin spines not covered with scales; fin membrane between dorsal-fin spines smooth; soft rays branched, 3rd soft ray longest; membrane between soft rays covered with small scales; last two branched soft rays joint at base. Anal-fin origin below bases of 2nd and 3rd dorsal-fin soft rays; spines strong not covered with scales, 2nd spine widest, 2nd and 3rd spines almost equal in length (3rd spine longer); soft rays branched, covered with scales at fin base; 2nd or 3rd soft rays longest; small

scales between soft ray membrane; last two soft rays joint at base. Caudal fin forked; covered with small scales. Body scales large and ctenoid. Lateral line highly arched below between 5th and 7th dorsal-fin spine bases. Head covered with scales, except inter-orbital space, snout area, mandible, and anteroventral region of head. Patch of villiform teeth at vomer and palatines. Conical teeth at upper and lower jaws; conical teeth at anterior tip of jaws greatly enlarged.

Lower jaw slightly projecting. Tongue rough with numerous spinules. Gill rakers long, slender, covered with spinules at inner surface. Pseudobranchial filaments present.

*Color when fresh (Fig. 1).* Head and body pinkish and yellowish dorsally grading paler pink ventrally. Nape, maxilla, and opercular margin yellow. Dorsal fin yellowish with pinkish basally and anterodistally on soft-rayed portion. Pectoral fin semi-transparent yel-

Table 1. Counts and proportional measurements, expressed as percentages of standard length (SL), of *Giganthias immaculatus* from the Osumi (Yaku-shima and Tanega-shima islands) and Tokara islands, northern Ryukyu Islands, Japan.

	Tokara Islands		Osumi Islands		Mode
	<i>n</i> = 10		Yaku-shima island <i>n</i> = 1	Tanega-shima island <i>n</i> = 2	
Standard length (mm)	220.9–284.0		277.8	205.0–246.3	
Counts					
Dorsal-fin rays	IX, 13		IX, 13	IX, 13	IX, 13
Anal-fin rays	III, 8		III, 8	III, 8	III, 8
Pectoral-fin rays	16 / 16		16 / 16	15–16 / 16	16 / 16
Pelvic-fin rays	I, 5		I, 5	I, 5	I, 5
Caudal-fin rays	16–18		17	17	17
Pored lateral-line scales	41–44		41	43	43
Scale rows above lateral line	6.5–8.5		7.5	7.5	7.5
Scale rows below lateral line	16.5–18.5		18	17.5	17.5
Gill rakers	10 + 21–24		10 + 22	10 + 22	10 + 22
Measurements (% SL)					Mean
Body depth	41.5–45.3(43.5)		44.5	43.0–44.0 (43.5)	43.6
Body width	17.8–20.0 (18.9)		20.1	18.5–20.4 (19.5)	19.1
Head length	34.4–36.6 (35.6)		35.2	35.0–35.4 (35.2)	35.5
Snout length	7.0–9.6 (8.0)		7.9	7.6–7.9 (7.8)	8.0
Orbit diameter	10.8–12.9 (11.6)		11.3	11.0–12.2 (11.6)	11.6
Interorbital width	12.7–14.2 (13.3)		13.9	12.5–13.1 (12.8)	13.3
Upper-jaw length	17.6–19.3 (18.3)		18.9	18.2–18.5 (18.3)	18.3
Postorbital length	15.4–17.5 (16.7)		16.6	16.3–16.7 (16.5)	16.7
Pre-dorsal-fin length	36.1–38.6 (37.5)		36.5	35.7–37.3 (36.5)	37.3
Pre-anal-fin length	61.9–65.9 (63.1)		63.5	61.9–65.5 (63.7)	63.3
Pre-pelvic-fin length	36.1–39.0 (37.7)		38.3	36.6–37.6 (37.1)	37.7
1st dorsal-fin spine length	4.0–6.6 (5.4)		4.8	5.8–6.0 (5.9)	5.4
2nd dorsal-fin spine length	7.7–11.6 (9.6)		8.0	10.0–10.4 (10.2)	9.6
3rd dorsal-fin spine length	10.4–14.9 (12.9)		12.0	12.4–13.0 (12.7)	12.8
4th dorsal-fin spine length	12.5–14.6 (13.7)		13.2	13.8–14.4 (14.1)	13.7
Last dorsal-fin spine length	10.3–12.3 (11.2)		12.4	11.5–11.6 (11.6)	11.3
1st dorsal-fin soft ray length	13.0–16.7 (15.0)		16.3	15.5–16.1 (15.8)	15.2
Longest dorsal-fin soft ray length	16.4–20.0 (18.5)		20.8	18.1–18.8 (18.4)	18.7
1st anal-fin spine length	5.0–7.3 (6.5)		7.0	6.6–6.8 (6.7)	6.6
2nd anal-fin spine length	10.0–12.0 (10.8)		11.3	11.5–11.7 (11.6)	11.0
3rd anal-fin spine length	10.5–12.7 (11.6)		12.6	12.0–12.8 (12.4)	11.8
1st anal-fin soft ray length	15.3–18.2 (17.0)		19.2	16.7–18.6 (17.7)	17.3
Longest anal-fin soft ray length	17.4–21.2 (18.8)		21.6	18.7–20.4 (19.5)	19.1
Pectoral-fin length	27.5–30.5 (29.3)		28.4	28.5–28.6 (28.6)	29.1
Pelvic-fin spine length	14.7–18.7 (16.8)		18.0	16.2–17.0 (16.6)	16.8
Pelvic-fin length	23.7–27.5 (25.6)		26.4	23.8–25.6 (24.7)	25.5
Caudal-fin length	33.2–39.8 (35.9)		33.8	34.3–35.5 (34.9)	35.6
Dorsal-fin base length	46.1–50.2 (47.7)		48.2	47.6–48.1 (47.8)	47.8
Anal-fin base length	16.8–19.0 (18.0)		18.8	17.0–19.1 (18.1)	18.1
Pectoral-fin base length	6.5–7.2 (6.9)		6.7	6.8–6.9 (6.9)	6.9
Caudal-peduncle depth	13.7–15.4 (14.8)		14.7	14.0–14.1 (14.0)	14.7

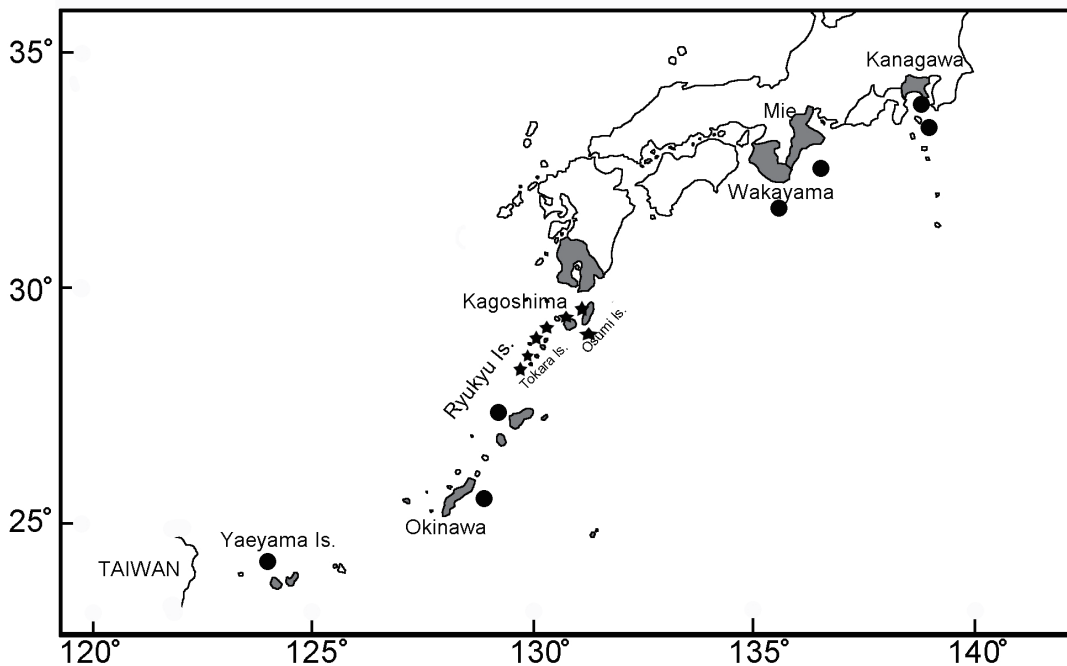


Fig. 2. Distributional records of *Giganthias immaculatus* in Japanese waters. Stars and circles indicate records by this study and previous reports respectively.

low, with pinkish base. Caudal fin pinkish yellow, with whitish posterior margin. Pelvic fin membrane semi-transparent white, with yellowish base. Anal fin pinkish.

**Color when preserved.** Head and body pale uniformly brownish, with darker membranes of spinous portion of dorsal fin and dorsolateral body.

**Remarks.** The 13 specimens from the Osumi and Tokara islands were identified as *G. immaculatus* on the basis of the following combination of characters which closely match the diagnostic features given by Katayama (1954), Lee (1990), White and Dharmadi (2012), Senou (2002, 2013), and Peristiwady et al. (2014): IX, 13 dorsal-fin rays, III, 8 anal-fin rays, 16 pectoral-fin rays, 41–44 pored lateral-line scales, 10 + 21–24 gill rakers, upper-jaw length 1.9–2.0 in HL, interorbital width 2.5–2.9 in HL, body depth 2.2–2.4 in SL, a highly arched lateral line, the lower jaw rather projecting, the anterior tips of the jaws with greatly enlarged conical teeth, and the head and body pinkish with yellow patches dorsally.

*Giganthias immaculatus* differs from its only congener, *G. serratospinosus*, in having higher numbers of pectoral- (16 vs. 13–14) and dorsal-fin soft rays (13 vs. 12), and the tips of the first to third dorsal-fin spines (usually third spine) with serration (vs. first to fourth spines with serration; White and Dharmadi, 2012). However, the serration was rarely observed at the tip of

the fourth dorsal-fin spine in this study. In addition, Peristiwady et al. (2014) mentioned that the two species can be distinguished by body depth, interorbital width, and head, predorsal-fin, upper-jaw, and preanal lengths.

*Giganthias immaculatus* has been recorded from Japan (Senou, 2002, 2013), Taiwan (Lee, 1990), and Indonesia (Peristiwady et al., 2014). In Japanese waters, this species was recorded from Sagami Bay (KPM-NR 51114), Izu-oshima island (Katayama, 1954), Mie Prefecture (Suzuki and Kataoka, 1997), Wakayama Prefecture (Fukui, 1999), Amami-oshima island (Nakae et al., 2018; Mochida, 2018), Okinawa (White and Dharmadi, 2012), and the Yaeyama Islands (KPM-NR 20196) (Fig. 2). The specimens from the Osumi (Yaku-shima and Tanega-shima islands) and Tokara islands represent the first records of the species from the northern Ryukyu Islands, indicating that the species is continuously distributed in Japan from Sagami Bay to the entire Ryukyu Islands.

**Sexual dimorphism.** All specimens examined in this study were at full mature stage, having a fully developed gonads: 4 were females (205.0–251.4 mm SL) and 9 were males (220.9–284.0 mm SL), males being slightly greater than females (264.2 mm SL in average vs. 234.4 mm respectively). Larger males tend to have more prominent enlarged conical teeth at the anterior jaws (Fig. 3). The enlarged conical teeth is one

of diagnostic characters for the genus *Gigantias* (Katayama, 1954, 1960). However, development of the teeth should be determined if it is associated with the onset of sexual maturity. Erisman (2008) reported that the family Serranidae, closely related to *Gigantias*, exhibits complex sexual patterns such as gonochorism, simultaneous hermaphroditism, protogyny, and protogynoid hermaphroditism. The sexual pattern of *Gigantias* has been unknown and histological analysis of the gonads of *Gigantias* is required to assess sexual dimorphism.

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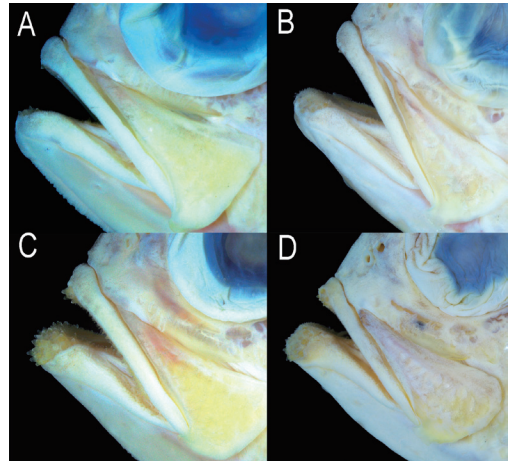


Fig. 3. Enlarged conical teeth at anterior jaws in male and female *Gigantias immaculatus*. A, KAUM-I. 67902, female, 205 mm SL; B, KAUM-I. 77358, female, 251.4 mm SL; C, KAUM-I. 89491, male, 258.4 mm SL; D, KAUM-I. 54144, male, 283.3 mm SL.

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