

Review of Japanese Records of a Grouper, *Epinephelus amblycephalus* (Perciformes, Serranidae), with New Specimens from Kagoshima and Wakayama

Hiroyuki Motomura^{1*}, Masahide Ito², Hiromi Ikeda³, Hiromitsu Endo⁴,
Mizuki Matsunuma⁵ and Kiyotaka Hatooka⁶

¹The Kagoshima University Museum, 1-21-30 Korimoto, Kagoshima, 890-0065 Japan

²Kasasa Fishery Cooperative Society,

2-6772 Kataura, Kasasa, Minami-satsuma, Kagoshima, 897-1301, Japan

³32-41 Akebono, Tanabe, Wakayama, 646-9837 Japan

⁴Laboratory of Marine Biology, Faculty of Science, Kochi University,

2-5-1 Akebono, Kochi, 780-8520 Japan

⁵Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima, 890-0056 Japan

⁶Osaka Museum of Natural History,

1-23 Nagai Park, Higashi-sumiyoshi, Osaka, 546-0034 Japan

Abstract. Records of the Banded Grouper, *Epinephelus amblycephalus* (Perciformes: Serranidae), from Japanese waters are reviewed on the basis of specimens examined and literature accounts, and descriptions provided of three newly collected specimens from Kagoshima and Wakayama Prefectures. Although *E. amblycephalus* has previously been thought not to occur in Japanese waters, eight individual records are now known, five specimens having been deposited in museum collections. Distributional implications are discussed.

Key words: Serranidae, *Epinephelus amblycephalus*, distribution, Japan.

The Banded Grouper, *Epinephelus amblycephalus* (Perciformes: Serranidae), originally described by Bleeker (1857) as *Serranus amblycephalus* from a single specimen from Ambon, the Moluccas Islands, Indonesia, is a medium-sized, primarily tropical grouper (attaining 50 cm total length) distributed in the eastern Indian and western Pacific Oceans, where it is usually found on offshore coral and rocky reefs (Heemstra and Randall, 1993, 1999). Occurrences of the species around Japan have been equivocal. Senou (2000) believed that it was unlikely to occur in Japanese waters and suggested that two early records (Masuda, 1942; Katayama, 1960)

may have been based on specimens collected from overseas, prior to being landed at fish markets in Japan.

Recently, three individuals of *E. amblycephalus*, collected from Japanese waters, were made directly available to us from local fishermen. In addition, a survey of relevant literature and fish held in Japanese aquariums revealed both historical and aquarium examples of the species collected from Japan. Records of the species from Japan were reviewed and all existing Japanese specimens examined. Distributional implications are also discussed.

Counts and measurements followed Heemstra and Randall (1993, 1999), Allen and Robertson (1999) and Randall and Satapoomin (2000). Standard and total lengths are expressed as SL and TL, respectively. Institutional abbreviations used in this

*Corresponding author: motomura@kaum.kagoshima-u.ac.jp

paper are as follows: BSKU—Department of Biology, Faculty of Science, Kochi University, Japan; FAKU—Department of Fisheries, Faculty of Agriculture, Kyoto University, Japan; HUMZ—Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University, Japan; KAUM—Kagoshima University Museum, Japan; OMNH—Osaka Museum of Natural History, Japan; NMW—Naturhistorisches Museum, Wien (Vienna), Austria; RMNH—National Museum of Natural History, Leiden, the Netherlands; URM—Department of Marine Sciences, Faculty of Science, University of the Ryukyus, Japan; and ZUMT—Department of Zoology, University Museum, University of Tokyo, Japan. The following specimens recently collected from Japanese waters were examined in this study: FAKU 93700, 340.5 mm SL, off Inami, Wakayama, 60 m depth, long-line, 19 Nov. 2006, coll. by K. Hamamoto; KAUM-I. 821, 280.2 mm SL, north of Koejihama Beach, Oura, Minami-satsuma, Kagoshima, 31°27'N, 130°13–14'E, 25–27 m depth, hand-line, 3 Oct. 2006, coll. by F. Yamashita; and OMNH-P 13890, 270.0 mm SL, off Shibushi, Kagoshima, 27 Apr. 2000, coll. by the late M. Kumemura.

Results and Discussion

Historical records of *Epinephelus amblycephalus* from Japanese waters — In their revision of the Indo-Pacific groupers, Randall and Heemstra (1991) examined a single specimen of *E. amblycephalus* (NMW 40812, 176 mm SL) collected from Yokohama, Japan, but they did not indicate any other information on the specimen. According to H. Wellendorf (NMW), the specimen was donated by Dr Karl Haberer from Yokohama, Kanagawa Prefecture (probably in 1903). Most fishes landed in Yokohama Market were collected outside Kanagawa Prefecture (Yokohama Market web site). We believe that the NMW 40812 specimen was also collected from overseas, prior to being landed at a fish market in Yokohama.

In his review of Japanese fishes of the genus *Epinephelus*, Masuda (1942) reported a single speci-

men of *E. amblycephalus* (as *E. diacanthus amblycephalus*), along with an illustration (pl. 5, uppermost fig.) and brief description. However, the locality of the specimen was unknown, although given as “probably Riukiu Islands (=Ryukyu Islands) or Formosa (=Taiwan)”. Because numerous marine fishes collected from Taiwan had been landed at fish markets in Okinawa in the first half of the 1900s (T. Yoshino, *pers. comm.*), and no subsequent records of *E. amblycephalus* have been reported from the Ryukyu Islands, Masuda’s specimen was most likely to have been collected from Taiwan.

Masuda (1942) gave the specimen size (170 mm TL), but did not indicate its whereabouts. However, during this study, we found a single specimen of *E. amblycephalus* registered as “ZUMT 39148, *Epinephelus amblycephalus*, locality unknown” in the fish collection of the University Museum, University of Tokyo. Although there was no other information, the specimen ledger of the fish collection indicated that specimens ZUMT 39146–39147 and ZUMT 39149–39154 were collected in June of Shouwa 12 (=1937) and August of Shouwa 13 (=1938), respectively, suggesting that ZUMT 39148 was collected between those dates. The specimen measured 167.8 mm TL (134.0 mm SL), and had a similar number and arrangement of spots on the dorsal head and body as those illustrated by Masuda (1942). Thus, it is probably the specimen used by Masuda (1942).

Kamohara (1957) reported a single specimen (as *E. diacanthus amblycephalus*) from Kochi Prefecture, Shikoku, Japan as follows: “a single specimen, 122 mm long, was obtained by Mr. Kunio Amaoka, a student of the Kochi University, at the Mimase market, Kochi City”. Although the whereabouts had not been given, we found a specimen (registered as BSKU 7442) in the fish collection of Kochi University, the collection data (*i. e.* coll. by K. Amaoka at Mimase Fish Market on 26 Aug. 1957) being consistent with that given by Kamohara (1957). This is the first specimen, based record of *E. amblycephalus* confirmed from Japanese waters (Mimase Market was probably for locally-caught fishes only). Kamo-

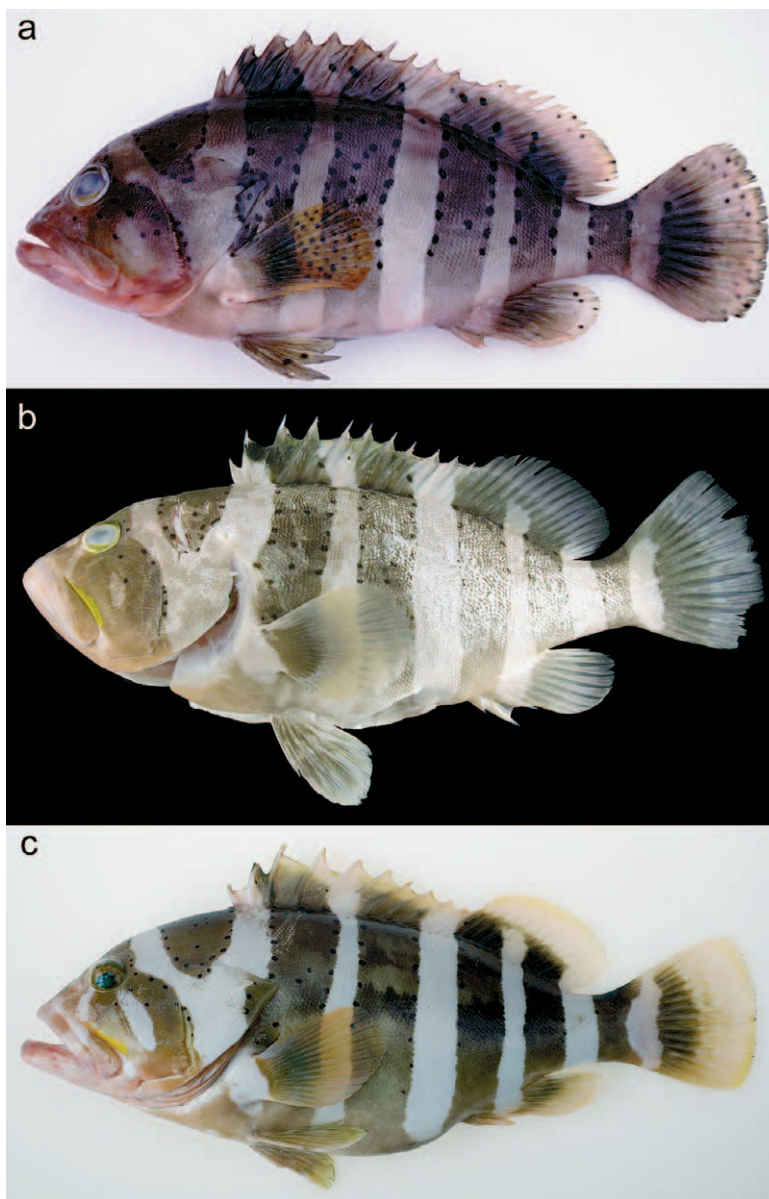


Fig. 1. Fresh specimens of *Epinephelus amblycephalus* collected from Japan, showing back spots on fins disappearing with growth. a, OMNH-P 13890, 270.0 mm SL, off Shibushi, Kagoshima Pref. (photo by K. Hatooka, 2 days after collection); b, KAUM-I. 821, 280.2 mm SL, north of Koejihama Beach, Oura, Minami-satsuma, Kagoshima Pref. (photo by H. Motomura); c, FAKU 93700, 340.5 mm SL, off Inami, Wakayama Pref. (photo by H. Ikeda).

hara (1957) also proposed a new Japanese name, Kokuten-aohata, for the species.

In his catalog of fishes of Kochi Prefecture, Kamohara (1958) included *E. diacanthus ambly-*

cephalus, without reference to specimens. There being no additional specimens of *E. amblycephalus* collected before 1958 in the fish collection of Kochi University, this was probably based on his earlier

(Kamohara, 1957) record. Subsequently, Kamohara (1960) listed the species in a list of the shore fishes of Okinoshima and adjacent regions, Kochi Prefecture. Although specimen data was not included, the record was probably based on a specimen (BSKU 8475, 89.5 mm SL) collected from Susaki, Kochi, on 17 April 1959, since the listed species included some “collected from Susaki” (see Introduction of Kamohara, 1960). Thus, BSKU 8475 appears to have been the second example of *E. amblycephalus* collected from Japanese waters.

Katayama (1960) described *E. amblycephalus* in detail on the basis of a single specimen collected from Yamakawa (correct spelling, Yamagawa; current name, Kaimon-cho, Ibusuki City), Kagoshima, Kyushu, Japan, including an illustration (pl. 46). The present whereabouts of the specimen is unknown. The distribution of the species given by Katayama (1960) included “Amboina [=Ambon, Indonesia]; Riu Kiu Islands or Formosa [=the Ryukyu Islands or Taiwan]; Japan (Yamakawa [=Kaimon], Kagoshima Prefecture)”, the first two localities having been based on Bleeker (1857) and Masuda (1942), respectively. Although Katayama (1960) did not refer to Kamohara’s (1957, 1958, 1960) publications and did not include Kochi in the distribution of the species, he did use the Japanese name, Kokuten-aohata, proposed by Kamohara (1957).

In his revised catalog of fishes of Kochi Prefecture, Japan, Kamohara (1964) referred to his earlier papers (above) and listed *E. amblycephalus*. However, no new specimens have been collected or reported from Kochi since Kamohara’s (1960) record.

In the fishes of the Japanese Archipelago, Katayama (1984) briefly described *E. amblycephalus* and provided a color photograph (pl. 114, taken by K. Kyushin). However, the photograph is the same as one reported by Kyushin *et al.* (1982), the specimen having been collected from the South China Sea. That specimen has been registered in the fish collection of the Hokkaido University Museum (HUMZ 87475, 05°52.00’N, 114°50.00’E, 111 m, 4 July

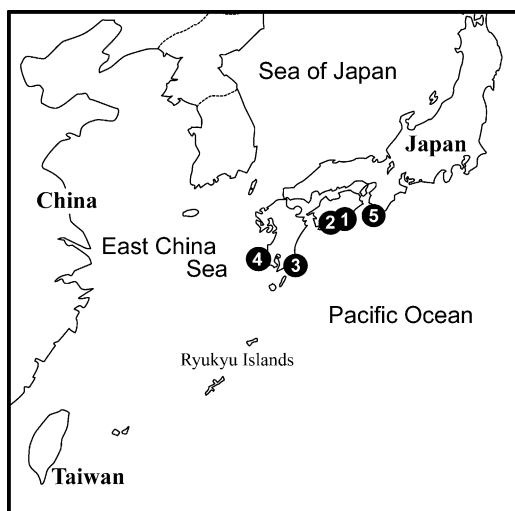


Fig. 2. Map of Japan (except for Hokkaido) and adjacent waters. Numbers in this figure indicate capture localities of specimens examined in this study (numbers in the order of collected date, oldest first): 1, Kochi, Kochi Pref.; 2, Susaki, Kochi Pref.; 3, Shibushi, Kagoshima Pref.; 4, Minamisatsuma, Kagoshima Pref.; and 5, Inami, Wakayama Pref.

1975) (H. Imamura, *pers. comm.*).

Senou (1993, 2000) later referred to Masuda (1942) and Katayama (1964) and concluded that there was little possibility that *E. amblycephalus* occurred on the coast of Japan. In addition, Senou (2002) stated “Katayama (1960) reported this species from Yamakawa of Kagoshima Prefecture, but there has been no further firm record based on specimens from Japan”. However, he overlooked the two BSKU specimens from Kochi, which were used in Kamohara’s (1957, 1960) lists.

Misaki (2000) reported a single individual of *E. amblycephalus* (ca 60 cm TL) collected by longline off Kushimoto, Wakayama Prefecture, at a depth of ca 40 m, on 4 September 2000. Subsequently kept at Kushimoto Marine Park, Wakayama, the specimen died in August, 2005 and was not retained (Y. Kotera, *pers. comm.*).

However, an example of *E. amblycephalus* collected from off Tomita, Shirahama, Wakayama Prefecture on 16 October 1997 (H. Tanase, *pers. comm.*

Table 1. *Epinephelus amblycephalus* reported from Japanese waters (see text).

Reported scientific name	Reference	Locality	Source
<i>E. diacanthus amblycephalus</i>	Masuda (1942)	Taiwan	One specimen (ZUMT 39148, 134.0 mm SL)
<i>E. diacanthus amblycephalus</i>	Kamohara (1957)	Kochi, Kochi Pref.	One specimen (BSKU 7442, 98.3 mm SL)
<i>E. diacanthus amblycephalus</i>	Kamohara (1958)	—	No specimens; quoted from Kamohara (1957)
<i>E. diacanthus amblycephalus</i>	Kamohara (1960)	Susaki, Kochi Pref.	One specimen (BSKU 8475, 89.5 mm SL)
<i>E. amblycephalus</i>	Katayama (1964)	Ibusuki, Kagoshima Pref.	One specimen; present whereabouts and size unknown
<i>E. amblycephalus</i>	Kamohara (1984)	—	No specimens; quoted from Kamohara (1957, 1958, 1960)
<i>E. amblycephalus</i>	Katayama (1984)	off Brunei, South China Sea	One specimen (HUMZ 87475, 386 mm SL)
<i>E. amblycephalus</i>	Randall & Heemstra (1991)	Yokohama, Kanagawa Pref.**	One specimen (NMW 40812, 176 mm SL)
<i>E. amblycephalus</i>	Senou (1993)	—	No specimens; quoted from Masuda (1942) and Katayama (1960)
—*	Senou (2000)	—	No specimens; quoted from Masuda (1942) and Katayama (1960)
—*	Misaki (2000)	Kushimoto, Wakayama Pref.	No individual; kept in aquarium and died in Aug. 2005; specimen not retained
<i>E. amblycephalus</i>	Misaki (2000)	Shirahama, Wakayama Pref.	One individual; kept in aquarium and still alive as of Jan. 2007
<i>E. amblycephalus</i>	Senou (2002)	—	No specimens; quoted from Masuda (1942) and Katayama (1960)
<i>E. amblycephalus</i>	This study	Shibushi, Kagoshima Pref.	One specimen (OMNH-P 13890, 270.0 mm SL)
<i>E. amblycephalus</i>	This study	Minami-satsuma, Kagoshima Pref.	One specimen (KAUM-I 821, 280.2 mm SL)
<i>E. amblycephalus</i>	This study	Inami, Wakayama Pref.	One specimen (FAKU 93700, 340.5 mm SL)

* As "Kokuten-aohata"; **capture locality unknown, landed in Yokohama

in Misaki, 2000) and kept at the Kyoto University Aquarium, is alive as of January 2007. Accordingly, five reliable records of *E. amblycephalus* from Japanese waters (one from Kagoshima, two from Kochi and two from Wakayama) have been reported prior to this study, two specimens being currently retained as BSKU 7442 and 8475 (Table 1).

Newly collected specimens from Kagoshima and Wakayama Prefectures — Recently, three specimens of *E. amblycephalus* have been collected from Japanese waters (Fig. 1), from Shibushi, Kagoshima (Pacific coast side) on 27 April 2000, from Minami-satsuma, Kagoshima (East China Sea side) on 3 October 2006 and from Inami, Wakayama (Pacific coast) on 19 November 2006 (Fig. 2). Counts and measurements of the three specimens are given in Table 2, along with data for BSKU 7442 and 8475.

Morphological description based on all of the Japanese specimens — Dorsal profile of head slightly convex; nape and anterodorsal portion of body without numerous pores; anterior and posterior nostrils subequal in size; posterior margin of maxilla extending slightly beyond a vertical through posterior margin of eye (not confirmed in BSKU 7422 specimen as its mouth widely opened and head was bent dorsally); middle part of lower jaw with 2 rows of teeth; palatines with teeth; preopercular margin with 4–6 slightly enlarged serrae posteroventrally and 13–32 tiny serrae centrally, upper margin smooth, without serrae in larger specimens; 2 opercular spines; interspinous dorsal-fin membranes moderately incised; base of spinous portion of dorsal fin longer than base of soft-rayed portion; pectoral fins nearly symmetric, middle rays longest; base of upper pectoral-fin rays joined by scaly skin flap to body; caudal-fin margin rounded; lateral-line scales with single tubule. Coloration of fresh specimens (based on color photographs of KAUM-I. 821 and FAKU 93700): head and body brownish to whitish, with dark brown bars; anterior portion of head with 4 dark brown bars radiating from eye, 2 of the 4 extending onto upper-jaw lip; nape with a broad dark brown saddle; body with 5 dark brown bars, first to fourth bars extending onto ventral surface from dor-

Table 2. Counts and measurements of all existing specimens of *Epinephelus amblycephalus* collected from Japanese waters.

Registration number	BSKU 7442	BSKU 8475	OMNH-P 13890	KAUM-I. 821*	FAKU 93700
Locality	Kochi Pref.	Kochi Pref.	Kagoshima Pref.	Kagoshima Pref.	Wakayama Pref.
Collection date	Aug. 1957	Apr. 1959	Apr. 2000	Oct. 2006	Nov. 2006
Standard length (mm)	98.3	89.5	270.0	280.2	340.5
Total length (mm)	122.1	110.6	329.0	344.3	415.1
Dorsal-fin rays	XI, 15	XI, 16	XI, 15	XI, 15	XI, 14
Anal-fin rays	III, 8	III, 8	III, 8	III, 8	III, 8
Pectoral-fin rays	18	19	18	19	18
Pelvic-fin rays	I, 5	I, 5	I, 5	I, 5	I, 5
Lateral-line scales	52	51	57	–	50
Longitudinal scale series	97	105	115	–	114
Gill rakers	7+16=23	8+15=23	7+16=23	–	8+16=24
% of standard length					
Body depth	37.6	39.4	38.9	37.8	38.0
Body width	18.6	19.3	21.3	20.1	19.4
Head length	40.2	41.8	42.4	43.6	42.2
Snout length	9.7	10.5	11.2	11.7	11.3
Orbit diameter	10.2	9.8	7.6	7.3	6.6
Interorbital width	5.4	6.0	8.1	8.4	8.0
Upper-jaw length	19.0	20.9	20.6	21.1	19.7
Caudal-peduncle depth	10.2	10.4	11.7	11.5	11.3
Caudal-peduncle length	16.6	17.2	15.3	15.4	14.5
Predorsal length	37.7	37.1	36.7	37.2	37.3
Preanal length	73.9	70.6	69.6	73.4	71.7
Prepelvic length	45.8	40.7	37.1	42.5	40.2
First dorsal-fin spine length	7.6	8.2	7.4	5.7**	6.2
Longest dorsal-fin spine length	14.6 (4th)	16.6 (4th)	14.4 (4th)	13.8 (4th)	13.0 (4th)
Longest dorsal-fin soft ray length	18.1 (4th)	18.0 (4th)	15.1 (4th)	15.4 (4th)	15.2 (4th)
First anal-fin spine length	6.7	7.2	1.9	4.2	4.1
Second anal-fin spine length	14.1	11.5	10.5	8.8	8.2
Third anal-fin spine length	12.4	11.7	11.2	9.6	8.8
Longest anal-fin soft ray length	17.8 (4th)	17.0 (4th)	20.1 (4th)	19.2 (4th)	18.9 (4th)
Caudal-fin length	24.5	23.7	21.4	22.9	21.9
Pectoral-fin length	23.3	19.6	21.9	23.8	22.9
Pelvic-fin spine length	11.8	12.7	11.6	12.5	11.5
Longest pelvic-fin soft ray length	19.8** (2nd)	21.6 (3rd)	18.1 (3rd)	21.8 (3rd)	19.8 (3rd)

*Gill, internal organs and scales removed. **Tip slightly broken.

sal-fin membranes, fifth bar on caudal peduncle, narrowest; numerous black spots scattered mainly along edges of bars and saddle; eye membrane yellowish; maxillary groove vivid yellow; dorsal fin yellowish-brown; pectoral fin yellowish translucent; pelvic and anal fins dark brown basally, yellowish-brown distally; caudal fin brown distally, yellowish-brown distally, with a narrow yellow marginal band. Specimen

OMNH-P 13890 with black spots on all fins, characteristic of young stages of the species (Heemstra and Randall, 1993, 1999), but which eventually disappear with growth (see Fig. 1).

The above characters of the Japanese specimens were completely consistent with those of *E. amblycephalus* given by Heemstra and Randall (1993, 1999) and the holotype of *S. amblycephalus* (RMNH

5159, 241.5 mm SL, Ambon, Indonesia) examined in this study. Although Heemstra and Randall (1993, 1999) described number of the dorsal-fin soft rays as 15 or 16, the holotype and the Wakayama specimen had 14 soft rays. In addition to those examined in this study, all of the specimens reported in the publications listed in Table 1 were identified as *E. amblycephalus*, on the basis of their descriptions, illustrations and photographs.

Distribution and conclusions — The literature and specimen survey revealed that a total of eight individuals of *E. amblycephalus* have been collected to date from Japanese waters, despite the considered rarity or absence of the species in Japanese waters (e.g. Senou, 2002). Of the eight individuals, five specimens are currently held in museum collections (Tables 1–2).

Epinephelus amblycephalus is distributed in the eastern Indian and western Pacific Oceans, where it ranges from the Andaman Sea east to Fiji (Heemstra and Randall, 1993, 1999). In Japanese waters, the species has been recorded from Kagoshima, Kochi and Wakayama Prefectures, but has never been found in the Ryukyu Islands (Masuda's specimen was probably collected from Taiwan) or north of Wakayama Prefecture. These three aforementioned prefectures face the flow path of the Kuroshio Current running from Taiwan via the coast of China, but not through the Ryukyu Islands. This suggests that the primary tropical epibenthic fish, *E. amblycephalus*, is transported by the Kuroshio Current to the Pacific coast of southern Japan from Taiwan or China, at egg or larval stages. The Japanese specimens varied from juveniles to adults (89.5–340.5 mm SL), being collected throughout the year (Apr., Aug., Oct. and Nov.). Such indicates that *E. amblycephalus* can probably over-winter and attain adult size in Japanese waters (at 340.5 mm SL, the Wakayama specimen is close to maximum size recorded for the species). However, because so few of this distinctly colorful grouper have been found over the past 50 years in Japanese waters, being first time catches for all of the local fishermen involved, it is unlikely that the species reproduces around

Japan.

Acknowledgments

We greatly appreciate Fukuyoshi Yamashita (Kasasa Fishery Cooperative Society, Japan), Mitsuo Kumemura (Shibushi Fishery Cooperative Society, Japan) and Shunji Kaji (Shibushi Station, National Center for Stock Enhancement, Fisheries Research Agency, Japan) for opportunities to examine the newly collected specimens of *Epinephelus amblycephalus*, and Tetsuji Nakabo (FAKU), Mayumi Takayama, Yuriko Haraguchi, Nami Kita, Masatoshi Meguro and Gouta Ogihara (KAUM) and Junko Omori (Kagoshima Aquarium, Japan) for their curatorial assistance. We thank Kazuo Sakamoto (ZUMT) for a specimen loan, and Takeshi Yamakawa (BSKU), Hisashi Imamura (Hokkaido University Museum, Japan), Helmut Wellendorf (NMW), Tetsuo Yoshino (URM) and Yoshihiko Kotera (Kushimoto Marine Park, Japan) for providing data and information on previously reported specimens of *E. amblycephalus*. The first author thanks Yuko Motomura (Kagoshima, Japan) for her assistance, Martien J. P. van Oijen (RMNH) for opportunity to examine the holotype of *Serranus amblycephalus* and Graham S. Hardy (Ngunguru, New Zealand), who read the initial manuscript and offered helpful comments. This study was supported in part by Grant-in-Aids for Scientific Research (A) by the Japan Society for the Promotion of Science, Tokyo, Japan (19208019) and for Young Scientists (B) by the Ministry of Education, Science, Sports and Culture, Japan (19770067).

Literature Cited

- Allen, G. R. & Robertson, D. R., 1999. *Epinephelus clippertonensis*, a new species of serranid fish from the tropical eastern Pacific. *Rev. Fr. Aquariol.*, **26**: 11–15.
- Bleeker, P., 1857. Achtste bijdrage tot de kennis der vischfauna van Amboina. *Acta Soc. Sci. Indo-Néêrl.*, **2**: 1–102.
- Heemstra, P. C. & Randall, J. E., 1993. Groupers of

- the world (family Serranidae, subfamily Epinephelinae). An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyretail species known to date. *FAO Species Catalog*, **16**. *FAO Fish. Synopsis* No. 125. viii, 382 pp. FAO, Rome.
- , 1999. Serranidae. Groupers and sea basses (also, soapfishes, anthiines, etc.) In Carpenter, K. E. & Niem, V. H. (Eds), *Bony fishes part 2 (Mugilidae to Carangidae)* *FAO Species Identification Guide for fishery Purposes. The living marine Resources of the western central Pacific*, **4**: 2442–2548. FAO, Rome.
- Kamohara, T., 1957. Some little known fishes from Kochi Prefecture (Prov. Tosa), Japan, including one new species of the family Peristediidae. *Jpn. J. Ichthyol.*, **6**: 75–81.
- , 1958. A catalogue of fishes of Kochi Prefecture (Province Tosa), Japan. *Rep. Usa mar. Biol. Stn.*, **5**: 1–76.
- , 1960. On the shore fishes of Okinoshima and adjacent regions, Kochi Prefecture, Japan. *Res. Rep. Kochi Univ., natl. Sci. 1*, **9**: 1–16 (in Japanese).
- , 1964. Revised catalogue of fishes of Kochi Prefecture, Japan. *Rep. Usa mar. Biol. Stn.*, **11**: 1–99.
- Katayama, M., 1960. *Fauna Japonica*. Serranidae (Pisces). 189 pp. Biological Society of Japan, Tokyo.
- , 1984. Serranidae. In Masuda, H., Amaoka, K., Araga, C., Uyeno, T. & Yoshino, T. (Eds), *The Fishes of the Japanese Archipelago*: 123–134. Tokai University Press, Tokyo. (In Japanese).
- Kyushin, K., Amaoka, K., Nakaya, K., Ida, H., Tani-no, Y. & Senta, T., 1982. *Fishes of the South China Sea*. 333 pp. Jpn. Mar. Fish. Resource Res. Cent., Tokyo.
- Masuda, S., 1942. Notes on the Japanese fishes of the genus *Epinephelus*. *Annotnes. zool. Jpn.*, **21**: 106–123.
- Misaki, H., 2000. Isokojiki 18. *Mar. Pavilion*, **29**: 58 (in Japanese).
- Randall, J. E. & Heemstra, P. C., 1991. Revision of Indo–Pacific groupers (Perciformes: Serranidae: Epinephelinae), with descriptions of five new species. *Indo-Pacif. Fish.*, (20): 1–332.
- Randall, J. E. & Satapoomin, U., 2000. *Cephalopholis polyspila*, a new species of grouper (Perciformes: Serranidae: Epinephelinae) from south-western Thailand and Sumatra. *Phuket mar. biol. Cent. Res. Bull.*, No. 63: 1–8.
- Senou, H., 1993. Serranidae. Groupers and basslets. In Nakabo, T. (Ed), *Fishes of Japan with pictorial Keys to the Species*: 601–632, 1306–1312, 1377. Tokai University Press, Tokyo. (In Japanese).
- , 2000. Serranidae. Groupers, basslets and soapfishes. In Nakabo, T. (Ed), *Fishes of Japan with pictorial Keys to the Species* (2nd Edn): 690–731, 1539–1547. Tokai University Press, Tokyo. (In Japanese).
- , 2002. 219 Serranidae. Groupers, basslets and soapfishes. In Nakabo, T. (Ed), *Fishes of Japan with pictorial Keys to the Species* (English Edn): 690–731, 1532–1540. Tokai University Press, Tokyo.

(Accepted February 21, 2007)