

Freshwater fishes of Yaku-shima Island, Kagoshima Prefecture, southern Japan

Toshihiko Yonezawa^{1*}, Akihiko Shinomiya² and Hiroyuki Motomura³

¹Foundation of Kagoshima Environmental Research & Service, 1-1-5 Nanatsujima, Kagoshima 891-0132, Japan

²Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan

³Kagoshima University Museum, 1-21-30 Korimoto, Kagoshima 890-0065, Japan

*Corresponding author: e-mail: yonezawa@kagoshima-env.or.jp

Abstract An annotated checklist of freshwater fishes of Yaku-shima Island, Kagoshima Prefecture, southern Japan, was compiled from field and literature surveys. A total of 32 species (22 genera, 11 families, 7 orders) are listed with citation of literature, registration numbers, sizes, localities in the island, ecological notes, and color photographs if available.

Key words: Freshwater fishes, checklist, Yaku-shima Island, Kagoshima, Japan.

Introduction

Yaku-shima Island has well-developed mountains, including the highest peak in Kyushu, Mt. Miyanoura, at 1936 m. Annual precipitation is high, 2,400–5,000 mm in lowland areas and 5,000–7,400 mm in the mountains (Takahara and Matsumoto, 2002). Therefore, the island's rivers are well developed, especially the Ambo River, which is more than 10 km long. In addition, the island has very limited flatlands and in its entirety appears as one large, steep mountain, with the mountain slope continuing under the sea. Thus, the estuaries are poorly developed, and the rapid mountain streams flow directly into the sea without any obvious estuarine area.

The water temperature in the larger rivers of the lowland areas drops below 10°C in the winter season because the headwaters of these rivers are fed by snowmelt. On the other hand, the water temperature in some small-scale rivers with hot springs exceeds 15°C even in winter.

The freshwater ichthyofauna of Yaku-shima Island is poorly known, with only a few faunal studies published (e.g., Jordan and Starks, 1906; Kuroiwa, 1927; Ogawa, 1937). During recent surveys of freshwater fishes of Yaku-shima Island by the first author, a gobiid, *Stiphodon surrufus*,

was discovered from a small river with a hot spring (Yonezawa and Iwata, 2001) and the species is currently known only from the island in Japan. However, no other survey results (except for Yonezawa, 2002; Yonezawa and Shinomiya, 2002) have been published.

This paper provides a list of 32 species of freshwater fishes occurring in the upper and middle reaches of rivers on Yaku-shima Island on the basis of published papers, collected specimens, and underwater photographs and observations during the surveys.

Materials and methods

The systematic arrangement of families follows Nelson (2006). Species in families are arranged in alphabetical order of species name. Standard Japanese names generally follow Nakabo (2002), and are transliterated using the Hepburn system. Each species record was compiled from voucher specimens and literature sources related to freshwater fishes recorded from the upper and middle reaches of the island's rivers. Each voucher specimen includes registration number, number of specimens registered if more than one, standard length (abbreviated as SL), and locality on Yaku-shima Island (Fig. 1). Nishi and Imai



Fig. 1. Map of Yaku-shima Island, with major rivers. Names of places and rivers given in this map are used in text.

(1969) listed 11 species from Yaku-shima Island. However, these fishes are not listed in this study because some or most species might be collected from estuaries of the Issso River.

Specimens used in this paper have been deposited at the following collections: Biological Laboratory, Imperial Household, Tokyo (BLIP); Kagoshima University Museum, Kagoshima (KAUM); National Museum of Nature and Science, Tokyo (NSMT); and Museum Support Center of the Smithsonian Institution National Museum of Natural History, Suitland (USNM).

List of freshwater fishes

ORDER ANGUILLIFORMES

FAMILY ANGUILLIDAE

Anguilla japonica Temminck and Schlegel, 1846 [Japanese name: Unagi] (Fig. 2)

USNM 53542, 2 specimens, 247.1–256.5 mm SL, Miyanoura River.

Jordan and Starks (1906); Kuroiwa (1927); Ogawa (1937); Sakai et al. (2001).

Remarks. The species usually inhabits gently flowing rivers and is relatively rare at Yaku-shima Island. Classified as ‘data deficient (DD)’ in the 2007 Red List by the Ministry of Environment, Japan.



Fig. 2. *Anguilla japonica*. USNM 53542, 247.1 mm SL, Miyanoura River (preserved specimen).

Anguilla marmorata Quoy and Gaimard, 1824 [Japanese name: Ounagi] (Fig. 3)

Kuroiwa (1927); Ogawa (1937); Sakai et al. (2001); Mizuno and Nagasawa (2009).

Remarks. In small streams at Yaku-shima Island, the species occurs from the headwaters to river mouths. The population of *A. marmorata* is larger than that of *A. japonica* at Yaku-shima Island.



Fig. 3. *Anguilla marmorata*. Issso River, 0.5 m, 16 Oct. 1999, T. Yonezawa.

ORDER CYPRINIFORMES

FAMILY CYPRINIDAE

Tribolodon hakonensis (Günther, 1877)

[Jpn name: Ugui] (Fig. 4)

Yonezawa et al. (2003).

Remarks. An introduced species; released together with *Oncorhynchus masou masou* into the Ambo River in 1971 (T. Oyama, pers. comm.). The Yaku-shima Island population of the species is most likely to be landlocked because its spawning has been confirmed from an upstream dam. Catadromous and landlocked populations are known for the species.



Fig. 4. *Tribolodon hakonenensis*. Ara River, 0.5 m, 23 Nov. 2005, K. Morita.

Carassius langsdorfi (Temminck and Schlegel, 1846)
[Japanese name: Gimbuna]

Ogawa (1937, as *Carassius carassius*).

Remarks. No records of the species have been reported from Yaku-shima Island since Ogawa (1937). He reported it as “Funa, *C. carassius*” without voucher specimens, and provided a photograph of a fish collected from Okinoerabujima Island (not Yaku-shima Island). If his record of “Funa” was certain, his fish was probably *C. langsdorfi* (rather than *C. carassius*) because *C. langsdorfi* is widely distributed in the islands, including Tanega-shima and Amami-oshima Islands, and on the mainland of Kagoshima Prefecture.

FAMILY COBITIDAE

Misugumus anguillicaudatus Cantor, 1842

[Japanese name: Dojo]

Kuroiwa (1927); Ogawa (1937).

Remarks. No records of the species have been reported from Yaku-shima Island since Ogawa (1937). This species is probably very rare or extinct on Yaku-shima Island because preferred habitats of the species, e.g., reservoirs, ponds, and rice fields with small channels, are limited on the island. It has been classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office.

ORDER OSMERIFORMES

FAMILY OSMERIDAE

Plecoglossus altivelis altivelis Temminck and Schlegel, 1846
[Japanese name: Ayu] (Fig. 5)

KAUM-I. 19101, 146.0 mm SL, Isso River;
KAUM-I. 19102, 83.7 mm SL, Isso River;
KAUM-I. 19103, 100.4 mm SL, Isso River;
KAUM-I. 19104, 80.3 mm SL, Isso River;
KAUM-I. 24679, 93.5 mm SL, Miyanoura River;
KAUM-I. 24680, 84.3 mm SL, Miyanoura River;
KAUM-I. 24681, 84.4 mm SL, Miyanoura River.

Kuroiwa (1927); Ogawa (1937); Sawashi et al. (1993); Sakai et al. (2001); Yonezawa et al. (2003).

Remarks. Occurs in relatively large rivers on Yaku-shima Island. The Yaku-shima Island population represents the southernmost distributional range of *P. altivelis altivelis* (see Yonezawa et al., 2003). A closely related subspecies, *P. altivelis ryukyensis*, is distributed on Amami-oshima Island but has never been recorded from Yaku-shima Island; this is probably because the survival rate of juvenile *P. a. ryukyensis* is extremely low when sea water temperature exceeds 20°C (Kishino et al., 2008) and they usually stay in coastal areas and do not venture offshore (Tsukamoto, 1988). *Plecoglossus a. altivelis* is classified as ‘vulnerable (VU)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office.

ORDER SALMONIFORMES

FAMILY SALMONIDAE

Oncorhynchus masou masou (Brevoort, 1856)
[Japanese name: Yamame] (Fig. 6)

Kawanabe and Mizuno (1989); Yonezawa et al. (2003).

Remarks. A landlocked population in the Ambo River; introduced into the upstream area of the Arakawa Dam in 1971 by the Freshwater Fish Protection Society in cooperation with the Faculty of Fisheries, Kagoshima University, and Fisheries Department, Kagoshima Prefectural Office.

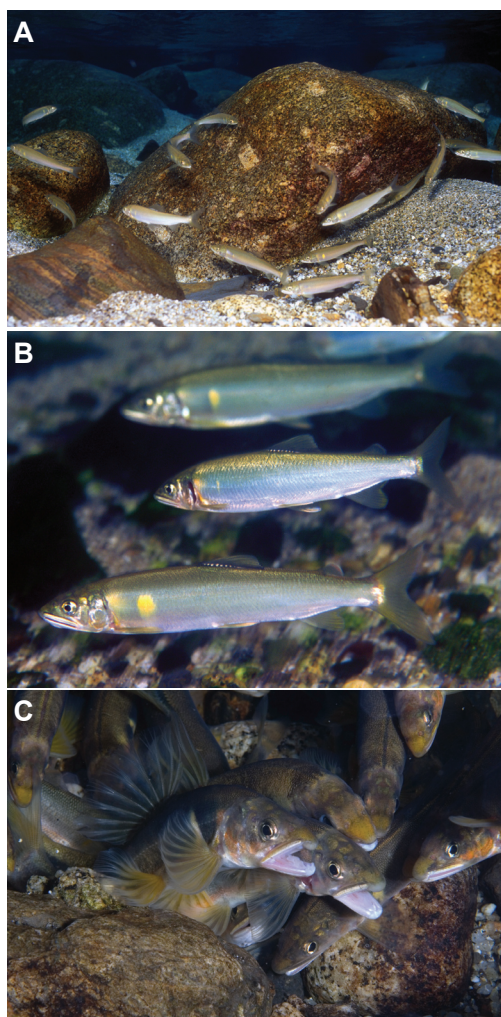


Fig. 5. *Plecoglossus altivelis altivelis*. **A**, Miyanoura River, 0.5 m, 15 Oct. 1999, T. Yonezawa; **B**, Isso River, 0.5 m, 16 Oct. 1999, T. Yonezawa; **C**, Isso River, 0.8 m, 23 Dec. 2009, S. Harazaki.



Fig. 6. *Oncorhynchus masou masou*. Ara River, 0.5 m, 23 Nov. 2005, K. Morita.

ORDER BELONIFORMES

FAMILY ADRIANICHTHYOIDAE

Oryzias latipes (Temminck and Schlegel, 1846)

[Japanese name: Medaka]

Sakai et al. (2001).

Remarks. This species is probably very rare or extinct on Yaku-shima Island because preferred habitats of the species, e.g., reservoirs, ponds, and rice fields with small channels, are limited on the island. There are three distinct genetic populations of *O. latipes* (Satsuma, Osumi, and Ryukyu populations) in Kagoshima Prefecture (Sakaizumi, 1997). *Oryzias latipes* at Yaku-shima Island is most likely to be the Ryukyu population. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘vulnerable (VU)’ in the 2007 Red List by the Ministry of Environment, Japan.

ORDER SYGNATHIFORMES

FAMILY SYNGNATHIDAE

Microphis leiaspis (Bleeker, 1853)

[Japanese name: Issen-yoji]

Sakai et al. (2001).

Remarks. At Yaku-shima Island, the species apparently disappears during winter.

ORDER PERCIFORMES

FAMILY KUHLIIDAE

Kuhlia marginata (Cuvier, 1829)

[Japanese name: Yugoi] (Fig. 7)

KAUM-I. 17823, 47.3 mm SL, a stream at Kusugawa; KAUM-I. 17833, 46.9 mm SL, a stream at Kusugawa; KAUM-I. 17858, 32.3 mm SL, Isso River; KAUM-I. 25049, 78.4 mm SL, Ambo River.

Ogawa (1937); Sakai et al. (2001).

Remarks. Common at Yaku-shima Island.



Fig. 7. *Kuhlia marginata*. KAUM-I. 17833, 46.9 mm SL, a stream at Kusugawa (preserved specimen).

Kuhlia munda (De Vis, 1884)

[Japanese name: Togenagayugoi]

Kawanabe and Mizuno (1989); Sakai et al. (2001).

Remarks. Extremely rare at Yaku-shima Island. No specimens were confirmed during this study. The species is classified as ‘data deficient (DD)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘endangered (EN)’ in the 2007 Red List by the Ministry of Environment, Japan. Sato et al. (2004) synonymized *K. boninensis* (Fowler, 1907) with *K. munda*.

Kuhlia rupestris (Lacepède, 1802)

[Japanese name: Okuchiyugoi] (Fig. 8)

KAUM-I. 19094, 79.5 mm SL, Hide River.

Kuroiwa (1927); Ogawa (1937); Sakai et al. (2001).

Remarks. Often occurs with *Kuhlia marginata* at Yaku-shima Island. The population of *K. rupestris* is much smaller than that of *K. marginata* at the island. The species apparently disappears during winter at Yaku-shima Island and adults have never been observed.



Fig. 8. *Kuhlia rupestris*. KAUM-I. 19094, 79.5 mm SL, Hide River (preserved specimen).

FAMILY RHYACICHTHYDAE

Rhyacichthys aspro (Valenciennes, 1837)

[Japanese name: Tsubasahaze] (Fig. 9)

BLIP 1999194, 24.9 mm SL, Okawa River; BLIP 1999195, 24.5 mm SL, Nagata River.

Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. Rare at Yaku-shima Island; have been observed at small waterfalls near mouths of small rivers. Although the species can overwinter

at Yaku-shima Island, possibility of reproduction at the island is relatively low. The northernmost recorded range of the species is probably Yaku-shima Island. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘endangered (CR)’ in the 2007 Red List by the Ministry of Environment, Japan.

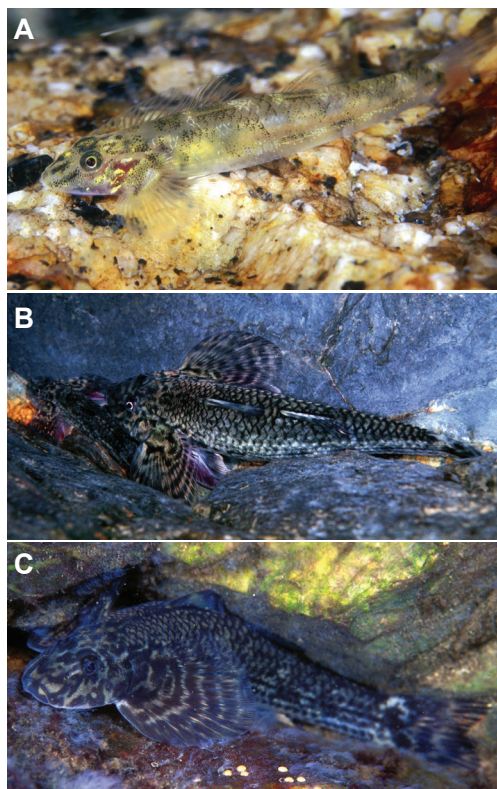


Fig. 9. *Rhyacichthys aspro*. A, Nagata River, 0.3 m, 14 Oct. 1999, T. Yonezawa; B and C, a stream at Onoaida, 0.5 m, 25 Dec. 1999, T. Yonezawa.

FAMILY ELEOTRIDAE

Eleotris fusca (Forster, 1801)

[Japanese name: Tenjikukawaanago] (Fig. 10)

Remarks. Occurs in the lower portions of the middle reaches of small-scale rivers; relatively rare at Yaku-shima Island. The species cannot overwinter at the island and dead individuals can be observed on the bottom of rivers in winter.



Fig. 10. *Eleotris fusca*. A stream at Onoaida, 0.3 m, 25 Dec. 1999, T. Yonezawa.

***Ophieleotris* sp.**

[Japanese name: Tametomohaze] (Fig. 11)

Akihito et al. (2002); Yonezawa and Shinomiya (2002); Suzuki and Shibukawa (2004).

Remarks. Occurs in the lower portions of the middle reaches of small-scale rivers; very rare at Yaku-shima Island. The individuals found at Yaku-shima Island are probably transported by the Kuroshio Current from the south. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘endangered (EN)’ in the 2007 Red List by the Ministry of Environment, Japan.



Fig. 11. *Ophieleotris* sp. A stream at Harumaki, 0.5 m, 14 Oct. 1999, T. Yonezawa.

FAMILY GOBIIDAE

Awaous ocellaris (Broussonet, 1782)

[Japanese name: Minamihaze] (Fig. 12)

Suzuki and Shibukawa (2004).

Remarks. This relatively rare species inhabits the lower portions of the middle reaches of gently flowing rivers on Yaku-shima Island.



Fig. 12. *Awaous ocellaris*. Nagata River, 0.5 m, 14 Oct. 1999, T. Yonezawa.

Gymnogobius petschiliensis (Rendahl, 1924)

[Japanese name: Sumiukigori] (Fig. 13)

KAUM-I. 17865, 67.3 mm SL, Isso River; NSMT-P 29077, 3 specimens, 55.6–73.0 mm SL, Nagata River; NSMT-P 29082, 45.0 mm SL, Nagata River; NSMT-P 29091, 4 specimens, 38.3–44.3 mm SL, Nagata River; NSMT-P 29120, 12 specimens, 41.5–63.8 mm SL, Isso River; NSMT-P 29368, 53.8 mm SL, Yaku-shima Island.

Kawanabe and Mizuno (1989); Sakai et al. (2001); Akihito et al. (2002, as *Gymnogobius* sp. 1); Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. The southernmost recorded range of the species in Japan is considered to be Yaku-shima Island (Suzuki and Shibukawa, 2004).



Fig. 13. *Gymnogobius petschiliensis*. NSMT-P 29120, 42.5 mm SL, Isso River (preserved specimen).

Gymnogobius urotaenia (Hilgendorf, 1879)

[Japanese name: Ukigori]

Suzuki and Shibukawa (2004).

Remarks. No specimens were confirmed during this study. The southernmost recorded range of the species is considered to be Yaku-shima Island (Suzuki and Shibukawa, 2004).

Lentipes armatus Sakai and Nakamura, 1979

[Japanese name: Yoroibozuhaze] (Fig. 14)

BLIP 1999196, 19.2 mm SL, Okawa River.

Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. Rare at Yaku-shima Island; have been observed at small waterfalls near mouths of small rivers. Although individuals with nuptial coloration are observed at Yaku-shima Island, the possibility of reproduction at the island is unknown. The northernmost recorded range of the species is probably Yaku-shima and Tanega-shima Islands. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘critically endangered (CR)’ in the 2007 Red List by the Ministry of Environment, Japan.

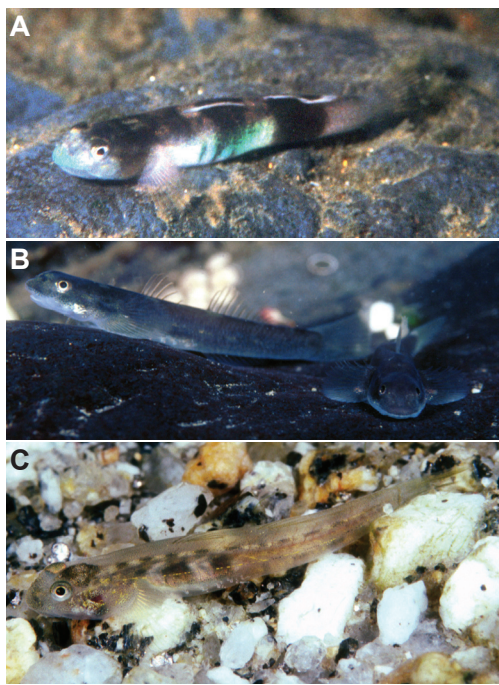


Fig. 14. *Lentipes armatus*. **A**, male, a stream at Onoaida, 0.3 m, Oct. 2000, T. Yonezawa; **B**, female, a stream at Onoaida, 0.3 m, Oct. 2000, T. Yonezawa; **C**, juvenile, Okawa River, 0.5 m, 16 Dec. 1999, T. Yonezawa.

Rhinogobius giurinus (Rutter, 1897)

[Japanese name: Gokurakuhaze] (Fig. 15)

KAUM-I. 17818, 39.8 mm SL, a stream at Kusugawa; KAUM-I. 17819, 42.2 mm SL, a stream at Kusugawa; KAUM-I. 17820, 39.0 mm SL, a stream at Kusugawa; KAUM-I. 17821, 40.5 mm SL, a stream at Kusugawa; KAUM-I. 17822, 64.0 mm SL, a stream at Kusugawa; KAUM-I.

19097, 47.4 mm SL, Isso River; NSMT-P. 29045, 5 specimens, 54.2–79.9 mm SL, Nagata River; NSMT-P 29055, 41.2 mm SL, a stream at Torigoe; NSMT-P 29069, 2 specimens, 39.0–58.6 mm SL, a stream at Torigoe; NSMT-P 29076, 58.3 mm SL, Nagata River; NSMT-P 29081, 2 specimens, 41.2–55.2 mm SL, Nagata River; NSMT-P 29085, 54.4 mm SL, Nagata River; NSMT-P 29090, 4 specimens, 40.9–47.5 mm SL, Nagata River; NSMT-P 29099, 27 specimens, 47.5–88.9 mm SL, Isso River; NSMT-P 29107, 12 specimens, 42.2–72.9 mm SL, Isso River; NSMT-P 29119, 9 specimens, 22.1–75.8 mm SL, Isso River; NSMT-P 29126, 2 specimens, 39.6–80.8 mm SL, Miyanoura River; NSMT-P 29132, 3 specimens, 38.7–47.0 mm SL, Miyanoura River; NSMT-P 29136, 51.6 mm SL, Miyanoura River.

Kuroiwa (1927); Ogawa (1937).

Remarks. Common at Yaku-shima Island.



Fig. 15. *Rhinogobius giurinus*. **A**, male, Nagata River, 0.5 m, 14 Oct. 1999, T. Yonezawa; **B**, female, Nagata River, 0.5 m, 14 Oct. 1999, T. Yonezawa.

***Rhinogobius* sp. DA**

[Japanese name: Kuroyoshinobori] (Fig. 16)

KAUM-I. 17834, 52.6 mm SL, a stream at Kusugawa; KAUM-I. 17835, 64.5 mm SL, a stream at Kusugawa; KAUM-I. 17836, 63.1 mm SL, a stream at Kusugawa; KAUM-I. 17837, 42.7 mm SL, a stream at Kusugawa; KAUM-I. 17859, 53.7 mm SL, Isso River; KAUM-I. 17860, 37.5 mm SL, Isso River; KAUM-I. 19098, 48.8 mm SL, Isso River; KAUM-I. 19099, 57.8 mm SL, Isso River; KAUM-I. 19100, 59.8 mm SL, Isso River; KAUM-I. 19648, 49.6 mm SL,

Isso River; KAUM-I. 19649, 50.5 mm SL, Isso River; KAUM-I. 19650, 40.9 mm SL, Isso River; KAUM-I. 19651, 40.6 mm SL, Isso River; KAUM-I. 19652, 41.4 mm SL, Isso River; KAUM-I. 19653, 37.6 mm SL, Isso River; KAUM-I. 19654, 37.7 mm SL, Isso River; KAUM-I. 19655, 41.0 mm SL, Isso River; KAUM-I. 19656, 34.5 mm SL, Isso River; KAUM-I. 19657, 27.6 mm SL, Isso River; KAUM-I. 19658, 28.6 mm SL, Isso River; KAUM-I. 19659, 34.0 mm SL, Isso River; KAUM-I. 19660, 42.3 mm SL, Isso River; KAUM-I. 19661, 43.2 mm SL, Isso River; KAUM-I. 19662, 24.8 mm SL, Isso River; KAUM-I. 19663, 23.9 mm SL, Isso River; KAUM-I. 19664, 44.1 mm SL, Isso River; KAUM-I. 19665, 26.9 mm SL, Isso River; KAUM-I. 19666, 27.5 mm SL, Isso River; KAUM-I. 19667, 23.4 mm SL, Isso River; KAUM-I. 19668, 24.3 mm SL, Isso River; KAUM-I. 19669, 26.3 mm SL, Isso River; KAUM-I. 19670, 24.6 mm SL, Isso River; KAUM-I. 24718, 38.4 mm SL, a stream at Yudomari; KAUM-I. 24719, 46.2 mm SL, Miyanoura River; KAUM-I. 24720, 25.9 mm SL, Miyanoura River; NSMT-P 29059, 9 specimens, 43.1–58.7 mm SL, a stream at Torigoe.

Sakai et al. (2001).

Remarks. Common at Yaku-shima Island.

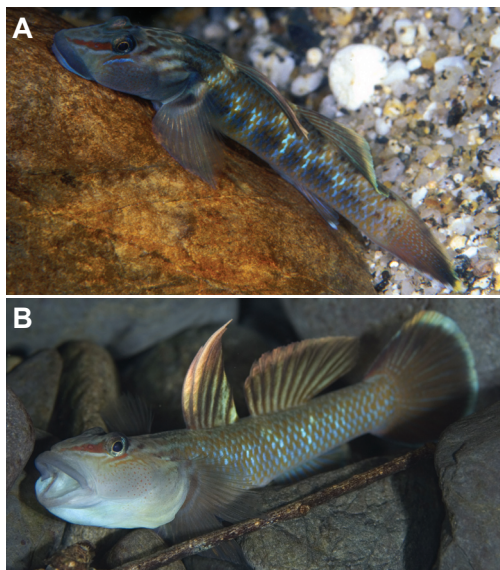


Fig. 16. *Rhinogobius* sp. DA. **A**, male, Nagata River, 0.5 m, 14 Dec. 1999, T. Yonezawa; **B**, male, Tabu River, 2 m, 6 July 2007, S. Harazaki.

Rhinogobius sp. DL

[Japanese name: Hirayoshinobori] (Fig. 17)

KAUM-I. 24721, 34.7 mm SL, Miyanoura River; KAUM-I. 24722, 31.7 mm SL, Miyanoura River; KAUM-I. 24723, 33.8 mm SL, Miyanoura River; KAUM-I. 24724, 30.1 mm SL, Miyanoura River; KAUM-I. 24725, 30.0 mm SL, Miyanoura River; KAUM-I. 24726, 27.6 mm SL, Miyanoura River; KAUM-I. 24727, 20.6 mm SL, Miyanoura River.

Sakai et al. (2001); Yonezawa (2002); Suzuki and Shibukawa (2004).

Remarks. Occurs in the relatively large-scale rivers of Yaku-shima Island. The population of the species at the island is smaller than that of *Rhinogobius* sp. DA. The northernmost distributional range is probably Yaku-shima and Tanega-shima Islands. The species is classified as ‘near threatened (NT)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office.

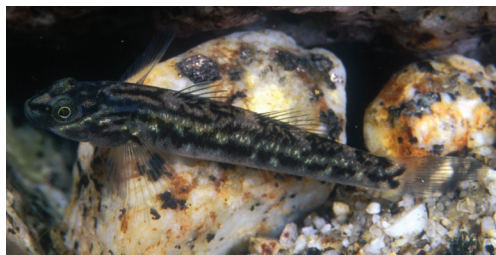


Fig. 17. *Rhinogobius* sp. DL. Juvenile, Nagata River, 0.5 m, 14 Dec. 1999, T. Yonezawa.

Schimatogobius ampluvinculus Chen, Shao and Fang, 1995 [Japanese name: Shimaesohaze] (Fig. 18)

BLIP 1999191, 2 specimens, 14.8–15.6 mm SL, Nagata River.

Yonezawa and Shinomiya (2002); Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. Extremely rare at Yaku-shima Island. The species is observed in or on sandy bottoms in the rapids. Although the northernmost distributional range is probably Yaku-shima and Tanega-shima Islands, the species does not reproduce there. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Pre-

fectural Office, and as ‘endangered (EN)’ in the 2007 Red List by the Ministry of Environment, Japan.

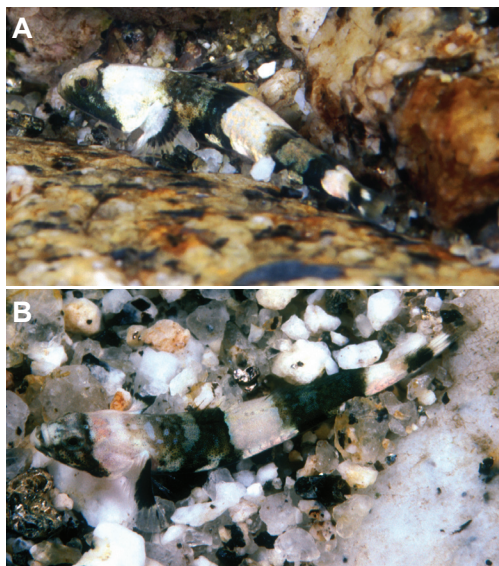


Fig. 18. *Schismatogobius amphuvinculus*. **A** and **B**, Nagata River, 0.5 m, 14 Oct. 1999, T. Yonezawa.

Sicyopterus japonicus (Tanaka, 1909)
[Japanese name: Bozuhaze] (Fig. 19)

KAUM-I. 17816, 50.9 mm SL, a stream at Kusugawa; KAUM-I. 17817, 46.0 mm SL, a stream at Kusugawa; KAUM-I. 17855, 65.0 mm SL, Isso River; KAUM-I. 17856, 56.2 mm SL, Isso River; KAUM-I. 17857, 68.0 mm SL, Isso River; KAUM-I. 19095, 81.1 mm SL, Isso River; KAUM-I. 19096, 78.5 mm SL, Isso River; NSMT-P 29057, 4 specimens, 51.1–63.1 mm SL, a stream at Torigoe; NSMT-P 29063, 53.3 mm SL, a stream at Kusugawa; NSMT-P 29071, 2 specimens, 44.3–48.2 mm SL, a stream at Torigoe; NSMT-P 29078, 8 specimens, 43.2–63.0 mm SL, Nagata River; NSMT-P 29083, 6 specimens, 36.0–79.6 mm SL, Nagata River; NSMT-P 29109, 2 specimens, 52.3–68.6 mm SL, Isso River; NSMT-P. 29122, 4 specimens, 45.7–65.8 mm SL, Isso River; NSMT-P 29133, 57.6 mm SL, Miyanoura River; NSMT-P 29137, 4 specimens, 56.5–81.2 mm SL, Miyanoura River; NSMT-P 29139, 6 specimens, 38.7–62.7 mm SL, Okawa River.

Sakai et al. (2001).

Remarks. Common at Yaku-shima Island.



Fig. 19. *Sicyopterus japonicus*. KAUM-I. 17856, 56.2 mm SL, Isso River (preserved specimen).

Sicyopterus lagocephalus (Pallas, 1770)
[Japanese name: Ruribozuhaze] (Fig. 20)

BLIP 1999200, 27.7 mm SL, a stream at Onoaida.

Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. This rare species appears not to overwinter at the island. The northernmost distributional range is probably Yaku-shima and Tanega-shima Islands. The species is classified as ‘vulnerable (VU)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and classified as ‘endangered (EN)’ in the 2007 Red List by the Ministry of Environment, Japan.



Fig. 20. *Sicyopterus lagocephalus*. A stream at Onoaida, 0.3 m, Nov. 1996, T. Yonezawa

Sicyopus leprurus Sakai and Nakamura, 1979

[Japanese name: Kaeruhaze] (Fig. 21)

BLIP 1999197, 2 specimens, 28.0–32.1 mm SL, a stream at Onoaida.

Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. The species usually inhabits small waterfalls in the forests and valleys of Yaku-shima Island, and appears to overwinter at the island. Nuptial-colored individuals are observed at the island. The northernmost distributional range is probably Yaku-shima Island. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘critically endangered (CR)’ in the 2007 Red List by the Ministry of Environment, Japan.

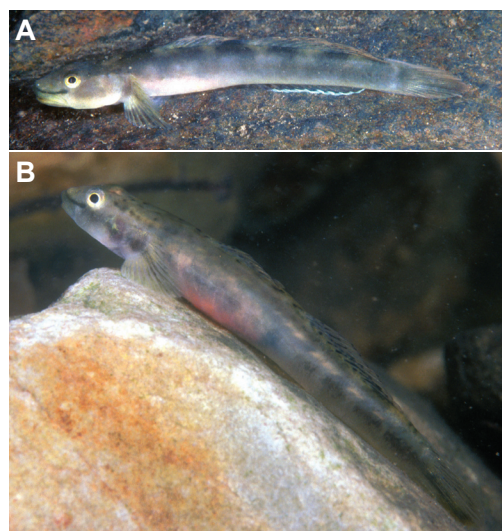


Fig. 21. *Sicyopus leprurus*. **A**, male, a stream at Onoaida, 0.2 m, 13 Oct. 1999, T. Yonezawa; **B**, female, a stream at Onoaida, 0.2 m, 13 Oct. 1999, T. Yonezawa.

Sicyopus zosterophorus (Bleeker, 1857)

[Japanese name: Akabozuhaze] (Fig. 22)

BLIP 1999198, 2 specimens, 28.8–33.2 mm SL, a stream at Onoaida; BLIP 1999199, 7 specimens, 22.0–26.9 mm SL, a stream at Yudomari.

Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. The species usually inhabits small waterfalls in the forests and valleys of Yaku-shima

Island, and appears to overwinter at the island. Nuptial-colored individuals are also observed at the island. The species often occurs with *Sicyopus leprurus*. The northernmost distributional range is probably Yaku-shima and Tanega-shima Islands. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘critically endangered (CR)’ in the 2007 Red List by the Ministry of Environment, Japan.



Fig. 22. *Sicyopus zosterophorus*. **A**, male, a stream at Onoaida, 0.2 m, Oct. 1996, T. Yonezawa; **B**, female, a stream of Onoaida, 0.2 m, 13 Oct. 1999, T. Yonezawa.

***Stenogobius* sp.**

[Japanese name: Tanekawahaze]

Suzuki and Shibukawa (2004).

Remarks. The species usually occurs in the lower portions of the middle reaches of gently flowing rivers and is relatively rare at Yaku-shima Island.

Stiphodon atropurpureus (Herre, 1927)

[Japanese name: Konteribozuhaze] (Fig. 23)

BLIP 1999201, 24.4 mm SL, a stream at Onoaida.

Yonezawa et al. (2003); Suzuki and Shibukawa (2004).

Remarks. The Yaku-shima Island population of the species is extremely small. The species inhabits the same areas as *Stiphodon percnopterygionus*. The species is classified as ‘critically endangered + endangered (CR+EN)’ in the 2003 Kagoshima Red Data Book by the Environment

and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘critically endangered (CR)’ in the 2007 Red List by the Ministry of Environment, Japan.



Fig. 23. *Stiphodon atropurpureus*. Male, Okawa River, 0.5 m, 16 Oct. 1999, T. Yonezawa.

Stiphodon percnopterygionus Watson and Chen, 1998 [Japanese name: Nan-yobozuhaze] (Fig. 24)

KAUM-I. 24730, 18.9 mm SL, a stream at Yudomari; KAUM-I. 24731, 23.4 mm SL, Okawa River.

Kawanabe and Mizuno (1989); Sakai et al. (2001); Suzuki and Shibukawa (2004).

Remarks. The species inhabits the middle reaches of small-scale rivers on Yaku-shima Island. It prefers to stay on stones in full sun, but swims to deeper water when threatened.

Stiphodon surrufus (Watson, 1995) [Japanese name: Kakirohimebozuhaze] (Fig. 25)

NSMT-P 61273, 20.0 mm SL, a stream at Onoaida.

Yonezawa and Iwata (2001); Suzuki and Shibukawa (2004).

Remarks. Currently known only from a single Yaku-shima Island specimen from Japan (Yonezawa and Iwata, 2001). The collected specimen was observed to occur with *Sicyopus leprurus* and *Sicyopus zosterophorus*. The species is classified as ‘data deficient (DD)’ in the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and as ‘data deficient (DD)’ in the 2007 Red List by the Ministry of Environment, Japan.

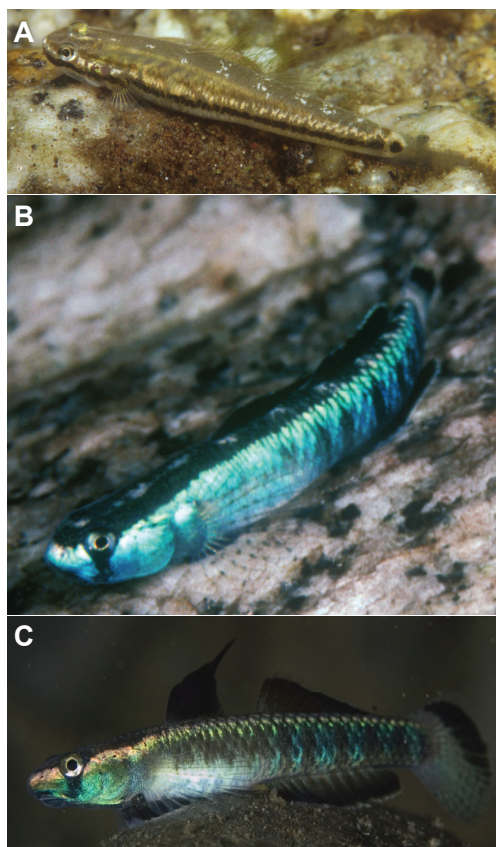


Fig. 24. *Stiphodon percnopterygionus*. A, female, Nagata River, 0.5 m, 14 Oct. 1999, T. Yonezawa; B, male, Okawa River, 0.5 m, 16 Oct. 1999, T. Yonezawa; C, male, Tabu River, 0.5 m, 12 Sept. 2007, S. Harazaki.



Fig. 25. *Stiphodon surrufus*. A and B, male (same individual), a stream at Onoaida, 0.3 m, 3 Oct. 2000, T. Yonezawa.

Tridentigers kuroiwae Jordan and Tanaka, 1927
[Japanese name: Naganogori] (Fig. 26)

KAUM-I. 17839, 33.3 mm SL, Isso River;
KAUM-I. 17840, 40.1 mm SL, Isso River;
KAUM-I. 24732, 27.3 mm SL, Miyanoura River.

Kuroiwa (1927); Sakai et al. (2001); Suzuki
and Shibukawa (2004).

Remarks. Common in the middle and lower
reaches of the relatively large-scale rivers of
Yaku-shima Island.

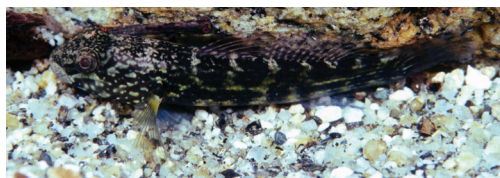


Fig. 26. *Tridentigers kuroiwae*. Miyanoura River, 0.3 m, 15
Oct. 1999, T. Yonezawa.

Conclusion

A total of 32 fish species (22 genera, 11 families, 7 orders) was confirmed from the upper and middle reaches of the freshwater rivers of Yaku-shima Island in this study. Only three species, *Plecoglossus altivelis altivelis*, *Gymnogobius petschiliensis*, and *G. urotaenia*, occurring at Yaku-shima Island represent the southernmost records for each species. On the other hand, 12 species, *Kuhlia boninensis*, *Rhyacichthys aspro*, *Ophieleotris* sp., *Lentipes armatus*, *Rhinogobius* sp. DL, *Schismatogobius ampluvinculus*, *Sicyopterus lagocephalus*, *Sicyopus leprurus*, *S. zosterophorus*, *Stiphodon atropurpureus*, *S. surrufus*, and *Tridentigers kuroiwae*, represent the northernmost records for each species. This indicates that the Yaku-shima Island freshwater ichthyofauna is strongly influenced by southern faunal elements.

No reliable records of two species, *Carassius langsdorfi* and *Misugumus anguillicaudatus*, have been reported from Yaku-shima Island for the last 70 years since Ogawa (1937). These species are most likely to be already extinct or exist only as an extremely small population on the island. Two introduced species, *Oncorhynchus masou masou* and *Tribolodon hakonensis*, were confirmed to be established at Yaku-shima Island. Interestingly,

however, major introduced species, such as two centrarchids, *Lepomis macrochirus* Rafinesque, 1819 and *Micropterus salmoides* (Lacepède, 1802) and a poeciliid, *Gambusia affinis* (Baird and Girard, 1853), widely distributed elsewhere in Japan, have never been recorded from Yaku-shima Island.

Of the 32 fish species recorded from Yaku-shima Island, the following 15 are listed on the 2003 Kagoshima Red Data Book by the Environment and Citizens Affairs Department, Kagoshima Prefectural Office, and/or the 2007 Red List by the Ministry of Environment, Japan: *Anguilla japonica* (— in 2003 Kagoshima Red Data Book/DD in 2007 Red List), *Misugumus anguillicaudatus* (CR+EN/—), *Plecoglossus altivelis altivelis* (VU/—), *Oryzias latipes* (CR+EN/VU), *Kuhlia boninensis* (DD/EN), *Rhyacichthys aspro* (CR+EN/CR), *Ophieleotris* sp. (CR+EN/EN), *Lentipes armatus* (CR+EN/CR), *Rhinogobius* sp. DL (NT/—), *Schismatogobius ampluvinculus* (CR+EN/EN), *Sicyopterus lagocephalus* (VU/EN), *Sicyopus leprurus* (CR+EN/CR), *Sicyopus zosterophorus* (CR+EN/CR), *Stiphodon atropurpureus* (CR+EN/CR), and *Stiphodon surrufus* (DD/DD). In addition to more research of Yaku-shima Island's freshwater ichthyofauna, conservation measures are required to protect rare species and populations from threats such as water pollution and introduced species.

Acknowledgments

We are especially grateful to T. Kishino (Office of River Ecological Research, Kyoto) and N. Horiki (Fisheries Department, Wakayama Prefectural Office, Wakayama) for their assistance with collecting fishes from Yaku-shima Island. We thank K. Morita (Hokkaido National Fisheries Research Institute, Fisheries Research Agency, Hokkaido) and S. Harazaki (Diving Service Mori to Umi, Kagoshima) for providing photographs of some species, S. Raredon (USNM) for taking Figure 2, Y. Ikeda and K. Sugiyama (Biological Laboratory of Imperial Household, Tokyo) for cataloging some specimens from Yaku-shima Island, K. Kuriwa and Y. Takata (NSMT) and students of KAUM for curatorial assistance, and G. Yearsley (Hobart) for reviewing the manuscript.

Literature cited

- Akihito, K., Sakamoto, Y., Ikeda and K. Sugiyama. 2002. Gobioidae. Pages 1139–1310, 1596–1619 in T. Nakabo (ed.). Fishes of Japan with pictorial keys to the species, English edition. Tokai University Press, Tokyo.
- Jordan, D. S. and E. C. Starks. 1906. List of fishes collected on Tanega and Yaku, offshore islands of southern Japan, by Robert Van Vleck Anderson, with descriptions of seven new species. Proceedings of the United States National Museum, 30(1462):695–706.
- Kawanabe, H. and N. Mizuno (eds.). 1989. Freshwater fishes of Japan. Yama-kei Publishers Co. Ltd., Tokyo. 720 pp.
- Kishino, T., A. Shinomiya and H. Kotobuki. 2008. Survival rates of larval Ryukyu-ayu *Plecoglossus altivelis ryukyuensis* under differing experimental conditions of temperature and salinity. Japanese Journal of Ichthyology, 55(1):1–8.
- Kuroiwa, H. 1927. Catalogue of fresh water fishes of collected in Riukiu curve, 1912–1925. Zoological Magazine, 39:355–368.
- Mizuno, K. and K. Nagasawa. 2009. The current status of the geographical distribution of the giant mottled eel *Anguilla marmorata* (Anguilliformes, Anguillidae) in Japan. Bulletin of the Biogeographical Society of Japan, 64:79–87.
- Nakabo, T. (ed.). 2002. Fishes of Japan with pictorial keys to the species, English edition. Tokai University Press, Tokyo. lxi + 1749 pp.
- Nelson, J. S. 2006. Fishes of the world, fourth edition. John Wiley & Sons, Inc., New Jersey. xv + 601 pp.
- Nishi, G. and S. Imai. 1969. On the juvenile of *Anguilla marmorata* Quoy et Gaimard in Yakushima (Yaku Island). Its ecology and morphology. Memoirs of the Faculty of Fisheries, Kagoshima University, 18:65–76.
- Ogawa, K. 1937. Regional distribution of freshwater fishes of Kagoshima Prefecture. Natural Science Association Magazine, Hiroshima University, (5):1–27.
- Sakai, H., M. Sato and M. Nakamura. 2001. Annotated checklist of the fishes collected from the rivers in the Ryukyu Archipelago. Bulletin of the National Science Museum, 27(2):81–139.
- Sakaizumi, M. 1997. Genetic characteristics and strain control of the local populations of freshwater fishes. Pages 218–227 in Y. Nagata and K. Hosoya (eds.). Circumstance in endangered Japanese freshwater fishes and their protection. Midorishobo Co. Ltd., Tokyo.
- Sato, M., H. Sakai and M. Nakamura. 2004. *Kuhlia boninensis* (Fowler, 1907), a junior synonym of *Kuhlia munda* (De Vis, 1884) (Perciformes: Kuhliidae). Ichthyological Research, 51(1):70–72.
- Sawashi, Y., H. Fujimoto, M. Azuma, S. Nishijima and M. Nishida. 1993. Genetic and morphological characteristics and distribution of the ayu *Plecoglossus altivelis* in the northern Ryukyus. Nippon Suisan Gakkaishi, 59(2):191–199.
- Suzuki, T. and K. Shibukawa. 2004. A photographic guide to the gobioid fishes of Japan. Heibonsha Co. Ltd., Tokyo. 536 pp.
- Takahara, H. and J. Matsumoto. 2002. Climatological study of precipitation distribution in Yaku-shima Island, southern Japan. Journal of Geography, 111(5):726–746.
- Tsukamoto, K. 1988. Migratory mechanisms and behavioral characteristics in Ayu. Pages 100–133 in T. Uyeno and M. Okiyama (eds.). Ichthyology Currents. Asakura-shoten, Tokyo.
- Yonezawa, T. 2002. *Rhinogobius* sp. DL. Izu Oceanic Park Diving News, 13(8):1.
- Yonezawa, T. and A. Iwata. 2001. First record of gobioid fish *Stiphodon surrufus* from Yakushima Island, Japan. Izu Oceanic Park Diving News, 12(9):2–4.
- Yonezawa, T. and A. Shinomiya. 2002. Record of two gobioid fishes, *Ophieleotris* sp. and *Schismatogobius ampluvinculus*, from Osumi Islands, Japan. Izu Oceanic Park Diving News, 13(8):2–6.
- Yonezawa, T., A. Shinomiya and T. Kishino. 2003. Brackishwater and freshwater fishes [original title in Japanese: Kisui-tansuisan gyorui]. Pages 117–158 in Environment and Citizens Affairs Department, Kagoshima Prefectural Office (ed.). Kagoshima Red Data Book (Zoology). Kagoshima Environmental Research and Service, Kagoshima.