Japan. J. Ichthyol.
40(4): 504–508, 1994

魚類学雑誌
40(4): 504–508, 1994

Eggs, Larvae and Juveniles of the Bagrid Fish, *Pseudobagrus aurantiacus*, from the Chikugo River, Kyushu Island, Japan

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(*Received June 7, 1993; in revised form November 24, 1993; accepted December 25, 1993*)

The bagrid fish, *Pseudobagrus aurantiacus* (Temminck et Schlegel), is discontinuously distributed, being found in Kyushu Island and the Kanto to Tohoku regions in northern Honshu Island, Japan (Nakamura, 1963; Miyadi et al., 1976). Ueno (1974) reported *P. aurantiacus* from Kyushu as having 48 chromosomes, compared with 56 from northern Honshu, as well as differences in respective isozyme pattern. In addition, osteological differences in the shape of the hyomandibular and the suture between the metapterygoid and quadrate were noted by Juso (1979). Eggs, larvae and juveniles of *P. aurantiacus* from an unspecified locality were described by Okada and Seiishi (1937, 1938). However, since their descriptions were focused on fish distributed in northern Honshu, their materials were probably collected from that region. This paper considers the development of eggs, larvae and juveniles of fish collected from the Chikugo River, Kyushu.

Materials and Methods

Adult fish (11 males, 129.6–180.1 mm standard length (SL); 10 females, 119.7–136.0 mm SL) were collected by gill-net in the middle reaches of the Chikugo River, Haki, Fukuoka Pref., 33°21′24″N, 130°46′29″E, on 17 July 1989. Twenty-four hours after injection of gonadotropin (10 unit per 1 g of body weight) into the dorsal muscle of both mature males and females, the eggs pressed out were artificially inseminated by the dry method, using sperm obtained from crushed testes. Incubating water temperatures ranged from 18 to 23°C. *Artemia salina* larvae, Cladocera, Tubificidae and chironomid larvae were used progressively as food. Eggs, larvae and juveniles were measured using a binocular microscope and micrometer. Larvae and juveniles were anesthetized with quinaldine to enable examination and measurement.

Results and Discussion

Eggs.—The egg membranes, transparent and light yellow in color, were covered with a sticky, jell-like coat, causing them to stick to the glass wall of the aquarium. The eggs were almost spherical in shape, measuring 2.4–2.7 mm (mean 2.5 mm) in diameter, compared with 2.3–2.4 mm recorded by Okada and Seiishi (1937, 1938). However, because the latter did not state the size of the spawning females, which may be related to egg diameter, their data is not directly comparable. On the egg membrane, many lines radiated from a single spot, being initially straight, but subsequently forming irregular waves from about midway to the opposite side of the egg (Fig. 1A). These lines were similar to those described by Okada and Seiishi (1937, 1938).

Embryonic development could be observed clearly through the egg membrane. The blastodisc appeared 2 hr 30 min after insemination, with small subsiding circles being noticed on the surface of the yolk (Fig. 1B). The first cleavage occurred, with the blastodisc dividing into 2 equally-sized cells, of about 3 hr after insemination (Fig. 1C). 3 hr 20 min elapsed from insemination to the 4-cell stage (Fig. 1D), 3 hr 40 min to the 8-cell stage (Fig. E), 4 hr to the 16-cell stage (Fig. 1F), 6 hr to the morula stage (Fig. 1G) and 12 hr to the blastula stage (Fig. 1H). In the early gastrula stage, 17 hr after insemination, the blastodermal cup began to spread over the surface of the yolk (Fig. 1I). By 25 hr, the rim of the germ ring covered about 2/3 of the yolk, and an embryonic body had appeared (Fig. 1J). The latter had elongated and the blastopore closed by 28 hr (Fig. 1K). After 33 hr, 7 myomeres were recognized (Fig. 1L). A pair of optic vesicles and otocysts were noticed 38 hr after insemination (Fig. 1M). The notochord and a pair of lenses were found after 41 hr (Fig. 1N). After 48 hr, brain differentiation was recognized and heart pulsation started (Fig. 1O). A pair of upper jaw barbels had formed after 55 hr (Fig. 1P). Kupffer's vesicle was not observed. Between 75 and 100 hr after insemination, the majority of embryos hatched.

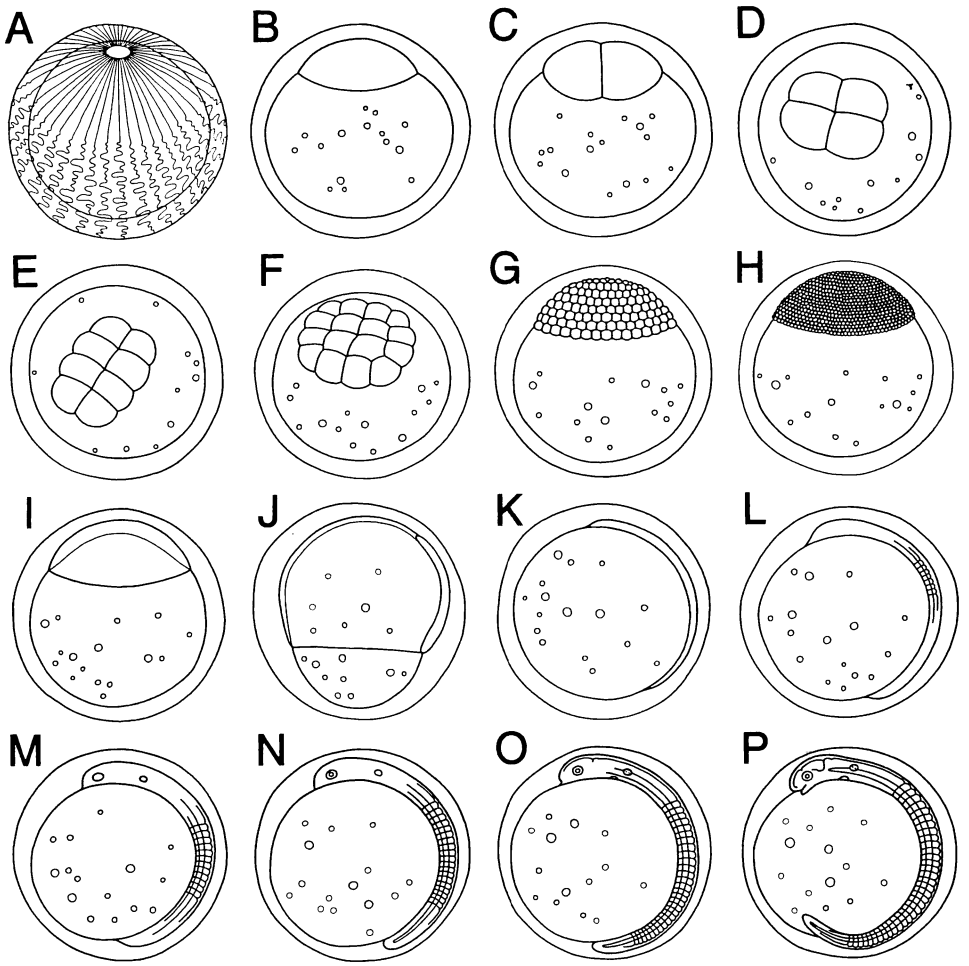
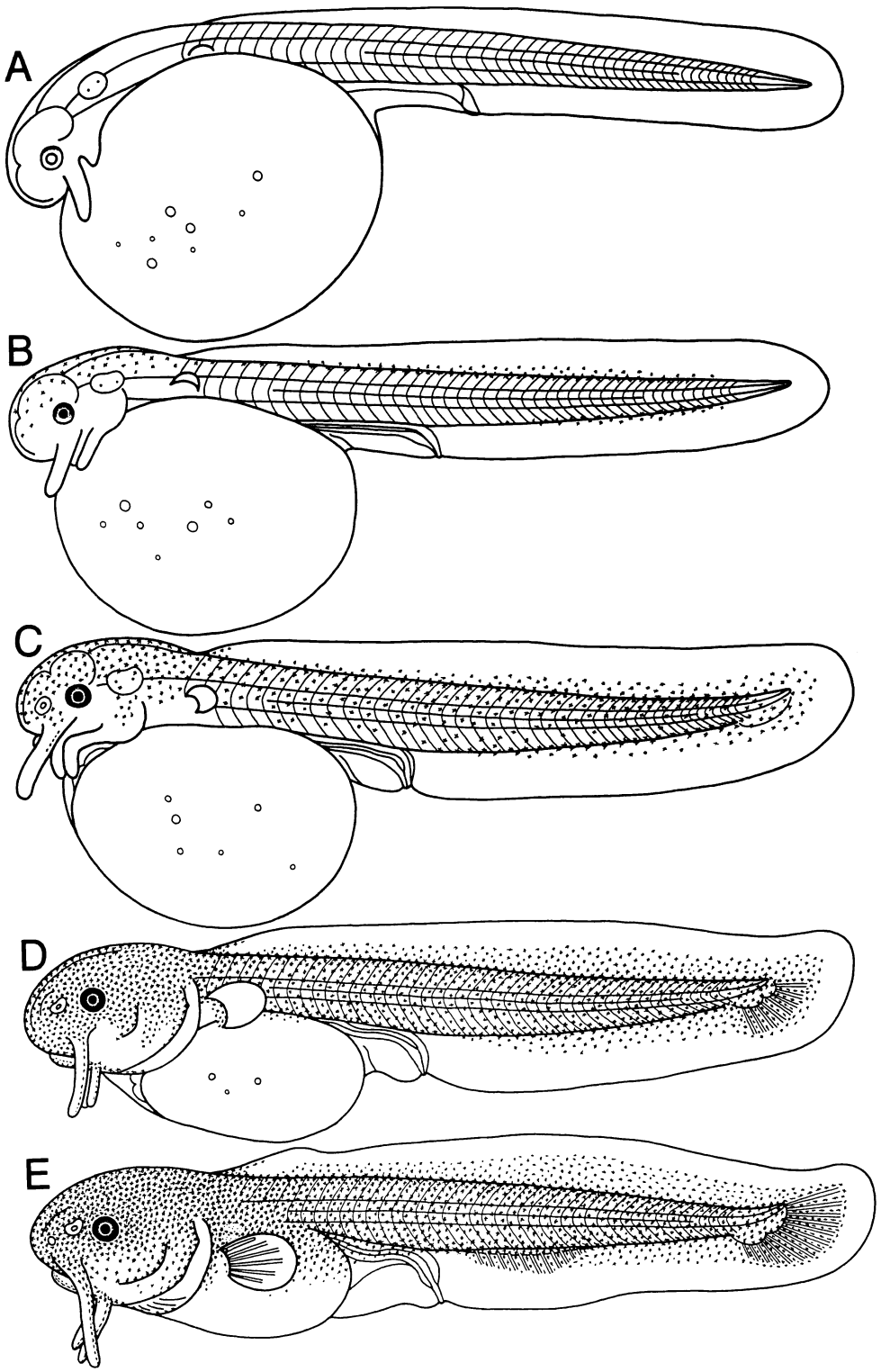


Fig. 1. Egg development of *Pseudobagrus aurantiacus* of the Chikugo River, Kyushu. A) Egg just after artificial insemination; B) blastocyst stage, 2 hr 30 min; C) 2-cell stage, 3 hr; D) 4-cell stage, 3 hr 20 min; E) 8-cell stage, 3 hr 40 min; F) 16-cell stage, 4 hr; G) morula stage, 6 hr; H) blastula stage, 12 hr; I) early gastrula stage, 17 hr; J) formation of embryonic body, 25 hr; K) close of blastopore, 28 hr; L) formation of 7 myomeres, 33 hr; M) formation of a pair of vesicles and otocysts, 38 hr; N) formation of notochord and a pair of lenses, 41 hr; O) differentiation of brain, 48 hr; P) formation of a pair of barbels on upper jaw, 55 hr.

Larvae and juveniles.—The newly-hatched larvae, measuring 5.3–5.5 mm (mean 5.4 mm) total length (TL), had 15–17+29–30=45–47 myomeres (Fig. 2A). A pair of barbels on the lower jaw and rudimentary pectoral fins had already formed. Melanophores were recognized only on a part of the optic cup. The newly-hatched larvae from Chikugo River parental stock were smaller than those apparently from northern Honshu, the latter measuring 6.20 mm TL (Okada and Seiishi, 1937, 1938), although the egg diameter of the former had been slightly larger than that of the latter. Prelarvae 1 day after hatching measured 5.6–5.9 mm TL (Fig. 2B), having the branchial mantle and a pair of barbels on the lower jaw, in addition to melanophores on the dorsal part of the head, and dorsal and ventral parts of the body. Two-day-old prelarvae were 6.3–6.9 mm TL, at which point the mouth opened (Fig. 2C). Melanophores were also noticed on the optic cup, and a rudiment of the hypural bone and a pair of nostrils had formed. After 4 days, the caudal fin rays appeared, the prelarvae being 7.5–8.3 mm TL (Fig. 2D). Five-day-old prelarvae were 8.6–9.0 mm TL, at which point notocohord flexion had started (Fig. 2E). Pectoral and anal fin rays and pectoral fin spines had appeared. After 7 days, the yolk was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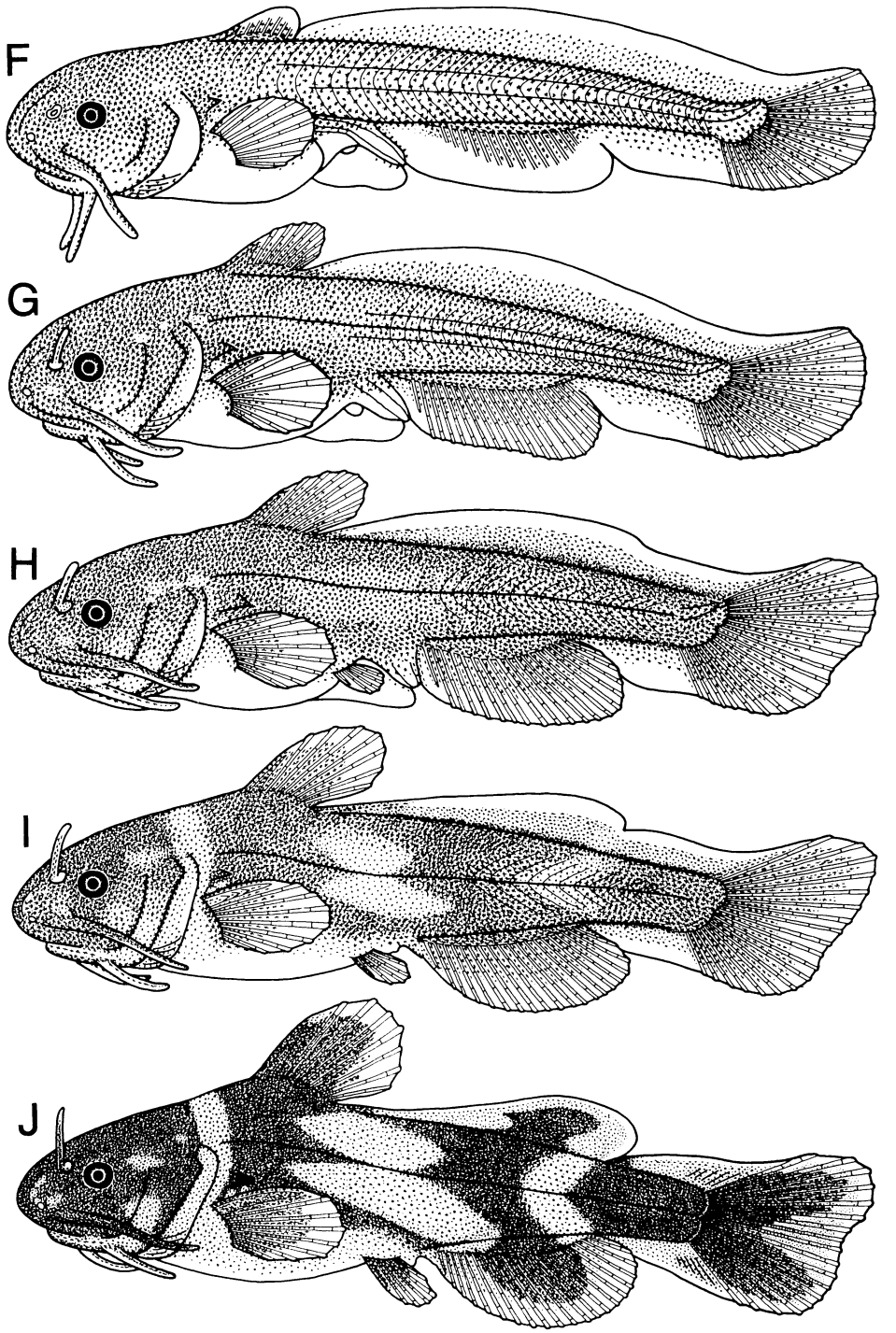

Fig. 2. Larvae and juveniles of *Pseudobagrus aurantiacus* from the Chikugo River, Kyushu. A) Newly hatched larva, 5.5 mm TL; B) prelarva, 1 day, 5.9 mm TL; C) prelarva, 2 days, 6.5 mm TL; D) prelarva, 4 days, 8.3 mm TL; E) prelarva, 5 days, 9.0 mm TL; F) postlarva, 7 days, 10.5 mm TL; G) postlarva, 9 days, 12.3 mm TL; H) juvenile, 11 days, 14.3 mm TL; I) juvenile, 14 days, 17.4 mm TL; J) juvenile, 20 days, 21.9 mm TL.

absorbed and a few *Artemia salina* larvae were observed in the digestive tract. At this stage, the postlarvae were 10.2–10.7 mm TL, and had the dorsal fin spine and fin rays, and a pair of rudimentary pelvic fins formed (Fig. 2F). In addition, the pectoral and caudal fin rays became fixed at 7 and 18–19, respectively. By comparison, postlarvae of 10.2 and 10.4 mm TL, described by Okada and Seiishi (1937 and 1938, respectively) still lacked rudimentary pelvic fins, but had already formed a pair of nasal barbels. After 9 days, the lateral line and a pair of nasal barbels had formed in the present study specimens, the dorsal and anal fin rays becoming fixed at 7 and 19–20, respectively, at 11.5–12.4 mm TL (Fig. 2G).

Aggregate numbers of all fin rays, including pelvic (5–6) were completed 11 days after hatching, at which point juveniles measured 13.5–14.4 mm TL (Fig. 2H). In addition, serrations on the inner side of the pectoral fin spine had appeared and the adipose fin had begun to separate from the caudal fin. Yellowish lateral bands were visible on the sides of the body 14 days after hatching, the juveniles measuring 16.0–17.4 mm TL (Fig. 2I). At this time, larger juveniles began to form individual territories in the corners of the aquarium, the owner of each such territory attacking other approaching juveniles. After 20 days, at 21.7–23.1 mm TL, the adipose fin had become completely separated from the caudal fin (Fig. 2J).

Okada and Seiishi (1937) described the adipose fin as being separated from the caudal fin, along with a faint band appearing between the head and trunk, at 20.0 mm TL. Subsequently, they described the adipose fin as being separated from the caudal fin at 13.0 mm TL (Okada and Seiishi, 1938). Thereafter, Miyadi et al. (1976) and Hosoya (1988) followed the description of Okada and Seiishi (1938). Judging from the present observations of Chikugo River juveniles, it is considered that the total length of northern Honshu juveniles, which have a completely separated adipose fin, may be about 20.0 mm.

Juveniles in the present study reached 47.3–52.3 mm TL, and 53.5–76.2 mm TL, 100 and 200 days after hatching, respectively.

Acknowledgments

We wish to express our particular appreciation of the kind support of Emerit. Prof. Kunio Kobayashi, Kyushu University and Prof. Koji Takeshita, Shimonoseki University of Fisheries. Also, we extend our heart-felt thanks to Dr. Midori Kobayakawa, Fisheries Laboratory, Faculty of Agriculture, Kyushu University, for her valuable advice and Mr. Miyokichi Kaziwara, for collecting adult specimens of *Pseudobagrus aurantiacus*.

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筑後川産ギバチ（ギギ科）の卵および仔稚魚

竹下直彦・木村清朗

ギバチ *Pseudobagrus aurantiacus* は関東以北の本州と九州に分かれて分布する．これら両地域で採集されたものの間には，染色体数，アイソザイムパターン，懸垂骨などに違いが認められ，遺伝的差異は大きいと考えられている．関東以北産ギバチの卵および仔稚魚の記載はあるが，九州産についてはなされていない．そこで，筑後川のギバチを用いて人工授精を行い，卵内発生と仔稚魚の形態を記載した．受精卵は直径 2.4–2.7 mm で，表面がゼリー状の物質で覆われ強い粘着力をもつ．水温 18–23°C において 75–100 時間で孵化した．孵化直後の仔魚の全長は 5.3–5.5 mm で，筋節数は 15–17+29–30=45–47，1 対の上顎鬚と下顎鬚を備えていた．孵化後 5 日で全長 8.6–9.0 mm になり，脊索の屈曲が始まった．孵化後 7 日で全長 10.2–10.7 mm になり，卵黄をほぼ吸収し終えた．鰭条総数は全長 13.5–14.4 mm で定数に達した．全長 16.0–17.4 mm で黄色帯が形成され始め，縄張りをもつ個体が出現し始めた．全長 21.7–23.1 mm で脂鰭と尾鰭が分離した．

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