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Mature Milkfish, *Chanos chanos*, Caught in Okinawa Island, Japan

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Milkfish, *Chanos chanos* (Forsskål), are caught with a set net and other fishing gears in the Ryukyu Islands, though rarely (Gushiken, 1972), and fish around 40 cm TL are sometimes seen in fish markets.

Mature milkfish have been known from Indonesian waters (Tijptoaminoto, 1955; Martosudarmo et al., 1976), the vicinity of Panay Island, Philippines (Tiro et al., 1976; Liao et al., 1979) and the southern part of Taiwan (Liao, 1971), but have never been recorded from Japanese waters. On the other hand, records of milkfish eggs in nature have been reported from Java Sea (Delsman, 1929–30), Madras and its vicinity in India (Jacob and Krishnamoorthi, 1948; Chacko, 1950) and the vicinity of Panay Island (Senta, Kumagai and Castillo, 1980).

The authors had the opportunity to examine large sized milkfish which were caught with a set net in Nakagusuku Bay of Okinawa Island. They had well developed ovaries or testes. This is the first record of mature milkfish from Japanese waters, strongly suggesting possible spawning of milkfish around Okinawa Island.

The status of catch and site

About twenty large milkfish were caught on May 27, 1983 with a set net laid at 15 m depth in Nakagusuku Bay, about 500 m off Umino, Chinen village (26°11′N, 127°49′E, Fig. 1). Mr. Choshin Terukina, the chairman of the Chinen Fishery Co-operative Association, said that some of captured fish had discharged sperm and eggs.

Surface temperature and specific gravity of sea water (σ_{15}) on that day were 24.4°C and 26.63, respectively at the sea shore of Azama which is 2 km southwest of the set net site and 24.7°C at the mouth of Nakagusuku Bay near Kudaka Island (Fig. 1).

Size and gonads of captured milkfish

Although most of the captured milkfish were sold on that day, three individuals, which had

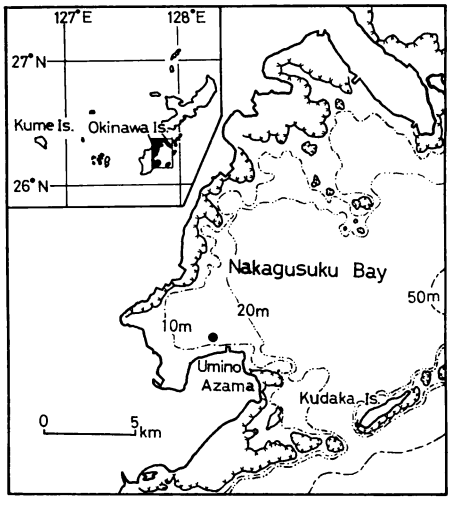

Fig. 1. Maps of Nakagusuku Bay, Okinawa. Solid circle indicates the locality of the set net with which mature milkfish, *Chanos chanos*, were caught.

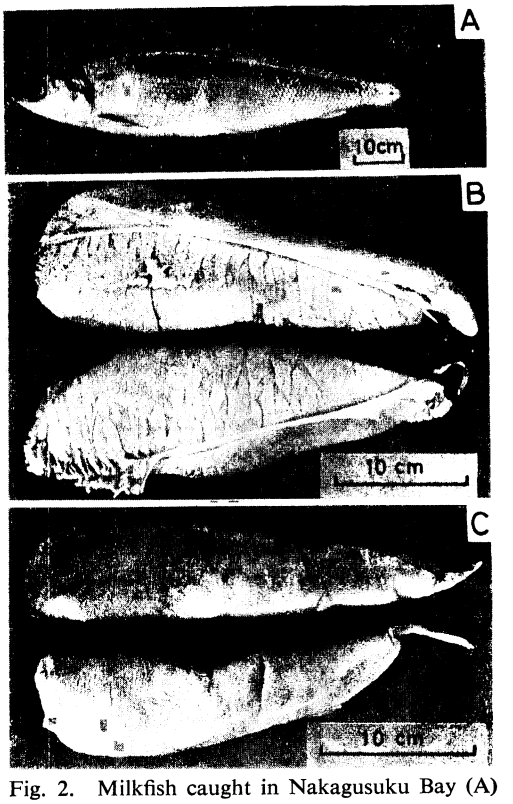

Fig. 2. Milkfish caught in Nakagusuku Bay (A) and gonads (B, C). A, a female, 970 mm TL. B, ovaries from a 1,035 mm TL female. C, testes from a 990 mm TL male.

been kept frozen at the Chinen Fishery Co-operative Association, were forwarded to us on May 30, 1983. They were adult fish measuring from 97.0 to 103.5 cm TL and weighed 9.08 to 12.91 kg (Table 1, Fig. 2A). Mr. Terukina said that other individuals captured with them were nearly of the same size.

Two individuals were dissected after measurement and were identified as male and female, respectively. The male discharged sperm under light pressure on the abdomen before dissection. The third individual was identified as a female by observation of the anal portion, after Chaudhuri et al. (1977), and was kept intact as a complete specimen.

The ovary weighed more than 1 kg (Table 1, No. 1; Fig. 2B) and was yellowish brown in color. When the ovarian wall was nicked during dissection, it burst open revealing the turgid nature of the ovary replete with eggs. Ovarian eggs were easily separated from a portion of the ovary with light pressure, but no transparent eggs were found. After fixing in formalin solution, the eggs of the posterior portion of ovary were more whitish than anterior ones.

Testes (Table 1, No. 2; Fig. 2C) were pinkish grey in color and showed a fully developed condition, and sperm seeped out when the membrane of the testis was wounded.

Ovarian eggs

The size frequency distribution of ovarian eggs was examined after fixing the ovary in 10% neutral formalin solution diluted with fresh water. A total of 0.91 g ovarian egg masses were taken almost equivalently from anterior, central and posterior portions of left ovarian lobe. Egg masses were mixed and eggs were separated from the masses. Parts of these eggs were taken three times randomly, and eggs larger than 0.20 mm in the longer axis were measured. The eggs are in elliptical: their shorter axis was about 80 to 90% of the longer axis in length.

The size frequency distribution of ovarian eggs revealed a bimodal distribution with the modes at 0.30–0.35 mm and 0.85–0.90 mm respectively (Fig. 3). However it is assumed that another peak of distribution would be constituted in the range smaller than 0.20 mm, because many smaller eggs, though not measured, were

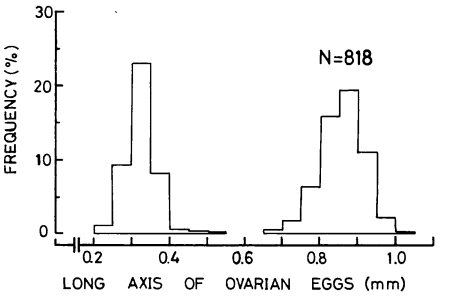

Fig. 3. Frequency distribution of long axis of ovarian eggs, excluding those smaller than 0.20 mm in long axis.

observed.

Previous studies stated that the diameters of matured ovarian eggs of milkfish are about 0.7 mm (Delsman, 1929–30), 0.800–0.880 mm (Tampi, 1957) or 1.12×1.23 mm on the average (Liao, 1971). Furthermore, Liao et al. (1979) stated that milkfish, measuring 77.2 cm FL with 0.75 mm ovarian eggs in diameter, spawned about 9 hours after treatment for inducing spawning.

On the other hand, fertilized eggs of milkfish were 1.10–1.25 mm in diameter (Delsman, 1929–30; Liao et al., 1979).

As a result of these observations, it is considered that the milkfish captured in Nakagusuku Bay were ready to spawn.

Other masses of ovarian eggs totaling 2.22 g were taken from three portions of the left ovarian lobe in the same manner as in the analysis of the size frequency distribution. Ovarian eggs larger than 0.65 mm in long axis were counted. A 2.22 g ovarian egg mass consisted of 6,609

Table 1. Measurements of fresh specimens of the milkfish caught with the set net in Nakagusuku Bay, on May 27, 1983.

Specimen number	1	2	3
Total length (mm)	1,035	990	970
Fork length	849	800	803
Body length	820	758	780
Body weight (g)	12,910	9,080	9,230
Sex	female	male	female*
Gonad weight (g)	1,065	460	—
right lobe	560	225	—
left lobe	505	235	—

* Estimated after Chaudhuri et al. (1977).

eggs. As the fixed ovary weighed 1,185 g, eggs larger than 0.65 mm contained in it were estimated to total 3,528,000.

Possibility of spawning around Okinawa Island

It has been suggested that milkfish postlarvae collected in Taiwan would have originated from the Philippine waters (Nakano, 1932; Kafuku, 1975). On the other hand, there is the presumption that milkfish migrate for spawning as far as Taiwan and southern Japanese waters (Lin, 1968). Senta (1982b) also suggested the possibility of spawning in the Nansei Islands waters based upon the fact that many postlarvae were collected in Tanegashima, south of Kyushu although it is not impossible that they might be transported from Philippines with Kuroshio Current. However these ideas are not confirmed.

Milkfish postlarvae have frequently been recorded north of the Ryukyu Islands (Yoshida, 1932; Senta, 1956; Senta and Hirai et al., 1980; Senou and Suzuki, 1980; Senta and Hirai, 1981). It is also known that a great number of milkfish come into a prawn culture pond every year which is located on Kume Island westward of Okinawa Island (Fig. 1; Senta, 1982a). Furthermore, 816 postlarvae were collected with 28 operations of a triangular scoop net collection around Okinawa Island in 1980 (Kanashiro, unpublished). These facts indicate that occurrence of milkfish postlarvae is not accidental in the Okinawa area.

According to Mr. Terukina, it seems that milkfish nearly as large as ones reported here have been caught from spring to summer every year since the set net was placed off Umino. Therefore, occurrence of adult milkfish is not limited to 1983 although the number of fish caught may fluctuate annually.

The present observations and general occurrence of postlarvae around Okinawa and further northwards strongly suggest that milkfish spawn in Okinawa waters.

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沖縄島で捕獲されたサバヒーの成熟個体

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約 20 個体の大型のサバヒーが，1983 年 5 月 27 日に沖縄島の中城湾内の定置網で捕獲された．このうちの 3 個体を調べたところ，全長 97.0～103.5 cm，体重 9.08～12.91 kg で，最大のものが雌，最小のものが雄であった．他の 1 個体は解剖しなかったが，肛門部分の形態から雌と考えられた．雌はよく成熟した卵巣を持ち，その重量は 1,065 g であった．卵巣卵のうち長径 0.20 mm 以上の卵を測定したところ，卵径頻度分布は 0.30～0.35 mm と 0.85～0.90 mm にピークがみられる 2 峰型を示した．しかし 0.20 mm 未満の卵も数多く見られたことから，卵巣卵径頻度分布は 3 峰型を成すと考えられた．また長径 0.65 mm 以上の卵数は，3,528,000 粒と推定された．雄は腹部を圧迫すると放精し完熟状態で，その精巣重量は 460 g であった．

沖縄島周辺やさらに北の種子島などではサバヒーの後期仔魚が普通に見られることと以上の観察から，沖縄島周辺でサバヒーが産卵することは，ほぼ確実と考えられる．

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