

## Distribution and Fluctuations in Occurrence of the Japanese Centropomid Fish, *Lates japonicus*

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(Received January 13, 1993; in revised form July 7, 1993; accepted August 24, 1993)

**Abstract** Distribution and occurrence patterns of the Japanese centropomid fish, *Lates japonicus*, were examined on the basis of 299 records (estuarine 86.4%; sea 13.6%), compiled from 1979 to 1992, inclusive. *Lates japonicus* was restricted to the Pacific coast of southern Japan, but was nevertheless absent from the Nansei and Ryukyu islands and the East China and Seto Inland seas. Daily sea water temperature changes from 1987 to 1991 at Kumano, Nobeoka, Miyazaki Prefecture, were similar to the estuarine occurrence pattern of the species, being relatively high in late spring to autumn, June to November. In contrast, peak monthly catches in small set nets (masu-ami) occurred from autumn to winter (November to February).

*Lates japonicus* is an endemic Japanese centropomid fish (Katayama and Taki, 1984), whereas a related species, *L. calcarifer*, is widely distributed from subtropical to tropical coastal rivers in the Indo-West Pacific (Greenwood, 1976). Many studies of the latter have been made in the last two decades (Ghosh, 1971; Wongsomuk and Manevonk, 1973; Moore, 1979, 1982; Davis, 1982, 1984a, b, 1985 a, b; Moore and Reynolds, 1982; Reynolds and Moore, 1982; Russell and Garrett, 1983; Kohno et al., 1986; Griffin, 1987). On the other hand, understanding of the occurrence and general life history of *L. japonicus* is poor. Several isolated records of the species exist (Tanaka, 1922; Chiba, 1980; Katayama and Taki, 1984; Takamatsu, 1985; Araga and Tanase, 1987; Kinoshita, 1989), but there has been only a single ecological report (Kinoshita et al., 1988), which examined larval and juvenile occurrence of *L. japonicus* in the Shimanto estuary, Kochi Prefecture. The species has recently been included in a list of endangered fish species (Asahina et al., 1992).

This study describes the distribution and occurrence patterns of *L. japonicus* in southern Japan, incorporating small and large set net (masu-ami and oshiki-ami) catch statistics, in addition to other data

sources.

### Materials and Methods

Distributional and ecological data used in this study were obtained from five sources: specimens, including internal organs, photographs, including fish prints (gyotaku), literature records, large (oshi-ki-ami) and small (masu-ami) set net catch receipts, and personal communications. Fish prints were able to be used because *Lates japonicus* could be specifically identified on the basis of its rounded caudal fin, high depth, number of lateral-line scales and overall body appearance, which differentiated it from similar-looking species, *Lateolabrax japonicus* and *Lateolabrax latus* (Percichthyidae), *Nibea japonicus* (Sciaenidae), and *Lobotes surinamensis* (Lobotidae).

Distribution records were obtained from the Pacific coast of Honshu, Shikoku, Kyushu, and the Nansei and Ryukyu islands (Chiba, Kanagawa, Shizuoka, Aichi, Mie, Wakayama, Kagawa, Tokushima, Kochi, Ehime, Fukuoka, Oita, Miyazaki, Kagoshima, Kumamoto and Okinawa prefectures), mainly from 1979 to 1983, inclusive, by using questionnaires along with 653 "Wanted: *Lates japonicus*"

posters and local examination of captured specimens. Additional sampling was conducted from 1989 to 1992, inclusive, in Miyazaki, Kagoshima, and Okinawa prefectures.

Monthly small set net catches of *L. japonicus* from 1986 to 1991, inclusive, were obtained from statistics compiled by the Nango Fisheries Cooperative Association (NFCA), Miyazaki Prefecture, *L. japonicus* being differentiated in the NFCA statistics as "maruka" or "akame." The set nets were positioned around Oshima Island and Meitsu, Nango-cho, Miyazaki Prefecture, in depths of 5–20 m. Up to about 30 small set nets each year were permitted by the NFCA, but about 20 were usually established at the same position on a year-round basis. Large set nets were permitted by the NFCA in depths of 20–50 m only, from October to the following April each year. Selling receipts of these catches were checked in 1989–1992.

Collection sites were differentiated into three categories: fresh water basin, estuarine and sea. For the purpose of this study, sea was defined as "sea area except area within 100 m just outside a river mouth," estuarine as "from the area within 100 m just outside a river mouth to the lowerstream of the tidal basin," and fresh water basin as "upstream of a tidal basin." Seasons were defined as follows: spring, from April to June; summer, from July to September; autumn, from October to December; winter, from January to March.

In cases of the body weight (BW, g) and/or standard length (SL, mm) data only being available, the data were converted into total length (TL, mm) by using the following two equations:

$$TL = 1.2 \times SL + 3.2 \quad (r = 0.999, n = 119)$$

$$BW = 6.90 \times 10^{-6} \times TL^{3.12} \quad (r = 0.997, n = 121)$$

Sea water temperature data were recorded daily from 1987 to 1991, inclusive, at a depth of 5 m in Kumanoe Culture Fishery Center, Kumanoe, Noboka, Miyazaki. Preserved specimens were deposited in the Fisheries Science Course, Department of Animal Science, Miyazaki University (MUFS). Live specimens were transferred to the Miyazaki Prefectural Fisheries Station (MPFS) in 1989–1992 for further rearing, after SL, TL and BW measurements had been taken.

## Results

**Distribution pattern.**—Data from 299 individuals were used to establish the species' distribution. This included data on 216 specimens, 66 photographic records, 2 literature records, including data on 5 individuals, 10 large set net captures and 2 personal communications particular to Mie Prefecture (O. Tsukada). Individual records and size ranges of the species for each prefecture are given in Table 1. *Lates japonicus* was confirmed from Shizuoka (Lake Hamana), southern Mie, Wakayama (Araga and Tanase, 1987), southern Tokushima, Kochi, southern Oita, Miyazaki, and Kagoshima (Shifushi Bay only) prefectures, but has not been collected from Chiba, Kanagawa, Aichi, Kagawa, Ehime, Fukuoka, Kumamoto or Okinawa prefectures. Clearly, *L. japonicus* is considerably restricted along the Pacific coast of southern Japan, being absent from the Nansei and Ryukyu islands, and the East China and

**Table 1.** The confirmed number and size ranges of *Lates japonicus* from each prefecture. For specimens and photographs, the number in parentheses indicates internal organs only and fish print data, respectively

	Shizuoka	Mie	Wakayama	Tokushima	Kochi	Oita	Miyazaki	Kagoshima	Total
Size in total length (mm)	95–132	ca. 750–ca. 800	ca. 500–790	400–653	59–1250	280	24–1100	365–1100	
Specimens	2 (0)	0 (0)	0 (0)	1 (0)	12 (1)	1 (0)	199 (5)	1 (0)	216 (6)
Photographs	0 (0)	0 (0)	0 (0)	5 (0)	18 (15)	0 (0)	42 (6)	1 (0)	66 (21)
Literature records	1	0	4	0	0	0	0	0	5
Large set net catches*	—	—	—	—	—	—	10	—	10
Personal communications	0	2	0	0	0	0	0	0	2
Total number	3	2	4	6	30	1	251	2	299

\* Examination of large set net catches at each prefecture was not carried out, except at the Nango Fisheries Cooperative Association of Miyazaki Prefecture.

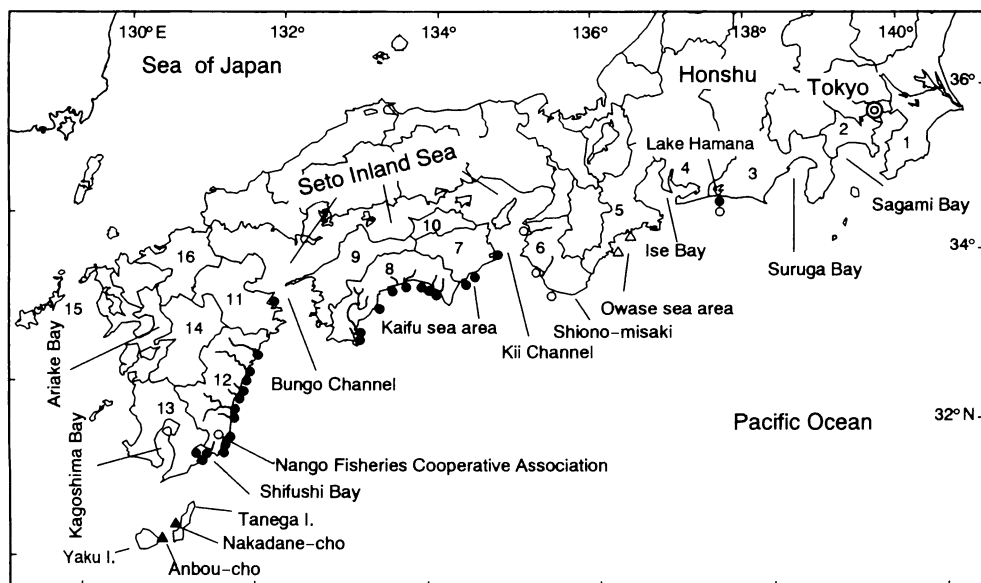


Fig. 1. Distribution of *Lates japonicus* based on specimens and photographs (●), literature records and large set net catches (○), personal communication (△), and local information (presumed distribution, ▲). The Nansei and Ryukyu islands, although investigated, are deleted, owing to the absence of information on the species. 1—Chiba; 2—Kanagawa; 3—Shizuoka; 4—Aichi; 5—Mie; 6—Wakayama; 7—Tokushima; 8—Kochi; 9—Ehime; 10—Kagawa; 11—Oita; 12—Miyazaki; 13—Kagoshima; 14—Kumamoto; 15—Nagasaki; 16—Fukuoka.

Seto Inland seas (Fig. 1).

All stages of *L. japonicus* were observed only in the Miyazaki and Kochi sea areas (Table 1). Only juvenile *L. japonicus*, less than 150 mm TL, were confirmed from Shizuoka, but subadults (150–700 mm TL) were confirmed from Wakayama, Tokushima, Kochi, Oita, Miyazaki and Kagoshima. Larger individuals, over 700 mm TL, were observed in Mie, Wakayama, Kochi, Miyazaki, and Kagoshima. However, in southern Tokushima, much local information indicated that all life stages of *L. japonicus* once occurred there, especially in the Ebiga-ike (brackish pond, about 2 km in circumference), Kaifu-gun, Tokushima (M. Koshiba, pers. comm.).

At Yaku (Anbou-cho) and Tanega (Nakadane-cho) islands, Kagoshima Prefecture, several reliable information sources suggested that, in those areas, local fish names, “okinofuna (sea crucian)” and “okinokoi (sea carp),” were referable to *L. japonicus*. Descriptions of fish over 1 m TL, with red eyes, a rounded caudal fin and a habit of occurring under stationary ships, are suggestive of *L. japonicus*. However, attempts to collect the species there were in vain, and there are no records from recent years (T. Kawaminami, pers. comm.).

*Relationships of temperature, occurrence and small set net catches.*—Figure 2A shows daily sea water temperatures for 1987 to 1991, inclusive, at Kumano, Nobeoka, Miyazaki. Data from 294 individuals were used to establish monthly occurrence patterns. This included 212 specimens, 66 photographic records, 2 literature records, including data on 4 individuals, 10 large set net captures and 2 personal communications. These combined data are given in Figure 2B, which shows the monthly occurrence of the species for two areas, estuarine (86.4% of records) and sea (13.6%). No records were obtained from fresh water basins.

Figure 2B shows a higher occurrence of estuarine collections from June to November, with a low point in winter. This profile is similar to the overall change in sea water temperatures (Fig. 2A), although in March the species was not recorded. On the other hand, in sea collections, there was no clear pattern of monthly fluctuations in occurrence.

Small set net catches peaked in the winter season according to monthly records (Fig. 2C), although the catches were light, amounting to approximately 10 kg per month. Each individual so caught measured between 0.5 and a few kg BW (Y. Yokoyama,

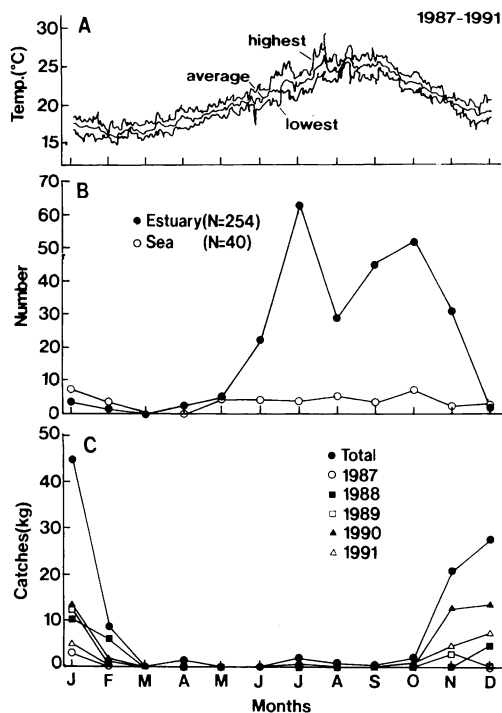


Fig. 2. Changes in daily sea water temperatures (A) at Kumano (Nobeoka, Miyazaki), monthly occurrences of *Lates japonicus* at estuarine, and sea collection sites (B) from all confirmed data; monthly small set net (masu-ami) catches (C) of *Lates japonicus* at the Nango Fisheries Cooperative Association, Nango, Miyazaki.

pers. comm.). Fish over 5.0 kg BW were not captured by small set nets. From April to October, monthly catches were almost nil.

## Discussion

**Distribution pattern.**—The distribution of *Lates japonicus* was restricted to the Pacific coast of southern Japan (Fig. 1). Water temperatures in the sea regions were generally higher than 16°C in winter (Kuniji, 1985). In the southern part of Mie, Wakayama, Tokushima and Oita prefectures, 16°C was the minimum temperature recorded in the Kaifu, Shiono-misaki, Owase and Saeki areas (<100 m deep), although temperatures dropped to 12–13°C in the Kii and Bungo channels (Kuniji, 1985). However, in the Kochi and the Miyazaki sea areas, minimum sea water temperatures were 16–17°C (Kuniji,

1985).

In contrast, the lowest sea temperatures of inshore waters in Ise Bay, Seto Inland Sea and Ariake Bay (Kuniji, 1985), where *L. japonicus* was not recorded, were less than ca. 10°C. Furthermore, minimum winter temperatures were 11–15°C in Sagami Bay, 13–15°C in Suruga and Enshu Nada, and 14–15°C in Kagoshima Bay (Kuniji, 1985). Only juvenile *L. japonicus* were found in Lake Hamana, Shizuoka but the pelagic stage larvae seemed to have been transported from the Kochi and/or Miyazaki sea areas to the lake. Survival over winter is unlikely, on the evidence of no collection records of subadults and adults during that season. The distributional evidence suggests that a minimum winter temperature of ca. 16°C might be a limiting factor for, for example, distribution and survival in winter.

During rearing of *L. japonicus* (109 individuals, 171–550 mm TL) in natural sea water at MPFS, observations (K. Tashiro, pers. comm.) of their feeding behavior supported the above suggestion. *Lates japonicus* continued to eat at around 18°C, but much less so at around 16°C. Furthermore, over the course of one week at temperatures between 12°C and 16°C, most fish stayed on the bottom without eating. Such fishes would probably die of starvation under long periods of temperatures less than 16°C.

No collection records of the species were obtained from the Nansei and Ryukyu islands. Yoshino et al. (1975) reported similarly for the Ryukyu Islands, although the lowest sea water temperature was 19°C for the above areas (Kuniji, 1985). Since *L. japonicus* mainly inhabits estuaries (see below), the lack of records may be related to the absence of large rivers, such as the Shimanto and Ooyodo rivers in Kochi and Miyazaki prefectures, respectively.

Much local information was available from Yaku (Anbou-cho) and Tanega (Nakadane-cho) islands, Kagoshima Prefecture, but attempts to collect the species there were in vain. However, there have been no juvenile or subadult collection records, and no records in recent years. Accordingly, any early records that might have been applicable to *L. japonicus* might be better considered to represent movement of pelagic larvae from major population areas in Shifushi Bay and the southern Miyazaki sea, such larvae subsequently surviving because of the warmer sea temperatures around Yaku and Tanega islands (over 16°C in winter) (Kuniji, 1985). The species seems to face extinction in Tanega Island (T. Kawaminami, pers. comm.).

The distributional evidence and assorted local information suggest that all life stages of the species are distributed from Shifushi Bay, through the Miyazaki and Kochi areas, to southern Tokushima. Records from Oita, Wakayama, Mie and Shizuoka prefectures do not appear to indicate local reproduction of the species, because of their very sporadic nature.

**Occurrence pattern.**—The related species, *Lates calcarifer*, is catadromous, the first year class inhabiting the upper part of fresh water river basins, moving to the estuary to spawn as mature males at about 3 years of age 600 mm TL. Most of the mature individuals probably remain in the tidal, brackish part of the rivers, where they eventually become females (Moore, 1979; Griffin, 1987). In other words, the habitat range changes at each stage of the life history.

In contrast, although the habitat requirements of the different life stages of *L. japonicus* are unknown in detail, the species is considered to be a brackish-water inhabitant, nevertheless showing seasonal movements so as to avoid low winter water temperatures (Fig. 2A–C). In general, estuarine basins and the brackish parts of small rivers are inhabited from spring to early winter, with likely movement in winter to shallow, nearshore areas probably influenced by fresh water.

Furthermore, sea-collected individuals (13.6%) seemed to be captured after considerable rain in June to October, especially during the rainy and typhoon seasons. It seems that they are washed out from estuarine areas to the open sea at such times. Clearly, further life history studies of this unique temperate centropomid fish are necessary, if its demise is to be prevented (Asahina et al., 1992).

#### Acknowledgments

We are most grateful to Dr. M. Akazaki for many facilities. We thank Messrs. F. Anazawa, M. Kinomiya, F. Funakoshi, T. Isano and other members of the Fisheries Research Club of Miyazaki University in 1979–1984 for their efforts in collecting sample data during a preliminary study by the club, and Mr. O. Tsukada of Toba Aquarium, Mie Prefecture, Mr. Y. Yokoyama of the Nango Fisheries Cooperative Association, Miyazaki Prefecture, Mr. T. Kawaminami of the Nakadane Fisheries Cooperative Association, Kagoshima Prefecture and Mr. M. Koshiba,

an owner of Ebiga-ike, Kaifu-gun, Tokushima Prefecture, for valuable information of *Lates japonicus*. We are greatly appreciative of many people and institutions for specimens, catch data and other important information, and the offering of facilities during the first author's visit: H. Fushimi, K. Chiba, H. Kishimoto, S. Kimura, C. Araga, K. Tatsumi, the late T. Yamasaki, K. Yasuoka, T. Marubayashi, M. Horiuchi, the late K. Akiyama, I. Nagatomo, K. Utatsu, N. Sunada, J. Yasumoto, H. Toyama, H. Sugita, A. Nakamura, T. Yoshino, and I. Kinoshita. Lastly, we thank Dr. G. S. Hardy, Osaka, for commenting on a draft of the manuscript.

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#### アカメの分布と出現

岩槻幸雄・田代一洋・浜崎稔洋

日本におけるアカメ (*Lates japonicus*) の分布ならびに出現パターンを 299 個体の記録に基づいて調査した。これらの記録のうちの 86.4% (254 個体) は汽水域から、また残りの 13.6% (40 個体) は海域からのもので、純淡水域からの記録はなかった。本種は、南日本太平洋岸の限られた水域のみ分布し、南西・琉球列島ならびに東シナ海・瀬戸内海には分布しない。汽水域における出現記録は、夏期 (6–11 月) に多く、この出現傾向は宮崎県の地先浅海域の海水温の日変化とよく似ていた。一方海域においては明確な傾向は見られなかった。しかし、海域における小型定置網による漁獲統計調査では冬期 (12–3 月) に多い傾向が認められた。

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