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Larvae and Juveniles of Blue Drum, *Nibea mitsukurii*, Occurring in the Surf Zone of Tosa Bay, Japan

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Abstract A total of 211 larval and juvenile *Nibea mitsukurii* (4.0–19.0 mm SL) was collected with a small seine in surf zones of Tosa Bay during the period of May 1981 to June 1984. They had morphological characteristics common to the larvae and juveniles of Sciaenidae, but were distinguished from the others by the distribution pattern of melanophores on body and spines at the anterior tip of maxillary. They occurred only in surf zone of Tei out of three locations facing Tosa Bay from middle May to middle August. Temperatures and salinities at the place when they were collected ranged from 21.7 to 29.5°C and from 24.5 to 31.3‰, respectively. Good catches were observed when minute dusts floated abundantly in the surf zone. In past studies using traditional larval nets or minnow-nets in coastal or shallow waters of Tosa Bay, larval and juvenile *N. mitsukurii* were not reported. It seems that they occur in association with minute dusts in extremely shallow waters such as surf zones.

The blue drum, *Nibea mitsukurii* (Jordan et Snyder) (Sciaenidae) is distributed from southern Sanriku region to the East China Sea (Okamura, 1984; Sakai, 1986). Much has been known about the morphology and ecology of this fish because of its importance in commercial fishing (Taniguchi, 1969; Taniguchi and Okada, 1979). Morphological changes from eggs to youngs were studied by Taniguchi et al. (1979) through rearing. However, little is known about the early life history in the wild of this fish.

It was recently found that postlarvae and juveniles of *N. mitsukurii* commonly occur in surf zone of Tosa Bay (Kinoshita, 1984). Their morphological characteristics and seasonal occurrence are presented in this paper.

Materials and methods

Semimonthly collections of larval and juvenile fishes were made at three beaches, Usa, Tanesaki and Tei of Tosa Bay from May 1981 to June 1984. On the detailed collection sites and methods, the reader is referred to our preceding report (Kinoshita and Fujita, 1988).

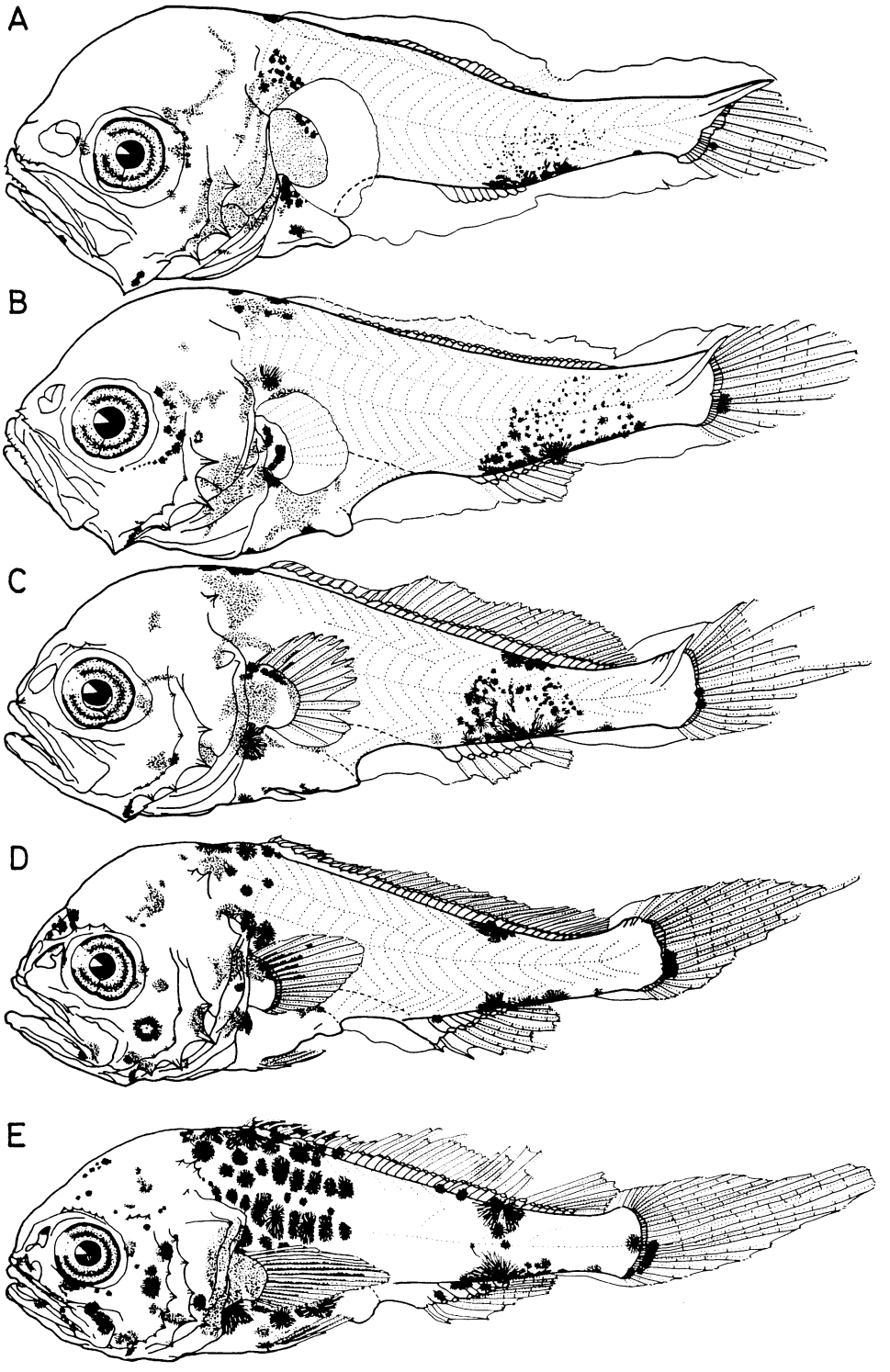
Of about 236,000 larval and juvenile fishes collected during the study period, 211 were identified with *N. mitsukurii* (4.0–19.0 mm SL).

Results

1. Description of larvae and juveniles. Morphology: The larvae and juveniles are compressed, tapering sharply posteriorly. The head is robust, with large and oblique mouth, and large eyes. Gut length is moderate. Snout-anus distance is 47% of the body length in the smallest larva, increasing gradually to 58% in 13.6 mm SL juvenile (Fig. 1A, F). Notochord flexion is complete at 4.8 mm SL (Fig. 1B).

In 5 mm SL larvae, the pelvic buds are present. The dorsal fin rays are completed in number and counted to be 11 spines and 27 soft-rays at 6.5 mm SL (Fig. 1C). In 7 to 8 mm SL, the rays are completed in the order of the anal, pectoral and pelvic fins, and the caudal fins became rhomboid (Fig. 1D). The ventral finfold is still evident in 7.5 mm SL juvenile, but disappears when the juveniles reach 9 mm SL (Fig. 1D, E).

The spines are counted to be four and three on the inner and outer margins of the preopercle in the smallest larva, increasing gradually to 11 and eight in 13.6 mm juvenile (Fig. 1A, F). Four spines are present at the anterior tip of maxillary at 4.0 mm SL, but reduce by degrees; thereafter disappear in juvenile period (Fig. 1A–D). The spines are counted to be two and one over the eye and on the posttemporal in 6.5 mm larva, increasing gradually


A
B
C
D
E

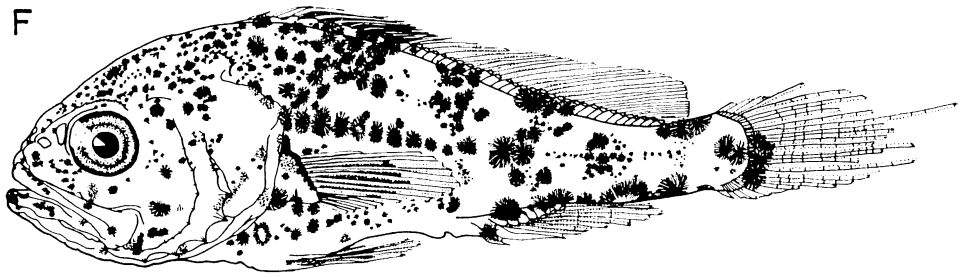


Fig. 1. Developmental stages of *Nibea mitsukurii*. A, 4.0 mm SL postlarva; B, 4.8 mm SL postlarva; C, 6.5 mm SL postlarva; D, 7.4 mm SL juvenile; E, 9.1 mm SL juvenile; F, 13.6 mm SL juvenile.

to nine and six, both forming serration at 13.6 mm SL (Fig. 1C–F). Three, one and one spines appear on the hyomandibular, the pterotic and the interopercle in 9.1 mm SL juvenile respectively, but were absent at 13.6 mm SL (Fig. 1E, F). In juveniles over 13 mm SL, the frontal has one spine on its posterior part (Fig. 1F).

Pigmentation: In the smallest larva (Fig. 1A), large branched melanophores are distributed on the occiput, the surface of gut, the anal fin base and the internal nape; small ones under the chin and on the lower end of preopercular ridge. Stellate melanophores appear on the pectoral base, the ventral margin of caudal peduncle and the lower caudal fin. In 5–7 mm SL larvae (Fig. 1B, C), large branched melanophores occur on the dorsal margin of middle tail and the pectoral fin membrane.

In juvenile period, large melanophores are present on the cheek; small ones on the snout. Large ones are more numerous and continuous on the side of trunk, forming a vertical band. Small ones are seen on the membranes of anterior dorsal and pelvic fins (Fig. 1D, E). Thereafter at 13.6 mm SL, branched melanophores become more numerous on the head and the body, and those on the latter form incomplete five vertical bands (Fig. 1F).

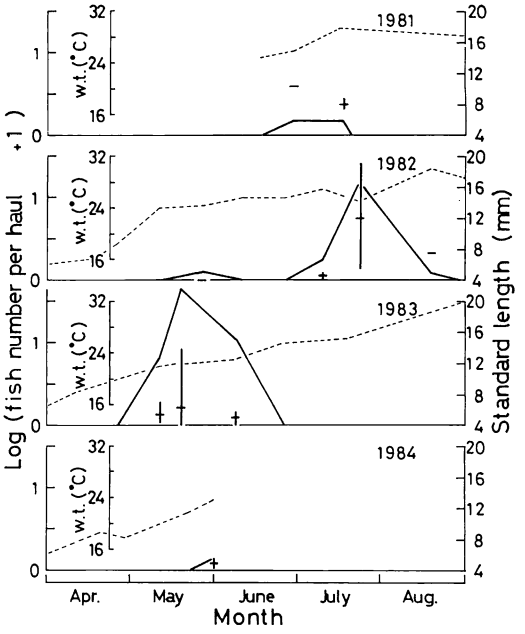


Fig. 2. Seasonal occurrence of larval and juvenile *Nibea mitsukurii* in a surf of Tei beach on Tosa Bay from 1981 to 1984. Horizontal and vertical bars in the figure indicate means and ranges of standard length, respectively. Water temperature is shown by a broken line.

2. Seasonal occurrence in Tosa Bay. Of collections at three beaches, only those at Tei beach yielded larval and juvenile *N. mitsukurii*. Their seasonal abundance considerably fluctuated by years, i.e., they occurred from late June to middle July in 1981, from late May to middle August in 1982, from middle May to early June in 1983, and in 1984 as late as in early June (Fig. 2). Good catches (July 23, 1982, May 11 and 18, and June 8, 1983) were observed when minute dusts were floating abundantly in the waters. Conversely, the minute dusts were scarce on other collection dates during the periods from May to August. Most of the dusts were fragments of decayed leaves of land plants, 1.09 ± 0.43 (mean and SD) $\times 2.72 \pm 0.85$ mm in size. Temperatures and salinities at Tei when larval and juvenile *N. mitsukurii* were collected ranged from 21.7 to 29.5°C and from 24.5 to 31.3‰, respectively.

Their sizes ranged from 4.0–19.0 mm SL with

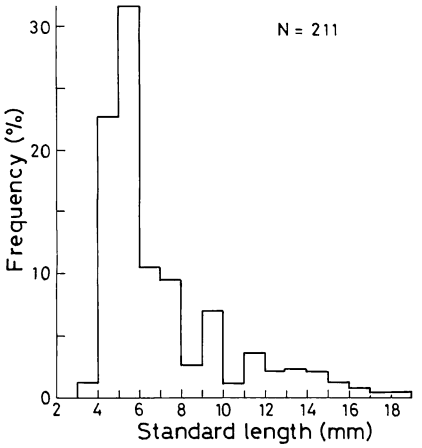


Fig. 3. Length frequency of larval and juvenile *Nibea mitsukurii* occurred in the present study period.

a mode at 5.1–6.0 mm SL, and the majority of them were 4 to 8 mm SL (Fig. 3). The means and ranges of size changed irregularly by collection dates (Fig. 2).

Discussion

Larvae and juveniles of *N. mitsukurii* are very similar in general morphology to those of other sciaenids.

In postlarval stage, some spines occur on the tip of maxillary in *N. mitsukurii* (Fig. 1A–C). They are absent in *N. albiflora*, *Argyrosomus argentatus*, and *Pseudosciaena* and *Collichthys* species. Furthermore, these other sciaenids are lighter in the melanophores distributing on the internal nape, and the dorsal and ventral margins of tail, against *N. mitsukurii* (Mito, 1966; Takita, 1974; Zang, 1985).

In juvenile stage, *Pseudosciaena* and *Collichthys* species have a occipital crest, which is absent in *Nibea* species and *A. argentatus*. Among two of the latter, melanophores are heavily distributed on the side of trunk, the dorsal margin of tail, and membranes of pectoral and pelvic fins in *N. mitsukurii*, while utterly or almost no melanophores are seen on these parts in *N. albiflora* and *A. argentatus* (Yabe, 1941; Mito, 1966; Yamada, 1973; Takita, 1974; Jiang, 1985).

The spines on the tip of maxillary have been overlooked in past morphological studies of larvae and juveniles of many fishes (Okiyama, 1982). Hence we are not presently sure if such spines are characteristic only for *N. mitsukurii* among sciaenids.

Reared *N. mitsukurii* (Taniguchi et al., 1979) is evidently more precocious than the wild one in the degree of melanophore development, i.e., the melanophores appear on the dorsal of tail at 5.1 mm TL (flexion stage) and on the membranes of dorsal, pelvic and anal fins at 8.9 mm TL (juvenile stage), while in the wild one those of the former first develop at 6.0 mm SL (postflexion stage) and those of membranes at 9.1 mm SL (juvenile stage). Furthermore, those of the anal fin membrane do not occur until 19.0 mm SL (the largest fish in the present study) (Fig. 1). Similar differences between reared and wild specimens are also observed in *Lateolabrax japonicus*, *Parapristipoma trilineatum*, *Pagrus major*, *Sparus sarba*, *Acanthopagrus schlegeli* and *A. latus* (Fukuhara and Kuniyuki, 1978; Kimura and Aritaki, 1985; Kinoshita, 1986).

On the basis of the growth of reared *N. mitsukurii* (Taniguchi et al., 1979), we consider that the larvae and juveniles collected during the present study could be about 10–45 days old (mostly 18–28 days old). This suggests that in Tosa Bay *N. mitsukurii* spawns from early April to late July, a little more prolonged than the spawning season of the fish in the bay reported by Taniguchi and Okada (1979) (April to June).

Larval and juvenile sciaenids never or seldom occur in samples collected with traditional nets in coastal waters or in catches of minnow-nets for whitebate in waters just outside the present study sites (Matsuda, 1969; Ikemoto et al., 1983). It seems that distribution of larval and juvenile *N. mitsukurii* is limited in extremely shallow waters such as surf zones. Frequent occurrences of larval and juvenile sciaenids in surf zones have been reported; *Bairdiella chrysoura*, *Cynoscion regalis* and *Menticirrhus saxatilis* in southern New England (Warfel and Merriman, 1944), *Argyrosomus hololepidotus* in South Africa (Lasiak, 1981), and *B. chrysoura*, *C. nebulosus*, *Leiostomus xanthurus* and some of *Menticirrhus* in the Gulf of Mexico (Ruple, 1984). It seems that utilization of surf zones in early stages of life history by certain sciaenids is a worldwide phenomenon.

Larval and juvenile *N. mitsukurii* occurred only at Tei. According to the findings of Taniguchi and Okada (1979), *N. mitsukurii* spawns in the

water shallower than 30 m off Tei beach.

Good catches of larval and juvenile *N. mitsukurii* in the surf zone are always associated with the abundance of floating minute dusts. They appear to be camouflaged by the dusts due to the presence of large branched melanophores on their body. Similar phenomenon is also known in juvenile *Plectorhynchus cinctus* with large branched melanophores occurring in the surf zones (Kobayashi and Iwamoto, 1984). Seasonal occurrences of larval and juvenile *N. mitsukurii* fluctuated yearly, though there was almost no difference in water temperatures among the years (Fig. 2). Hence catches may vary due to the presence of minute dusts rather than temperature.

Acknowledgments

We express our gratitude to Dr. Tetsushi Senta, Professor of the Faculty of Fisheries, Nagasaki University, for revising the manuscript. Mr. Shubun Fukudome, President of Nishinihon Institute of Technology, encouraged us through the present study, and we are much obliged. Thanks are due to researchers of the same Institute who helped us in collections. We thank Dr. Nobuhiko Taniguchi, Professor of the Department of Cultural Fisheries, Kochi University, for helping us with the identification of larval and juvenile *N. mitsukurii*. This work was partially supported by the grant from the Nippon Life Insurance Foundation, and we are much grateful for that.

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土佐湾の砕波帯に出現するニベ仔稚魚

木下　泉・藤田真二

土佐湾の砕波帯において 1981 年 5 月から 1984 年 6 月の間に行われた小型曳網を用いた採集で，ニベ仔稚魚，合計 211 尾 (4.0–19.0 mm SL) が得られた．本種仔稚魚はニベ科のものの一般的な形態的特徴を持ちつつも，黒色素胞の分布様式と主上顎骨先端の棘により識別できる．本種仔稚魚は，土佐湾に面する 3 海岸の内，手結の砕波帯にのみ，5 月中旬から 8 月中旬にかけて出現した．出現時の水温・塩分の範囲は，各々 21.7–29.5°C・24.5–31.3‰ であった．本種仔稚魚は，砕波帯に微小ゴミが大量に浮遊する時に豊漁であった．過去，土佐湾の沿岸域や浅海域では，本種仔稚魚は全く報告されておらず，砕波帯およびその付近で微小ゴミに混入しながら生息しているようである．

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