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Seasonal occurrence and abundance of the spotted scat, *Scatophagus argus*, in surf zones and rivers of the northern coast of Bali, Indonesia

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Abstract : The seasonal occurrence, abundance and size distribution of the spotted scat, *Scatophagus argus*, were examined on the specimens collected from the surf zone and river at two sites, Banyalit and Lovina beaches, on the northern coast of Bali, Indonesia, by a push-net from 3 January 1995 to 28 January 1996. All of the specimens collected were metamorphosing juveniles with unique head spination. The numbers of specimens collected were 9 (8.3–10.0 mm SL) and 17 (7.9–13.4 mm SL) from surf zones at Banyalit and Lovina, respectively, and 20 (9.2 30.6 mm SL) and 15 (9.2–18.1 mm SL), respectively, from the rivers at those localities, juveniles of 9–13 mm SL appearing in both habitats. Although surf zone specimens occurred restrictedly in February, March and December, river specimens occurred each month from December to June. The growth of fish was not observed in surf zone specimens but detected in river specimens. These results would suggest that the spotted scat utilize the surf zone as a short-stop area and rivers for subsequent growth.

Keywords : *Scatophagus argus; occurrence; juveniles; Indonesia.*

1. Introduction

The spotted scat, *Scatophagus argus*, is widely distributed in Indo-Pacific waters, north to Wakayama Prefecture, Japan (SHIMADA, 2000) and is well known as a euryhaline species living in coastal waters, estuaries and even freshwater (BLABER, 1997). The larvae and juveniles, which undergo a developmental stage (sometimes misapplied as the 'tholichthys' stage) specialized for a pelagic life style (LEIS and TRNSKI, 1989), are caught in lower salinity waters (BARRY and FAST, 1988). However, little is known about their occurrence patterns in such habitats. This study examined seasonal occurrence, abundance and size distribution of spotted scat juveniles in surf zones and rivers on the northern coast of Bali, Indonesia. Morphometric changes with growth of some body parts are also described.

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2. Materials and methods

Specimens used in this study (n=61, 7.9–30.6 mm SL) were collected from the surf zone and river at two sites, Lovina and Banyalit beaches (distance apart about 1 km), on the northern coast of Bali, Indonesia, from 3 January 1995 to 28 January 1996. The river sampling sites were located just inside the river mouth. Sampling was conducted with a push-net made of "mosquito net", operated for about 30 min on each sampling day. The total number of sampling days was 54 in the surf zones at both Lovina and Banyalit, and 64 and 65 in the rivers of those localities, respectively. Collected samples were fixed with 5% formalin and transferred to 70% ethyl alcohol for preservation. Standard length (SL) was measured from the snout tip to the posterior edge of the hypural plate, the notochord of all specimens collected being completely flexed. The head length, body depth and pelvic fin length were measured (expressed as percentages of SL) for all 61 specimens. Measurement methods followed LEIS and TRNSKI (1989). Water temperature and salinity

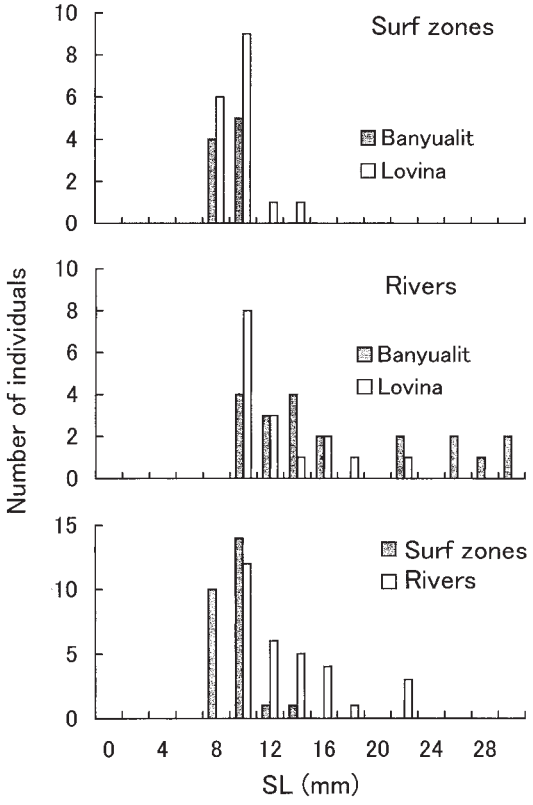

Fig. 1. Standard length (SL) distribution of juvenile *Scatophagus argus* collected from surf zones and rivers of the northern coast of Bali, Indonesia, from January 1995 to January 1996. In the bottom graph, the SL of the 5 largest river specimens were omitted.

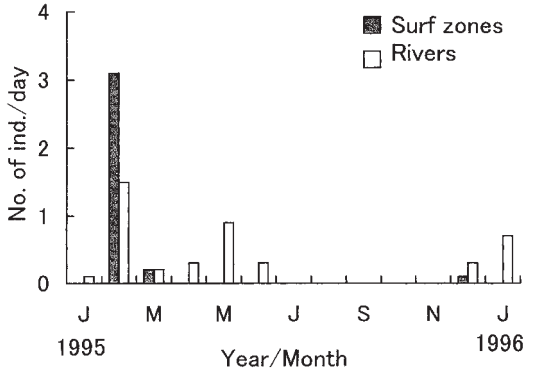

Fig. 2. Number of juvenile *Scatophagus argus* collected per day, shown as averages of each month, from surf zones and rivers of the northern coast of Bali, Indonesia, from January 1995 to January 1996.

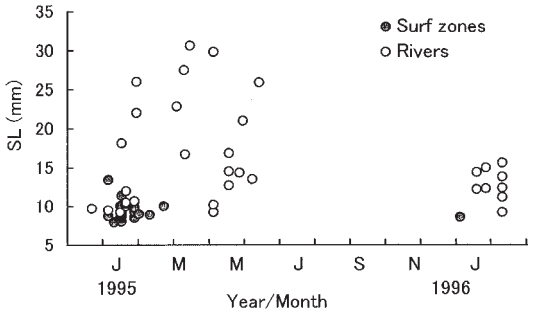

Fig. 3. Standard length (SL) of *Scatophagus argus* juveniles collected from the surf zones and rivers of the northern coast of Bali, Indonesia, from January 1995 to January 1996.

ranged from 30.0–35.0℃ and 27–33‰ in the surf zones, and from 28.0–35.7℃ and 0–27‰ in the rivers, respectively. The salinity was usually less than 10‰ in the rivers, the only exceptions being 17, 20 and 27‰ on three days in November and December at Banyalit. All of the specimens were deposited in the Museum, Tokyo University of Fisheries (MTUF-P (L)).

3. Results

All of the specimens collected in the present study were metamorphosing juveniles with complete fin-ray complements and unique head spination. Nine (8.3–10.0 mm SL, mean±SD= 9.1±0.7 mm SL) and 17 (7.9–13.4 mm SL, 9.5 ±1.3 mm SL) juveniles were collected from the surf zones at Banyalit and Lovina, respectively, and 20 (9.2–30.6 mm SL, 17.5±7.2 mm SL) and 15 (9.2–18.1 mm SL, 12.7±3.6 mm SL), respectively, from the rivers at those localities (Fig. 1). Although no significant difference occurred in mean SL between the surf zones of Banyalit and Lovina ($p>0.05$, t-test), mean SL of specimens from Banyalit and Lovina rivers differed significantly ($p<0.05$, t-test). However, in the latter case, the difference was not significant when five larger specimens (25.9–30.6 mm SL) collected from Banyalit were omitted from the comparison, the mean±SD for that locality becoming 14.0±4.1 mm SL. Accordingly, the 5 large Banyalit specimens were omitted from subsequent surf zone and river comparisons.

The specimens collected from the surf zones (7.9–13.4 mm SL, n=26) and rivers (9.2–22.8

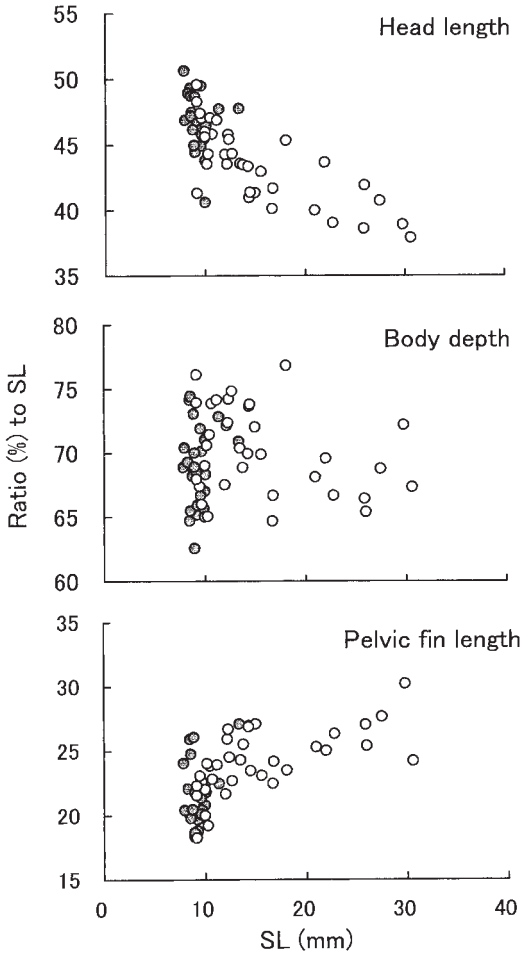

Fig. 4. Changes in body proportions, shown as percentages of standard length (SL) of *Scatophagus argus* juveniles collected from the surf zones (closed circles) and rivers (open circles) of the northern coast of Bali, Indonesia, from January 1995 to January 1996.

mm SL, n=30) overlapped in body size from 9.2–13.4 mm SL (Fig. 1), the number of overlapping specimens being 13 and 17 in the surf zones and rivers, respectively, and the overall overlap rate being 53.6% (30/56). On the other hand, mean SL differed significantly ($p<0.01$, t-test) between the surf zones (mean±SD=9.3 ±1.1 mm SL) and rivers (13.3±3.8 mm SL).

Surf zone specimens occurred restrictedly in February, March and December, with a peak in February (Fig. 2). River specimens, however, occurred each month from December to June, although again peaking in February (Fig. 2). No apparent growth cohorts were detected in the surf zone specimens, although three or four were observed in river specimens sampled from January to June (Fig. 3).

With overall body growth, relative head length decreased rapidly until about 10 mm SL, the rate becoming less thereafter (Fig. 4). Body depth varied from 65–75% SL, with no remarkable changes observed in the specimens examined (Fig. 4). Pelvic fin length increased rather rapidly until 12–13 mm SL, becoming stable thereafter (Fig. 4). Overall, the above measurements varied considerably and no significant differences were detected between the surf zone and river specimens.

4. Discussion

Based on the collection of smaller spotted scat juveniles of about 10 mm SL during this study, spawning occurred during the period from November to April, corresponding to the rainy season along the northern coast of Bali, Indonesia. Spawning of the spotted scat in Iloilo, Philippines, also occurs during the rainy season at that locality (from June to October) (BARRY and FAST, 1988). The occurrence of larvae and juveniles is limited to May-August in Taiwan (TSUMOTO and KIMURA, 1988) and to summer and autumn in Moreton Bay, eastern Australia (LAEGDSGAARD and JOHNSON, 1995), rainfall being more or less high at these times. Therefore, the spawning of spotted scat is apparently related to high rainfall, although the spawning period is longer in tropical areas such as Bali and Iloilo than in subtropical areas such as Taiwan and Moreton Bay. The peak of juvenile occurrence in the surf zone in this study was February, corresponding to a spawning peak in December-January (the beginning of the rainy season). This concurs with the observation of BARRY and FAST (1988), who pointed out that the start of the rainy season coincided with the peak of the spawning season at Iloilo, Philippines.

The smallest specimen collected in this study was 7.8 mm SL from the surf zone, but smaller spotted scat larvae of about 3 mm SL are known (WEBER and de BEAUFORT, 1936; TSUMOTO and KIMURA, 1988), indicating that

the surf zone is not the actual spawning ground. BARRY and FAST (1988) reported that adults living offshore in deeper waters moved inshore in preparation for spawning, concurrent with the maturation of oocytes. Therefore, neither the spawning ground nor habitat of individuals < ca. 8 mm SL can be specified.

Spotted scat departed from the surf zones by about 13 mm SL, whereas their appearance in the rivers was from about 9 mm SL. Apparently, juveniles of 9–13 mm SL actively move between the surf zones and rivers or utilize tidal flows into the same effect. Although, no drastic morphometric changes were observed, some flexion points occurred from 10–13 mm SL, as shown in head length and pelvic fin length. These observations, plus the apparent lack of fish growth in the surf zone, contrary to the river observations suggest that spotted scat utilize the surf zone as a short-stop area and rivers for subsequent growth.

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