

## Short Report

# Histological observations of ovotestis in the spotted scat *Scatophagus argus*

YI-TA SHAO,<sup>1a</sup> LI-YUE HWANG<sup>2</sup> AND TSUNG-HAN LEE<sup>1\*</sup>

<sup>1</sup>Department of Life Sciences, National Chung-Hsing University, Taichung 402 and <sup>2</sup>Taishi Station, Marine Aquaculture Research Center of Taiwan Fisheries Research Institute, Yunlin 636, Taiwan

**KEY WORDS:** gonad, gonad-somatic index, ovotestis, paraffin section, spotted scat.

The spotted scat (*Scatophagus argus*) is an euryhaline teleost, which is widely distributed throughout the Indo-Pacific Ocean.<sup>1</sup> Because of their attractive pattern, this species is quite common as an aquarium fish and is also an important food fish in Southeast Asia. In Taiwan, this fish has traditionally been kept in ponds to prevent overgrowth of algae. However, most of the larvae of the scat used in aquaculture are collected from the field. Only a few studies have attempted to breed them in hatcheries.<sup>2,3</sup>

The basic biological information of spotted scat has been described by Barry and Fast:<sup>4</sup> the reproductive season is from April to October in the Philippines; the sexes of the spotted scat can be distinguished by head shape and body size; the size of sexes is quite different – reproductive maturation can first be seen to occur in females of approximately 14 cm/150 g, while males mature at a smaller size (~11 cm/80 g). However, no report so far has described the occurrence of sex reversal of this species.

To determine the sexual development of the spotted scat, a series of studies were done in 1999–2000. The experimental fish ( $n = 30$ ) were donated by the Taishi Station, Marine Aquaculture Research Center of Taiwan Fisheries Research Institute, where fish were kept in outdoor ponds at the 22‰ salinity for months. The fish were then divided into three groups and reared in 2.5 ton FRP tank: the first group ( $n = 9$ ) was used for the experiment in

October 1999; the second group ( $n = 13$ ) was assessed in January 2000; and the last group ( $n = 8$ ) was completed in April 2000, in correspondence with the spawning season of the field scat population. Fish were fed daily with commercial marine fish pellets. Histological observations of the gonads and records of the gonad-somatic index (GSI) were carried out for each sample.

Table 1 illustrates a strong correlation between body weight and sex type of the scat, with female fish demonstrating significantly larger sizes than the males in all samples of different seasons. Among the fish sampled in October 1999 and April 2000, only males and females were found, while in January 2000 the intersexual fish appeared (Table 1). Cross sections of the testis showed many lobules containing different developmental stages of spermatocytes (Fig. 1a) as well as the Ductus deferens, which was filled with spermatozoa. Histological observations revealed that the gonads of males were mature and functional during the periods of this study (October to April). In contrast, the GSI of the females did not increase even in the spawning season (Table 1). The oocytes of the females did not develop and were retained in the previtellogenic phase in all samples of our experiments (Fig. 1b). Undevelopment of oocytes in samples of April 2000 may have been due to the stress of high-density culture or insufficient nutrients in the feed during periods of experiments. The spawning behavior of spotted scats in the Philippines usually occurs after the monsoon rains.<sup>4</sup> This may suggest that changes in salinity also play a role in induction of vitellogenesis.

In the samples of January 2000, ovotestes (Fig. 1c) were found in two individuals with a body weight greater than that of the male but smaller

\*Correspondence author: Tel: 886-4-2285-6141.

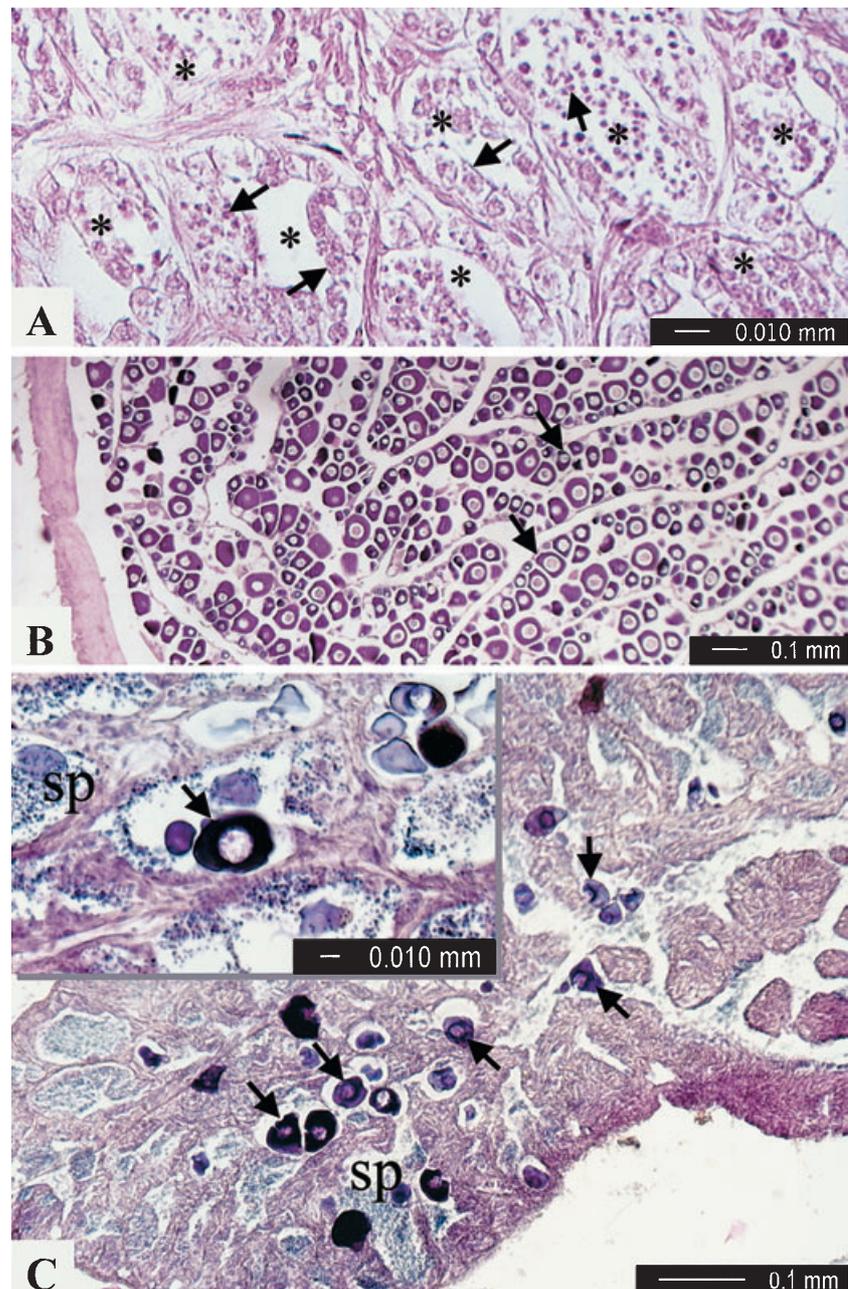
Fax: 886-4-2285-1797. Email: thlee@dragon.nchu.edu.tw

<sup>a</sup>Present address: Institute of Marine Biology, National Sun Yat-Sen University, Kaohsiung, Taiwan.

Received 24 October 2002. Accepted 30 June 2003.

**Table 1** The body weight (g) and gonadosomatic index (gonad weight/total body weight 100%) of the spotted scat (*Scatophagus argus*), used in different experiments of this study

Date	Male	Inter-sex	Female
October 1999	121.0 ± 13.5 <sup>†</sup> /0.0875 ± 0.0013 <sup>‡</sup> (4) <sup>§</sup>		198.0 ± 13.0/0.8844 ± 0.0024(5)
January 2000	133.0/0.0861(2)	143.0(2)	255.0 ± 9.0/0.8801 ± 0.0019(9)
April 2000	134.0 ± 21.1/0.0088 ± 0.0027(3)		244.0 ± 11.7/0.8020 ± 0.0038(5)

<sup>†</sup>Body weight (g).<sup>‡</sup>Gonadosomatic index.<sup>§</sup>Number of fish used.**Fig. 1** Histological micrographs of gonads of the spotted scat. (a) Cross section of the testis. Numerous lobules (asterisks) contain spermatocytes at various developmental stages (arrows). (b) Transverse section of the ovary. The ovigerous lamellae (arrows) of the saccular cystovarian ovaries crowded with oocytes at the chromatin nucleolar and perinucleolar stages. (c) Ovotestis. No spermatocytes and spermatids were observed. Pre-vitellogenic oocytes (arrows) were scattered in the testicular tissue filled with only spermatozoa (sp.).

than that of the female (Table 1). The intersexual gonads of *S. argus* showed structures typical of the convergent ovotestis with no clear boundary between testis and ovary parts (Fig. 1c). Pre-vitellogenic oocytes were distributed in the gonads, in which only spermatozoa were observed. Spermatozoa and spermatids, shown in testis during active spermatogenic phase, could not be observed, suggesting degeneration of testis (Fig. 1c). The gonadal features of both male and female scat are intermixed and unseparated by connective tissues as is typically observed in hermaphroditic fish.<sup>5</sup> The total lengths of the intersexual samples were 15 and 17.5 cm, and the ages were 1–1.5 years old (the age data were transformed from the total length with Popgrowth table).<sup>6</sup>

A combination of features including histological results of the ovotestis and the coexistence of degenerating testis and previtellogenic oocytes, as well as body lengths between that of males and females, suggest that protandrous hermaphro-

ditism is one of the possibilities of reproductive modes in *S. argus*. More detailed studies on the wild scat population are necessary to confirm the present results of cultured fish.

## REFERENCES

1. Ni IH, Kwok KY. Marine fish fauna in Hong Kong waters. *Zool. Stud.* 1999; **38**: 130–152.
2. Chang SL, Hsieh CS. Studies on the early development and larval rearing of spotted scat (*Scatophagus argus*). *J. Taiwan Fish. Res.* 1997; **5**: 41–49.
3. Liao CI, Su HM, Chang EY. Techniques in finfish larviculture in Taiwan. *Aquaculture* 2001; **200**: 1–31.
4. Barry TP, Fast AW. Biology of the spotted scat (*Scatophagus argus*) in the Philippines. *Asian Fish. Sci.* 1992; **5**: 163–179.
5. Sadovy Y, Shapiro DY. Criteria for the diagnosis of hermaphroditism in fishes. *Copeia* 1987; **1987**: 136–156.
6. Ingles J, Pauly D. An atlas of growth, mortality and recruitment of Philippines fishes. *ICLARM Techn. Reports* 1984; **13**: 126–128.