SPAWNING DATES, GROWTH AND OTOLITH SIZE OF *Acanthopagrus schlegelii* (SPARIDAE) EARLY-STAGE JUVENILES IN THE NORTHERN VIETNAMESE COASTS

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1. INTRODUCTION

Acanthopagrus schlegelii, commonly known as black porgy or blackhead seabream, from Sparidae [1] is distributed along coasts of eastern Asia from Vietnam to Japan [2]. They are important for commercial and sport fishing.

Much work has been done on their morphology and ecology in both adult and early stages along with the distributional range of *Acanthopagrus schlegelii*. For instance, ontogeny, distribution and growth were reported in the wild [3-8] and reared conditions [10, 11]. The results show that there were different in seasonal occurrence and growth of early stages of this species among the regions. Tran et al. (2019) showed the significant differences in seasonal occurrence of early-stage juvenile *A. schlegelii* between Vietnam and the other waters such as Japan [12]. The given phenomenon suggests the spatial variation in the timing of spawning of this species along the distribution range.

Otoliths are recently unique and important biological structure to examine the information of spawning, hatching dates and growth of early stages in the teleost fishes [6-9, 14]. Based on otolith analyses, this paper aims to provide the information on spawning date, growth and otolith size of *A. schlegelii*, which will be important to the development and implementation of conservation, management and culture plans for this species in local and global scales.

2. MATERIALS AND METHODS

Acanthopagrus schlegelii juveniles were collected along the bank waters in Tien Yen estuary, northern Vietnam from October 2014 to September 2015 [12]. Collections were made bimonthly from December to February and monthly in the other months. During the sampling period, *Acanthopagrus schlegelii* juveniles occurred from December 2014 to March 2015 [12]. All samples were preserved in a solution of 10% formalin. *Acanthopagrus schlegelii* specimens were sorted and transferred to 80% ethanol and subsequently the standard lengths (SL) were measured by developmental stages [13].

Age determinations from sagitta otoliths were performed in specimens. The left and right side otoliths were removed from specimens under a dissecting microscope and fixed on a microscope slide face up with epoxy resin and cover by a cover glass. Increments outside the nucleus of sagitta were counted under a light microscope at 400-600 magnification, and the average of three replicate counts in each otolith was used for estimating a ring number. Age [days after hatching (DAH)] was estimated to be added five days to ring number [6, 10]. The spawning dates were estimated from the age (days) and back calculating from the dates of capture. Otolith radius was measured along the longest axis of the otolith [14] using an ocular micrometer.

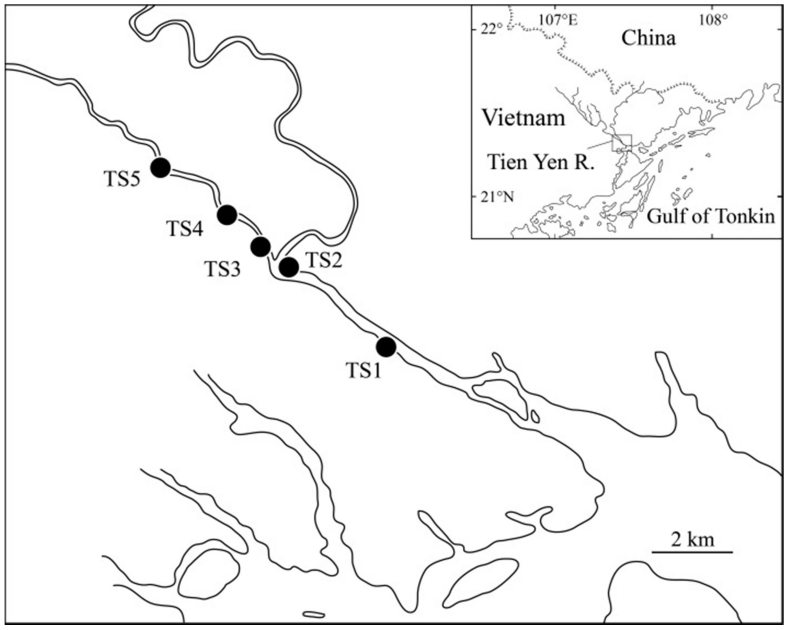

Fig. 1. Chart showing the stations where fish larvae and juveniles were collected in the Tien Yen estuary from October 2014 to September 2015

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Spawning date

Sagittae were removed from juveniles of *A. schlegelii* (8.2-18.0 mm) collected from December 2014 to March 2015. Spawning dates were from 20 November 2014 to 7 February 2015 and peaked during 21 December-5 January, being concentrated to the days around the spring tide (Fig. 2).

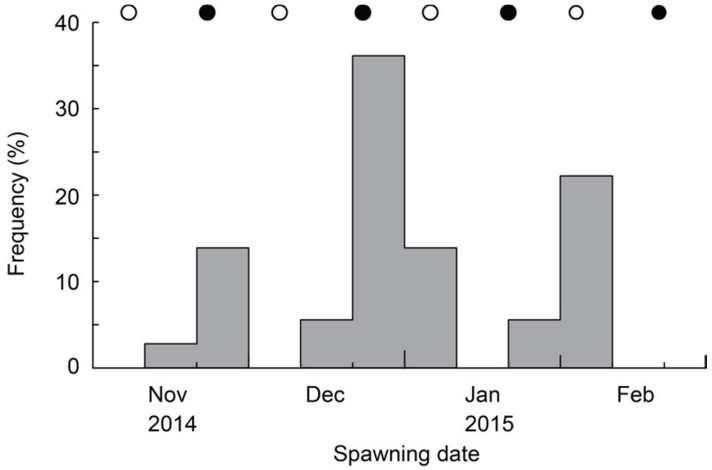

Fig. 2. Spawning date frequency distributions for the *Acanthopagrus schlegelii* (n=36) collected in the Tien Yen estuary from December 2014 to March 2015. *Solid* and *open dots* indicate the new and full moon, respectively

3.1.2. Growth

The age-standard length relationship of *Acanthopagrus schlegelii* is presented in Fig. 3. The linear regression formulae of standard length (y, mm) on age (x; day) was expressed as y = y = 0.2111x + 2.3195 (r = 0.847).

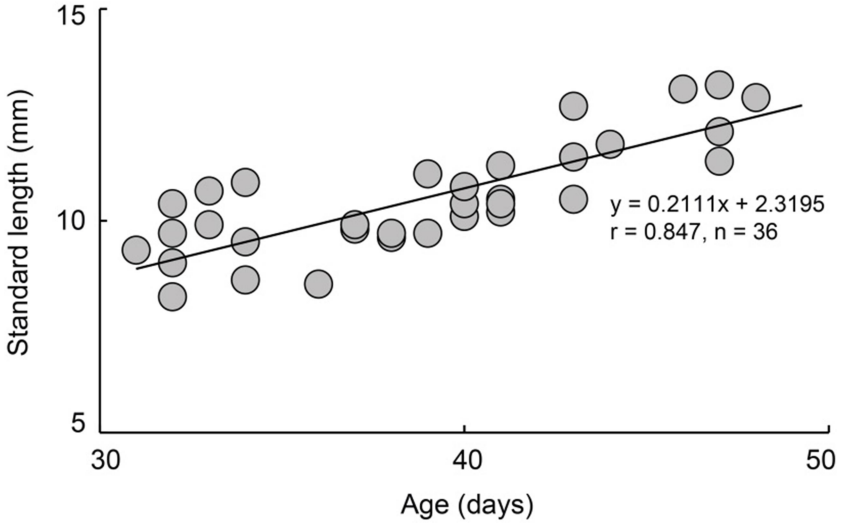

Fig. 3. Relationships between age and the standard length of *Acanthopagrus schlegelii* juveniles in the Tien Yen estuary

3.1.3. Otolith size

The standard length-otolith radius relationships of *Acanthopagrus schlegelii* are presented in Fig. 4. Linear regression formulae of otolith radius (y; µm) on standard length (x; mm) was expressed as y = 33.955x - 123.01 (r = 0.921) for sagittal radius-standard length relationships.

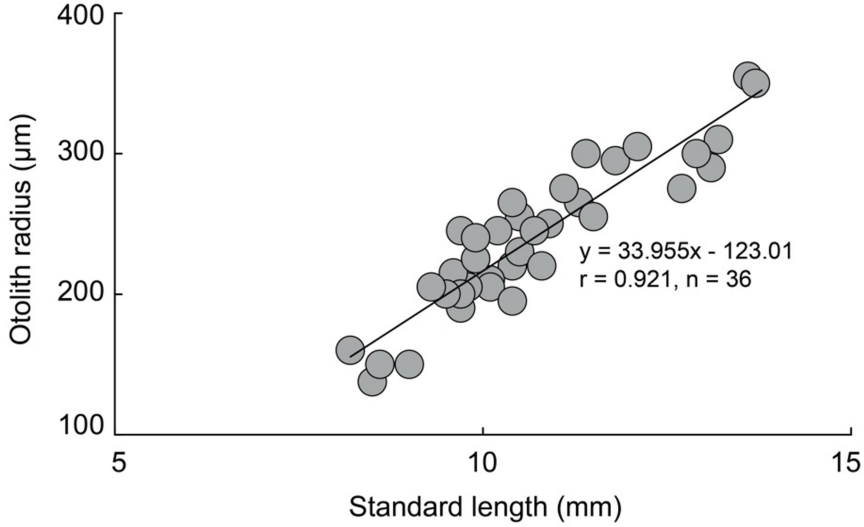

Fig. 4. Relationships between standard length and otolith radius of sagitta of *Acanthopagrus schlegelii* juveniles in the Tien Yen estuary

3.2. Discussion

The youngest juvenile collected at Tien Yen estuary was 26 DAH. This finding suggests that *A. schlegelii* started utilizing the estuarine environment as their habitat at the early juvenile stage. In our previous works, the sampling was also conducted at several estuarine sites [15, 16, 17], and some specimens at earlier developmental stages (i.e., larval stage) were caught in the center of the current. Commonly, larvae of *Acanthopagrus* fishes that spawned in the open sea closed to the estuary recruited to the estuary as their nursery [6-9, 12]. This study indicates that the post-hatching larvae spend approximately more than 20 days at the sea. Twenty days after hatching may also be the required time for fish to obtain the swimming ability against the water current to go to a favourable environment like estuary (i.e., swim from sea to the estuary).

Much evidence shows that the spawning season of sparid fishes is temperature dependent [18]. In the case of *A. schlegelii*, Tran et al. (2019) indicated that occurrence season of the juveniles in Vietnam [12] differed from those in other areas, i.e., Japan [6, 9] and Taiwan [7, 8]. However, no information about spawning time was reported. In this study, the spawning dates were concentrated during the period of the end of November to early of February, which was around the coldest period of the year [12]. This evidence is suitable for the hypothesis of Sheaves (2006) as the spawning of sparids at lower latitudes was concentrated close to the month of lowest sea surface temperature [18].

The relationships among standard length, age and otolith sagittal radius are highly correlated on high regression coefficients in this study ($r > 0.8$). The similar observations are evident in the other studies of the same species, genus, family [6, 9] and different family fishes such as *Cottus kazika* [19], *Plecoglossus altivelis* [20], *Nuchequula nuchalis* [21]. This phenomenon will be important in future researches or application. For instance, the length-age relationship may apply to estimate the age of individuals using their body size, or the otolith size-fish length relationships may be used for estimating the fish sizes using their otolith. In the study on the food content of aquatic animals, fish otolith of the preys usually remains in the digestive tube. Using the given relationships, size of the preys will be determined.

4. CONCLUSIONS

- The spawning dates were during the coldest period of the year from the end of November to early February.

- The linear regression formulae of standard length (y, mm) on age (x; day) and otolith sagittal radius (y; μm) on standard length (x; mm) was expressed as $y = 0.2111x + 2.3195$ ($r = 0.847$) and $y = 33.955x - 123.01$ ($r = 0.921$), respectively.

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SUMMARY

SPAWNING DATES, GROWTH AND OTOLITH SIZE OF *Acanthopagrus schlegelii* (SPARIDAE) EARLY-STAGE JUVENILES IN THE NORTHERN VIETNAMESE COASTS

Acanthopagrus schlegelii (Sparidae) is a commercially important euryhaline fish along coasts of eastern Asia from Vietnam to Japan. The timing of the early stages tends to be spatial variation. To clarify the spawning season, growth and otolith sizes of their early stages, collections were made bi-monthly and monthly from October 2014 to September 2015 in the Tien Yen estuary, northern Vietnam. Age determinations from sagitta otoliths were performed in specimens. The spawning season of *A. schlegelii* occurred during the coldest period of the year from

the end of November to early February. Their spawning dates were concentrated around the day of spring tide. The linear regression formulae of standard length (y; mm) on age (x; day) and otolith sagittal radius (y; μm) on standard length (x; mm) were expressed as y = 0.2111x + 2.3195 (r = 0.847) and y = 33.955x - 123.01 (r = 0.921), respectively.

Keywords: *Black porgy; Tien Yen estuary; Otolith; Age estimation, Cá tráp đen; Cửa sông Tiên Yên; Đá tai; Ước lượng tuổi*

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