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Study on Reproductive Performance of *Terapon jarbua* (Forsskal, 1775) in Tam Giang-Cau Hai Lagoon Systems, Thua Thien Hue Province

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Abstract: *Terapon jarbua* was collected from Tam Giang-Cau Hai lagoon systems and then their reproductive performances were investigated. Total 342 species were caught by otter trawlers and different fishing gears in marine and Tam Giang-Cau Hai lagoon systems on certain days of each month during period from September 2015 to August 2016 at fishing port. The determination of age was based on composition of the fish: ear, scaly, spine, gill cover and spine and the ovarian histology template. The gonads after being fixed with Bouins solution were cleansed, cut, dyed and put on the observation microscope. Results showed that the sex of *Terapon jarbua* was nearly clarified at the approximately 1+ age group and participated in reproduction process in the first time at the 1+ age group. The batch and relative fecundity of *Terapon jarbua* were high. The batch fecundity of *Terapon jarbua* varied from 239,029 to 420,400 eggs. The relative fecundity capacity fluctuated from 945 to 1,013 of eggs per gram of fish and the mean value by 981 eggs per gram of fish. The spawning season of fish occurred from March to May annually.

Key words: *Terapon jarbua*, reproductive biology, Thua Thien Hue.

1. Introduction

Terapon jarbua, commonly known as crescent grunter or tiger perch, is a medium-sized fish species belonging to the order Perciformes under the family Terapontidae. *Terapon jarbua* is common in subtropical and tropical Indo-Pacific coastal waters, and generally inhabits shallow waters (30 m depth) with sandy substrates, including estuaries and brackish waters [1]. This fish species has been reported to have good contribution to marine and coastal fisheries of its native countries. In order to contribute to the conservation of resources, towards the raising of the fish for aquaculture development in Vietnam, there should be data on reproductive characteristics and performance of the fish. Some aspects of biological traits of this species have been studied, such as reproductive biology in Taiwan [2, 3], gonadosomatic index and sex ratio of *Terapon jarbua* from Pondicherry coast, India [4]. Thus, the descriptions should broadly include gonad maturity, sex ratio and ovum size frequency distribution, however a conclusive information on the reproductive potential of this species will be uncovered. However, in Tam Giang-Cau Hai lagoon systems are required for culture on different systems, such as enclosed net, pond at low and high tides, but farmers do not have enough fingerlings for stocking and they must wait from natural fellows by changed tides in different seasons [5]. The study aimed to investigate and understand to the species in wild condition and catch them to discover the reproductive traits and performance, since aquaculturist will have data and application for reproductive aspects on artificial reproduction to get fingerlings for aquaculture in Tam Giang-Cau Hai lagoon conditions with marine,

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brackish water bodies in Thua Thien Hue province, Central Vietnam.

2. Materials and Methods

2.1 Time and Materials

A total of 342 specimens of *Terapon jarbua* were randomly collected on certain days of each month during period from September 2015 to August 2016 at fishing port in the water bodies from lagoon and sea related to Thua Thien Hue coastal region. They were caught by commercial otter trawlers and fishermen, by each week the morning boats were coming back from sea to ports and samples were collected and analyzed for data inputs.

2.2 Methods

Fish size is personalized to the total length (TL) and volume (body weight—BW) of the individual in the third stage (maturation stage) [6]. The developmental stages of the linear lines are determined according to the description of Nikolsky [6]. The development of fish is carried out by fishing and immersed in nature.

The ovarian histology template is based on the method of Hinton [7]. The gonads after being fixed with Bouin solution were cleansed, cut, dyed and put on the observation microscope. The specimen is stained by Hematoxylin-Eosin staining method. Gonadosomatic ratio (*GSR*) is determined for each collection sample and calculated according to Eq. (1):

$$GSR = 100 \times \text{gonadal volume/total mass} \quad (1)$$

Absolute fecundity (*F*) is determined according to Donalson [8] by the following Eq. (2):

$$F = nG/g \quad (2)$$

where, *G*: volume of ovary, *g*: mass of one egg taken into count and *n*: the number of eggs contained in a sample. The sample is taken to count in three places, head, middle, and end of ovary.

Relative fertility is calculated by Eq. (3):

$$\text{Relative fertility} = \frac{\text{absolute fertility}}{\text{mass amount of fish body}} \quad (3)$$

The embryonic development of fish is carried out by fishing females and males themselves. However, gonadotropin phase 3 and hormones stimulate ovulation, and claw eggs then for fertilization. Take the fertilized egg to observe the development of the embryo by microscope. All stages of embryo development and cell division are uniform. Full time and images are recorded until egg hatches. Study on fish gonadal morphology and fish reproductive biology is according to the methods of Nikolskin [6] and Bon and Moove [9]. The sex ratio is described as the ratio of number of males to the number of females. Fecundity is estimated from the most advanced mode ocytes of stage IV from a piece of 0.05 g ovarian tissue.

3. Results and Discussion

3.1 Sex Ratio of Terapon jarbua at Natural Condition

The study on sex ratio throws light on aspects, such as sex viability and segregation or aggregation of sexes according to breeding behavior. A knowledge of sex ratio in population of fishes is essential in the derived means of ensuring a proportional fishing of two sexes [10]. The sex ratio of 342 specimens of *Terapon jarbua* is present in Table 1 and Fig. 1.

The proportion of males and females was found to be 1:1.05. Non-gender individuals in the 0+ age group accounted for 9.36%. The 1+ age group had the highest sex radio with male:female = 1:1.42, followed by 1:1.25 in 4+ age group and 1:1.23 in 3+ age group. The group with the lowest sex ratio (1:1.10) was 2+ age group. The sex was disproportionate in the commercial catch, with the females generally outnumbering males [11].

3.2 The Genital Maturation by Age Group

The results of research on *Terapon jarbua* reproduction showed that fish had stages of gonadal development by age group from stage I to stage VI, as shown in Table 2 and Fig. 2. In the 0+ age group, only genital glands were found in stage I (9.36%). The 1+

Table 1 Sex ratio by age group of *Terapon jarbua.*

Sex \ Age		0+	1+	2+	3+	4+	Total
Juvenile	*n*	32	0	0	0	0	32
	%	9.36%	0.00%	0.00%	0.00%	0.00%	9.36%
Male	*n*	0	12	82	37	12	143
	%	0.00%	3.51%	23.98%	10.82%	3.51%	41.81%
Female	*n*	0	17	90	45	15	167
	%	0.00%	4.97%	26.32%	13.16%	4.39%	48.83%
Total	*n*	32	29	172	82	27	342
	%	9.36%	8.48%	50.29%	23.98%	7.89%	100.00%

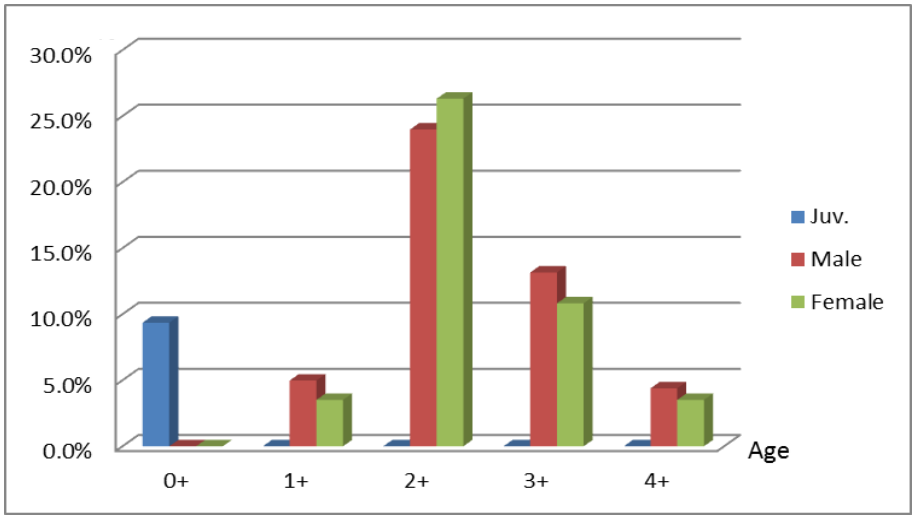

Fig. 1 Sex ratio by age group of *Terapon jarbua.*

Table 2 The maturation stages of fish by age group.

Stage	0+		1+		2+		3+		4+		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*N*	%
I	32	9.36%	7	2.05%	19	5.56%	0	0.00%	0	0.00%	58	16.96%
II	0	0.00%	10	2.92%	54	15.79%	17	4.97%	4	1.17%	85	24.85%
III	0	0.00%	6	1.75%	59	17.25%	25	7.31%	8	2.34%	98	28.65%
IV	0	0.00%	4	1.17%	17	4.97%	19	5.56%	7	2.05%	47	13.74%
V	0	0.00%	1	0.29%	18	5.26%	9	2.63%	3	0.88%	31	9.06%
VI	0	0.00%	1	0.29%	5	1.46%	12	3.51%	5	1.46%	23	6.73%
Total	32	9.36%	29	8.48%	172	50.29%	82	23.98%	27	7.89%	342	100.00%

age group had six stages of maturation, with the highest rate in stage II (2.92%) and with the lowest rate in stages V and VI (0.29%). As the same with 0+ age group, the 2+ age group had six stages of maturation, too. The highest rate was the stage III (17.25%) and the lowest was the stage VI (1.46%). The first stage was not found in two age groups 3+ and 4+. In the 3+ age group, the stage with the highest rate was stage III (7.31%), and in the 4+ age group, the stage with the highest rate was stage IV (2.05%). So *Terapon jarbua* sexually matures soon, and fish begins to mature at the age of 4+ [12, 13].

Results of fish reproduction over time at the sea water of Thua Thien Hue province are shown in Table 3 and Fig. 2.

The stages of maturation in months were different.

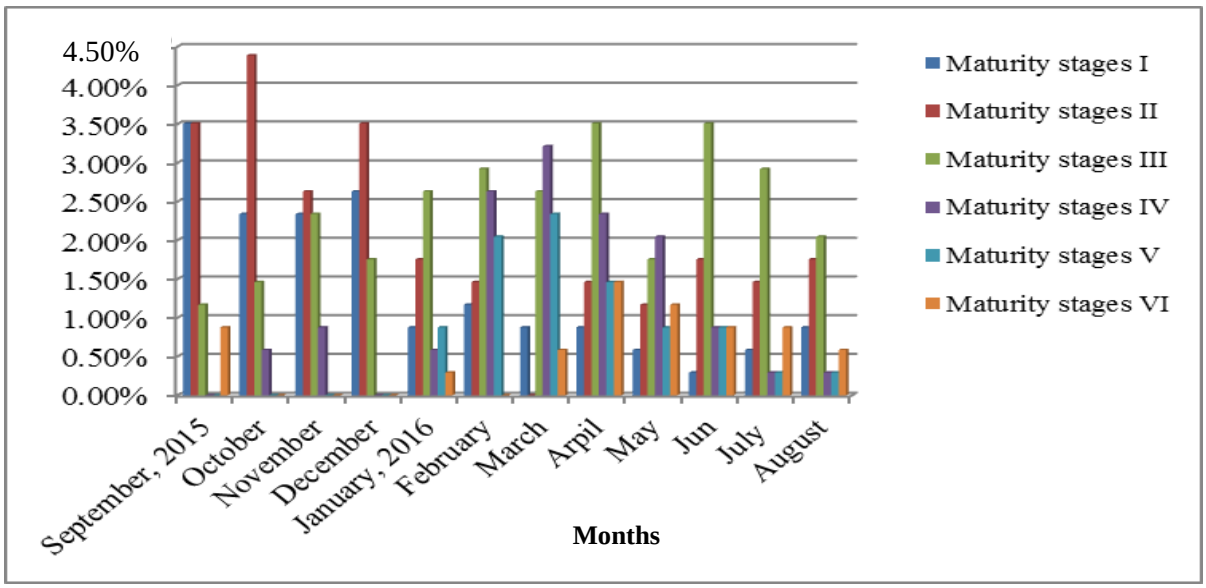

Fig. 2 Seasonal variations of maturity stages of *Terapon jarbua*.

Table 3 Seasonal variations of maturity stages of *Terapon jarbua.*

Month	The numbers of *Terapon jarbua* in different maturity stages						*N*
	I	II	III	IV	V	VI	
2015							
September	12	12	4	0	0	3	31
October	8	15	5	2	0	0	30
November	8	9	8	3	0	0	28
December	9	12	6	0	0	0	27
2016							
January	3	6	9	2	3	1	24
February	4	5	10	9	7	0	35
March	3	0	9	11	8	2	33
April	3	5	12	8	5	5	38
May	2	4	6	7	3	4	26
June	1	6	12	3	3	3	28
July	2	5	10	1	1	3	22
August	3	6	7	1	1	2	20
Total	58	85	98	47	31	23	342

From September to December, the genital glands were concentrated mainly in stages I and II, while there were very few individuals in stages IV, V and IV. The stage III was available in all months of the year. From February to April, genital glands were concentrated in stages IV and V. The spawning season of the species seems to be very prolonged with the peak season estimated to be in March and May. Such a lengthy spawning season in this species is probably due to the asynchronous spawning characteristics of the fish. The multimodal frequency distribution of egg size in ovary at any gonad stage suggested that it is a fractional spawner. Fractional spawner and a prolonged spawning season are main characteristics of tropical and subtropical fishes [6] which are adapted to spawn in several batches in order to avoid overcrowding of larvae and to reduce their food competition.

Table 4 Estimates of the batch fecundity of *Terapon jarbua.*

Age	Fork length (mm)	Body weight (g)	Gonad weight (g)	Batch fecundity (egg)	Relative fecundity (egg/g)	*N*
2+	279.17	289.19	17.77	293,029	1,013	10
3+	287.14	339.03	17.49	320,400	945	7
4+	315.27	425.90	19.20	420,400	987	8
Average	293.86	351.37	18.15	344,609	981	25

3.3 Absolute Fertility and Relative Fertility of Terapon jarbua

To determine reproduction of *Terapon jarbua*, 25 ovary samples in stage IV of females in three age groups: 2+, 3+, 4+ were analyzed. The results of the analysis are shown in Table 4. Batch fecundity of fish was quite large, depending on female weight. The bigger the fish, the bigger the number of eggs. Batch fecundity ranged from 239,029 to 420,400 eggs (mean 344,609 eggs), which is equivalent to the relative fecundity of 945-1,013 (mean 981) eggs per gram body weight.

4. Conclusions

In this study, the sex in the 0+ age group can not be distinguished, and the sex of fish began to be distinguished from age group 1+. The numbers of females were much greater than that of males. *Terapon jarbua* age sexually matured soon, and fish began to mature and reproduce at the age of 1+. The spawning season of the species seemed to be very prolonged with the peak season estimated to be in March and May. Batch fecundity ranged from 239,029 to 420,400 (mean 344,609) eggs and the relative fecundity of 945-1,013 (mean 981) eggs per gram body weight.

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