Journal of Agricultural Science and Technology A and B
& Hue University Journal of Science 5 (2015) 548-560
doi: 10.17265/2161-6256/2015.12.014

Biological Features and Distribution of Giant Trevally (*Caranx ignobilis* Forsskal, 1775) in Tam Giang-Cau Hai Lagoon Systems, Vietnam

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Abstract: The study aimed to investigate biological characteristics and distribution of a new fish species Giant trevally (*Caranx iginoblis*) in Tam Giang-Cau Hai lagoon systems and preliminarily discover the reproductive abilities of a migration species from sea into lagoon. Results showed that the species appeared in the lagoon since 2005 and farmers started raising by cages at Tu Hien estuary and Loc Binh area for well-growing and a best market to consumers. There were distributed of the fingerlings from sea into lagoon from October to December though inlets, so fishermen can collect every year by bottom nets and enclosed net. Fish heads are growing a faster than other species, but not sustainable development of the culture model. Besides, wild fish also can be collected by fishmen at inlets with the bigger of averaged body weight 1.99 ± 1.22 kg and length 45.66 ± 17.56 cm. The species are big mouth and contained sharp teeth. There are flat body and head length, pectoral fin rays, dorsal and anal yellow, gray dorsal, and ventral surface is silver white. They adapted in water environmental conditions of pH (7.1-8.5), dissolved oxygen (DO) (2.7-4.5 mg/L), salinity (17.0‰-33.3‰) and temperatures (16.8-32.5 °C). The reproductive performance of 50 fish samples, which were detected on mature female fish and male fish for eggs or spermatorrhoea, respectively, was investigated. Results of slices on gonads in stages I, II and III showed that the germplasm is a special source of valuable genes of the species and local aquatic resources.

Key words: Giant trevally, lagoon, biological features, distribution, characteristics.

1. Introduction

Tam Giang-Cau Hai has more than 22,000 ha area with many aquatic species and it is also good for fishing opportunities. Giant trevally (*Caranx iginoblis*) migrate and live in the lagoon, and fishing men can obtain the wild fish species from Cau Hai area and Tu Hien estuary to culture in the fish-cages and thus to have a good result and economic income. This fish is a natural source of a new species to live in the lagoon since 2005 through Tu Hien estuary, with a high commercial value of price and well-adapted to salinity changes from sea water to brackish water. The fish have a faster growth rate than other species at the fish cages. Giant trevally is the concern of many fishermen and communities to collect the fingerlings for aquaculture, but the seed source are limited and usually just drift in the estuaries in a short time (October to March) in rainy condition. Farmers and scientists would like to determine age and growth rate of this species, and they can have understand more biological characteristics, specially migrations, distributions and growth, mature in life cycle. The fish age study was conducted by scales, but forever soles at 20th century, the study about age and growth of new fish has many achievements recorded [1-3]. This was also the first case to have demonstrated in scientific and technological application for locations for backward water condition.

Due to requirement of scientific studies, the

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investigate trends on the biological characteristics and reproductive performance have been focused on, such as embryonic and gonad development, the level for gonad maturity, fecundity, hatchering and spawning conditions. Reproductive activity is closely related to various processes, such as growth, nutrition and feeding assurance. Study on the significant combination of theoretical and practical aspects at the same times contributes to exploit, protect and use resources appropriately [4-6]. The research aimed at investigation of biological characteristics and distribution of a new fish species with potential for cage culture in Tam Giang-Cau Hai lagoon systems, as well as preliminarily discovering the reproductive abilities of a migration species from sea into lagoon.

2. Materials and Methods

2.1 Materials

All specimens of giant trevally (*Caranx ignobilis* Forsskal, 1775) (Fig. 1) were collected at Thua Thien Hue coastal region, especially in Tam Giang-Cau Hai lagoon system from 2014 to 2015.

2.2 Methods of Collecting Information and Samples

The survey collected information via questionnaires to fishermen and farmers at Loc Binh, Vinh Hien and Hai Duong, Tam Giang-Cau Hai lagoon systems. Samples have been collected in wild and cage conditions. Morphologically samples must be intact form and shape in formaldehyde 5% enclosed with the label, and the local name, date and place of sampling are post outside sample bottles.

2.3 Biological Variables

The study of biological characteristics of fish giant trevally includes a morphological characteristics, growth variables, nutritional feeding characterizes and reproductive characteristics.

2.3.1 Morphological Characteristics

Morphological characteristics can be discovered by observation in fields and labs and based on the classification criteria from Figs. 1 and 2.

2.3.2 Growth Variables

The intercept (a) and slope (b) of regression line were calculated by using the following Eq. (1) according to Berverton-Holt (1956) updated by Ref. [3]:

$$W = a \times L^b \quad (1)$$

where, W = body weight (g) and L = body length (cm).

The age of fish was identified by scales. The fish Giant trevally with flakes are soaked in 4% NaOH solution to remove grease, dirt or pigment clinging on flakes. Cash observations of opaque concentric rings, contiguous rings throughout the fish on the scales and the boundary between the opaque regions allow us to identify individuals within the age in years. Directly observe using microscopy by eyes, and estimate fish age according to Nikolsky updated by Ref. [3].

2.3.3 Nutritional Feeding Characterizes

Feed was removed from the intestine and stomach for specimens and then observed under a microscope or magnifying glass binocular. Use keywords to classify low level plants, invertebrate aquatic, as “the kind of invertebrate” of the classification of marine planktonic algae silicon [3], identification of the invertebrate groups freshwater common in Vietnam. The coefficient of fat fish was calculated using Eqs. (2) and (3) according to Fulton (1902) and Clark (1928), updated by Ref. [3]:

$$Q = \frac{W}{L^3} \times 100 \quad \text{(Fulton)} \quad (2)$$

$$Q = \frac{W_0}{L^3} \times 100 \quad \text{(Clark)} \quad (3)$$

where, Q: fat parameter, W: body weight and L: body length.

Fat is accumulated in the fish and the fat fish can only be pinpointed with the fat accumulation into belly and fat layers. Additionally, when conducting anatomical fresh fish, the simple method can be used to determine fat under 5 levels by Prozovxkaia, M. L. (1957) updated by Ref. [3].

2.3.4 Preliminary Reproductive Characteristics

Fish samples were obtained at surgery tables and then determined the volume of the maturity stages and gonadal morphology under 6 ladder levels according by Kiselevits, K. A. (1923) updated by Ref. [3], and then fixed in Bouin solution which composed of picric acid, acetic acid and formaldehyde in an aqueous solution.

3. Results

3.1 The Classification System of Giant Trevally

Giant trevally belongs to order Perciformes, family Carangidae, genus *Caranx*, species *Caranx ignobilis* (Forsskal, 1775). The English name is giant trevally and the local name is Vau.

3.2 Some Morphological Characteristics

The measurement criteria of morphological characteristics as proposed by Lowe-McConnell (1971) and Grant & Spain (1977), updated by Ref. [2] in biological research are presented in Table 1.

Giant trevally (*Caranx ignobilis*) has a big head, big mouth, mouth under thrown up on, inside contains sharp teeth, flat body, with a body length (TL) in 3.13 times body height (BH) and in 4.19 times head length (HL) (i.e., TL/BH = 3.13 and TL/HL = 4.19), head length in 4.14 times the diameter of the eye (ED) (i.e., HL/ED = 4.14). Big round eyes have fat layer covering the outside, with four nostrils and each side has two holes. Giant trevally fish often change color according to the environment; when there is the same size 10 cm and on the body with the black stripes, the adults have gray body white or yellow depending on species and the environment where they live, and the abdomen is white. There are two dorsal fins; the 2nd dorsal fin is gray and the outer edge is black, upper lobe of caudal fin is black outer edge, the lower lobe of the outer edge is pale yellow, and pelvic fins is trimmed white. The body covering is round and oval scale. The pectoral fins, dorsal and anal fins are yellow to fish and also called Giant trevally contract yellow fin.

3.2.1 Description of Morphology

Dorsal (D1 = VII; D2 = I, 20): include two dorsal with dorsal 1 has 7 spines; dorsal 2 has 1 spine and 21 soft rays has to branch.

Pectoral fin (P = 19) has 19 branched soft rays, crescent-shaped, longer than the first length.

Ventrals (V = I, 4) has 01 spine and 4 soft rays.

Anus (A1 = I-III, A2 = 17-19) have two spines anal forward split followed by a sequence with soft rays branching spines include 17-19 soft rays.

Tail fin (C = (19 – 23) + 2). Tail lobe is divided into two clear, and each fin consists of 19-23 branched rays with soft spikes. A top of side edge lobes has yellow black colour, and the lower margin lobes has pale yellow colour.

The line has a distinct texture and moderately long, curved part intersecting with the straight part below the second dorsal fin lobe. Part of the road curved sides has 58-64 scales. Connections part includes one row connected continue, consisting of 31 layers (Fig. 2).

3.2.2 Biometric Indicators

The indicators of body (HL, ED, high body BH) in a correlation with TL are considered as an indicator of biometric (bio-metric index). In each index link between the target TL (HL/ED; TL/BH), the average value of the index will be determined biometric following Fig. 3, according to Bayagbona (1963) updated Ref. [3]. If in all size groups of fish research, biometric indicators of each individual characteristics

Fig. 1 ***Caranx ignobilis*** **Forsskal, 1775.**

Table 1 Morphological characteristics of giant trevally (*n* = 50).

No.	Morphological variables	Units	Mean	Min-Max	SD
1	Body weight (W)	g	1,993.954	2.2-4,500	1,223.98
2	Body length (TL)	cm	45.66196	5.15-70.0	17.56
3	Head length (HL)	cm	10.543	1.45-19.0	4.23
4	Front spines (PD)	cm	13.627	1.65-24.6	6.60
5	Eye length	cm	3.568	0.35-7.4	2.03
6	Space between two eyes	cm	4.512	0.5-8.1	2.08
7	Eye dimension (ED)	cm	2.611	0.4-4.9	1.18
8	Above mouth length	cm	5.0418	0.6-9.0	2.30
9	Below mouth length	cm	4.358	0.5-7.8	2.08
10	Anus length	cm	15.02	1.1-24.4	6.72
11	Body height (BH)	cm	14.05	1.9-22.3	5.55
12	Head height	cm	12.592	1.7-21.1	5.15
13	Mouth width	cm	3.493	0.4-6.2	1.51
14	Front dorsal spine width 1	cm	3.983	0.7-6.3	1.35
	Behind dorsal spine width 2	cm	7.425	0.6-13.4	3.32
15	Front dorsal spine width 1	cm	6.603	0.7-18.6	3.06
	Behind dorsal spine width 2	cm	13.644	1.5-20.9	5.21
16	Breast spine length	cm	12.098	1.1-20	5.21
17	Breast spine width	cm	2.476	0.3-5.25	1.21
18	Anus spine width	cm	7.182	0.7-12.3	3.12
19	Anus spine length	cm	12.662	1.4-24	4.83
20	Belly spine length	cm	5.444	0.6-9.6	2.38
1	Belly spine width	cm	1.5928	0.1-3.2	0.79
22	Mouth high	cm	8.308	0.9-15.2	3.72
23	Body high at dorsal	cm	13.657	1.9-21.9	5.50
24	Body high at chest	cm	12.841	1.8-20.4	5.00
25	Body high at anus	cm	13.529	2.0-20.8	5.15
26	Tail spine high	cm	13.186	1.2-21.2	5.59
27	Tail length	cm	6.807	0.5-13	3.30

indicate each odds decreased continuously, then characteristics survey shows a positive correlation (+). On the contrary, the characteristics of the survey was inversely correlated (-). If the index does not change biometric, means the development of the survey indicators in relation to the correlation length and a peer [7]. Thus, based on Fig. 3, it is found that the correlation between TL/BH, TL/HL and HL/ED compared to TL is a positive correlation.

3.3 Growth Characteristics

3.3.1 Age Structure of Fish

Table 2 and Fig. 4 showed the age distribution of the fish caught from sea and lagoon in four groups: < 1-year-old group (0 +), > 1-year-old group (1 +), > 2-year-old group (2 +), > 3-years-old group (3 +). The length of individuals under age group 0 + ranged from 51.5 mm to 395 mm with average 234.733 mm, and the weight ranged from 2.2 g to 1,230 g with average 429.11 g, respectively. The length of individuals aged 1 + ranged from 382 mm to 444 mm with average 419.730 mm, the corresponding volume ranged from 1,300 g to 2,200 g with an average of 1,608.5 g, respectively. The length of individuals aged 2 + ranged from 530 mm to 573 mm with average 557.257 mm, and the corresponding volume ranged from 2,300 g to 3,140 g in average 2,760.7 g, respectively. The length of individuals aged 3 + ranged from 563.3 mm to 673 mm with average 646.1 mm, and the corresponding amount ranged in 3,200 -4500 g, averaging 3,750 g.

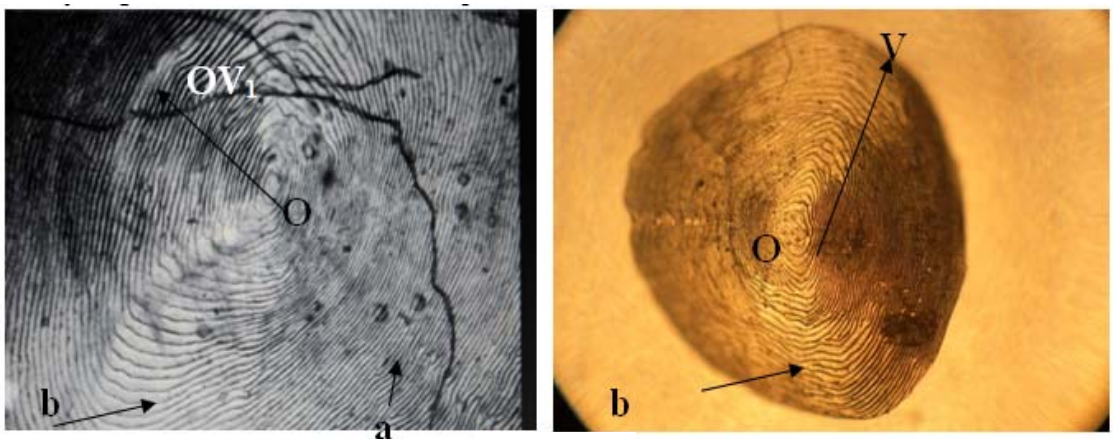

Fig. 2 Fish scales.

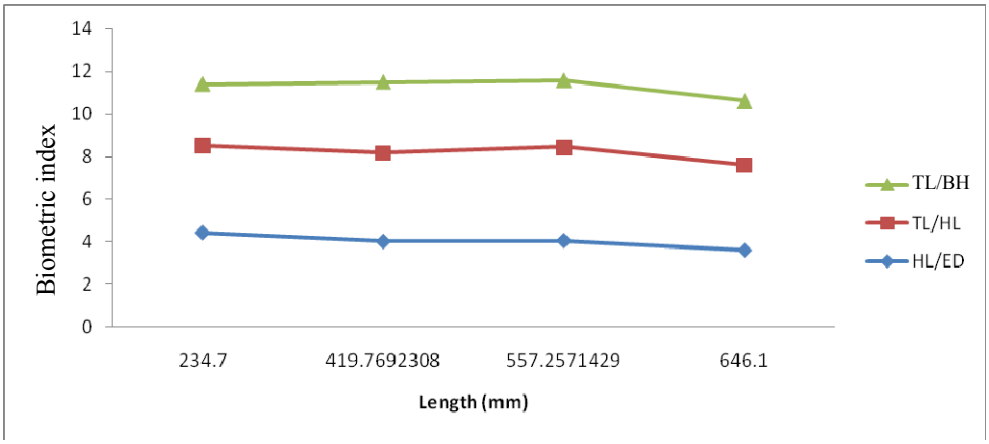

Fig. 3 The index of personal biometric giant trevally body length of each age group.

Table 2 Age and distribution composition.

Age	Length L (mm)			Weigh W (g)			Numbers	
	Mean	Min-Max	SD	Mean	Min-Max	SD	Frequency	%
0 +	234.733	51.5-395	139.711	429.11	2.2-1,230	466.61	15	30
1 +	419.730	382.0-444	15.000	1,608.5	1,300.0-2,200	258.03	13	26
2 +	557.257	530.0-573	16.734	2,760.7	2,300.0-3,140	240.55	14	28
3 +	646.100	563.3-673	36.661	3,750.0	3,200.0-4,500	396.41	8	16
Mean	438.958	51.5-673	172.533	1,919.93	2.2-4,500	1,253.47	50	100

3.3.2 Correlation between Length and Body Weight of the Fish

In the process of growth and development of fish, the increase between length and weight has a relationship with each other. After analyzing 50 samples of fish with many sizes and different age groups, the correlation between the length and weight of fish is shown in Fig. 5.

Based on the formula Beverton-Holt (1956) updated by Ref. [3] and analyzing the research results, it was obtained that the correlation between length (L) and weight (W) of giant trevally is expressed as Eq. (4)

$$W = 0.025L^{2.8898} \quad (4)$$

From Fig. 5, the growth in length and weight of giant trevally close relationship with each other is clearly reflected in the correlation coefficient R^2 = 0.987, and this is positively correlated, meaning that when length increases, the volume of fish Vau also increased. However, the growth and length of giant

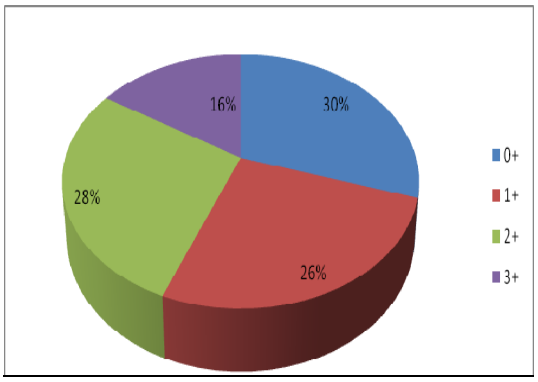

Fig. 4 Age structure of fish.

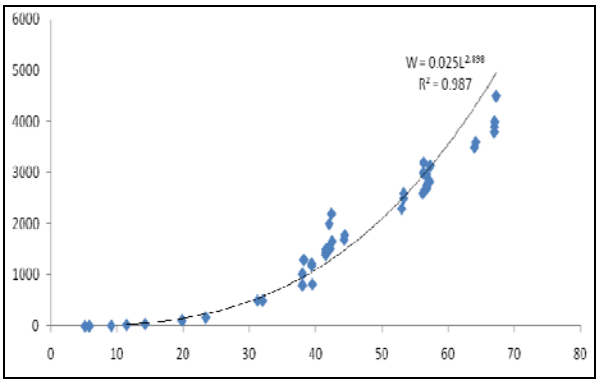

Fig. 5 Correlation between length and body weight of the fish.

Fig. 6 Teeth and stomach of giant trevally.

trevally was uneven shown in Fig. 5. Particularly, in the early stages (age 0 +), the length increased, the volume increases slowly. By the stage 1 +, 2 +, 3 +, giant trevally showed rapid growth in volumes and slow growth in length. Maybe at this stage, fish have increased in volume in relation with nutrient accumulation process, and the increase in size in early life is due to adaption in competition for food and animal data to ensure survival.

3.4 Nutritional Features

3.4.1 Anatomy of the Digestive Organs of Giant Trevally

The results observed showed that a giant trevally species have big heads, wide mouth, mouth under upwards, mouth width of 50 samples ranging in 0.4-6.2 cm and average of 3.493 + 1.51 cm; the upper jaw contained a series of sharp fangs outside with uneven distribution and the smaller teeth in innermost, while mandibular teeth have a conical line, and inside there are many teeth almost distributions as shown in Fig. 6. Gill rakers are long and thin situated on bone sparse supply carries towards oropharyngeal cavity. On the supply carries, there are 18-24 carries combs, each side has the four leaf bearing and multi-motor bearing is surrounded by the gill cover. Esophagus is short, thick-walled, and many folds present in the esophagus should be so elastic lug that fish can swallow large prey. J-shaped stomach is large and thick wall capable of contraction. The fish has a short bowel, therefore it can be recognized that this fish can eat origin animal feed. They are carnivorous fish and in most of the habitat, they are known as independent predators. The research results are consistent with previous studies of some scientists, who believed that food of giant trevally was the primary prey of

crustaceans, molluscs and mollusks. The strategic large predatory fish like to ambush their prey. The diet is similar, mainly including fish eels, small squid, octopus, mantis shrimp, lobster and other crustaceans.

3.4.2 Correlations between Gut Length (Li) to Body Length (Lo)

According to Nikolsky (1963) updated by Ref. [3], the species of fish which are fond of animal feed would be valuable of Li/Lo ≤ 1, omnivorous fish have Li/Lo = 1-3 and fish with natural feeding about plants have Li/Lo ≥ 3. From collated results in Table 3, it was shown the coefficient RLG = 0.468 and it can be concluded that giant trevally feeding inclined to animal due to Li/Lo = 0.468 ≤ 1.

3.4.3 Feeding Analysis by Occurrence Frequency

To determine the composition of giant trevally feeding, the food in the gastrointestinal tract with 50 fish samples were analyzed and divided according to the size based on the length of the largest and smallest fish by means of determining occurrence frequency of these foods in the digestive tract. The results about occurrence frequency of foods in the digestive tube lugs fish are presented in Table 4. It can be seen that the food of giant trevally feeding is mainly animal.

3.4.4 Natural Food of Fingerlings

Analyze food in the digestive tract of 15 specimens of giant trevally following different size group, where the smallest was 2.0 cm and the largest was 12.0 cm, to determine the natural spectrum of giant trevally fingerlings feed. The analysis results of giant trevally fingerlings are very diversified, including three groups of phytoplankton and animals (zooplankton and small size) and organic humus (decomposed food).

According to Table 5, concrete phytoplankton group includes 14 species of four phylums. Among them, Chlorophyta phylum had the highest rate with six species and made up 42.8% of phytoplankton group; Bacillariophyta phylum with five species made up 35.7%; Cyanophyta phylum had two species and made up 14.2%; the least was Euglenophyta phylum with one species and made up 7.3%. The spices of animals consist of zooplankton and small size animal; it had 19 species on 7 classes. Among them, the Copepoda class had the highest rate with eight species and 42.1% of animal group, and the lowest rate was Gastropoda class with one species and 5.26% of animal group. In Osteichthyes class, it just can be identified in order and unidentified in species. In addition, the organic humus component wad also identified. It consists of algae and decomposing animal, accounting for 30% high present in the digestive tract.

3.4.5 Fat Level of Giant Trevally

According to Nikolsky (1963) updated by Ref. [3], the method of Fulton (1902) and Clark (1928) [3] was used to determine the difference of fat ratio, the level of individual nutrients accumulate of giant trevally.

According to the results of the study (Table 6), fat levels of individuals of giant trevally varied between age groups. The fat level III and IV appeared mostly in all age group. At the age group 2 + and 3 +, the fat

Table 3 The variation rate Li/Lo by size (*n* = 50).

Measurement indicators	Mean	Min	Max
Total length (mm)	438.958 ± 172.5	51.5	673.0
Gut length (mm)	205.780 ± 66.3	65.0	273.0
Correlations between gut length and total length (RLG)	0.468	0.03	1.00

Table 4 The results of feeding analysis by frequency of occurrence (*n* = 50).

Dietary composition	The number of caught times	Frequency of occurrence (%)
Crustacean	40	80
Fish	32	64
Ink	24	48
Mollusca	10	20

Table 5 The result in the digestive tract of giant trevally fingerlings (*n* = 15).

Category	Name of food	Size group (cm)	
		2-7	7.1-12.0
(1) Phytoplankton			
I Bacillariophyta			
1	*Cerataulina pelagica*	-	+
2	*Thalassiosira sutilis*	+	-
3	*Coscinodiscus* sp.	+	+
4	*Navicula* sp.	+	-
5	*Achnanthes* sp.	+	-
II Chlorophyta			
6	*Pediastrum* sp.	+	+
7	*Selenastrum* sp.	+	-
8	*Microsporaceae*	+	+
9	*Oophila amblystomatis*	+	-
10	*Chlorella* sp.	-	+
11	*Chlorococcaceae*	+	-
		2-7	7.1-12.9
III Euglenophyta			
12	*Phacus* sp.	+	+
IV Cyanophyta			
13	*Microcystis* sp.	-	+
14	*Chroococcus*	-	+
(2) Animal			
V Crustacean class			
15	*Scylla paramamosain* (Estampador, 1949)	-	+
16	*Penaeus monodon* Fabricius, 1798	-	+
VI Rotatoria			
Asplanchnidae order			
17	*Asplanchna priodonta* Gosse, 1850	+	+
VII Cladocera			
(a) Sididae order			
18	*Diaphanosoma sari* Richard, 1894	-	+
(b) Bosminidae order			
19	*Bosminopsis deitersi* Richard, 1895	+	+
VIII Copepoda			
(a) Pseudodiaptomidae order			
20	*Schmackeria dubia* Poppe & Richard, 1979	+	+
21	*Pseudodiaptomus incisus* Shen & Lee, 1963	-	+
(b) Acartidae order			
22	*Acartia clausi* Giesbrecht, 1889	+	+
23	*Acartiella sinensis* Shen & Lee, 1963	+	+
(c) Oithonidae order			
24	*Limnoithona sinensis* (Bruckhardt, 1912)	-	+
25	*Oithona nana* (Giesbrecht, 1892)	+	-
(d) Temoridae order			
26	*Temora turbinate* (Dana, 1849)	+	+
27	*T. discaudata* Giesbrecht, 1889	+	+

(Table 5 continued)

Category	Name of food	Size group (cm)	
		2-7	7.1-12.0
(1) Phytoplankton			
IX Polychaeta class			
(a)	Chrysopetalidae order	-	+
(b)	Hesionidae order	+	+
(c)	Nephthydidae order	+	+
(d)	Opheliidae order	+	+
XI Osteichthyes class			
28	*Stolephorus* sp.	+	+
29	Lish larval	+	+
30	Fish eggs	+	+
X Bivlavia class			
(a) Corbiculidae order			
31	*Corbicula* sp.	-	+
(b) Arcidae order			
32	*Anadara* sp.	+	+
(c) Placunidae order			
33	*Placuna* sp.	+	+
XI Gastropoda class			
(a) Potamididae order			
34	*Cerithidea sinensis* (Gmelin)	+	+
(3) Organic humus			
Disintegrate animals + plants		+	+

Table 6 The accumulation of fat degree by giant trevally age group.

Age group	Fat levels										Total	
	0		I		II		III		IV			
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
0 +	3	6	2	4	4	8	4	8	2	4	15	30
1 +	0	0	0	0	5	10	4	8	6	12	15	30
2 +	0	0	0	0	0	0	5	10	7	14	12	24
3 +	0	0	0	0	0	0	1	2	7	14	8	16
Total	3	6	2	4	9	18	14	28	22	44	50	100

Table 7 The fat ration of giant trevally.

Age group	Fulton ratio (1902)	Clark ratio (1928)	*N*	
			n	%
0 +	$3{,}317.7 \times 10^{-6}$	$2{,}843.23 \times 10^{-6}$	15	30
1 +	$2{,}175.2 \times 10^{-6}$	$2{,}027.66 \times 10^{-6}$	13	26
2 +	$1{,}595.3 \times 10^{-6}$	$1{,}526.18 \times 10^{-6}$	14	28
3 +	$1{,}390.4 \times 10^{-6}$	$1{,}341.16 \times 10^{-6}$	8	16

was the most 14% in level IV, and at this age there was not fat in stage 0, I, and II. In the age group 0 +, the fat was caught at all stages from 0-IV, and in group 1 +, the fat was not caught in stages 0 and I. Thus, it can be concluded that the fat levels of fish species with giant trevally is very high. Thus, it can be concluded that the fat levels of fish species with giant trevally is very high. Table 7 showed that there are relationships between ages and fat accumulation by Fulton ratio (1902) and Clark ratio (1928) with percentages of fish grow-up 3 +, they can have mature soon gonads in culture stages in cages.

3.5 Reproductive Characteristics

Only a small number of fish species differ in outside appearance between males and fingerlings (stingrays, sharks), and some species have differences in spawning time (salmon males have a longer snout in female children during reproduction). Many fish species have distinctive characteristics of sex and can be identified through the external morphological characteristics, such as the level of micro-smooth chest in carp, big belly and protruding genital growth. However, for some wild fish species, identification of sex based on outside shape is difficult, especially for not sexually mature fish.

For individuals of giant trevally, some giant trevally fish have eggs with size > 3.5 kg/head. At the same time, a survey on fishing capture on lagoon and sea was done, but not found yet any fishes having eggs. Besides, the gonads of giant trevally fish were only identified in phase I, II, III of aquaculture farming with cages and was observed clearly in Fig. 7 on phase III.

Phase I: For individuals with gonads in stage I, it can not distinguish between male and female gonad when observed with the naked eye (Figs. 7 and 8). The back of gonads has a lot of fat clinging to, if not carefully observe it very easy to mistake for a part of gonads, as it is the same color as the gonads and also vascular distribution. Gonads have the distribution of blood vessels, but small numbers, very small diameter and no ramifications. Gonads have very small volume and cell attributes were observed at ovarian in phase I; under the microscope, the acolytes appeared in synthetic period and also gonad cells developed, so the next, the ratio between the gonad diameter and the body diameter of the fish species was compared with other fish species. Results showed that the ratio of gonad in Giant trevally was slowly and smaller.

Phase II: TSD has become larger, but still not goes to mature as expecting, when observed with the naked eye, except in cases of ovarian at late phase II by this time, some small eggs had formed as beads. Yellow is the first period of growth in nutrition which can be seen by naked eye. Blood vessels are distributed in more gonads, and small blood vessels branch run around gonad to make gonad white roses. Due to the increase of protoplasm, egg cells become larger and uneven due to the tension of the plasma membrane to the cell polygon-shaped eggs. The relationship between egg diameter and sex cell diameter was deflected to a corner.

Besides, there are interstitial spaces for many gonad cells still in synthetic period. The size and weight of the ovaries increased significantly, so that the naked eye can distinguish the males and females. Ovaries occupy two-thirds of the volume of the abdominal cavity. Ovaries have a lot of blood vessel distribution, along the ovaries are the major blood vessel diameter and they are divided into smaller blood vessels surrounding the ovary. Use the hand to stroke along belly, there is egg to flow out (Fig. 9).

Phase III: In ovary of giant trevally, a big difference of size and different development phases of the oocytes can be seen in the nutritional growth period.

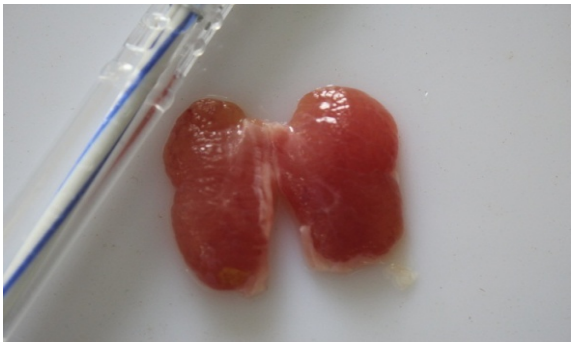

Fig. 7 The gonad of giant trevally.

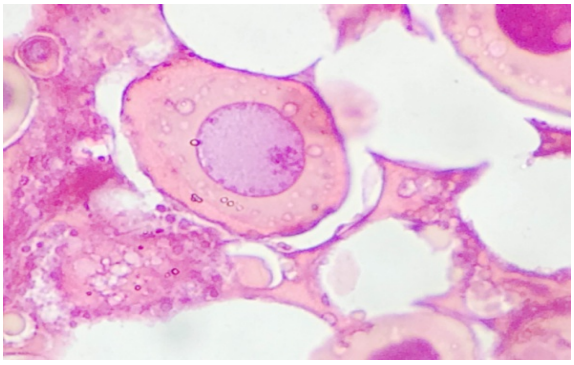

Fig. 8 Ovarian of fish at phase I.

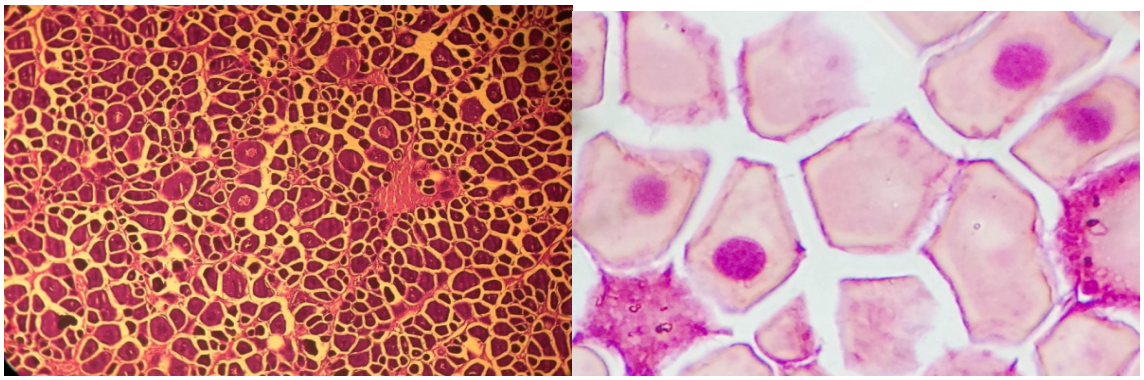

Fig. 9 Ovarian of fish at phase II.

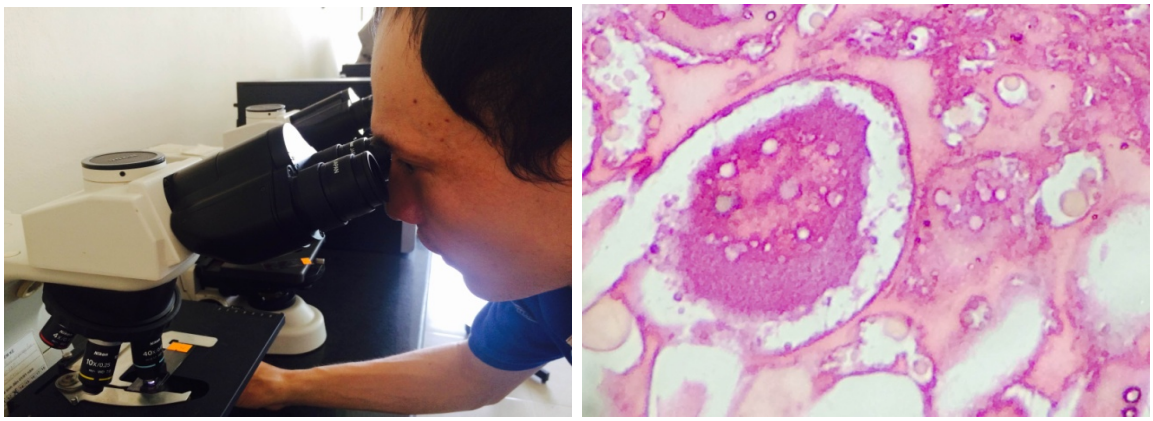

Fig. 10 Ovarian of fish at phase III.

There are larger cells inaccumulated yolk phase, they were smaller than the unsaturated cells that is storage stage the nutrition of oocytes for the next round of mature. However, the egg cells of small size are also different with each another (Fig. 10).

4. Discussion

Giant trevally fish is widely distributed in tropical seas and subtropics of the Indian Ocean and the Pacific, ranging along the coast of three continents and hundreds of small islands and archipelagos. In the Indian Ocean, the easternmost range of the species is the coast of the African continent, which is distributed from the Southern to South Africa, North along the East coast of Africa to the Red Sea and Persian Gulf. Its scope extends to the East along the coast of Asia, including Pakistan, India and Southeast Asia, Indonesian Archipelago and Northern Australia. Elsewhere in the Indian Ocean, the species has been recorded from hundreds of small island groups, including the Maldives, Seychelles, Madagascar and the Cocos (Keeling) Islands. Sometimes, immature fish live in the estuaries, upstream river and coastal lakes in some places, including South Africa, Solomon Islands, Philippines, India, Taiwan, Thailand, North of Australia and Hawaii. Through surveys of households who exploited and lived around Tu Hien (Vinh Hien) and Thuan An estuaries (Thuan An town), it is found that hatch of fish (Giant trevally) is in sea, and larvae growing to fingerlings is under the water going into the lagoon through two estuaries (Thuan An and Tu Hien). Most fingerlings are primarily concentrated in October to April every year, and every year just has one or two batches in raining seasons, often slipping into pre-season floods and storms. Every night, one bottom corral can catch hundreds of fingerlings, and sizes of fingerlings are around 3-10 cm of length according to Refs. [1, 7, 8].

Based on the morphological analysis of the body, results showed that there are some differences among the lower part on the lateral dorsal, lateral area of the body, the part near the tail fin fish scales, but generally fish scales are relatively large with oval, and bears some general characteristics of bone fish species. Giant trevally has thin scale, and is oval, central development, so the growth is flourishing in both the front and the back of the scales. In different areas of the body, fish scales, shapes and different sizes were observed in the study. The larger scales are in the lateral head of the body, and the front flounce of larger size is at rear area. Head part of fish has an abdomen paler, and contains less pigment than the body part, however, the larger head is not clear; the growth rings close to the lateral middle have the largest distance, the color equivalent between belly parts of fish body is not explicit compared with the lateral body. Therefore, the length of scabs in the body on either side of the road was used to determine the age of fish. According to the results of some previous studies, the habitat of giant trevally has extensive salinity, from brackish to marine water environment, estuaries, bays and lagoons, while the immature live in the deeper reefs and offshore atolls. In the same period, the authors lived in a very low salinity waters, such as coastal regions and rivers upstream, and tended to prefer turbid waters, as research done by Smith and Parrish updated by Ref. [9].

Fingerlings were fed crustaceans and small fishes every day in the culture cages. For individuals collected and caught from lagoon and sea, it was showed their diets in Table 4 with 80% of the stomach of fish and mostly they are small species combined, as shown in Refs. [5, 10-12]. Fig. 5 showed the growing rate of body weight and length with significant ($P < 0.05$) correlation, and the body weight will be expected to 4-5 kg after three years feeding in lagoon conditions with dietary composition as in Table 4. Many fish species have distinctive sex characteristics and can be identified through the external morphological characteristics. However, wild fish species are difficult to identify based on outside sex shape, especially for not sexually mature fish. For individuals of giant trevally collected from wild condition, they have eggs size weighing over than 3.5 kg/head. Meanwhile, individuals raised in culture condition showed mature sooner, inducing gonad stage, vascular distribution. At phase II, gonad becomes larger, but still not goes to mature as expecting, when observed with the naked eye, except in cases of ovarian at late phase II; and mature can reach at phase III with ovary of giant trevally for oocyte in the nutritional growth period. The larger ovarian cells are accumulated more yolk and stored the nutrition of oocytes for the next round of mature [9].

5. Conclusions

The giant trevally (*Caranx ignobilis*) is large fish, big mouth, mouth under thrown up on and inside mouth contains sharp teeth, flat body, with a total body length in 3.13 times of body height and in 4.19 times of head length (TL/BH = 3.13, TL/HL = 4.19) and head length in 4.14 times of eye diameter (HL/ED = 4.14), pectoral fin rays, dorsal and anal yellow, gray dorsal, and ventral surface is silver white.

The research results showed correlation between length and weight of fish Vau is: $W = 0.0252 \times L^{2.898}$ and $R^2 = 0.987$, and this is correlated with age structure of giant trevally groups (0 +, 1 +, 2 +, 3 +).

Composition of food in the digestive tube lugs fish includes three groups: phytoplankton, animals (zooplankton and small size animals) and specific organic humus containing 14 species of phytoplankton and 19 species of animals. The average correlation coefficient between gut length and body length of giant trevally (RLG) is $0.468 < 1$, and it can be concluded that the feeding of giant trevally was inclined to animal.

Of the 50 samples studied, it could not distuinguish yet between sexes clearly, may be due to that the time of sampling does not coincide with the breeding

season of giant trevally in Tam Giang-Cau Hai lagoon system. However, only mature female fish for eggs and male fish for spermatorrhoea were detected. Results showed that in slice of fish samples, some gonads were identified in phase I, II, III and the sex cells and gonads were continuing to grow.

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