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Growth and Reproduction of bluefin searobin (*Chelidonichthys spinosus*) in the Geoje Island of South Korea

by

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Interdisciplinary program of Marine-Bio,
Electrical & Mechanical Engineering

The Graduate School

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(거제도에 서식하는 성대의 성장과 생식)

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A dissertation

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CONTENT

List of Figures iv

List of Tables..vi

Abstract vii

1. Introduction..1

2. Material and methods..4

2-1. Sample collection 4

2-2. Biological characteristics..4

2-3. Age and growth..7

2-3-1. The length-weight relationship 7

2-3-2. Otolith preparation and reading techniques 7

2-3-3. Precision of age and annuli cyclicity 8

2-3-4. Age determination and growth parameters 9

2-4. Statistical analysis...11

3. Result 12

3-1. Biological characteristic 12

3-2. Age and growth..17

3-2-1. Relationship between length and weight....................................17

3-2-2. The annuli formation cyclicity 19

3-2-3. Age composition..21

3-2-4. Growth parameter 29

4. Discussion 31

5. Acknowledgement..37

6. References..38

List of Figures

Figure 1. Sampling area of *Chelidonichthys spinosus* in the Geoje Island of South Korea. 6

Figure 2. Length-frequency distribution of *Chelidonichthys spinosus* by sexes...14

Figure 3. Monthly change in the gonad somatic index (GSI) of *Chelidonichthys spinosus* by sexes. 15

Figure 4. A logistic function fitting proportion of mature females to total length of *Chelidonichthys spinosus*. 16

Figure 5. The relationship between total length and body weight in female (a) and male (b) of *Chelidonichthys spinosus.* 18

Figure 6. Monthly change of marginal increment (MI) with ± standard error in *Chelidonichthys spinosus*. 20

Figure 7. First and second reading of otolith. 22

Figure 8. The von Bertalanffy growth function (VBGF) of female (a) and males (b) and combined sex (c) of *Chelidonichthys spinosus* by Walford method. 30

List of Tables

Table 1. Mean length of annulus (mm) for each age group of otolith for females of *Chelidonichthys spinosus.* 23

Table 2. Mean back-calculated total length (cm) for each ring group of otolith for females of *Chelidonichthys spinous.* 24

Table 3. Mean length of annulus (mm) for each age group of otolith for males of *Chelidonichthys spinosus.* 25

Table 4. Mean back-calculated total length (cm) for each ring group of otolith for males of *Chelidonichthys spinosus.* 26

Table 5. Mean length of annulus (mm) for each age group of otolith for combined sex of *Chelidonichthys spinosus*. 27

Table 6. Mean back-calculated total length (cm) for each ring group of otolith for combined sex of *Chelidonichthys spinosus.* 28

Table 7. Comparison of growth parameter of triglid species. 35

Growth and Reproduction of bluefin searobin (*Chelidonichthys spinosus*) in the Geoje Island of South Korea

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Abstract

A total of 557 bluefin searobin *Chelidonichthys spinosus* were collected from Beam trawl during the period from October 2017 to September 2018 in the Geoje Island of South Korea. The size of the samples ranged from 9.3 to 40.7 cm total length. The sample were composed of 361 (64.81%) females, 196 (35.18%) males, with female to male ratio of 1.8:1. The gonad somatic index (GSI) was examined to determine the spawning season. Spawning season of *C. spinosus* was from February to March. Based on proportions that over mature in gonad stage, length at sexual maturity ($L_{50\%}$) of female was approximately 23.21 cm. The length-weight relationship was calculated as $BW = 0.0111TL^{2.956}$ (n = 557, r^2 = 0.9781) for all samples, $BW = 0.0092TL^{3.01}$ (n = 361, r^2 = 0.9765) for females and $BW = 0.0147TL^{2.862}$ (n = 196, r^2 = 0.9796) for males. The age of the sampled individuals, which ranged from 2 to 9 years, was estimated by using the count of growth ring recorded on the otolith. Length-at-age data were fitted using von Bertalanffy growth model. The estimated von Bertalanffy growth functions were $TL_t = 50.58(1 - e^{-0.12(t-0.77)})$ for female, $TL_t = 59.15(1 - e^{-0.10(t-0.73)})$ for male and $TL_t = 55.39(1 - e^{-0.11(t-0.71)})$ for combined sex. Growth performance Index (φ) was estimated from von Bertalanffy growth parameter. Females and males was estimated to be 2.50 and 2.54, respectively. Growth performance Index (φ) of combined sex was 2.52.

1. Introduction

The bluefin searobin, *Chelidonichthys spinosus* (McClelland, 1844) is distributed from East China Sea to the waters of Korea, Japan, Australia and New Zealand (Heath and Moreland, 1967; Yamada *et al*., 1986; NIFS, 2004). *C. spinosus* inhabits benthic sandy, muddy, or mixed substrata from 20 to 600 m depth (Yamada *et al*., 1986; NIFS, 2004). They mainly consume shrimps, small invertebrate and small fish (Kozo *et al*., 1965, Huh *et al*., 2007; Kim *et al*., 2011). Three separate soft rays located at the bottom of the pectoral fin are used for locomotion and searching prey purposes. The inside of pectoral fin has a light green background with light blue spots, and the outside has a bright blue color. It has a colorful and big pectoral fin than other fish (Kim *et al*., 2005).

The bluefin searobin in the waters around Korea are mainly found in the northern part of the East China Sea and are known to be divided into three groups according to their shape and size of the Yellow sea, the East China Sea, and the Tsushima Sea (Yamada *et al*., 1986). They are not main commercial species in Korea. However, the catch of triglid species in Korea has been gradually increasing. The catch of triglid species was 80 to 400 tons, in the early 2000s and increased to 1,000 to 1,700 tons in the 2010s (MOF 2017). With this tendency, *C. spinosus* are becoming increasingly important fishery resources in Korea. In Europe and New Zealand, triglid species are the main commercial species and there are many studies (Staples, 1972; McBride, 2002; Ali and Pinar, 2004; Cicek *et al*., 2008; Boudaya *et al*., 2008; Akin *et al*., 2010; Vallisneri *et al*., 2011; Meulen *et al*., 2013; Montanini *et al*., 2017). Furthermore, *C. spinosus* were studied well in China and Japan (Yunokawa, 1961; Kunishige. 1965; Zhang *et al*., 2009; Li *et al*., 2010). However, only feeding behavior of this species has been studied in Korea (Huh *et al*., 2007; Kim *et al*., 2011). In addition, the precise spawning time of *C. spinosus* is little known.

In order to manage fishery resources, research should be conducted on the relationship between fisheries resources and the environment, feeding habits, reproduction and recruitment, age and growth, and population fluctuations. Among them, age and growth of fishery resources are the most fundamental research for management of fishery resources.

The specific objectives of this study are to: 1) determine age of *C. spinosus* with otolith, 2) estimate growth parameters of *C. spinosus* and 3) reveal precise spawning time of *C. spinosus* based on gonad somatic index (GSI).

2. Material and Methods

2-1. Sample collection

Sampling region was located near of the Geoje Island (Fig. 1). Monthly fresh sample of the bluefin searobin *C. spinosus* were collected from Beam trawl during the period from October 2017 to September 2018. Captured samples were stored alive in the icebox and brought to the laboratory.

2-2. Biological characteristics

In the laboratory, total length (TL) was recorded to the nearest 0.1 mm for all fish samples. The wet body weight (BW) and gonad weight (GW) were recorded to the nearest 0.01g and 0.0001 g with electronic balance, respectively

The sex was recorded on the basic of morphological characteristics of their gonad. Gonad were stage visually assigned in the laboratory to one of the following classes: Immature, Developing, Mature, Spawning and Spent. A gonad somatic index (GSI) was determined by the following formula;

$$\text{GSI} = \frac{Gonad\ weight}{Total\ weight\ of\ fish} \times 100$$

Mature, Spawning and Spent ovaries were selected for estimating size at sexual maturity. A logistic curve may be fitted to the proportion (P) of sexually mature individuals by length (L) using (King 1995):

$$\text{P} = \frac{1}{1 + e^{-r(L-L_m)}}$$

Where r is the slope of the curve in logistic model, and L_m is the mean length at sexual maturity, or the length which corresponds to a proportion of 50% in reproductive condition.

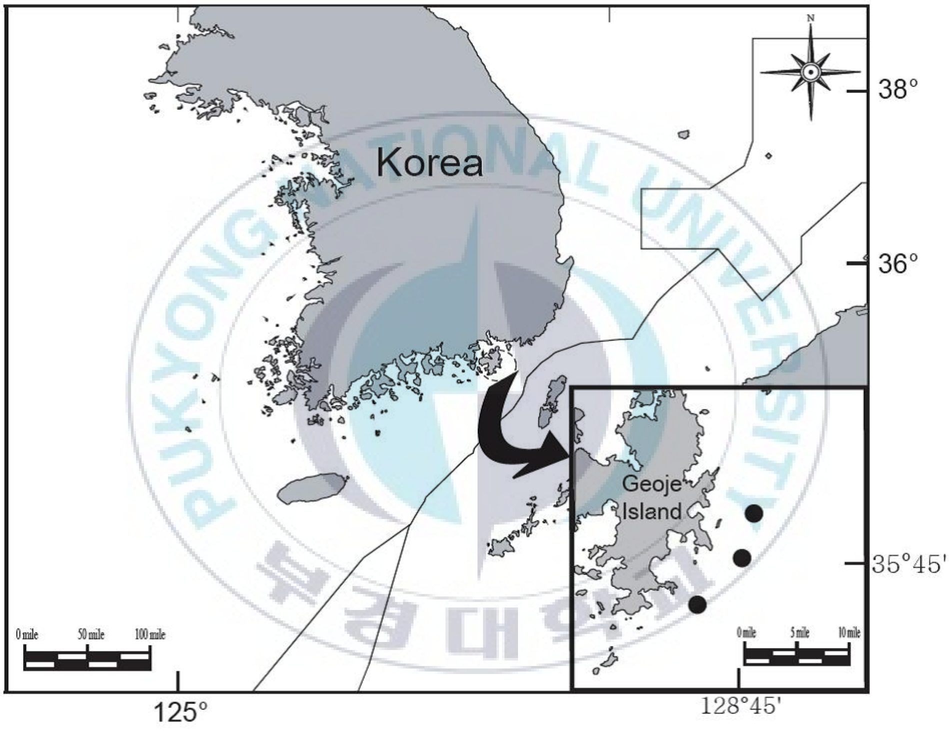

Figure 1. Sampling area of *Chelidonichthys spinosus* in the Geoje Island of South Korea.

2-3. Age and growth

2-3-1. The length-weight relationship

The length-weight relationship was described by equation

$$W = aL^b$$

Where W is weight, L is total length, b is the growth exponent or length-weight factor and a is a constant.

2-3-2. Otolith preparation and reading techniques

Sagittal otoliths were removed from the cranial cavity, cleaned from adherent tissues and stored dry in labeled box. The prepared otoliths were embedded in the Crystalbond™ on the glass slide. These otoliths were polished using grinding machine (Minitech 233). All undamaged sagittal otoliths were measured for length to the nearest 0.01mm under the stereoscopic microscope (Carl

Zeiss Discovery v.8). Microscope was used magnification of 16 X.

A growth chain was defined as pair of bands, consisting of one translucent zone (assumed to be slow growth) and one opaque zone (assumed to be fast growth). The growth chains observed in each of the otolith were counted translucent zone.

2-3-3. Precision of age and annuli cyclicity

To compare the precision of structures reading, each structure was read at least twice by the same reader. To compare age reading, the average percentage error (APE) was used (Beamish & Fournier 1981):

$$APE_j(\%) = 100 \times \frac{1}{R}\sum_{i=1}^{R}\frac{|X_{ij} - X_j|}{X_j}$$

Where R is the number of times each fish is aged, X_{ij} is i (th) age determination of the j (th) fish, and X_j is the mean age calculated for the j (th) fish.

Annuli formation was done to ascertain whether age structures actually happened and for detected mistake growth annuli from checked growth annuli. Marginal increment (MI) analysis was used to validate the periodicity of growth (Lai *et al*.,1996)

$$MI = \frac{R - r_i}{r_i - r_{i-1}}$$

Where R represents structure radius, r_i and r_{i-1} are annular radii of the last and penultimate annuli. MI was expressed percentage of structure with opaque and translucent margins were plotted by monthly capture.

2-3-4. Age determination and growth parameters

The von Bertalanffy growth function (VBGF) was fitted to individual length and age data for the *C. spinosus* population. VBGF approached with equation. Two methods of growth function were calculated by back-calculation, age at mean length data and age. The relationship is expressed by the following equation:

$$L_t = L_\infty[1 - e^{-k(t-t_0)}]$$

Where L_t is the length (cm) at age *t*, L_∞ is asymptotic length (cm), *k* is rate at which the growth curve approaches the asymptotic length ($year^{-1}$), t_0 is hypothetical age of the fish at zero length.

The estimates of L_∞ and k were used for comparison of growth performance indices (φ) (Munro & Pauly 1983) using the equation:

$$\text{Growth performance Index}(\varphi) = 2\log L_\infty + \log k$$

Where L_∞ is the asymptotic length of von Bertalanffy growth parameter, k is growth constant of von Bertalanffy growth parameter.

2-4. Statistical analysis

The difference of sex ratio was examined using a Chi-square test. The differences in size and body weight between sexes were tested by one-way analysis of variance (ANOVA). The Kolmogorov-Smirnorv two-sample test was applied to test differences in the size frequency distributions between sexes. Analysis of covariance (ANCOVA) was applied to test difference in length-weight relationship and in growth curve by sexes. Paired *t*-test was performed in order to compare first and second reading. These statistical test were performed using Minitab Ver.18.

3. Result

3-1. Biological characteristic

Total 557 specimens of *C. spinosus* were collected in the sampling area. Of these, females were 361 (64.81%) and males 196 (35.18%). The sex ratio of female and males was 1.8:1, and significantly different from 1:1 (x^2 = 24.965, *df* = 1, P < 0.001). The sample of females ranged from 10.3 to 40.7 cm in length and from 13.56 to 543.35 g in weight. The males ranged 9.3 to 36.4 cm and from 9.55 to 442.95 g in weight. There was a significant difference in observed total length (F = 24.61, df = 1, $P < 0.001$) and body weight (F = 19.94, df = 1, $P < 0.001$) between sexes. The Kolmogorov-Smirnorv two-sample test showed that there was no significant difference in length-frequency distribution between sexes ($P > 0.05$, Fig. 2).

The gonad somatic index (GSI) was examined to determine the spawning season. The females GSI values were peaked in February. The value of GSI in March began to decline. The males GSI values were peaked in February (Fig. 3). Spawning season of *C. spinosus* was from February to March. Major spawning season was February.

The smallest mature size of female was observed 20.4 cm. Based on proportions that over mature in gonad stage, length at sexual maturity ($L_{50\%}$) of female was estimated to 23.21 cm. A logistic curve was fitted to the proportion of sexual maturity in *C. spinosus* (Fig. 4), and it was estimated as follow:

$$\text{Female: } P = \frac{1}{1+e^{-0.81(L-23.21)}}$$

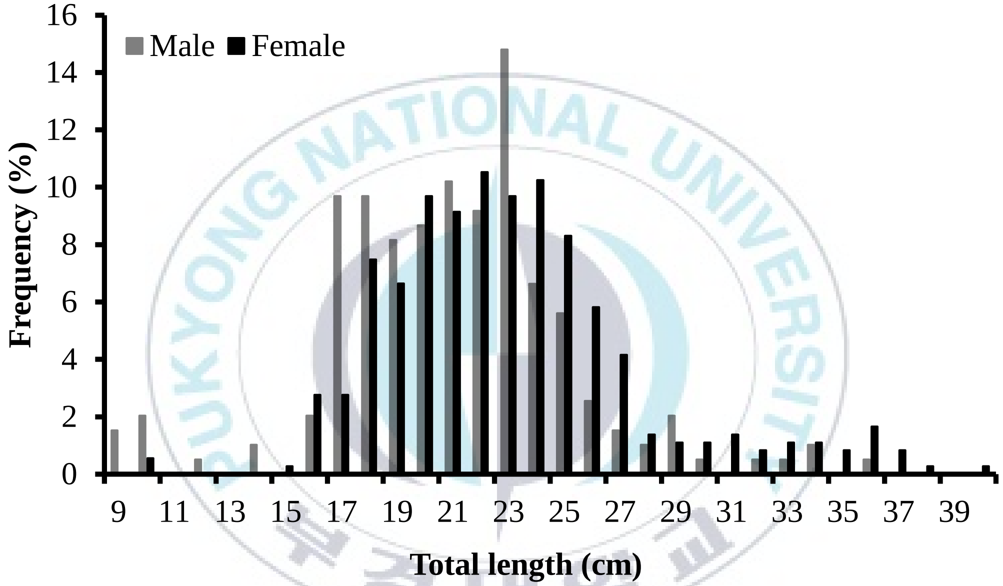

Figure 2. Length-frequency distribution of *Chelidonichthys spinosus* by sexes.

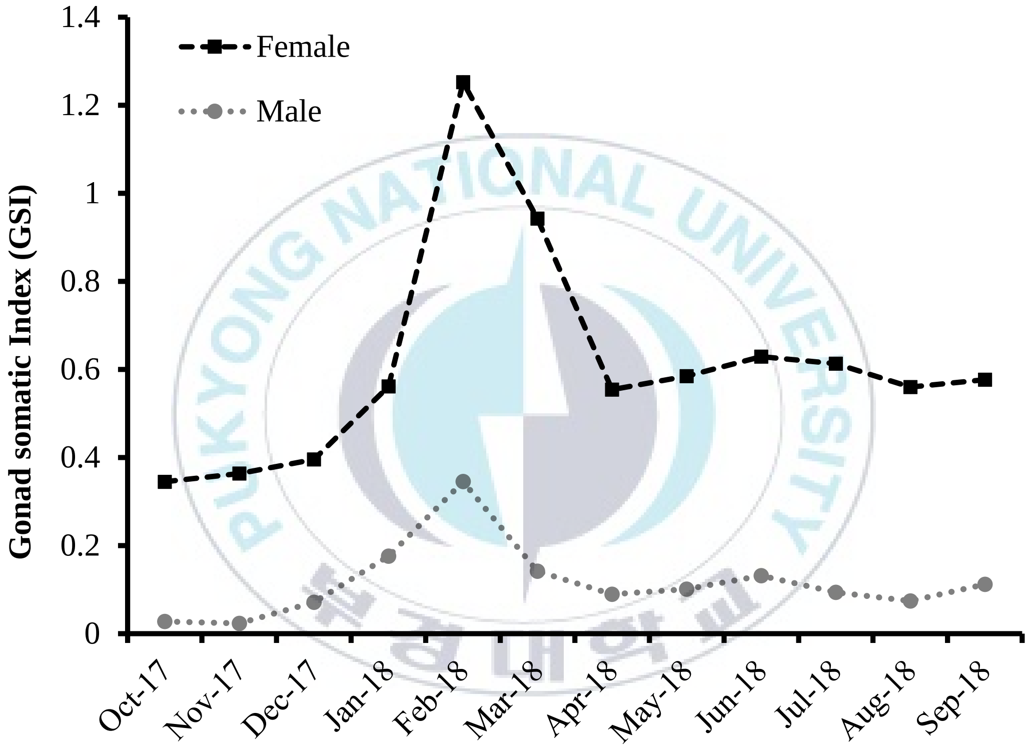

Figure 3. Monthly change in the gonad somatic index (GSI) of *Chelidonichthys spinosus* by sexes.

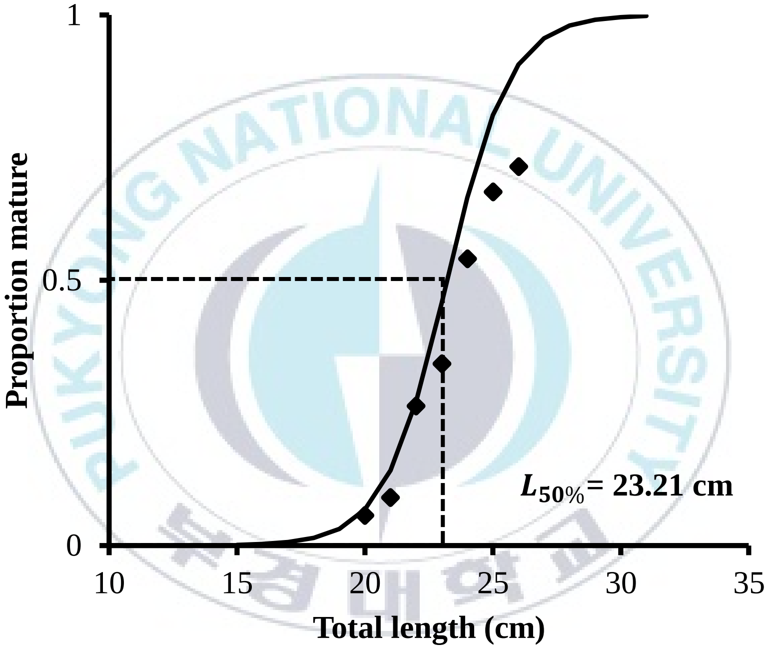

Figure 4. A logistic function fitting proportion of mature females to total length of *Chelidonichthys spinosus.*

3-2. Age and growth

3-2-1. Relationship between length and weight

The relationship between total length and body weight were determined. All sample was $BW = 0.0111TL^{2.9569}$ ($r^2 = 0.9781, n = 557, P < 0.001$) . Female was $BW = 0.0092TL^{3.016}$ ($r^2 = 0.9765, n = 361, P < 0.001$) and male was $BW = 0.0147TL^{2.8629}$ ($r^2 = 0.9796, n = 196,\ P < 0.001$, Fig. 5). The slope of relationship between length and weight were significantly different between sexes (ANCOVA, F = 112.58, P < 0.001).

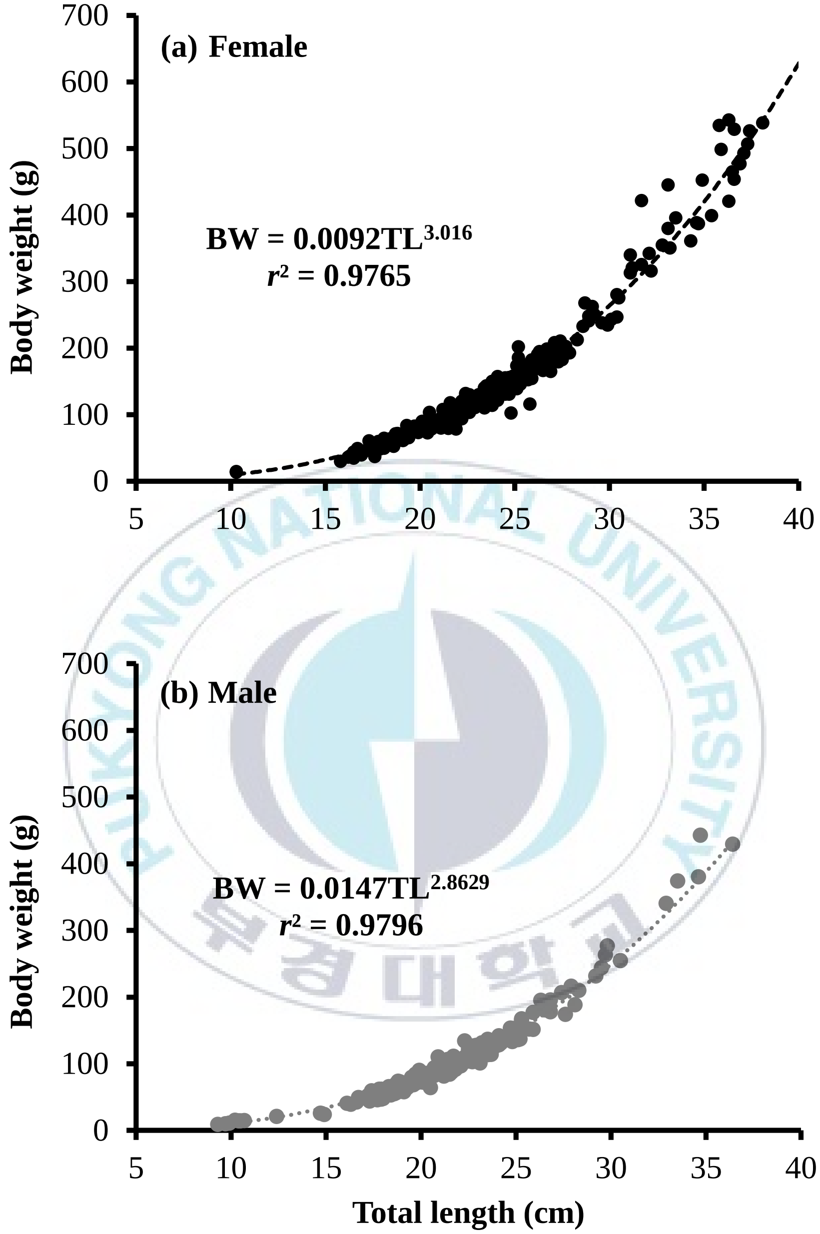

Figure 5. The relationship between total length and body weight in female (a) and male (b) of *Chelidonichthys spinosus.*

3-2-2. The annuli formation cyclicity

Mean monthly marginal increment (MI) was calculated from specimens for each month (Fig. 6). MI showed high values in June, and the lowest value was in August. Kruskal-wallis test showed the greatest MI value in June (H = 46.66, df = 11, P < 0.001). Therefore, the MI value is highest in June, starts decreasing from July, and is lowest in August.

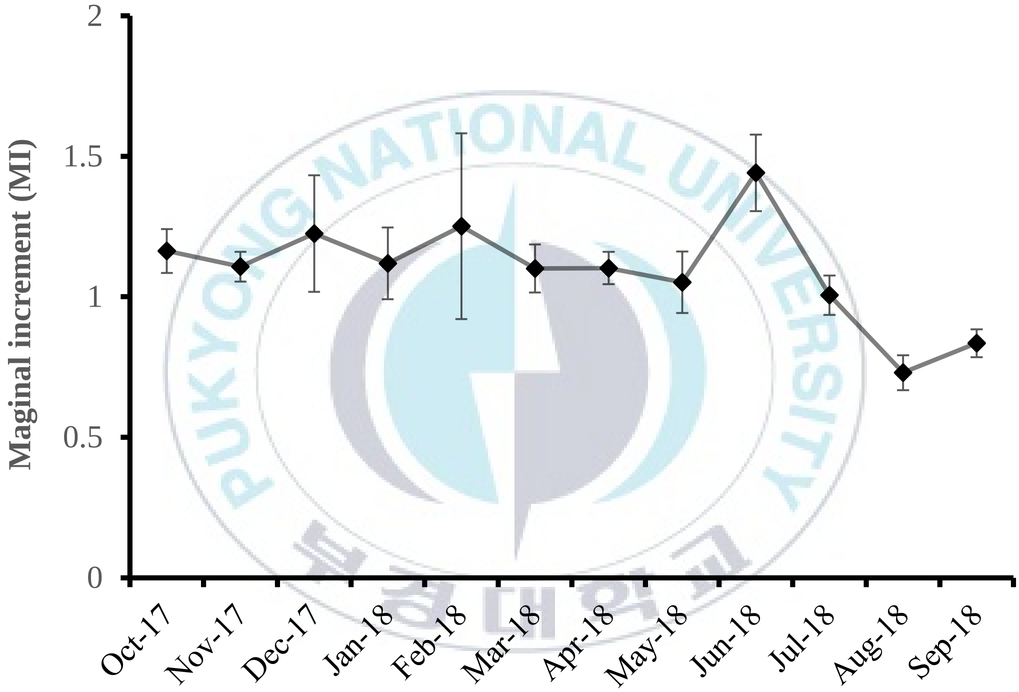

Figure 6. Monthly change of marginal increment (MI) with ± standard error in *Chelidonichthys spinosus*.

3-2-3. Age composition

The age of *C. spinosus* ranged from 2 to 9 years. The average percentage error (APE) between first and second reading was very low with only 4.21%. The paired t-test result indicated that there was no significant differences between first and second reading (t = 0.37, P > 0.05) (Fig. 7).

The back calculated total length was obtained from the corrected ring for female (Table 1, 2) and male of *C. spinosus* (Table 3, 4). The relationship between total length and radius of otolith was as follow:

$$\text{Female: } \mathrm{TL} = -6.2381 + 20.134\mathrm{OR}\ (r^2 = 0.7135, n = 250, P < 0.001)$$

$$\text{Male: } \mathrm{TL} = -5.5032 + 19.079\mathrm{OR}\ (r^2 = 0.7248, n = 132, P < 0.001)$$

$$\text{Combined sex: } \mathrm{TL} = -5.952 + 19.77\mathrm{OR}\ (r^2 = 0.7128, n = 382, P < 0.001)$$

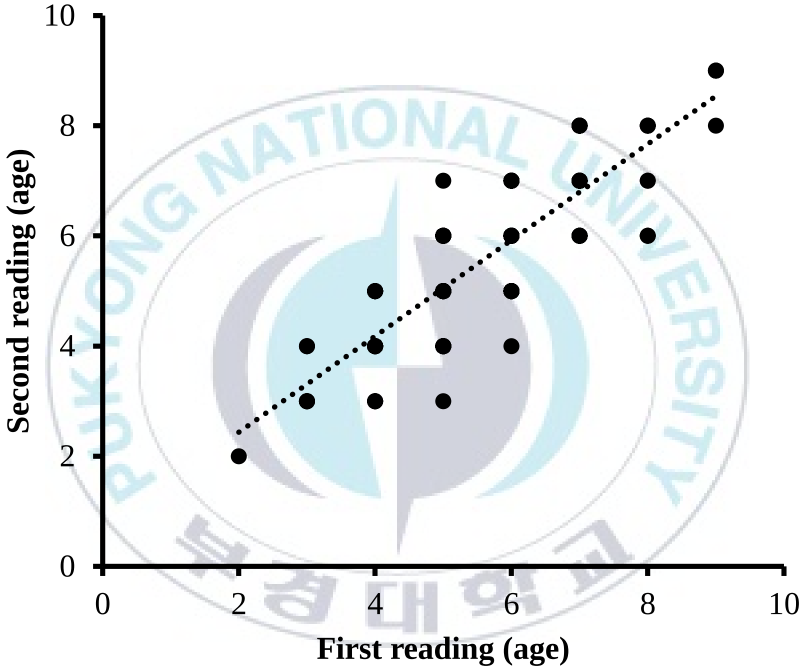

Figure 7. First and second reading of otolith

Table 1. Mean length of annulus (mm) for each age group of otolith for females of *Chelidonichthys spinosus*.

Age group	Number of fish	Total length	Mean length of annulus (mm)									
			OR	r1	r2	r3	r4	r5	r6	r7	r8	r9
1	0	-	-	-								
2	0	-	-	-	-							
3	3	15.93	1.02	0.31	0.71	0.85						
4	26	19.50	1.26	0.32	0.69	0.87	1.06					
5	97	22.15	1.41	0.32	0.71	0.87	1.04	1.22				
6	79	24.92	1.57	0.32	0.71	0.87	1.03	1.20	1.38			
7	34	28.21	1.71	0.32	0.75	0.93	1.08	1.21	1.36	1.53		
8	8	36.10	2.01	0.32	0.78	0.96	1.11	1.25	1.39	1.58	1.79	
9	3	38.06	2.14	0.35	0.77	0.95	1.07	1.20	1.40	1.53	1.73	1.92
Mean	250	26.41	1.58	0.32	0.73	0.90	1.06	1.21	1.38	1.54	1.76	1.92

Table 2. Mean back-calculated total length (cm) for each ring group of otolith for females of *Chelidonichthys spinous*.

Age group	Number of fish	Back-calculated total length (cm)								
		1	2	3	4	5	6	7	8	9
1	0	-								
2	0	-	-							
3	3	0.20	8.04	10.86						
4	26	0.20	7.64	11.26	15.09					
5	97	0.20	8.04	11.26	14.68	18.31				
6	79	0.20	8.04	11.26	14.48	17.90	21.53			
7	34	0.20	8.85	12.47	15.49	18.11	21.12	24.55		
8	8	0.20	9.45	13.07	16.09	18.91	21.73	25.55	29.78	
9	3	0.80	9.25	12.87	15.29	17.90	21.93	24.55	28.57	32.39
Mean	250	0.28	8.48	11.87	15.19	18.23	21.58	24.88	29.17	32.39

Table 3. Mean length of annulus (mm) for each age group of otolith for males of *Chelidonichthys spinosus*.

Age group	Number of fish	Total length	Mean length of annulus (mm)									
			OR	r1	r2	r3	r4	r5	r6	r7	r8	r9
1	0	-	-	-								
2	1	9.7	0.99	0.34	0.78							
3	7	15.85	1.03	0.31	0.67	0.80						
4	21	17.56	1.24	0.31	0.69	0.88	1.06					
5	44	21.27	1.40	0.31	0.70	0.87	1.04	1.22				
6	46	23.66	1.54	0.31	0.71	0.87	1.04	1.19	1.36			
7	12	28.11	1.72	0.32	0.77	0.95	1.08	1.24	1.34	1.52		
8	1	33.5	2.15	0.31	0.8	1.06	1.19	1.38	1.5	1.66	1.89	
9	0	-	-	-	-	-	-	-	-	-	-	-
Mean	132	23.04	1.56	0.32	0.73	0.91	1.08	1.25	1.41	1.63	1.77	-

Table 4. Mean back-calculated total length (cm) for each ring group of otolith for males of *Chelidonichthys spinosus.*

Age group	Number of fish	Back-calculated total length (cm)								
		1	2	3	4	5	6	7	8	9
1	0	-								
2	1	0.98	9.37							
3	7	0.41	7.27	9.76						
4	21	0.41	7.66	11.28	14.72					
5	44	0.41	7.85	11.09	14.33	17.77				
6	46	0.41	8.04	11.09	14.33	17.20	20.44			
7	12	0.60	9.18	12.62	15.10	18.15	20.06	23.49		
8	1	0.41	9.76	14.72	17.20	20.82	23.11	26.16	30.55	
9	0	-	-	-	-	-	-	-	-	-
Mean	132	0.62	8.44	11.74	15.19	18.38	21.54	25.59	30.65	-

Table 5. Mean length of annulus (mm) for each age group of otolith for combined sex of *Chelidonichthys spinosus*.

Age group	Number of fish	Total length	Mean length of annulus (mm)									
			OR	r1	r2	r3	r4	r5	r6	r7	r8	r9
1	0	-	-	-								
2	1	9.7	0.99	0.34	0.78							
3	10	15.88	1.03	0.31	0.68	0.85						
4	47	18.63	1.25	0.31	0.69	0.88	1.06					
5	141	21.87	1.41	0.31	0.71	0.87	1.04	1.22				
6	125	24.46	1.56	0.32	0.71	0.87	1.03	1.20	1.37			
7	46	28.18	1.71	0.32	0.76	0.93	1.08	1.22	1.35	1.50		
8	9	35.81	2.02	0.32	0.79	0.97	1.12	1.27	1.41	1.58	1.8	
9	3	37.22	2.22	0.35	0.76	0.96	1.07	1.20	1.42	1.57	1.7	1.96
Mean	382	23.96	1.52	0.32	0.73	0.90	1.06	1.22	1.38	1.55	1.75	1.96

Table 6. Mean back-calculated total length (cm) for each ring group of otolith for combined sex of *Chelidonichthys spinosus*.

Age group	Number of fish	Back-calculated total length (cm)								
		1	2	3	4	5	6	7	8	9
1	0	-								
2	1	0.76	9.46							
3	10	0.17	7.49	10.93						
4	47	0.17	7.68	11.44	15.00					
5	141	0.34	8.08	11.24	14.60	18.16				
6	125	0.37	8.08	11.24	14.41	17.72	21.13			
7	46	0.37	9.07	12.43	15.39	18.16	20.73	23.70		
8	9	0.37	9.66	13.22	16.19	19.15	21.92	25.28	29.63	
9	3	0.96	9.07	13.02	15.20	17.77	22.12	25.08	27.65	32.79
Mean	382	0.42	8.57	11.93	15.13	18.20	21.47	24.69	28.64	32.79

3-2-4. Growth parameter

The von Bertalanffy growth model was estimated from the back-calculation of mean otolith annulus at age of *C. spinosus* (Fig. 7, 8). The VBGF by Walford method for females and males were expressed in following way:

$$\text{Female: } L_t = 50.58(1 - e^{-0.12(t-0.77)})$$

$$\text{Male: } L_t = 59.15(1 - e^{-0.10(t-0.73)})$$

$$\text{Combined sex: } L_t = 55.39(1 - e^{-0.11(t-0.71)})$$

Growth performance Index (φ) was estimated from von Bertalanffy growth parameter. Females and males was estimated to be 2.50 and 2.54, respectively. Growth performance Index (φ) of combined sex was 2.52. This indicates the male grow faster than females.

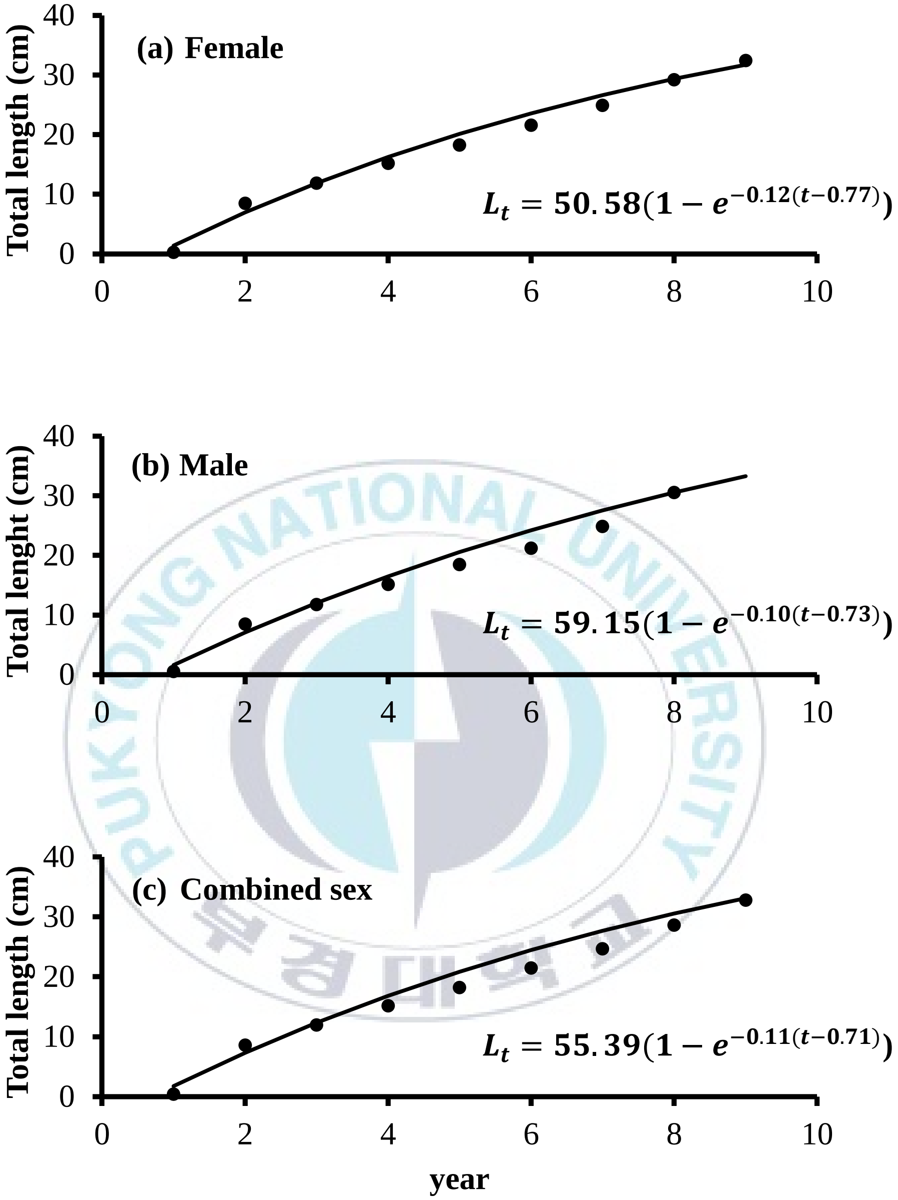

Figure 7. The VBGF of female (a) and males (b) and combined sex (c) of *Chelidonichthys spinosus* by Walford method.

4. Discussion

The Bluefin searobin, *Chelidonichthys spinosus* is distributed from East China Sea to the waters of Korea, Japan, Australia and New Zealand (Heath and Moreland, 1967; Yamada *et al*., 1986). This species is described as *Chelidonichthys kumu* or *C. spinosus* according to the taxonomist, and they are considered to be the same species because they coincide with each other in geographical distribution and taxonomic main features (Chyung, 1977; Matsubara, 1979; Jin, 1985; Shen, 1990; Yatou, 1985; Ochiai and Yatou, 1988; Shimada and Nakabo, 2002).

In this study, the proportion of female was higher than that of male. The similar tendency was observed in previous studies of triglid species (Ali and Pinar, 2004; Boudaya *et al*., 2008; Akin *et al*, 2010; Basusta *et al*., 2017). Spawning period of *C. spinosus* was estimated from February to March (spring). In case of *C. kumu* studied in New Zealand, spawning season was from spring to early summer (Clearwater and Pankhurst, 1994). *C. spinosus* is known to spawn in summer in the

Jeju Island of South Korea, whereas winter to spring in East China Sea (Li *et al*., 2010). Therefore, *C. spinosus* in the Geoje Island and East China Sea share the similar spawning period. The different spawning period observed in Geoje and Jeju Island is most likely due to water temperature differences (Pankhurst and Munday, 2011).

Total length of females and males ranged from 10.3 to 40.7 cm and from 9.3 to 35.4 cm, respectively. There was a significant difference. The similar tendency was observed in other triglid species (Staples, 1972; Baron, 1985; McPhail *et al*., 2001). Length at sexual maturity ($L_{50\%}$) of female was estimated to be 23.21 cm. In case of *C. kumu* in New Zealand, Lyon and Horn (2011) reported that length at sexual maturity of combined sex was 24 cm. The result of this study is consistent with the previous studies.

In this study, *C. spinosus* was estimated to eight class age with age 2 to 9. Similarly, *Lepidotrigla dieuzeidei* was observed from 3 to 11 years old (Basusta *et al*., 2016). *Chelidonichthys lucerna* was observed from 1 to 9 years old (Boudaya *et al*., 2008) and *C. kumu* has from 1 to 11 years old (Lyon and Horn, 2011). In contrast, *Prionotus carolinus* was observed from 1 to 6 years old (Mcbride, 2002). Therefore, *C. spinosus* is considered to have relatively longer lifespan than other triglid species.

The growth pattern between sexes is not significant different. The size of female is generally larger than male (Richard and Gordon 1987, Zhang 2010). However, asymptotic length (L_∞) of male was larger than female in the present study. This result is probably associated with collected sample; only one specimen of 8-year old male was observed, whereas eight were found in female. Since back-calculation is based on average length according to the age, this lack of sample might be affected the result. Asymptotic length (L_∞) of combined sex was 55.39 cm and Staples (1972) reported that L_∞ is 52 cm. The result of the present study and the previous studies were consistent.

Estimated *K* value for female and male of *C. spinosus* is 0.12 and 0.10, respectively. So grow rate of females was slightly faster than males. The asymptotic length (L_∞) or growth coefficient (*K*) value was not an indication to determine growth rate. Growth performance index using von Bertalanffy's growth parameters is used for comparing growth difference of triglid species (Table 7). In the present study, *C. spinosus*, when its length was zero, the theoretical age was 0.77 of female and 0.73 of male. Most of the other studies on triglid species had a negative age when the length was zero, but some triglid species had a positive age. *C. spinosus* showed the largest value after *C. capensis* reach at the maximum length. Also, the maximum length was very similar to that of *C. kumu*, which is considered to be the same species. As shown in table 7 presents, L_∞ and K values are inversely related and this tendency was also observed in this study. The growth performance index value of *C. spinosus* and *C. capensis* were relatively lower than that of other trigid species. Therefore, a small-sized triglid species grows fast, and has a short life span and reaches the maximum size early, whereas *C. spinosus* has a relatively slow growth and a long lifespan and reach the maximum size late.

Table 7. Comparison of growth parameter of triglid species.

Species	Parameters					Authors
	Sex	t_0	L_∞	K	φ	
Aspitrigla cuculus	Male	-0.08	37.1	0.52	2.85	Baron (1985)
	Female	-0.05	41.7	0.46	2.90	
Chelidonichthys capensis	Male	-2.52	75.49	0.08	2.66	McPhail *et al.* (2001)
	Female	-1.61	80.33	0.10	2.81	
Chelidonichthys kumu	All	-	52.0	0.41	3.04	Staples (1972)
Chelidonichthys queketti	Male	-0.24	29.7	0.50	2.64	Booth (1997)
	Female	-0.59	32.8	0.38	2.61	
Eutrigla gurnardus	Male	0.14	34.4	0.77	2.96	Baron (1985)
	Female	0.16	38.0	0.86	3.09	

Table 7. Continued.

Species	Parameters					Authors
	Sex	t_0	L_∞	K	Φ	
Chelidonichthys lucerna	Male	-0.41	48.4	0.46	3.03	Baron (1985)
	Female	-0.46	66.8	0.32	3.15	
Chelidonichthys lastoviza	Male	0.15	36.9	0.65	2.95	Baron (1985)
	Female	0.04	39.5	0.58	2.96	
Chelidonichthys spinosus	All	0.71	55.39	0.11	2.52	This study
	Male	0.73	59.15	0.10	2.54	
	Female	0.77	50.58	0.12	2.50	

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