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Reproductive Biology of Oci Fish *Selaroides leptolepis* in Tomini Bay

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ABSTRACT: *Local people name Selaroides leptolepis distributed in Tomini Bay as Oci Fish. A study of the fish reproductive biology, which is one aspect of fisheries biology, is crucial to support the implementation of sustainable Oci Fish resource management policies. This study aims to determine the average length at first maturity, gonad maturity stages, and fecundity of the fish in Tomini Bay. Sampling was carried out using a stratified random sampling method from the catches of the fishermen landed in Fish Landing Base Kampung Tenda, Gorontalo City. The time interval sampling was conducted per month during April, May, and June 2020. Fish and egg samples preserved using ice cubes and a 10% formaldehyde solution correspondingly. The results of the study showed that the Oci Fish in Tomini Bay had a length range of the first maturity between 166 and 174 mm with a gonad maturity index ranging from 1.773 to 2.760%. The average fish fecundity was 16623 ± 4850 eggs.*

Keywords: *fisheries biology, gonadosomatic index, Selaroides leptolepis, Tomini*

INTRODUCTION

The semi-enclosed area makes Tomini Bay as the nutrient-rich waters supporting aquatic organism life. Tomini Bay functions as a spawning, nurturing, and catching area for numerous types of fishery resources (Wagiyo *et al*., 2019). Administratively, the bay is located in the south of the Gorontalo Area. Therefore, Gorontalo fishers depend on the catch from the bay (Nento *et al*., 2014; Mardijah & Rahmat, 2016; Asruddin & Hasan, 2019; Adam *et al*., 2020). Tomini Bay is part of the territory of the Republic of Indonesia Fisheries Management/Wilayah Pengelolaan Perikanan Negara Republik Indonesia (WPPNRI) 715 (Rahmat & Witdiarso, 2017). Suwarso *et al*. (2017) mentioned that fish resources in this region are open access and likely to be shared stocks with several countries.

Oci, as one of the Tomini Bay fish resources, is a local terminology used by the Gorontalo community to a fish that is relatively little in shape with elongated flat bodies, has small scales, and a yellowish color from anterior to posterior alongside the body. In several publications, Oci is known as Selar fish (Baskoro *et al*., 2020; Imbir *et al*., 2019; Sahara *et al*., 2020). The small pelagic fish that has the scientific name as *Selaroides leptolepis* is also named as the yellowstrip scad. (Fawzya *et al.*, 2020; Fuad *et al*., 2020; Hussin *et al.*, 2019; Jaafar *et al*., 2020; Desrita *et al.*, 2020). Oci is categorized as an essential commodity for local society due to its high market demand. Gorontalo fishermen informed that the price of the fish is ranging from 15,000 to 30,000 IDR per kg.

Not only has an economic value, but Oci fish also plays a role in the aquatic ecosystem balance. Oci fish eats phytoplankton, zooplankton, and small crustaceans (Sriyati *et al*., 2018), and in the next trophic level, the fish fall prey to other predators. *S. leptolepis* are a group of carnivorous fish which can be seen from the Prefonderance Index value which consumes Copepoda (Anugerah *et al*., 2019)

Hatta & Mulyani (2019) stated that excessive low-level trophic fishing could be detrimental as it may reduce the carrying capacity of large pelagic fish with higher economic value. Gorontalo fishers conduct Oci fishing in Tomini Bay to fulfill the market demand. Ecologically, resource exploitation without considering aspects of sustainability and conservation will threaten the sustainability of the fish in nature. If there are inappropriate management measures implemented,

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the worst possibility that would occur in the future is the decrease of catches. Conversely, the fishing under an optimal condition would bring the potential to support the implementation of a strategy to improve the welfare of fishing communities. Nationally, the potential of small pelagic fish has not been used optimally. However, in other waters, the resources were overexploited (Khatami *et al*., 2019).

The potential of fisheries in the Tomini Bay region can contribute to regional development and community welfare if managed in an integrated and sustainable way based on data and comprehensive scientific studies. Previous studies of aspects of Oci fishing and other small pelagic fish in Tomini Bay have been carried out (Rahmat & Witdiarso, 2017; Asruddin *et al*., 2019; Madjowa *et al*., 2020). However, reproductive biology information has not been available. Reproductive biology study is one aspect of fisheries biology needed by stakeholders to support the application of sustainable fish resources management policies. This study aims to determine the gonadal maturity stages (GMS), the size of the first gonad mature fish, gonadosomatic index (GSI), and the fecundity of Oci *S. leptolepis* in Tomini Bay.

MATERIALS AND METHODS

Sampling was done through collecting Oci fish landed at the Fish Landing Base (PPI) Kampung Tenda, Gorontalo City, by fishermen who do fishing in the Tomini Bay area (Figure 1). Fish samples were taken using a stratified random sampling method from the fishermen catch landed at the PPI. Sampling time intervals were per month during April, May, and June 2020. Fish samples and the eggs were preserved with ice cubes. Samples were analyzed in the Laboratory of Fisheries and Marine Science, Gorontalo State University.

The total length and the weight of samples were measured using a ruler and a digital scale, respectively. Furthermore, determining the sex and maturity level of the gonads was performed visually after the sample was dissected. Gonads were weighed using a digital scale (accuracy = 0.001 gram) prior to preserving samples in a 10% formaldehyde solution. A magnifying glass was used to provide a more accurate calculation of fecundity.

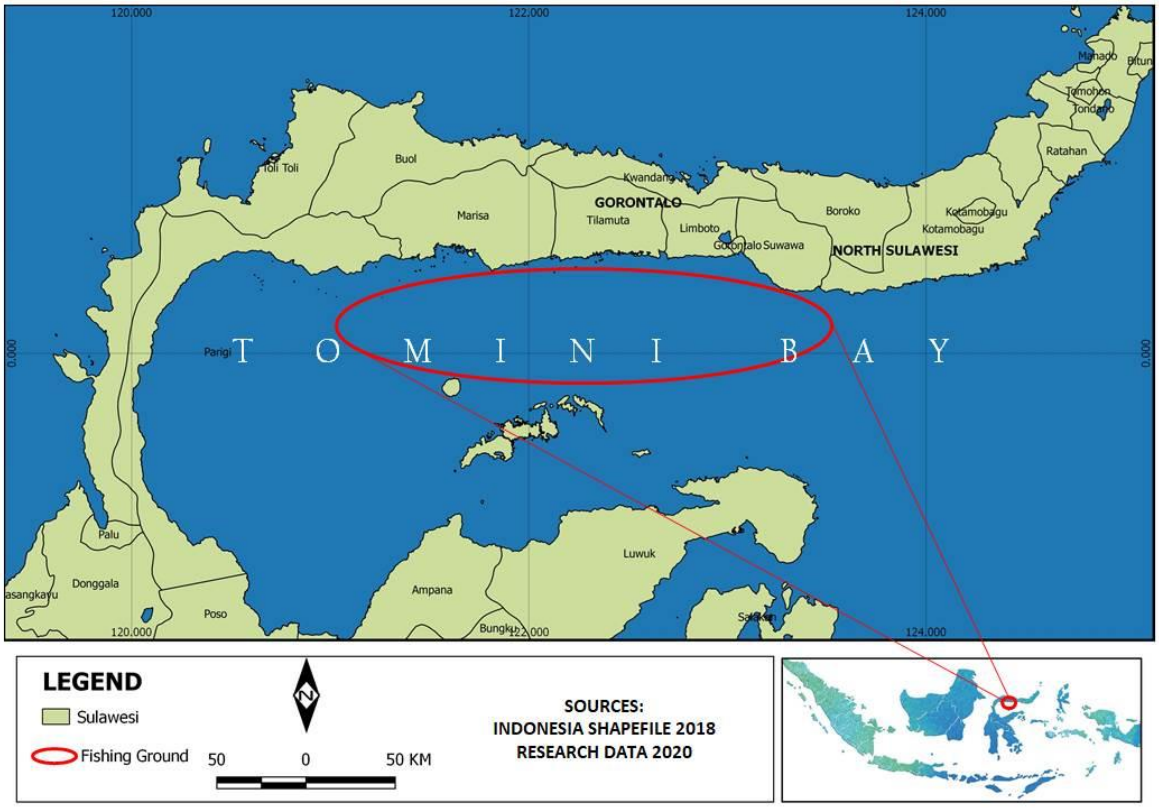

Figure 1. Oci *Selaroides leptolepis* fishing ground by Gorontalo fishers in Tomini Bay

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The data obtained include the total length and weight of fish, sex, gonadal maturity stages, gonad weight, and the number of eggs. Data were analyzed descriptively for providing information on gonadal maturity stages, the size at first gonad maturity, the gonadosomatic Index, and fecundity of the fish.

Gonadal Maturity Stages (GMS)

Analysis of Gonad Maturity Stages (GMS) of fish refers to modification method by Cassie (1954) *in* Effendie (1997) with the detail description in Table 1 below:

Tabel 1. Determination of Fish Stages of Gonadal Development (Cassie 1954 *in* Effendie 1997)

GMS	Female	Male
Stage I	The ovary is like a thread, extending to the front of the body, smooth surface	Testes are threadlike, apparent in color, and the edges are visible in the body cavity
Stage II	Larger ovaries, yellowish in color, and the eggs are not yet clearly visible	Larger testes, milk-colored
Stage III	Ovaries are yellow; morphologically the eggs begin to appear	The surface of the testes appears jagged, the color is whiter than the previous level, and the size is getting bigger.
Stage IV	Ovaries are getting bigger; the eggs are yellow, easily separated. Oil grain is not visible, filling the body cavity of 1/2 to 2/3	The testes easily broken in preserved conditions and increasingly solid
Stage V	Crimped ovaries, thick walls, leftover eggs near the release area	The back of the testes is deflated while in the near release area it still contains

Mean size at first maturity in the population.

Length at first maturity gonad (m) was predicted using the Spearman - Karber formula (Udupe, 1986) as follow:

$$m = \left(X_k + \frac{X}{2}\right) - (X \sum p_i)$$

with the length range is estimated as:

$$CL = \text{antilog}\,(m \pm 1.96\sqrt{(\text{var}\,(m))}$$

Where: m = length size at first gonad maturity; X_k = logarithm size at which 100% of fish are fully mature; X = logarithm of size increment; $p_i = \frac{r_i}{n_i}$ = proportion of mature fish for each size group; r_i = frequency of mature gonad on fish length class-i; n_i = the number of fish samples on length class-i

Gonadosomatic Index (GSI)

The fish gonadosomatic index (GSI) was calculated using the following formula (Effendie, 1997):

$$GSI = \frac{Bg}{Bi} \times 100\%$$

Where: GSI = Gonadosomatic Index (%); Bg = gonad weight (gram); Bi = fish weight (gram)

Fecundity

Fecundity was performed on female Oci fish samples, which were in TKG III and TKG IV. The number of eggs was calculated using a combined gravimetric and volumetric method by Effendie (1997) as follow:

$$F = \frac{G \times V \times X}{Q}$$

Where: F = fecundity (eggs); G = gonad weight (gram); V = dilution volume (10 ml); X = number of eggs per ml; Q = sample eggs weight (gram)

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RESULTS AND DISCUSSION

Gonad Maturity Stage (GMS) is an essential aspect in the study of fish reproductive biology. GMS is the stage of gonad development before and after spawning. As the gonad's maturity increases, the fish eggs and sperm develop. Gonadal weight of the fish will reach its maximum shortly after the fish will spawn then will decrease rapidly during the spawning process that lasts to completion. Ma'ruf *et al.* (2019) stated that during the process, most of the metabolic output would be directed towards the development of the gonads. The recording of the gonad maturity stage is needed to know when fish from specific populations spawn. Gonadal fish development varies significantly among species. Likewise, the populations of the same fish species that inhabit waters with diverse conditions and geographical locations might have different GMS.

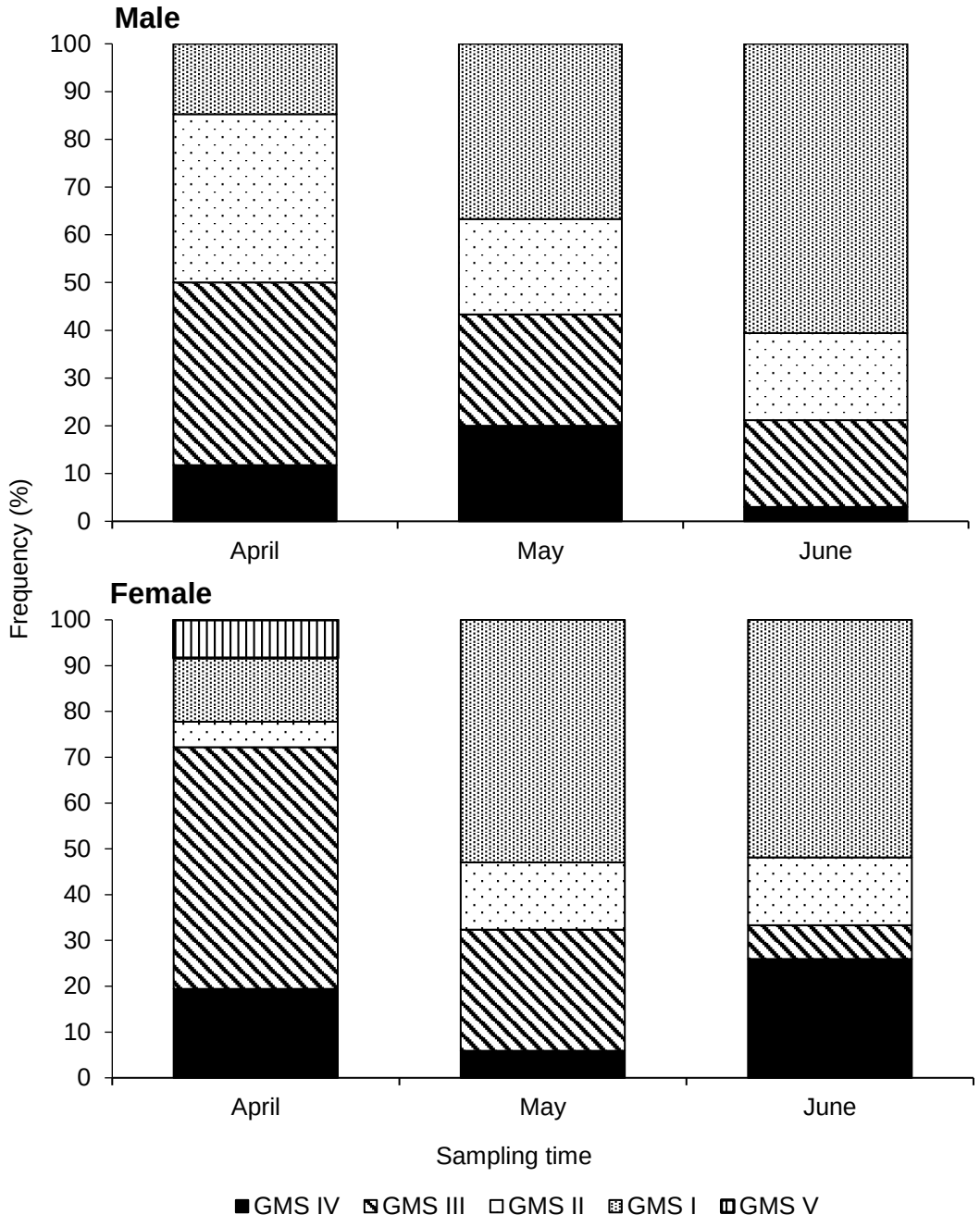

Figure 3. Gonad Maturity Stage (GMS) of Oci *Selaropides leptolepis* in Tomini Bay during April, May, and June 2020

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The results of this study indicate that the percentage of male and female GMS from the three months observation has a similar distribution pattern. In April, it was dominated by fish in GMS III by 53% (female) and 38% (male). In May, it was dominated by fish in GMS I by 53% (female) and 37% (male). In June, it was dominated by GMS by 52% (female) and 61% (male) (Figure 3). Overall, male and female Oci *S. leptolepis* were mostly in the GMS III and IV in April. This is a signal that April is the Oci spawning season in Tomini Bay. In Sungailiat, around the waters of the Karimata Strait area, Sriyanti *et al.* (2017) informed that *S. leptolepis* dominating TKG III and IV were found in April and May. Although a slightly different TKG distribution pattern was shown, this is common for pelagic fish. As cited from Roy *et al*. (1992), that in some areas, the spawning season of pelagic fish coincides with the upwelling season, but in other areas spawning and upwelling are out of phase.

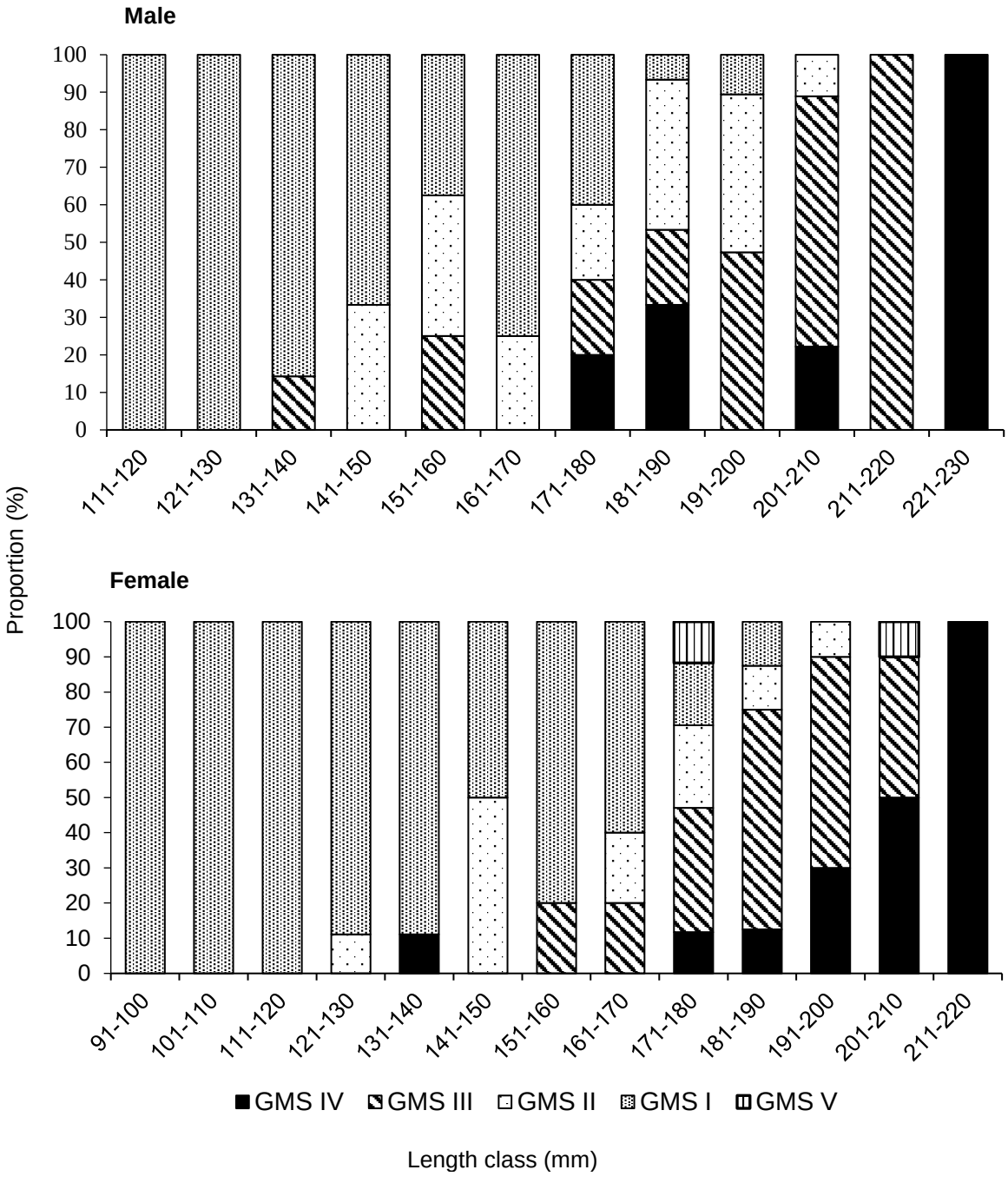

Figure 4. The proportion of Gonad Maturity Stages (GMS) of Oci *Selaropides leptolepis* in Tomini Bay based on length body during sampling periods

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Gonadal development is increasingly visible along with the growth of fish body length (Figure 4). Based on the length range, males begin to develop gonads at a size of 131-240 mm, while this occurs in females at 121-130 mm. Both sexes of fish are in full GMS IV at different lengths, where 221-230 mm for males and 211-220 mm for females.

Length at first maturity

The results show that the average size of the first gonad maturity of Oci fish is 173 mm and 167 mm for male and female fish, respectively. The size of a mature female Oci is smaller than the male. It indicates that female Oci matures faster than the male. Dissimilar results revealed by Ibrahim *et al.* (2016) in the Sunda Strait waters that male and female of *S. leptolepis* first matured gonads at a length of 105.5 mm. Sinaga *et al.* (2018) reported that the size of the first mature male and female gonads of *S. leptolepis* in Manado Bay was 189 mm in length. The various size of mature fish from different areas can predict of exploitation level and the existence of the resources in the area as a form of a growth and reproduction strategy. The smaller the fish length of the first time mature relative to the same species found in a particular location, the higher the level of threat faced by fish in the waters.

Gonadosomatic Index

Gonadosomatic Index (GSI) is a quantitative index that shows a condition of fish sexual maturity. In general, the longer the body, the higher the gonad index value. It shows that a more mature ovary has higher weight and size, including the addition of egg size. In April, the highest average GSI values were found for males and females and then declined in the following two months (Figure 5). This pattern further strengthens the suspicion that the Oci spawning season in Tomini Bay takes place in April.

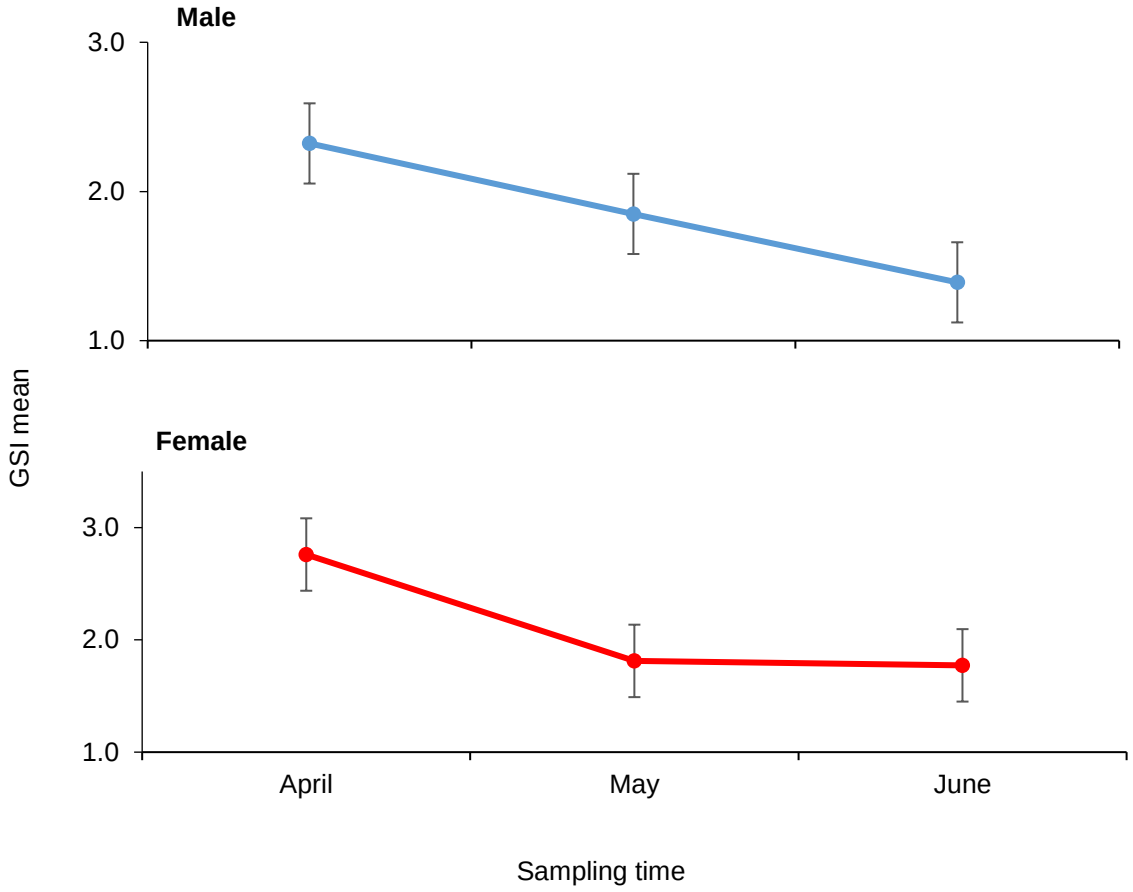

Figure 5. GSI mean of Oci *Selaroides leptolepis* in Tomini Bay during April, May, and June 2020

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Table 2.. Fecundity of *Selaroides leptolepis* in Tomini Bay during April, May, and June 2020

No	Month	Length (mm)	Weight (g)	Fecundity (eggs)
1		180	74.30	7747
2		180	84.92	22902
3		180	96.38	12574
4		185	106.00	13769
5		190	86.20	12557
6		190	95.86	13106
7		194	91.86	14541
8		195	107.90	17169
9		195	102.98	9005
10		195	97.80	16188
11		195	96.38	16409
12		195	83.20	16956
13	April	200	115.00	17053
14		200	103.00	14925
15		200	102.00	15703
16		200	101.00	13841
17		200	106.86	16805
18		200	111.86	19261
19		200	105.04	20245
20		200	105.58	19410
21		200	113.84	15901
22		203	90.60	15135
23		205	121.00	16782
24		205	110.14	19507
25		210	109.00	12535
		160	45.15	21409
2		163	49.48	8106
3		175	73.95	9211
4		177	62.79	12126
5	May	179	69.35	9792
6		182	72.98	15460
7		197	97.03	19531
8		199	96.94	16103
9		202	104.65	18540
10		207	105.81	27629
1		132	14.03	25391
2		164	57.34	15210
3		180	76.28	20746
4		180	74.49	19617
5	June	185	75.89	25009
6		201	105.75	8837
7		203	119.08	24225
8		205	113.17	21324
9		211	134.73	23077

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Fecundity

Fecundity is the number of eggs in a female fish before it is released when it will spawn. Therefore, the calculation of the number of eggs was only prepared on fish that are in TKG III and IV. In each sampling period, the fecundity in April, May, and June were 15601 ± 3390, 15791 ± 6194, and 20382 ± 5364, respectively. In total, the range of Oci fish fecundity was 7747 - 27629 eggs (Table 2). Sinaga *et al.* (2018) reported that the average fecundity of *S. leptolepis* fish caught in the waters of Manado Bay during April and May 2018 was 11716 ± 6088 eggs. Fecundity has a relationship with age, length, or weight of individuals and fish species (Effendie, 1997). Therefore, differences in the number of eggs among the different months and locations are reasonable. Fecundity is also generally associated with egg diameter distribution to predict fish pattern spawning. *S. leptolepis* is a species that has a partial spawning pattern (Ibrahim *et al.*, 2016; Hestiana *et al*., 2019).

CONCLUSION

Based on research during April, May, and June 2020, it can be concluded that the Oci *Selaroides leptolepis* Fish in Tomini Bay first time mature was 173 and 167 mm at length for male and female correspondingly. The gonadosomatic index ranges between 1,773 and 2,760%, with the highest percentage index occurring in April. The range of fish fecundity is approximate of 11716 ± 6088 eggs.

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