The gonad maturity level of Tor Fish (Tor spp.) in upstream Wampu Watershed Langkat Regency of North Sumatera

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Abstract. The aim of this research is to observe the maturity level of gonad, the size of fish first-time ripe gonad, sex ratio and gonad maturity index of Tor Fish (Tor spp.) in Upstream Wampu Watershed. Sampling was conducted for three months, from July to September 2017. The development of gonad maturity was observed morphologically. GMI was analysed based on a comparison between gonad weight and body weight of Tor Fish (Tor spp.). The caught fish consists of two species: Gemo Fish (Tor soro) and Jurung Fish (Tor tambroides). The gonad maturity level of Tor soro male was obtained from levels I, II, III, and IV and Tor soro females obtained from levels I, II and IV. The gonad maturity level of Tor tambroides male was GML I, II and II and Tor tambroides female obtained GML I and II. GMI Tor soro males ranged from 0.01% - 4.66%, while GMI Tor soro female 0.04% -5.68%. GMI Tor tambroides male 0.05% - 1.25%, while GMI Tor tambroides females ranged from 0.02% -0.88%.

1. Introduction
Genus of Tor Fish is a local freshwater fish Indonesia whose existence is threatened with extinction. Based on the Endangered Red List issued by the IUCN in 1990, 29 species of fish from Indonesia, including all the Genus Tor. IUCN issues in 2012 listed 12 species of fish Genus Tor is endangered, including Tor tambroides and Tor tambra from Indonesia. In Indonesia, there are four types genus of Tor Fish that is Tor tambroides Blkr, Tor douronensis (CV), Tor tambra (CV) and Tor soro (CV). Experts previously named Labeobarbus and distinguished the type based on the size of the lips on the lower lip. Taxonomically and systematically the fish species of the Genus Tor are unclear [1].

Tor fish (Tor spp.) is a genuine local species that is hunted for its high price [2]. In general, the natural population condition of Tor family of fish species has decreased due to overfishing and habitat destruction, while domestication effort has not been done. In accordance with the nature of natural resources will experience a decrease in efficiency if the environmental impact caused by human activities, the decline in the use of water quality in the form of physical, chemical, and biological impact on the presence of fish [3].

Therefore, it is necessary to manage the Tor fish to ensure the existence and survival of this fish population. Efforts to optimize fish catch, utilization and preservation of Tor need information on reproduction aspects of Tor Fish. Therefore, reproduction is one of the links in preserving a species. The
reproduction aspect of Tor fish (Tor spp.) Consists of GML, GMI, sex ratio, and the first size time of matured gonad of fish.

2. Materials and methods

2.1. Time and site
This research was conducted for three months i.e. July-September 2017 in Upstream Wampu Watershed. The research was conducted in two upstream creeks of Wampu namely Bahorok River and River Berkail. Fish sampling was done 3 times in 3 months with a sampling interval of 1 month (4 weeks), fish caught by Backpack Electrofishing Units (BEU).

2.2. Research procedures
Sampling in each station captured by a backpack of electrofishing units where the resulting electric current is sourced from 12 volt and 9-ampere batteries. This tool is very effective for shallow water such as rivers and creeks. The method used is multiple-pass depletion or removal methods based on Ziranpin technique (1958) in [4]. Operation of electrofishing by following the zig-zag flow along both banks of the creek. Electrofishing operators will move in opposite directions with river currents (moving upstream), assisted by one or two net mesh carriers with 2-inch mesh size to help move the unconscious fish to a plastic container filled with water.

The total length of the fish is measured from the leading edge of the head to the tip of the rear tail fin by using a ruler. The weight of the fish is weighed using scales. Fish samples obtained were dissected directly in the field using a scalpel. Surgery starts from the anus to the top of the abdomen below the lateral linear line to the back of the opercula then towards the centre to the abdominal base. The weight of the gonads is weighed using an analytical scale. Determination of Gonad Maturity Index (GMI) was obtained by comparing the weight of gonads with body weight and the results obtained in percent (%).

2.3. Data analysis
The Gonad Maturity Index was measured by comparing body weight with gonad weight of the fish [5]:

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\text{GMI} \% = \frac{Gw}{Fw} \times 100
\]

Where :
GMI : Gonad maturity index (%)
Gw : Weight (gram)
Fw : Fish weight (gram)

3. Results and discussion
The number species of Tor Fish (Tor spp.) caught in Upstream of Wampu Watershed consists of 2 (two) species namely Tor soro and Tor tambroides. This is also in accordance with [2] about the structure of the nekton community in the Wampu Watershed that found two species of Tor fish namely T. soro, and T. Tambroides and 1 species of eel (Anguilla sp.).

3.1. The sex ratio of Tor Fish (Tor spp.)
Fish caught during the study consisted of two species: Gemo (Tor soro) and Jurung (Tor tambroides). The number of Tor soro fish caught in the Bahorok River is 47 fish consisting of 25 male fish and 22 female fish with the sex ratio 1.14, while Tor tambroides are caught by 6 tails consisting of 5 male fish and 1 female fish with a sex ratio of 5.0. Tor soro fish caught in the Berkail River more with 83 fish, consisting of 49 male fish and 34 female fish with sex ratio 1.44 and Tor tambroides fish are 17 fish consisting of 6 male fish and 11 female fish with sex ratio 0.55. Fish sex ratio Tor fish (Tor spp.) are shown in Table 1.
Table 1. Sex ratio fish Tor (*Tor* spp.) in The Upstream Wampu Watershed

| River name    | Species name  | Frequency | Sex ratio (M/F) |
|---------------|---------------|-----------|-----------------|
|               |               | Male      | Female          |                 |
| Bahorok river | *Tor soro*    | 25        | 22              | 1.14            |
|               | *Tor tambroides* | 5        | 1               | 5               |
| Berkail river | *Tor soro*    | 49        | 34              | 1.44            |
|               | *Tor tambroides* | 6        | 11              | 0.55            |

Sex ratio Tor males and female fish in the Bahorok and Berkail Rivers are 1.14:1 and 1.44:1. While the male sex ratio of male and male *Tor tambroides* in the Bahorok and Berkail Rivers is 5:1 and 1:1.83. According to [6], the differences in the number of female and male fish caught are related to the behaviour patterns of fish migration (for spawning and foraging), differences in growth patterns, different mortality rates, and age difference of mature gonads. The sex ratio of Tor fish and other freshwater fish species is constantly changing depending on the population and conditions of the existing waters. Thus, the information on the sex ratio above may change depending on the situation in the waters themselves [7].

Overall, looking at the sex ratio of samples from July to September, the male and females of *Tor soro* and *Tor tambroides* are close to the 1:1 predicted spawning season occurring at this interval or earlier. From the observations made in the field by [8], Batak Fish (*Tor soro*) is estimated to spawn from January to February. According [9], alleged spawning period Jurung fish does not occur at the beginning of the rainy season but more backward. This is in accordance with the information of locals who say that this type of fish does spawning in mid to late rainy season between January to March.

3.2. Gonad maturity level of Tor Fish (*Tor* spp.)

Observation of macroscopic gonadal maturity level is different in male and female fish. In male fish are used signs such as testes, large testes and colour testes, whereas in female fish is based on the ovary shape, the size of the ovary, the colour of the ovary, the smoothness of the ovary surface and the size of the egg in the ovary [5]. The maturity level of the gonads was determined using the classification of gonad maturity based on [10]. The macroscopic characteristics of male and female gonads of *Tor soro* and *Tor tambroides* are presented in Table 2.

Table 2. Gonad maturity level of Tor Fish (*Tor* spp.) morphology

| GML | Male                                                                 | Female                                                                 |
|-----|----------------------------------------------------------------------|-----------------------------------------------------------------------|
| NFY | No gonads have been found yet                                        | No gonads have been found yet                                         |
| I   | Small testes are not as long as the abdominal cavity, shaped like a  | Ovary along the abdominal cavity, shape like yarn, colorless, smooth,  |
|     | fine, transparent thread                                              | egg granules not yet seen                                              |
|     | Testes 1/2 of the abdominal cavity, ribbon-shaped with a width of a  | Ovary along the abdominal cavity, yarn form rather thick, clear color, |
|     | ½ abdominal cavity, reddish-white, flat texture, slippery and soft    | smooth texture, slippery and soft                                       |
|     | Testes meet 2/3 of the abdominal cavity, 1/3 width testes tape,      | Its shape is a cylinder, till to 1/3 of the abdominal cavity, the      |
|     | milk-white erogen, ½ abdominal width, dense texture of wavy          | ovaries are yellow, shaped bumps but flat, the ovaries appear with    |
|     | Testes 5/6 to full in the abdominal cavity, opaque white, the tape    | the naked eye, the shape is real, yellow, not yet free                  |
|     | is ½ times the width of the testes, the texture is dense, flat and    | Ovary 2/3 to the full in the abdominal cavity, the ovary is dark       |
|     | slippery, sperm fluid comes out                                       | yellow, the real shape, the yellow old, large, the egg is free        |

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Histologically, GML I testes founded spermatogonia with much connective tissue. The GML II began to form a tubular sac seminiferous filled by primary spermatogonia. The GML III, seminiferous tubular sacs begin to enlarge and primary spermatocytes become secondary spermatocytes. The GML IV there are spermatocytes that have developed into spermatids and have spread, also have formed spermatozoa ready to fertilized (Figures 1 and 2).

Figure 1. Histological structure of testes gemo fish (Tor soro) at various levels of gonad maturity. Information: s (spermatocytes), st (spermatid), sz (spermatozoa)

Figure 2. Histological structure of testes Jurung Fish (Tor tambroides) at various levels of gonad maturity. Information: s (spermatocytes), sg (spermatogonium)

The histologic ovaries (Figures 3 and 4) of GML I gonad are dominated by oogonia and a few oocytes. GML II eggs are getting bigger, dominated by oocytes and more and more nucleus. While at GML III, formed ootid, egg's diameter is greater, eggs yolks and oil granules have started to form. At GML IV ootid developed into an ovum, the number of eggs yolks and oil grains more and more.

Figure 3. Histological structure of ovarium gemo fish (Tor soro) at various levels of gonad maturity. Information: og (oogonium), os (oocyte), ov (ovum), ot (ootid)
The research that has been done is known that based on the caught in the Bahorok River the amount of *Tor soro* fish with GML I is 6, GML II is 22, GML III that is 5 and GML IV 14. Sum of *Tor tambroides* with GML I is 1, GML II is 4, GML III that is 1 and 0 for fish GML IV. The amount of caught of Tor fish (*Tor spp.*) based on gonad maturity level can be seen in figure 5.

**Figure 5.** (a) Gonad maturity rate of *Tor soro* fish based on observation month in Bahorok River (b) Gonad maturity rate of *Tor tambroides* fish based on observation month in the Bahorok River

Based on the fish caught on the Berkail River, amount of *Tor soro* fish with GML I is 51, GML II 15, GML III that is 7 and GML IV of 10. Sum of *Tor tambroides* with GML I is 12, GML II is 5, GML III and GML IV amount 0. The number caught of Tor fish (*Tor spp.*) based on Gonad Maturity Level can be seen in Figure 6.

**Figure 6.** (a) Gonad maturity rate of *Tor soro* fish based on observation month in Berkail River (b) Gonad maturity rate of *Tor tambroides* fish based on observation month in Berkail River

### 3.3. Gonad maturity index of Tor Fish (*Tor spp.*)

Based on research conducted in the Bahorok River, the highest GMI on *Tor soro* male and female contained in September with the average GMI value of male and female in a row is 2.31% and 0.92%
and the lowest GMI in August was 0% in the lowest male and female GMI in July with the average GMI value being 0.78%. The highest average GMI of *Tor tambroides* male was found in August with an average GMI value of 1.25% and the highest mean female GMI was September with an average GMI value of 0.02%. While the lowest average male GMI was in September was 0% and the average GMI females were in July and August was 0%. GMI of *Tor soro* and *Tor tambroides* fish can be seen in figure 7.

Figure 7. (a) Gonad maturity index of *Tor soro* fish based on observation month in Bahorok River (b) Gonad maturity index of *Tor tambroides* fish based on observation month in Bahorok River

Based on the research that has been done in the Berkail River, the highest GMI in *Tor soro* male and female was in September with the mean GMI values of males and females respectively 0.39% and 0.08%. The highest GMI of *Tor tambroides* male and females were highest in August with the mean value of it were 0.35% and 0.29%. While the lowest average male and female GMI present in July is 0%. GMI *Tor soro* and *Tor tambroides* fish based on observation month can be seen in Figure 8.

Figure 8. (a) Gonad maturity index of *Tor soro* fish based on observation month in Berkail River (b) Gonad maturity index of *Tor tambroides* fish based on observation month in the Berkail River

The GMI value obtained during the study is smaller than <20%, this is in accordance with [11] stating that fish that have a GMI value smaller than 20% are groups of fish that can spawn more than once each year. This indicates that Tor Fish (*Tor* spp.) is a group of fish with small GMI value, so it is categorized as a fish that can spawn more than once each year.

3.4. The first-time size of matured gonad of Tor Fish (*Tor* spp.)

Determination of the first size time of ripe gonad using Sperman Karber method [12]. Mature gonad criteria at GML III, IV, and V using the first-size time mature gonads of *Tor soro* and *Tor tambroides*, can be seen from the total length relationship with adequate maturity levels of III and IV gonads. In the Bahorok River, the first-size mature gonad of *Tor soro* male Fish is 99.383-203.899 mm and the female is ± 359.56 mm. The first-time size of mature gonad of *Tor soro* fish caught in the Berkail River is 75.540-150.088 mm in male fish and 56.878-1423.903 mm in female fish.
The first size time of gonad of *Tor soro* fish in the Bahorok and Berkail Rivers is different although one species. The difference size first ripe gonad in the Bahorok and Berkail Rivers is influenced by internal factors such as size, an age of fish and physiological properties of fish. In addition, the first size of mature gonads is also influenced by external factors, namely differences in the spread and availability of food. This is in accordance with [6] which states that the factors that affect the first time the fish reach mature gonads are species, age, size, and physiological properties of the fish. Every species of fish and even in the same species do not have the initial similarity of the gonad, this can be due to differences in the area of distribution and the number of foods. According to [6] states that the size of the first fish matured gonads is not the same for each species. Similarly, fish of the same species, if spread over different latitudes of more than five degrees, will experience the size difference and the age of first ripe gonads.

4. Conclusions
The sex ratio of *Tor soro* is unbalanced, while in *Tor tambroides* fish is in the balanced condition. The maturity level of gonad obtained on *Tor soro* male fish is GML I, II, III, IV and *Tor soro* female GML I, II, and IV. The maturity levels of gonads obtained on male *Tor tambroides* male was GML I, II, III, and *Tor tambroides* female GML I and II. The size of the first mature gonad *Tor soro* male fish is bigger than *Tor soro* female.

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