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Growth and mortality of tor fish (*Tor soro* valenciennes 1842) in asahan river

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Abstract

This study aims to determine the growth and mortality of tor fish in the River Asahan. The study was conducted for 4 months from December 2016 to March 2017 in the Asahan River which still includes headwaters areas; Administratively into the territory of North Sumatra Province. Fish sampling using fishing gear in the form of a length of three meters, gill net with three mesh (¾, 1.5 and 2 inch) with length of 20 m and width of 2 meters, and electrofishing. The study included field activities (sampling of fish) followed by sample measurements. Total mortality rate (Z) of Tor fish 4.09 per year with natural mortality rate (M) 0.66; The mortality rate due to catch (F) 3.43, so that the rate of exploitation is 0.84. The rate of exploitation of the Tor fish in the Asahan River exceeds the optimum exploitation rate value of 0.5.

Keywords: growth, mortality, torfish, asahan river

Introduction

Tor fish is included in the family Cyprinidae. Kottelat *et al.* (1993), said there are four species of the Tor genus in Indonesia. Fishbase (2008), noted the four species, among them Mahseer (*Tor soro Valenciennes* 1842) with local name is Tor soro, and kancra bodas, Mahsir Javsky (*T. tambra Valenciennes* 1842) with local name is Sibaro, Semah Mahseer (*T. douronensis Valenciennes* 1842) with the local name is Kancera, Thai Mahseer (*T. tambroides Bleeker* 1854) with the local name is Sengkareng and Garing. This study focused on Tor soro fish as a research study. Characteristics of Tor soro fish than other Tor genus can be known visually. Haryono and Tjakrawidjaja (2005), distinguish through the existence of two lobes in the lower lip of the fish's mouth. Other differentiators are known based on the size of the lower anal fin rather than the dorsal fin and there is a shiny silver color on the back.

The spread of Tor fish in Indonesia can be found in Sumatra, Kalimantan, and Java (Haryono 2006). Tor fish can be found in rivers or public waters with rock subtrates. This is because the Tor fish can grow well in water conditions with the type of rocky substrate, clear, high oxygen needs, and flow from medium to fast (Nontji 1992; Conway and Kottelat 2011; Wibowo 2012). The existence of Tor fish can also be found in Ciliwung River Bogor and ponds in Kuningan, West Java. The existence of Tor fish in nature is increasingly threatened, including high utilization intensity, unsustainable fishing, anthropogenic activities, and land conversion (Ali *et al.*, 2013). Threats received by Tor fish in Ciliwung river are ecologically damaged such as critical land, high fluctuation of debit, deforestation, and land reclamation (Utomo and Krismono 2006; Sikder *et al.* 2012; KLH 2014).

The potential of Tor fish resources in the Asahan River is not widely known. One type of Tor fish found in the river Asahan and is an important economic consumption fish is the Tor soro fish. Based on interviews with some fishermen, there is an indication of Tor fish population decreasing. This is indicated by the decreasing of catch. Meanwhile, information on the biological and ecological aspects of Tor fish still limited even more to the population found in the headwaters area of the Asahan River. In order to formulate the appropriate management strategy of Tor fish resources for sustainable use, it is necessary to have enough basic data including biological and ecological aspects in their natural habitat. One of the important data that needs to be known as input for fishery regulation and management of resource potency is population dynamics aspect, including catching rate parameter and mortality parameter (Gulland 1983). This study aims to determine the growth and mortality of tor fish in the River Asahan.

Methods

The study was conducted for 4 months from December 2016 to March 2017 in the Asahan River which still includes headwaters areas; Administratively into the territory of North Sumatra Province. Fish sampling using fishing gear in the form of a length of three meters, gill net with three mesh (¾, 1.5 and 2 inch) with length of 20 m and width of 2 meters, and electrofishing. The study included field activities (sampling of fish) followed by sample measurements.

The Ford-Walford plot is one of the simplest methods of predicting the growth parameters $L\infty$ and K of the von Bertalanffy equation with the same sampling time interval (King 1995). Determination of total mortality by using the K/Z technique and its modivication was developed by Beverton and Holt (1957). Z (total mortality), K (growth coefficient von Bertalanffy).

Results and discussion

Correlation Between Length and Fish Weight

The equation model of the total length (L) and weight (W) correlation of Tor fish (Tor Soro) male and female is $W = 5x10^{-06}L^{3.152}$ and $W = 7x10^{-06} L^{3.176}$ respectively. For the whole male and female we get $W = 6x10^{-06} L^{3.149}$ (Fig 1). The result of statistical analysis of the correlation between total length and body weight of Tor fish (Tor soro) for each sex has a correlation coefficient (r) which is one, 0.98 for male fish and 0.96 for female fish. The value of this coefficient indicates that the length of the fish is followed by the increase of body weight. The value of fish b for female fish (3.176) is greater than b value of male fish (3.152). The growth pattern of male and female fish is allometric positive (b> 3), that is, the increase of length is not as fast as the increase of fish weight. The magnitude of the regression coefficient (b) of female fish versus female indicates that the male fish is fatter than the male fish. Bagenal (1978) states that the factors that cause different values of b in addition to species differences are environmental factors, different fish stocks in the same species, fish growth stage, gender, maturity level of gonads, even time difference in days due to changes in stomach contents. Kharat *et al.* (2008) states that the difference in the value of b can also be due to the difference in the number and variation of the observed fish size. The value of b obtained will then be used in calculating the value of the condition factor of the fish.

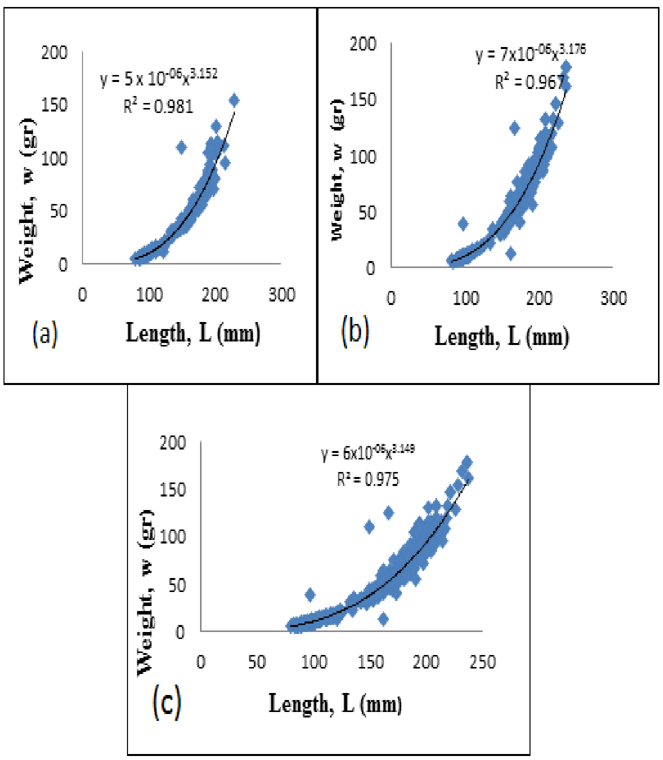

Fig 1: Correlation between Length and Weight of Tor (Tor Soro) (a) Male, (b) female, (c) Combined females and males in Asahan River

Table 1: Correlation Between Length and Weigth Tor Fish (Tor Soro) Each Stasion

Zone	Sex	Length - Weight Equation	R^2	Growth patterns after t test and a = 0.05
Stasion 1	Female	$W=5x10^{-06}L^{3.145}$	0.93	Allometric positive
	Male	$W=4x10^{-06}L3.167$	0.97	Allometric positive
	Combined	$W=5x10^{-06}L^{3.169}$	0.96	Allometric positive
Stasion II	Female	$W=1x10^{-05}L^{3.188}$	0.97	Allometric positive
	Male	$W=6x10^{-06}L^{3.037}$	0.97	Allometric positive
	Combined	$W=5x10^{-05}L^{3.166}$	0.98	Allometric positive
Stasion III	Female	$W=5E\text{-}06L^{3.156}$	0.98	Allometric positive
	Male	$W=5E\text{-}06L^{3.144}$	0.98	Allometric positive
	Combined	$W=5E\text{-}06L^{3.155}$	0.98	Allometric positive

The growth pattern of male and female fish in each zone is allometric positive (b> 3), ie the length increase is not as fast as the weight of the fish, while the Tor Soro fish growth pattern in the Asahan River is isometric (b = 3) Weight is proportional to the increase in total length. Neff and Cargnelli 2004 states differences in growth patterns in fish are strongly effected by age differences, gonadal maturity, gender, geographical location, environmental conditions, gastric fullness, disease and parasitic pressure.

Different patterns of fish growth, also found in other fish species. Result of research of Hasri (2010), growth pattern of Rasbora tawarensis fish at Laut Tawar lake, Rasbora dusonensis fish in peat swamp forest of Dadahub village, Central Kalimantan (Zahid 2008). Soumakil (1996) the differences in growth patterns in fish is likely due to differences in maturity level of gonad, seasons and fertility of waters. Most of the growth patterns of Tor fish (Tor soro) obtained during the study in the waters of the Asahan River are allometrically positive.

Growth coefficient

The results of growth analysis (K and L∞) with ELEFAN 1 method showed that the asymptotic length value of the standard length was 185.14 mm, while the growth coefficient of fish of each location was different (Table 4). The growth equation of von Bertalanffy Tor fish (Tor Soro) in headwaters zone of combined fish (female and male) is $L_t = 185.14\ (1-e^{-0.66\ (t\ +\ 0.151)})$, Middle zone of combined fish (males and females) $L_t = 185.14\ (1-e^{-0.67\ (t\ +\ 0.145)})$ and lower fish zone combined (males and females) $L_t = 185.14\ (1-e^{-1\ (t\ +\ 0.087)})$.

Table 2: Tor growth parameters of Tor fish (Tor Soro) Male, Female and Combined

Zone	Sex	Lenght Range (mm)	Mean	L∞ (mm)	K	t_0
Down - Stream	Female	35.00 -141.14	93±15	185.51	1.10	-0.08
	Male	45.44-175.11	98±16	185.51	1.10	-0.08
	Combined	35.30-175.14	96±15	185.51	1.00	-0.08
Middle	Female	35.50 -175.14	110±20	185.51	0.67	-0.14
	Male	49.59-175.14	108±18	185.51	0.68	-0.14
	Combined	35.50-175.14	110±20	185.51	0.67	-0.14
Head -Waters	Female	63.51-175.14	103±11	185.51	0.66	-0.15
	Male	47.68-166.21	115±12	185.51	0.65	-0.14
	Combined	47.68-175.14	109±10	185.51	0.66	-0.15

The value of (K) in the headwaters zone is a low K value of K value in females 0.66 and males 0.65. The highest growth coefficient (K) values occur in female and male fish in the downstream zone. Fish with high K values are shorter in life.

According to Lagler (1977) carp-carp group (minnows) of the family Cyprinidae in both subtropical and tropical regions are generally 2 years old. Differences in growth rate of Tor fish from the Cyprinidae family can be caused by several factors:

internal factors consisting of a) genetic factors that directly limit the maximum size of fish, and b) fish body size. If the growth rate is low then the fish body size will increase (Wooton 1990; Pauly 1994 in Welcomme 2001). Therefore, the internal factor that causes the K value on the Tor fish (Tor Soro) is higher is the genetic factor due to the difference of species and the size factor of Tor fish (Tor Soro) which is relatively lower. Differences in the value of K (growth coefficients) both temporally and spatially are also thought to be caused by different food supplies at each location, as well as differences in growth rates of Tor fish (Tor Soro) (Pauly 1994 in Hasri 2010).

By the time the fish is 4 years old, theoretically the total length of the fish is 185 mm. The length of the Tor fish (Tor Soro) caught is 185.14 mm, the length of the fish is larger than the asymptotic length of Tor fish The curve above shows that the growth rate of the fish over its life span is not the same. Young fish have a faster growth rate compared to old fish (close to L∞). Despite the low growth rate, fish will still experience long growth even under unsustainable environmental factors. Increases in length generally remain in spite of possible fish in the case of food shortages (Anderson and Gutreuter 1983 in Busacker *et al.,* 1990). Growth parameters give a very important role in the assessment of fish stocks and in developing fisheries management plan both short and long term. One of the simplest applications is to know the length of the fish at a certain age or by using the inverse von Bertalanffy growth equation that is knowing the age of the fish at a certain length.

Mortality and Exploitation Rate

The measured mortality is the total mortality rate (Z), the natural mortality rate (M), and the mortality rate due to catch (F). The total mortality rate (Z) is assumed by the long-based data-based haul curve (Sparre and Venema 1999) and natural rate of death using the Pauly empirical formula with average surface temperature of the lake 11.7 ^{0}C. In fish populations that have been exploited, mortality is a combination of natural mortality and mortality due to catch. Mortality and rate of exploitation of Tor fish (Tor Soro) showed in Table 3.

Table 3: Mortality and Exploitation Rate of Tor fish (Tor Soro) on each zonation

Zone	JK	Total Z	Natural (M)	Catch (F)	Exploitation Rate (E)
Down-Stream	Female	4.53	0.78	3.75	0.82
	Male	1.13	0.83	0.3	0.26
	Combined	10.92	0.73	10.19	0.93
Middle	Female	1.36	0.57	0.79	0.50
	Male	1.68	0.57	1.11	0.66
	Combined	1.36	0.58	0.78	0.57
Head-waters	Female	1.42	0.57	0.86	0.60
	Male	1.57	0.56	1.01	0.64
	Combined	2.06	0.57	1.49	0.70

The rate of exploitation is a value that describes the condition of fisheries utilization in a region. The optimum catch point occurs at E = 0.5. A value higher than 0.5 represents a more over-exploited use condition while underlying values are under lower exploitation (Sparre and Venema 1999). The rate of exploitation of Tor fish (Tor Soro) can be known through the value of death of catch (F) to total mortality (Z). The estimated value of the death rate of male and female catch in each zone is different. In downstream zones the estimated value of male and female captive mortality rates are respectively 1.13 and 4.53 whereas the estimated total death rate of males and females is 0.3 and 3.75. Thus the rate of exploitation of Tor fish (Tor Soro) both male and female is 0.26 and 0.82. The middle Zone estimates the rate of male and female captive deaths respectively of 1.68 and 1.38 while the estimated rate of total mortality of males and females is 1.11 and 10.19. Thus the rate of exploitation of Tor fish (Tor Soro) both male and female in the middle zone is 0.66 and 0.50, whereas in the upstream zone the estimated value of male and female captive mortality rates are 1.57 and 1.42, respectively, whereas the estimated total death rate of males and females Is 1.01 and 0.86. Thus the rate of exploitation of Tor fish (Tor Soro) both male and female is 0.64 and 0.60.

The value of the exploitation rate indicates that the utilization of Tor fish (Tor Soro) in each zone is categorized under more catch fishery conditions and beyond its sustainable limit. Only in the lower fish zones the lower utilization condition (under exploitation) and in the middle zone the female captive condition is still at the optimum point of aggregation ie at the rate of exploitation 0.50. The rate of exploitation in each zone has exceeded its sustainable limit. To maintain the continuity and continuity of Tor fish (Tor Soro) catch in Asahan River, the value of exploitation rate should be at optimum E. According to Gulland (1977) Eopt is at a value of 0.50 because in such conditions a sustainable catch is obtained. The rate of exploitation in the female Tor fish (Tor Soro) in the downstream zone is higher at 0.82.

The mortality rate of male Tor (Tor Soro) in the downstream zone is higher than the mortality rate due to catch. Natural mortality rates can be caused by predation, disease, high water temperatures and low dissolved oxygen content in waters that can cause sudden natural mortality of fish (Welcomme 2001). The rate of exploitation of male Tor (Tor Soro) in the downstream zone is still below the optimum value proposed by Gulland (1971) in Pauly (1984) that is 0.5.So the exploitation of these fish is still under fishing. Give rise to more catch indications, and remain sustainable.

Conclussion

Total mortality rate (Z) of Tor fish 4.09 per year with natural mortality rate (M) 0.66; The mortality rate due to catch (F) 3.43, so that the rate of exploitation is 0.84. The rate of exploitation of the Tor fish in the Asahan River exceeds the optimum exploitation rate value of 0.5.

Based on the results of this study can be proposed some suggestions that can be considered as part of the management plan of fish resources, i.e: arrange fishing equipment, arrest restrictions, especially on Station I, and custody of habitat conditions.

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