Biological aspect and exploitation status of striped threadfin fish (*Polydactylus plebeius* Broussonet, 1782) in Merauke waters and its surrounding, Papua Province, Indonesia

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Abstract. Striped threadfin fish (*Polydactylus plebeius* Broussonet, 1782) belongs to the family Polynemidae and is a demersal fish that is mostly caught in Merauke and surrounding waters by small and medium scale fishermen. The use of this fish is carried out without regarding the sustainability of resources, so management based on scientific studies is needed. The study was conducted for two years in a row, namely in March-December 2017 and in April-December 2018, with a survey method that was assisted by enumerators, and resulted with a total sample of 7,641 fish. Fish size structure was 23-43 cm in 2017 and 19–49 cm in 2018, with isometric growth property. The sex ratio of the fish was found to be out of balance with the size of the male sample and female sample of fish spreading at every size interval. The gonad maturity level amounted for 97.2% specimens in immature condition, for both male and female. The length of first capture fish (Lc) was getting smaller, namely 31.06 cm in 2017 and 30.21 cm in 2018. The natural mortality was smaller than the fishing mortality, with an exploitation level of 0.58. This means that the exploitation status of fish was overexploited, and that management and supervision must reduce fishing pressure, to achieve sustainability.
Key Words: exploitation status, *Polydactylus plebeius*, FMA 718, gonad maturity, sustainable fishing.

Introduction. Arafura waters is a fishing ground destination for fishing vessels from Indonesia and from foreign countries. This makes the management of fisheries in these waters quite complex and unique compared to other waters management, because the area is partly included in the Fisheries Management Area 718 and partly into the Australian shelf waters (Hasanudin 1998; Prisantoso & Badrudin 2010; Suman & Satria 2014). These waters have a high fertility level due to the mixing of freshwater masses from the mainland with waters that undergo periodic upwelling from the Pacific Ocean through the Indonesian Through Flow or ARLINDO (Pranowo 2012; Ramadyan & Radjawane 2013; Tambun et al 2018). Another cause is that the mangrove forests on the coast of Papua sustain the primary productivity that supports the potential of Arafura fisheries (Suman et al 2016). This water fertility allows this fishery to make up to 30% of Indonesia's total fishery exports (Mulyana et al 2012).

Demersal fishery is the mainstay of these waters and its production reaches 58.89%, but the high rate of fishing will further increase exploitation, so it shows an indication of overfishing and overcapacity (Pranowo et al 2013). The reason is because in the use of demersal fisheries, various kinds of fishing gear can be used such as basic nets, fish trawl, shrimp trawl, fishing line and longline (Purwanto & Nugroho 2010; Mahulette & Samu-samu 2014; Umamah et al 2017). According to the Regulation of the Minister of Marine and Fisheries No. 50 of 2017, the potential for demersal fish in these waters is 876,722 tons, with the allowable catch amount of 701,378 tons and exploitation level of 0.67. This level of exploitation indicates that supervision is needed for the fishing activities, in order that fish resources are maintained. Supervision is necessary because the current fishing effort is still oriented towards maximum profit, so it tends to ignore the environmental conditions and fish resources (Mulyana et al 2011).

Fishing activities are conducted in Merauke and surrounding waters by local fishermen that dominantly use gill nets. The fishing fleet used in fishing activities is generally small scale (<10 gross tonnage, GT) and medium (10-30 GT). Although small and medium scale gill nets are used, the body of the net reaches the bottom of the water and demersal fish are caught. That is because the shape of the seabed topography tends to be flat and the depth of these waters ranges from 5-60 m, with an average of about 30 m (Ramadyan & Radjawane 2013; Tambun et al 2018).

The catches of fishermen are generally longfin beachsalmon (*Leptobrama pectoralis*), Papuan mackerel (*Scomberomorus muliradiatus*) and demersal fish such as striped threadfin fish (*Polydactylus plebeius* Broussonet, 1782) (Figure 1) (Pane et al 2019). Striped threadfin fish is classified as Polynemidae family, with Percoidae sub-order, with 8 genera and 50 species (Shihua Kang 2017). In some areas in Indonesia, this kind of fish is commonly called kuro and senangin fish. Striped threadfin fish (*P. plebeius*) has a special characteristic, the lateral line is straight along the body and slightly bends down when approaching the tail. It has five pectoral filaments and several dark stripes along the scale rows above and below the lateral line, but differs from the latter in having lower counts of pectoral fin rays (16–18) (Motomura et al 2001a; Motomura et al 2001b).This fish is similar to other species, Motomura et al (2002) say that this fish resembles *Polydactylus longifilis* in the early life stages, despite being different species. This fish has a wide distribution throughout habitats in the Indo Pacific, including South Africa, Madagascar, India, Oman, Sri Lanka, Thailand, Indonesia, the Philippines, Papua New Guinea, Australia, Solomon Islands, China, Japan and Hawaii (Motomura et al 2001a; Motomura et al 2001b; Motomura 2004). This fish habitat is usually around river mouths, along shallow coasts (Motomura 2004).

The exploitation of striped fish (*Polydactylus plebeius*) conducted by small and medium scale fishermen still requires management, so that the fish population is maintained. In carrying out the management, scientific information is needed about the biological aspects and the level of exploitation of these fish. Scientific studies on the biological aspects and use of these fish are hardly found, even though they are widely distributed in the Indo-Pacific. For this reason, scientific studies are carried out on the biological aspects and the exploitation status of these fish, especially in Merauke waters. The purpose of this study was to determine the exploitation status of *Polydactylus plebeius* fish and the efforts to maintain its population. The results are expected to help in the management of striped threadfin fish (*Polydactylus plebeius*) in general and specifically in Merauke waters.

Material and Method

Data collection. Data collection was carried out for two years in a row, namely March to December 2017 and April to December 2018, with the assistance of enumerators. Enumerators collected data monthly by visiting fishermen who landed their catches on Lampu Satu Beach, Merauke. Striped threadfin fishing areas are presented in Figure 1. Data collection was done by measuring the fork length (FL) using a ruler at 3,993 individuals in 2017 and 3,648 individuals in 2018. Fork length (FL) represents the measurement from the front end of the head to the outer end of the curve of the fork. Measurement of fish body weight was done by the researchers with a total sample of 219 fish using a 0.01 grams precision digital scale. The measured fish were then dissected to determine the sex of the fish, the level of gonad maturity and the composition of the fish's stomach contents. Observation of the stomach contents of the fish was done directly, without being taken to the laboratory. The stomach of the dissected fish was weighed, then dissected and the contents were examined visually. The contents of the hull weighed with a 0.01 grams precision digital scale. Next, the hull contents were categorized and quantified in food types (fish, shrimp, crustaceans etc.).

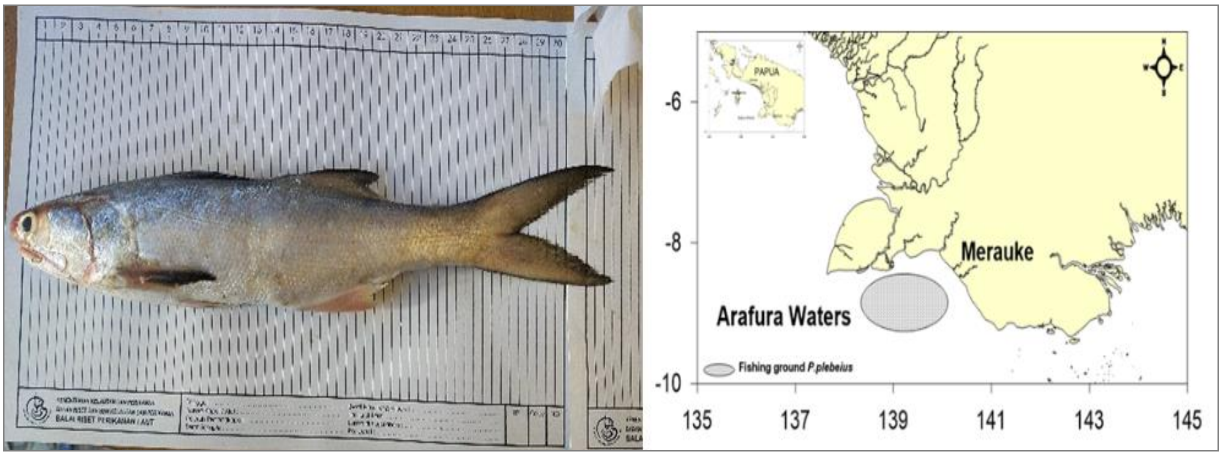

Figure 1. Striped threadfin fish (*P. plebeius*) and the fishing area of striped threadfin fish (*P. plebeius*) on Merauke waters and its surrounding.

Data analysis. The size structure of the fork length (FL) of fish was tabulated monthly and analyzed to obtain the distribution of fish size and the dominant size that was caught. Analysis of the relationship between the length of the fork (FL) of striped threadfin fish and their body weight followed the equation of Bal & Rao (1984) and King (1995) and if b=3 then the relationship is isometric, b≠3 then it is allometric. To determine that the value of b=3 or b≠3, the t-test (Walpole 1992) is used, the value will then be compared between t arithmetic and t table, (H0:b=3; H1:b≠3). Analysis of the sex ratio was also based on the length of the fish fork (FL), because in some references, Polynemidae fish are hermaphrodite protandry fish (Motomura 2004).

Genital ratio followed the equation of Chiang et al (2011) while the gonad maturity level (GML) was analyzed based on Effendie (2002) (Table 1) and gonad maturity level for *P. plebeius* in Merauke water is depicted in Figure 2.

Table 1

Fish gonad maturity level (GML) based on Cassie (1956) in Effendie (2002)

GML	*FEMALE*	*MALE*
1	Ovaries are clear and like thin threads, they are long from the front to the end of the body cavity.	Testicles are clear and like threads.
2	The ovaries are enlarged and yellowish.	Testicles are enlarged with a colour like milk.
3	The ovaries are bigger, they start to turn yellow and fill the body cavity.	The testicles are bigger and whiter.
4	The yellow egg structure is clearly visible and it fully fills the abdominal cavity.	Testicles are milky white and solid.
5	The ovaries are small, wrinkled and the eggs are released.	The testicles are deflated and there is residual sperm from the release.

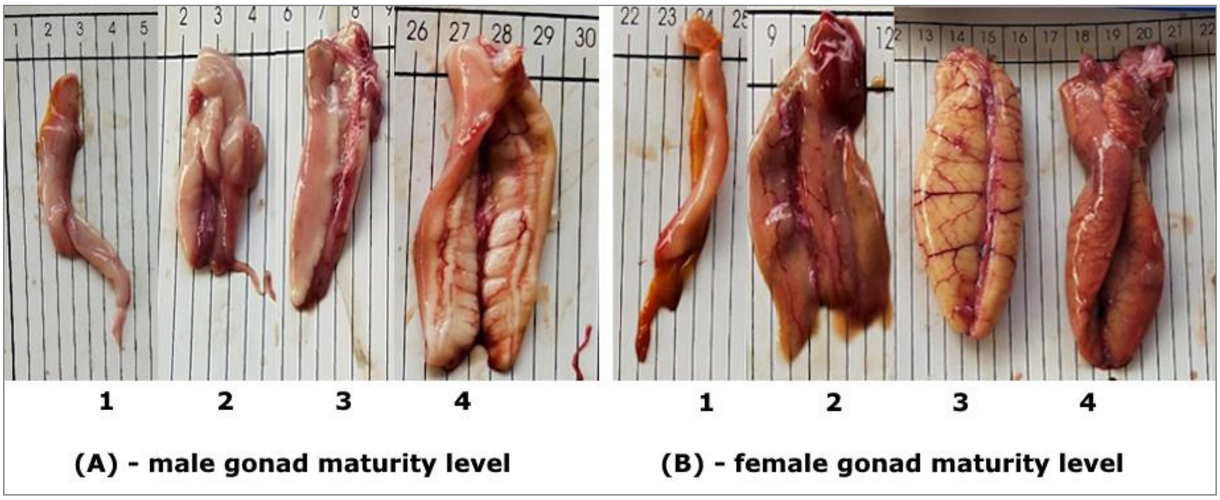

Figure 2. Gonad maturity level (GML), from level 1 to 4, of striped threadfin fish (*P. plebeius*) in Merauke waters and its surronding, (A) male and (B) female.

Observation of stomach contents was carried out visually in the field to find out the type of food in the stomach of striped threadfin fish. The size of the first time caught fish (length at first capture, Lc) was obtained by plotting the length of the fork of the fish (FL) based on length group (class interval) with the frequency of fish expressed in cumulative percentage. Lc could be interpreted as the length where 50% of fish are captured in nets (King 1995; Spare & Venema 1999). Whereas the analysis of the length at first maturity (Lm) could not be determined due to the limited number of female fish mature gonad samples (GML 3 and GML 4) in this study.

Some population parameters were analyzed using the FiSAT II program (FAO-ICLARM Stock Assessment Tools) (Gayanilo et al 1996). The asymptotic length and value of growth constants were estimated using the ELEFAN Program I (Electronic Length Frequency Analysis) developed by Pauly & David (1981) and Gayanilo et al (1996). The total mortality (Z) was assumed by the catch curve method which is the slope (b) between LnN/t and relative age (Sparre and Venema 1999). The formula is LnN/t=a–Zt, in which Ln is natural logarithm, N is the total number of fish, t is the time needed to grow, and a is catches converted to length. For the estimation of theoretical age, when the length of a striped threadfin fish (*P. plebeius*) was equal to zero, we used the empirical formula of Pauly (1980) from Sparre & Venema (1999). The natural mortality of striped threadfin fish was analyzed using the Pauly (1980) formula. Furthermore, based on the natural mortality, the fishing mortality (F) could be obtained using the total mortality (Z) and the natural mortality (M) or F=Z-M and the exploitation rate (E) was calculated as E=F/Z (Sparre & Venema, 1999).

Results

Structure of size and relationship of fork length (FL) and body weight. The distribution of the size of the fork length (FL) of the fish caught by gillnet in Merauke during the study was 23-43 cm in 2017 and 19-49 cm in 2018. Fish were found dominant at the size of 35 cm FL in 2017 and experienced a shift to 33 cm FL in 2018 (Figure 3). According to Fishbase (2020), this fish size structure is maximal at 45 cm, although generally is at 30 cm TL (representing the total length of the fish), but Bunce et al (2008) found the size of 50 cm FL in southwestern Indian Ocean waters. Striped threadfin fish (*P. plebeius*) is found in the waters of the eastern Indian Ocean with the size of 5-28 cm on various seasons and fishing locations (Lenanton et al 2017).

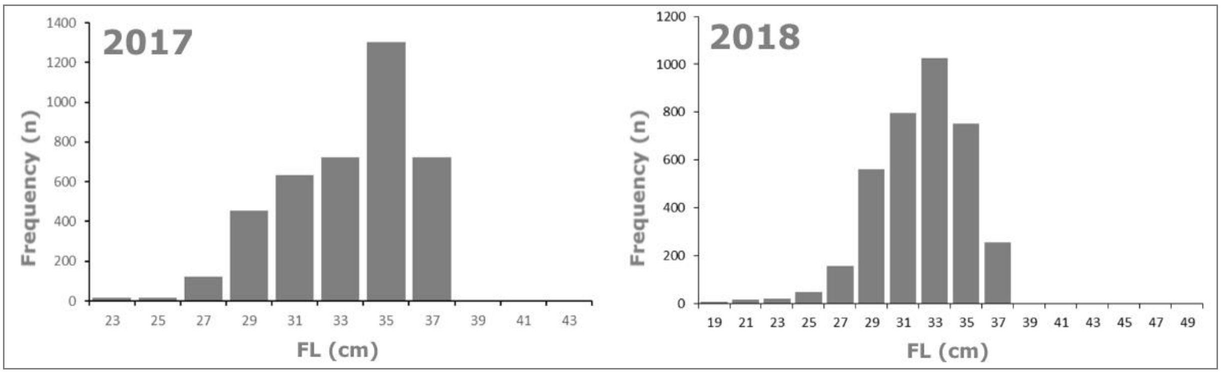

Figure 3. Structure of striped threadfin fish (*P. plebeius*) size in Merauke Regency waters and its surrounding, in 2017 and in 2018.

The relationship between fork length (FL) and fish body weight during the study of 218 fish showed that a=0.0114 and b=3.0571. Based on the obtained results of the t-test analysis, the value of b=3 (t arithmetic value of 0.713<t table value of 2.2570), meaning this is an isometric growth. This shows that the addition of fish body weight was at the same intensity as the growth in body length (Figure 4). The nature of this growth is like the growth of *Polynemus dubius* in Pelabuhanratu Bay, *Polynemus dubius* in Indragiri Riau, and *Eleutheronema tetradactylum* in Musi River, which are also isometric (Asyari & Herlan 2013; Hasibuan et al 2018a). However, the growth patterns of *Polydactylus quadrifilis* in Gambia, *Polydactylus approximans* in California, and *Polynemus paradiseus* in Bangladesh are allometric, for both male and female fish (Ecoutin et al 2005; Aguirre et al 2008; Nurhayati et al 2011; Chaklader et al 2016).

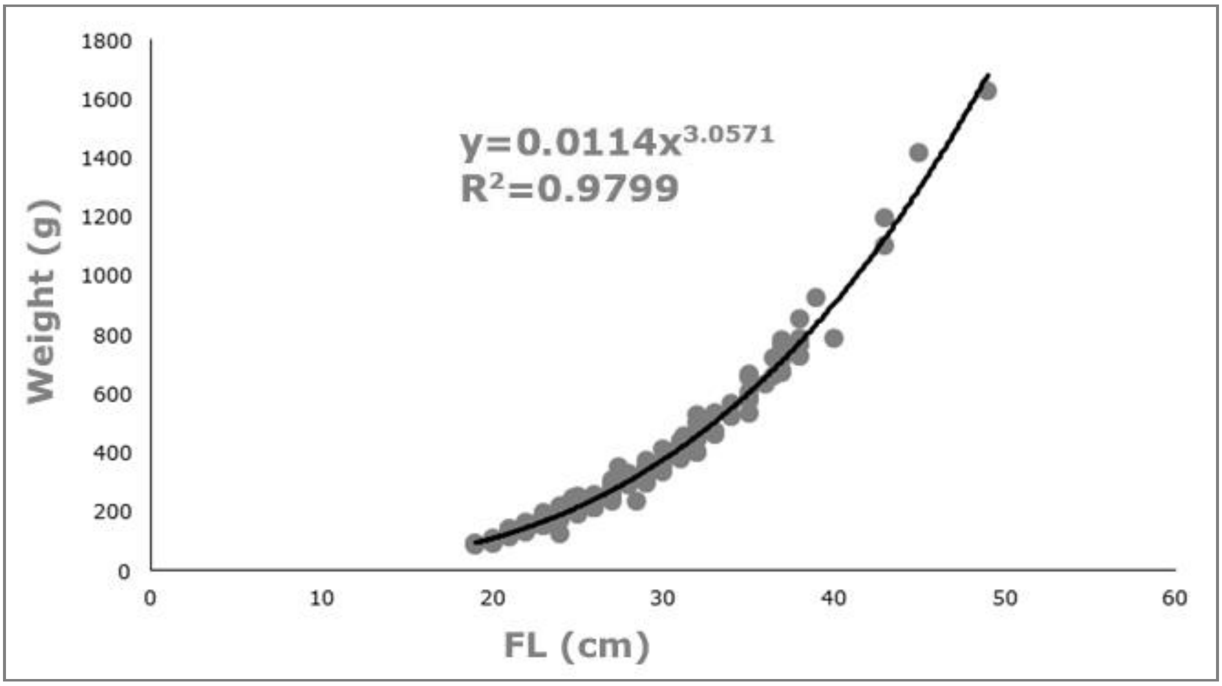

Figure 4. Relationship between the length of fish fork (FL) and the body weight of *P. plebeius*.

The difference in the value of b and the nature of growth even in one family occurs due to different types of species. This is caused by many factors, including food and environmental conditions. According to Effendie (2002) and Prihatingsih et al (2017), the causes are species differences, differences in the number and structure of fish samples, sex, amount of food and the fish habitat.

Genital ratio and gonadal maturity. The genital ratio of fish showed that male fish were dominant to female fish (6.2:1). According to Bal & Rao (1984), the balance of sex ratio is needed in maintaining the survival of a population. The unbalanced sex ratio could be an indication that the fish population could be disturbed. The cause of the imbalance in the sex ratio could be affected by the changes in water temperature, the ease of female fish to be eaten by predators, natural risk and migration phases of female broodstock population, that differ from male broodstock (Hasibuan et al 2018b). The relationship between the sex of the fish and its length is presented in Figure 5.

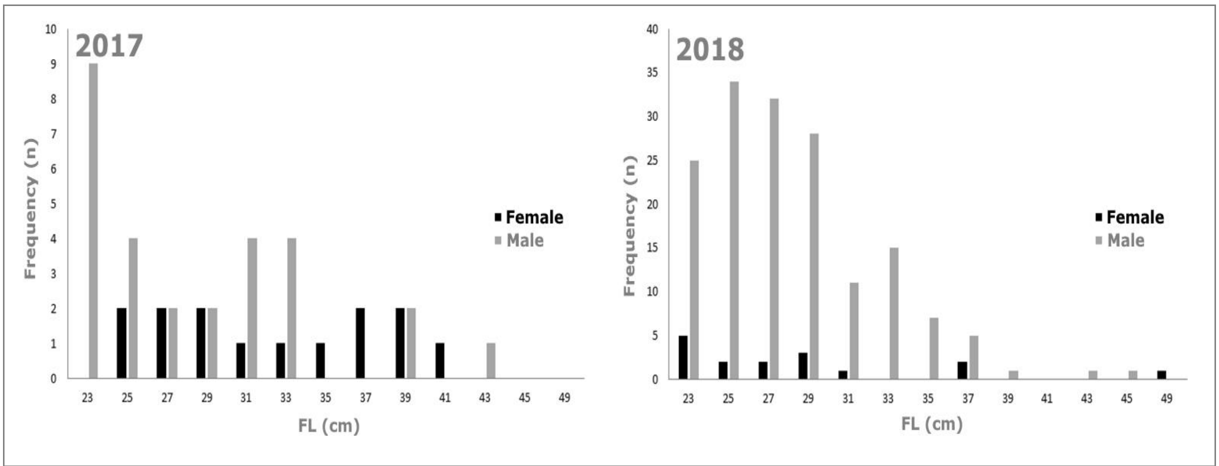

Figure 5. Sex type of *P. plebeius* fish due to fork length (FL), in 2017 and in 2018.

Males and females were found in almost all sizes. Both sexes were found at sizes above 40 cm FL, males being found up to 45 FL and females were found up to 49 cm FL. The hermaphrodite protandry nature could not be concluded, although Motomura (2004) mentions fishes ranging in the size of 18-26.4 cm standard length (SL) that had the composition of 1 hermaphrodite, 1 immature male and 8 immature females and no further scientific studies have been found about this fish reproduction to date. *Eleutheronema tetradactylum* fish found by Ballagh et al (2012) in Australia and Ardiani et al (2018) in Gresik East Java were fish with hermaphrodite protandry nature. The transition period of sex change in *Eleutheronema tetradactylum* fish from males in brackish water to females in seawater is around 6 months at the age of 2 years (Motomura 2004; Pamber 2006; Horne et al 2011). *Eleutheronema tetradactylum* fish on the coast of Malaysia was also found to be males at a smaller size of 14.8-39 cm total length (TL) than females with the size of 35-55 cm TL (Zamidi et al 2012). The fish in our study were generally found with immature gonads (GML 1 and GML 2) on both male and female fish, which was 97.2% (Table 2).

Table 2

Gonad maturity level (GML) of *P. plebeius* in 2017-2018

Month	*Year*					
	2017					
	Female			Male		
GML	GML 1	GML 2	GML 5	GML 1	GML 2	GML 3
Sept	14	0	0	23	3	2
	2018					
May	6	0	0	26	1	0
July	0	0	1	15	14	2
Sept	6	1	0	7	1	0
Nov	1	1	0	11	82	1
Total	27	2	1	82	101	5

Composition of food types. The types of food consumed by fish can be indicative of eating habits, ecological relations with other organisms and food chains in the ecosystem (Effendie 1992). The composition of food types in the hull of *P. plebeius* is dominantly 55% fish and as much as 44% of shrimp, while the rest are crabs (Figure 6). Crab food was also mentioned by Motomura (2004), where he found crabs of the *Emerita asiatica* species in the stomach of 17 *P. plebeius* specimens, out of 42 specimens dissected. The composition of different types of food found in the waters of Indragiri Riau in *Polynemus dubius* fish is 47.5% crustaceans, 38% fish, 6.5% worms, 3.2% molluscs and 4.8% unidentified food (Asyari & Herlan 2013). The dominant hull contents of *Eleutheronema tetradactylum* in Dumai waters are 58.24% crustaceans, 14.48% fish, 21.78% fish eggs, 1.14% worms and 4.35% detritus (Titrawani et al 2013). So, based on the type of food identified, it is known that this type of fish is carnivorous due to its eating habits (eating animals such as fish, shrimps and crabs).

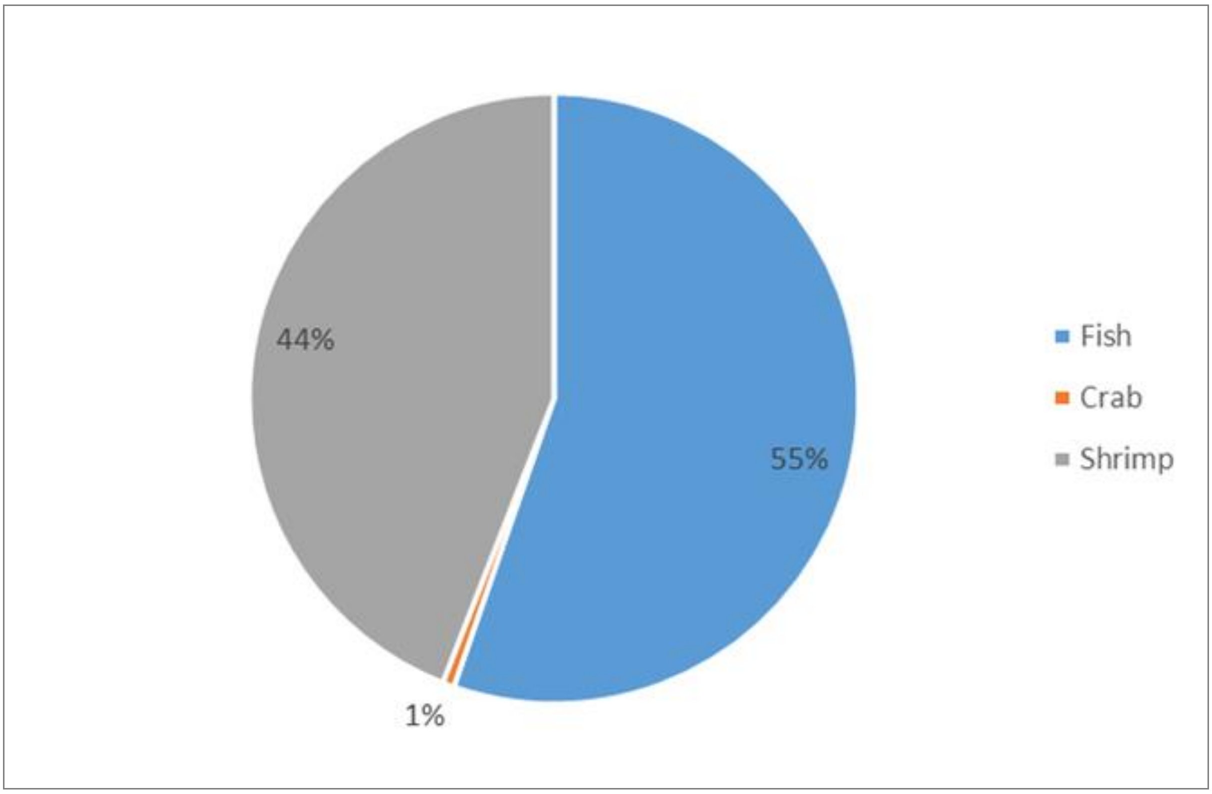

Figure 6. The hull content composition of *P. plebeius*.

The dominant food type of striped threadfin is determined by the abundance of small fish in the waters, that become food for larger fish. This abundance is caused by upwelling, namely the increase in mass of water which is rich in nutrients and food ingredients (Hasanudin 1998). Another reason is because the water follows the monsoon season patterns and dynamic vertical currents support the availability of primary productivity for fish food sources (Pranowo 2012). The availability of this abundant food chain is based on two elements, namely detritus and plankton (Mulyana et al 2012). Plankton basis supports small fish for demersal and pelagic fish food and detritus is the basis for shrimp and other demersal eating organisms (Pranowo et al 2013).

The first length at capture (Lc) and the parameters of growth and exploitation status. Based on the size structure, the size of the fish first length at capture was analyzed. The fish first length at capture is the average length of the fish captured. The results of the analysis obtained for the first length at capture (Lc) of striped threadfin fish in Merauke and its surrounding waters was 31.06 cm in 2017 and 30.21 cm in 2018. This means that the fish caught have decreased in fork length (FL) size (Figure 7).

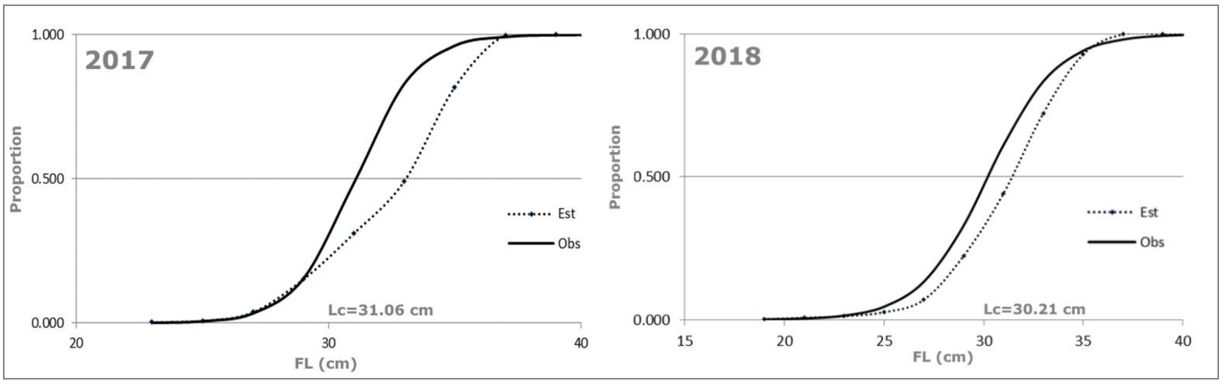

Figure 7. The length at first capture (Lc) of *P. plebeius* Merauke, in 2017 and in 2018.

Based on the analysis of the size structure of the striped threadfin fish in Merauke waters, the value of growth rate (K) was 0.64-0.65 per year with a infinity fork length (FL∞) of 46.85 cm FL in 2017 and 51.10 cm FL in 2018 (Table 3).

Table 3

Parameter value of striped threadfin fish population (*P. plebeius*) in Merauke waters and its surrounding

Parameter	Unit	*Value*	
		2017	*2018*
The first length at capture (Lc)	cm	31.06	30.21
Infinity fork length (FL∞)	cm	46.85	51.1
Growth rate (K)	year	0.65	0.64
The time when the length is zero (t_0)	year	-0.219	-0.218
Total mortality (Z)	year	2.85	2.76
Natural mortality (M)	year	1.21	1.17
Fishing mortality (F)	year	1.64	1.59
Exploitation level (E)	%	0.58	0.58

Sparre & Venema (1999) state that the value of growth coefficient (K) indicates the level of time required for individuals to reach their asymptotic length. In addition, it is known from various resources that growth coefficient (K) of *Polynemus heptadactylus* in Mumbai, India waters is 0.82 (Prasad et al 2005), *Polynemus paradiseus* in Bangladesh is 0.48 (Rashed-Un-Nabi et al 2007) and Kurau fish (*Polynemus taenitatus*) in Bunyu waters is 0.718 (Salim & Kelen 2018). Comparison of the growth rate of striped threadfin fish in these waters and other fish in this family shows that these fish are slow in growth because the K value is above 0.5 (Sparre & Venema 1999).

Striped threadfin fish natural mortality (M) was lower than fishing mortality (F), meaning that the fish were widely exploited. According to Hidayat et al (2017), the fishing mortality is directly proportional to the fishing effort and fishing ability. Therefore, according to the value of fishing mortality, it shows that the exploitation level of striped threadfin fish was of E=0.58 per year, which illustrates the overexploitation of striped threadfin fish in these waters. The overexploited status is based on the higher value of exploitation than E=0.5 (Gulland 1971), which means that the exploitation of striped threadfin fish in these waters must be reduced.

The management of demersal fisheries, especially for the fish in the waters of Merauke, must be properly done to maintain the fish population. Management in this case means the control of fishing efforts (Prisantoso & Badrudin 2010). Control of fishing efforts must be done to maintain the balance of fish populations (Pane et al 2019). According to Mulyana et al (2011), fisheries management has multidimensional impact for ecology, economy, technology, and society. Fisheries management does not only involve the Regional Government, but it also must involve fishing communities and environmental organizations to take an active role, so that the rights to use and manage it efficiently can be implemented (Mahulette & Samu-samu 2014). Management of fisheries for striped threadfin fish resources can be done with policies regarding the terms of fishing gear selectivity and control of fishing efforts. The selectivity of fishing gear can be in the form of restrictions on the mesh size of the net, so that fish <30 cm are not caught. Controlling of the fishing efforts can be done by not increasing the number of fishing vessels and the number of fishing gear. Cooperation in monitoring and promoting the implementation of policies amongst the Government, fisheries organizations and environmental organizations is absolutely necessary, in order that fisheries resources remain sustainable.

Conclusions. Striped threadfin fish (*Polydactylus plebeius*) caught in Merauke waters were between 19-49 cm FL with a dominant size of 33-35 cm FL. The relationship between body length and body weight was balanced between the addition of body weight and the length increase. The sex ratio of male and female striped threadfin fish during the study 6.2:1. The gonads of striped threadfin fish were more than 95% immature (GML 1 and GML 2). The decrease in the first length at capture (Lc) was one indication that the fork length of the caught fish was getting smaller. The fishing mortality (F) was higher than the natural mortality (M), which indicated that fishing had been done intensively. The status of the exploitation of the fish is overexploited, meaning that the fishing efforts must be reduced. Effective management can be done by applying policies in the selectivity of the fishing gear and controlling fishing efforts. Policies can be in the form of net mesh size regulation, so that fish under 30 cm FL are not caught and that the fishing efforts do not increase (fleet and fishing gear).

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References

Aguirre H., Amezcua F., Vera J. M., Soto C., 2008 Length-weight relationship for 21 fish species from a coastal lagoon in the southwestern Gulf of California. Journal of Applied Ichthyology 24:91-92.
Ardiani R., Sulmartiwi L., Triastuti R. J., Rahardja B. S., 2018 Study in macroanatomy and microanatomy of the four finger threadfin (*Eleutheronema tetradactylum*) reproduction aspects caught in the Gresik Sea, East Java. Journal of Marine Coastal Science 7(1):21-30.
Asyari, Herlan, 2013 [Some biological aspect of Eastern Paradise fish (*Polynemus dubius*) in Indragiri River Estuary, Riau]. Bawal 5(2):67-72 [in Indonesian].
Bal D. V., Rao K. V., 1984 Marine Fisheries. New Delhi: Tata Mc. Graw-Hill Publishing Company Limited :5–24 pp.
Ballagh A. C., Welch D. J., Newman S. J., Allsop Q., Stapley J. M., 2012 Stock stucture of the blue threadfin (*Eleutheronema tetradactylum*) across northern Australia derived from life-history characteristics. Fisheries research 121-122:63-72.
Bunce M., Rodwel L. D., Gibb R., Mee L., 2008 Shifting baselines in fishers perceptions of island reef fishery degradation. Journal of Ocean Coastal and Management 51:285-302.
Chaklader M. S., Siddik M. A. B., Nahar A., Hanif M. A., Alam M. J., Mahmud S., 2016 Morphometric parameters and allometric growth in Paradise Threadfin *Polynemus paradiseus* (Linnaeus, 1758) from a Coastal River of Bangladesh. Journal of aquaculture 7(3):1-5.

Chiang W. C., Hsu H. H., Fu S. C., Chen S. C., Sun C. L., Chen W. Y., Liu D. C., Su W. C., 2011 Reproductive biology of longtail tuna (*Thunnus tonggol*) from coastal waters of Taiwan. IOTC Working Party on Tropical:1-30.
Ecoutin J. M., Albaret J. J., Trape S., 2005 Length-weight relationship for fish populations of a relatively undisturbed tropical estuary: The Gambia. Fisheries research 72:347-351.
Effendie H. M. I., 2002 [Fisheries Biology. Yogyakarta: Yayasan Pustaka Nusantara]. [in Indonesian].
Effendie H. M. I., 1992 [Methods Fisheries Biology]. Faculty of Fisheries. Department of Ichthyology IPB: 112 p [in Indonesian].
Fishbase, 2020 *Polydactylus plebeius* (Broussonet, 1782). Accessed on 9 January 2020 https://www.fishbase.se/summary/7901.
Gayanilo F. C. Jr., Sparre P., Pauly D., 1996 FAOICLARM Stock Assessment Tools (FiSAT) user's Guide (p. 126) FAO Computerized Information Series (Fisheries) No. 8 FAO, Rome.
Gulland J. A., 1971 Fish Resources of the Ocean Fishing New Books, London. 255 p.
Hasanudin M., 1998 [Flow across Indonesia (ARLINDO)]. Oseana XXIII (2):1-9 [in Indonesian].
Hasibuan J. S., Boer M., Ernawati Y., 2018a [Length weight relationship and reproduction potential of Eastern Paradise Fish (*Polynemus dubius* Bleeker, 1853) in Pelabuhanratu Bay]. Journal of tropical fisheries management 2(1):37-42 [in Indonesian].
Hasibuan J. S., Boer M., Ernawati Y., 2018b [Population structure of Eastern Paradise Fish *Polynemus dubius* in Palabuhanratu Bay]. Journal of tropical fisheries management 10(2):441-453 [in Indonesian].
Hidayat T., Noegroho T., Wagiyo K., 2017 [Size structure and some population parameters of skipjack tuna (*Katsuwonus pelamis* Linnaeus, 1758) in the Pacific Ocean North of Papua]. Bawal 9(2):113–121 [in Indonesian].
Horne J. B., Momigliano P., Welch D. J., Newman S. J., Herwerden L. V., 2011 Limited ecological population connectivity suggests low demands on self-recruitment in a tropical inshore marine (*Eleutheronema tetrdadactylum*: Polynemidae). Molecular ecology 20:2291-2306.
King M., 1995 Fisheries Biology, Assessment and Management. Fishing News Books: 341p.
Lenanton R. C. J., Dowling C. E., Smith K. A., Fairclough D. V., Jackson G., 2017 Potential influence of a marine heatwave on range extensions of tropical fishes in the Eastern Indian Ocean-invaluable contributions from amateur observers. Regional Studies in Marine Science 13:19-31.
Mahulette R. T., Samu-samu A., 2014 [Institutional Strengthening to Support Arafura Marine Fisheries Resource Management]. J. Kebijakanan Perikanan Indonesia, 6(2):87–96 [in Indonesian].
Motomura H., Iwatsuki Y., Yoshino T., 2001a A new species, *Polydactylus siamensis*, from Thailand and redescription of *P. plebeius* (Broussonet, 1782) with designation of a neotype (Perciformes: Polynemidae). Ichthyological Research 48(2):117-126.
Motomura H., Iwatsuki Y., Yoshino T., 2001b *Polydactylus bifurcus*, a new species of threadfin from Lombok Island, Indonesia (Perciformes: Polynemidae). Ichthyological Research 48(3):299-305.
Motomura H., Kullander S. O., Yoshino T., Iwatsuki Y., 2002 Review of seven-spined *Polynemus* spesies (Perciformes: Polynemidae) with designation of a neotype for *Polynemus paradiseus* Linnaeus, 1758. Ichthyological research 49:307-317.
Motomura H., 2004 Threadfins of the world (family Polynemidae). Food and Agriculture Organization of the United Nations, Rome, 131 p.
Mulyana R., Haluan J., Baskoro M. S., 2011 [Multidemensional analysis of capture fisheries business licensing management: case study of Arafura sea]. Jurnal Teknologi Perikanan dan Kelautan 2(1):71-79 [in Indonesian].
Mulyana R., Haluan J., Baskoro M. S., Wisudo S. H., 2012 [Sustainability of Large Scale Fisheries in the Arafura Sea]. Buletin PSP 20(1):35-43 [in Indonesian].

Nurhayati, Fauziyah, Bernas S. M., 2011 [Relationship of length–weigth and growth pattern of fish in Musi river estuary Banyuasin regency South Sumatra]. Maspari Journal 8(2):111-118 [in Indonesian].

Pember M. B., 2006 Characteristics of fish communities in coastal waters of north-western Australia, including the biology of the threadfin spesies *Eleutheronema tetradactylum* and *Polydactylus macrochir*. PhD thesis, Murdoch University, Western Australia. 286 p.

Pane A. R. P., Wagiyo K., Suman A., 2019 [Biological aspects and exploitation Papuan Seerfish (*Scomberomorus multiradiatus* Munro, 1964) with gillnet in Merauke waters and adjacents]. Jurnal Ilmu dan Teknologi Kelautan Tropis 11(3):763-776 [in Indonesian].

Pauly D., 1980 On the inter-relationships between natural mortality, growth performanceand mean environmental temperature in 175 fish stocks. Journal du Conseil International pour I' Exploration de la Mer. 39(3), 175-192.

Pauly D., David N., 1981 ELEFAN-I a basic program for the objective extraction of growth parameters from Length frequency data Meeresforschung/Rep Mar Res. 28(4):205-211.

Pranowo W. S., 2012 [Upwelling-downwelling dynamics of Arafura and Timor seas]. Widyariset 15(2):415-424 [in Indonesian].

Pranowo W. S., Wirasantosa S., Syahrial N. A., Dewi L. C., Ratnawati H. I., Af Ati R. N., Prihantono J., Makarim S., Hutahaean A. A., 2013 [Characteristics of the Arafura & Southwestern Sea Resources of Papua. Pusat Penelitian dan Pengembangan Sumberdaya Laut dan Pesisir. Badan Penelitian dan Pengembangan Kelautan dan Perikanan]. Kementerian Kelautan dan Perikanan. 46 p [in Indonesian].

Prasad R. R., Jaiswar A. K., Reddy S. B. Chakraborty S. K., Palaniswamy R., Parida P., 2005 Growth, mortaliy and yield per recruit of *Polynemus heptadactylus* (Cuvier) (Teleostei:Polynemidae) from Mumbai waters, India. Fisheries research 76:155-161.

Prihatingsih., Kamal M. M., Kurnia R., Suman A., 2017 [Length-weight relationship, food habits and reproduction of humpback red snapper (*Lutjanus gibbus*: Family Lutjanidae) in the Southern Part of Banten waters]. Bawal 9(1):21-32 [in Indonesian].

Prisantoso B. I., Badrudin, 2010 [Red Snapper Resource Management Policy (Lutjanus spp.) In the Arafura Sea]. Jurnal Kebijakan Perikanan Indonesia 2(1):71-78 [in Indonesian].

Purwanto., Nugroho D., 2010 [Optimal level of exploitation of shrimp, demersal fish and small pelagic stocks in the Arafura Sea]. Jurnal penelitian perikanan Indonesia 16(4):311-321 [in Indonesian].

Ramadyan F., Radjawane I. M., 2013 [Seasonal surface geostrophic currents in Arafura-Timor waters]. Jurnal Ilmu dan Teknologi Kelautan Tropis 5(2):261-271 [in Indonesian].

Rashed-Un-Nabi M., Hoque M. A., Rahman R. A., Mustafa S., Kader A. M., 2007 Population dynamics of *Polynemus paradiseus* from Estuarine Set Bag Net Fishery of Bangladesh. Chiang Mai Journal Science 34(3):355-365.

Salim G., Kelen P. B., 2018 [El Von Bertalanffy and Mortality from Fish Kurau (*Polynemus taenitatus*) of the Catch Fisherman in Waters Bunyu]. Insist 3(2):165–169 [in Indonesian].

Shihua Kang, 2017 [Comparative morphology and phylogenetic relationships of the family Polynemidae (Pisces: Perciformes)]. Part of Disertation. Hokkaido University [in Japanese].

Sparre P., Venema S., 1999 [Introduction to tropical fish stock assesment. (*Introduksi Pengkajian Stok Ikan Tropis*, alih bahasa: Pusat Penelitian dan Pengembangan Perikanan)]. Buku 1: Manual. Badan Penelitian dan Pengembangan Perikanan. Jakarta. 438 p [in Indonesian].

Suman A., Irianto H. E., Satria F., Amri K., 2016 [Potency and exploitation level of fish resources 2015 in fisheries management area of Indonesian Repbulic (FMAs) and its management option]. Jurnal Kebijakan Perikanan Indonesia 8(2):97-110 [in Indonesian].

Suman A., Satria F., 2014 [Management option of shrimp resourses in Arafura sea (FMA 718)]. Jurnal Kebijakan Perikanan Indonesia 6(2):97-104 [in Indonesian].
Tambun R., Simbolon D., Wahju R., Supartono., 2018 [Potensial zones of fishing ground based on season at FMA RI 718]. Jurnal Ilmu dan Teknologi Kelautan Tropis 10(3):757-768 [in Indonesian].
Titrawani, Elvyra R., Sawalia R. U., 2013 [Analysis of the stomach contents of the happy fish (*Eleutheronema tetradactylum* Shaw) in Dumai waters]. Al-Kauniyah Jurnal Biologi 6(2):85-90 [in Indonesian].
Umamah M., Wisudo S. H., Wahyu R. I., 2017 [Suistanable management of shrimp resources in Aru and Arafura Sea]. Albacore 1(3):245-255 [in Indonesian].
Walpole R. E., 1982. Introduction of Statistics. Third Edition. New York: Macmillan Publishing Company, Inc. 515pp.
Zamidi S. A., Zaidi C. C., Mazlan A. G., Alam G. M., Al-Amin A. Q., Simon K. D., 2012 Fecundity and Temporal Reproductive Cycle of Four Finger Threadfin (*Eleutheronema tetradactylum*) in Malaysian Coastal Water. Asian Journal of Animal and Veterinary Advances 7(11):1100-1109.

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