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Short Communication: Growth and mortality rate of Black Pomfret *Parastromateus niger* (Bloch, 1795) and Silver Pomfret *Pampus argenteus* (Euphrasen, 1788) in Paloh Waters, West Kalimantan, Indonesia

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Abstract. *Damora A, Ariyogagautama D, Wahju RI, Susanto H, Wang J. 2018. Short Communication: Growth and mortality rate of Black Pomfret* Parastromateus niger *(Bloch, 1795) and Silver Pomfret* Pampus argenteus *(Euphrasen, 1788) in Paloh Waters, West Kalimantan, Indonesia. Biodiversitas 19: 2247-2251.* Three species of pomfret fish were caught in Paloh waters including *Parastromateus niger*, *Pampus argenteus,* and *Pampus chinensis*. *P. niger* and *P. argenteus* which were more dominant than *P. Chinensis*. Pomfret fishing in the Paloh waters is not carried out throughout the year, but generally only in August to October every year. The main fishing gear used was drift gill net. Data on the growth parameter and mortality of the pomfret fish is required as an effort for the management of this fish. This study was aimed to estimate the growth and mortality rate of *P. niger* and *P. argenteus* in Paloh waters, located in West Kalimantan. This study was conducted from April 2014 to June 2017. The fish samples were collected by catching the fish using drift gill net used by the fishing vessels. The data were analyzed using an analytic model and run using ELEFAN 1 software and Length-converted Catch Curve on FISAT II software. The result showed that von Bertalanffy growth parameters covering growth curvature (k), asymptotic length ($L\infty$), and the age of fish in length zero (t_0) was 0.26 year^{-1}, 46.2 cm TL and -1.85 years for *P. niger* and 0.53 year^{-1}, 46.2 cm TL and -0.88 years for *P. argenteus*. The von Bertalanffy growth function for *P. niger* as $L_t = 46.2[1\text{-}e^{-0.26\ (t+1.85)}]$ and for *P. argenteus* as $L_t = 46.2[1\text{-}e^{-0.53\ (t+0.88)}]$. These functions described the expected or average length at a time (age). Total mortality rate (*Z*), natural mortality rate (*M*) and fishing mortality (*F*) were 0.93 year^{-1}, 0.29 year^{-1} and 0.64 year^{-1} for *P. niger* and 1.68 year^{-1}, 0.47 year^{-1} and 1.21 year^{-1} for *P. argenteus*. Exploitation rate (*E*) was 0.68 year^{-1} for *P. niger* and 0.72 year^{-1} for *P. argenteus*. The growth of *P. niger* is slower than the growth of *P. argenteus* and the fishing mortality of *P. argenteus* is higher than *P. niger*'s. Both of the exploitation rates indicated that the fish resources are over-exploited.

Keywords: Growth, mortality, paloh, pomfret fish, population

INTRODUCTION

The coast of Paloh is part of Sambas District region, West Kalimantan. The length of the coastline is around 63 km and is included in fisheries management area (FMA) Republic of Indonesia 571 North Natuna Sea (South China Sea). Capture fisheries production in FMA 571 reached 45,013.38 tons in 2016 (BPS Sambas 2017).

The major catches of marine fishes from Sambas District consist of neritic tuna, big-eye snapper, mackerel, sardine, scad, travel, and pomfret fish. There are three species of pomfret fish caught in Paloh waters, namely *Parastromateus niger*, *Pampus argenteus* and *Pampus chinensis*. *P. niger* and *P. argenteus* were more dominant than *P. chinensis*. Pomfret fish is not fished throughout the year, generally only from August to October in each year. The main fishing gear used is drift gill net.

Biological information about *P. niger* and *P. argenteus* is required to prevent the fish population decline due to the high intensity of fishing. These species are economically important fish for the people of Paloh and the adjacent areas. One of the important biological aspects of the fish to be reviewed is growth and mortality rates. Research on the growth and mortality rates of pomfret fish in Indonesia was previously conducted in Tarakan waters, North Kalimantan. The result of the study showed that *P. argenteus* was already over-exploited (Prihatiningsih et al. 2015). Mohamed et al. (2008) and Amrollahi et al. (2011) who conducted similar research on *P. argenteus* in the Persian Gulf of Iran and the Persian Gulf of Iraq, respectively. The results of these two studies indicated that the species had the growth rate higher than 0.5 year^{-1}. The growth rate of *P. niger* in Taiwan Strait and West Coast of India were 0.3157 year^{-1} and 0.73 year^{-1}, respectively (Tao et al. 2012; Khan et al. 1992). The age of *P. niger* in Iranian Coast of Oman Sea was determined at the age 1 to 6-year-old fish based on otolith cross sections (Yadollahvand and Rahnama 2014).

The purpose of this study was to find out the growth and mortality parameters of *P. niger* and *P. argenteus* in Paloh waters. This research is expected to be an input for the management of these species.

MATERIALS AND METHODS

Study area

This research was conducted by observation on a fishing vessel measured 12.5 m in length and 2.5 in width and a capacity of 5 GT. The fishing target was pomfret fish sampled in coastal waters of Paloh Subdistrict, Sambas District, West Kalimantan Province, Indonesia. This study was conducted from April 2014 to June 2017. All of the fish samples caught by by drift gillnet were measured for their total length followed by the fish identification.

Data analysis

The first caught size average (SL_{50}) calculation used an escape vent selectivity approach with a logistic function (Sparre and Venema 1992). The formula used is as follows:

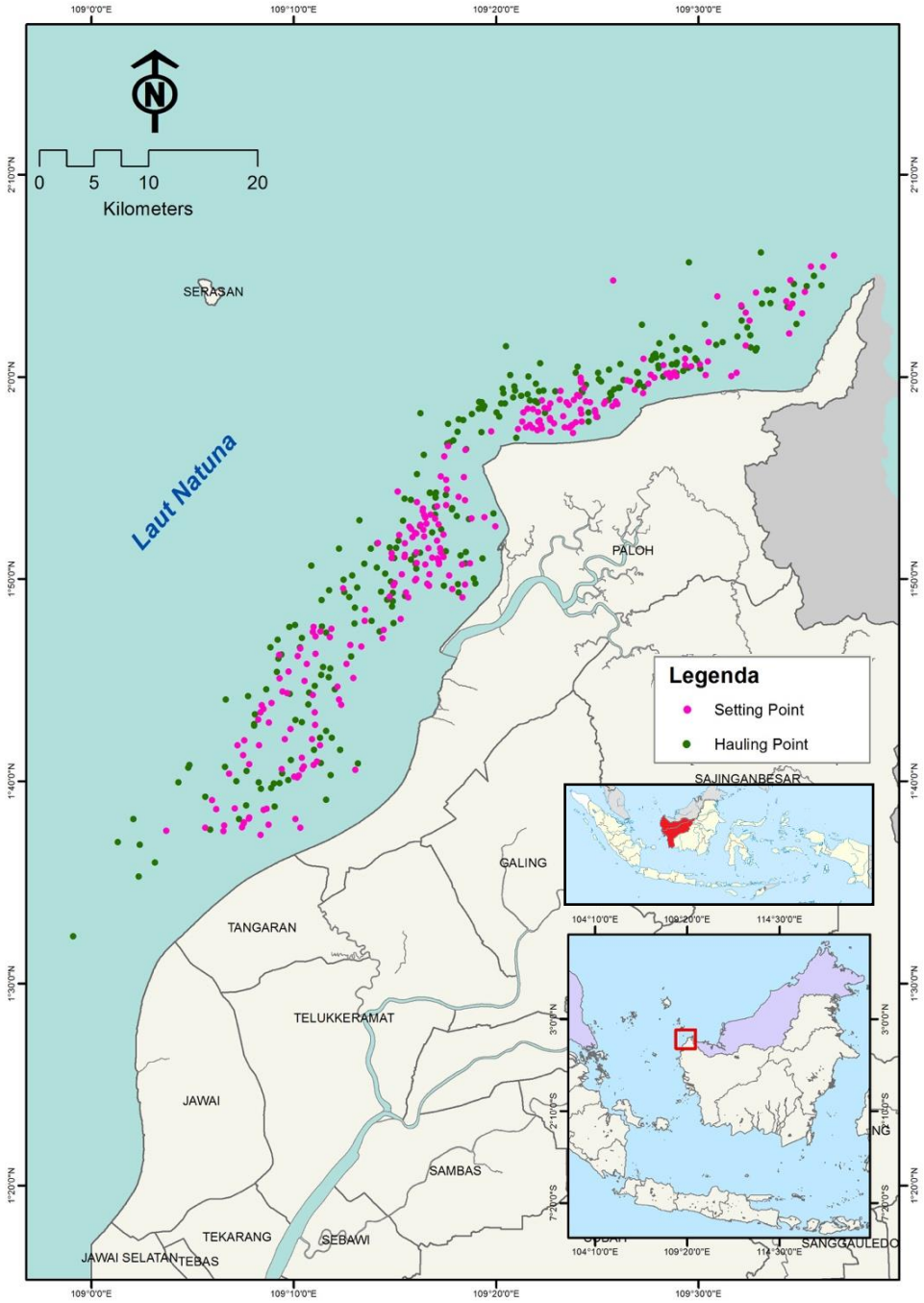

Figure 1. The sampling sites of *Parastromateus niger* and *Pampus argenteus* in the Paloh waters, West Kalimantan, Indonesia

$$SL_{50} = \frac{1}{1 + exp\,(aL + b)}$$

Where:
SL_{50} : Fish with L length caught is divided by fish with length escaped from fishing gear
a and b : Curve parameter (a<0 and b>0), so the length at 50% caught (SL_{50}) same with $-a/b$

Growth parameter (K and $L\infty$) was determined by ELEFAN I method referring to Pauly (1987) based on the von Bertalanffy equation as follows.

$$L_t: L\infty\ (1 - e^{-k\,(t\,-\,to)})$$

Where:
L_t : Total length of fish on the age of t (cm)
$L\infty$: Asymptotic length (cm)
k : Growth curvature

k value was obtained by tracing the total length data of fish from month to month. The growth parameter t_0 was calculated by the equation of Pauly (1987) as follows:

$$\log\,(-t_0) = -0{,}3922 - 0{,}2752\,\log\,(L\infty) - 1{,}038\,\log\,(k)$$

The total mortality rate (Z) was estimated by the fish catch curve method using slope (b) and Ln N/t with relative age according to Pauly (1990) formula as follows:

$$\text{Ln}\ N/t = a - Zt$$

Where:
N : The number of fish in the t period
t : The period needed for growing a length class
a : Fish catch result conversed towards length

Meanwhile, the natural mortality of fish was assumed using Pauly empirical formula (1990) as follows.

$$\text{Log}\ M = -0{,}0066 - 0{,}279\ \text{Log} + 0{,}654\ \text{Log}\ k + 0{,}4534\ \text{Log}\ T$$

Where:
M : Natural mortality rate
L : Maximum total length (mm)
k : Growth rate (mm/year)
T : Temperature (ºC)

For the mortality rate due to fishing was obtained by reducing the total mortality rate (Z) with natural mortality rate (M) or $F = Z\text{-}M$ and the rate of exploitation (E) was calculated as $E = F/Z$ (Sparre and Venema 1992).

RESULTS AND DISCUSSION

Length distribution

The number of samples reached 401 specimens for *P. niger* and 844 for *P. argenteus.* The length frequency distribution of these species in research location was a quite narrow range of sizes, and there was only one mode for each species. The size of both fish captured ranges were between 12 to 45 cm TL and the mode value was 31 cm for *P. niger* and 35 cm TL for *P. argenteus* and the longest first captured fish (SL_{50}) were 31.6 and 31.8 cm respectively were quite similar in Tarakan waters, North Kalimantan, however, *P. argenteus* SL_{50} value was 15.9 cm FL (fork length) (Prihatiningsih et al. 2015). The SL_{50} value was considered high when the size distribution curves to the right (Figure 1). Mohammadkhani and Shirangi (2013) reported the length frequency range of *P. argenteus* in Oman Sea as 15 to 35 cm FL. Parsa et al. (2017) reported the same study in Iranian waters as 10 to 32 cm FL with 19.97±0.12 cm FL for mean length. Amrollahi et al. (2007) found that SL_{50} and L_m of *P. argenteus* in the northern waters of Persian Gulf were 10.1 cm FL and 19.2 cm FL, respectively. An indicator of good fisheries condition was shown by higher SL_{50} value than the length of first maturity (L_m).

Growth function

The von Bertalanffy Growth Function (VBGF) for *P. niger* was $L_t = 46.2[1\text{-}e^{-0.26\ (t+1.85)}]$ and *P. argenteus* was $L_t = 46.2[1\text{-}e^{-0.53\ (t+0.88)}]$ (Figure 2). The VBGF showed that the maximum age was 12 years for *P. niger* and 6 years for *P. argenteus*. After reaching those ages, the growth will steady or in other words, the fish will face natural death. Prihatiningsih et al. (2015) found that the growth for *P. argenteus* caught in Tarakan, North Kalimantan was $L\infty$ = 37.28 cm FL and k = 0.52 year^{-1}; while in Persian Gulf (Iraq) it was discovered that the $L\infty$ = 42.4 cm FL and k = 0.53 year^{-1} (Mohammed 2008). In addition, in the Persian Gulf (Iran) $L\infty$ was 33.9 cm FL and k was 0.55 year^{-1} (Amrollahi et al. 2011). Thus, it showed that k value of *P. niger* was lower compared to *P. argenteus* which means that the growth of *P. niger* was slower than that of *P. argenteus*. In addition, the VBGF also indicated that *P. niger* took a longer time to reach its maximum length.

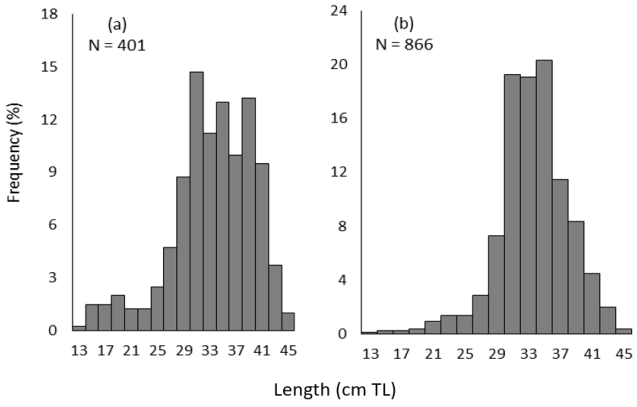

Figure 2. Length distribution of (a) *Parastromateus niger* and (b) *Pampus argenteus* from Paloh waters, West Kalimantan, Indonesia sampled from April 2014 to June 2017

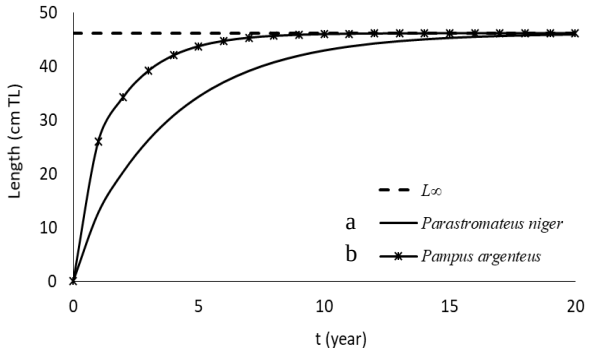

Figure 3. Von Bertalanffy growth function curve of (a) *Parastromateus niger* and (b) *Pampus argenteus* from Paloh waters, West Kalimantan, Indonesia.

Table 1. Mortality and exploitation rate of (a) *Parastromateus niger* and (b) *Pampus argenteus* from Paloh waters, West Kalimantan, Indonesia

Parameter	*Parastromateus niger*	*Pampus argenteus*
Total mortality rate (*Z*)	0.93	1.68
Natural mortality rate (*M*)	0.29	0.47
Fishing mortality rate (*F*)	0.64	1.21
Exploitation rate (*E*)	0.68	0.72

The t_0 value was the hypothetical age when the length of fish was 0 cm. This parameter was believed as the preliminary condition in deciding the point in a set of time where species length is zero. Biologically, this was meaningless because the growth was started when the larvae were bred and already had a length of *L* (0) if using *t* = 0 in the breeding period. However, *L* (0*)* was not an estimation of the length in a realistic breeding, because larvae did not necessarily grow by following the growth model of von Bertalanffy. Thus, this research was previously planned for bigger species which had already been in an exploitation area (Sparre and Venema 1992).

There is possibility of growth parameter differences between the current and previous research. The calculation of growth parameter using different methods or even the same methods often showed different results (Paras et al. 2017). The different $L\infty$ value could be due to the estimation was only for the fishing activity in a specific location. Similarly, the *k* value frequently showed significant differences. Thus, it was essential to have a deeper understanding on the consequences of the application of growth parameter in stock assessment model, because the population prediction of each model depends on data, including age and growth (Lessa and Duarte-Neto 2004; Damora and Wagiyo 2012; Damora and Baihaqi 2013). Moreover, different values of $L\infty$ and *k* are associated with the sampling error, variation in fishing intensity, or environmental conditions (Taghavi Motlagh et al. 2010).

Mortality parameters

Natural mortality, fishing mortality, and total mortality of *P. niger* and *P. argenteus* were derived from the Pauly empirical formula (Table 1). The fishing mortality (*F*) of *P. argenteus* was much higher than that of *P. niger* and the exploitation ratio (*E*) of both was more than 0.5, indicating that two species were exploited in the Paloh waters.

The estimation of natural death (*M*) had several challenges due to the influence of the estimation model and observation location. The variation of natural mortality rate (*M*) is usually considered as stagnant from year to year (Pauly et al. 1984). The total mortality rate (*Z*) was determined by the fishing mortality rate from year to year (*F*). The variety of *F* determined by the different efforts (*f*) for each year. It showed the changes in fishing pressure on the fish population.

Exploitation rate (*E*) was 0.68 year^{-1} for *P. niger* and 0.72 year^{-1} for *P. argenteus*. The yield would reach the maximum sustainable yield (MSY) if *F* equal to *M* (F=M), so *E* would be optimum if $E = F/2F$ or $E_{opt} = 0.5$. The result showed that the value of $E_{0.5}$ of *P. niger* and *P. argenteus* were over 0.5 which could be concluded that this species was overfished.

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