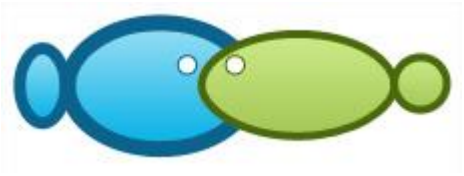

The potential reproduction of Kelabau (*Osteochilus melanopleurus*) in Kampar and Siak Rivers, Riau Province, Indonesia

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Abstract. Kelabau, *Osteochilus melanopleurus*, is a freshwater fish with a high economic value and also with a great potential for cultivation. The purpose of this study was to determine the reproductive of this fish caught by the fishermen using splinter and pillar nets to fish in Kampar and Siak rivers in Riau Province. This study used a survey method with descriptive quantitative data analysis and the parameters observed were sex ratio, gonad maturity level and gonad maturity index. Total sample was of 171 specimens, of which 113 were from Kampar River and 58 from Siak River. From the results, it was observed that that sex ratio of *O. melanopleurus* in Kampar River was 69.39% for males and 30.61% for females, while it was 60% for males and 40% for females in the Siak River. The gonad maturity level in Kampar River was dominated by *O. melanopleurus* gonad maturity level I phase, while the Siak River was dominated by those in gonad maturity level IV phase. The gonad maturity index of the female *O. melanopleurus* in both rivers was greater than that of males. The gonad maturity index value in Kampar River ranged from 0.1-14.95% for females and 0.002-10.14% for males, while in the Siak River it ranged between 0.05-12.18% for females and 0.04 to 4.7% for males. *O. melanopleurus* caught in both rivers were in the stage of gonad development and spawning.
Key Words: freshwater, descriptive quantitative data analysis, sex ratio, gonad maturity level.

Introduction. Riau is one of the provinces on the island of Sumatra having four major rivers with a high population of fish. These are Kampar, Rokan Hilir, Siak and Indragiri rivers (Asiah & Junianto 2020). They serve as a means of transportation, fishing purposes, irrigation, drinking purposes as well as sources of energy. There are 58 species of fish in these rivers which can be further classified into different orders, families and genera (Fithra & Siregar 2011; Pranata et al 2016; Pulungan 2011).

Fishery production was of 307.39 billion fish in 2014, but has been on the decline since 2015 (CSA 2015). This is reflected by the decrease in the rate at which fishing activities are conducted there and by the scarcity of the local fish present in the Riau River. One of the fish species met in the four rivers is the *Osteochilus melanopleurus,* locally known as the kelabau fish. This is a freshwater fish found in Sumatra and Kalimantan that belongs to the genus *Osteochilus* (Kottelat et al 1993). Apart from fishing, Kelabau fish are extensively used for aquaculture purposes due to their high prices and high economic value (Kristanto et al 2008). It has a performance similar to the nilem fish (*Osteochilus vittatus*), but not easily found in its natural environment (Subagja & Djajasewaka 2007). The continuous fishing activities with less selective fishing equipment by the local fishermen are the major reason why these fish are decreasing and becoming scarce. Therefore, *O. melanopleurus* is currently on the critically endangered species list, according to the IUCN and except proper supervision is carried out in that region, especially stopping the act of fishing when they are still developing their reproductive cells, they will go into extinction. For this reason, there is a need to know the reproductive stages of the fish and to use the right catching nets in order to conserve it. Hence, the purpose of this study was to determine the reproductive potential

of *O. melanopleurus* caught by the splinter net used by the fishermen in the Kampar and Siak rivers in Riau.

Material and Method

Description of the study sites. The research, which lasted 12 months, started in April 2017, at the Laboratory of Fisheries Biology, Faculty of Fisheries and Marine, University of Riau. The research was carried out through a survey and a purposive sampling technique was used to select the participants. This was done in two locations: Kampar and Siak rivers, determined by the most common fish catches, with uncontaminated waters. The data were analyzed using quantitative descriptive analysis. And the parameters observed are sex ratio, gonad maturity level (GML) and gonad maturity index (GMI).

Sex ratio. Sex ratio can be calculated by comparing the number of the male with the female fish, as shown below (Haryani 1998):

$$X = J : B$$

Where:
X - sex ratio;
J - number of male fish (tail);
B - number of female fish (tail).

Gonad Maturity Level (GML). Determination of the gonad maturity level was carried out visually through gonad morphology observations (Effendie 1979). This is shown in Table 1 below.

Table 1

Classification of gonad maturity level based on Effendie (1979)

GML	*Female*	*Male*
I	The ovary is like a thread, long to the front of the body cavity. Clear color. Slippery surface.	Testes such as thread, clear color, and the edges are visible in the body cavity.
II	Ovary size is bigger. The color of the ovary is dark yellowish. Eggs have not been clearly seen.	Larger testes size. White coloring like milk. Forms are clearer than the level I.
III	The ovary is yellow. The morphology of the egg begins to appear.	The surface of the testes appears jagged. The color gets white, the testes get bigger.
IV	Ovary gets bigger, eggs are yellow, easily separated. The oil grain is not visible, filling 1/2 - 2/3 of the abdominal cavity.	In a controlled state, it's easy to break. Testes are getting worse.
V	Ovary wrinkled, thick walls, leftover eggs were found near the release.	The deflated rear testes and in the near part of the release still contain.

Gonad Maturity Index (GMI). GMI can be calculated using the formula below (Effendie 1979):

$$GMI = \frac{Bg}{Bt} x100$$

Where:
GMI – gonad maturity index;
Bg – gonad weight;
Bt –gonad weight.

Results and discussion. From the Kampar River, the number of male fish caught was 68 (69.39%), while 30 (30.61%) female specimens were caught in the same river. This is an indication that there was an imbalance between the number of male and female. Also, the number of male *O. melanopleurus* caught in the Siak was 33 (60%), against 22 (40%) females. This was also an indication that the sex ratio is not balanced, affecting the reproductive aspects of the fish, especially the spawning process, which can lead to its extinction (Figure 1), unlike the Layang fish in Latuhalat with a balanced sex ratio of 1:1 between the males and the females (Ongkers & Rijoly 2016).

This imbalance in the sex ratio is a result of the excessive fishing activities in the Siak River. The small number of captured fish, 55 tails, shows a decline in the fish population. The Pacific oyster population in Cimanuk Delta also has a clump distribution pattern caused by differences in the water quality between the two locations, in Pabean Ilir and Pagirikan Sub deltas or in other habitats (estuary, coastal and brackish pond) of the Cimanuk Delta (Hermawati & Samosir 2017). The factors that influence the sexual ratio deviation are differences in fish distribution (Orhan et al 2002), fish activity and movement and sexual variation of males and females during growth, mortality, and length of life, as well as ways of parenting (Mote 2014). Also, the sexual variation between males and females is caused by fishermen catching more females in the growth period than males as shown from the results of this study.

According to Nikolsky (1963), an unbalanced sex ratio can result in small recruitment because the reproductive cycle is affected, the reproductive process is disrupted and there is a difference in the growth and age of early maturity of the gonads (Jayadi & Husma 2016). So if the recruitment of *O. melanopleurus* gets smaller, on the long term it can lead to their extinction. And the ideal sex ratio between the male and female should be close to 1.0:1.0, according to Jayadi & Husma (2016). Achieving this ideal sex ratio will have a positive impact on the inland fishing activities in Kampar and Siak rivers which will be seen in the increase in the reproductive ability of the fish and a large recruitment since the reproductive process is not disturbed as a result of differences in age and early maturity of gonads of the fish.

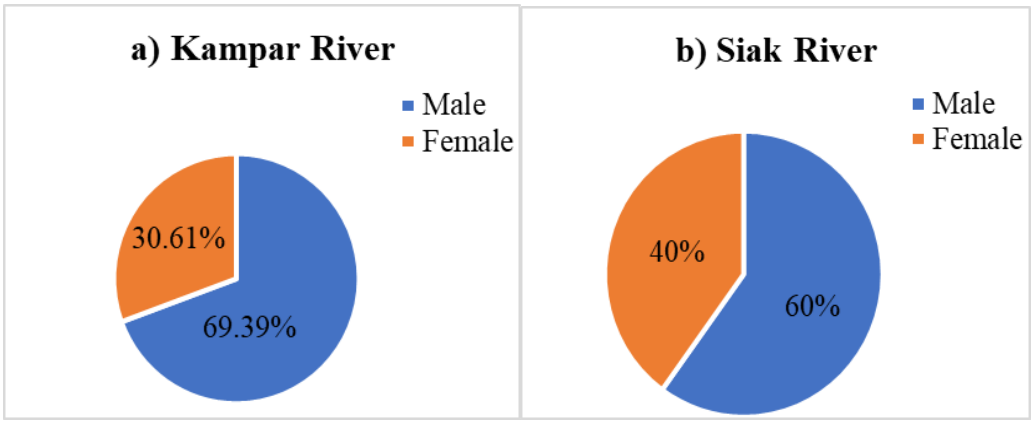


Figure 1. Gender ratio of *Osteochilus melanopleurus* in Kampar and Siak Rivers.

Gonad Maturity Level (GML). There are variations in the gonad maturity level (GML) of the Kelabau fish from Kampar and Siak rivers, ranging from GML I to GML IV, as Represented in the graph shown in Figure 2.

Considering the above figure, the fish from Kampar was dominated by Kelabau fish in the GML I phase with 41.84%, while those from Siak River were dominated by Kelabau fish in the GML IV phase, amounting to 38.18%. This is an indication that those that entered the spawning phase (GML IV phase) are larger in Siak than in Kampar River. As seen in Figure 2, the males began to enter the GML III phase at a length interval of 390-449 mm, while the females entered the GML III phase at a total length interval of 330-389 mm. This is an indication that the females grow faster and use energy for the growth of their reproductive cells, Therefore their gonads mature faster than those of males. The study of nilem also showed that their male was relatively smaller in size than

females when their gonads reached maturity for the first time (Omar 2010). In GML I to III, *O. melanopleurus* is experiencing a period of gonadal growth, when it cannot yet spawn and therefore it is not recommended to catch it at this stage, in order to control the imbalance of the sex ratio.

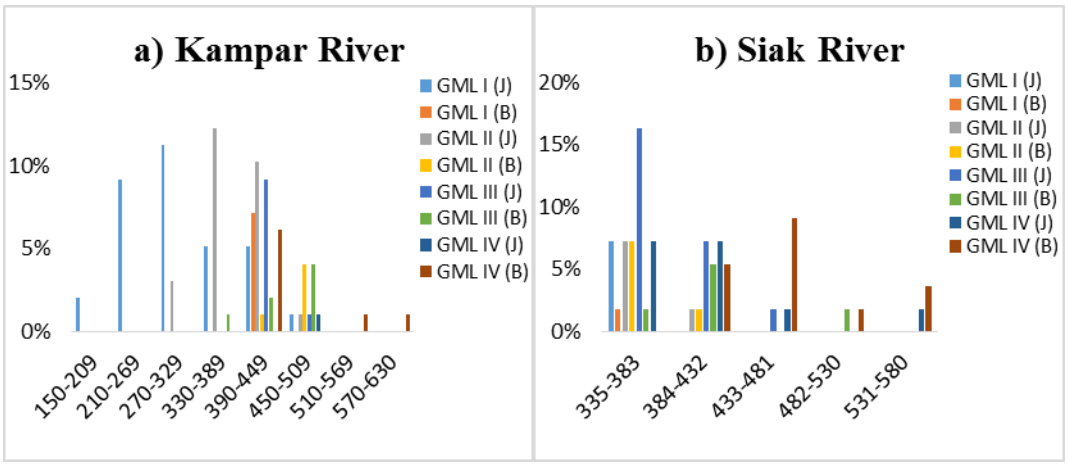


Figure 2. Total length relationship to GML.

O. melanopleurus in the Siak waters is dominated by specimens in the GML IV phase, indicating that the fish can spawn faster than those in the Kampar River. This is shown by the highest number of Kelabau in the Siak that are in GML IV phase, as shown in Figure 3. And the fish present in both rivers in GML IV phase or the spawning phase is an indication that they are ready to spawn.

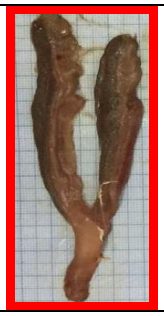
			
Male GML I	Male GML II	Male GML III	Male GML IV
			
Female GML I	Female GML II	Female GML III	Female GML IV

Figure 3. Observation results of *Osteochilus melanopleurus*'s GML.

Gonad Maturity Index (GMI). Considering the results from the graph above, it is obvious that as gonads develop and mature, the GMI value increases. And it is in line with the statement that GMI is directly related to GML and the highest value of GMI is achieved at the peak of the spawning process, at the GML IV (Effendie 2002). Also, the study on nilem showed that the GMI of male and female increases from the GML I to IV and then decrease, at GML V (Omar 2010). The GMI of the fish caught in the Kampar and Siak rivers also show different results, as shown in Figure 4.

In general, the GMI values of male *O. melanopleurus* specimens are lower, compared to those of the females. In this study, the GMI value of male fish in Kampar ranged from 0.002 to 10.14% while those of females ranged between 0.1 and 14.95%. The GMI of *O. melanopleurus* males in Siak ranged between 0.04 and 4.7%, and for females between 0.05 and 12.18%. Even though the GMI value of male fish is lower than for the females, it is still included in the relatively high category. This is in line with the research, where the highest GMI value was found in female *O. vittatus*, at 45.32%, with a length of 145 mm and a weight of 33.3 g, while for the males it was of 23.07%, with a length of 133 mm and a weight of 26.1 g (Rochmatin & Saputra 2014). At each GML, the GMI value of the male *O. vittatus* is relatively smaller than the GMI value of the female fish, because the gonad weight of the female is relatively larger than the weight of male gonads in each GML (Omar 2010).

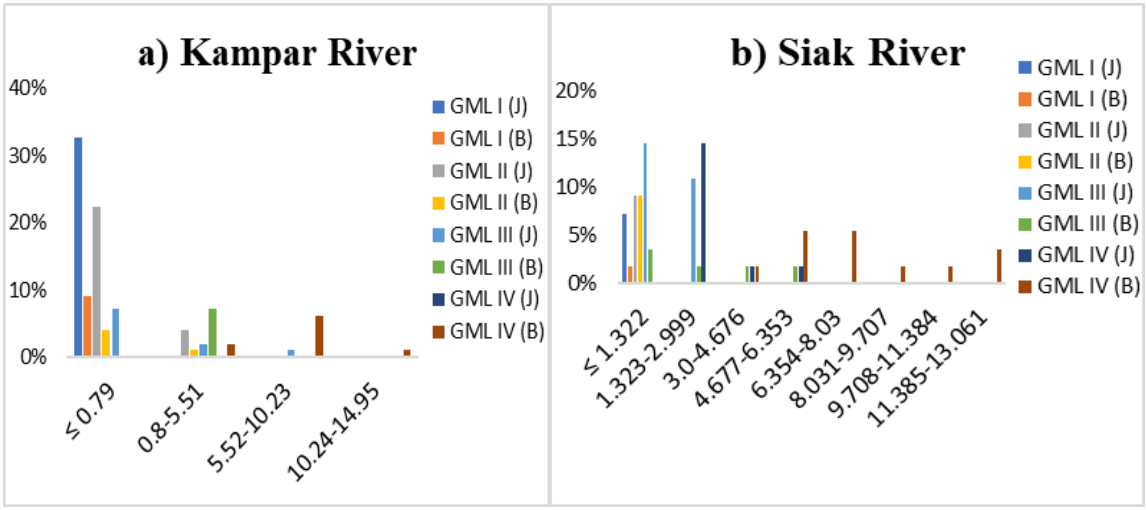


Figure 4. GML's relationship to GMI.

Finally, the results indicated that the fish from both rivers are in the GML IV phase, which is the gonadal development and spawning phase. This is shown by the relatively high value of the GMI for both sexes of the fish. In general, the gonad weight gain in the female fish is 10–25%, compared to 5-10% in the male (Effendie 2002). It can be concluded that *O. melanopleurus* caught in both rivers are in the stage of gonad development and spawning phase.

Conclusions. Based on the results of the current study, *O. melanopleurus* caught in both Kampar and Siak rivers have unbalanced sex ratios, 69.39% for males and 30.61% for females in Kampar River, then 60% for males and 40% for females in Siak River. The gonad maturity level in Kampar River dominated by GML I was 41.84%, while in Siak River which was dominated by GML IV was 38.18%. The gonad maturity index in male *O. melanopleurus* was lower than in females. The GMI values of fish in Kampar River was 0.002-10.14% for males and 0.1-14.95% for females, while in Siak River, 0.04-4.7% for males and 0.05-12.18% for females.

Conflict of interest. The authors declare no conflict of interest.

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