# GROWTH AND EXPLOITATION STATUS (*Channastriata* Bloch, 1793) IN LUBUK LAMPAM FLOODPLAINS, SOUTH SUMATERA

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**ABSTRACT**

Due to the economic importance of *C. striata*in Lubuk Lampam floodplains (Indonesia), this study is aimed to estimate the biological and population parameters required for proposing a future plan to sustain and manage this valuable fish resource. The growth, mortality and explotation ratio of *Channa striata* estimated by employing FiSATProgramme are reported. The parameters of Von Bertalanffy growth model of 1,529 sample fishes were estimated as K= 0.36/ year, L" = 72.98 cm and to = -0.52 year. The coefficients of total mortality (Z), natural mortality (M) and fishing mortality (F) were 1.72, 0.73 and 0.99 year$^{-1}$ respectively. Relative yield per recruit analysis shows that the presentexploitation rate (E) was 0.58. Yield per recruit can be maximized at the exploitation ratio of 0.5 and Lc/Linf values of 0.3. The Yield per recruit and biomass per recruit models indicated that, the fisheries status of *C. striata*in Lubuk Lampam floodplains exceed the limit reference point (Fmax), thus stock of this species in Lubuk Lampam floodplains is indicated being driving down.Reduction in fishing effort and increase number of selective fishing gears are suggested to sustain the fishery of *Channa striata* in Lubuk Lampam floodplains.

**KEYWORDS : Lubuk Lampam floodplains, growth, mortality, management, Biological reference points, Channastriata.**

## INTRODUCTION

*Channa striata* is commonly found in swamps, freshwater plains and also occurs in the lowland rivers, usually caught in bathymetric range of 1-2 m (Allington, 2002 *in* Makmur, 2004). The fish is widely distributed in the Southern Asia, Central Asia and along the South Eastern Asia from Thailand to Indonesia including Papua New Guinea (FAO, 2000 *in* Muflikhah, 2007).

There have been few studies published on *C. striata* in different areas of Indonesia, so it's biological aspect has been little described from several literatures. It is summarized that the maximum length of *C. striata*reportedly can reach about 100 cm, while in several lake and dams in Indonesia asymptotic length of *C. striata* ranged 457 and 722 mm (Kartamihardja, 1994; 2000, Makmur, 2004). Spawning season of *C. striata* occurs in the rainy season with the peak period occurred from February to April. In the floodplains ecosystem, spawning occurs throughout the year, while the peak frequency of spawning occurs in the rainy season, it is seen from the observed diameter of the eggs contained at least 3 of the population size of the eggs in each month (Muflikhah *et al.,* 2005; Makmur, 2003).

The species of *Channa striata* is commercially important freshwater fish and one of the major fish species in Lubuk Lampam floodplains. This area is a shallow basin located at about 60 km southeast of Palembang, South Sumatera. Due to high demand of this fish and habitat degradation, it is necessary to evaluate the population of this fish to ensure the proper management of this fishery.

Hence, the present study was design to provide a review preliminary assessment and management of the species of *C. striata* in Lubuk Lampam fishery. It is aimed to estimate the biological and population parameters required for proposing a future plan to sustain and manage this valuable fish resource.

## MATERIALS AND METHODS

Random samples of *C.striata* were collected for nine months from the commercial catch in the landing site, in Lubuk Lampam floodplains during the period from April to November 2011 (Fig. 1). From each collected fish sample, total length and total weight were recorded to the nearest centimeters and gram, respectively. Length weight relationship was estimated for 1,529 fish of *C. striata* according to Le Cren (1951). The condition factor was calculated according to Hile (1936).

Growth parameter of *C. striata* was estimated using Von Bertalanffy growth model (1938) by fitting the Ford-Walford plot (Lt vs L(t+Δt), while $t_0$ was estimated by inverse Von Bertalanffy growth equation and $W_{inf}$ was

estimated by converting $L_{inf}$ to the corresponding weight using length weight relationship.

$$L(t + "t) = a + b * L(t)$$
$$K = -(1/"t) * \ln b$$
$$Linf = a / (-b) \quad \ldots\ldots (1)$$
$$t0 = 1/k * \log eLinf - \log e (Linf - Lt) \quad \ldots\ldots (2)$$
$$Winf = a' * Linf^{b'} \quad \ldots\ldots (3)$$

where, L(t) = length of fish at time (t) in cm,
Linf = asymptotic length (cm),
K = growth coefficient (year$^{-1}$),
a = intercept ;b = slope,
t0 = hypothetical age (in years) when length of fish at zero length,
Winf = asymptotic weight (gram)
a' & b' = length-growth coefficient.

Performance of length and weight were estimated according to Moreau *et al*. (1986). The maximum age was determined according to Pauly & David (1981), and the massive maturity age was obtained using Richter-Evanov methods (1972).

The instantaneous total mortality coefficient (Z) of *C.striata*in Lubuk Lampam floodplains was obtained by using length-converted catch curve method (Gayanilo *et al.,* 1994). The natural mortality (M) was calculated using Pauly empirical formula (1980): Log M= - 0.0066 – 0.279 log $L_{inf}$ +0.6543 log K +0.4634 log T,where, $L_{inf}$ & K are VBGF parameters and T is the annual mean temperature ($^{o}$C). Instantaneous fishing mortality (F) was calculated by subtracting the natural mortality coefficient (M) from the total mortality coefficient (Z).

The estimation of survival rates (S) was estimated by the equation $S = e^{-z}$ (Ricker, 1975). The exploitation ratio (E) was calculated for *C.striata* according to Baranov (1918) formula. Length at first capture and Length at recruitment (Lc&Lr) were investigated from the equation of Beverton and Holt (1956 & 1957). While Age at first capture and Age at recruitment (tc&tr) were estimated by applying back calculation of growth equation of Von Bertalanffy.

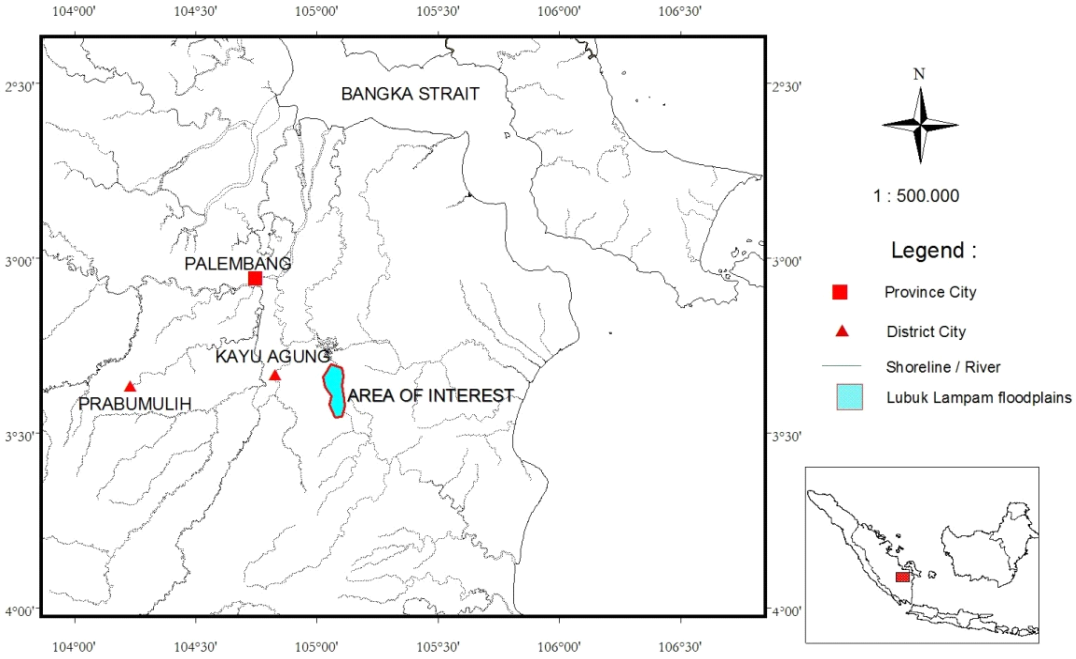


Figure 1. Lubuk Lampam floodplains location, South Sumatera.

The relative yield per recruit (Y'/R) and biomass per recruit (B'/R) were estimated by Beverton and Holt models (1957). The biological reference points values of fishing mortality such as $E_{max}$ and $E_{0.1}$ were investigated together with various relationships between the yield per recruit, fishing mortality, age at first capture and natural mortality.

## RESULTS

### Length-Weight Relationship and Condition Factor

The examined sample of *C. striata* varied in length between 5.1 and 70.0 cm and from 7 to 2,997 gram in weight. The condition factor (q) value of *C.striata* in Lubuk Lampam floodplains was found to be 0.9, where length weight relationship equation was found to be:

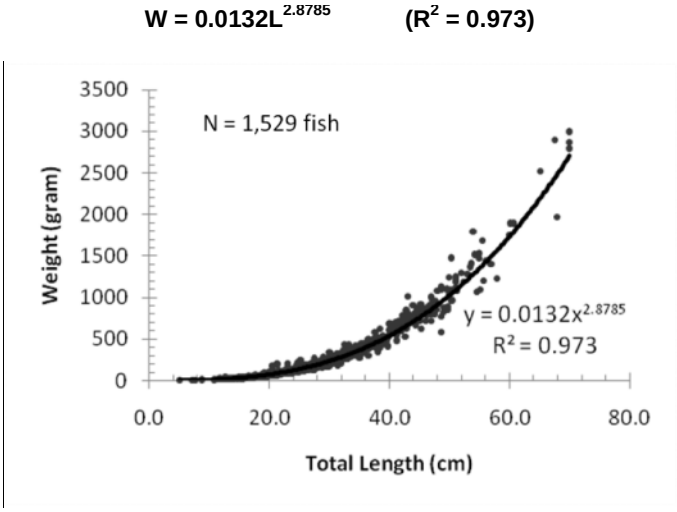


Figure 2. Length-Weight relationship of *C. striata.*

Monthly condition factor of *Channa striata* ranged from 0.5 – 2.2 and monthly average ranged from 0.87 – 0.90. Condition factor of *Channa striata* fluctuated monthly affected by the difference of age, maturity, environment and food aviability in those area (Makmur, 2004). While growth pattern of *C. striata* showed isometric pattern in April and September, and allometric pattern in May-August and October-November (Table 1).

**Growth Performance and Maximum Age**

The growth parameters using Von Bertalanffy equation were estimated as K= 0.36/year, L" = 72.98 cm and $t_0$ = -0.52 year. Values of W" obtained from length-weight relationship was estimated 3,049 gram. The growth performance values in length (ÔL) and in weight (ÔW) of this species were 3.283 and 1.879 respectively. Growth performance values showed that *C. striata* growth rapidly in length than weight scales. According to the present data, it was found that maximum age (longevity) and age of massive maturity of *C. striata* in Lubuk Lampam floodplainsare 11.5 year and 2.60 year respectively. Monthly length frequency distribution of *C. striata* is showed in Figure 3.

Table 1. Condition factor of snakehead fish *(**Channa striata* **Bloch, 1793)**

| Month | Range | Average | L-W equation | $R^2$ |
|---|---|---|---|---|
| April | 0.6 - 1.5 | 0.90 | $W = 0.0079\ L^{3.038}$ | 0.98 |
| May | 0.6 - 2.4 | 0.88 | $W = 0.0252\ L^{2.662}$ | 0.96 |
| June | 0.6 - 1.3 | 0.88 | $W = 0.0054\ L^{3.1449}$ | 0.99 |
| July | 0.6 - 2.1 | 0.90 | $W = 0.0128\ L^{2.8921}$ | 0.96 |
| August | 0.5 - 1.5 | 0.90 | $W = 0.0166\ L^{2.8121}$ | 0.97 |
| September | 0.7 - 1.6 | 0.90 | $W = 0.0088\ L^{3.0042}$ | 0.98 |
| October | 0.6 - 2.2 | 0.87 | $W = 0.0205\ L^{2.7359}$ | 0.97 |
| November | 0.7 - 1.2 | 0.89 | $W = 0.0143\ L^{2.8527}$ | 0.98 |

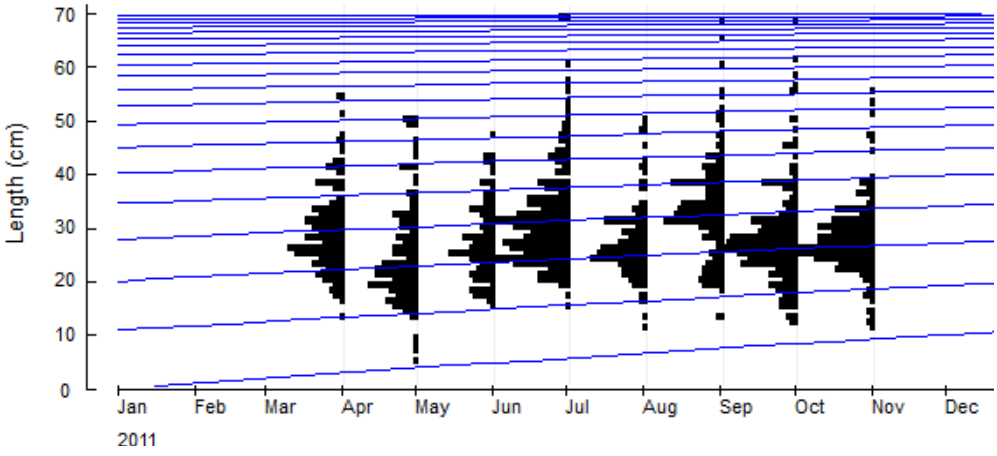


Figure 3. Length frequency distribution of *C. striata*

### Mortality and Exploitation rate

The length converted catch curve analysis for *C. striata* in Lubuk Lampam floodplains produced total mortality estimates of Z = 1.72 ± 0.09 (Figure 4). The natural mortality M = 0.73 is calculated using Pauly's empirical formula, with annual temperature about 29 °C (Pauly, 1980). The fishing mortality (F) is therefore 0.99/year. The survival rate value of *C. striata* in Lubuk Lampam floodplains was found to be 0.57, while the exploitation ratio (E) was 0.58. Length and age at first capture (Lcand tc) as obtained in the present study were found to be 21.44 cm and 0.70 year, while length at recruitment (Lr) was 19.18 cm and the corresponding age at recruitment (tr) was 0.3 year.

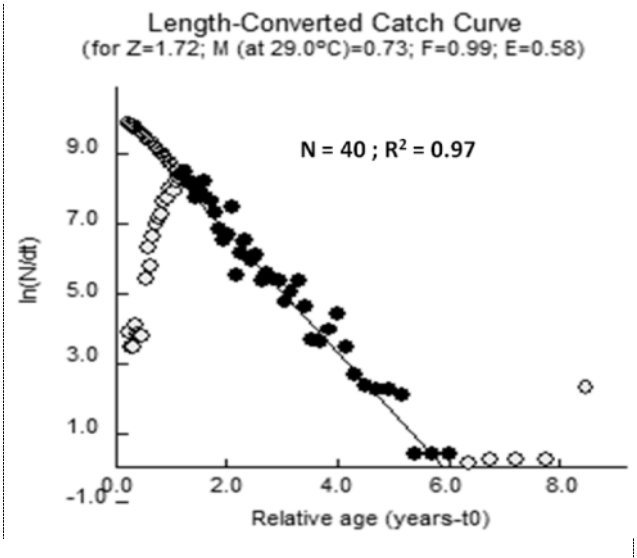


Figure 4. Length-Converted Catch Curve of *C.striata* in Lubuk Lampam floodplains.

### Recruitment Pattern

Plot of the percentage recruitment of *C. striata* into the fishery in the portions of the floodplains showed continues recruitment from January to November with three pulses were recorded in March (14.2%), April (9.5%) and October (14.7%) with average recruitment in one year was 8.3% (Figure 5).

### Relatif Yield Per Recruit (Y'/R) and Biomass Per Recruit (B'/R)

Using knife edge selection of Beverton and Holt, the yield per recruit for *C. striata* in Lubuk Lampam floodplains with input parameter M/K and Lc/Linf, and the optimum exploitation rates were calculated. The $E_{max}$, $E_{0.1}$ and $E_{0.5}$ values for relative yield per recruit analysis were 0.52, 0.41 and 0.30 respectively (Figure 6). Relative yield per recruit analysis showed that the present exploitation rate (E) was 0.58. Yield per recruit can be maximized at the exploitation ratio of 0.5 and Lc/Linf values of 0.3. The exploitation rate (E) in Lubuk Lampam floodplains was slightly higher than maximum acceptable limit and the position present exploitation value was on the right side of yield per recruit curve ($E_{present}$ (0.58) >$E_{max}$ (0.52)).

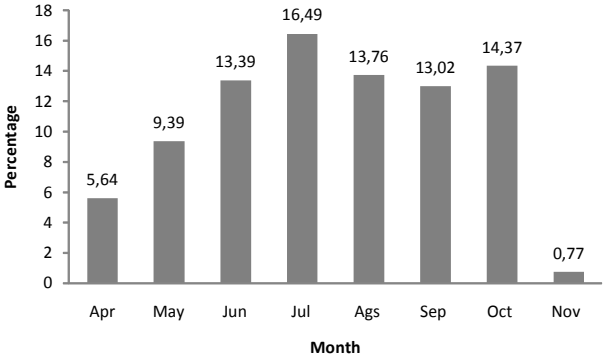


Figure 5. Recruitment pattern of *C. striata* in Lubuk Lampam floodplains.

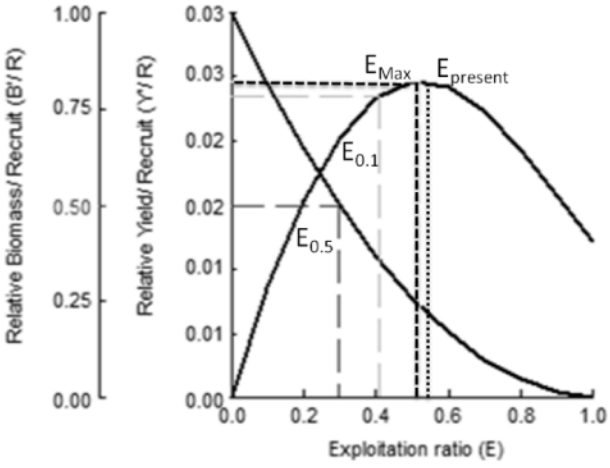


Figure 6. Relative Yield/Recruit and Relative Biomass/Recruit of *C.striata* in Lubuk Lampam floodplains.

### DISCUSSION

In the present study, the value of the exponent "b" was found to be 2.8785 which indicated negative allometry. This value compared with previous study was higher than values of "b" of *C. striata* which was estimated by Kartamihardja (1994) in Kedungombo dams (2.743) and Makmur (2004) in Talang Fatima floodplains, South Sumatera, but still within the range of values in Banjaran River (2.77-3.123) (Table 2).

Table 2. Von Bertalanffy growth parameters for *C. striata* in different places.

| Authors | K | Linf (cm) | b | Location |
|---|---|---|---|---|
| Kartamihardja *et al*., 1994 | 0.40 | 66.93 | 2.74 | Kedungombo Dams, Central Java |
| Kartamihardja *et al*., 2000 | 1.10 | 45.70 | | Tondano Lake, North Sulawesi |
| Sinaga *et al*., 2000 | - | | 2.77 - 3.12 | Banjaran River, Central Java |
| Makmur, 2004 | 1.36 | 72.20 | 1.23 - 1.14 | Talang Fatima flood plains, South Sumatera |
| Kakkakeo *et al*., 2004 | 0.35 | 67.00 | | Ubolratana Reservoir, Thailand |
| Present study | 0.36 | 72.98 | 2.88 | Lubuk Lampam floodplains, South Sumatera |

In fisheries studies; the condition factor is an essential biological parameter needed to understand the suitability of the environment for good living of fish (Le Cren, 1951; Mahmoud *et al.*, 2010). The condition factor (k) was estimated 0.9, compared with previous authors (Makmur, 2004) gave different values (0.51 – 1.81). This controversy was explained to be due to the variations in the environmental conditions (Hernandez, 1986). The condition factor fluctuated monthly, affected by differences of age, gonad maturity and food suitability in their habitat (Makmur, 2004).

The growth performance index is considered to be a convenient and robust tool for the comparison of growth parameters from different data sets (Moreau *et al*., 1986 & Pauly, 1980). The growth performance of *C. striata* in the present study, ($\hat{O}L$ = 3.283), which is lower than that observed by Kartamihardja, (1994) ($\hat{O}L$ = 5.253) in Kedungombo dams and Tondano Lake (2000) ($\hat{O}L$ = 5.36) and Makmur (2004) in Talang Fatima floodplains ($\hat{O}L$ = 5.85). Variations in the values of the parameter of growth performance might suggest variations in the growth rate (Moreau *et al*., 1986).The value of growth performance index in the present study compared with Makmur (2004) which has the same type of habitat and near geographic location has only half performance due to adaption flexibility on change of environmental condition.

Maximum age of *C. striata* in Lubuk Lampam floodplain scould live 11.50 years in the present study. The longevity of fish species might be affected by the environmental conditions under which a fish lives (Wootton, 1990; Mahmoud *et al.*, 2010). *C. striata* is highly predacious species, ambush feeders on other fishes. In addition, their adaptability to living in turbid or clear waters, their apparent ability to tolerate extreme water temperature change were considered affected maximum age of this species.

The recruitment pattern established in this study revealed an all year around recruitment with three pulses in March, April, and October. This observation agreed to the assertion of Makmur *et al.*, (2003) that *C. striata* in South Sumatera floodplains spawned along the year with length at recruitment (Lr) 15.4-18.0 cm while in the present study value of Lr was 19.18cm respectively.

Species *C. striata* in the present study estimated, that exploitation rate E = 0.58 showed that fishing mortality was higher than natural mortality. The implication is that *C. striata* died more due to human exploitation than natural death (e.g disease, predation etc). For an optimally exploited stock, natural and fishing mortalities should be equal or E = 0.5 (Gulland, 1971; Abowei *et al.,* 2010). The maximum exploitation rate (Emax), which gives maximum relative yield-per-recruit, is estimated at 0.52 and slightly differs from the exploitation rate (0.58) estimated in this study. This further indicated that the stock of *C. striata* is driving the stock down into overfished condition.

## CONCLUSIONS

*Channa striata* in Lubuk Lampam floodplains shows a negative allometric growth. Although this species recruits along the year, the stock has slightly reached an overfished phase ($E_{present} > E_{max}$). This was due to the fishing mortality for *C. striata* is higher than the natural mortality. Therefore, it is necessary to reduce fishing effort tand applied selective fishing gears to maintain fish stocks sustainably.

## ACKNOLEDGEMENTS

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