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Population dynamics of parameters and the size of the first gonade maturity on Java Barb (*Barbonymus gonionotus*) in Pondok Reservoir, East Java

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ABSTRACTS

The Pondok Reservoir has an area of 407 hectares located in Ngawi Regency, East Java Province. Java Barbs in Pondok Reservoir still dominates but the trend of the percentage of catches decreases every year, while introduced fish such as Tilapia tend to rise. Information on population dynamics of Java Barbs (*Barbonymus gonionotus*) is needed as input for sustainable fisheries management. This study aims to analyze the parameters of the population dynamics of Java Barbs in the Pondok reservoir, East Java. The method of collecting length frequency data is carried out every month starting from January to November 2020, data analysis was assisted by using the FISAT II package program. The results showed that the length of the first gonad maturity of Java Barbs in Pondok reservoir was 23.9 cm. Growth parameters of infinitive length (L_∞) = 29 cm, growth coefficient (K) = 0.55/year, and Barb's growth equation is Lt = 29 (1-e $^{-0.55\ (t+0.29844)}$). Natural mortality parameters (M) = 1.25/year, fishing mortality (F) = 2.45/year, total mortality (Z) = 3.70/year, and exploitation rate (E) = 0.7.

Key word : *Population Dynamic, Java Barb, Reservoir*

Introduction

Pondok Reservoir is included in the Bengawan Solo River management area, geographically located at south latitude S: 7°23'35"; east longitude E: 111°34'27", in Ngawi Regency, East Java Province. Pondok Reservoir has an area of 407 hectares, the volume of water is 25,232,857 m^3, the main function is to provide irrigation water while other important functions are for aquaculture and capture fisheries (Depatment of Public Work, 2015; Kasiyanti *et al.*, 2013).

Fisheries activities in the Pondok reservoir are fish aquaculture in floating net cages (KJA) and capture fisheries. Total catch production increased from 128.7 tonnes in 2016 to 170,200 tonnes in 2019. Capture fisheries production is dominated by Java barb (*Barbonymus gonionotus*), but the percentage decreased from 62.4% in 2016 to 45% in 2019 (Food and Fishery Service Ngawi Regency, 2019; BPS-Statistics of Ngawi Regency, 2020).

The characteristics of Java barb in Pondok reservoir have the number of linealateralis (LL) = 31, maximum total length 28 cm, standard length = 23

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cm, height 6.3 cm, head length = 4.5 cm. Fin formula: D.III.8, C.21, A.II.6, V.I.9, P.14. Name synonyms include: *Puntius javanicus* Bleeker, Puntius (Barbodes), *Puntiusviehoeveri* Fowler, *Barbuskoilometopon*, and *Puntius gonionotus* (FAO, 2010; Kottelat *et al*., 1993).

Fig. 1. Java barb (*Barbonymus gonionotus*)

The novelty of this research is that previous research in the East Java reservoir only concerns aquatic environmental problems, there is still very little research on fish population dynamics. For example: Aida and Utomo (2019) stated that the waters of the Pondok reservoir in East Java are already in an eutrophic status with an indication that the total phosphorus content is quite high = 40.9 mg/l, and the TSI (trophic state index) value is also quite high = 62. Susilo (2019) stated that the regulation of the Pondok Reservoir floodgate in East Java which aims to distribute water to rice fields can increase the high intensity of rice planting, and high net benefits. Viani and Retnaningdyah (2018) state that the water quality in the Lahor reservoir in East Java is not good with indications of a high BOD value of 13.95 – 15.73 mg/l, low brightness of 90-96 cm, status of the reservoir waters is eutrophic to hypereutrophic. While the research being conducted now is about the population dynamics of Java barbs in Pondok Reservoir East Java, these research needs to be done as input for sustainable fisheries management in Pondok Reservoir East Java.

Materials and Methods

The study was conducted from January to November 2020 in the Pondok reservoir, Ngawi Regency, East Java Province, Indonesia (Figure 2). Data collection was carried out at the fish landing site (TPI) assuming this place already represented the catch of fish in the Pondok reservoir, because fishermen generally sell fish in TPI from various types of fishing gear (gill-net various mesh sizes, cast-net, scoop-net). Data collection was assisted by enumerators to record the length frequency data of Java barbs every month.

Estimation of Growth Parameters

The growth pattern of the relationship between length and weight is based on Carlander in Effendi (1997): $W=aL^b$; dimana W= weigth (gram), L=length (cm). The value of "b" is used to predict the growth pattern of fish. If the value of b=3 is an isometric growth pattern, but if b≠3 it is an allometric growth pattern (Walpole, 1992). The growth performance

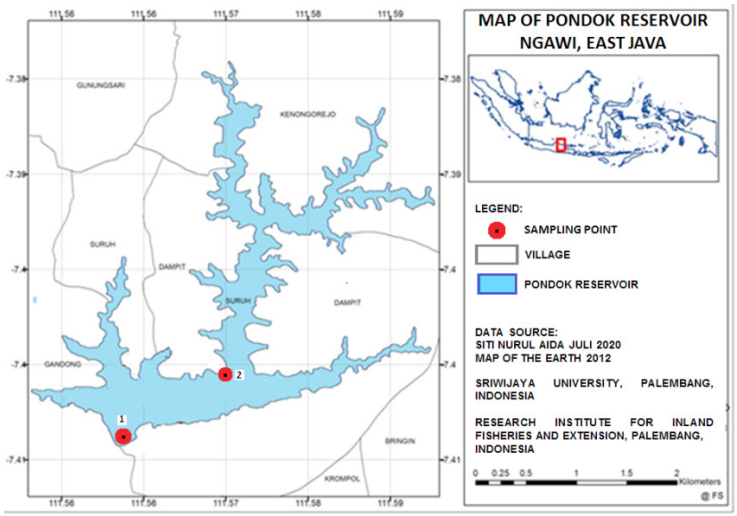

Fig. 2. Map of Pondok reservoir. Research location

index (Φ',phi-prime) was calculated using the equation based on Pauly and Munro (1984) as follows: Φ'= Log10 K + 2 Log10 L∞.

The growth parameters of individual fish, namely infinitive length ($L_{¥}$) and growth coefficient (K) were analyzed based on monthly data on length frequency (cm) using the ELEFAN (electro length frequency analysis) program, in the FISAT II package program (Gayanilo *et al.*, 1996).

The growth equation based on the Von Bertalanffy model in Pauly (1984): $Lt = L\infty (1-e^{-k(t-t0)})$; Lt = length of fish at time t (cm); Lt = length of fish at time t (cm); t_0 = age when the length is 0 cm. The growth coefficient value is K = -b, while L∞ = -a/b.Estimation of t_0 value is calculated based on Pauly's (1984) equation:Log (-t0)=-0.3922 – 0.2752 Log (L) – 1.038 Log (K).

Estimation of Mortality Parameters

Parameters of total fishing mortality (Z) were analyzed based on Jones and Van Zalinge in Spare and Venema (1992). The method uses the following regression equation: Log C {(L ,$L_{¥}$)} = a +Z/K * Log ($L_{¥}$ - L), where : Z/K = b (slope of regression); C (L , $L_{¥}$)= Cumulative catch at length L (cm); $L_{¥}$ = infinitive length (Cm), K = growth acceleration constant, Z = total mortality parameter. Estimation of natural mortality parameters (M) based on Pauly's (1984) equation: Log (M) = - 0.0152 – 0.2790 Log (L) +0.6543 Log(K)+0.4634 Log(T), T is the average water temperature. While fishing mortality parameters (F) = Z – M and exploitation rate E = F/Z. If the value of E is greater than 0.5, it indicates over fishing and if it is less than 0.5 it is under fishing.

Estimation of the Size of the First Gonade Maturity

Estimation of the size of the first gonad maturity using the Spearman-Karber method (Udupa, 1986). To estimate the length at the first time gonade maturity assuming the mean size of the first gonad maturiture occurs when 50% of Java barbs mature. The equation of The size of the first gonad maturity(m) is:

m = (Xk + X/2) – (X, Σpi)

m : logarithmic of size at the first gonad maturity.

Xk : logarithmic of size at mean value of 100% mature.

X: The addition of the logarithmic of the middle value of the length class.

Pi = Ratio onnumber of gonade mature in class-i and the number of fish samples in class i.

Results

Growth Parameters

Analysis of growth parameters based on monthly data of length frequency using the FISAT II program package obtained the infinity length of Java barbs (L∞) = 29 cm, growth constant (K) = 0.55 /year, t_0 (age t_0) = -0.29; mean water temperature = 29.5 °C (Figure 3), so that it was obtained a graph of fish growth based on Von Bertalanffy:

(Lt) = $29(1-e^{-0.55(t+0.29844)})$ estimated to reach a maximum length of 29 cm at the age of approximately 7 years(Figure 4).

Mortality and Exploitation Rate

Natural mortality (M) estimated based on Pauly's method (1984) = 1.25/year; fishing mortality (F) =

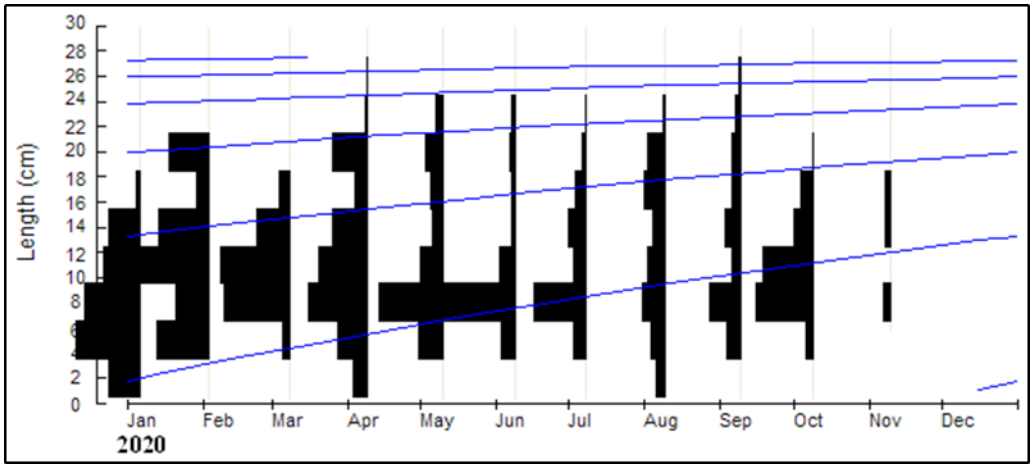

Fig. 3. Fisat analysis of Java barb (*Barbonymus gonionotus*) in Pondok reservoir, Ngawi East Jawa.

2.45/year; Total mortality (Z) = 3.70/year, Exploitation rate (E) = 0.7 (Figure 5).

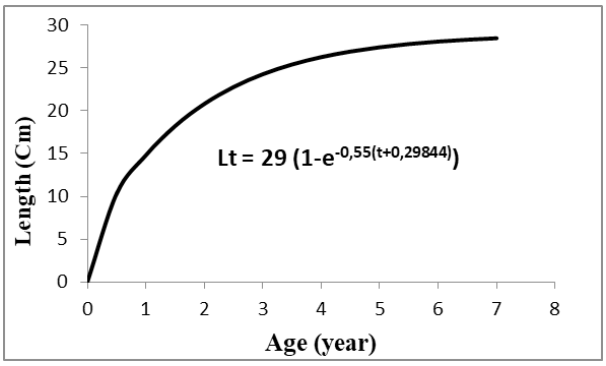

Fig. 4. Growth of Java barb (*Barbonymus gonionotus*) in Pondokreservoir, Ngawi East Jawa.

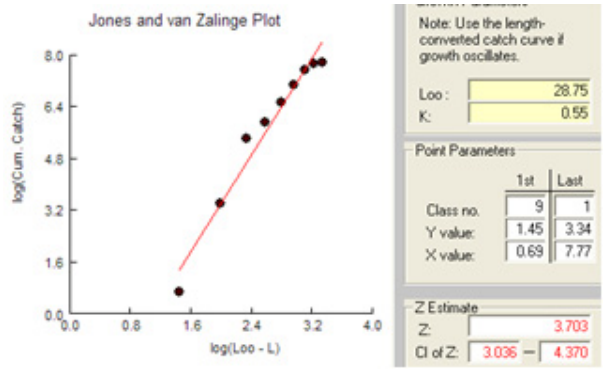

Fig. 5. Total mortality of Java barb (*Barbonymus gonionotus*) in Pondok reservoir.

Length and Weigth Relationship of Java Barb in Pondok Reservoir

The results of the analysis of the relationship between length and weight of Java barbs in April (rainy season) obtained the equation is W = 0,0049L^{3,34}, in October (dry season) the equation is W= 0,0925L^{2,35}.

The Length Size at First Gonade Maturity (Lm)

The average size of the first gonad maturity is important to know because it is used as input in the management of fish resources. The size of the first gonad maturity (Lm) of Java barbs in Pondok reservoir was 23.9 cm (Figure 7).

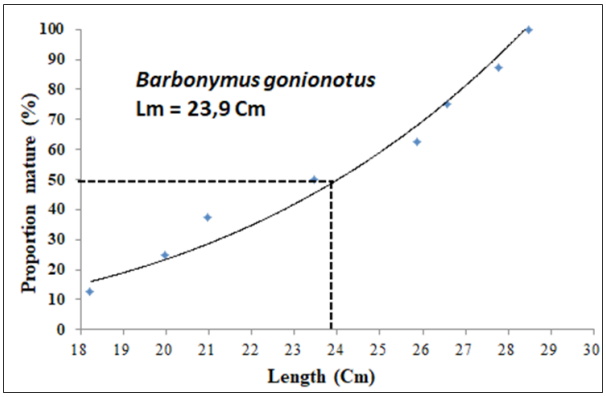

Fig. 7. The length size at first gonadematurity of Java barb in Pondok reservoir waters.

Discussion

Growth and Mortality Parameters

The maximum length (L∞) = 29 cm, this size is smaller than the Java barbs in the the Jatiluhur and Wonogiri reservoirs (Table 2). The growth rate (K) of 0.55 years^{-1} and the performance index of 2.66 showed slow growth, as well as the average size of fish caught was smaller, this could be due to unfavorable environmental factors or competition with other fish species (Fauzi and Anna, 2005; Jackson *et al.*, 2001). Besides that, because the Pondokreservoir is smaller and the water quality is worse than the Jatiluhur and Wonogiri reservoirs (Purnomo and

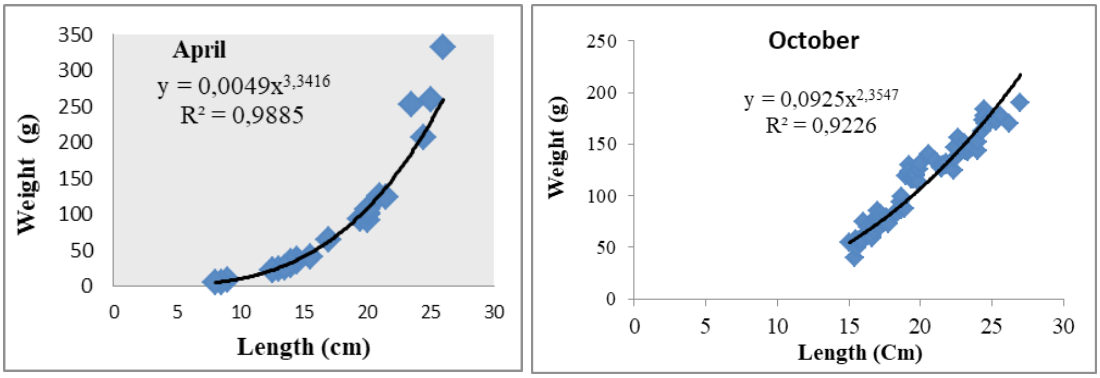

Fig. 6. The length and weight relationship of Java barb (*Barbonymus gonionotus*) in Pondok reservoir.

Table 2. Some population dynamic parameters and size at first gonadematurity of Java barbin several Location

	Location (Cm)	L∞ (yr^{-1})	K (yr^{-1})	M (yr^{-1})	Z	E (Cm)	Lm	Source
Reservoir :								
Jatiluhur	42,8	0,92	1,56	1,032	-	22,8		Warsa and Tjahyo, 2017
Wonogiri	42	0,3	0,75	1,95	0,62			Aida and Utomo, 2011
Tempe Lake	29,14	0,3	0,85	1,58	0,46			Samuel *et al.,* 2010
Padma River	-	-	-	-	-	16		Jasmine and Begum, 2016

Kartamihardja, 2005; Warsa and Tjahjo, 2017).

The growth pattern during the dry season is allometric negative, while during the rainy season it is allometric positive, this is because during the rainy season the water quality is better and the temperature during the dry season is hotter (Aida *et al.,* 2016; Kolding and Zwieten, 2012; Hoggarth and Utomo, 1994; Ng'onga *et al.,* 2019) (Figure 6). Slow growth can be caused by high fishing pressure, poor water quality, and lack of availability of natural food (Bagenal and Tesch, 1978; Huet, 1990; Dulc¡ic *et al.,* 2003). If the value of the exploitation rate more than 0.5 is include over fishing satatus (Paully, 1984). Exploitation rate of Java barb in Pondok Reservoir (E) = 0.7, then it is included in the category of over fishing. This is because Java barb including relatively large fish and high economic value, so that it becomes a target for fishing, thefishing activities are already intensive.

First Gonade Maturity

The average size of Java barb caught was 14.4 cm, while the size of the first gonad maturity of Java barb (Lm) = 23.9 cm. The average size caught is smaller than the size of the first maturity of the gonads, which can pose a threat to the Java barb population in the Pondok reservoir. This is due to fishing activities in Pondok reservoir, there are still many fishing gears with small mesh sizes, so that many small fish are caught (Aida *et al.,* 2016); so it doesn't have a chance to spawn. On the other hand, in other waters the size of the first gonad maturity in Jatiluhur reservoir, Indonesia is 22.8 cm (Warsa and Tjahyo, 2017), in Padma river 16 cm (Jasmine and Begum, 2016), Chi River, Thailand 34.0 cm (Satrawaha and Pilasamorn, 2009).

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Conclusion

The growth of Java barb in Pondok Reservoir is slow when compared to other Reservoirs such as in Jatiluhur and Wonogiri Reservoirs, this is due to the smaller size of the Pondok Reservoir and poorer water quality. The exploitation rate of Java Barbs in Pondok Reservoir is already over fishing because Java Barbs have a relatively large size that is easy to catch, Java Barbs are an important economic fish that are the target for catching, Java Barb catching activities are already intensive. The average size caught is 14.4 cm smaller than the size when the first gonads mature 23.9 cm, which can pose a threat to Java Barbs population in the Pondok reservoir.

References

Aida, S.N. and Utomo, AD. 2019. Carrying Capacity Estimation fro Fish Culture of Floating Net Cages in Pondok Reservoir, Ngawi East Java. *BAWAL.* 10 (3): 197-208. http://ejournal-balitbang.kkp.go.id/index.php/bawal. (in Indonesian)

Aida, S.N., Utomo, A.D., Hidayah, T., Ali, M., Kusuma, H., Subroto, G. and Waroh, B. 2016. Technic Report, Aspects of Biology and Dynamics of Fish Populations At Pondok and Widas. Reservoir, East Java. Research Institute for Inland Fisheries and Fisheries Extention Fisheries Research And Development Center. Agency For Marine And Fisheries. Research And Development. Ministry of Marine Affairs and Fisheries.135 P. (In Indonesian).

Bagenal, T. B. and Tesch, F. W. 1978. Age and growth in methods for assessment of fish production in freshwaters. IBP Handbook Unwin Bros. Ltd. Survey 3. 365 pp.

Central Bureau of Statistics-Statistics of Ngawi Regency. 2020. Published by: BPS-Statistics of Ngawi Regency. BPS-Statistics Indonesia. "CV. Azka Putra Pratama". 464.P. (In Indonesian).

Dulcˆic', J., A. Pallaoro, P. Cetinic, M. Kraljevic, A. Soldo, and I. Jardas. 2003. Age, growth, and mortality of picarel, *Spicara smarls* L. (Pices: Centracanthidae), from the eastern Adriatic (Croatian coast). *J. Appl. Ichthyol*. 19 : 10- 14

Effendi, I. 1997. *Fisheries Biology*. Foundation Archipelago Library. Yogyakarta. (in Indonesian).

Food and Agriculture Organization. 2010. The State of World Fisheries and Aquaculture. FAO Rome: 153p

Fauzi and Anna, 2005. Fisheries and Marine Resources Modeling. Jakarta: PT. Library Gramedia (In Indonesian).

Department of Livestock and Fisheries of Ngawi Regency. 2019. Data on general inland water fishery production (p. 6). Ngawi Regency.(In Indonesian).

Depatment of Public Work. 2015. Water Resources Management Plan Bengawan Solo RiverRegion.234 P. https://sda.pu.go.id/balai/bbwsbengawansolo/portal/index.php/document-category/pola-dan-rencana (in Indonesian)

Hoggarth, D.D and Utomo, A.D. 1994. The fisheries ecology of the LubukLampam river floodplain in south Sumatra, Indonesia. *Fisheries Research.* 20 : 191-213

Gayanilo Jr F.C., Sparre, P. and Pauly, D. 1995. The FAOICLARM stock assessment tools (FISAT) User's guide. *FAO Computerized Information Series Fisheries*. ICLARM Contribution 1048. 126 pp.

Huet, M. 1990.Text *Book of Fish Culture Breeding and Cuktivation of Fish Fishing*. News (Book) LTD, Surrey London

Jackson, D.A., Pedro R. Peres-Neto, and Julian D. Olden, 2001. What Controls Who is Where in Freshwater Fish Communities the Roles of Bioic, Abiotic, and Spatial Factors. *Canadian J. fish.Aquat. Sci.* 58 : 157 – 170.

Jasmine, S. and Begum, M. 2016. Biological aspects of *Barbonymus gonionotus* (Bleeker, 1849) in the Padma River, Bangladesh. *International Journal of Fisheries and Aquatic Studies.* 4(5) : 661-665.

Kasiyanti, J., Nugroho, H. and Dwijoyanto, 2013. *Study of flood control at Widas River, Nganjuk Regency, East Java Province*. Thesis. Master's Program in Water Resources Management.Bandung Institute of Technology (In Indonesian).

Kolding, J. and van Zwieten, P. A. M. 2012. Relative lake level fluctuations and their influence on productivity and resilience in tropical lakes and reservoirs. *Fisheries Research.* 115-116, 99–109. doi:10.1016/j.fishres.2011.11.008

Kottelat, M., Whitten, A.J., Kartikasari, S.N. and Wirjoatmodjo, S. 1993. Freshwater Fishes of Western Indonesia and Sulawesi-Ikan Air Tawar Indonesia Bagian Barat dan Sulawesi. (Edisi Dwi Bahasa). Periplus Editions (HK) Ltd. 377 p. (In Indonesian).

Ng'onga, M., Kalaba, F. K., Mwitwa, J. and Bright, N. 2019. The interactive effects of rainfall, temperature and water level on fish yield in Lake Bangweulu fishery, Zambia. *Journal of Thermal Biology.* doi:10.1016/j.jtherbio.2019.06.00

Pauly, D. 1984. Some simple methods for the assessment of tropical fish stocks. *FAOFish.Tech. Pap.* (234): 52 p.

Pauly, D. and Munro, J.L. 1984. Oncemore on the comparison of growth in fish and invertebrates. ICLARM *Fishbyte.* (2). 21 p.

Purnomo, K. and Kartamihardja, E.S. 2005. Growth, moratality and feeding habits of Java barb (Barbodesgonionotus) in the Wonogiri Reservoir. *Jurnal Penelitian Perikanan Indonesia.* 11 (2). 1-8. (In Indonesian).

Satrawaha, R. and Pilasamorn, C. 2009. Length-weight and length-length relationships of fish species from the Chi River, northeastern Thailand. *Journal of Applied Ichthyology - J Appl Ichthyol*. 25. 787-788. 10.1111/j.1439-0426.2009.01293.x.

Sparre, P. and Venema, S.C. 1992. Introduction to tropical fish stock assessment. Part 1. Manual FAO Fish. Tech. Pap. 376 pp.

Susilo, H. 2019. Management Optimization on Pondok Reservoir in Ngawi, East Java. PILAR TEKNOLOGI. 10 (2): 54-58. http://pilar.unmermadiun.ac.id/index.php/pilarteknologi. (In Indonesian).

Udupa, K.S. 1986. Statistical method of estimating the size at first maturity in fishes. *Fishbyte.* 4 (2) : 8-10. ICLARM, Metro Manila.

Viani, D.Z. and Catur, R. 2018. Evaluation of Trophic Status and Organic Pollution at Lahor Reservoir Malang Using Diatoms as Bioindicator. *Biotropika*. 6 (1): 10-15. https://biotropika.ub.ac.id/

Walpole, R. E. 1995. *Introduction to Statistics* (Translated by Bambang Sumantri). Edition Third. PT Gramedia. *Jakarta.* 515 p.

Warsa,A. and Tjahjo, D.W.H. 2017. Optimal size for fishes exploitation at Jatiluhur Reservoir, West Java. *Acta Aquatica: Aquatic Sciences Journal*, 6:1 (April, 2019): 13-21. (In Indonesian).