International Journal of Earth Sciences Knowledge and Applications
journal homepage: http://www.ijeska.com/index.php/ijeska

Research Article

e-ISSN: 2687-5993

Population Dynamics of *Pampus Griseus* (Cuvier & Valenciennes, 1833) in Mon Coastal Area

Zarni Ko Ko[1]*

[1]*Department of Marine Science, Sittway University, Rakhine State, Myanmar*

INFORMATION

Article history
Received 25 July 2023
Revised 07 August 2023
Accepted 09 August 2023

Keywords
Growth rate
Mortality rates
Recruitment pattern
Pampus griseus
Mon coastal area

Contact
*Zarni Ko Ko
zni1446@gmail.com

ABSTRACT

The study on the population dynamics of *Pampus griseus* (*P. griseus*) was conducted from 2018 to 2023 in Mon coastal area. Specimens of *P. griseus* were collected with their lengths ranged from 8 to 36 cm and their weights ranged from 20 to 872.5 g. The population parameters such as asymptotic length L∞ and growth curvature parameter K were found to be 38.33 cm and 0.94 per year, and the length of the fish was attained at the end of 1 to 6 years. The mortality parameters obtained from the ELEFAN method; the total mortality coefficient (Z), the natural mortality coefficient (M) and the fishing mortality coefficient (F) were estimated to be 1.81 per year, 1.58 per year, and 0.23 per year. The natural mortality was higher than the fishing mortality during the present study. The value of exploitation value, E = 0.13 which pointed toward underfishing conditions (E < 0.50) for *P. griseus* in the present study.

1. Introduction

Fishing is an important activity that provides food from the sea and creates employment for the fishermen and the other operators along the entire market chain. Therefore, Myanmar's marine fisheries are essential for the national economy. However, the literatures on Myanmar fish and fisheries are scanty.

In Myanmar fishery sector, the pomfret fishery is primarily comprised of three species, the Bengal silver pomfret, *P. griseus* (Cuvier and Valenciennes, 1833); the Chinese pomfret, *Pampus chinensis* (Euphrasen, 1788) under family Stromateidae and the black or brown pomfret, *Parastromateus niger* (Bloch, 1795) under family Carangidae. In Mon State, among of export marine fishes, the Bengal silver pomfret, *P. griseus* (nga moke phyu) is one of the important export marine fish species of Myanmar.

P. griseus are caught by drift nets and trawl nets from Mon fishing ground (Mon state) area. *P. griseus* is usually sliver or white color, with few small scales. *P. griseus* is commonly known as nga moke phyu and is regarded commercial fishes of Myanmar. *P. griseus* are sold fresh in local markets or shipped frozen, dried and salted to urban centers. It can be eaten as fish soup and fish porridge.

Mortality in fish stocks occurs on account of the natural causes as well as fishing. Mortality is usually expressed as instantaneous total annual mortality coefficient (Z), which includes both the instantaneous natural mortality coefficient (M) due to the all-natural cause such as predation, disease and old age and instantaneous fishing mortality coefficient (F) due to fishing. The total instantaneous mortality (Z) can be estimated directly using the length frequency data while it is often impossible to estimate natural mortality by direct measurements. As a rough generalization, species with a high growth coefficient (K) have values of M and species with low K have low values of M (Joseph, 1992).

There are several studies on the population dynamics of the

pomfret (*Pampus argenteus*) in different regions. Moreover, the previous literatures were from western parts of the Indian Ocean but the literatures from eastern part of the Indian Ocean were scant. However, there were no information about the population data on *P. griseus* in Myanmar coastal area. Nevertheless, the previous research, Aung (2010), reported the fishery status of silver pomfret (*Pampus argenteus*) from Mon fish landing centers. So, this finding of the species was the local species (*P. griseus*).

Therefore, the present study is an attempt to conduct the population investigation of *P. griseus* in Mon coastal area.

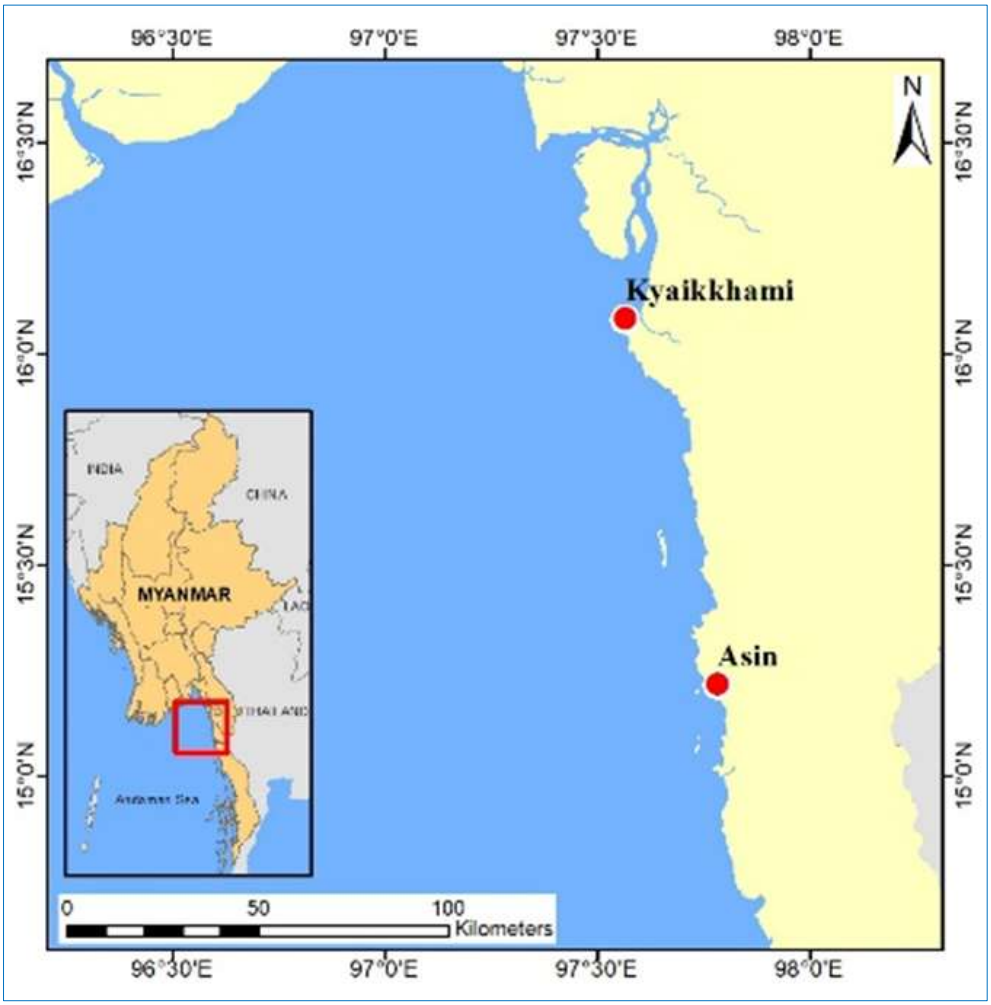

Fig. 1. Map showing the present study landing centers in Mon coastal area

2. Materials and Methods

2.1. Study Areas and Sample Collection

The samples of Bengal silver pomfret, *P. griseus*, were collected from Kyaikkhami fish landing center (16°05'N and 97°34'E) and Asin fish landing center (15°13′ N and 97°47′ E) of Mon coastal area (Fig. 1) during the period from June 2018 to March 2023, with the exception of June 2019– August 2019 and April 2022– June 2022, where no samples were taken due to the closing season of fishing in Myanmar coastal area under the regulation of Department of Fisheries. The selected landing areas were the most available areas for the collection of the specimen because these areas were the main landing centers in Mon coastal area.

2.2. Estimation of Growth Parameters and Growth Performance İndex

Monthly length frequency distribution of *P. griseus* was analyzed using the FiSAT II computer programmed. The parameters of the von Bertalanffy Growth Function (VBGF), the asymptotic length (L_∞) and growth curvature (K) were estimated by means of ELEFAN-I. The value of theoretical age at length zero (t_0) was estimated by using Pauly's empirical equation (Pauly, 1979):

$$Log(-t_0) = -0.392 - 0.275\ Log\ L_\infty - 1.038\ K. \quad (1)$$

The resultant values of growth parameters (L_∞, K, t_0) were substituted in the von Bertalanffy growth equation;

$$L_t = L_\infty (1-e^{-K(t-t_0)}) \quad (2)$$

Where L_t is the length at age t, L_∞ is the asymptotic length that is the mean length of fish would reach if they were to grow indefinitely; K is the growth coefficient or the rate at which L_∞ is approached and t_0 is the age of the fish at zero length.

The resultant L_∞ and K were used to calculate the growth performance index (ø′) using the Pauly and Munro (1984)'s equation:

$$ø' = 2\,logL_\infty + logK \quad (3)$$

The recruitment pattern was estimated from recruitment curves obtained by the reverse projection of the length frequency data onto the time axis using the estimated value L_∞, K and t_0 (Pauly, 1984).

2.3. Estimation of Mortality Rates and Exploitation Rate

The length-converted catch curve was utilized for the calculation of instantaneous annual mortality rate (Z) (Pauly, 1984). The natural mortality (M) was calculated by Pauly's empirical equation:

$$Log\ M = -0.0066 - 0.279\ log\ L_\infty + 0.6543\ log\ K + 0.4634\ log\ T \quad (4)$$

where T = the mean annual water temperature °C, which is assumed to reflect the sea surface temperature in the survey area (Pauly, 1984). In this study, the mean annual temperature of the sea surface was considered as 27 °C (Ebrahimi, 2006) (as cited in Pauly, 1984).

The fishing mortality (F) was calculated by subtracting the natural mortality from the instantaneous annual mortality (Appeldoom, 1984 as cited in Pauly, 1984):

$$F = Z\text{-}M \quad (5)$$

The exploitation rate (E) was calculated using the following formula (Gulland, 1985 as cited in Pauly, 1984):

$$E = F/Z \quad (6)$$

2.4. Estimation of Recruitment Pattern

Recruitment patterns were obtained by projecting the length frequency data on the time axis using the estimated values of the growth parameters using the ELEFAN II program. Relative yield per recruit (Y/R) and relative biomass per recruit (B/R) were estimated from the model of Beverton and Holt (1966) as modified by Pauly and Soriano (1986).

3. Results

3.1. Growth Parameters and Growth Performance Index of Pampus Griseus During the Present Study

During the present study, the growth parameters, asymptotic length (L_∞) of *P. griseus* was estimated at 38.33 cm and the growth coefficient (K) was 0.94 year^{-1} using von Bertalanffy's growth curve. The age at zero length (t_0) was estimated at -0.016. The length base index of the growth performance index (ø′) was 3.14 (Fig. 2).

3.2. Length at Age of P. Griseus During the Present Study

Using von Bertalanffy's growth formula (VBGF) (t_0 = 0), the lengths attained by *P. griseus* were 23.36 cm, 32.48 cm, 36.05 cm, 37.44 cm, 37.98 cm and 38.19 cm at the end of (1-6) relative ages of year 1, year 2, year 3, year 4, year 5, and year 6, respectively, as shown in Fig. 3.

3.3. Mortality Rates of P. Griseus During the Present Study

Total mortality coefficient (Z) was estimated at 1.81 per year using the length converted landing weight method. Natural mortality (M) was estimated at 1.58 per year. Based on Z, fishing mortality (F) was found to be 0.23 per year. The exploitation rate (E) was calculated at 0.13 (Table 1 and Fig. 4). The fishery in Mon coastal area seemed to be below the optimum level of exploitation (E = 0.50).

3.4. Recruitment Pattern of P. Griseus During the Present Study

Two recruitment peaks were found in the present investigation (Fig. 5), one in March-April (the highest in March) and another in July-August (the highest in July) during the period of June 2018 - March 2023. The percentage of recruitment varied from 2.57 percent (January) to 16.34 percent (March).

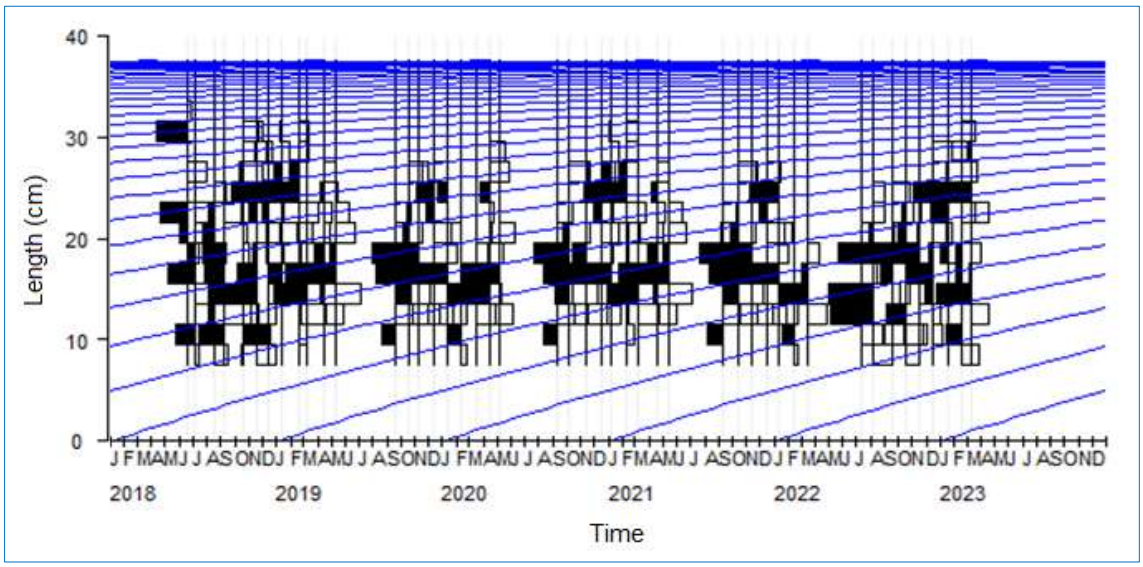

Fig. 2. Von Bertalanffy growth curve of *P. griseus* superimposed on the restricted length frequency histogram. (L_α = 38.33 cm and K= 0.94 per year). The black and white bars are positive and negative deviation from weighted moving average of three length classes and they represent pseudo-cohorts

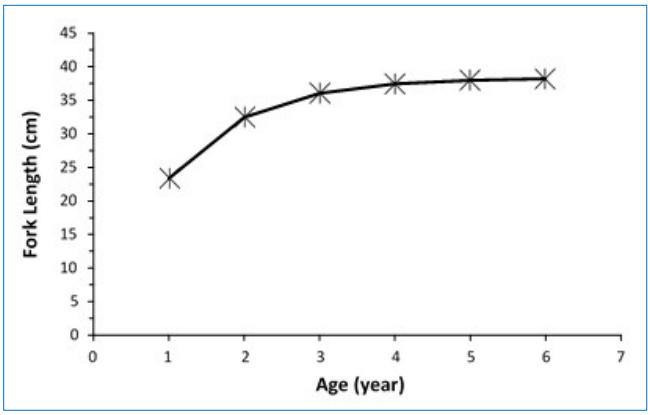

Fig. 3. Growth curve of *P. griseus* during the present study area

4. Discussion

The study of growth was basically the determination of body size as a function of age. The growth curvature parameter (K) determined how fast it approaches its L_{∞}. In general, the tropical fish have higher K values than the temperate ones. However, the age determination was very difficult in the tropical areas because there were no well demarcated fluctuations in the seasons. Moreover, a tropical fish is considered difficult to age by means of hard parts such as otolith because the otolith structure is complex and the daily increments are highly irregular, making them difficult to observe and interpret (Devi, 2006).

Table 1. Some estimated parameters of *P. griseus* during the present study

Parameters	Results
Asymptotic length (L_{∞}-cm)	38.33
Growth coefficient (K-per year)	0.94
Natural mortality (M-per year)	1.58
Fishing mortality (F-per year)	0.23
Total mortality (Z-per year)	1.81
Exploitation rate (E)	0.13

P. griseus, being a tropical fish, considered difficult to age by means of hard parts such as the otolith, therefore; the age determination of *P. griseus* was not estimated exactly in the present study.

The maximum length and the average growth rate of *P. griseus* were estimated based on von Bertalanffy's growth model. From this estimation, the asymptotic length (L_{∞}) of Bengal pomfret was 38.33 cm and the growth coefficient (K) was 0.94 per year.

Moreau et al. (1986) reported that the estimated L_{∞} value of the VBGF should be quite close to the maximum length of the fish, while t_0 should be less than zero so that the fish may have a positive length at zero age. In the present study, the t_0 value was -0.016, which was similar to the above investigation. Furthermore, it had been observed that the juveniles with positive t_0 values grow slowly, while the juveniles with negative t_0 values grow more quickly than the adult species (King, 1996). Therefore, it might be proven that the juveniles of *P. griseus* had the high condition observed in the present study.

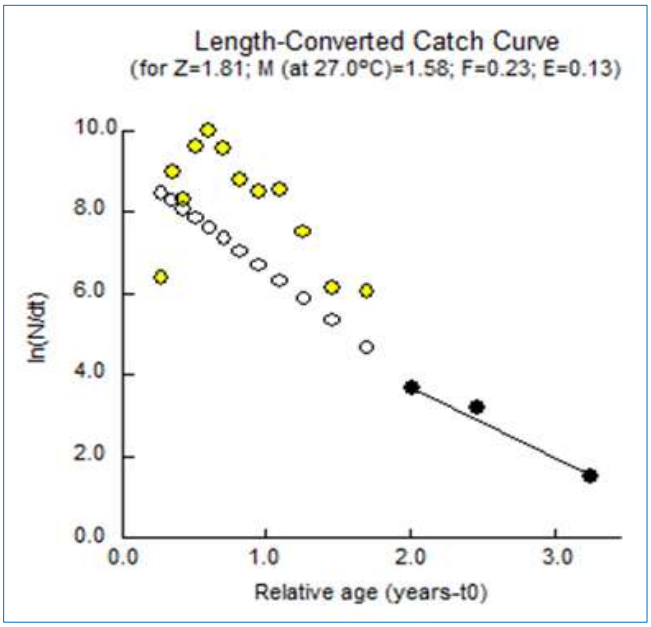

Fig. 4. Length converted curve of *P. griseus* during the present study

In the present estimations, the growth performance index (ø′) of *P. griseus* obtained from the growth parameters was found to be 3.14. Mandal (2006) explained that the growth performance index (ø′) values in fish generally vary between 2 and 4, with the majority of the cases around 3. The author also described how the above variations were associated with environmental conditions and differential fishing intensities. The ø′ values in the present estimations were within the ranges previously mentioned. So, the variations of the present findings were also associated with the different fishing activities.

Based on the results of the present investigation, the relationship between length and age explained that *P. griseus* in the present study area had an age of 1-6 years. The growth of *P. griseus* was relatively fast at a young age and would slow down when entering old age to reach the asymptotic length. During the present study, fish experience relatively rapid growth at the ages of 1-2 years and tend to slow down when entering the age of 6 years.

The rate of total mortality (Z) indicated the rate of reduction of fish from the population due to death. The present estimation of total mortality for *P. griseus* was 1.81 per year. The values of the natural mortality (M) and fishing mortality (F) estimated using the length converted catch curve method during the present study were 1.58 per year and 0.23 per year, respectively.

In the present study, the fishing mortality was lower than the natural mortality. This present finding differed from the findings on silver pomfret (*Pampus argenteus*) of the earlier reports; Devi (2006); Ghosh et al. (2009); Narges et al. (2011); Hashemi et al. (2012); Prihatiningsih et al. (2015); Damora et al. (2018); Hikmawansyah et al. (2019); Salim et al. (2010); Prihatiningsih et al. (2020); Dutta et al. (2021) where the fishing mortality rates were higher than the natural mortality rates.

Since the rate of exploitation was recorded to be 0.13, suggesting that the stock of *P. griseus* in the present study was said to be underfished. However, the exploitation rates of silver pomfret (*Pampus argenteus*) from Indian Regions, (Khan et al., 1992; Devi, 2006; Ghosh et al., 2009; Narges et al, 2011; Hashemi et al., 2012; Dutta et al., 2021) showed that the stocks of the species were overfished.

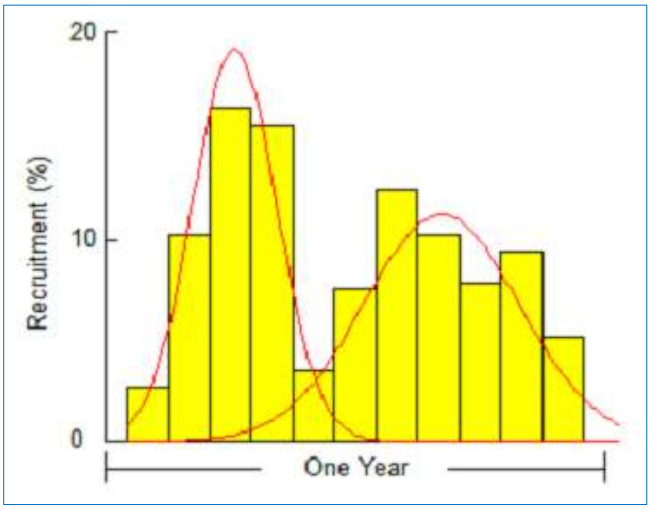

Fig. 5. Recruitment pattern of *P. griseus* during the present study

The present study showed the two major recruitment peaks of *P. griseus* per year, indicating two cohorts were produced in a year. Similarity, the bimodal recruitment pattern obtained in the present finding was similar to the previous findings on pomfret (*Pampus argenteus*); Damora et al. (2018) in Indonesian waters, Karim et al. (2018) in Bangladesh, Abdul-Razak et al. (2008) in Iraq waters of Persian Gulf, Ghosh et al. (2009) in Indian waters, and Ali et al. (2000) in Northwest Arabian Gulf. However, Mustafa (1993) reported that the pomfret (*Pampus argenteus*) recruited into the fishery only during one peak in the Bay of Bengal.

Therefore, in order to achieve sustainable management of Bengal silver pomfret (*P. griseus*) fishery, further studies on the age-structure analysis through otolith observation, mortality, growth and yield-per-recruit analysis are needed through different methods or modeling to better understand the population characteristics of this fishery.

5. Conclusion

In the investigation of population dynamics, the growth parameters indicated that the juveniles were caught more than the adults. During the present study, the length of the species at first capture was 8 cm, while the mature species found at the size 17 cm, reduced the fish recruitment. Therefore, the fishery in the present study area leads to the depletion of the area. The low fishing mortality of *P. griseus* compared to the natural mortality observed in the present study, indicated the balance position in the stock. The low exploitation level of *P. griseus* indicated that the species was under fished. Nevertheless, further studies would be needed for the more detail understanding of the biology and population dynamics of Bengal pomfret fish in the Mon coastal area.

Acknowledgements

I wish to express my gratitude to U Min Htut and officers, Thanlwin Aye Co. Ltd., Ye Township, Mon State for providing useful information and for their constant assistance in field work. My specials thank to Dr. Nyo Nyo Tun, Professor and Head, Department of Marine Science, Mawlamyie University for her valuable guidelines, permission and providing facilities which make my research progress conveniently and smoothly. I am very special thank Ko Myo Thant, beloved brother and my students, Department of Marine Science, Mawlamyine University for help the data collection field trip. My heartfelt thanks to Dr. Naung Naung Oo, lecturer, Department of Marine Science, Pathein University for his guidance and for the loans invaluable reference books throughout the study period. Finally, my infinite thanks are to my beloved family for their kind and financial support throughout this study period.

References

Abdul-Razak, M.M., Amjad, K.R., Amna, A.H., 2008. The Stock Assessment of Silver Pomfret *Pampus argenteus* (Euphrasen, 1788) in Iraqi Marine Waters during the period 2004-2005. Basrah J. Agric. Sci. 21:1-16.

Ali, T.S., Mohamed, A.R.M., Hussain, N.A., 2000. Growth, mortality and stock assessment of Silver Pomfret, *Pampus argenteus* in the Northwest Arabian Gulf, Iraq. Marina Mesopotamica 15 (2), 373-387.

Appeldoom, R.S., 1984. The effect of size on mortality of small juvenileconchs (Strombus gigas L. and S. costatus G.). J Shellfish Res 4: 37-43.

Aung, Z.Z., 2010. The fishery status of Pomfret (*Pampus argenteus*) in coastal areas of Mon State. Unpublished MSc Thesis, Department of Marine Science, Mawlamyine University. Myanmar.

Beverton, R.J.H., Holt, S.J., 1966. Manual of methods for fish stock assessment. Part 2. Tables of yield functions. Rome: FAO, FAO Fish. Tech. Pap. No. 38 (Rev. 1), 67 pp.

Bloch, M.E., 1795. Naturgeschichte der Ausländischen Fische. Vol. 9. Berlin: Schlesinger, 192.

Cuvier, G., Valenciennes, M., 1833. Histoire Naturelle des Poisons, Vol. 9. Paris: Nabu Press, 552.

Damora, A., Ariyogagautama, D., Wahju, R.I., 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 (6), 2247-2251.

Devi, O.J., 2006. Studies on Population Dynamics of *Pampus argenteus* (Euphrasen) from Kakdwip Coastal Region of West Bengal, India. Unpublished M.F.Sc Thesis. Department of Fishery Biology and Resources Management, West Bengal University of Animal and Fishery Sciences, India.

Ebrahimi, M., 2006. Continuing studies of hydrology and hydrobiology ofPersian Gulf and Strait of Hormuz (waters of Hormozgan province).Iranian Fisheries Research Organization (IFRO) Press, Tehran, Iran.

Euphrasen, B.A., 1788. Beskrifning po trenne fiskar. Vetensk. Akad. Nya Hand.l Stockholm 9, 49-55.

Dutta, S., Orlov, A.M., Hazra, S., 2021. Population biology and

exploitation status of four commercially important marine fishes of the northern Bay of Bengal, India. Iranian Journal of Fisheries Sciences 20 (1), 62-83. https://doi.org/10.22092/ijfs.2021.123477.

Ghosh, S., Mohanraj, G., Asokan, P.K., Dhokia, H.K., Zala, M.S., Bhint, H.M., 2009. Fishery and stock estimates of the silver pomfret, *Pampus argenteus* (Euphrasen), Landed by gill netters at Veraval. Indian Journal of Fisheries 56 (3), 177-182.

Gulland, J.A., 1985. Fish stock assess ment: a manual of basic methods.Wiley and Sons, New York.

Hashemi, S.A.R., Safikhani, H., Vahabnezhad, A., 2012. Growth, Mortality and exploitation rate of Silver Pomfret (*Pampus argenteus* Euphrasen, 1788) in northwest of Persian Gulf (Khuzestan Coastal Water, Iran). American-Eurasian Journal of Agricultural & Environmental Sciences 12 (8), 1095-1101. https://doi.org/10.5829/idosi.aejaes.2012.12.08.66127.

Hikmawamsyah, Y., Andriani, Y., Khan, A.M.A. Dewanti, L.P., 2019. Stock Estimates of White Pomfret (*Pampus argenteus*) Based on Length and Weight Data in Pangandaran Waters. Asian Journal of Fisheries and Aquatic Research. 5 (1-2), 1-13. https://doi.org/10.9734/ajfar/2019/v5i130065.

Joseph, M.C., 1992. Biology, Population Dynamics, Stock Assessment and Fishery of Scoliodon latigaudes I the Coastal Waters of Maharashtra. Ph D. Thesis (Unpublished). Central Institute of Fisheries Education, Indian Council of Agricultural Research Versova, Bombay.

Karim, E., Liu, Q., Rahman, M.F., Khatun, M.H., Barman, P.P., Shamsuzzaman, M.M., Mahmud, Y., 2018. Comparative assessment of population biology of three popular pomfret species, *Pampus argenteus*, *Pampus chinensis* and *Parastromateus niger* in the Bay of Bengal, Bangladesh. Iranian Journal of Fisheries Sciences, 19 (2), 793-813. https://doi.org/10.22092/ijfs.2018.119873.

Khan, M.Z., Kumaran, M., Jayaprakash, A.A., Scariah, K.S.,Desmukh, V.M., Dhulkhed, M.H., 1992. Stockassessment of Pomfrets off west coast of India. Indian Journal of Fisheries 39 (3-4), 249-259.

King, R.P., 1996. Growth performance of Nigerian fish Stocks. NAGA, the ICLARM Quarterly 20 (2), 31-35.

Mandal, B., 2006. Population Dynamics of Jonius gangeticus Talwar from Esturaine Region of Kadwip, West Bengal. Unpublished M.F.Sc Thesis. Department of Fishery Biology and Resources Management, West Bengal University of Animal and Fishery Sciences, India.

Moreau, J., Bambino, C., Pauly, D., 1986. A comparison of four indices of overall growth performance based on 100 tilapia population (Fam. Cichlidae). In: Maclean, J., Dizon, L., B., and Hosillo, L., V. (Ed.). The first Asian fisheries forum, Asian Fisheries Society. Manila, pp. 201- 206.

Mustafa, G.M., 1993. ELEFAN based growth parameters of white pomfret *Pampus argenteus* from the Bay of Bengal. Bangladesh. Journal of Zoology 21 (1), 143-149.

Narges, A., Preeta, K., Jasem, M., Gholam-reza, E., Vahid, Y., 2011. Stock Assessment of Silver Pomfret *Pampus argenteus* (Euphrasen, 1788) in the Northern Persian Gulf. Turkish Journal of Fisheries and Aquatic Sciences 11, 63-68. https://doi.org/10.4194/trjfas.2011.0109.

Pauly, D., 1979. Gill size and temperature as governing factors in fish growth: a generalization of von Bertalanffy's growth formula. Berichte aus dem Institut für Meereskunde an der Christian-Albrechts-Universität Kiel, 063 . Institut für Meereskunde, Kiel, Germany, 156 pp. https://doi.org/10.3289/ifm_ber_63.

Pauly, D., 1984. Fish Population Dynamics in Tropical Waters: A Manual for Use with Programmable Calculator. International Center for Living Aquatic Resources Management, Manila, Philippines. 325 pp.

Pauly, D., Munro, J.I., 1984. Once More on the Comparison of Growth in Fish and Invertebrates. Fish Byte 2, 21-23.

Pauly, D., Soriano, M.L., 1986. Some practical extensions to Beverton and Holt' relative yield-per-recruit model. In: Maclean, J. L., Dizon, L. B. and Hosillos, L.V. (Eds.), Proceedings of the First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines. pp. 491-495.

Prihantiningsih, Lastari, P., Chodrijah, U., 2020. Reproductive biology, growth and mortality of silver pomfret (*Pampus argenteus*) in Tarakan waters, North Kalimatan. International Conference on Fisheries and Marine, IOP Conference Series: Earth and Environmental Science 584 (2020) 012038, 158, 1- 9 https://doi.org/10.1088/1755-1315/584/1/012038. International Conference on Fisheries and Marine..

Prihatiningsih, Mukhlis, N., Hartati, S.T., 2015. Population parameters of white pomfret (*Pampus argenteus*) in Tarakan Waters, East Kalimantan. Bawal 7 (3), 165-174.

Salim, G., Handayani, K., Indarjo, A., Ransangan, J., Atieqah, N., 2020. Growth, Mortality and exploitation rate of *Pampus argenteus*, *Parastromateus niger* and *Scomberomorus commerson* in Sebatik Waters, Indonesia. Biodiversitas 21 (11), 5363-5372.