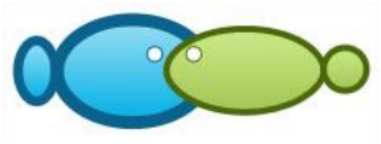
anna_striata__in_the_Lake_Tempe_South_Sulawesi_Indonesia1_1.pdf

by

Submission date: 02-Jan-2022 08:27PM (UTC+0700)
Submission ID: 1736866841
File name: anna_striata__in_the_Lake_Tempe_South_Sulawesi_Indonesia1_1.pdf (942.27K)
Word count: 4518
Character count: 22735



Population dynamics of snakehead fish (*Channa striata*) in the Lake Tempe, South Sulawesi, Indonesia

[1]Andi Wakiah, [2]Achmar Mallawa, [2]Faisal Amir

[1] School of Fishery, Bone, South Sulawesi, Indonesia; [2] Department of Fishery, Faculty of Marine Science and Fishery, Hasanuddin University Makassar South Sulawesi Indonesia.
Corresponding author: A. Mallawa, achmar_mallawa@yahoo.co.id

Abstract. Snakehead fish (*Channa striata*) is one of the Tempe Lake fish productions, exploited for a long time using various types of fishing gear so that its population is thought to have decreased. This research was conducted from February 2018 to February 2019 aimed at analyzing the *C. striata* population dynamics in the waters of Lake Tempe. Data on total fish length were collected from catches of pot trap, bottom gill nets, traditional guiding barrier and cast nets. The number of samples measured was 1,594 specimens, consisting of 1,079 females and 515 males. Fish growth was shown using the Von Bertalanffy growth model. Analysis of growth rate and asymptotic length used the Ford-Walford method. Total mortality uses the length catch converted model, natural mortality rate by Pauly method, fishing mortality, exploitation rate and Y/R using the Beverton and Holt method. The combined population of males and females, males and females had asymptotic lengths of 76.9 cm, 79.6 cm and 76.90 cm, respectively. Growth rates showed 0.29 year^{-1}, total mortality rates was 1.36, 1.28 and 1.26 year^{-1} respectively, natural mortality rates were 0.61, 0.62 and 0.62 year^{-1} respectively, fishing mortality rates were 0.75, 0.77 and 0.67 year^{-1}, respectively, exploitation rates were 0.52, 0.55 and 0.55 year^{-1}, respectively. The recruitment process in both sexes and males population were optimal while in females was found to be not optimal.
Key Words: growth, mortality, exploitation rate, recruitment, Tempe Lake.

Introduction. Indonesia as an archipelagic country, besides having extensive sea waters also has inland waters which are also quite extensive. According to the Statistical Information Book of the Ministry of Public Works and Human Housing of Republic Indonesia, MPWHH-RI (2017) Indonesia had 1,046 lakes with an area of 97,899.53 km^2 spread over five large islands and several small islands, and 15 lakes with an area of 860.71 km^2 located in South Sulawesi Province. Ministry of Maritime Affairs and Fisheries of Republic Indonesia, MMAF-RI (2018) reported that in 2017, the total volume of capture fisheries production was 7,071,452 tons and 467,821 tons came from inland waters. Based on the same data, in 2017 the volume of capture fisheries production in South Sulawesi Province amounted to 362,068 tons where 29,268 tons came from inland waters. One of the inland waters as the biggest contributor to capture fisheries production in South Sulawesi Province was Tempe Lake (Ramadhan et al 2008; Haerunnisa et al 2015). Bastiar (2015) reported that Lake Tempe produced various species of fish such as silver carp (*Hypophthalmichthys molitrix*), giant gourami (*Osphronemus goramy*), kissing gourami (*Helostoma temminckii*), snakeskin gourami (*Trichopodus pectoralis*), three spot gourami (*Trichopodus trichopterus*), nile tilapia (*Oreochromis niloticus*), common carp (*Cyprinus carpio*), silver barb (*Barbonymus gonionotus*), mud barb (*Barbonymus* sp.), climbing perch (*Anabas testudineus*), catfish (*Clarias* sp.), eels (*Anguilla* spp.) and snakehead fish (*Channa striata*). Furthermore, it was explained that the fish production of Lake Tempe amounted to 30,000-40,000 tons in 1948-1968 and reached a peak of 50,000 tons in 1957-1959 and then decreased continuously to 10,000 tons year^{-1} at present. Several factors are

thought to cause a decline in fish production Lake Tempe as the siltation of lakes due to sedimentation (Balkhis et al 2011), pollution from agricultural activities and community waste (Qiufen et al 2013; Samidjan & Rachmawati 2016), the fulfillment of the surface of lake waters by water hyacinth plants, and overfishing (Nasrul 2016). In addition to environmental factors, fishing activities also influence the decline in Lake Tempe fish stocks (Samuel et al 2010). Lake Tempe cork fish is in high demand because of its good taste and the chemical content of albumin as a drug-making material (Suprayitno 2003; Fitriyani & Deviarni 2013), where such high demand can trigger high levels of utilization and affect the sustainability of the population. To maintain the sustainability of Lake Tempe fish resources, especially of *C. striata*, it is considered important to conduct research on *C. striata* population dynamics, where the results of the study are expected to be important information in determining policies for sustainable management and utilization fish resources.

Material and Method

Period and location of the research. This research was conducted from February 2018 to February 2019 in the waters of Lake Tempe, South Sulawesi, Indonesia. Sampling was carried out at three traditional fishing landing sites, namely Tanasitolo Subdistrict, Tempe and Sabbangparu (Figure 1).

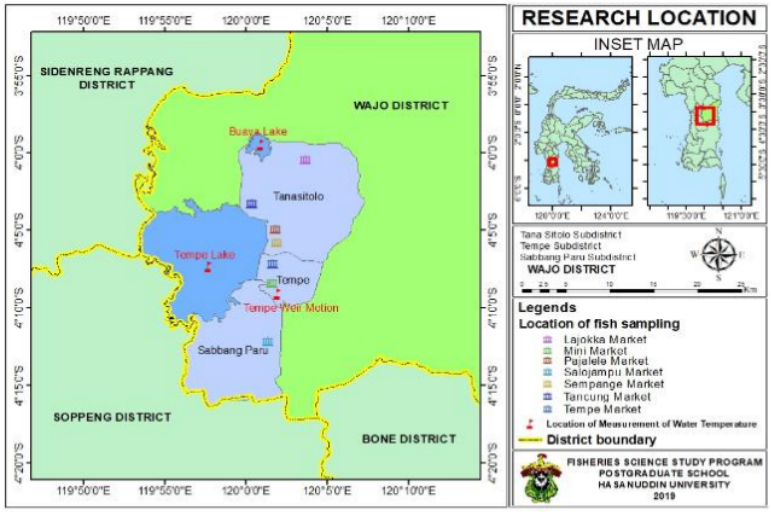


Figure 1. Research area - Tempe Lake (Wakiah et al 2019).

The materials and equipment that have been used in the present research were labeling paper for numbering fish samples, digital thermometer to measure waters temperature, measuring board to measure fish length, digital camera for documentation, cool box for storing samples, scissors for dissecting fish, fishing boat for collecting fish samples. We also used personal computers and software such as SPSS, Microsoft Excel and FISAT II for data analysis. Total Length (LT) of fish collected through direct measurements in the field four times a month using a Stratified Random Sampling if the catches were high, and measuring all fish if the catches were low. The *C. striata* measured comes from catches of fishermen who use bottom traps, small bottom long lines, bottom gill net and traditional guiding barrier. The samples measured were 1,594 specimens, consisting of 1,079 females and 515 males. For the determination of sexes we used morphological methods according to Sitepu (201), Puspaningdiah et al (2014) and Vodunnou et al (2017).

Data analysis. Growth of *C. striata* population in Tempe Lake was analyzed by exponential equation of Von Bertalanffy (Sparre et al 1989) as follows:

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

Where:
Lt = Fish length at age t (cm)
L∞ = Asymptotic length of fish (cm)
K = Growth rate coefficient (per year)
to = The theoretical age of a fish when the length is zero (years)
t = Age (years)

The values of asymptotic length (L∞) and growth rate coefficient (K) were calculated using the ELEFAN I program which is packaged in FISAT II. The value of estimation "to" can be found by Pauly empirical equations (Sparre et al 1989) that is:

Log (-to) = -0.3922 – 0.2752 log L∞ - 1.0380 - log K

The total mortality rate (Z) was estimated by the linearized length converted catch curve using FISAT II software (Sparre et al 1989; Gayanilo et al 2005).

$$\ln \frac{C(L1,L2)}{\Delta t(L1,L2)} = C - Z\left(\frac{t(L1)+t(l2))}{2}\right)$$

Where:
y = ln C (L1, L2)/Δt (L1, L2) and x = [t (L1) + t (L2)]/2 and slope (b) = - Z.

The natural mortality (M) was estimated by Pauly's empirical method (Sparre et al 1989) as follow:

Log M = 0.8*exp (-0.152 – 0.279 log L∞ + 0.6543 log K + 0.4634 log T

Where:
M = Natural mortality rate (per year)
L ∞ = Asymptote length of fish (cm)
K = Growth rate coefficient (per year)
T = Water temperature (°C), the waters temperature was 30°C

The fishing mortality (F) was estimated by the equation:

Z = F + M, so that it can be obtained F = Z - M

Where:
F = Fishing mortality (per year)
Z = Total mortality (per year)
M = Natural mortality.

Exploitation rate (E) was calculated using equation:

E = F/Z

Where:
E = Exploitation rate
F = Fishing mortality
Z = Total mortality

Yield per Recruitment (Y/R) value was estimated using the equation of Beverton and Holt (Sparre et al 1989) as follow:

$$Y/R = E.U^{M/K}\left(1 - \frac{3u}{1+m} + \frac{3u^2}{1+2m} - \frac{u^3}{1+3m}\right) \quad \text{and,}$$

$$U = 1 - \frac{Lc}{L\infty} \qquad m = \frac{1-E}{M/K}$$

Where:
E = Exploitation rate

Lc = The size that was first caught by fishing gear
L_∞ = Infinity length
M = Natural mortality
K = Growth rate coefficient

Result and Discussion

Size structure. The amount of *C. striata* samples obtained during the study was 1,594 fish consisting of 1,079 females and 515 males. The combined population of females and males had a length of 16.0 cm to 57.7 cm, the dominant length was 27.0–33.0 cm and the average length was 32.14±7.88 cm. The population of males had a length of 19 cm to 57 cm, the dominant length was 23.0–37.0 cm and the average length was 31.75±8.29 cm. The female fish populations had a length of 16 cm to 57.7 cm, the dominant length was 27.0–33.0 cm and the average length was 31.75±8.28 cm (Figure 2).

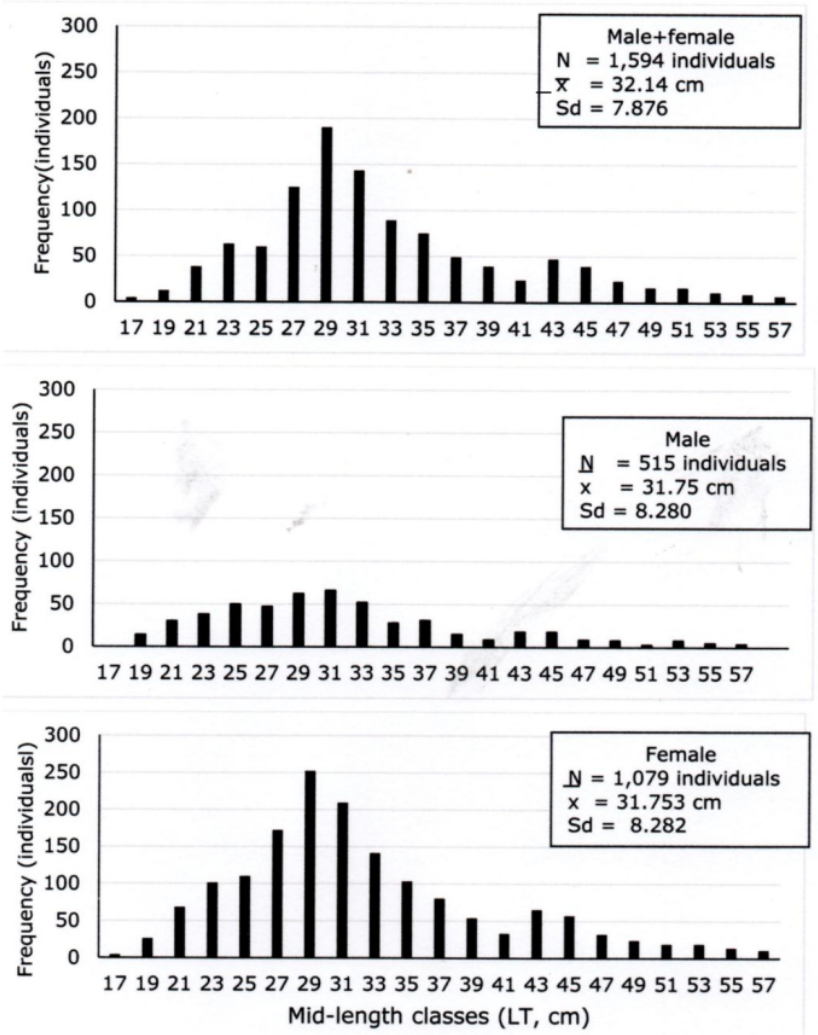


Figure 2. Size structure of combined males and females (a), males (b) and females (c) of *Channna striata* in Tempe Lake, Wajo district.

Age groups. The results of the analysis found that *C. striata* combined male-female, male and/or female samples consisted of three age groups (Figure 3). The average length of *C. striata* of the same age group was different between a combination of male-female and male and or female. Similarly, the average length of snakehead fish from the same age group is different between males and females.

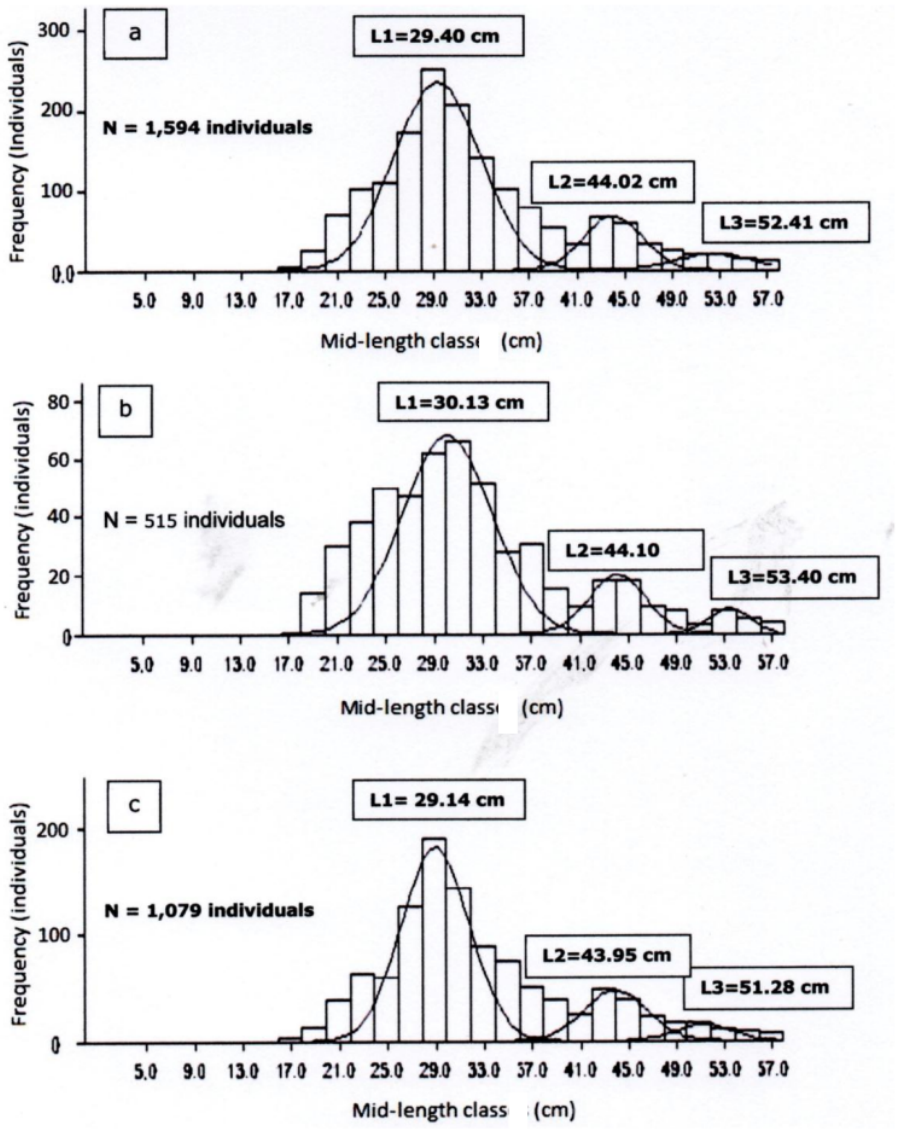


Figure 3. Age groups of combined male-female (a) male (b) and female (c) in Tempe Lake.

Growth rate. Based on data on the average length of *C. striata* according to age group and using FISAT II software, we can find out the Von Bertalanffy growth equation parameters values as presented in Table 1.

Table 1

Growth rate parameter of *Channa striata* in Tempe Lake, Wajo District, South Sulawesi

Sexes	*Value of growth parameter*		
	L_∞ *(cm)*	*K year*$^{-1}$	t_o *(year)*
Both sexes	76.90	0.29	-0.1497
Male	79.60	0.29	-0.1509
Female	76.90	0.29	- 0.1497

Based on the growth parameter values in Table 1, we can write Von Bertalanffy's growth equation for the combined male and female, male and female population of snakehead fish in Lake Tempe waters as follows:

The combined male and female snakehead fish, $L_t = 76.90(1\text{-}e^{0.29(t+0.1497)})$, male $L_t = 79.60(1\text{-}e^{0.29(t+0.1509)})$ and females, $L_t = 76.90\ (1\text{-}e^{0.29(t+0.1497)})$. The growth curve of the population of male-female, male, and female *C. striata* is shown in Figure 4.

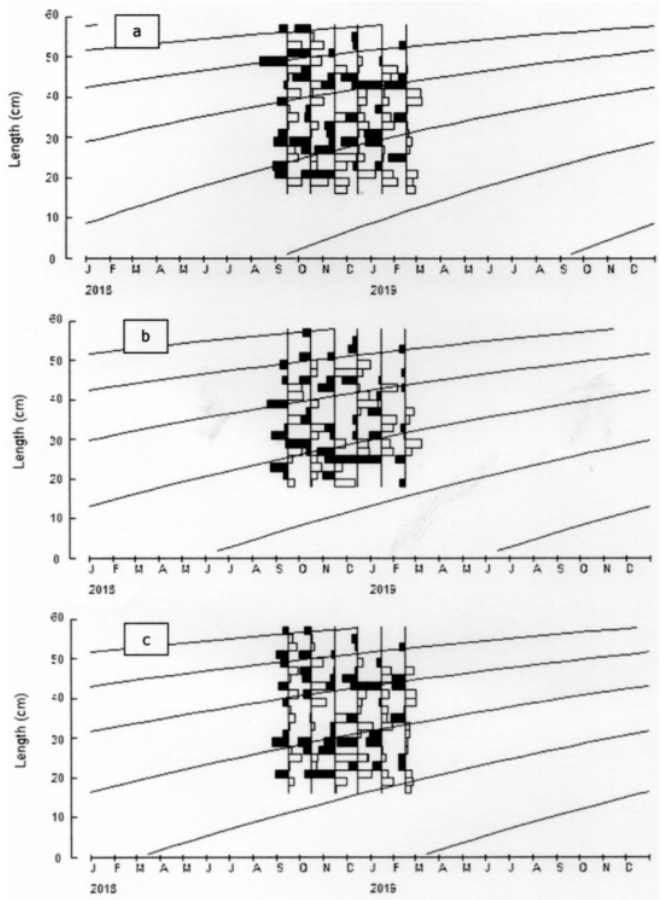


Figure 4. Growth rate curve of combined males and females (a), males (b) and females (c) of *Channa striata* in Tempe Lake Wajo District.

Mortality rate. Linearized length converted catch curve of the combined male female, male and female and the values of Z obtained is shown in Figure 5. This value explains that the total mortality rate of *C. striata* populations in the waters of Lake Tempe is quite high. Calculation results using Pauly's method showed that the natural mortality rate for

combined males - females, males and females were 0.61, 0.62 and 0.62 year^{-1} respectively. The natural mortality value of *C. striata* in Lake Tempe is quite high.

Furthermore, the fishing mortality rate for combined males-females, males and females were 0.75, 0.77 and 0.67 year^{-1} respectively. This shows that the natural mortality rate of male and female *C. striata* in Lake Tempe was not to highly different, on the contrary the fishing mortality rate of the male and female is slightly different, where the fishing mortality rate of the male of *C. striata* is higher than of female individuals.

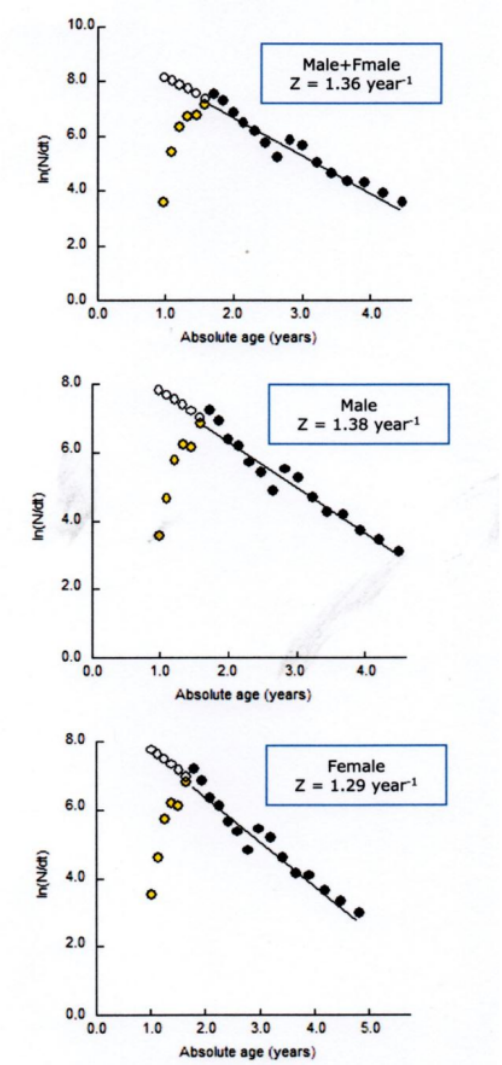


Figure 5. Length converted catch curve and values of Z of combined males and females, males and females of *Channa striata* in Tempe Lake waters Wajo district South Sulawesi.

Exploitation rate. The value of the total mortality rate confronted with the natural mortality, using the Beverton and Holt equations, resulted in the *C. striata* exploitation rate in the waters of Lake Tempe. The values of E per year of both sexes, male and female were 0.55, 0.55 and 0.52 year^{-1} respectively. This value explains that the rate of *C. striata* exploitation in the waters of Tempe Lake was relatively high. The exploitation rate of male *C. striata* was higher than of female fish.

Yield per recruitment. The results of the yield per recruitment analysis (Figure 6) show that the actual Y/R values and optimal Y/R values are not different for combined male and female, as well as for male *C. striata*. While in females, the actual value of Y/R was lower than the optimal Y/R value. This explains that the combined male-female recruitment process is running optimally, as well as male *C. striata*, while the recruitment process for female population is less than optimal.

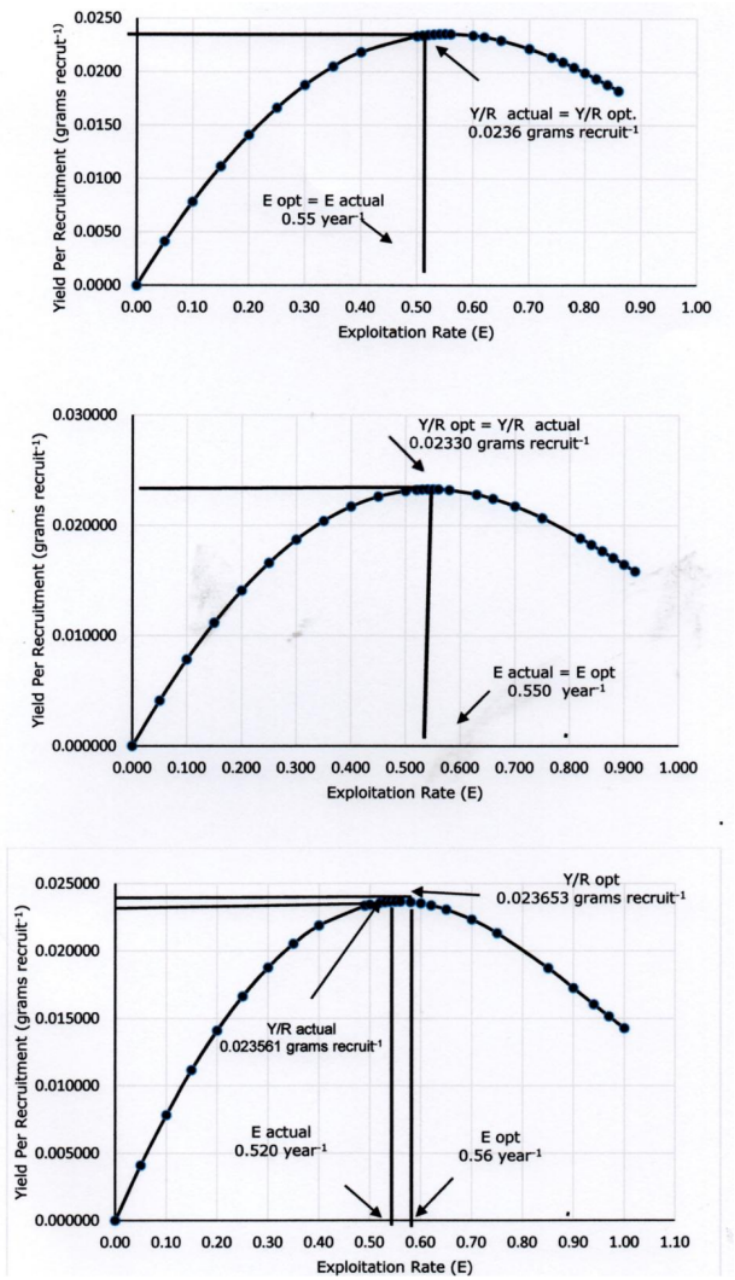


Figure 6. Yield per recruitment of combined male-female, male and female of *Channa striata* in Tempe Lake, Wajo District, South Sulawesi.

The structure of *C. striata* size based on several research results in Indonesia and in other countries are presented in Table 2. From the data it can be seen the difference in *C. striata* size structure between one area and another.

The difference in the size structure of *C. striata* according to the waters and researchers is thought to be caused by the following factors: 1) because of the differences in fishing gear used for harvesting fish samples (Suraya & Haryuni 2013), 2) there are differences in the environmental conditions of the fish habitat (Morioka et al 2016; Selviana 2017), and 3) there was a difference in the level of exploitation in each population (Morioka et al 2016; Mallawa 2020).

Table 2

Size structure of *Channa striata* in several areas in Indonesia

Area	*Sexes*	*Length range (LT, cm)*	*Dominant length (LT, cm)*	*References*
Wetland Musi River, Sumatera	Both sexes	14.0–18.9	-	Makmur 2003
Rungan River, Central Kalimantan	Both sexes	14.0–41.0	21.0–25.0	Suraya & Haryuni 2013
Pening Swamp, Semarang, Java	Both sexes	24.0–60.0	33.0–37.0	Puspaningdiah et al 2014
Swampy of Musi River, Sumatera	Both sexes	20.0–50.0	-	Nardawati et al 2014
Banjiran Swamp, Sumatera	Both sexes	19.0–46.5	-	Aida 2016
Banjiran Swamp, Sebangau River, Central Kalimantan	Male	16.0–36.9	20.2–30.6	Selviana 2017
	Female	16.0–36.9	22.3–30.6	
Aopao Swamp Southeast Sulawesi	Male	18.4–54.0	24.3–36.8	Cia et al 2018
	Female	18.4–54.0	24.3–36.8	
Panggang Lake Swamp South Kalimantan	Both sexes	5.0–45.0	12.5–22.5	Sofarini et al 2018
Tempe Lake, Wajo District, South Sulawesi	Box sexes	16.0–57.7	27.0–33.0	Present study
	Male	19.0–57.0	23.0–37.0	
	Female	16.0–57.7	27.0–33.0	

Tempe Lake *C. striata* K value of 0.29 year^{-1} is considered low. A low K value means that *C. striata* needs a relatively long time to reach its maximum length (Sparre et al 1989; Mallawa & Amir 2019). Low K values in *C. striata* also have been reported by several researchers (Fahmi et al 2013; Suraya & Haryuni 2013; Nardawati et al 2014; Khan et al 2015; Morioka et al 2016), but conversely high K values were reported by other researchers (Selviana 2017; Cia et al 2018) as presented in Table 3. The difference in K values in the same species can be due to the size structure of fish in the population. Populations dominated by large fish tend to give small K values (Sparre et al 1989; Mallawa & Amir 2019). The availability of sufficient food and the position of *C. striata* as predators makes the fish can grow larger in the waters of Tempe Lake.

Tempe Lake is one of the inland waters, which is very rich in nutrient abundance from the surrounding rivers in the rainy season (Ramadhan et al 2008; Setiawan & Wibowo 2013), causing the growth of plankton as a basic level of food and food for herbivore fish, which subsequently feed predatory fish such as *C. striata*.

Table 3

Comparison of L∞, K values of *Channa striata* based on several research results

Research area	*Von Beralanffy parameter*				*References*
	Sexes	*L∞ (cm)*	*K (year^{-1})*	*t_0 (year)*	
Lubuk Lapan swamp South Sumatra	Both sexes	72.98	0.36	-	Fahmi et al 2013
Rungan River Central Kalimantan	Both sexes	45.00	0.30	-	Suraya & Haryuni 2013
Mus river swamp	Both sexes	57.58	0.17	-	Nardawati et al 2014
Semangau River	Male	37.09	0.79	-0.19	Selviana 2017
	Female	37.69	0.73	-0.21	
Aopa Swamp, Southeast Sulawesi	Male	59.14	0.61	-0.84	Cia el al 2018
	Female	52.50	0.42	-0.55	
Panggang Lake South Kalimantan	Both sexes	63.40	0.15	-	Sofarini et al 2018
Gonti River, India	Both sexes	89.40	0.11	-0.93	Khan et al 2015
Nasaythong District, Central Laos	Male	34.50	0.37	0.01	Morioka et al 2016
	Female	31.00	0.44	0.01	
	Both sexes	34.50	0.41	0.01	

The moderate value of F explains that *C. striata* mortality in Lake Tempe was caused by fishing activities that are driven by high demand. This is in line with the previous explanation that *C. striata* is the target fish of fishermen because in addition to its good taste, the albumin content is also used as a medicinal ingredient. Moderate F values were also reported by several others researchers (Table 4).

Table 4

The Value of Z, M and F of snakehead fish in several waters in Indonesia

Area	*Population*	*Total mortality (Year^{-1})*	*Natural mortality (Year^{-1})*	*Fishing mortality (Year^{-1})*	*Exploitation rate (Year^{-1})*	*References*
Rempan River Central Kalimantan	Both sexes	1.7	0.72	0.98	0.57	Suraya & Haryuni 2013
Musi River Swamps South Sumatra	Both sexes	0.76	0.23	0.53	0.70	Nardawati et al 2014
Lubuk Lampau Swamp South Sumatra	Both sexes	1.72	0.75	0.91	0.58	Fahmi et al 2013
Panggang Lake South Kalimantan	Both sexes	1.12	0.43	0.69	0.62	Sofarini et al 2018
Aopa Watumohai Swamp Southeast Sulawesi	Both sexes	0.94	0.01	0.94	0.70	Cia et al 2018

Conclusions. The *C. striata* in the waters of Lake Tempe can grow to reach a bigger size than the same type of fish in other waters but it takes longer to reach the asymptotic length. As a target fish, the main cause of *C. striata* mortality in Lake Tempe is fishing. A fishing mortality rate that is not to high causes a rate of exploitation that is also not to high or moderate. The exploitation rate that is not to high results fish recruitment process being near optimal, which is marked by the value of the actual Y/R value which is almost comparable to the optimal Y/R.

Acknowledgements. We would like to thank the Management and Staff of the Fisheries Services around Lake Tempe for the assistance provided during the present research. The same remarks were conveyed to the Dean of the Faculty of Maritime and Fisheries Sciences at Hasanuddin University for the opportunity given in conducting the present research. Our gratitude is also extended to the leadership of the Bone Regency Fisheries School for the facilities provided to researchers.

References

Aida S. N., 2016 [Comparative study of the type of food of snakehead fish (*Channa striata*) in the Lubuk Lampan swamp, South Sumatra]. Proceedings of the 8th National Fish Seminar, pp. 333-343. [In Indonesian].

Bachtiar T., 2015 [Lake Tempe Tappareng Karaja is becoming increasingly shallow. Ministry of Energy and Mineral Resources. Bandung. West Java]. http://geomagz.geologi.esdm.go.id/danau-tempe-tappareng-karaja-yang-kian-mendangkal/ [In Indonesian].

Balkhis A. B. S., Jamsari A. F. J., Hwai T. S., Yasin Z., Azizah M. N. S., 2011 Evidence of geographical structuring in the Malaysian snakehead, *Channa striata* based on partial segment of the CO1 Gene. Journal of Genetics and Molecular Biology 34(3):520–523.

Cia W. O. C., Asriyana, Halili, 2018 [Mortality and exploitation level of snakehead fish (*Channa striata*) in Aopa Watumohai swamp South Konawe District]. Journal of Water Resources Management 3(3):223–231. [In Indonesian].

Fahmi Z., Nardawati S., Supryadi S., 2013 Growth and exploitation rate of snakehead (*Channa striata* Bloch 1793) in Lubuk Lampau floodplain, South Sumatera. Journal of Indonesia Responsible Fisheries 19(1):1–7.

Fitriyani E., Deviarni I. M., 2013 [The use of snakehead fish albumin extract as a basic ingredient for wound healing cream]. Journal of Marine and Fisheries Science 9(3):166-117. [In Indonesian].

Gayanilo F. C. Jr., Sparre P., Pauly D., 2005 FAO-ICLARM Stock Assessment Tools II (FiSat II). Revised Version. User's guide. FAO Computerized Information Series (Fisheries). No. 8, Revised version, FAO Rome, 168 p.

Haerunnisa, Budimawan A. S. A., Burhanuddin A. I., 2015 Management model of sustainability fisheries at Lake Tempe, South Sulawesi, Indonesian. International Journal of Science and Research 4(6):1939–1944.

Khan M. A., Khan S., Miyan K., 2015 Age and growth of a freshwater snakehead *Channa striata* (Bloch, 1793) from river Gonti, Poster Conference LUCSON 2015, Aligarh Muslim University, India.

Makmur S., 2003 [Fecundity and egg diameter of snakehead (*Channa striata* BLOCH) in Banjiran Musi river South Sumatera]. Journal of Fishery 8(2):254–259. [In Indonesian].

Mallawa A., Amir F., 2019 Population dynamic of narrow-barred Spanish mackerel *Scomberomorus commerson* (Lacepede, 1800) in Bone Bay waters, South Sulawesi Indonesia. AACL Bioflux 12(3):908–917.

Mallawa A., 2020 Comparison of catches of skipjack tuna (*Katsuwonus pelamis* Linnaeus 1758) purse seines inside and outside FADs areas. Pertanika Journal of Science and Technology 28(2):717–733.

Morioka S., Vongvichath B., Chantasone P., Pommachane P., Suzuki N., 2016 Reproductive season, age determination and growth in a striped snakehead *Channa*

striata population in Nasaythong District, Vientiane Province, Central Laos. Aquaculture Science 64(2):183–191.
Nasrul R. Y., 2016 [Biodiversity of freshwater fish in Tempe Lake waters]. Report research, Faculty of Science and Technology, Alauddin Islamic University, Makassar.
Nardawati S., Rais A. H., Supryadi S., 2014 [Estimation of growth parameters, mortality and size of the first ripe gonad of snakehead fish (*Channa striata*) in the Musi River Flood Swamp. Bawal 6(3):127–130. [In Indonesian].
Puspaningdiah, Solichin M. A., Ghofar A., 2014 [Biological aspect of snakehead fish (*Ophiocephalus striatus*) in Pening swamp waters, Semarang district]. Journal of Fishery 3(4):75-82. [In Indonesian].
Qiufen D., Zhidong P., Gaoshang M., 2013 The snakehead fish from China is considered as an exotic prhybrid snakehead fish farming in China. Aquaculture Asia Pacific Magazine 12:3–36.
Ramadhan A., Triyanti R., Koeshendrajaya S., 2008 [Characteristic and economic value of waters resources of Tempe Lake, South Sulawesi]. Journal of Policy and Social Economical of Maritime and Fishery Research 3(1):89–102. [In Indonesian].
Samidjan I., Rachmawati D., 2016 Technology engineering of aquaculture snakeheads [*Channa striata* (Bloch, 1793)] using cross breeding from different waters for determining the genetic variation of superior seeds. International Symposium on Aquatic Products Processing and Health ISAPPROSH 2015, Aquatic Procedia 7:136–145.
Samuel, Makmur S., Masak P. R. P., Farid A., Adiansyah V., Selamet S., Burnawi, Hifni T., 2010 [Technical report: Study fisheries resources stock in Tempe Lake waters South Sulawesi]. Inland Fisheries Research Institute. Palembang, Indonesia. [In Indonesian].
Selviana E., 2017 [Growth and reproduction of snakehead fish (*Channa striata* Bloch, 1793) in Banjiran swamp Sebangau river Palangka Raya, Central Kalimantan]. Thesis, Post Graduate School, IPB, Bogor. [In Indonesian].
Setiawan F., Wibowo., 2013 [Physical characteristic of Tempe Lake as flood exposure]. Proceeding of 1st Science Annual Meeting of Indonesia Limnology Community, Cibinong, Indonesia. [In Indonesian].
Sitepu F. G., 2012 [Reproductive biology of snakehead fish (*Channa striata* Bloch, 1973) in Tempe Lake]. Research Report, Faculty of Marine Science and Fishery, Hasanuddin University, Indonesia. [In Indonesian].
Sofarini D., Mahmudi M., Hertika A. S., Herawati E. Y., 2018 [Population dynamic of snakehead fish (*Channa striata*) in Panggang Lake swamp, South Kalimantan]. EnviroScienteae 14(1):16-20. [In Indonesian].
Sparre P., Venema S. C., Urchin P., 1989 Introduction to tropical stock assessment, Part I, Manual, Rome Italy, 399 p.
Suprayitno E., 2003 [Albumin of snakehead fish (*Ophiocepalus striatus*) as functional food to overcome future nutrition]. http://www.antarajatim.com. [In Indonesian].
Suraya U., Haryuni, 2013 [Evaluation of fishery capture in Rungan River, Central Kalimantan]. Tropical Animal Science Journal 2(2):75–82. [In Indonesian].
Vodunnou D. S. J. V., Kpogue D. N. S., Akpo Y., Aknika M., Fiogbe E. D., 2017 Determination of sexual dimorphism of snakehead (*Parachanna abscura*): morphometric and meristic parameters, weight-length relationship and condition factor. International Journal of Biology and Chemistry Science 11(4):1742–1752.
Wakiah A., Mallawa A., Amir F., 2019 Sex ratio and length weight relationship of snakehead fish (*Channa striata*) in Tempe Lake, Wajo District, Indonesia. International Journal of Scientific and Research Publication 9(4):584–590.
*** MMAF-RI (Ministry of Maritime Affair and Fishery of the Republic of Indonesia) 2018 Marine and Fisheries Table in Figures. Jakarta, Indonesia, 120 p.
*** MPWHH-RI (Ministry of Public Works and Human Housing of Republic Indonesia) 2017 Statistical Information Book, Jakarta, Indonesia, 112 p.

Received: 21 September 2020. Accepted: 23 October 2020. Published online: 30 October 2020.
Authors:
Andi Wakiah, School of Fisheries, Indonesia, South Sulawesi, 72701 Watampone, Jln. Sungai Musi KM 8, e-mail: andis.qa@gmail.com
Achmar Mallawa, Hasanuddin University, Faculty of Marine Science and Fishery, Department of Fishery, Indonesia, South Sulawesi, 90245 Makassar, Tamalanrea, Jln. Printis Kemerdekaan KM 10, e-mail: achmar_mallawa@yahoo.co.id
Faisal Amir, Hasanuddin University, Faculty of Marine Science and Fishery, Department of Fishery, Indonesia, South Sulawesi, 90245 Makassar, Tamalanrea, Jln. Printis Kemerdekaan KM 10, e-mail: faisalamir_unhas@yahoo.com

How to cite this article:
Wakiah A., Mallawa A., Amir F., 2020 Population dynamics of snakehead fish (*Channa striata*) in Tempe Lake, South Sulawesi, Indonesia. AACL Bioflux 13(5):3015-3027.

anna_striata__in_the_Lake_Tempe_South_Sulawesi_Indonesi...

ORIGINALITY REPORT

23%	14%	20%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to School of Business and Management ITB Student Paper	3%
2	A Pakro, A Mallawa, Sudirman, F Amir. " Population dynamic of red snapper ( ) at Alor waters East Nusa Tenggara Province, Indonesia ", IOP Conference Series: Earth and Environmental Science, 2020 Publication	3%
3	Suwarni, Moh Tauhid Umar, Sri Ramayani M. "Population dynamics of sailfin catfish (pterygoplichthys sp. Hancock, 1828) in sidenreng lake water, Sidenreng Rappang District, South Sulawesi", IOP Conference Series: Earth and Environmental Science, 2021 Publication	2%
4	sersc.org Internet Source	2%
5	Budiman Yunus, Suwarni, Basse Siang Parawansa. "POPULATION DYNAMICS OF TUNA (EUTHYNNUS AFFINIS, CANTOR 1849)	1%

IN WESTERN WATERS OF SOUTH SULAWESI", International Journal of Research - GRANTHAALAYAH, 2020
Publication

6	www.ijsrp.org Internet Source	1 %
7	S Herwaty, A Mallawa, Najamuddin, M Zainuddin. "Population dynamic of skipjack (Katsuwonus pelamis) in Timor Sea, East Nusa Tenggara, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 Publication	1 %
8	www.smujo.id Internet Source	1 %
9	Ramla, J Tresnati, M T Umar, Irmawati, D W Inaku, I Yasir, A Yanti, P Y Rahmani, R Aprianto, A Tuwo. "Unregulated fishing impact on yellowfin parrotfish scarus flavipectoralis in Spermonde Islands, Makassar Strait, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 Publication	1 %
10	A Damora, T Firdiyanti, A Rahmah, R M Aprilla, M A Chaliluddin. "Population dynamics of Indian scad (Decapterus russelli) in the northern and western waters of Aceh", IOP Conference Series: Earth and Environmental Science, 2021	1 %

	Publication	
11	www.bioflux.com.ro Internet Source	1 %
12	www.pertanika2.upm.edu.my Internet Source	1 %
13	Submitted to Universitas Airlangga Student Paper	1 %
14	en.wikipedia.org Internet Source	1 %
15	scimedjournal.org Internet Source	1 %
16	Fei Liu, Edwine Yongo, Zhice Liang, Qiongyao Fu, Bo Huang, Xing Wei Cai, Zhiqiang Guo. " Age, growth, reproductive biology and mortality of , a threatened freshwater fish in Hainan Island, China ", Journal of Applied Ichthyology, 2021 Publication	1 %
17	Submitted to University of East London Student Paper	<1 %
18	www.redalyc.org Internet Source	<1 %
19	ÇOBAN, Mehmet Zülfü, GÜNDÜZ, Fatih, DEMİROL, Ferhat, ÖRNEKÇİ, Gürel Nedim, KARAKAYA, Gökhan, TÜRKGÜLÜ, İbrahim and	<1 %

ALP, Ahmet. "Population dynamics and stock assessment of Capoeta umbla (Heckel, 1843) in Lake Hazar, Elazığ, Turkey", TÜBİTAK, 2013.
Publication

---

20 A Mallawa, F Amir, I Halid. "Comparison of the catch of two fishing technologies for yellowfin tuna (Thunnus albacares Bonnaterre 1788) in Bone Bay waters, South Sulawesi Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 <1 %
Publication

---

21 G Bintoro, T D Lelono, L Deafatmi. "Biological aspect and dynamic population of fringescale sardine (Sardinella fimbriata: Valenciennes, 1847) in Prigi waters Trenggalek, East Java, Indonesia", IOP Conference Series: Earth and Environmental Science, 2020 <1 %
Publication

---

22 U Tangke, R Laisouw, A Talib, Azis Husen, R Kota, W A Z Umagap. "Population dynamics of eastern little tuna (Euthynnus affinis) in Ternate Waters", IOP Conference Series: Earth and Environmental Science, 2021 <1 %
Publication

---

23 Submitted to University of Malaya <1 %
Student Paper

---

24 A Mallawa, F Amir, I Halid, E Mallawa. "Stock condition evaluation by length base <1 %

assessment: Case yellowfin tuna (Thunnus albacares) in Bone Bay waters", IOP Conference Series: Earth and Environmental Science, 2021
Publication

---

25 Firdha Iresta Wardani, N Nadiarti, Alfa FP Nelwan, Muhammad Jamal. "Vulnerability analysis of pelagic and demersal fisheries in the Indian Ocean, Fisheries Management Area 572, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 <1%
Publication

---

26 Griffiths, S.P.. "Population dynamics and fishery benefits of a large legal size of a pelagic sportfish, the Talang queenfish, Scomberoides commersonnianus, in northern Australia", Fisheries Research, 200612 <1%
Publication

---

27 Irwani, Agus Sabdono, Diah Permata Wijayanti. " Growth, Mortality and Exploitation Rate of Spiny Lobster ( ) from Kebumen and Cilacap Coastal ", IOP Conference Series: Earth and Environmental Science, 2019 <1%
Publication

---

28 1library.net <1%
Internet Source

---

29 Nhan, D.K.. "Integrated freshwater aquaculture, crop and livestock production in <1%

the Mekong delta, Vietnam: Determinants and the role of the pond", Agricultural Systems, 200705
Publication

30 mafiadoc.com
Internet Source
<1%

Exclude quotes	On	Exclude matches	< 5 words
Exclude bibliography	On		