Journal of Parasite Science
Vol. 9, No. 1, March 2025, Pages 6 - 11

JOURNAL OF PARASITE SCIENCE
2656-5331 (online) | 2599-0993 (print)
https:/e-journal.unair.ac.id/JoPS

Original Research

OPEN ACCESS

Identification of Parasitic Worms in Tilapia (*Oreochronis niloticus*) in Tanjung Bunga Lake, Makassar City

[1)]Ummu Amalia, [2)]Adyatma Muhammad Nur, [1)]Rian Hari Suharto, [1,2*)]Muhammad Fadhlullah Mursalim

[1)]Study Program of Veterinary Medicine, Faculty of Medicine, Hasanuddin University, Makassar, Indonesia
[2)]Veterinary Paramedic Study Program, Faculty of Vocational Studies, Hasanuddin University, Makassar, Indonesia

***corresponding author**: dullahmursalim@gmail.com

ABSTRACT

In the cultivation of tilapia (*Oreochromis niloticus*), parasitic worms can be detrimental in the form of mortality, resulting in increased financial losses. This study aimed to detect and identify parasitic worms in tilapia cultivated in Tanjung Bunga Lake. This study was conducted in March-April 2024. Fifty eight tilapia fish samples were randomly sampled at seven lake points and water sample for water quality examination including pH, salinity, temperature, dissove oxigen, nitrate, nitrite, and amonia. The identification results showed that only *Cichlidogyrus* sp. were worm parasites found in tilapia samples. This research indicates that Cichlidogyrus is the most frequent worm infecting the gills of tilapia in the lake, which could result in greater financial losses and a decline in health for fish producers in the region. The results emphasize the necessity of efficient management strategies to minimize parasitic infections in tilapia aquaculture systems.

ARTICLE INFO

Article history

Received: September, 14th 2024
Revised: December, 19th 2024
Accepted: January, 13th 2025
Published: March, 15th 2025

Keywords

Cichlidogyrus sp.
Identification
Parasite
Tilapia

INTRODUCTION

Tilapia (*Oreochromis niloticus*) is widely distributed in lakes, reservoirs, rivers, and swamps and is the second most important farmed fish in the world after carp (Bayissa *et al.*, 2021). Tilapia has a high socio-economic value in many countries around the world. Generally, tilapia is characterized by rapid growth and the ability to colonize a wide range of aquatic environments. However, tilapia is also subject to disease and can cause parasitic diseases in humans. For example helminth parasites, have been reported in tilapia and can infect humans through the consumption of undercooked or raw fish, leading to clinical conditions such as intestinal and hepatic disorders (Chai *et al.*, 2005). These zoonotic infections underline the importance of monitoring parasitic load in tilapia populations to ensure food safety and reduce health risks in aquaculture-dependent communities (Pérez *et al.*, 2022). Parasites are essential components in host biology, population structure, and even ecosystem function; they can be found in any fish species and various aquatic and aquaculture systems. Their range includes protozoa to metazoans, such as trematodes, nematodes, cestodes, and acanthocephala (Mitiku *et al.*, 2018).

The main worms found in tilapia are trematodes, nematodes, cestodes, and Acanthocephala. Nematodes that have been found in tilapia are *Gnathosma* spp. (Pérez *et al.*, 2022). In addition, the most commonly seen are *Anisakis*, *Pseudoterranova*, and *Cantracaecum*. The cestode worm that has been found in tilapia is *Pseudophyllidean*. Tilapia can also be infected with cestode worms of *Proteocephalus*, *Diphyllobothrium latum*, and *Caryophyllaeidea* (Motamedi *et al.*, 2018). Meanwhile, trematodes can be found in the gut and gills of fish, namely *Faciola gigantica*, *Echinostoma revolutum*, *Centrocestus formosanus*, and *Clinostomum marginatum* (Shafiq

doi.org/10.20473/jops.v9i1.61870

et al., 2023). In addition, there are other trematodes such as *Haplorchis yokogawi*, *Pygidiopsis genata*, and *Phagicola ascolonga*. (Pérez *et al.*, 2022). Meanwhile, one example of a worm with the acanthocephalan phylum is *Pallisentis* sp. (Ghassani *et al.*, 2016). Helminth infections pose a serious risk to the health of their hosts, animals, and humans and can devastate fisheries and the economy. Worms have a complex life cycle, starting in their first intermediate hosts, such as freshwater snails, and are widespread in most geographical areas. The distribution of worms depends on the intermediate availability of the host (Dodangeh *et al*., 2019).

Tanjung Bunga Lake Makassar is located in the Tanjung Bunga area in the western part of Makassar City. This lake is the flow of the Jeneberang River, which empties into the west coast of Makassar City, but a dam or sluice gate blocks the lake. The lake is elongated from southeast to west, and the lake water enters from downstream of the Jeneberang River and exits at Akkarena Beach. The community uses the lake for recreation, fishing, and fish rearing (Zulfikar, 2013). This study aims to identify parasitic worms in tilapia. This research is expected to help understand parasitic worms in tilapia as consumable fish.

MATERIALS AND METHODS

Sample Collection

From March to April 2024, fifty eight tilapia samples were collected from seven points (Table 1) in Tanjung Bunga Lake, Makassar City, South Sulawesi (Figure 1). Fish were examined at the Integrated Laboratory of Veterinary Medicine Study Program, Faculty of Veterinary Medicine, Hasanuddin University.

Table 1. Sampling coordinates and water quality at Tanjung Bunga Lake

No	Sample station	Coordinates
1	Point 1	S: 5°11'00 E: 119°24'28
2	Point 2	S: 5°10'50 E: 119°24'12
3	Point 3	S: 5°10'46 E: 119°24'09
4	Point 4	S: 5°10'43 E: 119°24'04
5	Point 5	S: 5°10'58 E: 119°24'32
6	Point 6	S: 5°11'01 E: 119°24'34
7	Point 7	S: 5°11'04 E: 119°24'31

Figure 1. Research location map (Source : Personal document)

Isolation and Identification

Tilapia examination was first coded, and subsequently, the weight and length body of the fish was measured. Tilapia were observed on the body surface and the gills. Then, the sample was extracted by sticking the needle right in the medulla oblongata. The abdomen was sliced lengthwise from the cloaca to the operculum of the fish. The gills, liver, and digestive tract were separated and put into a petri dish containing distilled water solution; the samples were viewed using a stereo microscope. To clarify, the gills were scraped and observed under a binocular microscope. Thus, parasitic worms were found in the gills, stored in an object glass given a distilled water solution, and put into a refrigerator at a temperature of 8ºC. After all worm samples are obtained, the staining process was carried out for trematodes using semichon's acetocarmine staining or permanent staining. Specimens were soaked in 70% ethanol for 10 minutes and immersed in semichon's acetocarmine solution for 15-20 minutes until it was absorbed and the color of the worm turned bright red. After that, the immersion specimens were rinsed with 70% ethanol and dripped with an acid alcohol solution. Specimens were dehydrated using graded alcohol (70%, 85%, 95%, and 100%) by immersing for 5 minutes at each alcohol concentration level. Next, the specimens were dripped with xylol until they became translucent. Finally, the specimens were mounted using entellan. The morphology of parasitic worms was examined using a stereo and binocular microscope with 400x magnification (Chai *et al*., 2013).

Water Quality Check

Water quality measurements were conducted simultaneously with tilapia sampling at Tanjung Bunga Lake, Makassar City. One hundred ml of lake water was put into a glass bottle. Parameters observed in the field were pH, salinity, and temperature using a thermometer, litmus paper, and salinity hydrometer, respectively. Meanwhile, the examination of dissolved oxygen (DO), ammonia, nitrate, and nitrite were carried out at the Water Quality Laboratory of the Faculty of Marine Science and Fisheries.

RESULTS AND DISCUSSION

Clinical Signs

In this study, most of the fish collected were healthy, but some fish showed changes in the gills, as presented in Figure 2 presents the clinical signs seen in tilapia, which are excessive mucus and pale red gill color in the gills. According to Kamil *et al*. (2017) Cichlidogyrus is one of the parasites of the monogenea group that infest tilapia. Cichlidogyrus attacks the gills attached to the gill filaments and feeds on gill epithelial cells, mucus, and blood in the gills. This ectoparasite attaches to the gills of its host with a structure called a haptor located at the back of the body; the haptor is armed with hooks and bars, but lacks many separate suckers and pincers (Ebert *et al*., 2024). This can lead to the death of young tilapia fish or weakened due to stress and acute infection.

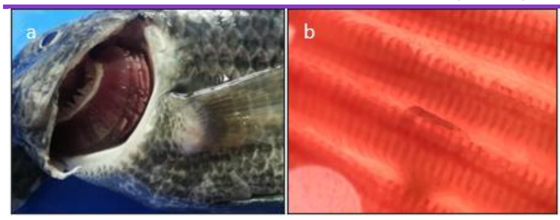

Figure 2. Clinical signs of fish infected with *Cichlidogyrus* sp. a. pale red gills b. parasitic infestation of worms on gill filaments

Isolation and Identification

As shown in Table 2, thirty seven **(**37) samples showed the presence of helminth parasitic infection in tilapia, of which Cichlidogyrus was the majority. Cichlidogyrus was found in the gills when observed using a microscope with 4x magnification. Cichlidogyrus was seen attached to the gill filaments. Figure 3 displays the staining result showing the morphology of the transfer bar and anchor on the posterior part of the Cichlidogyrus. In addition, the body length and anchor length of Cichlidogyrus were also measured. The results of the body length obtained averaged 221.942±8308 µm and the length of the anchor averaged 10.954± 350 µm.

Table 2. Infected fish sample

Location	Number of fish sample	Infected fish codes	Number of infected fish
Point 1	8	-	-
Point 2	8	B1, B3, B5, B6, B8	5
Point 3	8	C1, C2, C3, C4, C6, C7	6
Point 4	8	D3, D4, D6	3
Point 5	9	E1, E2, E3, E4, E5, E6, E7, E8, E9	9
point 6	9	F1, F2, F3, F4, F6, F7	6
Point 7	8	G1, G2, G3, G4, G5, G6, G7, G8	8
Total	**58**	**Number of Infected Fish**	**37**

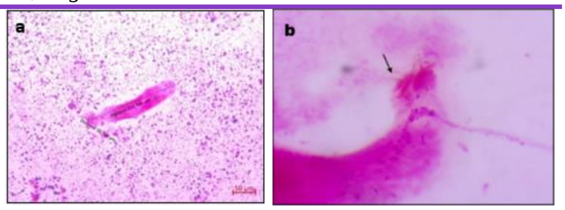

Figure 3. Cichlidogyrus staining results. a. Cichlidogyrus total magnification 100; b. Haptor Cichlidogyrus total magnification 400.

Water Quality Check

Table 3 presents the results of the water quality examinations, including temperature, salinity, dissolved oxygen (DO), pH, ammonia, nitrite, and nitrate. All water quality parameters are still at the optimal level except DO at point two, slightly below the optimal limit for tilapia culture.

A total of 58 tilapia fish were examined, with a length of 14-21 cm with an average weight of 97.96 grams. Parasitic worms in the gills are *Cichlidogyrus* sp., classified as a trematode from the Ancyrocephalidae family. This worm has characteristics, namely having an elongated flat body; on the opishaptor, there is a pair of eye spots, a pharynx, and three head lobes. Furthermore, the haptor section has two anchors, a marginal hook, two bars, and two bars (Laia *et al*., 2018). These features enable the parasite to effectively attach to the gills of the fish, causing significant damage and leading to respiratory distress (Olmeda *et al*., 2011).

The gill damage in tilapia found is not only due to *Cichlidogyrus* sp. but can also be caused by other parasites, including ciliates, *Trichodina* spp., *Ichthyophthirius multifiliis* Fouquet, 1876, and monogenea are the most common parasites infecting tilapia (Lim *et al*., 2016). *Cichlidogyrus* sp. was found in the gills when observed using a microscope with 4x magnification. *Cichlidogyrus* sp. was seen attached to the gill filaments, and Kamil *et al*. (2017) stated that Cichlidogyrus attaches to the gill filaments and feeds on gill epithelial cells, mucus and blood in the gills.

Table 3. Water quality examination results of Lake Tanjung Bunga

Water Quality Parameters		Location 1	2	3	4	5	6	7	Standard Range
Temperature (ºC)	Outside / Inside	30ºC	30ºC	29ºC	30ºC	31ºC	31ºC	31ºC	28-32 ºC
Salinity (mg/L)	Outside / Inside	0	0	0	0	0	0	0	0-30 ppt
pH	Outside / Inside	6	6	6	6	6	6	6	6-9
Dissolved Oxygen (mg/L)	Outside	7.36	2.88	10.24	5.76	3.48	4.48	6.08	>3 mg/L
	Inside	5.12	2.24	6.08	5.44	4.16	5.44	8.31	
Nitrate (mg/L)	Outside	0.1495	0.1365	0.0218	0.1875	0.1318	0.1241	0.0164	<0.2 mg/L
	Inside	0.1372	0.1565	0.0195	0.1326	0.1265	0.1226	0.0141	
Nitrite (mg/L)	Outside	0.0869	0.5555	0.0848	0.0597	0.0576	0.0493	0.0514	<0.2 mg/L
	Inside	0.0869	0.0597	0.0535	0.0618	0.0514	0.0576	0.0451	
Ammonia (mg/L)	Outside	0.0081	0.0078	0.0034	0.0034	0.0066	0.0043	0.0032	<0.02 mg/L
	Inside	0.0095	0.0088	0.0039	0.0033	0.0055	0.0039	0.0028	

On the lower body of the monogenean obtained are two pairs of large oviraptors, two transverse bars, and 14 small marginal hooks. Thus, it was identified that the monogenea species obtained was Cichlidogyrus. According to Rahmouni *et al*. (2021), the posterior end of all monogenea has a distinctive structure or haptor. Monogena is also considered one of the best model systems for determining the morphology of helminth parasites.

As the water quality examination indicates, the tilapia can tolerate temperatures between 29o - 31ºC. The results of this study are comparable to those reported by Yusni and Rambe (2019), who determined that tilapia has a water temperature tolerance of 28-32ºC. Kolia *et al*. (2021) have conducted numerous studies in tropical regions that confirm that parasitism increases at higher temperatures, such as those experienced in spring and summer, about the impact of water temperature on *Cichlidogyrus* sp. Tilapia can survive in waters with a salinity range of 0 to 30 ppt, enabling them to be cultivated or inhabited in brackish water (Rusidi *et al*., 2022). Additionally, aquatic monogeneans are also reported as salinity-tolerant (Roux *et al*., 2011). Furthermore, the pH range of 6-9 is appropriate for tilapia (Yusni and Rambe, 2019). Higher pH values influence fish health and parasite infestation, while parasite infestation and disease in the water can also be increased by low pH levels (Ojwala, 2017).

Tilapia require specific chemical characteristics that, when altered, cause the fish to become stressed and threatened by increased parasite infestation. Tilapia survives well in dissolved oxygen conditions that exceed 3 mg/L. Concurrently, a weakened immune system and diminished growth performance result from dissolved oxygen levels below 3 mg/L, rendering the organism susceptible to parasitic infections (Ojwala, 2017). The dissolved oxygen examination results at point two were low, with values of 2.88 and 2.24, suggesting the condition was inadequate. The dissolved oxygen values do not meet the tolerance limit for tilapia production. The low DO value is believed to be associated with the water condition, as the watercolour is brown, indicating that a significant amount of sediment is present in the water. The measurement is conducted in the morning, and numerous water hyacinth plants are near the enclosures. High parasite intensity is also believed to be induced by the quantity of water hyacinths (Ali *et al*., 2013). Nevertheless, fish are exceedingly resilient to oxygen levels below 4 mg/L (Pérez *et al*., 2022).

The optimal water quality range for tilapia is nitrate (<0.2 mg/L), nitrite (<0.2 mg/L), and ammonia (0.02 mg/L) (Larasati *et al*., 2020). The presence of nitrate, nitrite, and ammonia in Tanjung Bunga Lake is caused by domestic and industrial waste, given that the lake is a stream from the Jene Berang River. Following the theory (Anas *et al*., 2017), ammonia comes from domestic and fish feed waste. Parasitic infections can also occur due to differences in feed, water conditions, farming, and aquaculture activities. Fish farming activities and aquaculture activities carried out in open areas require the implementation of appropriate health management. Further research is needed to determine the best methods for controlling and preventing *Cichlidogyrus* sp. infestations to improve the overall health and profitability of tilapia farming in Tanjung Bunga Lake.

CONCLUSION

The research results conclude that *Cichlidogyrus* sp. was found in tilapia samples obtained from Lake Tanjung Bunga Makassar City, which should concern farmers. The presence of *Cichlidogyrus* sp. in the tilapia samples could negatively impact the fish population's health and productivity. Farmers should take proactive measures to prevent the spread of this parasite, such as implementing proper hygiene practices and regular monitoring of their fish stocks. Farmers need to work together with researchers and experts to develop strategies for controlling and treating infections to protect their livelihoods. Education and training programs can also be established to raise awareness about the risks associated with *Cichlidogyrus* sp. and promote best practices in fish farming.

ACKNOWLEDGEMENT

We want to thank Institute of Research and Community Service Hasanuddin University for the funding and also for the laboratory of microbiology of the veterinary study program, the Faculty of Medicine, Hasanuddin University for all of the facilities.

AUTHORS' CONTRIBUTIONS

UA and MFM: Conceptualized, investigated, reviewed, and drafted the manuscript.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

FUNDING INFORMATION

This work was supported by grant of Collaborative Fundamental Research, Hasanuddin University number 00309/UN4.22/PT.01.03/2024.

ETHICAL APPROVAL

The procedures for this study were performed following the methods approved by Hasanuddin University Health Research Ethics Commission (UH24050348).

REFERENCES

Ali, S. K., Koniyo, Y., and Mulis. (2013) 'Identifikasi Ektoparasit Pada Ikan Nila (*Oreochromis nilotica*) di Danau Limboto Provinsi Gorontalo', *Jurnal Ilmiah Perikanan dan Kelautan*, 1(3), pp. 114–125. Available at: https://doi.org/10.37905/.v1i3.1231

Anas, P., Jubaedah, I., and Sudino, D. (2017) 'Kualitas Air dan Beban Limbah Karamba

Jaring Apung di Waduk Jatiluhur Jawa Barat', *Jurnal Penyuluhan Perikanan dan Kelautan*, 11(1), pp. 35–47. Available at: https://doi.org/10.33378/jppik.v11i1.84

Bayissa, T. N. *et al*. (2021) 'The Impact of Lake Ecosystems on Mineral Concentrations in Tissues of Nile Tilapia (*Oreochromis niloticus* L.)', *Animals*, 11(4), pp. 1–14. Available at: https://doi.org/10.3390/ani11041000

Chai, J. Y. *et al*. (2005) 'Fish-borne parasitic zoonoses: status and issues', *International Journal for Parasitology*, 35(11-12), pp. 1233-1254. Available at: https://doi.org/10.1016/j.ijpara.2005.07.013

Chai, J.Y., Bahk, Y. Y., and Sohn, W. M. (2013) 'Trematodes Recovered in the Small Intestine of Stray Cats in the Republic of Korea', *The Korean Journal of Parasitology*, *51*, 99-106. Available at: https://doi.org/10.3347/kjp.2013.51.1.99

Dodangeh, S. *et al*. (2019) 'Freshwater Snails as The Intermediate Host of Trematodes in Iran: A Systematic Review', In *Epidemiology and Health*, 41(1), pp. 1-13. Available at: https://doi.org/10.4178/epih.e2019001

Ebert, M. *et al*. (2024) 'Parasites (Monogenea) of tilapias *Oreochromis niloticus* and *Coptodon rendalli* (Cichlidae) in a river spring in Brazil', *Parasite*, 31(22), Available at: https://doi.org/10.1051/parasite/2024021

Ghassani, S., Hidayati, D., and Abdulgani, N. (2016) 'Prevalensi dan Intensitas Endoparasit pada Ikan Gabus (*Channa striata*) dari Budidaya dan Alam', *Jurnal Sains dan Seni ITS*, 5(2), pp. 67–70.

Kamil, M. R., Prayitno, S. B., and Desrina. (2017) 'Studi Kasus Infestasi *Cichlidogyrus* pada Ikan Nila (*Oreochromis niloticus*) dari Satker BPBIAT dan Luar Satker BPBIAT Janti, Klaten, Jawa Tengah', *Journal of Aquaculture Management and Technology*, 6(4), pp. 120–129.

Kolia, W. S. K., Sunarto, and Widiyani, T. (2021) 'The relationship between water quality and prevalence of ectoparasites on cultured Nile tilapia at two reservoirs in Central Java, Indonesia', *IOP Conference Series: Earth and Environmental Science*, 824(1), pp. 1–8. Available at: http://dx.doi.org/10.1088/1755-1315/824/1/012013

Laia, N. P., Desrina, and Haditomo, A. H. C. (2018) 'Infestasi Monogenea pada Ikan NIla (*Oreochromis niloticus*) dari Desa Genuk, Ungaran Barat dan Ikan Lele (*Clarias gariepinus*) dari Kp. Ngglarang, Gunung Pati, Jawa Tengah', *Journal of Aquaculture Management and Technology*, 7(1), pp. 107–113.

Larasati, C., Mahasri, G., and Kusnoto. (2020) 'Korelasi Kualitas Air terhadap Prevalensi Ektoparasit pada Ikan Nila (*Oreochromis niloticus*) di Keramba Jaring Apung Program Urban Farming Kota Surabaya, Jawa Timur', *Journal of Marine and Coastal Science*, 9(1), pp. 12–20. Available at: https://doi.org/10.20473/jmcs.v9i1.20756

Lim, S. Y., Ooi, A. L., and Wong, W. L. (2016) 'Gill monogeneans of Nile tilapia (*Oreochromis niloticus*) and red hybrid tilapia (*Oreochromis* spp.) from the wild and fish farms in Perak, Malaysia: infection dynamics and spatial distribution', *Springerplus*, 5(1), pp. 1609. Available at: https://doi.org/10.1186/s40064-016-3266-2.

Mitiku, M. A., Konecny, R., and Haile, A. L. (2018) 'Parasites of Nile Tilapia (*Oreochromis niloticus*) from Selected Fish Farms and Lake Koftuin central Ethiopia', *Ethiopian Veterinary Journal*, 22(2), pp. 65–80. Available at: http://dx.doi.org/10.4314/evj.v22i2.6

Motamedi, M. *et al*. (2018) 'Detection of Contracaecum Multipapillatum (Nematoda: *Anisakidae*) in The Indigenous Killifish Aphanius hormuzensis (Teleostei; *Aphaniidae*) and Its Histopathological Effects: A Review of Iranian Aphanius Species Parasites', *Journal of Applied Ichthyology*, 35(2), pp. 1–12. Available at: https://doi.org/10.1111/jai.13848

Ojwala, R. A. (2017) *Effect of Water Quality on The Parasite Assemblages Infecting Nile Tilapia in Selected Fish Farms in Nakuru County* [Thesis, Egerton University]. Available at: https://www.researchgate.net/publication/358808333

Olmeda, A.S. *et al* (2011) 'Occurrence of the oribatid mite *Trhypochthoniellus longisetus longisetus* (Acari: *Trhypochthoniidae*) on tilapia *Oreochromis niloticus'*, *Diseases of Aquatic Organisms*, 94, pp. 77-81. Available at : https://doi.org/10.3354/DAO02309

Pérez, V. J. A. *et al*. (2022) 'Prevalence of Parasitic Infections with Zoonotic Potential in Tilapia: A Systematic Review and Meta-Analysis', *Animals*, 12(20), pp. 1-17. Available at : https://doi.org/10.3390/ani12202800

Rahmouni, C. *et al*. (2021) 'Intraspecific Morphological Variation in Cichlidogyrus (Monogenea) Parasitizing Two Cichlid Hosts from Lake Tanganyika Exhibiting Different Dispersal Capacities', *Hydrobiologia*, 848(16), pp. 3833–3845. Available at: https://doi.org/10.1007/s10750-020-04429-1

Roux, L. E. I., Oldewage, A. A., and Walt, F. C. Van Der. (2011) 'Aspects of The Ecology of Cichlidogyrus Philander Collected from *Pseudocrenilabrus Philander* from The Padda Dam, Gauteng, South Africa', *African Zoology*, 46(1), pp. 103–116. Available at: https://doi.org/10.1080/15627020.2011.11407484

Rusidi, I., Jailani, and Akhmad. (2022) 'Pengaruh Salinitas Air Terhadap Pertumbuhan Ikan Nila (*Oreochromis niloticus*) di Desa Panoragan Kecamatan Loa Kulu Kabupaten Kutai Kartanegara Provinsi Kalimantan Timur', *in Seminar Nasional Pendidikan Profesi Guru Tahun 2022*, 3, pp. 1–9.

Shafiq, A. *et al*. (2023) ‘Parasite Diversity in a Freshwater Ecosystem’, *Microorganisms*, 11(8), pp. 1–16. Available at: https://doi.org/10.3390/microorganisms11081940

Yusni, E. and Rambe, N. (2019) ‘Identification of ectoparasites in Fry Tilapia (*Oreochromis niloticus*) in Aquaculture Pond’, *IOP Conference Series: Earth and Environmental Science*, 260(1), pp.1–7. Available at: https://doi.org/10.1088/1755-1315/260/1/012110

Zulfikar (2013) ‘Survei Kualitas Air Danau Arena Dayung Tanjung Bunga, Makassar’, *Sainsmat*, 2(1), pp. 32–51. Available at: https://doi.org/10.35580/sainsmat217542013