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Parasite infestation in Bluefin Trevally *Caranx melampygus* (G. Cuvier, 1833) in Bongao, Tawi-Tawi, Philippines

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Abstract

Bluefin trevally (BFT, *Caranx melampygus*) were studied in Bongao, Tawi-Tawi, for parasite infestations and prevalence at different body weights (300 - 500 g, 500 - 1500 g, and 1500 - 3000 g). Twenty-seven samples were collected for parasitic investigation. Out of this, nine fish with 300 - 500 g body weight, nine fish with 500 - 1500 g body weight, and nine fish with 1500-3000 g body weight were obtained from the fishermen at the wet market landing site. Results revealed that a total of 46 parasites were recorded in six BFT fish weighing 300 g to 500 g, 44 parasites were recorded in eight BFT fish weighing 500 g to 1500 g, and 101 parasites were recorded in eight BFT fish weighing 1500 g to 3000 g. Based on the ANOVA analysis, the prevalence, abundance, and intensity of parasite infestations in BFT species with different body weights were not significantly different ($p>0.05$). Moreover, it was found that four species of parasites (*Argulus* spp., *Caligus* spp., *Cymothoa* spp., and *Pulchrascaris* spp.) were present in the heart, intestines, mouth, and operculum of different body weights of BFT fish, of which the majority were found in the gills, mainly *Caligus* spp. parasite. Thus, the results of this study indicate no significant differences in parasite infestation of BFT, *C. melampygus*, between individual body weights and host locations in Bongao, Tawi-Tawi.

Keywords: Abundance, *Caranx melampygus*, Intensity, Parasite infestation, Prevalence

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1. Introduction

The production of fish from natural water and aquaculture is being focused on now that fish can provide a relatively cheap source of protein for man and his livestock. (Coche et al., 1994; Khalil & Polling, 1997; Bichi& Yelwa, 2010; Komatsu & Kitanishi, 2015). Besides providing food for immediate consumption, fishing provides economic gains and jobs for large numbers of people (Tahiluddin & Kadak, 2022). Developed countries have a ready market for tropical fish products, making them good foreign earners (Imam & Dewu, 2010). Since the Philippines is an archipelagic nation, it is blessed with a wealth of fisheries resources that Filipinos can rely on for food and livelihood, as well is recognized as a major producer of international fisheries (Guevara & Camu, 1988; Tahiluddin & Terzi, 2021; Tahiluddin & Kadak, 2022). As of 2018, the Philippines produced 1.89 million MT of fish, ranking 13th globally in terms of fish production (FAO, 2020). In parallel with the rapid increase in the world's population, seafood has become an increasingly important source of protein (Abolarin, 1971; Bichi & Yelwa, 2010; Merino et al., 2012; Tahiluddin & Kadak, 2022). As the need for animal protein has increased, fish farming and culture have developed rapidly in recent years. However, there are also problems associated with fish farming, such as poor environmental conditions, overcrowding, and pollution, which contribute to reducing fish immunity and make them more susceptible to diseases and parasites (Murray, 2005; Biu et al., 2014).

There are many factors that contribute to the decline of fish production, including overexploitation, globalization, conservation of marine biodiversity, inadequate government capacity and cooperation to regulate, manage, and control fisheries and fisheries trade, environmental changes, as well as diseases. As the environment deteriorates and organisms are stressed, many diseases are associated with these conditions (Bichi & Yelwa, 2010). A wide range of diseases and parasite infections plague fishes, just as they do humans and other animals (Bamidele, 2015). There are many parasitic diseases of fish around the world, especially in tropical areas (Roberts et al., 2000; Soliman & Nasr, 2015). All vertebrates are parasitized to some degree, but fish are the most vulnerable (Arme & Wakey, 1970). In recent years, parasitic diseases have become increasingly recognized as one of the major threats to fish populations (Paperna, 1996; Keremah & Inko-Tariah, 2013). Numerous parasite larvae and adults can be found in mammals, reptiles, amphibians, birds, predatory fish, and humans are also susceptible to parasitic infections, causing them to become easy prey for predators and affecting their health (Yusuff & Ibidapo-Obe, 2019). Public health concerns have been raised about some parasites that can transmit zoonotic diseases to mammalian hosts, including humans (Ukoli, 1969).

The role that parasites play in ecological areas is crucial because they provide insight into population structure, environmental stressors, evolutionary hypotheses, trophic interactions, climatic conditions, and biodiversity (Williams et al., 1992). Nevertheless, fish populations are declining as a result of continuous fishing and environmental disturbance, which may also have an adverse effect on parasite populations (Sakthivel et al., 2016). Wild environments and aquaculture have different parasites associated with *Clarias gariepinus*, which can cause mortality and morbidity as well as economic losses (Subashinghe, 1995; Biu et al., 2014). In addition, *Caranx ignobilis* lives in a marine environment and is frequently parasitized by acanthocephalans, copepods, isopods, trematodes, and nematodes (Sakthivel et al., 2016). Moreover, it has been documented by many researchers that *Caranx sexfasciatus* fish are infested with parasites (Grobler et al., 2003; Yuniar et al., 2007; Rueckert et al., 2009; Violante-González et al., 2020). However, the presence of parasites on BFT *Caranx melampygus* has not been documented. To deal with parasitic diseases, capturing and maintaining marine fish poses a major challenge. Hence, this study aims to determine parasitic infection prevalence, abundance, and intensity in BFT *Caranx melampygus* in Bongao, Philippines.

2. Material and Methods

2.1. Study site, duration, and sample collection

The study was carried out at Public Wet Market of Bongao, Tawi-Tawi, Philippines (5°04’11.2’’N 119°53’02.0’’E) for a duration of 21 days. Twenty-seven (27) BFT *C. melampygus* species were used in the study with varying body weights caught by means of ring net fishing. Fish samples were kept in a Styrofoam box containing crushed ice and transported to the MSU TCTO Multi-Species Hatchery, College of Fisheries, Sanga-Sanga, Bongao, Tawi-Tawi for parasite inspection and observation.

2.2. Ectoparasite and endoparasite examinations of samples

A scalpel blade was used to collect any epibiota found. The mucus from the fish's gills was observed and recorded under the microscope after they were scraped with scalpel blades. A sterilized knife was then used to dissect the fish. We collected the fish gills, placed them in a petri dish, and examined them under the microscope. Using a pointed needle, all ectoparasites were collected and placed in a petri dish or glass slide. Observations and photographs were taken of the protozoan parasites. A glass bottle was filled with a 10% brine solution, and a piece of epibiont was placed inside. Fish entrails consisting of intestines, liver, and heart were prepared in the petri dish for microscopic examination. The same method was used to collect endoparasites as we did to examine ectoparasites. In addition to recording each species of parasite found in each location, a total number of parasites per sample was also recorded. A morphological criterion was used for species identification of parasites (Williams, 1994; Gibson, 1996; Smit et al., 2014).

2.3. Evaluation of prevalence, intensities, and abundances of parasites

The prevalence, intensities, and abundance of parasites infestation was calculated using the model of Margolis et al. (1982).

$$Prevalence\ (\%) = \frac{Number\ of\ samples\ infected}{Number\ of\ samples\ examined} x100 \quad (1)$$

$$Mean\ Intensity = \frac{Number\ of\ parasites}{Number\ of\ sample\ infected\ fish} \quad (2)$$

$$Mean\ Abundance = \frac{Number\ of\ parasites}{Number\ of\ samples\ examined} \quad (3)$$

2.4. Statistical analysis

The prevalence, mean abundance, mean intensity of infection, and site preferences of parasites in different body weights of C. melampygus species were examined through a one-way analysis of variance (ANOVA). Duncan's Post-Hoc Test was used to rank the mean. An analysis of the data was conducted using SPSS version 20 at a significant level of 0.05.

3. Results

Table 1 shows the prevalence, abundance, and intensity of parasite infestation in BFT *C. melampygus*. It was found that six BFT *C. melampygus* with a weight range of 300 g to 500 g were infected with 46 parasites, while there were eight infected fish and 44 parasites found in fish weighing 500 - 1500 g in body weight of BFT *C. melampygus*. In addition, we found 101 parasites in eight BFT *C. melampygus* fish with a body weight between 1500-3000 g. Results revealed that the prevalence of different body weight (300 - 500 g, 500 - 1500 g, and 1500 - 3000 g) were 66.67 ± 19.25%, 88.89 ± 11.11%, and 88.89 ± 11.11%, respectively. ANOVA revealed no significant difference (p>0.05) among the different body weights of BFT *C. melampygus*. The intensity of parasites in different body weights were 6.11 ± 2.73, 6.06 ± 2.46, and 11.50 ± 7.78, respectively. There were no significant differences (p>0.05) among BFT *C. melampygus'* body weights. In addition, parasite abundances of different body weights were 5.11 ± 2.90, 4.89 ± 1.49, and 11.22 ± 7.95, respectively. Based on ANOVA analysis, BFT *C. melampygus'* body weights were not significantly different (p>0.05).

Four (4) parasites were prevalent, including *Argulus* spp., *Caligus* spp., *Cymothoa* spp., and *Pulchrascaris* spp. (Figure 1). BFT *C. melampygus* parasitic incidence in Bongao, Tawi-Tawi is shown in Tables 2, 3, and 4. Based on the site location of parasites in the examined fish species, it was revealed that the largest number of parasites were recovered in the gills (4.94 ± 1.95%), followed by the operculum (2.47 ± 1.63%), and in the intestine (1.23 ± 1.23%) of 300 - 500 g body weight fish. Furthermore, it was found that the 500 - 1500 g body weight of BFT *C. melampygus* had the most parasites recovered in the gills (6.17 ± 1.95%), similarly to 1500 - 3000 g body weight of BFT *C. melampygus* that had parasites recovered in the gills (8.64 ± 3.08).

Table 1. Prevalence, abundance, and intensity of parasite infestation in BFT *C. melampygus* based on body weight in Bongao, Tawi-Tawi, Philippines

Body Weight (g)	N	No. of fish infected	No. of parasites collected	Prevalence (%)	Mean Intensity	Mean Abundance
300.50 - 500.50	9	6	46	66.67 ± 19.25^a	6.11 ± 2.73^a	5.11 ± 2.90^a
500.51 - 1500.50	9	8	44	88.89 ± 11.11^a	6.06 ± 2.46^a	4.89 ± 1.49^a
1500.51 - 3000.50	9	8	101	88.89 ± 11.11^a	11.50 ± 7.78^a	11.22 ± 7.95^a

Values are measures in triplicates. Means with different letters within a row are significantly different (p<0.05), n=27.

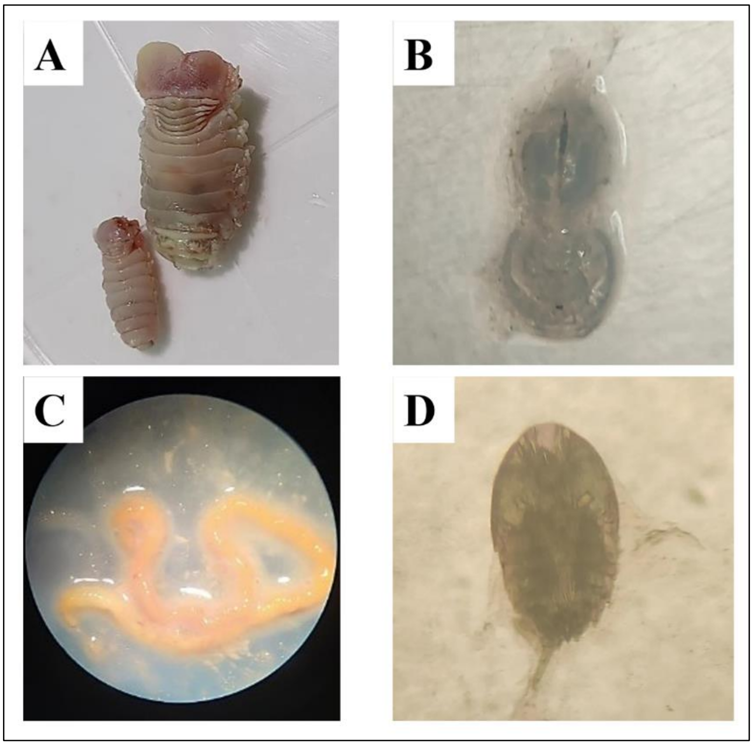

Figure 1. Parasites species recorded in BFT *C. Melampygus*; A: *Cymothoa* spp.; B: *Caligus* spp.; C: *Pulchrascaris* spp.; D: *Argulus* spp.

Table 2. Incidence of parasites in 300 - 500 g body weight of BFT *C. melampygus*

Parasites	%	Gills (%)	Mouth (%)	Operculum (%)	Heart (%)	Intestines (%)
Argulus spp.	-	-	-	-	-	-
Caligus spp.	66.67 ± 16.67	4.94 ± 1.95	-	2.47 ± 1.63	-	-
Cymothoa spp.	-	-	-	-	-	-
Pulchrascaris spp.	11.11 ± 11.11	-	-	-	-	1.23 ± 1.23

Table 3. Incidence of parasites in 500 - 1500 g body weight of BFT *C. melampygus*

Parasites	%	Gills (%)	Mouth (%)	Operculum (%)	Heart (%)	Intestines (%)
Argulus spp.	11.11 ± 11.11	-	-	-	1.23 ± 1.23	-
Caligus spp.	66.67 ± 16.67	6.17 ± 1.95	-	1.23 ± 1.23	-	-
Cymothoa spp.	11.11 ± 11.11	-	1.23 ± 1.23	-	-	-
Pulchrascaris spp.	-	-	-	-	-	-

Table 4. Incidence of parasites in 1500 - 3000 g body weight of BFT *C. melampygus*

Parasites	%	Gills (%)	Mouth (%)	Operculum (%)	Heart (%)	Intestines (%)
Argulus spp.	-	-	-	-	-	-
Caligus spp.	66.67 ± 16.66	7.41 ± 1.85	-	-	-	-
Cymothoa spp.	11.11 ± 11.11	1.23 ± 1.23	-	-	-	-
Pulchrascaris spp.	-	-	-	-	-	-

4. Discussion

As expressed by prevalence, mean intensity, and abundance of parasites in BFT *C. melampygu* species, there is a large number of parasite infestations. In the present study, the prevalence rate of the parasite in different body weights (300 - 500 g, 500 - 1500 g, and 1500 - 3000 g) were 67%, 89%, and 98%, respectively, in Bongao, Tawi-Tawi. Compared to Amos et al. (2018), whose study found that *Clarias gariepinus* of weight range 254 - 304 g and 305 - 355 g had 100% parasite prevalence in Lake Geriyo. In addition, *Caranx ignobilis* fish weighing between 3500 g and 4000 g were found to exhibit a higher prevalence of 64% (Sakthivel et al., 2016). It means that fish with heavier weights were more infested than those with lighter weights. This study supports the findings of other researchers that parasite infection levels are higher with fish age and weight (Kudoro, 1995; Oniye et al., 2004; Allumma & Idowu, 2011). As a result of their reduced immunity, adult fish may be more susceptible to parasite infestations than juveniles. Researchers suggested that older fish were exposed to infectious agents in the environment for a longer period of time, which may explain the higher infection rates in adults. To support this claim, Oniye et al. (2004) reported that juvenile fish do not suffer parasitic infections, but adult fish experience parasitic infections due to changes in their diet during adulthood, while according to Bichi and Dawaki (2009), parasite abundance increases with host size. In contrast, Adeyemo (2001) found that juveniles were more susceptible to infection with *Chrostomium tilapiae* on farms in Oyo State. The present study also differs from what Akinsanya et al. (2007) reported, who stated that smaller fish were more infested. Moreover, study findings indicate that BFT *C. melampygu* species weighing between 1500 g and 3000 g exhibit a higher mean intensity and abundance of 11% and 12%, respectively. A study by Sakthivel et al. (2016) found that *C. ignobilis* species with body weights between 3500 g and 4000 g had 10% and 6% higher mean intensities and abundances. In addition, we found a higher incidence of parasites in the gills, in line with Mohammed et al. (2009), Bichi and Yelwa (2010), Heba et al. (2012), and Sakthivel et al. (2016) findings. Furthermore, sex plays a huge role in determining the parasitic infected fishes (Sakthivel et al., 2016). However, a sex-based measure of parasitic incidence was not carried out in the present study. To support this, Amos et al. (2018) found that females were more likely to be parasitized than males, based on the parasite incidence rates on sex. Most gravid females tend to have lower resistance to parasitic infections due to their physiological state and to differential feeding due to their different degrees of resistance to parasites (Emere & Egbe, 2006).

5. Conclusion

In a healthy environment, parasites and hosts are normally in a dynamic balance. A variety of ecological factors may be associated with the number of parasites that have been recorded for different body weights of Bluefin Trevally *C. melampygu* species in Bongao, Tawi-Tawi. This study suggested that older fish are more likely to acquire infections because of prolonged exposure to infectious agents in the environment. Therefore, prior to restocking activities, wild fish must be thoroughly screened and cleaned. In addition, educating the public about proper fish preparation can help prevent food poisoning. Keeping fish degutted and cooked properly is essential in preventing the spread of zoonotic diseases.

Conflict of interest

The authors declare that there is no conflict of interest.

References

Abolarin, M. O. (1971). A New Species of Henneguya (Myxosporida, Protozoa) from West African Catfish, *Clarias lazera* Val., with a Review of the Genus Henneguya Thelohan, 1892. *African Journal of Tropical Hydrobiology and Fisheries*, *1*(2), 93-105.

Adeyemo, A. O. (2001). *Incidence and pathogenesis of Chrostomum Tilapia: A trematode parasite of Tilapia (Oreochromis niloticus)* [PhD thesis, University of Ibadan].

Akinsanya, B., Otubanjo, O. A., & Hassan, A. A. (2007). Helminth Parasites of *Malapterurus electricus* (Malapteruridae) from Lekki Lagoon, Lagos, Nigeria. *Journal of American Science*, *3*(3), 1-5.

Allumma, M. I., & Idowu, R. T. (2011). Prevalence of Gills Helminth of *Clarias gariepinus* in Baga Side of Lake Chad. *Journal of Applied Sciences and Environmental Management*, *15*(1), 47-50. https://doi.org/10.4314/jasem.v15i1.65674

Amos, S. O., Eyiseh, T. E., & Michael, E. K. (2018). Parasitic Infection and Prevalence in *Clarias gariepinus* in Lake Gerio, Yola, Adamawa State. *MOJ Anatomy and Physiology*, *5*(6), 376-381. https://doi.org/10.15406/mojap.2018.05.00229

Arme, C., & Wakey, M. (1970). *The physiology of fishes in aspect of fish parasitology*. Blackwell Scientific Publications.

Bichi, A., & Yelwa, S. (2010). Incidence of Piscine Parasites on the Gills and Gastrointestinal Tract of *Clarias gariepinus* (Teugels) at Bagauda Fish Farm, Kano. *Bayero Journal of Pure and Applied Sciences*, *3*(1), 104-107. https://doi.org/10.4314/bajopas.v3i1.58732

Biu, A. A., Diyaware, M. Y., Yakaka, W., & Rita, D. J. (2014). Incidence of Parasites of *Clarias gariepinus* (Burchell, 1822) Caught from Lake Alau, Maiduguri, Borno State, Nigeria. *Nigerian Journal of Fisheries and Aquaculture*, *2*(1), 74-80.

Coche, A. G. (1994). *Aquaculture development and research in Sub-Saharan Africa: National reviews (No. 23)*. Food & Agriculture Organization.

Emere, M. C., & Egbe, N. E. L. (2006). Protozoan Parasites of *Synodontis clarias* (A Fresh Water Fish) in River Kaduna. *The Best Journal*, *3*(3), 58-64.

FAO. (2020). *The state of world fisheries and aquaculture 2020: Sustainability in action*. Food & Agriculture Organization.

Gibson, D. I. (1996). Trematoda. In L. Margolis, & Z. Kabata (Eds.), *Guide to the Parasites of Fishes of Canada, Part IV* (373 pp). NRC Research Press.

Grobler, N. J., Van As, J. G., & Olivier, P. A. S. (2003). Additional Morphological Information on Two Species of *Caligus* (Copepoda: Caligidae) Parasitic on South African Marine and Estuarine Fish. *African Zoology*, *38*(1), 139-143. https://hdl.handle.net/10520/EJC17856

Guevara, G., & Camu, C. C. (1988). *The fish processing industry in the Philippines: Status, problems and prospects* [Oral presentation]. 20th Anniversary Seminar on Development of Fish Products in Southeast Asia, Singapore.

Heba, I., Mawla, A., & Walaa, T. E. (2012). Some Studies on Parasitic Infection among *Morone labrax* (Seabass Fish) as Bio-indicator of Environmental Conditions. *Egyptian Journal for Aquaculture*, *2*, 95-98.

Imam, T. S., & Dewu, R. A. (2010). Survey of Piscine Ecto-and Intestinal Parasites of *Clarias* Species Sold at Galadima Road Fish Market, Kano Metropolis, Nigeria. *Bioscience Research Communications*, *22*(4), 209-214.

Keremah, R. I., & Inko-Tariah, M. B. (2013). Comparative Study of Ectoparasites on Nile Tilapia (*Oreochromis niloticus*) Cultured under Integrated and Unintegrated Pond Systems. *African Journal of Biotechnology*, *12*(19), 2711-2714. https://doi.org/10.5897/AJB10.1238

Khalil, L. F., & Polling, L. (1997). *Check list of the helminth parasites of African freshwater fishes* (2nd ed.). University of the North, Pietersburg.

Komatsu, K., & Kitanishi, K. (2015). Household Protein Intake and Distribution of Protein Sources in the Markets of Southern Ghana: A Preliminary Report. *African Study Monographs*, *51*(3), 157-173. https://doi.org/10.14989/197200

Kudoro, O. A. (1995). Some parasites of cultured fishes of Mobolaji Fish Farm, Ado-Odo [Master's thesis, University of Ibadan].

Margolis, L., Esch, G. W., Holmes, J. C., Kuris, A. M., & Schad, G. (1982). The Use of Ecological Terms in Parasitology (Report of an Ad Hoc Committee of the

American Society of Parasitologists). *The Journal of Parasitology*, *68*(1), 131-133. https://doi.org/10.2307/3281335

Merino, G., Barange, M., Blanchard, J. L., Harle, J., Holmes, R., Allen, I., & Rodwell, L. D. (2012). Can Marine Fisheries and Aquaculture Meet Fish Demand from a Growing Human Population in a Changing Climate?. *Global Environmental Change*, *22*(4), 795-806. https://doi.org/10.1016/j.gloenvcha.2012.03.003

Mohammed, A., Kalu, A. U., Yem, I. Y., Kolndacha, O., Nyaku, R. E., & Sanni, A. O. (2009). Bacteriological Quality of *Clarias gariepinus* (Burchell, 1822) in Lake Alau, Borno State, Nigeria. *The Best Journal*, *6*, 15-18.

Murray, A. G., & Peeler, E. J. (2005). A Framework for Understanding the Potential for Emerging Diseases in Aquaculture. *Preventive Veterinary Medicine*, *67*(2-3), 223-235. https://doi.org/10.1016/j.prevetmed.2004.10.012

Oniye, S. J., Adebote, D. A., & Ayanda, O. I. (2004). Helminth Parasites of *Clarias gariepinus* (Teugels) in Zaria, Nigeria. *Journal of Aquatic Sciences*, *19*(2), 71-75.

Paperna, I. (1996). Parasites, Infections and Diseases of Fishes in Africa - An Update. *CIFA Technical Paper*, *31*, 1-220.

Robert, L. S., Janovy, J., & Schmidt, G. (2000). *Foundations of parasitology*. McGraw-Hill.

Rueckert, S., Hagen, W., Yuniar, A. T., & Palm, H. W. (2009). Metazoan Fish Parasites of Segara Anakan Lagoon, Indonesia, and Their Potential Use as Biological Indicators. *Regional Environmental Change*, *9*(4), 315-328. https://doi.org/10.1007/s10113-008-0076-2

Sakthivel, A., Selvakumar, P., & Gopalakrishnan, A. (2016). Acanthocephala (*Acanthocephalus lucii*) Infection on *Caranx ignobilis* from Nagapattinam, South East Coast of India. *Indian Journal of Geo-Marine Sciences*, *45*(3), 448-452.

Smit, N. J., Bruce, N. L., & Hadfield, K. A. (2014). Global Diversity of Fish Parasitic Isopod Crustaceans of the Family Cymothoidae. *International Journal for Parasitology: Parasites and Wildlife*, *3*(2), 188-197. https://doi.org/10.1016/j.ijppaw.2014.03.004

Soliman, N. F., & Nasr, S. M. (2015). Metal Contents in Common Edible Fish Species and Evaluation of Potential Health Risks to Consumers. *Journal of Coastal Life Medicine*, *3*(12), 956-961. https://doi.org/10.12980/jclm.3.2015j5-191

Subasinghe, R. (1995). Diseases Control and Health Management in Aquaculture. *FAO Aquaculture Newsletter*, *9*, 8-11.

Tahiluddin, A. B., & Kadak, A. E. (2022). Traditional Fish Processing Techniques Applied in the Philippines and Turkey. *Menba Kastamonu University Faculty of Fisheries Journal*, *8*(1), 50-58.

Tahiluddin, A. B., & Terzi, E. (2021). An Overview of Fisheries and Aquaculture in the Philippines. *Journal of Anatolian Environmental and Animal Sciences*, *6*(4), 475-486. https://doi.org/10.35229/jaes.944292

Ukoli, F. M. A. (1969). The Host Specificity and Zoogeographical Distribution of Certain Platyhelminth Parasites of West African Birds. *Nigerian Journal of Science*, *3*(1), 45-63.

Violante-González, J., Monks, S., Gallegos-Navarro, Y., Santos-Bustos, N. G., Villalba-Vasquez, P. J., Padilla-Serrato, J. G., & Pulido-Flores, G. (2020). Interannual Variation in the Metazoan Parasite Communities of Bigeye Trevally *Caranx sexfasciatus* (Pisces, Carangidae). Parasite, 27(6), 1-11. https://doi.org/10.1051/parasite/2020001

Williams, H. (1994). *Parasitic worms of fish*. CRC Press.

Yuniar, A. T., Palm, H. W., & Walter, T. (2007). Crustacean Fish Parasites from Segara Anakan Lagoon, Java, Indonesia. *Parasitology Research*, *100*(6), 1193-1204. https://doi.org/10.1007/s00436-006-0391-9

Yusuff, K. O., & Ibidapo-Obe, E. (2019). *Parasite fauna of tilapia species in the Federal University Of Agriculture, Abeokuta (FUNAAB) reservoir, Abeokuta, Ogun State, Nigeria* [Oral presentation]. 1st National Conference of WITED, Ilaro, Nigeria.