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Condition Factor and Observable Disease Manifestation of *Clarias gariepinus* (Burchell, 1822) obtained from Non-Wild Ponds in Ibadan, South-Western Nigeria.

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Abstract
The study compared the condition factor and observable disease manifestation in 405 randomly and maturely selected *Clarias gariepinus* in Ibadan. The condition factor as a measure of well-being was calculated using the formula $K=100W/L^3$. Out of the 405 apparently healthy fish, 302(74.57%) were found within condition factor (CF) range of 0.6-0.79 and 62(15.31%) within those with 0.8-0.99. The condition factor of >1.0 had 13(3.21%) of fish, while the least number of fish 4(0.98%) were observed within the least CF of 0.39. The mean weight of fish progresses from 339.3±90.3g to 696.0±211.6g as the CF increased from (0.39 - >1.0) and so did the standard length increase from 30.78±3.61-35.52±3.50cm. Higher mean weight of fish (446.1±11.70g) found within 0.39 CF could be due to the little number of fish encountered in the category. There were significant differences between both mean of the weight, the standard lenght of fish and the CF ($p<0.05$). However, the relationship between the CF and the total length showed no significant difference ($p>0.05$). Microscopic observation of the organs studied revealed no gross significant signs in the fish organs as follow, skin (91.10%), gills (96.79%), intestine (96.79%) and liver (98.02%). Disease manifestation in the skin included white spots in 19(4.2%), tail rot 12(2.96%), peel in 5(1.23%) fishes, while in gills 13(3.21%) showed pale colour which suggest anaemic situation, however no physical diseases were manifested in the intestine except for observed varying contents such as green algae, coloured exudates, and cannibalized fish. The liver samples in each case had 3(0.74%) that showed poor texture and yellowish exudates. While most fish were in moderate condition (CF 0.60- 0.79) and appeared healthy both internally and externally, the study thus highlighted few signs of physical diseases. However, due to the absence of microbiological and histopathological screenings, the study recommends further aetiological investigations to improve fish diagnosis and management.

Keywords: Condition factor, Diseases, Manifestation, Microscopy, Aetiological
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Introduction

Condition factor has been described as an indication of wellbeing or robustness of fish as well as an index of feeding and growth among fishes (Ighwela *et al.*, 2011). Good conditions of fish in Lekki lagoon have been responsible for the zero prevalence of parasites (Akinsanya *et al.*, 2015), supporting Oswald *et al.* (1992) where fish have thrived well under a good condition factor. In addition, Owolabi (2008), had also reported that good environmental conditions do not make fish species susceptible to the attack of parasites and fish diseases.

Condition factor provides a deep understanding into the fish physiology and ecological conditions by estimating body conditions and biomass, thus contributing to effective fisheries and management (Kunlapapuk *et al.,* 2024). Condition factor is employed to understand the life cycle of fish species and to assess the status of their habitats (Gesto, 2017). The estimate of the general well-being of the fish is defined as the ratio of weight of the whole fish (g) to the cube of its standard length (cm^3) (Froese, 2006). This is influenced by sex, age, stress, water quality parameters and season (Kallaf *et al.,* 2003).

The condition factor is used to compare the well–being of the fish, based on the hypothesis that heavier fishes of particular length are in better physiological condition (Ujjania *et al.,* 2012) This is corroborated by the outcome of Saher and Suleyman, (2012) where fish specimen with a given length and exhibiting a higher weight is said to be in a better condition. Condition factor may vary among species across different locations (Blackwell *et al.*,2000)

High condition factors reflect good environmental quality and other wise (Fawole and Adewoye, 2004). This is also applicable to the fact that fish growth in a farmed environment by farmer investors in the bid to accrued maximum profit needs the display of good pond managerial skills. These skills according to Alawa, (2016) and FAO, (2005) include pond construction to specification, water quality checks, reputable fish species, good, adequate and nutritive feeding, correct identification of diseased fish, medications and records keeping.

Due to dynamism of both biotic and abiotic conditions, which may modulate the condition factor under which parasitism, feed conversion ratio, leading to marketability and profitability of aquaculture is hinged, made this investigation imperative. This study aims to provide insights into the health status of *Clarias gariepinus*, identify potential stressors and likelihood of disease- causing agents Based on this, the aim of the study is to compare the condition factor and observable diseases manifestation of *Clarias gariepinus* in Ibadan.

Materials and Methods

This study was conducted in Ibadan, the capital, and the most populous city of Oyo State, located in Southwestern Nigeria. Ibadan is located on GPS coordinates of latitude 7.3775°N and longitude 3.9470°E. (Google map, 2025). It is cosmopolitan in nature with diverse population of people. The business forms include governmental activities, private sectors and individual enterprises under which fish farming can be categorized as a significant economic activity. The estimated number of fish farms in Ibadan is not assertive as most of it operate at informal level. The town has rivers such as Eleiyele, Odo- Ona, Ogunpa and kudeti. Also exist is Asejire reserviour built on Osun river that borders the town and neighbouring Osun state (ADB, 2010).

Fish markets and retail outlets are numerous within Ibadan. The fish sample collection sites for this study were Mashopa fish farms sales point at Alakia on 7.391°N and 3.9741°E, Albarka fish farm along Lagos - Ibadan express way on 7.3483°N and 3.8490°E and Aquatec College of agricultural technology sales point, Ring Road on 7.3767°N, 3.939°E, Others are fish farms estate sales outlet at Logudu Bembo, Apata Area on 7.447°N, 3.905°E and Lantinwy fish farms, Omi Adio on 7.39°N, 3.7537°E (Google map, 2025).

Morphometric measurement and sex determination:

The fish specimens were weighed individually using the electronic scale model Gallenkomp England type DT, 3,000g, d=0.1g and e=10d. The standard length was measured from the snout tip to the start of the peduncle, the total length was taken from the snout tip to the tip end of the tail using a graduated metre rule (Tarantion *et al.,* 2024). Each fish identity was carefully monitored to prevent a mix-up of measurement. Condition factor was calculated for each fish using the formular described by Pauly (1983) in equation 1

$$\text{Condition factor} = \frac{100 \times \text{fish weight}}{\text{Standard length (cm)}^3} \quad \text{-------------------Equation (1).}$$

Clinical examination of fish specimen – Both the Physical and microscopic examinations were done on the collected specimens by the use of magnifying hand lens to see abnormalities and overall physical disease signs as clinically manifested in any form as caused by parasites infliction, at the skin, gills intestines and the liver, there was a careful observation on visible cysts at both external and internal surfaces during the examination according to Palic *et al.*(2017) and RAMP, (2014).

Results

In this study, there was a correspondence increase in the condition factor to the standard lengths. The condition factor displayed in this investigation have been ranged, with higher number of fish, which is 302 representing 74.57% found within 0.60-0.79, there is a wider margin between the fish samples of varying condition factor, such that fish within the condition factor range of 0.80-0.99 were 62(15.31%), while 13(3.21%) were fish that were found within the condition factor of >1.0, the least number of fish which was 4 (0.98%) were found to dwell in condition factor of <0.39.

The highest mean weight of fish with 696.0±211.6g were found in the condition factor of >1.0 with 13(3.21%) fish samples in the range, this was followed by 479.1± 184.2g in the range of 0.80- 0.99. The class with condition factor of 0.60-0.79 had the highest number of fish as 302(74.57%) within it and 396.0±171.3g as the mean weight. The relationship between the mean weight and the condition factor is significant ($p<0.05$).

The highest mean standard length of 35.52±3.50cm was found within fish of condition factor>1.0 followed by those within 0.8-0.99 with 33.16± 4.02 cm, the least mean standard length (30.78±3.61) was found in fish with condition factor of <0.39. There is significant difference in the condition factor and standard length ($p<0.05$).

The highest mean total length of 39.92± 4.47 was found in fish with a condition factor of >1.0, followed by those in <0.39 with 39.03±1.27, and 38.05± 4.04 in the condition factor 0.40-0.59. The total mean length of 37.75±4.47 in *C. gariepinus* in this investigation were found within 0.6-0.79 condition range. There is no significant difference in the condition factor and total length ($p>0.05$).

The correlation between the mean weight and the condition factor shows a significant difference and positive correlation in the fish sample ($r = 0.298$, $p=0.00$). Similarly, a significant difference and positive correlation were found between the condition factor and standard length ($r =0.107$, $p= 0.032$). However, no significant difference existed between the condition factor and the total length of fish ($r=0.020$, $p=0.687$). (Table 1).

Gross and observable clinical examination of *Clarias gariepinus* in the investigation

The observable gross signs on sampled *Clarias gariepinus* skin showed that 19 samples representing (4.20%) had whitish spot on the skin especially the mouth region and barbels, 12 (2.96%) had tail rot, 2 (0.49%) had bruises on the skin, while 5 (1.23%) had skin peel / erosion, with 369 (91.10%) with no gross sign on the skin.

The gill examination recorded 13 (3.21%) with pale colour, as 392 (96.79%) had no gross observable damages. In the intestine, 392 (96.79%) showed no observable damage, while 2 (0.49%) each had green and yellow exudates, also 2 (0.49%) each had cannibalised fish and fish bone in its intestines, while 3(0.74%) had swallowed conspicuous wood.

The observations on the liver comprise 397 (98.02%) of the fish, had good liver colouration, while 2 (0.49%) had unclear brownish colouration with 3 (0.74%) each having poor texture and yellowish exudate (Table 2).

Table 1: Relationship between condition factor and weight (g), Standard length (cm) and Total length (cm) of *Clarias gariepinus*

Condition factor	No of fish	Frequency	Mean weight± Standard deviation (g)	P value	Mean standard length ± Standard deviation (cm)	P value	Mean total length ± Standard deviation	P value
< 0.39	4	0.98	446.1 ± 117.6	0.000[b]	30.78 ± 3.61	0.0095[b]	39.03 ±1.27	0.477[a]
0.40 - 0.59	24	5.93	329.3 ± 90.3		32.60 ±4.17		38.05 ±4.40	
0.60 – 0.79	302	74.57	396.0 ±171.3		32.95 ± 3.62		37.75±4.47	
0.80 - 0.99	62	15.31	479.1 ± 184.2		33.16 ±4.02		37.53±4.90	
> 1.0	13	3.21	696.0 ± 211.6		35.52 ± 3.50		39.92±4.47	
Total	405	100.00	414.6±181.1		32.78±4.11		37.82±4.50	
			r=0.298; p=0.00		r=0.107 ; p=0.032		r=0.020 ; p=0.687	

a- There is no significant difference ($p>0.05$); b- There is significant difference ($p<0.05$)

Table 2: Physical clinical Examination of the organs of *Clarias gariepinus* used in the study

Skin		Gills		Intestine		Liver	
Variable	**Frequency (%)**	**Variable**	**Frequency (%)**	**Variable**	**Frequency (%)**	**Variable**	**Frequency (%)**
No gross sign	(369) 91.10	No gross sign	(392) 96.79	No gross sign	(392) 96.79	No gross sign	(397) 98.02
Whitish Spot	(19) 4.20	Pale color	(13) 3.21	Greenish Exudate	(2) 0.49	Brownish color	(2) 0.49
Tail Rot	(12) 2.96	-	-	Yellowish Exudate	(2) 0.49	Poor texture	(3) 0.74
Bruises	(2) 0.46	-	-	Cannibalized Fish	(2) 0.49	Yellowish exudate	(3) 0.74
Skin Peel/ Erosion	(5) 1.23	-	-	Fish Bone	(2) 0.49		
				Conspicuous wood	(3) 0.74		-
Total	(405) 100.0		(405) 100.0		(405) 100.0		(405) 100.0

Discussion

In this study, higher numbers of fish were found in a better condition factor which could indicate that the condition of culturing fish seems good and had not encouraged massive proliferation of parasites amongst other culturing inputs which could have pronounced effect on the fish. Majority of the fish in the study have shown a good and isometric growth contrary to the study of Brahim *et al.* (2023) that showed negative allometric growth.

Fewer fish that have been captured to having poor condition factor could be due to environmental factors, food availability, age and sex (Segun *et al.,* 2022). Also inclusive among other factors are pathogens, parasites, nutritional factor, water quality and stress (Reynolds, 2014), which could disturb the homeostasis of the fish body (Sanders, 2023), making fish to give reactions outside the normal range as recorded in the reports of both Chrousos, (2009) and Schreck *et al.* (2016), affecting the overall growth, survival and reproductive potentials of fish according to Boltana *et al.* (2017) and Bertucci *et al.* (2019).

The clinical examination of *C. gariepinus* had shown that majority of the four organs of the fish in the study had no gross signs, however those with signs supported the work of Petty (2022) that stated diseases signs include greyish white, cotton like growth on the skin and gills. This indicated that the majority of fish screened, looked non-diseased. The number of fish whose skin had no gross signs was the lesser, which confirmed that the skin may not have been heavily infected with parasites, due to defensive barrier of the skin and mucus production during infection and eventual sloughing of the parasites off the skin. (Suliman *et al.,* 2021)

The whitish spots on the fish skin could be attributed to the presence of protozoan infection known as Ichthyophthiriasis as reported by Francis- Floyd (2012), while the tail rot as a complex health issue in *C. gariepinus* could have been caused by combination of protozoan, *Gyrodactylus* sp and environmental factors, and which create an environment for secondary bacterial effect according to Hardiroseyani, (2006) and Francis- Floyd *et al.* (2023). However lower fish immunity has also been implicated allowing such abnormalities to occur (Nimah *et al.,* 2022)

The low bruises may indicate that fishes in the population study have been well graded and at the appropriate stocking density, growing at almost equal rate, leading to less cannibalism on each other as opined by Khan *et al.* (2021).

In the gills, the low proportion of the sample had shown pale colour sign contrary to the expected bright red colour, this may be at similitude with parasites which may occur at low prevalence in the gills, and indicated that most gills infection in the study was an acute type. However, the affected fish may be suffering from excessive fluid storage (edema) due to malfunction of the gills caused by parasites effects and opportunistic pathogenic organisms on it (Lewisch *et al.,* 2014), as well as compromised water quality which helps in proliferation of parasites that often attack the gill during ventilation (Mikheev *et al.,* 2014)

The few fish samples with greenish exudates from the stomach, did not give out any foul smell which indicated freshness of the screened fish and probably absence of putrefaction, also suggesting the absence of volatile amines that cause decay in fish as reported by Etienne and Nantes, (2005) however since it was a major component of the stomach, further investigation confirmed the green components of the stomach to be an aggregation of phytoplankton, and higher green algae consumed by the fish, prior to the sales due to stoppage of feeding of fish by farmers.

This starvation is important to minimize excretion of ammonia, reduction of both physical activity and metabolic rate as well as transportation stress (Robb, 2008). The presence of *Ulothrix* sp and *Uroglena* sp in the stomach of *C. gariepinus* represent the diverse green algae group, which are limnetic in nature as supported by Eyayu (2019), while *Loxodes* sp found also represent free living ciliates, thriving in a condition similar to *Clarias* sp in terms of low oxygen needs (Euro fish, 2019).

The low presence of cannibalised fish found in the intestine is also meant to say that the fish sizes are uniform due to appropriate grading to minimize size disparity to achieve higher survival rate, and such, had not created opportunity for higher cannibalism supporting the outcome of Mollah *et al*, (1999), however, those found can be carcass of mortality that are consumed by *Clarias gariepinus* due to its omnivorous status and in accordance with the outcome of Wakil *et al.* (2014) and probably due to starvation which had occurred prior harvesting. The highest number of fish found in the good condition factor had suggested that the culturing water medium has provided better suitability for both growth and development of the fish, which was adjudged to be progressive, supporting Imam *et al.* (2018) that specified that higher condition factor had supported such growth pattern.

The liver as an associated organ to the intestine, in term of both nutrient and blood, storage and distribution had lowest prevalence showing both poor texture and yellowish exudates. Fish with yellowish exudate may be due to liver damage by bacteria infection (Smyrli *et al.*, 2017) and Zhai *et al.* (2023), however, this is contrary to Chinabut (2002) where no bacteria, viruses and fungi of known pathological significance were isolated from jaundiced fish, in addition to this claim the presence of yellowish exudate suggested jaundice, which could be through dietary issues such as feeding fish with rancid chicken offals which is not totally uncommon amongst catfish farmers (Keremah, 2014). Jaundiced fish is also related to high bilirubin level which could have been caused by the inefficient disintegration of red blood cell by the liver (Hastuti *et al.*, 2019).

Conclusion

The study highlights that fish biomass depends on both the growth and development with the condition factor serving as key indicator. However, the condition factor is influenced by amplitude of environmental dynamics of which the opportunistic diseases causing organisms play key roles on the fish health that impair fish growth. The study evaluated the condition factor and relevant physical disease manifestations, emphasizing the importance of environmental factor, feeding practices and water quality in successful fish farming. This study revealed generally that favourable condition factor levels was good to accommodate higher number of fish and recommends continuous environmental monitoring to ensure sustainable fish production and improved habitat stability

References

African Development Bank (2010) Environmental and Social management plan 'Nigeria water and sanitation for Oyo and Taraba States. Project No-P-NG-E00-004

Akinsanya, B., Kuton, M., Saliu, J., Lambe, O., Ukwa, U.D. (2015). Condition factor and gastrointestinal parasitic fauna of three fish species as stress indicators in lekki lagoon, Lagos, Nigeria. *Egyptian Journal of Biological Sciences E Medical Entomology and Parasitology*, 7(1): 1-13.

Alawa, D. (2016). Entrepreneurship skills required by youths in fish production for reduction of insurgency and economic development of South-South, Nigeria. *Education for Today*, 12(1): 1-10. www.researchgate.net

Bertucci, J.I., Blanco, A.M., Sundarrajam, L., Rajeswari, J.J., Velasco, C and Uniappan, S. (2019). Nutrient regulation of endocrine factors influencing feeding and growth in fish. *Frontiers in Endocrinology.* 10(83): 1-17 doi:10.3389/fendo.2019.00083.

Boltana, S., Sanhueza, N., Anguilar, A., Gallardo-Escarate, C., Arriagada, G., Valdes, J.A., Soto, D and Quinones, R.A. (2017) Influence of thermal environment on fish growth. *Ecology and Evolution* 7(17): 6814-6825.

Brahim, A.A., Houndonogbo, P.K., Baglo, I.S., Chikou, A and Laleye, P. A. (2023). Weight-length and total lenght-standard length factor relationships, and condition factor of the main fish species in Lake Maabo, Chad (Central Africa). *International Journal of Biological and Chemical Sciences,* 17(7): 2631-2642.

Chinabut, S. (2002) Jaundice disease in Catfish- a case study demonstrating a decline in incidence as a result of research output. p77-80. In J.R. Arthur, M.J Phillips, R.P. Subasinghe., M.B. Reantaso and I. H. MacRae (eds) Primary aquatic animal health care in rural, small scale, Aquarium Development FAO Fish Technical Paper No 406.

Chrousos, G.P (2009) Stress and disorders of the stress system. *Nature Review Endocrinology*. 5(7): 374-381.

Eyayu (2019). Fish biology and Fisheries of the flood-plain rivers in the Alitash National park, North-western Ethiopia. (Ph.D. Dissertation) Addis Ababa University pp222

Eurofish (2019) African Clarias catfish are robust survivalist, Eurofish Magazine.

Fawole, O. O. and Adewoye, S. O. (2004). Aspect of the Biology of *Clarias gariepinus* (Burchell, 1822) in Oba Reservoir, Ogbomoso, Nigeria, *Science Focus* 8: 96-100.

Food and Agricultural Organization. (FAO, 2005). Fish pond construction and management, technological information materials from National special programme for food security rural aquaculture training workshop in Nigeria, 17th- 18th April 2005. Pp 58.

Francis- Floyd, R., Klinger, R.E., Petty. D and Pouder, D (2023) Monogenea parasites of fish. http://doi.org/10.32473/edis-fao33-2012.

Froese, R (2006) .Cube law, condition factors and weight- length relationship: History mate-analysis and recommendations, *Journal of Applied Ichthyology*, 22(4): 241-253.

Google (n.d. 2005) Ibadan, Nigeria. Google maps, Retrieved June 16, 2025.

Hardiroseyani, (2006) Catfish parasite Intarization *Clarias* sp in the Bogor area, Indonesia. *Journal of Aquaculture* 5(2): 167-177

Hastuti, S, Subandiyono, S and Windarto, S (2019) Blood performance of jaundice Catfish (*Clarias gariepinus*) *AACL Bioflux* 12(2): 480-489.

Ighwela, K.A., Ahmed, A.B. and Abol Munafi, A.B (2011).Condition factor as an indicator of growth and feeding intensity of tilapia fingerlings (*Oreochromis niloticus*) fed on different levels of maltose. *American Eurasian Journal of Agriculture and Environmental Sciences,* 11(4): 559-563.

Imam, T., Abdullahi, Z.D. and Sani, A. (2018).Effect of different water quality on *Clarias gariepinus* growth and survival. *Journal of Veterinary and Biomedical Sciences.* 1(2): 78-84.

Khallaf, E., Galal, M and Athuman, M (2003). The biology of *Oreochromis niloticus* in a polluted canal. *Ecotoxicology* 12: 405-416

Khan, S.K., Salin, K.R., Yakupitiyage, A. and Siddique, M.A. (2021). Effect of stocking densities on the growth performance, cannibalism and survival of the Asian Seabass *Lates calcarifei* (Bloch, 1790) fry in different nursery rearing system. *Agriculture Research*, 52 (11):1-8.

Kunlapapuk, S., Boonnom, S., Klangrahad, C., Siriwong, P and Kongchum, P (2024). Length-weight relationship and reproductive biology aspects of *Sardinella melanura* caught from the coastal waters of Phetchaburi, the inner gulf of Thailand. *Fish Science* 90(2): 191-200.

Lewisch, E., Dressler, A.,Menanteau-Ledouble, S., Saleh, M.,El-matbouli, M.(2014). Francisellosis in ornamental African Cichlid in Australia. *Bullletin of the European Association of fish Pathologist.* 34: 63-70

Mikheev, V.N., Pasternak, A.F., Valtonen, E.T and Taskinen, J (2014) Increased ventilation by fish leads to a higher risk of parasitism. *Parasites Vectors* 7(281): 9pp https://doi.org/10.1186/1750-3305-7-281.

Mollah, M.F.A., Islam, M.S., Faroque, M.A.D and Khan, M.H.K (1999).

Minimization of cannibalism of African catfish (*Clarias gariepinus* Burchell) larvae in indoor culture system. *Bangladesh Journal of Fisheries Research*. 3(2): 181-186.

Etienne, M., and Nantes, I. (2005). Volatile amines as criteria for chemical quality assessment. Valid-methods for chemical quality assessment, SeafoodPlus Traceability, Project 6.3-valid, 22Pp

Nimah, A., Ardhya, G.S., Plumeriastuti, H and Budiarto, S.K (2022)Identification of ectoparasites in Pearl Catfish (*Clarias gariepinus*) with one and three months age in Mackle cultivation, Tuban district, Tuban Regency. *Journal of Parasite Science* 6(2): 60-66

Okoye, I.C., Abu, S.J., Obiezue, N,N.R. and Ofoezie, I. E.(2014).Prevalence and seasonality of parasites of fish in Agulu Lake, Southeast Nigeria. *African Journal of Biotechnology*. 13(3): 502-508.

Oni, S.K., Olayemi, J.Y. and Adegboye, J.D. (1983). The comparative physiology of three ecologically distinct freshwater fishes. *Alestes nurse* Ruppel, *Synodontis schall* and *Tilapia zilli* Gervais. *Journal of fish Biology* 22: 105-109.

Oswald, E. and Hulse, J. E. (1992).Fish quarantine and fish diseases in South East Asia, Report of a workshop held in Jakarta, Indonesia, UNDP/FAO South China Sea Fisheries Development and Coordinating Program, International Development Research Centre (Canada) Pp 79

Owolabi, O. D. (2008). Endoparasitic Helminths of the Upside-Down Catfish *Synodontis membranaceus* (Geoffroy Saint Hilarie) in Jebba Lake, Nigeria. *International Journal of Zoological Research*. 4(3): 181-188.

Palic, D (2017) Clinical evaluation of fish; Common clinical signs of fish diseases. 42nd World Small Animal Veterinary Association Congress. And FECAVA 23rd Eurocongress, Copenhagen, Denmark 25-29 09. 2017. https://www.vin.com/ooC/71d=8506471

Petty, B.D., Francis- Floyd, R. and Yanong, R.P.E. (2022) Parasitic Diseases of Fish-Professional version. MSD Veterinary Manual Pp 8

Reynolds (2014) Effects of water quality in fish species in Cutler Reservoir Usu Student Showcase Paper107. https://digitalcommons.usu.edu/student_showcase/107

Robb, DHF (2008) Welfare of fish at harvest. In Branson EJ, editor. Fish welfare. Blackwell Publishing limited Oxford pp 217-241.

Sanders, J (2023) Swim bladder disorders in fish. https://www.petmed.com/fish/conditions/respiratory/swim-bladder- disorder-fish

Schreck, C.B., Tort, L (2016). The concept of stress in fish. Editor(s) Schreck, C.B., Tort, L., Farrel, A.P. and Brauner, J. Fish Physiology, 35: 1-34. ISBN 9780128027258.

Segun, A.D.S., Iyabo, O.S and Yusuf, B (2022) Length -weight relationship and condition factor of *Hydrocynus forskahli* (Cuvier, 1819) in River Yobe, Northeast, Nigeria. *Aceh Journal of Animal Science* 7(2): 53-58.

Seher, D. and Suleyman, C. I. (2012).Condition factors of seven Cyprinid fish soecies from Camligoza dam lake in central Anatolia, Turkey. *African Journal of Agricultural Research*. 7(3): 4460-4464.

Smyrili, M., Prapas, A., Rigos, G., Kokkari, C., Pavlidis, M. and Kathrios, P(2017) *Aeromonas veronii* infection associated with high morbidity and mortality in farmed European Seabass-*Dicentrarchus labrax* in the Aegean Sea, Greece. *Fish Pathology*. 52(2): 68-81

Suliman, E.M., Osman H.A.and Al-Deghayem, W. A. (2021). Histopathological changes induced by ectoparasites on gills and skin of *Oreochromis niloticus* (Burchell 1822) in fish ponds. *Journal of Applied Biology and Biotechnology* 9(1): 68-74.

Tarantino, G., Motta, G., D'Ambrosio, P., Felline, S., Sbragaglia, V., Bevilacqua, S., Tedesco, P., Scordella, G. and Terlizzi, A. (2024). Increasing trammel mesh size reduces biomass removal, mitigates discards and increases economic revenue in artisanal fisheries. *Frontiers in Marine Science*. https://doi.org/10.3389/fmars.2024.1267381

Ujjania, N.C., Kohl, M.P.S and Shairma, L.L (2012). Length – weight relationship and condition factors in Indaian Carps. *C. catla, L. rohita* and *C. mrigala* in Mahi Bajaj Sagari, India. *Research Journal of Biology,* 2(1): 30-36.

Wakil, U.B., Haruna, A.B., Mohammed, G.A., Ndirmbita, W.L, Yachilla, B.K and Kumai, M.U (2014). Examinations of the stomach contents of two fish species *Clarias gariepinus* and *Oreochromis niloticus* in lake Alau, North eastern, Nigeria. *Agriculture, Forestry and Fisheries* 3(5): 405-409

Zhai, W., Wang, Q., Zhu. X., Jia, X., Chen, L (2023) Pathogenic infection and microbial composition of yellow Catfish (*Pelteobagrus fulvidraco*) challenged by *Aeromonas veronii* and *Proteus minbilis*. *Aquaculture and Fisheries* 8(2): 166-173