MedCrave Step into the World of Research
Journal of Aquaculture & Marine Biology

Research Article
Open Access

Comparative analysis of somatic and otolith parameters in wild and cultured clarias gariepinus from Katsina state, Nigeria

Abstract

Fish are valuable bioindicators for monitoring aquatic environments, with somatic indices reflecting nutritional and reproductive status, while otoliths provide insights into life history traits. This study compared somatic and otolith parameters of wild and cultured *Clarias gariepinus* in Katsina State, Nigeria. A total of 150 specimens were collected from Zobe Dam (wild) and the biological garden of Umaru Musa Yar'adua University (cultured). Total length ranged from 18.3–33.5cm (wild) and 16.9–40.0cm (cultured), with no significant difference ($t = 1.98$; $p > 0.05$). Wet weight varied between 10.7–100.5g (wild) and 25.5–450.0g (cultured), showing significant differences ($t = 13.87$; $p < 0.05$). Otolith dimensions (length and width) were significantly greater in cultured fish ($p<0.05$). Length–weight relationships revealed positive allometric growth in cultured specimens ($b = 3.125$) and negative allometric growth in wild specimens ($b = 1.231$). Water quality parameters were within tolerance limits for catfish, although dissolved oxygen was significantly higher in the wild (6.67mg L^{-1}; $p<0.05$), while ammonia nitrogen was elevated in the cultured system ($p<0.05$). These findings demonstrate that otolith morphometrics can effectively discriminate between wild and cultured *Clarias gariepinus*, highlighting their potential as markers of rearing origin.

Keywords: Otolith, catfish, cultured and wild environmnt, Katsina

Volume 14 Issue 3 - 2025

Taofik Ademola Babatunde, Dada Ajoke Taofeekat
Department of Biology, Umaru Musa Ya'radua University, Nigeria

Correspondence: Dada Ajoke Taofeekat, Department of Biology, Umaru Musa Ya'radua University, P.M.B. 2218, Katsina State, Nigeria

Received: November 14, 2025 | **Published:** December 01, 2025

Introduction

Otoliths, calcium carbonate structures in the inner ear of fish, are critical in understanding the life history of catfish species. They provide valuable data on the age, growth, and environmental history of both wild and cultured catfish.[1] Studies have shown that otoliths can provide essential information for managing fish populations and ensuring sustainable fishing practices.[2] Moreover, discriminant analysis using otolith data can effectively differentiate among catfish species and populations, which is crucial for biodiversity studies and the preservation of species.[3] The shape and size of otoliths can also reflect the environmental conditions experienced by the fish, such as variations in water salinity, temperature, and foo expert availability.[2-4] Somatic indices, such as the lenght-weight relationship, offer insights into the overall health and well-being of these fish.[5] health concerns. Wild fish from natural habitat, such as a river, lake, or ocean, feed on natural food, while cultured catfish are raised in a controlled environment, such as a fish farm or aquaculture facility. The cultured catfish are typically fed a specific diet and are monitored closely to ensure their growth and health. Therefore, comparing otolith and lenght weight parameters of the wild and cultured environments can reveal the impacts of the rearing conditions on the growth and health of catfish. This will also elucidate the quality of water bodies. This is essential to the improvement of aquaculture practices and the conservation of wild populations.

Materials and methods

Sample collection

A total of 150 samples of catfish of different weights and sizes were collected from the Zobe Dam fish landing site at the Dutsima local government area, Katsina in July 2023. The fishermen mostly used gill nets for fishing in the area. A total of 150 samples of catfish of different weights and sizes were also samples from Umaru Musa Yaradua University biological garden, Katsina. Samples were transported in an iced chest to the biology laboratory of Umaru Musa Yar'adua University for further analysis.

Morphometric measurement and otholit extraction

Samples of fish from wild and cultured catfish were identified for sex. The total weight of each specimen was taken using a digital weighing balance. The total length (TL) and standard length (SL) were measured using a measuring meter rule. Otoliths were extracted from the fish head following disection, cleaned, and labeled, respectively. The weight, length, and width of the right and left otoliths were recorded for all the samples.

Determination of water quality parameters

Water parameters were measured during the fish samplings. Temperature (°C) was determined using a mercury in glass thermometer while the pH and elctrical conductivity (EC) were measured using a Metrohm Herisau E520 pH meter. Dissolved oxygen concentration was determined through the Winkler-Azide method. Chemical oxygen demand (COD) was determined titrimetrically, while biological oxygen demand (BOD) was determined using the incubation method at 20 °C for five days. Total dissolved solid was measured gravimetrically while the total ammonium nitrogen (NH_3-N) concentration was determined using the spectrophotometric method.

Data analysis

The length-weight relationship was evaluated using: $W = aL^b$,[6] where W= wet weight in kg, L= total length in cm, a = constant and b = relative growth coefficient. The logarithmic transformation of length-weight relationship: $\log W = \log a + b \log L$, was used to estimate 'a' and 'b' using least squares linear regression. The coefficient of determination (r^2) was used as an indicator of the association of the variables of the linear regression.[7]

Statistical analysis

Results were presented as mean ± SD. Data were subjected to two sample T-tests to the test of significant between otolith and somatic parameters of the cultured and wild catfish. The significant level was set at 5%.

Results and discussion

Water quality parameters

The important physico-chemical parameters recorded from the study areas during this experiment showed water temperature was significantly higher ($p<0.05$). in the wild (27.45 ℃) compared with the cultured environment (24.50°C) (Table 1). The pH ranged from 6.75 in the wild to 6.90 in the reared environment with no significant difference ($p>0.05$) . The average dissolved oxygen level was significantly higher ($p<0.05$) in the wild (6.67mg L^{-1}), while the total of ammonia nitrogen value was significantly higher ($p<0.05$) in the cultured system. Water quality have direct affects the wellbeing of fishes and otolith growth both in the wild and laboratory conditions.[4] All the parameters recorded during the experimental period were within the optimum range for catfish.[8]

Table 1 Physicochemical parameters of water in the Tılapıa culture tank in Umaru Musa Yaradua University (cultured) and Zobe reservoir (wild) during the study

	Wild catfish	Cultured catfish
Temperature°C	27.45±0.55^a	24.50±0.25^b
pH	6.94±0.02^a	6.90±0.12^a
EC	139.16±10.20^a	16.38±4.80^b
DO (mg/l)	6.65±0.21^a	7.00±0.17^b
COD (mg/l)	8.14±0.52^a	9.20±0.37^b
BOD (mg/l)	35.10±3.24^a	23.55±1.12^b
TDS (mg/l)	419.35±9.22^a	228.28±11.18^b
Total ammonium nitrogen (mg/l)	1.75±0.02^a	3.90±0.08^b

Morphometric and otolith parameters

The total length of the samples ranged from 18.30 cm to 33.50 cm for the wild specimens with average of 24.23 ± 3.84cm and 16.9cm to 40.0cm for culture specimens with a mean of 30.41 ± 4.92cm (Table 2). There was no significant different between the total length of the wild and cultured samples ($t=1.98$; $p>0.05$). The wet weight ranged from 10.7g to 100.5g and 25.5g to 450.0g for wild and culture specimens and this was significantly different ($t = 13.87$;$p>0.05$). Right otolith length, left otolith length, right otolith width, and left otolith width were significantly higher in the cultured fish ($p>0.05$). Otolith shape analysis distinguish fish species and,[9] Otolith development is change by both endogenous factors such as ontogeny, physiology, and feeding habits, as well as exogenous factorss like the water depth, temperature, salinity, and environment.[10] Our current finding has revealed the inpact of environment of the otolith dimensions of catfish.

Table 2 Morphometric and otolith parameters of cultured and wild catfish in Katsina

	Cultured				Wild				
	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	P-value
Total length (cm)	16.90	40.00	30.41	4.92	18.30	33.50	24.23	3.83	ns
Standard Length (cm)	15.00	36.00	27.25	4.44	16.90	30.00	21.70	3.30	ns
Wet weight (g)	25.00	450.00	241.50	100.26	10.00	100.00	41.30	19.12	s
Right otolith weight (g)	0.00	0.02	0.01	0.00	0.00	0.03	0.01	0.01	ns
Left otolith weight (g)	0.00	0.07	0.01	0.01	0.00	0.02	0.01	0.00	ns
Right otolith length (cm)	0.35	0.60	0.48	0.07	0.25	0.50	0.38	0.06	s
Left otolith length (cm)	0.30	0.60	0.45	0.07	0.20	0.50	0.34	0.07	s
Right otolith width (cm)	0.20	0.45	0.30	0.05	0.15	0.40	0.23	0.05	s
Left otolith width(cm)	0.15	0.40	0.29	0.04	0.15	0.40	0.21	0.06	s

Key: Min. Minimum; Max. Maximum; SD. Standard deviation; ns. Not significant; Significant.

Length-weight relationship

Culture catfish showed positive allometric growth with a b-value of length-weight relationship of 3.125 (Figure 1), while the wild specimen revealed negative allometric growth with $b = 1.231$ (Figure 2). The importance of catfish as a food source depends on a variety of factors, including cultural and economic considerations as well as environmental and health concerns.[11] The practice of catfish farming could be said to have addressed the health of the fish in captivity, while the wild once may have suffered from environmental pollution and poor nutritional status, as suggested by the 'b' values in this research.[12]

Citation: Babatunde TA, Taofeekat DA. Comparative analysis of somatic and otolith parameters in wild and cultured clarias gariepinus from Katsina state, Nigeria. *J Aquac Mar Biol.* 2025;14(3):120–122. DOI: 10.15406/jamb.2025.14.00431

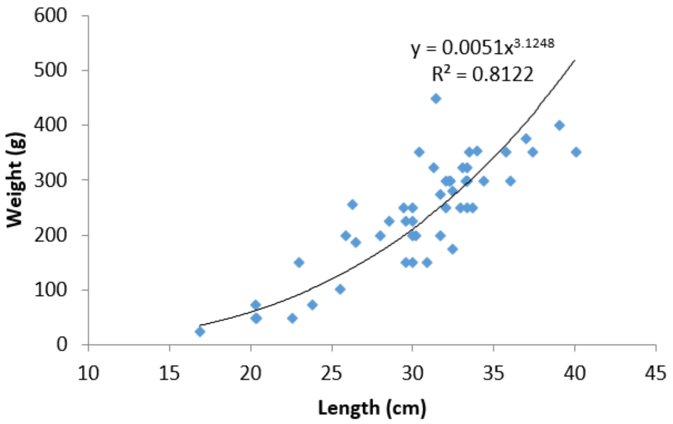

Figure 1 Length-weight relationship of cultured *Clarias gariepinus* obtained from Darma Fish Farm, Katsina State, Nigeria.

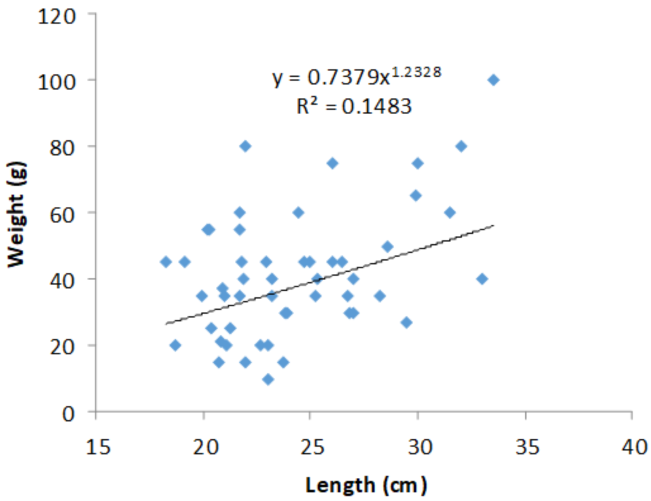

Figure 2 Length-weight relationship of wild *Clarias gariepinus* obtained from Zobe Dam, Katsina State, Nigeria.

Conclusion

The result of this work showed that otolith parameters could discriminate between wild and reared catfish. In addition, the need for protection of aquatic environments for better fish health is evident.

Acknowledgement

None.

Conflicts of interest

We declare that there is no conflict of interest of any kind.

References

1. Campana SE, Thorrold SR. Otoliths, increments, and elements: keys to a Comprehensive understanding of fish populations?. *Canadian Journal of Fisheries and Aquatic Sciences*. 2001;58(1):30–38.
2. Tzadik OE, Curtis JS, Granneman JE, et al. Chemical archives in fishes beyond otoliths: A review on the use of other body parts as chronological recorders of microchemical constituents for expanding interpretations of environmental, ecological, and life-history changes. *Limnology and Oceanography: Methods*. 2017;15(3):238–263.
3. Nazir A, Khan MA. Using otoliths for fish stock discrimination: status and challenges. *Acta Ichthyologica et Piscatoria*. 2021;51:199–218.
4. Aina OA, Babatunde TA, Azubike IV. Evaluation of Response Patterns in Somatic and Otolith Features of Laboratory–Reared and Wild Clarias garieipinus Exposed to Industrial Effluent. *Research Journal of Applied Sciences, Engineering and Technology*. 2013;5(2):626–634.
5. Isibor PO, Ogochukwu OO, Valerie IE, et al. Comparative analysis of the trophic status, length–weight relationship, gastro–somatic index and bioaccumulation of trace metals in wild and captive Clarias gariepinus. In *Biotechnological Approaches to Sustainable Development Goals*. 2023;85–101.
6. Ricker WE. Computation and interpretation of biological statistics of fish populations. *Bulletin of Fisheries Research Board of Canada*. 1975;191:382.
7. Seifali M, Arshad, SMN Amin, et al. Population dynamics of Caspian spirlin (Actinopterygii: Cyprinidae) in the Kesselian Stream, Iran. *African Journal of Biotechnology*. 2012;11:9214–9222.
8. Daniel S, Larry WD, Joseph HS. Comparative oxygen con sumption and metabolism of striped bass (Morone saxaatilis) and its hybrid. *J World Aquac Soc*. 2005;36(4):521–529.
9. Smoliński S, Schade FM, Berg F. Assessing the performance of statistical classifiers to discriminate fish stocks using Fourier analysis of otolith shape. *Canadian Journal of Fisheries and Aquatic Sciences*. 2020;77(4):674–683.
10. Hüssy K, Limburg KE, De Pontual H, et al. Trace element patterns in otoliths: the role of biomineralization. *Reviews in Fisheries Science & Aquaculture*. 2021;29(4):445–477.
11. Lynch AJ, Cooke SJ, Deines AM, et al. The social, economic, and environmental importance of inland fish and fisheries. *Environmental reviews*. 2016;24(2):115–121.
12. Fulton T. *Rate of Growth of Sea Fish 20th Annual Report of the Fishery Board for Scotland London*. 1902;21.