Oceanography & Fisheries
Open access Journal
ISSN: 2476-0536

Juniper Publishers
key to the Researchers

Short Communication
Volume 5 Issue 1 - October 2017
DOI: 10.19080/OFOAJ.2017.05.555654

Fish & Ocean Opj

Observations on Habitats for the Growth of *Tenualosa ilisha* Population in the Hooghly River Estuary, West Bengal, India Revealed From Isotopic Analysis of Ear Bone (Otolith) Carbonate

Sourav Ganguly[1], Prosenjit Ghosh[1,2]*, Yogaraj Banerjee[1], Ashim Nath[3] and Mousumi Chatterjee[4]

[1]*Centre for Earth Sciences, Indian Institute of Science, India*

[2]*Divecha Centre for Climate Change, Indian Institute of Science, India*

[3]*Department of Zoology, Serampore College, India*

[4]*West Berkshire Council, UK*

Submission: August 24, 2017; **Published:** October 16, 2017

***Corresponding author:** Prosenjit Ghosh, Centre for Earth Sciences, Indian Institute of Bangalore,
Email: pghosh@ceas.iisc.ernet.in / ghoshceas@gmail.com

Short Communication

The exotic taste of Hilsa shad (*Tenualosa ilisha, Clupeidae*) makes it one of the most economically significant edible fish communities found in the water of Bengal estuaries. A large part of the local inhabitants in and around the southern zones of West Bengal depends on the production of Hilsa in the estuarine water. However it has been reported recently that the average dimension of individuals from this Hilsa shad community are on a decline than those found in Bangladesh waters [1]. Pollutants mixing with the waters from anthropogenic sources and over exploitation without proper monitoring in the habitat areas can be held responsible for troughs in production of Hilsa. This fish community is known for its anadromous behavior and can migrate up to the rivers for spawning process [2]. The migration pattern of Hilsa shad population is a major concern in fishery research to identify most beneficial fishing zones and proper maintenance of the state of conservation for further exploitation at commercial level. This study reveals a model based observation on the favourable habitats of individuals from a Hilsa shad population collected from Bengal estuarine water in the year of 2013-14 based on stable isotopic techniques.

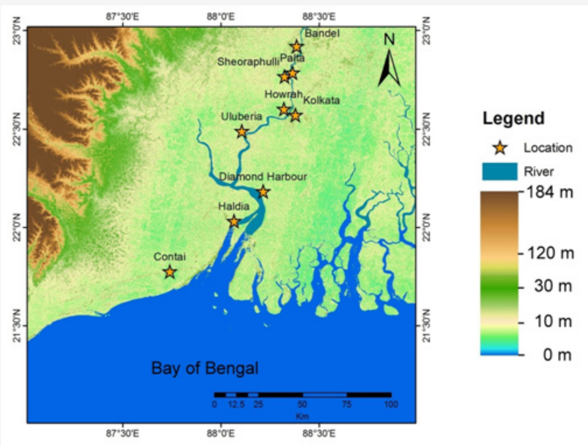

Figure 1: A map of the Hooghly river draining into the Bay of Bengal and the drainage pattern of estuarine region. Hilsa Shads were captured from different location (marked yellow star) with progressive distances from the mouth of the estuary for the present study.

The fishes used in this study were captured along the course of the Hooghly River in the downstream from the main channel of the river Ganges. The sample locations on map are shown in Figure 1. Sagittal otoliths were extracted from these sets of specimens of Hilsa shad after dissection and were separated from the saccule or utricle of the inner ear from all individuals. Otolith samples were then treated with H_2O_2 for 12 hours to clear out the labile organic matter and then were crushed into powder using an agate mortar and kept in clean glass vials. Isotopic analyses were carried out with acid digestion method [3], where in 0.2μg of otolith powder was reacted with 0.1ml of 105% phosphoric acid at a constant bath temperature of 70 °C maintained in the Gas Bench II [4] and followed by isotopic analyses of produced CO2 using a MAT 253 Isotope Ratio Mass Spectrometer [3,5]. The reproducibility of NBS-19 calcite for $\delta^{18}O$ was 0.03 as ±0.08‰ and results were reported in VPDB scale.

The carbonates of otolith were found to be aragonitic in nature. The Stable oxygen isotope ratio of aragonite in otoliths is controlled by temperature and isotopic composition of the river water [6]. The measured $\delta^{18}O$ values of otoliths were compared with inferred composition of carbonate assuming an equilibrium relationship between water and aragonite mineral at known ambient temperatures. Samanta et al. [7] provided salinity and temperature data for locations, lying at different distances from the coast, in the studied area for the months of 2012-2013. Salinity data were then converted into $\delta^{18}O$ of water ($\delta^{18}O_w$) for different seasons using the empirical relationship [8,9]. The deduction of the $\delta^{18}O_w$-$\delta^{18}O_{arag}$ relationship generally requires the knowledge of $\delta^{18}O_w$ and temperature variations. Fractionation–temperature relationship of Grossman & Ku [10] was used in this study. Estimated $\delta^{18}O_{arg}$ for different months at variable distances from the coast of the Hooghly River were plotted. All the distances were measured taking into consideration the geometry of river channel and placing Bakkhali (Lat. 21.563°, Long. 88.259°); a coastal station as zero. The polynomial equation governing the isotopic composition of aragonite with distance is expressed as, Distance=2.48 x $(\delta^{18}O_{otolith})^2$+21.6 x $\delta^{18}O_{otolith}$ + 57.7 (r^2= 0.88). Alongside the model based estimation of $\delta^{18}O_{arg}$ values, the same from otolith carbonate samples from the present study were plotted and compared with the estimated data (Figure 2). The locations near mouth of the river or in close proximity to the Bay show enriched $\delta^{18}O_{arg}$ values where as the distant ones show much depleted values which is clear from the model. The otolith carbonate compositions from Hilsa shad population reflect the same trend. It was seen from the results (Figure 2) that maximum adult individual plot near the mouth of the river, approximately 10-20km from the coast which is believed to be the zone where the individuals had spent the most of their life span. At the same time smaller individuals remain at a significant distance from the coast, approximately 60-80km from the coastal region [11-13].

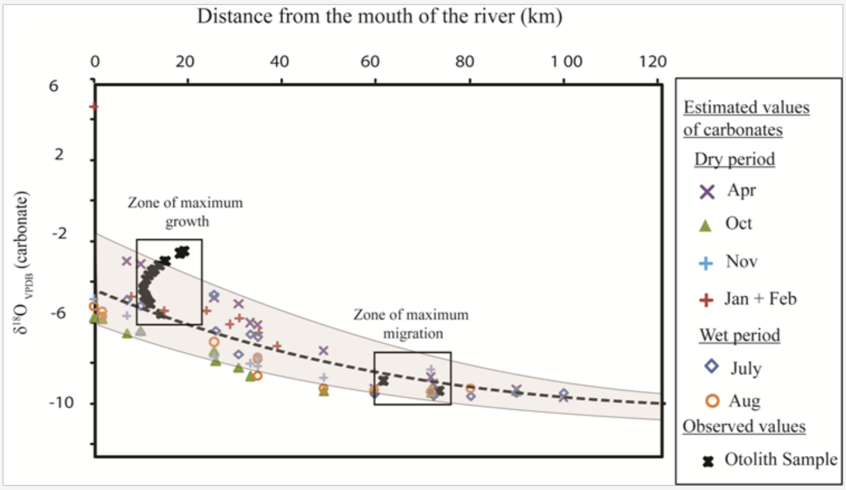

Figure 2: Model based estimations of oxygen isotopic composition in aragonite precipitated in equilibrium with ambient water, with progressive distance from the river mouth. Plotted in the figures are compositions of otolith powder from individual fish captured along the course of river Hooghly. Note a large population of the fish which were adult recorded composition of river mouth water while smaller individuals preferred inland water that exhibits a lighter composition.

In this study we used well controlled Hilsa fish samples for extraction of otolith carbonates and deriving the zones of maximum growth and their preferred habitat. The oxygen stable isotope composition of the otolith carbonates has a strong relation with the progressive distance from the coastal area towards inland water. Using isotopic tools we designed a technique to observe the favoured habitats and zones of maximum growth for individuals of Hilsa shad population in Bengal estuarine waters. There are scopes for future investigation to probe if there are changes in pattern of Hilsa shad habitats in connection to the effects of climate change at regional level.

Conflict of Interest

The authors declare no conflict of interest.

How to cite this article: Sourav G, Prosenjit G, Yogaraj B, Ashim N, Mousumi C. Observations on Habitats for the Growth of *Tenualosa ilisha* Population in the Hooghly River Estuary, West Bengal, India Revealed From Isotopic Analysis of Ear Bone (Otolith) Carbonate. Fish & Ocean Opj. 2017; 5(1): 555654. DOI:10.19080/OFOAJ.2017.05.555654.

References

1. Dutta S, Maity S, Chanda A, Hazra S (2012) Population structure, mortality rate and exploitation rate of hilsa shad (Tenulosa Hilsa) in West Bengal coast of Northern Bay of Bengal, India. World Journal of Fish and Marine Sciences 4(1): 54-59.
2. Ahmed MS, Sharif ASM, Latifa GA (2008) Age, growth and mortality of Hilsa shad, (Tenualosa hilsha) in the River Meghna, Bangladesh. Asian Journal of Biological Sciences 1(2): 69-76.
3. Rangarajan R, Ghosh P (2011) Tracing the source of bottled water using stable isotope techniques, Rapid Communications in Mass Spectrometry 25(21): 3323-3330.
4. Paul D, Skrzypek G, Fórizs I (2007) Normalization of measured stable isotopic compositions to isotope reference scales - A review. Rapid Commun Mass Spectrom 21(18): 3006-3014.
5. Rangarajan R, Ghosh P, Naggs F (2013) Seasonal variability of rainfall recorded in Growth bands of the Giant Africa Land Snail Lissachatina fulica (Bowdich) from India Chemical Geology 357: 223-230.
6. Epstein S, Mayeda TK (1953) Variations of the $^{18}O/^{16}O$ ratio in natural waters. Geochim Cosmochim Acta 4(5): 213-224.
7. Samanta S, Dalai TK, Pattanaik JK, Rai SK, Mazumdar A (2015) Dissolved in organic carbon (DIC) and its $\delta^{13}C$ in the Ganga (Hooghly) River estuary, India: Evidence of DIC generation via organic carbon degradation and carbonate dissolution. Geochemica Et Cosmochemica Acta 165: 226-248.
8. Somayajulu BLK, Rengarajan R, Jani RA (2002) Geochemical cycling in the Hooghly estuary, India. Marine Chemistry 79: 171-183.
9. Ghosh P, Chakrabarti R, Bhattacharya SK (2013) Short-and long-term temporal variations in salinity and the oxygen, carbon and hydrogen isotopic compositions of the Hooghly Estuary water, India. Chemical Geology 335: 118-127.
10. Grossman EL, Ku TL (1986) Oxygen and carbon isotope fractionation in biogenic aragonite: temperature effects. Chemical Geology 59: 59-74.
11. De DK, Datta NC (1990) Age, growth, length-weight relationship and relative conditions in Hilsa (Tenulosa ilisha, Hamilton) from the Hooghly estuarine system. Indian Journal of Fisheries 37: 199-209.
12. Hora SL (1938) A preliminary notes on the spawning grounds and bionomics of the so-called Indian shad, Hilsa ilisha (Ham.), in the river Ganges. Records of Indian Museum 40: 147-158.
13. Kalish JM (1989) Otolith microchemistry: validation of the effects of physiology, age and environment on otolith composition. Journal of Experimental Marine Biology and Ecology 132: 151-178.

DOI: 10.19080/OFOAJ.2017.05.555654

How to cite this article: Sourav G, Prosenjit G, Yogaraj B, Ashim N, Mousumi C. Observations on Habitats for the Growth of *Tenualosa ilisha* Population in the Hooghly River Estuary, West Bengal, India Revealed From Isotopic Analysis of Ear Bone (Otolith) Carbonate. Fish & Ocean Opj. 2017; 5(1): 555654. DOI:10.19080/OFOAJ.2017.05.555654.