The Relationship between otolith dimensions and fish body size of *Nemipterus japonicus* (Bloch, 1791) in Iraqi marine water

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Abstract

The relationship between otolith morphology and fish size of *Nemipterus japonicus* was investigated. Samples of 117 specimen were taken from Iraqi marine waters of Persian Gulf. The outline of the otolith was used to describe its length cm height cm and weight g. Measurements of left and right otolith did not appear significant differentiation, according to T-test. The optimal regression model, which relates otolith weight to the total length and body weight, was found by correlating each otolith parameter to the total length and weight of fishes. There was also a relative positive relationship between dimensions of otolith with the total length and weight of fishes.

Keywords: Nemipterus japonicus, otolith, otolith dimensions, Fish size, Persian Gulf.

Introduction

Fisheries biologists have used the correlations between size and otolith parameter of fishes for variety of purposes, including predation studies and fish growth [1]. Otolith size might be used to evaluate fish total length because fishes growth has a noticeable greatly affect and is correlated positively with otolith mass [2]. If there is correlations between morphological characteristics of the prey (like length of otolith) and the accurate size of the prey, and length- weight relationship of the prey species are known, if undamaged prey found in the diets of catch fishes it can be identified correctly to which species level or genus related, it is able to reproduce prey size from finding otoliths in the stomach contents of fishes [3, 4]. According to Lombarte [5], length of otoliths and its width features, as well as their correlations, are extensively used in morphology keys of fish otolith and the identification manuals, making them reliable taxonomic aids.

Japanese Threadfin Bream, *N. Japonicus*, is a benthic species that is widely distributed in coastal waters [6]It is a significant species that is commercially caught in the Persian Gulf, south of Iraq. Fish's inner ears have calcified formations called otoliths that can be used to learn about the biology, ecology, and fisheries science for fishes [7]. Otoliths are used also to evaluate population dynamics, trophic level, movement, and varied habitat for fish species [8]. Morphological characters of otoliths is used to recognize taxonomic, phylogenetic, ichthyological and dietic studies of fish species [9]. Gaemers [10] mentioned that otolith shape is also used to identify stocks within species. However, many study found that variance between both right and left otoliths may affect the findings otolith shape that analysis as a tool for stock identification [11]. The main purpose of this research to give new information about the morphological features of otolith and its relations to the *N. japonicus* body size in the marine water of Iraq in the north of Persian gulf.

MATERIALS AND METHODS

Collected of fish samples of *N.Japonicus* started in February until September 2021. The whole number of fish caught was 117 specimens by bottom trawlers from Khor Abdullah at the south of Basrah within marine waters of Iraq in the Persian gulf (fig1).

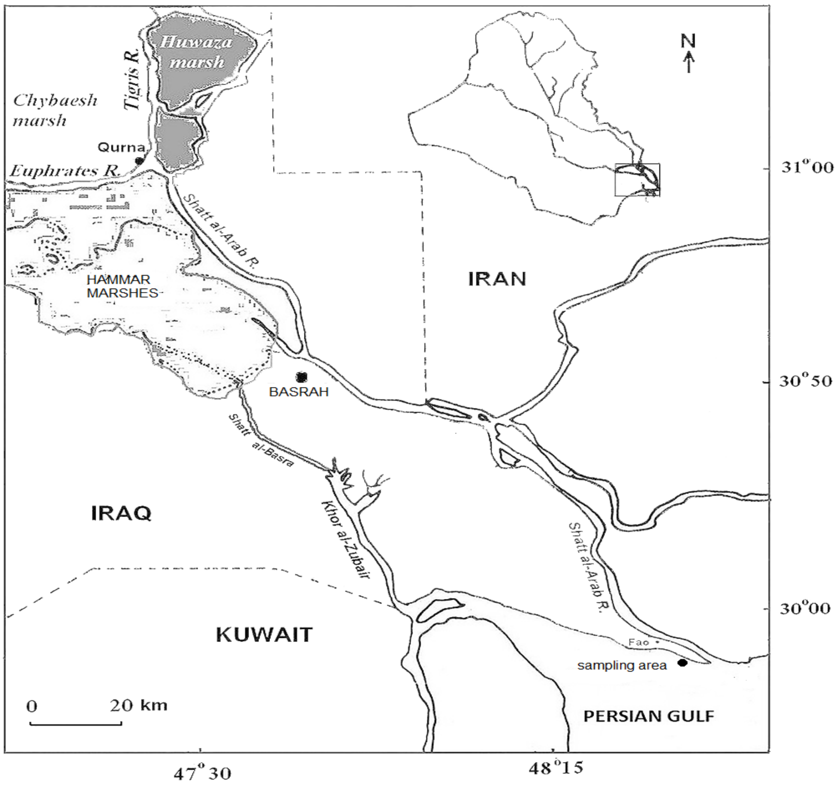
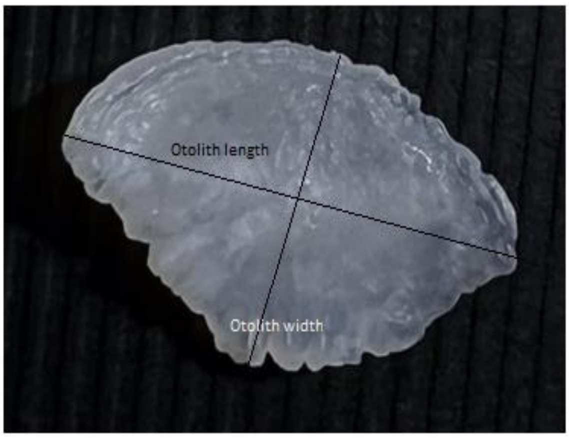


Fig (1). Sampling area of *N. japonicus* from marine waters of Iraq , Persian Gulf

A total of fish specimens were transported to the laboratory (Marine science center, Basrah University), where they were identified. The total fish length, high and its weight were measured to the nearest 0.1 cm, 0.01 g respectively. The sagittal otoliths isolated by cutting the skull to expose them, clean by distilled water and dried out to store after washing with 96% ethanol [12, 13]. Sagittal otoliths were used for measure its parameters (Fig 2). A paired t-test were using to analysis the differences between both left and right otoliths. All following analyses were performed on either the right or left otolith of each spacemen. Otolith measurement carry out for each specimen using hand Vernier callipers to the nearest 0.01cm. Digital balance was using to determine otolith weight to the nearest0.001g. To compare the differences between right and left sagitta, paired t-test (SPSS version 17.0) was used.



Fig(2) image showing length and width of *N. japonicus* otolith

The following equation, which was developed by Harvey [14], was used to find out the correlations between otolith dimensions and overall fish length: y = a + bx, where a represent the intercept and b the allometric coefficient. Standard deviation (SD) and statistical significance level of R^2 for parameters a and b were calculated [15]. The impact of the categorical factor of sex on all associations between fish body and otolith parameters was evaluated with ANOVA one-way at level 0.05. All analyses were done separately for male, female, and both sexes together. The data were exposed to the IBM SPSS Statistics ver. 22.0 for Windows statistics application.

RESULTS

There is no differences in morphological characters between the right and left otoliths among the 117 *N.japonicus* individuals included in this investigation (Fig3). The total length and weight of fish samples frequency distributed between13.4 to 23.2 cm, with body weights ranging from 55.31-218.12 g with the mean of 15.8 cm and 97.4 g respectively (Table I). Otolith measurements (length, high and weight) had respective ranges of 0.56-1.02 cm, and 0.39- 0.57cm, 0.043- 0.136g and means of 0.06cm ,0.45cm and 0.78g respectively (table 2).

Fig(3) right(R) and left(L) otoliths of *N. japonicus*.

Table 1. Morphometric characteristics of 117 *N. japonicus* in Iraqi marine water

N=117	Fish length (cm)	Body weight (g)
Mean	15.8	97.4
Min	13.4	55.31
Max	23.2	218.12
SD	6. 14	5.72

Table 2. Otolith morphological features in *N. japonicus*.

N = 117	OL (cm)	OH (cm)	OW (g)
Mean	0.78	0.45	0.06
min	0.56	0.39	0.043
max	1.02	0.57	0.136
SD	1.38	0.75	0.042

(TL-OL) as well as fish body weight and otolith weight (BW-OW) (table3).

In the current study, there is a significant linear relationship between fish total length with otolith length (TL-OL), and otolith height

Table 3. linear regression (R^2) between otolith morphometric and body size of *N. japonicus*

Parameter	TL	BW
Otolith length	OL=0.0401TL+0.4125 0.7301 R^2:	OL = 1. 607W+0.2553 R^2:0.803
Otolith hight	OH = 0.0227 TL - 1.0071 0.654 R^2 :	OH = 2.0021 W +0.2532 R^2:0.760
OtolithWeight	OW = 0.0000012TL+1.975 0.872 R^2:	OW = 0.0019W+ 0.0108 R^2: 0.712

DISCUSSION

Fish species can be recognized using otoliths recovered from the diet of various aquatic creatures and sediments from epigraphic sites. Furthermore, measurements of otolith and qualities such as length and width are critical in determining the mass and size of the fishes preyed on it [16]. Otolith morphology differs between two species or among populations of the same species [17]. Because of this reasons The morphological feature of the otolith has been widely utilized in species identification and, in certain circumstances, stock separation [17, 18]. The consequences of this research on morphometric properties of otolith and fish body size can be used to confirm the otoliths importance in organization, taxonomic classification, and discrimination of fish in future studies. Otolith features was importance in feeding ecology studies because they are sometimes the only residual components of a prey finding in the predator stomach [4]. These information could be used in a back-calculation studies to expect the size of fish from recovered otoliths revealed in predator fish stomachs, which is useful for species feeding biology fish stock assessment. The close relationship between somatic length and otolith size of fish shows that somatic growth influences otolith growth [19, 20] . The measured of fish length and otolith shape in this work should spur additional investigation into the critical role that otolith morphometric data plays in identifying fish stocks.

Otolith imbalance considered as important healthy indicator for fish which affects on the performance of the fish because they are essential for fishes hearing and balance [21,22]. The findings are consistent with earlier research indicating that fish species may be distinguished and varied based on their morphology, nutrition, weight, and growth using otoliths [7, 23].

Length of otolith is generally proportional to length of fish, when it reaches maximum size; beyond that, they mainly become thicker [24]. According to Radhiah [25] measurement of otolith such as length and height are normally linearly related to the length of fish until it richs the maximum size after that otolith increases in thickness. This investigation confirmed a linear correlation between sagitta and fish lengths. Seyfabadi [26] designed a linear relationship between fish body size with otolithes measurement on the same species of fishes in Oman sea. An important linear association between otolith weight with fish weight has been discovered in numerous investigations [26,27,28]. According to Hunt [29], the sagitta otolith weight is the most accurate criterion to determining the length of fish and the most straightforward characteristic for measure.

Otolith weight is an excellent predictor of length and weight of fishes ,because the R^2 value for both correlations is larger than for the others [9]. The regression revealed more than 87% of data deviation with that species, when weight of otolith is used to estimate fish length and weight. Former publications claim that the otolith weight is the best predictor of total length, weight, and otolith perimeter of fishes [30, 31].

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