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Investigation of otolith in *Priacanthus tayenus*in persian gulf and Oman Sea

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Abstract

This study aimed to investigation of otolith in *Priacanthus tayenus*in Persian Gulf and Oman Sea. Sampling lasted from September 2011 to December 2012. During this period 5 samples of *Priacanthus tayenus* were cut and studied. Trawling time was 2-2½ hours and trawling depth was considered as 10-100 m daily. Catching and sampling operations was done within 24 hours. Sampling and catching was done in Khuzestan and Bushehr waters in fall and winter of 2011and since the third week of September 2012 sampling was done in Hormozgan and Sistan and Baloochestan waters. All thefish were identified and their otolith was extracted to verify them. Investigation of otolith morphometric characteristics (length, breadth, weight, perimeter and area) were conducted.

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Introduction

Inner ear of bony fish is made up of bony and vestibular labyrinth. Vestibular labyrinth distinctively consists of three more or less separated chambers (called utricle, saccule, and lagina) and three semicircular canals or ducts. Utricle and ducts form the upper extremities andsaccule and lagina form the lower ones. Saccule is connected to utricle from ventral surface and lagena which is attached to the posterior part of succule is well recognized, but in some species it is not possible to identify it.In all three sectors mentioned above, there are beds of neuromast cells that otoliths are placed on them. Otoliths which are available in utricle, saccule, and lagina chambers are called Lapillus, Sagitta, and Asteriscus respectively (Sattari, 2002).Otoliths are small calcified structures found in the heads of fish, which assist in detecting sound and are used for balance and orientation. All bony fish have three pairs of otoliths (Campana and Neilson 1985; Among the bony fish with three pairs of otoliths, Sagitta is the biggest one in most species and has the most morphological changes among the species which is basically used in determining age and size, classification, migration, and paleontology studies (Harvey *et al.*, 2000; Kinacigi *et al.*, 2000). Morphological characteristics of Sagitta are species specific and most species can be identified by certain sagitta morphology (Harvey *et al.*, 2000; Hunt, 1992). Thus, the otoliths found by paleontologists from past geological periods suggest that they are the best documents for doing systematic research on teleost fish (Harvey *et al.*, 2000; Kinacigi *et al.*, 2000). Moreover, the growth pattern of sagitta otoliths is used for speciesidentification and recognition of different populations of a species because their growth is influenced not only by genetic factors but also by environmental factors such as seasonal changes, temperature, habitat, and food habits and thus investigating the effect of environmental factors on similar species by means of otolith is highly important in eco-morphological studies (Bermejo, 2007). To the fisheries biologist, the otolith is one of the most important tools for understanding the life of fish and fish populations. Today, different methods are used in identification and classification. For example, in identifying the family, genus, species, and subspecies, the size and shape of otoliths are used as one of the safest classification methods. Considering the fact that no measures are taken in this regard so far by academic and scientific research centers, this research aimed to study otolith differences in *Priacanthus tayenus*.

Priacanthidae**:** Marine; tropical and subtropical, Atlantic, Indian, and Pacific. Eyes very large; mouth large, strongly oblique; dorsal fin continuous, usually with 10 spines and 11–15 soft rays; anal fin with three spines and 10–16 soft rays; caudal fin with 16 principal rays (14 branched), slightly emarginate to rounded; membrane present connecting the inner rays of the pelvic fin to the body; scales modified spinous cycloid (with strong spines but not ctenoid); scales on the branchiostegal membrane; color usually bright red; vertebrae 23. Bigeyes are usually carnivorous and nocturnal. Maximum length about 65 cm TL. Four genera with about 18 species (Nelson, 2006).

The aim of this study is determination of morphological and structural differences in order to recognize fish species.

Materials and methods

Sampling

In present study, 30samples of *Priacanthus tayenus*were provided since September 2011 until December 2012. The samples were caught by Kavian Trawler owned by Kavian South Fishing Company. Trawling time was 2-2½ hours and trawling depth was considered as 10-100 m daily. Catching and sampling operations was done within 24 hours.

Site Selection

The studied area included Khuzestan to Sistan and Baloochestan provinces. The total of area was classified into five stratums respectively from west to east (A, B, C, D, E). In each stratum, four deep layers as 10-20, 20-30, 30-50, and 50-100 m were respectively identified and isolated (Fig. 1).

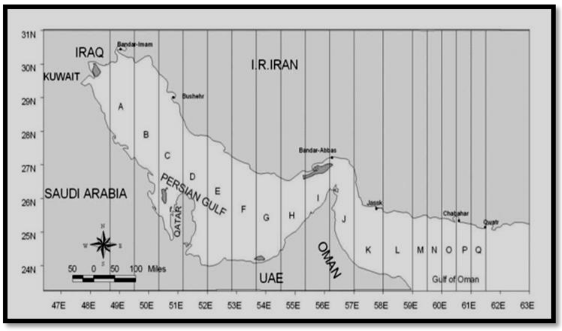

Fig.1. Study area in the Persian Gulf and Oman Sea.

Biometry

Biometry was done after choosing the species andeach specimen was measured for total length (TL), fork length (FL), body weight (W), otolith length (OL) and otolith weight (OW)and classified by the taxonomicclassification according to Nelson (2006).

Otoliths extraction

Sagittalotoliths were removed from the skulls by the verticalcut method, cutting the back of the heads. Sagittalotoliths of these fish species are large so that they canbe removed in a short time with a sharp fish knife. The thumb and forefinger were usedto force the head of fish in the eye sockets. The knifeblade forced down the skull directly over theoperculum, the plane of cutting was a curved line ¾ of the way back on the gill flap. The blade waspushed down from the top through the skull. The leftand right thumbs were used to separate the anteriorpart and posterior part of head, the skull and opticcapsules were broken open and separated. The largepairs otolith (sagittal otoliths) then lay exposed insidethe otic capsules. This area is well supplied withblood vessels so that they were removed withabsorbent paper before extracting the sagittal otolith .

Otoliths preparation

The forceps were used to remove the largest pairsfrom the otic capsules, below the rear of the brain .After that, the sagittal otoliths were washed in cleanwater to remove the otic fluid, gelatin, tissue andblood. They were allowed to air dry for 12-24 hours (Jitpukdee, 2009). Then, the turbid otoliths were washed by sodium 1% for two minutes and in order to prevent oxidation, the otoliths, based on their size, were placed in the small frames of solid paraffin which had earlier been thawed by heat until they got cold and solid.

Otoliths classification

Finally, the otoliths were classified based on their shapes and their photographs were taken. Also investigation of otolith morphometric characteristics (length, breadth, weight, perimeter and area) were conducted.

Results

5 samples of *P. tayenus*were studied; fig.s 2 and 3 illustrate each sample and its otolith.

The samples characteristics such as the relationship between otolith length and weight, the relationship between fork length and otolith length, the relationship between fish length and weight and also the length range of the caught fish (cm) were shown in table (1).

Table 1. relationship between biometric characteristics of P. tayenus and its otolith.

Relationship between otolith length and weight	$OW=5684*10^{-5}OL^{0.0847}$ ($R^2=0.8914$)
Relationship between fork length and otolith length	$FL= 25.684x - 0.8598$ ($R^2=0.8928$)
Relationship between fish length and weight	$W= 0.4857\ L^{2.9284}$ ($R^2=0.7333$)
length range of the caught fish (cm)	13-26

Morphometric characteristics of *P. tayenus*and otolith's parameters (such as:TL: Total Length, SL: Standard Length, TW: Total Weight, ROL: Right Otolith Length,ROB: Right Otolith Breadth, ROD: Right Otolith Depth, ROW: Right Otolith Weight, LOL: Left Otolith Length, LOB: Left Otolith Breadth, LOD: LeftOtolith Depth, LOW: Left Otolith Weight, OP:Perimeter and OS:Area) were shown in table (2).

Table 2. Morphometric characteristics of P. tayenus and its otolith.

Parameter	TL cm	SL cm	TW g	ROL mm	ROB mm	ROD mm	LOW g	LOD mm	LOB mm	LOL mm	OS	OP
Max	26	22	684	3.11	2.56	0.894	0.0076	0.887	2.44	3.14	0.000155	5.840674
Min	13	9	341	1.555	1.28	0.447	0.0038	0.4435	1.22	1.57	3.16E-05	5.829139
Mean	21	17	426	2.99	1.85	0.628	0.00418	0.745	1.94	2.84	7.95E-05	5.8336
S.D.	5.8	4.3	78	0.11	0.082	0.038	0.0007	0.026	0.0736	0.17	0.0005	

S.D.: Standard deviation, Min: minimum, Max: maximum

Fig. 2. *P. tayenus.*

Fig. 3. Proximal and distal surface of otoliths in P. tayenus.

Discussion

Otoliths in fish have the same function as the inner ear in human beings. The contribute to both hearing sense and balance; therefore, aquatic animals that are skilful swimmers or those that are floating in the water and are swimming very slowly or those that are creeping on the sea floorare expected to have different forms of otolith. For example, otoliths in pelagic bony fish such as Scombridae, Carangidea, and Istiophoridae which are fast swimmers are small while they are bigger in the fish which swim slowly or which are benthic like Sciaenidae, Serranidae, etc. (Parafkande Haghighi, 2008).As mentioned before, otolith in the fish is like otoconia in other vertebrae. Otoliths are bigger than otoconias and are very complicated and different in various species of fish in terms of form and size. Like otoliths, otoconias function to keep the balance. Usually, three pairs of otoliths are all different in the fish in place, size, shape, and structure. Otolith size is slightly bigger in the species whose body structure is round such as Cod or Haddock. Flying fish also have big otoliths which are probably associated with their adaptation to maintain their balance when they come out of water. Pleuronechtiformes have thinner otoliths. Generally, bigger sagittas in species and populations which have low somatic growth are called uncoupling. In this case, sagitta otolith's growth is independent of body's somatic growth. It should be noted that in some researches, the results were different from what was mentioned, that is individuals have been seen who grow more slowly but their Sagitta otolith is bigger than those who grow more quickly (Parafkande Haghighi, 2008). Of course, there are some reports about the impressive effect of growth rate on the shape of sagitta (Wilson, 1985). Most of the reports even those about some deep species indicate that faster growth could somewhat affect the otolith shape (Blltha, 1971; Lombarte and Lieonart, 1993; Lombarte, 1992). *P. tayenus* is a demersal fish and the size of otolith was big, otolith's longitude was wide and otolith's thichness was medium. The shape of otolith was hour-glass developed ventrally, dorsal margin sinuate, ventral margin convex and lobed,Sadighzadeh *et al.*,(2012) obtained similar results on the otolith of *P. tayenus* ; However, in this study the results showed thatVariation in otoliths shape and size indicates their species features, fish which are slower moving or benthic have larger otoliths, as mention in Campana and Neilson (1985)Large sagittae occure in non-ostariophysean fishes which have well developed hearing or which communication is important such as Gadidae, Batrachoidida and Sciaenidae. Although speculative, the large size of saggitae in deep sea fishes (e.g., Macrouridae and Ophidiidae) might be important in hearing.Since otoliths function in equilibrium and acceleration, it might be expected that different otolith morphologies should be expected for fish which drift, crawl and swim with varying speeds. Fast swimming pelagic fish (e.g., Istiophoridae ، Scombridae ،Carangidae) have otoliths greatly reduced in dimension and fish which are slower moving or benthic have larger otoliths(e.g., Megalopsidae, Serranidae,Sciaenidae,Gadidae, Centrarchidae. Otolith shape and dimension can also be related to geographic location, ocean depth and chemical and physical qualities of the environment (Campana and Neilson, 1985).

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