
Morphological characteristics of lapillus and aging of *Plicofollis dussumieri* (Ruppell, 1837) from Oman Sea

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Abstract

In this paper age determination and morphological characteristics of blacktip catfish, *Plicofollis dussumieri*, from Oman Sea were evaluated. A total of 132 fish specimens were collected from fishing trawlers or landings from March 2011 to July 2012, with minimum and maximum of 245 mm, 195 g; and 767 mm, 5801 g, respectively. Maximum life span was 12 years for the length range of 245 – 767 mm FL, while total body weight (BW) ranged between 195 and 5801 g and the resultant equation was: $W = 0.040 L^{2.8275}$ ($R^2 = 0.99$). High correlation coefficient value found between age and FL was $R = 0.97$ and for age-BW was 0.94. This value for otolith weight and BW was estimated to be 0.91 and showing that there were significant correlations between measured parameters. Lapillus otolith in blacktip catfish is the biggest otolith among most teleostei fishes, also the Sagitta is the biggest. Lapillus of this species is round, robust, onion-like and without sulcus curve, with no obvious growth increments in rostrum and antirostrum zones. In ventral side Gibbus maculae is concave having prominentia marginalis in anterior and basal line in posterior parts.

Keywords: Blacktip catfish, Morphology, Age, Otolith, Oman Sea

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Introduction

Catfishes (Family Ariidae) are a predominantly marine family, which is found in Indian, Pacific and Atlantic oceans and contains many species of commercial and/or recreational importance but they are not used for aquaculture (Valinassab *et al.*, 2006, 2011). Catfishes are an important component in Persian Gulf and Oman Sea demersal fisheries. They are exploited by different types of fishing gears, mostly by bottom trawl yielding a mean of 2300 tonnes per annum (Planning and Programming Dept. of IFO, 2012). Catfishes are found along Iranian waters of Persian Gulf and Oman Sea (Fig. 1) at depths ranging between 5 and 125 m (Assadi and Dehghani, 1996) but their majority concentrated in shallow waters at depths between 20-50 m.

A total of 5 species of catfishes were identified in the study area (Valinassab, 2013), one of these important species is blacktip catfish (*P. dussumieri*). Blacktip catfish is distributed throughout Western Indian Ocean extending eastward to Indo-Malayan archipelago and eastern Indian Ocean. While it inhabits a wide range of bottom types to 130 m depth, young individuals occur in very shallow waters of sheltered bays (Sadeghi, 2006). Despite the commercial importance of this species, a few studies are available on its biology and fisheries (Mohammadkhani *et al.*, 1998; Daryanabard *et al.*, 2004; Dehghani *et al.*, 2005; Valinassab *et al.*, 2006, 2011, 2013).

Population characteristics and age composition of a fish stock are important

parameters used in stock assessment models in fisheries management. The age profile of a stock gives an indication on how healthy the stock is (Metin and Ilkyaz, 2008).

Age determination in bony fishes can be carried out using anatomical method by counting growth annuli appearing on hard structures such as otoliths. Depositions of annual growth rings formed in this tissue are caused by seasonal changes in the environment (Ilkyaz *et al.*, 2011). Each year of growth is composed of an opaque and a translucent zone (corresponding to summer and winter growth, respectively). Thus the age of an individual fish can be determined by reading the pattern of bands on the otoliths, such as lapillus in catfishes. By determining the age of a large number of individuals, it is possible to build up a picture of age structure of the whole population. Knowledge of age structure provides an indication of how the stock is measuring up in exploitation (Metin and Ilkyaz, 2008).

So, the present work is directed to provide a preliminary assessment of *P. dussumieri* from Oman Sea coasts of Iran. This may help in suggesting the required fisheries regulations to manage this fish resource in a sustainable manner.

Materials and methods

The study area was restricted to Iranian coasts of Oman Sea, from longitude 59° 00'E to 61° 25'E (Fig. 1) from March 2011 to February 2012.

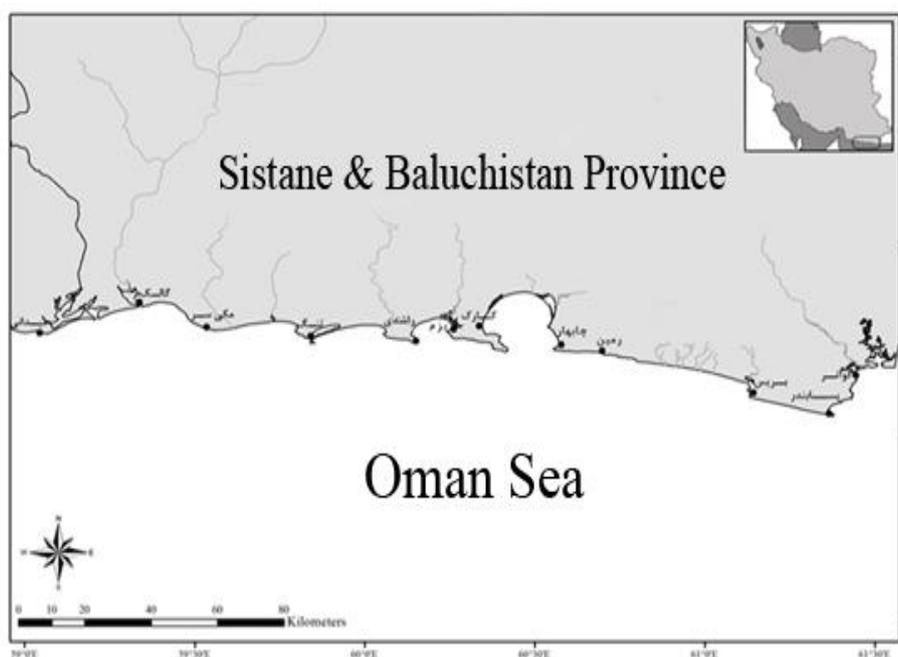


Figure 1. The map of study area in Oman Sea.

A total of 132 specimens of blacktip catfish, *P. dussumieri* (245–767 mm FL) were collected from fishing trawlers or landings. Each fish was measured to the nearest mm for fork length FL and weighed to the nearest 0.1 g total weight, and then sex was determined with macroscopical abdominal incision. Lapillus otoliths were taken from each specimen separately from left and right sides, washed with warm water, cleaned and stored dry for age determination. Annual rings (each alternating translucent and opaque zones together) on whole otolith were identified and counted using research microscope at

4× and 10× magnifications connected to transmitted light. The total radius of otolith and the radius of each annulus were measured to the nearest μm . Regression analyses of otolith maximum radius - total length was calculated by the method of least squares. Otolith weight (OW) was measured using an electronic balance with 0.0001 g sensitivity. Otolith length (OL) is defined as the longest dimension between the posterior edge of otolith; and otolith width (OH) as the dimension from dorsal to ventral edges. Also research images were prepared from all extracted lapillus otoliths (Fig. 2).

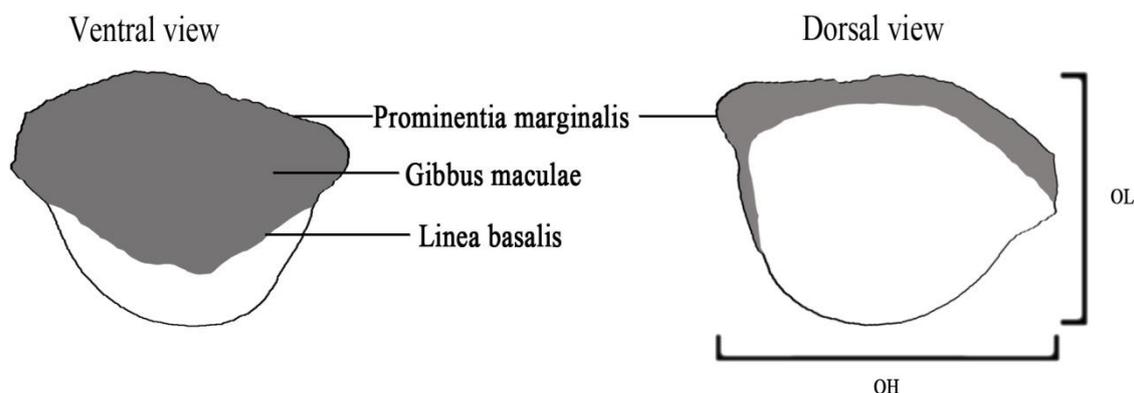


Figure 2: Lapillus otolith of blacktip catfish used for morphometric measurements.

OL: otolith length; OH: otolith width

The right otolith was embedded in clear epoxy resin and sectioned using an Isomet low-speed saw containing a diamond wafering blade which cuts a thin section (350 μ m) through the nucleus. A grinding wheel fitted with silicon carbide paper with different grit sizes (400 to 1200 grits) flushed with water was used to remove excess resin on the face of the sections and to provide a polished face for viewing. The section is then mounted on a glass slide and read under a Zeiss compound microscope equipped with zoom lens using transmitted light.

Sectioned otoliths were read independently three times with no reference to the previous readings and without any knowledge of the length or weight of the fish. The precision was measured by the percentage of agreement between the three readings (Al-Kiumi *et al.*, 2013).

Length-weight relationship was described using potential function fitted to the data (Sparre and Venema, 1992) as the following formula. Confidence intervals (CI) were calculated for the slope to see if it was statistically different from 3.

$$BW = a \times FL^b$$

Where:

BW is body weight (g), FL: fork length (mm),

a: intercept of regression; and b: regression coefficient

Results

To validate age determination of *P.dussumieri* from Oman Sea, Iranian waters, ages were determined by comparing the growth increment readings on lapillus otoliths (Fig. 2) and their sections (Fig. 3). It was found that numbers of annuli counted for each individual were similar for the two readings. The right and left otoliths were examined separately and t-test analysis revealed no significant difference between them ($p>0.05$). On the other hand, from point of view of sex, male and female, the otolith samples were taken into consideration and their morphological measurements such as length, weight, diameter and perimeter were compared using Tukey test and no significant difference was observed ($p>0.05$).

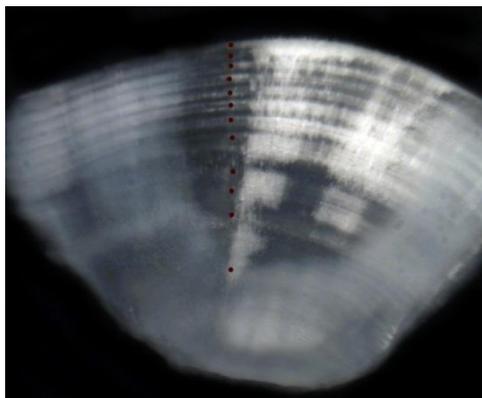


Figure 3: Lapillus otolith of blacktip catfish used for aging.

Total length varied from 245 to 767 mm, while total weight ranged between 195 and 5801 g. and the resultant equation (Fig. 4) was: $W = 0.022 FL^{2.9218}$ ($R^2 = 0.922$). The slope or b was estimated to be 2.9218 and it certified the isometric growth in this species; and high correlation coefficient of $R=0.96$ showed high correlation between weight and fork length in blacktip catfish.

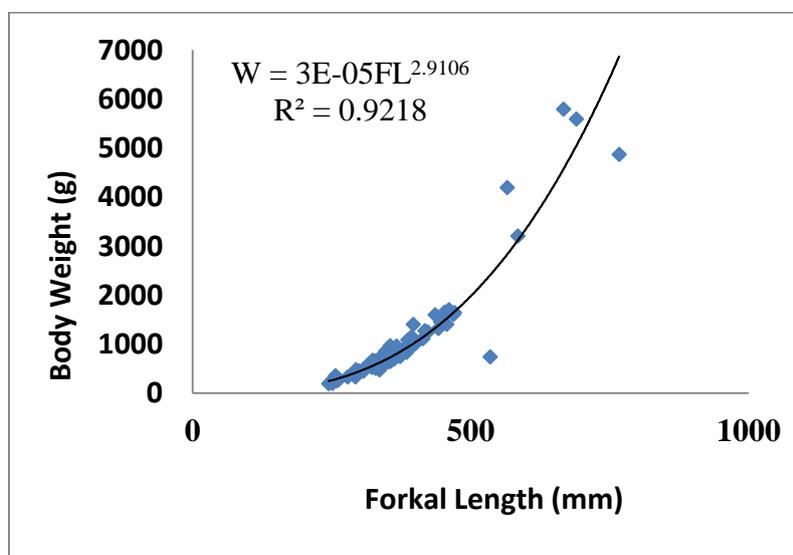


Figure 4: Length- Weight relationship for *Plicofollis dussumieri* from Oman Sea.

The results revealed that maximum observed age for *P. dussumieri* in Oman Sea was 12 years for a specimen with FL= 767 mm, and age groups 3 and 4 were the

most frequent groups in the catch and constituted 22.85% while the age group 12 was the least frequent age group and formed 2.85% of the catch (Fig. 5).

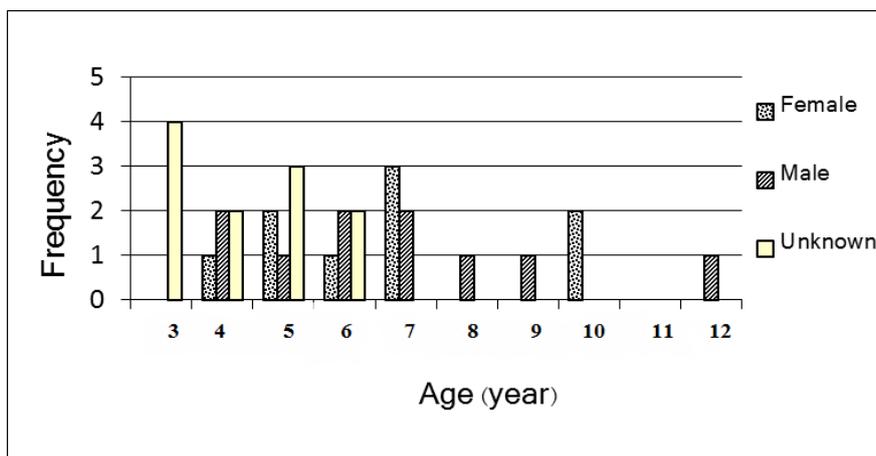


Figure 5: Age frequency for *Plicofollis dussumieri* from Oman Sea.

The results of main biometric and morphometric measurements for blacktip

catfish separately for both male and female sexes are tabulated in Table 1.

Table 1: A summary of morphometric and biometric measurements (mm, g) of minimum and maximum ages for *Plicofollis dussumieri* from Oman Sea (2012).

Age	OW	OW _i	OL	WB	FL	Variable	Gender
4	0.39	8.18	9.77	491.12	307	min	male
12	1.92	12.83	16.51	4876.5	767	max	
	6.65 ± 2.42	0.63 ± 0.32	9.45 ± 1.09	11.79 ± 1.47	1179.16 ± 1024.21	393.94 ± 92.29	mean ± SD
4	0.3	7.37	9.37	285.61	253	min	female
10	2.44	13.62	19.28	5801.1	690	max	
	6.72 ± 2.17	0.57 ± 0.38	9.14 ± 1.16	11.27 ± 1.63	928.19 ± 955.41	371.28 ± 72.00	mean ± SD
3	0.27	7.01	9.14	195.21	245	min	unknown
6	0.69	10.3	11.86	1703.8	535	max	
	4.23 ± 1.17	0.41 ± 0.08	8.44 ± 0.68	10.44 ± 0.63	617.09 ± 268.21	335.91 ± 56.03	mean ± SD

OL: Otolith Length, OW_i: Otolith Width, OT: Otolith Diameter, OW: Otolith Weight

The age-length (R=0.97) and exponential age-body weight (R=0.94) relationships

indicated high and significant correlations (Figs. 6, 7).

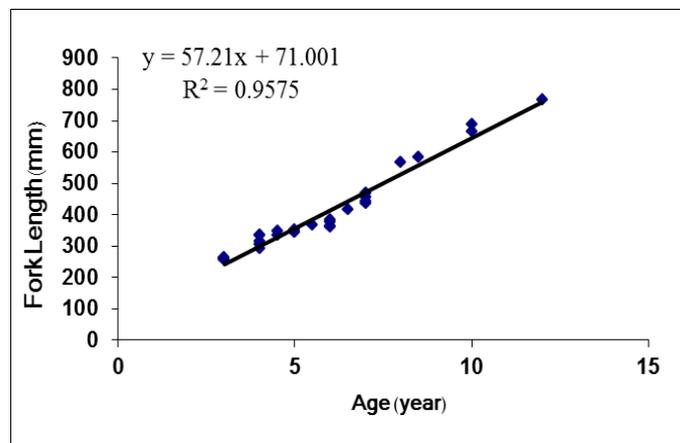


Figure 6: Age-length relationship for *Plicofollis dussumieri* from-Oman Sea.

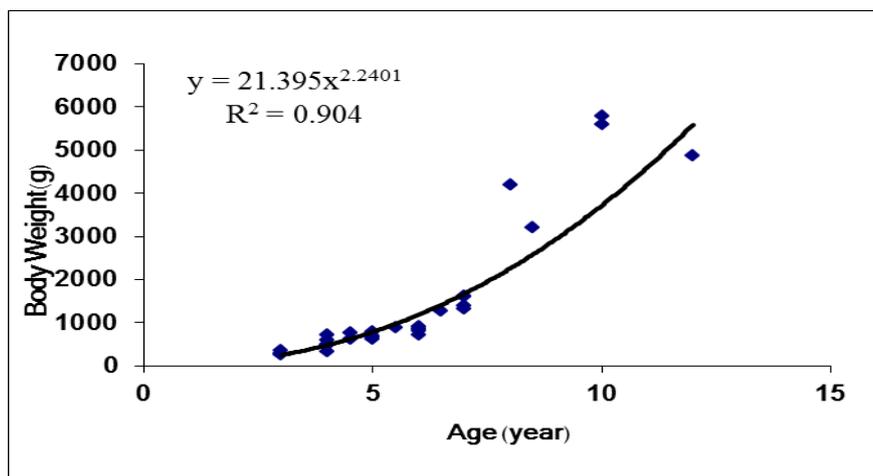


Figure 7: Age -body weight relationship for *Plicofollis dussumieri* from Oman Sea.

Discussion

This study has investigated morphological characteristics and aging of one of the most important Ariid species in Oman Sea coasts of Iran; *P. dussumieri*, as well as providing the required information for further population dynamics estimation and so far its rational fisheries management. One of the most serious mistakes made by fisheries biologists is the failure to validate age determination procedure that provides accurate age confirmation of the ageing technique. Without exception, age determination techniques must be validated for all age classes in the population and each time they are applied to a new species. In the present study, age determination of *P. dussumieri* was validated by comparing the annuli readings between the whole and sectioned otoliths.

Minimum and maximum life span recorded in the present study (3 to 12 years old) for fork length ranged from 245 to 767 mm and body weight ranged from 195 to 5801 g, with the most abundant age group of 5 yr. The observed maximum age was in agreement with that reported in the only previous work dealing with age

determination of this species in Persian Gulf in Kuwaiti waters (Cech *et al.*, 2010). They found that, female and male *P. dussumieri* age ranged between 2 and 12 years with the highest observation for age classes of 4-8 yr. Analysis of residual sums of squares indicated no significant difference between the sex-specific length-weight relationships of *P. dussumieri* in northern Oman Sea, consequently a power regression was applied to the length-weight data of all individuals combined. An Isometric growth was observed for blacktip catfish, as the value of ($b=0.922$) was not deviated from the value 3 (95% Confidence Interval = 2.798-2.869) with formula of $W = 0.022 FL^{2.9218}$ ($R^2 = 0.922$). Also, a high significant correlations were found between age/FL ($R=0.97$) and age/body weight ($R=0.94$) (Figs. 6, 7).

In most of teleostei fishes the biggest otolith is sagitta but in clupeids the asteriscus is bigger than sagitta and lapillus. This difference is observed in Ariid species including blacktip catfish, *P. dussumieri*, that the lapillus is the biggest otolith with the following morphological characteristics (Fig. 2): rounded, robust and with concave

surface both in lateral and dorsal sides. No sulcus groove was observed and it has a homogenous structure. The gibbus maculae in ventral surface has a knob structure in which terminates to basal line. The prominentia marginalis is located in lateral side of ventral surface. There are no obvious and countable denticles on asteriscus.

The blacktip catfish is unexploited and its resources in Persian Gulf and Oman Sea (Valinassab *et al.*, 2006, 2013) are virgin, it is proposed as an important policy to establish some form of cooperation among fishermen, scientists, and government agencies for implementing management programmes for further commercial and sustainable exploitation.

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