ISSN: 2347-5129
IJFAS 2015; 2(5): 353-358

www.fisheriesjournal.com
Received: 11-03-2015
Accepted: 13-04-2015

Abidizadegan Maryam
MSc of Aquatic Organisms Ecology, Sari University of Agricultural Sciences and Natural Resources, Iran.

Esmaeilpoor Poode Saeid
MSc of Aquatic Organisms Ecology, Sari University of Agricultural Sciences and Natural Resources, Iran.

Rahmani Hosein
Assistant Professor, Department of Fisheries, Sari University of Agriculture Science and Natural Resources, Iran.

Correspondence:
Abidizadegan Maryam
MSc of Aquatic Organisms Ecology, Sari University of Agricultural Sciences and Natural Resources, Iran.

Partial morphometrics and meristic evaluation of the two species mudskippers: Scartelaos tenuis (Day, 1876) and Periophthalmus waltoni (Koumans, 1941) from the Persian Gulf, Bushehr, Iran

Abidizadegan Maryam, Esmaeilpoor Poode Saeid, Rahmani Hosein

Abstract
Mudskippers are index of fish in the tidal mud region. 50 species of Scartelaos tenuis and 52 species of Periophthalmus waltoni were collected from the Persian Gulf, Iran in order to partial evalution of morphological and meristic characteristics. The mean weight, total length and standard length of S. tenuis were measured 11.17, 134.4 and 105.7 mm, respectively and for P. waltoni was obtained 11.93, 107.8 and 89.02 respectively. The number of vertebrae in S. tenuis and P. waltoni were counted 23-29 and 24-27 respectively. The regression equation the length and weight of S. tenuis and P. waltoni were W= 0.0005 L 2.0506 and W= 0.00001 L2.9519 respectively. Results of gut and food preference index evaluation showed that the main food in S. tenuis was mussels, while for P. waltoni Was Crabs. Relative length of the gut (RLG) showed that S. tenuis tend to omnivores and P. waltoni tend to carnivores. Growth patterns were calculated for S. tenuis and P. waltoni 6.14671 and 0.403199 respectively. According to t-table the shower of b were less than 3, growth pattern for S. tenuis and P. waltoni were negative allometric and isometric respectively. The estimation of maximum age for S.tenuis was estimated at 5 years and for P.waltoni 4 years.

Keywords: Bushehr Province, Periphthalmus waltoni, Scartelaos tenuis, meristic characteristics, morphological characteristics.

1. Introduction
Mudskippers belong to the family Gobiidae and subfamily Oxudercinae in which been dispersed in mangroves ecosystems and tidal mud in the throughout indo-pacific region and along the African coast (Murdy, 1989) [19]. Mudskippers are included 25 air-breathing species in 4 genius Periophthalmus, Periophthalmodon, Boleophthalmus and Scartelaos (Murdy, 1989) [19]. Three species; Periophthalmus waltoni, Boleophthalmus dussumieri and Scartelaos tenuis has been identified in southern water of Iran (Polgar *et al.*, 2009) [21]. Two species which has been studied in this research are the dominant in Deylam region – Bousher province. These fishes have certain physiological and behavioral adaptations to amphibious life that gives them a possibility to movement on land and water effectively (Heris, 1961) [13]. This fishes have an important role in food web with pitting, scaling, rotation and nutrient reclamation of organic substances in the upper layers by the Bioturbation (Mohammadpour, 2009) [18]. Moreover they can tolerate environmental challenges, tidal fluctuations and extreme habitat changes (Ishimatus *et al.*, 2007) [15].
Fishes of this Order are completely adapted to amphibians living, and are doing many activity including feeding, mating and defending territory on land and have evolved specialized organs such as ventral fins and skin breathing. Although Mudskippers have a little economic value but, they are popular food in Taiwan, Japan, Korea and China. In additional, they are known as the main source of food for birds and fish (Clayton, 1993; Clayton and Vaughan, 1988) [8, 7]. These fish can be used as a biological indicator to show impacts of human activities on mangrove ecosystems and tidal areas (Polgar 2008; Wong *et al.*, 2000) [20, 31].
So far, few studies have been done on behavioral and ecological characteristics of Mudskippers on the Persian Gulf coasts. Due to very interesting biological and behavioral characteristics and importance of fish as biological indicators to detect contamination of coasts, this study were aimed to evaluate some morphological and biological characteristics of the two species S. tenuis and P. waltoni in Persian Gulf coast of Bushehr province (Deylam region).

2. Materials and Methods

2.1 Study area

Sampling was performed in the tidal coast of Dyelam city (Boushehr province) with geographic profile: 50´ 8" E and 30´ 17" N. Samples were collected by hand and by digging into burrows on the mudflats during a month in November 2012. According to difficult fishing and lack of easy access to area sampling as well as living species in swampy and very sticky mud, was sampled a few of species.

2.2 Sampling and data analysis

Altogether, 102 fish (50 species to P. tenuis and 52 species to P.waltoni) were fixed in 10% formalin at the collecting location. In the laboratory, samples were studied by identified key (Larson and Takita, 2004; Murdy 1989) [17, 19]. In this study, were measured 29 morphometric characteristics to the 0.01 mm using a dial caliper and were counted 7 meristic characteristic. Also used to calculate the coefficient of variation of morphometric and meristic characteristics were used from Van valen (1978): C.VP = $\sqrt{\frac{\sum s^2}{\sum x^2}} \times 100$, where S2 is variance and X2 is the mean square of studied characterizes.

The length-weight relationship was calculated by the formula: W=aLb, where W is weight in grams, L is total length in centimeters, and a and b are regression parameters (Bagenal, 1978) [5]. The exponent b often has a value close to 3, but ranges between 2 and 4 (Tesch, 1971) [28]. The value b=3 indicates that the fish grows symmetrically or isometrically. Values other that 3 indicate allometric growth (Tesch, 1971) [28]. Fulton's condition index is calculated as K= W/L3, where W is the weight of the fish in grams and L is the length of the fish in centimeters.

Also the diet using a Food Prevalence Index defined (Euzen, 1987) [11]; who called it "Food Preference Index" was calculated as: $FP = \frac{N_i}{N_s} * 100$, where Ni is total number of individual prey of species i in all samples (stomach and intestine) and Ns is total number of samples containing food. If FP < 10 then species i is considered to be negligible in the diet. For FP between 10 and 50, species i is considered a minor prey species and if FP>50 the species I is a main diet item (Euzen, 1987) [11]. The formula for Relative length of gut, RLG = GL/TL, where GL is gut length and TL is the total fish length, was used is indicate the feeding habits (Biswas, 1993) [6]. If the amount of RLG is less than 1, the fish will be carnivorous (meat-eater) anf if more than 1, it tends to be herbivore and the medium size indicates it to be omnivore. To determine the growth pattern was used of the Pauli formula, $t = \frac{sd\ln L}{sd\ln W} * \frac{|b-3|}{\sqrt{1-r^2}} * \sqrt{n-2}$, where sdlnW and sdlnL are logarithmic standard deviation of weight and length respectively, b is the slope of the regression line between the length and weight, r is the correlation coefficient between length and weight and n is the sample size. The obtained t compared with t-table with n-2 degrees of freedom.

Age estimation was based on the method of Tsukamoto *et al.* (1983) [29] and Washio *et al.* (1991) [30], using the second pectoral radial bones taken from the pectoral fins. First, the pectoral fins were cut away from the body and boiled for 20 min. Then the second pectoral radial bones were dipped into 3% NaOH in water for nearly 24h to remove the muscles and spines. The remaining pectoral radial bones were ckeaned in distilled water. The central areas of each bone, with its alternating translucent and opaque zones (i.e., rings), could then be observed clearly nuder transmitted light. The radial bone was observed under a Nikon profile projector at 10 × magnification. For graphing and calculation was used Excel 2013.

3. Results

Results extracted from 102 mudskippers showed the mean, standard deviation, minimum, maximum and coefficient of variation of 29 morphometric characteristic. According to results of this study, the mean weight, total length and standard length of S.tenuis were measured respectively 11.17, 134.4 and 105.7 and the values for P.waltoni was obtained 11.93, 107.8 and 89.02 respectively (Table 1). The mean coefficient of variation for morphometric characteristic was 18.61 for S.tenuis and 19.23 for P.waltoni.

Table 1: Morphometric characteristics of S. tenuis and P. waltoni in Bushehr Province, Iran.

Morphometric characteristics	S. tenuis				P. waltoni			
	Min	Max	Mean±SD	C.V	Min	Max	Mean±SD	C.V
Total weight	3.3	20.09	11.17±3.34	29.94	2.94	20.42	11.93±4.30	36.05
Total length	75.56	163.86	134.4±19.35	14.37	69.42	127.1	107.8±14.28	13.24
Standard length	70	126.81	105.7±13.88	13.12	55.9	108.8	89.02±12.84	14.42
Body depth	7.7	12.81	11.07±1.24	11.20	8.59	18.39	15.03±2.40	15.97
Caudal peduncle depth	4.16	7.85	6.49±0.87	13.46	4.55	8.66	7.44±1.06	14.27
Caudal peduncle length	0.94	3.56	2.04±0.61	29.82	6.82	18.36	13.18±2.66	20.16
Predorsal length	26.25	43.46	38.44±4.34	11.31	20.19	35.27	31.53±3.88	12.33
Postorsal length	17.4	47.02	10.98±5.07	16.37	18.12	64.26	33.78±9.81	29.04
Preanal length	35.91	66	56.63±7.34	12.96	34.72	63.55	55.94±7.48	13.36
Postanal length	19.25	39.82	34.43±5.13	14.91	14.52	43.72	37.56±7.14	19.01
Anal fin length	30.47	58.06	48.38±6.99	14.45	10.11	22.63	18.10±2.67	14.77
Pectoral fin length	4.36	8.41	6.93±0.92	13.38	4.11	9.76	7.77±1.30	16.74
Venteral fin length	2.66	5.81	4.35±0.72	16.64	3.9	7.61	6.29±1.01	16.07
Depth of anal fin	2.41	6.38	4.58±1.19	25.95	2.57	7.17	4.45±0.99	22.30
Head length	17.5	28	25.16±2.48	9.87	16.18	29.15	26.41±3.39	12.84
Head width	10.62	18.1	15.90±1.90	11.96	11.08	22.82	19.04±3.03	15.92
Head depth	7.66	14.53	11.52±1.94	12.97	9.04	19.6	15.91±2.72	17.14
Snout length	4.41	8.26	7.20±0.94	13.08	4.74	11.1	9.06±1.63	18.03
Postorbital length	10.03	16.8	14.79±1.73	11.70	9.21	17.7	14.69±2.09	14.22
Eye diameter	1.6	5.56	4.45±0.74	16.57	3.33	5.81	4.93±0.58	11.91
Maxilla length	1.18	11	6.37±2.98	46.86	2.94	11.68	8.45±2.71	32.15
Premaxilla length	4.15	10.1	7.35±2.01	27.34	3.28	11.6	6.84±2.15	31.52

Mandible length	2.25	9.7	7.43±1.69	22.75	5.26	10.69	8.53±1.40	16.42
Pecto-venteral length	1.74	3.43	2.53±0.40	15.80	1.47	4.08	2.73±0.60	22.13
Interorbital length	0.36	1.43	0.89±0.30	33.81	0.38	1.52	0.79±0.24	31.22
Dorsal fin length 1	4.2	10.11	6.77±1.12	16.60	9.16	24.33	19.10±3.74	19.58
Dorsal fin length 2	33.41	66	55.42±8.79	15.86	15.94	28.66	23.88±3.25	13.63
Depth of dorsal fin 1	6.04	14.33	10.07±2.14	21.29	5.72	18.43	13±3.42	26.30
Depth of dorsal fin 2	3.66	11.54	8.44±2.27	26.93	3.45	11.49	8.68±1.99	22.99

Also, 7 meristic characteristic were measured (Table 2). According table 2, the number of vertebrae in S.tenuis and P.waltoni were calculated 23-29 and 24-27 respectively. Anal fin rays in S.tenuis and P.waltoni were observed 22-27 and 10-14 respectively. The pectoral fin rays, were obtained 11-20 in S.tenuis and 12-18 P.waltoni. The mean coefficient of variation for meristic characteristic in S.tenuis and P.waltoni were obtained 11.06 and 9.71 respectively.

Table 2: Meristic characteristics of S. tenuis and P. waltoni in Bushehr Province, Iran.

Meristic characteristics	S. tenuis				P. waltoni			
	Min	Max	Mean±SD	CV	Min	Max	Mean±SD	CV
Dorsal fin ray 1	4	7	4.41±0.80	18.23	8	14	11.6±1.64	14.15
Dorsal fin ray 2	23	30	26.45±1.67	6.34	11	16	14.56±0.86	5.91
Anal fin ray	22	27	25.07±1.12	4.50	10	14	12.54±0.86	6.87
Pectoral fin ray	11	20	16.94±1.63	9.62	12	18	14.68±1.53	10.43
Gill (Posterior)	4	10	7.07±1.21	17.15	6	11	8.54±1.29	15.18
Gill (interior)	7	15	11.17±1.81	16.27	9	14	11.76±1.45	12.33
Vertebrae	23	29	26.21±1.39	5.30	24	27	25.8±0.80	3.13

Study on gut and food preference index in S.tenuis showed mussels are main course, shrimp and crab are lateral food and insects were accidental food. But in P.waltoni showed that crabs and then mussels are the main course, shrimps are lateral food and insects are seen randomly in their gut. The survey on relative length of the gut (RLG) showed that S.tenuis tend to omnivores and P.waltoni tend to carnivores (Table 3).

Table 3: Indexes of Frequency Percentage and Relative Length of Gut of S. tenuis and P. waltoni in Bushehr Province, Iran.

Feeding Index	RLG	IF Crab (%)	FP Shrimp (%)	FP Mulusc (%)	FP Insect (%)
S. tenuis	1.02	16.28	23.25	88.37	9.30
P. waltoni	0.66	92	24	52	4

The results showed that regression equation the length and weight of S.tenuis and P. waltoni were W= 0.0005 L 2.0506 and W= 0.00001 L2.9519 respectively (Figure 1). Values of a, b and r2 represented for both species in table 4.

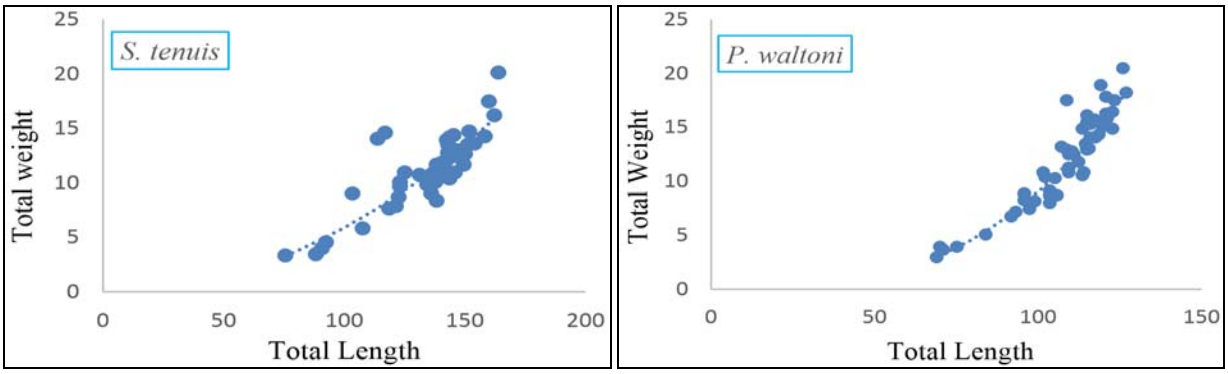

Fig 1: Regression relationship between length and weight of the two species S. tenuis and P.waltoni in the Bushehr, Iran.

The results showed that is condition index in the S.tenuis and P.waltoni 0.45 and 0.95 respectively (Table 4).

Table 4: Mean and SD of length and weight of S. tenuis and P. waltoni in Bushehr Province, Iran.

	Length (mean±SD)	Weight (mean±SD)	A	b	r^2	K (Fulton)
S. tenuis	134.83±19.35	11.17±3.34	0.0005	2.0506	0.7845	0.95
P. waltoni	107.85±14.28	11.93±4.30	0.00001	2.9519	0.9245	0.45

Index of growth patterns were calculated for S.tenuis and P.waltoni 6.14671 and 0.403199 respectively. According to table-t and that values of b is less than 3, growth pattern for S.tenuis were negative allometric and P.waltoni were isometric.

In estimation of age in S. tenuis was observed in age groups of 1 to 5 years (only one species was estimated one year). Also in P. waltoni were identified age groups of 1 to 4 years, that age abundance are in figure (2).

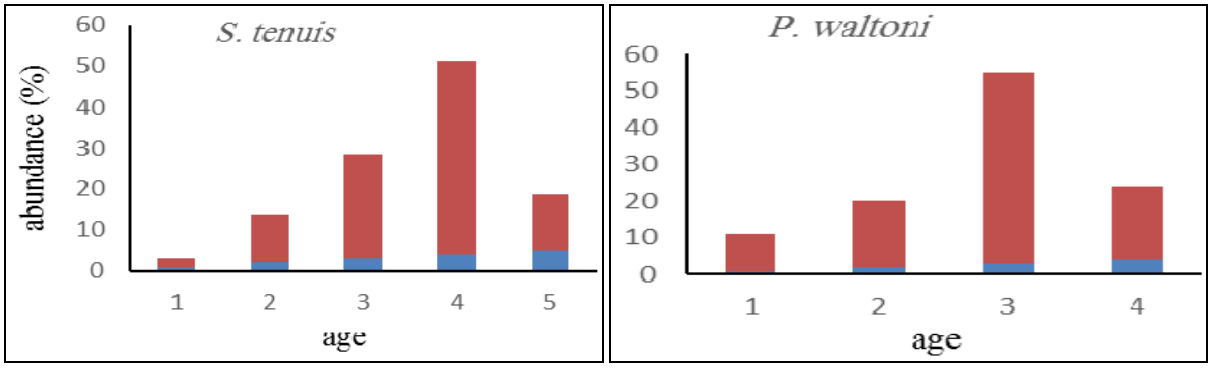

Fig 2: Abundance of age in captured Mudskippers in Persian Gulf, Bushehr, Iran.

The mean and SD of length and weight in different age groups in two species S. tenuis and P. waltoni in the Persian Gulf coast showed in table (5).

Table 5: The mean and SD of length and weight in different age groups in two species S. tenuis and P. waltoni in the Bushehr, iran.

Age group	S. tenuis			P. waltoni		
	N	Mean weight±SD	Mean Length±SD	N	Mean weight±SD	Mean Length±SD
1^+	1	-	-	5	3.85±0.762	74.148±6.055
2^+	6	6.83±4.066	99.43±10.24	9	5.44±1.385	98.902±4.409
3^+	13	10.09±1.759	127.75±7.21	27	12.84±2.443	112.2±5.506
4^+	24	11.96±1.494	143.437±4.358	9	17.17±1.866	122.51±2.701
5^+	7	15.69±2.43	157.283±5.013	-	-	-

4. Discussion

Gobiids have important role in the food chain of aquatic ecosystems and have the greatest impact on the floor of ecosystems (Helfman *et al.*, 1997) [14]. Therefore, any study in the era of ecology, biology and management of their resources is an interesting and important subject. The morphometric changes are created in response to environmental conditions faster than genetic changes in which are controlled by a polygenic and comes into existence in response to genes-trait relationships (Soule and Cuzin-Roudy, 1982) [27]. This point increases the survival that so-called adaptation. Morphology, usually changes in response to habitat condition and provides useful information on the study of species (Karakousis *et al.*, 1991) [16].

Soule (1982) [26], believes that the values of the coefficient of variation of morphological characteristics is more than meristic characteristics. According to the results obtained in the present study, it was found that the coefficient of variation of both species S.tenuis and P.waltoni in morphological characteristics is more than meristic characters. Low coefficient of variation in the meristic characteristics is due to variability of this characteristics in the genetic of fish and high levels of this factor in morphological characteristics is due to affected this characteristics from environmental factors (Soule and Cuzin-Roudy, 1982) [27].

The values obtained for meristic and morphometric characteristics in this study was correspond with other studies. Shukla *et al.* (2014) [25] reported that on P.waltoni, width of head is 18.6% standard length, ventral fins length is 13.17% standard length and anal fin length is 20.93% standard length. P.waltoni total dorsal fin was recorded 10-13, anal fin rays: 10-11, head width 13.7-21.9% standard length, ventral fin length 11.8 -13.9 % standard length and anal fin length 16.2-21% standard length (Murdy, 1989) [19]. In S.tenuis reported dorsal fin rays (total):6, dorsal fin soft rays (total): 23-28, anal fin soft rays: 24 – 27, head width 9.5-10.8% standard length and anal fin length 21.7-26.3% standard length (Murdy, 1989) [19].

Food selection by organisms in the environment associated to abundance of food, in addition feed rate depend on several factors such as substrate nutrient, season, water temperature and pattern of organism density and distribution (D-Grossman *et al.*, 1980) [10]. Mostly mudskippers are feeding, when are out of water for doing their in ebb (Colombini *et al.*, 1996) [9]. This is a reason, why nutrition is dependent on macro benthos that are available at every tide.

Survey on frequency of organisms ingested in S.tenuis and P.waltoni showed that abundance of mussels in both species was predominant prey. Food performance index in S.tenuis demonstrated that the pattern of feeding was mussels as main course, shrimp and crab as lateral food and insects as accidental prey. But in P.waltoni indicated that crabs and then mussels are main course, shrimps are lateral food and insects are seen randomly in their gut. Afshar *et al.* (2014) [4] explained same results on P.waltoni collected from Hormozgan province that reported Gastropods and then crabs as main course of P.waltoni, witch corresponded with present study. Abdoli *et al.* (2012) [3] remarked Copepods as main course of S.tenuis in Hormozgan province. Studies have shown that between dietary habits and the relative length of gut in fish, there is a high correlation and is variable at different life stages and individuals of a species (Rajabinejad *et al.*, 2010) [22]. Study on the relative length of gut (RLG) showed that P. waltoni tend to carnivorous and S. tenuis tend to Omnivore that these results are confirmed in the check of intestinal contents (Table 6). Amount of this index in study of Afshar *et al.* (2014) [4] in P.waltoni was 0.47, also Abdoli *et al.*

(2012) [3] obtained this index 1.27 for S.tenuis, that results of both of studies is consistent with present results.

Table 6: a and b in different research.

Author (year)	Location	Species	Sex	a	b	r^2
Abdoli *et al.* (2009)	Persian Gulf, Iran	S. tenuis	-	0.00002	2.86	0.92
		P. waltoni		0.00006	2.50	0.93
Sarafraz *et al.* (2011)	Bandar-Pol	P. waltoni	-	0.0000193	2.801	0.861
	Bandar-Abbas			0.0000228	2.772	0.92
	Qeshm Island			0.0000261	2.735	0.848
Salarpouri *et al.* (2012)	Hormuzgan province, Iran	S. tenuis	-	0.02735	2.1655	0.8657
Afshar *et al.* (2014)	Hormuzgan province, Iran	S. tenuis	Male	0.00138	2.6523	0.8584
			Female	0.00116	2.7245	0.7897

The length-weight relationship was represents of negative allometic growth pattern (b: 2.0506) in S.tenuis and isometric growth pattern (b: 2.9519) in P.waltoni. Also in study of Sarafraz *et al.* (2011) [24] in southern of Iran, reported growth pattern in P.waltoni According to the slop of the regression line between length and weight was isometric.

In the length-weight relationship, value of a and b are different not only in different species, also are different in the same species. These differences can be attributed to seasonal fluctuations, environmental factors, fish physiological conditions, the availability of food, health and growth of the fish, the amount of dissolved oxygen and sample size (Haimovichi and Velasco, 2000; Ragonese and Bianchini, 1998) [12, 23].

In study of Abdoli *et al.* (2010) [2], was observed that age of S.tenuis ranged from 1 to 4 years. That this difference can related to place and period of samling. For P. waltoni identified four age groups from the three sites Bandar-pol, Saraoor and Soroo (Sarafraz *et al.*, 2011) [24], That this observation were similar with our study.

Finally, it can be stated that, due to differences in the biological characteristics of these species in different regions of Iran, Is required to more accurate exploration and identification these species and other Persian Gulf mudskippers. Obviously, such studies play an important role in maintaining species diversity and mangrove environmental on the southern coast of Iran.

5. References

1. Abdoli L, Kamrani E, Abdoli A, Kiabi B. Age and growth of the Mudskipper, *Scartelaos tenuis* (Gobiidae: Oxudercinae) in the coastal areas of Persian Gulf at Bushehr province, Iran. Journal of Zoology in the Middle East 2004; 32:5-8.
2. Abdoli L, Kamrani E, Abdoli A, Kiabi B. Age and growth of the Mudskipper, *Scartelaos tenuis* (Gobiidae: Oxudercinae) in the coastal areas of Persian Gulf at Bushehr province, Iran. Journal of Zoology in the Middle East 2010; 51:113-115.
3. Abdoli L, Kamrani E, Abdoli A. Feeding Habits of *Scartelaos tenuis* in Bushehr Province, Iran. Journal of Fisheries, Iranian Journal of Natural Resources 2012; 64(4):309-318.
4. Afshar T, Abdoli A, Kiabi B. Comparative study of the reproductive biology of Mudskipper, *Scartelaos tenuis* in coast tidal of protected areas of estuary water and Azini protected areas (Hormozgan Province). Journal of Khoramshahr Marine Science and Technology 2014; 12(2):33-46.
5. Bagenal T. Methods for assessment of fish production in fresh waters. Blackwell publications, Oxford 1978. U.K.
6. Biswas SP. Manual of methods in fish biology. South Asian, 1993: 157.
7. Clayton DA, Vaughan TC. Ethogram of *Boleophthalmus boddarti* (Pallas), a mudskipper found on the mudflats of Kuwait. Kuwait Journal of Science 1988; 15:115-138.
8. Clayton DA. Mudskippers. Oceanogr Mar Bull Annu rev AD Ansell RN Gibson and Barnes M eds. UCL Press 1993; 31:507-577.
9. Colombini I, Berti R, Nocita A, Chelazzi I. Foraging Strategy of the Mudskipper *Periophthalmus sobrinus* Eggert in a Kenian mangrove. Journal of Experimental Marine Biology and Ecology 1996; 197(2):219-235.
10. D-Grossman G, Coffin R, B-Moyle P. Feeding ecology of the Bay Goby (Pisces: Gobiidae). Effects of behavioral, ontogenetic and temporal variation on diet. Journal of Experimental Marine Biology and Ecology 1980; 44(1):47-59.
11. Euzen O. Food habitats and diet composition of some fish of Kuwait balletion of marine science, 1987, 65-85.
12. Haimovichi M, Velasco G. Length-Weight relationship of marine fishes from Southern Brazil. The ICLARM Quarterly 2000; 23(1):19-23.
13. Harris VA. On the locomotion of the mudskipper *Periophthalmus koelreuteri* (Pallas) (Gobiidae). Proceedings of the Zoological Society of London 1961; 134:107-135.
14. Helfman GS, Collette BB, Facey DE. The Diversity of Fishes. Blackwell Science Inc., Malden, MA, 1997.
15. Ishimatsu A, Yoshida Y, Itoki N, Takeda T, Lee HJ, Graham JB. Mudskippers brood their eggs in air but submerge them for hatching. Journal of Experimental and Biology 2007; 210:3946-3954.
16. Karakousis Y, Triantaphyllidis C, Economidis PS. Morphological variability among seven populations of brown trout, *salmon trutta* L., in Greece. Journal of Fish Biology 1991; 38:807-817.
17. Larson HK, Takita T. Two new species of Periophthalmus (Teleostei: Gobiidae: Oxudercinae) from northern Australia, and a re-diagnosis of *Periophthalmus novaeguineaensis*. The Beagle. Rec Mus Art Galleries N Territ 2004; 20:175-185.
18. Mohammadpour Z, Nabavi MB, Dehghan Mediseh S. Study on the Seasonal Change of the Diet in *Periophthalmodon schlosserii* According to Occurrernce index in Samaeily Intertidal coast of Mahshahr. Journal of Marine Biology 2009; 1(2):92-102.
19. Murdy EO. A Taxonomic Revision and Cladistic Analysis of the Oxudercine gobies (Gobiidae: Oxudercinae)". Records of the Australian Museum Suppl 1989; 11:1-93.
20. Polgar G. Species-area relationship and potential role as a biomonitor of mangrove communities of Malayan

mudskippers. Journal of Wetlands Ecology and Management 2008; 17:157-164.
21. Polgar G, Burreson EM, Stefani F, Kamrani E. Leeches on mudskippers: host-parasite interaction at the water's edge. Journal of Parasitology 2009; 95(4):1021-1025.
22. Rajabinejad R, Azaritakami Q, Esmaeili Sari A, Nikouian AR. The relationship between natural nutrition *Salmo trutta fairo* to Biomass density of demersal in Lar dam. Journal of Marine Biology, Ahvaz University 2010; 2(8):13-21.
23. Ragonese S, Bianchini ML. Growth, mortality and yield-per-recruit of the poor cod, *Trisopterus minutus capelanus*, from the Strait of Silcily. Nega, the ICLARM quarterly. Fishbyte section. Jonyray-March, 1998, 61-69.
24. Sarafraz J, Abdoli A, Hassanzadeh Kiabi B, Kamrani E, Akbarian MA. Determination of age and growth of the mudskipper *Periophthalmus waltoni* Koumans, 1955 (Actinopterygii: Perciformes) on the mudflats of Qeshm Island and Bandar-Abbas, Iran. Progress in Biological Sciences 2011; 1(1):25-30.
25. Shukla ML, Trivedi J N, Soni GM, Patel BK, Vachhrajani KD. Mudskipper (Gobiidae: Oxudercinae) fauna of Northern Gulf of Khambhat with two new record of the species from Gujarat, India. European Journal of Zoological Research 2014; 3 (3):67-74.
26. Soule M. Allometric variation. The theory and some consequences. American Naturalist 1982; 120:751-764.
27. Soule M, Cuzin-Roudy J. Allometric variation 2. Developmental instability of extreme phenotypes. American Naturalist 1982; 120:765-786.
28. Tesch FW. Age and growth. IN: Methods for assessment of fish production in fresh waters, Richer WE ed. (Blackwell Scientific Publication: Oxford, UK), 1971, 99-130.
29. Tsuamoto M, Onohara T, Ushirogawa K, Matsuura S. Study on age characters of the mudskipper, *Boleophthalmus chinensis*. Bulletin of the Japanese Society for the Science of Fish, Nissuishi 1983; 49(1):69-74.
30. Washio M, Tsutsui M, Takita T. Age and growth of the mudskipperm *Boleophthalmus pectinirostris* distributed in the mudflat of Midori River, Kumamoto Prefecure. Nippon Suisan Gakkaishi. Bulletin of the Japanese Society for the Science of Fish, Nissuishi 1991; 57(4):637-644.
31. Wong LC, Corlett R, Young L, Lee JY. Comparative feeding ecology of little egrets on intertidal mudflats in Hong Kong, South China. Water Birds 2000; 23:214-225.