Systematic review of Anguilliformes order in Iranian Museums from the Persian Gulf and Oman Sea

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Abstract

This study focuses on Anguilliformes specimens revising which collected during 2006-08 in some Iranian museums. For this study, all museum samples from Iranian coastal waters of the Persian Gulf and Oman Sea were investigated. The results indicated that species diversity in the Iranian waters can be classified into six families of Anguiliformes (Eels and Morays fishes).

A total of 11 species - consisting of six families have been identified, of these the highest species diversity belongs to the Muraenidae with five genus and eight species. Also, there were two endemic species *Muraenesox cienerus* (Muraenesocidae) and *Gymnothorax undulates* (Muraenidae). More than ten rare species were the first report and record from Iranian territorial waters. There are *Ichthyapus acuticeps*, *Synaphobranchus affinis*, *Strophidon sathete*, *Rhynomuraena quaestia*, *Gymnothorax johnsoni*, *G.kidako, Muraenesox bagio*, *Pseudoxenomystax albescens*, *Muraenesox talabonoides*, and *Conger cinereus cinereus*.

Keywords: Systematic, Anguilliformes, Morphology, Persian Gulf, Oman Sea

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Introduction

Anguilliformes order included 4 subclass, 18 families, 156 genera and more than 500 species (Vander laan et al., 2013). There appeared 9 families in Iranian waters; consisting of Anguillidae, Mastacemblidae (Echelidae), Muraenesocidae, Muraenidae, Ophichthidae, Ophidiidae (from: Ophidiiformes), and Synaphobranchidae. Seven families were found in marine environments (Owfi et al., 2005a). It seems that previews authors do not discussed about two families as name Anguillidae and Echelidae, which their main habitats are in Iranian freshwaters (Owfi and Rabbaniha, 2007). Eels and morays families (Anguilliformes order) are common groups of fishes in the study area . They have ornamental and human consumption as food value in some species. They are eel shape and long body, have small pectoral and anal fins. In some species anal and pectoral fins are not presented. Almost they have long dorsal fin through the caudal fin. Fins have without soft rays, with cycloid and under skin scales. Pelvic fins are absence, holobranchia or have bronchia pit on beneath or side of the head (Froese et al., 2013).

Ichthyology research in Iranian waters of the Persian Gulf and Oman Sea with emphasis on Anguilliformes order, divided to four periods included:

1st period: Belgvad and Loppenthin (1937) and Belgvad (1944); Introduced 216 species one genus and one species of it belongs to Congridae.

2end period: Kuronuma and Abe (1968-1972); introduced 465 species consisting of 244 collected commercial species and 222 reported species, two families in two genus and species belong to the sea's eels. FAO (1977-1978); introduced 82 commercial species.

3rd period: Fischer and Bianchi (1984); introduced 380 species from fishing area 51. Bianchi (1995) introduced three families of eels in six genus and species. Coad (1992) and Al-Abdessalam (1995); introduced four genus and five species in two families of eels. Randall and Carpenter (1997) and Carpenter et al. (1997); introduced 577 commercial and noncommercial fish species.

4th period (After 2000 investigation)**:** Dehghani and Asadi (1996); introduced 260 species consisting of 77 families. Mohammadpour and Owfi (2001), Hoseinzadeh and Kamali (2003); introduced 114 ornamental marine species consisting of 44 families. Also, Owfi (2005) and Yasemi et al. (2008) introduced 902 fish species from the Persian Gulf and the Oman Sea .

So, recent study was carried out with the main objective to achieve the specific and new information about Anguilliformes taxonomy, systematic and morphology of the museum eels and morays in Iran.

Materials and methods

All museum samples of the Anguilliformes were collected in Iranian terrestrial waters of the Persian Gulf and Oman Sea since 1976 - 2006. The present study reviews the 27 samples from six families of Anguilliformes order during 2006 – 2008.

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17 genera and 26 species by different types of taxidermy samples or fixed in formalin dedicated in Iranian museums. But some museums (Ref codes: B, F, G, H, M, N) would not have this fish species as following list: (Table1)

Ichthyology Museum- Islamic Azad University- Babol- Ref. code: A

Ichthyology Museum- Shahid Bahonar University– Kerman- Ref. code: B

Marine Biology Museum- Iran Shrimp Research Center- Bushehr- Ref. Code: C

Pardis Biodiversity Museum- DoE- Tehran - Ref. Code: D

Zoology Museum -Tehran University - Tehran– Ref. code: E

Ichthyology laboratory- Mazandaran University- Sari- Ref. code: F

Ichthyology Museum- Islamic Azad University- Savadkooh- Ref. cod e: G

Zoology Museum- Shahid Beheshti University- Tehran- Ref. Code: H

Biology Laboratory- Offshore Fisheries Research Center-Chahbahar- Ref. code: I

Marine Biology Museum- Ecology Research Center- Bandar Abbas- R ef. code: J

Darabad Natural History and Wildlife Museum- Tehran- Ref. code: K

Iranian Natural History and Wildlife Museum- Tehran- Ref. code: L.

Haft Chenar Natural Museum- Tehran- Ref. code: M

Ichthyology Laboratory -Qaemshahr Islamic Azad University -Ref. code: N

Ichthyology Museum -Fisheries Education Center -Rasht -Ref. code: O

Zoology Museum -Tehran University- Karaj-Ref. code: P

Assessment of biometrical parameters and appearance characters were classified into two groups:

1- Morphometric parameters including: Total length, Fork length, Standard length, Fins length, Fin base, Caudal peduncle length, Head length, Snout length, Eye diameter, Body depth, and in some of the relation parts for identification keys.

2- Meristic parameters including: Number of vertebrate, soft rays and spines, scales, teeth, head spines, upper and lower spines of gill arches (Biswas, 1993)

Used microscope and binocular, Biometrical board, Caulis by 0.01 precision, magnifying glass, this information recorded in identification sheet. Samples categorized on different family taxa (Fischer and Bianchi, 1984; Smith and Heemstera, 1986).

Fins formula standard identification table were used for genus and species identification (Smith and Heemstera, 1986). The sample of diagnostic characters compared by valid reference qualities and ichthyologic reliable sites such as: Fishbase , Reef Base, and Fish Catalogue of Life for finally accordance and species collation (Smith and Heemstera, 1986; Al-Abdessalam, 1995; Carpenter, 1997).

All of the studied specimens were collected from museums; therefore some morphometric and meristic parameters clarifying were limited.

Results

According to museum samples, there are nine families of eels in the northern Persian Gulf and Oman Sea consisting of: Anguillidae, Mastacemblidae, Muraenesocidae,

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Muraenidae, Congridae, Nettastomatidae, Ophichthidae, and Synaphobranchidae from Anguilliformes; Ophidiidae from Ophidiiformes which Anguillidae and Mastacemblidae are fresh water groups, and others are marine species.

Congridae: Included 22 genera and 150 species from Congrinae (Fish Base, 2013). Two genus and two species identified and reported in Iran from Congrinae from Ramin and Meidani (Oman Sea) (Table 3).

***Conger cinereus cinereus* (Ruppell, 1830)**

English name: Longfin African Conger

Morphology: Dorsal and anal spines 0-0; vertebra number 139-146. Color brownish grey, yellow in the below of the body and on fins, median fins with narrow black edge, black patch on lower, rear edge of eye and on pectorals. Fangs put on upper and lower lips well developed two rows of teeth in jaws, those of outer row is larger; closely set and compressed to from cutting edge; 6th infra orbital pore located close behind and slightly about posterior angle of jaw. Best way to assign and distinguish sex of sample is a pattern of dark bands at night and related the position of pair fins (pelvic and pectoral fins). This species collected from Ramin zone of the Oman Sea and kept in the Zoology Museum of Tehran (Ref code: E) without scientific and museum code number (Table 3, Figure 1).

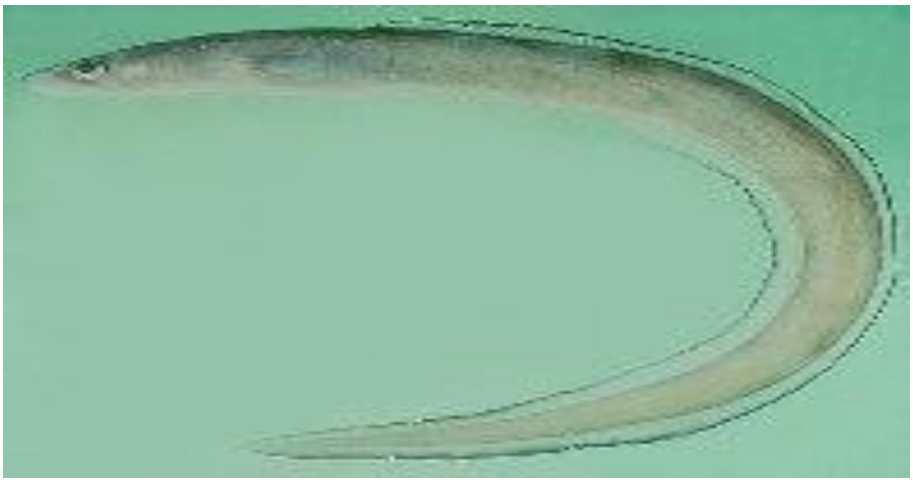

Figure1: *Conger cinereus cinereus* Ref. code: E, (Randall, 1997)

***Pseud ox enom ystax albea cen s* (Barand, 1923)**

English name*:* Hairy Conger

Morphology: Dorsal spines 0-0, dorsal fin soft ray 276-300, anal fin soft ray 183-213; vertebra number 168-172. Pored lateral line scale 140-151, lateral view of the body is an eel-like. Color is milky or light white, below of the body is light brown and the posterior part of the body is lighter than beneath. Also have a dark edge on dorsal and anal fins.

This species collected from Meidani (Oman Sea) and kept in Rasht Ichthyology Museum (Ref. code: O), by scientific and museum code 101 (Tables 1, 2).

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Muraenesocidae**:** Included four genus and eight species that recently, two genus and four species in Iranian water from Ramin, Meidani and Gowatr (Oman Sea) were recorded (Table 1).

Cong eresox t alabon ides **(Bleeker, 1853)**

English name: Indian Pike Conger
Morphology: Total length 250 cm (Max. size); dorsal and anal spines 0-0; vertebra number 132-135. Body robust and eel shaped, mouth very large with gape reaching well beyond eyes. Dorsal fin interested before gill opening, 57-68 fin rays put in before level of vents. Pectoral fins relative small, about four times in head length, lateral line pores before level of anus is 41 or 42.

This sample collected from Meidani (Oman Sea) and Kept in Tehran University Zoology Museum (Ref. code: P), without scientific and museum codes (Tables 1, 2; Fig. 2)**.**

Figure 2: ***Congeresox talabonoides*** **Ref. code: P, (Chau, 2003)**

Mu ra enesox b agio **(Hamition, 1822)**

English name**:** Common Pike Conger
Morphology: Total length 200 cm. (Max. size); dorsal and anal spines 0-0; vertebra number 128-141. Body robust and eel shape, eye diameter 3 item in snout length. Head narrower and Intra-orbital width about 10 times in head, 33-39 lateral line pores before anus, dorsal fin rays before anus 47- 49.

Posterior nostril only slightly nearer to eye than to anterior nostril, mouth very large, teeth generally large and conspicuous.

Two samples of this species find out in the survey. One specimen is in Tehran Uni. Zoology Museum (Ref code: E) by F-175 museum code and without scientific code, collected form Gowatr Bay (Oman Sea) and second one collected from Ramin (Oman Sea) and kept in Rasht Ichthyology Museum (Ref. code: O) by scientific code 100, and Muraena Mb. 1 museum code (Tables 1, 2; Fig. 3).

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Figure3: ***Muraenesox Bagio*** **Ref. code: E, (Owfi and Abbasi, 2007)**

Muraenidae: Included 15 genera and 200 species, and 5 genera and 8 species identified from Muraninae subfamily.

Generally collected in Ramin, Gowatr, Meidani, Kolahi Creek (Oman Sea); and also Khark**,** Lavan, Sirri and Kish Islands (Persian Gulf) (Table 1).

Gym nothrax jo hn soni **(Smith, 1962)**

English name: White Spotted Moray

Morphology: Total length 30 cm. (Max size); vertebra number 135-137. Body color is pale brown with irregular, and light spots anteriorly, larger and more rounded on tail and in young corner of mouth and gill opening dusky.

Three specimens find and identified in this study. Two of them collected from Ramin and Kolahi Creek (Oman Sea) that were kept in Tehran University Zoology Museum (Ref. Code: E) with museum code F-176 and without scientific code (Table1). The Third one collected from Gowatr Bay (Oman Sea) and was kept in Rasht Ichthyology Museum (Ref. code: O) by scientific code 102 and museum code Muraena G.j.2. (Tables 1, 2, Figure 4).

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Figure 4: *Gymnothrax johnsoni* Ref. code: O- E, (Owfi and Abbasi, 2007)

***Gym nattorax kidako* (Temminck & Schlege, 1846)**

English name: Kidako Moray

Morphology: Total length 120 cm. and standard length 91.5 cm. (Max. size). Collected in Khark, Kish, Lavan and Sirri Islands (Persian Gulf), living in the coral reefs and rocky caves habitats. Observed one sample of that in this study and kept in Chahbahar Offshore Fisheries Research Center (Ref. code: I) without scientific and museum code (Tables 1, 2).

Gym nothorax pha sm atodes

English name: Phantom moray

Morphology: Total length 46 cm. (Max. size). Body color was pale yellow, lighter ventrally but the specimen identification for species taxa was not carefully, because preserving condition was not standard and suitable in museum (Tables 1 and 2).

This species recorded the suspecting sample in Tehran University Zoology Museum (Ref. code: E) with scientific code G. sp. and without museum code.

***Rhinom uraena quaest ia* (Garman,1888):**

English name: Ribbon Moray

Morphology: Total length 130 cm. (Max. size).Without dorsal and anal spines (0-0).Three fleshy tentacles on the tip of lower jaw, a single fleshy pointed projection at the tip of its, snout and tubular anterior nostrils ending in gaudy, fanlike expansions. Juveniles all black, males have yellow dorsal fins and fameless change to a nearly all yellow color, but usually with blue in posterior.

This sample collected from Meidani (Oman Sea) and kept in Rasht Ichthyology Museum (Ref. Code: O) by 102 scientific code and museum code Muraenin R.q.3 (Tables1, 2).

***Strophidon sathet e* (Hamilton, 1822)**

English name: Slender Giant Moray

Morphology: Total length 40 cm. (Max. size); vertebra number 183-196.Without dorsal and anal spines (0-0); dorsal fin inserted on head before gill-opening; scales absents. Body color is brownish grey in above and lighter below. Body moderately elongate, cylindrical in front, compressed along tail. Eyes small, teeth small, biserial sharp teeth on jaws and inner series enlarged; head not obviously distinct from

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trunk. Although the profile is moderately steep, very large mouth, extended to beyond eye. The specimen collected from Meidani (Oman Sea) in Rasht Ichthyology Museum (Ref. Code: O) by 102 scientific code and Muraenin S.s.4 museum code (Tables 1, 2).

Nettastomatidae: Included six genera and 30 species that one genus and one species observed and recorded from Meidani (Oman Sea).

Hoplunni s diom edianu s(Good & Be an, 1896)

English name: Black Tail Conger

Morphology: Total length 37 cm. (Max. size). Snout long and pointed dorsal and anal fins are black, along posterior part of tail. Collected from Meidani (Oman Sea) in Rasht Ichthyology Museum (Ref. code: O) by 99 scientific code and Nettas H.d.1 museum code (Tables1, 2).

Ophichthidae: Included 52 genera and 250 species. Six genus and six species identified in 2 subfamilies: Ophichthinae and Myrophinae in the Persian Gulf and Oman Sea Iranian territorial waters. The specimen identified and recorded during 2001- 2002 by Iranian researcher.

Subfamily: Ophichthinae

***Ichthyapu s a cuti cep s* (Barnard, 1923)**

English name: Sharp Nose Sand Eel

Morphology: Total length 40 cm. (Max. size). Body color is light brown and lighter in below, darker point on head, extreme tip of snout dark.

Kept in Tehran Zoology Museum (Ref. code: P), without scientific and museum codes and sampling information (Tables 1, 2).

Synaphobranchidae: With one subfamily (Synaphobranchinae), 10 genera and 26 species. One genus and one species reported from Kish Island (Persian Gulf).

***Syna phob ran ch us affinis* (Gunther, 1877)**

English name: Grey Cutthroat

Morphology: Total length 40 cm. (Max. size); dorsal and anal soft rays 230-230. Body color is dark grey.

Collected from Kish Island in coralline rocky habitats (Persian Gulf) and kept in Darabad Museum (Ref. code: K), without scientific and museum codes (Tables 1, 2; Fig. 5).

Figure 5: *Synaphobranchus affinis* Ref. code: K, (Owfi and Abbasi, 2007)

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Table 1: **Anguilliformes species check list of the Persian Gulf and Oman Sea, based on reference codes**

Family	Scientific Name	No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Congridae	*Pseudoxenomystax albecens*	1															*	
	Congeresox talabon	1					*											
	Congeresox talabonoides	1																*
Muraenesocidae	*Muraenesox bagio*	2					*							*			*	
	Muraenesox cinereus	7	*				*											
	Muraenesox sp.	1					*											
Muraenidae	*Gymnothorax johnsoni*	2					*										*	
	Gymnothorax undulatus	2					*							*			*	
	Gymnothorax sp.	1					*											
	Gymnothorax sp.	1					*											
	Gymnothorax kidako	1									*							
	Rhinomuraena quaestia	1															*	
	Strophidon sathete	1															*	
Nettastomatidae	*Hoplunnis dio medianus*	1															*	
Ophichthidae	*Ichthyapus acuticeps*	1																*
	Ophichthus apicalis	2				*											*	
Synaphobranchidae	*Synaphobranchus affinis*	1											*					

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Table 2: Anguilliformes specimens in Iranian museums from the Persian Gulf and Oman Sea, base on reference codes

Family	Scientific Name	No. Sample	Scientific cod	A	B	CDE	FGH	I	JKL	MNOP
Congridae	*Conger cinereus cinereus*	1						*		
	Pseudoxenomystax albecens	1	101							*
Muraenesocidae	*Congeresox talabon*	2				*				*
	Congeresox talabonoides	1								*
	Muraenesox bagio	2	100			*				*
	Muraenesox cinereus	7	100	*		*		*		*
	Muraenesox sp.	1				*				
Muraenidae	*Echidna nebolusa*	1	F-173					*		
	Gymnomuraena zebra	1			*					
	Gymnothorax johnsoni	2	102 (F-176)			*				*
	Gymnothorax kidako	1						*		
	Gymnothorax phasmatodes	1				*				
	Gymnothorax undulatus	3	102 (F-175)			*			*	*
	Gymnothorax sp.	1				*				
	Gymnothorax sp.	1				*				
	Rhinomuraena quaestia	1	102							*
	Strophidon sathete	1	102							*
Nettastomatidae	*Hoplunnis diomedianus*	1	98							*
Ophichthidae	*Ichthyapus acuticeps*	1								*
	Lamnostoma orientalis	1								

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	Continue table 2:						
	Muraenichthys schultzei	1				*	
	Ophichthus apicalis	2	99	*			*
	Ophichthus celebicus					*	
	Pisoodonophis hoeveni	1					
	Brotula multi barbata	1		*			
Ophiidae	*Neobithys steatiticus*	1					
	Neobithys stefanovi	1					
Synaphobranchidae	*Synaphobranchus affinis*	1				*	

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Discussion

Conger cinereus cinereus (Longfin African Conger) is disperse in thirty degree of north and south from tropical latitude. Also Fricke (1999) reported from Indo-Pacific zone, Red Sea and East Africa to the Marquesan and Easter Islands, north to southern Japan and the Ogasawara Islands, south to northern Australia and Lord Howe Island. The present sample characters were same as Froese and Rainer (2013) and Carpenter (1997) samples.

Pseudoxenomystax albeacens (Hairy Conger) characters were same as Froese and Rainer, 2013; Fischer, 1984 sample and differ with FAO (1997) in vertebra number and pored lateral line scale. Also, disperse in tropical deep water in continental slope with 270-1700 meter depth, so there was a bathy-demersal fish (Figueiredo et al., 2002).

Congeresox talabonides (Indian Pike Conger) characters were same as described by Froese and Rainer (2013); Fischer and Bianchi (1984). The present sample disperses in tropical marine and brackish water with 800-875 meter depth (Froses et al., 2013). So on, found in coastal waters and estuaries, on soft bottom in the West Indo-Pacific, coasts of India and Sri Lanka, eastward through Indonesia to the Philippines, Hong Kong and Taiwan (Talwar and Jhingran, 1991).

Muraenesox Bagio (Common Pike Conger) characters were already described by Fischer and Bianchi (1984); FAO (1997); IFRO (2002) Froese and Rainer (2013) and distribute in tropical marine and brackish water. The range of below 100 meter depth in Indo –West Pacific and Oman Sea (Randall, 1997; KISR, 1986).

Gymnothrax johnsoni (White Spotted Moray) was dispersing in subtropical marine and demersal water .The range of 20-70 meter in Western Indian Ocean, Red Sea, Aqaba Gulf, South Africa (KISR, 1986; Randall, 1995 and 1997; Khalaf and Disi, 1997; Fish Base, 2013;). Also all of them were same with whole ichthyology references which revised in the study.

Gymnattorax Kidako (Kidako Moray) was the same in all morphological and meristic parameters by Kuiter (2002); Vander laan et al. (2013) and Reef Base (2013). It has an endemic species in southwest waters of Asia such as; Korea, Japan, Taiwan also in western central Pacific; Australia and Hawaii is a native too. Occur in tropical marine and reef-associated, depth range 2 - 350 m.

Rhinomuraena quaestia (Ribbon Moray) was the same by Randall (1997); Kuiter (2002); Fischer and Bianchi (1984) and Bianchi (1995). Also, diverse in marine, reef-associated of the tropical zone from 32°N - 26°S latitudes non-migratory fish live in depth range 1- 67 m. occurs in lagoons and coral reefs.

Strophidon sathete (Slender Giant Moray) was same by Fischer and Bianchi (1984); Bianchi (1995); Randall (1997); Kuiter (2002). Also, diverse in marine, fresh and brackish waters that reef-associated by 15 – 30 m. range. It's an amphidromous fish which live in depth range of below 15 meter of tropical climate and 23°C - 28°C in 30°N - 23°S latitudes. Inhabits in muddy ocean bottoms and estuarine areas, but sometimes found in rivers, estuaries and

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inner bays of the Indo-West Pacific from Red Sea to West Pacific Ocean (Fish Base, 2013).

Hoplunnis diomedianus (Black Tail Conger) for diagnostic characters was same to Smith and Heemstera (1986); Smith and Smith (1983); Vander laan et al. (2013); Fish Base (2013), but others wouldn't report that but also reported in KISR (1986) and IFRO (2002)**.** It has dispersed in subtropical marine. Its demersal fish which live in depth range below 200 meter identified as native species in the Western Atlantic Ocean (Froses et al., 2013)

Ichthyapus acuticeps (Sharp Nose Sand Eel) for diagnostic characters was the same to Smith and Smith (1963); Smith and Heemstera (1986); Vander laan et al. (2013). Also, live in demersal, marine and subtropical climate, and Known only in Zululand and Durban, South Africa. Most diversity and distribution is in Western Indian Ocean from Oman, Qatar and Aqaba Gulf (Randall et al., 1997; Kuiter, 2002).

Synaphobranchus affinis (Grey Cutthroat) for diagnostic characters had same to Smith and Heemstera (1986); Smith and Smith (1963); Fischer and Bianchi (1984); Khalaf and Disi, (1997); Vander laan et al. (2013); Froses et al.(2013); . It seems that this one is endemic species in the Persian Gulf because; most of them live in over rocky substrata upper the continental slope. In the other hand it was a circum-global specimen except from the Northeast Pacific (Froses et al., 2013).

The eels has an unusual in fisheries exploitation system, thus would be limited in taxonomical research carefully. In the studied area there is less attention to noncommercial fishes. Hence data collections are very limited in taxonomical research of this species. From conclusively the lack of the public systematic studies in the region had led to misidentification of the species. So any review to identification and classification of the species are necessary although is not easy. In this regard it should be mentioned that 11 species of eels and morays (Anguilliformes) have not been reported so far. So, this is the first record and report from mentioned species from the northern Persian Gulf and Oman Sea (Tables1, 2).

The first factor of biological studies in each research can be true knowledge on the morphological characters of dwellers, sex related and breeding fecundity across the optimum biological specialists (Owfi, 2005a). Base on information and according to Owfi (2005) report for count of mistrustful and specimens consist of 39 samples, this subject became obvious that Congridae with 2 specimens have 5.1%, Muraenesocidae and Muraenidae with 26 specimens have 66.6%, Nettastomatidae and Synaphobranchidae with 2 specimens have 5%, and Ophichthidae with 6 specimens have 15.38% of studied samples. In the other hand Ophidiidae from Ophidiiformes with 3 specimens included 7.6 % of eels species (Table 3).

In the research paid attention to final classification changing around all taxa of order including family, genera and species. All systematic information presented in Table 1. This information basis to compose correct scientific name and identification species by

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collected or /and comparing this data by Owfi (2005a, b) reports (Table 3).

Totally, 39 eels and morays specimens from the Persian Gulf and Oman Sea of the Iranian waters in 7 family and 19 genera were reported and recorded. Among these samples, 24 samples identified in genera and 15 specimens were reviewed and defected. 11 new specimens presented in this study and their genus and species were reviewed and defected (Tables 4, 5).

The new results help to used guide references in the area and computer searching on Fish Base, Reef Base, Catalogue of Life websites and scientific names. Comparing the study results and Owfi (2005a) show that, 10 new specimens, 6 joint specimens, 3 unknown specimens, 9 changed name and 11 specimens are unique species by UNCC (Owfi, 2005a,b) in Iranian territorial waters of the Persian Gulf and Oman Sea which have been reported (Owfi et al., 2013) (Table 5).

Present species diversity and variety shown in Table 4. Seven species changed in family taxa level which their accepted names presented in Table 5. According to number of diversities for each family without investigation counting in the study (27 samples) consisting of: Muraenesocidae with 13 samples (48.4%), Muraenidae; with eight samples (29.6%), Ophichthidae with 3 samples (11.10%), Congridae with 2 samples (7.4%), and other families by one sample contained 3.7%. On the other hand this study illustrated 3 mistrustful specimens and 4 unidentified specimens too.

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Table 3: Reported Anguilliformes species (Eels and Morays) from the Persian Gulf and Oman Sea

Family	Species	Reference						
References code		A	B	C	D	E	F	G
Congridae	*Conger Cinereus cinereus (Ruppell, 1828)*				*			
	Uroconger lepturus (Richardson, 1848)							
	Congresox talabon (Curvier, 1829)							
	Congresox Talabonoides (Bleeker, 1853)	*						
Muraenesocidae	*Muraenesox Bagio (Hamilton,1822)*							
	Muraenesox Cinereus (Forsskal, 1775)	*		*	*	*	*	*
Muraenidae	*Echidna Nebulosa (Ahl, 1789)*			*	*			*
	Gymnomuraena Zebra (Shaw, 1797)				*			
	Gymnothorax Phasmatodes (Smith, 1962)				*			
	Gymnothorax undulates (Lacepede, 1803)				*			
	Thyrsoidea. Macrura (Bleeker, 1854)							
Ophichthidae	*Lamnostoma Orientalis* (McClelland, 1844)			*	*			
	Muraenichthys schultzei(Bleeker, 1857)			*	*	*	*	
	Ophichthus apicalis(Bennett, 1830)	*					*	
	Ophichthus celebicus (Bleeker, 1856)						*	
	Pisodonophis hoevenii (Bleeker, 1853)				*	*		
Ophidiidae	*Brotula multibarbata*(Temminck & Schlege, 1846)				*			
	Neobythites Steatiticus(Alcock, 1893)				*			
	Neobythites Stefanovi(Nielsen & Uiblein 1993)				*			

A: Iranian Fisheries Research Organization – IFRO (1986-88)

B: Marine Science and Fisheries Center of Oman – MSFCO (1995)

C: Kuwait Institute for Scientific Research – KISR (1986)

D: Iranian Fisheries Research Organization – IFRO (2001-02)

E: FAO, 1986

F: FAO, 1997

G: Owfi, 2005

[DOR: 20.1001.1.15622916.2014.13.2.1.3]

Table 4: Anguilliformes species diversity and distribution of the Persian Gulf and Oman Sea, base on ecological groups

Family	Scientific Name	English Name	Persian Gulf	Oman Sea	Ecological Group
Congridae	*Conger cinereus cinereus*	Long fin African Conger	*	*	D
	Pseudoxenomystax albecens	Hairy Conger	*	?	
Muraenesocidae	*Congeresox talabon*	Yellow Pike Conger	*	*	
	Congeresox talabonoides	Indian Pike Conger	*	*	D
	Muraenesox bagio	Common Pike Conger	*	*	
	M. cinereus	Dagger Tooth Pike Conger	*	?	R & D
	Muraenesox sp.	Conger	*	?	
Muraenidae	*Echidna nebolusa*	Starry Moray	*	*	D
	Gymnomuraena zebra	Zebra Moray	*	*	D
	Gymnothorax johnsoni	White Spotted Moray	*	*	D
	Gymnothorax kidako	Kidako Moray	*	*	R & D
	Gymnothorax phasmatodes	Phantom Moray	?	*	D
	Gymnothorax undulatus	Undulated Moray	*	*	D
	Gymnothorax sp.	Moray	*	?	
	Gymnothorax sp.	Moray	*	?	
	Rhinomuraena quaestia	Ribbon Moray	*	*	
	Strophidon sathete	Giant Slender Moray	*	*	
Nettastomatidae	*Hoplunnis diomedianus*	Black Tail Pike Conger	*	?	
Ophichthidae	*Ichthyapus acuticeps*	Sharp Nose Sand Eel	*	*	R
	Lamnostoma orientalis	Oriental Snake Eel	?	*	R & D
	Muraenichthys schultzei	Maimed Snake Eel	*	*	R & D
	Ophichthus apicalis	Blunt Nose Sand Eel	*		D

[DOR: 20.1001.1.15622916.2014.13.2.1.3]

Continue table 4:					
	Ophichthus celebicus	Eel	*	?	
	Pisoodonophis hoeveni	Hoeven's Snake Eel	*	*	D
	Brotula multi barbata	Goats Beard Brotula	*	*	R
Ophidiidae	*Neobithys steatiticus*	Barred Cusck Eel	?	*	D
	Neobithys stefanovi	Dark Fin Cusck Eel	?	*	D
Synaphobranchidae	*Synaphobranchus affinis*	Grey Cutthroat Moray	*	?	D

D: Deep water, **R:** Reef and rocky habitats, **R & D:** Deep and reef habitats

Table 5: Scientific name changes of Anguilliformes species of the Persian Gulf and Oman Sea

Family	New accepted family name	Scientific name	New accepted scientific name	Reference
Congridae	Congridae	*Pseudoxenomystax albecens*	*Congermuraena albecens*	Smith & Smith,1963
Muraenidae	Muraenesocidae	*Muraenesox cinereus*		Smith & Hemstera,1986
Muraenesocidae	Muraenesocidae	*Muraenesox bagio*	*Muraenesox cinereus*	Smith & Hemstera,1986
Muraenesocidae	Muraenesocidae	*Congeresox talabon*		Smith & Smith,1963
Muraenesocidae	Muraenesocidae	*Congeresox talabonoides*	*Muraenesox talabonoides*	Smith & Hemstera,1986
Muraenidae	Muraenidae	*Gymnothorax johnsoni*	*Licodontis johnsoni*	Smith & Smith,1963
Muraenidae	Muraenidae	*Gymnothorax undulates*	*Licodontis undulatus*	Smith & Smith,1963
Muraenidae	Muraenidae	*Strophidon sathete*	*Thyrsoidea macrura*	Fish base,2013; Vander laan et al.,2013
Nettastomatidae	Nettastomatidae	*Hoplunnis diomedianus*	*Hoplunnis diomedianna*	Smith & Hemstera,1986
Ophichthidae	Ophichthidae	*Ophichthus apicalis*	*Ophichthus unicolor*	Smith & Hemstera,1986
Synaphobranchidae	Ophichthidae	*Ichthyapus acuticeps*	*Synaphobranchus acuticeps*	Fish base, 2013; Vander laan et al.,2013
Synaphobranchidae	Synaphobranchidae	*Synaphobranchus affinis*	*Synaphobranchus branchysomus*	Fish base, 2013; Vander laan et al.,2013

[DOR: 20.1001.1.15622916.2014.13.2.1.3]

According to the conclusion significance and main suggestions of research included of:

A) Less taxonomical information about this class biodiversity in many parts of the world.

B) Need to taxonomical background; consist of reference subject, information banks, and taxonomical experts through the biodiversity of convection in whole area especially on under developed countries.

C) Taxonomical defects of Anguilliformes in national and territorial levels.

D) Help to kept of humanly resources, would be hatched and collected samples systems and under structure, then changed them to curate forms. In addition to several problems in this way; the project is the first complete and collected information about the order and showed the vague side of eels and morays classification.

E) Recognized the classified position, with emphasis on geographical division categories reviews and defects of specimens in the area. Classified coastal land and marine environmental diversities, describe the Persian Gulf and Oman Sea's Anguilliformes by

Linnae and Mayer classification and animal geography theories.

F) Use the results of ichthyology research in fisheries management and planning to calculate& assess of sustainable yield recruitments on special species or group species, health &disease of fish asp.ect special hosts such as parasites or other parts of disease in marine environments because eels and morays live in salt waters and non culture in Iranian waters, thus give in information results to Iranian Fisheries Research Organization (IFRO) and Iranian Fisheries Organization (Shilat).

G) Identification and complete information about Anguilliformes fauna by the goal of stock flexibility/species combination (species diversity index). Planning about endemic and endangered species biodiversity, survey and doing sustainable study in this chart and know the effects of ecological or environmental changing by human or natural too.

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