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Identification and assess anthropogenic impacts on species richness of coral reef fishes in Larak Island, Persian Gulf

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Abstract Coral reefs are amongst the most important and rich ecosystems in the world and are provide habitat for a diverse range of species groups of fishes and invertebrates. Larak Island is one of fourteen islands found in the Persian Gulf which was selected for this study. The reef fish distribution around this island was identified and then for sampling, six stations were randomly selected by Manta Tow method. The identification was conducted using visual census technique in all stations. A total of 54 species belonging to 42 genera and 23 families were identified and amongst them the abundant species group belonged to family Pomacentridae with 11 species. The results indicated that further the stations were from an urban area higher species richness was.

Keywords Coral reef fishes; Species richness; Larak Island; Persian Gulf

Introduction

Coral reefs rival that other well-known tropical community, the rain forest, in their beauty, richness, and complexity. Coral reefs are such massive structures, in fact, that they must be considered not only biological communities but geographical features, the largest geological features built by organisms (Castro and Huber, 1991). Major coral reef ecosystems occur in the tropical Indo-Pacific region, the tropical western Atlantic mostly in the Caribbean Sea, the Red Sea, and the Persian Gulf (Liske and Myers, 2001).

The highest diversity of fishes is found in coral reef ecosystems and it has been reported that 25% of marine fish species (about 6000 to 8000) inhabit in coral reefs (Feary et al., 2009). Destruction of coral reefs can lead to decrease of coral-dependent fishes due to direct effects of habitat loss on feeding, recruitment, or mortality (Feary et al., 2009).

In the Iranian waters of the Persian Gulf, the coral reefs are found around 14 islands. Coral reefs around the islands are fringing reefs and in some shallow water areas there are patch reefs (Shokri et al., 2005). Factors affecting the coral reef communities in this area include salinity, change of temperature and low tides. During the last two decades coral reef bleaching events due to high temperatures had occurred in this area as reported in other areas in all around the world, including the Persian Gulf (Valavi et al., 2009).

There are a few publications on identification of reef fish in coral regions of the Persian Gulf (Rezai and Savari, 2004) and a total of 168 species have been reported previously in this area (Asadi and Dehghani, 2003). Some Iranian islands, including Larak Island that has been incompletely studied (Hosseinzadeh and Kamali, 2003). Therefore, the main objective of this research was to make species identification and diversity determination of coral reef fishes around Larak Island and to assess anthropogenic impacts on species richness.

1 Materials and Methods

In this study, six stations around Larak Island were selected by Manta Tow method (Valavi et al., 2009) from July to December 2010. The coral reef regions have been identified previously in Larak Island (Rezai et al., 2010). The visual census technique was used for reef fish identification (Randall, 1963).

Stations	Latitude (N)	Longitude (E)
A	26° 53’ 13.1”	56° 24’ 12”
B	26° 53’ 19.6”	56° 23’ 20.2”
C	26° 52’ 46.1”	56° 20’ 19.1”
D	26° 51’ 54.8”	56° 19’ 13.6”
E	26° 49’ 27.2”	56° 19’ 22.6”
F	26° 49’ 16.7”	56° 19’ 30”

Stations were selected to provide a contrast in the degree of anthropogenic impact expected (Figure 1). Stations A and B were selected in urban areas (near a break-water) which were likely to be affected by human activities, including a desalination plant and transportation. Stations C and D were selected at an intermediate distance from urban regions in areas with mostly patch reef corals (distance from urban areas 5 and 8 km, respectively). Stations E and F were selected in areas remote from human activity and likely to have experienced limited anthropogenic stress (distance from urban areas 11 km). In these areas the coral reefs were both fringing and patch reefs. The Margaloff test was applied for comparing species richness of six stations.

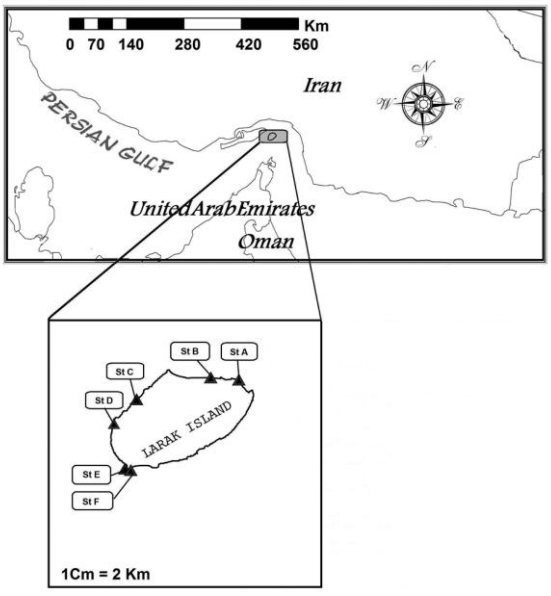

Figure 1 Sampling sites in the Larak Island in Persian Gulf (St = Stations)

2 Results

A total of 54 species belong to 42 genera and 23 families were identified over all sites during the sampling period. Family Pomacentridae dominated this assemblage with 11 species (Table 1, Figure 2). Twelve of the 54 identified species were observed in all six stations, belonging to the families Pomacentridae, Pomacanthidae, Carangidae, Labridae, Mullidae, Chaetodontidae, Nemipteridae and Lutjanidae.

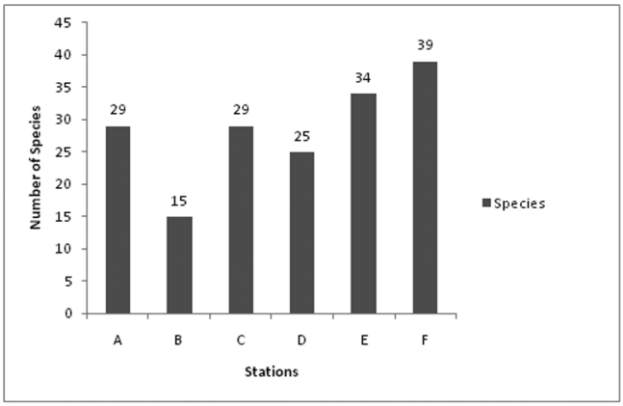

Figure 2 Species richness of reef fish around the Larak Island, Persian Gulf

According to the results of the present study, species richness from the sampling sites in Larak Island were differed. The results indicated that however the stations were far from urban area; the species richness has been higher (Table 2). The lowest species richness have been reported from B station near urban areas.

3 Discussion

The few previous studies on identification of coral reef fish in Persian Gulf reported lower species counts from this area. Hosseinzadeh and Kamali (2003) and Asadi and Dehghani (2003) respectively reported only 24 and 43 species around Larak Island, while this study identifies 54 fish species.

Changes in species composition and condition of coral habitats have significant effects on diversity and abundance of associated species (Pratchett et al., 2004; Munday, 2004; Wilson et al., 2006; Coker et al., 2009). In addition to anthropogenic impacts, the coral reefs of the Persian Gulf experienced bleaching events due to El Niño phenomenon in 1997-98 and the live coral coverage decreased from 90% to 22-26% (Pratchett et al., 2011). Such events have had impacts on fish diversity as well as affecting the survival of fishes such as coral-feeding butterflyfishes, (Chaetodontidae) (Pratchett et al., 2011). Five species of Chaetodontidae (of 116 species worldwide) have been reported from the Persian Gulf, four species of *Chaetodon* and one species of *Heniochus* (Shokri et al., 2005). Three

Table 1 Checklist of coral reef fish species from 6 sampling sites around Larak Island,Persian Gulf

No	Family	Species	Sites					
			A	B	C	D	E	F
1	Torpedinidae	*Torpedo panthera*						×
2	Scorpaenidae	*Scorpaenopsis* sp.		×				
3	Serranidae	*Cephalopholis hemistiktos*	×		×		×	×
4	"	*Epinephelus coioides*	×			×	×	×
5	Pseudochromidae	*Pseudochromis aldabraensis*						×
6	Apogonidae	*Apogon fleurieu*					×	×
7	"	*Cheilodipterus novemstriatus*	×		×	×	×	×
8	Carangidae	*Aleps jedaba*			×			
9	"	*Carangoides bajad*	×	×	×	×	×	×
10	"	*Gnathanodon speciosus*					×	
11	Lutjanidae	*Lutjanus ehrenbergii*	×	×	×	×	×	×
12	"	*Lutjanus argentimaculatus*						×
13	"	*Lutjanus johni*					×	
14	Caesionidae	*Caesio varilineata*	×				×	×
15	Nemiptridae	*Scolopsis ghanam*	×	×	×	×	×	×
16	Mullidae	*Parupeneus margaritatus*	×	×	×	×	×	×
17	Pempheridae	*Pempheris vanicolensis*			×			×
18	Chaetodontidae	*Chaetodon nigropunctatus*	×	×	×	×	×	×
19	"	*Chaetodon melapterus*						×
20	"	*Heniochus acuminatus*			×			×
21	Pomacanthidae	*Pomacanthus maculosus*	×	×	×	×	×	×
22	Pomacentridae	*Abudefduf vaigiensis*	×	×	×	×	×	×
23	"	*Abudefduf* sp.			×			
24	"	*Pomacentrus leptus*	×	×	×	×	×	×
25	"	*Pomacentrus trilineatus*						×
26	"	*Pomacentrus aquilus*			×			
27	"	*Chromis fluvaxilla*	×			×		
28	"	*Chromis xanthopterygia*	×	×	×		×	×
29	"	*Neopomacentrus cyanomos*	×		×	×	×	×
30	"	*Neopomacentrus sindensis*				×		
31	"	*Dascyllus trimaculatus*	×	×	×	×	×	×
32	"	*Dascyllus* sp.	×	×	×	×	×	×
33	Labridae	*Thalasso malunare*	×	×	×	×	×	×
34	"	*Labroides dimidiatus*	×	×	×	×	×	×
35	"	*Cheilinus lunulatus*	×				×	×
36	"	*Halichoeres marginatus*			×		×	×
37	Scaridae	*Chlorurus sordidus*	×			×		
38	"	*Scarus persicus*	×		×		×	×
39	"	*Scarus ferrugineus*			×			
40	Blenniidae	*Ecseniuspulcher*				×		
41	Gobiidae	*Amblygobius albimaculatus*		×				
42	"	*Cryptocentrus lutheri*	×			×	×	×
43	"	*Gnatholepis enjerensis*	×		×	×	×	×
44	"	*Istigbius decoratus*				×		
45	"	*Valenciennea sexguttata*	×		×	×	×	×
46	"	*Gobiodon citrinus*	×					
47	Siganidae	*Siganus javus*					×	×
48	"	*Siganus canaliculatus*					×	×
49	Acanthuridae	*Acanthurus sohal*	×		×		×	×
50	"	*Zebrasoma xanthurum*	×		×		×	×
51	Balistidae	*Rhinecanthus assasi*				×		
52	Ostraciidae	*Ostracion cubicus*			×			
53	"	*Ostracion cyanurus*				×	×	×
54	Tetraodontidae	*Arothorn stellatus*					×	×
Number of species			29	15	29	25	34	39

Table 2 Species counts by study sites and expected degree of anthropogenic impacts

Anthropogenic Impact	Sampling sites	Observed species counts	Mean	SD
Impacted	A	29	22	9.899
	B	15		
Intermediate	C	29	27.0	2.828
	D	25		
Remote from impact	E	34	36.5	3.535
	F	39		

species (*Chaetodon melapterus*, *C. nigropunctatus* and *Heniochus acuminatus*) were observed at Larak Island, but only *C. nigropunctatus* was found in all stations.

The Chaetodontidae have been considered as a useful fishing mortality index (English et al., 1997). *Chaetodon melapterus* is a rare and obligate corallivore ornamental fish (Cole et al., 2008) which was observed only in station F although this species was previously reported from other islands of Kish, Bu-Musa and Farour in the Persian Gulf (Hosseinzadeh and Kamali, 2003). The limited distribution and low abundance of this precious species may be an indicator of illegal overfishing of ornamental fishes in the study area.

Red tides are another factor causing damage to coral reefs and fishing mortality. A major red tide event occurred in the Persian Gulf in 2008 and 2009 (Richlen et al., 2010) and caused considerable damage to the coral reefs including at Larak Island (Rezai Marnani et al., 2010). Coral loss due to the red tide phenomenon led to decreased fish species diversity based on obtained results of this study. According to the field observation in year 2007 (unpublished data), there was a high frequency of *Rhinecanthus assasi* (Balistidae) in stations C and D meanwhile during this survey only one times was observed in station D in which can be effect of overfishing and red tide.

Amongst of coral reef fish in Persian Gulf the Pomacentridae is the most diverse family with 20 species reported by Hosseinzadeh and Kamali (2003). This is also true in this study with 11 species belonging to this family identified at Larak Island. Amongst them, three species (*Abudefduf vaigiensis*, *Pomacentrus leptus* and *Dascyllus trimaculatus*) were found in all stations. While the occurrence of Pomacentrids on live and un-damaged corals was high, these species are omnivorous or herbivorous and do not feed on corals. Symbiotic effects of some species with corals may even lead to increased growth of corals (Cole and Pratchett, 2011).

The highest abundance of fishes have been reported from the family Lutjanidae in coral regions in the Persian Gulf (Rezai and Savari, 2004); and the same results were obtained in this study. Amongst reef fish the species *Pomacanthus maculosus* (Pomacanthidae) and *Acanthurus sohal* (Acanthuridae) have the greatest reported distribution in the Persian Gulf (Rezai and Savari, 2004) and at Larak Island *P. maculosus* was observed in all stations and *A. sohal* was observed in four of the six stations.

The pattern of results is consistent with anthropogenic impacts reducing species richness (Table 2). However, there was no significant differences between species richness per site ($p>0.05$). The species richness were highest at the stations that are far from urban areas and the lowest count (Station B, 15 species) was from a site adjacent to urban area and desalination plant. Waste water from the desalination plant near Station B (elevated temperature and salinity water) may cause damage to the coral reefs (Hawkins and Roberts, 1994) with consequent decrease in frequency and diversity of reef-dependent species (Coles and McCain, 1990). Ten identified species were found only in stations E and F (i.e. areas remote from impacts) suggesting some or all of these may be useful indicators of relatively pristine conditions. By comparison, the site of near urban area had 5.69 ±0.54% coral cover, wheras the station E and F had 21.74 ±1.92% (Mohammadizadeh et al., 2013; Kavousi et al., 2014).

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