A review of mangrove value and conservation strategy by local communities in Hormozgan province, Iran

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Abstract: Mangroves are forest community within the intertidal region of tropical and subtropical areas. This study provides the values, functions and attributes of mangrove ecosystem and the importance of the local people in biodiversity conservation in the mangrove of Gas and Hara Rivers Delta (GHRD) in the Iranian coastline of Oman Sea. This study indicated that mangroves of GHRD are greatly influenced by the coastal environment and fulfil important socio-economic and environmental functions, therefore, it is considered that the protection of this site from threats must be enfaced. This study also provides the state of key guidelines for protecting biodiversity of mangroves by the local people. Over-use, lack of identity of mangrove resource and lack of tools for mangrove economic evaluation are the main destruction factors of the mangrove in this region. This study suggested that the end goal is to involve communities in direct management of resources. Furthermore, this study highlighted the role of awareness-raising in local communities in GHRD biodiversity conservation. There should be a willingness to move from old ideas on the use of this natural resource by villager and other people, which are largely dependent on this ecosystem. Awareness-raising campaigns must be developed for local communities using local languages, religious leaders and cultural events. [Journal of American Science. 2010;6(10):329-338]. (ISSN: 1545-1003).

Keywords: Mangrove, Conservation, Locale people, Gaz and Hara Rivers Delta, Iran

Introduction

The mangroves usually occur in the intertidal zone (Naidoo, 2009) within tropical and subtropical coastal rivers, estuaries and bays of the world (Zhou *et al.*, 2010) where they may receive organic materials from estuarine or oceanic ecosystems (Ellison & Farnsworth, 2000). Mangroves have been defined by Hamilton and Snedaker (1984) as salt tolerant ecosystems of the intertidal regions along coastlines. Mangroves generally grow in loose, wet soils, saltwater and are periodically submerged by tidal flows along sheltered coastal, estuarine and riverine areas in tropical and subtropical latitudes (Kasawani *et al.*, 2007).

In order to fulfil important socio-economic and environmental functions, the issues concerning mangrove forest functions and their biodiversity have become the main topics in conservation biology and biological diversity all over the world (Badola & Hussain, 2005; Clough, 1993; Hogarth, 1999; Jennerjohn & Ittekkot, 2002; Radhika, 2006; Simard *et al.*, 2006).

Mangrove forests were first recorded in the Persian Gulf and Oman Sea by Eratosthenes (194 to

276 BC), a geographer from Alexandria (Safiari, 2002). Nowadays, mangroves are found along the Iranian coasts of the Persian Gulf and Oman Sea, as well as around Manama (Bahrain), Doha (Qatar), Saudi Arabia and the United Arab Emirates (Danehkar, 1996).

Iran has the highest acreage of natural mangrove forest and its area ranks 43rd in the world and 10th in Asia (FAO, 2007). Mangrove forests on the southern coast of Iran, are given the common title "The Hara forests", and they cover several locations between the 25˚11' and 27˚52' parallels (Safiari, 2002). Mangrove growth in Iran consists of only two species of trees called 'Harra' (*Avicennia marina*) and 'Chandal' (*Rhizophora mucronata*), with *Avicennia marina* scrub being the most prolific, contributing over 90% of the Oman Sea and Persian Gulf's mangrove habitats. Chandal growth is limited and is usually only found in creeks of the Syric region (included GHRD). Other locations, however, are dominated by *Avicennia marina*, known locally as the "hara" or "harra" tree.

In Hormozgan, mangrove forests occur naturally in thirteen locations including Tiyâb, Syrik, Jâsk, Qešhm Island and Bandare Khamir. Estimates for total mangrove forest area in Hormozgan Province was about 11704.6 ha (Danehkar, 2006; Safa, 2006) . In this area mangroves are interspersed with intertidal mud and sand flats and fragmented by coastal developments (per obs.). Using 2004 satellite data, with resolution 5.8 meters, the following estimates were made of mangrove forest areas: in parts of Khamir-Qeshm including Pol vegetative areas (92 ha), Mardoo (382.2 ha), Khamir(1502.8 ha), Sayeh Khosh (121.6 ha.) and Qeshm (6484.7 ha), in part of Kolaghan-Kolahi, including Kolaghan (761.7 ha), Tiyab (616.7 ha) and Kolahi (135 ha), in part of Sirik (773 ha) and in part of Jask, Jask (59 ha), Khouryat-e-Jacek (555 ha), Sourgalm (5.2 ha) and Jagin- Gabrik (215.7 ha), which mainly, all mangrove habitats are known as Ramsar International Wetland sites and are in the list of Iranian protected areas or are given as a MAB convention list.

Mangrove forests are a unique (Wilson, 2006), and one of the most productive ecosystems of the world (Qamar, 2009). Furthermore, they provide shelter and feeding sites in coastal environments (Kon *et al.*, 2010). Mangroves are one of the most bio-diverse wetlands on earth due to their rich nutrient content (Ahmed, 2008; Jusoff, 2008). Mangroves also provide a physical habitat and nursery grounds for a wide variety of marine animals such as birds, reptiles, fish and mammals (Nagelkerken *et al.*, 2008; Wilson, 2006). In addition, the branches and leaves of mangrove plants are important forage for nourishment of domestic animals such as camel and cow in Iran. Materials such as Saponin, Flavonoid and Tannins which have remedial effects, are obtained from mangrove leaves and branches by rural people of GHRD area (Rezaii, 1993). Mangrove wood is used in construction of buildings, as firewood and in the manufacture of charcoal and applied in local wooden industries for construction (Zahed *et al.*, 2010).

There has been relatively little research on processes that occur by rural people for conservation of mangrove in the Hormozgan province, especially in the international wetland of GHRD. The present study collected local records on several uses of mangrove forests in this area. This manuscript can be used as guideline for managers and agencies who plan an effective management for sustainable development on Persian Gulf mangroves in the future.

Material and Methods

Study area

Gaz and Hara River's Delta (GHRD), with 15000 ha area, is located in the coast of Oman Sea, Hormozgan province, south of Iran, within 26˚30′–26˚50′N and 57˚00′–57˚40′E. This international wetland is a large area of intertidal mudflats and mangrove swamps at the mouths of two rivers on the eastern shore of the Straits of Hormoz, at the entrance to the Persian Gulf. The entire wetland has been designated a Ramsar site in 1975 and has been identified as an Important Bird Area by Birdlife International. The minimum, maximum and annual mean temperatures are 3.5˚C, 49.6˚C and 26.5˚C over a 30 year period (1975-2005) at the Minab meteorological station, respectively. The mean annual rainfall is about 40.6 mm that mainly occurs in the winter. The lowest mean monthly rainfall (0 mm) occurred over 6 months, between April and October. Highest monthly rainfall (19.6 mm.) occurred in January. The mean annual relative humidity is 77.9%. The patch of mangrove forest, at the mouth of the rivers, is probably the finest stand of *Rhizophora*, in terms of tree size and density. The area is remote and very sparsely populated with only a few tiny fishing villages nearby.

Methods

This study was part of the work in Hormozgan province mangrove forest for conservation of waterbirds. The totally direct observation method was carried out from 22 September 2008 to 21 September 2009, to finding mangrove values and the role of local communities in the conservation of mangrove forests. The peoples of twelve villages including Kargushki, Berizak, Posht Band, Nakhl-e Karamdad, Bazreh, Sureqi, Karatan, Gonari, Mehregi, Bazgar, Sul Jamak, and Karandahu, which are located in the border land of GHRD mangrove wetland, were studied by

interviewing the villagers randomly. The quality of goods, direct and non-direct uses of mangroves and their threats were estimated using interview and field observation.

Result and Discussion

1- Effects of GHRD mangroves in the rural communities

A wide range of services have been provided to coastal communities by mangrove ecosystems. The value of the sum of compatible uses of the above goods and services forms the '*Total Economic Value*' (TEV) of mangrove forests. Thus, the facts are that many people of villages in the GHRD area depend upon mangroves for their subsistence. However, only few people recognize the importance of mangrove and the benefits it provides in terms of products and services. On the other hands, there is no clearcut picture relating to economical valuable services of mangrove in the GHRD. Based on the different kinds of uses, TEV of GHRD mangroves can be classified into *use* and *non-use values* (UV and NUV respectively) categories. As shown in Figure 2, the UV argument, which is worth protecting regardless of its value to humans, can be subdivided into *direct* and *indirect* uses. While NUV, which reflects the value of an ecosystem to humans and irrespective of whether it is used or not, can be separated into e*xistence* and *bequest* values (EV & BV respectively).

Each of these values has associated economic benefits, yet they remain undervalued in GHRD mangrove forest. There are a lot of studies that provide the values, functions and attributes of mangrove ecosystems and significant importance in the mangrove associated communities (Bann, 1997; Batagoda, 2003; Emerton, 1994; Gunawardena & Rowan, 2005; Sathirathai, l998); however environmental characteristics vary greatly from area to area and change over time. It can be given an estimate of the TEV in the GHRD, and importance of this area for people communities to change old perceptions of this natural resource and a readiness to accept the new and different requirements offered by mangrove resources.

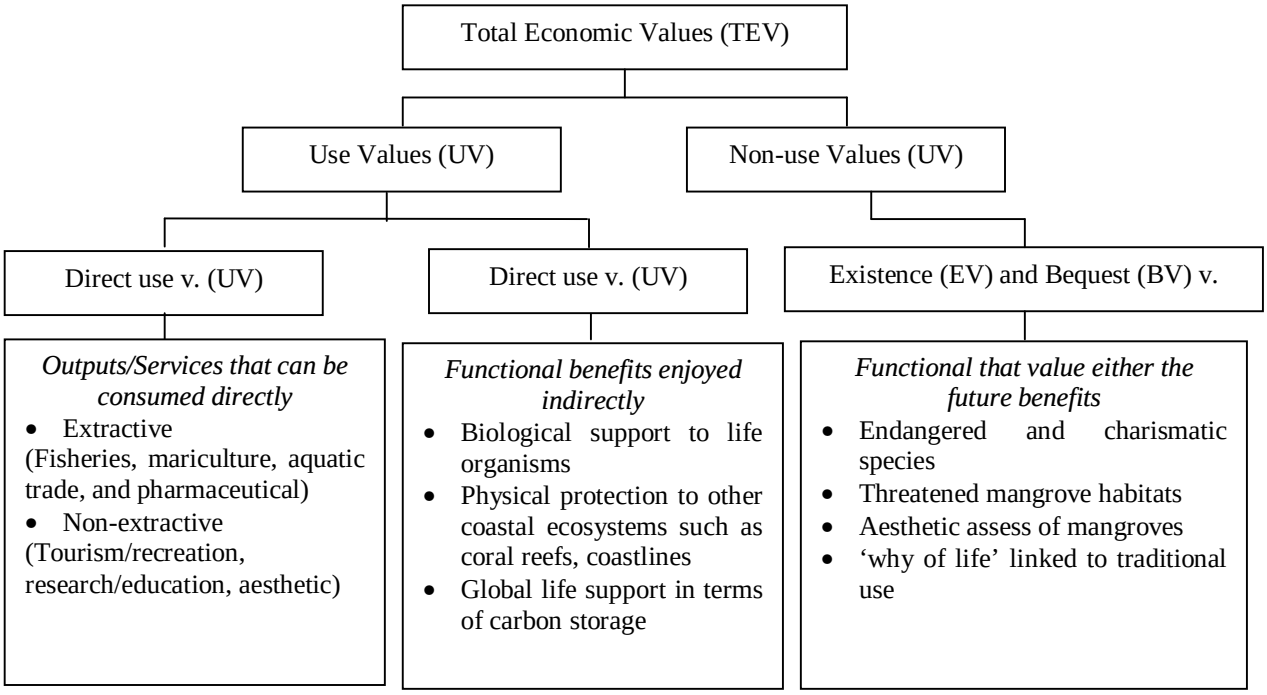

Fig. 1 Subdivision of the total economic value of mangrove forests

Table 1. Various estimates for values of mangroves

Country	Item of value	Cost (US$/ha/year)	Reference
Kenya (Arabuko Sokoke Forest)	wild meat, Fuel-wood	21183.51	(Emerton, 1994)
Cambodia (Koh Kong Province)	local level uses & indirect values	500-1600	(Bann, 1997)
Thailand	Traditional use	230-1200	(Sathirathai, l998)
	Coastline protection, Stabilization services	3000	(Sathirathai, l998)
	Carbon sequestration	100	(Sathirathai, l998)
Kenya (Arabuko Sokoke Forest)	Tourism, butterfly farming	31862.72	(Muriithi & Kenyon, 2002)
Sri Lanka	Storm protection	8000	(Batagoda, 2003)
Sri Lanka(Rekawa)	Coastal protection	1000	(Gunawardena & Rowan, 2005)

The rural communities' subsistence in GHRD depends on mangroves. The common uses of mangrove resources in this area include fuel-wood, aquatic products for food, shellfish and fish species, boat and building industry, medicinal herbs, and using mangrove leaves and branches as fodder for domestic animals.

The most important ecological usages of mangrove in the GHRD region are:

- Filtering system for run-off from the guts by root systems,
- The coastline protection from soil erosion by acting as wave breaks and mechanical structure seaward side against torrential storms,
- Control of pollution, naturally by filtering out industrial and human waste,
- Providing food, nesting and nursery areas for organisms, and
- To improves the water quality by trap debris, sediments, excess nutrients and toxicants through their natural filtering processes.

However, the function values of mangroves, generally, are directly related to the physical, chemical and biological integrity of mangrove wetland. Location is also key to these functions, as is the surrounding landscape, sub-surface geology, hydrology, and the types of living organisms present in the mangrove. Combining the various sources of data in Table 1 allows a comprehensive picture to be drawn of the total economic benefit of the mangrove forest in GHRD. However, much of the subsistence use of GHRD mangrove forest by local communities is considered illegal. Moreover, Table 2 gives total economic values of mangroves in the GHRD international wetland.

It is very difficult to estimate TEV in GHRD. Combining the sources of direct observation and secondary data in the other sites, the total economic values (TEV) which accrue to local populations might be estimated 10000- 20000 US$/ha/year. The economic valuation of natural resources presents a major challenge, for instance, currently no entry fee is charged to visitors of the forest and, however, a significant increase in income could come from making some charge.

Table 2. Total economic values (TEV) of GHRD mangrove forest

The GHRD mangrove uses	Types of economic values		
	Direct	Indirect	Non use
Components			
Forest Resources	XX		
Wildlife Resources	XXX		
Fisheries	XXX		
Forage Resources	XX		
Water Supply	X		
Functions/Services			
Groundwater discharge		XX	
Flood and flow control		XXX	
Shoreline stabilization		XX	
Sediment retention		XXX	
Nutrient retention		XX	
Water quality maintenance		XXX	
Storm protection/wave breaker		XXX	
External support		XX	
Micro-climatic stabilization		XXX	
Recreation/tourism	XXX		
Diversity/Attributes			
Biological Diversity			XXX
Uniqueness to culture/heritage			XX

x = Low; xx = Medium; xxx = High

2- Sources of threats in the GHRD mangrove forest

Mangroves are highly critical and fragile ecosystems (Maguire *et al.*, 2000). It is for this reason that mangroves should be protected and conserved (Farnsworth & Ellison, 1997). However, mangrove ecosystems across the world continue to be used extensively for variety of purposes (Walters *et al.*, 2008). Despite their importance, mangrove forests face increasing pressure and over the last century they have been cleared at an alarming rate to create space for settlements, agriculture and aquaculture. Even today they are still used for fuel and construction (Walton *et al.*, 2007). So, in the 21st century they are still one of the most threatened habitats in the world.

A number of case studies point to mangrove losses over time, but information on the status of and trends in the extent of global mangrove areas is scarce (FAO, 2007). More recently, increasing human population and the desire for rapid economic growth has led to over exploitation. More than 35% of the world's mangroves already disappeared, with estimates as high as 50% in countries such as India, the Philippines and Vietnam (FAO, 2004). The globally threats to mangrove forests and their habitats include clearing, overharvesting, river changes, overfishing, destruction of coral reefs, pollution, climate change and degradation of mangroves (Benton & Twitchett, 2003; Dahdouh-Guebas *et al.*, 2005; Manson *et al.*, 2003; Pezeshki *et al.*, 2000; Zhang *et al.*, 2007).

Broadly, the mangrove wetland industry refers to "those specialized and distinct business activities that derive quantitative and qualitative economic and social benefits and services generated from directly linked and spin-off activities stimulated by and from wetlands." Measures of the economic value of GHRD mangrove forest at the national level are few, especially in the case of Iranian mangrove wetlands. Clearly, any activities surrounding mangrove in GHRD are business with many people dependent on them for their livelihood and many species equally so for their survival. Also to be recognized are the important roles and benefits of mangrove wetlands in (a) Products and Manufacturing; (b) Supplies and Distribution; (c) Services; and (d) Knowledge. For all these reasons, there is an urgent need to develop and implement a comprehensive action plan to protect mangroves and to manage them sustainably.

Generally speaking, there is a lack of basic information about Iranian mangroves, especially in GHRD. However, during the main study, a total of 16687 waterbird individuals, belonging to 54 species and 14 families and 5 orders, were recorded at GHRD, and it shows that GHRD mangrove forest Hara protected mangrove forest area could be one of the `megadiversity' places not only in Iran but also in the Middle East. More research is needed to determine biodiversity and then to utilize the new knowledge. The challenges and key issues discussed below are those viewed as the key obstacles in achieving

sustainable management of GHRD mangroves and associated resources. The main factors which drive the key issues below are increasing human population density in the coastal zones, and strongly linked to this are poverty, rapid "development", local communities pressure and lack of good governance. There appears to be a lack of awareness of the importance of mangrove in these areas as well as a failure to see the connection between various goods and services provided and the resource itself. This situation is made worse by a lack of ecological data, and the absence of monitoring programs.

The following challenges to biodiversity conservation in the GHRD mangrove forests are:

Over-use: The main issue here relates to overuse of mangrove, mainly by local populations. It covers timber and non-timber products, fisheries and wildlife utilization. The main reasons are human population pressure and an eagerness for development. The most noticeable impact of human influence is ecosystem degradation while change to the mangrove forest environment is so profound that subsequent efforts at natural re-establishment are prevented or become very difficult and costly. Therefore, it can be seen that drainage, pollution, overharvesting with consequent habitat destruction together globally threats such as climate change and natural events such as cyclones have led to a widespread loss of GHRD mangroves and still continues. The pressure of a growing human population and habitat degradation are also contributing to a decline. Estimates suggest about 5 percent of GHRD mangroves has been lost over the last 5 years and it should be noted that an average rate of 1% mangroves lost per year (Field obs.). There is a real prospect of GHRD without mangroves.

Lack of identity of mangrove resource: There has been a slow recognition that wetlands make a significant contribution. This suggests the need for greater effort to characterize and quantify their ecology, economic impacts and social benefits. As a component of the landscape, mangroves have been difficult to differentiate from other landscape units. The scientific community has now arrived at a consensus that mangroves are distinctive and unique landscape units, which need to be managed differently from other resources.

Lack of tools for mangrove economic evaluation: There are no forest conservation program for characterizing the biodiversity of mangrove resource and do not perform it synchronous with police control and preservation from these forests in order to prevention of encroaches on and destruction of these natural sources by villager and other people. An urgent need exists, however, to develop tools which would enable an assessment of the value and economic impact of mangroves in GHRD. Available synchronous techniques with villagers must be explored and tested or modified to meet the various uses of this natural resource. New techniques may also need to be developed.

3- Guidance for the conservation of GHRD mangrove resources

The ecological carrying capacity should never be exceeded and resource sustainability should be given high priority (FAO, 1994), and the need for the conservation of biological diversity should be recognized (FAO, 2007). Thus, irrespective of economic values, the occurrence of more than 16500 waders and seabirds, including the globally threatened species such as Dalmatian Pelican, Black-tailed Godwit, and Eurasian Curlew strongly suggests the protection and conservation benefits of GHRD.

As described few rural people (and others) know the importance and benefits of mangrove wetlands in the region of GHRD. The primary goals of conservation and protection of mangrove forests are to increase public awareness. Above all an open-minded approach which accepts the new challenges and economic opportunities of mangrove wetland resources is needed. People and Mangrove ecosystems are interwoven to each other. Local communities in the GHRD have a long and well-established history in the mangrove business; however, some may see the very idea of utilizing mangroves as strange or unnecessary. There needs to be a willingness for villager and other people, where they are largely dependent on this habitat for all services, to move on from old ideas on the use of this natural resource. Thus, involvement of local communities in sustainable managing and protecting their coastal resource base is the best way to conservation and essential more than needs.

The economic, social, and environmental value of mangrove must be assess over short- to long-term scales and use these assessments for awareness rising at local communities as well as. All of them must remember impact and key guidelines for protecting mangroves, such as: Reclamation and dredging, Waterfront development, Flood mitigation and Mangrove restoration.

Awareness-raising campaigns must be developed for user communities using local languages, religious leaders and cultural events. Based on our field observation, there is an obvious correlation between the effectiveness of management and the level of education among local communities. In general there must be a readiness to accept the range of new and different requirements so that full advantage can be taken of the opportunities now offered by mangrove resources.

Overall guidance for the conservation and sustainable use of mangrove resources, and mechanisms to ensure protection for mangrove associated biodiversity can only be assured with the provision of new local, national and international legal frameworks. The communities around GHRD may also work jointly with government and NGOs. Environmental NGOs have long recognized that the public can be a powerful ally, and a formidable foe (Dahdouh Guebas, 2004), for governments and politicians. Twelve active NGOs were recognized in Hormozgan province, that they have to show the environmental friendly usage of mangroves to rural communities. The end goal is to involve communities in direct management of biodiversity in mangrove resources.

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Appendix: Abundance of waterbirds recorded at GHRD in four seasons, 2008-2009

Species	Scientific Name	Breeding	Wintering	Passage, Migrant, Vagrant	Global Status	Number of Observation During Seasons			
						Fall	Winter	Spring	Summer
Great Crested Grebe	*Podiceps cristatus*	R	W			0	1	0	0
Black-necked Grebe	*Podiceps nigricollis*	r	W			0	3	0	0
Dalmatian Pelican	*Pelecanus crispus*	r	W		CD,VU	351	612	61	0
White pelican	*Pelecanus onocrotalus*	S	W	P		0	3	0	0
Great Cormorant	*Phalacrocorax carbo*	r	W	P		386	771	59	93
Greater Flamingo	*Phoenicopterus(ruber) roseus*	R	W			106	170	32	14
Grey Heron	*Ardea cinerea*	r	W	P		70	121	36	26
Purple Heron	*Ardea purpurea*	S	w	P		0	0	2	0
Great White Egret	*Cosmerodius albus*	R	W	P		9	135	44	25
Western Reef Heron	*Egretta gularis*	R				49	86	183	98
Little Egret	*Egretta garzetta*	S	w	P		0	3	0	0
Indian Pond Heron	*Ardeola grayii*	R				7	12	8	0
Spoonbill	*Platalea leucorodia*	S	W	P		18	30	18	0
Shelduck	*Tadorna tadorna*	R	W			0	8	0	0
Crab Plover	*Dromas ardeola*	RS				0	0	6	0
Eurasian Oystercatcher	*Haematopus ostralegus*	s	W	P		63	137	29	4
Black-winged Stilt	*Himantopus himantopus*	RS	W	P		0	0	2	0
Great Stone Plover	*Burhinus recurvirostris*	r				24	57	0	0
Red-wattled Plover	*Vanellus indicus*	R				0	0	2	0
Grey Plover	*Pluvialis squatarola*		W	P		123	211	17	0
Ringed Plover	*Charadrius hiaticula*		W	P		0	1	0	0
Kentish Plover	*Charadrius alexandrinus*	RS	W	P		99	202	0	0
Mongolian Plover	*Charadrius*		W	P		50	594	150	31

	mongolus								
Greater Sand Plover	*Charadrius leschenaultii*	s	W	P		72	250	27	2
Black-tailed Godwit	*Limosa limosa*		W	P	NT	1	3	0	0
Bar-tailed Godwit	*Limosa lapponica*		W	P		1	81	0	0
Whimbrel	*Numenius phaeopus*		w	P		149	249	0	0
Eurasian Curlew	*Numenius arquata*		W	P	NT	1263	2284	98	44
Redshank	*Tringa totanus*	RS	W	P		306	582	35	39
Marsh Sandpiper	*Tringa stagnatilis*		w	P		0	1	0	0
Greenshank	*Tringa nebularia*		W	P		90	113	0	0
Terek Sandpiper	*Tringa cinerea*		W	P		348	717	0	0
Common Sandpiper	*Actitis hypoleucos*	s	w	P		59	51	0	0
Ruddy Turnstone	*Arenaria interpres*		W	P		15	24	0	0
Sanderling	*Calidris alba*		W	P		21	159	0	0
Little Stint	*Calidris minuta*		W	P		26	39	8	0
Dunlin	*Calidris alpina*		W	P		102	440	16	0
Curlew Sandpiper	*Calidris ferruginea*		W	P		0	3	0	0
Broad-billed Sandpiper	*Limicola falcinellus*		W	P		1	17	0	0
Sandpiper spp.	-					43	68	4	0
Common Gull	*Larus canus*		W			0	3	0	0
Caspian Gull	*Larus cachinnans*		W	P		409	390	18	0
Heuglini Gull	*Larus heuglini*		W	P		73	132	26	0
Great Black-headed Gull	*Larus ichthyaetus*		W	P		191	332	166	66
Black-headed Gull	*Larus ridibundus*	s	W	P		21	33	79	0
Slender-billed Gull	*Larus genei*	RS	W	P		51	98	341	81
Gulls spp.	-					0	55	66	0
Gull-billed Tern	*Gelochelidon nilotica*	RS	W	P		30	70	0	0
Caspian Tern	*Sterna caspia*	rs	w	P		12	14	0	0
Saunders' Little Tern	*Sterna saundersi*	S	w			30	49	0	0
Great Crested Tern	*Sterna bergii*	RS				0	2	0	0
Common Tern	*Sterna hirundo*	S		P		56	0	95	0
Lesser Crested Tern	*Sterna bengalensis*	RS				0	7	26	5
Sandwich Tern	*Sterna sandvicensis*		W	P		0	4	6	0
Bridled Tern	*Sterna anaethetus*	S				88	12	79	137
White-cheeked Tern	*Sterna repressa*	S				0	0	14	5
Terns spp.	-					0	6	6	0
Total of individuals						4813	9445	1759	670

R - common resident (breeding; present year round), r - scarce resident, S - common summer visitor (breeding), s - scarce summer visitor, W - common winter visitor, w - scarce winter visitor, P - common passage migrant (in spring and/or autumn), p - scarce passage migrant, O - common non-breeding visitor to the Persian Gulf and/or Gulf of Oman, V - vagrant (fewer than five records)

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