


Soil Texture of Nesting Sites and Breeding Population of Four Tern Species, Western Reef Heron, and Crab Plover in Mond Marine National Park in Persian Gulf

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Abstract

Investigating the breeding population and soil texture of breeding sites of four Terns, Crab Plover, and Western Reef Heron on the islands of Khan, Nakhilou, Om-al-Gorm, and Tahmadon in Mond Marine National Park in Persian Gulf carried out in the spring and summer in 2015. Twenty-two species of water birds identified on the islands. Eight species of them were breeder and reminder (14 species) was passage. The dominant species was Bridled Tern *Sterna Anaethetus* with 170427 breeder pairs that had bred on sandy ground under the Atriplex bushes. The populations of Lesser Crested Tern *Sterna bengalensis* and Greater Crested Tern *Sterna bergii* were 19933 pairs in Nakhilou and Om-al-Gorm Islands that had bred also on the Sandy ground. The breeder population of Western Reef Heron *Egretta gularis* was 12, 72, and 45 pairs in Om-al-Gorm, Nakhilou, and Khan Islands respectively. The nests have been built on the short bushes. The breeder population of Crab Plover *Dromas ardeola* was 2266 on Nakhilou and 481 on Om-al-Gorm. The nests of this species have been built under ground in tunnels. Soil texture of tern's nests sites in Nakhilou, Island consisted of 94.6% sand, 1.3% silt and 4.1% Clay, and under Atriplex bushes was 95.4% sand, 1.7% silt and 3.9% Clay. Soil texture of terns nesting sites in Om-al-Gorm, Khan, and Tahmadon consisted of 93.4% sand, 1.7% silt, and 4.9% clay; 92.8% sand, 2.7% silt and 4.7% clay, 89.4% sand, 3% silt and 7.6% clay respectively. The soil texture of the nesting sites on four islands did not differ significantly ($p=0.05$).

Keywords: Breeding population; soil texture; Islands; Persian Gulf; Iran

Introduction

Tern's species make nests on the ground [1-3] so soil texture is essential for nesting and protecting chicks. Iran, with its 105 important bird area (IBA) for native and wintering and breeding birds ranked first in the Middle East [4]. Accordingly, it is important to study the habitats of breeding species. Soil structure and vegetation studies of breeding habitats are important for long term identification of factors affecting reproductive successes, demographic trends, conservation and management plans for breeding species and sites [5-8] Many of the Persian Gulf islands are sensitive habitat for breeding seabirds and have been continuously changing since decades ago as the most important habitat for the reproduction of terns species, Crab Plover and Western Reef Heron [9,10]. These changes have increased in recent years due to developing in the islands. The islands of Khark, Kish, Lavan, Siri, and

Qeshm are among the islands that are no longer suitable habitat for reproduction for seabirds. Sea birds had bred on these islands in 1970s [11,12]. Perhaps we will see similar events in the islands of the MMNPI in the near future. The four-small sandy, inshore islands with extensive intertidal mudflats in the northern Persian Gulf, extremely important for breeding and wintering habitat seabirds, these islands located in (MMNPI) in the Bushehr province, which annually produce tens of thousands of terns of different species. Despite the great value and importance of the islands in preserving the generation of tern, shore birds, and sea turtles, unfortunately, little research has been carried out on this issue. The lack of awareness and understanding of environmental managers of the importance of the natural environment of the islands has limited their conservation process. So far, there has been no investigation

into the identification of habitat selection by breeding Terns species and soil structure in the breeding habitats in the four islands of the (MMNPI) in Bushehr province. Few studies have included counting and identifying breeding seabirds, and sea turtles. The islands of Om-al-Gorm, Khan, Tahmadoun, and Nahilou were declared as an important breeding habitat in 1994. Tuck performed studies on Persian Gulf birds in 1974 [13]. In 1985, the habitat conditions for the reproduction of tern's species on the islands are said to be sandy-clay soils [14]. In 1998, Snow and colleagues carried out research on tern's species, and they reported that terns are reproducing on the islands on sandy-clay soils [15]. In 2005 and in 2002, sandy habitats were also described for breeding terns [16]. Scott in 2008 lists the status of rare birds in Iran, including the breeding species on the Persian Gulf islands [17]. In 2008, studies have been carried out in relation to nest counting of four species of terns and Western Reef Heron on the 10 Island in Persian Gulf [18,19]. In 2008, Persian Gulf water birds, including the islands of Bushehr Province, have been published in the book of Dictionary of Persian Gulf Water birds [20]. In 2002, coastal bird population and breeding studied by Aspinall [21]. By reviewing the published articles, it is clear that the soil texture of tern's species reproduction sites in Persian Gulf Islands has not been studied. The purpose of this study was to determine the breeding population of four tern's species, Western Reef Heron, Crab Plover and soil texture of breeding sites of breeding species in four islands in (MMNPI).

Materials and Methods

Study Area

There are four islands called Om-al-Gorm, (55°27'E33°51'N) Khan (Um-al-Sileh) (29°27'N16°51') Nakhilou (27°49'19"N54°51'28"), and Tahmadon (Gaborin) (24°51'28"N50°27'12"E) in the (MMNP) (Figure1). Four small sandy inshore islands with extensive intertidal mudflats in the northern Persian Gulf are extremely important for breeding Crab plover, Western Reef Heron, tern's species and also important for nesting sea turtles [22]. The islands are located at a distance different from the coast and almost along each other. The climate of these islands is warm and humid. The average annual temperature is 26 °C, the average air pressure is 1008.6 H.P, the average relative humidity is 62%, and the average annual precipitation is 220 mm. The average annual rainfall is 56 days, mostly in the autumn and winter (Office of Meteorology of Bushehr Province, 2015). None of the four islands are inhabited. But fishermen stay at the nights during fishing seasons [23,24]. Due to the proper texture of the soil, massive vegetation, the richness of the surrounding waters of the food and the absence of natural predators, these islands are a safe and suitable environment for the nesting and egg laying for aquatic migratory seabirds as well as sea turtles. But terns, Crab Plover and Western Reef Heron are considered to be the most important habitat for the islands [10,12].

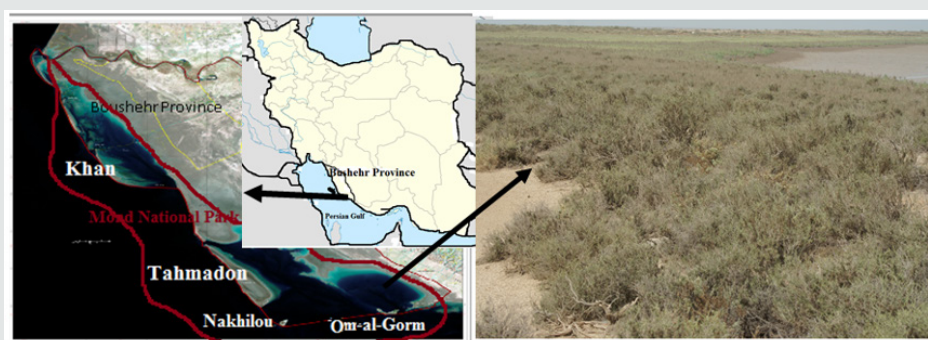


Figure 1: Location and vegetation cover of Islands in Mond Marine National Park in Persian Gulf (Google Earth, 2015).

Data Collection

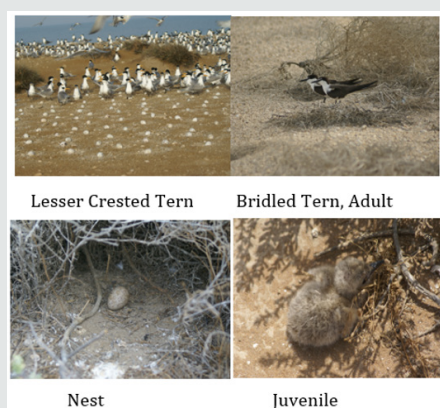


Figure 2: Nest site of Lesser Crested and Greater Crested Tern and Bridled Tern on Nakhilou Island in 2015.

The study period on (MMNPI) ran from March 2015 to September 2015, in the nesting period of six tern species, Crab Plover and Western Reef Heron. We used Binocular 10×40 Zeiss and a telescope 15×60 to identify the birds and the total count method to count the all species of breeders. Six tern's species Lesser Crested Tern, Greater Crested Tern, Caspian Tern, Little Tern, and White-cheeked Tern were nesting in open fields with sandy soils (Figure 2). The Crab Plover nest in the form of a tunnel in the sandy soils counted by total count Method also. The Bridled Tern nests were under the shade of the Atriplex bushes and nests were counted by lifting the branches of the Atriplex.

Soil Texture of Islands

Soil texture is determined by hydrometric method. In this study, 152H-62 hydrometers were used to determine soil texture. The basis of this is the measurement of the density of the suspension of soil and water, which gradually decreases due to the deposition of the material, and the hydrometer falls further in the liquid. The

numbers read on the hydrometer are proportional to the volume of fluid displaced [25].

Chemical Parameter of Water

PH, EC, TSS, TDS B.O.D., C.O.D., T.H. NO₃, PO₄, and TS have been measured in spring and summer according to Standard method 2005 [26] for the determination of chemical parameters of around water of island by certified laboratory.

Result and Discussion

The Terns, Gulls, and shore bird's species of the four islands were identified in spring and summer in 2015 (Table 1). The most species were identified on the Om-al-Gorm Island (20 species) and the least species on the Tahmadon Island (11 species). Fourteen species were identified on Nakhilou and sixteen species on Khan Island. Seven species were seen on each of the four islands, and four species only on one island (Table 1).

Table 1: Water birds recorded on 4 islands in the spring and summer in 2015.

Species	Tahmadon	Khan	Nakhilou	Om-al-Gorm	Total	%
White-cheeked Tern <i>Sterna repressa</i>	1	12	26	12	51	0.1
Geater Crested Tern <i>Thalasseus bergii</i>	0	260	246	3	509	1.03
Lesser Crested Tern <i>Sterna bengalensis</i>	15	1346	17512	14	18887	38.43
Little Tern <i>Sterna albifrons</i>	0	0	6	0	6	0.01
Bridled Tern <i>Sterna anaethetus</i>	26	300	24692	24	25042	50.97
Black-headed Gull <i>Larus ridibundus</i>	11	4	6	18	39	0.08
Caspian Tern <i>Hydroprogne caspia</i>	0	10	0	0	10	0.023
Lesser Black-backed Gull <i>Larus fuscus</i>	4	5	2	4	15	0.03
Crab Plover <i>Dromas ardeola</i>	10	20	3314	912	4256	8.66
Temminck's Stint <i>Calidris temminckii</i>	4	3	0	5	12	0.024
Turnstone <i>Arenaria interpres</i>	0	0	2	1	3	0.006
Little Ringed Plover <i>Charadrius dubius</i>	1	1	1	1	4	0.008
Terek Sandpiper <i>Xenus cinereus</i>	0	1	0	3	4	0.008
Dunlin <i>Calidris alpina</i>	0	3	1	4	8	0.016
Ringed Plover <i>Charadrius hiaticula</i>	0	0	0	1	4	0.008
Kentish Plover <i>Charadrius alexandrinus</i>	0	1	2	1	4	0.008
Oystercacher <i>Haemantopus ostralegus</i>	0	0	0	2	2	0.004
Eurasian Curlew <i>Numenius arquata</i>	1	2	0	2	5	0.01
Common Sandpiper <i>Tringa hypoleucus</i>	0	0	0	3	3	0.006
Marsh Sandpiper <i>Tringa stagnatilis</i>	1	2	1	2	6	0.01
Western Reef Heron <i>Egretta gularis</i>	5	90	144	24	263	0.53
Gray Heron <i>Ardea cinerea</i>	0	0	0	1	1	0.002
22 species	79 (11)	2061(16)	45956(14)	1039(20)	49134(22)	100

Breeding Species

Seven species of birds had bred on 4 islands (Table 2). Breeding species migrate to the islands and breed which have enough security and other environmental factors. After breeding they leave islands

end of summer. 94% of birds had bred on the island of Nakhilou and 6% on the other three islands (Figure 3). The Bridled Tern has a large population and has bred on Nakhilou Island (12521 pairs). Only three pairs of Little Tern have bred on Nakhilou. Lesser Crested Tern was the second with 123 breeder pairs (Figure 4).

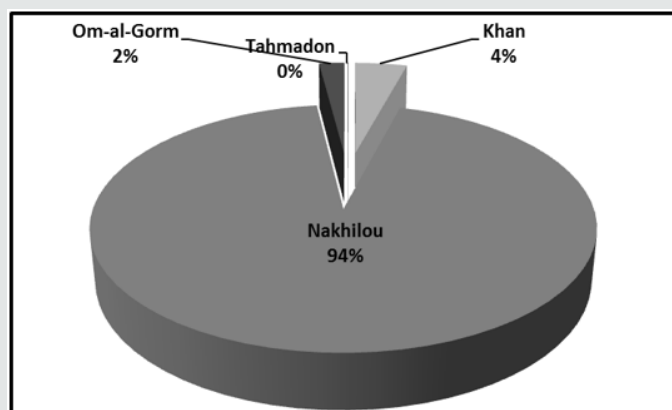


Figure 3: Breeding population percent on four Islands in 2015.

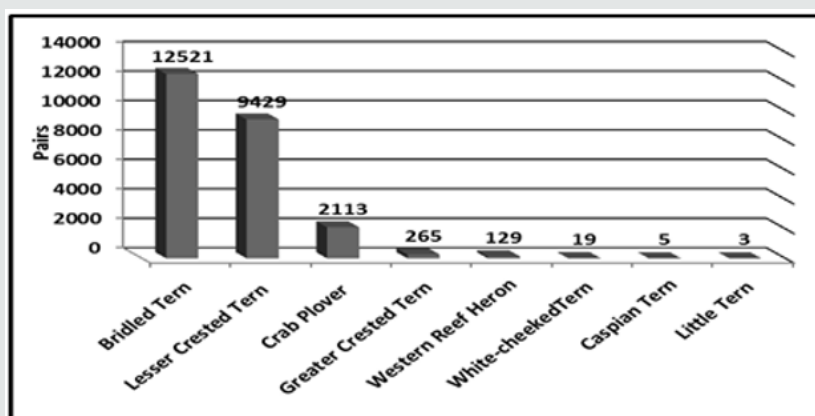


Figure 4: Number of breeding species reported on four islands in 2015.

Table 2: Breeding species counted on the four islands in 2015.

Species	Tahmadon Pairs	Khan Pairs	Nakhilou pairs	Om-al-Gorm pairs	Total Pairs
White-cheeked Tern <i>Sterna repressa</i>	0	6	13	0	19
Greater Crested Tern <i>Thalasseus bergii</i>	0	130	123	0	265
Lesser Crested Tern <i>Thalasseus bengalensis</i>	0	673	8756	12	9429
Bridled Tern <i>Sterna anaethetus</i>	13	150	12346	12	12521
Caspian Tern <i>Hydroprogne caspia</i>	0	5	0	0	5
Little Tern <i>Sterna albifrons</i>	0	0	3	0	3
Crab Plover <i>Dromas ardeola</i>	0	0	1657	456	2113
Western Reef Heron <i>Egretta gularis</i>	0	45	72	12	129
Total	13	1009	22970	492	24472

The Habitat Conditions of the Islands

The habitat conditions of the four islands that are used by breeding terns and other species are shown in Tables 3 & 4. Table 3 show that the soil texture of the islands in the breeding sites of seabirds has a sandy structure with an average of 93% of the sand. Perhaps because of the softness of the soil, easy nesting, conditions for the survival of newborn chicks are appropriate. Most of tern's reproduction has been reported on open area among density vegetation coverings. The salinity of the surrounding water of islands near the colony of nests was 38.5 mg/l. The Atriplex

species are dominant in each of the four islands, and the *Tamarix* sp, *Chenopodium murale*, *Suaeda vermiculata*, *Ephedra foliolata*, *Cyperus conglomerates*, *Lycium edgeworthii*, *Bromus japonicas*, *Limonium iranicum*, *Cistanche tubulosa*, and *Stipa capensis* are seen on each of the four islands, but their densities are higher in Nakhilou and Om-al-Gorm than Khan and Tahmadon. The vegetation of the various parts of the islands varies from 30 to 90 percent (Figure 1). Table 4 shows the chemical parameters of water at around of the islands is similar to Persian Gulf waters, and also there was no significant difference ($P=0.05$) between the chemical parameters of four islands.

Table 3: Soil texture of nesting sites on four Islands in 2015.

Islands/Factors	Depth Cm	S.P %	EC*103	PH	% T.N.V.	% O.C.	% Sand	% Silt	% Clay
Om-al-Gorm									
Non-nesting site	0-30	35.5	1.5	7.2	95	0.19	93.4	1.7	4.9
Nesting site	0-40	28.3	1.3	7.3	90	0	93.4	1.7	4.9
Nakhilou									
Margin of island	0-30	27.1	2.7	7.6	86	0.19	94.6	1.3	4.1
Colony site									
Margin of Island	0-30	39.3	0.91	7.6	99	0.05	93.7	1.4	4.9
Colony site									
Under Atriplex	0-20	26.5	5.2	7.6	94	0.12	95.4	1.7	3.9
Under Atriplex	0-30	38.1	6.1	7.2	89.5	0.15	95.4	4.7	4.9
Khan									
Colony site	0-30	29.2	4.7	8.02	0	0.59	92.8	2.7	4.7
Tahmadon									
Colony site	0-30	33.5	1.61	7.4	76	0.43	89.4	3	7.6
Under bushes	0-20	29.5	1.65	7.8	81	0.69	94.2	0	5.6

Table 4: Water parameters of islands in spring and summer in 2015.

Figures factors	Khan Spring	Khan Summer	Tahmadon	Tahmadon Summer	Nakhilou	Nakhilou Summer	Om-al-Gorm	Om-al-Gorm	unit
PH	7.8	8	8.48	7.6	8.4	8.02	8.2	8.15	-
D.O	6	6.5	6	5.3	6.5	6.5	7.8	5.5	mg/l
B.O. D	10	10	10	10	15	15	12	12.15	mg/l
COD	2000	6000	900	800	1296	6564	1900	1600	mg/l
Salinity	38.5	38.6	38.5	38.9	39	39	38.9	39.3	mg/l
T.H	12000	16000	10500	20000	13250	19500	1100	20000	mg/l
H. Ca	2000	3000	2250	8500	3250	10000	275	10000	mg/l
H. Mg	10000	13000	8250	11500	10000	9500	825	10000	mg/l
ALK	180	150	125	150	100	150	125	125	mg/l
T.D. S	48750	47875	46545	46756	47465	46765	48250	48595	mg/l
T.S. S	44500	43220	41675	40100	41625	40100	42854	42430	mg/l
T. S	4250	4655	4975	6665	584	6665	5405	1165	mg/l
E.C.	54950	56800	59400	54700	58400	54700	59400	55600	μs/cm
NO ₃	2.2	2.26	2.79	2.7	4.4	3.52	2.76	2.5	mg/l
PO ₄	0.56	0.07	0.04	0.012	0.12	0.14	0.066	0.066	μg/l

Soil Texture of Islands

Soil Texture of Om-al-Gorm

The shape of the island is arched and in the form of a half circle with its convex side facing south. The origin and structure of the island is the result of the collision of the sea floor irregularities with the sedimentation of the water entering the Mond River in the northeast of the island to the sea. In terms of its topography, there are no significant natural complications. Only in the middle part of the south and southwest of the island there are low-lying sand dunes (up to 2 meters). Soil texture of island is fine sand gravel, particularly in the west and southwest with shellfish, resulting in a kind of coarse-grained and distinct texture. Two soil samples were taken from the soil to compare the differences in the texture

structure nesting sites (Table 3). Tern's species nesting sites were with sandy soil structure with more than 93 percent sands (diameter 0.02-2 mm) and no specific building. These parts are lacking vegetation. Soil lime (Ca, MgCO₃) was about 93.4%, which causes the soil texture to be slightly tight. Electrical Conductivity of Saturation percent is about 1.3 Ds/m, PH was 7.3, the amount of organic matter in this part of the soil was zero, and the moisture was 35.5%. Soil drainage is very good, and its permeability is high. These types of soils are suitable for the nesting of Crab Plover. Soil margin structure of the island contains a lot of shellfish. There is moisture in this area, and drought-tolerant plants have an annual growth. The soil texture is sandy (93.4%), with a saturation of 28.3%, an electrical conductivity of 1.5 DS/m and a saturated acidity of 7.2. The equivalent amount of lime in this part is 95% and

organic matter content is about 0.2%, which is due to plant remains (Table 3).

Soil Texture of Nakhilou

The island of Nakhliou, in terms of its origin and structure, has the same conditions as the island of Om-al-Gorm. Nakhilou, the westernmost of the islands and the furthest offshore, is a small, almost circular island of about 35 ha, comprised mainly of sand with some rocky shore in the south and west. Soil texture of island is fine sand gravel, particularly in the central parts with shellfish (Figure 5). There are two small brackish pools near the south end and Shiekh Karameh grave near the west coasts. The island is fringed with low sand dunes which encircle a central basin almost completely covered in dense, low scrub. The island is

without inhabited. The soil structure of the island is twofold due to the presence of bivalve and gastropod shellfish, depth of soil and low elevations and soil color. The central part of the island, with its shellfish's, is a sandy soil structure, and the margins of the island, where the amount of shellfish is much more, and the color of the soil is white. In the central part of the island, the plant has become densely populated with *Atriplex* species and some other species. Soil characteristics of the breeding sites are sandy. The large amount of feces of breeding birds accumulated in this area and caused a slight soil hardening. Overall, the thickness of the (A) layer is about 2 cm. Its electrical conductivity is 5.2, sand 92.6% and organic matter is 0.12%, while the amount of sand under the *Atriplex* is 88.4%, there are some plant leaves, organic matter is 0.15%, and electrical conductivity is 9.1 Ds/m (Table 3).

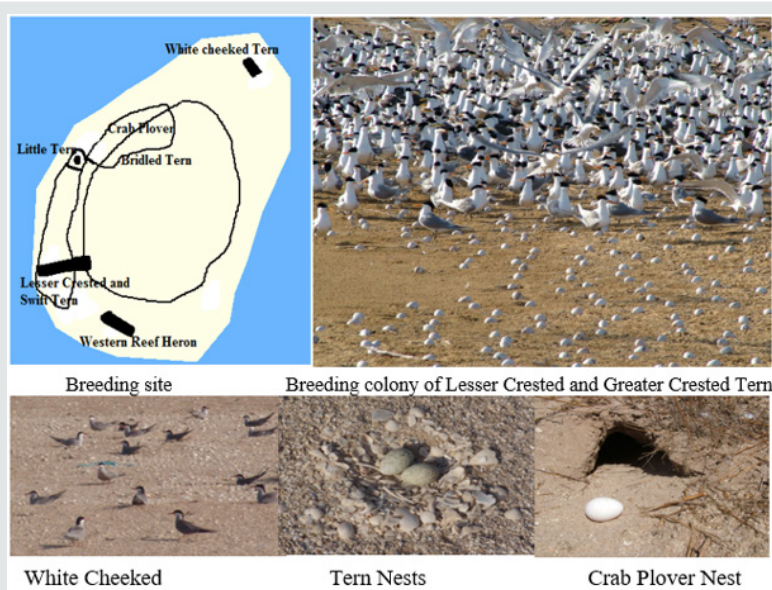


Figure 5: Nests of Lesser crested, Greater Crested, White cheeked Tern and Crab Plover on the Nakhilou Island in 2015.

Soil Texture of Tahmadon (Geberin)

The area of Tahmandon Island is between 700 and 1000 hectares. Its shape is triangular and its distance from the coast is about 300 meters. More than four-fifth, of the island, goes under water when it is high tide. The conditions for the formation of the island are similar to the other three islands. The central parts of the island are submerged by two canals in the tide and soil texture of this part is salty. Characteristics of both soils are shown in Table 3. Due to under watering a large part of the island, the birds do not breed in it. Because most of the time, surface is often muddy and wet.

Soil Texture of Khan (Um-al-Sileh)

Khan Island is a long narrow island consisting of a broad expanse of bare mudflats with a chain of low vegetated sand dunes along its southwestern (seaward) margin and round the southern end. The dunes are separated by narrow tidal channels which open into a chain of shallow lagoons on the mudflats on the landward side of the dunes. The area of the island varies and reaches 1000

hectares. At the time of the low tide, the island is connected to the land. Its geographic location is 29° 27'N 51° 22'E (Figure 1). It is surrounded by mudflats and the surrounding waters are very shallow. The island has very little vegetation, but the trunks and shrubs of many trees have been brought to the island by the Mond River. The soil texture is sandy, and its sand is 92.8 percent (Table 3). Island soil is classified in the group of saline soils. Due to the drowning of the island during the time of the high tide, the nests of Terns are destroyed, or their eggs breaks down, which makes the birds less nest on the island.

Chemical Parameters of Water

Chemical parameters of water around of 4 islands have been showed in Table 4.

Breeding Sites of Birds on Islands.

Nesting Site of Lesser Crested and Greater Crested Tern

The Greater Crested (Swift Tern) and Lesser Crested Tern breed in mix colony with together and breeds on many islands in

the Persian Gulf including Shidvar, Khabre Nakhoda, Boneh, Dara, Banifaror and (MMNPI) [18,19]. The nest is a shallow scrape in the sand on open, flat, or occasionally sloping ground. It is often unlined, but sometimes includes stones or shellfish. The breeding places of these species have a sandy soil (Figure 5). As shown in Table 3 soil texture of the nesting site of these species in 4 islands of (MMNPI) are sandy and the soil texture has more than 90% sand. Because these species do not use materials in building nest, they put eggs on the soft ground with sandy soils. Figures 2 & 5 shows

nest of Lesser Crested and Greater Crested Tern on the Nakhilou Island. Bridled Tern occupied the central part of the island and other species bred on margin of island. Western Reef Heron on Short bushes and the Lesser Crested and Greater Crested Tern on sandy soil and Crab Plover in tunnel (Figure 6). Breeder species on Om-al Gorm were Bridled Tern, lesser Crested Tern, Western Reef Heron (each of them 12 pairs) and Crab plover (456 pairs, 2%) in 2015. Crab Plover had bred on three colonies (Figure 6) and (Table 2).



Figure 6: Nest sites of Crab Plover, Bridled Tern, Lesser Crested Tern, and Western Reef Heron on Om-al Gorm in 2015.

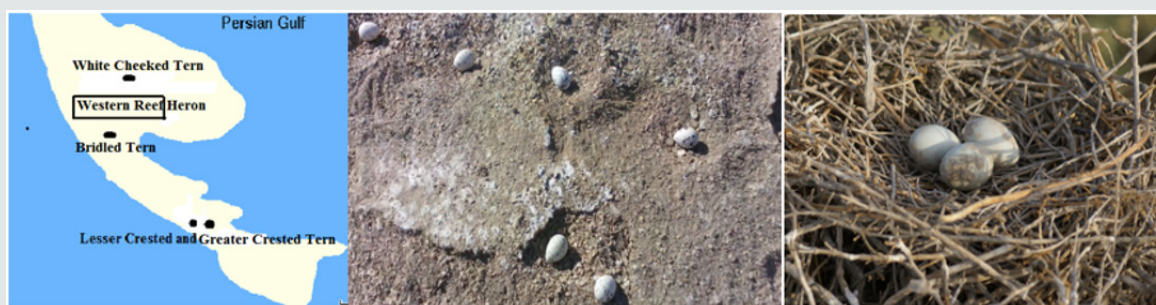


Figure 7: Breeding sites of Lesser Crested and Greater Crested Terns, Western Reef Heron and Bridled Tern on Khan Island in 2015.

Conclusion

The nest of Lesser Crested and Greater Crested Terns were a shallow scrape in the sand on open, flat on the four islands. It is often unlined, but sometimes includes stones or a few shellfish [27]. The data obtained showed that the Bridled Tern breed in covered vegetation parts on the islands. This species was only species that had bred on four islands, because all islands have proper vegetation. Density of the vegetation on Khan Island is lower than the other three islands and *Atriplex* sp is not dominant. The Bridled Tern creates the nest in the shade of *Syperus* on Khan. The soil texture in this place is sandy also. The amount of sand in the soil texture is more than 90 percent and soil are very soft in all islands in nesting sites. Due to the presence of massive vegetation (*Atriplex*) in the Nakhilou Island the dominant species of breeding seabirds was Bridled Tern with a population of 12346 pairs. Small sandy dunes near the sea are nesting sites of Lesser Crested and Greater Crested Terns. Breeding population of these two species were 8872 pairs on the Nakhilou Island. On the Thamadon Island there was a small colony of Bridled Tern (13 pairs) in 2015 (Table 2). White

cheeked Tern was other breeding species on the Nakhliou Island, which nested on the beach of the Island near water with shellfish (13 pairs) (Table 2). Nests were bowl-shaped and have distinct buildings (Figure 5). The soil surface of this area of island is covered with shellfish and its texture is rough. On the island of Nakhilou and Om-al-Gorm, 2113 pairs of Crab Plover had bred (Table 2). The nest of this species is different from the other breeding species in the islands. This species dug a tunnel for nest, is about 1 to 1.5 meters long, so it needs to have a soil texture that is a bit tight and usually there is little vegetation on the surface of the soil. The roots of the vegetation help to tighten of soil structure so, the nest does not crumble during breeding period. On the other hand, the soil texture should be soft that Crab Plover can dig the tunnel. These conditions exist among the open vegetation spaces of all 4 islands. But other environmental factors needed to survival of chickens, such as security on the two islands of Tahmadoun and Khan, are not provided enough. 129 pairs of Western Reef Heron had bred on Khan, Nakhilou and Om-al-Gorm (45, 72, 12 Pairs respectively). This species was made on the two islands of Nakhilou and Um-al-Gorm on the *Atriplex* shrubs, but on the island of Khan on the

branches of the trees that brought water to the island. The structure of the nests is not directly related to the soil texture. Only 13 pairs of Bridled Tern have been bred on Tahmadon Island in 2015, on central parts of island under the small bushes. Table 3 shows soil of breeding sites of Lesser Crested and Greater Crested Tern has a sandy structure that is consistent with the findings of Flasola and Canova in 1991[28]. Terns preferred to nest in the middle third of the beach, on areas with shell cover, and on ridges and slopes. On sparsely vegetated beaches, nests were closer to vegetation than were the random points; on heavily vegetated areas, nests were further from vegetation than were the random points. In the study of the habitat selection of Terns, they have also described these two species breed on the sandy soil's islands [8]. Lesser Crested and Greater Crested and Bridled Terns breed in mixed large colonies [21,29,30]. This finding confirmed the results of studies in the four islands of the (MMNPI). Behrouzi-Rad in 2008 and Behrouzi-Rad and Tayfeh in 2008 reported that tern's species breed in large colonies on sandy islands in Persian Gulf [9,18]. Scott reported breeding population of terns on Mond National Parks sandy islands were 15000 pairs in 2007 [11, 12]. Breeding four species of terns reported by Symens and Alsuhaibany on southern sandy island of Persian Gulf in 1996 [27]. Therefore, tern's species in the Persian Gulf islands in the open areas of vegetation breed on sandy soils. In the soil analysis, the amount of sand in each of the four islands with an average of 93.4% in Om-al-Gorm, 94.7% in Nakhilou, 92.8% in Khan and 91.8% in Tadamond, was not significantly different. Analyzing the amount of silt and Clay in 4 islands showed no significant difference among them($p=0.05$) (Table 3) Therefore, terns and Crab plover prefer sandy soils for breeding, but the number of species, density, and reproductive population in the islands are related to other environmental factors such as security, vegetation percentage, etc., which need further investigation. The four islands of (MMNPI) were introduced in 1994 as important bird area (IBA) [4]. The islands became known as sensitive habitats for breeding terns, Western Reef Heron and Crab plover in 2008 [10]. Other tern species like Sooty Terns [8], Yellow-billed Tern and Large-billed Tern [31] and whiskered Tern [32] breed on bare sand or in sites with sparse, low vegetation. The study of breeding access illustrated that area has a good stability in environmental condition, availability of food, nest sites, and lack of natural predators for a variety of birds such as terns, Crab Plover and Western Reef Heron. Besides terns, some terrestrial animals also inhabit the islands. These include a considerable variety of insects and spiders, which have not been studied in any details, a couple of species of lizards, and mice. The sandy and rocky beaches of the islands support the same of type organisms of Persian Gulf. Conspicuous among beach animals are the tower-building ghost Crab *Ocypode saratan* on sand beaches, and turban snails *Turbo* species on the algae-covered rocks. Several species of intertidal animals which are either uncommon or absent on the mainland beaches are abundant on the islands. These include the Large Rock Dwelling Crabs *Eriphia sebana smitbii* and *Grapsus tenuicrustatus*, frequently seen running

about the exposed rocks at night. Another beach animal common on the islands is large terrestrial Hermit Crab *coenobita* species feeding on algae. However, their plant and animal population are rich and unique, and are exceptionally beautiful and instructive as well as being of great scientific interest. Also, they represent a valuable, fragile, and irreplaceable resource, where preservation for the benefit, enjoyment, and instruction of future generation will demand increasingly careful attention in the face of the rapid development of industry, population, and recreational activity now taking place in some islands. However, for these reasons this area is under Department of Environment, Iran, and Marine National Park List and is protected.

References

- Chernichko I (1989) Breeding population of Seabirds (Gulls and Terns) on the Northern coast of the black Sea and the Sea of Azov. Proceeding of the 2nd Mediterranean Seabird Symposium Calvia p. 21-26.
- Behrouzi-Rad B (2008a) Dictionary of water birds of Persian Gulf. Published by Department of Environment pp.156.
- Harington F (1976) Bird survey in Mond Protected Area, Department of the Environment pp.10.
- Evans MI (1994) important bird areas in the Middle East: Birdlife International, Cambridge (UK), London, 2: 410.
- Losif C (1989) Breeding population of seabirds (Gulls and terns) on the northern coast of the Black sea and The Sea of Azov proceeding of the 2nd Mediterranean seabird Symposium, Calvia, Spain pp.125-131.
- Burger J, Lesser F (2008) Selection of colony sites and nest sites by Common Terns *Sterna hirundo* in Ocean County: New Jersey. Ibis 120(4): 433-449.
- Burger J, Gochfeld M (1986) Nest site selection in sooty terns (*Sterna fuscata*) in Puerto Rico and Hawaii. Colonial Water birds 9(1): 31-45.
- Burger J, Gochfeld M (1990) Nest Site Selection in Least Terns (*Sterna antillarum*) in New Jersey and New York. Colonial Water birds 13(1): 31-40.
- Behrouzi-Rad B, Tayfeh FH (2008) Nest Counts for Western Reef Heron and Four *Sterna* Species on Nakhilou Island in the Persian Gulf from 2005-2007. Podoces 3: 1-20.
- Behrouzi-Rad B (2008b) Sensitive Habitats of water birds in Persian Gulf. Published by Department of Environment (in Persian) pp.344.
- Scott DA (1995) A Directory of Wetlands in the Middle East. Published by IUCN Switzerland pp.43-221.
- Scott DA (2007) A review of the status of the breeding water birds in Iran in the 1970s. Podoces. 2(1):1-21.
- Tuck GS (1974) Seabirds of the Persian Gulf (The Gulf) and Gulf of Oman. A Survey (1958-1973). Sea Swallow 23: 7-21.
- Cramp S, Simmons KEL (Eds) (1983) Handbook of the Birds of Europe, the Middle East, and North Africa: The Birds of the Western Palearctic. Oxford University Press Oxford, UK, 3: 913.
- Snow DW, Perrine CM, Gillmor R, Hillcoat B, Roselaar, CSD, et al. (1998) The Birds of the Western Palearctic, concise Edition. Vol. 1 Non-Passerines.
- Loftin RW (2005) Bridled Tern Species Account Florida Breeding Bird Atlas.
- Scott DA (2008) rare birds in Iran in 1960s and 1970s. Podoces 3(1/2): 1-30.
- Behrouzi-Rad B (2013) Breeding Species of water birds on 10 islands of Persian Gulf in 2009. Octa Journal of Environment al Research 1(1):

52-64.

19. Behrouzi-Rad B (2014) Breeding population of birds on Banifaror Island in the Persian Gulf. *Journal of Coastal Development* 1:1-8.
20. Behrouzi-Rad B (2007) Investigation of effective factors on the reproduction of aquatic migratory birds in the Islands of Bushehr Province for providing management solutions. Office of Applied Research, Tarbiat Modarres University, Tehran, Iran pp.187.
21. Aspinal S (2002) Costal Bird population and Breeding. Abudabi NARC, Vol 1.
22. Behrouzi-Rad b (2006) Environmental monitoring of the islands of the Mond Protected Area, according to the trend of population changes in reproductive water birds. Office of Applied Research, Tarbiat Modarres University, Tehran, Iran pp.255.
23. (2015) Office of Meteorology of Bushehr Province.
24. Department of the Geography of Islamic Republic Army (2002) Geography of Iranian Islands of Persian Gulf (Bushehr Province, Khark, Om-al-Gorm, Khan and Nakhilou) (In Persian) pp.350.
25. Ahyayie A, Behbahani M (1993) Soil chemical analysis methods. Published by Soil and Water Research Institute, Tehran, Iran pp.45-96.
26. Eaton AD, Clesceri LS, Rice EW (2005) Standard Methods for the Examination of Water and Waste water. Part 2000, Physical and Aggregate Properties American Public Health Association Washington DC, USA 2(1): 2- 92.
27. Symens P, Alsuhaybany A (1996) Status of the breeding populations of Tern (Sternidae) along the eastern of Saudi Arabic following the 1991 Gulf war, NCWCD, Riyadh and Senckenberg Research Institute, Frankfurt, Germany pp. 404-420.
28. Fasola M, Canova L (1991) Colony site selection by eight species of gulls and terns breeding in the "Valli di Comacchio" (Italy) *Italian Journal of Zoology* 58(3): 261-266.
29. Bruun B, Zim HS (1996) Birds of North America New York. Western publishing company, USA.
30. Gochfeld M, Burger J, Kirwan GM, Garcia EFJ (2018) Lesser Crested Tern (*Thalasseus bengalensis*). In: del Hoyo J, Elliott A, Sargatal J, Christie DA, de Juana E (eds.) *Handbook of the Birds of the World Alive*. Lynx Editions Barcelona.
31. Zarza R, Cintra R, Anciães M (2013) Distribution, Abundance, and Habitat Selection by Breeding Yellow-billed Terns (*Sternula supercilialis*), Large-billed Terns (*Phaetusa simplex*) and Black Skimmers (*Rynchops niger*) in the Brazilian Amazon. *Water birds* 36(4): 470-481.
32. Meininger PL, Erkerk AV (1998) whiskered Tern (*Chlidonias hybridus*) breeding in the Nile Delta, Egypt, *Sand grouse* 20(1): 15-21.



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