Breeding success of Lesser Crested Tern and Swift Tern at Shidvar island, Iran

Saber Ghasemi[1], Farhad Hosseini Tayefeh[2], Neda Mola Hoveizeh[3]

[1]Faculty of Environmental science, Islamic Azad University, Bandar abbas Branch, Iran. Tel:(+98) (761) 6672328, Mobile:(+98)935-820-1684, E_mail:saberghasemi@gmail.com

[2]Department of Environment, Bushehr Province, Iran. Tel:(+98) (917)7755886, E_mail:farhadtayefeh@gmail.com

[3]Faculty of Environmental science, Islamic Azad University, Bandar abbas Branch, Iran. Mobile :(+98) 937-355 7610, E_mail:neda7975@yahoo.com

ABSTRACT: The aim of this study was to investigate the breeding success of Lesser Crested Tern *Sterna bengalensis* and Greater Crested Tern *Sterna bergii* at Shidvar Island, in Persian Gulf, southern of Iran. Total Count Method that included tree breeding colonies was carried out. A total of 365 nests, belonging to 240 nest of Lesser Crested Tern and 125 nest of Swift Tern, were categorized under number of eggs and were counted. The mean clutch sizes of Lesser Crested Tern and Swift Tern were estimated 1.04±0.01 and 1.04±0.03 respectively. Furthermore, the average of breeding success during incubation of eggs, nestling and post-nestling were measured 67.7%, 100% and 95.24% for Lesser Crested Tern and 83.3%, 70% and 100% for Swift Tern. The total breeding success was measured 74.43% and 66.63% for them respectively. Relative abundance of birds during outward migration was measured 65.32% and 34.68% for two species, respectively. It is considered that the importance of Shidvar Island for seabirds, especially for family of Sternidae, must be recognized and the protection of this site from threats must be enforced.

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1. INTRODUCTION

The breeding areas in the islands are known as a most important biological area for Tern spp. (Burger & Lesser, 2008), and are detected as indicators for dynamic process of their population's control (Elliott *et al*., 2007). Moreover, results of tern communities study also reliable as a tool to monitoring of habitat (Arnold et al., 1998).

The species of Lesser Crested Tern *Sterna bengalensis* and Greater Crested Tern *Sterna bergii* are a very common seabird along the entire south coast from the region of Khark Island in Bushehr province to the Pakistan border in Baluchestan province (Scott, 2007). They are under the species to which the *Agreement on the Conservation of African-Eurasian Migratory Waterbirds* (AEWA) applies (Azafzaf *et al*., 2006). However, Shidvar hosts the most important colony of Lesser Crested Tern *Sterna bengalensis*, Greater Crested Tern *Sterna bergii*, Bridled Tern *Sterna anaethetus* and White Cheeked Tern *Sterna repressa* in the Persian Gulf in Iran, there has been little discussion about breeding biology and phenology of this marine birds in this area. Likewise, there have been no controlled studies which compare differences in suitability of island to breeding success of terns. Despite its special importance, regular scientific studies have not been conducted on Shidvar Island and related subjects and most of the confirmed reports are outdated. This is a cause for concern. Furthermore, research of DoE have focused on birds counting during limited time, however, there has been an increasing interest in ringing of terns in recent years. This study presents detailed overviews of the breeding success of Lesser Crested Tern and Swift Tern at the Shidvar Island, Iran

2. MATERIAL AND METHODS

2.1. Study Area

The Shidvar Island, with 98 ha area, is located at 9 km offshore in the Hormozgan province, East of

Lavan island, in the Persian Gulf, southern of Iran, within 26˚47′–26˚48′N and 53˚24′–53˚25′E. It was designated as a wildlife refuge in 1971. In addition, due to its importance as a nesting site for migratory bird species (especially *Sterna* spp.), the island was nominated in 2000 as Iran's 20th international wetland in Ramsar sites.

Only the eastern and northern beaches of the island are sandy. The eastern part of the island is smooth and flat, but the northern part is composed of both gradient and less gradient beaches and is rocky in some places. Considering the limiting factors on Shidvar, such as low rainfall and the soil, which is completely sandy, there are a few species of plants on the island. The vegetation in the eastern and central areas is dense; include halophyte species such *as* Sueda spp., Atriplex sp. and *Cyperus rotundus*.

Except of terns, birds such as *Egretta gularis, Arenaria interpres* , *Galerida cristata, Columba livia, Phalacrocorax nigrogularis*, *Larus hemprichii*, *Prinia gracilis*, *Numenius arquata*, *Pandion haliaetus*, *Corvus ruficollis*, *Charadrius leschenaultia*, and reptiles such as *Echis carinatus sochureki*, *Scincus scincus conirostris*, *Mabuya aurata septemtaeniata*, *Mesalina watsonana*, *Eretmochelys imbricata bissa* and *Chelonia mydas japonica* were recorded during period of study in Shidvar Island or locally name 'Marou', which means island with too many snakes.

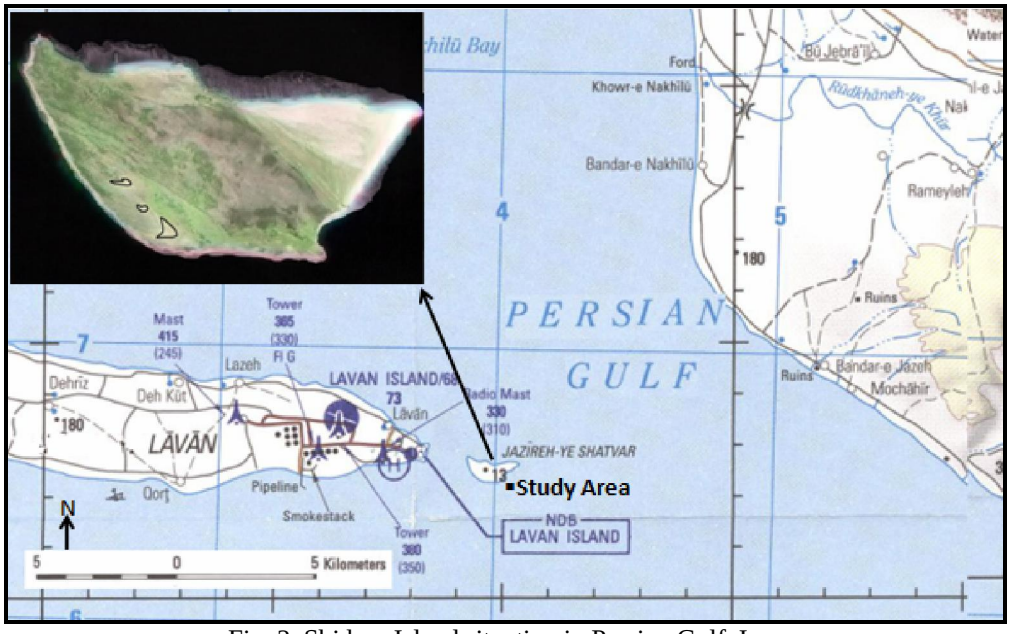

Fig. 2. Shidvar Island situation in Persian Gulf, Iran

2.2 Methods

The study was conducted with data being gathered via daily direct observation from 1st April to 1st September 2007. Total Count Method was carried out in three colonies of breeding. Monitoring of sampling site was carried out during 2008 and 2009. The survey was conducted from 0800 hrs to 1400 hrs. A pair of binoculars (10x) and spotting scopes (30x and 60x) were used for detecting and identifying birds.

The characteristics of eggs, chick, juvenile and adults such as size, form, painting, flight, song and Bird classification were identified by examining every nest and using the bird's field guide books (Mansoori, 2001; Baicich & Harrison, 2005; and Harrison & Castell, 1998). The characteristics of eggs (e.g. diameter, length and width) were measured using caliper with precision 0.01 cm and weight was measured using digital scales. The semi-structured approach was chosen by Holloway (1993); Spendelow & Zingo (1997); Elliott *et al.* (2007); and Behrouzi-Rad & Hosseini-Tayfeh (2008).

2.3 Data Analysis

The Eggs Volume (EV) (cm^3) and Eggs Form Index (EFI) were determined using expressions: *EV (cm^3) =K x L (m) x (B^2) (cm)* and *EFI=B/L x 100* respectively (Where *K* is fixed number, usually equal to 0.4866, *L* and *B* are length and width of eggs). The relative abundance (%) was determined using expression: *n/N x 100* (Where *n* is numbers of recorded and *N* is total observations recorded). All values were represented as Mean ± Standard error of the mean (SE). Data management and analysis were performed using SPSS 16.0 and Excel 2007. Degree of threatened was founded based on IUCN reports (2008) in http://www.iucnredlist.org/.

3. RESULTS

The population and breeding biology of Lesser Crested Tern *Sterna bengalensis* and Swift Tern *Sterna bergii* were studied at Shidvar islands. Several reproductive parameters have been recorded during 2 years (from 2007 to 2008), such as clutch size, egg size and breeding success, as well as the number of breeders during the study and their population dynamics.

The result of observations showed that the first arrival date of terns to Shidvar Island occurs on April 26th till May 2nd. Terns breed collectively in the three separate small colonies and in association with together during their breeding period, which begins at the second decade in May (9-14th).

Nests were built in open areas on the small rocky cliff and free of vegetation in the southwest of island, with 200 meters distance from the beach.

A total of 730 flying and alarm calling birds in the 365 nests, belonging to 240 nest of Lesser Crested Tern and 125 nest of Swift Tern, were recorded, categorized under species and number of eggs and were counted (Table 1). Directly observations illustrated that although breeding of these species were highly synchronous, females laying first in each species were probably in best body condition. In addition, it showed that laying of swift tern was earlier. Laying were also, observed in June and seems that period of laying is about one month, and also the male offers fish to the female as part of the courtship ritual.

Out of the total number, one or two eggs were laid by these monogamous birds, and incubated by both parents to hatching, which 95.4% nests of Lesser Crested Tern were recorded with 1 egg, while it was 99.2% for swift tern nests. The average clutch size was estimated 1.04±0.01 and 1.04±0.02 respectively (Table1). The eggs were differing mainly in the color, olive yellow to pink and cream peas yellow to white with blackish streaks.

Table 1. Clutch Size of Terns in Different Colonies, Shidvar Island (2007)

No. Colony	Lesser Crested Tern			Swift Tern		
	No. Nests	No. Eggs	Ave. Clutch Size	No. Nests	No. Eggs	Ave. Clutch Size
1	103	97	1.06	56	56	1.00
2	51	49	1.04	18	19	1.06
3	86	83	1.03	51	51	1.00
Mean	80	83.67	1.04	41.67	42	1.02
SE	15.31	16.39	0.01	11.92	11.59	0.02

The mean of length (mm), width (mm) and weight (g) of eggs were measured 49.33±0.53, 33.93±0.38, 32.33±0.79 for Lesser Crested Tern and 59±0.66, 46.27±0.54, 59.6±0.8 for Swift Tern, respectively. Also, The Eggs Volume (EV) and Eggs Form Index (EFI) were measured 27.78±0.91 cm^3 and 68.81±0.44 for Lesser Crested Tern and 61.75±2.03 cm^3 and 78.44±0.56 for Swift Tern respectively.

The average breeding success during incubation of eggs, nestling and post-nestling were measured 67.7%, 100% and 95.24% for Lesser Crested Tern and 83.3%, 70% and 100% for Swift Tern. The total breeding success was measured 74.43% and 66.63% for them respectively. However, the young terns fledge after 38 to 40 days; remain dependent on the parents after leaving the colony until they are about four months old. Furthermore, duration (days) of Reproductive Stage include Nest Building, Egg laying, Incubation, Nestling, Post-nestling, and Flying

were measured 1.06±0.31, 3.52±0.28, 22.03±1.41, 3.19±0.22, 19.41±1.54, and 2.2±0.1 for Lesser Crested Tern and 3.24±0.62, 2.31±0.17, 27.03±1.52, 6.35±0.76, 28.7±1.73, and 4.3±0.4for Swift Tern respectively (Table 2). The result of observations showed that the first arrival date, first laying date and hatching out of Lesser Crested Tern were April 26th , May 14th , and June 8th respectively. While, these date were April 26th , May 9th, and June 7th for Swift Terns at Shidvar island, respectively. The results of observations indicated that total stages extend till end of August for both of terns (Table 3).

The population size of swift tern in the first and end of migration and breeding periods at Shidvar Island were measured 480 and 648 individuals for Lesser Crested Tern, while there were 250 and 344 individuals for Swift Tern, respectively. Therefore, relative abundance (%) of birds during inward and outward migration were measured 65.75% and 65.32% for Lesser Crested Tern, while there was 34.25% and 34.68% for Swift Tern, respectively.

Table 2. Duration (days) of Reproductive Stage, Shidvar Island (Numbers are range of variation)

Species	Nest Building	Egg laying	Incubation	Nestling	Post-nestling	Flying
Lesser Crested Tern	1.06±0.31 (1-4)	3.52±0.28 (2-4)	22.03±1.41 (20-24)	3.19±0.22 (2-4)	19.41±1.54 (20-25)	2.2±0.1 (1-4)
Swift Tern	3.24±0.62 (3-5)	2.31±0.17 (2-4)	27.03±1.52 (25-28)	6.35±0.76 (6-10)	28.7±1.73 (25-32)	4.3±0.4 (1-7)

Table 3 Starting Date in terms of Terns Reproductive Phenology, Shidvar Island (2007)

Species	First Arrival	Laying			Hatching Out	Nest Leaving	First Flying	Outward Migrations
		First	Peak	End				
Lesser crested T.	26April	14May	14-19May	2june	8June	13 June	Mid-Aug.	Late Aug.
Swift T.	26April	9May	9-14May	2June	7June			

4. DISCUSSION

More recently, literature has emerged that offers contradictory findings about biology of Terns (Arnold *et al*., 1998; Burger & Lesser, 2008; Elliott *et al*., 2007; Eyler *et al*., 1999; Perrins, 2008; Wright *et al*., 2010). However, far too little attention has been paid to the Hormozgan province in Iran. However, DoE is counting the wintering or summering bird communities every year, but there have been no controlled studies which monitor population of Sternidae and their breeding biology. In this investigation, the aim was to assess breeding success of Lesser Crested Tern and Greater Crested Tern (Swift Tern) in the Shidvar Island.

Groups of Terns on the island of Shidvar have been recorded in the past. Scott (2007) reported breeding of Lesser Crested Tern (1000 adults and 10 nests in 1972, and 40 adults and 10 nests in 1977), and Swift Tern (30–40 adults and 1 nest in 1972; 100 adults and 4 nests in 1977) on Shidvar Island. In this study, a total of 365 breeding pairs in 2007 were identified that increased slightly to 382 in 2009 (mean annual growth rate was 1.05 per year).

The total number of breeding pairs increased slightly from 365 pair in 2007 to 382 in 2009 (mean annual growth rate was 1.05 per year). The most of the breeding parameters analyzed showed there are no statistically significant differences between years. Although the rate fluctuated greatly between years, these changes were probably related to many factors such as habitat condition and also human disturbances effect.

The present findings seem to be consistent with other research which found these terns feed by plunge diving or dipping, usually in the top 1 m of water (Hockey *et al*., 2005) and only fish near the surface are available as food (Crawford, 2009). This finding is in agreement with Crawford (2003) findings which showed numbers of breeding population were significantly related to food availability and biomass of small fish such as Clupeidae (e.g. sardine). Another important finding was that the colony size is related to the abundance of pelagic fish prey and distance of colonies from the beach. In addition, this study suggested that in general good recruitment to the mature population may have contributed to the increase.

The study of breeding access illustrated that area has a good stability in environmental condition, availability of food, nest sites and predation rates for a varieties of seabirds such as terns. However, this area is

under DoE Wildlife Refuges List and is under Ramsar Sites, this is consider that area is a sensitive and brittle habitat for breeding species such as terns, it is need to protect better than this, especially during breeding time of Terns and Turtles.

This study indicated that although no one lives on Shidvar Island, the adjacent island- Lavan, with an area of about 76 sq km- is notable because of its refinery, gas and oil exploitation and transportation infrastructure. Apart from the related staff, some local people are living there as well. These people are engaged in fishing and sea transportation activities. Therefore, main threats for these birds are human disturbance, fisheries, egging, gas and oil exploitation, which all of them related to human activity. Another main threat of breeding is natural predator of tern eggs such as Ruddy Turnstone *Arenaria interpres*, and eastern saw-scaled viper *Echis carinatus sochureki*, during laying and nestling time. It has often been recorded feeding on eggs and early chicks. Behrouzi-Rad & Hosseini-Tayfeh (2008) also recorded feeding of eggs by turnstone and Crab Plover. On the other hands, lack of counts at some coastal sectors and changes among breeding sites between seasons preclude an accurate estimation of total population size for both species and make spatial management challenging.

However, this study showed terns bred at a number of other suitable offshore islands for breeding in Hormozgan province (e.g. Siri, Tonb, Abu-moosa), which were never surveyed, and adjacent province such as Bushehr's islands (e.g. Khan, Tahmadon, Nakhiloo and Um-al-Gorm) (Behrouzi-Rad & Hosseini-Tayfeh, 2008), it found that Shidvar holds the largest Tern's colony in Persian Gulf limit in Iran (a total of 250000 pairs belonging 4 species). Therefore, it is considered that the importance of Shidvar island for seabirds, especially for family of Sternidae, must be recognized and the protection of this site from threats must be enforced.

It is recommended that further research be undertaken in the following areas: To regularly monitor the two known breeding colonies at all suitable islands of province; To ring all young at the colonies in order to get a better idea of the movements; To monitor the breeding avifauna of Shidvar and to clarify its importance and habitat changes for conservational activities.

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