Nemis Journals

Nemis Journal of Agricultural Science

VOL. 1(1), pp. 01-017, JANUARY 2015
ARTICLE NUMBER: NJAS150101
ONLINE: http://www.nemisjournals.org/NJAS

Full length Research Paper

Breeding biology and population of Western Reef Heron Egretta Gularis in Khore mosa creek, Persian gulf.

Behrouz Behrouzi-Rad

Kouzestan Science and Research Branch, Islamic Azad University, Ahvaz IRAN.

Accepted: 12 JANUARY, 2015.

ABSTRACT

The study of breeding biology and population of Western Reef Heron Egretta gularis carried out from April to August 2014 on 7 islands in Khore Mosa Creek in Persian Gulf. I estimated the breeding population, mortality, natality and the breeding success of this species in 7 islands of Khore Mosa Creek. The breeding success during the incubation, nestling, post-nestling and overall stages were 56.76 %, 80.95%, 78.82% and 36.21%, respectively. Being eaten the eggs and chicks by Common Buzards Buteo buteo, high temperature and due to unknown reasons were more important causes of their mortality. The average weight of chicks was 21.75±0.71 and 586.14±10 g at hatching and fledging respectively in Khore Mosa Creek Islands. The maximum nests counted in Heidari2 (17 nests) and minimum was counted (1nest) on Tiff2 island.

Keywords: Breeding biology, Egretta gularis, Khore Mosa Creek Islands, Persian Gulf.

Corresponding Authors Email: bbehrouzirad@yahoo.com,

INTRODUCTION

Colonial waterbirds comprise a diverse assemblage of species that share important characteristics of ecology and natural history (Custer, 1977; Forbs 1989; Gallagher et al 1984; Naik 1987; Rolland et al 1998; Behrouzi-Rad and Tayfeh, 2008; 2014). Waterbirds within this group depend on specific and often limited aquatic habitats for much of their life cycles, and generally breed in high-density groups or colonies, ranging from a few to several thousand individuals (Gallagher et al 1984; Scarton and Borella 1994). Coloniality within this group likely evolved independently within the different taxa and as a response to various environmental pressures (Custer, 1977; Burger 1981, Forbes 1989, Rolland et al. 1998).

This behaviour poses important challenges to waterbird conservation because large proportions of a species population may be concentrated in relatively small isolated areas (Kushlan & Hancock. 2005). Reproductive performance of large wading birds may be a sensitive bio-indicator of not only their populations and communities but also aquatic ecosystems generally (Naik, 1987; Enoder 2009). As top predators these birds rapidly respond to changes in marine and freshwater environments (Enoder 2009), such as in their productivity and trophic structure, due to human disturbance and contamination of wetlands (Custer, 1977; Dies, 2001). Also Long-legged wading birds are prominent members of estuarine ecosystems. The Western Reef Heron *Egretta gularis* is long-legged wading bird and life cycle of this species completely depends estuaries and islands ecosystems and occurs mainly on the coasts in tropical West Africa, the Red Sea, the Persian Gulf and east to India but vagrant individuals have been recorded as far away in Brazil, the Caribbean and North America (Birdlife International 2012).

During no-breeding seasons, it forages solitarily, although it is occasionally found in small groups (Grewal *et al.* 2002; Scott 2007). It feeds diurnally but also at night, depending on the tides, and roosts at night in large numbers of between 500 and 1,000 individuals, in mangroves or on rocky cliffs and islets.(Ghallagher and Rogers 1978; Dies, 2001; Grewal *et al.* 2002,). Out of breeding season is seen alone or in pairs (Milon 1946; Naik 1987; Scott 2008, Behrouzi-Rad 2009; 2013).

In the Persian Gulf, Western Reef Heron's breeding habitats are coastal wetlands and islands (Behrouzi-Rad and Tayfeh 2008; Behrouzi-Rad 2008; Behrouzi-Rad Rasekhi and Momeni 2010, Behrouzi-Rad 2013), and are one of the native birds of Khore Mosa Creek selects there for the resting, wintering, feeding and breeding activities. As a large and conspicuous waterbird that is relatively easy to study, the Western Reef Heron could be used as an indicator species to monitor the health of the Khore Mosa Creek in southern coastal areas of Iran. The percentage of mortality and natality reflects habitat quality and environment conditions. The aim of this study was to review the present status of the breeding biology and population of the Western Reef Heron on 7 islands in Khore Mosa Creek. This study is also important for conservation measures.

Behrouz Behrouzi-Rad.
Kouzestan Science and Research Branch, Islamic Azad University, Ahvaz IRAN.

METHODS AND MATERIALS

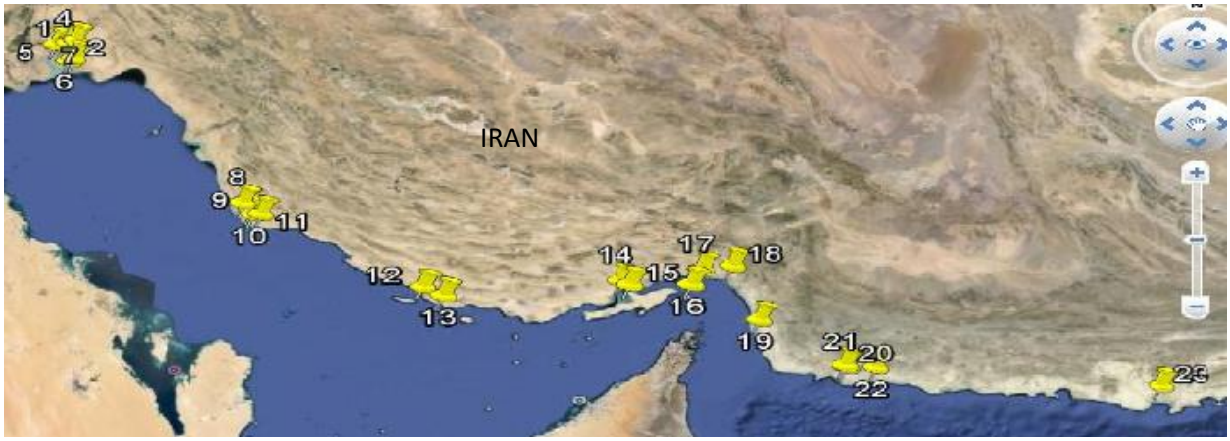
STUDY AREA

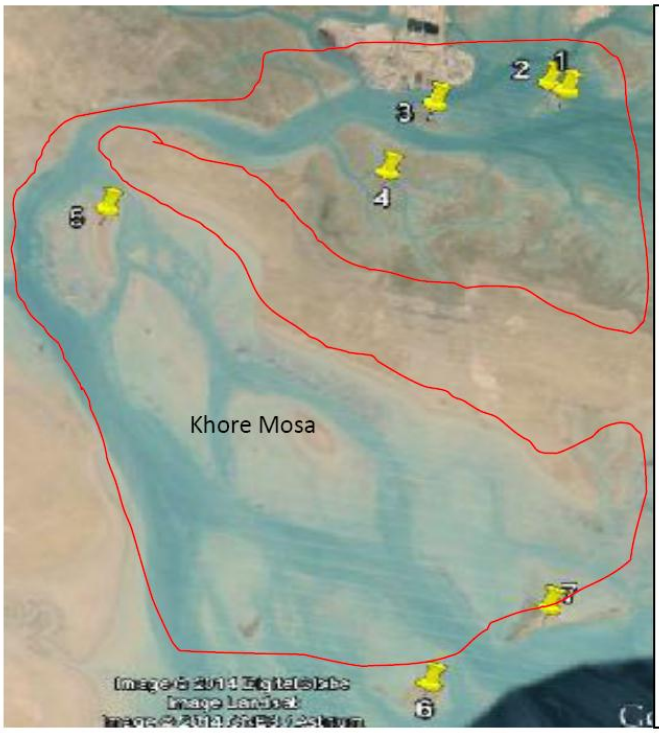
Khore Mosa Creek (30°11' 01" N 49°01' 56" E) extends from Mahshahar harbor in the north, south to the Persian Gulf. Khore Mosa Creek and all islands are most important intertidal habitats of the Persian Gulf shoreline. This creek is totals 60 km in length, is a part of Shadegan marsh the Ramsar site (Behrouzi-Rad 2014). There are 7 islands in Khore Mosa named, Dara, Boneh (in the entrance of Khore Mosa from Persian Gulf), Ghabre Nakhoda (in the middle of Khore Mosa), Heidari1, Heidar2, Tff1, Tiff2 (near Bandar Imam Port) (Fig.1). There are no springs or surface water in these islands. Rainfall is very low, and the summer temperatures frequently exceed 40°C. They are flat, sandy and Shelly, 70-90% of area of some of the islands covered by vegetation in February and March (Behrouzi-Rad 2014). All around of the islands is sandy and mudflat beaches. Area of the islands are as fallow: Dara 80, Boneh 170, Ghabre Nakhoda 4.2, Tiff1 16, Tiff2 5, Heidari1 10 and Heidari2 about 20 hectare in high tide and more than triple in ebbs. Main plant community of islands are *Atriplex+Stipa +Suaeda+Halostachys*. The main plant species of this community are *Atriplex leucoclada, Stipa capensis, Suaeda fruticosa, Halostachys belangeriana, Calanderula persica, Malva sp, and Cistanche tubolusa. Suaeda fruticosa* is the distinguishing species of this community. Western Reef Heron use the bushes of this species for nesting and breeding. There is another plant community in Dara, *Calendula+ Cistanche*. Sandy soil rich in oyster shell are covered with this community. *Cistanche tubolosa* is a vulnerable species in this community. *Calendula persica* is an endemic species. One of the main roles of this plant communities are conservation a surface soil against erosion and stabilize the Crab Plover nests and provides a shelter over them.

COUNT METHOD

Field works were conducted once a week from the beginning of nest-building (early of April) to fledging (Middle of August). Nests (N=58) were determined by numerical tags and some parameters such as length, width and diameter of nests were measured by measuring tape. Total count method (Symens 1996, Krebs 2001) was used for determination of number of nests. When clutch size completed in the nests, the length, and diameter of eggs was measured using calipers (± 0.1 mm) and were weighted by digital scale to nearest 0.1 g. The volume and the index of egg shape, were determining by equations of $V=k\ L\ (cm) \times B^2\ (cm)$ and, index of egg shape = B÷L.100 (Hoyt 1979; Symens 1996; Hancock et al 2001), where, L is the length of eggs, B is diameter or breadth of eggs and K is coefficient which is 0.4866. The chicks of the marked nests were weighted by the digital scale at birth and every week. The success in egg maintenance represents the number of eggs hatched and foster success of chicks means how many percent of chicks leave the nest and are able to fly (Scarton et al, 1994, Symens, 1996). By regular checking of the marked nests, the number of eggs, nestling and the number of chicks able to leave the nest, were registered. At the other breeding sites at Persian Gulf coasts (from

Govater Bay to Khore Mosa about 2200 km) the nests of this species counted directly on 20-25 June 2014 once only. We defined Nestling, Post-nestling and Fledging as follows: Nestling = less than 10 days old, or unable to leave the nest; Post-nestling = 10–25 days old, or able to leave the nest but unable to fly; Fledging = more than 25 days old, or able to fly.





1-Tiff1	30°25'50.80"N 49°09'35.50"E
2-Tiff 2	30°25'14.85"N 49° 09'21.59"E
3-Heidari1	30°24'12.76"N 49° 05'50.58"E
4- Heidari2	30°22'03.08"N 49° 04'36.26"E
5-Ghabre Nakhoda	30°20'26.32"N 48°55'43.47"E
6- Dara	30°05'47.61"N 49° 06'43.26"E
7- Boneh	30°08'10.92"N 49° 10'21.59"E
8- Tahmadon	27°59'31.70N 51° 20'22.38"E
9- Khan	27°51'12.07"N 51° 27'04.84"E
10-Nakhilo	27°49'12.73"N 51° 28'27.98"E
11- Um-Al-Gorm	27°49'51.48"N 51° 33'42.04"E
12- Sheedvar	26°46'45.19"N 53° 25'38.94"E
13-Hendorabi	26°39'56.53"N 53° 54'14.17"E

Fig 1. Geographical situation of Khore Mosa Creek and
Location of breeding sites of Western Reef Heron in Khore Mosa at Persian Gulf and Oman Sea coasts.

Behrouz Behrouzi-Rad.
Kouzestan Science and Research Branch, Islamic Azad University, Ahvaz IRAN.

RESULTS

According to field observations, arrival to the islands takes place early April and departure in Mid-August. In the Red Sea region the breeding season is from June to August. The nominate subspecies breeds in West Africa from late April to September. In India the breeding season is during the monsoon rains from April to August and end of May in the former breeding colony at Chilaw in Sri Lanka. Most of the breeding colonies in Gujarat in western India were on mangroves (Cramp and Simons 1977; Naik 1987). The Western Reef Heron had bred on 7 islands in Khore Mosa Creek and on 16 other sites at Persian Gulf and Oman Sea coasts (Fig. 1) and a total of 58 (11.04%) nests were counted in Khore Mosa. At other sites from Govater Bay to the Khore Mosa (Fig 1) 467 nests were counted.

BREEDING SEASON PERIOD

The nesting season of Western Reef Heron is between April and August in all parts of their range; except for one January record in eastern Nigeria (Cramp & Simmons 1977). On Khore Mosa Creek Islands breeding activities begins in early April and they leave the islands in mid-August. Breeding occurs between April and July and by October in Africa (Cramp & Simmons 1977, Kushlan & Hancock 2005), with some individuals forming solitary pairs, whilst others gather in small colonies of up to 100 pairs (Kushlan & Hancock 2005). In Khore Mosa, the largest colony was 17 nests on Heidari 2, associated with White-checked Tern *Sterna repressa*. On the Dara, Boneh and Ghabre Nakhoda Islands associated with Lesser-crested Tern *Sterna bengalensis*, Swift Tern *sterna bergii*, Bridled Tern *Sterna anaethetus,* and Whit-checked Tern *Sterna repressa*. In 2014 this species was only breeding species on the Heidari1.

The Western Reef Heron is a native breeding waterbird along the south coast of Iran and on offshore islands (Scott 2007, 2008; Behrouzi-Rad 2009). It has been found nesting on trees, shrubs and bushes at 23 sites consisting of 16 islands and 7 tidal areas and mangrove wetlands (Fig.1) (Behrouzi-Rad pers. obser.). In Khore Mosa Creek this species had bred on tall bushes on the islands. Nests are built on the top of dense vegetation. The capability of the vegetation to support a nest being the only apparent criteria (Kushlan & Hancock 2005). The nests are usually round or oval in shape (Table 1). Western Reef Herons generally nest in colonies but are also known to do so in isolation, as evidenced by these observations, for example, there was only one nest on Tiff1 Island.

NEST CHARACTERISTICS

On Khore Mosa Creek Islands, Western Reef Herons build their nests on the top of the tallest *Atriplex ssp, Suaeda fruticosa and Halostachys belangeriana* bushes averaging 95.87±12.76 cm in height (Table 1). The nests are constructed with pieces of *Suaeda fruticosa*, *Atriplex leucoclada* and *Arthrocnemum macrostachyum*. The mean of big diameter of the nests was 33.14±3.83 cm, and the mean width of the nests was 24.59. ±0.38 cm. The mean cup perimeter of the nest cups was

43.63±0.48 cm. The mean thickness of the nests was 13.14±3.41 cm (*N*=58). The minimum distance between nests was 8.50 m on Mirheidari2 while the minimum distance was only 2.4 cm on Ghabre Nakhoda. They nest in colonies, usually on platforms of sticks in trees or shrubs. These characters exist in Khore Mosa islands and the Western Reef Heron build their nests on higher vegetation bushes on 7 islands (Table 1).

Table 1. Nest characteristics of *Egretta gularis* on Khore Mosa Creek Islands in 2014.

Dimension of nest	**N=58**
Length or big diameter of nests	33.14±3.83 (cm)
Width or small diameter of nests	24.59±0.38 (cm)
Mean Thickness of nests	13.14±3.41 (cm)
Big Perimeter of nests	97.03±2.27 (cm)
Cup Perimeter of nests	43.63±0.48 (cm)
Average Length of nests	60.75±1.11 (cm)
High from ground	75.5± 15.34 (cm)
High of scrub	95.87± 12.76 (cm)

CLUTCH SIZE

The clutch of pale blue eggs varies from 2 to 3 in *dimorpha*, 3 to 4 in the other subspecies (Cramp & Simmons 1977; Hancock *et al.* 1978). On Khore Mosa Creek Islands, totally 90.4% of eggs were light blue and 6.5% were white or light green. The maximum clutch size in the present study was 4 (25.86%) (N=15 nest) and the minimum was nests with one egg (3.44%) (N=2) on Tiff1 island (Tables 2). Egg-laying took place between mid-April and mid-June and the chicks left their nests between late July and Mid-August, and then remained on the islands until September. The nesting season of nominate *gularis* falls Between April and August in all part of its range (Hancock *et al.* 1978).

The mean clutch size was 3.18, Clutch size ranged between 1 and 4 (Tables 2 and 3). Clutches of three eggs were the most frequent (60.34%) (*N*=35 nests) (Table 2). The average weight of the eggs was 27.58±0.09 g (*N*=185). The average length and breadth of the eggs were 49.52±0. 6 mm and 35.58±0.3 mm, respectively. The average volume of the eggs was 26.63±0.17 cc and the index of egg shape was 72.35±0.32 (*N*=185). Other authors have reported egg measurements of 44×32 mm in nominate *gularis*, 44.9×34.3 mm in *schistacea* (*asha*) and 46.5×33.6 in *dimorpha* (Hancock *et al.* 1978;). These are oval, smooth, pale blue/green, with mean average measurements of 45×34 mm (Grewal *et al.* 2002). (47.02×34 mm; Cramp & Simmons 1977).

Table 2 Clutch sizes of *Egretta gularis* on Khore Mosa Creek Islands in 2014

Islands	No. of nests	One egg nests	Tow egg nests	Three egg nests	Four egg nests	Total eggs
Dara	16	2	1	8	5	48
Boneh	5	-	-	3	2	17
Gabre Nakhoda	14	-	2	8	4	44
Tiff 1	3	-	-	3	-	9
Tiff2	1	-	-	-	1	4
Heidari 1	17	-	-	11	6	57
Heidari 2	2			2	-	6
Total	58	2	3	35	15	185
Frequency (%)	100	3.44	5.17	60.34	25.86	-

INCUBATION

They lay their eggs at intervals of one or more days and incubation begin only when the clutch size completes (Forbes 1989; Cramp & Simmons 1977; Hancock *et al.* 1978). In the Ardaidae family, incubation period takes at least 16 days (in some Little Bitterns) to a maximum of 30 days (Goliath Heron) and hatching is asynchronous (Hancock *et al.* 1978; Grewal *et al.* 2002). Western Reef Heron eggs period takes 20–25 days by both sexes in Khore Mosa.

BREEDING SUCCESS

Hatching success, i.e. the proportion of eggs laid that hatched, in 58 nests was 56.76% (105 chicks from 185 eggs), success in nestling 80.95% (85 nestling from 105 chicks), success in post-nestling 78.82% (N=67 post-nestling from 85 nestlings) and overall success from egg-laying to fledging 36.21% (Fig. 2).The average weight of the chicks at hatching was 21.75±0.70 g (*N*= 105), at seven days old, 125.30±4.1 g (*N*=105), and at 14 days old, 293.4±5.9 g (*N*=85) (Fig. 2). Average success rate of reproduction stages in Khore Mosa Creek islands in 2014 was 36.21% (Table3) and average mortality was 63.79% (Table3). Egg loss in 58 nests (*N*= 185 eggs) was 43.24%; nestling mortality was 19.4%; and post-nestling mortality was 22.22% (Table 4 and Fig.2).

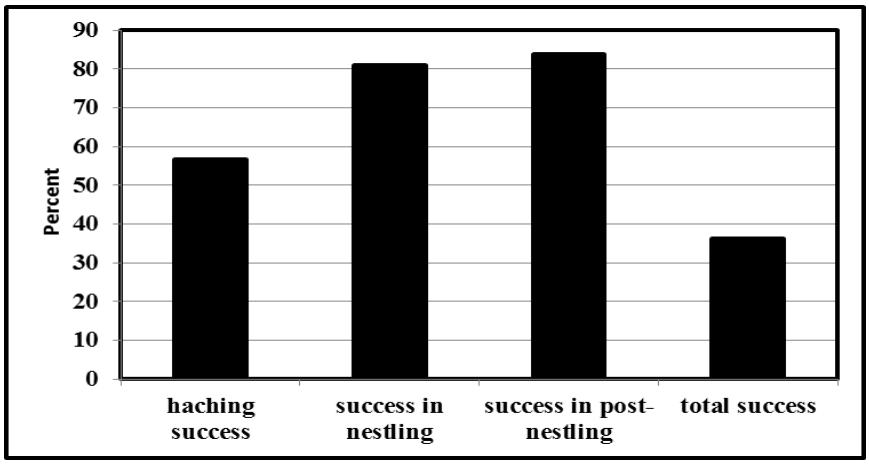


Fig 2. Breeding success of *Egretta gularis* on Khore Mosa Creek Islands in 2014

Table 3. Average success rate of reproduction stages in Khore Mosa Creek Islansds in 2014.

Average number of eggs in every nest	Average number of Chick in every nest	The number of successful nestling in every nest	The number of successful post-nestling	The number of losses eggs in every nest	The number of nestling losses in every nest	The number of post-nestling in every nest	Total susses in in every nests
3.18	1.81	1.46	1.15	1.37	0.34	1.15	1.17 Total 36/21%

Table 4 Mortality and natality rate of reproduction stage of breeding period in Khore Mosa Creek Islands

Post-nestling	Natality nestling	hatched	Post-nestling	Mortality Nestling	eggs	
67	85	105	18	20	80	Number
78.82	80.95	56.76	22.22	19.04	43.24	Percent
From 185 eggs	36.21% fledged		From 185 eggs	63.78%		Average

Behrouz Behrouzi-Rad.
Kouzestan Science and Research Branch, Islamic Azad University, Ahvaz IRAN.

CHICK

Semi-altricial young stay at nest about 30 days (Grewal *et al.* 2002). Milon (1946) found that *dimorpha* chicks begin clambering out of the nest after about 15 days but are incapable of flight for another month. In Khore Mosa Creek Islands chicks begin clambering out of the nest after 20 to 25 days, returning when a parent bird approaches with food. The young could flight after 45–50 days. The average weight of the chicks at hatching, 7days, 14 days and 28 days were 21.75±4.1, 125.3 ±4.1, and 293.4±5.9 and 586.14±10 g respectively. Average growth of the chicks were 20.15g/day. Hancock (1978) has reported, chicks were cared and fed by both sexes (Hancock 1978).In Khore Mosa Creek chicks were cared and fed by both sexes for 28 days around the nests. After fledging the young it was difficult to identify are the young feeds by parent or not.

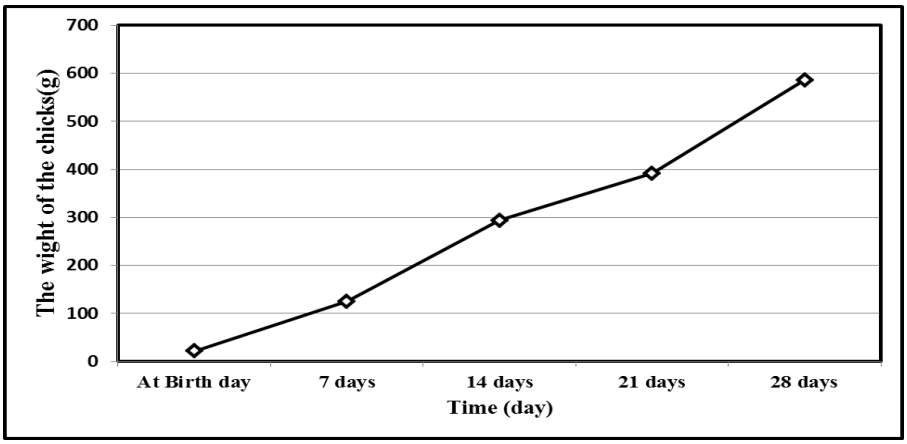


Fig 3. Relationship between age and weight of chicks of *Egretta gularis* in Khore Mosa Creek Islands in 2014

BREEDING POPULATION

Western Reef Heron is widespread along the Persian Gulf and Oman sea coasts However, it is now known that the species is a native along the entire south coast of Iran from the Iraqi border in the west to the Pakistan border in the east. Breeding population of this species at Persian Gulf and Oman sea coasts since 2003-2014 has been showed on table 5. Trend of the nest number of this species at breeding 23 sites at Persian Gulf and Oman Sea coasts has been showed in Fig4. In 1970s Scott reported, breeding colonies were located in the southern part of Shadegan Marshes (Khore Mosa), Khuzestan (40 pairs in 1974), on Morghu (Khan) Island (20 pairs in June 1975), Umal Karam Island (26 pairs in June 1975) and Sheedvar Island (12 pairs in 1972, 1976 and 1977) in the Persian Gulf, and in the mangroves in Hara Protected Area in the

Khouran Strait, Hormozegan (at least 50 pairs in 1975). The estimate of 150–200 pairs is a minimum, as large sections of the south coast were not surveyed during the breeding season (Scott, 2007).Etizadifar and Amini in (2010), reported in 13 sites as fallow: in 2004, 47 nest on Sheedvar, in 2006, 2 nest on Hormoz, in 2008, 356 nests on 8 sites consist of Hormos, Sheedvar, Ghabre Nakhoda, Khan, Nakhilo, Um-Al-Gorm island, and Khoran Strait (Hara Protected Area), in 2009, 228 nest in 2 sites (Hara protected Area and Hengam island) and in 2010, 120 nest on Hara protected Area). These number of nests and sites shows that in 2010, as large sections of the south coast of Persian Gulf and Oman sea coasts were not surveyed during the breeding season.

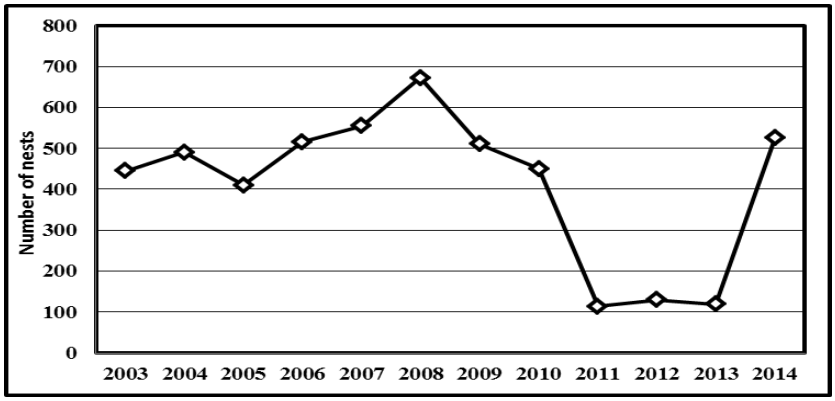


Fig 4. Trend of the Western Reef Heron nests at Persian Gulf and Oman sea coasts since 2003-2014

Table 5. Description of breeding sites of the Western Reef Heron at Persian Gulf and Oman Sea coasts in south of Iran in 2003-2014

Site Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total	%
Dara	14	0	0	8	7	11	1	0	12	18	18	16	105	2.11
Boneh	0	11	3	5	6	11	8	11	9	4	6	5	79	1.58
Ghabre Nakhoda	44	43	10	23	44	34	20	6	14	12	16	14	280	5.62
Tiff 1	4	2	4	3	1	3	2	5	3	6	4	3	40	0.80
Tiffe 2	3	3	2	2	4	3	5	1	1	3	2	1	30	0.60
Heidari1	2	8	5	5	4	4	9	7	5	3	1	2	55	1.10
Heidari2	12	16	13	15	8	14	11	9	14	11	18	17	158	3.17
Khan Nakhilo	22	35	45	77	55	72	70	92	?	?	?	62	530	10.65
Om-al-Gorm	0	8	34	44	64	92	92	42	?	?	?	46	422	8.38
Sheedvar	27	30	0	11	54	92	18	24	?	?	?	12	268	5.38
Hendorabi	43	43	56	32	24	33	20	45	?	?	?	19	315	6.33
Gheshm island	7	6	11	5	8	9	?	?	?	?	?	7	53	1.06
Delta of Rude Mehran*	173	167	123	132	196	168	180	120	?	?	?	193	1452	29.19
Tiab *	8	12	16	16	18	14	6	22	9	34	18	15	188	3.77
Hengham	8	6	2	8	7	9	5	3	?	?	?	11	59	1.18
Hormoz	6	5	7	3	0	6	9	?	?	?	?	6	42	0.84
Lark	10	8	11	9	7	6	10	?	?	?	?	9	70	1.40
Sirik *	6	0	4	3	0	0	0	?	?	?	?	3	16	0.32
Gabrik *	5	7	3	?	?	9	5	?	?	?	?	9	38	0.76
Jask *	0	45	23	38	14	29	11	30	?	?	?	34	224	4.50
Sharno *	11	21		43	13	26	?	14	14	?	?	12	154	3.09
Govater Bay *	6	9	0	12	0	15	14	8	15	?	?	6	85	1.70
Total	39	12	41	22	21	21	19	11	18	39	36	32	311	6.25
Average:	450	498	413	516	555	681	515	450	114	130	119	534	4974	100
Average: during 12 years, per site							414.5 Per Year							
Average, Per site, Per							216.26 Nest							
							9.39 Nest							

? = The sites have not visited * = Tidal Zone or Coastal Wetlands

Behrouz Behrouzi-Rad.
Kouzestan Science and Research Branch, Islamic Azad University, Ahvaz IRAN.

Year

COMPARING THE BREEDING BIOLOGY OF SPECIES IN NAKHILO AND KHORE MOSA

Comparing the breeding season, nest characters, eggs parameters and chick's weight has been showed in table 6. The weight and dimension of eggs incubation period, nests parameters and chicks weight on Khore Mosa did not show a significant difference from the samples in Nakhilo (P>0.05) (Table 6).

Table 6. Comparing the breeding stages of Western Reef Heron on Nakhilo Island and Khore Mosa islands

Parameters	**Khore Mosa, Reference (Behrouzi-Rad 2014)**	**Nakhilo Island 2008, Reference (Behrouzi-Rad & Momeni 2008)**	**Africa**
Breeding season	Early April - Mid August	Mid-April- Early September.	April-August (Cramp & Simmons1970)
Nest Parameters	Nest height from ground=75.5± 15.34cm (Nests were on Bushes). Nest distance =2.4-8.50 meter Mean of big diameter of the nests = 33.14±3.83 cm Mean width of the nests=24.59. ±0.38 cm. Mean circumference of the nests=104.48± 11.21 Thickness of the nests =13.14±3.41	Nest height from ground =133.3±2.86cm (nests were on Mangrove trees). Nest distance =10-20 meter Mean diameter of the nests =38.42.±0.53 cm Mean width of the nests = 27.59 ±0,38 cm Mean circumference of the nests = 107.03±2.7 Thickness of the nests =13.14±0.31 cm N=78 nest	-
Clutch Size	1-4 (mean clutch size) = 3.18	1-5 (mean Clutch size) = 3.2	2-3 in dimorphs, and 3-5 in other subspecies (Cramp & Simmons 1977)
Eggs parameters	49.52±0. 6 35.58±0.3 mm Average volume of the eggs = 26.63±0.17 cc The index of egg shape = 72.35±0.32 (N=185). Average weight = 27.58±0.09 g (N=185). Incubation Period=20-25 days	47.02±0.16×34.12±0.08mm Average volume of the eggs = 26.63±0.17 cc index of egg shape was 72.35±0.32 Average Weight= 27.38±0.09 g Incubation Period 22-25 days N= 153 (47 nest) Average eggs in every nest= 3.25	47×34 mm Incubation period 23-26 days (Cramp & Simmons 1977) Incubation period(20-25) days (Grewal *et al.* 2002)

	N=185 (58 nest) Average eggs in every nest=3.18		
Chicks weight	Average weight of the chicks at hatching was = 21.71±4.1g (N=105) At 7 days = 125.3±4.1(N=105) At 14 days = 293.4±5.9 (N=85) At 28 days = 586.14±10	average weight of the chicks at hatching was = 22.19±0.61 g (N= 95), At 7 days=140.91±12.3 g (N=71), At 14 days old= 251.63±14.9 g (N=71) At 28 days= 595.4± 14.5g	-
Breeding Success	Hatching =56.75% (105 from 185) Nestling = 80.95% (85 from 105) Post-nestling = 78.82% (67 from 85) Overall success from egg-laying to fledging = 36.21% Egg loss in58 nests (N=185 eggs) = 43.24% Nestling mortality = 19.14% Post-nestling mortality = 22.22%	Hatching 62.1% (N = 95 from153 eggs) Nestling 74. &% (N =71 from 95). Post-nestling 84.5% (N = 60 from 71nestling Overall success from egg-laying to fledging = 39.2% Egg loss in 47 nests (N =153 eggs) = 37.9%; Nestling mortality = 25.3%; Post-nestling mortality =15.5%	-

DISCUSSION

The Western Reef Heron *Egretta gularis* occurs in the Khore Mosa Creek throughout the year, and is a native breeding waterbird along the south coast of Iran and on offshore islands (Table 5). It has been found nesting on trees, shrubs, and bushes at 23 sites consisting 16 islands and 7 tidal areas (Table 5). The total breeding population was estimated at about 534 pairs in 2014.
The trend of breeding population had low variation among 2003-2014, (450 pairs in 2003-534 Pairs in 2014) except 2011-2013 that decreased considerable. The main reason for decreasing among 2011-2013 was not counting all breeding site in this three years.

The largest breeding colony of the species, with total 1452 pairs (29.41%) was on the mangrove forests at Gheshm island beaches, mainly on Hara Protected Area. Further studies on the status of the breeding populations and threats to the species will be useful for monitoring ecological changes in coastal, islands and wetland ecosystems in southern Iran. The proportion of hatched eggs in 58 nests were 56.76% (105 chicks from 185 eggs), success in nestling 80.95% (N=85 nestlings from 105 chicks), success in post-nestling 78.82% (N=67 post-nestling from 85 nestlings) and overall success from egg-laying to fledging 36.21% (Fig. 3 and Table 4). The average weight of the chicks at hatching was 21.75±4.1g (N= 105), and at fledging 28 days old, 586.4±10 g (N=67) (Fig. 2). Egg loss in 58 nests (N= 185 eggs) was thus 80 (43.24%), nestling mortality was 19.4% and post-nestling mortality was 22.22% (Tables 3 and 4). Comparing the breeding biology of Western Reef Heron in Nakhilo Island and Khore Mosa has

showed in table 6. The weight and dimension of eggs incubation period, nests parameters and chicks weight in Khore Mosa did not show a significant difference from the samples in Nakhilo Island (P>0.05) (Table 6).

The Khore Mosa creek islands support large and diverse breeding colonies of waterbirds. Nine species of colonial waterbirds nest within Khore Mosa Creek Islands, including two species of long-legged wading birds (Western Reef Heron, and Little Egret, (Behrouzi-Rad 2009), five species of terns, Crab Plover and the Dalmatian Pelican (Behrouzi-Rad 2013). This breeding avifauna is valuable bio-indicators of environmental quality, notably the concentrations of chemical contaminants, levels of human disturbance, resource abundance, and habitat health in the system. Because, they feed near the top of the food chain on numerous species of fish and invertebrates. As a large and conspicuous waterbird that is relatively easy to study, the Western Reef Heron could be used as an indicator species to monitor the health of the wetland ecosystems in southern coastal areas of Iran.

The monitoring of breeding colonies of Western Reef Heron may provide information on the conditions of Khore Mosa creek islands used for resting and breeding. Historically, the Khore Mosa complex has supports a high density of waterbird nesting since 1970s (Scott 2007), Khore Mosa was one the largest waterbirds colony on the Persian Gulf coast and contained approximately 24,450 waterbirds nests in 2013, while one of the largest Lesser crested and Swift Tern, Crab Plover and Western Reef Heron colonies in the Persian Gulf coasts was located at Khore Mosa (Behrouzi-Rad 2013). Unfortunately, due to man's activities, all of these colonies are presently decreased, but although the Khore Mosa Creek still supports substantial waterbird foraging and nesting populations, recent surveys suggest that population size has been reduced from historic levels.

Waterbirds are popular subjects for research and monitoring, and long-term datasets of waterbirds counts often provide a useful resource as indicators of ecological change. However, different waterbirds species undergo population fluctuations for different reasons, and a thorough knowledge of the ecology of a given species is required if trends are to be interpreted correctly. However, birds can be reliable indicators of nutrient status, fish stocks or the abundance of aquatic plants and environment health. As the difficulties inherent in monitoring some groups of organisms (e.g. aquatic vegetation) might be best avoided if a reliable indicator is available, in these last cases waterbirds may be considered as relatively easily measurable surrogates. When using waterbirds as indicators, clear objectives for the monitoring program are essential.

SURVIVAL

Khore Mosa Islands are safe place for Western Reef Herons to breed as they are uninhabited islands about 5-60 km from the Bandar Imam port with low natural predators. When the eggs first hatch, one parent normally stays close to the nest and can often be seen shading the chicks with its body. Overexposure to the hot sun poses a threat to young chicks, but both parents will often leave their chicks for extended periods when they go off to fish (Kushlan & Hancock

2005). The possibility of low disturbance by humans cannot be ruled out, but it is thought that this would be, at most, of a minor nature. The Western Reef Heron does not suffer from hunting in Iran. It remains common in the Persian Gulf and Oman Sea coasts, and does not appear to be under threat, although it does not receive any special protection in Iran. However it is suggested that long-term studies be carried out on the breeding colonies at the Persian Gulf and Oman Sea coasts and all islands to monitor populations trends and breeding success, and that a ringing program be initiated. Training and public awareness programs should be developed, in particular to raise the awareness of local people and fishermen about the island's ecological values and the need for effective protection of the island's habitats by publishing brochures, making films and producing other promotional material about in these areas. This species not listed in the red data book of IUCN as a threatened species (IUCN 2009) and also not listed in protected species in Iran.

ACKNOWLEDGEMENTS

The author would like to thank the personnel of Department of the Environment Office of Mahshar, in particular Mr. Soleimani, Head of Mahshahr Office, Mr. Hemadi and Mr. Norouzi who helped in the counts of the waterbirds population and assisted with transportation on Khore Mosa islands.

REFERENCES

Behrouzi-Rad, B. & Tayfeh., F.H. (2008). Nest Counts for Western Reef Heron Egretta gularis and Four Sterna Species in Khore Mosa Creek Island in the Persian Gulf from 2005 to 2007. Podoces 3(1/2): 45–52.

Burger, J. (1981). A model for the evolution of mixed-species colonies of Ciconiiformes. Quarterly Review of Biology 56:143-167.

Cramp, S. & Simmons, K.E.L. (eds.) (1977). Hand book of the birds of Europe the Middle East and North Africa. The birds of the Western Palaearctic, vol. IV, Terns to Woodpeckers, Oxford university press.pp287-289.

Custer, T.W., Osborn, R.G. (1977). Wading birds as biological indicators: 1975 colony survey. U.S. Fish and Wildlife Service Scientific Wildlife Report No.206. 1–28.

Dies, J.I., Prosper, J. Dies B (2001). Occasional breeding by Western Reef Egret in eastern Spain. British Birds 94: 382–386.

Enoder, L.D. (2009). A review of the use of seabirds as indicator in fisheries and Ecosystem management. Fish Res. 95:6-13.

Etezadifar, F., Amini, H. (2010). Current Status of the Breeding Population of the Western Reef Heron *Egretta gularis* along the Northern Coasts of the Persian Gulf and Oman Sea, and its Wintering Population in the South of Iran. Podoces, 2010, 5(2): 71–80.

Forbes,L.S., 1989. Coloniality in herons: Lack's predation hypothesis reconsidered. Colonial Waterbirds 12:24- 29.

Gallagher, M.D., Rogers, T.D. (1978). On the Breeding Birds of Bahrain. Bonn. Zool. Beitr. 29: 5–17.

Gallagher, M.D., Scott, D.A., Ormond, R.F.G., Connor, R.J., Jennings, M.C. (1984). The Distribution and Conservation of Seabirds Breeding on the Coasts and Islands of Iran and Arabia. In: Croxall, P.J., Evans, P.G.H., Schreiber, R.W. (eds), Status and Conservation of the World's Seabirds. ICBP Technical Publication No.2. ICBP, Cambridge, U.K., pp. 421–456.

Grewal,B., Harvey, B., Pfister, O. (2002). A Photographic Guide to the Birds of India and the Indian Subcontinent, Including Pakistan, Nepal, Bhutan, Bangladesh, Sri Lanka, and the Maldives. Princeton University Press, Princeton.

Hoyt, D.F. (1979). Practical methods of estimating volume and fresh weight of bird eggs. Auk 96: 73–77.

Hancock, J., Elliott, H., Gill Krebs, J. C.h. (2001). Ecological Methodology Published by Harper & Row Publishers. London. pp. 93-370. Mor R. 1978. The Herons of the World, published in 1978 by London Edition Limited, 30 Uxbridge Road, London W12 8ND.

IUCN. (2009). IUCN Red List. http://www.iucnredlist.org accessed March 2009.

Krebs, J. C.h. (2001). Ecological Methodology Published by Harper & Row publishers. London. pp. 93-370.

Kushlan, J.A., Hancock, J.A. (2005). Bird Families of the World: Herons. Oxford University Press, Oxford

Naik, R.M., Parasharya, B.M. (1987). "Impact of the food availability, nesting-habitat destruction and cultural Variations of human settlements on the nesting distribution of a coastal bird, *Egretta gularis*, in Western India". J. Bombay Nat. Hist. Soc. 84 (2): 350–360.

Rolland, C. E., Dan chin, M., De Fraipont, (1998). The evolution of coloniality in birds in relation to food, Habitat, predation, and life-history traits: a comparative analysis. American Naturalist 151:514-529.

Symens, H. (1996). Status of the breeding populations of (Sternidae) along the eastern of Saudi Arabic following The 1991 Gulf war. NCWCD, Riyadh and Senckenberg Research Institute, Frankfurt, pp. 404–420.

Scarton, F., Valle, R., Borella, S. (1994). Some comparative aspects of the breeding biology in–Black-headed Gull (Larus ridibundus), Common Tern *Sterna hirundo* and Little Tern *Sterna albifrons* in the lagoon of Venice, NE Italy. Avocetta 18: 119–123.

Schjorring, S., Bregnball, T. (1999). Prespecting enhance breeding success of first time breeder in the Great Cormorant. Animal Behavior 57(3): 664–674.

Scott, D.A. (2007). A Review of the Status of the Breeding Waterbirds in Iran in the 1970s. Podoces 2(1):1-21.

Scott, D.A (2008). Rare birds in Iran in the late 1960s and 1970s. Podoces Vol 3, 1/2:1-30.
www.osme.org/tripreports/PODOCES%203- % 20 rare%20.

Temple, S.A., Wiens, J.A. (1989). Bird populations and environmental changes: can birds be bio-indicators? American Birds, Summer: 260–270.

Behrouz Behrouzi-Rad.
Kouzestan Science and Research Branch, Islamic Azad University, Ahvaz IRAN.