DETERMINING POPULATION TREND AND BREEDING BIOLOGY OF COMMON KESTREL (*FALCO TINNUNCULUS*) AT SIR BANI YAS ISLAND OF EMIRATES

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ABSTRACT

Successful breeding is associated with propagation and well-being of the species and requires a healthy and intact ecosystem. However, to analyse these effects, the knowledge of the natural behaviours and variations in the breeding biology of the birds is essential. Common kestrel (*Falco tinnunculus*) is widely distributed in Asia, Africa and Europe. The current study was designed to evaluate the population trends and breeding success of common kestrel in Sir Bani Yas Island from 2014-2018, and to provide an insight to the survival of this species in a restored habitat. Population of common kestrel was monitored through line transect method by categorising it into three habitat types viz. Mountains, Forests, and Pastures/open area. In each habitat category, two transects of 2,000 meters length and 200 meters width on each side were laid. The population data from three habitat types showed statistically significant difference in preference of habitat types (H-Value = 27.43, DF = 2, P-Value = 0.0000011). The birds showed preference of open/pasture habitats in non-breeding season and mountains during breeding season. The courtship and nesting started during early April and the eggs were laid during late April. The average clutch size was 3.75 ± 0.31 eggs per clutch. The average incubation period was 29.13 ± 0.52 days resulting in average hatchlings of 3.50 ± 0.53 chicks. The eggs were incubated 74.02 ± 1.69 % and were unattended for 24.54 ± 1.64 % of the total incubation period. The finding of this study can be used as future reference to study the breeding success of the species and provide cues for further improvement of the ecosystem conditions by improving the habitat condition on the Island based ecosystems.

Key words: Afforestation, Apex predators, Breeding Behaviour, Common Kestrel, Ecological health

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INTRODUCTION

Aves are one of the principal classes of vertebrates, surrogated as ecological health indicators. They assist in the assessment of changes in the ecosystem, ecological health, and effects and risks to the ecological set up by climate change and anthropogenic activities (O'Connell *et al.*, 2007). Birds of prey can endorse increased biodiversity by both facilitation of resources and making them available to species that could not otherwise avail them, and by trophic cascades, i.e. by affecting the trophic levels (Sergio *et al.*, 2008). Top predators are used as conservation tools and are very effective to determine ecological health (Ronka *et al.*, 2011).

Successful breeding is regarded as an indicator of a healthy and intact ecosystem; any changes in breeding success can immediately provide cues for degrading ecological health that can be a result of environmental changes or anthropogenic catastrophes (Ronka *et al.*, 2011). However, to analyse these effects and aim the interpretations towards the conservation and management interventions, the knowledge of the natural

behaviours and variations in the breeding biology of the birds is essential (Ronka *et al.*, 2011).

The reproductive success is influenced by many factors such as photoperiod, availability of food during the breeding season, climate conditions, geographic variation of the breeding areas, presence or absence of predators, as well as the extent of human disturbance. All these factors may affect the onset of the courtship, egg laying, clutch size and fledging success in a given ecological set up (Bustamante and Rodriguez, 2003; Carrillo and Gonzalez-Davila, 2010; Vasko *et al.*, 2011).

Common kestrel (*Falco tinnunculus*) belongs to family Falconidae and is listed as Least Concern (LC) in Red List of Threatened Species by IUCN (BirdLife-International, 2016). In the United Arab Emirates (UAE) it is winter visitor and passage migrant with some resident populations (Aspinall *et al.*, 2011). Common kestrel prefers mountainous and rocky areas but is also found in deserts, forests, farmlands, towns and gardens (Anushiravani and Roshan, 2017a; Aspinall *et al.*, 2011).

The breeding pairs usually select cliff, tree cavities, crags, poles, artificial nesting boxes or sometimes building structures; they are also known to

usurp nests from other species (Anushiravani and Roshan, 2017a; Hustler, 1983). The reported start of the courtship and nest selection is late March, and egg laying starts between late April and early May with an average clutch size of 3-6 eggs (Massemmin *et al.*, 2002; Valkama *et al.*, 2002). The incubation in common kestrel is reported to be between 27-31 days; and the average fledging period is 27-39 days (Valkama *et al.*, 2002; Anushiravani and Roshan, 2017a).

Sir Bani Yas Island was developed as a wildlife reserve for the conservation of endangered species. The island was transformed from barren, arid land to suitable habitat for more than 160 migratory and resident bird species by the plantation of more than two million trees (Mehmood *et al.*, 2014). The abundance of prey species started attracting many raptors including eagles, falcons, harriers, osprey and kestrel. As discussed earlier, to assess the ecological health by surrogating birds of prey, it is imperative to note their behaviours, population trends and breeding pattern over the period to be able to infer the signals of a requirement of conservation intervention. There is no reported study on the breeding of common kestrel in UAE and in Sir Bani Yas Island. The current study was designed to evaluate the population trends and breeding success of common kestrel in Sir Bani Yas Island and to provide an insight to the survival of this species in a restored habitat and to serve as a guideline for further studies and management interventions regarding the conservation of these apex predators.

MATERIALS AND METHODS

Study Area: Sir Bani Yas Island is regarded as the largest natural island in the Emirate of Abu Dhabi, UAE (Figure 1). It is 180 km south-west of Abu Dhabi city and 8 km offshore with a total area of 87km² (Kabeer *et al.*, 2020). The island is declared as a protected area for conservation of endangered and indigenous fauna and flora (Mehmood *et al.*, 2014). The detailed description of the study area is presented in Table 1.

Data Collection: Population and breeding success of common kestrel was studied from January 2014 till December 2018. Population of common kestrel was monitored through line transect method monthly (Sutherland *et al.*, 2004). The island was categorised into three habitat types viz. Mountains, Forests, and Pastures/open land. In each habitat category, two transects were laid; each transect was 2,000 meters long and 200 meters wide on each side (L = 2,000 m; W = 400 m) (Anwar *et al.*, 2015). Each transect was visited once a month. Two transects were at least 1,000 meters apart from each other. A pair of binoculars (Steiner Skyhawk 10x42) and a camera (Nikon DSLR 3200 with 400 mm lens) was used to identify and record the birds (Anwar *et al.* 2015). The species identification was verified through

field guide “Birds of the United Arab Emirates - A guide to common and important species (Aspinall *et al.*, 2011).

The birds were observed to identify their nesting sites. Once located, the nests were identified and their locations were recorded (AlRashidi and Shobrak, 2015). To monitor breeding activities, each nest was monitored early morning (7 to 8 am), afternoon (12-1 pm) and late evening (4:30 to 5:30 pm) for one hour each (three hours per day). The observation time and activities were limited to avoid disturbance and undue stress to the nesting birds. The team was properly camouflaged while monitoring the nests with binoculars. Each monitoring was done by a team of two observers. During 2017 and 2018, multiple teams were used to collect breeding data due to additional nests. The incubation and fledging periods were recorded. Moreover, clutch size, number of hatchlings, and number of fledglings were also recorded for each nest. Other parameters such as the times where parents were feeding the chicks, and chicks with and without parents were also recorded (Antonov *et al.*, 2007; Poirazidis *et al.*, 2009).

Statistical Analysis: The population and habitat selection parameters were subjected to Kruskal-Wallis H Test using Minitab® 18 statistical software. Hatching success percentage was calculated by dividing number of hatchlings with the clutch size; the fledging success percentage was calculated by dividing number of fledglings with the number of hatchlings. Additionally, the survival rate percentage was calculated by dividing the number of successful fledglings with the clutch size (Antonov *et al.*, 2007).

RESULTS

The population (mean $\pm$ SE) was 8.17 ± 0.60 , 9.75 ± 0.55 , 10.50 ± 0.56 , 12.42 ± 0.84 , and 16.67 ± 1.50 individuals during 2014, 2015, 2016, 2017, and 2018 respectively. Kruskal-Wallis Test confirmed a statistically significant difference (H-Value = 22.07, DF = 4, P-Value = 0.00019) in the populations over the course of five years i.e. from 2014 – 2018 (Figure 2). The higher population density was from April to September (Figure 3).

The population data from three habitat types showed statistically significant difference (Kruskal-Wallis Test) in preference of habitat types (H-Value = 27.43, DF = 2, P-Value = 0.0000011) (Figure 4). The mean population during each year in different habitat categories is presented in table 2. The birds showed clear preference of open/pasture habitats, especially for feeding. They used to select a vantage point such as a tree top or a pole and search for prey from it. In breeding season, they chose mountains.

During the study period total eight nests were monitored. Common kestrel on Sir Bani Yas Island preferred small crevices or cavities on vertical cliffs of

the mountains (87.5 %) about 12-15 feet above ground or on the top of high tower (12.5 %) more than 100 meters high. The average height of the nest was 31.81 cm with an average width of 25.70 cm. The birds also preferred same nesting sites used during previous breeding season. Common kestrel started courtship and nesting during early April and the egg laying started during late April. The average clutch size was 3.75 ± 0.31 eggs with a range of 2-5 eggs per clutch. The average incubation period was 29.13 ± 0.52 days (range = 27-31 days); resulting in average hatchlings of 3.50 ± 0.53 chicks. The hatching and fledging success are given in table 3. All the hatchlings successfully fledged the nest. Only one nest failed and yielded no hatchlings. The mean fledging period was 35.63 ± 5.16 days (range = 37 – 45 days).

The eggs were incubated 74.02 ± 1.69 percent of the total incubation period. The incubation was mostly by

female, where male would incubate during her absence only and for shorter durations. While they were unattended 24.54 ± 1.64 percent of the total incubation duration (Table 4). Parents spent 1.44 percent time feeding in the nests, where male would bring food for the female. During the total fledging period, 68.22 ± 0.46 percent time the parents attended the chicks; whereas, the chicks were unattended in the nests 28.09 ± 0.43 percent of the time and 3.69 ± 0.16 percent of the fledging period was spent by chicks on feeding (Figure 5). The hunting technique varied during breeding and non-breeding season, as common kestrel used flight-hunting as major hunting technique during breeding season, whereas, they used both flight and perch-hunting techniques during non-breeding season.

Fig. 1. Map of Sir Bani Yas Island, UAE, for breeding success study of Common kestrel (*Falco tinnunculus*)

Fig. 2. Yearly population trend of Common kestrel (*Falco tinnunculus*) from 2014-2018 at Sir Bani Yas Island, United Arab Emirates

Fig. 3. Monthly population trend of Common kestrel (*Falco tinnunculus*) from 2014-2018 at Sir Bani Yas Island, United Arab Emirates

Fig. 4. Population trend of Common kestrel (*Falco tinnunculus*) in different habitat types from 2014-2018 at Sir Bani Yas Island, United Arab Emirates

Fig. 5. Photographs of Common kestrel (*Falco tinnunculus*) at Sir Bani Yas Island, United Arab Emirates (a) presence of both parents at nest (b) female turning eggs during incubation (c) female during incubation at night (d) chicks in the nest waiting for parents to bring food

Table 1. Description of the area (Sir Bani Yas Island, UAE) for breeding success study of Common kestrel (*Falco tinnunculus*) (Mehmood *et al.* 2014).

S.	Parameters	Description
1	Total Area	8,700 ha
2	Area of Arabian Wildlife Park (AWP)	4,100 ha
3	Coordinates	24°20' N; 52°36' E
4	Avg. temp	18.1-35.8 °C
5	Annual rainfall/year	54.97 – 119.04 mm
6	Avg. humidity	26.3% - 56.6%
7	Total number of animals	16,000
8	Total trees planted	> 2 million
9	Total number of birds' species	165

Table 2. Mean population of Common kestrel (*Falco tinnunculus*) during the study period at Sir Bani Yas Island, United Arab Emirates.

Year	Population Mean ± SE in Different Habitat Types		
	Mountains	Forest area	Pasture/Open area
2014	2.17 ± 0.51	2.58 ± 0.31	3.42 ± 0.53
2015	2.25 ± 0.60	3.08 ± 0.23	4.42 ± 0.42
2016	2.50 ± 0.63	3.08 ± 0.31	5.08 ± 0.56
2017	3.17 ± 0.81	3.33 ± 0.48	5.92 ± 0.79
2018	5.92 ± 1.46	4.17 ± 0.82	6.83 ± 1.11

Table 3. Breeding success of Common kestrel (*Falco tinnunculus*) during the study period at Sir Bani Yas Island, United Arab Emirates.

Breeding Success Variables	Value
Number of Nests	8
Average Clutch size (Numbers)	3.75 ± 0.31
Average number of hatchlings	3.50 ± 0.53
Average number of fledglings	3.50 ± 0.53
Hatching Success (Percentage)	87.50 ± 12.50
Fledging success (Percentage)	100.0 ± 0.00
Total Nests Failed (Numbers)	1

Table 4. Incubation and Parenting routine of Common kestrel (*Falco tinnunculus*) during the study period at Sir Bani Yas Island, United Arab Emirates.

Incubation and Parenting Variables	Value (Mean ± SE)
Total incubation period	29.13 ± 0.52 Days
Time for eggs incubation by parents during incubation period	74.02 ± 1.69 %
Feeding time by parents during incubation	1.44 ± 0.13 %
Time during incubation while eggs were unattended	24.54 ± 1.64 %
Total fledging period	35.63 ± 5.16 Days
Time Chicks were attended by parents during fledging period	59.70 ± 8.54 %
Time Chicks were unattended by parents during fledging period	24.57 ± 3.53 %
Time chicks were fed during fledging period	3.23 ± 0.48 %

DISCUSSION

The population trend, habitat preference and breeding success of the common kestrel were studied first time on Sir Bani Yas Island. Birds of prey can impact the

bird diversity of an area by regulating the resources and controlling the prey populations (Sergio *et al.*, 2008).

The results of current study show a steadily establishing population of common kestrel on Sir Bani Yas Island. The increase in population suggests

abundance of resources (such as shelter and prey) on the island and the success of the extensive afforestation efforts to create a suitable habitat for endangered, resident and migratory fauna on the island (O'Connell *et al.*, 2007). There was a surge in population from late April until September on the island. The population was higher during these months due to addition of hatchlings and later declined when the fledglings dispersed out of the island in October.

Common kestrel preferred habitats with pastures and open areas during non-breeding season and for predation. This could be attributed to the abundance of the prey and clear vantage to search their prey species. During breeding season, the birds preferred nesting in mountainous habitats. This preference can be due to the safety and privacy of the nests and chicks (Roberts, 1991). The preferred habitat of common kestrel coincides with our findings; as they are reported to exist in mountainous areas, forests, farmland and pastures (Anushiravani and Roshan 2017a; Aspinall *et al.*, 2011; Casagrande *et al.*, 2008).

The gradually establishing population and successful breeding of common kestrel on Sir Bani Yas Island also indicates the good health of the ecosystem as successful breeding is directly proportional to the ecological health (Ronka *et al.*, 2011). The preference of nesting site was for small crevices and cavities in the mountainous areas. Other studies also suggest that common kestrels prefer cliffs as nesting sites but are also found to nest on artificial structures and even nest boxes (Shrubb, 1993). The average nest dimensions of common kestrel nests were higher than the dimensions in studies from (Anushiravani and Roshan, 2017) who reported the nest dimensions from 32 sites to be 19.7 x 21.9 cm. However, this could be dependent on the availability of the good nesting sites, as the pair was not observed to expand the nests or to alter them significantly from their original condition.

The average clutch size in the current study was within the described range of 3-6 eggs (Massemin *et al.*, 2002; Valkama *et al.*, 2002); but the mean clutch size was lower as compared to 5.03 ± 0.7 eggs in a study conducted in Iran (Anushiravani and Roshan, 2017a). Only one nest had a lower clutch size of two eggs and was the only nest that failed to produce any hatchlings. Due to failure of one nest the hatching success dropped to 87.50 ± 12.50 percent; as all other nests had 100% hatching rate. Due to abundant food supply and critical nesting site selection, the fledging success was cent per cent. The hatching rate (87.50 %) was higher in our study compared to 84.4% reported in Iran along with the fledging rate which was previously reported as 73.9% (Anushiravani and Roshan., 2017a).

The incubation period in the current study coincided with the previous studies ranging from 27 – 31 days; the average fledging period in the current study was

similar to the previous studies on common kestrel (Anushiravani and Roshan, 2017a; Charter *et al.*, 2008; Valkama *et al.*, 2002).

The eggs were incubated 75% of the total incubation period and were left unattended 25% of the time during incubation period. Due to the choice of nesting site, there was no threat to the unattended eggs or chicks (unattended in the nest about 28% of total fledging period). All the nests were inaccessible to humans, predators or other animals. However, in the failed nest there were pugmarks of rock hyrax (*Procapra capensis*) near the nest. We could not establish a link of rock hyrax presence to the failure of the nest; due to absence of concrete evidence.

The male brought food for female 1.44% of the incubation time when female did not leave the nest for feeding; the male would bring food to the female. Mostly the prey species brought by the male were ocellated skink (*Chalcides ocellatus*), gecko species, gerbil species, parts of rock pigeon (*Columba livia*) and grey francolin (*Francolinus pondicerianus*). There were also many other prey items that could not be identified with binocular. Various studies have reported 49 prey items (Charter *et al.*, 2008) 172 prey items (Anushiravani and Roshan, 2017b) and 349 prey items (Gao *et al.*, 2009) for common kestrel during breeding season. Considering the abundance of prey species, safe nesting sites and successful breeding; it is indicative that the ecological health at Sir Bani Yas Island is in favour of biodiversity, especially propagation of raptors.

Successful breeding and healthy population is regarded as an indicator of a healthy and intact ecosystem; any decline in breeding success and population can immediately provide cues for degrading ecological health that can be a result of environmental changes or anthropogenic catastrophes. This could be attributed to the presence of the prey and clear vantage to search their prey species. Common kestrel started courtship and nesting during early April and the egg laying started during late April. Both parents take part in incubation and rearing of chicks. Male was more involved in hunting and feeding operations for the female and chicks.

Conclusion: The increase in population of Eurasian Kestrel during the study period suggests abundance of resources on the island and the success of the extensive afforestation efforts to create a suitable habitat. The bird prefers pastures and open areas during non-breeding season and for predation. The finding of this study could be used as future reference to study the breeding success of the species and provide cues for further improvement of the ecosystem conditions by improving the habitat condition at the Island. However, the observations on incubation and parental care can be further studied using camera traps to have concrete information on nest failure.

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