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Breeding Activities and Success of Pleske's Ground Jay *Podoces pleskei* in Touran Biosphere Reserve, Semnan Province, Iran

NOOSHIN SATEI*[1], MOHAMMAD KABOLI[2], SAEID CHERAGHI[1], MAHMOUD KARAMI[2], MITRA SHARIATI NAJAFABADI[2] & REZA GOLJANI[1]

[1] *Biodiversity & Habitats Division, Faculty of Environment & Energy, Science & Research Branch, Islamic Azad University, Tehran, IRAN*

[2] *Department of Fisheries and Environment, Faculty of Natural Resources, University of Tehran, Tehran, IRAN*

* *Correspondence Author. Email: nooshin112003@yahoo.com*

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Abstract: The breeding biology of Pleske's Ground Jay *Podoces pleskei* was studied on the Mehrano Plain (in Touran Biosphere Reserve, Iran) from February to May in 2007 and 2008. Nest sites were located mainly in the top centre of dense vegetation, such as thorny bushes of *Atraphaxis spinosa, Ephedra intermedia* and *Zygophyllum eurypterum*. The cup-shaped nests in *Atraphaxis* bushes and dome-shaped nests in other species shrubs like *Ephedra* and *Zygophyllum* were built from thin branches and twigs that help protect nestlings against direct radiation from the sun. Clutch sizes varied from three to six eggs (4.1±0.6 mean ± SD) laid at the end of February. Hatching occurred within 17.5±1.5, mid-March. The probabilities of survival were: eggs' during the incubation period 0.436, chicks during hatching period 0.86 and nestlings 0.963. The overall breeding success from the beginning of the incubation period until fledging was 0.36. The maximum mortality rate was calculated during the incubation period. Predators, such as Eastern Desert Monitor *Varanus griseus caspius* were important threats affecting egg survival. Reducing the rate of such threats during the incubation period through an effective management action plan would increase the breeding success rate of Pleske's Ground Jay.

***Keywords*:** Breeding biology, breeding success, Iran, Mayfield method, *Podoces pleskei*, Touran Biosphere Reserve.

INTRODUCTION

Pleske's Ground Jay *Podoces pleskei* Zarudny 1896 is a near endemic species of the arid and semi-desert plains of central Iran such as in Semnan, Esfahan, Yazd, Khorasan-e Razavi, South Khorasan, Kerman, Sistan-Baluchestan and Fars provinces (Sehhatisabet 2007). There is little knowledge of the species' ecology and biology (Balutch 1977, Dayani & Baloutch 1985, Hamedanian 1990, 1997, 2000; Sehhatisabet 2007). The lack of basic information on the biological and ecological traits of this species required the collection of information about breeding start dates and breeding habitat and nest site characteristics. Only then could breeding biology and breeding success rate be studied.

The percentage of successful nests is often used as a measure in reproduction biology studies. To do this, it is necessary to know the exact time of first egg-laying and hatching based on regular nest visits. In a vast area such as that in the Touran Biosphere Reserve, it was not possible to find all the nests before the first egg was laid. In many field studies, nests are first found at various stages of the breeding cycle depending upon the species, colony and habitat. Consequently, the data are incomplete, but in such cases, a remedy is the use of Mayfield's (1961, 1975) methods of estimating nest survival. Another option would be to adopt an alternative approach for estimating breeding success, for example, the "Systematic Nest-searching" and "Time-to-failure Analysis" techniques (Nur *et al*. 1999). However the former could not be applied in our study area. The latter does make fewer assumptions than the Mayfield method and allows nests whose ultimate fate is unknown to be included in the analysis, but its drawbacks are that it is very complicated and uses a more complicated analysis (Nur *et al*. 1999). Therefore Mayfield's method was selected as the preferred method

for analysis of the data collected in this study because of its simplicity produced acceptable results without complicated analysis.

Touran Biosphere Reserve is representative of desert areas preferred by the study species and has high and unique ecological value that enabled it to become the most important region under the management of the Department of the Environment (DOE) (Amery & Karami 2003). Furthermore, Pleske's Ground Jay had its highest population here (Sehhatisabet 2007) and so studying it is comparatively easier than elsewhere in Iran. This study attempts to estimate the breeding success of Pleske's Ground Jay by the use of the Mayfield method.

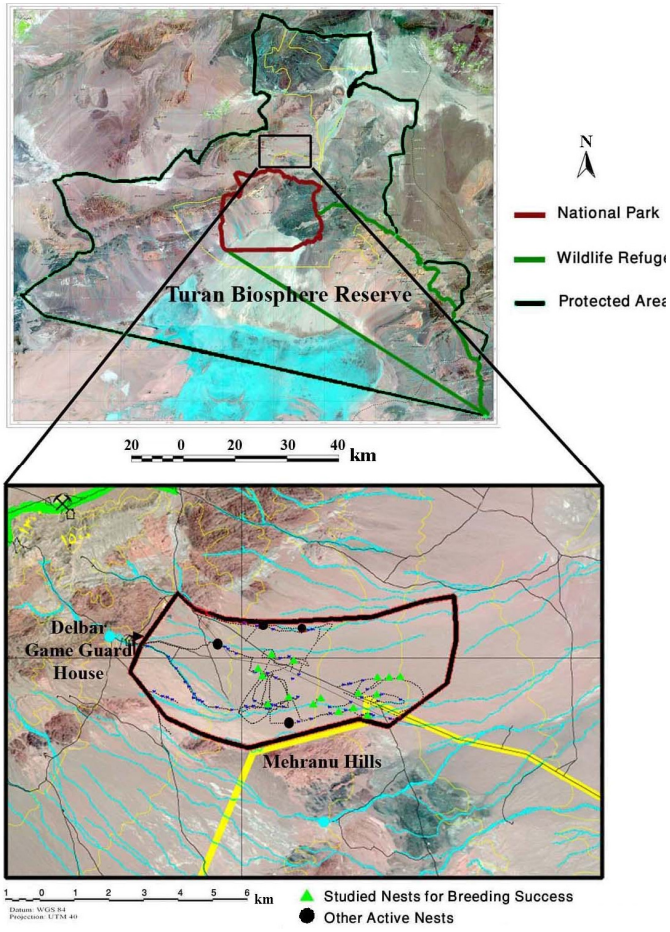

Figure 1. Location of Touran Biosphere Reserve and the Mehrano Plain.

STUDY AREA

This study was conducted in the Mehrano plain in the Touran Biosphere Reserve (B.R.) and Protected Area (54°22'–54°18'N, 49°50'–49°44'E, 950 m a.s.l.). Pleske's Ground Jay is usually distributed widely across the arid and semi-arid plains of the central desert of Iran. Previous observations had suggested that the northern and western parts of Touran B.R (such as the Mehrano plain) supported suitable Pleske's Ground Jay population. This plain is a relatively large area, cut by of the Khankhody-Ahmadabad road and stretching east to the Delbar Game Guard Station and the hills of Mehrano to the south. It is about 12 km long and 5.5 km wide (Fig. 1). Dominant plants species include *Zygophyllum eurypterum, Artemisia sieberiits* and *Ephedra intermediate*. The only permanent source of water in this area is the artificial Mehrano water storage pond complex. There are also several large seasonal streams that cross the area. The streambeds and adjacent areas are covered in *Atraphaxis* sp. The area's climate is arid and semi-arid, with temperature minima and maxima in the coolest and warmest months respectively of 15˚C and 40˚C (Mahabadian 1982). This area is also one of the important habitat for many species, some of which are in the IUCN Red Lists; for example, Cheetah *Acinonyx jubatus venaticus*, Persian Leopard *Panthera pardus saxicolor*, Goitred Gazelle *Gazella subgutturosa,* Persian Wild Ass *Equus hemionus*. Other species here under protection in Iran (also Red-listed are Macqueen's Bustard *Chlamydotis macqueenii* and Eastern Desert Monitor *Varanus griseus caspius* (Amery & Karami 2003).

MATERIALS AND METHODS

Pleske's Ground Jay begins egg-laying in early March, and so mating and nest building must occur in February. We carried out our study over two breeding seasons, 2007 and 2008, from February to May, in Touran Biosphere Reserve. In the first year, we focused on the species' breeding ecology and biology and then

pursued the calculation of breeding success in the following year. In mid-February, four people began to search the Mehrano plain for nests. This search continued throughout the breeding season. GPS nest coordinates were recorded (Fig. 1). The sheer size of the study area imposed a physical limitation on the numbers of nest visits. We monitored nests at 3- to 4-day intervals.

Once a nest was found, we recorded such variables as shrub species and their height. We also recorded the shape and colour of eggs on the first visit on which we found eggs. On each visit we checked the number of eggs and clutch size. We noted additional factors such as nest structure and its location details, even after fledging for nests found late on. We measured the nest parameters for the 21 nests found in this area, but access limitations meant that we could calculate breeding success for only 17 (Fig. 1). From the 21 active nests, we were able to check four from before the first egg was laid until the clutch was completed.

We followed bird survey protocol strictly throughout all breeding stages in our study were to minimise disturbance (*e.g.* we checked nests from as far away as possible with as few people as possible), we do not rule out that the presence of the researchers in the area might have influenced the breeding success of this species. Because of our knowledge of specific biological and behavioural traits of Pleske's Ground Jay, in some cases we were able to employ low-disturbance study methods based on previous experience gained elsewhere with other species (Moreno 2007, Mezquida 2001, Morrison 1999). . For example, we built dens to use as hides. In such studies, it is suggested that teams should limited to only two people when monitoring nests and collecting on-site data (Martin & Geupel 1993). The minimum number of visits undertaken with minimum disturbance to the nesting area will reduce the risk of attracting predators such as foxes *Vulpes* spp. and monitors *Varanus* spp. to the nests.

The breeding season of each Pleske's Ground Jay nest comprises three stages: incubation (between laying the first and the last egg), hatching (between laying of the last egg and hatching the first egg) and nestling (between hatching the first egg and fledging the last chick). The Survival Probability was calculated for each of 17 nests and for the three breeding stages using Mayfield's (1961) method. First, we calculated the Daily Mortality Probability rate, *r,* as *n/E*, where *n* = number of nests failing and *E* = total number of exposure nest-days. The concept is that counting exposure-nest days continues until the brood hatches (successful nests) or until the nest failed (unsuccessful nests). The total exposure nest-days for each of the above three stages is the summation of all days on which observations were made at each nest. A nest lost during a no-visit interval of several days is arbitrarily assumed to have been lost on the middle day of the interval. Additionally, the egg/nestling-exposure days were also calculated for the breeding stages. The Daily Survival Probability for each stage is $S = (1-r)$, where r is mortality rate. The survival probability of each stage for a period of days, d is $S^d=[1-(n/E)]^d$. The average incubation period of 17.5 days and average nestling period of 14.5 days were used for the calculation of survival rates. However, for the hatching stage, because of uncertainty of exact dates for most of the nests, breeding success rate was calculated as the percentage of number of all hatched eggs over the number of all eggs laid. Finally, the probabilities of survival rates in the different breeding stages were combined (by multiplying together the individual probabilities) to estimate the overall probability that an egg at the start of incubation will produce a fledgling, as follows: $S^d_{overall} = S^d_{incubation} \times S^d_{hatching} \times S^d_{nestling}$ where $S^d_{incubation} = S^d_{nest} \times S^d_{eggs}$ (Mayfield 1961).

RESULTS

Nests

Most observations of Ground Jay nests were recorded in the seasonal river-bed and on *Atrphaxis spinosa* (61%), but rarely on *Zygophylum eurypterum* (Figs. 2–3). Nests were cup-shaped in *Atraphaxis spinosa* bushes that had a good coverage, but dome-shaped in other species shrubs like *Ephedra* and *Zygophyllum*. The nests were and made from thin branches and twigs. The dome of twigs minimised the risk from avian predators and protected the nestlings from direct sunlight. Nests were sufficiently spacious that they could

accommodate eggs, and hatched chicks and a parent. They were also concealed well-enough to be invisible from fairly close. Usually nest-site selection is made in the top half of bushes, whose height reached 135 cm in this study. The average height of nests above ground was 86.4±7.19 cm (Height ranged from 40 to 115 cm, *N*=21).

Clutch size and characteristic of eggs

The female lays 3–6 eggs, the clutch size in our study bein4.1±0.6 (*N*=21, Fig. 4). Egg shape was elliptical to long elliptical and colour was dirty white to cream, with light brown spots (Fig. 5). Eggs averaged 28.35 mm in length, 20.65 mm in breadth and 6.01 g in weight (*N*=88).

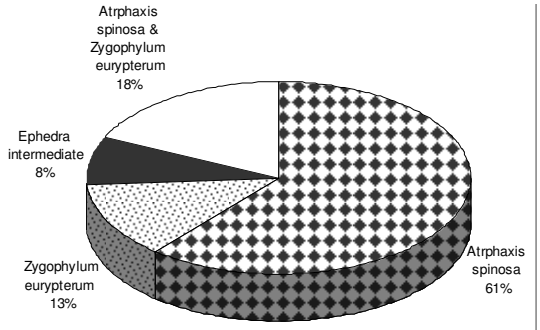

Figure 2. Frequency of different shrubs as nesting site of Pleske's Ground Jay *Podoces pleskei* in Touran.

Figure 3. Nest of Pleske's Ground Jay *Podoces pleskei* among *Zygophyllum eurypterum* and *Ephedra intermediate* shrubs.

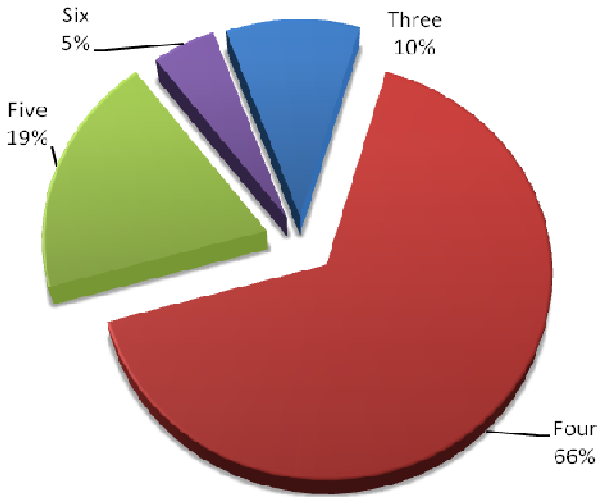

Figure 4. Clutch size of active nests.

Figure 5. A nest with eggs and chicks.

Egg-laying, incubation and hatching periods

Our results show that Pleske's Ground Jay breeds only once per year. Of 21 nests, in seven egg-laying began from 13 February to 2 March, 6 from 11 to 21 March, and one nest egg-laying on 30 March. We lack the no data at the remaining nests. In four nests checked for hatching eggs, clutch sizes (3, 3, 4, 5) were completed within 48 hours (Table 1).

Hatching occurred from 4 March to 17 April and the incubation period was 17–19 days (mean: 17.5±1.5, *N*=38). For this species, it seems the hatching period for the full clutch occurs over two days. Young birds fledged after 12–17 days (mean: 14.5, *N*=32) in the 20 March to 29 April period. We noted that the parents cared for the chicks for about two months after the nestlings had left the nest.

Table 1. Monitoring of four nests for the completeness of clutches between 13 February and 23 March. The / symbol marks the difference between morning and afternoon egg numbers.

Nest no.	First day	Second day	Third day	Fourth day
1	0/0	2/3	3/3	3/3
2	0/0	1/2	3/3	3/3
3	0/0	1/1	2/3	4/4
4	0/1	2/3	4/5	5/5

Nest survival

A total of 17 nests was monitored during the incubation period over 207 exposure days. In this group only one nest was destroyed. Therefore, the nest survival probability during the incubation period was ($S^d_{nest} = [1-(1/207)]^{17.5}$ =) 0.918. Since no nest was destroyed in the nestling period, the nest survival probability was 1.0.

Breeding success

Of 69 eggs laid, 31 eggs were destroyed during 745 exposure days, making egg survival probability for this period ($S^d_{eggs} = [1-(31/745)]^{17.5}$ =) 0.475. The probability of egg survival during the incubation period in combination with nest survival during the incubation period (0.918) was 0.436 (Table 2).

Among 38 eggs hatched, 33 nestlings survived for at least two days after the first egg hatched in each nest. Thus the probability of survival in the hatching period was 33/38=0.86 (Table 2).

Among 33 nestlings, only one was lost during 394.5 exposure days, making nestling survival probability ($S^d_{chicks} = [1-(1/394.5)]^{14.5}$ + $S^d_{nestlings} = S^d_{nests} \times S^d_{chicks}$ =) 0.963 (Table 2).

The overall egg and nestling survival from the beginning of incubation to the fledging period requires multiplying the individual probabilities of each stage: ($S^d_{incubations} \times S^d_{hatchings} \times S^d_{nestlings}$ =) 0.435×0.86×0.963 = 0.36.

Table 2. Number of surviving nests, eggs and chicks in different periods of breeding activities.

Periods	No. of nests	No. of destroyed nests	No. of destroyed eggs/chicks	No. of survived eggs/chicks	Total exposure days	*d* (mean no. of days	Daily survival	Breeding success (of eggs/chicks)
Incubation period (from eggs laying to hatching)	17	1	31	38	207 (for nests) and 745 (for eggs)	17.5	0.958	0.436
Hatching period (from hatching first egg to last egg)	16	0	5	33				0.86
Nestling period (from eggs hatching to leaving nest)	16	0	1	32	394.5 (for nestlings)	14.5	0.99	0.963

DISCUSSION

Pleske's Ground Jay occurs in the Touran protected complex, in extensive, low-slope and relatively flat deserts covered by *Zygophlum* sp. and *Artemisia* sp growth. Gubin *et al.* (1986) records that other *Podoces* species, including Pander's Ground Jay *P. panderi* (Rustamov 1970) select vast semi-dry deserts for their breeding. Sehhatisabet (2007) has documented habitat loss (due to conversion to agriculture, removal of shrubs for fuel-wood, and overgrazing by domestic livestock like sheep, goats and camels) as the principal factor adversely affecting the population of the Pleske's Ground Jay in Iran.

Since the studies showed that the Pleske's Ground Jay begins to lay eggs in February, copulation and nest building very probably occurs in January. Based on studies of Pander's Ground Jay by Bardin (1989), egg-laying begins at winter's end in the deserts of Mongolia, in February and lasting until late in the month.

Like Pander's Ground Jay, incubation for Pleske's Ground Jay starts upon laying the first egg (Gubin *et al.* 1986). Our study suggests an incubation period of 17±1.5 days), largely in agreement with Hamedanian (1990) (16–18 days) and Gubin *et al.* (1986) in Turkmenistan (16–19 days). After the nestling period (mean 14.5 days) and when there is no sufficient space for them inside the nest, the young leave the nest and settle under nearby bushes, which agrees with Hamedanian (2000) (15–18 days). For Pander's Ground Jay, Gubin *et al.* (1986) recorded 17 days. However, our record of six eggs in a clutch is the first for Pleske's Ground Jay. The average clutch we found (4.1) is slightly less than that of Gubin *et al.* (1986) for the related, than for Pander's Ground Jay (4.8).

Clutch completion takes about two days (in our small sample size of only four nests (Table 1)). We cannot know for certain whether only one female was laying eggs, because no bird was individually marked. Since such rapid clutch completion is unusual in birds, this aspect needs much further study and should involve a larger sample size and the marking of females. However, this species previously showed another unusual characteristic related to plumage; it expands its plumage to make it less conspicuous (Londei 2001a, b). The clutch size of 6 eggs might indicate that they have been laid by more than one female, and if this occurred within the normal laying period for a clutch, could also enable hatching to occur over the normal hatching period. In agreement with Hüé & Etchécopar (1970), the shape and colour of eggs resemble those of other members of the crow family.

The breeding period is the most sensitive and critical process in the life cycle of birds. Therefore, the determination of breeding success of different bird species, especially if rare and endangered, is highly important for the management and conservation of bird species. Although Pleske's Ground Jay has a wide distribution range, its numbers are low, and it is difficult to find (Hamedanian 1990). We hope that radio-transmitters recently put on four birds in a project in Iran (Cheraghi *et al.*, unpubl. data 2009) will reveal additional information on other aspects of the species' activities, especially their movements.

The results have shown the greatest level of risk in the reproduction cycle of this species occurred during the incubation period in which just under half the eggs were lost. Of the lost eggs, about 55% were destroyed by predators, especially reptiles. On the other hand, some 36% of eggs that were not lost, failed to hatch for a variety of reasons. The Pleske's Ground Jay incubation period in Touran coincided with cool blustery spring winds and sudden seasonal precipitation that posed severe threats to the eggs. Nestling mortality was low in the nestling period. This can probably be related to the characteristic high alertness and close attendance of the parent birds in the care and defence of chicks and nests as well reduced intensity of natural threat factors such as severe winds and intense precipitation. It is important for comparison purposes and to build a good database that other studies be undertaken of the breeding biology of this species in other regions. Without sufficient high-quality data from further field surveys, it will not be possible to assess the applicable IUCN categories accurately for this species.

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