BREEDING BIOLOGYOF BURMESE BUSHLARK, *MIRAFRA MICROPTERA* HUME, 1873 IN BAGAN ENVIRONS

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Abstract

Study on the breeding biology of avian species is the key to understand their behavior, demographics, and population dynamic. Thus, the present study was intense on this field in little know of Myanmar endemic species, Burmese Bushlark (*Mirafra microptera*) to fulfillthe regional data gap. The monthly field survey was conducted from March 2017 to September 2019. Fifty-one nests were found in three years study periods. The breeding seasonof *Mirafra microptera* was from the beginning of March to the mid of September with 1- 2 eggs in clutch size. Twenty-six eggs out of 100 eggs hatched with the hatching success (26%),fledgling successes (81%), breeding success (41%), and crude breeding success (21%) recorded for three years study periods. Breeding success was a significantly negative relationship with temperature and a positive relationship with humidity.

Keywords: Burmese Bushlark, breeding season, clutch size, hatching, fledgling and breeding success

Introduction

Information on breeding biology and performance is an important part of the population ecology of birds and is essential in effective conservation measures for endemic, threatened, and declining species (Martin *et al.*,2000).The breeding ecology of larks being mainly monogamous and territorial, they breed either as isolated pairs or in loose colonies, they nest on the ground, females are solely responsible for nest construction and incubation, clutch sizes are usually small but vary considerably, nestling growth and development is extremely fast, breeding success is generally poor and post-fledging dependence lasts relatively long (De Juana *et al.*2004). Larks breed either seasonally or particularly amongst nomadic species, opportunistically after irregular rain has fallen in semi-arid and arid regions. Breeding in larks is triggered by different environmental conditions for different habitats. In general, larks breed during the wet season or after irregular rains in arid areas when primary production is greatest and invertebrates are more abundant (Dean, 2004).

Bagan is one of the Key Biodiversity in Myanmar Central Dry Zone which is locatedin Nyaung U Township, Mandalay Region with an annual rainfall of 621.73 mm (24.47inches) and temperature ranges (25 – 39.2 °C). The natural vegetation includes semi-desertplant species, thorn bushes, and shrubs and scatters dwarf plants. Thus, the distribution ofBurmese Bushlark (*Mirafra microptera*) has a very large range in Myanmar central dry zoneonly. Moreover, a detailed study on reproductive performance of Burmese Bushlark in thestudy area has not been yet. Therefore, the present study has been focused on the breedingecology of *Mirafra microptrea* in Bagan environs. The specific objectives of the study were to record the breeding activity of the study species, to examine the breeding success of thestudy species and to determine the relationship between some environmental factors and breedingsuccess.

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Materials and Methods

Study area and study period

The present study was conducted in Bagan environ which is situated in Nyaung U Township, Mandalay Region (21˚7'N to 21˚12'N and 94˚52' E to 94˚56' E) from March 2017 to September 2019.

Identification

Identification of study bird species was followed by Alstrom (1998), Smythies (2001),and Robson (2011). Identification of plant species were referred to Hundley and Chit Ko Ko, 1987.

Field survey method and data collection

Weekly nest observation was conducted with the help of field assistants. Nests searching were predicted by habitat types and parental behavior cues of the target species. When a nest was found, a thorough observation was done by two days per week to collect thedata and to search for breeding activities: adults carrying nesting materials. Nest diameter,cup depth, clutch size, the length (*l*), and width (*w*) of the eggs were measured by ruler and measuring tape to the nearest centimeters. The nest micro-habitat structure was recorded within 1 m^2 quadrant of the nest. Nest orientation was determined with the aid of a compass. The growth and development of individual nestlings were recorded every two days. Nestling development was recorded concerning plumage development and growth. Parental care was observed by the aid of a camera trap (Nikon 300 and Meizu) from a hiding place (2–3 meters away).

Analysis of environmental factors

Temperature and humidity were measured by using a thermohygrometer. Rainfall wastaken from the Department of Meteorology, Nyaung U Station, Mandalay Region.

Data analysis

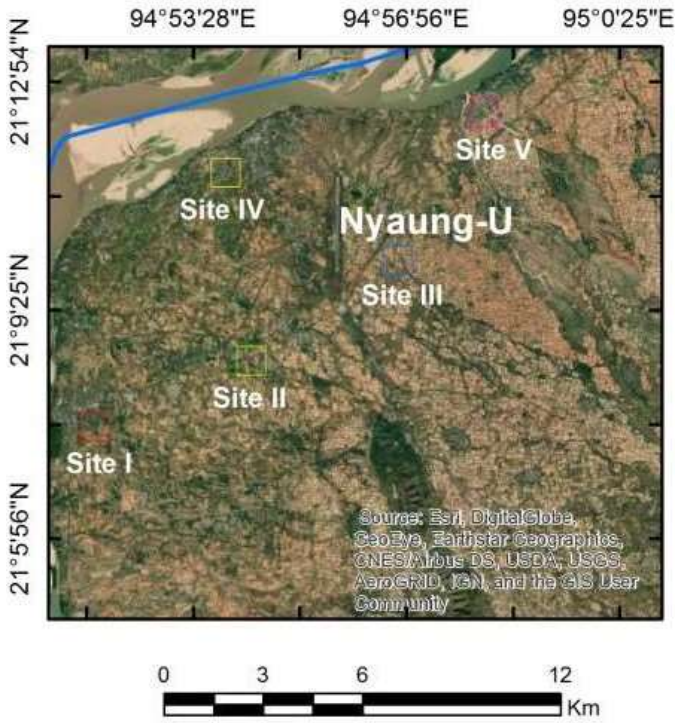
From the time of scraping ground of the base of the host plant to the nest built was regarded as the nest construction period. The incubation period was started from the egg- laying period to the hatching period. Hatching success, fledgling success, and breedingsuccess were estimated by Mayfield's (1975).

$$\text{Hatching success (\%)} = \frac{\text{Number of birds young}}{\text{Total number of eggs}} \times 100$$

$$\text{Fledgling success (\%)} = \frac{\text{Number of birds fledgled}}{\text{Number of hatching}} \times 100$$

$$\text{Breeding success (\%)} = \frac{\text{Nest with fledling sucess}}{\text{Total recorded nests}} \times 100$$

$$\text{Crude breeding success (\%)} = \frac{\text{Number of fledlings}}{\text{Total recorded of eggs}} \times 100$$



(**Source:** Goggle Earth, 2019)

Figure 1 Map of the Study Area

Results

Breeding season of *Mirafra microptera*

The breeding season of the study birds started from the onset of March to mid- September. In early March of the study periods, the male birds initiated the display flight songs. In mid-September, the reproductive process was successful (Plate 1A, B).

Nesting period and nest of *Mirafra microptera*

The present study witnessed the nesting behavior of *M. microptera* at the commencementof April and continued to the mid of September during the three-year study periods. Fifty-oneactive nests (12 nests in the year 2017, 19 nests in the year 2018, and 20 nests in the year 2019)were recorded. Nesting was the peak in the onset in June, July, and the second peak in May andthen a few nests in April 2017 (Table 1 and 2).

Nest construction of *Mirafra microptera*

The nest construction was fairly deep scrape in the ground first and then lined with fine grass blades and rootlets. *M.microptera* used only one kind of material (Grass, *Sarga* sp.)with a length of 30cm for nest. *M. microptera* spent three days on the construction of the nest.The nest of *M. microptera* was dome shape. The majority of nests faced to the south (32%) and the rest to north-east (23%), south-east (16%), north and south-west (10% each), north- west (6%) and east (3%). The nest site selection of *M. microptera* was the cropland without crop that has the base of herbs for the nest. Most nests (74%, n= 30) constructed at the baseof the forbs plant (*Sida cordofolia*).The remaining nests were on the grass tuft (*Sarga* sp.) (26%, n= 30) (Plate 1 C, D)

Clutch size of *Mirafra microptera*

A total of 100 eggs were recorded from 51 nests with the mean clutch size (1.96±0.19 eggs). Clutch size ranged from 1–2 eggs per nest was recorded during the study period. The mean inter-annual differences in clutch size were 1.83±0.3eggs in the year 2017, 2±0.00 eggs in the year 2018 and 2±0.00 eggs in the year 2019 (Table 1).

The mean nest diameter of *M. microptera* was 10.41±1.67cm in length and 5.5±1.58cm in width. The mean nest depth was 3.66 ± 0.6 cm (Table 1).

The mean dimension of egg size (2.22±0.48 cm in length and 1.26± 1.2cm in width) was within the range of 2-3 cm in length and 1-2 cm in width (Table 1).

Incubation period of *Mirafra microptera*

The incubation commenced upon lying of the first egg, and the incubation period was 12 to 13 days (12.42± 0.85 days) (Table 2).

Hatching success of *Mirafra microptera*

Twenty-six eggs out of 100 eggs hatched with the hatching success (26%) for three years study periods. For the year 2017, the hatching success was 18%, 21% in the year 2018, and 35% in the year 2019 (Table 2).

Breeding success of *Mirafra microptera*

For breeding success, *M. microptera* laid a total of 100 eggs in 51 nests, and from which 26 hatched, and 21 fledged successfully. The breeding success rate was 39%. As the yearly breeding success 25%, 37%, and 55% were recorded in the years 2017, 2018, and 2019 respectively (Table 2).

Crude breeding success of *Mirafra microptera*

The crude breeding success of *M. microptera* was 14% in the year 2017, 18% in the year 2018, and 28% in the year 2019.Overall crude breeding success was 21% (Table 2).

Some behaviors of parental care

Some behaviors in parental care: guiding the nest, polishing the nest, cleansing the nest, feeding, and flying were found during the study periods. Before *M. microptera* entered the nest, she guided and checked 2 meters around the nest for 2 minutes. Nestlings were fed caterpillar and arthropods by both parents (Plate 3A, B).

Relationship of weather parameters and breeding success

The environmental condition of the study area was within the range of 26.5˚C to 35˚Cfor minimum temperature, 36.5˚C to 45.8˚C for maximum temperature; 37% to 72% for minimum humidity, 93% to 100% for maximum humidity; 0 to 121 mm for rainfall during the study periods. Detail environmental weather conditions is shown in Table 3.

The relationship between studied weather parameters and breeding success of the *M. microptera*, the breeding success of the study bird species was a strong negative co relationship to the temperature ($p<0.01$). When the environmental temperature of the study area was high, the breeding and hatchability of the egg were low. In contrast, the breeding commenced after the first rain. Spearman's rho correlation test revealed that the breeding success of the study bird species was a strong positive relationship with the humidity ($p<0.01$) (Fig.2 and Table 3).

Table 1 Measurement of nests, eggs and clutch size of *Mirafra microptera* in the study area

Measurement	Number	Year 2017	Year 2018	Year 2019	Total
		Mean±SD (Range)	**Mean±SD (Range)**	**Mean±SD (Range)**	**Mean±SD (Range)**
Clutch size (no.)	51	1.83±0.3 (1 – 2)	2±0 (2)	2±0 (2)	1.96±0.19 (1 – 2)
Nest length (cm)	30	8.54±0.59 (8 – 9.5)	11.05±1.6 (8 – 13)	11.5±0.7 (10 – 12)	10.41±1.67 (8 – 13)
Nest width (cm)	30	3.7±0.3 (3 – 4)	6.33±1.6 (3.4 – 8)	6.33±0.5 (5.5 – 7)	5.5±1.58 (3 – 8)
Nest depth (cm)	30	3.11±0.54 (2.5 – 4)	4.05±0.53 (3.5 – 5)	3.79±0.27 (3.5 – 4)	3.66±0.6 (2.5 – 5)
Egg length (cm)	60	2.24±0.15 (2 – 2.25)	2.24±0.13 (2 – 2.5)	2.18±0.1 (2 – 2.4)	2.2±0.48 (2 – 2.5)
Egg width (cm)	60	1.51±0.18 (1.2 – 1.7)	1.31±0.16 (1 – 1.8)	1.24±0.07 (1.1 – 1.4)	1.26±1.2 (1 – 1.8)

A. Pairing behavior

B. Male singing

C. Nest built at the base of the ForbOrientation: East Clutch size (One egg)

D. Nest built at the base of the grass Orientation: South-eastClutch size (Two egg)

Plate 1 Some courtship behavior and nest condition of *Mirafra microptera*

Table 2 Breeding success of Mirafra microptera in the study area

Year	Months	Nest observed	Eggs laid	Incubation days	Hatching	Fledgling	HS%	FS%	BS%	CBS%
2017	April	2	4	12	0	0	0	0	0	0
	May	3	4	13	0	0	0	0	0	0
	June	4	8	13	3	2	37.5	66.66	50	25
	July	3	6	12	1	1	16.66	100	33.33	16.66
	Total	**12**	**22**	**12.5±0.57**	**4**	**3**	**18.18**	**75**	**25**	**13.64**
2018	April	0	0	11	0	0	0	0	0	0
	May	3	6	13	0	0	0	0	0	0
	June	7	14	13	3	3	21.42	100	42.85	21.42
	July	9	18	12	5	4	27.77	80	44.44	22.22
	Total	**19**	**38**	**12.25±0.95**	**8**	**7**	**21.05**	**87.5**	**36.84**	**18.42**
2019	April	1	2	11	0	0	0	0	0	0
	May	2	4	12	0	0	0	0	0	0
	June	2	4	14	0	0	0	0	0	0
	July	3	6	13	2	2	33.33	100	66.66	33.33
	August	5	10	12	4	3	40	75	60	30
	September	7	14	13	8	6	57.14	75	85.71	42.85
	Total	**20**	**40**	**12.6±0.81**	**14**	**11**	**35**	**78.57**	**55**	**27.5**
	Grand Total	**51**	**100**	**12.42±0.85**	**26**	**21**	**26**	**81**	**41**	**21**

HS= Hatching success, FS=Fledgling success, BS=Breeding success, CBS= Crude breeding success

Table 3 Relationship between some environmental factors and breeding success of *Mirafra microptera* in the study area

		HS		FS		BS		CBS	
		r	P	r	p	r	P	r	P
Spearman's rho	Temperature (˚C)	-0.749**	0.002	-0.836**	0	-0.730**	0.003	-0.730**	0.003
	Humidity (%)	0.846**	0	0.843**	0	0.865**	0	0.865**	0
	Rainfall (mm)	0.157	0.591	0.187	0.523	0.134	0.648	0.134	0.648

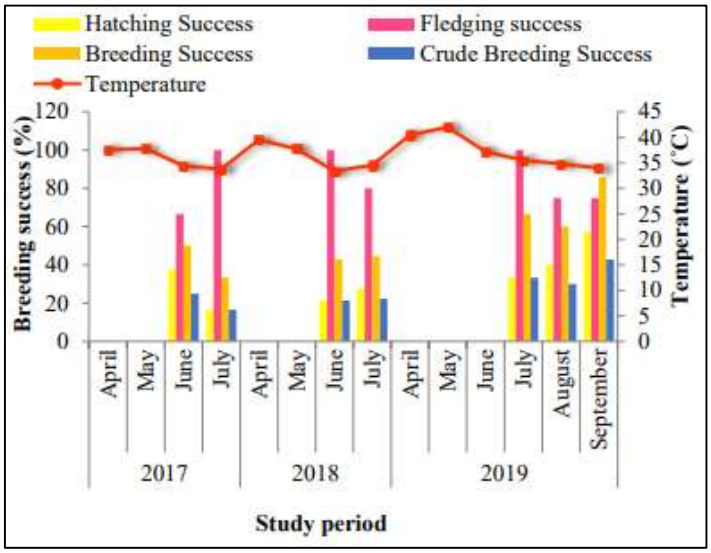


Figure 2A Temperature and breeding success

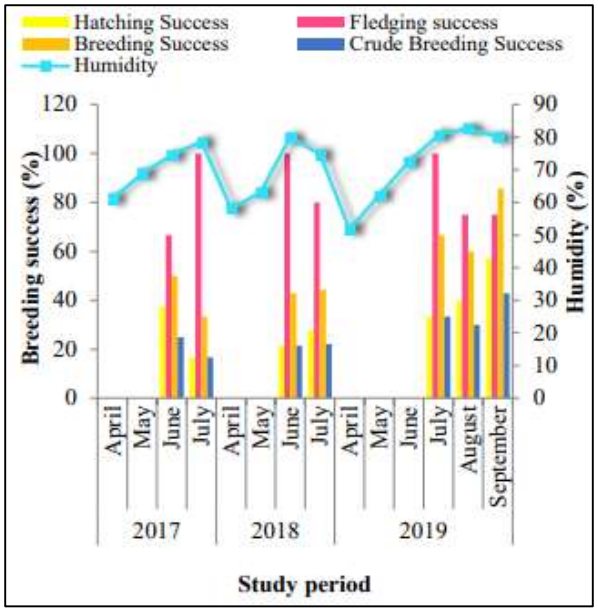


Figure 2B Humidity and breeding success

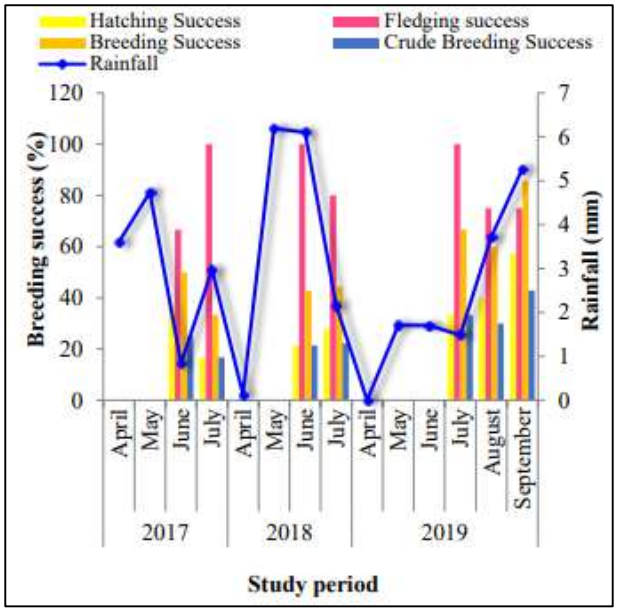


Figure 2C Rainfall and breeding success

Figure 2 Relationship between some environmental factors and breeding success of *Mirafra microptera* in the study area

A. Incubation

B. Two day after hatching

C. Three days after hatching

D. Four days after hatching

E. Six days after hatching

F. Seven days after hatching

Plate 2 Breeding success of *Mirafra microptera* in the study area

A. Fecal cleaning by parents

B. Food carrying and feeding behaviorof both parents

Plate 3 Some behaviors of parental care by *Mirafra microptera* in the study area

A. Grazing of cows and goats in studied area

B. Nest destruction by cows and goats

C. Threaten by dogs

C. Threaten by dogs

Plate 4 Some impacts on *Mirafra microptera* in the study area

Discussion

The breeding season of *Mirafra microptera* in Bagan environs was from March to September during the study periods. The present result coincided with the previous researcher, Hockey *et al.* (2005). They said that several lark species may avoid breeding season in winter as the low ambient temperatures and in mid-summer when the ambient temperature at a peak may

make breeding risky. However, the present study on the breeding season of Burmese Bushlark in Bagan environs differed from Kyaw Nyunt Lwin and Khin Ma Ma Thwin (2003) who reported in Birds of Myanmar that breeding seasons of the Burmese Bushlark is from June to October.

The present study of the nest construction period was similar to Thabo (2013) who reported the mean nest construction period of 2.5 days (range 1–3 days) in the Pink billed Lark. In the present study shorter than the 4–9 days reported for other larks (Maphisa *et al.*, 2009) and of Maclean (1970). De Juana *et al.* (2004) stated that both sexes continued to add material to the structure and lining of the nest throughout the incubation period, a common phenomenon in many lark species. Similar behavior was recorded in the study species. *Mirafra microptera* was completely constructed their nest three days. After two days ago, they laid eggs and incubation took 12.5 days and fledglings lasted 7.5 days.

Vickery *et al*. (1999) believed that the grassland bird community also relies on heterogeneity in nesting substrates. Grassland birds make their nests on the ground of forbs, grasses, or litter. The nest shape of Eastern meadowlarks (*Sturnella magna*) is dome-shaped and nest constructing materials are live and dead grasses. The present study was agreed with the statements due to the same types of nest material and nest shape.

According to Maclean (1970) and Tarboton (2011), most Pink-billed Lark nestsorientation face either south or east. During the present study period, the majority of nests faced to the south but also found to north, north-west, and east directions. It is clear that nest orientation may be correlated with the thermoregulatory function and other environmental factors e.g. wind directions which were important determinants of nest orientation on a local landscape level.

According to Morel and Morel 1984, the clutch sizes are 2-3 eggs on average in tropical or arid zone species of family Alaudidae but the clutch size of *Mirafra microptera* in the present study area was 1-2 during the study period. The small clutch size is necessary to ensure the nestlings get the most benefits from the transient. Every increase in the clutch size by one egg means an extra day for the breeding cycle and an extra day that nestlings are potentially exposed to nest predations and the possibility that the favorable conditions may besurpassed.

Relating to the breeding success, the mean incubation period (12.5 days) of present studied species *Mirafra microptera* matched with the 11-13 days in Black Eared sparrow Lark reported by Maclean (1970) and Lloyd (1999). In the present study, the nestling period of 7.5 days of *Mirafra microptera* is similar to African sparrow-larks which generally range from 7-10 days (Lloyd, 1999). Larks are faster growth and can walk or run well and even flutter-fly in some instances upon fledging. This allows the brood to disperse, thus reducing the likelihood of the entire brood being lost to predation (Donald, 2006).

Donald (2006) also observed that ground-nesting larks suffer very high nest depredation rates and crude breeding success is estimated less than 30% for larks. It is similarto the present study bird of crude breeding success (21%) in the present study bird.

Nonetheless, the percentage of crude breeding success of *Mirafra microptera* in the study area was decreased. Depending on the low breeding success and habitat destruction, thepresent study could be suggested that Myanmar endemic species, *Mirafra microptera* should be concentrated for conservation.

Finally, the male and female of the *Mirafra microptera* were slightly different only in the breeding period in the present study area. Moreover, the two sexes of birds examined showed very similar patterns throughout the year.

Acknowledgements

We are greatly indebted to Professor Dr Aye Mi San, Head of Zoology Department, University of Yangon for her encouragement of this research. We are also obliged to U Shwe Htaw Aung, Park Warden, Lawkanada Wildlife Sanctuary for his permission to carry out field survey and U Myint Maung, Forester, Lawkanada Wildlife Sanctuary for his hospitality, field assistance and valuable help in the data collections. We would like to grateful to Dr Haty Aung, Rector in Charge Loikaw University, Dr Khaing Shwe War Win Professor/ Head and Dr Sandar Win, Professor, Department of Zoology, Loikaw University for their recommendations for this paper writing.

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