



Nest and nest –building behaviour of Laughing dove *Streptopelia senegalensis*, at Khartoum, Sudan in (2013-2014)

Nawal Nugud Margani ¹, Ali Saad ²

Department of Fisheries and Wildlife Science Sudan University of Science and Technology

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ABSTRACT

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Field observations were made of the breeding habits of the Laughing dove *Streptopelia senegalensis* at six sites in Khartoum State, Sudan. Descriptions are given of the nest sites, nest building, nesting materials, nest measurements, and nest height was determined. In general the maximum number of nests was found in winter in January and February months and in wet season in August and September months, which indicate that there would be abundant food in these months when young were in the nest. The nest distribution of the Laughing dove (*Streptopelia Senegalensis*) was found to be moderate. With only 36 nests in the first breeding season (2013). In the second breeding season (2014), the nest distribution was also moderate with only 45 nests. One-way ANOVA was used to analyse variations in the number of nests in seasons and in the study area. The ANOVA revealed there was significant variation in numbers of nests in different seasons ($P=0.011$) and in study area ($P=0.001$) in 2013. In 2014 There was significant difference in numbers of nests in season ($P=0.05$), and in study area ($P=0.005$).

INTRODUCTION:

The Pigeons and doves belong to the order Columbiformes and family Columbidae. There are five subfamilies within Columbidae, 50 genera and 351 species. (Baptista, *et al.*, 2016). The Laughing Dove has an extremely large Isenmann and Moali 2000; Birdlife International 2014). The distribution extended to the Middle East and southern Asia east of India and Bangladesh (Baptista *et al.* 1997). The

range in Africa and Asia. Its African range includes the major part of the continent except the Sahara and some Western regions (Cramp and Perrins 1994;

species has expanded its distribution to the Canary Islands, within the Macaronesian region (de Juana *et al.* 2000) and has established breeding populations in five of the seven main

islands of this Spanish archipelago (Tosco 2010 and Romano *et al.* 2010). It

occurred in the Portuguese mainland, where one individual was recorded in Cascais in 1996 (Catry *et al.*,2010.).

Throughout Africa, breeding times of Laughing dove differ: In Malawi, breeding occurs in all seasons; in Zimbabwe (formerly Rhodesia) mainly May-November, as well as at other times also. In South Africa, breeding takes place at least August-April and in Egypt, between February-June (Etchécopar & Hüe, 1967). In North Africa Hanane, *et al.*(2011) reported the breeding season of approximately six months in Morocco, Boukhriss and Selmi (2009) also reported that the breeding season in Tunisia lasted from February until August. The onset of egg laying, the length of the breeding season, depend on the habitat condition (Perrins and Birkhead 1983). It was stated by Hanane, *et al.*, 2011 that the short egg laying period and reduced density of Laughing dove breeding pairs indicate that their study site might not be an optimum habitat for Laughing dove, despite the fact that olive orchards are intensively used by the species for breeding throughout North Africa (Boukhriss and Selmi 2009; Hanane, *et al.*, 2011). In India (Sikar) Laughing Doves laid eggs throughout the year (Ali 1964 and Maha.2014) Within Australia, breeding by *Streptopelia senegalensis*, is variable according to Desire (2013), and may occur throughout the year if conditions are favourable. In the United States, breeding extends March-November, and in Hawaii, February-October.

Nikolaus (1987) recorded 23 species of Columbidae (Doves and Pigeons) in Sudan, although some of these were rare

has

records. In the Sudan no records and studies on the breeding biology and behaviour of Laughing dove, although it is common and widely distributed in all habitat in Sudan).

The present study describes the nesting habits in a population of *Streptopelia senegalensis* in Khartoum State (Khartoum, Omdurman and Bahari), Sudan.

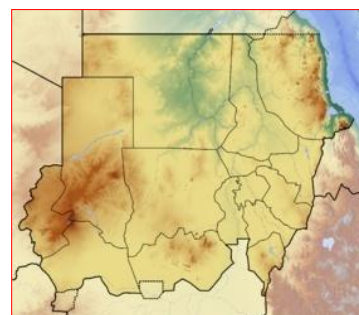
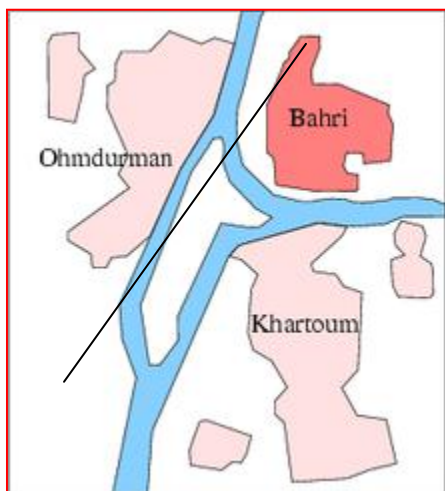
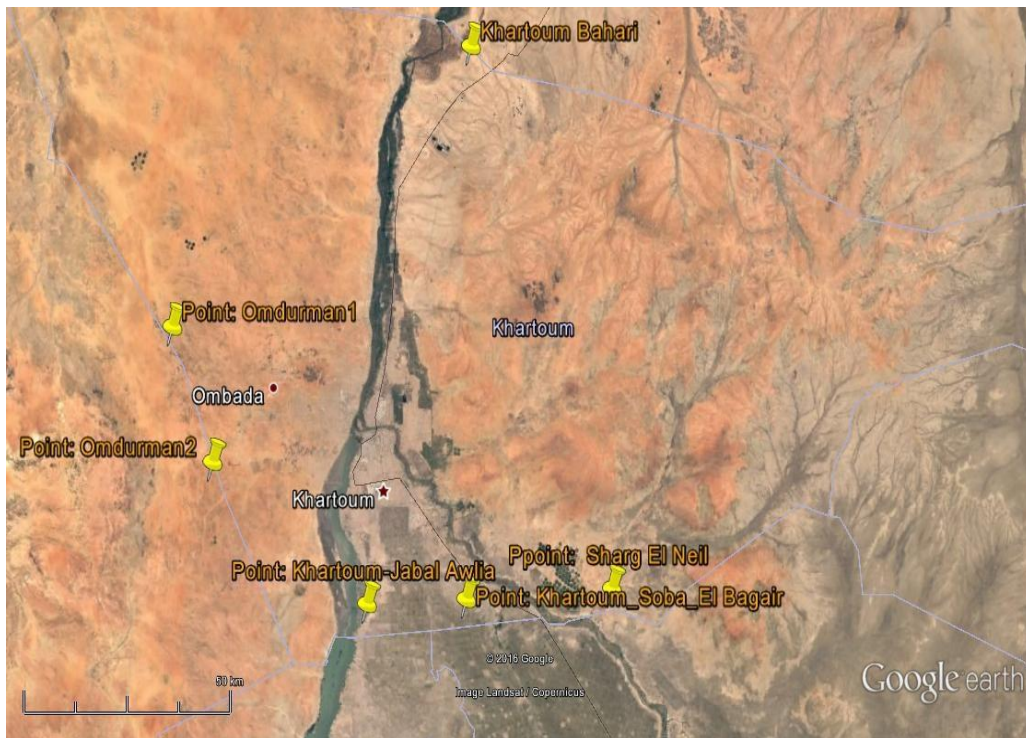
Material and Methods

2.1 Study area

The study was carried out at six sites in Khartoum State (Khartoum, Bahari and Omdurman), there are two points in Khartoum (Jabal Awlia and Soba –El Bagair in Omdurman there are two points Omdurman1 and Omdurman2 in Bahari also there are two points Khartoum Bahari and Sharq El Neil, in Khartoum state, the two sites in Khartoum is Jabal Awlia the geographical coordinates are (N15°15' E 32° 30') within 45.9 Km the other site is Soba –El Bagair the geographical coordinates are (N15° 16' E 32° 44') within 46.2 Km. In Bahari two points Khartoum Bahari, the geographical coordinates are (N 16° 17' E 32° 39') within 72.8 Km, the second site is Sharq El Neil the geographical coordinates are (N15° 17' E 33° 04') within 65.5 Km. The last two sites in Omdurman Omdurman1 the geographical coordinates (N 15° 45' E 32° 4') within 51.3 Km and Omdurman2 the geographical coordinates (N15° 31' E 32° 09') within 42.9 Km. The six sites were coordinate by using GARMIN/ GPS map (Geographical Positioning System)

(Figure 1). The western side of the surveyed area is generally a desert plain (Omdurman1 and Omdurman2). The

other sides in Bahari and Khartoum passes through different farms



Areas

Birds
Samples

Figure 1: The six site in the Study Area in Khartoum State (produced from Google earth and <http://krt-loc.gov.sd/>)

Climate

The annual mean temperature and total rainfall in 2013 and 2014 at Khartoum areas were 37.7°C and 97.1mm and 36.7°C and 166.4mm respectively. The rainy season starts from July to the end of September with occasional showers in May & October. The average amount of rainfall decreases from south to north and from east to west. Winter

(November to February) is rather mild, followed by a hot dry summer lasting from March to the beginning of the rainy season. Generally, the relative humidity in Khartoum area is low, especially during the dry season, but increases during the rainy season.

Statistical Analysis

One-way ANOVA test was carried out to investigate the significance of seasons winter, dry season and wet season for the number of nests. Also one-way ANOVA test was carried out to investigate the significance of the study area Khartoum, Bahari and Omdurman for the number of nests.

The Nest & Nest Building Behaviour

Nests building started in early January and continues until late December in the first and second breeding periods (2013-2014) in Khartoum (Jabal awlia, and Soba Elbagair), Bahari (Khartoum Bahari and Sharq El Neil), but in Omdurman the activity of nest building behaviour was recorded only in the second period (2014) in (wet season) in Omdurman. In general the maximum number of nests found in the in winter (January and February) months and in wet season in August and September months table (I). The number of nests found in 2013 was 36 nests and in 2014 was 45 nests.

Correspondence analysis (CA), applied in relation with the different seasons and also correspondence analysis applied in relation with the different area, was represented on the Factorial and the Factorial test analysis highlighted the variation of number of nests in seasons and in

Study area.

RESULT

Table 1: The distribution of nests in months during the breeding season in 2013 and 2014

year	January	February	March	April	May	June	July	August	Sept	Oct	Nov	December	Total
2013	5	4	3	2	1	1	2	7	5	2	2	2	36
2014	6	5	3	1	1	2	4	8	5	4	3	3	45

The Nest building material & Nest Measurements:

Nest building materials were gathered from nearby areas surrounding nest sites. During incubation period no building materials were added to the nest. Nests were well built because no complete nest was seen collapsing due to storms. Stem of grass and plastic wire were probably used to fix together the

different twigs and constitute the nest substrate. The nest which was platform made from thin and thick twigs, and lined with soft stems of grass like Najila (*Cynodon dactylon*) and plastic wire, or made from a wire of plastic with thin or thick twigs and with no soft stems of grass like Najila (*Cynodon dactylon*) in

man made structure, or without lined by soft material if the nest was built in semi arid area. The maximum length for nest 18cm, and for width 13cm in semi arid area and the minimum length of nest

same site in the same branch in lime trees which were discovered in January in a house around the farm in lime tree *Citrus paradise*. The male used dry twigs of neem tree (*Azadirachta indica*), Mahogany (*Khaya senegalensis*) and in semi arid area used twigs of Kiter *Acacia mellifera* and tundab (*Capparis deciduas*). Meskeat (*Prosopis glandulosa*). Completed nests were flat – shaped with slight central depression. The mean external measurement of Tundub, *Capparis deciduas* 10.7% Sedir, *Ziziphus spinachristi* 10.7% Heglieg, *Balanites aegyptiaca* 9.3%, Nakheel, *Phoenix dactylifera* 8%, Neem, *Azadirachta indica* 8%, Meskeat, *Prosopis glandulosa* 6.7%, Lime, *Citrus paradise* 6.6%, Kiter, *Acacia mellifera* 5.3%, talih, *Acacia Seyal* 4%, Damas, *Conocarpus lancifolius* 2.7%, Larenga, *Citrus larynge* 2.7%, Guava, *Pisidium guajava* 2.7%, Ushar, *Calotropis Procera* 2.7% Lantana, *Lantana camara* ,1.3%, Indian Al Mond, *Terminalia oatappa* ,1.3%, Mahogany, *Khaya senegalensis*, 1.3% and 4% in building eaves. All trees with high percentage are thorny which probably provide a mechanical barrier against predators. This is supported by the

Table 2a: Total numbers of nest in three towns during the breeding period (2013)

Area	Season	Number of Nest
Khartoum	Winter	8
	Dry season	3
	Wet season	9
Bahari	Winter	5
	Dry season	4
	Wet season	7
Omdurman	Winter	0
	Dry season	0

8cm and width 5cm in Nakheel (*Phoenix dactylifera*) tree in houses. In one case which was surprising to me there was two nests together in the

seventy two nests were as follow: length 11.5 ± 2.03 cm; width, 8.60 ± 1.98 cm and depth 2.35 ± 0.96 cm . The mean height of nests above the ground level was 2.49 ± 0.77 m. The lowest recorded nest was one meter above the ground in Meskeat *Prosopis glandulosa*, Tundub *Capparis deciduas*, and highest was 4m in Nakheel *Phoenix dactylifera* . The density for nesting, showing a clear preference for thorny trees Tamrhindi *Pterolobium exosum* constituted 12%,

findings at semi arid area where the species of nesting trees are thorny ones.

Variation in nest numbers during the breeding period in 2013

There was a difference in nest numbers between the three towns (Khartoum, Bahari and Omdurman), also there was a difference in numbers of nests in three seasons; winter, wet season and dry season. The highest number of nests were recorded in wet season (16 nests) and winter (13 nests), but in the dry season the numbers of nests decreased (7 nests). In Omdurman no nest was found during the breeding period (2013) Table (2a).

	Wet season	0
In (Table 2b) the total in the means between the three towns(Khartoum, Bahari and Omdurman), was found to be statistically significant (p<0.05) at level 0.000 (P=0.001),the significant differences in this level between Khartoum and Omdurman, also between Bahari and Omdurman	Also there was a significant difference between the seasons (winter, dry season and wet season) was found to be statistically significant (p<0.05) at level 0.011(P=0.011) , the significant difference in this level between winter and dry season also between wet season and dry season table(2b).	

Table 2b: Variation between the three towns and the three seasons during the breeding period 2013

Season Area	Winter Mean± S.D	Dry Season Mean± S.D	Wet Season Mean± S.D	Significance
Khartoum	4±1.4	1.5±0.7	4.5±0.7	
Bahari	2.5± 0.7	2.0±0.0	3.5±0.7	
Omdurman	0.0±0.0	0.0±0.0	0.0±0.0	
significance	*	0.011		**0.000
Main effect				
Areas	Mean±S.E			Significance
Khartoum	3.33±0.27a			
Bahari	2.67±0.27a			**0.000
Omdurman	0.00±0.27b			
Significance	*			
Seasons	Mean±S.E			Significance
Winter	2.17±0.27a			
Dry season	1.17±0.27b			*0.011
Wet season	2.67±0.27a			
Significance	*			

Variation in nest numbers during the breeding period in 2014

The highest of nests were recorded in wet Season (21 nests) and winter(17 nests) but in the dry summer the numbers of nest were decreased(7).In

Omdurman there were no nests except in wet season. There was difference in nest numbers between the three towns Khartoum, Bahari and Omdurman table (3a)

Table 3a: Total numbers of nests in three towns during the breeding period 2014

Area	Season	Number of Nest
Khartoum	Winter	10
	Dry season	4
	Wet season	10
Bahari	Winter	7
	Dry season	3
Omdurman	Wet season	8
	Winter	0
	Dry season	0
	Wet season	3

The differences in The means between the three towns (Khartoum, Bahari and Omdurman), was found to be statistically significant ($p < 0.05$) at level 0.005 ($P = 0.005$), the significant differences in this level between Khartoum and Omdurman, also between Bahari and Omdurman in table (3b).

Also the significance difference between the seasons (winter, dry season and wet season) was found to be statistically significant ($p < 0.05$) at level 0.05 ($P = 0.05$) , the significant difference in this level between winter and dry season also winter and wet season, Also other significant differences between wet season and dry season in table (3).

Table 3b: Variation between the three towns and the three seasons during the breeding period 2014

Season	Winter	Dry Season	Wet Season	Significance
Area	Mean± S.D	Mean± S.D	Mean± S.D	
Khartoum	5.0±0.0	2.0±1.4	5.0±2.8	
Bahari	3.5± 2.1	1.5±0.7	4.0±1.4	**0.005
Omdurman	0.0±0.0	0.0±0.0	1.5±0.7	
significance		* 0.05		
Main effect				
Areas	Mean±S.E		Significance	
Khartoum	4.0±0.57 a			
Bahari	3.0±0.57 a		**0.005	
Omdurman	0.5±0.57 b			
Significance	* *			
Seasons	Mean±S.E		Significance	
Winter	2.83±0.57 a b			
Dry season	1.17±0.57 b		*0.05	
Wet season	3.57±0.57 a			
Significance	*			

Discussion

The laughing dove (Palm dove), (*Streptopelia senegalensis*), is breeding throughout the year from early January until late December. There were three breeding seasons throughout out the year; Winter(November, December, January, February) Dry season (March, April, May, June), Wet season(July, Augusts, September, October). In the study area there were differences in breeding season cycles. In the first breeding season 2013 and second breeding season 2014 with a peak number of nest in wet season(Augusts, September) because in this time the nesting material are available in the study area birds were provided with many source of food(there were many

cultivated land, Sorghum and a lot of insects bred there also in the semi arid area there were many trees providing the birds with a fruit for example Tundub (*Capparis decduas*) as a source of food. The other adaptation was associated with availability of half ripe grass seeds and insects which form the diet for young in time of hatching. Also there were a peak number of nests in winter season(January and February) which were associated with the abundance and diversity of vegetables especially Tomatoes which were harvested in this time and this was associated with a decrease in the price of this vegetable ,that mean it was

available in scrap of people and also in field. In winter and wet season, the physical condition of the species is optimal for breeding. The breeding demands peak physical condition, fuelled by high levels of protein intake and access to moisture.

But in dry, season the weather conditions have an influence on the reproductive success, The lower vegetations in the area may have a greater influence indeed that decay the food supply for breeding, naturally occurring foods (seeds and Desiree(2013) in Australia hypothesised that whilst the gonadal cycles of laughing dove were significantly impacted by “fixed annual factors, including photoperiodic effects and by environmental factors including food. Also Frith *et al.* (1975) recorded that the nutrition levels of urban populations was often above the threshold that triggers breeding of laughing dove.

In the astudy area a peak of egg laying was delayed some weeks after the commence of the rains. The rainfall and low temperature significantly affected breeding. Despite the fact that changes in photoperiod are not sufficiently large to be used as breeding signal in the tropics. Generally , breeding of birds depends on synchronizing reproduction with the period of minimum stress on adult and maximum survival of nestlings. In 2013 There was significant difference in the numbers of nests between winter and dry season ($P=0.01$), also between wet season and dry season($p=0.01$), in 2014 there was a significant difference in the habitation in the selling point of cattle . Frith *et al.* (1975) found that Laughing dove can maintain supply of sufficient food and water to nourish the young in harsh environmental conditions. Klomp (1970) found that the variation of food abundance has been often correlated

vegetables) are scarce and food stuffs from the previous season are not plentiful enough to be viable, and declining surface water which explained the low number of nests in study area, and their physical condition is less than ideal for breeding. Klomp (1970) found that the variation of food abundance has been often correlated with the reproductive behaviour of altricial birds. Also there was high risk of predation in this months in the study area (farm land , semi desert area).

number of the nests between winter and dry season also between winter and wet season($p=0.05$), also there were significant difference between wet season and dry season($P=0.05$). There was significant difference in the numbers of nests between Khartoum and Omdurman($P=0.000$) , also between Bahari and Omdruman ($P=0.000$) . In 2014 also there was significant difference between Khartoum and Omdurman($P=0.005$), also between Bahari and Omdruman ($P=0.005$). This was associated with the different types of habitats in Omdurman which was covered with desert area in Omdurman1 and arid area in Omdurman 2 for these reasons there were no nests in 2013, but in the 2014 the highest rate of rains fall which were reflected in abundance of half ripe grass seeds and insects which form the diet for young in time of hatching ,for that reason there were three nests recorded in Omdurman2 near human

with the reproductive behaviour of altricial birds.

But in Khartoum and Bahari the areas were covered with semi desert habitat and these reflect to the type of vegetation cover the study areas which were

covered with some permanent trees and Walsh et al (2009) mentioned that birds build nests according to a genetic 'template' little influenced by learning or memory .Nest construction in the laughing dove, especially may be considerably more responsive to environmental influence than is typically considered to be the case for nest building in other birds (Walsh et al,2009).In this study there was a high adaptability in nest building material in laughing dove which were dwelling in human habitation area, there they used a wire of plastic with dry twigs to build the nest in most nests in the area, instead of using Najila(*Cynodon dactylon*) with dry twigs because aware of plastic was available around human habitation all There were different nesting habitat; some of the laughing dove were nesting in open semi-arid area in thorny trees ,others in houses (nest site in trees and building eaves) which were supported with food, also nesting in thorny trees proximity to industry of block near the Blue Nile River bank, and association with human residential areas probably to avoid predators like snakes.but the most important nest site habitat in houses in trees or in building eaves because its more safe for the adult and nestling and supported with sufficient food.

The mean height of nests above the ground level was 2.49 ± 0.77 m. The same result was recorded by Boukhriss and Selmi, (2009) they found that nests were built at an average height of 2.58 ± 0.09 m

That mean the habitat condition is the major factors to build the nest on it and it will match adaption with the different height of trees which cover the areas. This behaviour may be a response to the height of trees available for nesting

temporary vegetation in rain season. the year. But Najila (*Cynodon dactylon*) available only in wet season and local people play negative role in abundance of it they used it as a source of fire for cooking. In Semi desert area the nest was built only by the dry twigs and wood stick of Kiter (*Acacia mellifera*, tundub (*Capparis deciduas*), and Meskeat (*Prosopis glandulosa*). This difference in materials in study area is adaptation according to environmental influence. In India there were the same habit, patil and Shende (2015) found that Laughing dove collected soft and semidried materials, thin grass ,few wood sticks and plastic wires for nest building .

Also Desiree(2013) found that the ability of the Laughing dove to adapt to human modified habitats has made it a successful urban. It has been adapted by utilising built structures or trees as shelter and nest, and foraging for food stuffs or food scrap left by people. However its dependence on these urban provisions has limited its spread into natural environments, this is similar to results of the present study most of the nests were constructed in human habitation area.

which is an important factor affecting nest height in the case of many bird species (Taberner, *et al.*, 2012; Bensouilah et al.2014).

The species of plant, the thorn tree prefer in the farm and semi desert area supports the nest and location of the nest inside the plant or with the features of the immediate area around the nest. And there were the same results which supported this study. The Laughing dove preferring thorny trees thus improving

their breeding success. According to O'Connor 1984, the Long Tailed Tit *Parus spp* breeding success was improved by 12 to 47 times by nesting in thorny vegetation which offer protection against predator

O'Connor, (1984). The extent of distribution of nests are mainly affected by predation. The solitary well hidden nests and the nests which was higher were difficult to attack due to inaccessibility .According to Runde and Capen (1987) quality of nest site can be affected by micro-climate, food availability, and nest predation. However, density of snags and live trees could also affect risk of nest predation. Nest predation is usually the primary source of nest mortality for both open – and cavity –nesting birds(Nilsson, 1984) as a result, choice of nest sites with reduced risk of nest predation and more foraging substrates should be favored. This approach may show that some patterns might have emerged over evolutionary time due to the process of natural selection and that this process may be acting on short-term scale (Clark and Shutler, 1999). Nevertheless to strengthen the evidence supporting the action of the process of natural selection in shaping nest site preferences it is also necessary to show that some measure of fitness is higher in preferred nest sites (i.e.,that there is an adaptive response). However, this prediction is seldom tested in studies of nest site selection (Clark and Shutler, 1999).

It has been found in some species that the probability of nest predation varies The Laughing dove started their breeding from January to December, they bred solitary at tree or building eaves around human habitation. The number of nest was statistically significance differences in different

Probability of predation may decrease with increasing abundance of potential nest sites,because predators must search more empty sites to find an occupied site (Colin,et al 1998). Predation may also increase in lower nests (Monkkonen,et al 2007). These predators may be able to reach lower nests more easily and provide parent birds less time to detect and perhaps dislodge climbing nest predators (Nilsson 1984). Ability to detect and attack predators may also be reduced by dense foliage near the cavity (Finch,1989).Conversely, dense foliage near nests may reduce predation by concealing the nest (Martin, 1988). Most studies of nest site selection have assessed whether there are differences between the general habitat and the portion of the habitat used for nesting, and whether habitat characteristics of successful and unsuccessful nest sites differ (Kelly, 1993).

with the species of plant that supports the nest and location of the nest inside the plant or with the features of the immediate area around the nest. Thus, it is widely believed that nest site selection in birds may have evolved mainly as an adaptive response against nest predation (Kelly, 1993).

In this result variation in the breeding season and peak of breeding Furthermore, the densities of breeding pairs increased in 2014, which was rainier, pairs of Laughing dove found conditions in 2014 better, than 2013 .Newton (1964) reported that the year to year variation in the breeding season .

Conclusion and remark
season and in different study area in Khartoum State.

The following recommendations are suggested.

1. The study emphasized the need for more field work on the breeding biology of Khartoum birds.

2. Additional studies are also needed on the rare species

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