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Nesting biology of blue-cheeked bee-eater in the Fergana valley of Uzbekistan

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Abstract
In current paper the data on nesting biology of Blue-cheeked Bee-eater (*Merops superciliosus* L.) in the conditions of Fergana valley of Uzbekistan are presented. The basic attention was given to a spring arrival and flying away of bee-eaters, a nested life, digging of a hole, laying eggs, hatching nestlings, post-embryonic growth and development of nesting, ethology and the acoustic signal system of blue-cheeked Bee-eater. Presence of distress signals of Blue-cheeked Bee-eater for the first time is revealed, that has great value in management of behavior of birds in beekeeping husbandry of Uzbekistan.

Keywords: Nesting Biology, *Merops superciliosus* L, digging of a hole

1. Introduction
Bee-eating birds have wide distribution, particularly in arid and semi-arid zones (Mohamed Ali and Taha, 2012) [10]. Research were conducted on the migratory behaviors and numbers of *Merops* species in different parts of the world (e.g. Richner and Heeb, 1995; Borghesio *et al*., 2009; Gardner *et al*., 2012) [11, 3, 5]. However, detailed and long term research was not conducted on nesting biology of the blue-cheeked Bee-eater (*Merops superciliosus* L.). Data on nesting biology of *M. superciliosus* L. in Uzbekistan in the literature are limited, and particularly in Fergana valley of Uzbekistan the data on its biology, importance, on behavioral features and acoustic alarm system at all are absent. Fergana valley of Uzbekistan is one of the ancient centers of development of a cultural landscape, possesses all basic features peculiar to oases of Central Asia. And now Fergana valley, as well as in an antiquity, represents region of intensive managing and extremely high population density. All these facts indicate that in Fergana oasis we deal with strongly transformed landscapes, and the process of formation of anthropogenic biocenosis has already come to the end here. Studying of biology of separate bird species in the conditions of anthropogenic transformations has the important theoretical and great practical value.

2. Material and Methods
For the current paper the materials gathered by author for the period from 1994 till 2006 in Andijan region of Fergana valley has served as a main scientific information. Data about terms of spring and autumn migrations, behavioral features of adult birds during breakdown on pairs, a choice of places for nesting are cited, and at digging holes. Except that the data on terms of pairing and a laying of eggs, about hatching duration are resulted, the comparative analysis, between temperature of environment and temperature of the nested chamber is spent, terms of hatching and postembryonic growth and developments of nestlings, and also intensity of feeding are marked. For definition of economic value blue-cheeked Bee-eater have been collected and analyzed more than 2,5 thousand food lumps. Also the features of acoustic alarm system are studied for first time and are found out presence of distress signals of birds using special computer programs “Cool Edit Pro Version-2,1” have been processed and received spectrograms with accuracy 0,00001 sec.

3. Results and Discussion
Blue-cheeked Bee-eater – come flying - a nesting bird of Uzbekistan. Terms of an arrival in various parts of our republic are different. On M.N.Korelova's supervision (1948) [8] for blue-cheeked Bee-eater, the earliest arrival of this bird in Andijan region Fergana valley is marked on April, 21 (area Balikchinsky, v. Urmonbek). In Samarkand and Fergana valley birds most often meet in the first of May and in middle or the end of month usually 05.05.94; 13.05.94; 16.05.94; 17.05.94; 25.05.94; 30.05.94; 17.05.95; 10.05.95; 19.05.95; 25.05.97; 27.04.98;

14.05.2000; 04.05.05; 16.05.05; 20.05.05; 21.05.05; 08.05.06; 15.05.06.

The noticed birds soon are broken into pairs and start the device of jacks. Lodge mainly colonies (from 11 up to 70 pairs), occasionally there are detached jacks of separate pairs. Jacks arrange on loessial gentle slopes of channels, and sometimes nestling in very small hillocks. On slopes of the big channels form the mixed colonies together with the Indian sparrows, eurasian Roller, indian Myna, a house horned owl and a blue rock pigeon (Belik *et al*., 2003, Fedosov, Malovichko, 2006, Komarov, 2010) [2, 4, 7].

Influence of anthropogenous factors on distribution blue-cheeked Bee-eater is expressed, first of all, in creation of new nested habitats with steep slopes in moderately dense ground. The majority of places are used blue-cheeked Bee-eater for nesting has an anthropogenous origin. Additional places for blue-cheeked Bee-eater are created due to such kinds of human activity of the channels, connected with watering and agricultural development of deserted territories, and extraction of minerals. Influence of the listed factors became especially appreciable in last two - three decades (Komarov, 2010) [7].

M. N. Korelov (1948) [8] writes, that blue-cheeked Bee-eater to nesting start a little bit earlier, than (European) Bee-eater. At females blue-cheeked Bee-eater in second third of May have been already well advanced brood a stain. In Kizilkum N.A. Zarudnyj (1915) [13] extracted females with brood stains on June, 1. Our materials show, that in Fergana valley of Uzbekistan blue-cheeked Bee-eater start to laying eggs from third decade of May.

Both birds participate in digging a hole. For supervision over speed from which dig Bee-eatres, we have marked 14 holes and daily from the beginning and up to full readiness of a hole spent gaugings length of a course. The analysis of the received data has shown, that on digging of a hole at different pairs there leave 14-17, on the average 15,5 days. For light day of a bird pull out from 6 up to 52 sm. Most slowly digging is carried out in the first days that, probably, is connected to overcoming a firm external layer of a ground. The some testify to it undig up or the deserted holes Bee-eaters (tab. 1).

Table 1: The sizes of jacks blue-cheeked Bee-eater (n=14).

№	Measurement of jacks in sm	Parameters		
		A minimum	A maximum	On the average
1.	Length of a hole	116,8	255	185,9
2.	Diameter of an aperture of a hole	7,3	7,5	7,4
3.	Length of the nested chamber	17,0	68,0	34,7
4.	Width of the nested chamber	13,0	22,0	20,6
5.	Height of the nested chamber	9,5	11,5	9,7
6.	Depth of the nested chamber from a surface of the ground	60	160	84,4

The course of a hole round and the oval form, but sometimes deviates a surface of the ground, going under some corner to her. So, entrance apertures of some jacks settled down at height of 15-30 sm from the top edge of breakage. Nested chambers were on depth from 60 sm and 2 and more meters.

After construction of jacks in 2-4 days of a bird start to laying eggs. In the beginning in jacks no any litter. A little bit later the layer of the chitinous rests of insects belching by the birds, forming original litter is formed, the ground of the nested chamber differs original tenderness (tab. 2).

Table 2: Oologic parameters blue-cheeked Bee-eater

Measurements	Min	Max	M	±m	±δ	C	N
Length (mm)	23,5	28,5	25,4	0,13	1,00	3,94	59
Width (mm)	20,0	23,0	21,1	0,09	0,73	3,46	59
Weight (g)	4,95	7,60	6,05	0,03	0,68	11,24	59

One laying in one year from 4-7 eggs of white color of almost spherical form is observed. From 29 full laying eight 4 eggs contained, fourteen - on 5, five on 6, two - on 7, on the average 5,03 egg on a jack, for all operating time never it was possible will find out jacks with 9 eggs on what it was informed in the literature (Gubin, Sklarenko, 1990) [6].

Eggs postpone in day. According to A.K.Sagitov (1990) [12] long occupied a laying 24-26 days proceed. On our supervision long occupied begins after lays the second eggs and 24-27 days last. We track intensity long occupied a laying, within 14 hours (Malovichko, Konstantinov, 2000) [9]. In the beginning incubation birds were in a jack 10 hour, 58 min. (73,1 %), and for everyone " in years " - a minimum 6, a maximum of 50 minutes (on the average 33,1 min.). The laying remained without long occupied birds at 4 o'clock 02 mines (26,9 %). During supervision of a bird left a laying of 16 times. In the end incubation time of a presence of birds in a jack has left 13 hour. 27 minutes (96,3%) they had a seat 26 times a minimum for 15 minutes, the maximum for 55 minutes (on the average 42,4 min.), i.e. by the end density long occupied increases.

We lead the comparative analysis of temperature of the nested chamber Bee-eaters surrounding environments (Table 3).

The data of the comparative analysis of temperature of the nested chamber blue-cheeked Bee-eater and an environment show relative stability of temperature of the nested chamber in relation to an environment that creates favorable temperatures of a condition and provides success of a nested life blue-cheeked Bee-eater in conditions of hot heat of loessial breakages.

Our regular weighings 146 eggs from 29, laying have shown, that for eleven days long occupied each egg loses on the average 0,5-7,8% of initial weight, and for all incubatory period of 0,9-11,94%.

Table 3: The comparative analysis of temperature of the nested chamber blue-cheeked Bee-eater and an environment (Andijan region, v. Urmonbek).

Date	Time of day, temperature 0C								
	6 ^{00} hours			12^{00} hours			18^{00} hours		
	Temperature externel environments	Temperature of the nested chamber	A difference t^0	Temperature externel environments	Temperature of the nested chamber	A difference t^0	Temperature externel environments	Temperature of the nested chamber	A difference t^0
01.06.97	16	20	4	38	21	17	35	21	14
03.06.97	15	20	5	38	22	16	35	21	14
04.06.97	15	20	5	38	22	16	37	21	16
05.06.97	16	20,5	4,5	40	21	19	37	21	16
08.06.97	11	21	10	39	22	17	36	23	13
09.06.97	13	20	7	39	21	18	35	21	14
10.06.97	15	21	6	41	21,5	19,5	35	21	14
11.06.97	16	21	5	41	22	19	36	20	14
13.06.97	15	20,5	5,5	40	21	19	38	21	19
15.06.97	18	20	2	39	21	18	33	21	12
16.06.97	16	20,5	4,5	41	22	19	39	22	17
18.06.97	14	21	7	41	22	19	33	20	13
19.06.97	16	21	5	40	21	19	39	21	18
20.06.97	15	21	6	40	22	18	35	21	14
21.06.97	18	20	2	41	21	20	39	21	18
23.06.97	16	20,5	4,5	41	22	19	36	21,5	14,5
25.06.97	17	21	4	41	22	19	36	22	14
27.06.97	12	22	10	41	23	18	38	22	16
01.07.97	14	21	7	41	22	19	37	21	16
03.07.97	18	22	4	39	23	16	38	22	16
05.07.97	18	21	3	41	22	19	35	20,5	14,5
08.07.97	16	22	6	38	21,5	16,5	34	21	13
10.07.97	12	20	8	39	21	18	35	21	17
11.07.97	14	21	7	38	21,5	16,5	36	22	14
12.07.97	16	21	5	41	22	19	34	22	12
14.07.97	16	21	5	39	21,5	17,5	35	21	14
15.07.97	16	20,5	4,5	40	22	18	36	21	15
16.07.97	14	20,5	6,5	40	21,5	18,5	38	21	17
18.07.97	17	21,4	3,6	39	22	17	35	22	13
19.07.97	15	21,6	6,6	41	23	18	34	22	12
Average	15,3	20.7	5,4	39,8	21,7	18,1	36,0	21,2	14,8

Process hatching of nestlings lasts from 5 till 8 days. Just hatching nestlings are naked, a skin of pink color, an eye are closed, acoustical passes are open. On the average weight of an one-day nestling 5,3g. Nestlings develop rather slowly. Especially intensive gain weight is observed up to five-day age (48,5-50,0%) (tab. 5). The linear sizes undergo changes, especially length of a beak and a body. At this age at nestlings breasts, abdomen and coccyx are appeared through hemp of the future feathers on a neck, shoulders. Eyes are not completely open yet, a section of eyes as an ellipse. Further rate of a gain of weight is reduced, but remains rather high up to 11 day time age. By this time education stumps on all body (a head, a back, wings, a breast, overtail and a tail) is observed. A section of eyes round forms. With 11 for 17 day rate of growth and development of nestlings is slowed down. To 20-day's age the feather in regular intervals covers bodies. Nestlings leave a jack for 26-th day, and the some for 28-th day after hatching.

Feeding nestlings occupies both parents: one of birds hunts, another, being in a jack, accepts the brought forage. Quantity having brought forages a nestling of different age not equally. Intensity of feeding of nestlings of different age by us are resulted on Fig.1.

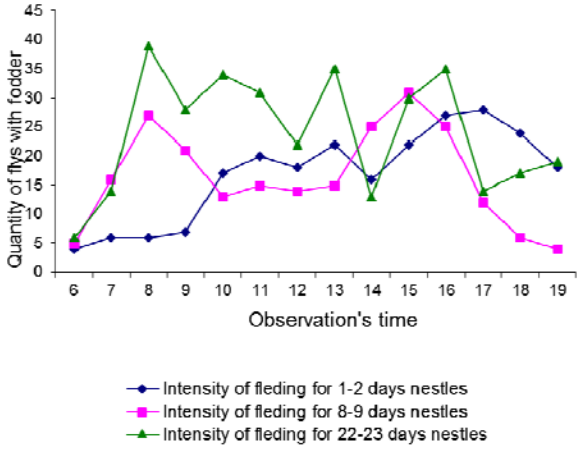

Fig 1: Intensity of feeding for nestles of different ages

Apparently from Fig. 1. First days after hatching nestlings are characterized by some stability of feeding, activity is observed lunch and evening hours. 8-9 day time age of nestlings in intensity of feeding the morning peak (7-9) and after dinner (15-17) peaks is precisely allocated. Before a start of nestlings from a jack parents of them feed more intensively, is precisely allocated morning (7-9), day time (12-14) and evening (15-17) peaks.

On character of a feed blue-cheeked Bee-eater are insectivorous birds. In nested and after nested periods a basis of food of adult birds made Hymenoptera (Table 6), with that only a difference, that during the spring and autumn periods bees, and in summer ants prevailed.

Table 6: Seasonal aspect a feed (meal) blue-cheeked Bee-eater

Objects of a feed (meal)	The spring - summer period		The summer - autumn period	
	abs	%	abs	%
Insects	477	100	286	100
Dragonflies	28	5,9	29	10,1
Aeschna grandis L	16	3,4	17	5,9
Coenarion	12	2,5	12	4,2
Termites	4	0,8	-	-
Anacanthotermes turkestanicus J	4	0,8	-	-
Orthoptera	2	0,5	2	0,7
Jocusta migratoria L	2	0,5	2	0,7
Hemiptera	1	0,2	-	-
Pentotomidae	1	0,2	-	-
Beetle	33	7,0	22	7,7
Carabus sp.	3	0,7	3	1,1
Cetonia sp.	9	1,9	-	-
Buprestidae	5	1,1	1	0,3
Tenebrionidae	3	0,6	5	1,8
Chrisomelidae	1	0,2	1	0,3
Cuculionidae	4	0,8	3	1,1
Coloptera	8	1,7	9	3,1
Butterflies	-	-	2	0.7
Hymenoptera	405	85,4	231	80,8
Opes mellijera I	332	70,0	29	10,1
Bobbus sp.	16	3,4	-	-
Philanthus triangulum F.	15	3,2	4	1,4
Vespa sp.	-	-	12	4,2
Vespoidea	-	-	18	6,3
Farmicidae	42	8,8	168	58,8
Diptera	1	0,2	-	-
Muscida	1	0,2	-	-

Features etology and the acoustic signal system blue-cheeked Bee-eater. After an arrival blue-cheeked Bee-eater during a week or ten days conduct vagrant lifestyle after that appears on places of nesting. After breakdown on pairs they start to a choice of convenient places of nesting, it takes away from them a lot of time. Dig up holes realize on flat coast of channels or on small hilly places. Both birds participate in digging a hole, especially intensively dig at morning and evening o'clock, day time - time marriage games have a rest or have simply a rest. Length of a course of a hole 2 m reach more, and quantities of the thrown out ground makes 10,7 kg (n=5). When female dig out a hole, a male watches closely conditions, hunts and from time to time feeds female and makes copulation movements. Long occupied eggs it is more than female, male her feeds, sometimes replaces, the instinct long occupied female is so great, what even at withdrawal of eggs from under for measurement, she does not leave its put continues long occupied.

Fly away blue-cheeked Bee-eater in October. But however, at the end of July on the average August it is possible to observe wandering birds. So on our data area Balikchinskiy Andijan region birds are marked from 18.08.96, in Djizak region we observed birds 24,27,28.09.97; in the city of Samarkand in its vicinities bee-eaters are marked: 27.09.94; 28.09.96; 30.09.96; 01.10.96; 02.10.96; 03.10.96; 04.10.96; 05.10.96; 06.10.96; 07.10.96; 08.10.96; 09.10.96; 10.10.96; 11.10.96; 13.10.96; 16.10.96; 04.09.97; 10.09.97; 13.09.97; 21.09.98; 22.09.98; 23.09.98; 25.09.98; 26.09.98; 26.09.98; 03.10.96; 08.10.96; 03.09.99; 14.09.99; 15.09.99; 21.09.99; 27.09.99; 28.09.99; 06.09.99; 07.09.99; 11.10.99; 12.10.99; 13.10.99; 29.09.2000; 03.10.2000; 09.10.2000; 10.10.2000; 24.09.2001; 28.09.01; 29.09.02; 04.10.02; 08.10.02; 13.09.03; 02.10.03; 03.10.03; 01.09.04; 02.09.04; 03.09.04; 04.09.04; 16.09.04; 24.09.04; 26.09.04; 29.09.04; 02.10.04; 03.10.04; 04.10.04; 05.10.04; 30.09.05; 01.10.05; 03.10.05; 04.10.05; 01.09.06; 12.09.06; 30.09.06; 11.09.07; 12.10.07.

Alongside with studying of biology of a nested life blue-cheeked Bee-eater us comprehensively beat the acoustic alarm system of birds is investigated. Depending on a various ecological situation of a bird issue comfortable or on the contrary discomfortable signals. As to repellent signals that they are precisely subdivided into warning signals, on alarm signals and dangers and at last repellent a signal serve as the culmination moment distress signals. In the bioacoustic literature in catalogue to a record library of voices of animals (Aleksandrova, Veprinsev, 1979) [1]. No data on presence of distress signals blue-cheeked Bee-eater. We for the first time had been found out distress signals blue-cheeked Bee-eater.

In time huntings behind flying insects bee-eaters between itself communicate means of the alarm communications, they

to each other pass the certain and important data. Signals of birds at a jack, an arrival male or female with a forage, but to sounding and the maintenance differ. Or at sudden occurrence above a nested colony of a bird of prey (shikra, (Eurasian) Hobby) or occurrences of the person in nested territory, cause at bee-eaters powerful repellent reaction. Thus birds issue as a rule short, quickly repeating trill signals and fly in the different sides and express those the protective reaction. Then birds are going to in flight which is condensed and bee-eaters rise on the big height and there from within several minutes they observe. Having convinced, that danger already passed, gradually fall downwards on territory of the nested colony.

Acoustic alarm systems and features of communicative behaviour blue-cheeked Bee-eater were studied by us for the first time. Presence and real existence of a culmination stage repellent signals of distress signals blue-cheeked Bee-eater us is revealed for the first time, is news certainly has the big theoretical and important practical value in practice management of behaviour of birds, into creation of acoustic repellents - simulators which will is introduced in practice of beekeeping economy of republic.

Acoustic alarm systems blue-cheeked Bee-eater it is conditionally subdivided into two groups: comfortable and discomfortable. Comfortable signals are issued by birds at favorable ecological situations for example, at presence abundance of insects in air and in time huntings for them, rest, etc. is more often. The forage, convenient vacation spots, a nested hole, activity of gluttonous nestlings serve In these cases as the basic stimulus. Blue-cheeked Bee-eater has a complex of acoustic signals, thanking which are provided success of a nested life and in general has the big biological value for course of all vital processes. In turn discomfortable signals too depending on a situation and a degree of danger are subdivided into three subgroups: trouble, a panic, alarm and disaster. Signals of trouble naturally issued by birds, a panic the biological sense has determined and are issued more often. These signals as have shown our supervision have the important adaptive value during migration, pairings and nestings, at formation of protective behaviour, at group protective reaction, etc.

As show our researches of communication acoustic signals of bee-eaters alongside with ecology and etology a kind take the important place in a life of birds I are an indissoluble component of their biology.

As a culmination stage acoustic repellent signals blue-cheeked Bee-eater distress signals of birds serve. In natural conditions this signal practically is not issued or issued by birds very seldom.

Distress signals blue-cheeked Bee-eater for the first time us managed to be written down on a magnetic tape in area Balikchinskiy Andijan region in kishlak Urmobek. Local beekeepers put a little traps at an input in a nested hole bee-eaters. One of birds (male) has got in a loop, during this moment we wrote down its distress signals.

Into a problem of our researches entered the analysis of the physical nature repellent signals blue-cheeked Bee-eater, the spectral-time analysis of distress signals of birds, on the basis of the received spectrogram will be synthesized acoustic repellent-imitation of blue-cheeked Bee-eater.

Magnetic recording distress signals of blue-cheeked Bee-eater have been analyzed using the special computer programs “Pentium-IV” and the spectrogram of distress signals birds ("fig. 2") is received.

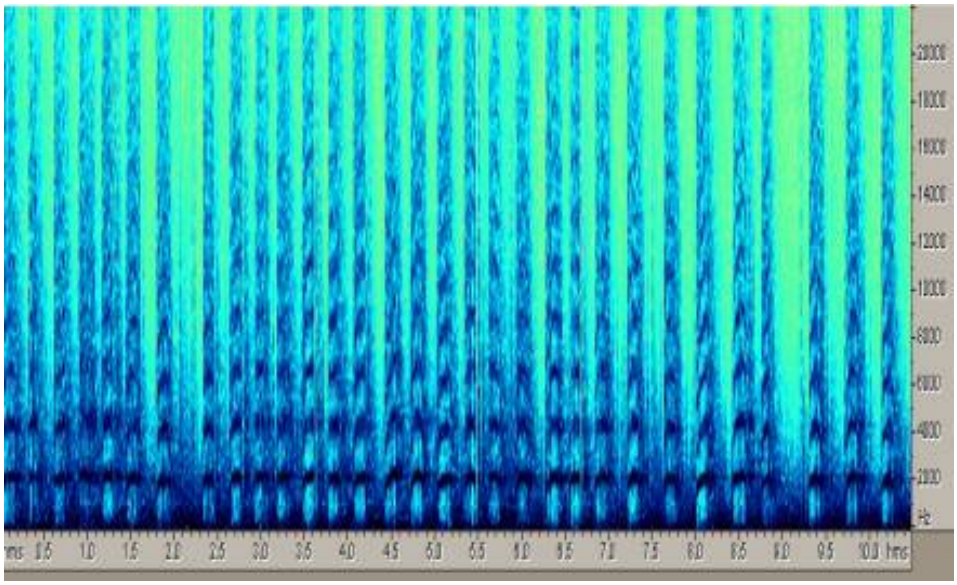

Fig 2: The spectrogram of distress signals blue-cheeked Bee-eater

Comprehensively the analysis of the spectrogram of distress signals blue-cheeked Bee-eater show, that distress signals are characterized by similar principles of the structural organization: presence of the expressed peak or frequency modulation. Periodic increase and falling of frequencies is submitted or the sawtooth form, or has complex chaotic character. As a rule, signals narrow strip and with harmonious components. Signals has the following spectral-time parameters: spectral borders of signals have made from 2,0 up to 20 to Hz, the basic frequency strip from 2,0 up to 7,0 кHz, duration of a signal from 0,25 up to 0,45 sek.

At translation of distress signals blue-cheeked Bee-eater by means of stationary bioacoustic installation of a bird have obviously shown characteristic protective reaction which was expressed as condensation male caused a panic in flight and scattering of birds.

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