Охорона птахів	Беркут	20	Вип. 1-2	2011	153 - 158

CAPTIVE BREEDING OF DEMOISELLE CRANE IN LAKKI MARWAT, KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract. Cranes are important birds migrating to Pakistan, their four species were recorded here in the past including Demoiselle, Eurasian, Sarus and Siberian Cranes. However, more recently only Demoiselle and Eurasian species have been found to visit Pakistan while the other two are rarely seen. For the last few decades, a decline in the crane populations has been observed worldwide. In such circumstances, their captive breeding can play a valuable role for the conservation and restoration of their populations. The current study, therefore, investigated the success of captive breeding of Demoiselle Crane in Lakki Marwat area. Three different sites were selected; each having maintained three pairs of breeding Demoiselle Cranes. The effect of specific food type on breeding success of the crane species was investigated by providing them three different kinds of feed (carbohydrates, combination of carbohydrates and proteins, and open feed) during their breeding season. The breeding success was compared through the results of three different captive breeding techniques used; natural incubation, multiple clutching and artificial insemination. A comparison of the results about clutch size, hatching success and survival rates at the three selected sites showed that cranes consuming a variety of foods from open fields (Site-III) had highest breeding success (hatching success 88.9%, and survival rate 87.5%) than those who received either single (carbohydrates only) or two types (carbohydrates and proteins) of food. The cranes of site-I that consumed only carbohydrates-containing food showed least breeding success (hatching success 40.0%, survival rate 50.0%). A comparison of breeding techniques revealed that multiple clutching and natural incubation as the most successful techniques (85.7% and 85.0% hatching success and 83.3% and 66.7% survival rate, respectively).

Key words: Demoiselle Crane, *Anthropoides virgo*, food, hatching success, survival rate.

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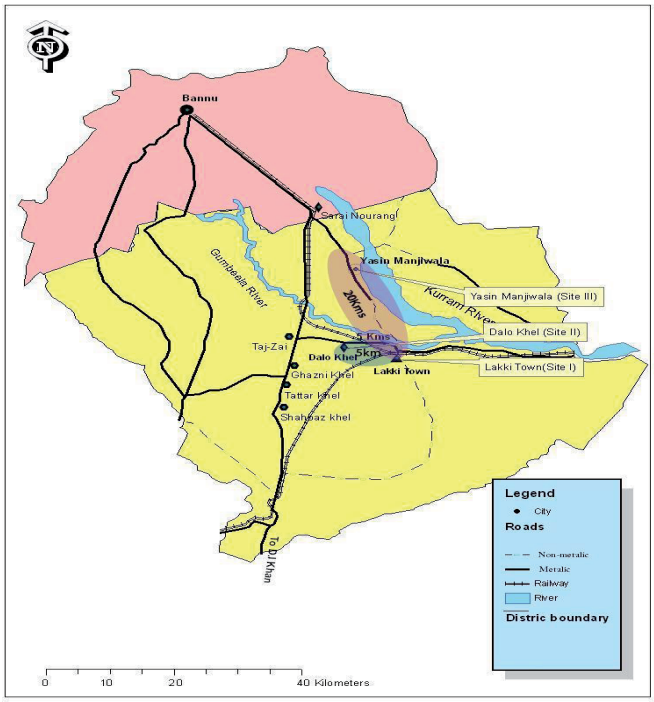
Размножение журавля-красавки в неволе в Лаки-Марват в Пакистане. - Т. Махмуд, Н. Амин, М. Раис. - Беркут. 20 (1-2). 2011. - В Пакистане отмечены 4 вида журавлей – серый, красавка, белый и антигона. Последние два в настоящее время встречаются очень редко. Изучалась эффективность разведения красавки в неволе. Были выбраны три участка, на которых содержались по три пары журавлей. Исследовалось влияние на успешность размножения различных кормов (углеводы, углеводы и протеины, природные корма на полях) и техники разведения. Сравнение показало, что более высокую успешность размножения имели птицы, получавшие разнообразные естественные корма на открытых полях. Из различных видов техники разведения наиболее эффективными оказались естественная инкубация и индуцирование повторных кладок.

INTRODUCTION

In Pakistan, four crane species were recorded in the past: Demoiselle (*Anthropoides virgo*), Eurasian (*Grus grus*), Siberian (*G. leucogeranus*) and Sarus Cranes (*G. antigone*). However, only Demoiselle and Eurasian species visit Pakistan more recently while the other two are rarely seen.

Demoiselle Crane winters in Indian subcontinent after flying over Himalayas during its fall migration. In Central Asia, there are two migratory routes, one flying directly over Himalayas and the other travel around the Hindu Kush mountains. During migration Demoiselle Crane travels long distances within short period of time (Kanai et al., 2000). This species is primarily found in dry grasslands and utilizes agricultural fields for its activities, including foraging and is normally plentiful around streams and rivers. Eurasian Cranes are now rarely seen in Pakistan. Populations of Siberian Crane traditionally used to flow over Pakistan during their annual migrations in the past, however, this species is also no more recorded and is expected to be extinct from here. The Sarus Crane is non-migratory, however, its populations may move on a seasonal basis in response to monsoons and droughts. It is regarded as irregular visitor to



Administrative map of District Lakki Marwat, showing three selected study sites.
Карта округа Лаки Марват с тремя пробными участками.

the wetlands of the Southeast Asia (Meine, Archibald, 1996).

Lakki Marwat area of Khyber Pakhtunkhwa province in Pakistan is included in the important migratory route of Eurasian and Demoiselle Cranes which pass through it during spring and fall migration seasons. Spring migration of Demoiselle Crane usually starts in the first week of March and continues till mid of April whereas its fall migration starts in first week of September and continues till early October. In Pakistan, large populations of Demoiselle Crane occur in captivity at Bannu, Lakki Marwat and adjacent tribal areas of northern Pakistan. Majority of them have been captured from wild, whereas a sufficient proportion also includes homebred pairs. During spring and fall migration seasons of cranes, the local hunters' camp along the river side lay down the traps with their trained decoys to capture these crane species (Ali, Khan, 2007). The communities at Bannu, Lakki Marwat and adjacent tribal areas have approximately 4,000 Eurasian and 8,000 Demoiselle Cranes in captivity. These cranes originally had their wintering and breeding grounds in the mild-temperate areas of India and Central Asia, respectively. However, they now have well adapted to the local conditions here where maximum temperature reaches around 50 °C (Khan, 2004).

The current study aimed to estimate the captive breeding success of Demoiselle Crane in Lakki Marwat area by investigating the role of various food components provided during breeding season and comparison of different captive breeding techniques.

MATERIAL AND METHODS

STUDY AREA

The current study was carried out in Lakki Marwat (32° 41′ 25″ N, 70° 50′ 05″ E), one of the southern districts of Khyber Pakhtunkhwa in Pakistan (Fig.). The district comprises of an area of 3,164 km² (GOP, 1998). District Lakki Marwat has all characteristics of a desert due to its sand dunes, scorching heat and dry weather conditions. Its summers are very hot, but winters moderately cool. June is the hottest month of the year with maximum temperature range of 42–45˚C and minimum of about 30–35˚C. Periodic sand storms rage through the area during May and June. How-

Table 1

Three different combinations of diet provided to captive breeding Demoiselle Cranes to investigate their breeding success during the study period
Три варианта диеты, использовавшиеся для изучения успешности размножения красавки

Study site No	No of crane pairs	Nature of diet given	Form of food
I	3	carbohydrates	grains, wheat, spinach, calcium
II	3	carbohydrates and proteins	liver, fish, wheat, spinach, calcium
III	3	carbohydrates, fats and proteins	open field (spinach, grasshoppers, frogs, insects, wheat, butter, calcium, etc.)

ever, the cool wave starts in early November and may recur throughout the winter months; December, January and February. Rainfall is very rare, sporadic and generally occurs in July and August each year (GOP, 1998).

STUDY DESIGN

The present study was conducted from August 2009 up to May 2010. Three different sites were selected in the study area: study site I – Lakki town (32° 41′ 25″ N, 70° 50′ 05″ E), study site II – Dallo Khel (32° 36′ 12″ N, 70° 51′ 40″ E) and study site III – Yasin Manjiwala (32° 44′ 50″ N, 70° 51′ 31″ E). Each site had a group of three pairs of Demoiselle Cranes. Regular study visits to selected sites were conducted on monthly basis, and a total of ten visits were made during the study period.

Investigation of role of specific food components in breeding success

Important role of specific food components during captive breeding and its subsequent effects on hatching success and chick survival were investigated by maintaining Demoiselle Crane pairs at three different study sites. Three different combinations of foods were provided to each of the three pairs at three different sites. At study site I, the pairs of cranes were fed with diet comprising of carbohydrates diet. Cranes at site II were given a combination of carbohydrates and proteins diet while at site III the captive Demoiselle Cranes were free to feed on any type of food available the in adjacent open fields (Table 1).

The food was provided to the cranes 3 to 4 times a day while special feed was provided from January to May 2010. For each feeding, every component of diet was weighed, mixed well and given freely. Average food provided to each individual crane was 100 g per day.

The record of eggs laid, incubation periods and hatching success were determined at all the sites.

Comparison of breeding techniques

Various breeding techniques were being practiced in the Lakki Marwat area for captive breeding of the Demoiselle Cranes, including Natural Incubation (NI), Multiple Clutching (MC), and Artificial Insemination (AI). During the current study period, we compared these three techniques for maximum breeding success in the captivity.

Natural Incubation and use of Dummy Egg. In this technique, Demoiselle Cranes themselves were used to incubate the eggs laid by them as described by Gee et al. (1995). In order to get more clutches (eggs) from the crane species, wooden models of crane eggs (dummy eggs) were used to replace with original eggs following Ali and Khan, 2007. Some pairs that had not laid clutches were induced to incubate eggs and adapt chicks by introducing dummy eggs.

Multiple Clutching. It is a process where eggs of cranes are hatched by using broody hen or broody ducks or even incubators. It is also used applied in the Lakki Marwat area with captive populations of Demoiselle Crane.

Table 2

Breeding results of Demoiselle Crane at three study sites with different diets
Результаты размножения красавки на трех пробных участках с различным питанием

Site	Eggs laid	Eggs addled	Eggs hatched	Hatching success, %	Chicks mortality	Chicks survived	Survival rate, %	Breeding success, %
I	5	3	2	40.0	1	1	50.0	20.0
II	6	1	5	83.3	2	3	60.0	50.0
III	9	1	8	88.9	1	7	87.5	77.8
Total	20	5	15	75.0	4	11	73.3	55.0
Mean	6.7 ± 1.2	1.7 ± 0.7	5.0 ± 1.7	70.7 ± 15.4	1.3 ± 0.3	3.7 ± 1.8	65.8 ± 11.2	49.3 ± 16.7

In captivity, females of cranes were induced to lay eggs repeatedly through the removal of their eggs. In this manner, females regularly produced up to ten or more eggs in a single breeding season.

Artificial Insemination. This technique is also applied to the captive crane populations. During this process, the females were inseminated with semen from several males during the breeding season or with semen from multiple males simultaneously due to unknown sperm viability of the breeding males. For the collection of semen from the male crane, mostly massage collection technique was used as described by Gee and Temple, 1978. In this process, the male Demoiselle Crane was under control by a person while another person collected its semen, which was later on used to inseminate female cranes artificially. The first person captured the male and cradled it between the legs and massaged the crane's leg rhythmically. The second person stroked the abdominal region, so that cloaca was open. Then cloaca was grasped by thumb, semen expressed and collected in small funnel. For insemination, female crane was also massaged and her back was stroked, so that she opened the cloaca. The vagina appeared as red rosette, inseminating device was inserted into the vagina and semen was injected into that following Archibald (1974).

Statistical Analysis

Data on effects of specific food components on breeding success of cranes and breeding techniques were statistically analyzed by using one way Analysis of Variance (ANOVA) single factor. Similarly association between the specific food components and breeding success were analyzed by using Chi-Square test.

RESULTS

Breeding success and specific food components

The breeding success of captive Demoiselle Cranes at three study sites is shown in Table 2. At study site I, where only carbohydrate containing diet was provided to the pairs of breeding cranes, the breeding success was minimal. At site III, where captive cranes were free to feed in the fields of surrounding area having a variety of food such as spinach, grasshoppers, frogs, insects, etc., the birds raised most of all youngs.

The results of the effects of specific food components on breeding success of Demoiselle Cranes at three selected sites were analyzed using single factor one way Analysis of Variance (ANOVA) with replication. There was found a significant difference ($F = 5.6$, $p < 0.05$, $df = 2$) among the specific food components and breeding success of the three groups.

Comparison of three different captive breeding techniques

Out of a total of 9 crane pairs used for the comparison of breeding techniques, 6 pairs were tested for natural incubation technique,

Table 3

Breeding results of Demoiselle Crane with three breeding techniques
Результаты размножения красавки с тремя техниками разведения

Techniques	Total pairs	Eggs laid	Eggs addled	Chicks hatched	Hatching success, %	Chicks survived	Survival rate, %	Breeding success, %
Natural Incubation	6	12	3	9	75.0	6	66.7%	50.0
Multiple Clutching	2	7	1	6	85.7	5	83.3%	71.4
Artificial Insemination	1	1	1	0	0.0	–	–	0.0
Total	9	20	5	15	75.0	11	73.3	55.0
Mean		6.7 ± 3.2	1.7 ± 0.7	5.0 ± 2.6	53.6 ± 27.0	5.5 ± 0.4	75.0 ± 8.3	40.5 ± 21.2

during which total 12 eggs were laid, 9 of those hatched into chicks, whereas 3 eggs got addled (Table 3).

Two pairs of crane got addled while remaining 6 hatched to raise chicks. By using this technique, not more than 4 eggs were hatched from the same pair because their weight became reduced and they became weak (Table 3).

In the process of artificial insemination during which the semen of male crane was collected in the vials and used to inseminate the female bird artificially following Archibald (1974), results showed that out of total 9 Demoiselle Crane pairs, only one pair could be successfully inseminated. Resultantly, only one egg was laid and that particular egg also became addled. Therefore, no chick could be hatched (Table 3).

The results regarding three different captive breeding techniques were compared using single factor one way Analysis of Variance (ANOVA) with replication. There was found a significant difference ($F = 4.9$, $p < 0.05$, $df = 2$) among the three different breeding techniques.

DISCUSSION

A comparison of the results of clutch size, hatching success and survival rate at the three selected sites showed that breeding crane pairs that consumed a variety of foods by utilizing the surrounding open fields, had highest reproductive success than those receiving either single (carbohydrates) or two types of food (carbohydrates and proteins). It was also noticeable that before egg laying started, captive female cranes also consumed dust/soil and calcium supplement as well. Halibey (1976) documented that in captive crane females, consumption of feed and oyster shell (which is a calcium reserve) increases during egg production. So, cranes of site III in the current study had a higher reproductive success than the other two sites. Murton and Westwood (1977) showed that during egg laying, cranes need diet having fats and calcium. They also consume more quantity of food to provide essential energy, protein, and other variety of nutrients, required for egg production. The results of the current study also get support from Serafin and Archibald (1977) who studied the natural and synthetic diets for cranes and concluded that birds may breed in response to direct availability of food.

Regarding comparison of different captive breeding techniques tested for Demoiselle Crane, 6 pairs were tested for natural incubation technique, and resultant hatching success was 75.0% while survival rate of chicks was 66.7%. Sullivan (1994) demonstrated that in

order to achieve a hatching success in cranes, natural or a combination of natural and artificial incubation might be used. Multiple clutching technique, applied in the current study, showed hatching success of 85.7% and survival rate of chicks as 83.3%. Koga (1976) and Putnam and Russman (1987) reported that extended production in cranes may cause calcium depletion, laying of uncalcified eggs, decreased growth rate, and reduced chick survival and hatchability. Nakayama (1967) showed that rate of egg laying under captive conditions may be increased by removing the eggs of White-naped Cranes (*Grus vipio*) each time when it is laid.

The current study concludes that multiple clutching and natural incubation are the two successful captive breeding techniques that can be used for Demoiselle Cranes in the Lakki Marwat area of Pakistan, since both of these resulted in high hatching and survival successes. Gee et al. (1995) also suggested natural incubation as the successful breeding technique because variation in nest temperature due to change in environmental temperature, exchange of incubation by the parents and temperature gradient from top to bottom of the eggs were not available in artificial incubation. Likewise, Derrickson and Carpenter (1987) also reached to the similar conclusion that those eggs incubated naturally, were not threatened by mechanical failure and enhanced pair bond which also promoted higher reproductive rates in future. Mahan (1992) demonstrated multiple clutching as successful technique, since chickens can withstand fairly cool and warm temperatures and can incubate all the eggs. But it is also found that multiple clutching may affect reproductive parameters. Putnam and Russman (1987) reported a seasonal decline in weight from first egg to last egg in most of the crane species. Similarly, Hunt (1994) noted a slight negative effect since the last eggs of the season were less likely to produce fledged chicks than earlier eggs.

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