

ASSESSING THE BIOLOGICAL STATUS OF DEMOISELLE CRANES (*ANTHROPOIDES VIRGO*) AND EURASIAN CRANE (*GRUS GRUS*) WITH RESPECT TO ILLEGAL HUNTING AND CAPTIVITY IN DISTRICT LAKKI MARWAT AND BANNU, KHYBER-PAKHTUNKHWA PROVINCE, PAKISTAN

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Abstract. The present research is focused on assessing the biological status of the Demoiselle crane (*Anthropoides virgo*) and Eurasian crane (*Grus grus*) with respect to Illegal hunting and captivity in the districts of Bannu and Lakki Marwat, located in Khyber-Pakhtunkhwa, Pakistan. The study involves field visits, interviews with crane hunters and local breeders, and the collection of relevant information through questionnaires. In Lakki Marwat, during the hunting seasons of fall 2021 and spring 2022, a total of 33 cranes were captured while 52 cranes were captured during hunting season of fall 2022 and spring 2023. Similarly, in district Bannu, 21 cranes were captured during fall 2021 and spring 2022, and 31 cranes were captured during fall 2022 and spring 2023. Throughout the study, collectively, 2300 Demoiselle cranes and 1400 Eurasian cranes were studied in captivity. In Lakki Marwat, the hatching success rate was 51% and 50.8% for Demoiselle crane and Eurasian cranes respectively. The chick survival rate for both Demoiselle and Eurasian cranes was 62.3% and 54.2% respectively. In district Bannu, the hatching success rate was 57.2% for Demoiselle crane and 56.8% for Eurasian cranes, with a chick survival rate of 54.8% for Demoiselle and 46.7% for Eurasian cranes. The main causes of mortality in captive cranes, in both districts, were diseases, heat stress, predation, injuries, and developmental problems of chicks.

Keywords: captive breeding, demoiselle crane, Eurasian crane, Kurram River, Gambila River, mortality

Introduction

Cranes are the threatened groups of birds belonging to the family *Gruidae*. They are found in all continents except South America and Antarctica (IUCN, 2018). The continent of Asia is home to 12 species of cranes, with nine species found in East Asia and three species in Eurasia (Europe and West Asia) (Lundgren, 2013). Endangered group of cranes in this region is the Siberian crane (*Grus leucogeranus*), which is almost extinct in the region (Ahmad et al., 2021). Pakistan, located in South Asia,

includes the world's largest mountainous chain, the Himalayas as well as rivers like the Indus and the Kurram. This kind of geography and landscape attract many migratory birds to use Pakistan as a migratory ground (Umar et al., 2018) including two species of cranes: the Eurasian Crane (*Grus grus*) and the Demoiselle Crane (*Anthropoides virgo*) (Nawaz et al., 2006). Both of these crane species are categorized as 'Least Concern' on the IUCN Red List of Threatened Species (IUCN, 2016). Due to severe hunting in Baluchistan, Khyber Pakhtunkhwa provinces and other parts of the country, the population of these two crane species faces significant threats, particularly in Khyber Pakhtunkhwa and Baluchistan provinces (Sarwar et al., 2013). In Khyber Pakhtunkhwa, cranes use the Kurram River, the Tochi river OR Gambila river, and small rivers like the Kashoo and Gomal Zam Rivers as migratory routes to their wintering grounds in India, Sudan, and other parts of East Africa (Nawaz et al., 2006). The districts of Bannu, Lakki Marwat, and adjacent tribal areas in the Kurram valley lie on the migratory route of Eurasian and Demoiselle cranes, where people from these districts establish hunting camps in the spring and fall seasons to capture and kill these migratory cranes. The means and tactics for hunting are guns, decoying cranes and special trapping devices, locally called "Soai" (Rehman et al., 2022; Sarwar et al., 2021). The spring crane hunting begins around the first week of March and continues until early April, while the autumn hunting runs from early September to mid-October. The population of migratory cranes has severely declined in recent years due to these hunting practices, and without serious conservation efforts, they will be endangered or critically endangered (Rehman et al., 2022). In the two districts, some people rear Demoiselle cranes and Eurasian cranes in captivity (Perveen, 2012). providing them with various facilities and diet that includes wheat, millet, meat, peanuts, garlic, fish oil, maize, fruits, bread, eggshells, dry fruits, juices and additional supplements in the form of medicines (Sarwar et al., 2013). Normally, cranes are monogamous birds that lay two eggs, but in the southern districts, crane breeders increase egg production up to six to eight through a technique called "multiple clutching." Some breeders are highly skilled in crane rearing and chick development (Ali et al., 2011). However, in most cases, cranes and their chicks fail to reach maturity due to various physical and medical problems. Adult cranes face environmental challenges such as temperature, predation, unavailability of proper habitats and inexperienced breeders in the study area. Medical problems include physiological issues and infectious diseases (Ahmad et al., 2021) such as bacterial, viral (Rathore et al., 2022), fungal and possibly protozoan and helminths parasites (Perveen, 2012). While the chicks mostly die due to developmental problems and lack of proper management by the crane breeders (Mahmood et al., 2011). Present study is conducted to assessing the biological status of common crane (*Grus grus*) and the Demoiselle crane (*Anthropoides virgo*), with respect to Illegal hunting pressure and captivity such as captive breeding, mortality rate among adult cranes and chicks in two districts of province Khyber Pakhtunkhwa Pakistan.

Materials and methods

Study area

The research is carried out in two southern districts of the Khyber Pakhtunkhwa province, Pakistan. The districts are Bannu (located between 32°16'N and 33°5'N and between 70°23'E and 71°16'E, with an area of 1,670 square miles) and Lakki Marwat (located at 32°41'25"N 70°50'5"E, covering a total area of 3,164 km²). These districts

are situated on the migratory route and important wetlands for cranes, such as the Kurram River and the Tochi or Gambila River. In addition to these main wetlands, the Baran Dam located on the Kurram River in District Bannu (*Fig. 1*), also attracts migratory avian fauna. People from various parts of the southern districts gather during the fall (November-December) and spring (March-April) seasons to set up hunting camps, consisting of 7-12 individuals. As the wildlife department has imposed restrictions on the illegal hunting of migratory birds, particularly cranes, in the study sites, it is important to note that most hunters do not possess the necessary permits for hunting. Hunters employ different techniques to capture migratory cranes, including the rope method (locally called “soai”), guns (*Fig. 2*) and the use of decoying cranes.

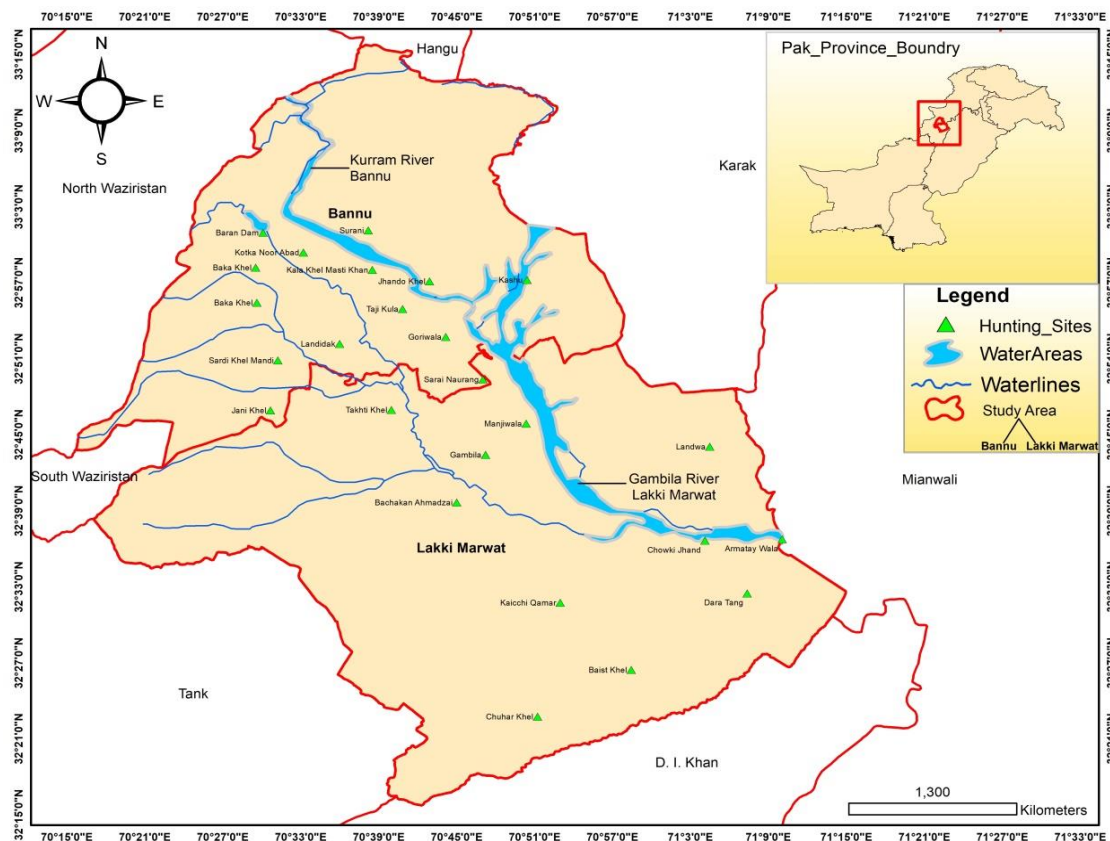


Figure 1. Study area Map of district Lakki Marwat and Bannu. Three hunting sites from Bannu are Kashoo Baran dam and Areas associated with River Kurram. Similarly, two main hunting sites from district Lakki Marwat are River Gambila and river Kurram and associated areas

Study design

The data were collected during the fall of 2022, from 1st September to 30th November and in the spring of 2023, starting from February 25 to April 15. The hunting data of two years (4 seasons i.e., fall 2021-spring 2022 and fall 2022 and spring 2023) was collected from the hunters. Field surveys were conducted. And regular visits were made to the study area (hunters and local breeders) for data collection. The main tools for data collection were field surveys, interviews and questionnaires. An effective questionnaire was developed, containing all the necessary questions related to hunting experience

with migratory cranes, the number of cranes captured over a two-year period, hunting methods employed, and knowledge about conservation efforts. Similarly, interviews were conducted with local peoples who were raising cranes in captivity to gather information on their experiences in captivity, the number of cranes in captivity, breeding pairs, breeding success rates, the diet provided to captive cranes, mortality rates, and the causes of mortality among adult cranes and their chicks during the study year. The questionnaire was individually filled out by the breeders and hunters of the cranes. Interviews were arranged with crane breeders and hunters and separate information was also obtained from experts.



Figure 2. Hunter from district Lakki Marwat killed Demoiselle crane by gun during hunting season 2021

Statistical analysis

Data associated with hunting were statistically proved by applying Chi-square and Partial Chi-square within log linear model. All of the statistical analysis was performed by software “The Statistix v. 8.1” (Analytical Software, 2005).

Results

Hunting of Demoiselle cranes and Eurasian cranes in district Lakki Marwat during hunting season fall 2021–spring 2022 and fall 2022–spring 2023

During the hunting season of both years fall 2021–spring 2022 and fall 2022–spring 2023, hunting camps were established on different hunting sites located on river Gambila (32°52’26” N: 70°32’20” E and River Kurram (32°42’39”N 70°54’23”E) of district Lakki Marwat. During hunting seasons 85 cranes was captured by the hunters in district Lakki Marwat. The numbers of cranes captured during hunting season of fall 2021–spring 2022 was 33 which include 24 Demoiselle cranes and 9 Eurasian cranes. While 52 cranes was captured during the hunting season of fall 2022 and spring 2023 comprise of 39 Demoiselle cranes and 13 Eurasian cranes. Highest numbers of cranes was captured during the hunting season of spring 2023 which include 23 demoiselle cranes and 8 Eurasian cranes. Besides capturing 42 cranes (28 Demoiselle cranes and 14 Eurasian cranes) were also killed during hunting seasons. Most of the cranes was killed during the hunting season of spring 2023 including 11 Demoiselle cranes and 5 Eurasian cranes (*Table 1*).

Table 1. Hunting of Demoiselle cranes and Eurasian cranes in district Lakki Marwat during hunting season 2021-2022 and 2022-2023

Crane species	Hunting year fall 2021–spring 2022				Hunting year fall 2022–spring 2023			
	Season fall 2021		Season spring 2022		Season fall 2022		Season spring 2023	
	Captured	Killed	Captured	Killed	Captured	Killed	Captured	Killed
<i>Demoiselle crane</i>	11 (33.3%)	5(29.4%)	13(39.3%)	6(35.2%)	16(13.7%)	6(24%)	23(44.2%)	11(44%)
<i>Eurasian crane</i>	4 (12.1%)	2(11.7%)	5(15.1%)	4(23.5%)	5(9.6%)	3(12%)	8(15.3%)	5(20%)
<i>Total</i>	15(45.4%)	7(41.1%)	18(54.5%)	10(58.8%)	21(40.3%)	9(36%)	31(59.6%)	16(64%)

Hunting of Demoiselle cranes and common cranes in district Bannu during hunting season fall 2021–spring 2022 and fall 2022–spring 2023

There are three main hunting sites in Bannu district, namely Baran Dam (N 33° 0.5056: E 70° 33.973’, Kashoo (32.9760 N: 70.8480 E), and Kurram River which are generally used for establishing crane hunting camps (*Fig. 1*).

The numbers of hunting sites in district Bannu are more than district Lakki Marwat and a total of 108 (72 Demoiselle cranes and 38 Eurasian cranes) was captured during the hunting season of fall 2021- spring 2022 and fall 2022-spring 2023. A total of 42 cranes comprise of 27 Demoiselle cranes and 15 Eurasian cranes was captured during the hunting Season of fall 2021 and spring 2022, while 66 cranes (45 Demoiselle cranes and 21 Eurasian cranes) was captured during fall and spring 2022-23 hunting seasons. During hunting season of Fall 2021 and spring 2022, totally 12 Demoiselle cranes and 8 Eurasian cranes were killed in all hunting sites of district Bannu. Similarly, 19 demoiselle cranes and 10 Eurasian cranes was killed during hunting season fall 2022 and spring 2023 (*Table 2*).

Table 2. Hunting of Demoiselle cranes and Eurasian cranes in district Bannu during spring 2022 and Fall 2021

Crane species	Hunting year fall 2021–spring 2022				Hunting year fall 2022–spring 2023			
	Season fall 2021		Season spring 2022		Season fall 2022		Season spring 2023	
	Captured	Killed	Captured	Killed	Captured	Killed	Captured	Killed
<i>Demoiselle crane</i>	13(31%)	5(25%)	14(33.3%)	7(35%)	21(31.8%)	7(24%)	24(36.3%)	12(41.3%)
<i>Eurasian crane</i>	6(14.2%)	3(15%)	9(21.4%)	5(25%)	9(13.6%)	4(14%)	12(18%)	6(20.6%)
<i>Total</i>	19(45.2%)	8(40%)	23(54.7%)	12(60%)	30(45.4%)	11(38%)	36(54.5%)	18(62%)

There is a significant association between the categories as the p-value of each individual effect, such as status (hunting/killing of crane), season, and species, is less than 0.05. However, when analyzing the association between the hunting season and crane species, it shows a significant association. More Demoiselle cranes were captured as compared to Eurasian in all of the hunting seasons ($P = 0.01$). However, the season and status of crane show a significant association ($P = 0.01$), as a greater number of hunting and killing was observed during spring (2022-23) compared to fall (2021-2022).

During the study period, it was observed that the numbers of cranes migrated during spring 2022-Fall 2023 was comparatively more than the previous many years. The main reasons behind this may be due to increase rainfall in the study areas which recovered the wetlands for the migratory birds also stimulate birds’ migration through their natural

route in both districts. Increased use of guns (*Fig. 2*) instead of traditional roping technique (soai) (*Fig. 3*), in both districts accelerate the cranes killing during hunting season.



Figure 3. Hunting rope (locally called “soai”) for capturing of cranes

Captive breeding of Demoiselle cranes in district Lakki Marwat and Bannu of Khyber Pakhtunkhwa, Pakistan

People in both districts’ rear cranes in captivity for economic and domestic purposes and also, they like this migratory bird very much. These cranes are used in various festivals and also serve as decoys for capturing other migratory cranes. Crane breeding is a widespread practice in both districts and some expert breeders have been successful in increasing the crane population in captivity every year. In order to achieve this, breeders utilize a multiple clutching method, where they place a wooden egg or an additional egg beside the crane’s own egg after hatching. This technique leads to the cranes laying more eggs and some breeders have been able to increase the number of eggs from a single pair (*Fig. 4*) of cranes from 2 to 8. During the current study, collectively 260 expert crane breeders were surveyed in both districts, with 150 breeders from Lakki Marwat and 110 from Bannu. The population of reared Demoiselle cranes is higher in Lakki Marwat compared to Bannu. In Lakki Marwat, 1090 demoiselle cranes were reared by 150 breeders, including 245 breeding pairs and 600 non-breeding cranes. A total of 570 eggs were laid by the cranes (490 through natural processes and 80 through the multiple clutching methods). Out of these, 275 eggs were added, and 295 eggs hatched, resulting in 295 chicks being born. However, only 184 (62.3%) chicks survived, and the 111 (37.7%) were perished. Similarly, in Bannu district, 810 Demoiselle cranes were reared by 110 breeders, including 196 breeding pairs and 418 non-breeding cranes. The cranes laid a total of 414 eggs, including 22 eggs through the multiple clutching methods. Out of these, 187 eggs were added and 227 eggs hatched, resulting in 227 chicks. Unfortunately, 97 (42.8%) of the chicks died, leaving 130 (57.2%) survivors. The chick survival rate was higher in Lakki Marwat district compared to Bannu and the multiple clutching techniques were more commonly practiced by breeders in Lakki Marwat than in Bannu (*Fig. 5*).



Figure 4. Breeding pairs of captive Demoiselle cranes with two chicks in captivity (district Bannu)

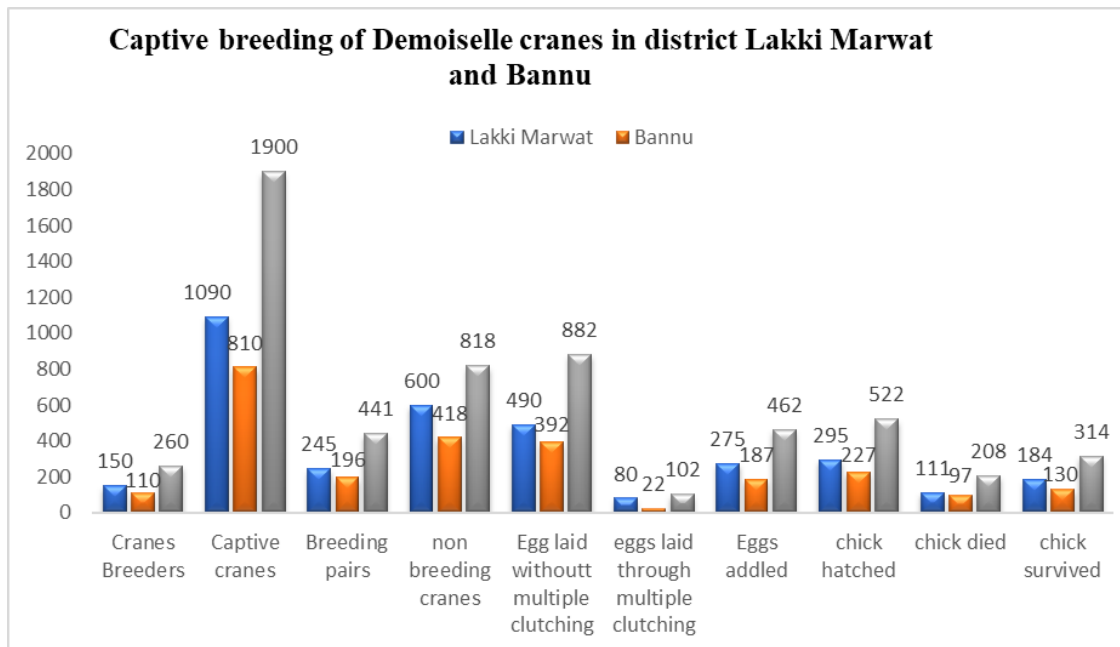


Figure 5. Captive breeding of Demoiselle cranes in district Lakki Marwat and Bannu of Khyber Pakhtunkhwa, Pakistan

Captive breeding of Eurasian cranes in district Lakki Marwat and Bannu of Khyber Pakhtunkhwa, Pakistan

It was observed during study that the population of Eurasian cranes reared in captivity was higher in district Bannu as compared to district Lakki Marwat. In Lakki

Marwat, 82 breeders reared a total of 217 Eurasian cranes, consisting of 52 breeding pairs and 113 non-breeding cranes. These cranes laid a total of 116 eggs with 104 eggs lay naturally and 12 eggs produced through the multiple clutching method. Out of the total eggs, 57 were added, and 59 eggs hatched, resulting in the birth of 59 chicks. Unfortunately, only 32 (54.2%) chicks managed to survive, while the remaining 27 (45.8%) did not survive. Similarly, in Bannu district, 115 breeders reared 43 captive Eurasian cranes, which included 109 breeding pairs and 212 non-breeding cranes. The breeding cranes laid a total of 241 eggs, including 23 eggs through the multiple clutching methods. Out of these, 104 eggs were added and 137 eggs successfully hatched, resulting in the emergence of 102 chicks. Unfortunately, 73 (53.3%) of these chicks did not survive, leaving a total of 64 (46.7%) survivors (*Fig. 6*). P value is 0.000 so there is significance association between captive breeding of Eurasian cranes and region, as captive breeding such as fertilization success, egg hatching and chick survival rate was higher in district Bannu as compared to district Lakki Marwat.

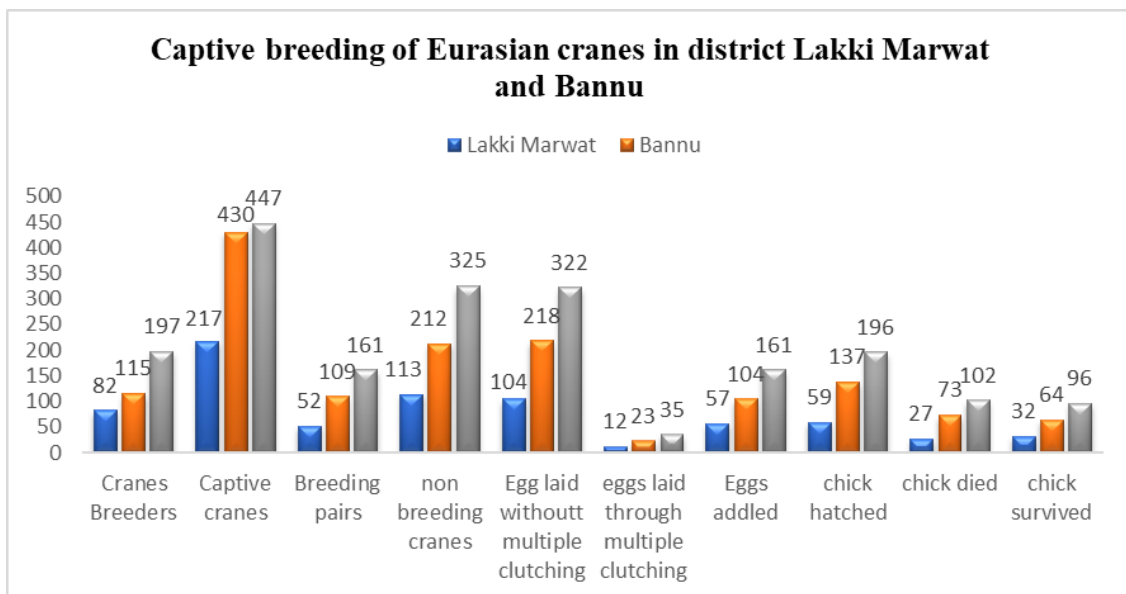


Figure 6. Captive breeding of Eurasian cranes in district Lakki Marwat and Bannu of Khyber Pakhtunkhwa, Pakistan

Mortality of adult Demoiselle and Eurasian cranes and its chicks in district Lakki Marwat Khyber-Pakhtunkhwa, Pakistan

During the study period, a total of 24 Demoiselle cranes and 10 Eurasian cranes died. The majority of demoiselle cranes died as a result of unknown diseases (infection, head tumor, stomach blockage, metabolic problems) (46%) and Heat stress (25%) (*Fig. 7*). Other factors contributing to the mortality among demoiselle cranes included predation by dogs and hyenas (12.5%), influenza (12.5%) and injuries (4%). Similar factors were associated with the mortality of captive Eurasian cranes, but in different proportions: unknown diseases (60%), Heat stress (20%), influenza (10%) and Injuries (10%). No mortality due to predation was observed (*Fig. 8*).

During the study period, a total of 111 demoiselle crane chicks and 27 Eurasian crane chicks was died in district Lakki Marwat. Factors contributing to the mortality of both

Demoiselle crane and Eurasian crane chicks included developmental problems such as poor growth, leg breaking, injuries and improper handling (47%:37%), predation (10%:7%) and unknown reasons (diseases, heat stress etc.) (43%:56%) (Fig. 9).



Figure 7. Demoiselle crane in district Lakki Marwat died due to heat stress

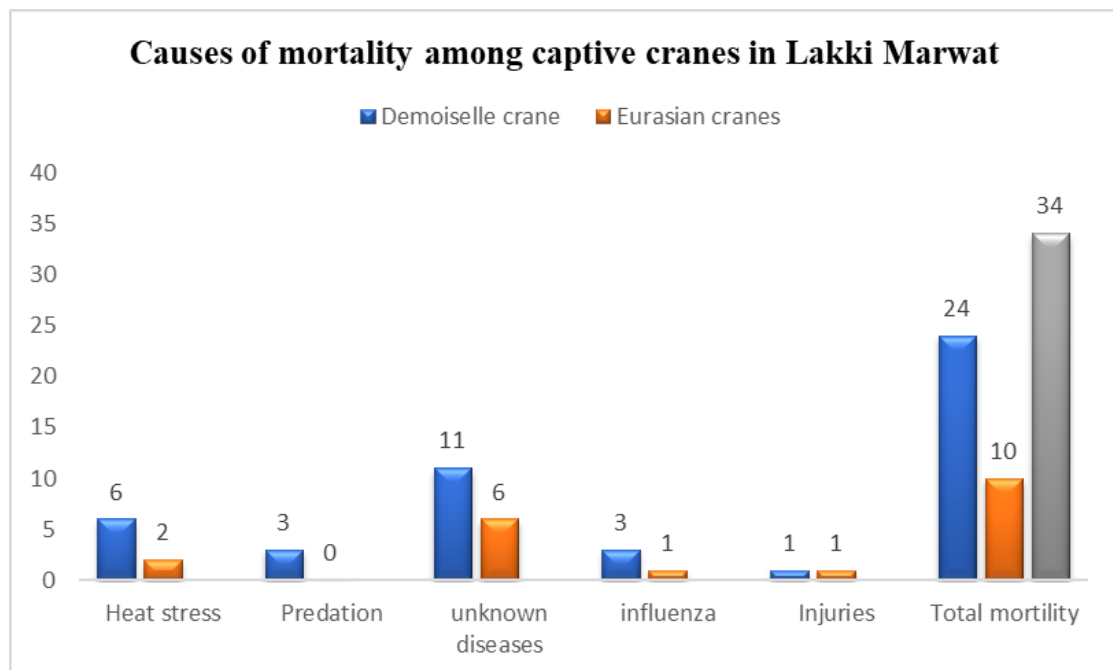


Figure 8. Mortality of adult Demoiselle and Eurasian cranes in district Lakki Marwat Khyber Pakhtunkhwa, Pakistan

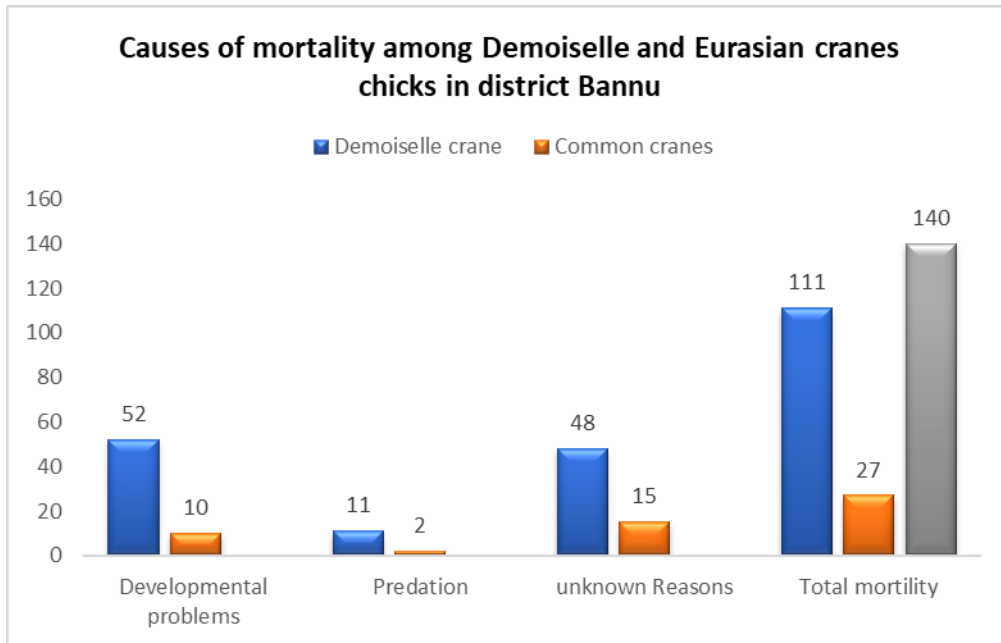


Figure 9. Factors associated with the Mortality of demoiselle and Eurasian cranes chicks in district Lakki Marwat Khyber Pakhtunkhwa, Pakistan

Mortality of adult Demoiselle and Eurasian cranes and its chicks in district Bannu Khyber-Pakhtunkhwa, Pakistan

During the study period in a district Bannu, a total of 11 Demoiselle cranes and 27 Eurasian cranes died. The majority of Demoiselle cranes died as a result of unknown diseases (82%) followed by influenza (9%) and Heat stress (9%). Factors associated with the mortality of captive Eurasian cranes are unknown diseases (70%), influenza (18%), Heat stress (6%), and predation by dog (6%) (Fig. 10).

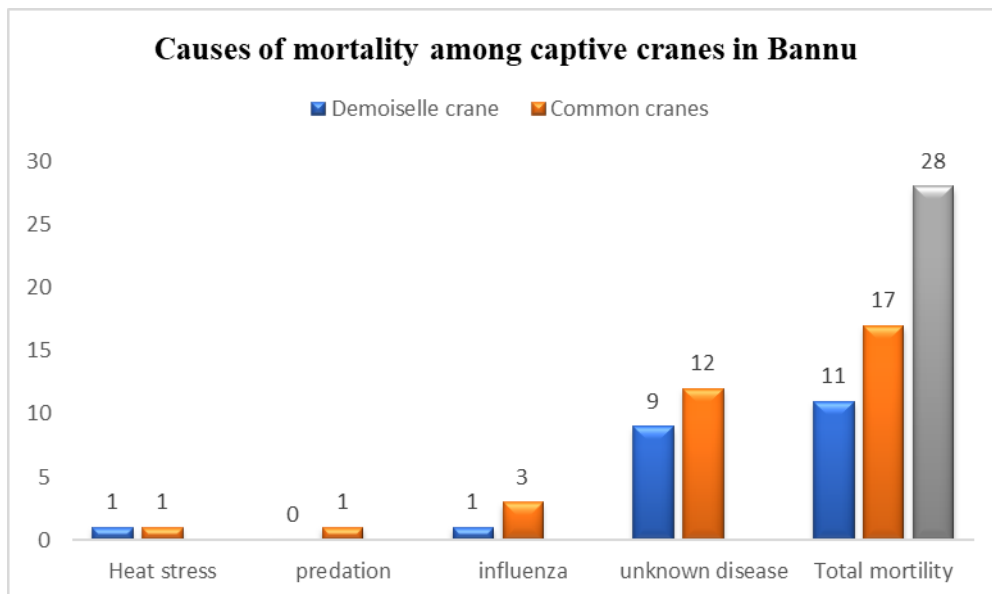


Figure 10. Mortality of adult Demoiselle and Eurasian cranes in district Bannu Khyber Pakhtunkhwa, Pakistan in a district Bannu

Similarly, a total of 97 Demoiselle crane chicks and 73 Eurasian crane chicks died. Factors contributing to the mortality of both demoiselle crane chicks and Eurasian crane chicks included developmental problems such as poor growth, leg breaking, injuries and improper handling (31%:30%) predation (11%: 15%) and unknown reasons (diseases, heat stress etc.) (58%: 55%) (Fig. 11).

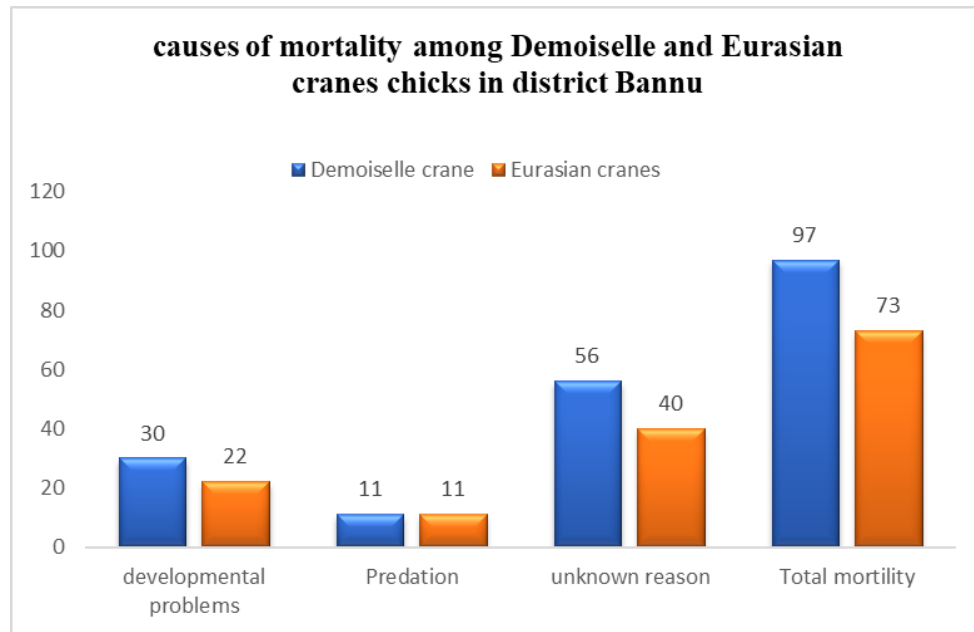


Figure 11. Factors associated with the Mortality of captive Demoiselle and Eurasian cranes chicks in district Bannu Khyber Pakhtunkhwa, Pakistan

Discussion

Pakistan and India are the main wintering quarters of the Eurasian and demoiselle crane (Nawaz et al., 2006). The demoiselle and common crane are more frequent during their autumn and spring migration. But their population is declining due to overhunting in Afghanistan and Pakistan (Ahmad et al., 2021). Hunting is one of the most favorite practices among the peoples of southern districts (Bannu and Lakki Marwat of Khyber-Pakhtunkhwa). Peoples use guns and rope (soai) for capturing of cranes. According to Sarwar et al. (2021), Shafiq (1998) most of the capturing was done through soai and less by guns. But in present study through field visits, questionnaires and social media, it was revealed that most of the crane's hunting were done through guns. The reason behind this was the decline in migratory flocks and increase altitude of the flight. But in Baluchistan people still use soai mostly as compared to guns. Moreover, the flock size of cranes passing through Kurram and Gambila rivers are less than the flock size passing over Zhob district of Baluchistan Province.

In 1966, 5000 cranes were reported to have either been trapped alive or shot. According to Kanai (2000), the hunters of the Kurram Valley trapped 4000 cranes and 100 were killed during the 1986 fall and the spring of 1987. About 3000 to 5000 cranes were captured in 1995 (Ahmad and Jan, 1995). During the 2008 fall and 2009 spring, a total of 2080 cranes were captured and 559 were killed. Of the 2080 captured cranes, 1580 were Demoiselle Cranes and 500 were Eurasian Cranes while 509 Demoiselle and 50 Common Cranes were killed (Perveen and Khan, 2010).

During the 2014 fall and 2015 spring, a total of 232 cranes were captured and 32 were killed. Of the 232 captured cranes, 189 were demoiselle Cranes and 43 were Eurasian Cranes while 25 Demoiselle and only 7 Eurasian Cranes were killed. Out of the captured 189 demoiselle and 43 Eurasian cranes 112 and 77 Demoiselle while 27 and 16 Common cranes were captured in Bannu and Lakki Marwat respectively. Of the killed Demoiselle and Common crane 15 and 10 demoiselle while 3 and 4 Eurasian cranes were killed in Bannu and Lakki Marwat respectively The maximum number of the crane was captured and killed in Baran Dame and Gambilla River (Ahmad et al., 2021). 7947 cranes were captured during the study period. Cranes captured during spring and fall from 2012 to 2015 included 1021 and 502; 981 and 527; 787 and 311 and 843 and 462 respectively. The difference between the spring and fall capture shows that significant mortality occurs during residence at summer quarters and return migration (Sarwar et al., 2021).

In present study the hunting data of two years (4 seasons i.e., fall 2021-spring 2022 and fall 2022 and spring 2023) was collected from the hunters of district of Bannu and Lakki Marwat. A total of 193 cranes was captured in both districts during aforementioned hunting seasons, in both districts during hunting season of fall 2021 and spring 2022, 33 cranes (24 Demoiselle and 9 Eurasian cranes) was captured in district Lakki Marwat while 42 cranes comprise of 27 demoiselle cranes and 15 Eurasian cranes was captured in district Bannu. Similarly, during the hunting season of fall 2022 and spring 2023 total numbers of captured cranes was 118, which include 52 cranes (39 demoiselle and 13 Eurasian cranes) captured in district Lakki Marwat and 66 cranes (45 demoiselle and 21 Eurasian cranes) was captured in district of Bannu. Overall, the numbers of migratory cranes faced severe decline in numbers over these two districts but as compared to previous many years increase crane migration was observed during fall 2022 and spring 2023 hunting season as compared to previous many years in both districts which may be due to increase rainfall in the study area before migratory season which recovered the wetlands for the migratory birds and also stimulate birds' migration through their natural rout in both districts.

Ahmad et al. (2021) conducted a study in districts Bannu, Lakki Marwat and Karak of Khyber Pakhhtunkhwa, Pakistan and surveyed a total of 230, 393 and 333 cranes from Bannu Lakki Marwat and Karak respectively. A total of 408 eggs were layed by the breeding pairs in all of the three districts. 225 eggs were addled (55%) while 183 (45%) were hatched and born a chick. 129 (70%) while the remaining chicks were died. in another study 9 pairs of captive Demoiselle cranes were studied. 6 pairs laid 12 eggs through natural incubation; 3 eggs were addled while the remaining were hatched (75%). 3(33.3%) chicks were died while the remaining survived (66.6%). 2 breeding pairs laid 7 eggs through multiple clutching technique. 1 egg were addled while 6 (85.7%) were hatched. One chick was died (16.6%) while other were survived (83.3%) (Mahmood et al., 2011).

In present study 2300 Demoiselle cranes (1200 from Lakki Marwat and 1100 from Bannu) and 1400 Eurasian cranes (490 in Lakki Marwat and 910 in Bannu) were studied in captivity. Breeders in both districts successfully increased the number of eggs through multiple clutching, resulting in up to 6-8 eggs. The hatching success rate was 51% for demoiselle crane eggs and 50.8% for common crane eggs in Lakki Marwat, with a chick survival rate of 62.3% for demoiselle cranes and 54.2% for common cranes. Similarly, in Bannu, the hatching success rate was 54.8% for demoiselle crane eggs and 56.8% for common crane eggs, with a chick survival rate of 57.2% for

demoiselle cranes and 46.7% for Eurasian cranes. As compared to previous studies the success rate of crane breeding in captivity was increased because of increase awareness and education regarding cranes captivity in both districts.

Cranes faced problems such as climate, predation, and diseases during captivity. according to Perveen (2012) the most probable problems were head tumor, influenza, stomach blockage with prevalence of 20%, 30% and 50% respectively in southern districts of province Khyber Pakhtunkhwa, Pakistan. endo parasites such as protozoan and helminthes also cause diseases among captive cranes which leading to a mortality but its prevalence ratio was lesser. According to Ahmad et al. (2021), 240 fecal samples were collected from both demoiselle and Eurasian cranes from district Lakki Marwat and Bannu. 70 (29%) samples were considered to be positive for parasites. The parasites detected within the positive samples were *E. gruis*, *E. reichenowi* and *A. galli*. The prevalence were (56.3%) and 43.6% among both demoiselle and common cranes respectively (Ahmad et al., 2021).

During 2012-13 a total of 22 samples were collected from whooping cranes, two protozoan parasites *E. gruis* and *E. reichenowi* were detected in 26.5% samples. Similar data were also collected during 2013-14 from 106 cranes samples but the prevalence both *Eimeria* parasites was 20.7% (Bertram et al., 2015). During present study a total of 62 captive cranes was died in both districts from 2022-2023, this includes 34 captive cranes (24 Demoiselle and 10 Eurasian cranes) from district Lakki Marwat and 38 cranes consist of 11 Demoiselle and 27 Eurasian cranes from district Bannu. The majority of captive Demoiselle cranes mortality is due to unknown diseases, heat stress, and predation by carnivores, injuries and influenza. Similar factors were also responsible for the mortality of Eurasian cranes. The effect of these factors on both captive crane species are different in both districts. For example, predation of Demoiselle cranes due to dogs and hyenas was only reported in district Lakki Marwat while no predation was observed in district Bannu. Because in Lakki Marwat the cranes are kept free in large grounds during day time which are easily prone to predators like hyenas and dogs. Similarly, mortality due to heat stress and extreme environmental condition was high in district Lakki Marwat due to its severe climate as compared to Bannu.

Similarly, during the study period, a total of 111 demoiselle crane chicks and 27 Eurasian crane chicks was died in district Lakki Marwat and in district Bannu the numbers of died demoiselle cranes and Eurasian cranes chicks was 97 and 73 respectively. Factors contributing to the mortality of both demoiselle crane chicks and Eurasian crane chicks included unknown reasons such as metabolic and infectious diseases, heat stress, predation and developmental problems comprise of poor growth, injuries, leg breaking and improper handling.

Conclusion

It was concluded that the decline in the number of migratory cranes in the southern districts of Bannu and Lakki Marwat was attributed to excessive illegal hunting pressure over the years. Little increase in crane migration was reported during 2022-2023. Moreover, captive breeding of both crane species is a common practice in both districts. In addition to this, adult cranes face various challenges in captivity, including diseases, predation, injuries, and inadequate management. Mitigating hunting pressure on the two crane species and discouraging people from rearing such migratory birds in captivity. It

is crucial to implement education and awareness programs, as well as collaborative conservation efforts involving both government and non-governmental organizations. Furthermore, the lack of crane centers or aviaries in the study area underscores the immediate need for breeding captive birds, which can serve as a fundamental basis for research related to the health and diseases of captive birds.

Statement of novelty. This research is the first time conducted in the study area and never conducted before the main purpose of the research is to find out the the hunting stress and captive breeding of demoiselle cranes and common crane in district Lakki Marwat and Bannu of Province Khyber-Pakhtunkhwa, Pakistan. the results based on the two years hunting i.e., Fall 2021-spring 2022 and Fall 2022-spring 2023 as well as captive breeding and mortality of demoiselle cranes and common cranes and its chicks in both districts.

Author contributions. Faiz Ur Rehman and Sulaiman Khan prepares idea and supervised study. Afnan Khan and Hafeezullah Khan Collect the data and write thesis. Tariq Ahmad helps in Data collection and Lab work. Najeebullah, review the research and approval of manuscript. Statistical analysis was performed by Muhammad Tayyab Khan. Qingming Wu supervised the research.

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