

ECOLOGICAL INSIGHT INTO NESTING, BREEDING, AND FEEDING BEHAVIORS OF PSITTACULA KRAMERI IN THE NATURAL HABITAT OF LAKKI MARWAT, KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract

Psittacula krameri is a popular, talkative bird that belongs to the phylum *Chordata* in the kingdom *Animalia*. Its common name is the *rose-ringed parakeet*, but in many regions of Pakistan, it is commonly known as "tota". It can mimic human speech, which makes it highly popular among people. In this study, *Psittacula krameri*'s general behavior patterns during nesting, breeding, and feeding in the three tehsils of Lakki Marwat, KPK, are observed. Prior to this research, no studies existed on the ecological behavior of *Psittacula krameri* in Lakki Marwat, KPK. This study addresses that gap. For data collection, I used scan and random sampling techniques along with various tools such as an inch tape, notebook, camera, binoculars, and pen. Bamboo sticks were also used to measure nest heights. SPSS was used to analyze data using a variety of statistical tests. Descriptive data suggested that the tallest nests were located in Lakki City, and the parrots preferred to build their nests above 20 feet on trees. According to One-way ANOVA and Chi-square analyses, the slight differences in average nest heights between the tehsils (27.2 feet in Lakki, 25.3 feet in Naurang, and 21.9 feet in Ghazni) were likely due to regional environmental factors and were not statistically significant. This suggested that the nesting patterns of *Psittacula* species were remarkably consistent across locations, supporting the idea that such behavior was instinctual and not strongly influenced by geographic variation. The study also observed *Psittacula krameri*'s monogamous breeding and herbivorous feeding behaviors in Lakki Marwat, KPK. It suggests that enhancing public awareness of the species' survival behaviors and its role in maintaining ecosystem balance is essential to strengthen conservation efforts and ensure effective management and preservation in natural habitats.

INTRODUCTION

Birds are bipedal, endothermic, oviparous, vertebrate animals with feathers on their bodies that live in water bodies, fields, cities, farmlands, and highlands at different elevations. Birds are members of the class Aves (1). *Psittacula krameri* is often referred to as a parrot. It is a member of the order Psittaciformes and family Psittacidae (2-4). The Austrian scientist Wilhelm Heinrich Kramer was the first to define this parrot's nomenclature, giving it the name "*Psittacula krameri*." "*Psittacus*," which translates to "parrot," was changed to "*Psittacula*," and the species "*krameri*" was named after the scientist (5). *Psittacula krameri* are indigenous to Africa and Asia (6). Alexander the Great introduced the first rose-ringed parakeet to Europe while journeying through India (7).

Four species of parrots inhabit Pakistan: the Alexandrine parakeet (*Psittacula eupatria*), Plum-headed parakeet (*P. cyanocephala*), Rose-ringed parakeet (*P. krameri*), and Slaty-headed parakeet (*P. himalayana*). It is the most common cage bird companion in Pakistan. Mature males of a species have dark green plumage, while females wear bright green rings. According to the Punjab Wildlife Act of 1974, this species is not protected (8). BirdLife International provides estimates of the estimated 356 parrot species, with only 25% available. Despite being one of the most understudied groups in terms of study on its many facets, parrots are rich in terms of species diversity and range. Near Threatened (NT) and Threatened (T) species comprise 42% of the parrot group. The ecology of a number of parrot species remains unclear (9).

The greatest number of parrots is recorded in summer while the lowest in winter in the wild habitat (10). In the top-ranked 100 alien species at the moment is the rose-ringed parakeet. (11). Farmers and other stakeholders have suffered significant financial losses as a result of the ongoing devastation of Pakistan's cultivated crops and fruit orchards, which has a direct effect on the country's ability to maintain a sustainable economy (12).

The first person to observe courtship and nesting behavior was Hume. Although they occasionally dig in softwood or even take up residence in building cavities, Ring-necked Parakeets are often secondary

hole-nesters that enlarge abandoned by woodpecker and barbet cavities (13).

It is a well-domesticated bird species that can survive in any environment, whether it is deciduous forest, dry scrub, or even heavily populated areas. It most often selects *Albizia lebbek*, *Acacia nilotica*, *Melia azedarach*, *Salvadora oleoides*, *Zizyphus spp*, *Phoenix dactylifera*, *Salmalia malabarica*, *Eucalyptus spp*, *Ficus bengalensis*, *Morus alba*, *Dalbergia sissoo* etc, for getting roosting and nesting room. Alternatively, they lead joyful home lives as well (14-16). The parakeet actively searches for the nest cavities in small groups of two to five birds between December and May and between August and October, even though copulation takes place from February to May (17).

Nesting parakeets range in height from 3 to 11 meters. Nest heights of 7-9 m are chosen (42.48%), while 3-5 m is the least preferred (5.88%) (8). RNPs reproduce in colonies of up to nine pairs, with females defending their nests before egg placement. Despite the fact that clutch sizes range from two to six, three to four eggs are typically deposited, and the incubation period lasts 22-24 days, with babies hatching non-concurrently. Fledglings hatch non-concurrently, with two consecutive eggs laid one to two days apart. Fledglings grow up between six and seven weeks of age. The chicks are fed by their parents, especially the male, for at least two weeks after leaving the nest. Following that, fledglings congregate in groups, and parents first distance themselves from the young before eventually separating from one another (18).

While the removal of male birds typically has little to no adverse impact on the number of offspring produced, the presence of female birds always boosts reproductive success. Given that the absence of males typically decreases the quantity or condition of offspring in altricial birds, this observation also suggests that male parental care is less significant in precocial songbirds with self-feeding young than in altricial species. Male removal does not cause complete reproductive failure in many species, suggesting that factors other than the benefits of biparental care frequently contribute to the preservation of monogamy (19). The rose-ringed parakeet is very territorial during the nesting and fledgling periods (20).

Parakeets are active between early morning (around 6:00–7:00 a.m.) and twilight (07:30–08:00 p.m.), when in the mating season (14). Seasonally, the rose-ringed parakeets are monogamous (21). The male parrots show off their breast as they erect their bodies. They alter the size of their pupils by stomping their feet on the perches, or branches, that dangle in the habitats. The males also brush their beaks on the females, feed them, and make figure-eight gestures with their heads. The females bend forward, extend their wings, and sit on the branches, adjusting the size of their pupils. Copulation takes place immediately following courtship. (22).

During the breeding season, males care for females by feeding them and remaining near the nest. The mating habits of ring-necked parakeets varied. The ring-necked parakeet is one of the easiest parakeet species to breed under an aviary system. The easy breeding aspect of this species is additionally complemented by successful breeding with aspects of food availability and nutrition. Additionally, bird's age affects their ability to reproduce. Saether and Bunin claim that younger birds tend to do less well when they reproduce, maybe as a result of having trouble locating a spouse who is the correct age. Compared to the somewhat younger partners (by 1 to 1.5 years), the oldest pair in the current research has the best reproductive parameters (22).

Fruits, seeds, flowers, and buds make up the Rose-ringed Parakeet's main diet. Moreover, the parakeets scarcely remain on the ground and even prefer to eat on the uppermost branches. In such instances, they gathered food and shifted to a higher, safer location to eat it. Rose-ringed Parakeets fiercely fight with native species, including birds, for trophic resources and breeding places (18, 23, 24). A well-known invasive species that is brought to the world mostly because of its appeal in the pet trade is the Rose-ringed Parakeet (25).

It can cause large financial losses and their consequences on agriculture are alarming. In addition to destroying native tree seeds and occasionally dispersing them, these parakeets may also peel bark from native trees, which causes the plants to die. Additionally, the parakeets may disperse invasive and alien plant species, particularly tiny seeds that can enter their digestive systems. Additionally, through food rivalry, these parakeets

have a detrimental impact on native bird species' foraging habits and may have a negative impact on native species' ability to obtain food in urban residential gardens (16, 26, 27).

RRPs have been documented in 126 different countries across five continents (34 native and 92 introduced). RRP is the most prevalent and populous of the twelve intrusive parrot species that have been introduced in Europe (28). RRP has a detrimental effect on agriculture and biodiversity in their nonnative area, according to several researches. RRP can endure a range of environmental conditions and can survive in ecosystems that humans have altered (29). Because they can change physiologically, morphologically, and behaviorally to maintain a stable internal environment, they can withstand a wide range of external situations. Changes in rate of metabolism, body weight, hibernation, displacement, fat buildup, digging holes, beak size, and insulation capability are all examples of these adaptations (30).

Birds have to acclimatize to seasonal temperature changes in places where the year-round temperature varies greatly in an effort to survive. The difference in the range of temperatures between which the body maintains its core temperature is higher in winter than in summer, and resting metabolic rate and basal metabolic rate are much lower in the former. The body mass (mb) **does not** significantly change with the seasons. These parakeets' thermoregulatory responses during the winter months **suggest** energy conservation rather than cold tolerance. At 1 degree Celsius, they **show** no symptoms of hypothermia, demonstrating their relative tolerance to cold temperatures (30).

While reviewing the existing literature, it becomes evident that limited data are available on *Psittacula krameri*, with most studies emphasizing its role as an invasive species. In order to ascertain the nesting, breeding, and feeding habits of *Psittacula krameri*, the current study is conducted using the scan and random sampling techniques in Lakki Marwat, Khyber Pakhtunkhwa province. It significantly advances the behavioral ecology of this species and is the first study of its nature in this field. The results are crucial for the government to create conservation policies and protect the species and its ecosystem from stalkers. This study also improves the awareness

about Parakeet and enhances our understanding of the avian ecology of the Lakki Marwat, KPK, Pakistan.

MATERIALS AND METHODS

For data collection on the behavioral ecology of parrots, as illustrated in the figure, my study was

conducted in the three tehsils of Lakki Marwat, Khyber Pakhtunkhwa: Ghazni Khel, Naurang, and Lakki City. The selection of these places was based on areas where *Psittacula krameri* was frequently found.

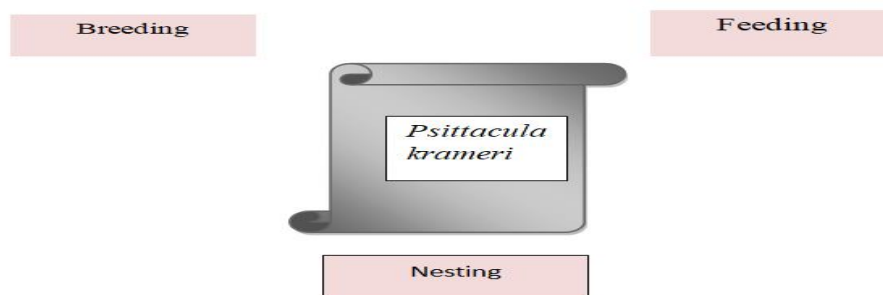


Figure 1: Behavioral components of *Psittacula krameri*

I chose the same ten tree species in all three tehsils and used scan and random sampling techniques to conduct direct field observations. Observations were performed at dawn and dusk because these were the times when parrots were most active. I had been visiting twice a day for up to six months. To gather the data, I used the following instruments: an inch tape/meter rod, a notebook, a camera, and a pen. In these areas, one nest per tree was chosen randomly from the same ten tree species in the three tehsils of Lakki Marwat, KPK, for comparing nest heights due to time and resource limitations. This

method provided a representative sample for comparing nest heights across various tree species and geographical areas. I identified nesting sites and recorded the following details: nest type (active or inactive), nest location (tree species, height from the ground), and materials used for nest construction. To measure the nest height on trees, I used 20-foot-long bamboo sticks. I attached one end of an inch tape to the top of a bamboo stick, which also had feet markings. When the nest height exceeded 30 feet, I joined two bamboo sticks together to measure the height more easily, as shown in the figure.

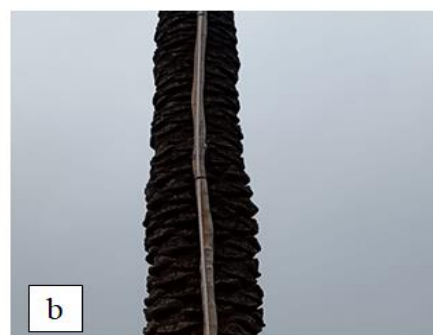


Figure 2: Bamboo sticks along with Inch tape were used to measure the nest height.

Following that, I observed courting behaviors, clutch size, egg-laying and incubation duration (including male and female participation), as well as the rate of hatching success, using a camera recorder. Lastly, I

studied dietary preferences and social interactions during feeding. After creating field notes for accurate observations and recordings, I used SPSS to analyze the behavior. To compare nest heights across the

tehsils of Lakki Marwat, I first calculated descriptive statistics and then applied one-way ANOVA and Chi-square tests.

RESULTS

Nesting behavior

The results of my study indicated that in comparison to Lakki City, Naurang had more parrots, while Ghazni had the fewest. Lakki City parrots frequently built their nests higher than those in neighboring tehsils. To make their nests, they chose mature/old, large trees or sometimes trees with fruits to easily access food. They preferred mature, large trees like Keekar, Palm Tree, and Sufaida because these trees had softwood, which was easy to scrape, and they naturally developed cavities as they aged. Parrots also used secondary nests made by other birds like woodpeckers. According to my observation, most of the parrots I observed made

their nests at a height between 20–30 feet. Higher elevations protected them from predators such as cats and snakes. Humans also found it difficult to capture them at these heights.

I observed that parrots engaged in collecting nest materials, but they mainly used the scraped wood material created during the nest excavation or they also chewed the barks of trees to use it for nests. Other materials, which they used minimally, included dead leaves, grasses, etc. By the use of a camera, I observed that in nests located at lower heights; they mostly laid 5–6 eggs non-synchronously which were easy to access. In most cases, 3–4 chicks were produced from 5–6 eggs. During incubation, the female mostly stayed inside the nest and was fed by the male parrot. After 20–28 days of incubation, rose-ringed parakeets gave birth to altricial young that left the nest after about 40–50 days of post-hatching.



Figure 3: Nests of Parakeet.

I collected data from December to May, measuring nest heights in three tehsils in Lakki Marwat while

also watching the nest-building process. That included:

Table-1: Illustrating the tree species and nest heights of *Psittacula krameri* in Lakki city

Sr.No	Tree species	Live Nest	Vacant Nest	Total Nest	Nest height from ground (ft)
1	<i>Phoenix dactylifera</i>	0	1	1	38
2	<i>Eucalyptus tereticornis</i>	1	1	2	29
3	<i>Mangifera indica</i>	0	2	2	20
4	<i>Psidium guajava</i>	1	0	1	18
5	<i>Prosopis juliflora</i>	2	0	2	22

6	<i>Tamarix aphylla</i>	0	2	2	26
7	<i>Dalbergia sissoo</i>	2	1	3	24
8	<i>Ziziphus mauritiana</i>	1	1	2	25
9	<i>Vachellia nilotica</i>	0	2	2	31
10	<i>Ficus religiosa</i>	2	1	3	39

Table 1 demonstrates different tree species, and for each tree, the height of one nest has been measured randomly in Lakki City, KPK. Some nests present on trees were active while some were not.

Table-2: Displaying the tree species and nest heights of *Psittacula krameri* in Naurang.

Sr.No	Tree species	Live Nest	Vacant Nest	Total Nest	Nest height from ground (ft)
1	<i>Phoenix dactylifera</i>	2	1	3	36
2	<i>Eucalyptus tereticornis</i>	0	2	2	30
3	<i>Mangifera indica</i>	2	1	3	18
4	<i>Psidium guajava</i>	2	0	2	19
5	<i>Prosopis juliflora</i>	0	2	2	20
6	<i>Tamarix aphylla</i>	1	1	2	23
7	<i>Dalbergia sissoo</i>	2	2	4	21
8	<i>Ziziphus mauritiana</i>	2	1	3	22
9	<i>Vachellia nilotica</i>	1	2	3	29
10	<i>Ficus religiosa</i>	2	2	4	35

applying random sampling technique, the height of one nest for each of the tree species shown in Table

2 has been measured at Naurang, KPK. After While some of the nests on the tree are active, others are not.

Table-3: Showing the tree species and nest height of *Psittacula krameri* in Ghazni Khel.

Sr.No	Tree species	Live Nest	Vacant Nest	Total Nest	Nest height from ground (ft)
1	<i>Phoenix dactylifera</i>	0	2	2	27
2	<i>Eucalyptus tereticornis</i>	1	0	1	26
3	<i>Mangifera indica</i>	0	2	2	17
4	<i>Psidium guajava</i>	1	1	2	15
5	<i>Prosopis juliflora</i>	1	1	2	18
6	<i>Tamarix aphylla</i>	0	2	2	20
7	<i>Dalbergia sissoo</i>	1	2	3	20
8	<i>Ziziphus mauritiana</i>	1	2	3	21
9	<i>Vachellia nilotica</i>	2	1	3	25
10	<i>Ficus religiosa</i>	1	0	1	30

Similarly, the height of one nest for each of the tree species shown in Table 3 has been measured at Ghazni Khel, KPK.

Table-4: Descriptive statistics of nest heights in all the three tehsils of KPK.

Descriptive Statistics	Lakki City(ft)	Naurang (ft)	Ghazni Khel (ft)
Total Tree	10	10	10
mean	27.2	25.3	21.9
median	25.5	22.5	20.5
mode	#N/A	#N/A	20
standard deviation	7.0993	6.6675	4.8637

Table 4 shows descriptive statistics of nest height in all the tree tehsils of Lakki Marwat, KPK. The mean values of the nest's height from the three cities indicated that in Lakki City Parrots build a nest at a higher elevation than in Naurang. They build nests

at lower heights in Ghazni as compared to the other two cities. The standard deviation is higher in Naurang than in other cities.

Table-5 : One-way ANOVA results show no statistically significant value for nest heights in all three tehsils of Lakki Marwat, KPK.

ANOVA	df	F	p-value
Between Groups	2	1.5242	0.2382

Table 5 presents a p-value greater than 0.05 when compared to the nest height of the same tree species,

indicating that the results are not statistically significant.

Table-6 : Chi-Square analysis showing no significant results in all three tehsils of Lakki Marwat, KPK.

Chi-square value	df	p-value
1.1	18	~1.0 (0.99999...)

Table 6 illustrates the p-value, which is greater than 0.05 when comparing the nest height of the same tree species, indicating that the difference is not statistically significant

Breeding behavior

By using binocular, I **observed** the breeding behavior of parakeets. To display mating desire, male parrots **bobbed** their heads and **produced** mating calls to get attention from females. They also **partially opened** their wings and **flattened** the tail. When they **found** female parrots, they first **joined** their beaks; male parrots also **touched** their necks with their beaks many times. The female parrots **moved** their chest portion downward while keeping their head in an upward direction. During the display, they **constricted** their pupil, which was physiological

behavior. In the end, the male parrots **grabbed** the females with their wings, **crouched** the females, and **showed** cloacal contact or preening. Sometimes, to build trust in the females and gain attention for mating, they **offered** emesis food to the female parrots.

Male parrots **were** monogamous; mostly they **preferred** to stay with a single female. In order to protect their mates, male parrots also **engaged** in combat with other males. They **produced** screaming sounds to warn the mating competitor. They **showed** wing flapping, chasing, or nibbling behavior against the competitor. Mating behavior also **depended** on their dormancy; otherwise, they **were defeated**. In the wild, they **perched** near the females to defend them from other parrots. Sometimes, when females **were not** in mating desires but males **wanted** to do

it, the female parrots **showed** angry behavior by **moving away**, **partially opening** their wings, **starting**

to fight with their beak, and **not allowing** the male parrots to mount them.



Figure 4: Breeding and perching of *Psittacula krameri*.

Feeding behavior

Mostly, the foraging time for parrots **was** early morning and late afternoon. They **had** granivorous and frugivorous inclinations and **were** mostly herbivorous. In the wild, they **ate** figs, guavas, papayas, bananas, bark and other soft fruits, sunflowers, maize, paddy, almonds, tamarind seeds,

young shoots, and flower buds. They **ingested** small insects or larvae, especially during the breeding season for protein. They **handled** the fruits with the help of their beak and foot. They also **helped** in the dispersal of seeds. Due to the feeding of parrots, many fruits **became** useless, and they **acted** as pests in the fields.

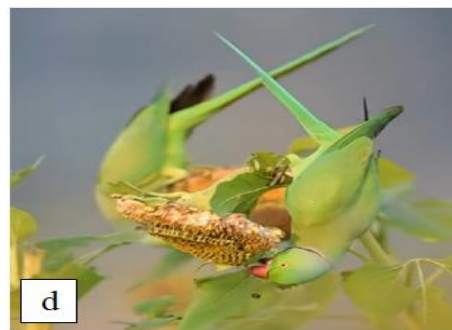


Figure 5: The food choices of parrots for feeding.

DISCUSSION

These findings suggest that the number of parrots is higher in Naurang than in Lakki City, while the fewest are present in Ghazni. As in the Naurang and Lakki river passes, they have access to food. While in Ghazni Khel, the river does not flow and has a high temperature, with limited food availability, which is why the number of parrots is lower there. Parrots in Lakki City often construct their nests at greater altitudes than those in other tehsils. Since Lakki is a city area, they prefer to make nests at high altitudes to avoid the hustle and bustle and to gain protection from humans. The mean nest height in Ghazni Khel is the lowest. The mean height of nests is more than 20 feet in all three tehsils. When comparing nest height in the three tehsils of KPK, the result of the one-way ANOVA suggests that nesting behavior is independent of the tehsil's region. Parrots consistently demonstrate an instinctive preference for nests that are, on average, higher than 20 feet. This implies that natural behavior is the main factor influencing nesting height. Although there are no statistically significant differences between the cities, local environmental factors may account for some of the minor discrepancies observed.

The other test which I performed to analyze the nesting behavior in all three tehsils was the chi-square test. The findings of this test suggested that The Chi-square analysis revealed no statistically significant differences in nesting behavior among the three tehsils of Lakki Marwat, KPK ($\chi^2 = 1.1$, $df = 18$, $p \approx 1.0$). This suggests that nesting behavior in *Psittacula* species is greatly consistent across geographies, supporting the hypothesis that nesting behavior is not highly determined by geographic variation and is, therefore, innate.

The breeding behavior of parrots is observed by using a binocular. Parrots usually display courtship behavior before mating. They shake their heads, make sounds, and partially open their wings to show interest in mating with a female partner. After repeatedly touching their necks and narrowing their pupils, they stoop, preen, and grab the female by the wings. During mating, male parrots make cloacal contact with females to show trust and affection through preening. They favor monogamous partnerships and may engage in combat with rivals, defending their mate by pursuing or nibbling.

Sometimes, when males desire to mate, females may show angry behavior, partially opening their wings and fighting.

The last behavior, I observe is the feeding behavior of parrots. Early morning and late afternoon are herbivorous foraging times for parrots. They consume fruits, seeds, new shoots, and insects. They hold fruits in their beak and feet, but feeding them renders fruits useless. When they gnaw on bark for feeding and nesting, they injure the trees by affecting the cambium, crucial for transporting food and water. As a result, they are seen as nuisances as well.

Conclusion

From my study, I conclude that in Lakki City, in order to avoid the noise, disturbance and to seek safety from others, they opt to construct nests at higher altitudes than in other tehsils. The statistical analysis shows that nesting behavior is primarily instinctual, with only minor alterations arising from certain environmental influences, which are not statistically significant. Secondly, they favor monogamous partnerships and show altruistic behavior toward their young ones. Another behavior I observe is their feeding behavior. Parrots are herbivores, frugivorous, and grain feeders. Their feeding destroys fruits as well as trees, for which they are considered pests, but we should not ignore their ecological importance in terms of dispersal of seeds and control of insect populations.

Acknowledgement of *Psittacula krameri* is necessary for ecological balance. By highlighting their ecological functions, this study contributes to raising public awareness and supporting informed conservation and management efforts aimed at preserving parakeet populations in their natural habitats. Illegal trade should be banned by the government and penalties imposed on poachers trapping them in the wild. It should also be categorized as 'Near Threatened' instead of 'Least Concern' because their population in the wild is decreasing due to captivity, poaching, and trade. The government must also establish protective measures, e.g., repellents, plastic predator models, or predator voice recorders for trees that are mostly affected by them. In this way, my research will not only challenge the perception of those who consider it invasive but also contribute to future studies by

highlighting its ecological significance through a better understanding of its behavior.

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