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COMMUNICATION

Nest tree preference shown by Ring-necked Parakeet *Psittacula krameri* (Scopoli, 1769) in northern districts of Tamil Nadu, India

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Abstract: This paper pertains to the nesting aspects of *Psittacula krameri* with specific reference to nesting-related habitats, number of individuals encountered, inter-specific interactions, and abnormalities in 71 villages covering seven northern districts of Tamil Nadu. A total of 797 nests (500 active and 297 non-active nests) and 1,119 individuals were enumerated on 284 trees and 13 temples/buildings belonging to eight species, seven genera, and five families. The highest number of nests (320) and birds (469) occurred on *Borassus flabellifer* L., followed by *Cocos nucifera* L., *Albizia lebbeck* (L.) Benth., *Madhuca longifolia* J.F.Gmel., *Phoenix sylvestris* (L.) Roxb., and *Ficus benghalensis* L. This species prefers dead trees than living trees for nesting. The study reveals that 63.4% nests (n= 505) and 65.1% birds (n= 729) were found on dead trees of *B. flabellifer*, *C. nucifera*, and *P. sylvestris*. They generally prefer to build nests on trees situated near agricultural lands, followed by those near water bodies, human settlements, and temples/buildings. Pearson's chi-square test indicates that the birds showed preference towards certain nesting sites/nesting species. Inter-specific interactions occurred between *P. krameri* and Blue Rock Pigeon, Spotted Owlet, Indian Roller, and Black-rumped Flameback for sharing of cavities/holes for construction of nests. Abnormalities in bird's beak, cere, colour of feathers, and a suspected psittacine beak & feather disease (PBFD) were observed.

Keywords: Active nests, beak deformity, inter-specific competition, nesting trees.

Tamil Abstract **சுருக்கம்:** வட தமிழகத்தின் ஏழு மாவட்டங்களில் உள்ள 71 கிராமங்களில் பச்சைக்கிளிகளின் கூடு கட்டி வாழும் வாழிடங்கள், கிளிகளின் எண்ணிக்கை, பச்சைக்கிளிகளுக்கும் வேறு சிற்றினங்களுக்கிடையேயும் உள்ள தொடர்புகள் மற்றும் அசாதாரணமான/ குறைபாடு பண்புகள் பற்றி இந்த அறிக்கையில் விவரிக்கப்பட்டுள்ளது. ஐந்து குடும்பம், ஆறு பேரினம் மற்றும் எட்டு சிற்றினங்களைச் சேர்ந்த 284 மரங்களிலும், 13 கோயில்கள்/கட்டடங்களிலும் 797 கூடுகள் (500 பயனில் உள்ள கூடு மற்றும் 297 பயனில் இல்லாத கூடு) மற்றும் 1119 பச்சைக்கிளிகள் கணக்கெடுக்கப்பட்டன. அதிகப்படியாக 320 கூடுகளும், 469 கிளிகளும் பனை மரத்தில் இருந்தது. அதற்கு அடுத்தபடியாக தென்னை, வாகை, இலுப்பை, ஈச்சம் மற்றும் ஆலமரங்களில் அதிகமான கூடுகளும், கிளிகளும் இருந்தது. இந்த பச்சைக்கிளிகள் கூடுகட்ட உயிருள்ள மரங்களைவிட இறந்த மரங்களையே அதிகம் தேர்வு செய்கிறது. 63.4% கூடுகள் (n=505) மற்றும் 65.1% எண்ணிக்கையிலான கிளிகள் (n=729) இறந்த பனை, தென்னை மற்றும் ஈச்சமரங்களில் காணப்பட்டது. பச்சைக்கிளிகள் பொதுவாக விவசாய நிலங்கள், நீர்நிலைகள், மனிதர்கள் வசிப்பிடம் போன்றவற்றிற்கு அருகாமையில் உள்ள மரங்களையும் மற்றும் கோயில்/கட்டடங்களையும் கூடுகட்டுவதற்கு தேர்வு செய்கிறது. பியர்சனின் வை வர்க்கச் சோதனையில் பச்சைக்கிளிகள் குறிப்பிட்ட இடங்களையே கூடுகட்டுவதற்கு தேர்வு செய்கிறது என தெரியவந்துள்ளது. பச்சைக்கிளிகளுக்கும், வேறு சிற்றினங்களுக்களான புறா, ஆந்தை, இந்தியன் ரோவர், மரங்கொத்தி ஆகிய பறவைகளுக்கும் கூடுகட்டுவது சம்மந்தமாக துளைகள் பங்கீடு செய்வதில் போட்டி நிலவுகிறது. கிளிகளின் அலகு, மூக்கின் மேல் உள்ள தசை ஆகியவற்றில் குறைபாடுகளும், சில கிளிகளின் சிறகின் நிறம் மற்றும் சிட்டாசின் என்ற நோயும் கண்டறியப்பட்டன.

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INTRODUCTION

The Ring-necked Parakeet or Rose-ringed Parakeet *Psittacula krameri* (Scopoli, 1769) (Aves: Psittaciformes: Psittaculidae) is a native of the Indian subcontinent and Sub-Saharian Africa and now occurs in 35 countries (Menchetti et al. 2016) such as Britain, Belgium, the Netherlands, Germany, and Spain (Braun & Wink 2013). A subspecies *P. krameri manilensis* is distributed in southern India and Sri Lanka (BirdLife International 2018). Intensive trade, accidental or deliberate release of this species into new environments and its adaptation has led to the establishment of viable populations outside its native range (Strubbe & Matthygen 2009; Neo 2012). Tolerance to human presence, an omnivorous diet and a great reproductive rate (Thabethe et al. 2013) make them successful invasive alien species and are even considered pests in the introduced European countries (Strubbe & Matthygen 2007). Many bird species use cavities as nesting sites, as it reduces the risk of predation more than other nest sites (Nice 1957; Cody 1985; Newton 1994). *Psittacula krameri* depends on trunk holes/ cavities for their reproduction. They compete with other birds for nest-cavities due to their aggressive behaviour in Mauritius (Jones 1980) and Belgium (Strubbe & Matthyen 2009). In India, they widely inhabit several habitats (Rasmussen & Anderton 2005) and breeding occurs during December–May. In northern India, about 15% of *P. krameri* populations build their nests in wall holes or crevices in buildings (Grandi et al. 2016). In view of the limited resources of nest-cavities, inter-specific competitions exist between *P. krameri* and other birds (Wesolowski 2007; Cornelius 2008).

This species is considered a major agricultural pest in its native range (Khan 2002b) and in countries where it has invaded (Schackermann et al. 2014). The birds consume dry & fleshy fruits and seeds (Ali & Ripley 1968, 1987); they cause considerable damage to agricultural crops such as corn (*Zea mays* L.), sorghum (*Sorghum bicolor* (L.) Moench), paddy (*Oryza sativa* L.), safflower (*Carthamus tinctorius* L.), sunflower (*Helianthus annus* L.), fruits, and stored grains (Shivanarayan et al. 1981; Dhindsa & Saina 1994; Mukherjee et al. 2000; Shivashankar & Subramanya 2008). Abnormalities/deformities in beak, cere, and colour were observed among *P. krameri* individuals due to various reasons (Low 1992; Zwart 1995; Butler 2003; Kanwar 2019). Gokula et al. (1999) observed intra-specific differences between *Psittacula cyanocephala* and *P. columboides* in Siruvani of Tamil Nadu.

The IUCN Red List of Threatened Species has evaluated the status of this bird as 'Least Concern' because its population appears to be increasing but in view of its popularity as a pet and control by farmers due to its invasiveness, this has reduced its numbers in its native range (BirdLife International 2018). Except the above few works, no literatures are available on the study of the nesting habitats and abnormalities of *P. krameri* in Tamil Nadu. Hence, this study was carried out to fill the gaps. The objectives of this study are to assess the nesting tree preference of *P. krameri*, and identification of the nesting sites.

MATERIALS AND METHODS

Study area

The present study was carried out in 71 villages in seven districts of northern Tamil Nadu, viz., Chennai, Thiruvallur, Ranipet, Kancheepuram, Chengelpet, Villupuram, and Kallakurichi spread over 17,680km^2 (Fig. 1). Agriculture is the primary occupation in these areas except Chennai City and adjoining areas. The major crops in the study area are *Oryza sativa* L., *Sorghum bicolor* (L.) Moench, *Pennisetum glaucumi* (L.) R.Br., *Eleusine coracana* Gaertn., *Setaria italica* (L.) P.Beauvois., *Saccharum officinarum* L. (Poaceae), *Vigna radiata* (L.) R.Wilczek., and *Arachis hypogaea* L. (Fabaceae). Small-scale cultivation of ornamental flowers, vegetables, and fruits also occurs. The maximum and minimum temperatures of these districts are 37°C and 28°C, respectively. The average annual rainfall of the state is 907mm (Tamil Nadu 2020).

METHODS

Three informants from villages who were traditionally engaged in farming and well acquainted with the location of tall trees, groves, and birds in the study districts were selected. Along with them areas were identified that had considerable populations of *P. krameri* and their nesting sites in 71 villages covering seven districts in the northern region of Tamil Nadu. The determined nesting sites were surveyed during the breeding season from 01 November 2019 to 31 March 2020 between 06.00 & 09.00 h and 15.00 & 18.00 h when the birds are usually active. The individuals and number of nests were determined using total count method (Bibby et al. 2000). *P. krameri* usually follow communal roosting during non-breeding periods and in the breeding season the flock splits and moves to various habitats searching for cavities to construct nests. Hence, the movements

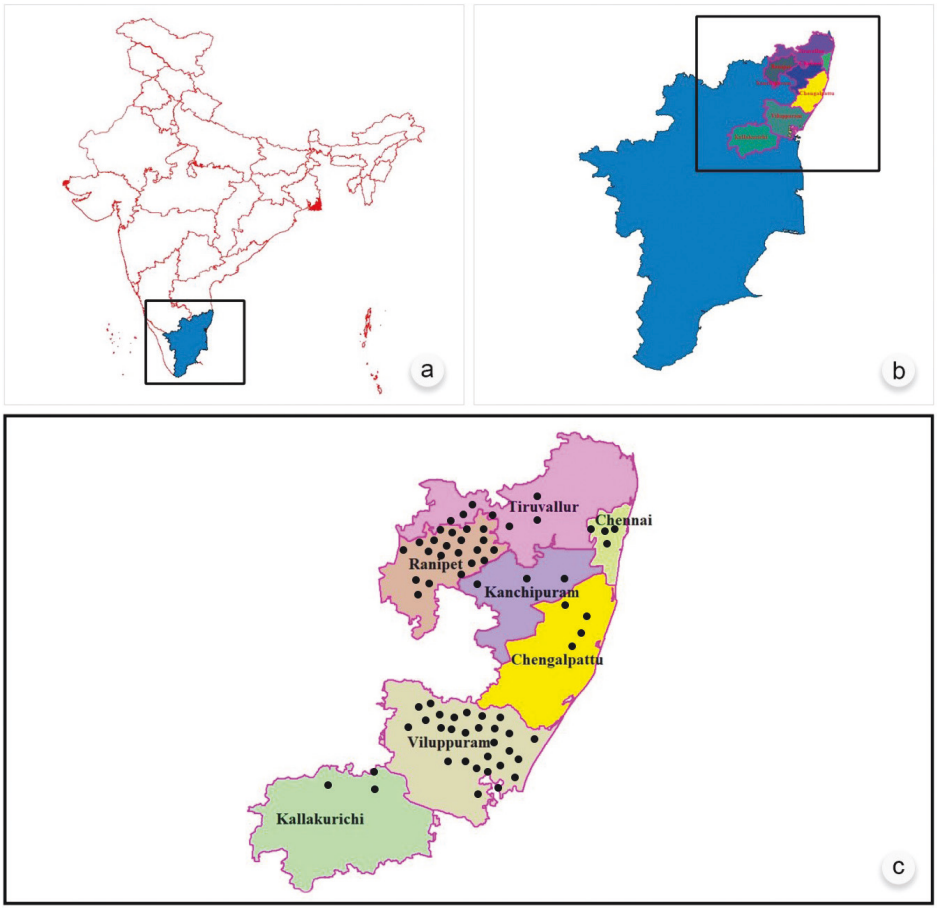

Figure 1. Study area, a—India with Tamil Nadu State highlighted | b—seven districts that are the study sites in Tamil Nadu | c—seven northern districts.

of birds, the nesting trees, excavating cavities on the trunks, holes and crevices in temples/buildings, entry and exit of birds from such cavities, number of nests, active/non-active nests, and inter-specific interactions with other birds for sharing nesting sites were observed using binoculars without causing any disturbance to the birds. The active nest cavities were ascertained by watching the frequent visits of birds to the cavities, carrying nesting materials: prolonged presence of any one of the pair in the cavity was presumed as the birds incubating eggs, and prey delivery to hatchlings. Non-active/abandoned cavities were ascertained by non-visiting of birds to the cavities during the study period after excavating cavities. The eggs and other breeding activities were not studied. Locations of the nesting trees and temples/buildings were determined using GPS. Pearson's chi-square test was applied to determine whether Ring-necked Parakeet individuals select trees, temples/buildings equally across the study area for construction of nests using SPSS (Statistical Package for Social Sciences) version 25.0 software. The test of significance was assessed at $p<0.05$. Photographs and videos were taken using Nikon P1000 digital camera.

RESULTS

Psittacula krameri individuals and their preference of nesting sites

In the present study, a total of 284 trees belonging to five families, seven genera, and eight species were found with nests of *P. krameri,* of which *Borassus flabellifer* L. harboured the maximum numbers of nests (n= 164; 55.2%), followed by *Cocos nucifera* L. (n= 90; 30.3%*), Albizia lebbeck* (L.) Benth. (n= 10; 3.4%), and *Madhuca longifolia* J.F.Macbr. (n= 9; 3%). Temples/buildings shared about 4.4% of nesting sites. A total of 797 nests (500 active nests and 297 non-active nests) and 1,119 individuals of *P. krameri* were enumerated on the 297 nesting sites (nesting trees -284 and temples/buildings-13) in seven districts (Table 1). Maximum of 72 nests and 88 birds were observed in Gadavari Kandigai

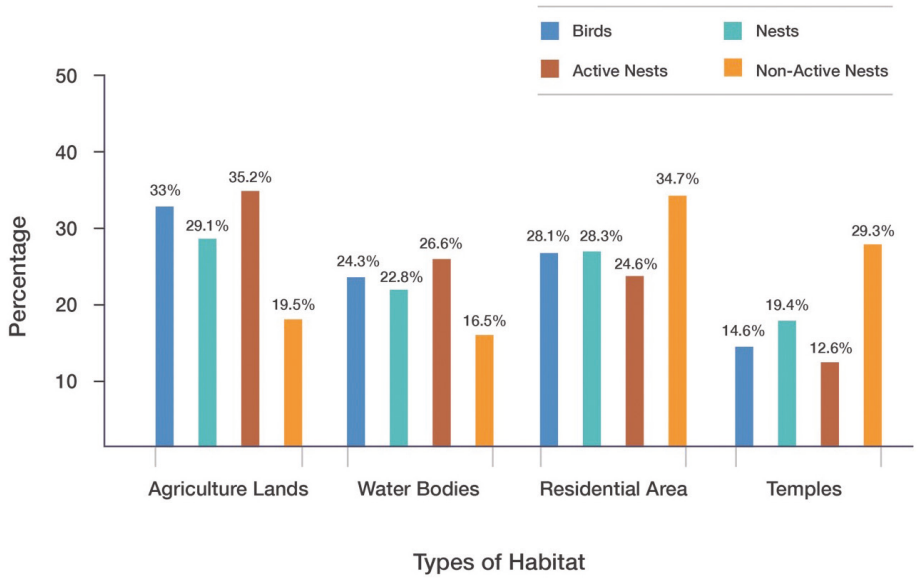

Figure 2. Distribution of *P. krameri* population and their nests in various habitats.

Village and in four villages no nests were counted but individuals of *P. krameri* were enumerated. The details of villages containing nests and birds are given in Table 2.

Of the total *B. flabellifer* trees (164) enumerated in the study area, 158 were dead and six were living trees. Among *B. flabeliifer*, maximum of 98.1% nests (n= 314) and 96.2% birds (n= 451) were found on dead trees and only 1.9% nests (n= 6), and 3.8% birds (n= 18) were enumerated on living *B. flabellifer* trees.

Out of 797 nests enumerated, 63.4% nests (n= 505) were found on dead trees of *B. flabellifer*, *C. nucifera*, and *P. sylvestris*. Similarly out of 1,119 birds counted, 65.1% birds (n= 729) were observed on these dead trees. About 26% nests (n= 208) and 16.8% birds (n= 188) were counted on temples and buildings. The remaining 10.3% nests (n= 84) and 16.4% birds (n= 184) were found on the living trees of *B. flabellifer*, *M. longifoia*, *F. religiosa*, *F. benghalensis*, *A. indica*, and *A. lebbeck*. Except roosting of birds, no nests were found on *F. religiosa* and *A. indica*. Out of total nests (797) enumerated during the current breeding season, 62.7% (n= 500) were active nests and the remaining 37.3% nests (n= 297) were non-active nests. The study reveals that the birds constructed 72.2% of active nests (n= 361) on the trunk cavities of three palm species, followed by 17.4% active nests (n= 87) on temples/buildings and 10.4% active nests (n= 52) on living trees, viz., *B. flabellifer*, *M. longifolia*, *F. benghalensis*, and *A. lebbeck*.

Chi-square test was used to determine whether any significance existed between the type of nesting sites such as trees, temples/ buildings and the number of birds, nests, active nests and non-active nests. The test revealed that there exists statistically significant association between nesting sites (trees/temples/ buildings) and the number of birds ($p< 0.05$), nests ($p< 0.05$), active nests ($p< 0.000$) and non-active nests ($p< 0.05$) in the study area.

Preference of habitats for nesting

The study also tested the relationship between the selection of nesting sites and surrounding habitats such as agricultural lands, water bodies, human settlements, and temples/buildings by *P. krameri* populations (Fig. 2). About 39.4% of nesting sites (n= 117), 29.1% nests (n= 234), and 33% birds (n= 369) occurred near agricultural lands. Thirty-five per cent of nesting sites (n= 104), 22.8% nests (n= 182), and 24.3% birds (n= 272) occurred adjacent to water bodies such as bunds of lakes, ponds, rivers, or canals. About 22.2% nesting sites (n= 66), 28.3% nests (n= 226), and 28.1% birds (n= 314) were found near human settlement areas; 19.5% nests (n= 155), and 14.6% birds (n= 164) were counted on 13 temples/buildings (3.4%). The study also revealed that a maximum of active nests 35.2% (n= 176) were found on trees located in the agricultural areas, followed by 26.6% active nests (n= 133) near water bodies, 24.6% nests (n= 124) in the human settlement areas, and 12.6% nests (n= 63) on temples/ buildings (Image 1). Statistically a significant association exists between the type of habitats such as agricultural lands, water bodies, residential areas, temple & number of birds ($p< 0.05$), nests ($p< 0.05$), active nests ($p< 0.05$), and non-active nests ($p< 0.05$). Hence, all four types of habitats had an impact on the number of birds and nests in the study area.

Table 1. Details of nesting sites, nests, non-active nests and birds counted in seven districts of Tamil Nadu.

	Nesting trees / temples / buildings	Family	No. of nesting trees/sites studied		Total No. of birds		Total No. of Nests		Active nests		Non-active nests	
			Count	%	Count	%	Count	%	Count	%	Count	%
1	*Borassus flabellifer*	Arecaceae	164	55.2%	469	41.9%	320	40.2%	232	46.4%	88	29.6%
2	*Cocos nucifera*	Arecaceae	90	30.3%	266	23.8%	185	23.2%	129	25.8%	56	18.9%
3	*Phoenix sylvestris*	Arecaceae	3	1.0%	12	1.1%	6	0.8%	6	1.2%	0	0.0%
4	*Madhuca latifolia*	Sapotaceae	9	3.0%	42	3.8%	27	3.4%	16	3.2%	11	3.7%
5	*Ficus religiosa*	Moraceae	1	0.3%	6	0.5%	0	0.0%	0	0.0%	0	0.0%
6	*Ficus benghalensis*	Moraceae	3	1.0%	18	1.6%	1	0.1%	1	0.2%	0	0.0%
7	*Azadiracta indica*	Meliaceae	4	1.3%	18	1.6%	0	0.0%	0	0.0%	0	0.0%
8	*Albizia lebbeck*	Fabaceae	10	3.4%	100	8.9%	50	6.3%	29	5.8%	21	7.1%
9	Temples/ buildings	-	13	4.4%	188	16.8%	208	26.1%	87	17.4%	121	40.7%
Total		5	297	100.0%	1119	100.0%	797	100.0%	500	100.0%	297	100.0%

Observation of inter-specific interactions

A pair of *P. krameri* competed with a pair of Blue Rock Pigeon *Columba livia* (Aves: Columbiformes: Columbidae) that had occupied one hole in a temple wall at Thiruvalangadu Village (13.1307°N & 79.7747°E), finally they chased away the blue rock pigeons, occupied the hole and continued breeding. Similar incidents of *P. krameri* competing with a Black-rumped Flameback *Dinopium benghalense* (Aves: Piciformes: Picidae), a Spotted Owlet *Athene brama* (Aves: Strigiformes: Strigidae), and an Indian Roller *Coracias benghalensis* (Aves: Coraciiformes: Coraciidae) in Gadavarikandigai Village (13.1300°N & 79.6226°E) for sharing trunk cavities were observed (Image 2).

Observation on abnormalities

In the present study, one male bird with beak deformity was observed on the compound wall of a temple in Thiruvalangadu Village (Thiruvallur District). The upper mandible of this bird was found elongated, curved and this colourless over grown part of the beak had elongated up to the neck. One female bird with swollen and distorted cere and a big nostril was observed in Gadavarikandigai Village (Ranipet District). Another bird with colour abnormality, i.e., yellow feathers on its back and four individuals (three females and one male) with loss of feathers and wart like skin on their heads were observed in Gadavarikandai Village. During the entire study period, they had the same symptoms without regeneration of new feathers on their heads (Image 3a–d).

DISCUSSION

***Psittacula krameri* individuals and their preference of nesting sites**

In the present study, it was observed that *P. krameri* individuals selected a variety of trees for nesting, but they showed a preference towards palms (Arecaceae): *B. flabellifer*, *C. nucifera* and *P. sylvestris*. Among the palms, they prefered *B. flabellifer* (55.2%; n= 164) in the study area since 40.1% of nests (n= 320) and 41.9% birds (n= 469) occurred on them. The present observation of maximum number of nests and birds were found on *B. flabellifer* trees. The present study also reveals that they largely preferred dead palm trees for construction of nests. Except six *B. flabellifer* trees, all the palm trees (n= 158) that bore nests were dead trees. It suggests that the birds selected dead tree trunks for easy excavation of cavities using their powerful beaks. Once they select

Table 2. List of villages where nests of individuals of Psittacula krameri were counted.

	District	Name of the village	Total no. of nests counted	Total no. of the birds counted
1	Tiruvallur	Tiruvallur	15	10
2		Pugathur	13	22
3		Chinna Kadambur mottur	6	8
4		Sembedu	4	6
5		Periya Kadambur mottur	7	10
6		Mambakkam	8	12
7		Thiruvalanggadu	54	70
8	Chennai	Egmore DPI	7	20
9		Egmore	19	26
10		LIC	6	10
11		Anna Salai EB office	1	2
12	Ranipet	Nanthiveduthangal	10	14
13		Soganur	3	7
14		Gadavari kandigai	72	88
15		Mathimangalam	4	16
16		Kunnathur	3	6
17		Pallakunnathur	6	10
18		Pazhayapalayam	10	14
19		Pazhayapalayam mottur	1	2
20		Minnal	13	18
21		Marankandigai	8	8
22		Chinna Vailambadi	17	29
23		Paranji	2	14
24		Gangai mottur	21	32
25		Melandurai	23	37
26		Kizhanthurai	8	12
27		Poiyappakkam	1	2
28		Kumpinipet	4	8
29		Melakadu	21	56
30		Arumpakkam	16	28
31		Paruthiputhur	1	2
32		Nagavedu	15	24
33		Padi	8	18
34	Kanchipuram	Kanchipuram East	6	8
35		Baluchettichatram	2	5
36	Chengalpattu	Padalam	16	24
37		Ottivakkam	17	14
38		Maduranthangam	0	2
39		Palur	4	2

	District	Name of the village	Total no. of nests counted	Total no. of the birds counted
40		Mailam	3	4
41		Kolliyangunam	5	8
42		Nallamur	4	6
43		Thenkalavai	13	14
44		Kiledayalam	20	30
45		Nedimozhiyanur	14	28
46		Vilangambadi	24	44
47		Thenkolapakkam	5	10
48		Kutteripattu	26	24
49		Sozhiyasorkulam	6	12
50		Thenputhur	6	12
51		Kenipattu	10	12
52		Thiruvakkarai	1	2
53		Kanniyam	1	2
54		Konamangalam	3	6
55		Thazhuthali	4	4
56		Perumbakkam	0	6
57		vanur	11	18
58	Villupuram	Aurovile	1	2
59		Veedur	2	2
60		Siruvai	11	24
61		Pombur	6	6
62		Thenkodipakkam	4	6
63		Gingee	60	44
64		Thiruvamathur	11	4
65		Tindivanam	0	12
66		kodukur	1	2
67		Tirumangalam	0	0
68		Tirukkovilur	38	26
69		Kizhayur	30	20
70	Kallakuruchi	Koduvur	1	2
71		Thirumangalam	0	1
Total	**7**	**71**	**797**	**1119**

a dead palm tree, both male and female individuals were involved in excavating holes in the tree trunks. In Tamil Nadu indiscriminate felling of *B. flabellifer* trees for firewood and due to urbanization, widening of roads, and construction of buildings have been reported (M. Pandian pers. obs.). The study further reveals that the birds utilized the already existing cavities in living trees such as *M. longifolia*, *F. benghalensis*, and *A. lebbeck* for building nests. No incident of excavation of cavities on the above three tree species was noticed during the study period.

Ali & Rilpey (1969) reported that in India, apart from the cavities of trees this bird also utilizes existing crevices in buildings for construction of nests. In Pakistan, this bird selected holes in trees as well as crevices in buildings for construction of nests (Jahan et al. 2018). Breeding of *P. krameri* in buildings is very common in Britain, Germany, Belgium, and Japan (Braun 2004, 2007). Some breeding pairs build nests in wall holes or crevices of buildings in north India and Spain. In Pavia (northern Italy), the entire population breeds in scaffold holes of the Visconti castle and towers (Grandi et al. 2016). The present study reveals

Image 1. Nesting habitats of *Psittacula krameria*: a—a pair of birds roosting on temple wall | b—female individual in wall hole in temple | c—male individual in a cavity of dead *B. flabellifer* trunk | d—a pair engaged in excavation of cavity on *B. flabellifer* trunk | e—female individual in a trunk cavity, and | f—a mating pair. © M. Pandian.

that 26% nests (n= 208) and 16.8% birds (n= 188) were counted on 10 temples and three buildings in the study area. The present observation of successful utilization of available holes/crevices in the temple and buildings for construction of nests by *P. krameri* population matches the findings of Ali & Rilpey (1969), Jahan et al. (2018), and Braun (2004, 2007).

Preference of habitats for nesting

As a social bird, *P. krameri* generally prefers to build nests on trees situated near agricultural lands. Occurrence of 29.1% nests (n= 234) and 33% birds (n= 369) on the trees situated near the agricultural lands prove that the birds preferred to breed in agricultural areas where abundant food materials are available. Another 22.8% nests (n= 182) and 24.3% birds (n= 272) were found on trees located near water bodies. Maximum nests of *P. krameri* were found in the areas where cultivation of crops occurs and near water bodies in Punjab (Khan 2002a) and Hawaii (Paton et al. 1982). In the present study, occurrence of 51.9% nests (n= 416) and 57.3% birds (n= 641) in agricultural lands and close to water bodies in rural villages clearly indicates that the birds selected nesting sites in agrarian landscapes ensuring availability of abundant food material. Hence it matches with the observations of Khan (2002a) and Paton et al. (1982).

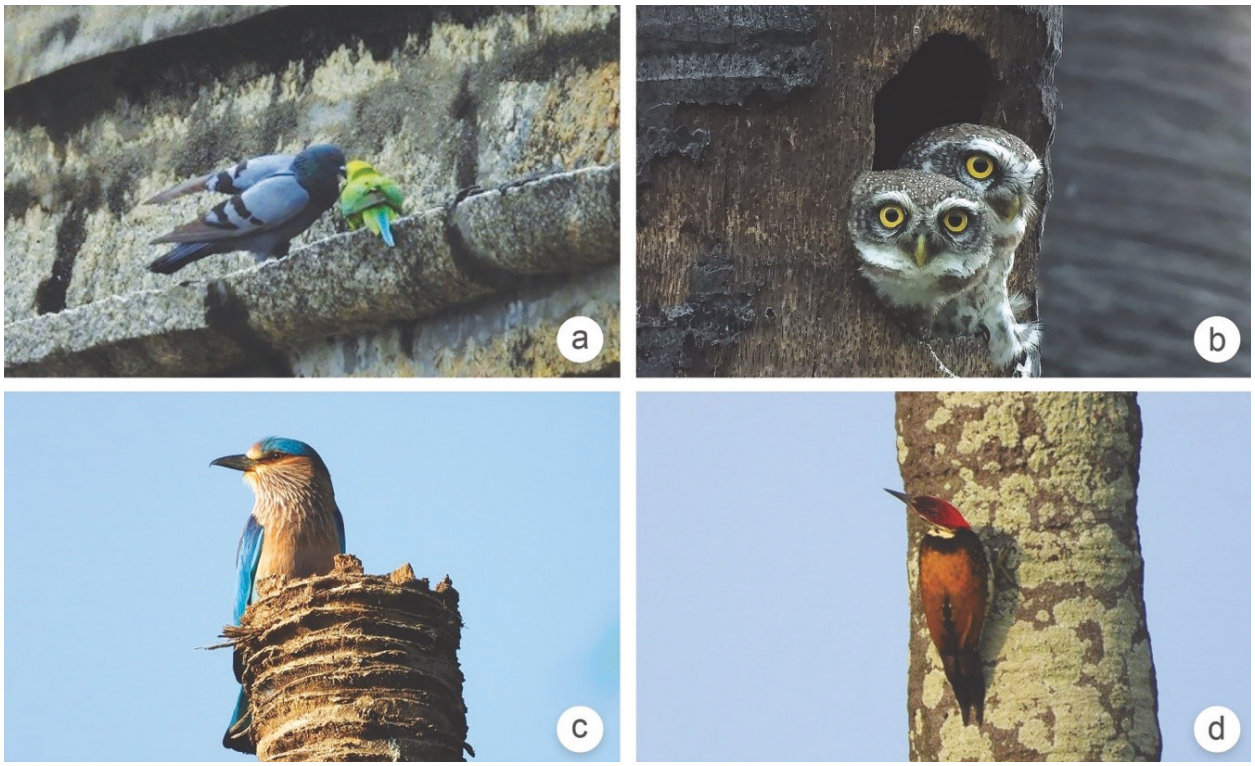

Image 2. Inter-specific competition: a—male parakeet fighting with a pair of Blue Rock Pigeons | b—nestlings of Spotted Owlet | c—Indian Roller guarding its nest on top of dead *B. flabellifer* tree, and | d—Black-rumped Flameback excavating cavity. © M. Pandian.

Image 3. Abnormalities in *Psittacula krameria*: a—male bird with beak deformity | b—female bird with cere deformity | c—female bird with suspected infection of psittacine beak & feather disease | d—female bird with colour abnormality. © M. Pandian.

This bird also preferred trees near human settlements and holes/crevices of temples/buildings for construction of nests. It suggests that the birds tolerate the presence of human.

Observation of inter-specific interactions

Cavity nesters pose a unique habitat problem. Obligate cavity nesters are associated with intra and inter-specific competition for nest sites (Collias & Collias 1984; Nilsson 1984). Jones (1980) had stated that incidents of competition between *P. krameri* and mynas *Acridotheres tristis* for sharing nest cavities in trees was reported in Mauritius. In view of the limited availability of nest-holes, inter-specific competition usually occurs between secondary cavity nesting birds in human altered landscapes (Cornelius 2008). They compete with native birds for sharing trunk-holes in Belgium also (Strubbe & Matthysen 2009). In the present study too *P. krameri* competed with a Blue Rock Pigeon, for sharing a hole in a temple, with a Spotted Owlet, an Indian Roller and a Black-rumped Flameback for sharing trunk holes in *B. flabellifer* trees during the breeding period. Hence, the present observation of inter-specific competition with other birds for sharing nesting sites corroborates with the findings of Jones (1980) and (Strubbe & Matthysen 2009).

Observation of abnormalities

Beak abnormalities may occur due to various causes such as malnutrition, infections, injury, mutations, defective bone growth, tear of rhamphotheca, and misalignment of maxilla & mandible (Oslen 2003; Handel et al. 2010; Zylberberg et al. 2018). Deformed beaks take many forms with upper/lower mandibles elongated, curved or mandibles crossed and are more prevalent in passerines (Craves 1994). Pomeroy (1962) has observed that abnormal bills in wild birds are rare with an estimated frequency of less than 0.5%. British Trust for Ornithology (BTO 2014) has recorded 36 species with beak deformities including ring-necked parakeets. In India, Kasambe et al. (2009) and Soni et al. (2019) have reported bill deformities in Yellow-billed Blue Magpie, Crow, and Common Myna. Kanwar (2019) has recorded beak abnormality in Ring-necked Parakeets in Chandigarh. In the present study, the upper mandible of one male bird was found colourless, curved and elongated up to its neck. This type of beak deformity may cause hardship to the bird while foraging and feeding chicks. Out of 1,119 birds studied, only one individual, i.e., 0.09% had a bill deformity. Hence, it confirms the view of Pomeroy (1962) that abnormal bills in wild birds are rare with an estimated frequency of less than 0.5%

One female bird with swollen and distorted cere with a big nostril was observed. Cornification and keratinization of the cere can progress to close up the nostrils. These abnormalities in cere might have been caused by the mite, *Knemidokoptes pilae* (Zwart 1995). The study reveals that one female bird with similar symptoms of swollen and distorted cere with big opening was found. The observed symptoms matched the findings of Zwart (1995).

Colour mutations in *P. krameri* such as yellow (Bhargava & Hanfee 1996), white-rose (Mahabal et al. 2015), albinism (Mahabal et al. 2016), and cinnamon green (Kushwaha & Kumar 2018) have been reported in India. In U.K., many colour mutations have occurred in captive birds (Low 1992; Butler 2003). Hence, the present observation of yellow colour mutation of feathers in the study area corroborates the findings of the aforesaid authors.

Pass & Perry (1984) and Ritchie et al. (1991) had stated that psittacine beak & feather disease (PBFD) caused by a virus has emerged as a major threat to the wild parakeet populations. The observed four *P. krameri* individuals with similar symptoms of feather loss and warty skin on their heads are suspected to have PBFD.

CONCLUSION

The present study was confined to a small geographical area covering 71 villages in seven northern districts of Tamil Nadu. Since a total of 1,119 individuals and 797 nests were enumerated in this region, it is considered a hotspot for breeding of this species. A systematic survey of the entire state would throw more light on the status and distribution of Ring-necked Parakeets in the state, and help in drafting an action plan to conserve their habitats in and around villages and also in the urban areas.

REFERENCES

Ali, S. & S.D. Ripley (1968). *Handbook of the Birds of India and Pakistan, Vol 3*. Oxford University Press, Oxford, 380pp.

Ali, S. & S.D. Ripley (1987). *Handbook of the birds of India and Pakistan, Compact Edition*. Oxford University Press, New Delhi, 278pp.

Bhargava, R. & H. Hanfee (1996). Sightings of a Yellow Rose-ringed Parakeet. *Newsletter for Birdwatchers* 36: 81.

Bibby, C.J., N.D. Burgess, D.A. Hill & S.H. Mustoe (2000). *Birds Census Techniques, 2nd Edition*. Academic Press, New York, 302pp.

BirdLife International (2018). *The IUCN Red List of Threatened Species*. Accessed on 01 April 2020. https://iucnredlist.org/species/22685441/132057695

BTO (2014). British Trust for Ornithology. Species Affected, *Garden Bird Survey*. *bto.org*. Accessed on 15 December 2019.

Braun, M. (2004). *Alien species in urban habitats: Ecology and niche*

expansion of Ring-necked Parakeets (Psittacula krameri Scopoli, 1769) in Heidelberg, Germany: Marburg University, 127pp.

Braun, M. (2007). How does thermal insulation on buildings as a result of EU climate protection-affect the breeding biology of tropical Ring-necked Parakeets (*Psittacula krameri*) in temperate Central Europe?. *Ornithol Jahresh Baden-Wurtt* 23: 39–56.

Braun, M.P. & M. Wink (2013). Nesting development of ring-necked parakeets (*Psittacula krameri*) in a nest box population. *The Open Ornithology Journal* 6: 9–24.

Butler, C.J. (2003). *Population biology of the introduced Rose-ringed Parakeet Psittacula krameri in the UK*. Thesis, Department of Zoology, University of Oxford, 312pp.

Cody, M.L. (1985). Habitat selection in the Sylviine Warblers of Western Europe and North America, 86–129 pp. In: Cody, M.L. (ed.) *Habitat selection in Birds.* Academic Press, Orlando, Florida, New York, 558pp.

Collias, N.E & E.C. Collias (1984). *Nest building and bird behaviour*. Princeton University Press, Princeton, New Jersey, 336pp.

Cornelius, C. (2008). Spatial variation in nest-site selection by a secondary cavity-nesting bird in a human-altered landscape. *The Condor* 110(4): 615–626.

Craves, J.A. (1994). Passerines with deformed bills-North American Birds. *Banders* 19(1): 14–18.

Dhindsa M.S. & H.K. Saina (1994). Agricultural Ornithology: an Indian perspective. *Journal of Bioscience* 19: 391–402.

Gokula, V., C. Venkataraman, S. Saravanan & S. Swaminathan (1999). Inter and intraspecific variation in the resource use of Blossom-headed and Blue-winged parakeets in Siruvani, Tamil Nadu, India. *Journal of the Bombay Natural History Society* 96(2): 225–231.

Grandi, G., M. Menchetti & E. Moris (2016). Use of putlog holes of Visconti Castle by breeding ring-necked parakeets (*Psittacula krameri*) in Pavia (northern Italy). *In: Atti del III Congresso Nazionale Fauna Problematica, Cesena., Palazzo del Ridotto*, 24–26 November 2016: 90—91.

Handel, C.M., L.M. Pajot, S.M. Matsuka, C.V. Hement, J. Terenzi, S.L. Talbot, D.M. Mulcahy, C.V. Meteyer & K.A. Trust (2010). Epizootic of beak deformities among wild birds in Alaska: an emerging disease in North America? *The Auk* 127 (4): 882–898.

Jahan, I., S. Begum, M. M. Feeroz, D.K. Das & A.K. Datta (2018). Nesting pattern of birds in Jahangirnagar University Campus, Bangladesh. *Journal of Threatened Taxa* 10(5): 11618–11635. https://doi.org/10.11609/jott.2799.10.5.11618-11635

Jones, C.G. (1980). The parrots on the way of extinction. *Oryx* 15: 350–354.

Kanwar, K. (2019). *Beak Deformities in Birds: Special on World Parrot Day*. Babushahi.com/trends.php?id=87473 Accessed on 15 December 2019.

Khan, A.K. (2002a). Breeding habitats of the rose-ringed Parakeet (*Psittacula krameri*) in the cultivations of central Punjab. *International Journal of Agriculture & Biology* 4(3): 401–403.

Khan, H. (2002b). Foraging, feeding, roosting and nesting behavior of the rose-ringed parakeet (*Psittacula krameri*) in the cultivations of central Punjab. *Pakistan Journal of Biological Science* 1: 37–38.

Kasambe, R., A. Joshi & S. Meppayur (2009). Bill deformities in House Crow *Corvus splendens* and Large-billed Blue Magpie *Urocrissa flavirostris* in India. *Newsletter for Birdwatchers* 49(5): 73–77.

Kushwaha, S. & A. Kumar (2018). Report on cinnamon green Rose-ringed Parakeet, *Psittacula krameri* (Scopoli 1769) (Aves: Psittacula) from Jhansi, India. *Journal of Wildlife Research* 6(3): 34–36.

Low, R. (1992). *Parrots. Their breeding and care, Blandford, London*, UK, 432pp.

Mahabal, A., R.M. Sharma & A. Sayyed (2015). Colour aberrations in Indian Birds. *Birding ASIA* 24: 119–121.

Mahabal, A., H.V. Grouw, R.M. Sharma & S. Takkur (2016). How common is albinism really? Colour aberrations in Indian birds reviewed. *Dutch Birding* 38: 301–309.

Menchetti, M., E. Mori & F.M. Angelici (2016). Effects of the recent world invasion by ring-necked parakeets *Psittacula krameri*, pp. 253–266. In: Angelici, F.M. (ed.). *Problematic wildlife. A Cross-disciplinary Approach*. Springer, New York, xvi+603pp.

Mukherjee A., C.K. Board & B.M. Parasharya (2000). Damage of rose-ringed parakeet, *Psittacula krameri* Bordeat, to safflower, *Carthamus tinctorius* L. *Pavo* 38: 15–18.

Neo, M.L. (2012). A review of three alien parrots in Singapore. *Nature in Singapore* 5: 241–248.

Newton, I. (1994). The role of nest sites in limiting the numbers of hole-nesting birds: a review. *Biological Conservation* 70: 265–276.

Nice, M.M. (1957). Nesting success in altricial birds. *Auk* 74: 305–321.

Nilsson, S.G. (1984). The evolution of nest-site selection among hole-nesting birds. The importance of nest predation and competition. *Ornis Scand* 15: 167–175.

Oslen, G.H. (2003). Oral biology and beak disorder of birds. Veterinary Clinics of North America. *Exotic Animal Practice* 6(3): 505–521.

Pass, D.A. & R.A. Perry (1984). The pathogens of psittacine beak and feather disease. *Australian Veterinary Journal* 61: 69–74.

Paton, P., C. Griffin & L. Griffin (1982). Rose-ringed parakeet nesting in Hawaii: A potential agricultural threat. *Elepaio* 43(5): 37–39.

Pomeroy, D.E. (1962). Birds with abnormal birth. *British Birds* 55: 49–72

Rasmussen, P.C. & J.C. Anderton (2005). *Birds of South Asia*: The Ripley Guide. 2 vols. Smithsonian Institution & Lynx Editions, Washington D.C. & Barcelona, 378pp.

Ritchie, B.W., F.D. Niasro, K.S. Latimer, W.L. Steffens, D. Pest & P.D. Lukert (1991). Haemagglutination by psittacine beak & feather disease virus and use of haemagglutination inhibition for detection of antibodies against the virus. *American Journal of Veterinary Research* 52: 1810–1815.

Schackermann, J., H.V. Wehrden, N. Weiss & A. Klein (2014). High trees increase sunflower predation by birds in an agricultural landscape. Vol 2. *Frontiers in Ecology and Evolution* 2: 35. https://doi.org/10.3389/fevo.2014.00035

Shivanarayan, N., K.S. Babu & M.H. Ali (1981). Breeding biology of Rose-ringed Parakeet, *Psittacula krameri* at Maruteru. *Pavo* 19: 92–96.

Shivashankar, T. & S. Subramanya (2008). Prevention of Rose-ringed parakeet *Psittacula krameri* damage to Sunflower *Helianthus annus. Indian Birds* 4(2): 60–65.

Soni, S., N.K. Sahi & T.K. Kler (2019). Records of beak deformities in Punjab, India. *Journal of the Bombay Natural History Society* 116: 52–53.

Strubbe, D. & E. Matthyen (2007). Invasive Ring-necked Parakeets *Psittacula krameri* in Belgium: habitat selection and impact on native birds. *Ecogeography* 30(4): 578–588.

Strubbe, D. & E. Matthyen (2009). Establishment success of native Ring-necked and Monk Parakeets in Europe. *Journal of Biogeography* 36(12): 2264–2278.

Tamil Nadu (2020). Government of Tamil Nadu website www.tn.gov.in. Accessed on 13 April 2020.

Thabethe, V., L. Thompson, L. Hart & M. Brown (2013). Seasonal effects on the thermoregulation of invasive rose-ringed parakeets (*Psittacula krameri*). *Journal of Thermal Biology* 38(8): 553–559. https://doi.org/10.1016/j.jtherbio.2013.09.006

Wesolowski, T. (2007). Lessons from long-term hole-nester studies in a primeval temperate forest. *Journal of Ornithology* 148: 395–405.

Zwart, P. (1995). Diseases of the respiratory tract in *Psittacine* birds. *Veterinary Quarterly* 17(1): 52–53.

Zylberberg, M., C.V. Hemert, C.M. Handel & J.C. Derisi (2018). Avian keratin disorder of Alaska Black-capped Chickadees is associated with Poecivirus infection. *Virology Journal* 15(1): 100.

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