

NESTING BEHAVIOR OF ROSE-RINGED PARAKEET (*PSITTACULA KRAMERI*) IN SOUTHERN PUNJAB, PAKISTAN

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ABSTRACT: This study describes the nesting behavior of Rose-ringed Parakeets (*Psittacula krameri*) in Southern Punjab, Pakistan. Rose-ringed Parakeets are native to Indian sub-continent, where they are considered to be one of the most significant agricultural and horticultural pests of fruits and grains. Altogether 50 trees of 6 species belonging to 6 genera and 4 families were recorded which were used to make nests. Block randomized method and systemic observation were preferred to collect data through check lists. Cross-sectional survey research design was employed to conduct the study. Results indicate tree species preferred by parakeets are *Dalbergia sissoo* (Sheesham), *Acacia nilotica* (Kikar), *Ficus religiosa* (Pipal), *Mangifera indica* (Mango), *Syzygium cumini* (Jaman) and *Albizia lebbek* (Black Siris) to make nests. The ratio of nest formation found more on *Dalbergia sissoo* and *Acacia nilotica* than the other tree species. Diameter at Breast Height (DBH) of the tree was found suitable for nesting ranged from 21.983 to 85.98 inches. Height of the roost was observed from 85.318 to 284.318 inches on tree from ground level. Rose-ringed Parakeet likes 2.285 to 8.04 inches wide roost hole and clutch size was 1-2 eggs per roost. It was concluded from the current study that population of this avian pest might be increasing due to availability of favorable conditions for its nesting behavior.

Keywords: Rose-Ringed Parakeet, Pest, Tree Species, DBH, Roost hole height, Roost hole size, Clutch size, South-Punjab, Pakistan

INTRODUCTION

The rose-ringed parakeet (*Psittacula krameri*) is commonly known as parrot. Its family is Psittacidae and order is Psittaciformes. It is a medium size (40 cm) bird with bright green plumage. The male has a distinctive black collar extending from the throat and below the cheeks where it turns into rose-colored ring around the hind neck. Females are colored similarly but lack the black throat collar as well as rose-colored ring on the neck. The bill is red, short, round and strongly hooked. Rose-ringed parakeet is present in good proportions throughout the cultivations and stored houses throughout the Pakistan [1, 2]. This is common bird that prefers to live in large and old trees [3]. Most commonly, rose-ringed parakeet prefers *Morus alba*, *Albizia lebbek*, *Acacia nilotica*, *Zizyphus spp*, *Melia azedarach*, *Salvadora oleoides*, *Tamarix aphylla*, *Phoenix dactylifera*, *Mangifera indica*, *Salmalia malabarica*, *Eucalyptus spp*, *Cedrella toona*, *Ficus bengalensis*, *Dalbergia sissoo*, *Terminalia arjuna*, *Erythrina suberosa*, *Jacaranda mimosifolia*, *Eugenia jambolana* and *Eugenia cumini*, to acquire roosting and nesting opportunities [1,4-6]. It feeds on a variety of food items viz. cereals, oil-seed crops and orchards, causing substantial economic losses amounting to millions of rupees annually [7,8]. It is a wasteful feeder and discards or destroys partially consumed food items [9]. Parakeets spend whole day for the search of feeding and foraging but at dusk they return to roosts for mating, shelter and custodial care of their families. Population of rose-ringed parakeet is wide spreading in all over the country, but in southern Punjab, its population is increasing due to the availability of roost cavities in old trees near water channel banks and plain agricultural fields that provide them food and shelter. Parakeets have some specific behavior regarding nesting and roosting. Nest has been defined as a structure that aids the development of the eggs and the survival of young [10]. The parakeet actively searches their nest holes in small parties from two to five birds from May through December and from October through August whereas copulation takes place in February through

May [11]. Parakeets select specific tree species present at proper site, mostly near water bodies and agricultural fields. Make nests in tree holes present at a specific height. Parakeets pick stubbles, feathers and soft materials like cotton as nesting material.

LITERATURE REVIEW

The Rose-ringed Parakeet

Rose-ringed parakeet has a status of avian pest in the whole world and established as breeding wild populations. Rose-ringed Parakeets are vegetarian in nature and consume fruits, flowers, nectar, grain, cereals, and seeds according to their availability throughout the year [9]. In Europe, parakeets are flexible in feeding behavior; they consume fruits, bread, cereals, and even meat [12]. Similarly, in United Kingdom, parakeets consume large quantities of peanuts and sunflower seeds; that costs £5000 annually [13], and this trend is increasing in UK from 15 to 30% per year [14]. Netherlands also facing increased trend in parakeet population with the rate of 22.5% since 1994. The rapid growth of this pest is alarming in terms of damage and it out-competes other species in nesting [15-17]. Rose-ringed Parakeets have exotic populations established in at least 35 countries on five continents [18]. Rose-ringed Parakeets inhabit a variety of forest types [16] managed farmland, urban gardens and parks [19]. Roosting is often common throughout the year and this aspect of their behavior provides a reliable mechanism for monitoring populations [14]. Ring-necked Parakeets have been breeding in the wild in England for nearly thirty years [20]. This species has been introduced into a variety of environments and sites worldwide, and in general has had high success as an intrusive species. In the Middle East, this species is a breeding resident in Israel, Egypt, Saudi Arabia, Yemen, Bahrain, the United Arab Emirates, Qatar, Oman, Iran, Turkey and Iraq. This Ring-necked Parakeet is generally also considered to be the alarming avian pest in its innate range in all these states [12,17 & 21-28]. In Oman, it has already been recorded eating dates, grains, legumes, and seeds of sunflowers [21]. Several farmers on the Batinah coast

complain about parakeets eating too much in their corn fields. This parakeet is also a species of concern, because of its possible negative effects on native birds through competition not only for food, but also for nesting space [11, 17 & 29]. The rose-ringed parakeet is considered an agricultural pest also in Israel and is also thought to affect local hole-breeding bird species and local flora like agricultural crops and horticultural crops [26, 30]. Rose-ringed Parakeet can out-compete with native species for nesting holes in many countries of Pacific-Asia including Japan [22, 31 & 32]. Rose-ringed Parakeets cause temporary damage to trees in city parks by feeding on growing shoots in China [33]. Rose-ringed parakeet is found north of 20°N in India, eastern Pakistan, Sri Lanka, Nepal and Myanmar [9]. Rose-ringed Parakeets are reported to cause significant damage to a variety of crops, including Sorghum *Sorghum bicolor* [34]. An average loss of 21% of maize crops in India [22]. In India and Pakistan, it causes appreciable damage to agriculture, primarily by feeding on grain and fruit crops, including, among others, maize, oilseed crops such as sunflowers, mangos, guava, and dates [7, 12 & 20]. Parakeet prefers specific tree species to live and breed. They choose different type of trees in various countries or regions of one country.

Tree Species

In Central Europe rose-ringed parakeet like *Acer campestre*, *Acer pseudoplatanus*, *Platanus x hispanica*, *Melia azedarach*, *Platanus spp*, *Enterolobium saman* (Rain tree) and *Populus spp* to make nests. Due to the presence of roost holes in abundance and on a specific height in these species. Many nests were discovered in Fraxinus (n = 23) and Quercus (n = 15). In US *Araceae* spp, *Pritchardia* spp, *Metrosideros polymorpha*, *Larix lyalli*, *Cryptomeria japonica*, *Taxodium distichum*, *Taxodium ascendens* tree species are preferred by rose-ringed parakeets to make nests [35, 36]. Rose-ringed parakeet mostly like Brazilian pepper (*Schinus terebinthifolius*), large sapodilla tree (*Achras sapote*), Australian cajeput trees (*Melaleuca leucodendron*), White Oak (*Quercus Alba*), Overcap Oak (*Quercus lyrata*) and Saw Palmetto (*Serenoa repens*) to make nests in Florida [37]. In Oman Sarh (*Maerua crassifolia*), Simer (*Boscia arabica*), Qasad (*Lycium shawii*), Hebek (*Euphorbia smithii*), Basbab (*Adansonia digitata*) and Luban (*Boswellia sacra*) are preferred by rose-ringed parakeet to make roosts [21]. Parakeet like to make nests in the holes of *Acer cissifolium*, *Acer carpinifolium*, Cherry blossom, *Cornus kousa*, *Diospyros kaki*, *Ficus subpisocarpa*, *Ficus superba*, *Ilex serrate*, *Larix kaempferi*, *Livistona chinensis*, *Zanthoxylum ailanthoides*, *Zanthoxylum pteritum* and *Zelkova serrate* in Japan [31]. *Acacia sassa*, *Afrocarpus dawei*, *Azelia bipindensis*, *Albizia amara*, *Albizia gummifera*, *Aloe marlothii*, *Anthonotha vignei*, *Euclea crispa*, *Euclea racemosa*, *Ficus cordata*, *Albizia vaughanii*, *Hythaene thebaica*, *Cordia Africana*, *Moringa stenopetala*, *Symphonia globulifera*, *Xylophia aethiopica* and *Ziziphus abyssinica* are preferred by rose-ringed parakeet to make nests in Africa [38, 39]. In China tree species like *Abies densa*, *Abies fabri*, *Dalbergia odorifera*, *Dillenia indica*, *Ficus superba*, *Betula utilis*, *Betula sinica*, *Maackia amurensis* and *Keteleeria davidiana* mostly have roosts of rose-ringed parakeet [40, 41]. *Ficus tilsa*, *F. benghalensis*, *F. glomerata*, *F. religiosa*

and *Morus Alba*. *F. tilsa* observed wealthy followed by *Polyalthia longifolia*, *Acacia spp* and *Dalbergia sisso* having a great population of rose-ringed parakeet in India [42-44]. Parakeets prefer tree species due to some special characteristics such as Diameter of tree at breast height (DBH) because it provides age of the tree and some trees develop holes and cracks due to aging.

Diameter at Breast Height (DBH)

Like other preferences, rose-ringed parakeet also prefers the diameter of the tree, because it provides height measurement and holes in the trunk of the tree due to aging. Average diameter at breast height of trees favored by rose-ringed parakeet is ± 15.4 to ± 47.8 inches [45]. In US parakeet prefer mean DBH of ± 50 to ± 120.88 inches to make nests [14, 18]. Rose-ringed parakeet like DBH between ± 46.25 and ± 206.864 inches for nests in Florida [46]. Oman have average tree DBH between ± 50.58 to ± 116.843 inches for presence of rose-ringed parakeet [25, 47]. Average DBH of trees in Japan preferred by rose-ringed parakeet to make roosts is 25.401 to 152.406 inches [48]. This parakeet like to live on a tree having diameter at breast height between 20.23-227.005 inches in Africa [49]. The range of DBH of trees having roosts of rose-ringed parakeet in China is ± 35.223 to ± 167.64 inches [50]. In India this parakeet prefer mean DBH between 19.6 to 139.705 inches to make nests in roosts of trees. Protection from predator and other hazards, rose-ringed parakeet require specific height to live and to make nests for nesting.

Roost hole height

Roost hole height varies according to tree species natively available in different countries of the world, such as in UK 60ft-89ft, in US 76ft-120ft, in Florida 58ft-87ft, in Oman 24ft-51ft, in Japan 12ft-85ft, in Africa 15ft-45ft, in China 12ft-37ft and in India 30ft-89ft [15-17, 40 & 41]. Entrance in the roost hole is the main concern of this species. If hole is small and parakeet does not enter in the roost than parakeet increase its size. Parakeet prefer a specific range of roost hole dimension to enter or exit.

Roost hole dimension

As with almost all other parrots, Rose-ringed Parakeets nest in tree holes and other cavities, including recesses in buildings. Mean range of roost hole dimension preferred by rose-ringed parakeet in different countries are as follows, in UK 5inch-8inch, in US 6inch-10inch, in Florida 8inch-11inch, in Oman 3inch-9inch, in Japan 2inch-7inch, in Africa 4inch-12inch, in China 6inch-10inch and in India 3inch-11inch [9, 31, 38, 42-44, 48 & 51]. Eggs laid by animal in one attempt in one roost or nest is called clutch. Due to availability of plentiful roosting sites and plenty of food, clutch size of rose-ringed parakeet is quite high.

Eggs of Rose-ringed Parakeet

Clutch size of rose-ringed parakeet varies in different countries of the world. This is due to the climate, breeding conditions, nesting availabilities and proportion of predators. Average number of eggs laid by rose-ringed parakeet (in one roost) in different countries are as follows, in UK 1 to 3 eggs, in US 2 to 3 eggs, in Florida 1 to 4 eggs, in Oman 2 to 4 eggs, in Japan 1 to 3 eggs, in Africa 1 to 4 eggs, in China 2 to 3 eggs and in India 2 to 4 eggs [9, 31, 38, 42-44, 47 & 51]

Purpose of the study

Food and feeding behavior of rose-ringed parakeet have already been studied in Central-Punjab Pakistan with special reference to cultivated crops. The purpose of current study is to dig out the nesting behavior (Tree Species, Diameter at breast height, High of roost hole from ground level, size of the roost hole, nesting material, number of eggs in one roost) of rose-ringed parakeet which might be a significant predictor in growth of over-size population in South-Punjab Pakistan.

Hypotheses of the Study

- H₁. It was anticipated that rose-ringed parakeet most commonly acquire *Albizia lebbbeck* and *Dalbergia sissoo* for roosting and nesting.
- H₂. It was hypothesized that average DBH (diameter at breast height) of trees selected by parakeets might be 80 inches.
- H₃. It was supposed that height of roost hole from ground level might be 110-185 inches.
- H₄. It was hypothesized that diameter of the roost hole might be 3 to 8 inches.
- H₅. It was supposed that 3-4 eggs were laid by rose-ringed parakeet in one nest.

Scope of the Study

This study will be initiated by three members of research group, on the issue of nesting behavior of rose-ringed parakeet, involves the selection of 50 tree species in Southern Punjab, Pakistan. The respondents will be randomly selected by research team themselves. The data will be collected via check lists from road side plantations, canal side plantations, crop field shelter belts and green belts from February 15 to May 20 this year.

METHOD

Sample characteristics

In total, 50 trees are selected to observe nesting behavior of parakeet based on the following criteria:

Eligibility Criteria - *Acacia nilotica* (Kikar), *Dalbergia sissoo* (Sheesham), *Albizia lebbbeck* (Black Siris), *Ficus religiosa* (Pipal) and *Syzygium cumini* (Jaman) were selected for observation of nesting behavior of parakeet. Most of the rose-ringed parakeets prefer to make nests in the hole of these tree species in other parts of Pakistan [6].

Exclusion Criteria - Some tree species like *Eucalyptus camaldulensis* (Safaida), *Albizia procera* (White Siris), *Melia azedarach* (Bakain or Dharek), *Azadirachta indica* (Neem), *Cassia fistula* (Amal-Taas) were excluded from research. Tree species have minimum or zero evidence of parakeet’s nesting activity [52, 53]

Sampling Technique and Procedures

Block randomization method is used to fix the blocks from which trees are purposefully selected. Furthermore, systematic observation is employed to make check lists for each tree [54]. Blocks are consisted on canal side plantations, road side plantation, green belt plantation of The Islamia University of Bahawalpur (Baghdad-UI-Jadeed Campus) and crop shelter belt plantation.

Research Design

Cross-sectional survey research design has been employed to conduct the current study.

Data Analyses

In the current study Descriptive Statistics, Standard Deviation (SD), and One-Way Analysis of Variance (ANOVA) are employed through Statistical Package for Social Sciences (SPSS-21.0) to process the results.

Ethical Considerations

First of all, departmental advisory committee has approved this study to proceed. Secondly, it has been taken care intentionally not to damage or injured any specie involved in this research. Parakeets nesting behavior is directly observed without interrupting their natural setting.

RESULTS

Table 1 *Frequency distribution of the overall sample according to Tree Species*

	F(50)	Percent	Cumulative Percent
<i>Acacia nilotica</i>	15	30.0	30.0
<i>Dalbergia sissoo</i>	11	22.0	52.0
<i>Mangifera indica</i>	9	18.0	70.0
<i>Albizia lebbbeck</i>	6	12.0	82.0
<i>Ficus religiosa</i>	5	10.0	92.0
<i>Syzygium cumini</i>	4	8.0	100.0

Table 1 shows the frequency distribution of the overall sample according to Tree Species. From the overall sample of 30% are *Acacia nilotica*, 22% are *Dalbergia sissoo*, 18% are *Mangifera indica*, 12% are *Albizia lebbbeck*, 10% are *Ficus religiosa* and 8% are *Syzygium cumini*.

Table 2 Use Descriptive Statistics in One Way ANOVA for multiple comparison among Tree Species with Their DBH, Roost Height, Roost Hole Dimension and Parrot's eggs

Variables	DBH (in Inches)			Roost Height (in Inches)			Roost Hole Dimension (in Inches)			No. of Eggs			
	N(50)	M	S.D	F (P)	M	S.D	F (P)	M	S.D	F (P)	M	S.D	F (P)
<i>Acacia nilotica</i>	15	80.67	17.735	1.617 (.175)	247.20	51.355	13.966 (.000)	9.27	1.792	7.182 (.000)	2.53	.990	.999 (.429)
<i>Dalbergia sissoo</i>	11	83.82	16.011		262.36	43.390		9.55	1.916		2.82	.982	
<i>Mangifera indica</i>	9	92.11	25.360		210.11	63.554		7.44	1.944		2.22	.972	
<i>Albizia lebbeck</i>	6	77.17	29.519		381.33	77.273		6.83	1.472		1.83	.983	
<i>Ficus religiosa</i>	5	107.80	29.047		378.80	43.894		5.60	1.817		2.20	.837	
<i>Syzygium cumini</i>	4	84.00	7.303		387.00	63.891		5.50	1.291		2.25	.957	

Table 2 shows the Descriptive Statistics among Tree Species with Their DBH, Roost Height, Roost Hole Dimension and Parrot's eggs. The DBH of *Acacia nilotica* tree species mean are 80.67 inches, the std. Devi are 17.735 inches, F values are 1.617 inches and P value .175 inches show that result is not significant and significant level is $P < .05$. The DBH of Tree species is high in *Ficus religiosa* as compared to *Mangifera indica*, *Syzygium cumini*, *Dalbergia sissoo*, *Acacia nilotica* and *Albizia lebbeck*. While the total tree species mean of DBH is 85.98 inches, Std. Devi is 21.983 inches and Std. error is 3.109 inches. The Roost Height of *Acacia nilotica* tree species mean are 247.20 inches, the std. Devi are 51.355 inches, F values are 13.966 inches and P values .000 inches shows that result is significant and significant level is $P < .05$. The Roost Height of Tree species is high in *Syzygium cumini* as compared to *Albizia lebbeck*, *Ficus religiosa*, *Dalbergia sissoo*, *Acacia nilotica* and *Mangifera indica*. While the total tree species mean of Roost Height is 284.318 inches, Std. Devi is 85.318 inches and Std. error is 12.066 inches. The Roost Hole Dimension of *Acacia nilotica* tree species mean are 9.27 inches, the std. Devi are 1.792 inches, F values are 7.182 inches and P values shows .000 inches result is significant and significant level is $P < .05$. The Roost Hole Dimension of Tree species is high in *Dalbergia sissoo* as compared to *Acacia nilotica*, *Mangifera indica*, *Albizia lebbeck*, *Ficus religiosa* and *Syzygium cumini*. While the total tree species mean of Roost Hole Dimension is 8.04 inches, Std. Devi is 2.285 inches and Std. error is 323 inches. The Eggs of parrot in *Acacia nilotica* tree species mean are 2.53, the std. Devi are .990, F values are .999 and P values shows

.429 result is not significant and significant level is $P < .05$. The Eggs of parrot in tree species is high in *Dalbergia sissoo* tree species as compared to *Acacia nilotica*, *Syzygium cumini*, *Mangifera indica*, *Ficus religiosa* and *Albizia lebbeck*. While the total Eggs of parrot mean trees species is 2.40, Std. Devi is .969 and Std. error is .137.

DISCUSSION

Based on Table 2, the results clearly show most of the parakeets prefer their habitat on tree species like *Dalbergia sissoo* and *Acacia nilotica* rather *Ficus religiosa*, *Mangifera indica* (Mango), *Syzygium cumini* and *Albizia lebbeck*.

H₁ "It was anticipated that rose-ringed parakeet most commonly acquire *Albizia lebbeck* and *Dalbergia sissoo* for roosting and nesting." is partially accepted in terms of *Dalbergia sissoo* because parakeets prefer to live on this tree species, and on the other hand partially rejected because secondly parakeets prefer *Acacia nilotica* for roosting. These species are present abundantly in planes of Punjab Pakistan. The species like *Acacia nilotica*, *Albizia lebbeck*, *Dalbergia sissoo* and *Ficus religiosa* are oldest trees in the country so cracks and holes are present in the trunks of these species [2, 19, and 56]. As compared to another study conducted the results of their research are similar to the current study [6]. Results in Table 2 shows that, rose-ringed parakeet prefer Mean DBH of 21.983 to 85.98 inches for make nests on the trees.

Similarly H₂ "It was hypothesized that average diameter at breast height of trees selected by parakeets might be 80 inches." is proved in current research. Current study

contradicts with previous study the results of their research are not similar to this study [55]. This difference in DBH might be due to difference in climatic conditions and soil type. As compared to Central Punjab, Pakistan, Southern areas of Punjab Pakistan might have more suitable soil and climatic conditions for optimum growth of above mentioned tree species. Therefore DBH vary place to place but preference of rose-ringed parakeet regarding tree species is same as in Central Punjab Pakistan. According to Table 2, it is observed parakeets prefer 85.318 to 284.318 inches roost hole height from ground level.

The hypothesis H₃ "It was supposed that the height of roost hole from ground level should be 110-185 inches." is partially accepted in this research. Contradict with this research no other study is conducted in which roost hole height from ground level is observed before. Roost hole height has very important in nesting behavior of any bird. Different birds prefer different hole heights to make nests. Might be height is a very important factor for nesting because height provides safety to new eggs, young ones and their parents. Many predators like eggs, eating insects, reptiles and animals that enter the roosts near ground level for food. So, maximum height provides maximum protection from predators. Parakeets also prefer a safe place on tree to make nest on specific height from ground level. Based on Table 2, the results clearly indicate that roost hole size preferred by rose-ringed parakeet varies from 2.285 to 8.04 inches.

Interestingly, hypothesis H₄ "It was hypothesized that diameter of the roost hole might be 3 to 8 inches." is proved in current research. As compared to another study conducted on roosts and roosting habits of rose-ringed parakeet the results of their research are not similar to the current study [52]. Holes in the tree stem are made by birds and insect and these holes expand due to the aging and growth of the stem. So the difference in both of these researches depends on growth rate of tree species in different areas of the country and availability of other birds like woodpecker which make holes in tree trunk. According to the results of Table 2, the mean number of eggs laid by parakeet is .969 to 2.4.

According to the hypothesis H₅ "It was supposed that 3-4 eggs were laid by rose-ringed parakeet in one nest." is not accepted into this study. Another similar study was conducted by [11] the results of their research are not similar to the current study. The difference is due to the number of rose-ringed parakeet in the area and availability of opportunities for parakeet to perform nesting habits properly [56].

It is concluded from results that rose-ringed parakeet prefer *Dalbergia sissoo* and *Acacia nilotica* to make roosts having DBH of 21.983 to 85.98 inches, parakeet like roost hole at the height of 85.318 to 284.318 inches, size of roost hole preferred by parakeet is 2.285 to 8.04 inches and number of eggs laid in one roost are .969 to 2.4.

CONCLUSION

Parrot, indigenously called as "TOOTA" (Rose-ringed Parakeet) is a communal bird and likes to live on tall and old trees like *Acacia nilotica* and *Dalbergia sissoo*. For nesting, this bird prefers special characteristics in tree diameter which is approximately 22 to 86 inches wide. It prefers height of the

hole from 85 to 284 inches tall from ground level. It means this parakeet prefers specific height to live. Rose-ringed parakeet like luxuriant places, therefore it prefers large holes to live. Observed hole sizes in current research are from 2 to 8 inches. This specie has a large clutch size in other areas of Punjab, Pakistan but in Southern Punjab clutch size is lower than other areas i.e. 1 to 2 eggs per roost.

Limitations of the study

Like every research, this study also has few limitations such as study employed purposive sampling in terms of selecting trees within one specific block; generalizability might be an issue. Similarly, some related variables like nesting material, incubation period, fledging, and parental behavior of pest are not addressed in current study. Finally, scope of research is not very wide in terms of area; to reach maximum geographical approximation other localities are ought to include.

Recommendations for Future Research

It is indicated by the literature review that Mynah and Starling's nesting behavior are associated with rose ringed parakeet's nesting behavior so in future researches both should be studied combine.

Conclusively, for prospective researchers, use of video cameras is highly recommended to deeply understand nesting behavior of pest while they are inside nest.

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