Behavioural observations on White-naped Tit *Machlolophus nuchalis* during its breeding season

Arjun B. Potter & André A. Dhondt

Potter, A. B., & Dhondt, A. A., 2019. Behavioural observations on White-naped Tit *Machlolophus nuchalis* during its breeding season. *Indian BIRDS* 14 (6): 161–165.
Arjun B. Potter, Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544, USA. E-mail: abp47@cornell.edu [Corresponding author]
André A. Dhondt, Lab of Ornithology, Cornell University, 159 Sapsucker Woods Road, Ithaca, NY 14850, USA. E-mail: aad4@cornell.edu
Manuscript received on 18 December 2017.

Abstract

The White-naped Tit *Machlolophus nuchalis* is a poorly known species that is endemic to India and is considered globally Vulnerable. Based on a four-week study in July 2011, at the beginning of its breeding season, observations are reported on territorial behaviour and territory size, foraging, breeding, and roosting behaviour. Territories are much larger than in previously studied tit species. Breeding behaviour described includes mating, courtship feeding, and feeding of young nestlings. Observations on roosting suggest, thus far, that male and female White-naped Tits roost each night in cavities, to which they show high fidelity.

Introduction

The White-naped Tit *Machlolophus nuchalis* is a poorly known endemic species, from India, with two disjunct populations, in north-western India and the southern Deccan region. Most prior studies have dealt with the status and distribution of this species in the country, apart from brief observation notes (Harrap & Quinn 2010; Gosler & Clement 2018; Pittie 2018). Sharma & Koli (2014) provide information on annual variation in habitat use, abundance, and tree choice for nest sites. Breeding biology is known primarily from early nest descriptions (Ali 1945; Ali & Ripley 1973) and from observations of an active nest during the late nestling and fledgling stages (Tiwari & Rahmani 1996).

A small number of breeding pairs were observed during four weeks in July 2011 in the thorn forest near Phot Mahadeo temple (Piyoni Temple), in Piyoni, Kachchh District, Gujarat, India (23.244ºN, 69.201ºE), and we documented their breeding behaviour.

Methods

The study site is a thorn forest located in a region of low hills near the headwaters of the seasonal Nayra River—this area was selected because of records of the study species in the literature (Tiwari & Rahmani 1996) and accessibility from Nakhatrana. The thorn forest is dominated (>95%) by *Acacia senegal* (synonym: *Senegalia senegal*), with smaller components of *A. leucophloea, A. nilotica, Balanites* sp., and *Prosopis* sp. Ground cover is sparse, consisting of shrubs, particularly *Grewia*, and *Ziziphus*, grasses *Cymbopogon*, and *Cenchrus*, and forbs (e.g. *Tribulus*). The region is semi-arid (350 mm annual rainfall), and the average tree height is five meters; grazing and firewood collection are common. The visit coincided with the beginning of the monsoon, which is when the White-naped Tit breeds (Ali 1945; Ali & Ripley 1973; Tiwari & Rahmani 1996). Although the birds were not banded, it was possible to identify three breeding pairs by slight plumage differences and simultaneous observations (Table 1). We report here on territorial, breeding, roosting, and foraging behaviour from field observations by the first author.

White-naped Tits were located using a combination of playback and active listening. Playback was used mostly during the first two weeks, after which it was possible to locate tits by searching areas where they had been seen before. White-naped Tit vocalisations were broadcast intermittently for no longer than ten minutes (usually less than one minute) or until detection. If a

Table 1. Plumage features used to individually identify White-naped Tits

Pair	Sex	Plumage	Behaviour
Temple Pair	Male	Breast band larger on the left side. Black messy block-like shape on right flank. Black finger-like projection on left flank.	Food was held in the right foot and this bird hung from pods with its right foot on top.
	Female	Only bird in study area with warm brown primaries. Hook-shaped dark smudge on the white of its left cheek. Fuzzy edge to breast stripe.	The left wingtip was usually folded over the right wingtip.
Banyan Pair	Male	A relatively straight and wide breast stripe.	NA
	Female	A very small white dot above the left eye was visible at close range. The belly stripe was prominently pinched such that it formed a gentle 'S' shape.	This bird repeatedly held food in its left foot.
East Pair	Male	NA	Associated with East Pair female
	Female	Female with no brown on wing and no white dot above eye.	NA

bird was not detected, recordings would not be played again for 15 mins or at a minimum distance of 100 m. As soon as a White-naped Tit was detected playback was ceased. Tits were usually encountered in pairs, although sometimes just a male was detected. The use of playback was limited to avoid habituation or disturbance of resident tits.

After a bird was detected, we followed it at a distance to take notes on its vocalisations, foraging, and territorial behaviour. Movements were tracked using a handheld GPS unit. One GPS point referred to all birds detected at one time, noting whether the bird was alone, with another (a pair), or if we observed a confrontation between two pairs. We followed tits until they were lost from sight, until they retired to roost, or until they sought shelter from the midday heat (*c.* 1100 hrs). Observations were made during both, morning (~0800 - 1100 hrs), and evening (~1700 - 2000 hrs).

We identified birds individually by location, simultaneous observations, and based upon minor plumage differences between individuals (Table 1). Members of the 'Temple' and 'Banyan' pairs could be identified individually, as could the East Pair female. It took approximately two weeks to learn to distinguish individual birds. Earlier sightings were retrospectively assigned to one of the three identified pairs based on notes on plumage variations taken at the time, as well as proximity to known roosting areas during the evening, and position relative to known territorial boundaries. Points referencing confrontations between pairs were assigned to both pairs. ArcMap (ESRI) was used to build the convex hull or minimum convex polygons using all GPS points where an individual was seen, and to calculate the area of each polygon. Since males were more active in territorial defence, and were occasionally detected without the female, we present distribution data, based upon males, to describe territories.

In addition to the male being a glossier black (Harrap & Quinn 2010; Grimmett *et al.* 2011), and sporting a short crest, (Tiwari & Rahmani 1996), we noted that the breast stripe of the female was narrower and more irregular than the wider stripe of the male in all the three pairs we observed.

Over six days (27 July–01 August 2011) we watched an active White-naped Tit nest for a total of 22.75 hrs, during a morning period (between 0626 and 1117 hrs), or an evening period (between 1730 and 1951 hrs). The evening period ended when the female entered the nest hole to roost for the night. Observations were made sitting quietly on the ground some distance from the nest hole, concealed by a patch of tall grass and bushes and the shade of a *Euphorbia* shrub. We remained out of the parents' flight path and the birds showed no signs of agitation. The nest hole was visible at an oblique angle making it possible to view birds from the side as they entered the nest hole. Observations of the nest tree were made with the aid of binoculars, a camera (no flash), and a stopwatch. We collected data on feeding rates only on 29, 30, and 31 July. The nest tree was quickly measured with callipers while the pair was out searching for food.

Before they roosted, we observed the behaviour of the Temple Pair's male on 12 occasions (20 July - 01 August), and of the female on five occasions.

Results & Discussion

All White-naped Tits observed in July 2011 showed evidence that suggested breeding. All three pairs in the Phot Mahadeo Temple study site responded to playback of conspecific song, suggesting territory defence (Ydenberg & Krebs 1987). Apart from these three pairs, a pair in the neighbouring Jathavira forest also reacted aggressively to playback on 06 July. On 23 July another female was photographed collecting nesting material near Naliya **[190]**. Hence, there is enough evidence to suggest that the tits in that area were all breeding during these months.

Sharad Sridhar

190. A female collecting nesting materials near Naliya, Kachchh District, Gujarat. Note the brown primaries and lack of crest.

Territory size and use

Foraging: Pairs of White-naped Tits were usually seen hunting for arthropods in the canopies of *Acacia senegal* trees. Frequently, tits hammered on the dried seedpods of *Acacia senegal*, either while hanging off the pod itself or after having removed the pod and holding it on a larger branch. Inspection of insect damage within discarded pods corroborates Sharma & Koli's (2014) assertion that larvae (unidentified) within seedpods are an important food source for White-naped Tits. Similar to Joshua *et al.* (2007), we once observed a tit hammering a *Capparis* berry. Tits hammered the mandibles of larger caterpillars before eating them, presumably to reduce their risk of injury. During a mass emergence of termite alates, tits sallied to catch them in midair.

Territory size: We observed eight territorial confrontations on six days between 11 and 23 July; seven of them were observed between the Temple Pair and the Banyan Pair and one between the Banyan Pair and the East Pair. All tits in the study area were territory holders; no floaters were recorded. Once the GPS data were visualised we found that the seven confrontations between the 'Temple' and 'Banyan' pairs formed a straight line. Confrontations were only seen in the forested area, though on one occasion we observed long distance counter singing in the sparser forests to the west of the boundary.

Fig. 1 summarizes the observations of these three pairs based on 157 GPS points. Territory sizes were: 28.9 ha (Temple Pair); *c.* 46 ha for the Banyan Pair; and *c.* 17 ha for the East Pair, for which there are only 17 GPS locations. An additional nine locations were tentatively assigned to the Banyan Pair—if these are included, the estimate for this territory size increases to 80 ha. Although territories were very large, conflicts were observed at the borders, and territories were non-overlapping. The nest of the Temple Pair was located 299 m from the nearest territory boundary. The male roosted in a cavity 180 m away from the nest.

This study describes larger territory sizes than usually observed in other Paridae (Perrins 1979). Densities of tits in Europe are usually measured in pairs per 10 ha—for instance, mixed woodland in Wytham, England supports 6.5–12.9 pairs of tits per 10 ha (Minot & Perrins 1986). Non-forest areas typically support lower breeding densities and larger territory sizes (Cowie & Hinsley 1987; Krebs 1971). For instance, territories of the Great Tit *Parus major* average 1.34 ha in woodland (n=16) but 3.72

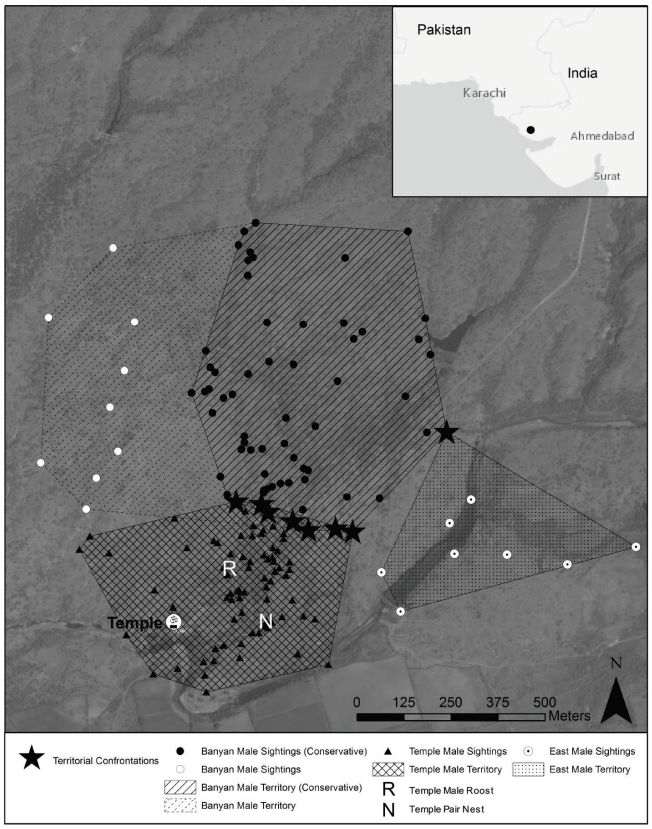

Fig. 1. A map of three territories of White-naped Tits in Phot Mahadeo (Piyoni), Kachchh District, Gujarat.

ha in the surrounding hedgerows (n=12) (Krebs 1971). Kala & Joshua (2011) found 16 pairs of White-naped Tits using their 2 km^2 study area in the thorn forest of the Aravalli hills of Rajasthan, and they estimate that the territories were slightly more than 12 ha. This study's conservative estimate (n=2) of 37.5 ha (approximately 3 pairs/km^2) is even larger than reported by Kala & Joshua (2011); however, it is similar to the territories (n=6) of the Southern Black Tit *Melaniparus niger* in an African open woodland savanna, which averaged 32 ha (Tarboton 1981). Taken together, this suggests that the large territory sizes in this study may be related to the sparseness of the habitat. The low breeding densities reported here, coupled with a known patchy distribution (Tiwari 2001), suggests that the overall numbers of the White-naped Tit must be low.

Breeding

Nesting cavity: The nesting cavity of the Temple Pair was found on 27 July 2011. The nest hole was located in the main trunk of a small live *Acacia senegal* in a patch of thick scrub near a dry riverbed **[191]**. The main trunk of the tree leaned at 75° to the ground and the hole was on the underside of the trunk, such that the lip of the hole was only 68 cm above the ground. The wood comprising the lower lip of the hole was relatively thick (46.3 mm) and the cavity extended 45.6 mm back from the inner lip of the hole. Since the diameter of the tree, just below the hole, was 11.5 cm, the back wall must have been much thinner; through the hole a small prick of light could be seen, indicating a crack in the back wall. The nest hole entrance, which faced west, was oval shaped: 37.0 mm wide and 23.5 mm high. The cavity was probably first excavated by a Yellow-fronted Pied Woodpecker *Dendrocopos mahrattensis*, given the geographic range of, and cavity dimensions created by, that species (Ali & Ripley 1970). Nest construction was not observed, however a photograph taken on 23 July 2011 in nearby Naliya shows a female White-naped Tit gathering fur from a roadkill, suggesting that fur is used to line the nest **[190]**.

Sharad Sridhar

191. The active nesting cavity of the Temple pair.

Nest tree parameters reported in our study (nest and nest tree heights, cavity and cavity branch diameters) are smaller than the averages reported by Sharma & Koli (2014). This may reflect the smaller size of the dominant *Acacia* trees in our study area. We report a nest hole opening of 37.0 mm x 23.5 mm, in contrast to the average nest hole diameter of 52.0 mm (N=12, SD=14.9) reported in Sharma & Koli (2014) but closer to the 35 mm reported by Tiwari & Rahmani (1996). Sharma & Koli (2014) gave 40 mm as the minimum entrance diameter of a potential nest site—it is clear that the minimum entrance diameter is smaller, particularly since White-naped Tits will use nest boxes with an entrance diameter of 36 mm (Kala & Joshua 2011). The minimum diameter of a useable cavity opening for White-naped Tits may be closer to 30 mm, given that Great and Blue *Cyanistes caeruleus* tits use holes of 32 and 26 mm respectively (Matthysen *et al.* 2001). This study, like others (Tiwari & Rahmani 1996; Kala & Joshua 2011; Sharma & Koli 2014) notes a scarcity of cavities in the thorn forest. Potential reasons for this apparent scarcity may include dominance of small hardwoods (*Acacia, Prosopis*), fewer primary cavity excavators, and pressure from fuelwood harvesting.

Mating: On 13 July, at 0914 hrs, the Temple Pair male mounted the female and uttered a harsh '*choyy-tsss tstststs*' sound. The quieter '*ts*' notes were uttered in rapid succession after the harsher first two notes. While mating, the female fluttered her wings and made soft '*tststs*' notes as well. Just before mating, the male had briefly left the female to challenge a neighbouring male. It returned singing loudly.

On 14 July, at 1019 hrs, the same pair mated again in a large *Euphorbia* clump after which the male remained close to the female for at least ten minutes. At 1037 hrs courtship feeding followed the soft '*tststs*' notes.

Incubation: During the eight-day period from 18 and 25 July, the Temple Pair's female was rarely seen. We presumed that that the female was incubating, and that this time represented a portion of the incubation period. During this time, the male foraged alone and called frequently, but was very skittish. Once, a male disabled a large caterpillar and flew with it in the direction of the nest, suggesting female provisioning. The total length of the incubation period is unknown. In the closely related Great

Tit, the incubation period is 14–15 days and varies, depending on factors such as ambient temperature and time spent on the nest (Kluijver 1950).

Feeding of nestlings: On 27 and 28 July both members of the Temple Pair visited the nest hole multiple times, suggesting feeding of newly hatched nestlings. On 29 July the female brought food to the nest hole, confirming the presence of hatched young. Visiting frequency varied between eight and ten visits per hour in the morning, and between three and 11 visits per hour in the evening. The pair brought food, at least, as early as 0630 hrs, and ceased bringing food between 1850 and 1925 hrs. The female often spent long spells inside the nesting cavity and the male would (sometimes) pass food through the hole to the female **[192]**. We never saw the pair leave the nest carrying faecal sacs, suggesting the young were still small when the observations were finished. When young are small, parents consume faecal sacks (Perrins 1979).

We observed 144 visits to the nest over three days. Either member of the pair entered the nest hole 116 times, or passed food through the hole 28 times. The male accounted for 74.5% of cases where the sex of the bird entering the hole was known (n=106), suggesting that, when the young are small, the male visited the hole more often than the female and brought correspondingly more food. In 27 of 28 instances, when food was passed through the hole, it was possible to confirm that the bird passing the food from the outside was the male.

These observations of an active nest are largely similar to those in previous studies of the species (Ali 1945; Ali & Ripley 1973; Tiwari & Rahmani 1996), although this is the first study that documents the early part of the nestling stage. Tiwari & Rahmani (1996) also documented that the breeding pair fed nestlings from just after sunrise to past sunset, called while approaching the nest, and often passed food to each other through the entrance of the nesting cavity.

Food items: We could identify the food that the birds brought the nest on 23 of their 144 visits. These were 'white grubs' (n=10, 6.9%), 'green grubs' (n=4, 2.8%), 'grey grubs' (n=4, 2.8%), 'small green caterpillars' (n=2, 1.4%), a small brownish arthropod (n=3, 2.1%), and unidentified food items (n=121, 84.0%). Ali (1945), and Tiwari & Rahmani (1996) also documented caterpillars and pupae in the diet of nestlings.

Female wing-fluttering display: On two occasions the Temple Pair's female was observed holding her body at a 45º angle to a perch, arch her head back, puff up her feathers, and droop and flutter her wings. The female did not raise the feathers on her head to form a small crest, as the male often does. This behaviour occurred once while the male was out of sight, and once while a male was bringing food to the nest. After the male entered the hole, the female, while holding food in her beak, continued this display for ten seconds before also entering the hole.

The function of this wing-quivering display is unknown. Tiwari & Rahmani (1996) also note this behaviour at the nest site during the nestling stage. Despite the similarity to the demand behaviour described by Smith (1980), this behaviour is not related because the female had food in her beak. This wing-quivering display appears more similar to the behaviour described by Lambrechts *et al.* (1993) in Black-capped Chickadees *Poecile atricapillus,* which is thought to coordinate nesting activities under the invitational hypothesis. This behaviour is also quite frequent in Blue- and Great Tits (A.A.D, pers. observ.) when both parents arrive at the nest with food.

Sharad Sridhar

192. The Temple male bringing food to the nesting cavity.

Mobbing and nest defence: We observed White-naped Tits mobbing, either alone, or along with other species, potential predators such as the Shikra *Accipiter badius,* Spotted Owlet *Athene brama*, Indian Eagle Owl *Bubo bengalensis*, a golden jackal *Canis aureus*, and Indian fox *Vulpes bengalensis*. Despite a generally aggressive defence of the nest hole, an Indian Robin *Saxicoloides fulicatus* was seen peering into the nest cavity while the male White-naped Tit watched silently from above.

Roosting

The Temple Pair roosted, each night, in separate tree cavities: the female in the nest hole, and the male in a separate roosting cavity. The neighbouring Banyan Pair was observed returning to the same area each evening, suggesting fidelity to a roosting site in that pair as well.

After the Temple Pair female entered the nesting hole for the night, the male would fly to his roost, which was 180 m away from the nest site. Upon arriving at the roosting area, the male would wait 02–20 min (mean 8.5± *SE* 1.77) before roosting, and alternated periods of calling with silence and relative stillness. During still periods, the male would alternately look to the left and right. The male tit retired to the roost 02–28 min (mean 17.3± *SE* 2.42) after sunset (*n* =12). After entering the crevice, the male backed into the cavity, until only its head and the top half of its body were visible **[193]**.

The roost was observed at dawn on one occasion; on 26 July, the tit left its roost at 0608 hrs, five minutes after sunrise.

Description of the roost: The Temple Pair's male roosted in a crevice, 3.2 m up in the branch of a six-meter *A. senegal.* The crevice had a C-shaped cross section for much of its length, with an inside diameter of 32–43 mm. On one end, the crevice became a narrow cavity that extended into the central core of the branch for 134 mm, of which the innermost 50 mm was wet with water. This cavity portion was too small to accommodate the entire bird.

These observations of roosting are consistent with those of previous authors. Ali & Ripley (1973) first discovered that White-naped Tits roost in cavities, or bark fissures, and show site fidelity. They described that two surveys, seven years apart, found a tit roosting in a hole in a gate crossbar in Bhujia Hills, Kachchh, although it was not possible to determine if it were the same individual. Tiwari & Rahmani (1996) also reported that White-naped Tits roost in natural holes, or fissures that are four to

Sharad Sridhar

193. The Temple male while entering his roosting hole.

eight meters above the ground, in dead *Acacia nilotica* trees, during the breeding season. They reported that tits were very vocal prior to roosting, making both 'sweet, musical whistles and bold scolding notes', and that a pair of tits used the same sites on consecutive days; one member of the pair roosted in the breeding cavity, but 'when the young birds became too big, both parents would occupy their favoured roost site'. Sharma (2016) found four White-naped Tits roosting individually, in December, in iron pipes that formed part of a leopard enclosure, and noted restless movements prior to roosting.

Although it is difficult to generalise, given the paucity of data, observations do suggest that both, the female and the male White-naped Tits roost each night in a cavity year around. The female, in our study, slept in the nest, as European tits do (De Laet & Dhondt 1989). Male White-naped Tits seem to roost in a cavity every night and seem to show high fidelity to their roosting cavity. This is in contrast to male European tits, which are only rarely found in nest boxes, at night, during the breeding season (Kluijver 1950; Winkel & Winkel 1973; Dhondt *pers. obs.*), but commonly roost in cavities in winter (Kluijver 1950). The male's fidelity to roosting in a small crevice, in our study, suggests limited options, and underline the preference of spending the night in a cavity compared to doing so outside, in foliage. In contrast, Corsican Blue Tits *Cyanistes caeruleus ogliastrae* do not use cavities for roosting, not even in winter (Dhondt *et al.* 2010). This behaviour seems to be innate in Corsican Blue Tits, because the cost/benefit balance of using a nest box, compared to foliage, for roosting favours spending the night in the canopy in an evergreen broad-leaved forest on an island with few owls (Dhondt *et al.* 2010). Thus, one hypothesis is that White-naped tits roost in cavities year around to avoid nocturnal predators.

Conservation

Grazing, firewood collecting, and clearing for agriculture have heavily impacted the thorn forests in Kachchh District. Since the White-naped Tit occurs at low densities, and breeds and roosts in cavities, degradation of their thorn forest habitat poses a serious threat to this species. Providing nest boxes could help White-naped Tits find both, nesting and roosting sites.

Acknowledgments

We thank A. Rahmani and B. Jethva for their early guidance, C. Spagnoli for help with figures, and Praveen J and two anonymous reviewers for helpful comments. Special thanks go to J. Tiwari and CEDO for essential guidance and logistics. ABP is grateful to the Cornell College of Agriculture and Life Sciences and to the Cornell Lab of Ornithology for financial support. In addition, ABP thanks The Explorers Club for laying the groundwork for this study through the Youth Activity Fund Grant.

References

Ali, S., & Ripley, S. D., 1970. *Handbook of the birds of India and Pakistan together with those of Nepal, Sikkim, Bhutan and Ceylon. Frogmouths to pittas.* 1st ed. Bombay: (Sponsored by Bombay Natural History Society) Oxford University Press. Vol. 4 of 10 vols. Pp. i–xvi, 1–256, 1 l.

Ali, S., & Ripley, S. D., 1973. *Handbook of the birds of India and Pakistan together with those of Bangladesh, Nepal, Sikkim, Bhutan and Sri Lanka. Robins to Wagtails.* 1st ed. Bombay: (Sponsored by the Bombay Natural History Society) Oxford University Press. Vol. 9 of 10 vols. Pp. i–xvi, 1–306.

Ali, S., 1945. *The birds of Kutch.* 1st ed. Kutch; Bombay: Government of Kutch; Oxford University Press. Pp. i–xviii, 1–175.

Birdlife International. 2012. *Parus nuchalis*. In: IUCN 2014. IUCN Red List of Threatened Species. Version 2014.1. Website URL: www.iucnredlist.org. [Accessed on 29 June 2014.]

Cowie, R. J., & Hinsley, S. A., 1987. Breeding success of Blue Tits and Great Tits in suburban gardens. *Ardea* 75 (1): 81–90.

De Laet, J. F., & Dhondt, A. A., 1989. Weight loss of the female during the first brood as a factor influencing second brood initiation in Great Tits *Parus major* and Blue Tits *P. caeruleus*. *Ibis* 131 (2): 281–289.

Dhondt, A. A., Blondel, J., & Perret, P., 2010. Why do Corsican Blue Tits not use nest boxes for roosting? *Journal of Ornithology* 151 (1): 95–101.

Gosler, A. G & Clement, P., 2018. White-naped Tit (*Machlolophus nuchalis*). In: *Handbook of the Birds of the World Alive*. del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). Barcelona: Lynx Edicions. Website URL: https://www.hbw.com/node/59903. [Accessed on 4 September 2018.]

Grimmett, R., Inskipp, C., & Inskipp, T., 2011. *Birds of the Indian Subcontinent.* 2nd ed. London: Oxford University Press & Christopher Helm. Pp. 1–528.

Harrap, S & Quinn, D., 2010. *Tits, Nuthatches & Treecreepers.* London, UK: Christopher Helm.

Joshua, J., Gokula, V., & Sunderraj, S. F. W., 2007. Status of Pied Tit *Parus nuchalis* in Narayan Sarovar Sanctuary, Gujarat, India. *Indian Birds* 3 (3): 91–93.

Kala, H., & Joshua, J., 2011. Observation on the nesting behavior of vulnerable White-naped Tit *Parus nuchalis* using artificial nest boxes in southern Aravalli Hills of Rajasthan: a pilot conservation and species recovery action. In: Bhupathy, S., Prusty, B. A. K., Kumara, H. N., Jayaraj, R. S. C., Quadros, G., & Pramod, P., (eds.). *Status of Indian birds and their conservation: First International Conference on Indian Ornithology (ICIO) - 2011*. Coimbatore, India: Salim Ali Centre for Ornithology and Natural History. Pp. 199–200.

Kluijver, H. N., 1950. Daily routines of the Great Tit *Parus major major* L. *Ardea* 38 (3): 99–135.

Krebs, J. R., 1971. Territory and breeding density in the Great Tit, *Parus major* L. *Ecology* 52 (1): 2–22.

Lambrechts, M. M., Clemmons, J. R., & Hailman, J. P., 1993. Wing quivering of black-capped chickadees with nestlings: invitation or appeasement? *Animal Behaviour* 46 (2): 397–399.

Matthysen, E., Adriaensen, F., & Dhondt, A. A., 2001. Local recruitment of great and blue tits (*Parus major*, *P. caeruleus*) in relation to study plot size and degree of isolation. *Ecography* 24 (1): 33–42.

Minot, E. O., & Perrins, C. M., 1986. Interspecific interference competition—nest sites for blue and great tits. *Journal of Animal Ecology* 55: 331–350.

Perrins, C., 1979. *British Tits*. London, UK: Collins.

Pittie, A., 2018. Bibliography of South Asian Ornithology. Website URL: http://www.southasiaornith.in. [Accessed on 09 Sept 2018.]

Sharma, S. K., & Koli, V. K., 2014. Population and nesting characteristics of the Vulnerable White-naped Tit *Parus nuchalis* at Sajjangarh Wildlife Sanctuary, Rajasthan, India. *Forktail* 30: 1–4.

Sharma, S. K., 2016. Night roosting on iron poles by the White-naped Tit *Parus nuchalis* in Udaipur, Rajasthan, India. *Journal of the Bombay Natural History Society* 112 (2): 100–101 (2015).

Smith, S.M., 1980. Demand behavior: a new interpretation of courtship feeding. *Condor* 82: 291–295.

Tarboton, W. R., 1981. Cooperative breeding and group territoriality in the Black Tit. *Ostrich* 5 (4): 216–225.

Tiwari, J. K., & Rahmani, A. R., 1996. The current status and biology of the White-naped Tit *Parus nuchalis* in Kutch, Gujarat, India. *Forktail* 12 (August): 79–85.

Tiwari, J. K., 2001. Status and distribution of the White-naped Tit *Parus nuchalis* in Gujarat and Rajasthan. *Journal of the Bombay Natural History Society* 98 (1): 26–30.

Winkel, V. W., & Winkel, D., 1973. Höhlenschlafen bei Kohlmeisen (*Parus major*) zur Zeit der Brut und Mauser [Nestbox sleeping of Great Tit (*Parus major*) at time of breeding and moulting]. *Vogelwelt*. 94: 51–59. (In German).

Ydenberg, R. C., & Krebs, J. R., 1987. The tradeoff between territorial defense and foraging in the great tit (Parus major). *American Zoologist*. *27* (2): 337–346.