

Етологія	Беркут	21	Вип. 1-2	2012	116 - 126
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OBSERVATIONS ON THE BREEDING BEHAVIOUR OF THE PIED BUSH CHAT (*SAXICOLA CAPRATA*)

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Abstract. Understanding the life history events is a crucial factor in developing conservation and management approaches for any avian species. Nevertheless such studies on the avifauna of the Indian subcontinent are scanty. This paper deals with the breeding behaviour of the tropical avian species, the Pied Bush Chat, observed during 2008–2009 in district Haridwar, Uttarakhand state, India. Breeding activities commenced with the advent of spring (in late February) and continued till July. The peak in breeding activity (availability of maximum clutches) was observed in May. Males were found highly territorial during breeding season and delivered dawn chorus with immediate variety. Dawn chorus seemed to play a role mainly in maintenance and adjustment of social relationship among neighbouring males. Nest-site selection was performed by both the sexes and only female built the nest. Nest was a cup of grass and rootlets lined with finer grass and animal hair. Clutch size averaged 3.67 ± 0.47 . Only females incubated and developed brood patch during incubation. Different factors such as predation, rain water overflow in nest, hatching failure were found responsible for the loss of eggs/young ones. Nestlings and fledglings delivered begging and contact calls respectively for being fed from parents. Both sexes fed the young and delivered alarm call on observing any predator nearby the nesting area. We observed pairs nesting in partially-developed human settlements also suggesting scarcity of natural nesting habitat due to urbanization in the study area.

Key words: breeding ecology, habitat, clutch, egg, song, incubation.

Наблюдения за гнездовым поведением черного чекана (*Saxicola caprata*). - В.К. Сети, Д. Бхатт, А. Кумар. - Беркут. 21 (1-2). 2012. - Исследования проводились в округе Харидвар (штат Уттаракханд, Индия) в 2008–2009 гг. Гнездовой сезон чеканов продолжался с конца февраля до июля. Пик гнездовой активности (максимум кладок) приходился на май. Каждая пара имела 2–3 кладки в сезон. У самцов выражена территориальность. Место для гнезда выбирали оба партнера, но строила его только самка. Гнездо в виде чаши из травы и корешков с выстилкой из тонких травинок и волос. Самка откладывала 3 или 4 яйца. Средние размеры яиц $17.41 \pm 0.35 \times 13.58 \pm 0.19$ мм (n = 16), вес свежеснесенного яйца – 1.64 ± 0.09 г (n = 54). Средний размер кладки 3.67 ± 0.47 яйца. Насиживала их только самка. Птенцы вылуплялись в один день. Потери яиц и птенцов были связаны с хищничеством, затоплением гнезд во время дождей, гибелью эмбрионов во время насиживания. Кормили птенцов оба родителя. Выделены 94 типа песни (12 самцов).

Introduction

Behavioural studies on birds have significant potential to contribute to a number of questions related to ornithology (Virolainen, 1984; Sherry, Holmes, 1992). That is, ornithological science can develop and mature mainly by the collection and proper interpretation of data collected in the field on different aspects of birds' life (Nolan, 1978). For example, studies on the breeding behaviour of a species provide insights in to the selection pressures that individuals of that species have faced over time. Long term and systematic data on the breeding ecology of unstudied species make it possible to conduct comparative tests with the studied ones to determine what factors

are responsible for the differences in breeding parameters between species (Dowling, 2003). Besides this, understanding the life history events is a crucial factor in developing conservation and management approaches for any avian species (Kitowski, Pawlega, 2010). Unfortunately, studies on the behavioural ecology of the avifauna of the Indian subcontinent are scanty (Sharma et al., 2004; Sethi, Bhatt, 2008). Consequently, we largely lack fundamental data on behavioural ecology of most of the Indian avian species.

This paper aims to fill one of these gaps through studying some aspects of the breeding behaviour of a tropical avian species, the Pied Bush Chat (*Saxicola caprata*) under natural conditions.



Photo 1. Ringed individuals of Pied Bush Chat: (A) Female and (B) Male.

Фото 1. Окольцованные особи черного чекана: (A) самка и (B) самец.

Materials and Methods

Study Species

The Pied Bush Chat (Order Passeriformes, Family Muscicapidae, Photo 1) is a tropical songbird that occurs discontinuously from Transcaспia and the Indian subcontinent to South-East Asia, the Philippines, Indonesia, New Guinea and New Britain (Ali, Ripley, 2001). The male is black except for a white rump, wing patch and lower belly along with dark brown iris. The female is dull brown and slightly streaked (Grimmett et al., 1998). This species is insectivore and found in open habitats. Males use dawn chorus from their respective territories during the breeding season (Ali, Ripley, 2001; Sethi et al., 2011a). Females also deliver songs and the structure and contexts of female song in this species have also been described (Sethi et al., 2012). This species appears to be socially monogamous (Bell, Swainson, 1985).

General Methodology

We observed breeding behavior of the Pied Bush Chat during 2008–2009 in district Haridwar (29° 55' N and 78° 08' E), Uttarakhand state, India. Field visits were carried out generally on alternate days or as required for recording different breeding activities.

Intersexual colour difference found in the Pied Bush Chat was of considerable help in the collection and interpretation of field data on various breeding related aspects such as nest site selection, nest building, incubation, parental provisioning etc. Behaviour of individuals was observed using 8 × 50 prismatic field binocular (Nikon) and still camera (Nikon FM 3A with 300 mm zoom lens).

Individuals were ringed for unique identity (Photo 1). Territories were mapped by noting locations of singing and boundary encounters. Songs of male were recorded using Sennheiser ME 67 directional microphone and Marantz PMD 670 portable solid state sound recorder. Spectrograms were prepared with Avisoft SASLab Pro 4.1 software (Specht, 2002). Close observations were made to record different breeding activities such as nest site selection, egg laying, incubation, parental provisioning, behaviour of young ones etc. Eggs were measured and weighed within 24 hrs of laying. Clutch size was defined as the number of eggs laid by a female in single breeding attempt. Incubation period was considered to be the time elapsed between the laying of the last egg of the clutch and hatching of the last young (Skutch, 1945). Nestling period was defined as the time lapsed between hatching of the first young and fledging of all young in nest.



Photo 2. Habitats of the Pied Bush Chat: (A) natural landscape and (B) partially-developed human settlements.

Фото 2. Гнездовые биотопы черного чекана: (А) природный ландшафт и (В) строящиеся поселения.

Attempts were also made to understand the cause of egg/young loss. Data were analyzed following standard statistical tests (Zar, 1999). Results are reported as mean \pm SD.

Results and Discussion

Breeding season

The breeding activities of Pied Bush Chat commenced with the advent of spring in India (late February) and continued till July. Female started adding nesting material to nest site in the first week of March. Building of the first nest started on 6 March and 9 March in 2008 and 2009 respectively. Dates of laying of the first egg were 14 March and 19 March in 2008 and 2009 respectively. The peak in breeding activity (availability of maximum clutches) was observed in May as maximum clutches (35%) were observed in the month of May alone.

Males were found highly territorial during breeding season. Territory size ranged from 2249.2 m² to 5447.4 m² with an average of 4018.5 \pm 860.4 m² (n = 17). Each pair produced two to three broods probably due to the long breeding season. Ali (1996) and Grimmett et al. (1998) have also reported almost the same length of breeding season for the Pied Bush Chat. However, in Port Moresby, Papua

New Guinea, breeding season of the species extends over a period of seven months from July to January (Bell, Swainson, 1985). In the present study, although availability of insect food for the nestlings in April – May (when early breeder rear their young) did not seem abundant as in the June – July (monsoon period), early breeding in the season might be adaptive in acquiring better nesting sites.

Habitat of the Pied Bush Chat

The species was found in open habitats including scrub, grassland and cultivated fields (Photo 2A). Similar habitat features for the Pied Bush Chat have been reported by other workers also (Bell, Swainson, 1985; Ali, Ripley, 2001). Besides, we observed four pairs nesting in partially-developed human settlements also (Photo 2B). Two of these nests were built even inside the half built houses. The reason of inhabiting human populated sites by a wild species seemed to be related with the scarcity of micro habitat for nesting. During this study, we witnessed rapid trend of urbanization in the study area engulfing large portion of the open lands (habitat of Pied Bush Chat). The species tried to cope with this habitat modification through nesting inside human settlements. However, this does

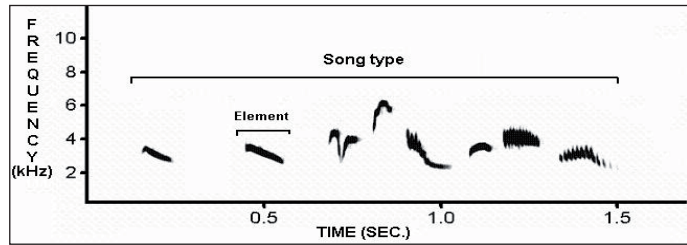


not ensure the survival of this bird for a long time. For example, in 2008 only four pairs bred inside half built houses, but in the successive year (2009) no pair was observed nesting inside these houses because humans had started to live in there. Thus, in the study area there appears to be scarcity of open and natural landscape for the breeding of the pied bush chat, which may threaten this species in near future.

Singing behaviour of male

Males delivered complex dawn chorus on daily basis during breeding season. Day time singing was also observed, however, it was performed in an unpredictable manner. Males started to sing 50.4 ± 8.1 min. before sunrise ($n = 14$) and became quiet around sunrise. Males sang continuously for about half an hour during dawn (median = 32.4 min.; range = 15–47 min.). Males performed continuous dawn singing throughout the breeding season and seemed to interact vocally through counter-singing. Our observations suggested that dawn song delivery in the Pied Bush Chat could play a role in maintenance and adjustment of social relationship among neighbouring males. Female removal experiment has also indicated that males Pied Bush Chat direct their dawn chorus to their neighbours instead of their mates (Sethi et al., 2011b). Recent studies have also suggested that birds may use their songs in a more complex or subtle way to interact with specific receivers, particularly in a territorial system where the relationships between territorial neighbours could be mediated by songs used during close-range interaction (Smith, 1997; Todt, Naguib, 2000).

Dawn chorus, as observed in the Pied Bush Chat, is a common feature of a number of song birds. It has been reported that during the dawn chorus, territorial male song birds sing intensively within signaling range of



Spectrogram of a song type of male Pied Bush Chat.

Сонограмма одного из типов песни самца черного чекана.

several conspecific males and can therefore be considered members of a busy communication network (Catchpole, Slater, 1995). Contrary to day time, the dawn song of the Pied Bush Chat could be easily heard from considerable distance due to quiet environment with minimum or no human-caused noise. Other workers have also suggested that in birds dawn appears to be the best time for singing because the hindrances to acoustic communication are least at this time of the day (Brown, Handford, 2003).

The dawn songs of the Pied Bush Chat were found to be highly varied and complex, composed of different song types. An example of the song type has been shown (Fig.). Based on visual inspection of the spectrograms, a total of 94 song types were identified in the dawn song repertoires of twelve males. Each song type consisted of a series of similar or dissimilar units referred to as element. The average minimum and maximum frequencies of song types were found 1.96 ± 0.19 kHz and 6.24 ± 0.68 kHz respectively. The number and types of elements in a song type averaged 8.0 ± 1.69 and 7.73 ± 2.01 respectively. Song type length averaged 1.43 ± 0.23 sec. and did not differ significantly among males (One way ANOVA: $F = 0.593$, $df = 11, 260$, $P = 0.833$). Song rates measured from recordings with a minimum length of 10 min of song bout ($N = 122$) averaged 14.2 ± 4.1 songs/min.

There are two extreme ways in birds for the presentation of repertoire during a singing performance (Hartshorne, 1973). Males may repeat a song type many times before introduc-



ing another, called 'eventual variety' (Borrer, 1987; Bhatt et al., 2000). Alternatively, they may sing with 'immediate variety', where successive song types are different from one another (Borrer, Reese, 1956). In this study, males sang most of their songs with immediate variety. The songs of Pied Bush Chat males were found highly varied consisting of repertoires of different song types. Our earlier study has also confirmed that males of the Pied Bush Chat keep large song repertoires (Sethi et al., 2011a).

Nesting behaviour

In the Pied Bush Chat, nest-site selection was performed by both sexes. However, final decision regarding site seemed to be of female. Male mostly initiated to explore the whole territory. He inspected various sites such as quarries, gravel pits, road cuttings, under-bushes etc. repeatedly. Thereafter, he restricted his activities to certain areas and explored them more thoroughly. Then he approached the female to show her the sites for final selection. Like the Pied Bush Chat, in several bird species also, the male typically displays at several nest sites, one of which is finally selected by female (Aguon, Conant, 1994; Bhatt, Kumar, 1999; Sethi, 2008). In this study, only female built the nest and males were never observed co-operating female in the nest building. Bell and Swainson (1985) and Fujimaki et al. (1994) have also found that only female builds the nest in *Saxicola* species. However, according to Hadden (1975) and Ali (1996), both sexes in the Pied Bush Chats may participate in nest building.

Nest was a cup of grass and rootlets lined with finer grass and animal hair. Spider web was also used in the cup boundary by the bird probably as a plastering material. Nests observed in this study were identical to those described for other *Saxicola* species (Dementiev, Gladkov, 1968; Bell, Swainson, 1985). Similar to this study, other species also use spider webs and animal hair in nest and there is suggestion that webs secure nest to substrate as well as bind nesting materials together and

animal hair provide insulation (Baicich, Harrison, 1997; Arbabi et al., 2008).

Individuals attempting to raise second or third brood in a single breeding season did not often use the nest of first brood. That is, for each breeding attempt pair looked for a new nesting site and built the new nest. Bell and Swainson (1985) in a study at Port Moresby, Papua New Guinea, however, have reported that the Pied Bush Chat raises its subsequent broods in the same nest. In this study, we observed only for 7 times when the pair raised the subsequent brood in the nest of the previous brood ($n = 83$ nesting attempts). The possible reason for rebuilding the new nest for successive broods seemed to be related with the shape of the nest. That is, the nest at the time of egg laying was observed quite compact and in a cup-like shape. However, when young grew in this small nest, it got enlarged and loose in structure. This enlargement of the nest probably caused females to rebuild the nest.

Egg characteristics, clutch size and incubation behaviour

The eggs were pale blue, marked mostly at the broad end with deep reddish brown blotches and freckles. The colour turned slightly dull near hatching. Weight of freshly laid eggs ranged from 1.47 to 1.74 g and averaged 1.64 ± 0.09 g ($n = 54$). The length and breadth of eggs averaged 17.41 ± 0.35 mm and 13.58 ± 0.19 mm respectively ($n = 6$). Baker (1934) has also observed almost similar values of egg length (17.6 mm) and egg breadth (13.9 mm) for the Pied Bush Chat. However, no previous information is available for the comparison of egg weight. Like Pied Bush Chat, turning of bright colour of eggs into dull near hatching has been observed in other species as well (Sethi et al., 2010a).

A total of 83 clutches were observed during 2008–2009. Three and four-egg clutches were the only clutch sizes recorded during the present study (Photo 3). Nests with three-egg clutches were 16 (35.6%) in 2008 and 11 (28.9%) in 2009, while nests containing four-egg clutches were observed 29 (64.5%)



Photo 3. Clutches of the Pied Bush Chat with three (A) and four (B) eggs.
 Фото 3. Кладки черного чекана с тремя (А) и четырьмя (В) яйцами.

in 2008 and 27 (71.1%) in 2009. On pooling two-year data, more nests (67.5% or 56 nests) had four-egg clutches than three-egg clutches (32.5% or 27 nests). Clutch size averaged 3.67 ± 0.47 ($n = 83$). We never observed any clutch consisting of less than three eggs. However, Bell and Swainson (1985) in their study site have reported the clutch of two eggs as a common feature in the Pied Bush Chat along with three eggs being the maximum clutch size.

Females possessed a featherless area on the breast and belly ($n = 19$). It was brood patch that developed only in females to facilitate heat transfer from incubating parent to eggs to increase the efficiency of incubation. None of the male developed brood patch ($n = 13$). Brood patch was unmistakably observed in all the females, however, only during incubation and pre-nestling phases. Females caught during non-breeding season did not develop any brood patch ($n = 5$). Most female birds also develop brood patches (Jones, 1971). Moreover, in biparental incubators, both sexes may develop brood patches (Jones, 1971).

In the Pied Bush Chat, one egg was laid each day with incubation commencing after but on the same day when the last egg was laid. On 39 occasions on which incubating birds were flushed from the nest, all were females confirming that only females incubate. The male Pied Bush Chat, which did not incubate,

was observed spending a considerable amount of time near the nest during incubation. Female sat motionless and left the nest reluctantly. Departure from and return to the nest were typically accomplished quickly and quietly.

Males were also observed feeding the incubating females in the nest ($n = 7$). Provisioning to female by the male during breeding season has been recorded in other avian species also (Bhatt, Kumar, 1999; Forschler, Kalko, 2006; Matysiokova, Remes, 2010). Since Pied Bush Chat is a species with uniparental incubation, feeding to incubating female by male could allow her to spend more time on eggs, i.e. to increase her nest attentiveness. Other studies have also suggested that feeding by male to female during incubation can significantly affect reproductive performance of birds through increasing incubating females' nest attentiveness that in turn may cause higher hatching success (Lyon, Montgomerie, 1985; Webb, 1987).

Hatching

Eggs of Pied Bush Chat hatched on the same day in almost all the cases. However, in two cases hatching of the entire clutch extended up to 40 hours. The newly hatched orange-brown young were with closed-eyes and almost naked. Some had minute tufts of fine grey down on the head and back. Female removed the egg shell from the nest immedi-



ately after hatching and dropped it far from the nest.

In the Pied Bush Chat, various factors caused egg loss. During the month of July, the study area witnessed frequent rainfall causing egg loss due to rainwater flow in the ground nest of the pied bush chat. Predation also caused egg loss. Potential predators observed in the study area included *Accipiter nisus*, *A. badius*, *Herpestes edwardsii*, *Sus domestica*, unidentified snake species etc. Predatory attacks were frequent in this study due to the easily accessible location of nest by a number of aerial and ground predators. We observed unhatched eggs also in some nests ($n = 6$). Hatching failure might be related to infertility of eggs or the death of the embryo. The bird usually did not remove the unhatched eggs from the nest and they retained in nest such a long period that in most of the cases they were found intact even after fledging of young.

As mentioned above, rainfall caused considerable loss of nests in the Pied Bush Chat. The reason for this loss was related to the location of nest i.e. on the ground. Similar to this study, rain water or flooding has been identified as an important factor causing egg loss in a number of ground-nesting bird species (Cuervo, 2004). Fujimaki et al. (1994) have observed the rain water overflow responsible for nest destruction in the Common Stonechat (*Saxicola torquata*) also. Predation was also held responsible for egg loss in the Pied Bush Chat. Here it may also be mentioned that it was difficult to see the actual predation of eggs and most of the conclusions in this respect were inferential, based on circumstantial evidence as in published literature (Lack, 1954; Skutch, 1976). Breeding birds have been subject to intense nest-predation pressure by a variety of predators (Gottfried et al., 1985). Moreover, predation has been identified as typically the primary cause of nesting failure in a number of bird species including *Saxicola* sp. (Ricklefs, 1969; Illera, Diaz, 2006). Besides, hatching failure, as found in the Pied Bush Chat has been reported widely in other bird species also (Seixas, Mourao, 2002; Sethi, 2008) and these

species also do not remove the unhatched eggs from the nests for a long time.

Soon after hatching, the parents started feeding young quite consistently. The food (mostly insects) was collected mainly from ground and brought at 3 to 10 min. interval. When both parents brought food simultaneously, only one of them approached the nest while the other kept on waiting. Young were fed with a variety of food items. The types of food items fed to the young included moth larvae, dung beetles, ground beetles, sawflies, winged termites, spiders, earthworms, ants etc. Sometimes identification of food items could not be possible due to their small size or frequent movements of the bird. Newly hatched young were fed mostly with smaller food items. As soon as they grew up, parents started feeding them with larger food items. Both parents continued to feed the young for about twenty days after fledging.

Similar to the Pied Bush Chat, involvement of both parents in provisioning to young has been observed in many species (Schadd, Ritchison, 1998; Kumar et al., 1999; Sethi, Bhatt, 2007; Sethi et al., 2010b). The prevalence of monogamy in birds has been explained by the need for biparental care (Lack, 1968). Moreover, the division of labour between the sexes in biparental systems has been conceptualized as an evolutionary game that depends upon the relative costs and benefits of investment for both sexes of parents (Chase, 1980). There are several factors that may affect parental provisioning such as brood size, age of young, time of day, intersexual provisioning rate etc. (Sherry, Holmes, 1992). It would be further interesting to conduct such studies in the Pied Bush Chat also.

Behaviour of young

Nestlings produced soft *che...che...* begging calls (Photo 4). The nestlings produced these calls almost throughout the day from their nests exhibiting begging display. These calls were loud enough to attract the attention of the predators and the observers. During this study, we were able to locate the nests of



this species by listening to these begging calls several times.

Nestlings use loud and rapid begging calls to signal their hunger and/or stimulate parental provisioning in birds (Kilner et al., 1999). There are reports that parents generally respond to these signals by directing feeding to the most intensively begging nestling in their brood (Kilner, 1995; Price et al., 1996; Kolliker et al., 1998) and by increasing their provisioning rate to the brood as a whole (Ottoson et al., 1997). It would be further interesting to understand the intersexual parental contribution in provisioning in the Pied Bush Chat.

The nestling period averaged 14.42 ± 0.64 days (range: 14–16 days, $n = 38$ nesting attempts). In their study, Bell and Swainson (1995) have also reported almost similar duration of nestling period for the Pied Bush Chat. However, Illera and Diaz (2006) have reported relatively longer duration of nestling period (mean: 17.7 days) for the Canary Chat (*Saxicola dacotiae*). Nestlings of the Pied Bush Chat faced several challenges for survival. For example, rain caused death of nestlings due to nest submergence. Besides, when normal and healthy nestlings were found missing from the nest, it was considered a case of predation. Since Pied Bush Chat is an open-nester, predation led to the destruction of the whole brood. In this species young started producing begging calls on the fifth-sixth day of hatching and the rate and loudness of these calls seemed to increase with the advancement of their age. Instances of predation in the Pied Bush Chat could be attributed to the delivery of begging call by nestlings. Other workers have also suggested that predation rate may increase after hatching due to increased noise



Photo 4. Nestlings of Pied Bush Chat delivering begging call for parental provisioning.

Фото 4. Птенцы черного чекана, выпрашивающие корм у родителей.

of young, odors and activity levels associated with presence and rearing of nestlings (Morton et al., 1993).

Parental alarm calls, phonetically described as *chak...chak...* were given by both members of the pair during this study. This vocalization consisted of a rapid series of 3–19 call notes with 6–20 being the most common. A series of this call was given by both the sexes. Parent chats were observed delivering alarm calls from high perches on noticing any predator or observers in the nesting area. However, we never saw parents to be capable to drive off a predator once it had located the nest. This was due to the small size of this species in comparison to the large predators.

Like the Pied Bush Chat, many other animal species give alarm calls when encountering predators or facing dangerous situations (Warkentin et al., 2001; Smirnova, 2011). Moreover, some species use more than one type of alarm calls encountering different circumstances/predators (Ficken, Popp, 1996; Gill, Sealy, 2003). However, in this study pair seemed to use only single type of alarm call notes (described above) in the presence of different predators.



Fledglings of the Pied Bush Chat were observed in the open fields. They used contact call for being fed from the parents. Their contact calls were sufficiently loud to attract predators. For a number of times in the open field, we were also able to locate the young through their loud contact calls. If contact calls attract the predators towards nest, it seems necessary to trade off the nutritional benefits of this call against the cost of predation (Maurer et al., 2003). Parents could reduce this cost through warning noisy chicks of danger so that they do not vocalize when predators are near (Platzen, Magrath, 2004).

There are evidences through playback studies conducted on Great Tit (*Parus major*) (Ryden, 1978) and Common Stonechat (Greig-Smith, 1980) indicating that nestlings suppressed begging after hearing playbacks of alarm calls. Platzen and Magrath (2004), through a field playback experiment, have also suggested that parental alarm calls can warn the young from a distance about the presence of a predator and as a result nestlings White-browed Scrubwren (*Sericornis frontalis*) suppress begging vocalization that might otherwise be overheard. However, contrary to these studies, parental alarm calls in Pied Bush Chat did not cause the young to become quiet and crouch in the nest. Moreover, they continued to beg even when the parents were giving alarm calls and observer was within 5 m from them. This suggests that parents either direct their alarm call to predators to lead them away from the nest or young might not have the ability to respond to parental alarm calls. Maurer et al. (2003) have also suggested that young White-browed Scrubwren acquire the ability to respond appropriately to alarm calls late in the nestling period.

Conclusions

The breeding season of the Pied Bush Chat ranged from late February to July. Males delivered dawn chorus possibly to interact with neighbouring males. Both sexes participated in nest site selection. Nest building and incuba-

tion duties were performed solely by the female. Pairs reared up to three broods in a single breeding season. Clutch size ranged from 3–4 eggs and eggs usually hatched synchronously. Different factors such as predation, rain water overflow in nest, hatching failure affected the survival of eggs/young ones. Observations also indicate that the high pace of urbanization in the study area is causing scarcity of suitable nesting habitat for the Pied Bush Chat.

Acknowledgements

We thank the Head, Department of Zoology & Environmental Science, Gurukula Kangri University, Haridwar, India for providing infrastructural facilities to carry out this research. Many thanks to Mr. Shivchand Arora for assistance in the field. Authors are grateful to Swami Shivananda Ji, Matri Sadan, Jagjeetpur, Haridwar, India for giving his kind consent to conduct a part of this study in his premises. Funding and permission was obtained from the Department of Science and Technology, Govt. of India (sanction no. SR/SO/AS/73/2006).

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