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Authors: Nikolov, Boris P., and Hristova, Iva P.

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Time-activity budgets of juvenile Woodchat Shrikes *Lanius senator* during the post-fledging period

Boris P. Nikolov^{1,*} & Iva P. Hristova²

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This study, conducted in the region of Sofia (western Bulgaria), investigated activity patterns of juvenile Woodchat Shrikes *Lanius senator* after fledging. Time spent to flying, social interactions, ground hunting and solitary behaviour increased with age, while the time spent food begging, obtaining food from adults, and staying close (<1 m) to adult birds decreased with age. Occupation of concealed perch-sites decreased with age whereas use of exposed lookout posts increased. Young Woodchat Shrikes became increasingly independent at an age of about 30 days. After 45 days they were not fed by parents at all.

Key words: behaviour patterns, juvenile Woodchat Shrikes, *Lanius senator*, perch-site use, post-fledging period, activity budgets

¹Bulgarian Ornithological Centre, Institute of Zoology, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., BG-1000 Sofia, Bulgaria; ²Climatech Engineering Ltd., 51 Prof. Kiril Popov Str., BG-1700 Sofia, Bulgaria;

*corresponding author (lanius.bg@gmail.com)



INTRODUCTION

Studying the animal's activity budget is important for several reasons: (1) to estimate energy expenditure, and (2) to elucidate the adaptive significance of the species' activity pattern (Ashkenazie & Safriel 1979). These issues have been extensively studied in shrikes (Weathers et al. 1984, Schaub 1996, Rehsteiner 2001, Soobramoney et al. 2004a,b, Yosef 2004), however little is known about the post-fledging behaviour of young shrikes (Harris & Franklin 2000). The time after fledging is recognized as important for survival of first-year birds and their subsequent distribution during the following breeding season. In addition, some passerine species are believed to imprint future breeding areas during this period (Sokolov 1997).

The Woodchat Shrike *Lanius senator* is a passerine confined to the Mediterranean region in the southwestern Palearctic (Lefranc & Worfolk 1997). Like all true shrikes, the Woodchat Shrike is a typical 'sit-and-wait' predator with raptor-like adaptations (Cade 1995, Schön 1996). It feeds mainly on insects (captured on the ground or in the air), but sometimes vertebrate prey is also taken (Cramp & Perrins 1993, Glutz von Blotzheim & Bauer 1993).

In this study we aimed to describe variation of behaviour of juvenile Woodchat Shrike with age; (1) activity patterns, (2) distances kept to other family members, and use of perch sites. Based on the description of behaviour of altricial birds during the post-fledging period, we predicted shifts with age in behaviour of the fledglings.

METHODS

Study area

The study took place in the vicinity of Bezden village, about 35 km NW of Sofia (western Bulgaria). The study area lies within a karst region and it includes stony slopes (600–750 m a.s.l.) with southern exposure. The area is covered with scattered bushy (Whitethorn *Crataegus monogyna* and Dog Rose *Rosa* sp.) and woody vegetation (Rock Cherry *Prunus mahaleb* and Cherry Plum *P. cerasifera*). The climate is moderate-continental (Stanev *et al.* 1991). Woodchat Shrikes build their nests preferably in *C. monogyna*, *Rosa* sp., and *P. cerasifera* (Nikolov 2006).

Data collection

Data were collected in July–August 2005, during the post-fledging period (Fig. 1). All observations were carried out on sunny and warm days (with maximum daily temperatures of 26–32°C) in order to minimize influences of climatic conditions. Four breeding pairs, with well-defined territories close to each other, were followed in detail. A total of 14 fledglings (juveniles) were observed, 10 of them were individually marked with colour rings. Time budgets of daily activities were obtained by the focal-animal-sampling-method (Altmann 1974) using stopwatches. During each sample session (30 min long), the amount of time that the focal bird was visible was carefully recorded ('time in').

In the region of Bezden juvenile Woodchat Shrikes usually fledge at an age of 14–15 days (Nikolov 2005, 2006). In order to analyse changes in behaviour patterns, juveniles were categorized in four age groups: 16–25, 26–35, 36–45 and 46–55 days old. A total of 1190 minutes of observation ('time in') in the course of 50 sessions were sampled (mean 23.8 ± 7.6 min 'time in' per session), distributed over the four age classes as 431 min (19 sessions), 323 min (12), 225 min (11) and 211 min (8). Data were collected with an almost equal effort per family (two families with 13 and two with 12 sessions).

The following activities of juvenile Woodchat Shrikes were recorded:



Figure 1. Juvenile Woodchat Shrike hidden in a bush of the study area, 35 km from Sofia (photo I.P. Hristova).

Perching branch: resting, perching, and scanning for prey while sitting on a branch. For a sit-and-wait predator like the Woodchat Shrike it is often impossible to distinguish among these categories (Rehsteiner 2001). *Perching ground:* resting, perching, and scanning for prey while sitting on the ground. *Inside-bush movements:* all movements performed when a bird changed position within a bush. *Comfort behaviour:* preening, bill cleaning, yawning, defecation, pellet regurgitation, body stretching. *Flight:* flying between two perching sites on different bushes without hunting attempts. *Social behaviour:* all inter- and intraspecific relationships with other shrikes (aggression by adult Woodchat and female Red-backed Shrikes *Lanius collurio*) except for the within-family feeding interactions. *Food begging:* loud, persisting calls usually accompanied with wing shivering while fed by adults or begging for food. *Vocalization:* all

acoustic signals except for food begging. *Feeding by adults*: the process of being fed by an adult. *Ground hunting*: any hunting attempt on the ground, including the time for flight and handling the prey afterwards. Hovering and scanning for prey above the ground without a subsequent attack was classified as ground hunting as well and was considered an unsuccessful hunting attempt. *Aerial hunting*: any hunting attempt in the air, including the time for flight and handling the prey afterwards.

For the last three categories the number of events was recorded, as well as the sex of the adult bird bringing food to the youngsters, and whether the hunting attempt was successful or not. We recorded: (1) the location of the perching site (after Yosef 2004): top, side and hidden; (2) the distance between the focal bird and the nearest other juvenile or adult Woodchat Shrike: <1 m (close proximity), 1–3 m (within the same bush or tree), and >3 m (elsewhere in the nesting territory). The focal juvenile was considered alone if no other young was seen around or they were known to be absent. Time to independence was measured according to Russell *et al.* (2004) as the time from fledging to the moment that the young were largely independent of parental feeding.

Statistical analyses

All statistical analyses were performed using the software package SigmaStat 1.0 (Jandel Corp., USA). Parametric tests were used when data were normally distributed. In all other cases non-parametric tests (Kruskal-Wallis ANOVA) were performed. Significance probabilities were adjusted by standard Bonferroni correction. Statistical significance was set at $\alpha = 0.05$ and means are given ± 1 SD.

RESULTS

Behaviour patterns

The recorded behaviour patterns of juvenile Woodchat Shrikes are shown in Table 1. At any age, juveniles spent most of their time (87–91%) on a branch (differences among age classes were not significant, Kruskal-Wallis, $H_3 = 2.29$, $P = 1.00$). Perching on the ground was recorded only once in two 25 days-old birds.

Changing perch-site within the same bush was most frequently observed immediately after fledging and in birds of 36–45 days (Kruskal-Wallis, $H_3 = 8.01$, $P = 0.184$).

Table 1. Percentage of time spent to behavioural categories by juvenile Woodchat Shrikes of different age. Given are means \pm SD.

Behaviour	Age (days)			
	16–25	26–35	36–45	46–55
Perching on branch	87.2 \pm 13.6	90.8 \pm 7.0	88.2 \pm 4.7	90.4 \pm 2.5
Perching on ground	3.94 \pm 12.1	-	-	-
Inside-bush movements	1.25 \pm 1.1	0.42 \pm 0.3	0.99 \pm 0.8	0.44 \pm 0.2
Comfort behaviour	2.47 \pm 2.8	2.15 \pm 2.4	1.20 \pm 2.2	0.42 \pm 0.2
Flight activities	0.27 \pm 0.5	0.53 \pm 0.8	1.56 \pm 1.1	3.18 \pm 2.9
Social behaviour	-	-	0.17 \pm 0.6	0.33 \pm 0.4
Food begging	3.54 \pm 2.3	3.55 \pm 5.5	1.98 \pm 2.7	-
Vocalization	0.07 \pm 0.2	0.03 \pm 0.1	0.23 \pm 0.6	-
Aerial hunting	-	0.01 \pm 0.1	0.15 \pm 0.3	0.04 \pm 0.1
Ground hunting	0.34 \pm 0.9	2.05 \pm 2.8	5.53 \pm 3.3	5.17 \pm 1.8
Feeding by adults	0.81 \pm 0.7	0.46 \pm 0.5	0.10 \pm 0.1	-

The proportion of time applying comfort behaviour tended to decrease with age (Kruskal-Wallis, $H_3 = 6.14, P = 0.40$).

The proportion of time juvenile shrikes spent flying increased steadily (Kruskal-Wallis, $H_3 = 22.0, P < 0.001$). Involvement in social activities (mainly intraspecific relationships with non-family members and interspecific interactions) was only recorded in young which were at least 36 days old and this increased with age (Kruskal-Wallis, $H_3 = 22.1, P < 0.001$).

For about 20 days after fledging juveniles spent on average 3.5% of their time begging for food; this behaviour occurred less often in juveniles of 36–45 days, and completely disappeared afterwards. The differences between all age groups were significant (Kruskal-Wallis ANOVA, $H_3 = 17.4, P < 0.01$). Other types of vocalization did not differ among age classes (Kruskal-Wallis, $H_3 = 2.85, P = 1.00$).

Time spent hunting on the ground differed significantly among age classes (Kruskal-Wallis, $H_3 = 29.0, P < 0.001$). Feeding by adults decreased (Kruskal-Wallis, $H_3 = 24.4, P < 0.001$). Similar relationships were found when hunting attempts and feedings by adults were measured as mean

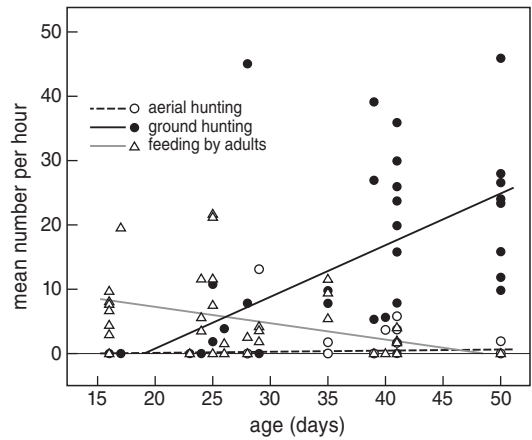


Figure 2. Rates of hunting and provisioning by adults in relation to age of Woodchat Shrikes.

number per hour (Fig. 2). Juveniles spent more time hunting with age, which inversely correlated with the percentage of time spent by the adults to feed them ($r = -0.97, P = 0.02$).

After fledging, juveniles were fed mainly by females; males played only a marginal role in provisioning the offspring (Table 2). Although the

Table 2. Distribution of feedings by adults and hunting success for juvenile Woodchat Shrikes of different age. Given are percentages within each behavioural category with sample size between brackets.

Behaviour	Age, days			
	16–25	26–35	36–45	46–55
Fed by adults				
males	14.3 (9)	9.1 (2)	0	0
females	52.4 (33)	86.4 (19)	100 (5)	0
unknown	33.3 (21)	4.5 (1)	0	0
Aerial hunting				
successful	0	0	0	0
unsuccessful	0	100 (1)	80 (4)	100 (2)
unknown	0	0	20 (1)	0
Ground hunting				
successful	25 (1)	22.2 (8)	7.9 (7)	11.9 (10)
unsuccessful	75 (3)	52.8 (19)	70.8 (63)	54.8 (46)
unknown	0	25 (9)	21.3 (19)	33.3 (28)

share of males feeding the young decreased in time while that of the females increased, the correlation between the two was not significant ($r = 0.15$, $P = 0.85$). In all four age groups unsuccessful hunting attempts predominated, amounting to 62% of all hunting activities recorded ($n = 213$; Table 2).

Proximity to other family members

Juveniles tended to behave solitarily and spent a decreasing percentage of time close (<1 m) to other young (Fig. 3) (Kruskal-Wallis, $H_3 = 24.4$, $P < 0.001$). Similarly, time spent close to adults varied among age classes (Kruskal-Wallis, $H_3 = 17.1$, $P < 0.01$).

Perch site use

During the early stages of the post-fledging period, juvenile Woodchat Shrikes used more often hidden perch sites than later in life (Kruskal-Wallis, $H_3 = 14.2$, $P < 0.05$; Fig. 4). The use of lookout posts on the topmost part of the bushes showed an opposite pattern (Kruskal-Wallis, $H_3 = 25.6$, $P < 0.001$). Use of side perch sites did not differ among age classes (One-way ANOVA, $F_{3,46} = 1.73$, $P = 0.70$).

DISCUSSION

As expected, fledged juvenile Woodchat Shrikes showed a strong shift in behaviours. Also, our findings are consistent that avian sit-and-wait predators spend most of their time perching. Juveniles were more prone to such behaviour because they waited to be fed by their parents, especially during the first days after fledging. For that purpose, inside-bush movements were most frequently made in order to find the best position.

Preening and bill cleaning were the most common patterns of comfort behaviour. Except for being essential for thermoregulation (Gates 1970) preening is also important for the partial post-juvenile moult, which starts at an age of 26–35 days (Cramp & Perrins 1993).

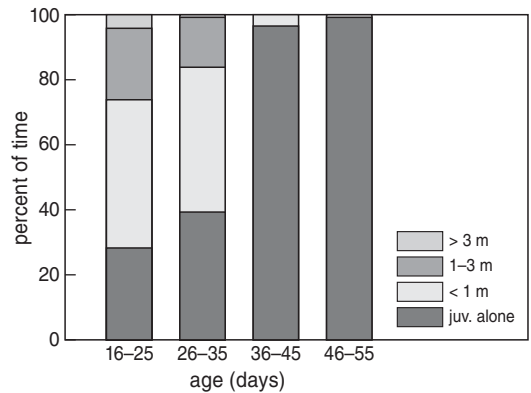


Figure 3. Distance to other juveniles, as percentages of time within age classes. The focal juvenile was considered alone if no other juveniles were noticed around.

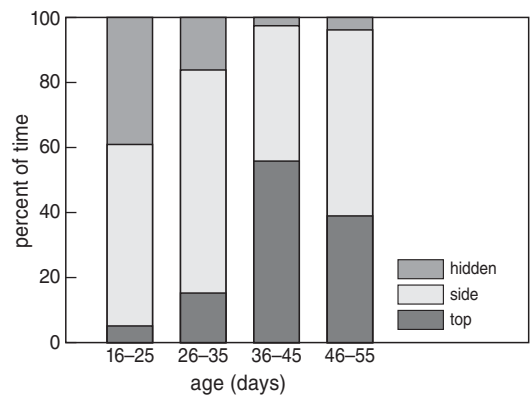


Figure 4. Percentage of time spent on different lookout posts by juvenile Woodchat Shrikes in relation to age.

About 30–40 days after fledging the flight activity of juveniles was 10–12 times higher compared to the period just after fledging, reaching a level similar to that of adult birds (approximately 3–5% of the time; Schaub 1996, Rehsteiner 2001). This development corresponded to the acquisition of full-grown plumage, and hence to the ability to perform hunting activity and involvement into social interactions. Older young frequently suffered from aggression by adult Woodchat and female Red-backed Shrikes

It is believed that begging in nestling birds may represent a composite of multiple signals that carry complex information about different nestling requirements (Budden & Wright 2001). Probably the same holds true for the fledglings. As the post-fledging period progressed juvenile Woodchat Shrikes spent less time to begging for food; this behaviour was recorded for the last time at an age of 41–42 days. Older fledglings relied entirely on prey caught by themselves, thus explaining the increase in time spent hunting.

Attempts of aerial hunting were not recorded during the first 10 days after fledging. Older juveniles hunted in the air regularly but less often than hunting on the ground. At an age of 36–55 days the juvenile Woodchat Shrikes devoted on average 5–6% of their time to hunting on the ground. It is the most common hunting method of true shrikes and this perch-and-pounce technique provides between 65 and 80% of all prey caught by Woodchat Shrike (Lefranc & Worfolk 1997). At an age of 50–51 days while attempting ground-hunting flight, even hovering above ground was recorded once but without following an attack. Surface gleaning was not observed. The frequency of hunting events (both aerial and terrestrial) recorded in juveniles of 36–55 days corresponded well to the behaviour of adult birds (Schaub 1996, Rehsteiner 2001). Although data suggested that the role of female Woodchat Shrikes in provisioning the young was larger than that of the males it was not confirmed statistically. Juvenile Woodchat Shrikes showed low hunting efficiency, and much lower than the success of adults (61%; Schaub 1996). In young Woodchat Shrikes, the improvement of foraging efficiency with age suggested that a period of apprenticeship is needed to develop foraging skills, similarly to other avian species (Wunderle 1991). This may be related to the development of tomial teeth, which are used in shrikes for handling chitinized prey and for disarticulation of cervical vertebrae in larger prey. Although it is generally accepted that in shrikes the hooked bill and tomial teeth become apparent at an age of about

four weeks (Lefranc & Worfolk 1997), the differentiation of the latter commenced in nestling Woodchat Shrikes at an age of 8–9 days (Nikolov 2006).

As juvenile Woodchat Shrikes became older, they were fed less by their parents. According to our observations, the time to independence of the young was about 30 days, and they were totally independent at about 45 days, which is in agreement with the literature (23–42 and 40–60 days, respectively; Schön 1994). In Germany (Baden-Württemberg) young still receive some food from the parents 3–4 weeks after fledging, and the family remains loosely together until migration, 4–6 weeks after fledging (Ullrich 1971). Parental care after fledging may be attributed to the necessity to develop specific skills for hunting activity by young Woodchat Shrikes, which has been suggested to be particularly long in southern breeders (Russell *et al.* 2004).

After fledging juveniles used mostly concealed perch-sites within bushes, which could be explained by the need to stay hidden while waiting to be fed by the adults. To remain unnoticed during the early stages of the post-fledging period the juveniles often stay motionless and their brownish plumage provides an excellent camouflage. As they acquired fully-grown plumage they started to use more exposed perches. Similarly to adults (Nikolov 2006), older juvenile Woodchat Shrikes mainly used lookout posts on topmost parts of bushes and small trees, which allowed better detection of prey. This is in contrast to shrike species bound to woody areas, like Brown Shrike *L. cristatus* during migration in Taiwan (Yosef 2004) and Masked Shrike *L. nubicus* in Bulgaria (Nikolov 2006), that usually prefer perching on protruding branches from the side of the tree canopy, moving to the tree-tops only during intraspecific interactions or courtship-behaviour.

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SAMENVATTING

Er is betrekkelijk weinig bekend over de tijdbesteding van Roodkopklauwieren *Lanius senator* direct na het uitvliegen, een periode die veel invloed heeft op de kans om het eerste levensjaar te overleven. Deze studie, uitgevoerd in de buurt van Sofia, Bulgarije, bracht het activiteitspatroon van jonge Roodkopklauwieren in beeld. De tijd besteed aan vliegen, sociale interacties en jagen op de grond nam in de loop van de tijd toe, terwijl de jonge vogels gaandeweg ook een grotere afstand tot elkaar aanhielden. In de loop van de tijd werden bedelen om voedsel, en het aannemen ervan, minder belangrijk. Aanvankelijk hielden de jonge vogels zich verborgen in struiken maar met het verstrijken van de tijd zaten de vogels meer op uitkijkposten. Nadat de jongen 30 dagen waren geworden werden ze steeds onafhankelijker van hun ouders, en na 45 dagen werden ze helemaal niet meer gevoerd. (BIT)

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