

S34-4 Spatial behavior of some nocturnal passerine migrants during stopovers

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Abstract Capture-recapture analysis of the pattern of movements of some passerine migrants during stopovers suggest that some species, such as European robins and winter wrens, establish small home ranges which could potentially be defended as territories, whereas others, such as the European reed warbler, sedge warbler and blackcap, move rather broadly across the stopover site. Telemetric study of stopover behavior in European robins during spring migration confirms that these birds hold very small home ranges once they establish themselves at a stopover site. Before that, they move broadly about for some time (up to two days) which is probably the search/settling time of optimal migration models. The small home ranges are, however, not exclusive territories as conspecifics are tolerated even in core areas. The potential reasons underlying the different spatial behaviors of nocturnal passerine migrants during stopovers are discussed.

Key words Stopover, Spatial behavior, Home range, Fuel deposition

1 Introduction

Spatial behavior is an important aspect of stopover ecology in migrants. Some passerines, such as pied flycatchers (*Ficedula hypoleuca*), European reed warblers (*Acrocephalus scirpaceus*), rufous hummingbirds (*Selasphorus rufus*) and grey-streaked flycatchers (*Muscicapa griseisticta*) (pers. obs.) are known to occupy temporary territories during stopovers (Bibby and Green, 1980, 1981; Kodric-Brown and Brown, 1978; pers. obs). So, in some cases, do northern wheatears (*Oenanthe oenanthe*) as well (Delingat and Dierschke, 2000). Other migrants, obviously, move broadly across a stopover site, or share it with others as reported for the sedge warbler (*Acrocephalus schoenobaenus*) (Bibby and Green, 1981).

The aim of our study was to compare patterns of spatial use in several nocturnal passerine migrants, and their variation during the stopover. In one species, the European robin (*Erithacus rubecula*), we were able to use telemetric data to test conclusions derived from analysis of captures and recaptures. We also attempted to discover the reasons underlying the different patterns found in different species.

2 Materials and methods

We analyzed data from a standardized banding project run at Rybachy, Courish Spit, Russia (55°09'N, 20°52'E) in 1994–2000. A total of 73 mist-nets were used. At each (re) capture, the number of the mist-net where the bird was caught was recorded. This enabled the creation of a frequency distribution of distances between capture localities for each individual bird. Its purpose was to test whether multiple captures of the same individual occurred indepen-

dently of one another. To do this, a simulation model was built which assumed that captures are independent of each other, and from it the frequency distribution of distances between capture points was calculated. The resulting distribution was then compared with the distribution of recaptures of real birds. Were the two distributions to show no significant difference, there is no reason then for interpreting the pattern of real recorded movements as nonrandom.

If, however, recaptures occur significantly closer to a site of previous capture than predicted by the neutral model, then there is evidence that birds retrapped had kept to a limited home range that was smaller than the whole trapping area. If recaptures occur farther away than predicted, there is also evidence of avoidance of the site of previous capture. To run the simulations, the real net numbers were replaced by numbers generated by a random numbers generator. The probability of “capture” in a certain virtual net was related to the capture probability in the real net with this number, i.e. species-specific habitat selection was taken into account (model 2 from Titov, 1999a).

In a telemetric study, we followed the movements of European robins stoppingover at the same site during April 2002. We used LB-2 transmitters produced by Holohil Systems Ltd. The transmitters were fitted on the back of the robins by Rappole harness; their weight with harness was 0.7 g. Battery life was 10 days or slightly more. The birds were tracked by hand-operated receivers with Yagi antennae. We tried to obtain a location from each bird once per hour during the whole period between the onset of activity at dawn until the end of activity in dusk. The locations were plotted on a digitized map of the study area. We tagged the birds soon after their presumed arrival, judged by arrival

waves. Migratory waves are very pronounced on the Baltic coast in spring and sometimes in fall, and seniority analysis showed that on the first day of a wave of arrivals, the probability that newly banded European robins had been present undetected at the site is low (Chernetsov and Titov, 2000).

3 Results

For European robins in autumn, distribution of distances between capture localities did not differ between the simulation model ($n = 7\ 064$) and actual recaptures within the first two days of initial capture ($n = 7\ 064$) (Fig. 1; Wilcoxon matched pairs test, $z = 0.63$, $P = 0.53$). However, in birds recaptured on the third and later days after first capture ($n = 4\ 082$), the recaptures were strongly biased towards shorter distances, significantly different from the simulation model (Fig. 1; Wilcoxon matched pairs test, $z = 2.72$, $P < 0.01$). This means that during the first two days, the movements of European robins across our study area were not significantly different from random, but that those that remained for longer became confined to a much smaller area.

A similar pattern was found in winter wrens (*Troglodytes troglodytes*), but they did not keep to a confined area until the fourth day after the initial capture (Titov, 1999b). The situation in European reed and sedge warblers and in blackcaps (*Sylvia atricapilla*) was different: even when they kept to an area smaller than the whole stopover site, its size was too large for it to be exclusive (Chernetsov and Titov, 2001; Chernetsov, 2002). The same area was shared by several individuals, such that territoriality was out of the question.

The results of radio tracking the robins during spring

stopovers were in line with the capture-recapture results in autumn. Of the 22 individuals tracked just after arrival, seven did not remain in a small home range but moved on. Their stopover duration varied from less than one day to two days, on average: 1.4 ± 0.6 (mean \pm SD). Two birds of this group left the site by slow daytime movements through scrub, one after a stopover of less than one day, and the other after 1.5 days. The other five robins departed by nocturnal flight during the first or the second night after arrival.

Eleven individuals remained, each within a small home range usually up to 40–50 m in diameter, but as small as 10 m in diameter; one had initially been a floater but it subsequently occupied a small range. Stopover duration of home range owners varied between 2 and 12 days, averaging 6.9 ± 3.6 days. The difference in stopover duration between floaters and home range owners was statistically significant (Mann-Whitney test, $z = 3.2$, $P < 0.002$). Ten individuals with a small home range took off at night, but one bird departed at dawn. Departure at dawn was recorded again in a bird of an uncertain territorial status. This mode of migratory departure has not been reported before for the European robin, even though “special morning flights” are known for other nocturnal passerine migrants (Gauthreaux, 1978; Bingman, 1980; Moore, 1987). Three individuals were tracked for too short a time to determine their territorial status; and one bird with a small home range was probably a local individual, not a migrant.

As shown by the spring telemetric data, home ranges of residents were not defended as territories. We have frequently observed untagged conspecifics (intruders) in the core areas of known home ranges of marked birds. No at-

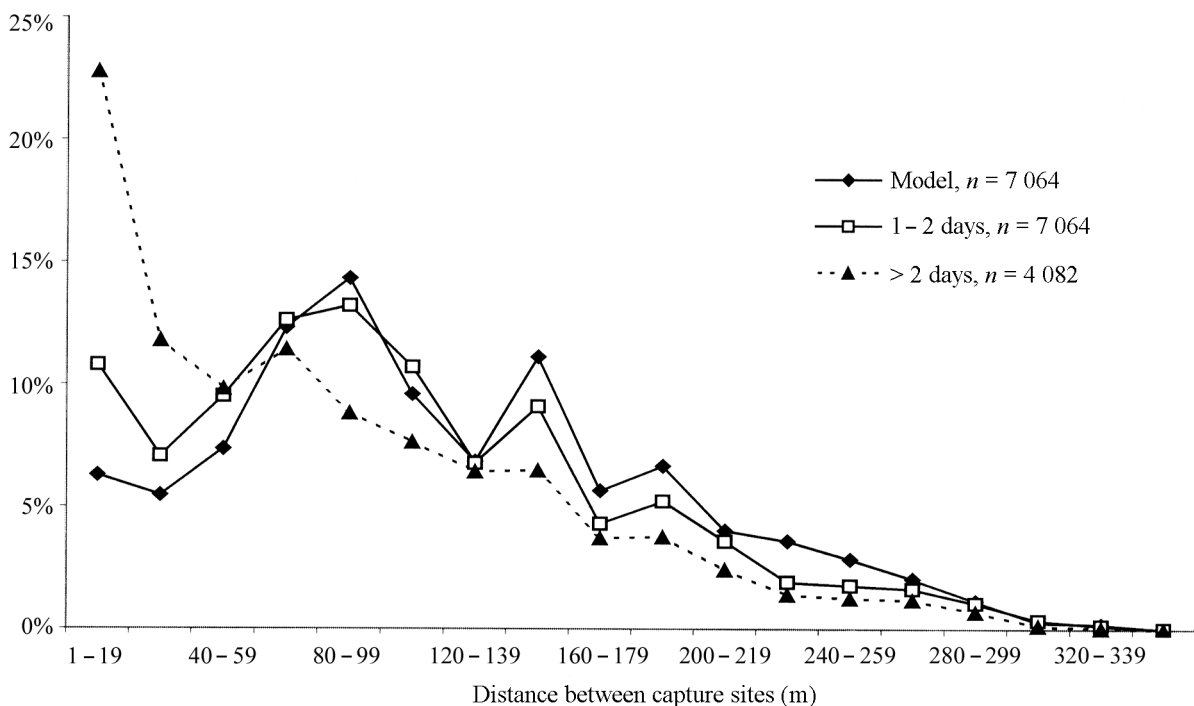


Fig. 1 Distribution of distances moved between capture localities by European robins retrapped within 1–2 days of initial capture, and more than two days after

tempts to evict the intruders were recorded. When the density of European robins at the stopover site was high, moreover, no territorial behavior was involved.

4 Discussion

The analysis of recaptures in fall suggested, and the telemetric data from spring confirmed, that European robins need some time to establish themselves at novel stopover sites. The period between actual arrival and gaining a small home range — not a defended territory, *pace* Titov (1999a) — may be between several hours and two days. Individuals which fail to gain a small home area — or decide not to — leave the area, either by nocturnal flights or by daytime movements through vegetation. The scale of these diurnal movements is difficult to estimate. Telemetric data suggest that they may cover at least 1.0–1.5 km; they are certainly less than 11 km, the distance to the next permanent trapping site. Many thousands of European robins have been captured at the second site during both spring and fall migrations, but no exchange with the first site has been recorded in 10 years of parallel work. The diurnal movements are not necessarily oriented in the migratory direction and are probably related to habitat selection and foraging optimization; their scale probably does not exceed several kilometers.

It has been shown that in autumn, European robins gain mass at stopover sites when they have a small home range, at least those that arrive with depleted fuel stores and need to refuel (Titov, 1999b). It is most likely that the period needed for gaining a small home range represents the search/settling time of optimal migration models (Weber and Houston, 1997; Houston, 1998). Search/settling time is an important parameter in the models which assume stochastic variation in fuel deposition rate at stopover sites (Chernetsov et al., in prep.). Thus the empirical data obtained in this study are particularly valuable. Time costs of settling may be the cause of the low initial refueling rate, but the latter was not demonstrated directly in our study (cf. Schwilch and Jenni, 2001). Our data suggest that in European robins, the search/settling costs are due at least partly to behavioral and ecological factors, even though physiological factors cannot be ruled out.

Our data suggest that different species of nocturnal passerine migrants show varying spatial behavior at stopovers. The pattern of spatial distribution of migrants may be related to the distribution of preferred food (Chernetsov and Titov, 2001; Chernetsov, 2002). Birds that utilize more or less evenly distributed resources occupy restricted home ranges, whereas those that forage on superabundant but unpredictable prey move broadly. It remains unclear whether migrants which have large and broadly overlapping home ranges, such as the warblers, need some time to establish themselves at a new site, as

European robins or winter wrens do. Knowledge of this aspect could provide clues as to whether it indeed represents the time costs of settling, or is used rather to estimate refueling potential at the site, i.e. site quality.

Acknowledgements The authors are most grateful to all participants of the banding project at Rybachy. Nikolay Titov deserves very special thanks for suggesting simulation modeling and for numerous discussions. Many people have contributed to the success of the telemetry project, either by sharing their experience, or by giving logistical support, or by their assistance in the field, among them Andrey Mukhin, Wolfgang Fiedler, Martina Lajda, Dmitry Leoke, Vladislav Kosarev, Victor Bulyuk, and Arseny Tsvey. Equipment was kindly lent by the Max-Planck-Forschungsstelle für Ornithologie (Vogelwarte Radolfzell). This study was part-funded by the Heinz Sielmann Foundation and Russian Foundation for Basic Research (grant 02-04-48608 to C.V. Bolshakov).

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