Spatial behaviour of first-year Blackcaps (*Sylvia atricapilla*) during the pre-migratory period and during autumn migratory stopovers

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Summary

The spatial distribution of Blackcaps (*Sylvia atricapilla*) was studied on the basis of ringing recaptures during the post-fledging period and during autumn migratory stopovers on the Courish Spit of the Baltic Sea. The distribution of distances between capture locations of individual birds was compared with the simulation model assuming random movements. During the pre-migratory period, the movements of Blackcaps did not significantly differ from the random pattern. During migratory stopovers, the birds remained within home ranges which were clearly smaller than the study site but still too large to be defended territories. This is suggested to be caused by different diets during pre-migratory and migratory periods and by different spatial distribution of the preferred food.

Keywords: post-fledging movements, autumn migration, home range, stopover.

Zusammenfassung

Das räumliche Verhalten diesjähriger Mönchsgrasmücken (*Sylvia atricapilla*) zur Vorzugzeit und auf dem Wegzug

Die räumliche Verteilung von Mönchgrasmücken (*Sylvia atricapilla*) wurde über Fang/ Wiederfang während der Vorzugzeit und auf dem Wegzug auf der Kurischen Nehrung untersucht. Die Häufigkeitsverteilung der Distanzen zwischen den Fangorten der einzelnen Vögel wurde mit einem Modell verglichen, das zufällige Bewegungen im Fanggebiet annimmt. Treten keine signifikanten Unterschiede zur Modellverteilung auf, wird angenommen, dass sich die Vögel zufällig bewegen. Liegt der nächste Fangort signifikant näher zum letzten Fangort, wird angenommen, dass die Vögel ein abgegrenztes „Home Range" besitzen. Intensiv mausernde Vögel wurden als noch nicht ziehende Individuen betrachtet, solche mit abgeschlossener Mauser als auf dem Zug rastende. Zur Nachbrutzeit bewegten sich die Mönchgrasmücken zufällig im Untersuchungsgebiet. Zur Wegzugzeit blieben die Vögel signifikat öfter innerhalb der 150-Meter-Zone um den letzten Fangort. Diese „Home Ranges" waren aber zu groß, um als Territorien zu gelten. Die Tendenz, innerhalb eines abgegrenzten Gebietes zu bleiben, hatte bei den ziehenden Mönchgrasmücken sehr wahrscheinlich mit den Nahrungspräferenzen zu tun: die Vögel versuchten in der Nähe der Holunder-Büsche zu bleiben. Das Muster des räumlichen Verhaltens der Vögel ist von der Verteilung ihrer Nahrungsobjekte abhängig.

Introduction

The spatial distribution of migrants is an important element of their stopover behaviour. Many bird species acquire temporarily territories or at least occupy small home ranges during stopovers (Szulc-Olech 1965, Kodric-Brown & Brown 1978, Bibby & Green 1980, Mehlum 1983, Titov 1999a, 1999b). In Robins (*Erithacus rubecula*) and Wrens (*Troglodytes troglodytes*) it has been shown that individuals that make longer stopovers acquire a small home range and do not move randomly across a large area (Szulc-Olech 1965, Mehlum 1983, Titov 1999a, 1999b). In Portugal, Pied Flycatchers (*Ficedula hypoleuca*) and Reed Warblers (*Acrocephalus scirpaceus*) are territorial during stopovers, whereas Sedge Warblers (*Acrocephalus schoenobaenus*) are not (Bibby & Green 1980, 1981). The approach explaining the pattern of spatial behaviour on the basis of prey distribution is a very promising one.

The aim of this study was to test whether Blackcaps (*Sylvia atricapilla*) show a preference for a restricted area during post-fledging movements (before the onset of autumn migration), and during migratory stopovers in autumn. During the pre-migratory period, Blackcaps utilize mainly invertebrates which are more or less uniformly distributed, whereas on migration they switch to a fruit diet (Berthold 1976, Berthold et al. 1990, Brensing 1977, Bairlein 1998, Eggers 2000, Zelenova 2001). My expectation was that the pattern of spatial exploitation would differ between periods when birds take food which is differently distributed in space.

Study site and methods

I used capture data from the Rybachy station on the Courish Spit (Eastern Baltic), obtained in the course of a joint project of the Biological Station Rybachy (Russia) and the Vogelwarte Radolfzell (Germany). Trapping and ringing procedures followed the guidelines of the ESF programme (Bairlein 1995). A total of 73 mist-nets were placed in a mixture of reed patches and willow scrub. Net rounds were made each hour from dawn until dusk. For each capture, the net number was noted. Thus, exact capture and recapture locations were known for each individual. All birds were released from one of the two ringing huts (not near the nets where they had been captured).

I analysed capture data for first-autumn Blackcaps from 1994–2000, from 1 August onwards. Some birds, especially from late August on, had completed their juvenile moult and were probably in the migratory disposition. Others, especially those captured before early September were in active moult, carried no fuel stores and were probably in the phase of post-fledging movements. Certainly, some temporal overlap occurred between captures of these two categories.

Recently, a suggestion was put forward to study the pattern of movements of birds by analysing their recaptures (Titov 1999a). The idea is to test whether multiple captures of the same individual at a trapping site occur independently of each other. To do this, a simulation model is constructed which assumes that recaptures are independent. Then the frequency distribution of distances between captures locations is calculated for the model. This distribution is compared with an analogous distribution for the recaptures of real birds. If the distributions show no significant difference, there is no reason to claim that the pattern of movements is non-random. If recaptures occur significantly closer to the site of the previous capture than predicted by the neutral model, the birds tend to remain within a limited home range which is smaller than the whole trapping area. If recaptures occur farther than predicted, the birds try to avoid the site of the previous capture.

To run the simulations, the real net numbers were replaced by numbers generated by the random numbers generator of FoxPro 2.0 software. Blackcaps were much more frequently trapped in the scrub than in reed patches. The probability of 'capture' in any particular virtual net was related to the capture probability in the real net with this number (model 2 from Titov 1999a).

Over 7 years of study, 746 pairs of recaptures were available for Blackcaps in juvenile moult and 1005 pairs for birds in post-juvenile plumage. In comparisons of the frequency distribution of distances with the data from the simulation model, the sample size in the model is of importance. Unlike previous studies when the number of simulated
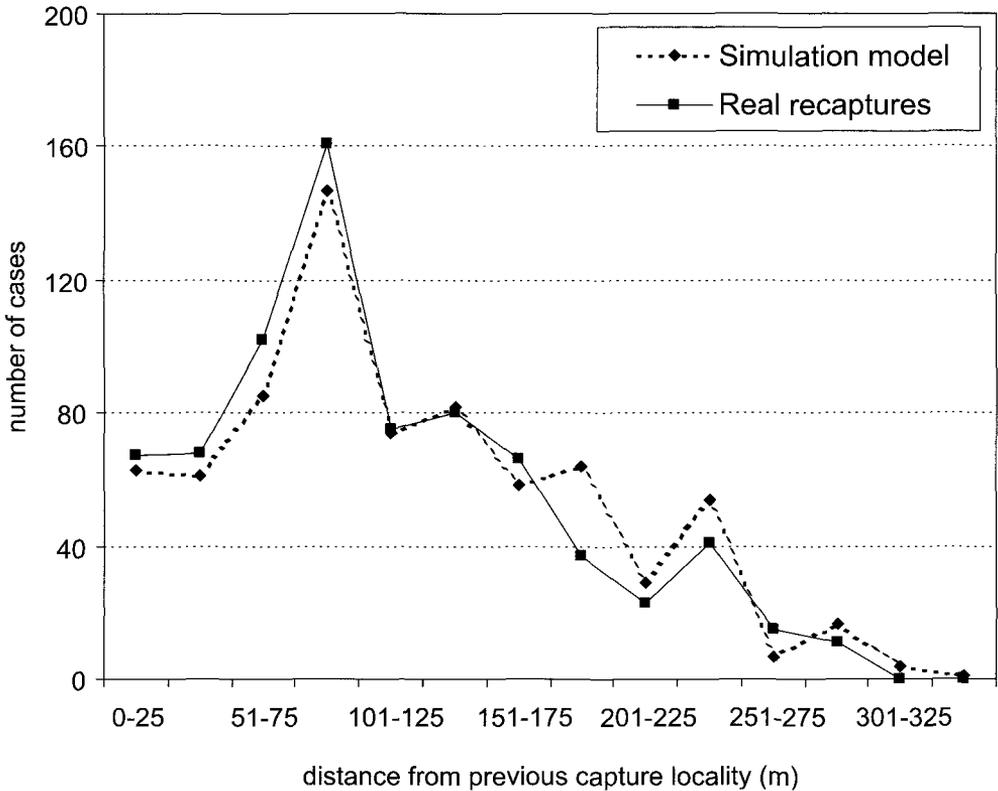
Fig. 1. Distribution of distances moved between capture localities by moulting Blackcaps.
Abb. 1. Distanz zwischen Fangorten von mausernden diesjährigen Mönchsgrasmücken.

'recaptures' was set at 10 000 (Titov 1999a, 1999b, Chernetsov & Titov 2001), in this work the number of simulations was made equal to the real sample size, i. e. 746 for the moulting birds and 1005 for the non-moulting ones.

To study the diet of Blackcaps at the study site, between 27 August and 27 October 1996 food samples were taken from captured birds. The samples were collected by stomach flushing (Brensing 1977) and by faecal sampling.

Results

In moulting birds, the distribution of distances between subsequent capture locations was not significantly different from the pattern predicted by the neutral model (Fig. 1, Kol-mogorov-Smirnov test, $\lambda = 1.27$, n = 746, p > 0.05). During the pre-migratory period, Blackcaps moved broadly across the trapping site and were not apt to remain within restricted home ranges.

In Blackcaps which had completed juvenile moult, the distribution of distances between capture locations significantly differed from what was expected on the basis of random captures (Fig. 2, Kolmogorov-Smirnov test, $\lambda = 2.94$, n = 1005, p < 0.0001). The birds were more often recaptured at distances less than 150 m from the previous capture site than predicted by the neutral model. This means that during migratory stopovers, Blackcaps had home ranges smaller than the trapping area.
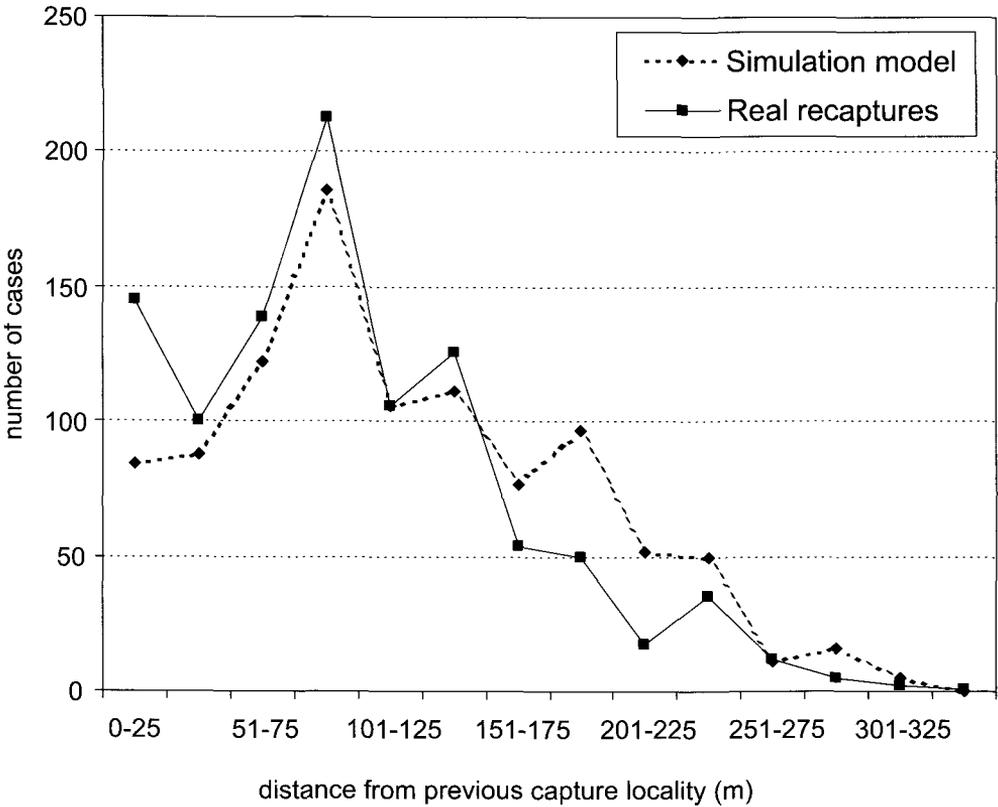
Fig. 2. Distribution of distances moved between capture localities by Blackcaps in post-juvenile plumage.
Abb. 2. Distanz zwischen Fangorten von vermauserten diesjährigen Mönchsgrasmücken.

Between 27 August and 27 October 1996, a total of 109 food samples taken from Blackcaps contained Black Elder (*Sambucus nigra*) seeds. This fruit is known to be frequently taken by fattening Blackcaps during autumn migration (Bairlein, 1990, 1998, Eggers 2000, Zelenova 2001). Black Elder was found in only 12 moulting individuals (11 %). During this period, moulting birds made up 27.5 % of captured Blackcaps (n = 727). The difference is highly significant (χ^2 = 12.8, p < 0.001). During the same season, moulting Blackcaps at Rybachy took Black Elder significantly less frequently than their conspecifics which had completed moult.

Discussion

Our data show that the pattern of spatial use by Blackcaps during post-fledging movements and on autumn migration is different. Before the onset of migration, the movements of Blackcaps do not differ from the random pattern. The home ranges of individual birds overlap broadly and cannot be the defended territories. This is in agreement with the data obtained by the same method for Reed and Sedge Warblers (Chernetsov & Titov 2001). After the onset of migration, home ranges become smaller but are still obviously too large to be defended territories. Like Garden War-

blers (*Sylvia borin*; Thomas 1979, Schaub & Jenni 2000), Blackcaps do not show intraspecific aggression when food availability is high (Chernetsov, unpubl.).

Before the onset of migration, Blackcaps moved broadly and did not remain within small home ranges. This could be related to their general tendency to be mobile during post-fledging movements. At autumn migratory stopovers, Blackcaps remain in microhabitats where many Black Elder bushes are available and thus have home ranges clearly smaller than the study area.

The reasons for switching from animal to mainly fruit diet during migratory period in *Sylvia* warblers have been discussed in detail (Bairlein 1990, 1996, 1998, Bairlein & Simons 1995). Fruits are often abundant, and the carbohydrates which they contain may be used for lipid synthesis. This adaptation seems to be favourable for quick and efficient fat deposition which is of importance for migrating warblers. On the Courish Spit, chironomids are an important prey of Blackcaps until early September (Zelenova 2001). In the beginning or middle of September, chironomid abundance usually sharply declines (Chernetsov, unpubl.).

The pattern of spatial distribution of Blackcaps appears to be related to the distribution of the preferred food. Individuals in whose diet Black Elder does not play a decisive role (moulting, pre-migratory birds) move randomly. In Germany (Eggers 2000) and on the Courish Spit (Zelenova 2001) Blackcaps take fruits from at least the beginning of July, in midsummer it is primarily Blackberry (*Rubus fruticosus*). However it is taking Black Elder, which is very patchily distributed, which causes Blackcaps to remain within smaller home ranges. It has previously been shown in Robins and Wrens (Titov 1999a, 1999b) and in Reed and Sedge Warblers (Chernetsov & Titov 2001) that the pattern of spatial distribution is related to the distribution of prey. Birds that utilize more or less evenly distributed resources occupy restricted home ranges, whereas those which forage on superabundant but un-predictable prey move broadly. This appears also to be true in Blackcaps.

Acknowledgements

References

Bairlein, F. (1990): Nutrition and food selection in migratory birds. In: Gwinner E. (Ed.): Bird migration: physiology and ecophysiology: 198–213. Berlin.

Bairlein, F. (1995): European-African Songbird Migration Network. Manual of field methods. Wilhelmshaven.

Bairlein, F. (1996): Fruit-eating in birds and its nutritional consequences. Comp. Biochem. Physiol. 113A: 215–224.

Bairlein, F. (1998): The effect of diet composition on migratory fuelling in Garden Warblers *Sylvia borin*. J. Avian Biol. 29: 546–551.

Bairlein, F. & Simons, D. (1995): Nutritional adaptations in migrating birds. Israel J. Zool.: 357–367.

Berthold, P. (1976): Animalische und vegetabilische Ernährung omnivorer Singvogelarten: Nahrungsbevorzugung, Jahresperiodik der Nahrungswahl, physiologische und ökologische Bedeutung. J. Ornithol. 117: 145–209.

Berthold, P., Querner, U. & Schlenker, R. (1990): Die Mönchsgrasmücke. Wittenberg-Lutherstadt.

Bibby, C.J. & Green, R.E. (1980): Foraging behaviour of migrant Pied Flycatchers, *Ficedula hypoleuca*, on temporary territories. J. Anim. Ecol. 49: 507–521.

Bibby, C.J. & Green, R.E. (1981): Autumn migration strategies of Reed and Sedge Warblers. Ornis Scand. 12: 1–12.

Brensing, D. (1977): Nahrungsökologische Untersuchungen an Zugvögeln in einem südwestdeutschen Durchzugsgebiet. Vogelwarte 29: 44–56.

Chernetsov, N. & Titov, N. (2001): Movement patterns of European Reed Warblers *Acrocephalus scirpaceus* and Sedge Warblers *A. schoenobaenus* before and during autumn migration. Ardea 89: 509–515.

Eggers, S. (2000): Compensatory frugivory in migratory *Sylvia* warblers: geographical responses to season length. J. Avian Biol. 31: 63–74.

Kodric-Brown, A. & Brown, J.H. (1978): Influence of economics, interspecific competition, and sexual dimorphism on territoriality in migrant Rufous Hummingbirds. Ecology 49: 285–296.

Mehlum, F. (1983): Resting time in migrant Robins *Erithacus rubecula* at Store Færder, outer Olsofjord, Norway. Fauna norv. Ser. C. Cinclus 6: 62–72.

Schaub, M. & Jenni, L. (2000): Fuel deposition of three passerine bird species along the migration route. Oecologia 122: 306–317.

Szulc-Olech, B. (1965): The resting period of migrant Robins on autumn passage. Bird Study 12: 1–7.

Thomas, D.K. (1979): Figs as a food source of migrating garden warblers in southern Portugal. Bird Study 26: 187–191.

Titov, N. (1999a): Individual home ranges in Robins *Erithacus rubecula* at stopovers during autumn migration Vogelwelt 120: 237–242.

Titov, N. (1999b): Home ranges in two passerine nocturnal migrants at a stopover site in autumn. Avian Ecol. Behav. 3: 69–78.

Zelenova, N. (2001): Weight gain and diet changes in young Blackcaps (*Sylvia atricapilla*). Ring 23: 179–189.