Comparison of habitat selection characteristics of the Robin (Erithacus rubecula) and the Dunnock (Prunella modularis) in riparian forests along the River Danube

C. Moskát, T. I. Fuisz and J. Y. Park

Moskát, C., Fuisz, T. I. and Park, J. Y. 1996. Comparison of habitat selection characteristics of the Robin (*Erithacus rubecula*) and the Dunnock (*Prunella modularis*) in riparian forests along the River Danube. - Ornis Hung. 6: 15-22.

Eleven vegetation variables were measured in willow (*Salix*), poplar (*Populus*) and mixed willow-poplar riparian forests in the Szigetköz region, N. Hungary around the song perches within the territories of the Robins (*Erithacus rubecula*) and the Dunnocks (*Prunella modularis*). Stepwise and multiple discriminant analyses revealed only minor differences between the habitat selection of the two species in the study area. While Robins prefer closed forest stands where the understory and the bush layers are well-developed, Dunnocks prefer more open stands where willow trees dominated over the poplar trees.

The drying process in the Szigetköz region, caused by altering the main branch of the River Danube towards the new Slovakian hydroelectric power station, will possibly alter the riparian habitats in the area. If the level of the water table drops, this will alter the structure of the riparian forests, which are characterized by high trees, dense shrub level and understory. The area covered by the willow forests, which occupy the wet places, will possibly be reduced. Bird populations are expected to respond to these changes of the habitat in a species-specific manner.

C. Moskát, T. I. Fuisz, and J. Y. Park, Animal Ecology Research Group of the Hungarian Academy of Sciences, Hungarian Natural History Museum, Budapest, Baross u. 13., H-1088, Hungary. (Permanent address of J. Y. Park: Institute of Ornithology, Kyung Hee University, Hoegi-Dong, Dongdaemun-Gu, Seoul 130-701, Republic of Korea)

1. Introduction

An intensive study of the riparian avifauna together with other animals has been carried out within the framework of ecological and biomonitoring programs organized by the Hungarian Natural History Museum in the Szigetköz region since 1989. The River Danube forms hundreds of branches and islands, so the area contains a great variety of terrestrial and aquatic habitats, and a high diversity of animal and plant species.

The construction of the Bös-Gabcikovo hydroelectric power station in the Slovakian part of the region threatens this unique landscape and the high diversity of wildlife with an ecological catastrophe.

Habitat selection characteristics are important when possible changes of the animal populations have to be evaluated in a changing landscape. For this reason our study focused on the habitat choice of bird species. The alteration of the main branch into a new channel leading to the power

station is expected to cause an intensive drying process in the region. Most of the water in the main branch disappeared, and some of the side branches have dried out, mostly in the northern and middle part of the region. The decrease of the water table will possibly cause the drying of the riparian forests, too. Forestry is about to replace the tree species of the wet riparian forests with drought-tolerating ones.

The riparian forests in the Szigetköz region have a valuable avifauna with extremely high densities of species, including several passerine species rare in Hungary (Waliczky 1992, Báldi & Kisbenedek 1994, Báldi & Moskát 1994, Báldi *et al.* 1995, Moskát & Fuisz 1995). The Willow Tit (*Parus montanus*), the Icterine Warbler (*Hippolais icterina*), and the Dunnock (*Prunella modularis*) are relatively rare breeding species in Hungary, but all of them have good breeding populations in the Szigetköz region. The habitat characteristics of the Icterine Warbler has already been analyzed (Waliczky *et al.* 1991, Moskát *et al.* 1993). The present paper concentrates on the evaluation of habitat features of the Dunnock, in comparison with its possible main competitor, the Robin (*Erithacus rubecula*). The goal of this paper is to reveal the nest-site selection characteristics of the Robin and the Dunnock in the riparian forests of the Szigetköz region, and to address questions regarding conservation biological problems of the area.

2. Study area

Observations concerning the habitat selection of Robins and Dunnocks were carried out during the breeding season from mid-April to the end of May of 1995, in the Szigetköz region, NW Hungary (48°00'-47°49'N, 17°15'-17°45'E). We searched for bird territories in willow (*Salicetum albae-fragilis*) forests, and in hybrid poplar (*Populus deltoides* x *Populus nigra*) plantations in the flood area between the settlements Dunakiliti and Ásványráró. Only mature forests were visited. The willow and poplar forests, and often their mixture, the willow-poplar forests occupy most of the riparian zone. Trees grow very fast in this area, and usually a well-developed shrub layer is found (e.g. *Sambucus sanguinea, Euonymus europaeus, Viburnum opulus, Sambucus nigra*).

3. Methods

We looked for breeding territories of the Robin and the Dunnock in mature riparian forests in 1994. Although we did not try to locate nests, continuous singing of male birds in the territory indicated their breeding with a high probability. Habitat characteristics were measured around the song perch of the birds. So our data set is representative for the song perch, rather than for the territory. If a large number of habitat characteristics around the song perches are collected, they probably be indicative of the characteristics of the territories, or at least those parts, which are used by the territory-holding males. This technique has already been applied in several studies (e.g., James 1971, Anderson & Shugart 1974, Whitmore 1975, 1977, Smith 1977, see review by Holmes 1981).

The data set contained measurements from 28 territories of the Robin, and 29 of the Dunnock. Eleven vegetation variables were measured in a circle with 25 m radius

Tab. 1. Two-group stepwise discriminant analysis for the habitat use of the Robin (*Erithacus rubecula*) and the Dunnock (*Prunella modularis*). (Selection rule in stepwise selection: minimize Wilks' Lambda.)

Sample size

Robin	28			
Dunnock	29			

Canonical discriminant functions

Function	Eigenvalue	Percent of variance	Canonical correlation	
1	0.360	100.00	0.514	
After function	Wilk's lambda	Chi-square	DF	Significance
0	0.735	16.286	4	0.0027

Standardized canonical discriminant coefficients

Variables	Function 1
understory cover	- 0.616
bush cover	- 0.413
tree distance	0.929
willow cover	0.440

Structure matrix

Pooled-within-groups correlation between discriminating variables and canonical discriminant functions:

Variables	Function 1
understory cover	- 0.501
bush cover	- 0.202
tree distance	0.407
willow cover	0.521

Group Centroids

Group	Function 1
Robin	-0.599
Dunnock	0.578

Mahalanobis D^2 = 1.178

F statistic = 3.968 at df = (4, 52), P = 0.00695

Classification results

Actual group	No. of cases	Predicted group membership			
		Robin		Dunnock	
Robin	28	20	(71%)	8	(29%)
Dunnock	29	10	(34%)	19	(66%

around the song perches: V1=canopy cover (%), V2=understory cover (%), V3=canopy height (m), V4=understory height (m), V5=bush height (m), V6=bush cover (%), V7=average tree distance (m), V8=average tree diameter at breast height (cm), V9=willow cover [contribution of willow trees to foliage cover] (%), V10=poplar cover (%), V11=cover of other tree species (%). Vegetation variables were measured by visual estimation after training. The same vegetation structure parameters were also measured at 100 randomly selected points.

Stepwise discriminant analysis was carried out to test for significant differences in habitat characteristics among populations by the SPSS/PC+ computer program package (Norusis 1986). This technique selects the variables important for group separation. The stepwise variable selection in discriminant analysis has been criticized

recently because it selects the statistically important variables regardless of their ecological importance (Ludwig & Reynolds 1988), and also from the background of statistics (James & McCullogh 1990). Wilkinson (1990) states that if we select too many discriminators out of a large set, it is unlikely to replicate in a new sample. Fortunately, the present data set cannot be regarded as a large data set, it contained only 11 variables. During the preliminary analyses we found the stepwise technique superior over the non-stepwise variant of the multiple discriminant analysis (also called canonical variate analysis).

4. Results

Two-group stepwise discriminant analysis was carried out to select the best variables for separation of the territories of Robins and Dunnocks, and to determine the discriminant function for the separation of individuals belonging to the two groups (Tab. 1). The variables understory cover (V4), bush cover (V6), tree-distance (V7), and willow cover (V9) were retained by the program as the suggested variables for discrimination between groups. The first two variables (V4, and V6) have negative loadings on the discriminant function, but the latter two variables (V7, and V9) are positively correlated with the new function. Although there is a clear tendency for separation among the groups, the frequency histograms of the two groups partly overlap with each other, and both species have their maximum values in the same category (Fig. 1). As the Robins were located more towards the negative end of the discriminant axis, it shows that Robins selected those places for establishing a ter-
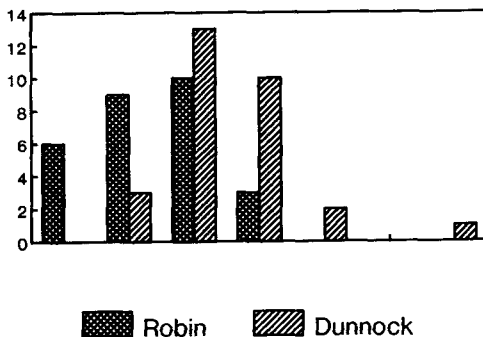

Robin   Dunnock

Fig. 1. Distribution of the Robin and Dunnock territories according to the first discriminant function, derived by stepwise discriminant analysis.

ritory, where the understrory and the bush layer was well-developed (high values of the understory cover and bush cover variables), and the forest was dense (low values of the tree distance variable). This species also prefers the dominance of poplar trees to that of the willow (low values of the variable willow cover, which indicates the high value of poplar cover, because the willow and the poplar were the dominant tree species all over the sampling points). Dunnocks showed preference for a more open forest (high values of the tree distance vegetation variable), where the understory and the bush layer is not so dense (lower values of the understory cover and the bush cover variables). This species prefers willow dominance to the dominance of the poplar trees (high values of the variable willow cover). A closely related method, the multiple discriminant analysis, also revealed a very similar result, but the peaks of the histograms of the two species were placed further apart from each other (Fig. 2).

When random points were also included in the stepwise discriminant analysis, the same vegetation variables were retained, but with the opposite signs (V4,
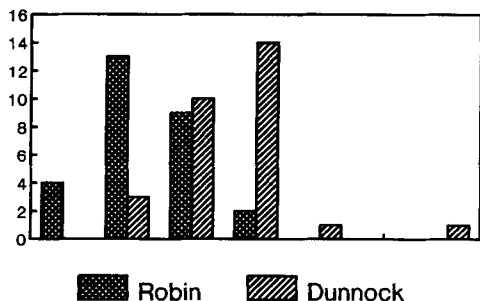
Fig. 2. Distribution of the Robin and Dunnock territories according to the first canonical function, derived by canonical variate analysis.

V6, V7, and V9; Tab. 2). The multiple discriminant analysis does not drop any variables from the variable set, but calculates canonical axis for the separation of the predefined groups of objects (Robins, Dunnocks, and random points). The convex polygons of the groups show high overlap between the two bird species (Fig. 3). Evaluating the plot of Robins' territories, and Dunnocks' territories in relation to the random points we can conclude that (1) the two bird species show some tendency for separation regarding the vegetation variables, but (2) they overlap in the discriminant space, so (3) this preference is not highly specialized.

Tab. 2. Partial output of three-group stepwise discriminant analysis for the habitat use of the Robin (*Erithacus rubecula*) and the Dunnock (*Prunella modularis*), including randomly selected points in the area. (Selection rule in stepwise selection: minimize Wilks' Lambda.)

Sample size
Robin	28
Dunnock	29
Random points	100

Standardized canonical discriminant coefficients
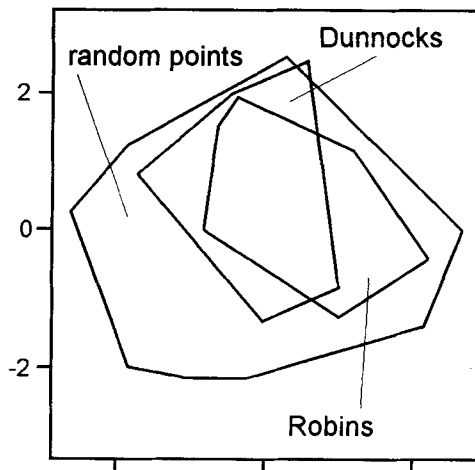| variables	function 1	function 2
understory cover	0.592	0.020
bush cover	0.626	0.550
tree distance	- 0.569	- 0.355
willow cover	- 0.125	- 0.941

Fig. 3. Location of randomly selected sites, Robin and Dunnock territories according to the first two discriminant function, as revealed by stepwise discriminant analysis.

5. Discussion

The high proportion of willow trees is characteristic for large areas in the Szigetköz region. We think that the Dunnock occupies willow forest stands for breeding as a primary habitat, but it also spreads to the poplar forests as a secondary habitat. For a long time the Dunnock was known as a breeding species only in the Szigetköz region in Hungary (Keve 1960). In the 1960s it was recorded as a very rare breeder in the Bükk Mts. (Szabó 1962), but at the beginning of the 1980s it became a common breeding species there, mostly in spruce plantations (Moskát 1984). The species also started to breed in the 1980s in other mountains in Hungary, e.g. in the Medves Mts. the first nest was found in 1980 (Varga 1983). Nowadays the Dunnock is a quite common breeding bird species in Hungarian mountains. The habitat selection strategy of the Dunnock has changed from a habitat specialist to a habitat generalist in woodland habitats.

The Robin is known to be a habitat generalist species in woodland habitats. Although in the Szigetköz region total density of the passerine birds is high (Báldi & Moskát 1994), both species have only moderate abundances. Moskát & Fuisz (1995) reported density values of about 1.06 pairs/10 ha for the Robin in willow forests, 2.45 pairs/10 ha in poplar forests, and 2.27 pairs/10 ha in mixed forests. For the Dunnock the following densities were measured: 2.65 pairs/10 ha in willow forests, 1.34 pairs/10 ha in poplar forests, and 1.36 pairs/10 ha in mixed forests. (These are relative densities, because the Finnish line transect technique (Järvinen & Väisänen 1975) applied for estimation of bird densities underestimates relevantly the true population. The actual absolute values must be higher, at least by 50%. This ratio was estimated by Moskát (1987), who compared this relative technique with the more accurate mapping method in a mature beech forest, and found ca. 70% accuracy.)

Moskát & Fuisz (1995) analyzed relationships between the bird community and the vegetation structure in the Szigetköz region by multivariate ordination methods. It was also shown that the Dunnock prefers stands where the willow is dominant. The Dunnock showed a significant negative relationship with the first vegetation component. This component was derived by principal component analysis, and reflected the willow-poplar contribution. (High positive values of the component indicated poplar dominance, while high negative values indicated willow dominance in the stand.) They also incorporated the Robin into the analysis, and revealed a significant relationship with the 2nd principal component. This component

was identified as a bush component, where the negative end of the axis represented an undeveloped bush layer, and the positive end of the axis indicate a well-developed bush layer. Both the study of Moskát & Fuisz (1995) and the present study revealed the preference of Dunnocks for willow-dominated stands. Moskát & Fuisz (1995) revealed preference of the Robin for stands where the bush layer is well-developed. The present study showed a similar result. The Robin exhibits a pronounced preference for stands where bush cover and understory cover is well-developed. Although both the goals and the applied methods of the study were different in Moskát & Fuisz (1995) and in the present study, very similar characteristics of the habitat selection were revealed for both the Robin and the Dunnock.

When we compare habitat selection results of species arising from different studies we have to take into consideration the methods for sampling and analysis (special effect of techniques on the results), the effect of the spatial scale (Wiens 1989) and timing. Along a successional sere of beech forests in the Bükk Mts. (Moskát & Székely 1989) a habitat shift was found during the breeding season of the Robin. At the beginning of the season, when most of the trees had no leaves at all, the Robins often occupied young, dense, and bushy stages of the successional sere. Later in May they were rarely observed there, but they more often established territories for their second brood in forest stands, where there were only a few Robins found in April (Moskát unpubl.).

A drying process has started in the Szigetköz region, as a consequence of diverting the main branch of the river to Slovakian territory. The ground-water

table has dropped, which threatens especially the willow forests in the area. The structure of the willow-poplar riparian forests is also expected to change in the future, if the drying process will go on. We expect the reduction of the well-developed understory and bush layer in the riparian forests. Some kind of water recharge system is being constructed to avoid the ecological catastrophe in the area, but its effect on wildlife is questionable. It is impossible to predict the changes of the bird fauna in the riparian forests, but we could expect a decrease in abundance values. We explained earlier that two decades ago this region was almost the only breeding area of the Dunnock in Hungary, but later it has spread all over the country. The Dunnock will be able to survive in much dryer, secondary habitats only if the population of this species in Hungary will remain stable in the future.

Összefoglalás

A vörösbegy (*Erithacus rubecula*) és az erdei szürkebegy (*Prunella modularis*) habitatszelekciós sajátságainak össze-hasonlítása dunamenti ligeterdőkben

A Szigetköz területén 1995-ben, fűzesben, nyárasban és vegyes erdőben 28 vörösbegy és 29 erdei szürkebegy territóriumban mértünk vegetációs paramétereket, az éneklési pontok körül 25 m sugarú körben. További száz mintavételi pontot random módon választottunk ki. Lépésenkénti diszkriminancia analízissel és kanoni-

kus változó analízissel kimutattuk, hogy a vörösbegyek és a szürkebegyek által preferált területek részben átfednek, de mutatkozik egy tendencia, hogy a vörösbegyek a sűrűbb erdőrészeket választják, ahol a második lombkoronaszint és a cserjeszint jól fejlett. Az erdei szürkebegyek a füzesek felé mutatnak preferenciát.

A Bős-Gabcikovo-i vízierőműhöz felépült elterelő csatorna, mely a szigetközi Duna ág vízkészletének jelentős részét elviszi, száradási folyamatot indított be a térség felső részén, kb. a Szigetköz kétharmadában. Ez várhatóan a füzesek visszaszorulását fogja eredményezni, s csökkenteni fogja a másodlombkoronaszint és a cserjeszint fejlettségét is, ha nem sikerül valamilyen vízpótlási rendszerrel megállítani a folyamatot. (Az erdészet szárazságtűrő fafajok telepítését tervezi, mely az erdei madárfaunára is nyilván hatással lesz.) A szigetközi erdei szürkebegy populáció a 70-es, 80-as évekig szinte egyedülálló volt Magyarországon, azóta a faj - főleg a hegyvidékeken - sokfelé elterjedt, országos állománya feltehetőleg nem függ a szigetközitől.

References

Anderson, S. H. & H. H. Shugart, Jr. 1974. Habitat selection of breeding birds in an east Tennessee deciduous forest. - Ecology 55: 828-837.

Báldi, A. & T. Kisbenedek. 1994. Comparative analysis of edge effect on bird and beetle communities. - Acta zool. hung. 40: 1-14.

Báldi, A. & C. Moskát. 1994. Effect of the edge on the structure of bird communities in Hungarian riparian forests. pp. 7-10. In: Hagemeijer, E. J. M. & T. J. Verstrael. (eds). Bird Numbers 1992. Distribution, monitoring and ecological aspects. Poster appendix of the proceedings of the 12th Int. Conf. of IBCC and EOAC, Noordwijkerhout, The Netherlands. - Statistics Netherlands, Voorburg/Heerlen & SOVON, Beek-Ubbergen, The Netherlands.

Báldi, A., Zágon, A. & A. Bankovics. 1995. Status of the avifauna in the Szigetköz riparian area: a conservation biological evaluation. - Miscnea zool. hung. 10: 127-136.

Holmes, R. T. 1981. Theoretical aspects of habitat use by birds. pp. 33-37. In: Capen, D. E. (ed.). The use of multivariate statistics in studies of wildlife habitat. - USDA For. Ser. Gen. Tech. Rep. RM-87., Rocky Mountain Forest and Range Experimental Station, Ft. Collins, Colorado, USA.

James, F. C. 1971. Ordinations of habitat relationships among breeding birds. - Wilson Bull. 83: 215-236.

James, F. C. & C. E. McCullogh. 1990. Multivariate analysis in ecology and systematics: panacea or Pandora's box? - Ann. Rev. Ecol. Syst. 21: 129-166.

Järvinen, O. & R. A. Väisänen. 1975. Estimating relative densities of breeding birds by the line transect method. - Oikos 26: 316-322.

Keve, A. 1960. Nomenclator Avium Hungariae. - Hungarian Orithological Institute, Budapest.

Ludwig, J. A. & J. F. Reynolds. 1988. Statistical ecology. - Wiley, New York.

Moskát, C. 1984. Habitats of the Dunnock (Prunella modularis) in the Bükk-plateau and in the Sátor Mountains. – Madártani Tájékoztató 1984: 69-70. (In Hungarian.)

Moskát, C. 1987. Estimating bird densities during the breeding season in Hungarian deciduous forests. - Acta Reg. Soc. Sci. Litt. Gothoburgensis. Zoologica (Proc. Fifth Nordic Ornithological Congress, 1985) 14: 153-161.

Moskát, C., Báldi, A. & Z. Waliczky. 1993. Habitat selection of breeding and migrating icterine warblers Hippolais icterina: a multivariate study. - Ecography 16: 137-142.

Moskát, C. & T. Fuisz. 1995. Conservational aspects of bird-vegetation relationships in riparian forests along the River Danube: a multivariate study. - Acta zool. hung. 41: 151-164.

Moskát, C. & T. Székely. 1989. Habitat distribution of breeding birds in relation to forest succession. - Fol. Zool. 14: 153-161.

Norusis, M. J. 1986. SPSS/PC+ for the IBM PC/XT/AT. - SPSS Incorporation, Chicago, Illinois, U.S.A.

Podani, J. 1993. SYN-TAX. Computer programs for multivariate data analysis in ecology and systematics. Version 5.0. User's guide. - Scientia Publishing, Budapest.

Smith, K. G. 1977. Distribution of summer birds along a forest moisture gradient in an ozark watershed. - Ecology 58: 810-819.

Szabó, L. V. 1962. The breeding of the Hedge Sparrow in the Bükk Mountains. - Aquila 67-68: 235.

Varga, F. 1983. Colonization of the Dunnock (Prunella modularis) in the forests of the Medves Mountains. – Madártani Tájékoztató 1983: 94. (In Hungarian.)

Waliczky, Z. 1992. Structure of avian communities in the forests of Szigetköz, Hungary. - Ornis Hungarica 2: 25-31. (In Hungarian with an English abstract).

Waliczky, Z., Moskát, C., Báldi, A. & G. Lőrincz. 1991. Habitat selection of the Icterine Warbler (Hippolais icterina Vieill., 1817) in Szigetköz. - Aquila 98: 135-140. (In Hungarian with English summary.)

Whitmore, R. C. 1975. Habitat ordination of passerine birds of the Virgin River Valley, southwestern Utah. - Wilson Bull. 87: 65-74.

Whitmore, R. C. 1977. Habitat partitioning in a community of passerine birds. - Wilson Bull. 89: 253-265.

Wiens, J. A. 1989. The ecology of bird communities. Vol. 2. Processes and variations. - Cambridge Studies in Ecology, Cambridge University Press, Cambridge.

Wilkinson, L. 1990. SYSTAT: The system for Statistics. - SYSTAT Inc., Evanston, Illinois, USA.