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Wintering birds in floodplain forests – Effects of vegetation structure and landscape composition on species assemblages

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Keywords

bird species diversity, European mistletoe, vegetation structure, National Park Donau-Auen, riparian forest, winter

Introduction

This study explores the wintering bird community of floodplain forests in the National Park Donau-Auen. The national park was established in 1996 and stretches from Vienna, Austria to the Slovakian border. It contains the biggest semi-natural floodplain forest in Central Europe and one of the last free flowing sections of the Danube (MANZANO 2000).

Most of bird studies are conducted during spring season when migratory birds already arrived in their breeding area. Only few studies include the winter bird community (MANUWAL & HUFF 1987), but large differences are existing between breeding and wintering bird communities. For better protection and management strategies, it is crucial to understand the biology and behavior of birds as well as the ecological mechanisms which shape bird assemblages in nature. Hence, this study aimed detecting vegetation and landscape parameters which are responsible for shaping bird assemblages in a lowland riparian forest in winter.

Material and Method

Through 10-minute point counts, conducted between December 2015 and February 2016, bird assemblages were recorded and various vegetation parameters were estimated. The census points used for assessing bird assemblages were located at the northern shore of the Danube in the National Park Donau-Auen. Every census point was visited 3 times, only birds inside the 50-meter radius were used for further analysis. Plots were located north and south of the flood protection dam 'Marchfeldschutzdamm'. They were located at the intersection of 100 m grids established by the Österreichische Bundesforste AG and the MA 49 of Vienna in the framework of their forest inventory scheme. The points were filtered with ArcMap 10.2 (ESRI 2011) for the following criteria's:

1. max. 100 m away from paths (for good accessibility);
2. no forest margin within a 50-m radius;
3. >200 m apart from other points (for spatial independency).

Further, the plots were grouped by distance to next permanent water bodies using the following categories: <75 m, 75-150 m, 150-250 m and >250 m. In total 69 plots were used in this study.

Results

We used 34 bird species with 1934 individuals for further analysis. The most abundant bird species which was detected in all 69 plots were Great Tit with 506 individuals. Blue Tit was detected 320 times and Eurasian Nuthatch 303 times.

Species diversity

To find important habitat and landscape parameters which influence bird assemblages, we calculated generalized linear models for bird species diversity (Shannon Diversity Index).

The best GLM model included distance to open land, standing deadwood, proportion of grey alder in the canopy layer, number of mistletoes and number of fruits and seeds. In this model, only open land and mistletoes proved to significantly affect bird diversity (see Tab. 1).

Explanatory variables	**Estimate Std.**	**SEr**	***t* value**	***Pr* (>|*t*|)**
(Intercept)	1.8932	0.0472	40.077	<0.0001 ***
Openland	-0.0005	0.0002	-2.076	0.0420 *
st_dw	-0.0023	0.0012	-1.827	0.0725 .
alnus_incana	0.0071	0.0038	1.892	0.0632 .
mistletoes	0.0028	0.0006	4.927	<0.0001 ***
nr_fruits	0.0101	0.0057	1.781	0.0798 .

Table 1: Summary of the best model of sh_birds, Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Fig. 1 shows the importance of the environmental predictors for the best 100 models. The predictors mistletoe, grey alder and open land were in over 80% of the 100 best models present. The amount of deadwood and forest age were not significant but deadwood showed a negative effect on bird species diversity. No spatial autocorrelation was detected for the best model.

Further, the number of mistletoes on the south side of the dam is significant higher than north of the dam (Kruskal-Wallis test for equal medians: p= 0.0083).

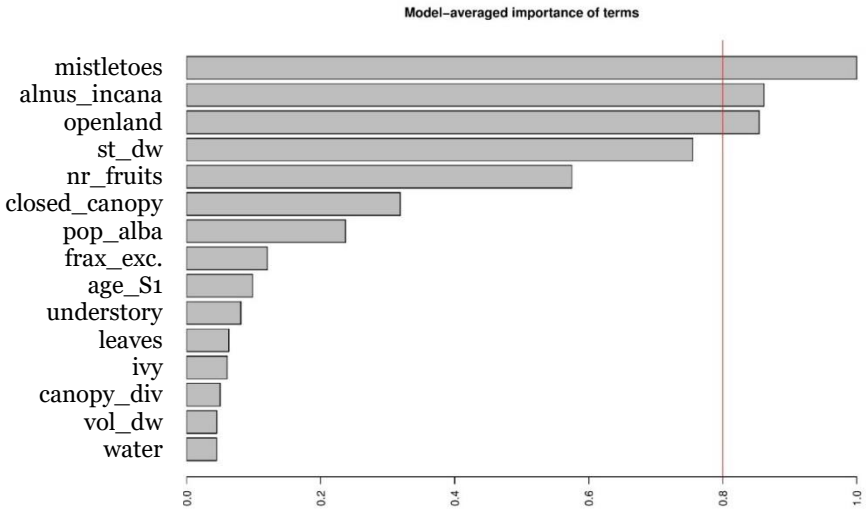

Figure 1: Model-avaraged importance of terms, red line at 80%

Species composition

The overall beta diversity for our 69 census points achieved a Sørensen dissimilarity of 0.93 (βSOR). The spatial turnover in species, measured as Simpson dissimilarity, was mainly responsible for the recorded beta diversity (βSIM= 0.89). Nestedness, measured as Sørensen dissimilarity, contributed sparsely (βSNE= 0.05) to overall beta diversity.

Bird species composition differed significantly between census points north and south of the dam (one-way ANOSIM: p= 0.039). Bird assemblages north and south of the dam are significantly different from each other and the variance within each group is smaller than between groups. Furthermore, more bird species were detected south of the dam (one-way ANOVA, p= 0.0182). Nonmetric Multidimensional Scaling (NMDS) was performed too. The occurrence of Eurasian Tree creeper seems to be strongly associated with the age of the canopy layer. Mistle Thrush and Jay are located near the arrows of the number of mistletoes and proportion of alder in the canopy layer. Height of canopy seems to be a good predictor for Long-tailed Tit and for Hawfinch. Chaffinch seems to correlate with distance to open land.

Discussion

Distance to open land, the proportion of alder in the tree layer and the number of mistletoe on the plot were the most important predictor for bird species diversity. Alder trees as well as mistletoes are important winter food sources and therefore it seems likely that birds prefer plots with a higher number of mistletoes and alder on it. Species diversity decreased with the distance to open land. This is an expected finding, because we assumed that the edge effect will be stronger developed in winter than in spring. ADRION (2016) did not find a significant relationship in spring. The edge effect explains the phenomenon that boundary habitats have a greater biodiversity than the adjacent bigger ecosystems (SCHAEFER 2012).

We could not find an effect from distance to permanent water bodies on the abundance of birds, therefore it seems likely that aquatic insects do not play a key role in winter nutrition. It seems likely too, that in the floodplain forest of the National Park Donau-Auen, habitat preferences of various bird species are stronger developed in winter than in spring. In addition, we found out, that bird assemblages north and south of the dam differed significantly from each other. Further, census points south of the dam were characterized by higher species richness than census points north of the dam. This is probably because alder only occurs south and mistletoes had higher numbers south of the dam. ADRION (2016) did not find a significant difference in bird assemblages north and south of the dam. This demonstrates that food supply plays a key role in bird distribution and assemblages in winter. In spring, various other food sources appear to be more important.

Deadwood and forest age

There was no significant relationship between the amount of deadwood and species richness or species diversity, although the number of standing deadwood was included in the best diversity model. Deadwood is often correlated with bird species richness because it provides habitat, feeding and overwintering sites for many insects as well as for birds (NILSSON 1979). In our study bird richness and diversity decreased with increasing number of standing deadwood. This irritating result was found by ADRION (2016) as well. WARINGER (2017) also found a negative effect of standing deadwood on Collared Flycatcher, normally a typical deadwood bird. The best explanation might be that, at the National Park Donau-Auen, the amount of deadwood is an indicator of former intense forestry management. We also could not find an effect of forest age on bird species abundance and diversity, although many studies documented a positive effect of old forest stands for overwintering birds (MANUWAL & HUFF 1987; DONALD et al. 1997; LAIOLO 2002; LAIOLO et al. 2003). This might be because the National Park Donau-Auen was established just 20 years ago, and so all investigated forest stands are remnants of the former intense forestry management. Due to these forestry measures implemented until recently, older stands may still lack typical features of mature forests.

Conclusion & Recommendation

Our study suggests that in the National Park Donau-Auen winter food availability is the strongest predictor for bird richness and bird diversity. It seems likely that mistletoes and alder trees are very important winter food sources in the riparian forest for many resident bird species. Aquatic insects as a winter food source are most likely neglectable. The former intense forestry management still influences the vegetation structure and the bird diversity. Most of the mistletoes parasite hybrid poplar stands and therefore these stands are very important winter habitats for many bird species. As a conservation recommendation for the national park this study suggests maintaining the formerly planted, highly infected hybrid poplar stands because of its importance for overwintering bird assemblages. Further, species richness was higher south of the dam, indicating that softwood forests provide better overwintering conditions for more bird species than hardwood forests. Therefore, it is recommended to preserve the softwood forest with its alder stands by stopping the fast succession from softwood to hardwood forest. This could be achieved by improving the hydrological connectivity of the floodplain forest with the water level of the Danube through the reconnection of side arms with the Danube.

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