The Effects of Tree stand layers on Resident Bird Species in Belgrade Forest, Istanbul, Turkey

(With 2 Figures and 1 Table)

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1. INTRODUCTION

Vegetation is basic to any bird community, serving as the base of food chains and providing shelter and reproductive sites. Whilst there are many factors affecting bird population, in this article we are focusing on vegetation structure. The diversity in species and the frequency of birds depend primarily on the location, composition, age, and structure of the forest where the birds live in their natural and semi-natural habitat (JOKIMAEKI and HUHTA, 1996).

Belgrade Forest, geographically, is on the European shore of the city of Istanbul and lies between the Bosphorus on one side and the Black sea coastline on the other. The Belgrade Forest, like the Bosphorus, is an important area for birds (ERTAN et al., 1992; YARAR and MAGNIN, 1997). It is a deciduous forest; the dominant vegetation includes *Quercus frainetto* Ten., *Q. cerris* L. and *Fagus orientalis* Lipsky tree species mixed with varying amounts of *Acer campestre* L., *A. trautvetteri* Medw., *Alnus glutinosa* (L.) Gaertn., *Carpinus betulus* L., *Castanea sativa* Mill., *Populus tremula* L., *Sorbus torminalis* (L.) Crantz and *Ulmus campestris* auct., non L. with a normal crown closure (YALTIRIK, 1966). Oak species (*Quercus* sp.) cover 75% of the forested area. Alongside these, needle species such as *Pinus nigra* Arnold. and *Pinus silvestyris* L. have been introduced into the forest through afforestation. Although Belgrade Forest is a prime bird habitat, very few studies have been made on it. ALAPINAR (1963) (18 species), KUMERLOEVE (1962, 1970) (24 species), and SCHWEIGER (1965) (11 species) have identified some bird species in this forest. Of these species, *Bubo bubo* (L., 1758) (ALAPINAR, 1963), *Falco vespertinus* L. 1766, *Burhinus oedicnemus* (L., 1758) and *Jynx torquilla* L., 1758 (KUMERLOEVE 1962/1970) are refered to in ARSLANGÜNDOĞDU's study. ARSLANGÜNDOĞDU (2005) identified 146 bird species of 41 known families within 17 orders.

ARSLANGÜNDOĞDU (2005) used a variety of regression and correlation analysis to establish which elements of tree stand type (tree species, tree layer, stand age) affect the number of native birds in Belgrade Forest. The results, using Multiple Linear Regression and Correlation Analysis, showed an equation of: Y (bird species) = 7.951 + 0.203 (tree species) + 2.735 (stand layer) + 1.285 (stand age). This gave a result of 73.20% comparative relationship between the number of the various bird species and the three variables (tree species, tree layer, stand age), with the variation in tree stand layers as the main factor effecting the numbers of birds. Therefore the purpose of this paper is to show the relationship between resident bird species in Belgrade Forest and tree stand layer.

In this work, the authors used One-Way ANOVA to investigate whether the one independent variable of the tree stand layers has any effect on the dependent variables of bird species. Point count method was used to count all the observed birds in this study for five years.

2. FLORA AND CLIMATE OF THE STUDY AREA

Belgrade Forest is situated between 28°53'25"–29°00'55" eastern longitude and 41°09'44"–41°14'40" northern latitude (*Figure 1*). The total land area of the Belgrade Forest, including all vegetation cover and the reservoirs, is 5408, 29 hectares. In terms of Mayr's silvicultural climate zone classification, the study area falls in the Castanetum-Fagetum transition zone. Oaks (*Quercus petraea* (Matt.) Liebl., *Q. robur* L., *Q. frainetto* Ten., *Q. cerris* L., *Q. infectoria* Oliv., *Q. coccifera* L.), accounting for almost 75% of the forest flora, are the most important tree species (ARSLANGÜNDOĞDU, 2005). Although Belgrade Forest is a protected natural forest, the forest is still managed to a degree, specifically dead, old and unhealthy trees are removed.

Belgrade Forest is in the local Marmara Sea climatic zone, with a year-round wind direction from the northeast (i.e. from Black sea). This zone falls in the transition zone between Mediterranean and Central European climatic zones with cool springs, hot summers, and relatively cold winters. Mean annual precipitation is around 1161.0 mm and the mean annual temperature is 13.2 °C. The region, according to the Thornthwaite climate classification system, is humid, mesothermal oceanic, with a moderate soil-water deficit in summer. The soils are shallow to deep, gravely, loamy clay in texture, rich in

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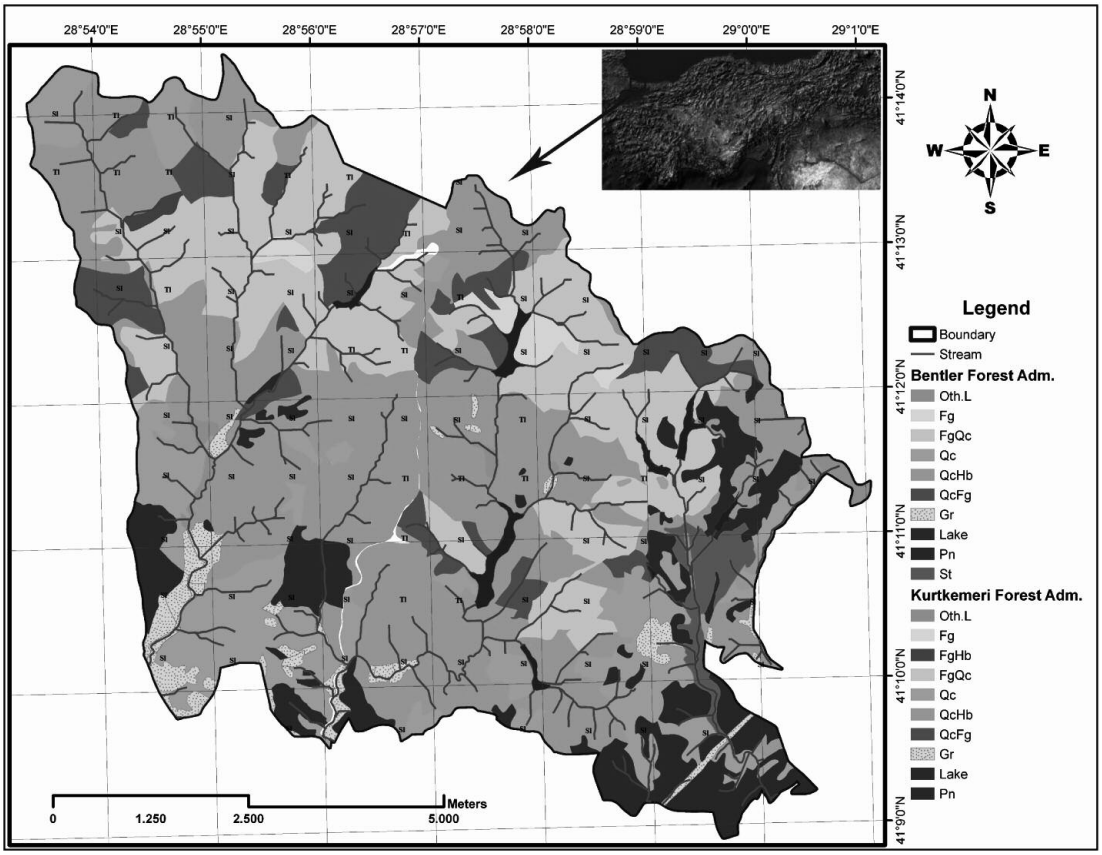

Fig. 1
The location of Belgrade Forest and of the points.
Der Standort von Belgrader Wald und die Punkte.

organic matter with medium to good permeability rates (KANTARCI, 1980; KARAÖZ, 1988; OZYUVACI et al., 2004).

Belgrade is a protected forest. It is used for water collection, scientific study, recreation and wood production (PEHLIVANOĞLU, 1986). It is known that in the Byzantine period the forest continued north west along the Black Sea coast of Thrace. It gradually reduced in size, until in the Ottoman period it was about two and a half times its present size. There are 6 reservoirs within the present boundaries of the forest, all dating to the Ottoman period and joined to the city by a joint aqueduct. There is also evidence for water collection in the Byzantine era (KANTARCI, 1980).

3. MATERIALS AND METHODS

Point count method (BIBBY and ROBINS, 1985; VERNER and MILNE, 1989; HILL et al., 1990; JEDICKE, 1994) was used in this study. The sampling points, 93 in number and 750 m apart in every direction, were spread over the whole study area (*Figure 1*). The observation period was set to 10 minutes. At each point all the bird species, their numbers, and reproduction information for the resident birds, was collected for 10 minutes. Counting was done for five consecutive years from 2001 to 2005, for the four months from March to June, with each study point being visited once per month. Morning and afternoon hours were selected for observations.

The 93 observation points were classified into 15 stand types as shown in *table 1*. As stated above, ARSLANGÜNDOĞDU (2005) has shown that the main effect upon bird species comes from the presence or absence of multiple layering in the tree stands. Hence this article concentrates only on a comparison of single layered stands (73 examples) and double layered stands (20 examples).

The resident birds recorded, were as follows:

I. Order: ACCIPITRIFORMES
1. Family: Accipitridae
Accipiter nisus (Linnaeus, 1758)
Buteo buteo (Linnaeus, 1758)

II. Order: COLUMBIFORMES
2. Family: Columbidae
Columba livia Gmelin, 1789
Streptopelia decaocto (Frivaldzsky, 1838)

III. Order: STRIGIFORMES
3. Family: Strigidae
Strix aluco Linnaeus, 1758

Tab. 1

Number of Resident-Breeding Bird Species in Stand types.
Anzahl der heimischen Brutvogelarten in Bestandestypen.

Stand types*	Nr. of Obs. points	Number of layers	Number of Resident-Breeding Bird Species				
			2001	2002	2003	2004	2005
Pna1	1	single	11	12	11	11	11
Pnb3	6	single	15	10	20	14	12
PnOccb3	2	single	15	19	15	15	15
CpOdcb3	3	single	15	15	14	14	15
Fgab3	1	single	10	11	10	10	10
Fgdc3	7	single	17	18	16	17	18
FgOddc3	7	single	17	16	20	14	19
FgQcd3	6	single	13	12	16	19	14
Qcbc3	11	single	15	14	13	15	16
Qcc2	2	single	18	16	13	12	15
Qcd1/**Od**cb3	14	double	21	22	18	20	21
Qcd2/**Od**cb3	6	double	20	20	20	24	21
Qcd3	2	single	19	18	19	18	19
QcOdcd3	15	single	15	16	13	14	11
QcCpcb3	10	single	15	16	15	12	9

* Tree species: Pn = Corsican Pine, Oc = Other coniferous, Qc = Oak, Fg = Birch, Cp = Hornbeam, Od = Other deciduous.

Stand Development age: according to the diameter of the tree trunk (with bark) at breast height (1.30 m). Diameters given in cm: a = 0.11–0.40; b = 8.0–19.9; c = 20.0–35.9; d = 36.0–51.9; e = 52 ≤. Crown closure: 1 = 0.11–0.40, thinly closed, 2 = 0.41–0.70, moderately closed; 3 = 0.71 ≤, normally closed.

IV. Order: PICIFORMES

4. Family: Picidae
   Picus canus Gmelin, 1788
   Picus viridis Linnaeus, 1758
   Dendrocopos major (Linnaeus, 1758)
   Dendrocopos syriacus (Hemprich and Ehr., 1833)
   Dendrocopos medius (Linnaeus, 1758)
   Dendrocopos minor (Linnaeus, 1758)

V. Order: PASSERIFORMES

5. Family: Troglodytidae
   Troglodytes troglodytes (Linnaeus, 1758)
6. Family: Turdidae
   Erithacus rubecula (Linnaeus, 1758)
   Turdus merula Linnaeus, 1758
   Turdus philomelos Brehm, 1831
7. Family: Aegithalidae
   Aegithalos caudatus (Linnaeus, 1758)
8. Family: Paridae
   Parus palustris Linnaeus, 1758
   Parus ater Linnaeus, 1758
   Parus caeruleus Linnaeus, 1758
   Parus major Linnaeus, 1758
9. Family: Sittidae
   Sitta europaea Linnaeus, 1758
10. Family: Certhiidae
    Certhia familiaris Linnaeus, 1758
    Certhia brachydactyla Brehm, 1820
11. Family: Corvidae
    Garrulus glandarius (Linnaeus, 1758)
    Corvus monedula Linnaeus, 1758
    Corvus corone Linnaeus, 1758
12. Family: Sturnidae
    Sturnus vulgaris Linnaeus, 1758
13. Family: Passeridae
    Passer domesticus (Linnaeus, 1758)
14. Family: Fringillidae
    Fringilla coelebs Linnaeus, 1758
    Carduelis chloris (Linnaeus, 1758)
    Carduelis carduelis (Linnaeus, 1758)
    Coccothraustes coccothraustes (Linnaeus, 1758)

3. RESULTS

It was found from the 93 observation points that, of the 33 native bird species, less species were breeding in

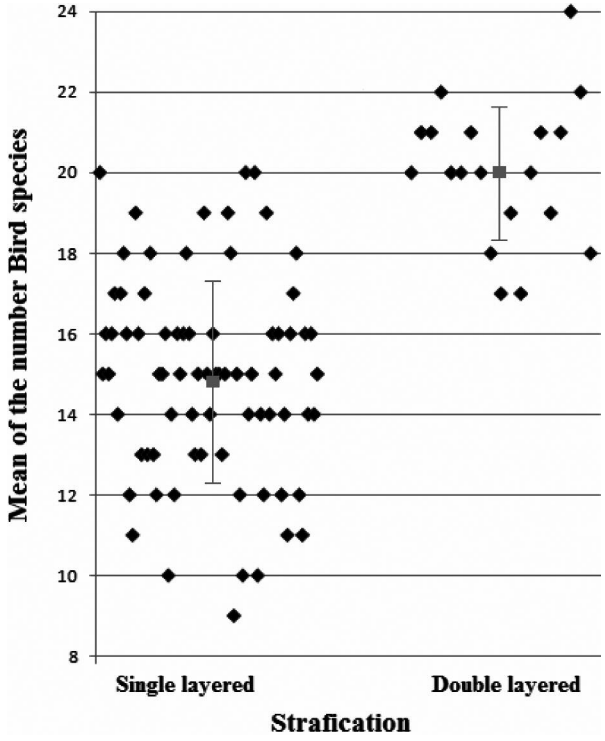

Fig. 2

Average number of bird species according to stand type.

Durchschnittliche Vogelartenzahl nach Bestandstyp.

single layered stands than there in two-layered ones ($n = 93$, $p = 0.05$). In the two-layered stands, the breeding bird counts are $m = 20.05 \pm 1.731$, whilst in the single layered ones the counts are 14.82 ± 2.480 (*Figure 2*). The Homogeneity of Variances was $p = 0.070 > 0.050$, showing that the samples were from the same bird community. Whilst the ANOVA analysis $p = 0.000 < 0.050$, shows a significant difference in the number of breeding bird species between single and double stand layers.

4. DISCUSSION

A consensus has emerged on the importance of tree height and vertical stratification for bird variety (ARCHAUX and BAKKAUS, 2007). Vertical (FERRY and FROCHOT, 1970) or horizontal stratification of forest vegetation is generally considered positive for forest avifauna, mainly because stratified stands offer a larger number of ecological niches (LEBRETON et al., 1987).

The two year study by ARSLANGÜNDOĞDU (2005) showed that the main effect on the variety of bird species was from the presence or absence of tree stand layers. Of lesser importance was the age of the stand. Some studies have suggested that tree variety is of importance (JAMES and WAMER, 1982). This is not supported by ARSLANGÜNDOĞDU (2005), whose study showed tree variety to have very small effect on the variety of bird species.

In this study we have looked only at the effect of tree stand layers on the variety of bird species and shown that there is a clear difference in the number of bird species between single layer and double layer tree stands. Double layer stands have older trees in their upper layer and younger ones in their lower layer offering a greater choice of micro habitat for the communities of organisms upon which birds depend for food, and a greater choice of nesting habitats. We likewise conclude from our study, that multiple tree stand layers contain more nesting native bird species and that both vertical tree stand layers are positive for avifauna.

5. SUMMARY

This study aims at determining the effect of tree stand layers on the variety of bird species and show that there is a clear difference in the number of bird species between single layer and double layer tree stands. The Belgrade Forest, where the research was carried out, covers 5408.29 hectare and is located in the north of the Istanbul province in the Marmara Region, between 28°53'25" and 29°00'55" eastern longitude and 41°09'44" and 41°14'40" of northern latitude. The study area is a protected natural forest in the north-west Turkish Castanetum-Fagetum transition zone, with oaks accounting for almost 75 % of the forest flora.

To count all the observed birds in this study for five years the "point count method" was used. At each point every bird species, their numbers and reproduction information for the resident birds was collected for 10 minutes once a month from March to June. The sampling points, 93 in number and 750 m apart in every direction, were spread over the whole study area. The 93 observation points were classified into 15 stand types. One-Way ANOVA was used to investigate whether the one independent variable of the tree stand layers has any effect on the dependent variables of bird species. It was found that from 33 native bird species less species were breeding in single layered stands than in two-layered ones ($n = 93$, $p = 0.05$). In the two-layered stands, the breeding bird counts were $m = 20.05 \pm 1.731$, whilst in the single layered ones the counts amounted to 14.82 ± 2.480. According to our results there is a significant difference in the number of breeding bird species between single and double stand layers. The multiple tree stand layers contain more nesting native bird species and are therefore esteemed to have a positive effect on avifauna.

6. ZUSAMMENFASSUNG

Titel des Beitrages: *Die Auswirkungen der Bestandesschichten auf heimische Vogelarten in Belgrader Wald, Istanbul, Türkei.*

Diese Studie möchte den Einfluss von Baumbestandesschichten auf die Artenvielfalt der dort vorkommenden Vögel feststellen und zeigen, dass es einen deutlichen Unterschied der Anzahl der Arten zwischen einschichtigen und zweischichtigen Baumbeständen gibt.

Der „Belgrader Wald" liegt im Norden der Provinz Istanbul in der Marmara Region auf 28°53'25"–29°00'55" östlicher Länge und 41°09'44"–41°14'40" nördlicher Breite.

Das Untersuchungsgebiet liegt in einem Waldschutzgebiet der Nord-West-Türkischen Castanetum-Fagetum-Übergangszone, in der Eichen 75% des Waldes ausmachen. Zur Zählung der in dieser 5-jährigen Studie beobachteten Vögel wurde die „Punkt-Stopp-Methode" gewählt. An jedem Zählpunkt wurden alle vorkommenden Arten, ihre Anzahl und Reproduktionsinformation in den Monaten von März bis Juni einmal im Monat für 10 Minuten erfasst. Die 93 Stichprobenpunkte, jeweils mit 750 m Abstand in jede Richtung zueinander, waren über das gesamte Untersuchungsgebiet verteilt und in 15 Bestandstypen unterteilt. Zur Feststellung, ob die einzige unabhängige Variable der „Baumbestandesschichten" Einfluss auf die abhängigen Variablen der Vogelarten hat wurde eine „Einweg-ANOVA" genutzt. Das Ergebnis war, dass von 33 heimischen Vogelarten weniger in einschichtigen Beständen als in zweischichtigen ($n = 93$, $p = 0.05$) brüteten. In den zweischichtigen Bestände beliefen sich die gezählten Brutvögel auf $m = 20.05 \pm 1.731$ während sie sich in den einschichtigen auf 14.82 ± 2.480 beliefen. Nach unseren Ergebnissen gibt es daher einen signifikanten Unterschied der Anzahl der Brutvögel zwischen einschichtigen und zweischichtigen Beständen. Mehrschichtige Baumbestände besitzen mehr nistende heimische Vogelarten und sind daher in Ihrer Wirkung auf die Avifauna als positiv einzuschätzen.

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