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How to get by in a floodplain forest: the reaction to forestry as evidenced by the Tawny owl *Strix aluco*

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Abstract – To establish a management plan that does not contribute to species loss, it is essential to fully understand the response by organisms to human impacts. Forests on floodplain of rivers face several threats. One of them is intensive forestry. Along the Danube River, forests are changing rapidly, which affects the composition of species. Due to short rotation logging, cavity-nesting birds are restricted by the lack of old trees. Thus, in our study we intended to identify the habitat preferences of the Tawny Owl, in areas with populous plantations and fragments of natural softwood forest. We measured 28 environmental parameters (type of forest, age, perimeter of trees, height and coverage of herbaceous layer, shrub and trees in proper categories) in Tawny owl territories as well as outside these territories. By using discriminant analysis with forward stepwise method we found significant difference in overall vegetation structure inside and outside the territories. The Tawny owl remains close to the oldest (older than 26 years) and largest trees (with perimeter greater than 161 cm), which are common for patches of natural forest. However, the owl seems to avoid monocultures with small trees and larger cover of tall grass and shrubs. Hence we concluded that the natural forests should be maintained as a fundamental element in the floodplain areas. Furthermore, based on our results, the priority of managing the populous plantations should be in a way that at least few old trees would remain in logging units.

Key-words: floodplain forest, Tawny Owl, habitat preference.

INTRODUCTION

The Tawny Owl *Strix aluco* is a common species that can tolerate a wide range of environmental conditions (Sánchez-Zapata & Calvo 1999, Coles 2000). Accordingly, the owl occupies a wide range of territories from mountainous habitats to lowlands (Sánchez-Zapata & Calvo 1999, Vrazec & Saveljic 2006, Balboaca *et al*. 2013), while the highest densities are reached in deciduous forests (Southern 1970, Hudec 2005, Tejkal 2010). Similarly, in the lowlands of Slovakia, the Tawny Owl population is concentrated in floodplain forest along the Danube, Latorica and Tisa rivers (Pačenovský & Obuch 2002). The abundance of the Tawny Owl in these areas oscillates around 1.5 male/1 km^2 (Lešičko 2005, Nagl *et al*. 2013).

The natural conditions in the inland Danube delta are optimal for the growth of softwood floodplain forests (Šimo, 1972), which are evaluated as habitats of European importance (Viceníková & Polák 2003). This area is assigned as an Important Bird Area; however, it is also one of the most endangered sites in Slovakia (Kaňuch 2002). The hinterland of the Danube delta is highly influenced by regulations on the river and intensive forestry (Kollár 2000, Kocinger 2005, Bohuš *et al*. 2011). Floodplain forests are mostly turned into Poplar monocultures (Kollár 2000, Bohuš *et al*. 2011) and a short rotation logging (30 years) is mainly applied, leading to a shortage of nesting possibilities for cavity-nesting birds. These trees need to be at least 20 years old to grow large enough to provide nesting cavities or eventually becoming dead tree stumps (Bohuš *et al*. 2011). While there is evidence, that Tawny Owls incorporate stands of older trees into their territory, as they require old trees with large cavities for nesting (Southern 1970, Wiacek *et al*. 2010), intensive forest management counts as an endangering factor for this species (Pačenovský & Obuch 2002). Moreover, the area is managed by clearcutting forestry, the most radical form of logging for organisms (Pišút 1993). There is evidence that Tawny Owls can remain in the areas that have been cleared, but pockets of old forest are still required (Wiacek *et al*. 2010). Consequently, the presence of clear-cuts, re-growing forest glades and density of vegetation affects hunting possibilities and reasonable prey composition of the Tawny Owl (Balčiauskiene & Dementavičius 2006, Capizzi 2000). In

floodplain forest, owls usually hunt for small mammals although abundance of latter may fluctuate (Wijnhoven *et al*. 2005). Nevertheless, rodents can shift into the forest from nearby fields (Tew & MacDonald 1993) or vice-versa. The owl is not strictly restricted to the forest area. It can hunt in adjacent agricultural land (Obuch 2003). In special cases, rodents can be replaced as the important food item (Jedrzejewski *et al*. 1996, Gstir 2012) by amphibians (Balčiauskiene & Dementavičius 2006, Zawadzka & Zawadzki 2007). Owls may also visit areas with standing water, where frogs are seasonally concentrated (Obuch 2003).

Forest raptors are highly sensitive to changes in the forest structure (Fuller 1996, Niemi & Hanowski 1997). Their reaction to intensive forestry is needed to be clarified comprehensively. Species such as the Tawny Owl may be used as a flagship or umbrella species, relevant for suitable management establishment (Marchesi *et al*. 2006, Kappers *et al*. 2013). Thus, we aimed to identify the Tawny Owl's preferences in monoculture area with patches of natural floodplain forest.

MATERIAL AND METHODS

Study area

The research was conducted along the left-side Danube river floodplain, south-western Slovakia. The study area is located around GPS coordinates 47° 53´ 18.9"N, 17° 28´ 21.0"E, between 1,826 and 1,823 rkm (Fig. 1). It forms part of the Protected Landscape Area Dunajské luhy. From the phytogeographic view, it is a region of Pannonian flora – *Pannonicum*. Natural floodplain forests are present in the form of fragments, covering 28% of the plot. Dominant trees in these areas are Willows (*Salix* spp.) and Poplars (*Populus* spp.), a few Ash (*Fraxinus excelsior* and *Fraxinus angustifolia danubialis*), Elms (*Ulmus minor* and *Ulmus laevis*), Maples (*Acer* spp.), Oaks (*Quercus* spp.) and Alders (*Alnus glutinosa*). The trees with a diameter larger than 160 cm are distributed irregularly in the plot. The remaining 72% of the plot is made up of a mosaic of uniform patches mostly with cultivated hybrid Poplar trees (*Populus* x *euroamericana*). Shrub layer is mostly composed of Elderberry (*Sambucus nigra*) and Ivy (*Hedera helix*), which increases the cover of both scrub and herb layer. In the two forest types, the herb layer is assembled and dominantly composed of European Drewberry (*Rubus ceasius*). The entire study area is devoid of any artificial nest-boxes.

Data collection

This study was carried out from 18th January to 3rd March 2014. The study area was visited 10 times, always from 4:05 CET to 6:35 CET. The Tawny Owl's vocal activity is at its highest at this time (Glurtz 1989, Brinzík *et al*. 2005, Lešičko 2005). A territory-mapping method and

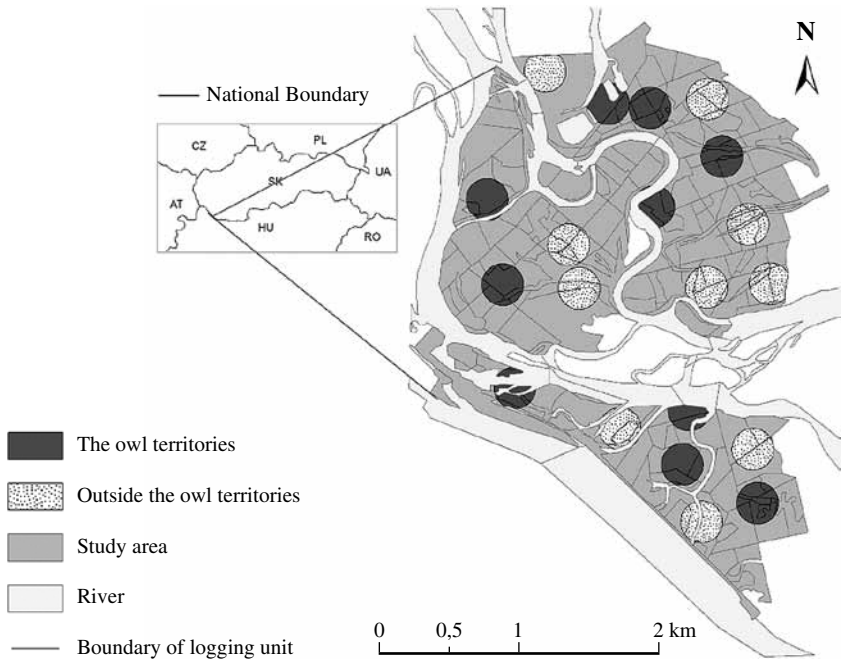

Figure 1. Study area in Danube branch system, south-western Slovakia (basemap NLC Zvolen, 2015).

point count method were used to determine the owl's calling locations. Observation points were set every 300 m. Seven minutes duration were spent at each listening point. The owls were not enticed to call back with the use of prerecorded calls. For the overall registration of the owls, we marked the direction and the place from where the owls called, on a map. We collected altogether 28 environmental parameters (Tab. 1) from randomly selected phytocenological squares with an area of 400 m^2 (20 × 20 m) on every forest unit and riparian vegetation.

Data Processing and Statistics

All the field data was transferred to a software ArcGIS 10.01. From the 26 recordings of male Tawny Owl, we randomly selected ten, so that each call corresponded to the territory of different male. However, males in their respective territories were not marked, therefore, the identity of each owl could not be determined and so it was not possible to establish if the calls originated from different individuals or not. Subsequently, 10 points were randomly selected from regions in the study area that were outside Tawny Owl territories. Around all of these points we created a circular buffer zone with a radius of 150 m. The resulting 20 circular areas did not overlap each other. Wetlands were not included in the analysis. Then, the exact size of the areas covered by each observed variable inside particular circular area were identified based on the attribute table of circular areas. To differentiate the areas in the owl's territories and random surfaces we used a discriminant analysis with forward stepwise method. Data were processed using the statistical program Statistica 7.

RESULTS

Overall we recorded 10 Tawny Owl males at a density of 1.3 males/1 km^2. A significant difference was found in the overall vegetation structure between the owl territories and the forest parts outside the territories ($F = 4.121$; $p < 0.0167$). Discriminant analyses confirmed eight environmental parameters which caused the most differences between compared forest parts (Tab. 2). The monoculture forest, height of the herbaceous layer in vertical intervals (1–1.5 m, 1.5–2 m and more than 2.5 m), height of the

Table 1. Measured environmental factors and their categories.

Environmental factor	category I	category II	category III	category IV	category V
type of forest	monocultures	natural	riparian		
age (years)	0 – 15	16 – 25	26 – 35	36 +	
perimeter of trees (per) (cm)	0 – 40	41 – 80	81 – 120	121 – 160	161 +
herbaceous coverage (herb_cov) (%)	< 50	50 +			
shrub coverage (shrub_cov)	whole				
canopy coverage (can_cov)	< 50	50 +			
herbaceous layer height (herb_high) (m)	0 – 1	1 – 1.5	1.5 – 2	2 – 2.5	2.5 +
height of shrub (shrub_high)	3 – 4	4 – 5	5 – 6		
height of the canopy (tree_high)	6 – 10	10 –15	15 – 20	20 +	

Table 2. Environmental factors identified by discriminant analyses as factors characterizing major differences between owl territories (ter) and parts of the forest outside the owl territories (out) in the Danube floodplain forest. For explanation of the factor abbreviations see Tab. 1.

	Wilks' Lambda	**F-remove** (1,11)	**p-level**	**aver_ter** (m^2)	**stdev_ter**	**aver_out** (m^2)	**stdev_out**
herb_high_2.5+	0.7059	20.0361	**< 0.001**	3080.7	5590.73	11731.1	13000.02
herb_high_1-1.5	0.5430	12.8753	**0.004**	13003.7	15685.38	24271.1	21031.19
monoculture	0.2668	0.7287	**0.411**	30311.2	22195.99	48573	23695.27
herb_high_1.5-2	0.5150	11.6455	**0.006**	33473.8	24847.91	19404.3	22280.81
herb_cov_50%+	0.3304	3.5269	**0.0871**	47875.9	25140.48	45599.8	20870.74
shrub_high_5-6	0.3799	5.7025	**0.0359**	381.4	1206.02	7250.2	17115.44
per_161+	0.3034	2.3420	**0.1541**	17116	23188.12	5223.5	9923.6
shrub_cov	0.2743	1.0625	**0.3247**	5950	11990.13	6721.1	14095.98

shrub layer in vertical interval 5–6 m and the overall cover of the shrub layer were identified as those parameters most characterizing of the forest outside the owl territories. On the other hand, the diameter of trees larger than 160 cm and the cover of the herbaceous layer greater than 50% tend to be factors associated with the owl territories (Fig. 2).

In general, owl territories can be characterized as forested areas with dominating mature-trees, with their bases covered with small herbs and shrubs. The most prominent parameters characterizing owl territories tend to be areas with mature trees of over 26 years of age and their diameter greater than 160 cm (Fig. 3). From all the forest types studied, it was noted that the Tawny Owl favours natural forests. Monocultures and study plots with smaller, younger and thinner trees seem to be rejected by owls. Moreover, forest plots outside the owl territories were characterized by greater cover of tall grass and shrubs.

DISCUSSION

The Danube natural floodplain forests in Slovakia are fragmented by monocultures of hybrid Poplars embedded in agricultural landscape matrix. The Tawny Owl is the most abundant owl here, while-fragmented natural forests provides a suitable habitat (Redpath 1995, Wiacek *et al*. 2010). We recorded 1.3 males/1 km^2. This corresponds with the findings by Lešičko (2001), who fourteen years ago recorded a density of 1.4 male/1 km^2 in an equal-area. Similarly, Nagel *et al*. (2013) recorded 1.6 male/1 km^2 in the nearby WWF reserve March-Auen.

Our study showed that the distribution of the Tawny owl is not accidental. In variegated forests the owl remains close to natural forest more than expected from random samples. Out of 28 environmental parameters tested we tried to determine the ones that are decisive for the Tawny Owl. First of all we took into consideration the owl's nesting requirements and hunting behaviour as determining factors when identifying the owl's territory. In some instances only one of the two behaviours was observed. If we take into account the size of home ranges (Redpath 1995, Sunde & Bolstad 2004) and the size of the area that we characterized (radius of 150 m), it is possible that we did not cover both of them. Moreover, the chance of incorporating the requirements of both habitats is lowered by expected movements caused by seasonality of the prey (Obuch 2003, Folk & Bělka 2005, Zawadzka & Zawadzki 2007, Gstir 2012).

Tawny owl territories were characterized by the cover of herbaceous layer larger than 50% and trees with diameter larger than 160 cm. Such large trees provide a variety of nesting-conditions, e. g. tree cavities, which are essential for a stabile population of cavity-nesting Tawny Owls (Pačenovský & Obuch 2002, Folk & Bělka 2005), the installation of nest boxes does not completely fulfil this requirement (Wiacek *et al*. 2010). As a consequence, we assume that the aim of the owls recorded was to obtain a safe nest-site. In this case, the herb layer being larger than 50% can be only incidental and therefore it is irrelevant to

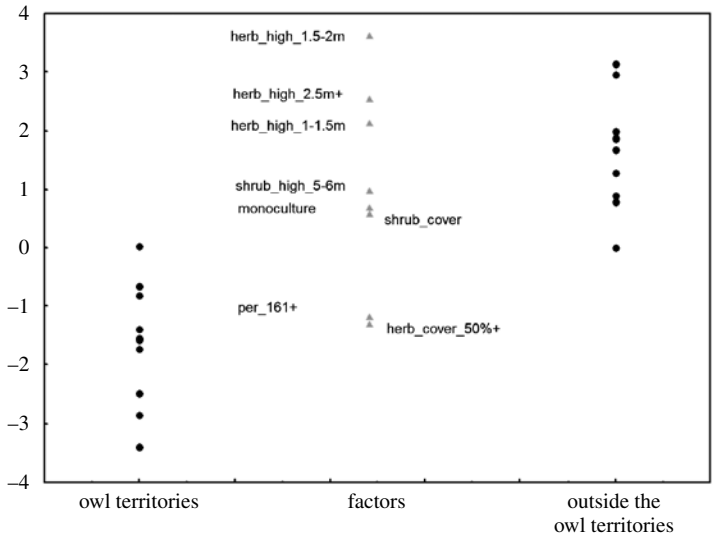

Figure 2. Major differences in habitat characteristics between owl territories and parts of the forest outside the owl territories. To explain the factor abbreviations see Tab. 1.

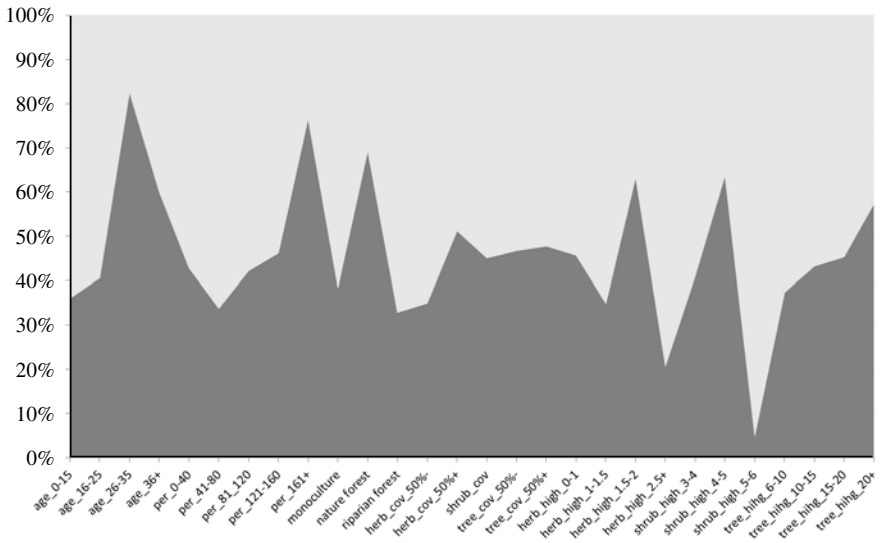

Figure 3. Characteristics of the owl territories (dark) and the parts of the forest outside the owl territories (light) in the Danube floodplain forest using the proportions of measured environmental factors in the owl territories and outside the territories. To explain the factor abbreviations see Tab. 1.

consider its effect while hunting. Additionally, we admitted that large trees provide important roosting places for adults as well as for young owls.

Those areas in which the Tawny Owl was not recorded were characterized as monoculture forests with high shrub layer in vertical interval of 5–6 m, the overall cover of the shrub layer, height of the herb layer in vertical intervals 1–1.5 m, 1.5–2 m and more than 2.5 m. In other words, these are homogenous areas with high shrubs and herbs. With respect to short rotation cycle applied in the managed areas, monocultures are suitable for cavity-nesting birds only for a period of 10 years (from their 20th year up to their removal age) (Bohuš 2011). Furthermore, if we take into account that for whole monoculture area only a part is of sufficient age, nesting possibilities are quite limited. Since there is evidence that the Tawny Owl avoids high vegetation while hunting (Lešičko 2003) and optimal vegetation structure is scarce, which allows easy access for the owl to the forest floor (Gstir 2012), we do not assume that this habitats can be effectively used for hunting. Thus, we consider that the monocultures in our study do not fulfil requirements of the Tawny Owl neither for nesting nor hunting.

To conclude, although the Tawny Owl inhabits areas with various conditions (Galeotti 1990, Vrezec & Tome 2004a, 2004b, Marchesi *et al*. 2006, Kajtoch *et al*. 2015), we investigated that the owl prefers remaining closer to natural stands. Our study point out the importance of natural floodplain forests, which is a core area for the Tawny Owl. Considering this, natural forests should be maintained and under the legislative protection. The monocultures of hybrid Poplar can be utilized only slightly by this species, so the maintaining of mature trees in logging units is essential.

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