

Can clearcuts increase bird species richness in managed forests?

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ABSTRACT: Clearcuts are one of the results of forest management. The aim of this study was to assess the effect of clearcuts on bird communities in a managed forest in Western Poland. I applied the method of point transect counts. 20 points were located near clearcuts (less than 100 m from the nearest clearcut) and 25 points in the forest interior. In total, 36 bird species were recorded. On average, I found 9.20 bird species at points located near clearcuts and 6.72 species at points situated in the forest interior, and the difference was significant. The cumulative number of bird species for a given number of sampling points in the vicinity of clearcuts was higher than in the forest interior. The obtained results indicate that in managed, even-aged forests the generation of clearcuts can lead to an increase in local bird species richness.

Keywords: forestry; diversity; forest conservation; rarefaction; gaps

One of the numerous effects of forest management is creating open areas (clearcuts) inside a forest complex. The habitat in clearcuts differs significantly from the closed canopy forest with regard to microclimate (e.g. air and soil moisture and temperature, wind speed) and vegetation structure (mainly height and density of plants) (AUSSENAC 2000). Consequently, forest canopy gaps, including clearcuts, are inhabited by the specific fauna that is composed of both typical forest species which come from the surrounding forest and early succession and grassland species which typically live in open habitats (BRAZAITIS et al. 2005). Furthermore, clearcuts can affect animal communities in adjacent forest (RENKEN et al. 2004). Despite the fact that forest management including clearcutting has commonly been applied for several centuries, the impact of logging on biodiversity in managed forests is poorly understood. The aim of this study was to assess the effects of clearcut proximity on the species richness of managed forest bird assemblages.

The study was conducted in western Poland, in the Mieszkowickie Forest Complex (52°48'N; 14°20'E).

The Forest is ca 140 km² in size, pine stands prevail, some oak dominated patches also occur there. Timber is harvested by the logging of the compact area of old growth patch, and created clearcuts have ca 0.5–7 ha in size. Most of the clearcuts are fenced, with only man-made afforestation method applied. In some parts of the forest complex I established a network of survey points, distributed evenly in a grid of 500 × 500 m. Some of the points were excluded from the analysis if logging or harvesting activities were still carried out in their vicinity or if they were located near built-up areas. These factors could additionally affect bird communities and distort studied patterns. Bird counts were conducted in June 2006, at a total of 45 points using point transect counts with unrestricted detection radius (GREGORY et al. 2004). They were performed in the morning (5–10 am) and lasted 10 minutes per each point. Only the species composition was recorded (no abundance data were collected). 20 points were located near clearcuts and 25 in the forest interior (0 to 100 and 100 to 450 m from the nearest clearing edge, respectively). This division was based on an

assumption that the audibility of singing birds most often does not exceed 100 m, which was confirmed in the field during the counts.

The analysis of results was based on species accumulation curves. By help of the Estimates 7.5.1. program (COLWELL 2005), I performed 200 randomizations of sample selection, separately for points in the vicinity of clearcuts and those situated in the forest interior. Using the χ^2 test (with Yates correction if necessary) preference for proximity to a clearcut was evaluated for each species recorded during the counts. χ^2 values ranged from -7.5 to 13.5 . Preference for being close to a clearcut corresponded to a positive value of χ and avoidance of clearcuts to a negative one.

In total, 36 bird species were recorded. 30 species were found at the points that were distant from clearcuts and 34 species were found near clearcuts (Table 1). On average, at a point located far from a clearcut, 6.72 ($SD \pm 1.9$) species were recorded, as compared to 9.20 (± 2.2) near a clearcut, and the difference was statistically significant (t -test; $t = 4.04$; $df = 43$; $P = 0.0003$). The analysis based on rarefaction curves revealed differences in the expected number of species between the habitats (Fig. 1). The accumulation curve based on the near-clearcut counts lies above the other one, which indicates that higher species richness is associated with clearcuts but the differences were not significant (i.e. 95% confidence intervals for Mao Tau estimators overlapped; see COLWELL 2005).

The collected material is not large and therefore it should be treated as preliminary results. However, even such a small sample size allowed me to obtain

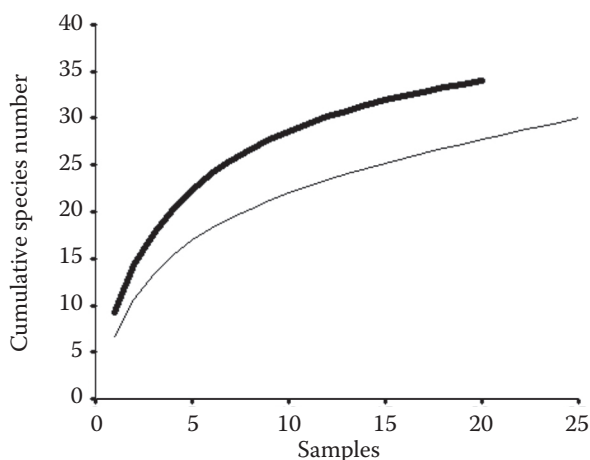


Fig. 1. Expected bird species richness obtained from 200 randomizations of the sequence of count points choice situated near clearcuts (thick line) and far from clearcuts (thin line)

significant results and draw conclusions concerning the effects of clearcuts on bird species richness.

In historical times the structure and species composition of primeval forest ecosystems were strongly affected by natural disturbances. The most important ones were hurricanes, fire, large herbivore pressure and outbreaks of insects (VERA 2000 but see also BOBIEC 2002; SVENNING 2002, and references therein). As a consequence, considerable forest areas were partially or completely destroyed and many canopy gaps were created. Natural canopy gaps created by the disturbing agents were inhabited by specific fauna and provided conditions suitable for regeneration of light-demanding trees, such as oaks and pines (AXELSSON, ÖSTLUND 2001; SVENNING 2002). By contrast, in managed forests natural disturbances and their consequences have been eliminated by foresters to a great extent, as they can dramatically decrease the volume and quality of harvested timber (especially fire and hurricanes). Due to foresters' practices, in the majority of forests natural canopy gaps and partially opened areas are uncommon and short-lasting. Hence, there arises an important question concerning modern managed forests: Can clearcuts created by timber harvesting substitute natural disturbances and be sufficient for species originally associated with these disturbances?

Clearcuts can have a twofold effect on avifauna. First, as mentioned above, many bird species which avoid dense, dark forest are seen on clearings and in their neighbourhood (FULLER 2000; GREENBERG, LANHAM 2001, these results). This results in a local increase in species richness and diversity of bird communities. Moreover, clearcuts can be used during the post-breeding period by mature-forest birds (VITZ, RODEWALD 2006). On the other hand, open areas are not utilized by many species that are forest specialists, thus decreasing the area of their preferred habitat. It has also been observed that some forest birds avoid proximity to clearcuts (e.g. LÖHMUS et al. 2005, these results) or avoid crossing them. This indicates that clearcuts are ecological barriers for these species and can decrease habitat connectivity and compactness (IMBEAU, DESROCHERS 2002; CREEGAN, OSBORNE 2005). It appears that in the case of managed forest avifauna, which was the subject of my study, clearcuts positively affected species richness. The observed pattern can result from specific features of managed forest, such as: lower tree species diversity (pine domination), lower average age of tree stand, lack of multilayer stands and uniformization of habitat mosaic (TOMIAŁOJC, WESOŁOWSKI 2004). These characteristics differ from those of natural forests, and apply also to my

Table 1. Bird species observed in 25 points laid in the forest interior and 20 points near clearcuts. χ^2 test was performed for species with $n \geq 5$, only significant results are given

Species	Number of points with species in			Significance	
	interior	clearcut	pooled	χ^2	P
<i>Fringilla coelebs</i>	25	19	44	1.28	
<i>Sylvia atricapilla</i>	14	13	27	0.37	
<i>Dendrocopos major</i>	13	13	26	0.77	
<i>Phylloscopus collybita</i>	11	13	24	1.97	
<i>Anthus trivialis</i>	9	11	20	1.62	
<i>Phylloscopus trochilus</i>	4	14	18	13.50	0.002
<i>Parus ater</i>	10	6	16	-0.48	
<i>Phylloscopus sibilatrix</i>	12	4	16	-3.80	0.051
<i>Emberiza citrinella</i>	3	12	15	11.52	0.001
<i>Erithacus rubecula</i>	9	6	15	-0.18	
<i>Turdus merula</i>	7	8	15	0.72	
<i>Troglodytes troglodytes</i>	12	2	14	-7.49	0.006
<i>Parus major</i>	7	3	10	-1.08	
<i>Turdus philomelos</i>	6	4	10	0.00	
<i>Sylvia borin</i>	1	8	9	6.89	0.009
<i>Certhia familiaris</i>	3	5	8	0.55	
<i>Columba palumbus</i>	2	5	7	1.32	
<i>Lullula arborea</i>	1	6	7	3.91	0.048
<i>Oriolus oriolus</i>	3	4	7	0.10	
<i>Sitta europaea</i>	3	4	7	0.10	
<i>Parus cristatus</i>	4	2	6	-0.02	
<i>Sylvia curruca</i>	1	4	5	-	
<i>Garrulus glandarius</i>	1	3	4	-	
<i>Turdus viscivorus</i>	1	2	3	-	
<i>Corvus corax</i>	1	2	3	-	
<i>Buteo buteo</i>	1	1	2	-	
<i>Dryocopus martius</i>	0	2	2	-	
<i>Parus caeruleus</i>	1	1	2	-	
<i>Phoenicurus phoenicurus</i>	0	2	2	-	
<i>Regulus regulus</i>	1	1	2	-	
<i>Apus apus</i>	0	1	1	-	
<i>Carduelis cannabina</i>	0	1	1	-	
<i>Columba oenas</i>	0	1	1	-	
<i>Cuculus canorus</i>	1	0	1	-	
<i>Ficedula parva</i>	1	0	1	-	
<i>Upupa epops</i>	0	1	1	-	

study site (unpublished data). These anthropogenic factors lead to lower bird species richness. If, however, such a poor even-aged forest becomes interspersed with clearings, the habitat heterogeneity increases and, in turn, enhances species richness and probably species diversity of forest bird communities. However, it has to be underlined that species richness is not a perfect proxy for habitat quality or habitat conservation value. As found by PRENDERGAST et al. (1993) species rich habitat patches are often devoid of rare species. Therefore, the effect of clearcutting on less common, rare and declining species must be assessed before the importance of clearcuts for preservation of forest biodiversity is declared. The response of rare species to timber harvesting and clearcutting is not well known and needs further research.

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Mohou paseky zvýšit druhovou diverzitu ptáků v hospodářských lesích?

ABSTRAKT: Paseky jsou jedním z důsledků hospodaření v lesích. Cílem studie je zhodnotit vliv pasek na ptačí společenstva v hospodářských lesích v západním Polsku. Byla aplikována metoda bodového transektu. 20 bodů bylo

lokalizováno blízko pasek (méně než 100 m od nejbližší paseky) a 25 bodů v interiéru lesního porostu. Celkově bylo zaznamenáno 36 druhů ptáků. V průměru bylo nalezeno 9,2 ptačího druhu na bodech lokalizovaných blízko pasek a 6,72 druhu na bodech v interiéru lesa. Rozdíly jsou statisticky významné. Celkový počet ptačích druhů na daný počet bodů v blízkosti pasek byl vyšší než v interiéru lesa. Získané výsledky indikují, že stejnověké lesní porosty na pasekách mohou lokálně zvýšit druhovou pestrost ptáků.

Klíčová slova: lesnictví; diverzita; ochrana lesa; zředění; narušené místo v porostu

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