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Ecological management forests in Lithuania

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Abstract

In ecological forest management, it is essential to find compromises between environmental and society's economic demands. In intensively managed forests dominated by clear-cutting, the effect appears beyond the management area. The effects can be seen up to 120m from the clear-cut area. A variety in the size of clear-cuts creates different conditions for birds and biodiversity and might be useful management tool to create a diverse environment on the landscape level. Thinning is a common silvicultural practice in most forests, we found negative short-term effect, however, we do not consider long-term negative impact on biodiversity. Tree retention and deadwood conservation during the final felling is an essential tool for the creation of long-term close-to-natural conditions in forests.

Key words: bird community, clear-cutting, deadwood, retention time, thinning.

Introduction

In Ecological forest management it is important to find compromises between the economic and ecologic demands of society. To favor biodiversity, we need to mimic the natural disturbance processes on the tree, stand, and landscape levels (Kuuluvainen et al. 2021). Tree retention and deadwood conservation are vital to conserve natural deadwood that supports a vast group of species related to old-growth elements. (Gustafsson et al., 2010). Forest managers are applying the principles of retention forestry to extensive regions of temperate and boreal forests in Europe (Kuuluvainen et al. 2019; Gustafsson et al. 2020). Landscape-level management focuses on designing landscape shapes and sizes on a temporal scale, making it an excellent tool for creating sustainable conditions for various bird guilds and other taxa (Brazaitis, 2003). In this paper we aimed to review studies on ecological forest management in Lithuania, it covers the landscape effect of clear-cut areas, survival analysis of green tree retention and deadwood distribution.

Methods

The study was fulfilled in south-west Lithuania, bordering temperate and boreal forests. Deciduous mixed forests (*Betula pendula, Populus tremula, Alnus glutinosa, Quercus robur, Carpinus betulus*) dominated with share of *Picea abies*.

Effect of clear-cutting on birds communities was studied within and outside clear-cut area. Birds were evaluated by two-time mapping method (Brazaitis and Kurlavičius, 2003) in naturally regenerating clear-cuts as well as standard line transect method by 200 m-length lines perpendicularly from clear-cut border further forest interior. Aiming to evaluate precommercial thinning we compare the data from thinned and not thinned natural

Figure 1. An aerial photography of the study sites including several tending treatments in forests. On left side extensive managed area by clear-cutting is combined with combined with continuous cover forest on right side. Details are referred to the next page.

regeneration up to 20 yrs old clear-cut areas. The effects of commercial harvest (thinning) were evaluated by standard line transect method fulfilled prior and after the thinning on the same routes.

Survival of biodiversity tree in clear-cut areas covered period of 1-6 yrs after clear-cutting (Figure 2). The studied parameters were consisted from tree species, diameter, development class, root nutrition area, distance from clear-cut edge evaluated, there were measured for every tree in clear-cut area. Finally, the analyses of deadwood were based on Lithuanian National Forest

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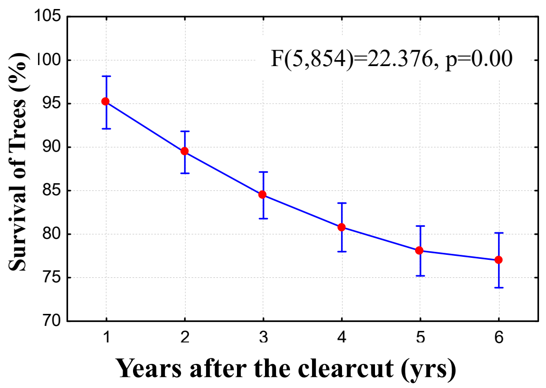

Figure 2. Survival of biodiversity trees within 6-yrs. after clear-cutting

Inventory data. We analysed how much deadwood volume of tree species was distributed within forest stands and landscape.

Results

Effect of clear-cutting on bird communities in forest landscapes

Clear-cutting affects forest bird communities in several ways at the landscape level. The edge effect appears in remained old forests in vicinity of the clear-cuts (Figure 3). The are several zones which consist of

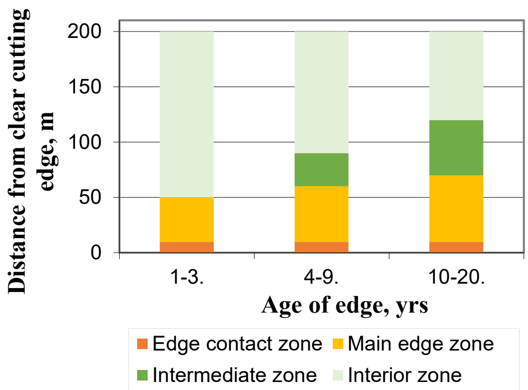

Figure 3. Edge effect development within 20 yrs after clearcutting further old forest

the edge contact zone, the main edge zone, and the intermediate zone. These zones develop within the first 20 years after clear-cutting, and they formed a belt around the felled area and increase from 50 m to 120 m in width by diminishing the forest interior.

Bird communities appear at the edges of these zones as the total relative abundance of birds is almost the same along the edge-interior gradient. However, bird species showed different preferences for the edge. They were classified into the following guilds: edge (7 species), the edge zone (12 species), the forest interior (7 species), and those that show no preference (7 species). The most sensitive species was the red-breasted flycatcher (*Ficedula parva*), which cannot be found in extensively managed landscapes, including suitable old stands due to the negative edge effect.

The clear-cut size determines the bird community structure in the regenerating area. The landscapes compared were 0.5 ha and 5.0 ha clear-cuts (the total clear-cut area was 100 ha). The 5.0 ha clearing showed a significantly higher number of species (43 to 18 species) but a much lower number of registered birds (650 to 950 pairs). With an increase in the size of the clear-cut area, the number of bird species increased, and the total density of the bird community decreased.

Influence of thinning on forest bird communities

We studied non-commercial and commercial thinning and their effect on bird communities. Bush stage stand thinning affects species number and community density (Brazaitis et al., 2005). We observed a 1.7-2.4 decrease in species number and a 1.6-2.4 decline in relative density; however, species number and community density did not return to the pre-thinning levels within seven years of the thinning. Maximum horizontal leaf density at 1.5 m height was the most critical factor affecting breeding birds. The total number of bird species after commercial thinning showed little change ($T=0.01$; $p<0.92$), however, total bird abundance decreased by 1.39 ($T=3.1$; $p<0.006$).

We analyzed 17 bird species for abundance, and 64.7% decreased, 29.4% increased, and 5.9% showed little change. The density of migrant birds significantly decreased ($T=3.48$; $p<0.0024$), sedentary birds increased slightly, but it was not statistically significant ($T=1.58$; $p<0.13$. We observed an adverse effect of thinning for vertebrate predators ($T=2.61$; $p<0.02$), invertebrate predators ($T=2.61$; $p<0.02$), and herbaceous ($T=2.76$; $p<0.02$) bird species searching for food in the canopy and air ($T=2.32$; $p<0.03$).

Survival of biodiversity trees in clear-cut areas

More than 75% of the biodiversity trees survived within six years after a clear-cut (Figure 3).

However, in 12% of the clear-cuts studied, less than 60% of the biodiversity trees survived. Surviving trees had a higher diameter ($F=2.77$; $p<0.06$), a higher tree development class, and the density was more than ten trees/ha.

The survival probability of trees was more than 0.8 if the root nutrition area was >100 m^2 (Figure 4). The most successful survivor trees were black alder (*Alnus glutinosa*), pedunculate oak (*Quercus robur*), and Scots pine (*Pinus sylvestris*). The most damaged tree species were silver birch (*Betula pendula*), common ash (*Fraxinus excelsior*), and Eurasian aspen (*Populus tremula*). The distance to the edge zone did not significantly affect tree survival.

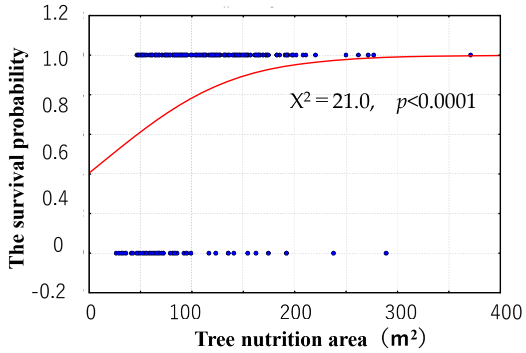

Figure 4. Tree-root nutrition area and survival probability of tree survival.

The extent of deadwood in Lithuanian forest landscapes

Dead trees and course woody debris have essential role in biodiversity in a forest ecosystem (Figure 5). The highest volumes of deadwood were in common ash (*Fraxinus excelsior*), Eurasian aspen (*Populus tremula*), and pedunculate oak (*Quercus robur*). The species with the lowest deadwood volumes were common hornbeam (*Carpinus betulus*), Scots pine, and Norway spruce (*Picea abies*).

Figure 5. An example of dead tree and course woody debris in a forest ecosystem.

The proportion of habitat over 80% was selected by birds where course woody debris attained above 20 m3/hr (Figure 6). The deadwood volumes were highest in stands older than 41 years, fully protected, and situated more than 350 m from roads. Evaluating the research area, almost 50% of it did not contain deadwood. However, the deadwood volume within 10% of the forest landscape exceeded 30 m^3/ha.

Discussion

As our study shows, forest management must decrease the amount of clear-cut edges in the forest landscape by cutting more solid shapes and larger clear-cuts for conservation purposes (Figure 2). Bird guilds of forest interior and area sensitive species often prioritized on conservation planning and at least 25 % of forested landscape must have solid unfragmented structure (Arroyo-Rodríguez et al. 2020).

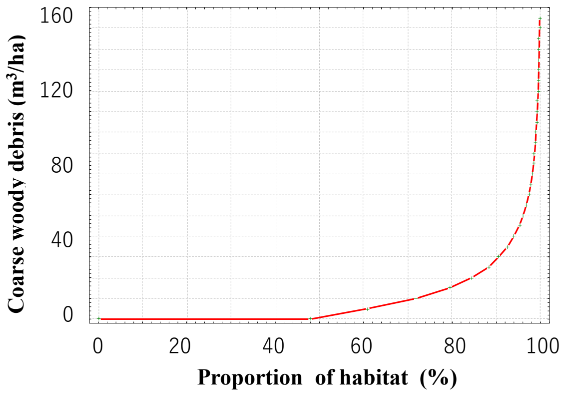

Figure 6. Proportion of habitat selected by birds (%) and volume of course woody debris.

Creating larger fragments of relatively evenly aged stands will be a suitable habitat for forest interior old-growth species in the future. The rest of forest landscape with the variety of age and structure of stands would serve mainly for generalist, edge affiliated species (Mortelliti et al. 2010, Carrara et al., 20015). Our modelling of bird communities in clear-cut areas shows there are no optimal size ensuring both, the highest species number and density. The landscape must contain variety in clear-cut sizes and it must mimic size distribution of prevailing natural disturbances (Angelstam, 1998; Kuuluvainen et al., 2021). As in our study region dominate deciduous mixed forests, disturbed by small scale events, so large number of small clear-cuts should be prioritized (Figure 2).

Bird community structure is affected by stand thinning's. Non-commercial thinning negatively affects bird species richness and density as well as commercial only density. It contradicts with other author findings (Artman, 2003, de la Montana et al. 2006, Gonsalves et al. 2018), where registered neutral or positive effect.

Our study assessed comparatively short-term effect of thinning, however long-term effect of both thinning types might be positive as: (I) non-commercial thinning increase significantly the longevity of semi-open habitat, important for most of typical bird species; (II) commercial thinning might enhance undergrowth and spatial diversity; (III) due to habitat tenancy some migrant birds avoid recently disturbed areas and might return after a while. Commercial thinning in similar yearly proportions allows for forest birds to adapt to such disturbance. Thinning significantly influences bird distribution, but we do not have enough evidence to conclude it affects population status. However, birds might have to change their breeding location inside the forest landscape which might increase mortality.

The retention of biodiversity trees should be well-planned gaining maximum efficiency. Green tree retention should be in patches and cover all forest ecosystem elements from the bottom to the top (Gustafsson et al., 2020). Patches should contain ecologically valuable elements (Figure 1): protected or rare species habitat, ant nest, small wet area, large nest, and hollow tree or small stream. These valuable elements can be damaged during management.

Figure 7. A cross section view of the study site in Fifure1 for inducing natural regeneration and remaining trees as a mother tree for producing seeds.

Unless we select trees has highest chance to survive (Figure 6), probability of dying is rather high. As shown in Figure 6, forest dwelling species that require more than 30 m^3/ha of deadwood are in a high-risk zone (Andren, 1994). The amount of deadwood gradually increases, but it is necessary for deadwood management. Due to salvage cutting, low volumes of deadwood were registered in vicinity of forest roads, suggesting strategy is needed to create for deadwood spatial conservation within forest landscape.

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References:

Andren, H. (1994) Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. Oikos, 71: 355-366.

Angelstam, P. K. (1998) Maintaining and restoring biodiversity in European boreal forests by developing natural disturbance regimes. Journal of vegetation science, 9(4): 593-602.

Arroyo-Rodríguez, V., Fahrig, L., Tabarelli, M., Watling, J. I., Tischendorf, L., Benchimol, M., and Tscharntke, T. (2020) Designing optimal human-modified landscapes for forest biodiversity conservation. Ecology letters, 23(9): 1404-1420.

Artman, V. L. (2003) Effects of commercial thinning on breeding bird populations in western hemlock forests. The American midland naturalist, 149(1): 225-232.

Brazaitis, G. (2003) Influence of clearcutting to deciduous forest bird communities. PhD Thesis, Department of Silviculture, Lithuanian University of Agriculture, Kaunas

Brazaitis, G., and Kurlavičius. P. (2003) Inventory of bird communities in small forest fragments. Ekologija, 4: 8-17 [In Lithuanian]

Carrara, E., Arroyo-Rodríguez, V., Vega-Rivera, J. H., Schondube, J. E., de Freitas, S. M. and Fahrig, L. (2015) Impact of landscape composition and configuration on forest specialist and generalist bird species in the fragmented Lacandona rainforest, Mexico. Biological Conservation, 184: 117-126.

De la Montana, E., Rey-Benayas, J. M. and Carrascal, L. M. (2006) Response of bird communities to silvicultural thinning of Mediterranean maquis. Journal of applied ecology, 43(4): 651-659.

Gonsalves, L., Law, B., Brassil, T., Waters, C., Toole, I. and Tap, P. (2018). Ecological outcomes for multiple taxa from silvicultural thinning of regrowth forest. Forest Ecology and Management, 425: 177-188.

Gustafsson, L., Kouki, J., and Sverdrup-Thygeson, A. (2010) Tree retention as a conservation measure in clear-cut forests of northern Europe: a review of ecological consequences. Scandinavian Journal of Forest Research, 25(4): 295-308.

Gustafsson, L., Bauhus, J., Asbeck, T. et al. (2020) Retention as an integrated biodiversity conservation approach for continuous-cover forestry in Europe. Ambio 49: 85–97.

Gustafsson, L., Hannerz, M., Koivula, M., Shorohova, E., Vanha-Majamaa, I., and Weslien, J. (2020) Research on retention forestry in Northern Europe. Ecological Processes: 9(1): 1-13.

Kuuluvainen, T., P. Angelstam, L. Frelich, K. Jogiste, M. Koivula, Y. Kubota, B. Lafleur, and E. Macdonald. (2021) Natural disturbance-based forest management: Moving beyond retention and continuous-cover forestry. Frontiers in Forests and Global Change, 4: 629020.

Kuuluvainen, T., Lindberg, H., Vanha-Majamaa, I. et al. (2019) Low-level retention forestry, certification, and biodiversity: case Finland. Ecol Process, 8: 47.

Mortelliti, A., Fagiani, S., Battisti, C., Capizzi, D. and Boitani, L. (2010) Independent effects of habitat loss, habitat fragmentation and structural connectivity on forest-dependent birds. Diversity and distributions, 16(6): 941-951.