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Brief report

Impact of common silvicultural treatments on nest tree accessibility for Common Buzzard *Buteo buteo* and Goshawk *Accipiter gentilis*

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1. Introduction

Publications concerning forest-dwelling birds of prey often refer to the impact of cutting down or fragmentation of old stands on nesting by such birds, their hunting efficiency, as well as on the populations of their prey (Kennedy 1997, Widén 1997, Penteriani & Faivre 2001). Although some publications point out the dimensions and shape of trees suitable for nesting (e.g. Anonymous 1989, Speiser & Bosakowski 1989, Hubert 1993, Cerasoli & Penteriani 1996, Penteriani 2002), the problem has not yet been analysed from the viewpoint of various silvicultural practices that affect the shapes of individual trees.

While there is a steady increase in the area of forests under intensive economic exploitation, natural forests have been on a decrease (DeGraaf & Miller 1996). Silvicultural practices applied throughout intensively managed forests concentrate on production functions, i.e. on the marketable values of stands (Rykowski 1996). This process is particularly evident in Europe where because of the long time of human pressure "very few or even no forest areas can be regarded as strict virgin forest" (Larsson 2001), and most forests are only semi-natural (MCPFE 2003). Due to forestry practices, fixed harvest intervals (short rotation period) and the lack of natural disturbance regimes, managed forests are relatively uniform in tree species composition, size and spacing. In such forests animal species diversity and abundance are considerably lower than in natural ones, mainly because of the lack of structural complexity, which is positively associated with forest age (Hansen *et al.* 1991).

On a single-tree level, most management practices applied in forestry (the selection, shelterwood or even the clear-cutting system), eliminate – under sanitary cutting and thinning – individuals manifesting features undesirable from the perspective of silviculture. The process begins with seed management and continues throughout the growth phases of the stand, up to the age of felling. The seeds for artificial regeneration are collected from the finest seed bearers, featuring correct growth, straight trunks free of side branches and suitable shapes of crowns. As the stand grows, dying trees are eliminated, as well as those with defects such as bent or forked trunks. Also individuals with wide crowns or showing intensive lateral branch growth (so-called branchy "wolf" trees) are removed, as they take too much space and inhibit the growth of surrounding trees. Even though these trees are sometimes not cut down, they are nevertheless subjected to the practices of pruning, removing unnecessary branching, shortening excessively long stems and thinning dense whorls. In order to inhibit the growth of lateral branches and achieve faster growth of "pure" trunks, the stands are initially kept rather compact (e.g. the uniform system) and, in the uneven-age stands, the understorey is maintained in order to halt the growth of lower branches in the crowns of favoured trees (e.g. the irregular shelterwood system). The stands nearing harvesting age should consist of trees with long, straight stems, that are free of branches and with relatively narrow crowns, which nevertheless provide complete canopy cover (see Matthews 2001 for review).

There are good grounds for suspicion that all these practices promoting uniformity and production values of trees do not best serve the needs and requirements of forest raptors. This can result in the absence of nesting over fairly large patches of forest stands and reduction in density of most sensitive species. The important role of trees of a particular shape and structure has been shown both in raptor species (Reynolds *et al.* 1982, Speiser & Bosakowski 1989, Squires & Ruggiero 1996) and in other birds, especially cavity nesters (Newton 1994, Duncan 1997, Lõhmus 2003). The aim of this study was to find whether two common birds of prey species, Common Buzzard *Buteo buteo* and Goshawk *Accipiter gentilis*, more often select those trees which have a high probability of being eliminated by silviculture.

2. Study area and methods

The study was carried out in 2003 in the southern part of the Niepolomice Primeval Forest (NPF; 50°07' N, 20°23' E), a large forest complex, extending 10 to 30 km east of Kraków (southern Poland). This part of NPF (area of 88.7 km^2; henceforth referred to as "Coniferous forest") is a compact area of managed forest with predomination of moist mixed oak-pine forest (*Pino-Quercetum*). The dominating species in the tree layer is Scots Pine *Pinus sylvestris*. Oaks (*Quercus robur* and *Quercus petrea)*, Common Alder (*Alnus glutinosa)* and birches (*Betula* spp.) are minor components of the stands (Ćwikowa *et al.* 1984). The terrain is slightly undulating with an elevation in the 185 to 215 m range. The entire area is cut through by rather regular and dense network of drainage ditches. The climate in the area is typical of sub-mountain valleys and dells, with a predominance of continental effects (Klein 1984).

The area of NPF is under state forestry management. The prevailing forestry practise is clear-cutting with artificial regeneration. A significant portion of NPF (almost the whole southern part) is covered by pine monoculture of an even-age and single-storey structure. The mean age of pine stands is 66 years. Stands older than 50 years cover ca. 62% of the area.

In the search for nests a cartographic method was employed, with marking field observations on a map of forest stands in 1:20,000 scale (Król 1985). In the Coniferous forest, 17 active nests of Common Buzzard and 10 nests of Goshawk were found on pine trees in 2003. The following four parameters of nests and nest trees were determined: 1) the nest position on the tree; 2) the length of the trunk to the first crown branches (measured by a PM-5/1520 P SUUNTO height gauge); 3) presence or absence of tree shape deformation; and 4) width of the crown (measured on the ground with a measuring tape in N–S and W–E directions and then averaged).

The nests of Common Buzzard and Goshawk were analysed jointly, because the way they are established in trees are similar and the reported cases of their alternative use by these two species are frequent (Solonen 1984, Hubert 1993, Krüger 2002). The nest trees were then compared with 30 random trees selected with the use of a randomisation function of Idrisi32 software on the digital layer of the study area. Only pine trees in stands of a minimum 50 years of age were used as random trees (no nests of either of these two raptor species were found in younger stands). After geographical coordinates of the randomly drawn positions had been entered into a handheld GPS receiver, these places were identified in the field and the first tree found in each position was treated as the random tree.

3. Results and discussion

Out of 27 nests under consideration, 22 nests (81.5%) were established on pine trees liable to elimination under commonly applied silvicultural

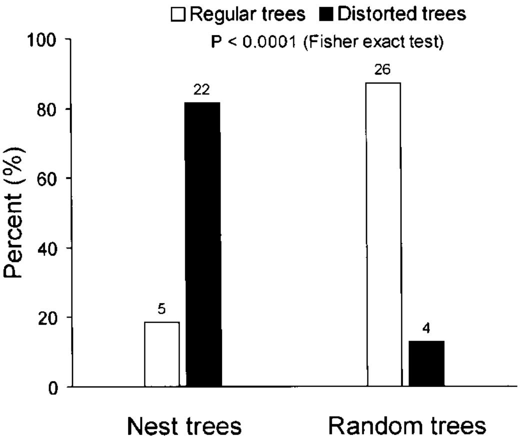

Figure 1. The proportion of distorted trees among nest trees of Common Buzzard and Goshawk compared with the proportions in a sample of random trees; Niepolomice Primeval Forest, 2003. Sample sizes are shown above the percentage bars, P-value indicates the statistical difference in the proportions of distorted trees and regular trees between the sample of nest trees and random trees.

practices in commercial forests (Matthews 2001). Such trees occurred significantly less often among the random trees (13% of trees, n = 30; Fisher exact test, P < 0.0001; Fig. 1). The mean width of the crown of nest trees was greater than that of random trees (on average 7.0 m for nest trees, SD = 1.6 and 6.1 m for random trees, SD = 1.6; Mann-Whitney U = 263.0, P = 0.023). The length of trunk without side branches was similar in nest and random trees (Mann-Whitney U = 373.5, P = 0.614).

The curvature of trees and the lack of the principal tree top are the most common defects developing mostly as a result of mechanical damage (e.g. by wind, snow, insects, fungal diseases and forest mammals; Larsson 2001, Czekalski 2002, Danielewicz & Maliński 2002). This sort of tree is considered undesirable under forest management principles. Out of 22 deformed nest trees studied in NPF, in 13 the deformation of the crown was combined with the absence of the principal tree top (59% of trees, n = 22; Fig. 2a, c and d) and in 9 trees only trunks were deformed (41% of trees, n = 22; Fig. 2b). The remaining 5 nest trees had a regular, healthy shape of the crown and trunk.

The absence of the principal tree top was most often accompanied by the presence of a whorl of lateral branches, providing an ideal support for a nest (Fig. 2c and d). In the case of nest trees with a horizontally bent crown, the nests were placed on the main trunk, and were firmly supported by crooked side branches that also sheltered them to some extent (Fig. 2a).

The most common place for a nest on a tree was the fork of the main stem (52% of nests, n = 27; Fig. 2c and d). Nests were also situated on lateral branches, both near the main trunk (15% of nests, n = 27; Fig. 2b, one case being on an undeformed tree), and at a distance of more than 1 m from the trunk (15% of nests, n=27; all cases on

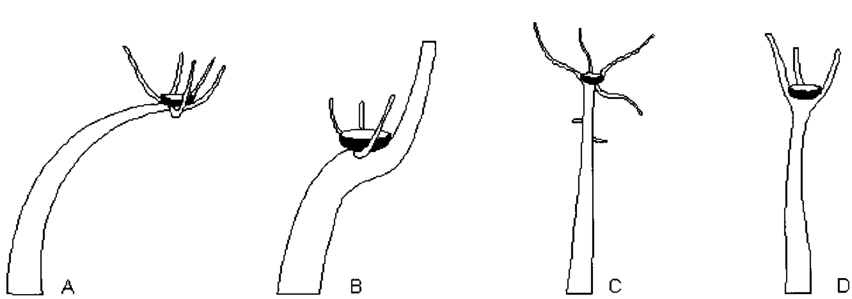

Figure 2. A schematic presentation of types of distorted pines used for nests by Common Buzzard and Goshawk in the Niepolomice Primeval Forest in 2003: (A) crown bent horizontally, with a nest placed directly on a trunk, surrounded by lateral tree top branches; (B) nest situated at the point where the main trunk bends, supported by lateral branches; (C) flat crown at the tree top, without a principal apical trunk, the nest supported by secondary top branches; (D) crown formed by several secondary branches taking over the role of the main tree top (the nest situated in a fork).

undeformed trees). Five more nests were situated on the deformed, horizontally crooked tops of tree crowns (18% of nests, n=27; Fig. 2a). The position at a fork of the main stem is referred to in literature as typical for the nests of large raptors (Cramp & Simmons 1980). Such massive, heavy structures do require stable and solid support in order to provide safety for broods (Anonymous 1989, Penteriani 2002). These requirements are met by thick boughs growing almost perpendicularly out from the main fork (Reynolds *et al.* 1982, Cerasoli & Penteriani 1996, Penteriani & Faivre 1997). Also the nests situated on lateral boughs, especially those set at more than 1 m from the main trunk are associated with the strongest horizontal branches.

Nests were placed on average in the lower 30% of the crown's height (SD = 21, n = 27). The position of nests in the lower part of the crown, above the branchless trunk enables easier manoeuvres in flight near the nest and better observation of its surroundings, which is essential for early detection of possible intruders and the protection of the nest (Reynolds *et al.* 1982, Speiser & Bosakowski 1987, Penteriani 2002). It is worth noting that the practices applied in commercial forests are only accelerating the natural process of self-pruning of the lower branches otherwise occurring in any naturally growing forest. The fact that the trunk without lateral branches constituted, on average, as much as 68% of tree's height (mean length of trunk = 16.4 m, SD = 3.7, n = 30 random trees) indicates that these practices, aimed at improving the log's shape and quality, are commonly applied in NPF.

Under sustainable forest management, attention should be paid to ensure nest sites for raptors. This can be achieved by leaving some fragments of forests for natural selection of trees, or by leaving single "negative" trees, such as branchy "wolf" trees or misshaped trees, meeting the criteria of preferred nesting trees for raptors. Taking into account the large size of raptors territories (e.g. in the Coniferous forest of NPF the mean distance between the two nearest concurrently occupied nests was 1434 m, SD = 796 m for Common Buzzard and 2257 m, SD = 572 m for Goshawk; Bielański, 2004, unpubl. data), the number of retained "negative" trees does not have to be large, and would not adversely affect the profit from timber production in commercial forests, especially when compared with the total costs of nature conservation measures (Janeczko 2002). It is recommended that some live trees be intentionally left in commercial forest stands to reach the old-growth stage or even to die and decompose naturally (cf. Cline *et al.* 1980, Franklin 1989, Hansen *et al.* 1991, 1995). These trees could be chosen from among "negative" trees especially those with straight trunks and deformed top of crowns, that is, trees particularly favourable for nesting of raptors (Fig. 2c). Such a solution would not affect timber production significantly, as some trees should be left anyway. These practices would result in increased diversity (including canopy genetic diversity) in managed forest stands which are frequently very homogenous (cf. Larsson 2001).

Results of this study should be interpreted with some scrutiny due to the small sample of analysed nest trees. Relationships between the shape of trees and their availability for raptors need to be verified in other forested areas. Also the crown structure and shape of nest trees used by Common Buzzard and Goshawk in managed forests should be compared with the characteristics of nest trees in natural forests. Studies in natural forests will allow recognition of the full spectrum of their habitat requirements (DeGraaf & Miller 1996).

There are alarming changes in the condition of forests in Europe, including increasing fragmentation, structural simplification, decrease of old-growth stands and the average stand age (DeGraaf & Miller 1996, Larsson 2001). Most of these processes are likely to continue and have negative impacts on biodiversity (DeGraaf & Miller 1996). In the Polish circumstances, clear-cutting and artificial regeneration methods are still widely practiced (70% and 93% of forest area respectively; Longauer 1999), and the proportion of mixed forests is relatively small (18%; MCPFE 2003). There are, however, some encouraging changes in approaches to silviculture, including recommendations to abandon clear-cutting and schematism as well as increase the role of natural regeneration. In the European perspective, forest management is changing towards more uneven-aged and mixed stands; at present, two-thirds of forests are regenerated naturally and plantations account only for 3% of the forest area (MCPFE 2003). These changes are to a large extent the result of the co-operation between researchers and forest managers, and will certainly have a positive effect on conservation and restoration of biological diversity in European forests.

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Metsätaloustoimien vaikutus hiirihaukalle ja kanahaukalle sopivien pesäpuiden määrään

Artikkelin kirjoittaja selvitti tutkimuksessaan, valitsivatko hiirihaukka ja kanahaukka pesäpuikseen sellaisia puuyksilöitä, joita metsätaloustoimien yhteydessä pyritään nimenomaan poistamaan metsistä. Tutkimus toteutettiin Etelä-Puolan laajoilla metsäalueilla vuonna 2002. Tutkimusalueen valtionmetsiä on uudistettu avohakkuilla ja istuttamalla uudistusaloille taimia. Kummankin tutkimuslajin pesät käsiteltiin analyyseissä yhdessä. Sekä hiirihaukka että kanahaukka perustuavat pesänsä puuhun samalla tavoin ja lajit käyttävät yleisesti toistensa pesiä.

Tutkimuksessa vertailtiin pesäpuita 30 satunnaisesti valittuun puuhun, joiden tuli olla vähintään 50 vuotiaita mäntyjä. Kaikkiaan 22 pesää (81,5 %) oli rakennettu mäntyihin, jotka olisi pitänyt poistaa metsistä käytössä olevien metsänkäsittelyohjeiden mukaisesti. Tällaisia puuyksilöitä oli satunnaisesti valittujen puiden joukossa huomattavasti vähemmän, vain 13,0 %. Pesäpuiden latvuston leveys oli suurempi kuin satunnaisesti valittujen puiden. Oksattoman rungon pituus ei eronnut pesäpuiden ja satunnaispuiden välillä. Vain viidessä pesäpuussa oli normaali elävä latvusto ja runko. Kuvassa 2 esitetään erilaisia puiden "pesäalustoja". Pääosa pesistä (52 %) sijaitsi puun latvassa. Pesien sijaintikorkeus oli noin 30 % latvuskorkeuden alapuolella.

Metsätalouden tulisi huomioida petolintujen pesäpaikkavaatimukset. Metsätalouskäytössä oleville alueille tulisi jättää luontaisesti uudistuvia metsälaikkuja. Lisäksi metsätalousohjeiden mukaisesti poistettavaksi määrättyjä puuyksilöitä tulisi jättää talousmetsiin petolintujen pesäpuiksi. Koska petolintujen reviirit ovat laajoja, tällaisia puuyksilöitä ei tarvita paljon.

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