CONSERVATION VALUE OF BEECH (*Fagus silvatica* L.)
DOMINATED STANDS IN “BUKAKA” NATURE RESERVE,
“SHUMENSKO PLATEAU”

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Abstract

Nature Reserve “Bukaka” was established in 1980. It includes one of the lowest-elevated preserved beech populations in Bulgaria. The stands in the reserve had a typical horizontal structure, being at the beginning of the understory reinitiation stage or transition phase of their development. Beech (*Fagus silvatica* L.) trees were up to 34 m and took dominant and co-dominant positions. Health condition of trees in the reserve was generally good: with no significant crown defoliation and stem rotting. The exception was the wild cherry. Almost all mature trees of this species were already dead. Regeneration potential of the stands in “Bukaka” Nature Reserve was high. Hornbeam reproduction was most abundant in 67 % of sample plots. It was entirely oppressed, however, due to the high canopy closure and better-developed beech reproduction. The latter dominated the understory, nearly one-third of the individuals being taller than 1 m.

The stands in “Bukaka” Nature Reserve only partially covered most of the “old-growthness” criteria. Their index of “old-growthness”, however, is expected to increase steadily in future, providing no major natural or human related disturbances to occur. No management activities but strict protection was recommended.

**Key words:** *Fagus silvatica*, conservation, regeneration

INTRODUCTION

Most environmentalists consider that conservation means preservation: setting aside of natural, unmanaged ecosystems as permanent, unchanging “ecological benchmarks”. In contrast, by conservation foresters generally mean the sustainable use of forest resources. The latter interpretation of conservation is the one adopted by the United Nations World Commission on Environment and Development (Kimmins, 1997; Wced, 1987).

The old-growth forests in the plateaus of North-eastern Bulgaria have almost entirely been cleared away. That is mainly because of the widespread use of clearcuttings and coppice systems. The vegetation cover of “Shumensko plateau” Nature Park has also been significantly altered. Seed originated oak (*Quercus* sp.) and beech (*Fagus silvatica* L.)
forests have been replaced by coppice ones. The share of Oriental hornbeam (*Carpinus orientalis* Mill.) dominated forests has increased. Stands in “Bukaka” Nature Reserve are the only exception, being mainly of seed origin and comparatively well preserved (Georgiev, 1993).

In Bulgaria, in the second half of XX century, nearly twenty nature reserves were set with the main objective to preserve some of the most valuable beech (*Fagus silvatica* L.) dominated forests. “Bukaka” Reserve, however, is the only one situated in Danube plain-hilly region (Georgiev, 1993; Turok et al., 2000; Pavlova, Bezlova, 2004). The objective of the study was to assess the main silvicultural characteristics of stands in “Bukaka” Nature Reserve connected with their current and future conservation value.

**MATERIALS AND METHODS**

The study area is located in Danube plain-hilly region of Bulgaria. The elevation varies between 400 m and 500 m. The average annual precipitation is 600 mm, predominantly occurring from April to July (Koleva, Peneva, 1990). The mean annual temperature is 10.5 °C, with July mean of 22 °C and January mean of 0 °C (Kyuchukova, 1983).

Nature Reserve “Bukaka” was established in 1980. It includes one of the lowest-elevated preserved beech populations in Bulgaria. During the period 1980-1999 the Reserve was set under protection regime. The active management was permitted again in 1999.

Three representative plots, each 1 ha in size, were sampled. The DBH, height and age of the trees in sample plots were measured by standard forest inventory methods (Nyland, 1996). The degree of defoliation was assessed according to Cadahia et al. (1991).

To quantify the regeneration, 3 transects, each 300 m long, were sampled. Seedlings and saplings were counted in 30 rectangular plots, measuring 2 x 4 m, installed at regular intervals along each transect, with the longest side of each plot perpendicular to the transect line.

Ordinary least squares (OLS) regressions were created using SPSS (SPSS Inc., Chicago, Illinois).

**RESULTS**

The stands in “Bukaka” Nature Reserve had a typical horizontal structure, being at the beginning of so-called understorey reinitiation stage (Oliver, Larson, 1996) or transition phase of their development (Nyland, 1996). Beech trees were up to 34 m in height and took dominant and co-dominant positions whereas the hornbeam rarely penetrated into the uppermost parts of main canopy. The other tree species such as wild cherry (*Prunus avium* L.), sycamore (*Acer pseudoplatanus* L.), field maple (*Acer campestre* L.), sessile oak (*Quercus petraea* Liebl.), silver lime (*Tilia tomentosa* Moench) and service tree (*Sorbus terminalis* Crantz.) altogether took less than 5% of total basal area in sample plots, the wild cherry being the most numerous.

Distribution of beech and hornbeam trees by diameter of breast height classes is shown on Fig. 1. For both species, the curves depict a close to normal distribution typical for the even-aged tree communities. The average diameter was 47 cm for beech and 31 cm for hornbeam. Forty-nine per cent of beech trees and 52% of hornbeam ones were characterized by diameters bigger than the average diameter of each species. The shape of the curve that depicts the frequency distribution of beech stems by relative diameter of breast height (Fig 2) resemble that of thinned even-aged beech forests, counted by Marinov at al. (1961). There is difference, however, in the right side of the curves, where the larger diameters are placed. Here, curve 1 is closer to curve 2 (Fig 2), which is peculiar to unthinned even-aged beech forests, characterized by DBH bigger than 32 cm (Marinov at al., 1961). If all tree species stems are taken together, then the tree frequency distribution by relative DBH classes in “Bukaka” Reserve is closer to that of unthinned even-aged beech forests (Fig 3).

Health condition of stands in the Reserve was generally good; with no significant crown defoliation and stem rotting. The exception was the wild cherry. Almost all mature trees of this species were already dead. Most of them had converted into snags. At places, where individual trees or groups of trees had died, gaps were formed. In most cases, diameter of the gaps was up to 0.5 times the height of surrounding trees.

Regeneration potential of stands in “Bukaka” Nature Reserve was high. That was proved in most of the sample plots. In half of them the number of seedlings (newly germinated seedlings were not counted) was more than 16,000 per ha (Fig 4). Hornbeam reproduction was most abundant in 67% of sample plots. It was entirely

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**Fig. 1.** Distribution of beech (*Fagus silvatica* L.) and common hornbeam (*Carpinus betulus* L.) trees by diameter of breast height (DBH) classes.
Fig. 2. Frequency distribution of stems by relative diameter of breast height in: (1) "Bukaka" natural reserve (beech stems only); (2) unthinned relatively even-aged beech forests, DBH > 32 cm (from Marinov et al., 1961) and (3) thinned relatively even-aged premature beech forests (from Marinov et al., 1961).

Fig. 3. Frequency distribution of stems by relative diameter of breast height in: (1) "Bukaka" natural reserve (all tree species stems); (2) unthinned relatively even-aged beech forests, DBH > 32 cm (from Marinov et al., 1961) and (3) thinned relatively even-aged premature beech forests (from Marinov et al., 1961).

Fig. 4. Frequency distribution of sampled plots by seedling density classes.

Fig. 5. Frequency distribution of sampled plots by beech sapling density classes.

oppressed, however, due to the high canopy closure (0.8-1.0) and the better-developed beech reproduction. Almost all hornbeam seedlings were less than 25-35 cm in height and aged up to 3-4 years. Beech reproduction dominated the understory, nearly one-third of individuals being taller than 1 m. The frequency distribution of sampled plots by beech sapling density classes is depicted in Fig. 5. Beech reproduction was best developed in gaps created by the death of individual trees and small groups of trees, the age and the dominant height of the individuals being most often up to 13-15 (20) years and 2.5-4 m respectively. Due to comparatively small size of gaps, most of the trees from the understory taller than 2-2.5 m had already diminished their height growth.

DISCUSSION

The following criteria are commonly employed in assessing the index of old-growthness and thus the current conservation value of a forest (Kinni, 1997): (1) trees' size or presence of very large trees; (2) trees' age or presence of very old trees; (3) forest structure; (4) species composition or existence of conditions that satisfies the habitat requirements of certain "old-growth dependant" wild life or plant species, and (5) accumulation of dead organic matter. Establishment of reserves of low and
average index value forests that will increase in old-growthness over time is sometimes necessary. This is especially applicable for regions where few forest with higher index of old-growthness are currently reserved.

The stands of “Bukaka” Nature Reserve cover the first of the above mentioned criteria, some trees being 33-34 m in height and over than 80 cm in DBH. It should be noted that the most productive beech forests in Bulgaria are generally situated at twice higher elevation: between 900 and 1300 m.

The age of six beech trees that were recently cut was measured by counting the increment on stump rings. The youngest tree was 92 and the oldest was 108 years old, the stump diameters being 25 and 46 cm respectively. No increment cores from the largest trees in the Reserve were taken. According to data from local forestry service they are not older than 130-140 years (life span of European beech is considered to be up to 300-350 years).

As a climax species, beech tends to form uneven-aged old-growth forests. During most of their lifespan, however, these forests are characterised by a single cohort stand structure: older and younger trees forming heterogeneity only in the crown layer but not full vertical stand irregularity (Schütz, 2002). On the other hand, even the presence of a significant diametre variation is not a reliable indicator of age variation or structuring (Marinov et al., 1961; Perrin, 1954; Peters, 1997; Schütz, 2002). As it was shown in the results part, stands in “Bukaka” Nature Reserve are characterised by a close to normal distribution of beech trees by diametre of breast height classes, the shape of curve being similar to those of the even-aged beech stands.

Another important peculiarity of the uneven-aged old-growth beech forests is the presence of gaps created by death of individual old trees (Oliver, Larson, 1990; Sagheb-Talebi, Schütz, 2002). It cannot be asserted, however, that the presence of canopy gaps in the current study stands is an indication of old-growthness. Canopy gaps here were mainly a result of the mass die-off of cherry trees. If could be expected that most of the gaps will close before the regeneration inside them emerge: beech trees are characterized by intensive lateral growth potential of the crowns, even during their maturity, which often leads to canopy closure.

The presence of large diametre snags (standing dead trees) and rotting logs in stands of “Bukaka” Reserve was mainly connected with the cherry trees die off. The number of large snags, however, will most likely not be sustained in the near future. Deep accumulation of organic forest floor should not be considered as a feature of old-growthness in the case of this study. The soil and climate conditions in the studied region generally facilitate the rapid litter decomposition.

It might be generalised that the stands in “Bukaka” Nature Reserve only partially cover most of the “old-growthness” criteria. Their index of “old-growthness”, however, is expected to increase steadily in the future, providing no major natural or human related disturbances occur (no management activities but strict protection are recommended at this stage). The conservation value of the stands in the reserve becomes even higher considering the fact that they are unique for the Danube plain-hilly region of Bulgaria.

REFERENCES


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