Analyses of stand structure as a tool for silvicultural decisions – a case study in a Quercus petraea – Sorbus torminalis stand

Analyse der Bestandesstruktur als Hilfsmittel für waldbauliche Entscheidungen – Fallstudie in einem Traubeneichen-Elsbeeren-Bestand

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Abstract

The study applies structural indices using the example of an oak (Quercus petraea (Matt.) Liebl.) – chequer tree (Sorbus torminalis (L.) Crantz) stand in order to derive recommendations for the silvicultural treatment of Chequer trees. The investigated stand, located in the northern part of Bavaria, comprises eight tree species and four shrub species. Various indices were used to analyse the stand structure and the crown coverage frequency. It was shown that chequer trees, which are presently of high economic interest, are strongly oppressed in the upper layer and almost completely missing in the lower layers of the stand. The possible reasons for this finding and alternatives for the further management of the stand are discussed. Persistent and repeated thinnings in order to ensure sufficient crown development of the chequer trees seem to be essential for their survival.

Key words: Sorbus torminalis, stand structure analyses, species diversity, mixed-species stand, silvicultural treatments

1 Introduction

The distribution and the use of chequer trees (Sorbus torminalis (L.) Crantz) has decreased drastically since the conversion of coppices with standards to high forests and the substitution of wood by other materials (CROHRIG 1972, KAUSCH-BLECKEN VON SCHMELING 1994, KLEINSCHMIT 1998). The chequer tree is therefore an almost forgotten tree species which has been “rediscovered” only recently for economic and nature conservation reasons (EWALD et al. 1994). Only in France it has also been of economic interest for a long time (WILHELM 1993). However, stands including chequer trees of a remarkable portion are rare. As a result there are considerable uncertainties regarding the silvicultural treatment of this species (SCHÜTE and BECK 1996). In contrast to the traditional proceeding –
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Deducing silvicultural recommendations by analysing data originating from long-term investigations - the present study tries to derive silvicultural advice for the handling of stands where chequer trees are concerned by interpreting the structural status of a particular stand combined with literature comparisons. The tools for the description of the stand structure are numerous structural indices. Structure is understood here in the sense of Oliver and Larson (1996) as "the physical and temporal distribution of trees and other plants in a stand".

2 Materials and methods

2.1 Study site

The stand investigated is located approximately at 55 km distance from Bamberg in Bavaria, Germany (10° 21' 41" E, 50° 17' 11" N) at an altitude of 320 m above sea level. The area is slightly (5°) inclined to the east. The annual precipitation amounts to a long-year average of approximately 600 mm, 200 mm of which fall in the vegetation period. The annual average temperature amounts to 9°C. The type of soil is Terra fusca, which has been formed from shell limestone disintegration. The substrate is well ventilated due to a high proportion of fragments beneath the surface, the nutrient content is very good. This also results from the fact that the shell limestone is partially covered by loess. In the whole area the ground vegetation is abundant in species. It is dominated by calciphilous species. The humus type is mull.

2.2 Measurements and tree species

The stand is part of a 3 hectare area and has developed from a former coppice with standards. A 0.6125 hectare section abundant in chequer trees was selected from this area. The diameter at breast height, the total height of the tree, the height at the point where the crown commences (lowest living branch), 8 crown radii (by way of looking up tangentially starting from the north and continuing in 45° steps) and the root collar coordinates were determined or measured in decimeter precision of all trees taller than 1.3 m on this area. The stand (between 90 and 140 years old) consists of Quercus petraea (Matt.) Liebl., Sorbus torminalis (L.) Crantz, Fagus sylvatica L., Carpinus betulus L., Pinus sylvestris L., Acer pseudoplatanus L. and Acer campestre L. The brushwood present almost throughout the whole area comprises the following species: Corylus avellana L., Crataegus monogyna Jacq., Sambucus nigra L., Lonicera xylosteum L. and Cornus sanguinea L.

2.3 Stand structure characteristics

The following measurements were carried out to describe the stand structure:

1. Stem numbers and basal areas of the stand in different strata. The largest height measured (= 100%) formed the basis of the strata, which were classified as follows: height class 1 (76% to 100%) = 24.2 to 31.8 m, height class 2 (51% to 75%) = 16.5 to 24.1 m, height class 3 (26% to 50%) = 8.8 to 16.4 m, height class 4 (0% to 25%) = 1.3 to 8.7 m.

2. Crown coverage frequency and crown maps. The crown coverage frequency was determined on the basis of a grid in a 10 cm layout (100 points per square meter forest floor). For each grid point calculations were carried out on the basis of the stem positions measured and the crown radii determined in order to ascertain whether a perpendicular drawn at that point crossed one or more tree crowns. Each crown shape was adjusted between 10 measuring points (tree height and height of the point where the crown commences as well as 8 crown radii) by means of cubic paraboloids in order to prepare spa-