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Dead wood accumulation in previously managed oak and beech forest reserves in Northwest and Central Europe

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Forests in Northwest and Central Europe have all been intensively used and altered by man. Over the last centuries, dead wood was almost absent from European lowland forests. Traditional forest management involved the removal of all dead wood. Also in the 19th and 20th century, the retention of dead wood was considered as a form of negligence, income loss or even bad management as dead wood was considered a source of proliferation of diseases. Only over the last decades, dead wood has become an important feature of forest management, not only to conservationists but also to foresters and guidelines have been developed to integrate the dead wood component in multifunctional forestry.

This historical background is clearly reflected in the average amounts of dead wood in European forests, that vary from less than 1 to 23 m^3 ha^{-1} (MCPFE 2007). In conventionally managed forests an average amount of 1-3 m^3 of deadwood ha^{-1} can be expected (Kappes and Topp 2004). In nature-oriented forestry an increase up to 5-10 m^3 of deadwood ha^{-1} is recommended (Ammer 1991). Recent studies however indicate that levels of 20-30 m^3 ha^{-1} might be required to safeguard the complete spectrum of species that rely on dead wood (Siitonen 2001, Stokland 2001, Angelstam et al. 2003, Humphrey et al. 2004).

Regional forest policies have the explicit goal to significantly increase both quantity and quality of dead wood. In order to fulfil this aim a two-way policy is developed where the retention of a certain quantity and quality of dead wood in regular forest management (integrative approach) is combined with the elaboration of a network of strictly protected areas (segregative approach), where dead wood recruitment is realised through processes of spontaneous development. Both approaches are necessary and complementary to reach the overall goal of biodiversity conservation in forests (Frank et al. 2007).

Strict forest reserves have been installed all over Northwest and Central Europe over the last decades. They all originate from previously managed forests, with low quantities of dead wood. Natural dynamics in these formerly managed forests are clearly different from primary forests. Whereas the latter are considered to be in a dynamic steady-state (e. g. Leibundgut 1978, Korpel 1995, Saniga and Schütz 2001), the newly established reserves are still developing in a more unidirectional succession towards this equilibrium. Indeed, they all start from a man-made structure, that is more or less divergent from the natural steady-state. The stands take off less stocked than primary forests, and with a species composition altered by man. The difference is most striking on the typical old growth elements: ancient trees and dead wood (Korpel 1997, Bobiec 2002).

This short communication summarises the results of a study (Vandekerkhove et al. 2009) that analysed dead wood levels and accumulation rates in lowland forests of Northwest and Central Europe, dominated by beech (*Fagus sylvatica*) and oak (*Quercus robur* and *Quercus petraea*). The study compiled data from more than 100 strict forest reserves that were withdrawn from regular management over the last 10 to 150 years. Mean time of non-intervention was 35 years, very few sites were left unmanaged for over 50 years.

Figure 1 shows the total dead wood amount as a function of time of non-intervention, differentiated for oak and beech dominated sites. The grey line on the figure represents a reference mean value of 130 m^3 ha^{-1}, as it was described for beech reference sites (Christensen et al. 2005). Figures from the limited number of oak reference sites in Poland and Slovakia (Korpel 1997, Bobiec 2002) indicate that this value also applies for oak dominated sites.

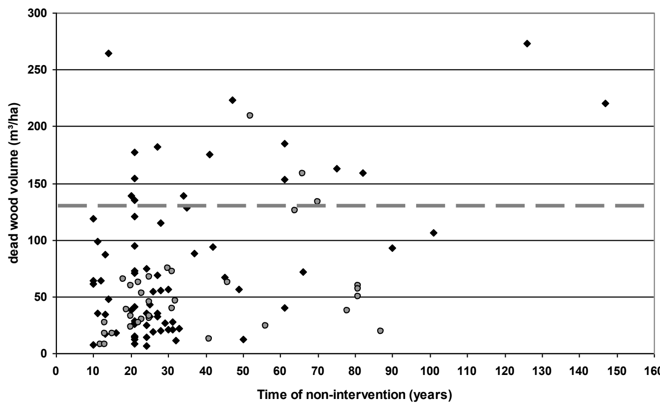

Figure 1. Total amount of dead wood in the 109 samples as a function of the time of non-intervention. Black squares represent beech dominated sites, grey dots are oak dominated sites. The grey line represents a reference average value of 130 m^3 ha^{-1} for natural beech and oak forests, based on Christensen et al. (2005), Bobiec (2002), and Korpel (1997).

The recorded total amounts of dead wood show a wide variation, ranging from 6 to almost 300 m^3 ha^{-1}, with a mean value of 75 m^3 ha^{-1}. The results are not evenly distributed, as more than ¾ of the sites contain less then 100 m^3 ha^{-1}. The median value is 53 m^3 ha^{-1}. The ratio of dead wood as compared to the total aboveground biomass was in most of the studied sites less than 10%.

The recorded average build-up rate also showed a wide range of results: from less than 0.1 up to 19 m^3 ha^{-1} $year^{-1}$. In the absence of major disturbances, dead wood accumulation is a slow and steady process: more than ¾ of the studied sites have an average accumulation rate below 2 m^3 ha^{-1} $year^{-1}$ The median accumulation rate was only slightly higher in beech as compared to oak dominated stands, but the variance of accumulation rate was significantly higher in beech dominated forests. Wind-throw is an important factor, responsible for extreme values that appear to be confined to the beech dominated reserves. In the absence of catastrophic events however, accumulation in beech stands can also be extremely slow, especially in middle-aged beech stands. Oak-dominated sites are far less influenced by windstorm. Dead wood build-up is a steady process in these forests, where trees mostly die standing and individually, only gradually breaking down and falling over after a few decades.

The way dead wood is recruited, from dying standing trees or wind-throw of living trees, does in the long run not influence the average total amount of dead wood, nor the ratio of lying dead wood volume to the total dead wood volume. In beech stands, this ratio is more or less constant at a level of 75%, regardless of time of non-intervention. In oak stands, this ratio is influenced by the time of non-intervention, rising from less than 50% in recently installed reserves to 75% in the long-established sites.

In man-made forests left for free development, a dynamic steady-state as described for primary old-growth forests may take very long to develop: the unnatural age structure of the stands and windstorm calamities may lead to more fluctuating processes, with pulses of dead wood accumulation and regeneration. This may take several centuries or tree generations to fade out (Koop and Hilgen 1987).

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