Forest development after large area disturbance in high elevations of the Bavarian Forest National Park.

In 1983 and 1984 hurricane like storms uprooted countless trees in the Rachel-Lusen area of the Bavarian Forest National Park, especially spruce forest stands on swampy and weak soil in the lowlandspruceforestsandtoalesserextent,inthe mountain mixed forests of the park. The totalarea ofdisturbedforestswas173ha.Only14.3haofthe disturbance occurred in the mountain spruce forest. Overall, half of the affected areas were in thePark'snomanagementzoneand,assuch,these areaswereleftalone.

In1992apermanentresearchplotwasestablished in the mountain spruce forests, comparable to the plots in the lowland spruce forests and mountain mixed forests. The plot is located in the north-easternpartofthe national park at an elevationof between 1140 and 1180 m. The transect starts in an undamaged tree stand, passes through a stand killed by bark beetle before passing into the windthrowarea(Fig.1).

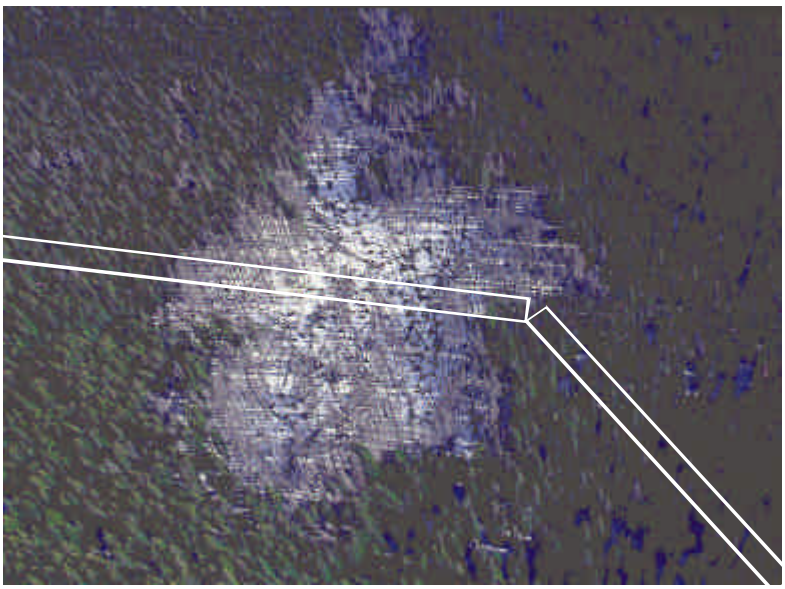


Fig.1 Aerialviewofthe investigationarea withtheapproxi-matepositionof thetransect

Detailed vegetation and structure measurements have been conducted every 5 years. The objective of theresearch is to document forest development inunmanagedareas. Besides thechangeofspecies diversity between living and standing dead tree stands and windthrow areas, one can also study the influence of the versatile mosaic of different forestsitessuchaslyingandstandingdeadtreesor treetrunksandrootplates.

In 1992 the first plot inventory wasconductedand 2228trees tallerthen20cm(living,dead,lyingand standing) were measured. In addition, 199 small forestsitessuchasrootplatesandtreetrunkswere measured and surveyed and 934 seedlings smaller than20cmcounted.

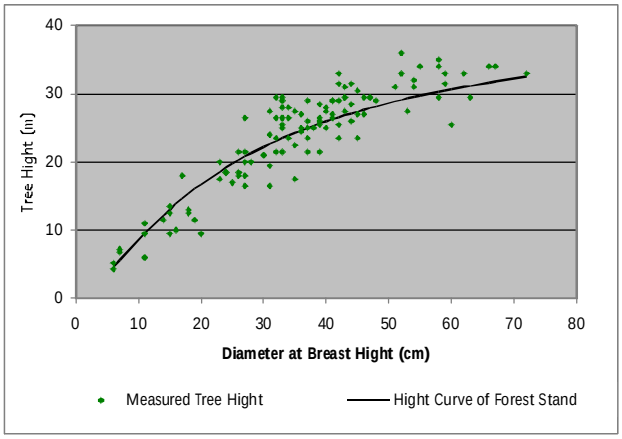


Fig.2:Measuredtreehightsofspruce independanceofdiameteratbreast hightandcalculatedhightcurveofthespruceforeststand.

The studied forest stand had high timber volume relative to the elevation. Eight hundred and fourteen m³/ha (814 m³/ha) were measured in the living stand next to the windthrow area and the standing dead stands. About one quarter of the timber consisted of lying and standing dead trees. The trees were not evenly distributed over the area and generally stood in clusters. Tree cores (n=47) showed that the age difference is very high with trees of between 80 and 256 years old being identified.Diameterdifferencewasminimal.

Herbal vegetation covered 70% of the ground. The numberofspecies present waslowatanaverageof 12.Smallstructuredsitessuchastrunks,lyingdead treesandrootplates were less prominent covering only 11%ofthestandarea.Thefirstsurveyresults showed that natural regeneration was high, with 2200 spruce (73 %) and 800 mountain ash trees (27 %) per hectare being present. Both species were found to be growing in clusters. The decomposing woodisthoughttoberesponsiblefor the grouping of the spruce as in 1992 and 1997, 53% and 72% respectively of the spruce regeneration grew on decomposing wood. The groupingofmountainashisbelieved tobecaused byseed spread.

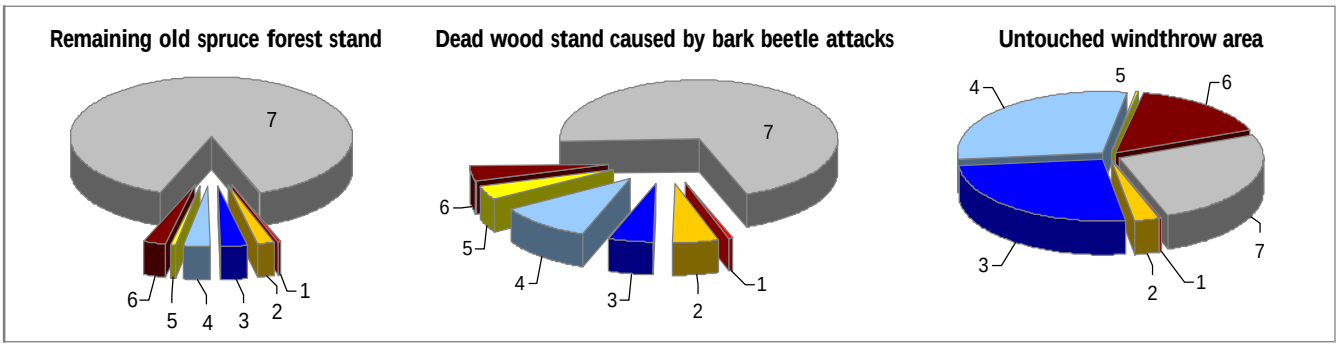


Fig.3 Expanseofdifferent microsites

1+2 Tree stumps + stump surroundings
3+4 Downed wood + surroundings
5 Rootcollar aroundthe base of deadtrees
6 Openedtopsoilcaused byuprootedtrees
7 Areaswithout any specialmicrosites

Windthrow changed the site conditions very dramatically and created a versatile mosaic containing different small site elements. Although the uprooted trees, which create patches of mineral soil, have an influence, the thrown trees were mostlyresponsible for the variedstructureof thewindthrowarea(Fig.3).

The herbal vegetation showed no significant change, in contrast to moss vegetation, which was significantly less in the windthrow area. The Calamagrostis villosa benefits from the changing site conditions as the coverage increased from 20 % in 1992 to 40 % in1997. On mineral soil areas, fireweed and raspberry had started to grow, coveringanareaof20%in1997(Fig.4).

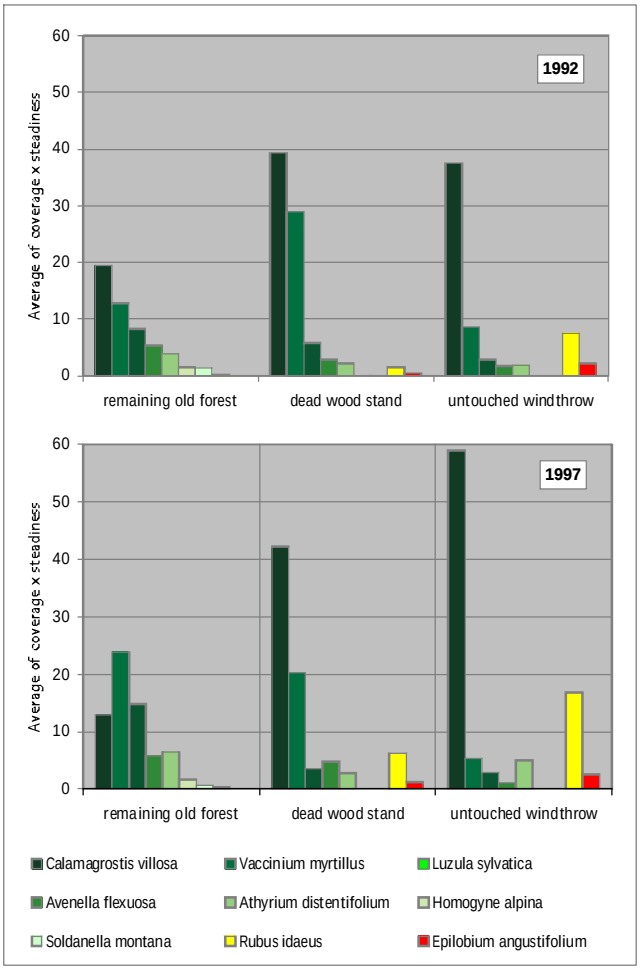


Fig.4:Dominantspeciesintheherballayer

In the standing dead tree area eight thousand five hundred (8500) spruce and seven hundred (700) mountain ash trees per hectare were measured in the area of standing dead trees around the windthrow(Fig.5).

In the windthrow area 6700 spruce and 500 mountain ash trees per hectare were counted. Pioneertreessuchasbirch,aspenandwillowplaya minor role making up only 0.6 % of natural regeneration. Most of the natural regeneration is over 20cm in height and was probably present before the storm.

Approximately 50 % of the natural spruce regeneration are growing on decomposing wood. Approximately 10% of this growth are established around root plates. In the surrounding area of standing deadtrees,regeneration on decomposing wood is clearly less. This is due to the natural seeding action of spruce around the base of dead trees. In 1989 the spruce had a seed year and the germination conditions were good, because of the falling needles, bark and small branches from the deadtrees.

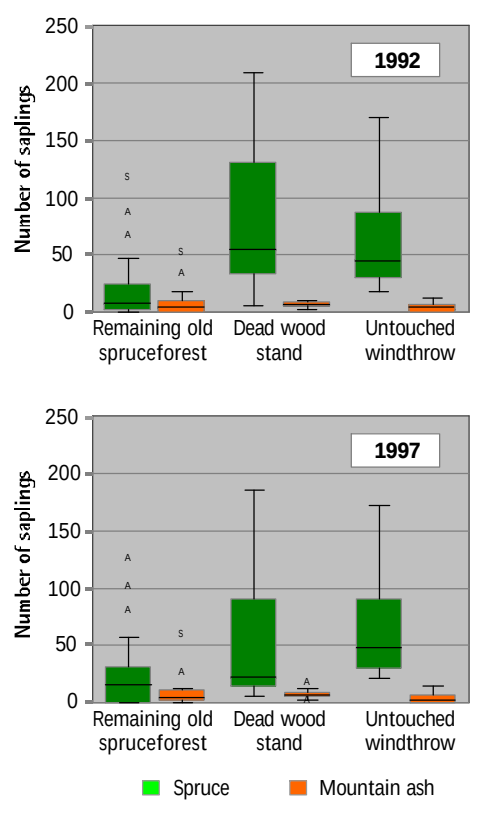
By 1997therehadbeenanincreaseof7%intrees over 20 cm. There was little change in the tree species.

In the living stand, the growth of regeneration was small, howeverinotherareasthesprucehadgrown by over 1 m and the mountain ash by up to 3 metres in five years. The average tree growth was ca.25cm/year.

In 1992 there were few signs of row deer and red deer browsing the spruce, whilst damage was evident on 70 % of all measured mountain ash individuals. By 1997 the damage to trees by wildlife was down to 30%. Most of the browsed trees arefoundintheliving standsandtheareaof standing deadtreesaroundthewindthrow.

Rejuvenationdensityin differentstagesof developmentin1992 und1997.

A:Extremevalues
S:Valuesoutofstandard



The results foundinthewindthrowareawithinthe mountain spruce forest are similar to those found inthewindthrowareasofthemountainmixedand lowlandspruce forests. However, the rate of forest development and species diversity is lower in mountainspruceforests.

In contrast to observations in natural forests of otherregions,birch,aspenandwillowdonotplaya major role in forest development even at the beginning of reforestation following large area disturbance.

The complete results of our research arepublished in:
HeurichM.,L.Fahse,A.Reineltand H.Jehl(2001): Waldentwicklung im Bergwald nach Windwurf und Borkenkäferbefall.
Wissenschaftliche Schriftenreihe der National-parkverwaltung Bayerischer Wald 14, Grafenau: 182S.,5Anl.

It can be found under the homepage of the Bavarian Forest National Park as a pdf.file (15,7MB) in the register “Veröffentlichungen, WissenschaftlicheSchriftenreihe”.

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