



Deadwood

Used as a technical term, “deadwood” covers any tree or branch that has died off. Dead trees and branches decompose at varying rates, eventually turning into humus. But before that, deadwood offers food and shelter to a wide range of specialized organisms. Federal authorities stipulate 20 cubic meters of deadwood per hectare in the Jura, on the Central Plateau and in the Southern Alps, even 25 cubic meters per hectare in the Northern Alps and in the Central Alps. Based on the latest 2009/13 survey, however, these targets have only been met in the Northern Alps and the Western Central Alps. The heavily utilized forests on the Central Plateau and in the Jura are still too poor in deadwood from an ecological point of view.

The E10 indicator has been jointly defined by BDM and the Swiss National Forest Inventory (NFI), with indicator values being computed at the NFI.

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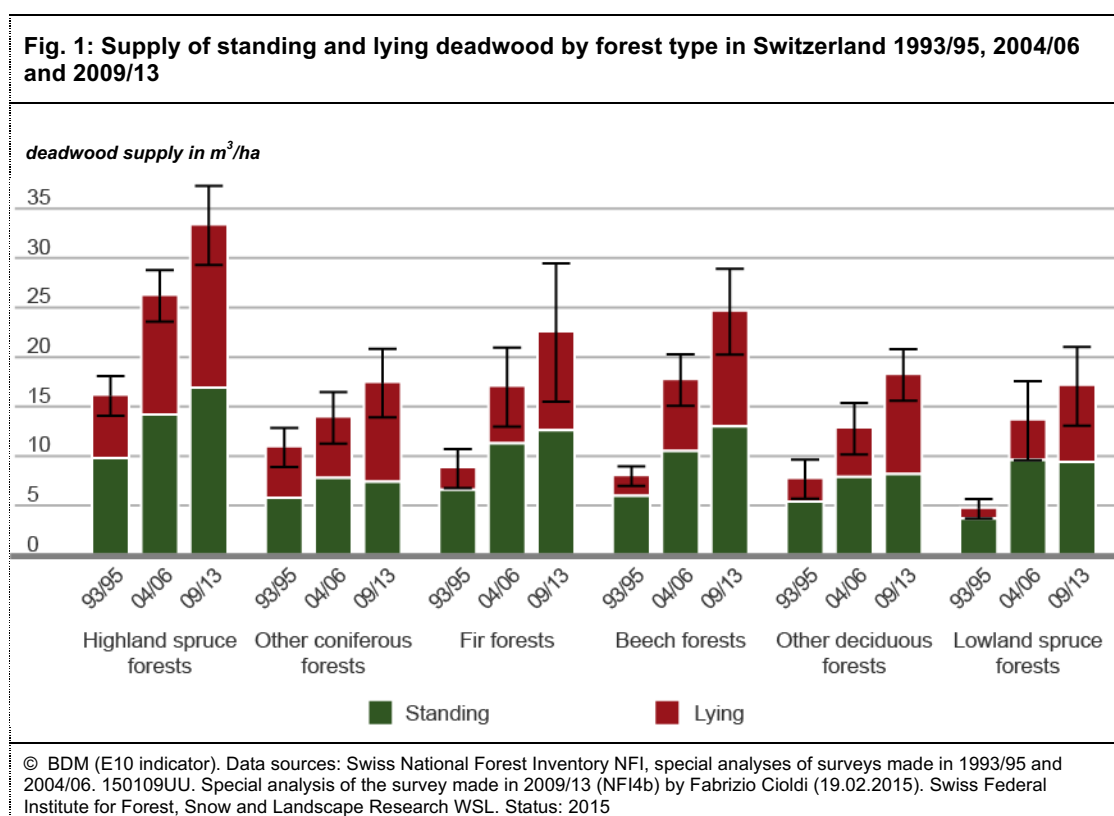
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Development in Switzerland

Switzerland's forests hold more deadwood today than ten years ago. In forests predominantly consisting of beeches and fir trees, the deadwood supply has doubled, in lowland spruce forests, it has even as good as tripled since then.

Subdivided into standing and lying deadwood, figure 1 below illustrates the mean deadwood supply (arithmetic mean) found in the major types of forests as measured in cubic meters per hectare in the 1993/95, 2004/06 and 2009/13 surveying periods with a 95% confidence interval.



Comments

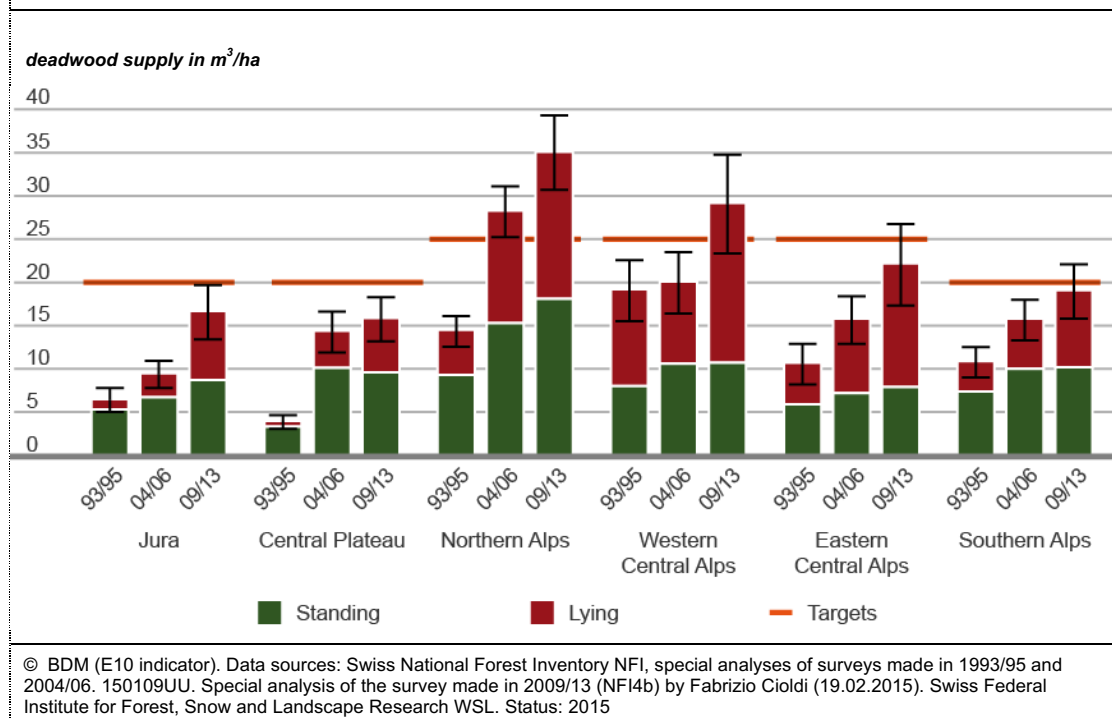
- In the 2009/13 surveying period, all forest types featured distinctly higher deadwood volumes than in the 1990s, with the increase averaging 14 cubic meters.
- Deadwood volumes increased most in highland spruce forests and in beech forests, and least in "other coniferous forests".
- "Other coniferous forests" include tree species such as pine, larch, Swiss stone pine, and the NFI category of "other conifers". "Other deciduous forests" consist of maple, ash, oak, or chestnut trees and the NFI category of "other broadleaves".
- The largest supply of deadwood accumulates in highland spruce forests. Such forests are difficult to reach, which quite often makes forestry use hardly worthwhile. Lowland spruce plantations and beech forests, however, hold very small amounts of deadwood.
- Lying deadwood increased more than standing deadwood throughout all forests. In the past 15 years, lying deadwood increased by 6.7 to 9.9 cubic meters per hectare, whereas standing deadwood only increased by 3.6 to 7.2 cubic meters per hectare.

- Between 1993/95 and 2004/06, standing and lying deadwood increased by similar volumes in most forest types, with the change averaging 4 cubic meters per hectare each. From 2004/06 to 2009/13, however, while lying deadwood supplies continued to grow in most forest types, dead trees still standing only kept increasing in highland spruce forests and in beech forests.
- In part, deadwood amounts also vary for natural reasons. Not only is decay slowed down or sped up by site factors such as temperature and precipitation, but different tree species decompose at different rates.
- Data have been extracted from the Swiss National Forest Inventory (NFI) based on surveys covering the time periods between 1993 and 1995 (NFI2) and 2004 and 2006 (NFI3). While NFI4 has been ongoing since 2009, only approximately half of all sampling areas have been surveyed as of 2013, allowing merely rough estimates albeit characterized by wide confidence intervals.
- The National Forest Inventory differentiates between lowland and highland forests, with the boundary being set at an altitude of 900 to 1'200 meters above sea level depending on growth area, exposition and geology. As a rule, highland spruce forests are subject to natural regeneration, while lowland spruce forests have been planted for economic reasons.
- Forest management guidelines (*FOEN Waldpolitik 2020*) promote high shares of mature stands and deadwood: By 2030, authorities stipulate 300-500 habitat trees and two mature stands covering an average of 1 hectare each per square kilometer of forest.

Development in the regions

Particularly the forests in the Northern Alps hold much more deadwood nowadays than 15 years ago (see fig. 2). In forests predominantly consisting of beeches and fir trees, the amount of deadwood tripled compared to the first survey, whereas it doubled in lowland and highland spruce forests. For the amount of deadwood found in various forest types per region, please refer to the Annex.

In its 2020 forest management guidelines, the Federal Office for the Environment (FOEN, 2013) stipulates the following minimum amounts of deadwood: 20 cubic meters per hectare in the Jura, on the Central Plateau and in the Southern Alps, 25 cubic meters per hectare in the Northern and the Central Alps.

Fig. 2: Supply of standing and lying deadwood by biogeographical region 1993/95, 2004/06 and 2009/13

Comments

- In 1993/95, the forests in the Jura held an average of 5 to 8 cubic meters of standing or lying deadwood per hectare. By 2004/06, this average had increased to 8 to 11 and in 2009/13 to 13 to 20 cubic meters of deadwood per hectare. Deadwood targets established by the Federal Office for the Environment (FOEN) specify 20 cubic meters per hectare in the Jura, on the Central Plateau and in the Southern Alps, as well as 25 cubic meters per hectare in the Northern Alps and in the Central Alps (orange lines in fig. 2).
- The largest supply of deadwood accumulates in the spruce forests of the Northern Alps. Spruce forests in other alpine regions also hold sizeable amounts of deadwood (refer to the Annex for detailed data). Such forests are typically difficult to reach, which quite makes forestry use hardly worthwhile. Moreover, rich in resin, spruce wood takes longer to decompose than beech wood, particularly in dry alpine climate zones.
- Between 1993/95 and 2004/06, deadwood volumes increased particularly in the Northern Alps and on the Central Plateau, with increases remaining low in the forests of the Western Central Alps and the Southern Alps. One reason for this difference is the 1999 hurricane "Lothar" wreaking havoc in the Northern Alps and on the Central Plateau, while leaving the Wallis and southern Switzerland unharmed.
- Species diversity is influenced by the way deadwood is distributed in forests. A considerable share of deadwood is found in areas devastated by hurricane "Lothar" in December 1999. On the Central Plateau in particular, only forests hit by a storm hold high volumes of deadwood.

- Analyses of NFI data¹ show that there is an above-average amount of deadwood accumulating at high altitudes, on steep slopes, in forests that are inaccessible and barely harvested, in damaged forests (e.g. due to windthrow), and in near-natural forests.
- Data have been extracted from the Swiss National Forest Inventory (NFI) based on surveys covering the time periods between 1993 and 1995 (NFI2) and 2004 and 2006 (NFI3). While NFI4 has been ongoing since 2009, only approximately half of all sampling areas have been surveyed as of 2013, allowing initial estimates albeit characterized by wide confidence intervals.

Supplementary data

Table 1 below lists forest areas in Switzerland and its regions by predominant tree species in the 2009/13 surveying period, indicated in thousands of hectares with a 95% confidence interval.

Forest types	Jura	Central Plateau	Northern Alps	Western Central Alps	Eastern Central Alps	Southern Alps	Nationwide
Highland spruce	38 ± 3	3 ± 0	167 ± 20	32 ± 2	64 ± 4	30 ± 2	334 ± 58
Other coniferous forests	5 ± 0	12 ± 0	10 ± 0	43 ± 3	41 ± 3	29 ± 2	140 ± 17
Fir	39 ± 3	41 ± 0	48 ± 4	2 ± 0	1 ± 0	4 ± 0	137 ± 18
Beech	67 ± 5	71 ± 1	53 ± 4	2 ± 0	1 ± 0	24 ± 1	218 ± 33
Other deciduous forests	21 ± 1	52 ± 3	40 ± 3	12 ± 0	8 ± 0	61 ± 5	194 ± 29
Lowland spruce	21 ± 1	71 ± 6	28 ± 2	5 ± 0	6 ± 0	3 ± 0	135 ± 17
No data ¹	5 ± 0	7 ± 4	14 ± 1	6 ± 0	3 ± 0	6 ± 0	41 ± 3
Total	196 ± 11	259 ± 6	360 ± 35	102 ± 5	123 ± 7	158 ± 11	1197 ± 192

© BDM (E10 indicator). Data sources: Swiss National Forest Inventory NFI, special analyses of surveys made in 1993/95 and 2004/06. 150109UU. Special analysis of the survey made in 2009/13 (NFI4b) by Fabrizio Cioldi (19.02.2015). Swiss Federal Institute for Forest, Snow and Landscape Research WSL. Status: 2015

¹⁾ Surveys recorded no trees whose diameter at breast height reached more than 12 centimeters.

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- “Other coniferous forests” include tree species such as pine, larch, Swiss stone pine, and the NFI category of “other conifers”. In the Jura and on the Central Plateau, such forests typically consist of pines, whereas in the Central Alps and the Southern Alps, they are mostly composed of larches and Swiss stone pines.
- “Other deciduous forests” contain maple, ash, oak, or chestnut trees and the NFI category of “other broadleaves”. In the Jura, on the Central Plateau and in the Northern Alps, such forests typically hold ash and mountain maple trees, in the Central Alps, “other broadleaves” prevail, and in the Southern Alps, the major role is played by chestnut trees and “other broadleaves”.

¹ Brändli, U.-B.; Abegg, M.; Bütler, R., 2011: Lebensraum-Hotspots für saproxyliche Arten mittels LFI-Daten erkennen. Schweizerische Zeitschrift für Forstwesen 162: 312–325.

- Alien to lowland habitats, spruce stands at low altitudes have shrunk by 5'000 hectares to 39'000 hectares between 1993/95 and 2004/06. At up to 27'000 hectares, the decline is particularly pronounced on the Central Plateau.

Significance for biodiversity

Tree trunks rotting on the ground, branchwood piles and dead trees that are still standing offer food and shelter to many wood-dwelling (xylobiont) organisms such as fungi, mosses, lichens, and insects, as well as birds. Snails, too, are more numerous to be found in the vicinity of lying deadwood. More than 20% of all living beings occurring in the forest depend on deadwood (Rigling & Schaffer, 2015). Contributing to the nutrient cycle, deadwood is part of any natural forest. The kinds of species living in and on deadwood are determined by dead trees standing or lying, the size of rotting tree parts, their degree of decomposition, and the tree species they were originally from.

Many xylobionts—for example more than half of all xylobiont bug species—are currently threatened. The amount of deadwood required to conserve endangered species is still being determined by research, but one thing is certain: “the more the better” will not do. After all, for a forest to harbor high biodiversity, it must consist of many living trees aside from deadwood. According to a literature review on the demands of xylobionts, most species are able to survive on 20 to 50 cubic meters of deadwood per hectare.² In its 2020 forest management guidelines, the Federal Office for the Environment stipulates the following minimum amounts of deadwood: 20 cubic meters per hectare in the Jura, on the Central Plateau and in the Southern Alps, 25 cubic meters per hectare in the Northern Alps and in the Central Alps. So far, these targets have only been reached in the Northern Alps and in the Western Central Alps. Applying to managed forests only, FOEN targets also do not suffice to conserve exacting species that may need much larger volumes of deadwood. For example, species diversity of xylobiont fungi will not distinctly increase until the threshold of 80 cubic meters of deadwood per hectare has been passed.

In five select Swiss forest nature reserves, surveys found a deadwood average of 69 cubic meters per hectare.³ While forest nature reserves hold close to three times as much lying and standing deadwood as the average Swiss forest, there are substantial differences between reserves. Deadwood supplies are especially abundant in forest nature reserves affected by storms or insect infestation.

Once forest management has been abandoned, it takes only a few decades for deadwood supplies to reach roughly 60% of pristine forest levels. Pristine forests in the Ukrainian part of the Carpathians, for example, hold 163 cubic meters of lying and standing deadwood per hectare.⁴

There is no denying that from an ecological point of view, most of today's forest areas contain too little a volume of deadwood. This is particularly true regarding the heavily utilized forests on the Central Plateau and in the Jura.

² Müller, J.; Büttler, R., 2010: A review of habitat thresholds for dead wood: a baseline for management recommendations in European forests. *European Journal Forest Research* 129: 981–992.

³ Herrmann, S.; Conder, M.; Brang, P., 2012: Totholzvolumen und -qualität in ausgewählten Schweizer Naturwaldreservaten. *Schweizerische Zeitschrift für Forstwesen* 163: 222–231.
www.wsl.ch/fe/waldressourcen/projekte/waldreservate/publikationen/totholzvolumen_in_ch_reservaten

⁴ Commarmot, B.; Brändli, U.-B.; Hamor, F.; Lavnyy, V. (eds), 2013: *Inventory of the Largest Primeval Beech Forest in Europe. A Swiss-Ukrainian Scientific Adventure*. Birmensdorf, Swiss Federal Research Institute WSL; L'viv, Ukrainian National Forestry University; Rakhiv, Carpathian Biosphere Reserve. 69 pp.

Definition

Changes in the volumes of standing and lying deadwood in Switzerland as a whole and its individual regions. Deadwood volumes are indicated separately by forest type.

Deadwood is defined to be both trees lying on the ground and dead standing trees reaching a diameter at breast height (130 centimeters above ground) of at least 12 centimeters. Forest types are determined by the “predominant tree species”, i.e. the species totaling the largest share of the tree basal area (sum of all cross-sectional areas at breast height). Surveys and analyses cover accessible forest areas excluding shrub forests.

Surveying methods

Based on NFI sampling surveys, deadwood data were registered by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) for the second, third and fourth Swiss National Forest Inventories in 1993/95 (NF12), 2004/06 (NF13) and 2009/13 (NF14). While NF14 has been ongoing since 2009, only approximately half of all sampling areas have been surveyed as of 2013, allowing initial estimates albeit characterized by wide confidence intervals. Deadwood data collected in 6'412 sampling areas (NF12), 6'608 sampling areas (NF13) and 3'376 sampling areas (NF14) respectively were used to compute the situation prevailing during those surveying periods.

In the course of these surveys, the NFI collected data on trees growing in circular sampling areas covering a surface of 500 square meters each. Spread out across all of Switzerland's forests, these sampling areas are located at the junctions of a grid whose individual cells measure 1.4 by 1.4 kilometers. In addition, so-called “interpretation areas” (50-by-50-meter squares) were used to register population and surface data as well. In a first step, the NFI surveyed forest sampling areas by means of aerial photos. In a second step, field teams collected data on site.

The NF12 does not cover deadwood unless the tree species can still be identified. As a result, the share of lying deadwood was in part strongly underestimated (on purpose).

Further information

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Additional sources of information

> www.lfi.ch (comprehensive information on the Swiss National Forest Inventory)

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This information is based on the German-language document 1260_E10_Basisdaten_2015_v2.docx dated December 16, 2015.