



Forest Area Dominated By Non-Indigenous Trees

Cultivating non-indigenous trees plays a very minor role in Switzerland's forestry: only 3–8% of the country's forests are dominated by alien tree species. This is welcome news from a biodiversity point of view, since non-indigenous tree species may profoundly interfere with the setup of animal food chains. Among others, tree species such as the Douglas Fir, the Eastern White Pine, the Lombardy Black Poplar, the Japanese Larch and the Grand Fir are rejected as a food source by native primary consumers. Cultivating alien tree species also impacts soil organisms, because for one thing, it displaces mycorrhizal fungi, which depend on the presence of specific tree species.

This indicator was developed in close collaboration with representatives of the Swiss National Forest Inventory (NFI) at the Swiss Federal Institute for Forest, Snow and Landscape Research WSL. E8 indicator values are calculated at the NFI.

Status: December 2015

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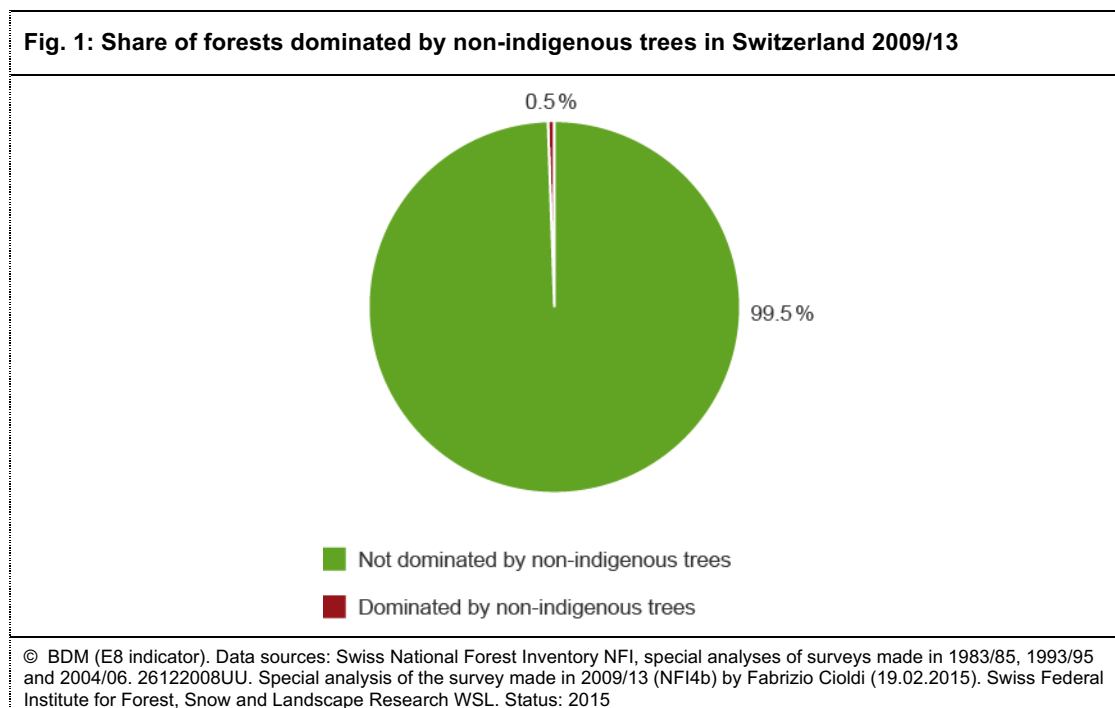
Development in Switzerland

Any forest area holding a tree stock made up of at least 50% of alien species is considered to be dominated by non-indigenous trees.

Table 1 below indicates the estimated share of forest area dominated by non-indigenous trees species, indicated in percent with a 95% confidence interval.

	1983/85	1993/95	2004/06	2009/13
Nationwide	0.3–0.5	0.3–0.6	0.4–0.7	0.3–0.8

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Comments

- In 2009/13, 0.3% to 0.8% of Switzerland's overall forest area was dominated by non-indigenous tree species. In 1983/85, this share amounted to 0.3% to 0.5%.
- Unlike other Central European countries or regions, cultivating alien tree species is of secondary importance in Swiss forestry.
- In the 2009/13 surveying period, Switzerland's forests covered roughly 13'000 square kilometers. Of that expanse, not more than 101 square kilometers were dominated by non-indigenous tree species.
- The most common alien tree species are the Black Locust and the Douglas Fir, each of the two species preponderating on roughly a third of the forest area dominated by non-indigenous trees.

- Data have been supplied by the Swiss National Forest Inventory (NFI) based on surveys covering the time periods between 1983 and 1985 (NFI1), 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.
- As the share of non-indigenous trees in Switzerland's forests is very low, even the dense NFI sampling grid will only yield relatively imprecise state and change values, also reflected in the wide confidence intervals.
- In the period between 1983/85 and 2009/13, the Swiss forest area dominated by non-indigenous trees has hardly changed at all. Based on NFI samples, the increase is estimated to vary between 0 and 65 square kilometers (estimate established with a 95% confidence interval).

Development in the regions

Table 2 below indicates the estimated share of forest area dominated by non-indigenous trees species, indicated in percent with a 95% confidence interval.

	1983/85	1993/95	2004/06	2009/13
Jura	0.2–0.9	0.2–1.2	0.2–1.3	0–1.4
Central Plateau	0.6–1.4	0.6–1.7	0.8–2.1	0.8–2.7
Northern Alps	0–0.3	0–0.3	0–0.3	0–0.4
Western Central Alps	0–0.9	0–1.2	0–1.1	0–2.0
Eastern Central Alps	0–0.4	0–0.7	0–0.7	0–1.2
Southern Alps	0.3–1.3	0.2–1.4	0.4–1.7	0.1–1.9

© BDM (E8 indicator). Data sources: Swiss National Forest Inventory NFI, special analyses of surveys made in 1983/85, 1993/95 and 2004/06. 26122008UU. 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

Comments

- On the Central Plateau, the share of forests dominated by non-indigenous trees was found to be at 0.6% to 1.4% in 1983/85 and at 0.8% to 2.7% in 2009/13. This biogeographical region is marked by a distinct divide, with the share being much higher in the West than in the East.¹
- Forest areas dominated by non-indigenous trees primarily occur on the Central Plateau and in the Southern Alps.
- On the Central Plateau, approximately 1.8% or 39 square kilometers of the region's forest area are dominated by non-indigenous trees, the majority of them Douglas Firs. The non-indigenous share has steadily been increasing during the observation period.
- In the Southern Alps, the forest share dominated by non-indigenous trees amounts to approximately 1% or 11 square kilometers. The major part of this area is predominantly stocked with Black Locusts.

¹ Rigling, A.; Schaffer, H.P. (Eds.) 2015: Waldbericht 2015. Zustand und Nutzung des Schweizer Waldes. BAFU-Reihe Umwelt-Zustand Nr. 1512. Bundesamt für Umwelt, Bern, Eidg. Forschungsanstalt WSL, Birmensdorf. 144 S.

Additional data

Tables 3 and 4 below list the mean number of logs (in 1000 units) and the tree stock (in 1000 cubic meters) for select non-indigenous tree species in Switzerland in the 1983/85, 1993/95, 2004/06 and 2009/13 surveying periods, indicated with a 95% confidence interval. The list order is determined by commonness (number of logs) and stock.

	1983/85	1993/95	2004/06	2009/13
Black Locust	892 (557 – 1227)	871 (397 – 1345)	1173 (567 – 1779)	1190 (437 – 1943)
Douglas Fir	451 (259 – 643)	1012 (546 – 1478)	1164 (615 – 1713)	888 (494 – 1282)
Black Pine	322 (146 – 498)	312 (69 – 555)	201 (7 – 395)	134 (0 – 289)
Eastern White Pine	268 (125 – 411)	196 (69 – 323)	161 (28 – 294)	82 (8 – 156)
Northern Red Oak	169 (36 – 302)	138 (0 – 316)	134 (0 – 346)	159 (0 – 418)
Various non-indigenous poplars	147 (61 – 233)	156 (44 – 268)	76 (2 – 150)	124 (0 – 261)
Horse Chestnut	24 (0 – 55)	18 (0 – 53)	27 (0 – 66)	7 (0 – 21)
Various Thuja species	20 (0 – 47)	18 (0 – 53)	36 (0 – 85)	25 (0 – 74)
Other non-indigenous deciduous tree	17 (16 – 18)	85 (0 – 234)	106 (0 – 273)	149 (0 – 382)

© BDM (E8 indicator). Data sources: Swiss National Forest Inventory NFI, special analyses of surveys made in 1983/85, 1993/95 and 2004/06. 26122008UU. 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

	1983/85	1993/95	2004/06	2009/13
Black Locust	393 (197 – 589)	417 (99 – 735)	536 (75 – 997)	328 (77 – 579)
Douglas Fir	548 (319 – 777)	803 (462 – 1144)	1161 (673 – 1649)	1609 (637 – 2581)
Black Pine	287 (128 – 446)	316 (108 – 524)	249 (47 – 451)	218 (75 – 361)
Eastern White Pine	393 (205 – 581)	348 (81 – 615)	189 (67 – 311)	176 (0 – 446)
Northern Red Oak	182 (70 – 294)	113 (7 – 219)	120 (0 – 265)	266 (0 – 584)
Various non-indigenous poplars	175 (69 – 281)	181 (38 – 324)	207 (17 – 397)	412 (0 – 912)
Horse Chestnut	13 (0 – 33)	7 (0 – 21)	5 (0 – 27)	8 (0 – 24)
Various Thuja species	3 (0 – 7)	3 (0 – 9)	23 (0 – 54)	27 (0 – 80)
Other non-indigenous deciduous tree	10 (0 – 20)	10 (0 – 28)	35 (0 – 84)	26 (0 – 69)

© BDM (E8 indicator). Data sources: Swiss National Forest Inventory NFI, special analyses of surveys made in 1983/85, 1993/95 and 2004/06. 26122008UU. 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

Comments

- With a likelihood of 95%, Switzerland harbored between 437,000 and 1,943,000 Black Locusts in 2009/13. The stock of this tree species totaled 77,000 to 579,000 cubic meters.
- While the Black Locust is the most common alien tree species found in Switzerland, its stock is smaller than that of the Douglas Fir, since the trunks of the latter grow to become more massive.

- As non-indigenous tree species are relatively rare to occur in Switzerland, estimated minimum and maximum numbers are far apart.
- Originating in Northern America, the Black Locust was introduced in Switzerland around 1600. Since it has been propagating on its own for several centuries, it is not considered to be an alien tree species in every respect. Black Locusts grow fast and are able to claim large areas by means of root and stump shoots. They may form very dense stands, displacing native shrubs and trees. For this reason, the Black Locust is the only one among the above-mentioned species to have been blacklisted. This black list contains plant species that were introduced after 1500 and “have been proven to exert a negative ecological impact, making them a problem from a nature conservation point of view”.
- Log numbers of the Black Locust and other non-indigenous deciduous trees tend to increase, with the stocks of Douglas Firs and poplar cultivars slightly growing as well. However, these estimates are very tentative indeed.
- Douglas Firs are mostly cultivated on the Central Plateau and in the Jura, while Black Locusts are typically found in the Southern Alps and on the Central Plateau.
- Even though non-indigenous tree species are very rare to preponderate, forests near settlement areas commonly hold exotic plants. In 2014, researchers from the University of Basel found that sampled plant species comprised a neophyte share of roughly 17% around Basel and even 25% near Lugano. In both regions, neophyte species most frequently occur in locations where private gardens directly border on forests. Forests located at least 300 meters away from settlement areas harbor a distinctly lower share of neophyte species. Moreover, researchers were able to prove that home owners often dispose of garden waste in nearby forests.
- Cultivating non-indigenous tree species has triggered a controversial discussion in connection with climate change. Among forestry experts, some alien tree species have been attracting attention because of their higher drought tolerance. As a result, they are looking for approaches to combine ecological compatibility and business objectives without greatly limiting the cultivation of non-indigenous tree species.²
- The low importance of non-indigenous trees for Switzerland's forests is also revealed by the conspicuous absence of suggestions regarding their cultivation from the FOEN's “basic standards of near-natural forest management” (*Grundanforderungen an den naturnahen Waldbau*; not available in English)³. Since native species prevail in near-natural forest management, forest areas dominated by non-indigenous trees are unlikely to increase considerably in the future.⁴

Significance for biodiversity

Alien tree species may interfere with the setup of animal food chains, compete with native tree species for locations, or change habitats. Moreover, non-indigenous tree species may bring other alien organisms into our landscapes—often to the disadvantage of native species, for such “stowaways” are sometimes not content to infest their original host plants, attacking native species as well. However, our native species are frequently ill equipped to fight off such new threats. Switzerland's elm stands, for example, are being devastated by Dutch elm disease, a fungal infection believed to have been imported from Asia. What is more, whenever introduced forest trees displace native species, insects dependent on specific host plants will lose a food source. On the other hand, only a few insect species—mainly those making scarcely specialized demands on their food—are able to benefit from introduced species or cultivars.

² http://www.waldwissen.net/dossiers/wsl_dossier_gastbaumarten/index_DE; Zugriff am 9.6.2015

³ Kaufmann, G.; Staedeli, M.; Wasser B., 2010: Grundanforderungen an den naturnahen Waldbau. Projektbericht. Bundesamt für Umwelt (BAFU), Bern. 42 S.

⁴ Imesch, N.; Stadler, B.; Bolliger, M.; Schneider, O., 2015: Biodiversität im Wald: Ziele und Massnahmen. Vollzugshilfe zur Erhaltung und Förderung der biologischen Vielfalt im Schweizer Wald. Bundesamt für Umwelt, Bern. Umwelt-Vollzug Nr. 1503: 186 S.

The E8 indicator, however, shows that cultivating non-indigenous tree species is of almost no importance in this country. Then again, there is a slight increase emerging during the observation period as a whole. What is more, climate change is causing the cultivation of non-indigenous tree species to be taken into consideration. A literature review about the impact of the Douglas Fir on biodiversity concludes that “any increase in cultivation of Douglas Firs in Switzerland is bound to bring about changes in biotic communities.”⁵ As a matter of fact, both the number of logs and the stock of some tree species such as, among others, the Douglas Fir has indeed been slightly increasing since 1983.

One does not have to look far to see the effects of large-scale cultivation of non-indigenous trees. In Spain, for example, whole forests of fast-growing Australian eucalyptus species were planted, with such plantations now replacing the original Macchia and Garrigue communities in many places. The loss of these thorny plants that thrive in a drought has changed the affected ecosystems completely.

Of the non-indigenous tree species mentioned above, only the Black Locust is causing major problems, albeit above all at forest skirts or entirely outside the forest range. Black Locusts may disperse spontaneously, preferably colonizing ruderal areas and dry meadows. In these locations, they successfully compete with the native pioneer vegetation. Precious dry meadows may undergo bush encroachment within a few years' time, turning into woodland as a result. The Black Locust is accelerating this process because it enriches soils with nitrogen, all of sudden allowing many nutrient-loving forest plants to grow on formerly poor soil. This is the reason why the Black Locust has been blacklisted, even though it supplies food for e.g. honey bees.

Definition

Changes in the share of forest area dominated by non-indigenous tree species in the overall forest area of the surveyed space.

For this purpose, the following tree species are considered to be non-indigenous: Black Locust, Black Pine, Eastern White Pine, Douglas Fir, Thuja, Giant Sequoia, other alien coniferous trees, Northern Red Oak, poplar cultivars, Horse Chestnut, Tulip Tree, other alien deciduous trees.

The expanse dominated by non-indigenous trees consists of forest areas featuring a stock share of more than 50% of the above-mentioned tree species.

Surveying methods

Information on forest areas dominated by non-indigenous trees is based on sampling surveys made for the Swiss National Forest Inventory (NFI). Surveys were made in the periods of 1983/85 (NFI1), 1993/95 (NFI2), 2004/06 (NFI3) and 2009/13 (NFI4b). Only approximately half of all sampling areas have been surveyed between 2009 and 2013, allowing merely rough estimates albeit characterized by wide confidence intervals.

10,980 sampling areas (NFI1), 6,412 sampling areas (NFI2), 6,608 sampling areas (NFI3) and 3'695 sampling areas (NFI4b) respectively were used to gather data on dominant tree species and establish the situation in 1983/85, 1993/95, 2004/06 and 2009/2013.

Data collection in sampling areas commenced using aerial photographs, followed by additional data being gathered in the field. Non-indigenous tree surveys monitor all tree species within two concentric circles, recording trees with a breast-height diameter of at least 12 centimeters in a circular area of 200 square meters and trees with a breast-height diameter of at least 36 centimeters in a circular area of 500 square meters. If at least one half of the tree stock is non-indigenous in both circles, the area is categorized to be “dominated by non-indigenous trees”.

5 Tschopp, T.; Holderegger, R.; Bollmann, K., 2014: Auswirkungen der Douglasie auf die Waldbiodiversität: Eine Literaturübersicht. WSL Berichte Nr. 20. Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft WSL. Birmensdorf. 52 S.

Staff at the Swiss National Forest Inventory subsequently computed means and standard errors regarding Switzerland overall and its six biogeographical regions. Standard errors were later converted into 95% confidence intervals by the BDM Coordination Office using a binominal distribution model.

Further information

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Additional sources of information

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

> www.cps-skew.ch (Swiss Commission for the Conservation of Wild Plants; information on the Black List)

Bibliography

Rigling, A.; Schaffer, H.P. (Eds.) 2015: Waldbericht 2015. Zustand und Nutzung des Schweizer Waldes. BAFU-Reihe Umwelt-Zustand Nr. 1512. Bundesamt für Umwelt, Bern, Eidg. Forschungsanstalt WSL, Birmensdorf. 144 S.

This information is based on the German-language document 1260_E8_Basisdaten_2015_v1.docx dated December 16, 2015.