

Effects of the 1947 and 2018 droughts on Swiss forests

Summer droughts can lead to significant forest damage. For example, the 2018 summer drought occurred after the severe winter storm “Burglind” and was followed by the warm years of 2019 and 2020. This cascade of extreme events caused massive damage across Switzerland, especially from bark beetle infestations. Here, we show why such damage occurs and how it relates to 1947.

Forest damage of the drought year 1947 was vividly described in reports and articles at that time. However, the damages are difficult to quantify overall, since drought not only leads to immediate damage but also incites medium-term dieback processes. Such dieback processes can affect individual branches of a tree or even entire trees. In contrast, damage from windthrow can be quantified very well because it occurs within a short and well-defined period.^{102,103} Nevertheless, there are comparable data on the extent of forest damage as a result of the drought in 1947 versus 2018; this is in terms of bark beetle infestation. Direct damage to forests includes the death of branches, crowns, and entire trees. Indirectly, drought leads to more extensive damage from bark beetle infestations or forest fires, among others. In the following, we take a closer look at the specific forest damages in 1947 and attempt to compare them to the forest damages in the dry year 2018. The year 1947 was considered exceptional for many forests in Switzerland. This can also be seen in the fact that the first forest chronicle was published in the “Schweizerische Zeitschrift für Forstwesen” in the following year¹⁰⁴. The aim was to record important forest events systematically. Obviously, one was aware of the historical significance of the 1947 drought.

Leaf senescence, death of branches and trees

Various sources report the specific effects that the 1947 drought had on Swiss forests. In very dry locations, leaf senescence, which typically occurs in fall, was observed throughout the country as early as the beginning of August.¹⁰⁴ There are also numerous reports of local forest damage. In the lower areas of the Canton of Basel-Land, the forest was discoloured on the south- and west-facing slopes and on gravel soils as early as the beginning of August. Hornbeams also withered in early August. On the permeable riparian soils of the Birs and Rhine rivers, the crowns of hornbeams, birches, oaks, maples, and willows were largely bare.¹⁰⁵ In the fall of 1947, entire groups of oaks and birches were dead there, while beech trees died less frequently.¹⁰⁶ In Heiligholz, hundreds of spruces withered, and on higher elevations (so-called Tafeljura), young stands of fir and isolated stands of 5 to 10-year-old firs withered widely. Drought damage was also reported from the Rhine area in northern parts of the Cantons of Zurich and Schaffhausen and the Jura slopes on Lake Biel.¹⁰⁶ In the fall of 1947, numerous bare trees, especially sessile oak, beech, and maple, were conspicuous in forest stands. Spruce trees held up better than fir trees. While no major damage was observed in the oak forests on the southern slopes of the Jura Mountains from Biel westward to Saint-Blaise on Lake Neuchâtel, dead oaks and snowball-leaved maples, and more rarely firs, spruces, and beeches, repeatedly stood out. In general, more damage was observed on young trees than on old ones.¹⁰⁶ The drought also led to the death of young spruce stands between Saint-Blaise and Le Landeron, hardwood crops in lower areas of the Canton of Bern, crops in plant nurseries, and planted hardwoods in clearings in the Canton of Zurich.¹⁰⁴ Figure 7.1 shows a map of the reported damage (mainly agriculture) at that time.¹⁰⁷

Bark beetle infestation of firs and spruces

Bark beetles reproduce under the bark of fir and spruce trees. To do this, they bore holes through the bark. This is difficult in healthy trees because the bark is infused with resin. During prolonged drought, trees produce less resin and are therefore more vulnerable. This can lead to the mass reproduction of bark beetles. Winter storms also affect bark beetle reproduction. They can damage or weaken trees over a wide area, making it easier for bark beetles to bore through dry,



Fig. 7.1: The areas affected by drought in Switzerland, published on August 27 August 1947, “Schweizer Illustrierte Zeitung”.

damaged bark. After forest damage from winter storms occurred in several Swiss Cantons in 1946,¹⁰³ bark beetles multiplied in the warm weather of the following year. Among others, the crooked-toothed fir bark beetle appeared. An initial proliferation spurt of this beetle was observed as early as 1945, which was also a dry year, but seems to have been tied back by the wet conditions of 1946. The bark beetles multiplied even more rapidly in the summer of 1947. Throughout Switzerland, about 340 000 m³ of beetle wood and 173 000 m³ of dry wood accrued by 1949 because of the 1947 drought.¹⁰⁸ Since 1800, the bark beetle calamity of 1944–1950 was the largest ever observed.¹⁰⁹

Forest fires

Increased drought also leads to an increased risk of forest fire. In the summer of 1947, a total of 75 ha of forest burned in two places in the Bedretto Valley (Canton of Ticino), and an unusually high number of fires were reported in the Canton of Valais, but all were quickly extinguished.¹⁰⁴ In the Canton of Graubünden, a large fire destroyed about 170 ha of forest near Tschlin.¹¹⁰ The forest fires described for the dry year 1947, however, were substantially smaller than the large forest fire on the southern slope of Calanda, which occurred in 1943 (in terms of the area of damaged forests; about 800 ha).¹¹¹ They were also smaller than the 300 ha of forest that burned down above Leuk (Canton of Valais) during the heatwave in the summer of 2003.¹¹² This is arguably because the summer drought of 1947 was less pronounced in the central Alpine valleys than in the central Swiss Plateau and in northern Switzerland (see p. 8).

Comparison of reported forest damages

How does the damage to trees and forests reported for the 1947 drought year compare to the recent 2018 drought year? The records by the various reporters compare well with the damage characteristics of the 2018 summer drought.^{8,113,114} All of the symptoms of trees reported for 1947 – from bark cracking to premature leaf discoloration, leaf fall, branch mortality in tree crowns, and death of mature and young trees – were also noted in 2018 and subsequent years (Fig. 7.2). The rapid proliferation of insects, especially bark beetles, as a result of prolonged warmth¹¹⁵ was also presented correctly for the 1947 case.¹¹⁶ However, the spatial distribution of the damage from the two events differs. In 1947, the low-lying areas in the Central Plateau, the Jura, and the north of Switzerland suffered the most (Fig. 7.1). In 2018, some areas in Eastern Switzerland (Walensee area from the Linth river



Fig. 7.2: A forest stand in summer 2020 with partially or completely dead beech trees in Hemishofen SH. The mortality was triggered by the summer drought in 2018. Image: Ulrich Wasem.

to the Seez valley, the upper Rhine valley) and the low-lying areas of the Valais were additionally affected.¹¹⁷ In 2018, leaf senescence partly started in mid-July – in 1947 it was early August. In 1947 and the years before, damage from several storms occurred locally in the drought-affected areas (for example, in the Canton of Neuchâtel).¹¹⁸ In contrast, in 2018, one severe winter storm (“Burglind”) swept through the Central Plateau and the Pre-Alps. It resulted in 1.3 million m³ of windthrow¹⁹ in Switzerland, and it represented the fourth largest storm-damage event since nationwide records began in 1865.¹²⁰ As a consequence, the combined effects of this storm, the 2018 summer drought, and the mass reproduction of bark beetles resulted in huge amounts of damaged wood in 2019 and 2020. It was on the order of 1.5 million m³, significantly exceeding those from 1947.¹¹⁴ However, it must be considered that timber stocks have increased considerably since World War II.^{103,121} Around 1947, forest stands were on average not only less densely stocked (live trees measured in m³/ha), but also the tree species composition and forest structures did not correspond to today’s conditions. In many forests, the proportion of conifer was higher compared to a natural tree species composition and compared to today. This is because conifer had been planted on a large scale in the 19th and 20th centuries.¹²² These artificial stands proved to be susceptible to drought, depending on the location. While natural regeneration predominates today, artificial regeneration was widespread in 1947. Accordingly, many plant nurseries and reforestation plots were severely affected by drought. In large parts of the Swiss Central Plateau, the summer drought of 1947 was the most prominent drought year of the 20th century, exceeding even the drought of 2018. However, the summer drought of 1947 affected much smaller areas than that of 2018, which also reached record levels in western Switzerland and the central Alps.

In summary, forest damage was severe in both 1947 and 2018, but the amounts of damaged wood were massively higher in 2018 and subsequent years. The differences in volume can be explained on the one hand by the higher average wood stock per area today, and on the other hand by bark beetle damage, which was promoted by the winter storm Burglind and multiple warm summers. Should the frequency of compound dry spells and winter storms increase in the future, it is to be expected that a drought comparable to 1947 or 2018 could have large impacts on forests on repeated occasions.

Bark beetle control in western Switzerland

The Canton of Neuchâtel reported about 15000 m³ of timber that was highly infested by bark beetles in 1948 and another 6000 m³ in 1949. Mainly fir (about 60 percent) was affected, and spruce to a lesser extent.¹²³ The situation was even more dire around Lake Biel, where many hectares of drought wood accumulated in fir stands in 1947 already: An area of 40 ha had to be completely cleared, and only 10 to 50 percent of the stocking remained on another area of 60 ha. From 1947 to 1950, about 50000 m³ of infested wood accumulated in the Seeland between La Neuveville and Lengnau. As a result, the cutting of timber had to be stopped until 1954, and the price of timber in the region fell by 10 francs per unit due to the oversupply.¹¹⁶ A few 100 men were employed to combat bark beetle gradation (Fig. 7.3).



Fig. 7.3: Workers in the Eschenberg forest near Winterthur peeling fir trees infested by the bark beetle and burning the bark in the summer of 1947 (Winterthur Libraries, Winterthur Collection).