FOREST HEALTH

Acid rain, bark beetles, drought damage: our forests are constantly facing new challenges – and so are WSL researchers.

The forest – a perpetual patient?

'Forest dieback' and 'acid rain' were topics of public concern. Here the district forester Hans Zehnder is pointing out the symptoms, presumably caused by sulphurous emissions, to a group of visitors.

At the beginning of the 1980s, foresters noticed progressive and pronounced defoliation in fir and spruce.

Concern about 'forest dieback' helped bring about the 1985 Clean Air Act, which specified measures such as catalytic converters for cars and desulphurised heating oil, as well as emission limits.

Photo: KEYSTONE/Str

Möhlin in Canton Aargau, 7 May 1983.

Location: somewhere in Canton Zurich. A long-haired reporter with a moustache and a woollen pullover is walking through the forest with a forester dressed in a suit and tie. "Look at this silver fir," says the forester. "It has hardly any needles left and very soon it will die off completely." The camera pans onto lanky fir trees, accompanied by dramatic music. The voice-over proclaims: "The forest is sick and suffering. The damage in Switzerland too is alarming." And asks: "What should we do?" The scene is from a 1983 Swiss television programme on 'forest dieback'.

Scientists at the time were initially at a loss about what was causing the defoliation of so many tree crowns – the main symptom of 'forest dieback'. Sulphurous emissions were thought to be entering the forests in the form of 'acid rain' and weakening the trees, which then made them susceptible to drought and pests. This cannot be proven beyond doubt because no comparable data from the past is available.

To remedy this lack of information, WSL's Sanasilva (Latin for 'healthy forest') Inventory was started in 1984. Since then, annual checks of the condition of the forest have been carried out at around 50 forest sites across Switzerland. The researchers decided to monitor defoliation, i.e. needle or leaf loss, as a symptom of disease because it is easy to assess. The threshold for classifying a tree as damaged was set at 25 percent defoliation.

The question of what constitutes a healthy tree or a healthy forest has preoccupied WSL researchers since the Institute was founded in 1885. At that time, people were already worried about the forest, especially in the mountains, where forests had been

plundered and overexploited. In 1876, after terrible floods, Switzerland passed a forest law that was revolutionary at the time and instigated the idea of sustainable forest use. WSL's predecessor, the 'Central Station for Experimental Forestry', was founded with the mission: "To create a secure basis for all aspects of forest management."

The researchers quickly began setting up permanent observation plots across Switzerland, where they measured the growth, composition and condition of the forest. This information was then used for planning timber harvesting. They also confirmed relationships between the forest and avalanches, landslides and floods. At that time, a forest was considered 'healthy' if it provided people with sufficient wood and protected them from natural hazards. But when air pollution began to take its toll in the 1980s, it became apparent that too little was known about the forest to explain why the trees were becoming unhealthy. That is why the Long-term Forest Ecosystem Research (LWF) was launched shortly after Sanasilva. Since 1994, researchers at WSL have been using a whole battery of measuring instruments to record environmental conditions and air pollutants on around twenty test plots throughout Switzerland to see how the trees there react to them.

For more information on the Sanasilva Inventory and Long-term Forest Ecosystem Research LWF, see:
www.wsl.ch/sanasilva-en
www.wsl.ch/lwf-en

The long-term data collected soon showed that, while the forest had been damaged, its existence was not directly threatened – in other words, the forests were not dying. In the 1980s, however, no reference values for assessing the condition of the forest were available, and both scientists and the public had the impression that an immense number of trees had weakened or even died.

Dead trees support new life

Perceptions of forest health have changed considerably since the 1980s. "While the focus was on 'forest dieback', people only looked at the trees," says Andreas Rigling, a forest engineer and member of the WSL Directorate. "Today we also take into account soil organisms, and indeed the entire ecosystem." Dead trees are part of this. When they fall, they make room for young growth, as well as for animal and plant species that require light, such as orchids or the woodcock. In addition, every third forest organism is thought to depend on deadwood, including wood-decomposing fungi, deadwood beetles and woodpeckers. Since 2005, the National Forest Inventory, which WSL conducts, has recorded the amount of deadwood as an important component of the forest ecosystem.

It is therefore normal, and even desirable, for some of the trees in a forest to be dead. Nevertheless, defining what constitutes a healthy forest is not easy because it depends very much on what people want a forest to provide. A forest could be considered healthy as long as it supplies enough wood or sufficient protection against avalanches, or even as long as people enjoy relaxing in it. Depending on the region, forests in Switzerland may have to fulfil several of their important functions at the same time: providing protection against natural hazards, supplying timber, and/or serving as a place for recreation, a habitat for flora and fauna, a sink for greenhouse gases, and a filter for water and air. Forests must, therefore, be multifunctional, but with the functions weighted differently.

Forest policy and management experts are constantly asking themselves questions like: What needs to be done where? And how much money is available? Clearly something should be done to tackle environmental toxins or introduced diseases. "But opinions differ even on how to deal with our native bark beetles," says Eckehard Brockerhoff, a forest insect specialist and head of the 'Forest Health and Biotic Interactions' Research Unit. How much bark beetle damage can and should be tolerated? WSL provides diagnoses and computer models to help foresters contain beetle infestations when the services forests provide are at risk (see page 16).

Forthcoming crises

Bark beetles are not the only problem the forest has to contend with. Forest pollution with nitrogen and ozone from agriculture and combustion processes is still critical in many places even though air pollution control measures have greatly reduced pollutant inputs. "We succeeded in getting rid of acid rain, but high nitrogen inputs continue to make sensitive soils too acidic," says Peter Brang, a forest engineer and expert on forests and climate change at WSL. Moreover, we are to some extent powerless against the many invasive plants and pests introduced through international trade – despite improved border controls. In 2014, a high-security laboratory was set up at WSL to diagnose and study such new arrivals and search for natural ways to combat them (see page 8).

And then we have climate change. It is progressing so fast that the natural adaptive capacity of forest ecosystems cannot keep up. This became evident during the dry summer of 2018 when numerous trees died due to lack of water. "We have to do everything we can to ensure forests remain stable in the future," says Andreas Rigling. Forests with a varied structure and diverse tree species are better at withstanding pests, storms and other disturbances and can recover from them more quickly. To promote such forests, a near-natural management system is needed that can steer forest development in the right direction in the future. "At the same time, we must first make sure that diverse young stands can fully mature," says Peter Brang. This is an issue because the currently large populations of red deer and roe deer are fond of eating the saplings of future climate-tolerant tree species such as oak and silver fir.

With all these issues, WSL staff can once again provide advice and support. Economists calculate what it costs to maintain the services a forest provides and how to compensate forest owners for maintaining them. Forest scientists are identifying tree species that can cope with the future climate in a new large-scale project, where the team is led by Peter Brang and Kathrin Streit. The project involves planting over 50,000 trees across Switzerland and monitoring how they develop over the next thirty years.

One thing the outcry in the 1980s about 'forest dieback' did show is that rapid action is possible. At the time, politicians and the general public were so concerned about the health of the trees that clean air regulations were introduced at record speed, and desulphurised heating oil, flue-gas filters and catalytic converters in cars became the norm. The coming crises will also require targeted action, which should be based on sound scientific findings. This is why WSL will continue its research on forest health. *(bki)*

Photos pages: Karrer