In 2022, a new project on tree growth and artificial intelligence started; within the project tree growth characteristics will be assessed. Furthermore the influence of different obtained parameters on tree growth will be analyzed. As part of the project dendrometers on all 6 core measurement sites have been renewed. Anita Zolles started her PhD in autumn 2022 and will work on the dendrometer data obtained at the six core sites.

Major results/highlights

The results of the measurements and the chemical analyses on the Austrian Level II plots can be found at: http://www.waldmonitoring.at

Outlook

The monitoring activities on the 16 plots will be continued on a similar level as within the past years. This includes regular investment in measurement facilities and replacement of broken equipment.

The six core-monitoring plots are included in the network of sites for monitoring the negative impacts of air pollution upon ecosystems under the National Emissions Ceilings (NEC) Directive (2016/2284/EU). These plots will form the basis for collecting and reporting the information concerning forest ecosystems required under the NEC Directive.

We are planning to test IOT sensors (soil moisture and climate data) at our monitoring site in Mondsee.

Belgium Flanders

National Focal Centre

Level I: Geert Sieon

Level II: Arne Verstraeten (NFC), Johan Neirynck

Research Institute for Nature and Forest (INBO)

Main activities/developments

The Level I survey was performed on 78 plots and 1486 trees (865 broadleaves and 621 conifers, 4x4 km grid). The most important tree species are *Pinus sylvestris* (31.6%), *Quercus robur* (26.9%), *Fagus sylvatica* (10.0%), *Pinus nigra* subsp. *laricio* (9.8%), and *Q. rubra* (6.3%). Other broadleaved species are pooled in a subset with 14 species (together 15.0%). There are only a few other coniferous species in the survey (0.4%).

Major results/highlights

26.5% of the Level I sample trees were rated as damaged. Mean defoliation was 24.0% and 0.7% of the trees had died. The share of trees in defoliation classes 2-4 was higher in broadleaves compared to conifers (28.2% and 24.3%). Mean defoliation was highest in conifers, with 24.1% compared to 23.9% in broadleaves. Defoliation was high in *Quercus robur* and *Pinus nigra*, with 35.7% and 39.3% of the trees considered as damaged. *Quercus rubra* was the least affected species, with 9.7% of the trees showing more than 25% defoliation. The share of trees with moderate to severe leaf loss was 19.8% in *Pinus sylvestris*, 23.3% in 'other broadleaves' and 26.8% in *Fagus sylvatica*.

10.7% of the trees showed moderate to severe discoloration. The share of trees with more than 10% discoloration was highest in *Quercus robur* (22.3%). Oak mildew (*Microsphaera alphitoides*) infection was the main cause of discoloration on *Quercus robur*. The share of trees with moderate to severe discoloration was 10.8% in 'other broadleaves' and less than 10% in *Fagus sylvatica*, *Quercus rubra* and *Pinus spp*.

Fungal infection and insect defoliation are the main causes of biotic damage. The share of trees, moderately to severely affected by defoliators was high, especially in *Quercus robur* (38.0%). *Sphaeropsis sapinea* is a disease, known to become more infectious on weakened trees. Dieback of shoots, twigs and branches of *Pinus sylvestris* and *Pinus nigra* increased but was still limited. Shoot dieback was moderate to severe in 1.9% of *Pinus sylvestris* and 2.8% of *Pinus nigra*. Moderate to severe twig dieback was observed in 6.4% of *Pinus sylvestris* and 3.4% of *Pinus nigra*.

Weather circumstances impacted the health status. Storm events during winter caused damage in several plots. A part of the trees showed discoloration or defoliation caused by summer drought.

Seed production improved in comparison to 2021. In 33.6% of *Fagus sylvatica* and 16.8% of *Quercus robur* trees fruiting was common to abundant.

Compared to 2021 the share of trees with more than 25% defoliation increased by 8.1%p. Mean defoliation increased by 2.2%p. Crown condition deteriorated in all species, except in *Quercus rubra*. From 1995 to 2022, increasing trends in defoliation were significant for *Fagus sylvatica*, *Quercus robur*, the total of broadleaves, and the total of all species. *Pinus nigra* was the only species with a significant improvement in crown condition.

A survey on the condition of *Fraxinus excelsior* started in 2014, partly in Level I plots. In 2022, crown condition assessments were performed on 29 plots and 251 trees. Crown condition of *Fraxinus* was still deteriorating. The cause of the poor health status is *Hymenoscyphus fraxineus*. Since the start of the monitoring, 29.1% of the sample trees died.

For Level II, a study on long-term changes (8-16 years, available data till 2021) in the groundwater levels in 4 plots was carried out. Groundwater levels declined significantly in 3 plots. With the very wet year 2021 excluded, the decline was significant in all plots. Trends were more downward for the yearly mean and yearly highest groundwater levels, indicating that the impact is most pronounced during summer.

Publications/reports published with regard to ICP Forests data and/or plots and not listed in Chapter 2

Sioen G, Verschelde P, Roskams P (2022) Bosvitaliteitsinventaris 2021. Results of the crown condition survey (Level I). Research Institute for Nature and Forest, Report 2022 (7). INBO, Brussels (in Dutch). ISSN:1782-9054, https://doi.org/10.21436/inbor.71783042

Verstraeten A, Neirynck J (2022) Daling van de grondwaterstanden in 4 Vlaamse bossen. Drop in the groundwater levels in 4 Flemish forests. Research Institute for Nature and Forest, Internal report. INBO, Brussels (in Dutch).

Outlook

The Level I and the Level II program will be continued, as well as the additional survey on the condition of *Fraxinus excelsior*. In certain core plots, the monitoring activities will be further developed in the prospect of eLTER Standard Observations.

Belgium Wallonia

National Focal Centre

Elodie Bay, SPW – Public Service of Wallonia

Main activities/developments

In 2022, data were collected on 7 plots for Level II/III and on 46 plots for Level I. To determine the cuttings and ageing of trees of the samples that had occurred since 2010 in Level I, a complete revision of the plots was conducted this winter.

A complete inventory of trees over a larger radius was carried out on each of the plots. With these data, the rules for selecting the trees to be observed were adapted to guarantee the representativeness of the sample. The number of spruce plots was also reduced due to bark beetle problems, this being offset by an increase in the numbers observed per plot. Plots with less than 50% coverage will be excluded from monitoring and replaced as appropriate.

Major results/highlights

A warm winter followed by a very cool start to spring accentuated the differences in the start of the growing season: early in the north and late in the south. The summer broke heat records and the drought impacted the stands located on difficult sites. Autumn, which was humid, made it possible to attenuate the negative effects of summer by allowing most species to continue their growing season until "normal" dates. However, in some southern plots, leaf fall occurred exceptionally early.

Since the 2022 observations were made before the peak of the drought, its direct effects are not visible in the network results. On the other hand, its indirect effects will probably be marked in the years to come.

- Although the peak of the bark beetle attack has passed, new damage continues to be observed, triggering the implementation of sanitary cuts. On the other hand, the health of the remaining trees, even in the absence of bark beetle attacks, is generally very poor, particularly since 2019, probably also due to the succession of drought episodes.
- The beeches have presented a worrying health situation since the beginning of the monitoring period. We observe small peaks in defoliation during years of high fruiting, but this phenomenon linked to the reallocation of nutrient resources is reversible. After deducting this effect, we observe a significant increase from 2019 to 2020, followed by a stabilization from 2020 to 2022. The impact of the dry periods of 2018 and 2020 therefore does not seem direct. The climatic conditions of the following summers (quite dry and very hot in 2019; very humid and cool in 2021) could accentuate or attenuate the effects of severe droughts.
- The increase in oak defoliation in 2019 was explained by an upsurge in spring caterpillars, but these attacks have since decreased. The sharp deterioration observed in 2021 would therefore be linked to another factor. It could also be a delayed effect of the droughts of 2018 and 2020, or on the contrary an effect of excessive humidity in 2021.
- For Douglas-fir, the sharp increase in defoliation in 2019 was attributed to a sharp increase in *Contarinia pseudotsugae* populations. The situation seems to have gradually improved since then. However, we occasionally observe old stands decimated by *Armillaria* attacks. The recovery of Douglas-fir plantations remains chaotic.
- In larch, the high defoliation values are mainly linked to a simplification of the architecture, with no significant branch mortality. No specific symptoms were observed. This simplification of branching could be linked to competition (current or ancient) for light, as well as to the conversion of lateral branches into fruiting branches. Fruiting is often very abundant in mature individuals.

Publications/reports published with regard to ICP Forests data and/or plots and not listed in Chapter 2

See our annual reporting on forest health (in French) which includes ICP Forests data on http://owsf.environnement.wallonie.be. Data are also included in the Walloon Regional Environmental Report (in French) on http://etat.environnement.wallonie.be.

Outlook

- Future developments of the ICP Forests infrastructure
  - Implementation of the sample revision on Level I