Excursion guide

of international scientific conference

FORESTS´ FUTURE 2022

Consequences of Bark beetle calamity
in Central Europe

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Fig. 1: *Salvage clear cuts after bark beetle outbreak in Highland region (area of excursion)*

Current spruce bark beetle calamity in Czechia

ING. MILOŠ KNÍŽEK, PH.D.

The current bark beetle outbreak in spruce stands of Czechia represents the worst and biggest bark beetle calamity in the history of the Czech lands. Except the gradually deteriorating condition previously (during last two decades) it can be dated since climatically extreme (dry and warm) years 2015 and later 2018 with culmination mainly in 2019. The calamity with exponential increase was recorded mainly between 2018 and 2020, culminating in 2020. In 2021 the volume of harvested wood was recorded in value of 2/3 in comparison with previous year.

The causes should be seen except the weather conditions also in other areas, such as human reasons: permanent loss of skilled labour, inactivity of a number of forest owners, inflexible system of public procurement, protracted sales crisis in the timber market, which caused the related impacts like late processing of bark beetles and other infested wood and insufficient processing of bark beetles infested wood.

The bark beetle calamity definitely spread throughout the whole Czechia in 2020. However, significant regional differences are evident. While in the eastern half of the country, in Silesia and Moravia, where the bark beetle calamity started, the gradation is mostly in decline, mainly due to a combination of a significant decline in the most attractive spruce stands and favourable weather conditions in the last two years. The situation is similar in the Třebíč and Jihlava regions, while in other districts of the Vysočina ("Highland") region, as the most affected region, the unfavourable bark beetle situation continues. In the western half of the state (Bohemia), the extent of the bark beetle infestation will probably culminate this year.

The most problematic area is in the north and northwest of Bohemia, in the Ústí nad Labem and Liberec regions, where low precipitation totals were recorded last years and where the extreme gradation continued in the NP České Švýcarsko (Czech Switzerland NP).

The main species of this bark beetle calamity in spruce stands is still *Ips typographus*. Accompanying species that occupy mainly the crown parts of infested spruces are *Pityogenes chalcographus* and *Ips duplicatus*. All three species occur very often together in most parts of Bohemia. Especially in the northeastern part of the country *Ips duplicatus* often reaches a higher proportion.

As a result of processing of infested trees, entire stands continue to disappear and large calamitous clearings and areas of unsecured stands are emerging, which often reach tens to hundreds of hectares and form subsequent heavy restoration and cultivation problems, especially considering the problems with overpopulated ungulate game.

It is absolutely necessary to use the favourable opportunity offered by nature and the sales situation and not resign to an effort of forest protection. The priority is searching for bark beetle infested wood, its timely processing and effective sanitation. The course of the weather will be determining factor in future development of bark beetle calamity in 2022 and subsequent years. Several months of drought, windy and relatively warm weather during the winter 2021/2022 and spring 2022 raised again the concerns about the possible further development. The spruce stands in Czechia are still enormously endangered!

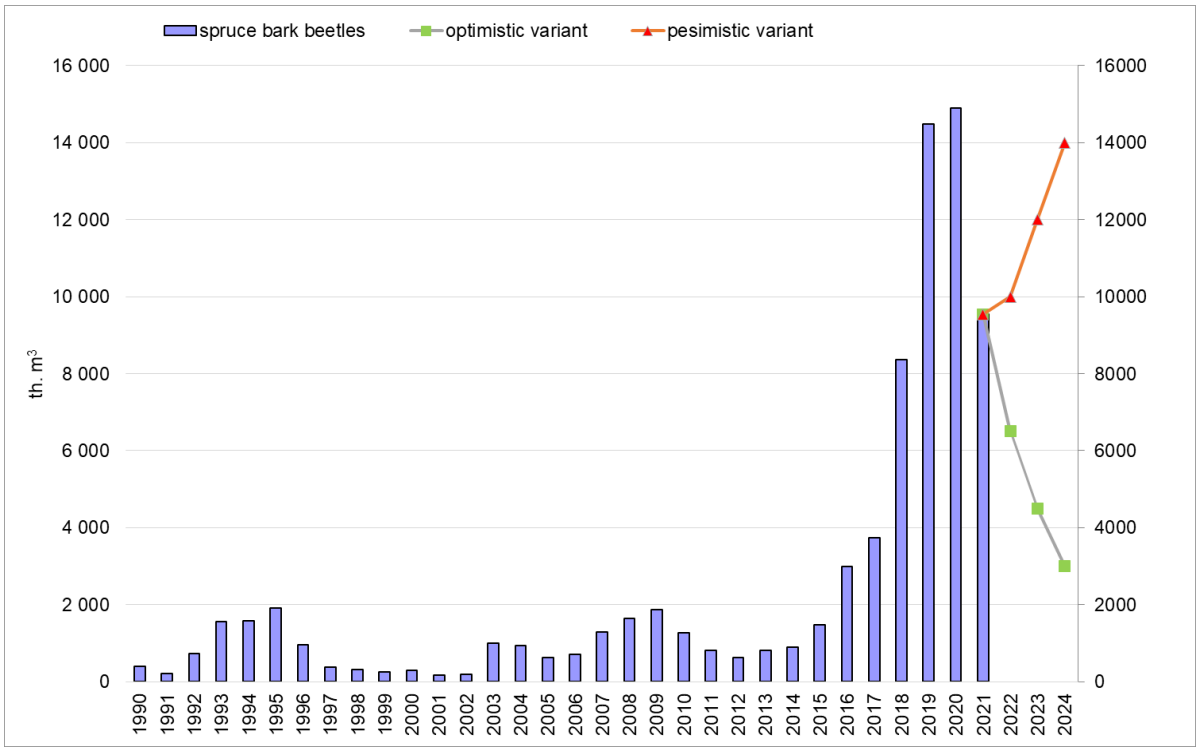

Fig. 2: *Recorded volume of harvested spruce wood infested by bark beetles in Czechia since 1990 with alternative development forecast (values from ca 70% forest surface; data source: FPS FGMRI)*

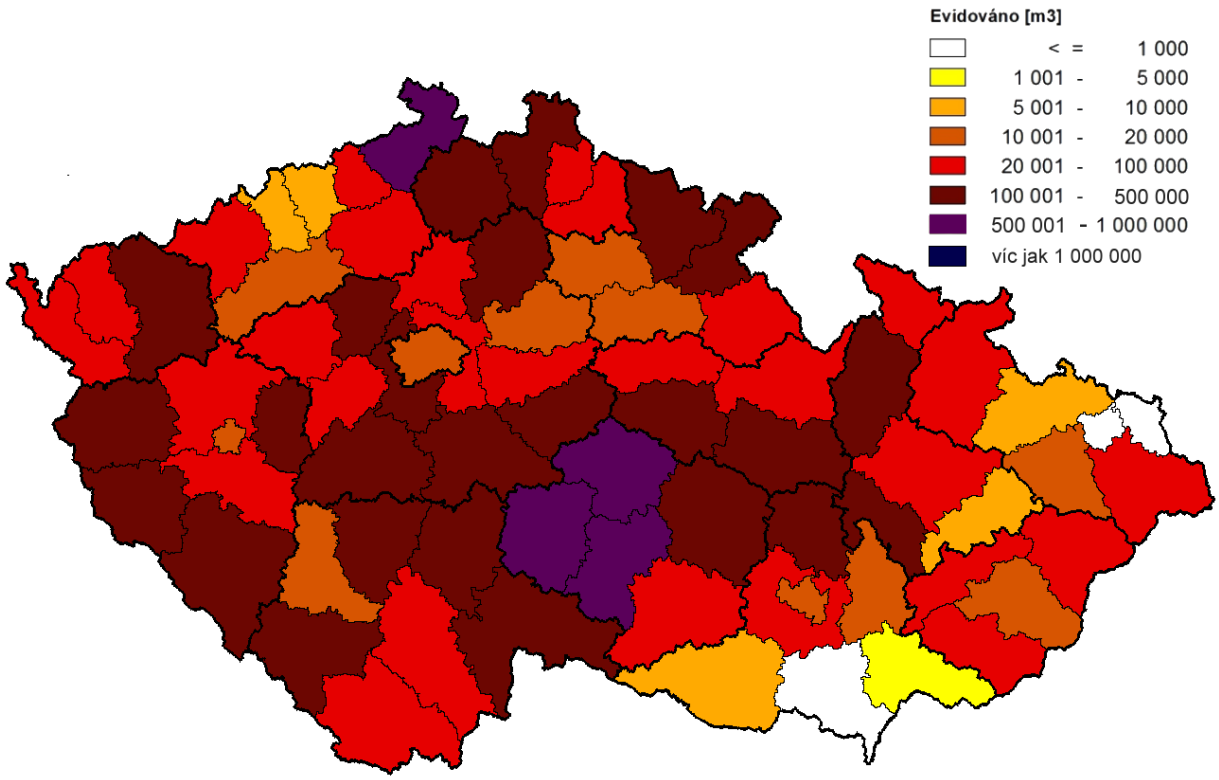

Fig. 3: *Recorded volume of spruce wood infested by bark beetles in 2021 (data source: FPS FGMRI)*

Fumigation of bark beetle infested spruce wood using EDN®

ING. JAN LUBOJACKÝ, PH.D.

Fumigation of log piles using EDN® (ethanedinitrile) preparation is developed by the Czech company Lučební závody Draslovka, a.s., Kolín. It is primarily intended for the phytosanitary needs of large timber exporters. Experimentally, this method was also used for the treatment of piles of bark beetle infested spruce logs in Czechia, for the first time in 2017.

The treatment procedure is as follows:

The spruce logs are stored on the plastic sheets and are covered by other plastic sheets. The cover doesn´t have to be hermetically sealed, the lower edge of the cover sheet is sufficient to load. After this preparation, the EDN gas is discharged in a controlled manner from the pressure vessel by the specialized workers under the cover plastic sheet. After about 24 hours, specialized workers will gradually start ventilating the pile of logs again. After ventilation, which lasts a maximum of several hours, the pile of logs is no longer "dangerous" for its surroundings. However, the spruce logs are still attractive to bark beetles, so if they weren´t fully occupied before fumigation, they can successfully infest them again, because the bark isn´t toxic. The EDN fumigation may only be performed by employees of the Lučební závody Draslovka Kolín. All safety precautions must be observed, such as workers must have appropriate protective equipment, the piles of logs must be marked with information on chemical treatment, etc.

The effect of EDN-treatment is manifested within a few hours on all insects and their developmental stages (eggs, larvae, pupae and adults), which occurs under the bark of logs. Mortality is one hundred percent.

The method is suitable for pile of logs with a size of about 350 m^3, while with a larger size of landings, the economy of application improves (optimum several thousand m^3). The cost of wood treatment is approximately 6-8 EUR per 1 m^3.

Currently, this method is permitted in the Czechia for the treatment of spruce wood infested by bark beetles *Ips typographus* and *Ips duplicatus*, stored at wood yards or wood dumps until 20 August 2022.

For details on this method, see:

Stejskal V. et al. 2021: Metodika ošetření napadeného dříví lýkožroutem smrkovým (*Ips typographus*) pomocí přípravku EDN® [Methodology of treatment of infested wood by spruce bark beetle (*Ips typographus*) using EDN® fumigation preparation]. Metodika pro pracovníky v lesnictví a DDD. Praha: Výzkumný ústav rostlinné výroby, v.v.i., 63 p. ISBN 978-80-7427-349-0

The damage caused by the large pine weevil in Czechia

RNDR. ADAM VÉLE, PH.D.

The large pine weevil (*Hylobius abietis* L.) is the most critical pest of seedlings in Czechia. The high abundance of this weevil and damages caused by it are linked to clear-cut management of coniferous plantations, respectively, area of replanted clearings.

The damage have long been at an annual level of 1.5-2 thousand ha. In recent years, the extent of the damage has increased to approximately 3 000 – 4 000 ha. The cause of the increase in damage can lie in the bark beetle calamity and the subsequent reforestation of bark beetle clearings. However, the increase in damage is not as high as we might expect from historical experiences.

As seen from the graph, the extent of the damage does not fully correlate with the size of the clearings nor the total replanted area. The more modest increase in recorded damage is a consequence of forest management changes. Thanks to a change in legislation, from 2020, extending the afforestation of calamity clearings to 5 years (instead of the previous two years) is possible.

At the same time, the area replanted with broadleaved seedlings is continuously increasing. Deferred replanting has reduced damage, but partly it has only shifted it to subsequent years. The dry spring/summer period of 2022 is likely to be reflected in the bark beetle sanitation cutting and, therefore, the amount of stumps suitable for the large pine weevil development.

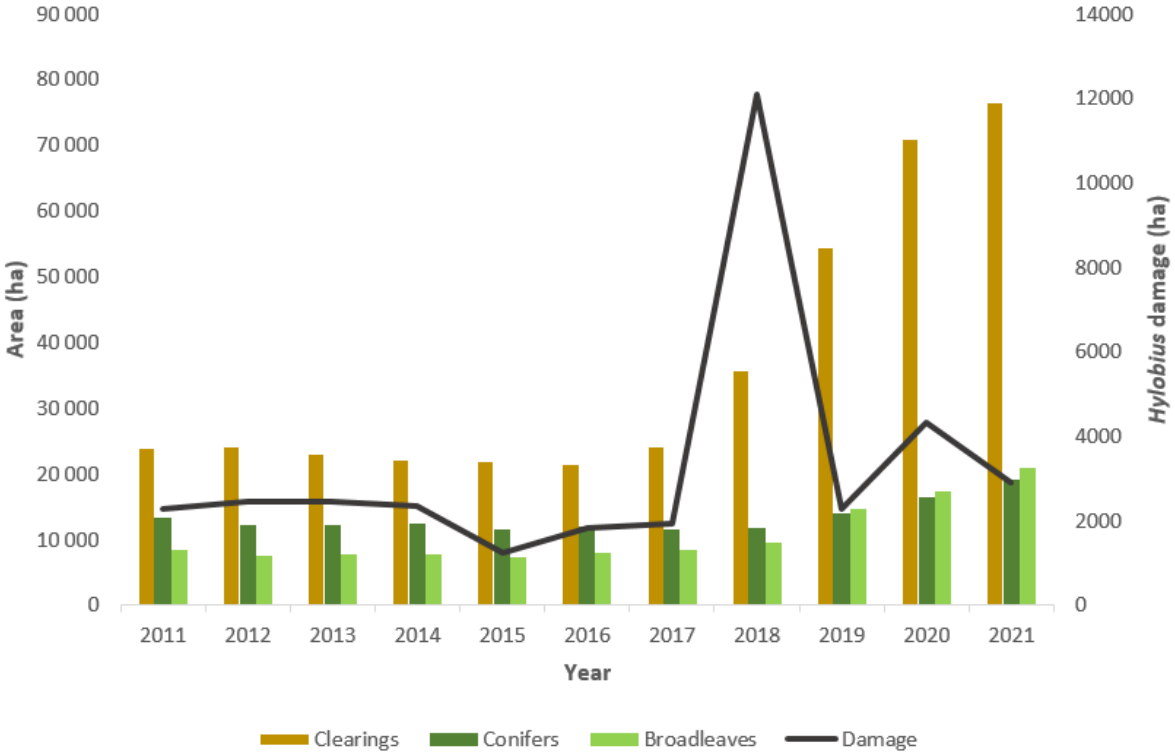

Fig. 4: *The area of clearings and their reforestation with coniferous and deciduous seedlings (left axis) and the extent of damage caused by the large pine weevil (right axis) between the years 2011 and 2021. The significant increase in damage in 2018 is based on damage recorded in only one region and cannot be applied to the entire Czechia territory. Data sources: CZSO, FGMRI.*

Fig. 5: *Spruce seedling damaged by the large pine weevil.*

The principal approaches to forest stands renewal on salvage clear cuts

ING. JAN LEUGNER, PH.D., ING. ONDŘEJ ŠPULÁK, PH.D

It is necessary to use all the naturally-regenerated tree species present on the site; other tree species should be planted so as to get appropriately mixed stands. Decision about which species is needed is taken into account for future juvenile stand tending. The principal aim is an establishment of mixed, fine-structured mixtures with broad spectrum of tree species providing expected services of forest. The principal approach consists in use of **at least three dominant species sharing the mixture nearly equally** on the same site where are also other accompanying species are desirable to increase diversity.

Combination of three principal approaches to salvage clear cuts renewal are recommended.

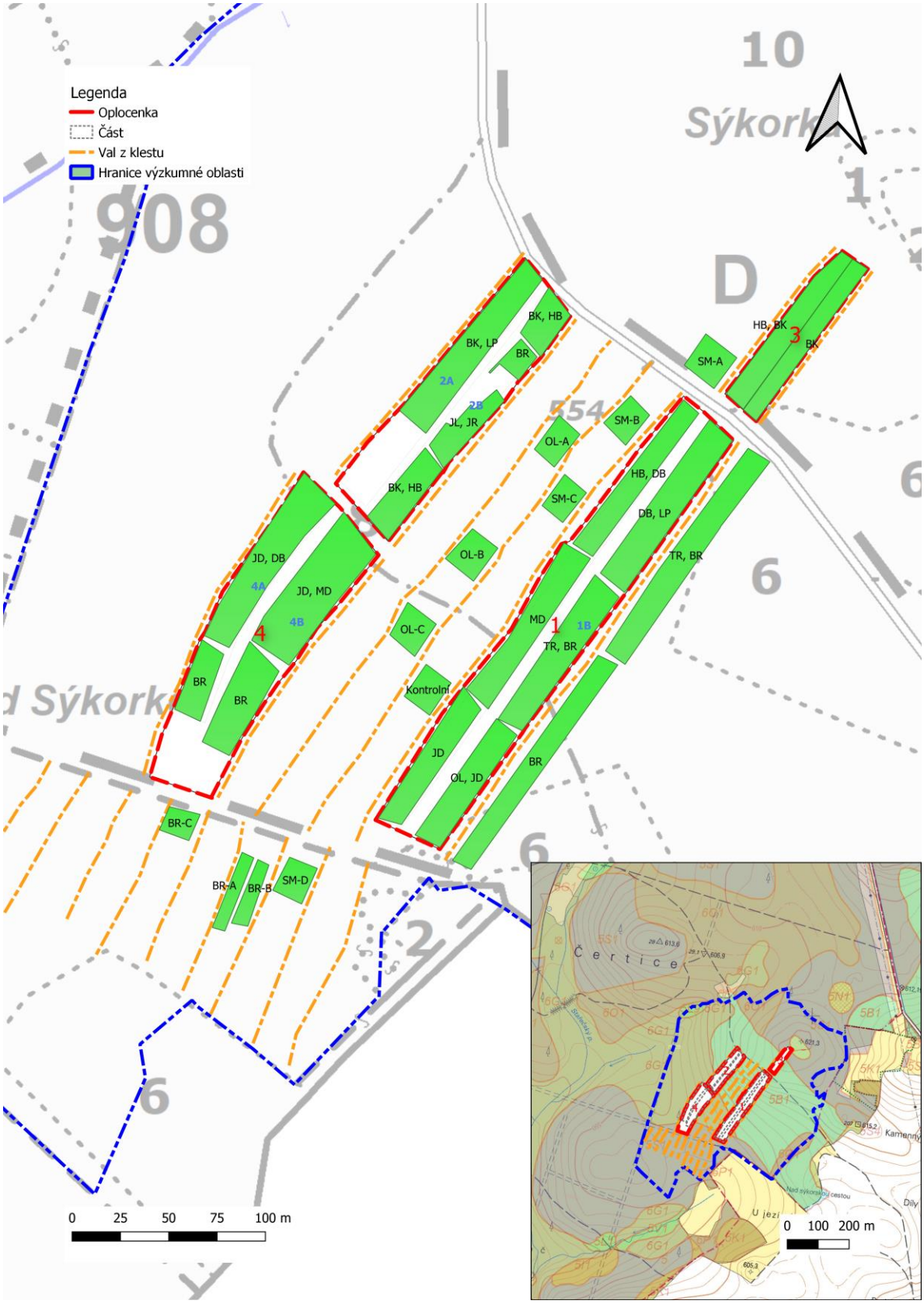

Fig 6: *Design of research plot "Heraltice" with different programs of reforestation*

Direct planting of tree species mixtures according to recommended species composition. Both main target species only and/or mixed with main pioneer species are allowed to be established. The target species on rich sites such as nutrient-rich, loamy and enriched-colluvial ones in accessible-terrain conditions are preferred.

Fig 7: *Artificially regenerated mixture of cherry and birch on nutrient-rich site*

Two-phase renewal when first phase consists in artificial regeneration mainly – preparatory stands can be established using both planting and seeding. Many tree species can be used; there are also allowed lower planting densities per hectare because next phase consists in interplanting of other species. This approach is recommended in large salvage clear cuts particularly. If natural regeneration is not satisfactory, it is necessary to add plantation using planting stock capable of well performance on the site.

Fig 8: *Height growth of trees out-planted with low density*

Two-phase renewal when first phase consists in natural regeneration mainly – the second phase can be realized via both natural regeneration and interplanting (underplanting) by tree species that need specific microclimate conditions. There is an essential prerequisite of its applicability; parent trees present and weed development on the site.

Tab. 1: *Parameters of natural regeneration on research plot "Heraltice"*

Natural regeneration		**birch**	**pine**	**aspen**	**spruce**	**larch**	**wilow**
Outside of fence	Height 2021	43,9	7,5	39,5	23,7	44,9	40,5
	No.	**14**	**2**	**10**	**7**	**18**	**68**
Fenced area	Height 2021	55	22	76,9	17,5	20	77,1
	No.	**11**	**2**	**13**	**11**	**1**	**95**

Number of seedlings from natural regeneration on clear-cuts per hectare is between 6 000 – 8 000.

Water source „Heraltice“

ING. JAROSLAV HEDBÁVNÝ

History of water source Heraltice

- Following large-area hydrogeologic prospection, headwater I and headwater II were established in 1938 and 1943, respectively
- Between 1938 and 1966 – the only water source for county capital Třebíč
- Due to its quality, the water is used for production of famous pop beverage Z.O.N.
- In 1996–2000 period, blocked pipes (e.g. due to ingrown roots) were replaced in the headwater area
- Since 2002, the water plant has had the same technical design after reconstruction
- In 2007–2009 period, the whole 13-km long feeder pipe was replaced (formerly steel DN 225, now cast-iron DN 250)

Services of Heraltice water source

- Collecting water using tapping pipes placed at depths from 3 to 6 m, the perforated pipes are covered all over gravel, clayed, protected by concrete slabs
- Tapping from two headwater areas
- 8-km pipes are placed in forests, conducting pipes transport water to the plant
- The perforated pipes are protected from surface water contamination using a system of ditches and chuckholes (where malfunctions of this system occurred, these were eliminated with cooperation with Forests of the Czech Republic – state enterprise)

- The buffer zones of 1st and 2nd level were established
- The processing of water is minimal, it is just filtered through crushed limestone in order to increase water pH and water hardness, it is also disinfected using sodium hypochlorite
- Water pollution, content of chlorine and nitrates and absorbance are measured continually in control center in Třebíč
- Currently, the water pollution is measured even in spring pits in the field (the device is powered by solar energy, developed and made by the water company)

Further, new wells HV 2, HV 3 and HV 4 were added to the system (backup reserve in case of low water capacity or increased pollution)

The capacity of the source, water quality, impacts of environment

- Until 2017, the mean capacity was approximately 18 l/s
- Droughts in 2017 and 2018 decreased the capacity to 10–12 l/s
- Extremely rainy 2020 showed capacity exceeding even 30 l/s; the water pollution and organic substances were sometimes untreatable
- Long-term mean nitrate content ranged between 5–7 mg/l (this was detected already in 1940)
- Since 2020, the nitrate contents have increased and the values are approximately 10 mg, sometimes 16 mg/l
- It was observed in the water plant that former cover of live forest protected water from pollution; it occurred when precipitation exceeded ca. 20 mm (excess rain, storms, intensive melting of snow due to rain)
- Following bark-beetle calamity and clear-cutting, water pollution was found even if precipitation amounted ca. 8 mm

- Increased capacity of the source (over 30 l/s) limited its use for drinking water; its untreatable properties caused that most of the springs could not be used which resulted in lack of water!

- **The absence of forest means a protection loss of shallow aquifers and significant fluctuation of both water yield and water quality!**

The future

- According to experience from 2017–2020 period, the planned reconstruction of the water plant was called off

- There is a project for construction of a new plant (Pokojovice = Heraltice II), which updated technology is going to process water from both existing headwater source and new wells near Římov and Štěměchy; it is going to get running in 2024

- **Renewal of the forest = a hope for Heraltice source restoration** *(spruce is preferred at least within the tapping area, the role of broadleaves for water management is uncertain)*

- **The experience from the last years = issues concerning forestry and water managements**

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Soil solution chemistry and soil water potential at the plot Nová Brtnice

DOC. ING. VÍT ŠRÁMEK, PH.D., ING. VĚRA FADRHONSOVÁ

Nová Brtnice is one plot of Intensive Monitoring of Forest Ecosystems within the ICP Forests programme established in 1994 in mature Norway spruce stand. During 2005 – 2012 it was fully equipped with measurement of deposition, soil water chemistry, soil chemistry, foliage chemistry, meteorological measurement, soil water measurement etc., then the number of survey was minimized due to capacity restriction within the programme. After the plot and surrounding forest was clear-cutted, we have installed sampling of soil water and measuring of soil temperature and soil water potential on the clear-cut and in a remnant of medium old N. spruce stand nearby.

We would expect increase of carbon, nitrogen and nutrients content on the clear-cut (CC) comparing to Norway spruce stand (NS) due to enhanced humus decomposition, but the signal is not as clear. Main differences (and higher values of all studied elements are under the humus (FH) layers. There is also much higher variability than in the depth of 30 cm. We record a period of remarkably higher DOC, NH_4^+ and NO_3^- concentration on CC comparing to NS under the humus layer during winter season 2020/21, during the vegetation seasons the differences are not systematic. DOC (dissolved organic carbon) concentration in the soil depth of 30 cm are significantly higher on the CC.

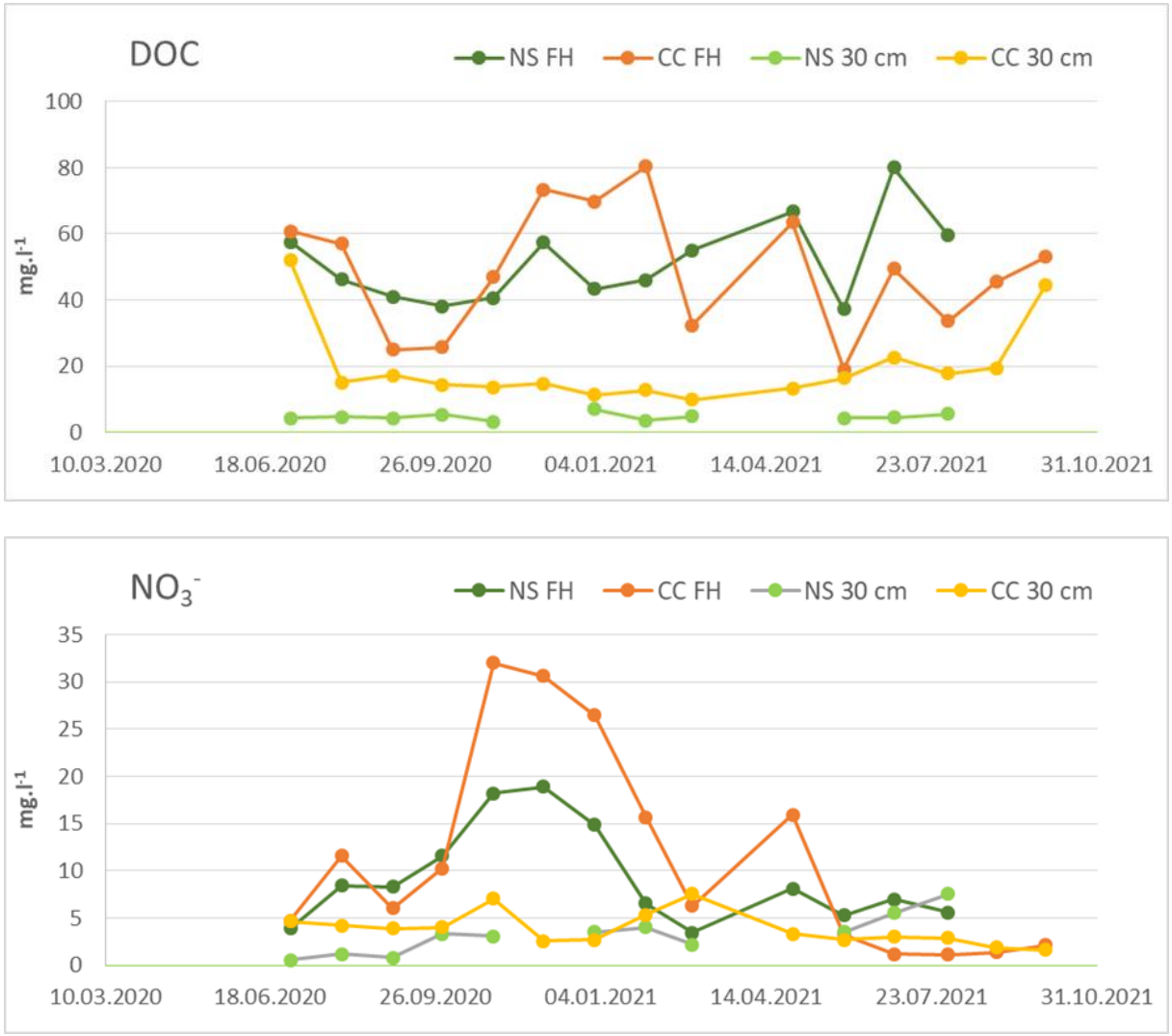

Fig. 9: *Concentration of dissolved organic carbon (DOC) and nitrates in soil solution on clearcut (CC) and N. spruce stand (NS) under humus layer (FH) and in the depth of 30 cm at plot Nová Brtnice*

Soil temperature was higher on clearcut – in the topsoil (10 cm depth) and in the depth of 30 cm on average by 2,1 °C but significant difference was recorded also in deeper soil of 50 cm depth – on average by 1,5°C.

The year 2021 was rather favourable with long winter season and sufficient rainfall during spring and vegetation season. The only drought period was recorded in the autumn starting in September and peeking in turn of October/November. In this period the Soil water potential dropped significantly in the Norway spruce stand with potential limitation of water supply for trees.

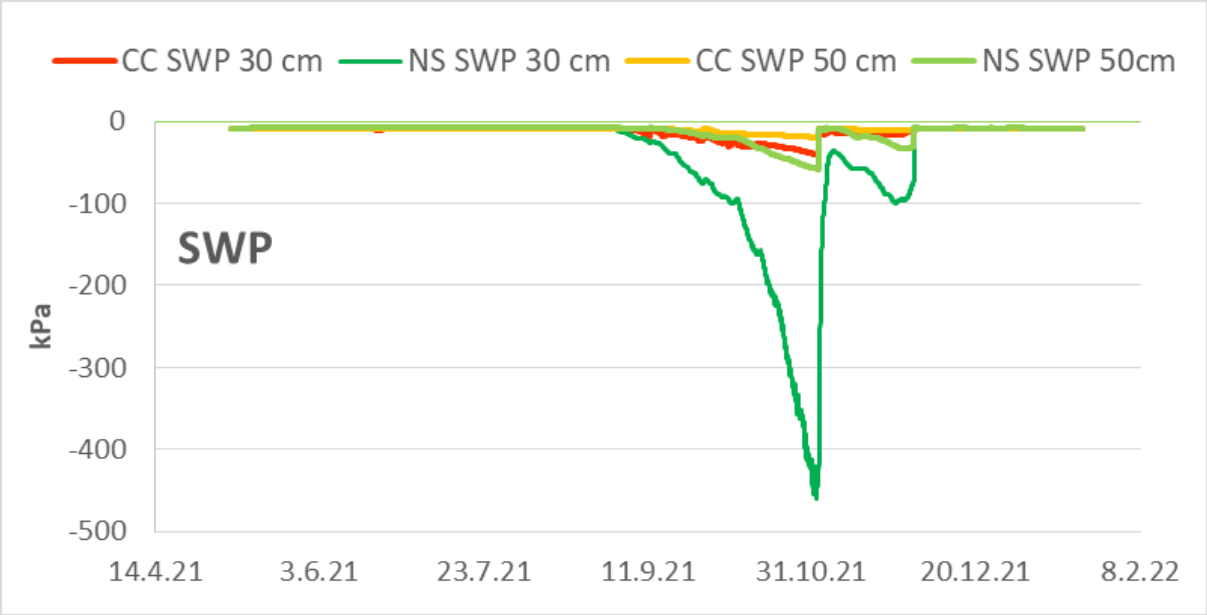

Fig. 10: *Soil water potential on clearcut (CC) and N. spruce stand (NS) in the soil depth of 30 and 50 cm at plot Nová Brtnice*

Fig. 11: *Current state at the plot Nová Brtnice (afforestation in 2021)*