

The recent bark beetle (Coleoptera, Curculionidae, Scolytinae) problems on spruce in Czechia

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A report on the current forest pest situation in Czechia is annually released by the Forest Protection Service (FPS) in the Forestry and Game Management Research Institute (FGMRI). The reports are based on data received from forest managers, covering approximately 70% of the forest area in Czechia. Weather conditions and the amount of bark beetle infested woods are correlated. The presented study focusses on the current state of the very severe bark beetle infestations. The actual beginning of the ongoing bark beetle mass attack can be dated back to 2015. However, an abrupt increase in the amount of wood infested by spruce bark beetles was recorded in 2018. The outbreak culminated in 2020, when the volume of cut infested timber in our record reached nearly 15 mil m³. If the calculations are extrapolated to cover the whole country the infested volume of timber reaches more than 22 mil m³.

Key words: Forest protection, forest health, damaging factors, abiotic influences, biotic agents, insect pests, monitoring, forest protection service, Coleoptera, Scolytinae, *Ips typographus*, *Ips duplicatus*, *Pityogenes chalcographus*.

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Introduction

The recent bark beetle calamity has been monitored since 2018. After a period of extreme weather conditions (Liška et al. 2018, Lubojacký et al. 2019, 2023), the enormous infestation of spruce stands developed rapidly and the volume of cut wood increased substantially. The very beginning of the present bark beetle mass attack is dated back to 2015 (Lubojacký 2018a, 2018b), and can be seen as a consequence of extreme drought and heat that weakened and reduced the

resistance of the spruce stands. Uncommonly hot weather conditions supported the development of three generations of spruce bark beetles (Liška et al. 2016). However, also some factors related to human activity could have contributed to this disaster. Examples are permanent loss of skilled labour, inaction of many forest owners, inflexible system of public procurement contracts and protracted sales crisis in the timber market. Further impacts such as late and insufficient processing of infested wood contributed to increase the calamity (Lubojacký et al. 2019).

Methods

Data related to factors harmful to forests are annually collected by the FPS (e.g. Knížek & Liška 2023). The figures include the volume of recorded damaged wood from ca 70% of the forest area in Czechia (in m³). All state forests, which means Forests of the Czech Republic, Military forests and all national parks representing 55% of all the forests of Czechia, are included. The remaining part (15%) is made up of municipal forests and private owned forests, forest nurseries etc. It is necessary to mention that the data collecting process is done on a “voluntary basis”, using questionnaires. It is not supported by any law or regulation. In some

cases, figures corresponding to the entire forest area of the country are simply calculated from available data. We critically evaluated the data, checking for possible mistakes, and included some observations from field monitoring as well.

Results

The annual average temperature recorded in Czechia exceeded the normal stated for the period between 1981 and 2010 (Figure 1), with the exceptions of some years. Similarly, the annual precipitation sums were below the normal, especially since 2015 (Figure 1).

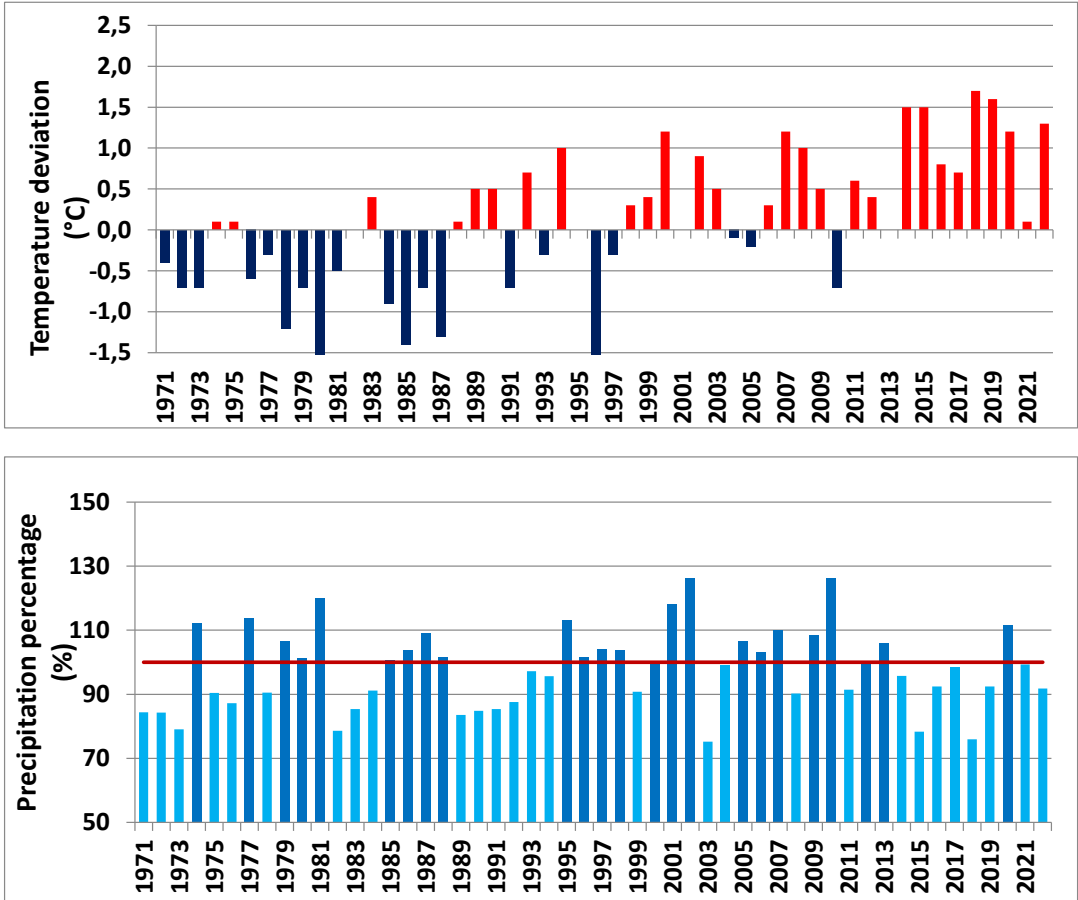


FIGURE 1. Annual temperature and precipitation deviation from the normal (the average temperature and precipitation levels between 1981 and 2010) in Czechia since 1971 (data source: Czech Hydrometeorological Institute).

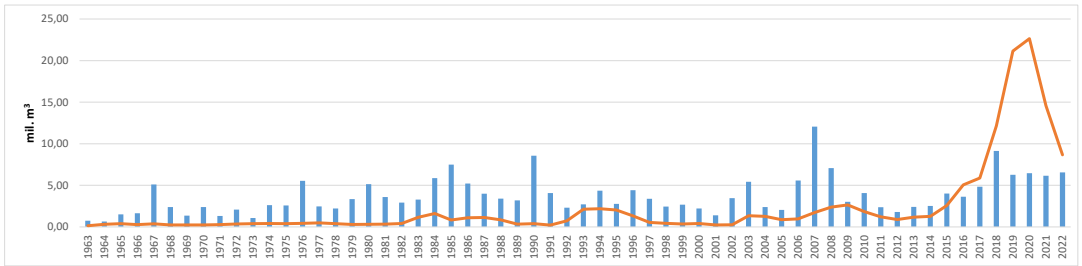


FIGURE 2. Sanitary cutting caused by abiotic factors and biotic agents (especially insect) in Czechia since 1963 (data source: FPS FGMRI)

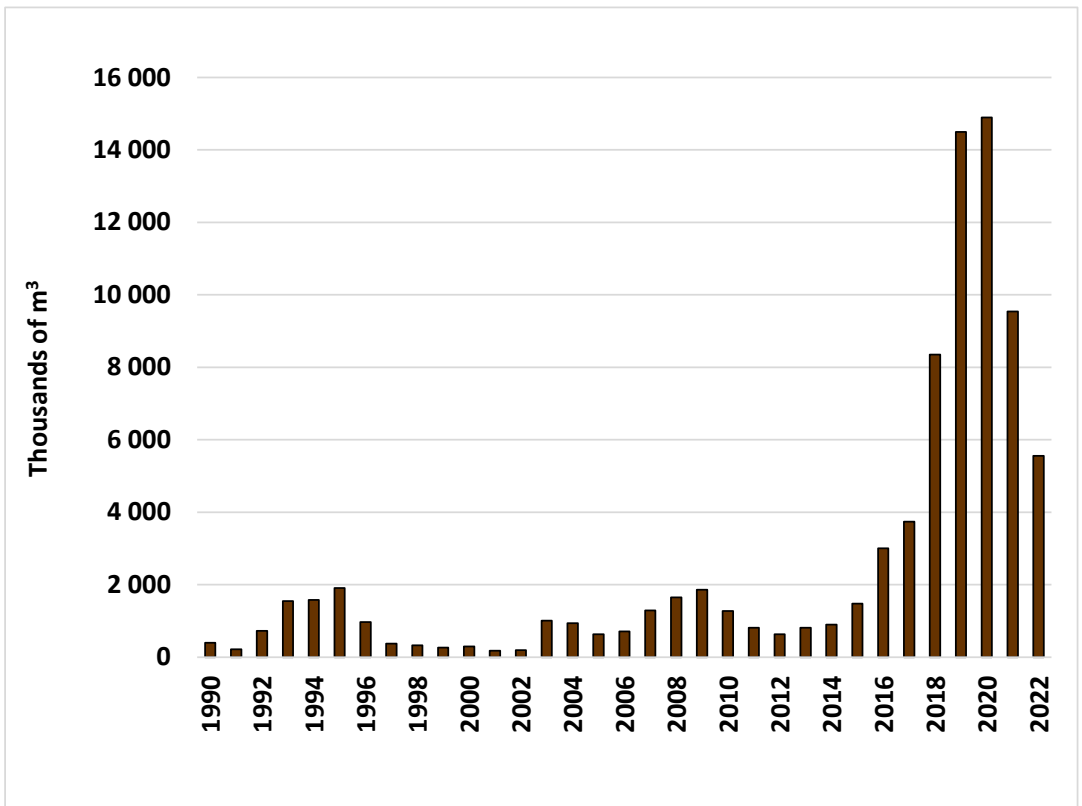


FIGURE 3. Recorded volume of spruce bark beetle infested wood since 1990 (data source: FPS FGMRI).

Unfavourable weather within several consecutive years caused weakening of trees. The result was increase in bark beetle activity and development of three beetle generations, with three full flight periods in a year, including production of sister broods. Rather mild winters enabled bark beetles to develop the immature

stages under tree bark at least through parts of the winter and get ready for its massive spring swarming. The situation resulted in massive bark beetle infestations on spruce. For the first time in history, the volumes of sanitary cutting of trees killed by biotic factors (mainly by bark beetles on spruce) exceeded the volumes of timber cut

because of abiotic damage (Figure 2). A detailed overview of sanitary cutting caused by spruce bark beetles is shown in Figure 3.

The dominant part of the biotic forest damage, approximately 95%, are due to spruce bark beetles, namely *Ips typographus* (Linnaeus, 1758), *Ips duplicatus* (Sahlberg, 1836) and *Pityogenes chalcographus* (Linnaeus, 1761). All three species are often found on the same trees. However, *I. duplicatus* often reaches high proportions, especially in the northeastern part of the country. *Ips typographus* is historically known as the most harmful bark beetle species in Czech spruce stands. The importance of *I. duplicatus* has been increasing since the 1980s, when it started to spread and invade new locations west- and southward of the region of Moravia and Silesia. Recently, *I. duplicatus* has spread throughout the whole country (Figure 5). It may be difficult to distinguish between *I. typographus* and *I. duplicatus* in practice, i.e. outside of laboratory environment, but foresters should be able to

achieve this after training. The size (length) ranges of the two species overlap slightly. The biggest specimen of *I. duplicatus* may be the same in size as the smallest specimen of *I. typographus* (Figure 4).

After eight years of continuously increase of the bark beetle pest (Lubojacký 2022), it is evident that the calamity is decreasing now. The first year-on-year decline was recorded in 2021

TABLE 1. The volume of bark beetle infested spruce timber cut during the period from 2018 to 2022, based on data from Lubojacký et al. (2023). The volumes represent timber from 70% of the forest areas in Czechia.

Year	Volume [mil m³]
2018	8.4
2019	14.5
2020	14.9
2021	9.5
2022	5.6



FIGURE 4. Size variation (upper and lower limits) comparisons of *Ips typographus* (Linnaeus, 1758) and *Ips duplicatus* (Sahlberg, 1836).

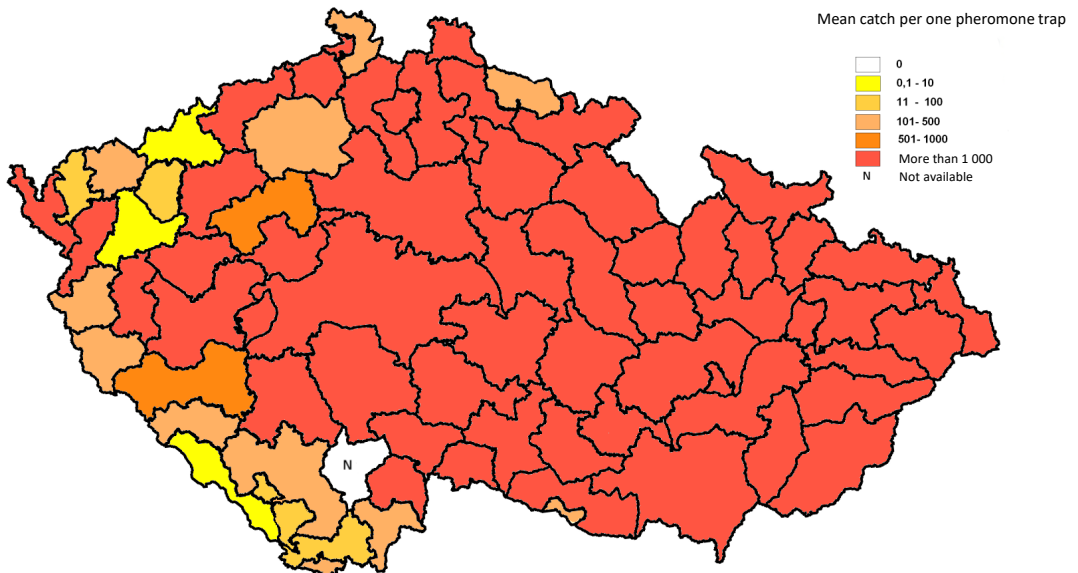


FIGURE 5. Cumulative map of maximal average catches of *Ips duplicatus* (Sahlberg, 1836) with pheromone traps in 1997–2021 (data source: FPS FGMRI)

(Figure 3). Volumes of infested wood are still high, even calamitous. It gives some optimism, but a conclusion is still premature.

In 2020 the bark beetle calamity was spread throughout the whole Czechia. The development in 2021 and 2022 are shown in Figure 6. However, significant regional differences are evident. The gradation is declining in the eastern half of the country, in Silesia and Moravia, where the bark beetle calamity started. This is also the same in the regions of Třebíč and Jihlava in Vysočina (“Highland”) region. It is mainly due to a combination of a significant decrease in the numbers of the most attractive spruce stands and favourable weather conditions. In comparison, other districts of the Vysočina region, where the situation used to be the worst, the population size remains relatively high (Lubojacký et al. 2022). In the western half of the country (Bohemia), the extent of the bark beetle infestation has been increasing in the last two years. The most problematic areas at the present are in the north and northwest of Bohemia, where low precipitation totals were recorded in recent years. Extreme gradation continued particularly also in the National Park České Švýcarsko (Lubojacký et

al. 2023).

Never the less, the unfavourable climatic conditions of previous years, influenced nearly the whole territory of Czechia. Consequently, the collapse of forest protection efforts continues. Unfortunately the infested trees are not effectively sanitized in time by most of forest owners and holders (Lubojacký & Knížek 2021, Knížek et al. 2022).

Discussion

As a result of the clear-cutting process of infested trees, entire spruce stands continue to disappear on a large scale. The deforested areas often reach tens to hundreds of hectares and subsequently present serious restoration and cultivation problems. Dead spruce stands of both young stands and economically less interesting stands have reached hundreds and even thousands of hectares locally. This constitute problems in the coming years (Lubojacký 2022), although of trees in these “dead stands” were cut during the last two years. In addition, troubles related to the overpopulation of ungulate game (Lubojacký et al. 2023) add

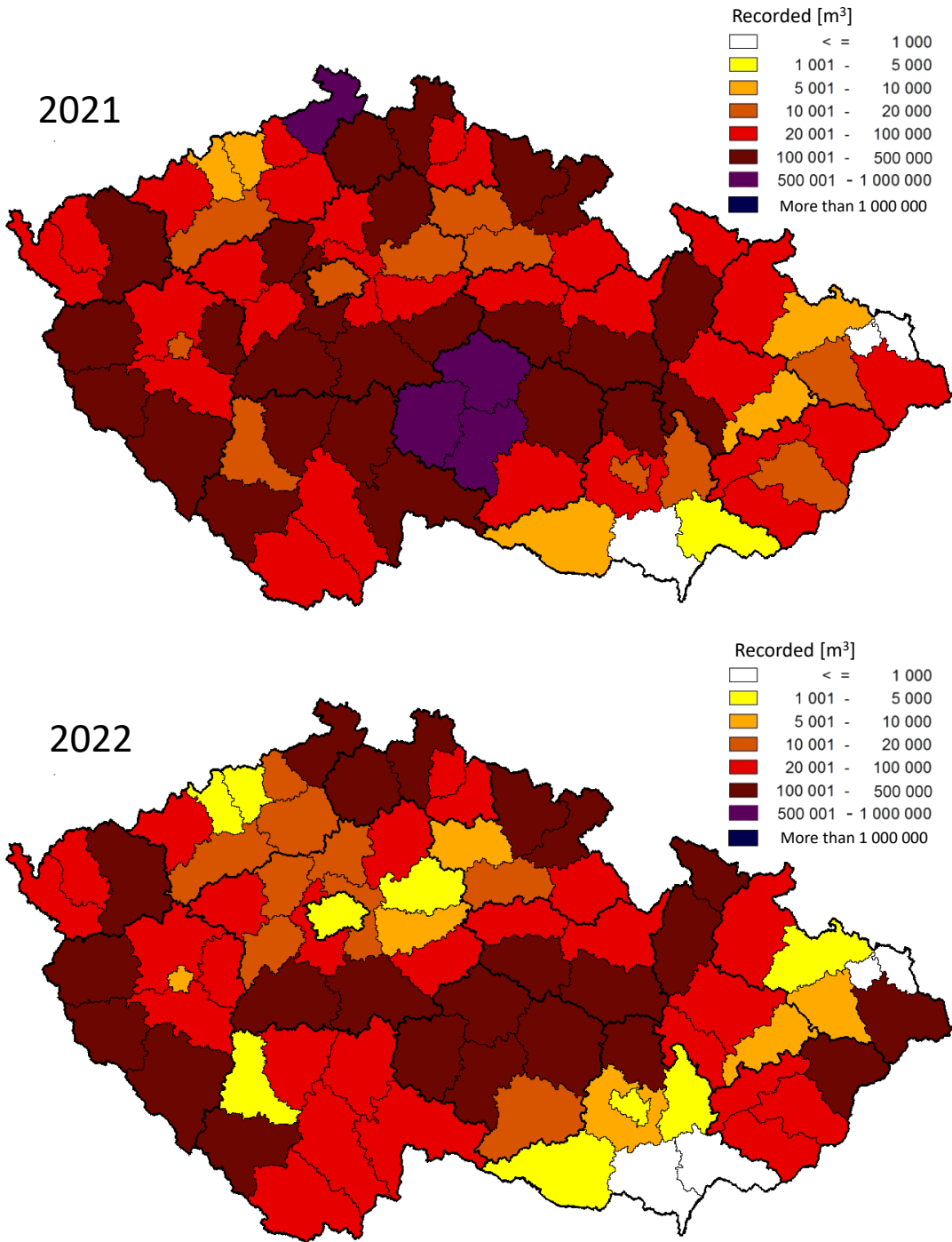


FIGURE 6. Recorded volume of spruce wood infested by bark beetles in 2021 and 2022 (data source: FPS FGMRI).

problems to the management of spruce forests.

The more favourable weather conditions in 2020 and 2021 significantly influenced and reduced a further expansion of the bark beetle crisis. It can be concluded that the current bark beetle calamity culminated in the year 2020. However, the extreme effects of the calamity persist. It is necessary to take advantage of the opportunity offered by nature and the favourable situation on the timber market and not give up on forest protection efforts. The priority is searching for bark beetle infested wood, its timely processing and effective sanitation. It is appropriate to speak of a lasting collapse in forest protection, when even relatively small bark beetle outbreaks remain without timely sanitation, thus enabling a subsequent infestation of the surrounding trees and the development of bark beetle gradation. The future development of the bark beetle calamity will largely be determined by weather conditions. The situation in 2022 confirmed that volumes of infested wood is declining. However, several months of drought, windy and relatively warm weather during the winter of 2021/2022 and spring 2022 raised some concerns about the development of the bark beetle situation. The spruce stands in Czechia are still enormously endangered.

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