Lessons Learned

The story of bark-beetle outbreaks in the Šumava National Park, in the Czech Republic along the German and Austrian borders, provides some insight into the impact of stable/unstable zonation regimes on efforts to fight the beetle, as well as a better understanding of what may be described as the "paradoxes of sanitary cutting."

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Bark beetle outbreaks occur on varying scales. The current bark beetle outbreak in the Białowieża Forest can be seen as small-scale in comparison to those that occur in other conditions, such as in the Šumava Mountains in the Czech Republic – the case to be described herein. In part this is due to the species composition of the forest there. The Šumava Mountains form part of the larger Bayerische Wald area, and they feature a plateau of mostly pure spruce stands along the peaks of the mountain chain itself, but mixed stands to the south. Our experience is that mixed stands are not susceptible to bark-beetle attacks, and so we have been surprised to see that in Białowieża there is an outbreak in mixed stands.

Straddling borders

Another distinctive feature of the Šumava case is that here the forest sits along the confluence of boarders. Białowieża stands astride the Polish-Belarusian border, but the Šumava forest covers parts of three different countries, with a tapestry of different forest owners employing different methods of forest management and pest control. The area has the status of a state forest in Germany, a private forest in Austria, and a national park plus protected landscape area in the Czech Republic. This complicated set of statuses, however, is generally not problematic, giving rise to few difficulties in terms of forest management – as long as there is no bark beetle outbreak, that is.

But we can also sometimes see quite big conflicts, between two or even three countries, depending on the situation. Fig. 1 shows an image from during a bark-beetle outbreak in 2010, showing some dead spruce forest within a core zone of the National Park in the Czech Republic (towards the top of the picture), and also illustrating how in the two adjacent areas we have large clear-cuts left behind after salvage cutting (Germany, bottom left, and Austria, bottom right).

Since this event we have had numerous discussions on different levels. We generally agree that if we want to manage bark beetles in national parks or protected areas, we should somehow minimize the

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effect of bark beetle outbreak and spruce mortality, not in core zones but in buffer zones. The question of course, is how this should be most appropriately and successfully done. We might use different techniques to try to decrease the extent of tree mortality, such as pheromone trap barriers or salvage cutting. This is not about passive or active forest control, but mostly about what we should do if we want to decrease the negative effect of no management. And one thing the Šumava case shows very well is the importance of an adequately chosen, stable forest zonation strategy in this.

The importance of stable zonation

Figure 2 shows a history of disturbances caused in the Šumava forest by two different factors – the yellow line charts damage caused by wind, the red line damage caused by bark beetles. We will see how these fluctuations tie into the general story of the Šumava National Park over these years: a story of zonation, disturbance, and new zonation.

In the first period illustrated in this data, from 1985 up to the national park zonation in 1991, we had not so much bark beetle damage, and there were almost only green forest stands (as seen in the image). The first system of zonation introduced in the Šumava national park in 1991 was based on relatively big core zones, or no-management zones. If we look back to the graph in Fig. 2, bark beetle mortality can be seen to slowly but consistently increase following the imposition of this zonation regime. This, in turn, led to a certain amount of pressure on the park authorities for greater bark-beetle management efforts. Here there were not such big peaks in beetle-caused mortality at this stage, but there was a certain visible upturn.

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Fig. 1. Part of a bark-beetle outbreak underway at the confluence of three borders (Czech Republic, Germany, Austria) in 2010.

For this reason, a new zonation regime was created and imposed in 1995, this time based on many small core zones, which were very small and fragmented. Again, in the core zones there was no management, whereas buffer zone there was management.

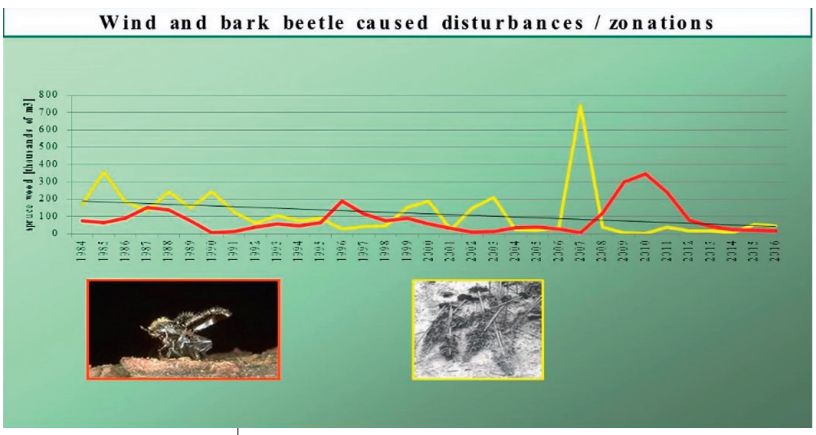
The Šumava case offers a certain very special insight into wind vs. bark-beetle interactions. Generally, when we have small core zones, with very precise space management, we can decrease ongoing damage by bark beetles (as seen in the period 1995–2007 in Fig. 2). But then there came a game-changing event: in January 2007 there was a big disturbance caused by the storm "Kyril", leaving behind a vast volume of windblown spruce wood (853,000 m²). As the sudden peak in the yellow line on Fig. 2 shows, this disturbance was indeed quite big.

After this there was much discussion, I will show you in the next section there was discussion about management and core zones and buffer zones, and the national park decided to leave a large share of the wind damage with no management. Big core zones were created, but this zonation was somehow not fixed, and to date there is not a stable zonation of the national park.

Overall, some 116,000 m² of spruce wood was left unprocessed in more strictly protected zones of the National Park. This, in turn, led to a natural bark beetle outbreak, which continued through the subsequent years, giving rise to conflict between the three countries and pressure for a change in zonation. In 2010 and 2011 there was change back to the zonation which had first been imposed back in 1995, with small core zones. This zonation has led to decline of mortality, but there is still conflict concerning the national park.

In general, then, the story of the Šumava forest has involved the zonation regime being switched depending on the situation: depending on the political situation on the on hand, and depending on the bark beetle damage situation on the other. This, we argue, is not a good approach, as zonation needs to be stable.

Fig. 2. Wind and bark beetle caused disturbances in the Šumava forest in 1984–2016.



Potential mistakes in combatting the beetle

What techniques can be used to fight the bark beetle? The most important method used by foresters in buffer zones is sanitary felling or cutting. But for this method is effective, but it has to be done very precisely (namely, it is very important to find a bark-beetle attacked tree in time to remove it). Essentially, then the situation we have is that if we want to maintain a healthy core zone, we have to "pay for it" by engaging in active sanitary felling in the buffer zones around it.

What do we actually do with the trees? Well, the standard technique is known as mechanical debarking, which results in 100% bark beetle mortality, although there are also other techniques, such as a new experimental technique from Germany, which has been tested in the Sumava Mountains. In many areas, trees are cut down, debarked and the trunks are simply left. In areas where you a tree cannot be cut down, it is possible to debark a standing tree, but this is quite expensive and is considered an extreme resort.

As for salvage cutting, there are many discussions as the issue is quite complicated. If it is done precisely and in proper time, done in a technically correct way, you will kill all the beetles in the given forest stand. However, there are several types of commonly seen errors made in salvage cutting, which can often detract from the presumed effectiveness of the salvage cutting efforts.

Firstly, yellowed trees may appear on the forest edge, which are nevertheless not actually being attacked by the bark beetle. Often we see that non-trained foresters may cut these trees in mistake.

Secondly, cutting may often be performed too late: tree–bark beetle interactions are very complicated. Very often there may be green trees with yellow needles, which may appear infected, but when one inspects closer the condition of the bark indicates that the beetles have already left the particular

tree. If such a tree is felled, it will not help the condition of the forest. One has to cut green trees with beetles inside.

Another problem is when we open a new forest edge, we expose standing trees to the light. Bark beetles then start to attack these warm places in forest stands. Thermal camera images show that the openings are warmer, and trees are more stressed (in the case of mountains). These temperatures affect the bark beetle's behavior.

Thermal imagery shows how fresh forest edges experience higher temperatures, and are therefore at greater risk of bark beetle attack

The paradoxes of sanitary felling

This brings us to what may be described as the "paradoxes of sanitary felling." There are different views on this issue and it is certainly a very complicated one. Basically, if you have a source of bark beetles, such as a core zone in a national park, they will be migrating from there. Still, you have the core zones and buffer zones, and you need to stop the beetles somewhere. But when you fight against them, you create new forest edges. These forest edges are exposed to the sun, warmer, constitute beetle-attractants, and the beetles are likely to migrate there. So, this means when you have a core zone there should be a buffer zone of minimally 500 meters, with a zone of clearcuts. There should not be a core zone without clearcuts (or they should only exist in mixed stands).

Other effect of sanitary felling involves the potential for wind damage. This was seen in Šumava forest in connection with the decision in 2008 to expand the core zones. Core zones mean sanitary felling in the buffer zones, and this in turn leads to more fragmented forest areas and more numerous open forest edges, which increases the susceptibility to wind damage. This, in the longer run, entails greater susceptibility to bark-beetle outbreaks. Of course, the size of the zones used in the zonation regime here plays a role as well.

In both cases, sanitary felling undertaken to combat the bark beetle may in fact ultimately have the reverse effect. As these paradoxes show, the bigger picture of forest management techniques and their long-term impact is therefore quite complicated.

In conclusion, we can state that the Šumava forest case has the following lessons to teach us:

1. There is a need for stable and generally accepted zonation regime, with core zones that are as compact as possible
2. In the case of spruce stands, the buffer zones could become heavily damaged, but we should try to minimize this.

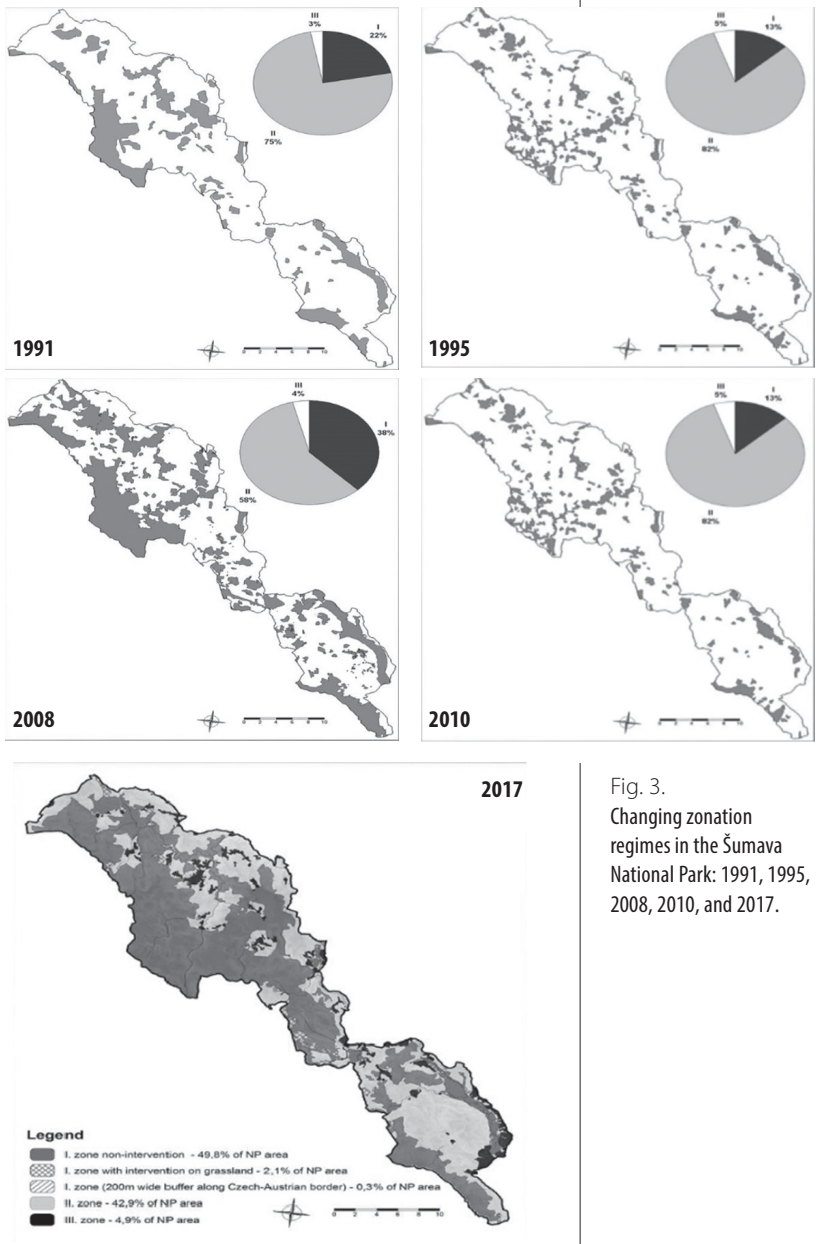


Fig. 3.
Changing zonation regimes in the Šumava National Park: 1991, 1995, 2008, 2010, and 2017.

3. In the buffer zones, intensive and precisely-performed salvage cutting and other methods of forest protection are needed.

In conclusion, we can state that the Šumava case provides some examples of ill-chosen forest management techniques and the consequences thereof, which it is good for other people involved in forest management or similar research to be aware of.

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This is a summary of a presentation given by Dr. Jakuš at the international conference "Managing the Bark Beetle Outbreak in the Białowieża Primeval Forest," organized by the Polish Academy of Sciences on 4 December 2017 (preceded by a study visit to Białowieża).

This article presents a synthesis of work by Ratislav Jakuš' team, by Šumava National Park staff and other researchers working in the Šumava Mountains.