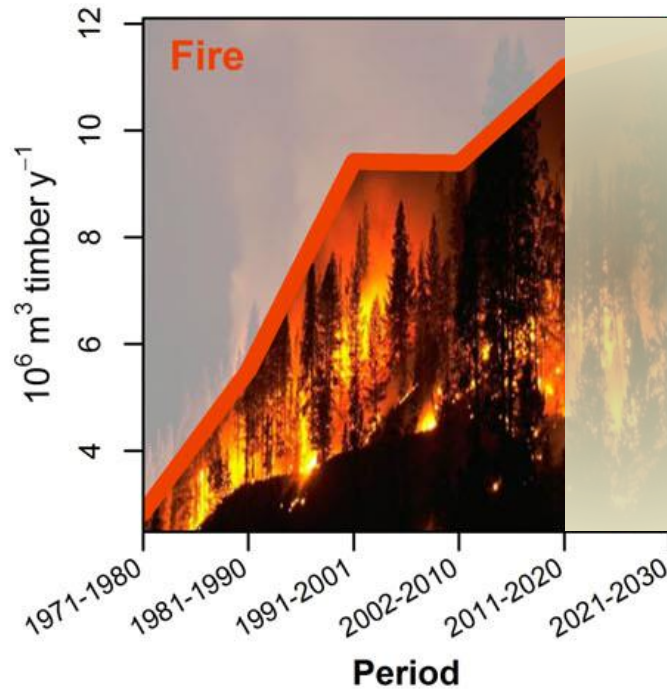


Living with bark beetles: impacts, outlook and management options

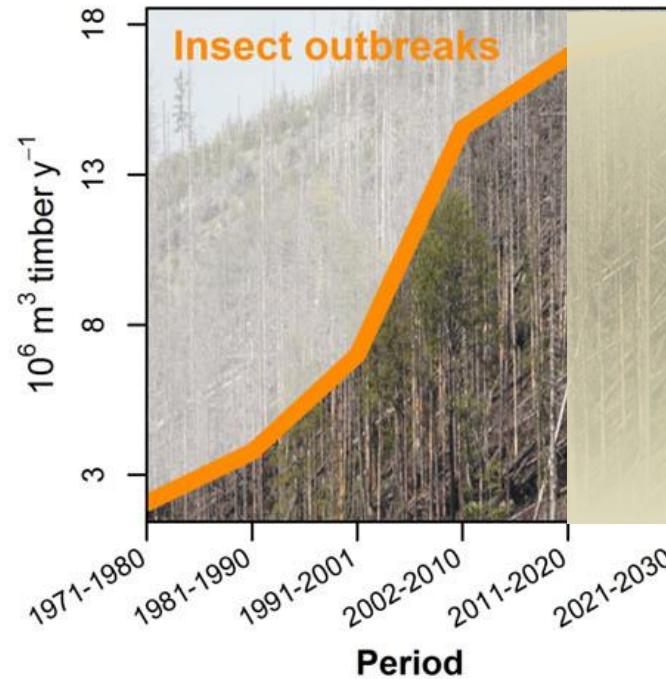
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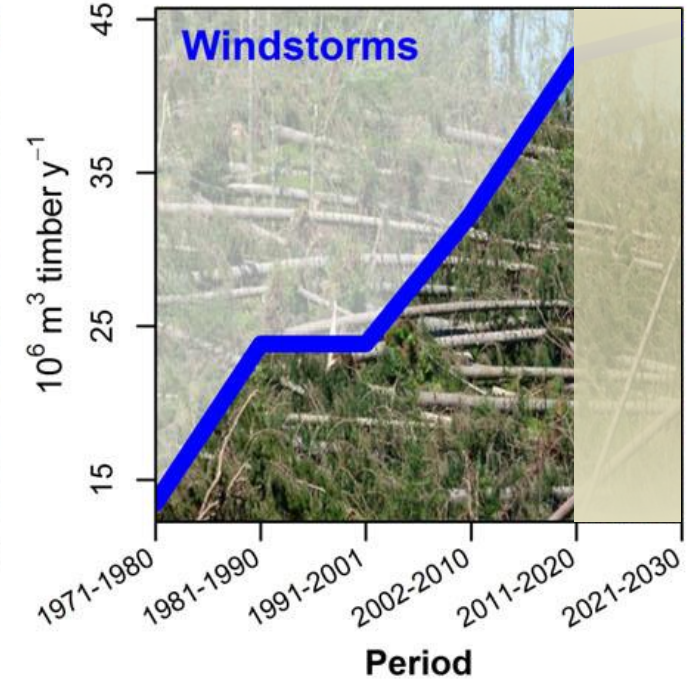
Observed and projected disturbance change in Europe's forests



+ 231 %



+ 600 %

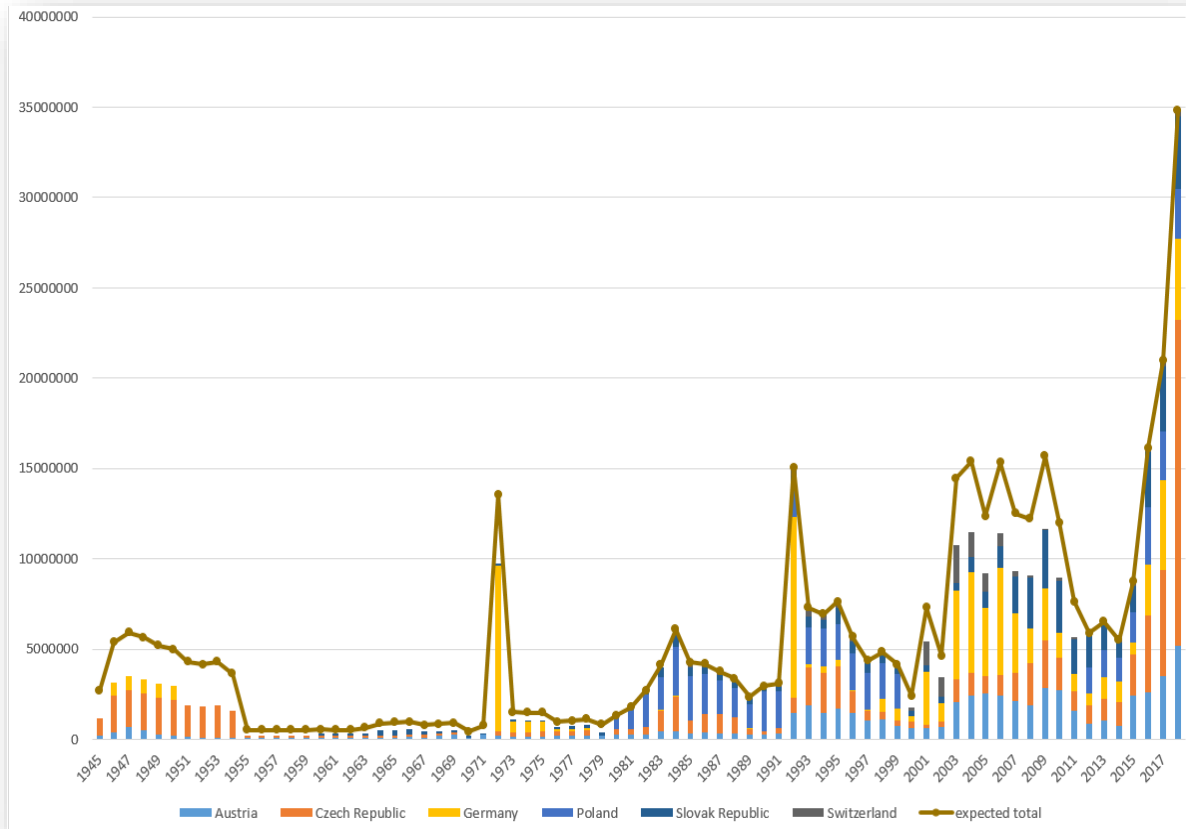


+ 139 %

Per cent change relative to 1971-1980

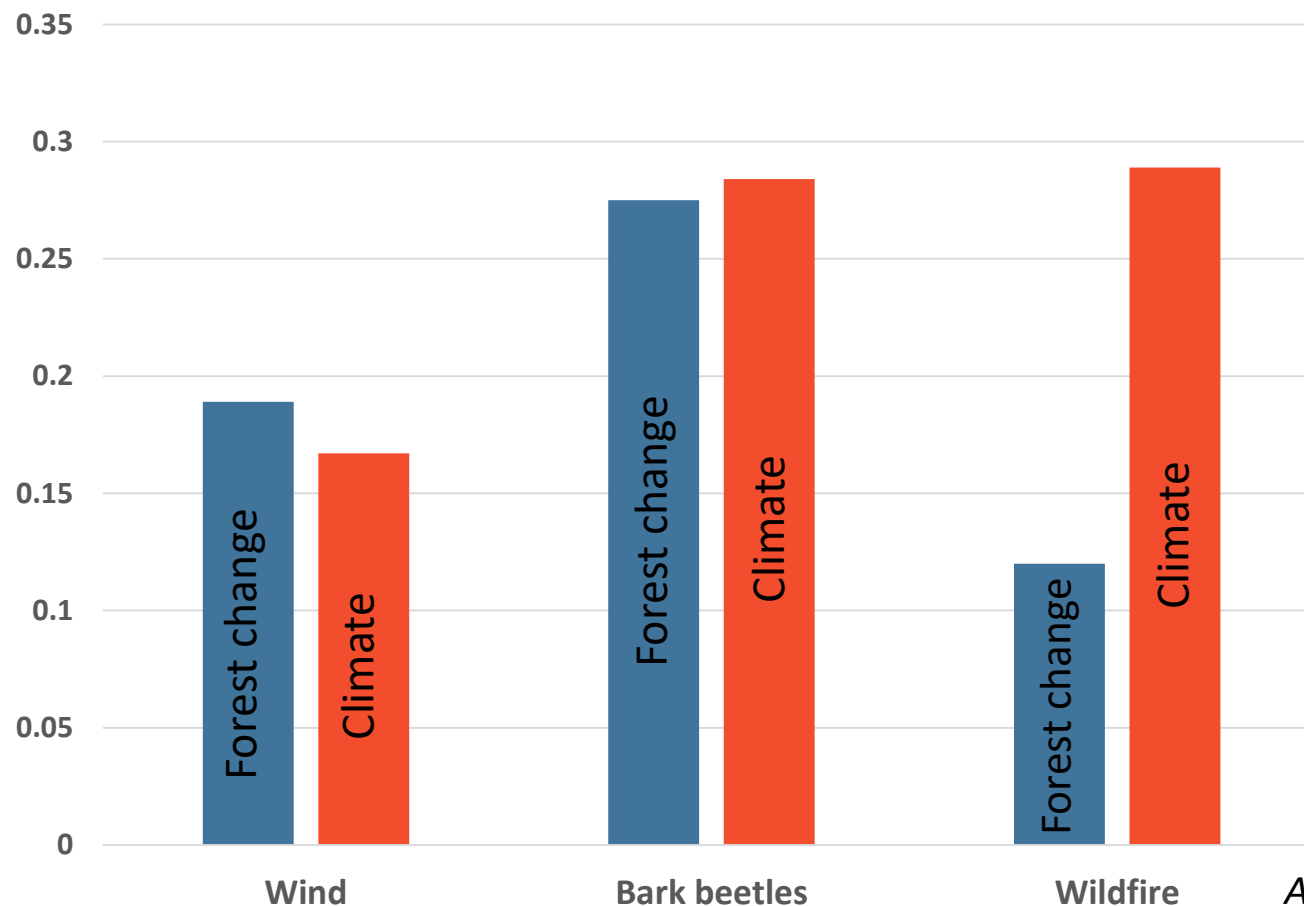
Seidl et al. (2014, Nature Climate Change)

Figure credit: S. Thom



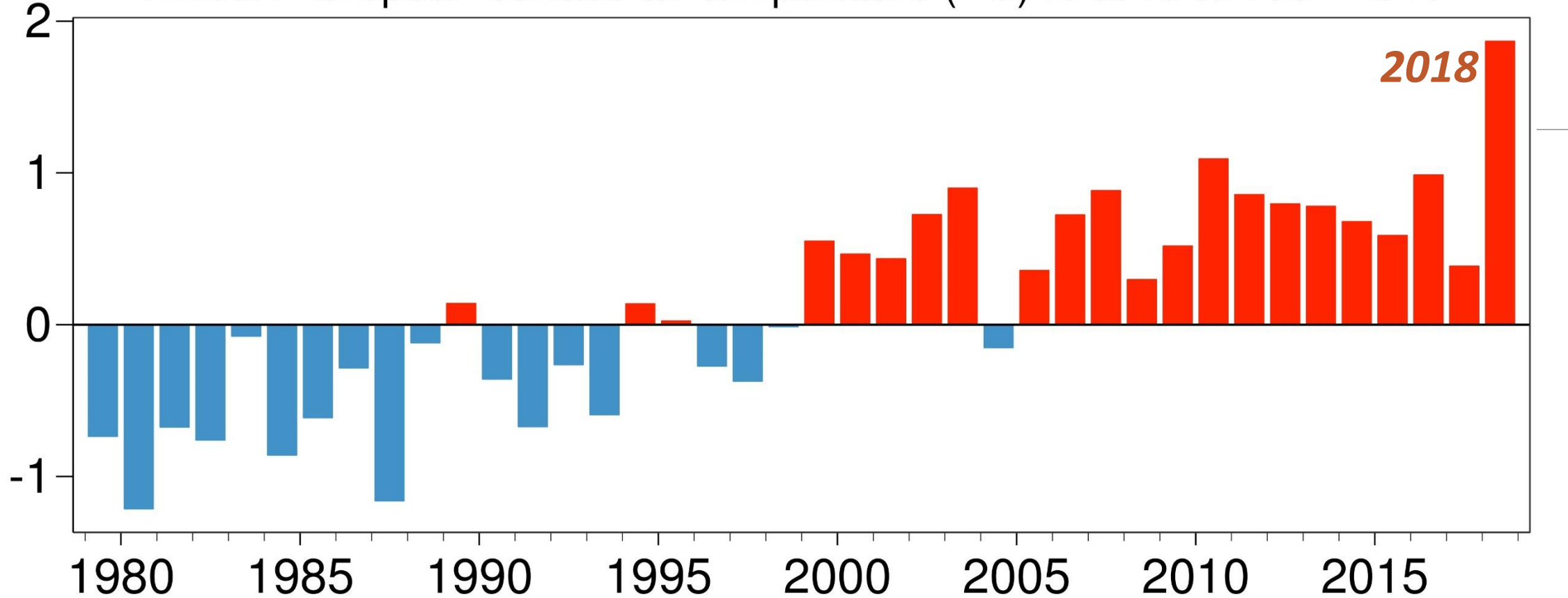
Source: Mart-Jan Schelhaas, Wageningen Environmental Research

Drivers of change in disturbance intensity



Adopted from Seidl et al. 2016

AMJJA European surface air temperature (° C) relative to 1981-2010



Forests and the 2018 temperature anomaly

- More than 400 forest fires in Brandenburg, Germany
- **Unprecedented increase in bark beetle damage in the Czech Republic**
- Bark beetle outbreaks intensified for example in parts of Austria and Germany
- Drought-induced tree mortality of several species



Recent study of the European Forest Institute

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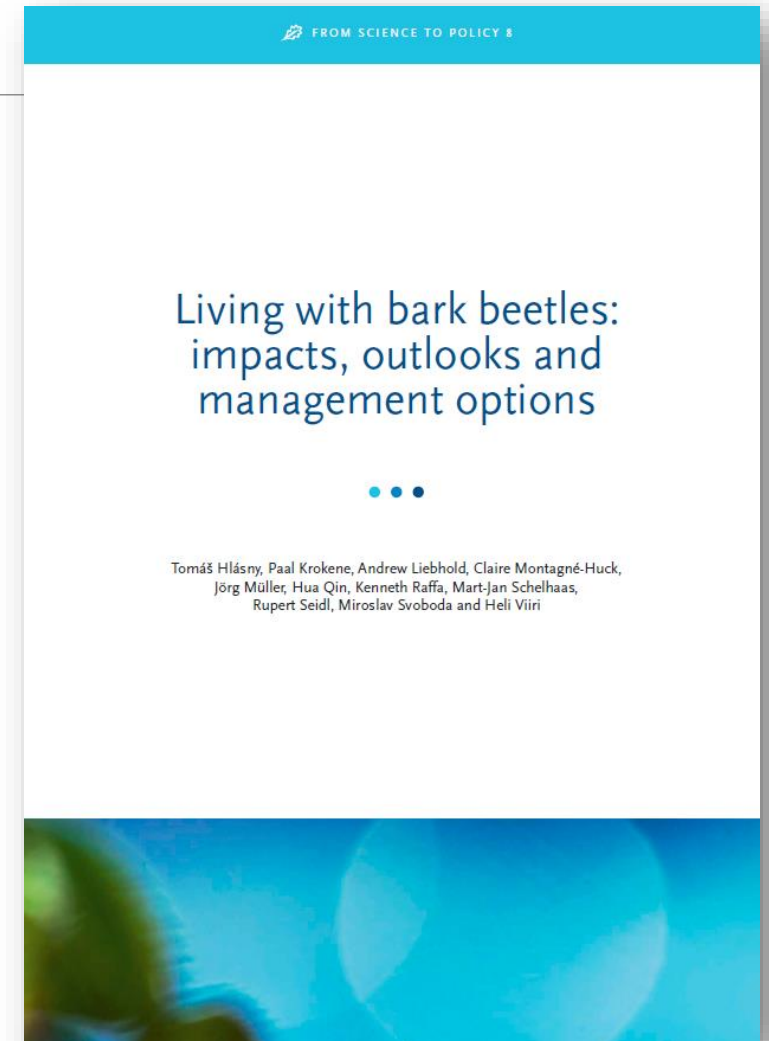
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<https://www.efi.int/publications-bank/living-bark-beetles-impacts-outlook-and-management-options>

What you can find in the report

- Most recent understanding about bark beetles
- Ecological, social and economic impacts of outbreaks
- Reasons of the present-day situation and the outlook
- Bark beetle management in „production“ forests
- Bark beetle management in forests managed for nature conservation and biodiversity
- Improved system for bark beetle management under climate change
- Knowledge gaps

Reasons of the current situation

During the last centuries, spruce has been largely planted in unsuitable sites; better growth at a cost of poorer defence

Homogenous forest are extremely conducive for the development of large-scale outbreaks; there is nothing to stop the spread

More extreme climate greatly accelerates beetle`s developments and compromises trees` defence

A tipping point was reached in 2018 in Central Europe



Ecological perspective

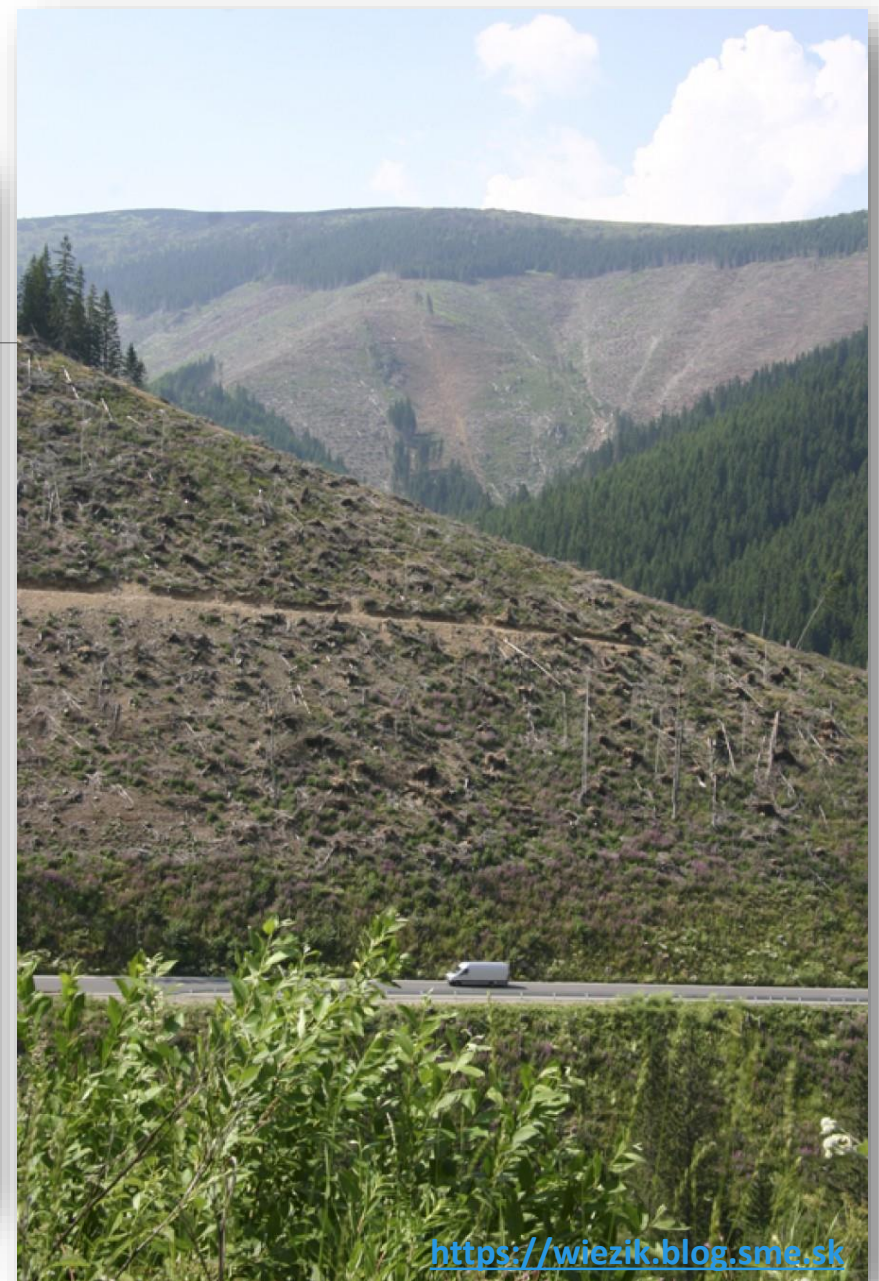
Many of spruce forests are reaching ecological margins of their persistence are being driven to the collapse



From the view of ecology, this is a reset of the unsustainable state and an effort to start from scratch

Humans greatly contributed to this situation by creating forests, which are easy to manage but also easy to collapse

- **Faster development in warmer climate, more beetles**
- **More beetles surviving winters**
- **Trees stressed from drought and heat unable to fend off the beetles**

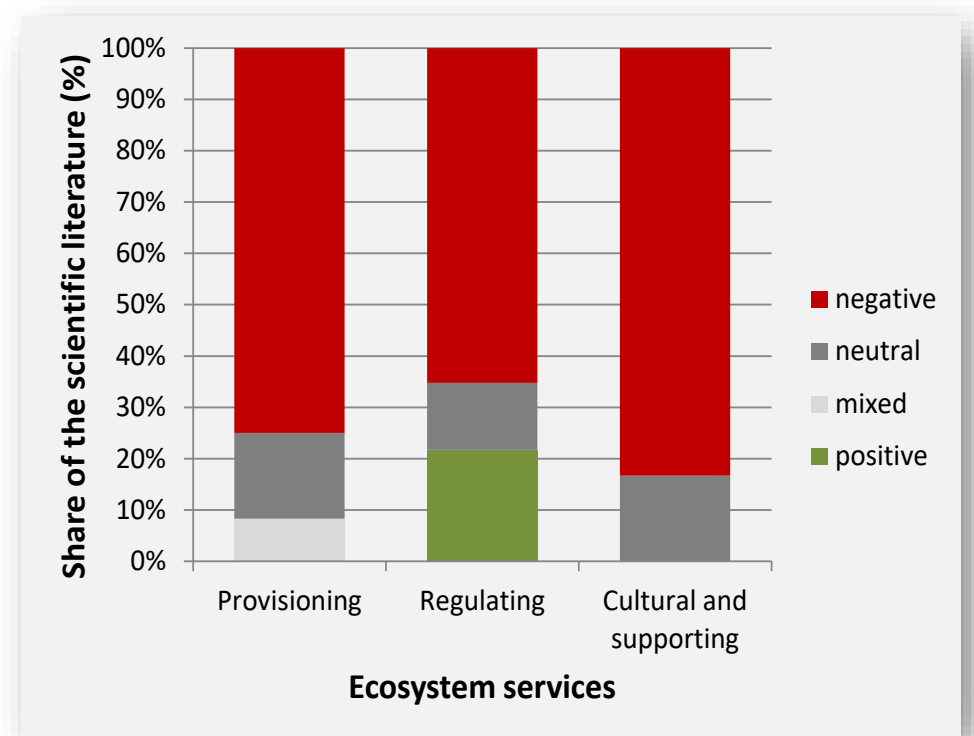


Impacts of bark beetle outbreaks

Ecosystem services – negative impacts dominate

Economy – complex pattern of losers and winners with overall negative balance

Social – rather uncertain, with research lacking for Europe



Outlook

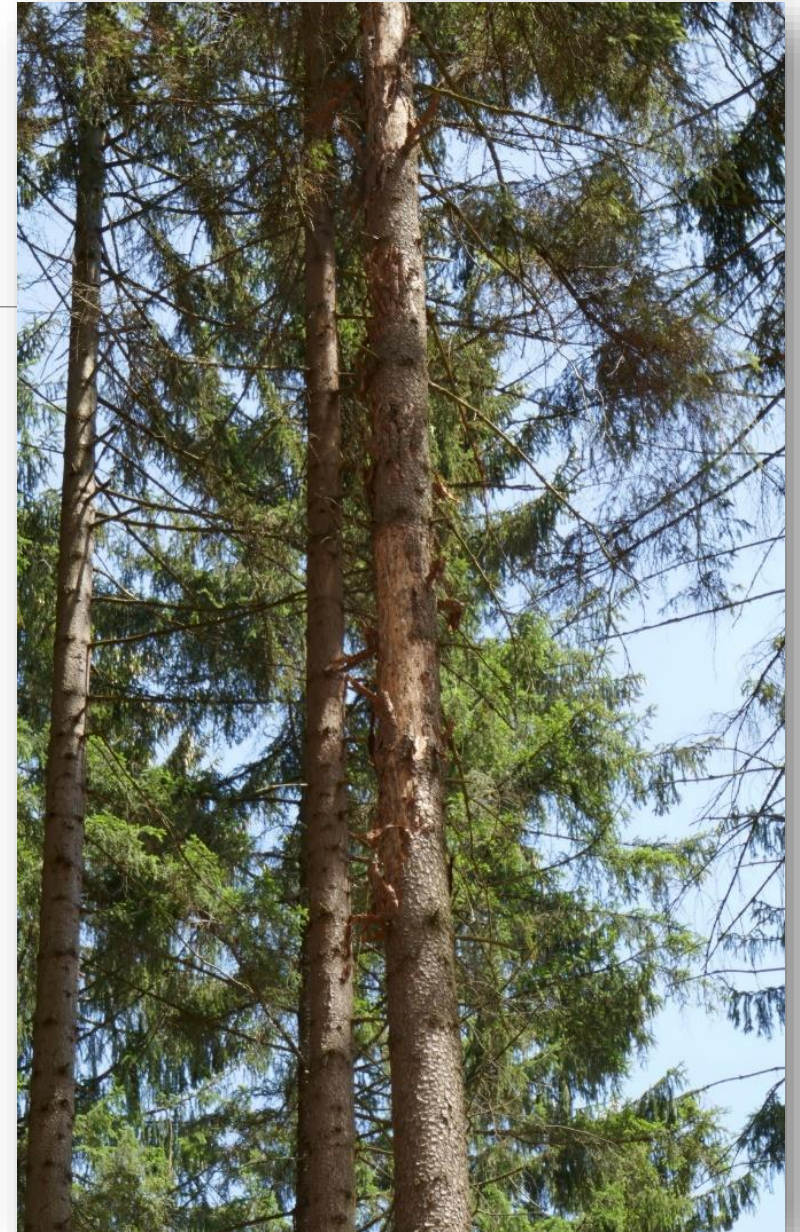
Future outbreaks strongly amplified by climate change

Reaching supranational scales and coming in waves
synchronized by extreme weather

Expanding to new territories

Risk of „ecological surprises“ from bark beetles will increase

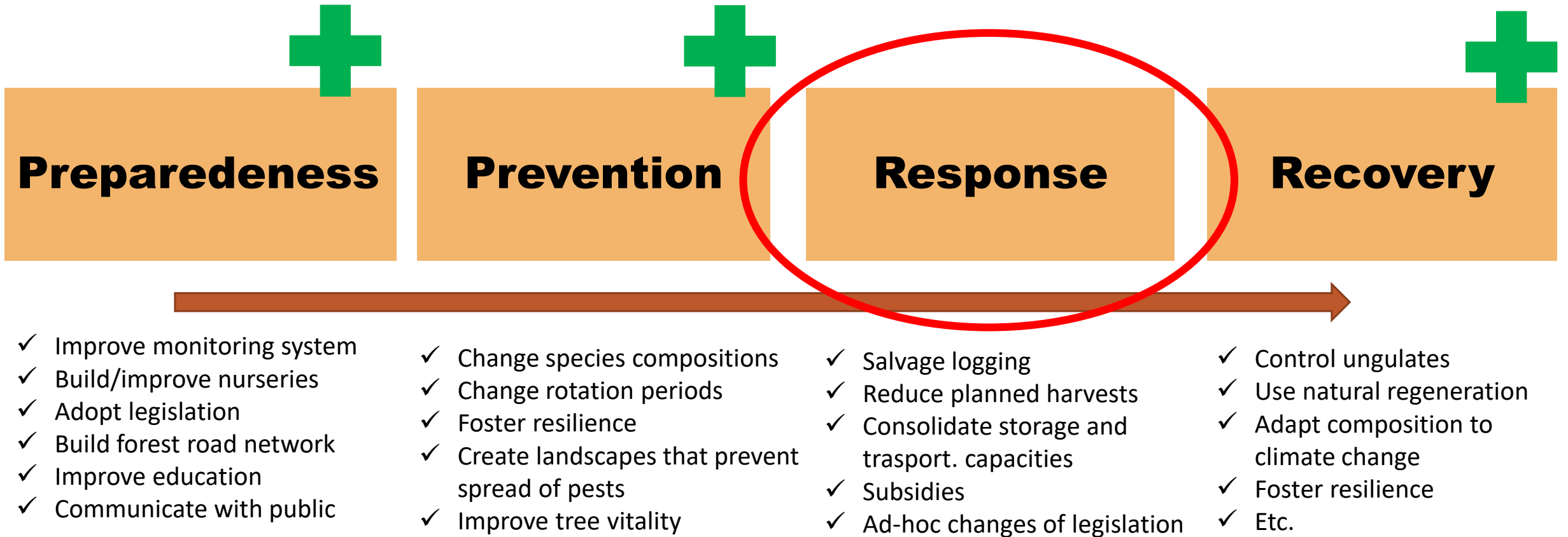
Increased risk of invasions - at least 18 non-native species
have become established in Europe



Remarks on future management

- Learn to live with natural disturbance rather than try to avoid unavoidable
- Build forest with strong abilities to naturally recover from disturbances – foster resilience
- Create landscapes that prevent the development of large-scale outbreaks – i.e. not only diverse stands but also landscapes!
- See disturbances as opportunities to adapt the forest to climate change and do the best to exploit this opportunity

A new management concept proposed



Some final remarks

Utilize „**integrated disturbance management**“ that combines monitoring, sanitation, silviculture and non-intervention rather than „forest protection“

Revise current interpretation of sanitation and salvage logging, and beetle trapping in view of the emerging scientific understanding of their effectiveness, economy and collateral impacts

Relax legal constraints that hamper more comprehensive disturbance management, e.g. the requirement on fast regeneration after disturbance or insufficient flexibility in rotation period



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Thank you for your attention

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