

**Climate Change and
Forest Disturbances in Europe**

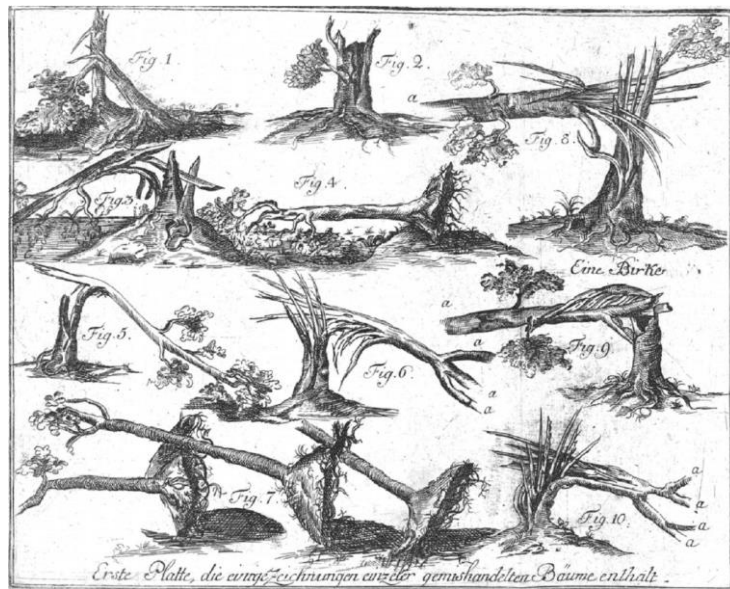
Rupert Seidl

April 4th 2019
Prague, Czech Republic

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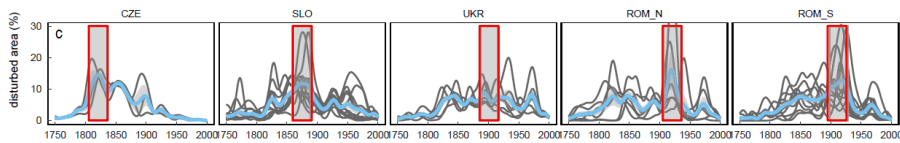
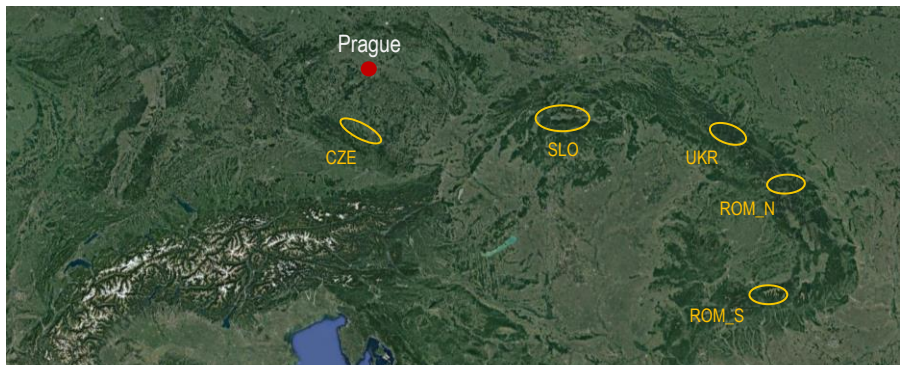
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Umständliche und zuverlässige Beschreibung des Orcans vom 29. Jun. 1764
G.B. Genzmer (1765)

Disturbances in C Europe's primeval forests



Red rectangles: Past disturbance episodes in different primival forests

Schurman et al. (2018, Glob. Change. Biol.)

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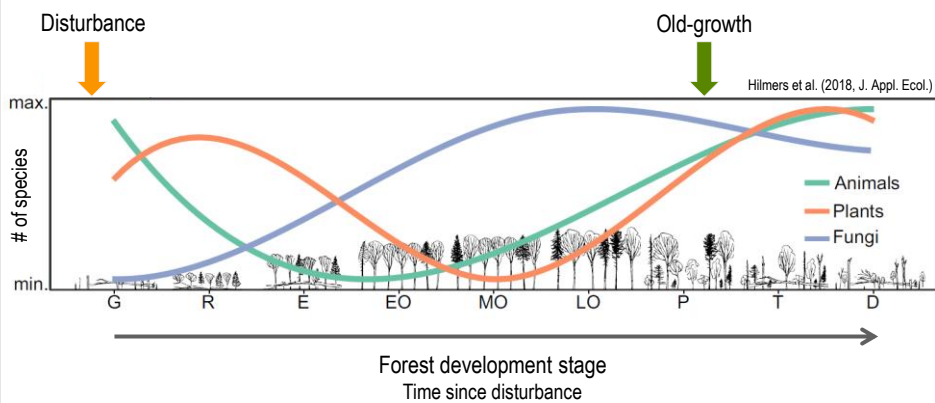


Petrified wood with markings of wood-boring insects
Middle Turonian (~90 Mill. years before present)



Biodiversity is high in disturbed forests

Disturbed areas harbor as many plant & animal species as old forests



Analysis for 2,956 species from 33 functional groups (from primary producers to decomposers)



Recent disturbance change in Europe

Natural disturbances have increased in Europe in the last 40 years

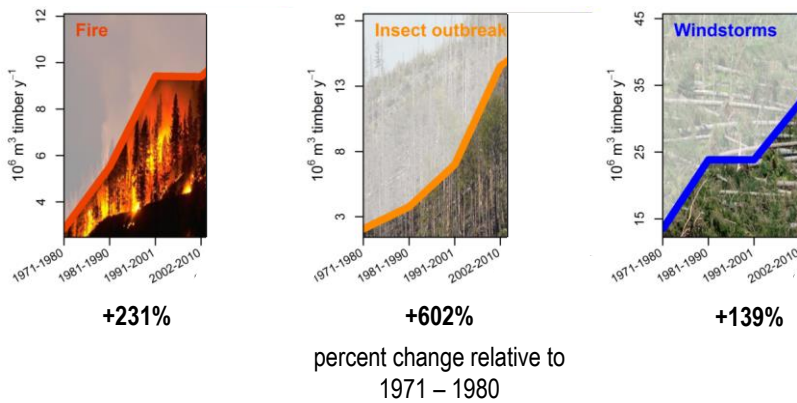
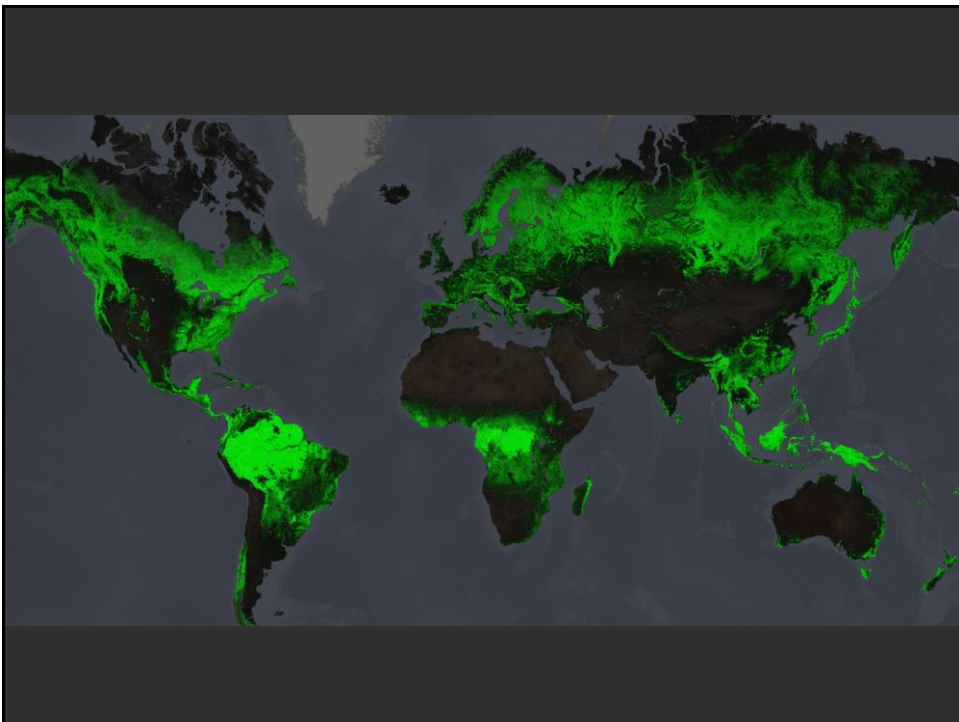


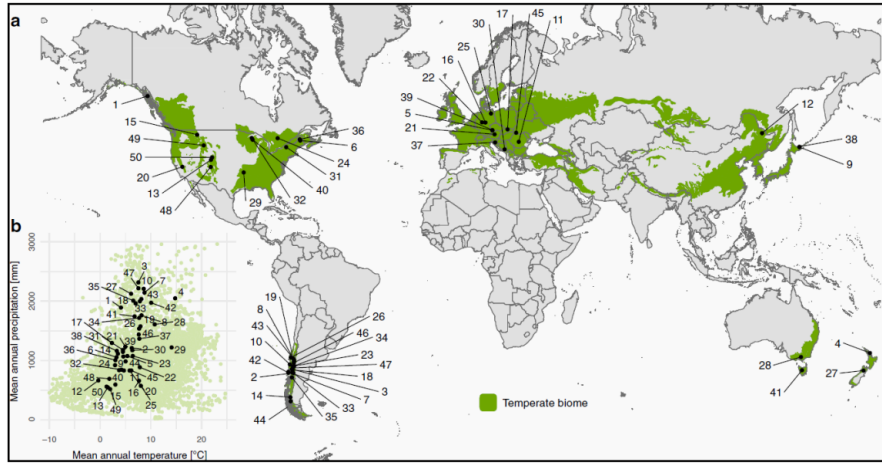
Figure credit: S. Thom

Seidl et al. (2014, Nature Climate Change)



Climate sensitivity of forest disturbances

Analysis of 50 forest landscapes throughout the temperate biome



Sommerfeld et al. (2018, Nature Communications)

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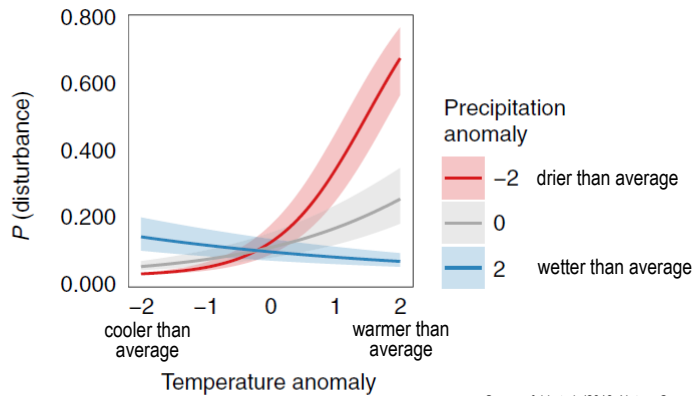
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Climate sensitivity of forest disturbances

Analysis of 50 forest landscapes throughout the temperate biome

Large-scale, severe disturbances are consistently linked to warm and dry years

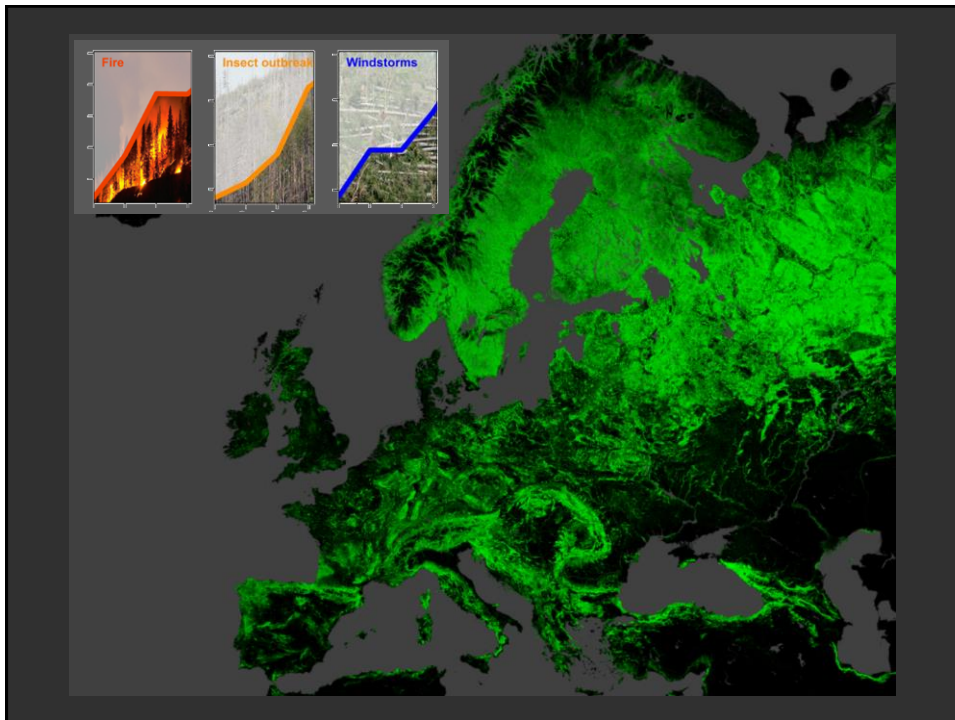


Sommerfeld et al. (2018, Nature Communications)

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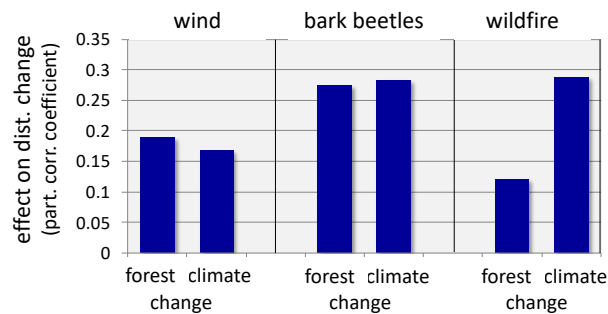
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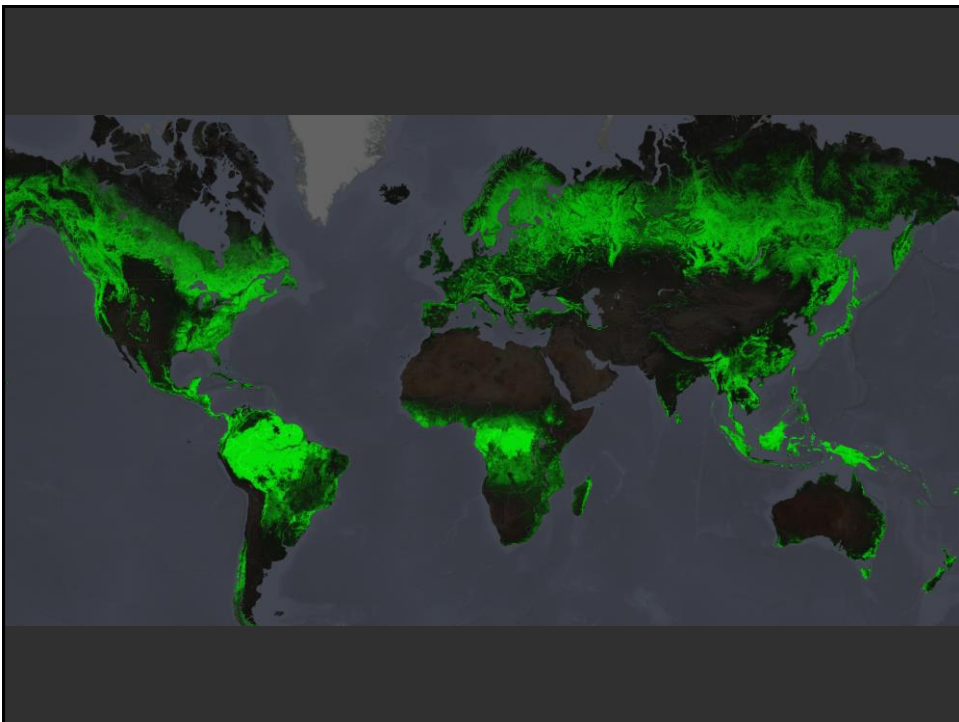
Drivers of disturbance change in Europe

Climate change is an important driver of increasing disturbances
...but...

also management contributed (via changes in forest structure and composition)

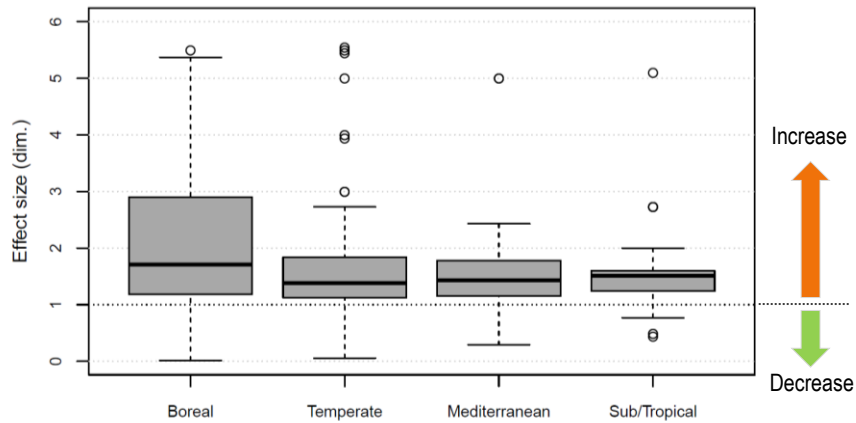


Seidl et al. (2011, Glob. Change Biol.)



The future of forest disturbance regimes

Climate change effect relative to reference climate conditions, summarized across all climate change scenarios studied in the reviewed literature.



Based on a global meta-analysis of >650 paper reporting on climate-disturbance relationships

Seidl et al. (2017, Nature Climate Change)

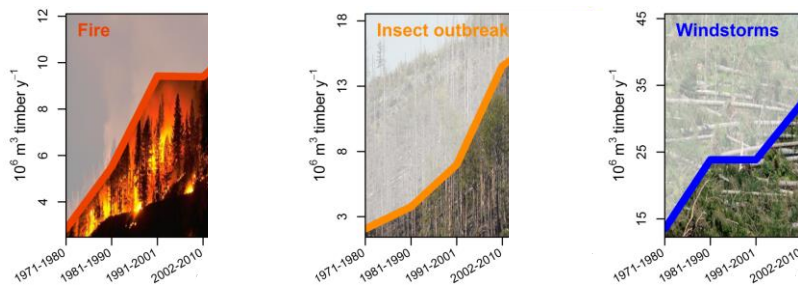
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Forest disturbances in Europe

A further increase is expected for the coming decades
Estimated rate of increase: +1 Mill. m³ per year



Main reason: Climate change

Disturbances increase in all investigated 14 climate scenarios and 4 land-use scenarios

Seidl et al. (2014, Nature Climate Change)

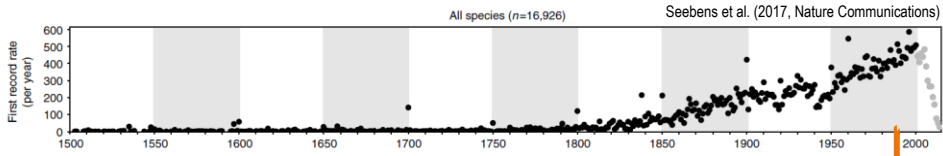
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Figure credit: S. Thom

Continued accumulation of alien species



Introduced species include highly aggressive tree pests

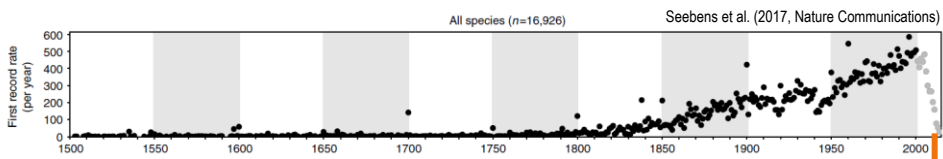


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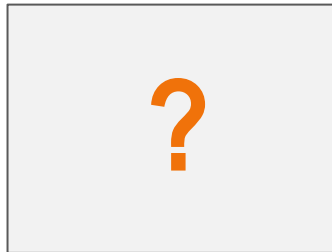
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Continued accumulation of alien species



Introduced species include highly aggressive tree pests



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Potential spread of invasive alien pests



ALB: Asian long-horned beetle
(*Anoplophora glabripennis*)

PWN: Pinewood nematode
(*Bursaphelenchus xylophilus*)

SOD: Sudden oak death
(*Phytophthora ramorum*)

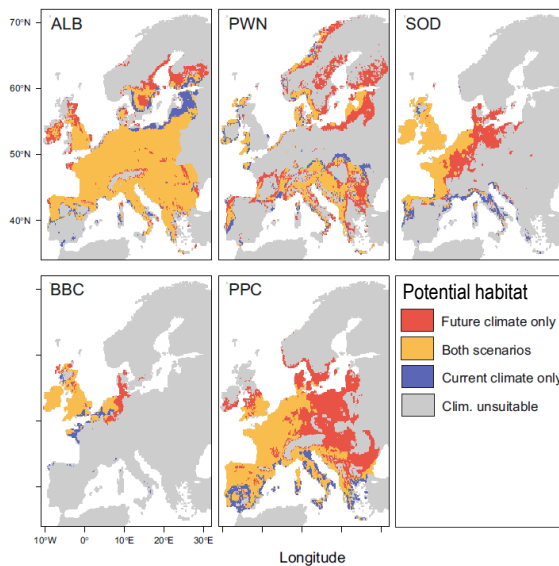


BBC: Beech bleeding canker
(*Phytophthora kernoviae*)

PPC: Pitch pine canker
(*Fusarium circinatum*)

Seidl et al. (2018, Nature Communications)

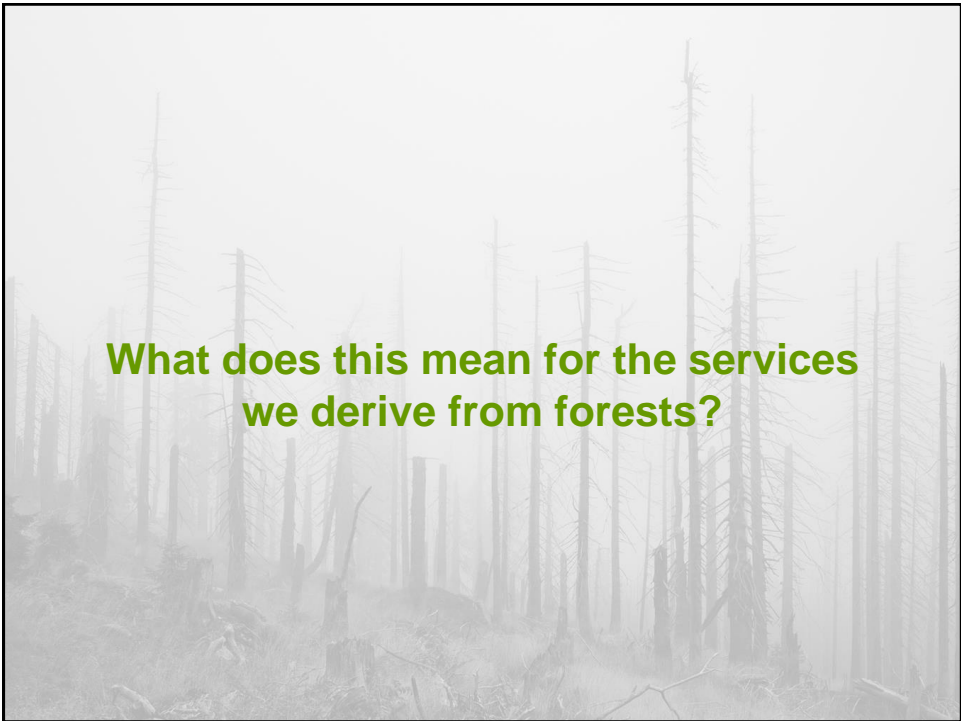
Potential spread of invasive alien pests



Asian long-horned beetle (ALB), pinewood nematode (PWN) and pitch pine canker (PPC) could establish on > 1 Mill. km² already under current climate

Climate change until 2050 will increase the potential range of pine pests (PWN and PPC) by ~50%

Seidl et al. (2018, Nature Communications)

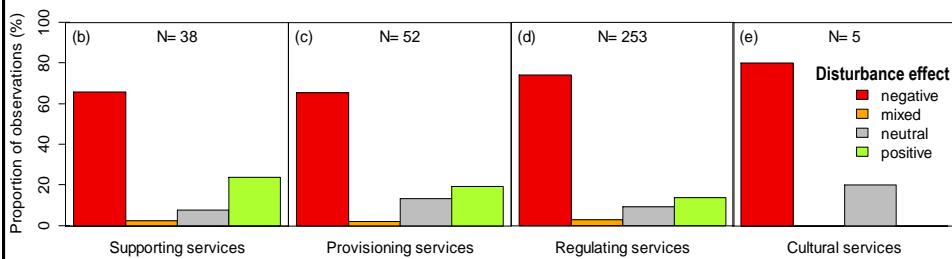


Disturbances impact ecosystem services

Ecosystem services provisioning affected negatively by disturbance

Result of a global review of >470 papers on disturbance impact.

All categories of ecosystem services are equally affected.



Thom and Seidl (2016, Biol. Rev.)



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Challenge for forest management

Reduce the negative impacts from disturbances where possible
Foster the resistance and resilience of forests through management

Learn to live with natural disturbances
They are natural processes and will continue to increase, despite our best efforts

See disturbances as an opportunity to change/ adapt
Never waste a good crisis!



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Take home messages

Disturbances are natural processes in forest ecosystems.

Recent waves of disturbances are in line with an Europe-wide increase in disturbances over the past decades.

Past forest management has increased the current disturbance risk in Europe.

Climate change amplifies natural disturbances globally.

Disturbances will continue to increase in the coming decades.

Novel disturbance agents are likely to appear in Europe.

Disturbances have a predominantly negative impact on ecosystem services.

Improved management is needed – this includes learning to live with disturbances.