Overview of European forest pest and pathogen population responses to climate change

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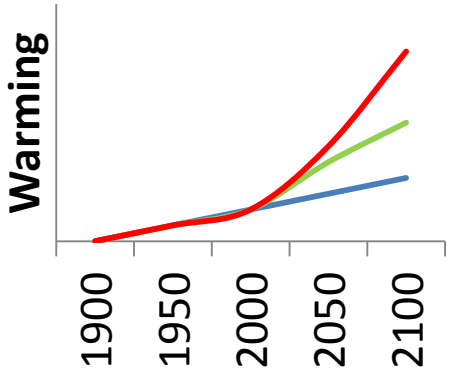
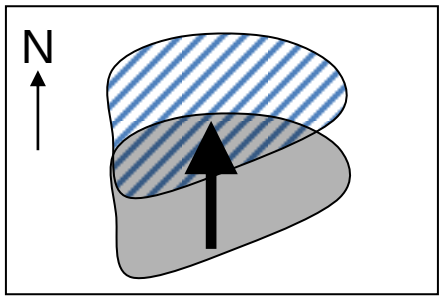
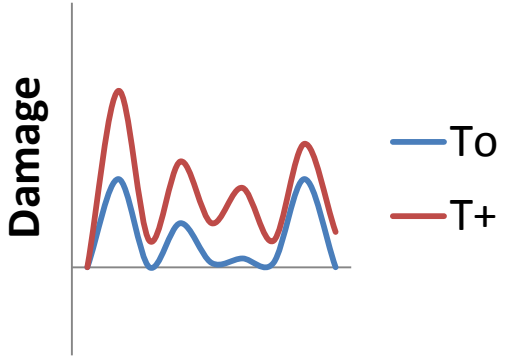






Methodological approaches in BACCARA:

1. Review of the literature and meta-analyses

2. Expert opinion on most relevant pests and pathogens species in EU and their likely response to climate change

3. Measure of species response to temperature gradients

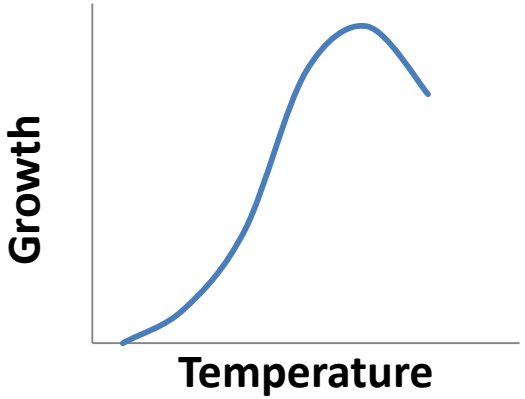
4. Manipulation of ecological conditions with translocation experiments

5. Time-series data of damage

1. Review

Direct and indirect responses

Direct responses of herbivores to temperature



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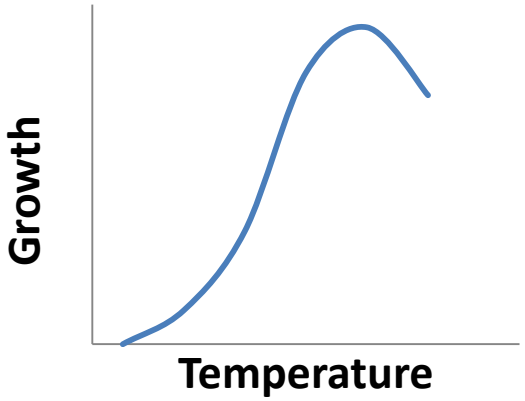
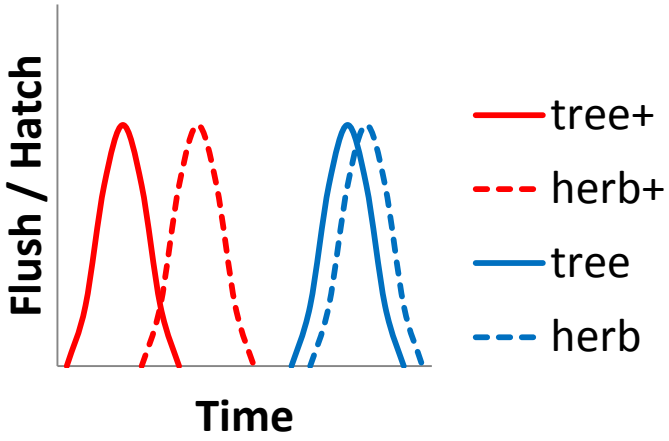


Indirect through host plant: how trees respond to cc and affect herbivores



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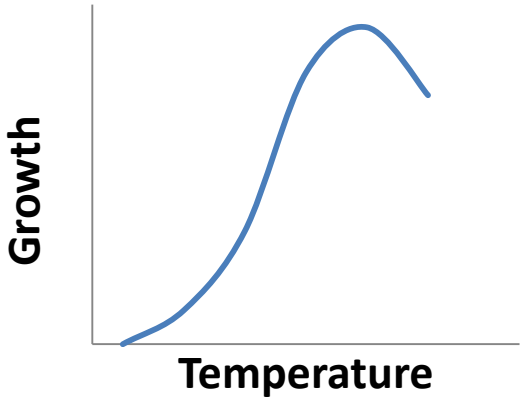

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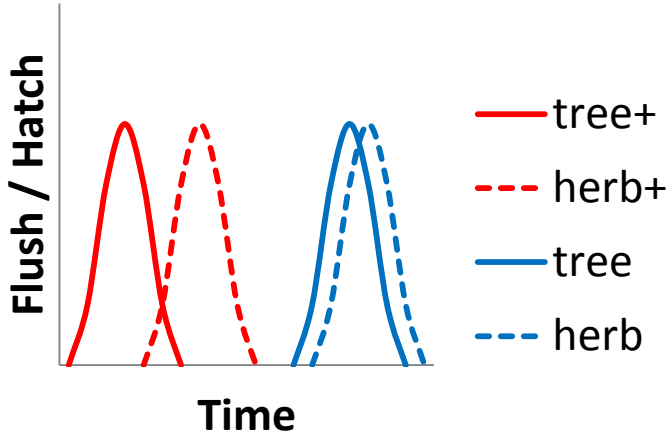
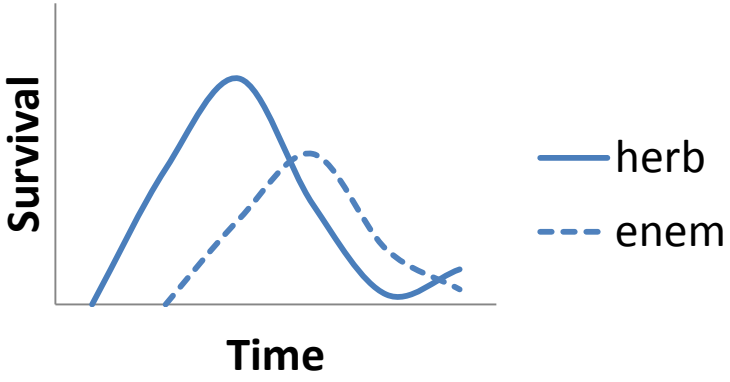


Indirect through natural enemies: how parasitoid, predators and pathogens respond to cc and affect herbivores



Direct effects of climate change on

+ Herbivore -

Development time

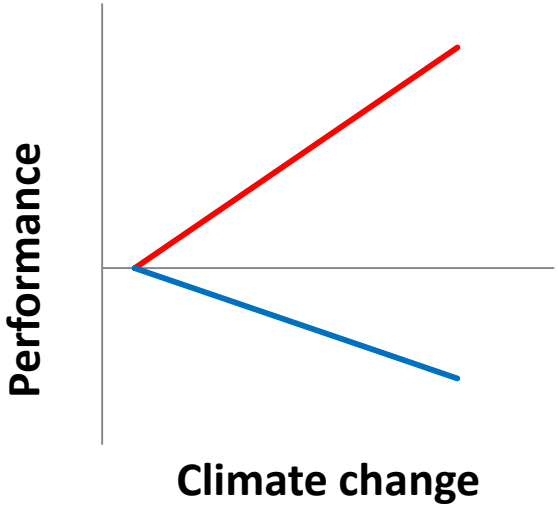
Voltinism

Extended diapause

Realised fecundity

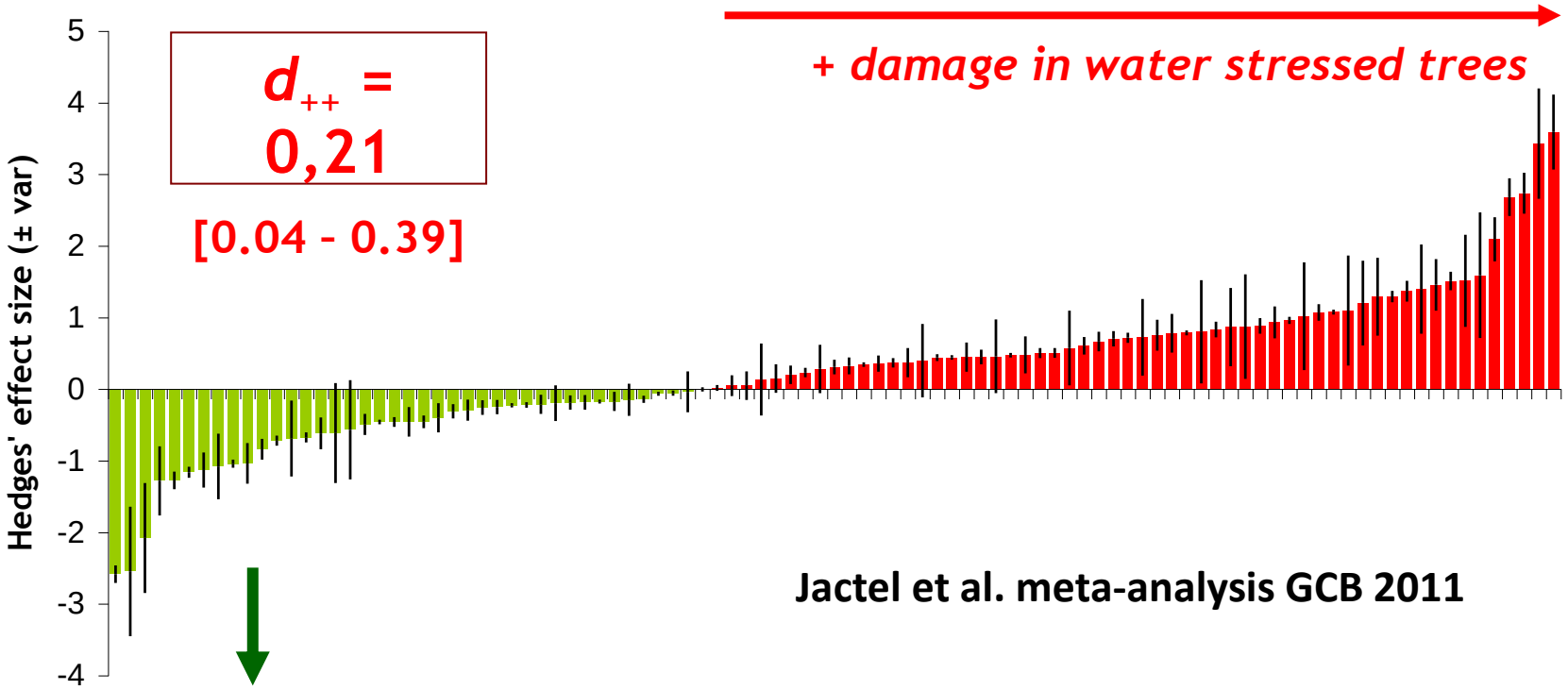
Winter survival

Summer survival



Indirect effects of climate change through **host plant** on

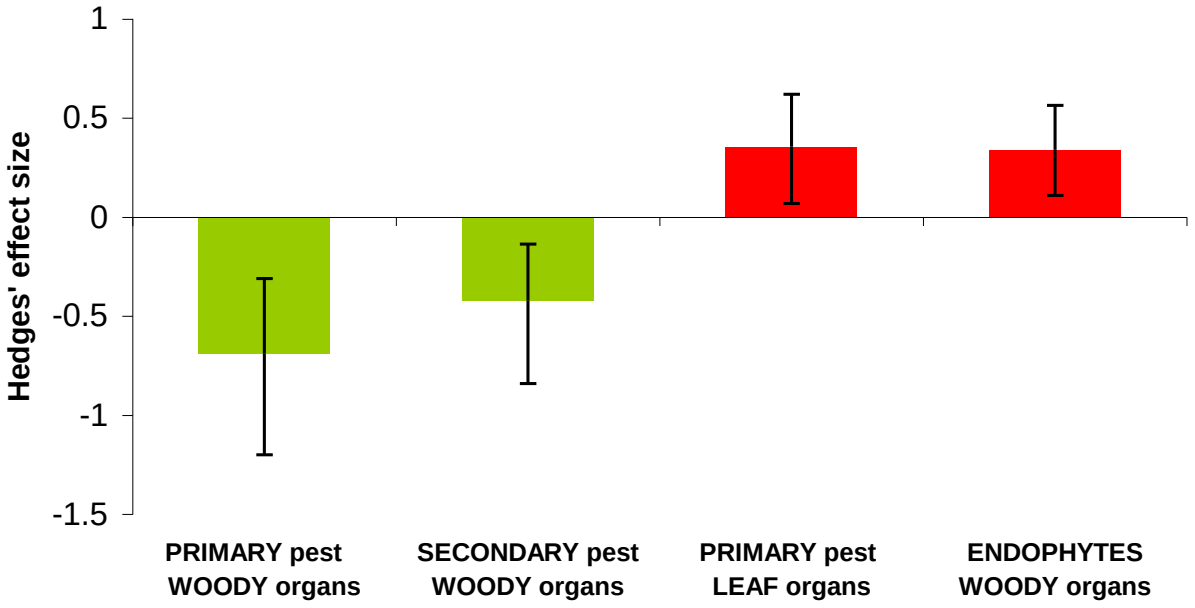
\+ Herb/Path -



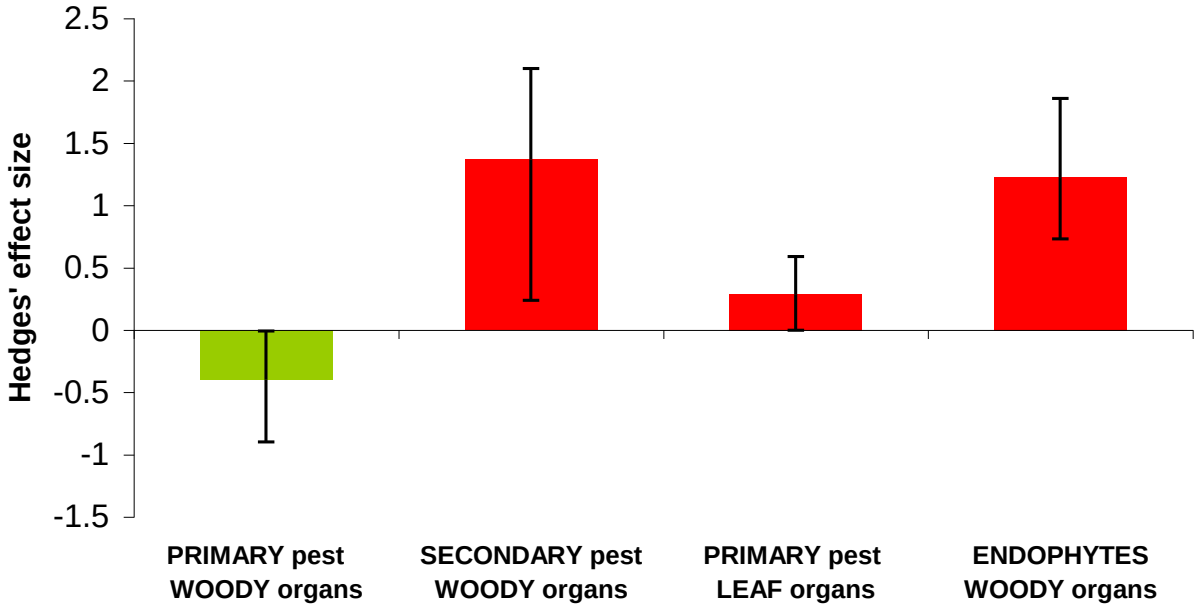
40% with less damage in water stressed trees

Risk rating will change with drought severity

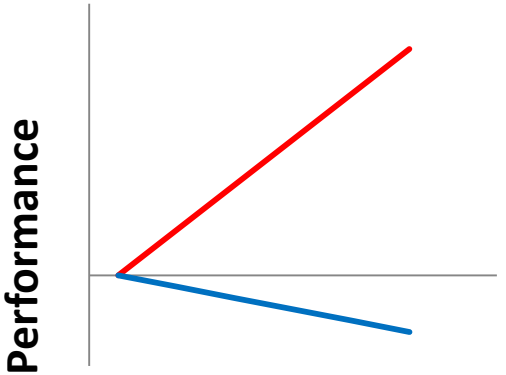
mild drought
(PLS/PL50)<30%



severe drought
(PLS/PL50)>30%

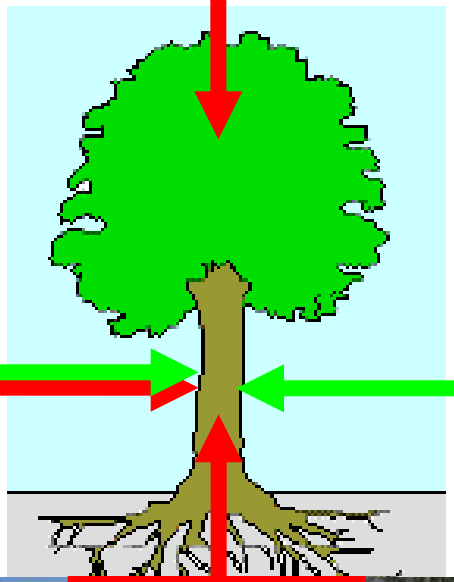


Defoliators, aphids
Foliar necrosis



Bark beetles

Ophiostoma
Fusarium

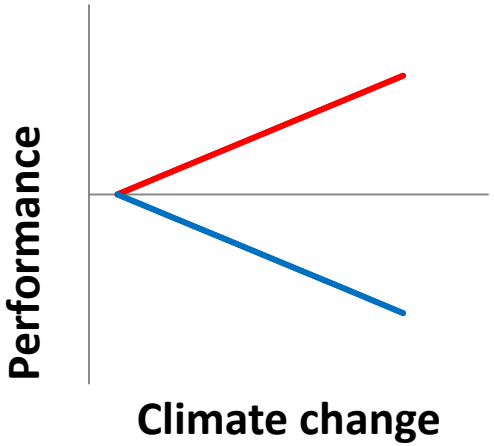


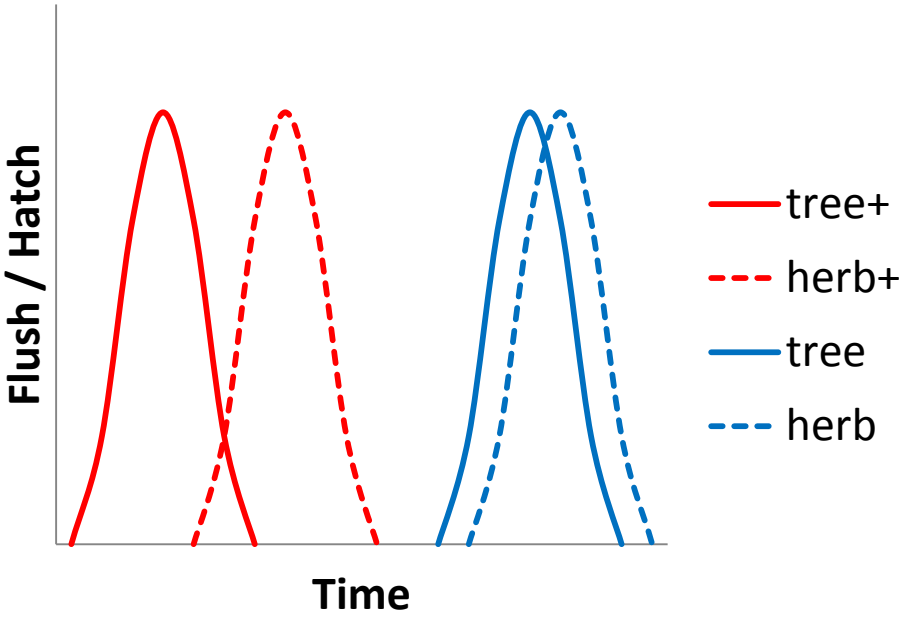
Weevils, stem borers
Tip moth
Scale insects
Phytophtora, cankers
Root rot

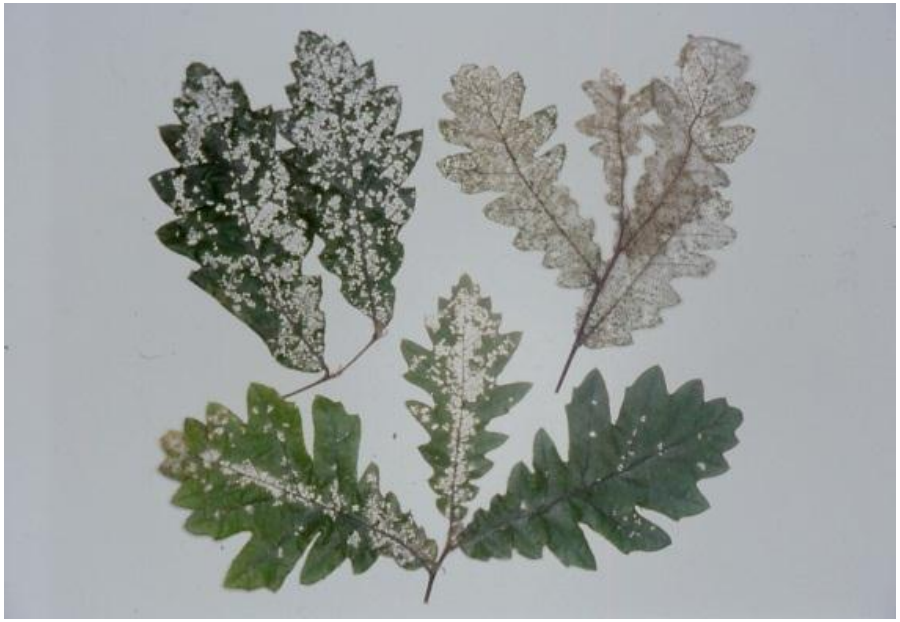
Endophytes
Sphaeropsis
Hypoxylon

Indirect effects of climate change through **host plant** on

\+ Herbivore -







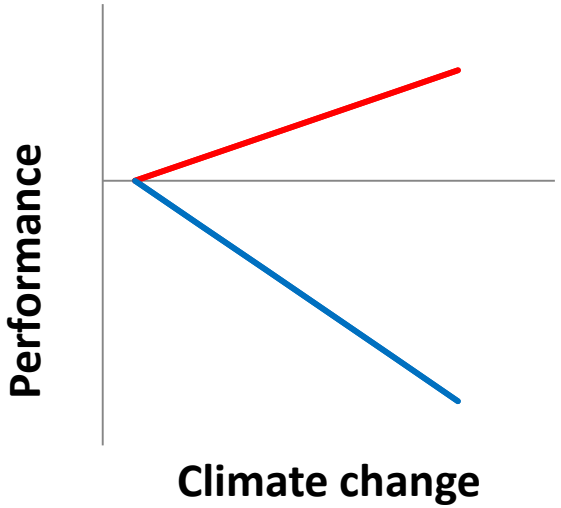
Indirect effects of climate change through **natural enemies** on

\+ Herbivore -

Arthropod fitness and behaviour

Voltinism

Intra-guild killing rate



Summary of **direct** and **indirect** effects of cc on performance

CC

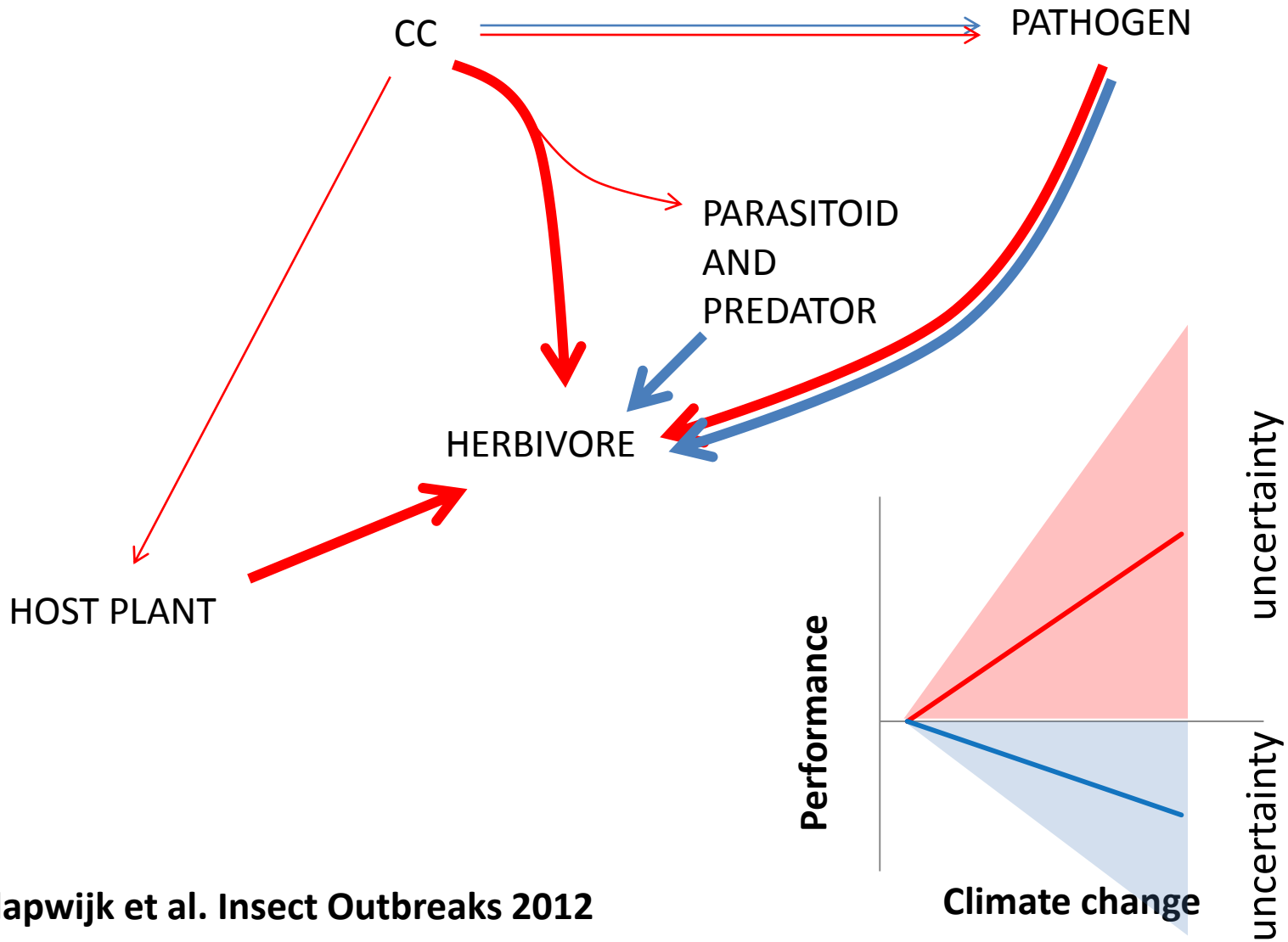
PATHOGEN

PARASITOID
AND
PREDATOR

HERBIVORE

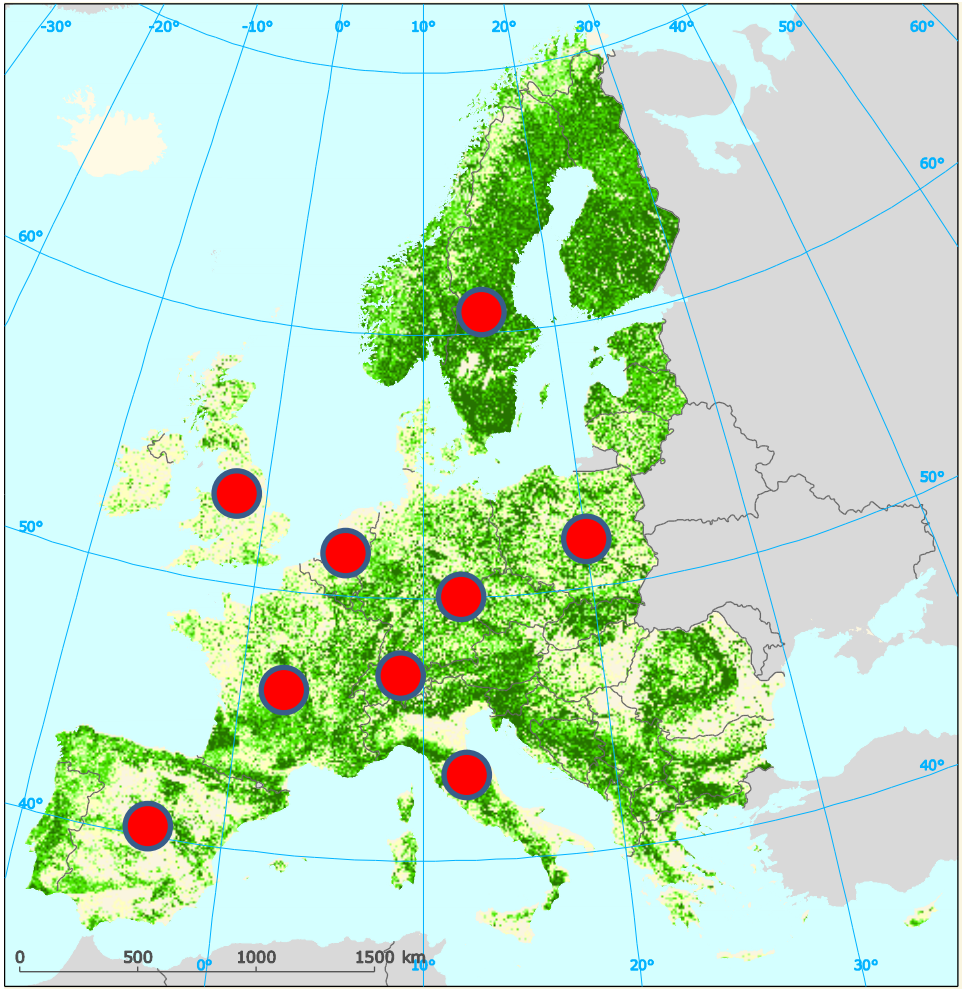
HOST PLANT

Summary of **direct** and **indirect** effects of cc on performance



Klapwijk et al. Insect Outbreaks 2012

2. Expert opinion on population response, in terms of amount of damage, of European forest pests and pathogens



Major drivers: temperature, drought, fire, storm

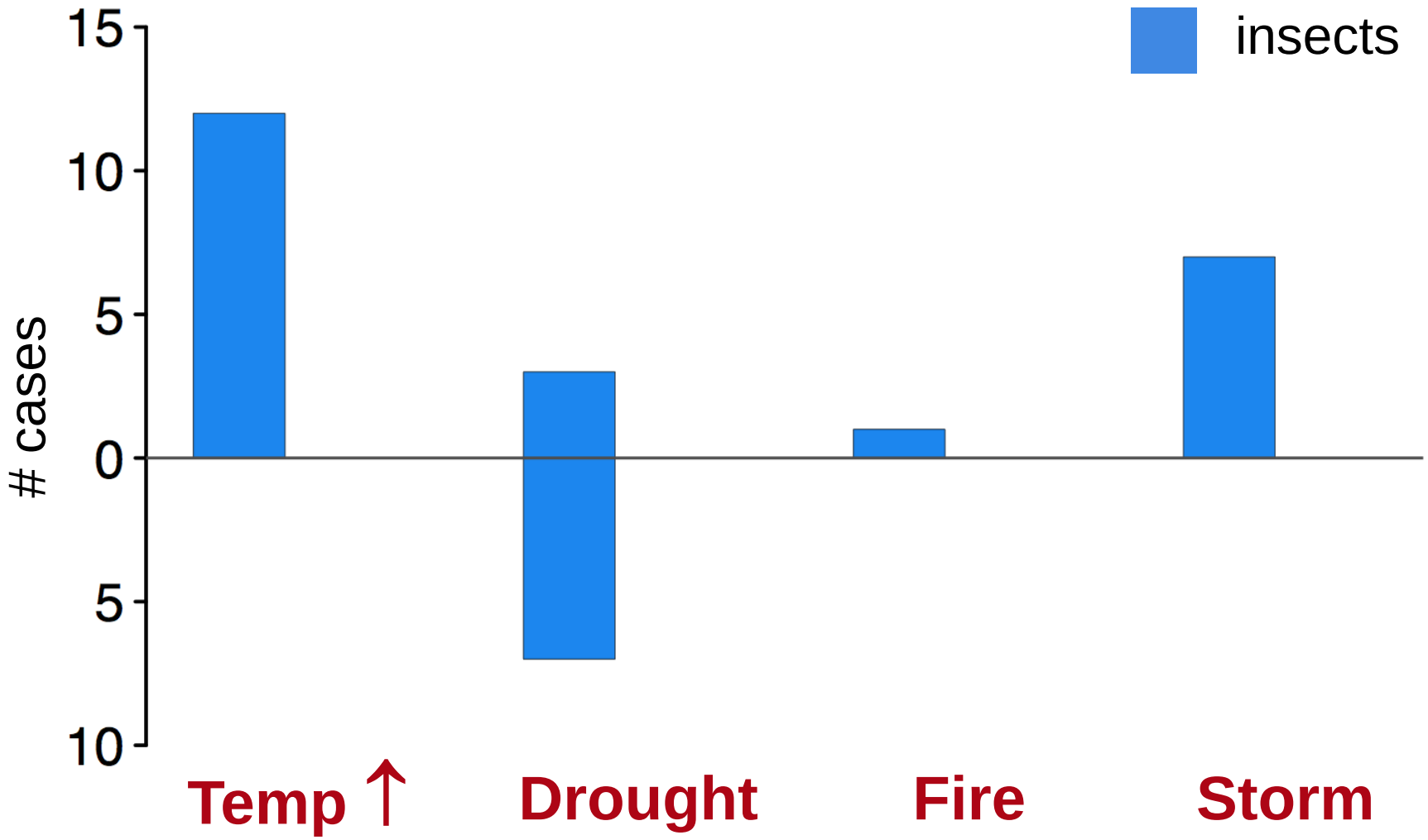
Species of pests/pathogens responding to the climatic driver: 21 pests and 22 pathogens, 67 case studies in EU

Tree species affected: Betula, Fagus, Picea, Pinus, Populus, Quercus

Sign (and magnitude) of pest and pathogen's response

Direct and indirect responses

Direction of responses to climatic drivers



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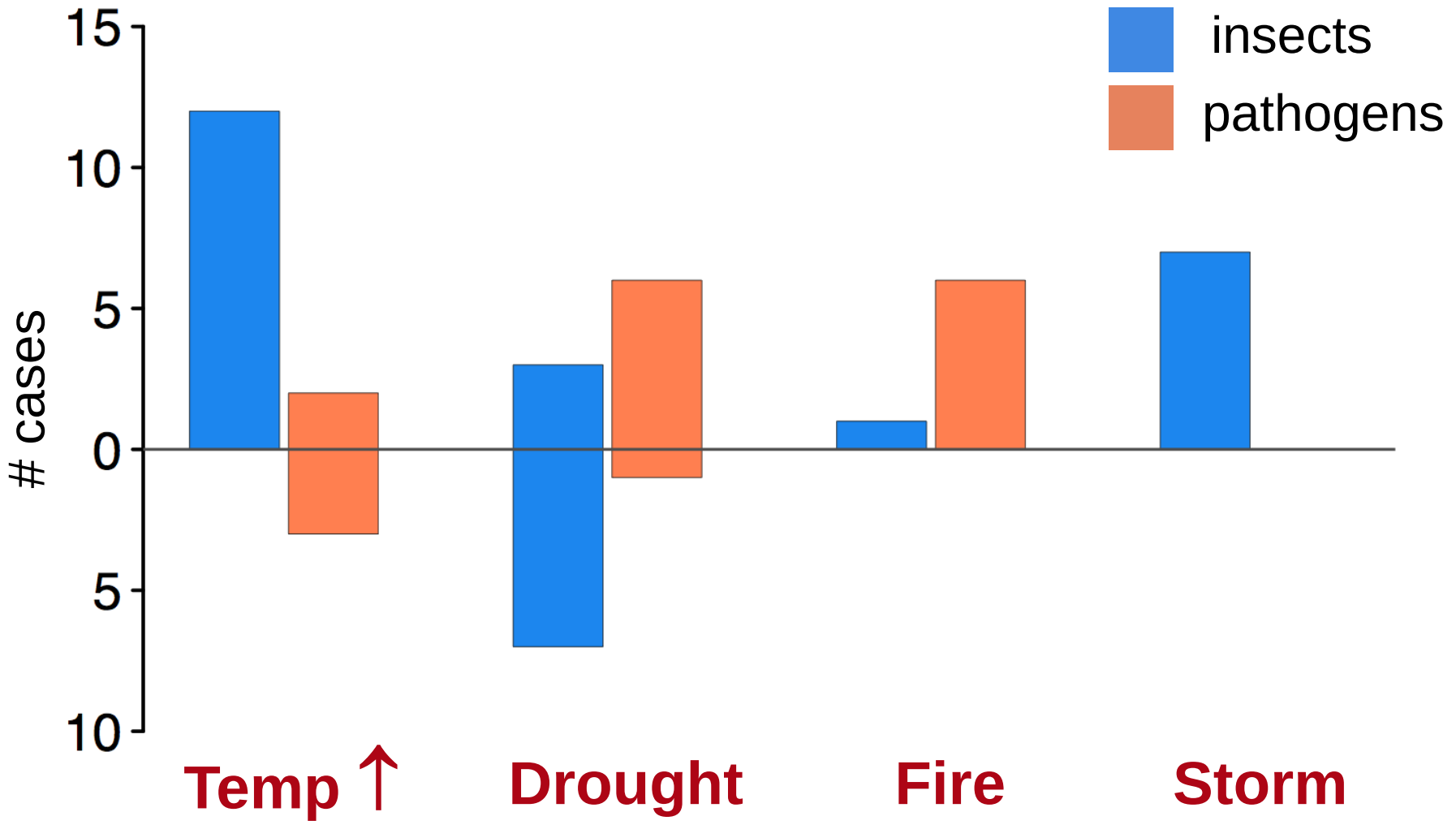
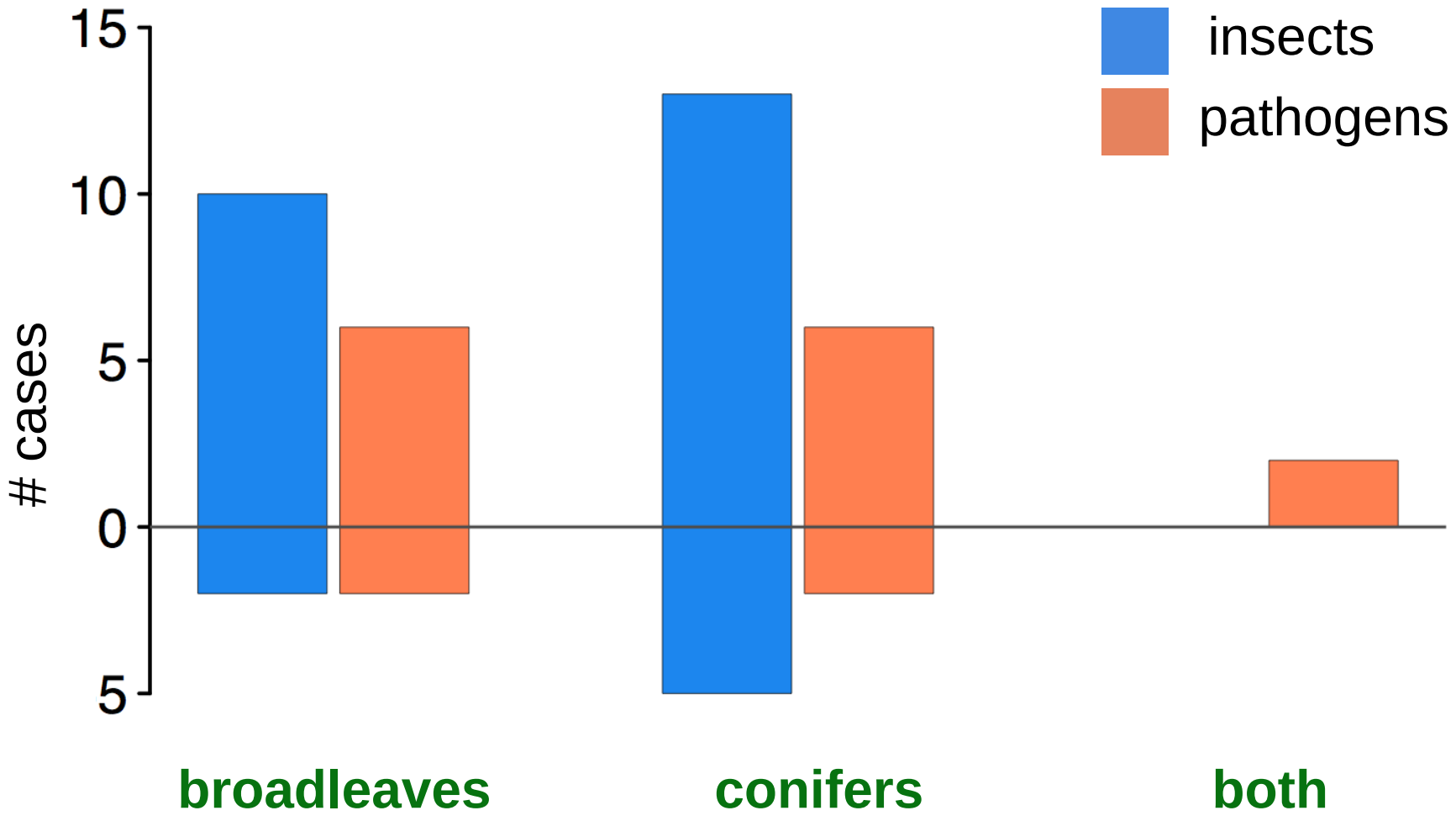
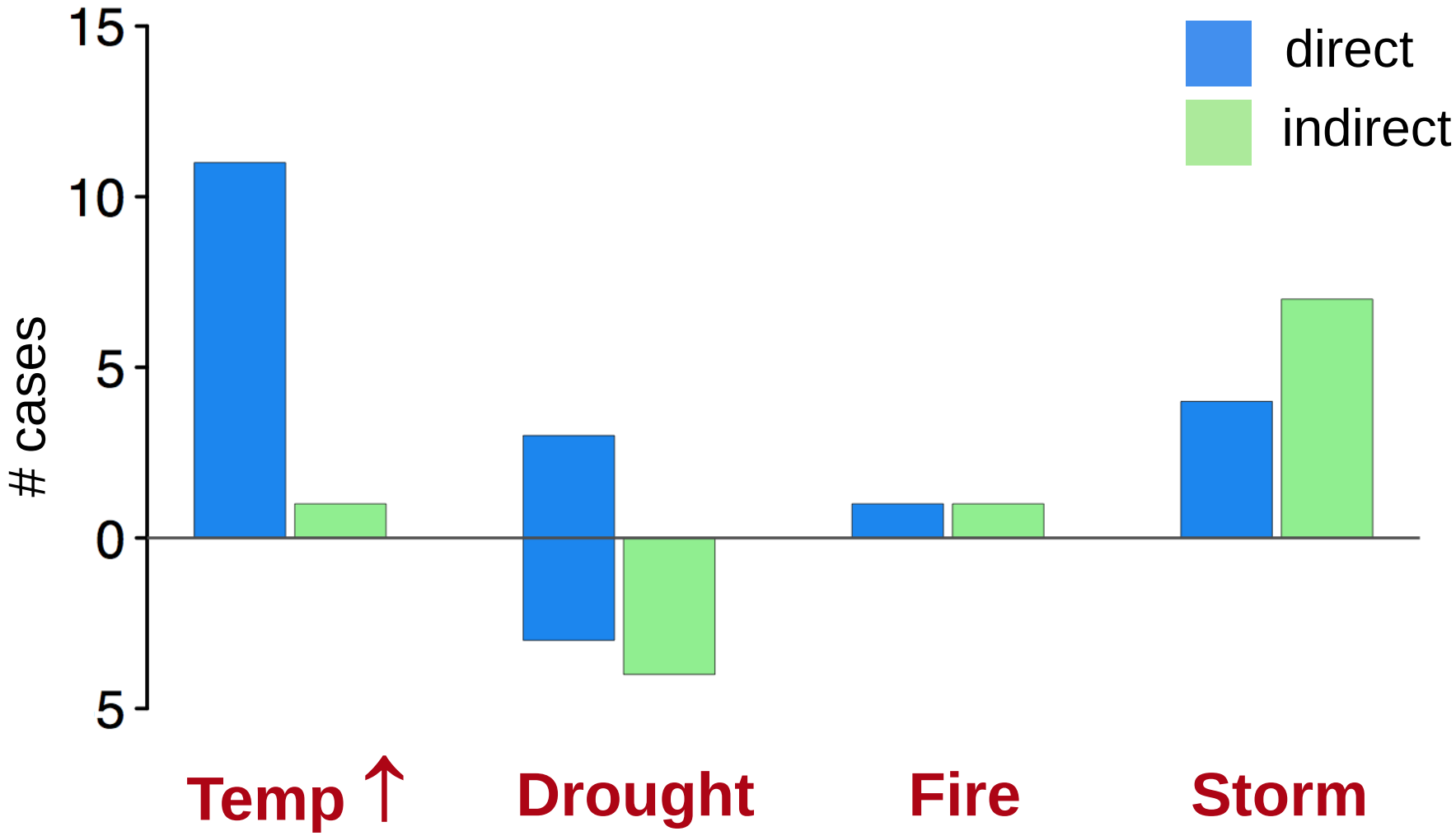


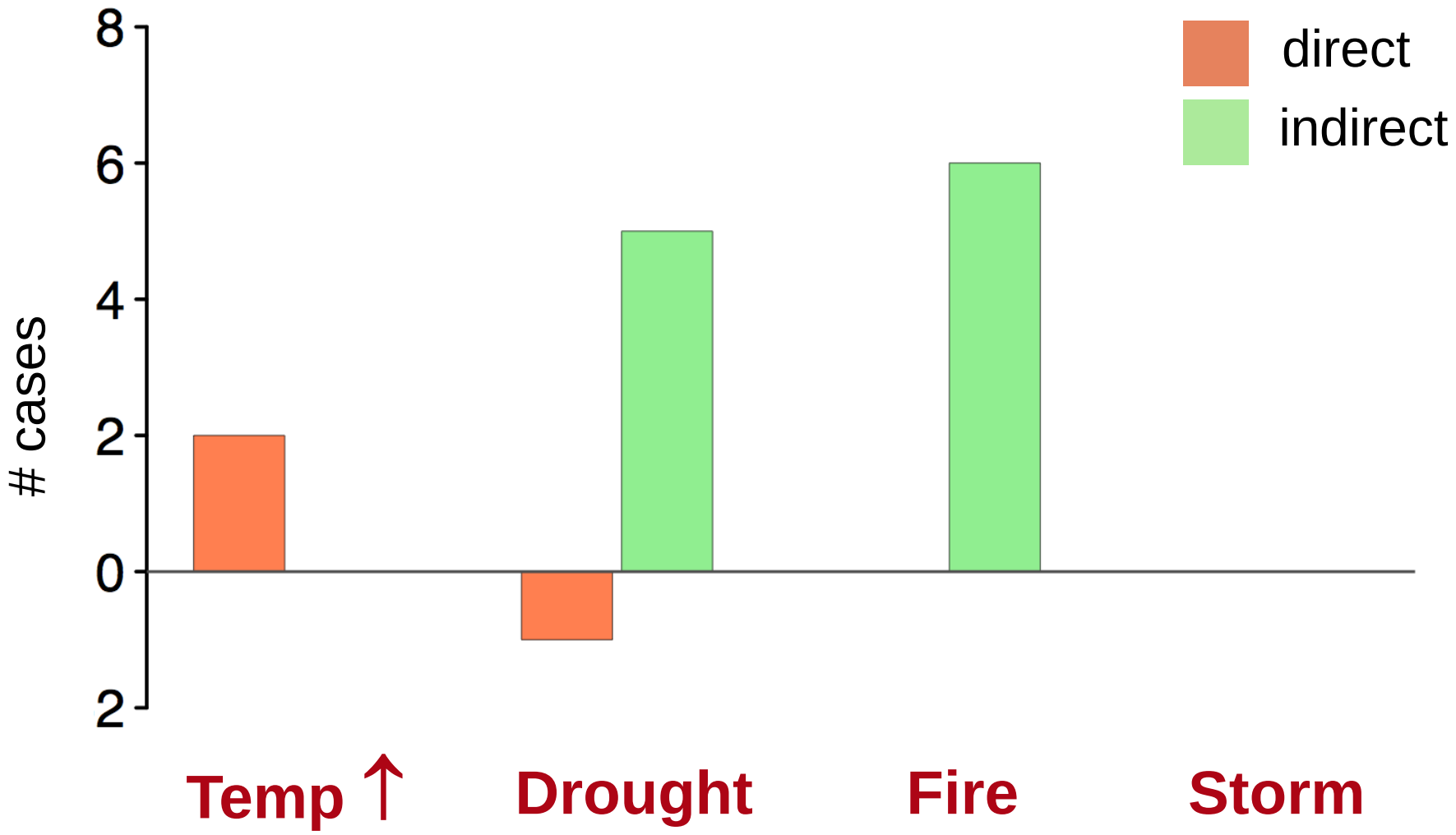
Direction of responses by tree groups



Direct versus indirect effects on insects



Direct versus indirect effects on pathogens



Synthesis and perspectives:

- Temperature and meta-analysis (Kenis et al., guilds, reaction norms)
- Consensus on indirect effects through drought

- Testing by damage assessment in the field (talk Czwienczek et al.)
- Testing by insect abundance in the field (poster Chinellato et al.)
- Interaction between T and damage dynamics (talk Marçais et al., Marini et al.)