How does global change shape the distribution of forest insects and pathogens?

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All Division 7 (Forest Health) Meeting

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K9 (Konzerthaus Freiburg)

IUFRO17-2206 **Climate extremes promote prolonged diapause in winter pine processionary moth: consequences of bet-hedging**

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Abstract: Prolonged diapause (PD) occurs in a number of forest insects and is considered as a way to evade extreme conditions. The pine processionary moth (PPM) Thaumetopoea pityocampa/wilkinsoni goes through facultative PD as a pupa in the soil, however little information is available on its mechanism and factors involved. We tested the role of temperature on both the occurrence of PD and pupal morality using a data set consisting of published and unpublished information. We collected a total of 115 PD records referred to the period 1964-2015 for a total of 49 sites in 7 countries, covering the whole thermal distribution range of the species in the Mediterranean and Southern Europe. We found high geographic diversity in PD rate, as all individuals of Corsica mountains always had an obligatory PD of at least one year, while the PD rate in the rest of the range varied between 0 and 100. Lower and higher temperatures were associated with higher PD rate as well as with pupal mortality. We conclude that such a U-shaped relationship identifies the optimal conditions for the insect development, whereas PD is associated with ecologically marginal conditions. We discuss how climate change can affect the pattern of PD and consequently its population dynamics in the whole species range. Besides, to better understand the ecophysiology of PD, we measured pupal metabolic rate in relation to temperature both in laboratory and field, on a number of populations collected along a climatic gradient in the Southern Alps. Preliminary data show that low temperature in the early pupa stage plays a major role in PD induction.

range edge, life history, risk-spreading,

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IUFRO17-500 **How does global change shape the distribution of forest insects and pathogens?**

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Abstract: Global change represents all changes on Earth, encompassing large-scale anthropogenic changes and climate change. With the intensification of the world trade, the probability to carry unintentionally infested materials has considerably increased, enhancing dramatically the number of biological invasions. Once introduced, some exotic species may find better climate conditions with the ongoing climate warming. Forest health can be threatened by newly arrived exotic pests but also by native pests shifting or extending their distribution resulting from both climate change and human-assisted dispersal.

As an introduction to the following lectures about insects and pathogens distribution, we review how global change can shape the distribution of three model species. 1) The pine processionary moth, *Thaumetopoea pityocampa*, is an emblematic Mediterranean insect species responding to climate warming. The species range expansion is mostly explained by higher larval survival in winter and also by human-mediated dispersal. 2) The pine wood nematode, *Bursaphelenchus xylophilus*, is an invasive organism, now widespread in the western part of the Iberian Peninsula, causing the pine wilt disease under some environmental conditions. High summer temperatures enable the development of the disease and the tree death. Due to complex interactions with pine trees and a native vector insect, *Monochamus galloprovincialis*, this nematode can profoundly disturb Mediterranean forest ecosystems. 3) The invasive pathogen, *Phytophthora cinnamomi*, is the causal agent of a devastating decline that threatens Mediterranean oaks ecosystems. Occurring through the Mediterranean area, the pathogen is spread by tree trade and by drainage water. This pathogen is moreover favored by the ongoing climate warming. Understanding and predicting ecosystem disturbance and resilience of Mediterranean forests in this context constitutes one of the main challenges of the coming years.

Climate change; spread; insect; pathogen; forest

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IUFRO17-1943 **Patterns of expansion of pine processionary moth and its specialist egg parasitoid at the northern edge of its distributional range.**

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Abstract: For several insect species there is strong evidence that the on-going climate change affects both their distributional range and phenology. Range expansion can be accelerated by human-mediated dispersal, with the establishment of new insect populations in suitable areas far from the native range, possibly due to the increase of inter-and intra- continental ornamental plant trade. A rapid expansion or long distance dispersal can lead to a decoupling of trophic interactions between the expanding insect species and its natural enemies, with a resulting higher risk of outbreaks. The pine processionary moth (Thaumetopoea pityocampa) is one of the main forest pine tree pests in the Mediterranean basin. During the last decades this species has naturally expanded both to higher latitudes and altitudes due to the recent climate change. In France, the northward expansion occurred in a few decades and the distribution edge has now reached the Paris basin and northern Brittany. More, isolated populations were recently identified beyond the front edge. Both host tree distribution outside forests and accidental human transportation also seem to play a key role in the spread of the moth. In this study we considered populations of pine processionary moth in the front expansion edge and potential source populations from the native range. Samples were analyzed using 22 microsatellite loci in order to identify the main expansion patterns in relation to host plant distribution and other environmental factors. Finally, a preliminary comparison between the expansion patterns of the pine processionary moth and its specialist egg parasitoid Baryscapus servadeii was carried out using a first set of microsatellite loci to determine if this species can follow its host during the expansion.

range expansion,climate change,man-aided dispersal