Pine sawflies and drought – from tested hypothesis to large scale vulnerability maps

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Population dynamics of pests are complex, and these complex dynamics are often modulated by climatic factors. Pine sawfly (*Neodiprion sertifer*, *Diprion pini*) damages are associated in the literature and empirically with drought, although the exact mechanism is unclear. On the other hand, extreme winter temperatures are known to be lethal to *N. sertifer*. In this study, we examine these hypotheses using damage data from ICP level I plots and weather related data, particularly soil water index derived from a simple ecosystem carbon exchange and water balance model. Based on the model, data, and data analysis, we thus investigate the possibility to generate maps to indicate the expected climate induced changes in vulnerabilities of forests to these damages.

ICP I data has been collected in most of the Europe, which makes it a potentially remarkable source of information for various kinds of continental assessments. ICP I, however, presents a data source not specifically intended for pest modelling, where data are collected from permanent sample plots once a year. The modelled process, i.e. the abundance of sawflies and the general form of the population dynamics are only partially known, which requires considerable simplification of the modelled process. We accomplished this by the use of a hierarchical Bayes model capable of linking the simplified population dynamics and regulation to the observed incidences of damage. We simplify the population process to a dichotomous first order Markov process. In other words, we model the probabilities of the system moving between the endemic state and the outbreak state. This is done within the Bayes model via a generalized linear model with a logit link. This formulation allows for an easy way to incorporate different explanatory variables, such as soil water (continuous), indicator for extreme temperatures, or site type (discrete). This enables e.g. the determination of site-type, or region specific and drought-sensitive transition probabilities of the model. We can then gain better understanding about the frequency, length and severity of the pine sawfly outbreaks, and how these patterns might be affected by the site properties and changing climate.

In this talk, we present the nature of the data and the structure of the model. We further use the model to draw vulnerability maps of forests to Pine sawfly damages, and present how we are extending the analyses to fungal diseases such as Gremmeniella abietina and Chysomnyxa ledi.

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