

BOOK OF ABSTRACTS

FORESTS & SOCIETY
TOWARDS 2050



STOCKHOLM 2024
WORLD CONGRESS
26th **IUFRO**
FORESTS & SOCIETY TOWARDS 2050

Stockholm, Sweden
23–29 June 2024

From single trees to country-wide maps: Modeling tree mortality across Germany

T5.24 Moving towards digital forests for a sustainable future

Nikolai Knapp¹

Nicole Wellbrock¹

¹ Thünen Institute of Forest Ecosystems

Abstract: Several extremely dry years have caused dramatic increases in tree mortality since 2018 in many regions of Central Europe. In particular Norway spruce has been strongly affected, but also other species have shown signs of decreased vitality and increased mortality risk. Long term monitoring programs such as the ICP Forests Level I monitoring provide valuable information about tree loss rates at annual resolution and on a systematic sampling grid. The German Level I monitoring (crown condition survey) consists of 410 plots on a 16 km × 16 km grid with a total of ca. 10,000 trees. The loss reasons for sample trees have been recorded since 1998. In this project, the goals were 1) to model tree mortality at the survey plots as a function of environmental drivers and 2) to produce country-wide maps of predicted mortality for a number of common tree species in Germany.

All trees in the dataset that died due to a cause other than planned management or windthrow were included as mortality events in the analysis, while all other trees were labelled as survivors. A set of more than 400 candidate predictor variables were derived with the condition that the data had to be available wall-to-wall for whole Germany. These environmental predictors covered the domains of climate, soil, topography, landcover and deposition. A multiple logistic regression model with the binary response “dead or alive” was fit to the data. The most important predictors for every tree species were identified via feature selection. Prediction accuracy and model robustness were tested via leave-one-location-and-year-out cross validations (AUCs between 0.65 and 0.9). Germany-wide maps of average mortality at 1-ha resolution were derived for Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*), European beech (*Fagus sylvatica*), pedunculate+sessile oak (*Quercus robur+petraea*) and other conifer and broadleaf species pooled.

The maps provide insights into the spatio-temporal patterns of mortality and enable the derivation of summary statistics at regional scales. The cause-effect relationships from the regression models will be combined with climate scenarios and process-based forest models to predict trajectories of future forest development.