European Commission

Science for Environment Policy

Predicting and controlling the spread of the invasive pine wood worm pest across Europe

The North American pine wood nematode (PWN), *Bursaphelenchus xylophilus,* is a pest worm species that causes a disease known as pine wilt. It was discovered for the first time in the EU in Portuguese forests in 1999. Today, the entire territory of Portugal is demarcated for the presence of PWN, with a 20 km buffer zone, free from the pest, established along the Spanish border with the aim of preventing its further spread. The spread and establishment of PWN in the rest of EU territory is very likely if no strict measures are taken, as required by Decision 2012/535/EU of the European Commission, with serious economic and environmental consequences. To date, Spain has experienced five outbreaks of PWN, three of which have been successfully eradicated thanks to the EU measures and the effective work of the Spanish forest administration; and two outbreaks are currently being eradicated.

This study develops and applies a model to predict the spread of PWN, noting susceptible areas and the effect that different control measures may have on stopping or slowing the onward invasion of this pest. Predicting when and where invasive species outbreaks are likely to occur is a difficult part of pest management — knowing the speed of invasion, its size, and the effect of containment measures helps land managers to control pest species.

Past expansion rates show that PWN has the capacity to spread over large areas, mainly via transmission by its natural vector, the longhorn beetle (*Monochamus galloprovincialis)*, or by the transport of infected wood. While measures for avoiding the latter can be effective and are already in place, the natural spread of the pest via the dispersal flights of the longhorn beetle remains to date much harder to control, given the abundance and dispersal capacity of this natural PWN vector. For this reason, the study aims to predict the locations and speed of natural spread of PWN using data collected over 10 years, mapping potential priority areas for pest control measures and assessing the effects of several containment strategies on spread rates: clear-cut belts, mass trapping of the vector beetle, and early removal of infected trees.

The researchers designed a new spatio-temporal network-based model to predict the spread of PWN, including a yearly prediction incorporating all infection pathways and sources of potential longhorn beetle populations and dispersal flights. The model was designed for a 145 000-km^2 study area that included the PWN range in Portugal and parts of Spain adjacent to the Portuguese border — Galicia, Castilla y León, Extremadura, and Andalucía. The study area was described in terms of one-km-square nodes, each with an associated coniferous forest. The model was tested using pest monitoring data from 2005 to 2015, and was found to reproduce the observed spread well: it predicted the status — infected or not infected — of forested areas with 93% accuracy.

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Early detection based on intensive monitoring, together with quick removal of infected trees and host trees in the surrounding area are important factors in controlling the pest, but still pose some challenges for an effective control strategy, especially in areas where symptoms are not clearly expressed. This study simulated the efficacy of clear-cut belts with different widths, confirming that the spreading capacity of the vectors and the reduction of the vector population via mass trapping, play an important role in the outcome of the control strategy.

The model can thus identify areas via which the nematode is most likely to invade, by natural means, the phytosanitary buffer zone established along the Portuguese border with Spain, allowing more targeted pest control measures in these areas. The results of this study confirm that an integrated pest management approach — which is already in place with current EU legislation — could be used to slow down or stop PWN expansion into Europe. This could be done more efficiently by using this model to target specific areas, making it a useful tool for those involved in halting this emerging risk to the conifer forests of Europe.