

# Areal assessment of pine wood nematode invasion risk, based on import statistics, forest inventory data and a grid-based spread model

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## Introduction

Pine wood nematode (PWN, *Bursaphelenchus xylophilus*) is a quarantine pest which can spread to new areas in wood packaging material (WPM). In Finland PWN is able to establish and spread, but it will not cause symptoms in the present climate. However, the strict import requirements that many countries impose related to PWN would disturb wood exports.

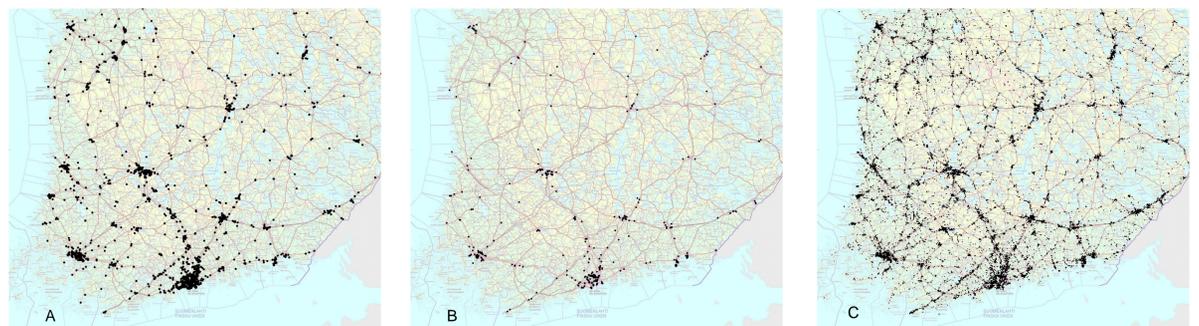
About 450 inspections are carried out annually in Finland to detect possible PWN invasions. Since early detection of an asymptomatic invasion is very unlikely the inspections need to be targeted carefully to be meaningful.

This study aims to identify the key risk areas for entry, establishment and dispersal of PWN in Finland. The results will enable targeting PWN surveys and risk communication at areas of high risk.

## Assessment of likely locations for PWN entry

Areas where the likelihood of PWN entry in WPM is elevated will be identified and ranked based on

- data on import events of goods that are likely to be accompanied by WPM originating from countries where PWN is present,
- locations of the main logistics centers and other areas with permanent WPM presence, and
- acreage of industrial land use and harbors.

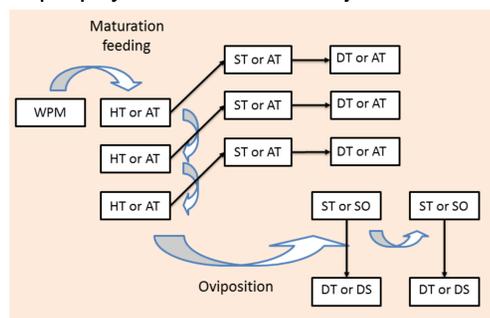


Maps of A) individual import events from risk countries, B) locations of the main logistic centers and C) Industrial areas show similar patterns. However, certain areas may gain a larger share of their import from risk countries than others.

## Areal susceptibility to establishment and dispersal of PWN

The areas with elevated probability of PWN entry will be compared with respect to the outcome of a possible PWN invasion. This is done by simulating PWN spread with a grid-based model that has both spatial and temporal aspects.

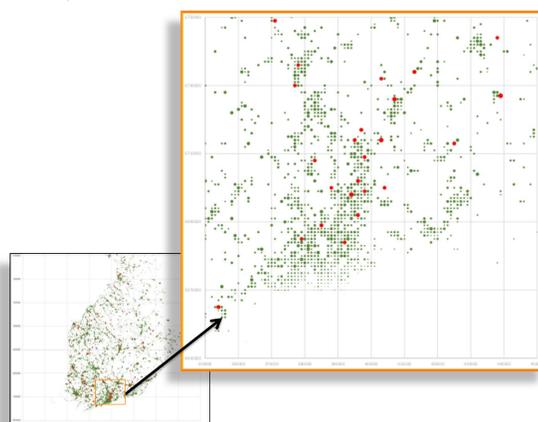
In the model, imported WPM items are expected to contain vector beetles (*M. galloprovincialis* and *M. sutor*), which may spread the infection to new host trees and saprophytic /dead-wood objects.



Monochamus beetles with PWN enter a cell in wooden packaging materials. Vectors fly to healthy trees (HT) or asymptomatic trees (AT) to feed and infect them with PWN. These trees become symptomatic (ST) or asymptomatic (AT) depending on the temperature. If the mean temperature of July is higher than 20 ° C, these trees die (DT), but with lower temperature they stay asymptomatic (AT). Female vectors fly to lay eggs either to symptomatic trees (ST) or fresh saprophytic objects (SO). These trees will turn to dead trees (DT) or dry saprophytic objects (DS), which are no longer suitable for oviposition.

Data on the availability of host trees (pine and spruce) and decaying woody matter is obtained from the multi-source national forest inventory data. The simulation will be carried out at 500 m and 1 km grid resolution.

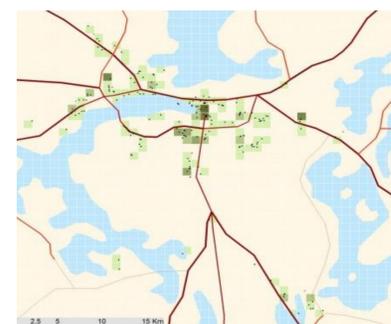
For the cells with elevated likelihood of PWN entry, the outcome of an invasion will be presented as the total of contaminated area, and the number of infected trees.



PWN dispersal from each potential entry cell (colored areas) will be simulated separately. The size of the dot describes the area of spread in a preliminary 20-year simulation. Cells with the largest influence area are shown with red color.

## Utilization of the results

The results will be presented as risk maps where the likelihoods of entry and dispersal have been combined into one risk index. The maps will be made available for plant health inspectors in an easy to use web mapping service, and feedback on their use and perceived quality will be gathered.



An example of an envisioned project outcome, a risk map where darker green indicates areas of higher risk, and black dots show final destinations of import events and other locations with constant WPM presence. The attribute data linked to the dots, such as company names and detailed information about imported goods together with aerial imagery can be used to select sites to be included in the PWN survey.