Deliverable summary D4.5

Optimisation of PnPs surveillance at stand/tree scale with ground and aerial systems

Project acronym:	**HOMED**
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Project coordinator:	**Herve Jactel (INRA)**
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WP leader:	**UNIPD**
Lead beneficiary:	**UNIPD**
Partners involved:	**INRAE, ISA, MEND, TPZF**
Version:	**01**

Dissemination Level	
PU Public	**PU**
CI Classified, as referred to Commission Decision 2001/844/EC	
CO Confidential, only for members of the consortium (including the Commission Services)	

1. Summary

The HOMED project aims to develop a full panel of scientific knowledge and practical solutions for the management of emerging of native and non-native Pests and Pathogens (PnPs) threatening European forests. The work is part of the Work Package 4, which focuses on the development of both ground and remote sensing strategies, methods and tools for early detection, surveillance and delimitation of affected areas by PnPs at stand/tree scale. The traditional methods for surveillance and delimitation mainly consist of the identification of visual symptoms, sometimes associated with counting the number of items in trapping devices. As forest PnPs are often very small and hard to detect targets, the traditional approach does not provide satisfactory results, especially in relation to new and emerging PnPs. New technologies may contribute to more accurate tracking and census of PnPs on trees. In addition, whereas ground survey is the most common approach for PnPs surveillance of trees and forests, the recent development of UAVs and satellite images opens interesting prospects, allowing better integration of ground and aerial observations of damage at stand/tree level.

Objectives:

This report sums up research activities related to ground and aerial surveys of PnPs damage at stand/tree level. The main constraints adopted were not only the detection but also the mapping of those damages or symptoms. This is mandatory to identify early enough infected trees and thus pinpoint the targets for eradication or control. Furthermore, the objective was to investigate the optimization of ground and aerial surveys in model species of wood boring beetles (Norway spruce bark beetle) and defoliators (processionary moths).

Rationale:

Ground assessment of damage is seriously hampered by tree size and shape and by time constraints. Even a well-trained human observer encounters difficulties in observing damaged items in dense canopies, especially when trees are tall. In addition, varying light conditions may further affect the capacity of an observer to detect the same amount of damage in different conditions. The analysis of images taken from above the trees may help to detect damage in a standardized way and it is theoretically less subjected to errors associated with the varying capacity of human observers. There is, however, the need to verify the accuracy and precision of the method and its general applicability to forest and tree management at various landscape scales.

Results:

Ground surveys of trees and tree clusters killed by Norway spruce bark beetles developed after the Vaia storm in a large area of the Southern Alps were organized with the development of an application working on portable devices and made available to a large group of practitioners in forestry. The results were compared with the analysis of satellite Sentinel 2 images by the application of a vegetation quality index (NDVI) (Deliverable 4.1). The analysis showed that the integration of the two methods provides the best approach to quantify and localize tree mortality, which is essential for adoption of management measures. Ground surveys of nests of the pine processionary moth were matched with AI nest detection from images taken from a drone at three sites. All cross comparisons between ground-platform-visual-and AI based assessments were performed. Between all surveys, each one brings its own inaccuracy and double check is

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ongoing to minimize errors. Most peripheral nests that were clearly visible from the ground (against the sky background) were probably missed in the drone image because of little contrast with the background. Nests can be geo-localized with a relative error of 2 m. This result can be used as a basis for deriving a nest probability map.

Teams involved:

The main teams involved in this action among the HOMED partners were from INRAE, ISA, MENDELU, TELESPAZIO, and UNIPD.

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