LWEC THAPBI PROJECT: *New approaches for the early detection of tree health pests and pathogens*

Contact: Dr Rick Mumford, Fera, Sand Hutton, York, YO41 1LZ, UK

Executive Summary of First Year Report: (*covering period April 2014 - March 2015)*

Work package 1: The use of an interdisciplinary approach to the effective deployment of detection technology

Within the first year there has been a major focus on stakeholders. Team members from Forest Research and St. Andrews have completed an initial stakeholder mapping exercise and a 'live' database created with over 100 stakeholder contacts from industry, policy, other government bodies, NGOs, land managers and the scientific community. We also organised and held the first of our three Learning Platform (LP) workshops at Fera in November 2014. With over 60 participants, across different stakeholder groups, this workshop was primarily interactive with the main objectives being:

- Establish an initial community of interest around detection technologies
- Demonstrate the stages of development and predicted impacts of 5 emerging technologies
- Share lessons learnt around the use of previous and existing technologies
- Identify stakeholder groups/individuals to engage with technology development

The key feature of the workshop was a 'Dragon's Den' style event where each of the WP leaders presented their technology in 7 minutes using only technology props. This proved to be a highly effective method for engaging with the audience and engendered a lot of questions and discussion. It was also followed-up with a short questionnaire on each of the technologies to identify whether they would be used in practice.

In addition to the LP, further work has focused on stakeholder engagement activities, to enhance the elements of technology co-design. This has included developing protocols for delivering the Socio-technological Learning Labs (SLLs) and also a tool for assessing impact using a new Diagnostic Technology Readiness Levels (dTRLs) matrix.

As another component of WP1, colleagues at Fera have developed a bio-socio-economic model framework. Based upon the NetLogo platform (an agent-based programming language and integrated modelling environment), the framework will allow us to assess the efficacy and optimal deployment of each of the technologiesbeing developed – where they are best deployed and their effectiveness at detecting a simulated pest spread. A specific model, based upon an Emerald Ash Borer outbreak occurring near Drax Power Station, has been used as to test the framework and help in the development of protocols.

The potential for conducting citizen science surveillance projects using the different technologies being investigated within the project has also been assessed by CEH. The pest trapping area was identified as the one with the best potential and this will be pursued in Year 2 of the project.

Work package 2: The use of volatile organic compounds (VOCs) for the early detection of pests and pathogens

Gas chromatography-mass spectrometry (GC-MS) methods for allowing the detection of VOCs from cultured pathogens have been developed at Aberdeen and validated against two pathogens: *Ceratocystis platani* and *Phytophthora cinnamomi*. Early analysis indicates that both pathogen species tested produce specific metabolites, which could be usable as chemical markers.

Work package 3: Multispectral imaging and analysis for the detection of biotic and abiotic stress

Work at RAL is focusing on the detection of Dothistromia (red band needle blight) in Scots Pine and progress has been made looking at the 'spectral fingerprints' of both healthy and infected trees (the latter through collaboration with William Cornforth, a PhD student at Edinburgh University). This work is building towards creation of a data base of stresses associated with different reflectance spectra of pine. Progress is now accelerating with the arrival of Michelle Hamilton, a full time researcher on the project, who joined the STFC and RAL Space in January 2015.

Work package 4: Airborne spore trapping networks, improving understanding of spread and development of a distributed network

Work has begun at Fera on developing a new metagenomic approach, based upon next generation sequencing (NGS), which will allow for the speciation of fungal spores taken from traps and ultimately developing a better system for pathogen surveillance. To test the approach 'mock communities' of fungal pathogens were created and tested, in order to provide data on the parameters/limitations of the system and to identify the best analytical approaches required to develop an effective bioinformatics pipeline.

In addition, work at Worcester University has further developed and optimised methods based on real time PCR for quantifying the ash die back pathogen, *Hymenoscyphus fraxineus.* This molecular method will be used to investigate the occurrence of ash dieback spores from a range of historical spore trap samples collected from 2010–2014 from different parts of the UK. In conjunction with this work, the establishment of models for the atmospheric transport of fungal spores and pathogen growth and infection has occurred, allowing for future development of risk-based mapping for ash dieback.

Work package 5: Novel approaches for the improved trapping of wood-boring beetle tree pests

Trials were carried out by the University of Greenwich on an improved attractant for oak processionary moth (OPM) adults and this new mix was shown to have improved efficacy over existing lures. Further more extensive trails are planned. In collaboration with the BIPESCO project, work has also started on the investigation of the trail pheromone of the pine processionary moth (PPM) and a new, cheap attractant for emerald ash borer is also being synthesised (in

collaboration with the Canadian Forestry Service). The development of risk-based trapping networks and potential citizen science-based surveillance are ongoing.

Work package 6: Development of non-targeted water surveillance methods for water-borne tree pathogens based on metagenomic approaches

The James Hutton Institute (JHI) has developed a molecular detection system that is effective in detecting multiple *Phytophthora* species in water samples. Work has been carried out to improve and enhance this system including transferring it from a conventional to a next generation sequencing (Illumina) format, improvements to the PCR assay to increase sensitivity and remove bias, and further developments of the bioinformatics pipeline, working with Exeter University and Fera.

Key knowledge exchange activities have included:

- Presentations at seven conferences/events both in UK and overseas
- One article in RELU Newsletter (Jan 2015)
- One peer-reviewed paper: Skjøth et al (Accepted). Quality of the governing temperature variables in WRF-Chem in relation to simulation of primary biological aerosols. Advances in Meteorology
- One appearance on BBC Countryfile: David Cooke talking about phytophthora (April 2015)