Aims

PROTREE is aiming to develop a general approach to getting the right data for managing new pest and disease threats in tree species. Although we will focus on Scots pine, we aim to use this work to demonstrate what is needed to tackle threats in other tree species.

To do this, the project will assess the biology, ecology and management of Scots pine and its interaction with three threat organisms: Dothistroma Needle Blight, Pinetree Lappet Moth and Pine Pitch Canker. New work will be integrated with ongoing studies, using existing and new experimental and genomic resources, to identify practical options for long term resilience. In addition, analysis of socio-economic drivers and communication channels governing uptake of the scientific results will identify best routes to implementation.

We will address the following questions:

1. How variable and adaptable are the three focal threat species?

Threat species themselves are genetically variable and capable of adaptation both to different host species and to variation within host species. The population dynamics of a threat species may have considerable influence in determining the course of an outbreak. For example, highly susceptible exotic species may act as reservoirs of infection - increasing spore loads or pest populations and facilitating transfer to indigenous species. Analysis of the evolutionary genetics of threat organisms will identify patterns of population change (dispersal, host shift, population growth, bottlenecks) and will also provide information regarding the origins of the threat species, their reproduction and diversity.

2. How much variation and adaptive potential is present in the host?

Tree species maintain a substantial internal capacity to adapt through evolutionary change. As well as maintaining high levels of genetic variation within populations – a capacity that is supported by highly effective gene flow at a landscape scale – most key phenotypic traits are complex and controlled by variation at many genes, yet show significant levels of heritability and adaptive potential. Therefore, where generational turnover is possible, there is a strong capability for tree populations to adapt to selective pressure – achieve adaptive escape – from pests, pathogens or other threats such as changing environmental conditions. To assess variation in the host we will examine the genotype, phenotype and extended phenotype of the trees and relate this information to resistance to the focal threat species. We will use existing genomic resources to develop high-throughput genotyping to identify genomic regions involved in resistance traits and to develop approaches for genomic selection.

3. What management options exist for increasing resilience to current and future threats?

The landscape configuration both of native host tree species, and related susceptible species, plays a major role in determining the rate and progress of attacks by threat organisms. Planting densities of trees within forests, frequency and distribution of forests in the landscape, proximity of co-hosts, and connectivity among host populations can all affect the rate of spread of a threat. Credible policies and strategies for the application of scientific data demand an understanding of both the functioning of tree populations and the geographic, socio-cultural and economic contexts within which tree species are managed. We will synthesize existing and new data on the seed supply, nursery trade, forest type, composition (including intra- and interspecific variation) and distribution for Scots pine in the UK. We will assess current policy tools such as the forestry grant schemes and examine management and regulation of tree planting. We will build on studies of land manager decision-making to understand stakeholder values and attitudes relating to Scots Pine, tree health and economic and cultural barriers to implementation of policy proposals. We will also carry out qualitative research to test current opinion on acceptability of management options to control tree pests and diseases. Based on the outcomes of this work we will develop management scenarios for testing via simulations, including manipulation of tree populations, the effects of current climate change predictions and changing market forces.