Forest management and silvicultural responses to predicted climate change impacts on valuable broadleaved species

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This report is the product of a Short-Term Scientific Mission conducted for COST Action E42, concerning the predicted impacts of global climate change in Europe, with the aims of: (1) appraising the scientific methods being used to predict the changes that will occur in distributions of valuable broadleaved species, and; (2) outlining forest management and silvicultural responses.

The current distribution and composition of European forests are relics of glacial history, although subsequently influenced by human activity. These forests are relatively species-poor compared to American and Asian forests, due to barriers in European topography limiting the ability of species to migrate and adapt to previous change (advance of ice). Predicted future impacts of climate change are wide ranging, from rising temperature and CO_2 (positive for tree growth in short to medium term), to large scale stochastic events such as increased incidences of fire, drought (frequency and severity), and increase (distribution and impact) of pests and pathogens. There is growing scientific evidence that climate change is impacting plant range and abundance, and examples are provided for impacts on forests and tree species in boreal, continental and Mediterranean biogeographic regions.

Understanding and modelling the impacts of climate change on European forests is crucial to plan for the future, both to minimise impacts through mitigation, and to develop adaptation strategies. It is important that policy interest and scientific activity is now focussed on adaptation as a priority. The shortcomings of climate envelope models were highlighted, in relation to the need to account for biological processes (*e.g.* evolution, interaction, dispersal) and anthropogenic factors. Specifically, the theoretical climate space predicted for many tree species, generally a 100 – 500 km shift north east, is unlikely to be realised due to physical topographic barriers and anthropogenic factors (agricultural, conservation, forestry and urban policies and development). More understanding of evolutionary mechanisms is needed, and wider international collaboration required.

Case studies focussing on modelling in France, the UK and the USA revealed widespread excellence but further scope for collaboration at European and wider scales. In particular, the Climate Change Tree Atlas developed for the north eastern USA, was highlighted as an exemplar. Such a tool, and the underlying pan-European collaboration of scientists (*e.g.* sharing of data and modelling approaches) that would be necessary if such an approach were taken, would be highly valuable as an outcome for scientists, and as a practical tool for forest owners and managers, and policy decision makers. The current lack of detailed distribution and abundance data for the valuable broadleaved tree species of Europe was revealed, where these are often ignored altogether or their identity lost in being grouped together as 'minor species'.

European forests will play a crucial role in the 21st Century. World timber trade trends are difficult to predict but it seems likely that the demand for timber products will rise in the future, and climate change may have a positive impact. A key function of forests will be in supporting a carbon-lean society: where material substitution (timber replacing brick, concrete or steel), bioenergy and management of forests as carbon sinks will be high priority. A stronger regional and domestic market may bring additionality to these functions. The provision of ecosystem services will become higher priority, such as adaptation provision for biodiversity, landscape connectivity, and soil and water protection and management.

Forest management and silvicultural practice must rise to meet these challenges, whilst forest owners should be able to capitalise on the multi-benefit provision from their resource. Assisting forests, tree species and associated biodiversity to adapt to change will be challenging. There may be a greater role for mixed-forests and close to nature forestry practice, and these may provide a more flexible and robust forest resource. The role of genetics and silvicultural best practice must be promoted in the sector. Decision makers will need to address some challenging questions in the light of predicted impacts, particularly in relation to provenance/seed transfer policies and even, with a view to the future, definitions of nativeness. Forestry adaptation strategies should be developed and adopted at regional and local scales, and adopted by certification schemes, to address gene management, forest protection and regeneration, silvicultural management and operations, and delivery of ecosystem services.

Broadleaved forests across Europe will therefore function as an invaluable resource to meet social, environment and economic priorities in the face of climate change. The role of valuable 'minor' species cannot be over stated.

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