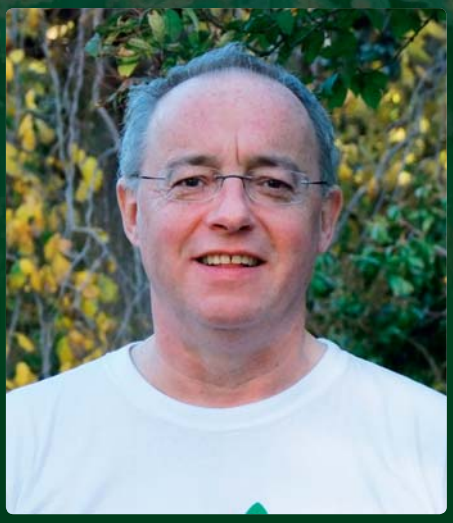
Cameraria damage to horsechestnut foliage

ISEFOR

A foreign invasion

Dr Steve Woodward, coordinator of ISEFOR – a collaborative EU research project – discusses his team's work, and highlights some of the significant threats faced by European forest ecosystems today



Could you begin by outlining the background and overall aims and objectives of ISEFOR?

The idea for the project arose due to the increasing numbers of alien invasive pests and pathogens we are seeing entering the EU, some of which are already causing major problems to our forest ecosystems. Clearly, these invasions are of great concern. The EU supported a small concerted action focused on these problems, FORTHREATS, coordinated by one of the ISEFOR partners (SLU, Sweden) and including many of the partners in ISEFOR. That project ended in 2008 and ISEFOR was the logical, research-driven follow up.

Of course, our overall aim for this type of research is to find ways to detect alien invasives before they establish and become problems to EU forest ecosystems. ISEFOR focuses on the detection and diagnosis of alien invasive threats within what is now the most important dispersal pathway: plants for planting (ie. finished plants being moved either from one nursery to another or from a nursery to the forest for planting). In addition, we'll be using the data we gather to model the probable pathways of distribution, along with potential break-out points for a selected group of representative invasive organisms.

Are there any plant species that are particularly susceptible to extinction in the face of these threats? Are there any symbiotic relationships that would be directly affected if these plants were lost and what can be done to save them?

Many plant species are threatened by these invasive species. Localised extinctions of certain tree species are quite possible. It would not be possible to grow species of particular susceptibility to *Phytophthora cinnamomi*, for example, in areas where temperatures and precipitation reached near optimum levels for this pathogen. The loss of ash to a combination of *Hymenoscyphe pseudoalbidus* and *Agrilus planipennis* would lead to concomitant loss of numerous insect species which are reliant on *Fraxinus* species for key parts of their life cycles. Similar problems apply to many other host plant species.

Damage to forest ecosystems could cause an unprecedented rise in natural disasters such as landslides and flooding. Which areas are likely to feel the greatest effect of pests and pathogens induced by climate change?

The effects will be felt in all areas of Europe. Of course, where forests are providing water catchment and flood amelioration functions, severe damage may lead to major and rather immediate problems. In such scenarios, mountain areas and the inhabitants and various industries reliant on these regions will be worst hit. The increasing damage to alders in Europe, however, resulting from the effects of *Phytophthora alni*, will have impacts throughout water courses, from upland areas to estuaries, as alders help to bind river banks in the riparian zone.

Are stricter border and import controls required to limit the number of pathogens and pests that enter the EU? What impact are the relatively loose restrictions of the Internet having on alien pathogen and pest distribution?

Certainly stricter border controls would be most useful in reducing these invasions, but we have to be practical. We need to focus on developing suitable protocols within the particular pathways of entry, to ensure that incoming materials are as clear of potentially problematic organisms as they possibly can be. Current regulations are not stringent enough to achieve this aim. The international traffic in plants via the Internet is of concern, and although small numbers of plants are traded using this method, there is little regulation possible for the postal service in this sense. This problem must be addressed.

How will ISEFOR disseminate its findings?

A very important part of ISEFOR is ensuring that the end-user community gains access to the techniques and other information generated within the project. Workshops will be held at strategic times during the project, with the first target group being European plant health organisations, including the EU Standing Committee on Plant health and EPPO, with further dissemination to the national quarantine/plant health organisations, giving direct access to policy makers in this area. Other forms of dissemination will include articles in the popular press to raise public awareness, peer-reviewed journal papers and conference proceedings, including oral presentations.

War of the woods

European tree populations are under dire threat from foreign invasive pests and diseases. The **ISEFOR** team are seeking to buck this trend and protect forest ecosystems from this insidious invasion

WHILE NOT A new threat in itself, the introduction of non-native invasive pests and pathogens to forest ecosystems is currently of particular pertinence across Europe. Globalisation has meant that pests and diseases that were previously geographically isolated now have a far greater reach than ever. In addition to this, climate change has brought about altered precipitation patterns and increased mean annual temperatures, leading to greater stress on tree species that have evolved under particular climatic conditions. These changes have not only led to trees becoming more susceptible to local pests and pathogens, but have also allowed invasive organisms to thrive in areas where they would have previously been unable to.

The impact of arboreal pests and diseases can lead to a host of associated ecological problems, such as increased risk of landslides, avalanches, flooding and soil erosion, as well as significant reductions in water availability and the efficiency of forest ecosystems to act as carbon sinks. Ecological diversity is also under threat via the distinct possibility of local extinction of susceptible species; the devastation of rural and urban landscapes is already apparent in parts of Europe. For example, during the late 20th Century, Dutch elm disease almost wiped out the entire elm tree population in Northern Europe, while in Spain and Portugal, cork oak and the related holm oak trees are currently ravaged by *Phytophthora cinnamomi*. Unfortunately, the use of pesticides to tackle these problems can be as hazardous to public health as some of the pests and diseases themselves.

CREATING ISEFOR

ISEFOR (Increasing Sustainability of European Forests: Modelling for Security Against Invasive Pests and Pathogens under Climate Change) is a new EU-funded initiative set up to tackle the problem of alien invasive organisms. Coordinated by Dr Steve Woodward, the project aims to identify and detect new and existing threats to European forests, develop models to predict regions at risk of attack due to climate change, and to analyse routes of entry for these threats. The task that faces them is huge, as many of the pests and diseases are already at large in European forests. For instance, in northern Europe, horse chestnut trees are endangered by a combination of pests and pathogens, such as *Cameraria ohridella*, a leaf miner that causes significant damage to the foliage, while *Guignardia aesculi* infects leaves, and the bacterial pathogen *Pseudomonas syringae aesculi*, causes a bark canker which kills them. Ash species are endangered by *Hymenoscyphus pseudoalbidus*, a fungus which causes dieback and is rife throughout northern and central Europe. Meanwhile, the emerald ash borer is migrating westwards from Siberia, and has been inadvertently introduced to North America, where it has already killed 50 million ash trees. Pine tree populations are in extreme jeopardy due to two North American natives: the pine wilt nematode, which can kill a mature tree within days of infection and has already been found in Portugal and Spain; and pine pitch canker, which has already spread to Italy from its initial base in Spain. Furthermore, in Greece and Italy plane species are succumbing to the North American *Ceratocystis platani* pathogen.

Woodward and his team are well aware of how many foreign invasive organisms have already entered Europe, including via large-scale imports of timber and wood products, as well on board global transport vessels. However, a surprising route of entry is the result of the innovations in communications and information technology, whereby exotic plants can be ordered by individual collectors via the Internet. Currently the major pathway for movement of pests and pathogens is the movement of plants between and from nurseries: "The so-called 'plants for planting' pathway now represents the most serious threat by far for the introduction of alien invasive pests and pathogens," Woodward explains, before elaborating: "In ISEFOR, we will make an extensive and critical analysis of this pathway to demonstrate in quantitative terms, the threat posed by this route for dispersal. We hope that, through this approach, we can reduce any disbelief or dissent in the industry". Although they recognise the best efforts of these importers to try and prevent the proliferation of foreign organisms, Woodward and his researchers are aiming to establish new protocols to curb their advance.

©Professor Jolanda Roux, FABI, University of Pretoria

Tan oak killed by *Phytophthora ramorum*

TECHNOLOGY TO SEEK AND PREVENT

In order to keep track of non-European invasive organisms and develop diagnostic protocols for individual species, ISEFOR is working on fine tuning procedures used to identify each type of pathogen or pest. Currently, most organisms are identified using one type of genetic marker only, a practice of questionable sensitivity when distinguishing between closely related species. The usage of multiple genetic markers, in combination with state-of-the-art pyrosequencing technologies, is enabling the team to transform current practice and develop diagnostic protocols which will be made available to stakeholders throughout the EU.

The other major use of technology that the ISEFOR team plan to make use of will help to predict the susceptibility of forest ecosystems to particular pathogens and pests. For this aim, the development of new modelling tools is among the top priorities of the project. These tools will help to highlight the geographical areas under the greatest risk from individual organisms under various scenarios posed by climate change. The practical benefits of such technology are very apparent to Woodward: "The outcomes of modelling will help stakeholders to understand how changing environmental conditions may impact on forest health," he elucidates. "Conclusions based on the model outputs will be used to make recommendations for forest managers on how to reduce the impact of invading pests and pathogens as the climate changes."

TACKLING A GLOBAL PROBLEM

As a project of such scope and vision, collaboration is vital. ISEFOR is made up of 16 different partner organisations, not only from within Europe, but also from Russia and China. Additionally, an advisory board has been set up which includes specialist contributors from the U.S., Australia and South Africa. The need for such widespread expertise is stressed by Woodward: "We would not be able to convince the regulatory authorities in the European Union of the need to alter phytosanitary rules without a good consensus between member states," he states, adding: "We need collaboration from outside Europe, in countries that are major suppliers, for example, and in other countries having recognisably similar problems". The diverse skill set of these collaborators is also a major advantage, as these include leading authorities on forest pest and pathogen biology, experts in the application of cutting-edge molecular biological technologies, forest ecosystem modellers and representatives from the world's largest forest certification organisation, PEFC, as well as those from European state and private forestries. Urgent action of this scale is certainly needed if the ecology and landscape of Europe is not to be irrevocably altered in a potentially devastating fashion.

INTELLIGENCE

ISEFOR

INCREASING SUSTAINABILITY OF EUROPEAN FORESTS: MODELLING FOR SECURITY AGAINST INVASIVE PESTS AND PATHOGENS UNDER CLIMATE CHANGE

OBJECTIVES

ISEFOR aims to address the threat to European forests from the combined forces of climate change and large increases in the numbers of alien invasive pests and pathogens.

PARTNERS

Consiglio Nazionale Delle Ricerche, Italy • **Chinese Academy Of Science**, China • **Programme For The Endorsement Of Forest Certification Schemes**, Switzerland • **Saint-Petersburg State Forest Academy**, Russian Federation • **Itä-Suomen Yliopisto**, Finland • **European State Forest Association**, Belgium • **Universite De Neuchatel**, Switzerland • **Confederation Europeenne Des Proprietaires Forestiers Asbl**, Luxembourg • **Instytut Badawczy Lesnictwa**, Poland • **Universita Degli Studi Della Tuscia**, Italy • **Institut National De La Recherche Agronomique**, France • **Universitaet Fuer Bodenkultur Wien**, Austria • **Universite Libre De Bruxelles**, Belgium • **Cab International**, UK • **Sveriges Lantbruksuniversitet**, Sweden

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DR STEVE WOODWARD is currently Chair of COST Action FP0801 Established and Emerging Phytophthora: Increasing Threats to Woodland and Forest Ecosystems in Europe. His research interests include the influence of rhizosphere microbiology and host physiology on the initiation and development of root diseases in trees.

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