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TRANZFOR

Transferring research between EU and Australia-New Zealand on forestry and climate change

TRANZFOR
Talking to the TRANZFOR team from both sides of the globe

SUSTAINPINE
Francisco M Cánovas on helping to boost Europe's forest-based sector

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Soaking up the CO_2

Research exchanges between Australasia and Europe increase our understanding of the essential role that forests and forestry play in adaptation to and mitigation of climate change, as members of the **TRANZFOR** team from both sides of the globe explain





Drs Jean-Michel Carnus, Margarida Tomé, Michael Battaglia, Tim Payn and Peter Freer-Smith

Can you provide an overview of the TRANZFOR project and what it is that the TRANZFOR team aim to achieve through this initiative?

The TRANZFOR project is a four-year joint programme of scientific cooperation concerning 75 people for exchange periods varying between two and 12 months. TRANZFOR provides mobility possibilities to individual staff members – from young scientists to technicians and senior researchers. The project also provides support to five major research organisations to establish and strengthen long-term research cooperation on forestry and climate change. Its main goal is to develop research partnerships through staff exchanges and networking activities between three European research organisations in France, Portugal, the UK and two organisations in Australia and New Zealand.

Who are the primary participants in TRANZFOR and how did they come to be involved in the project?

TRANZFOR has developed from active bilateral cooperation over the past decade between five individual countries and partners. The Seventh Framework Programme (FP7) IRSES scheme provided a great opportunity to integrate those past collaboration activities into a coherent programme addressing an issue of high priority on the political agenda of the European Union, New Zealand and Australia in relation with development of national strategies for adaptation to climate change.

How has TRANZFOR helped to improve the mobility of individual researchers between project partners?

So far, 30 researchers from the European institutions and countries involved in TRANZFOR have had the opportunity to travel and stay for several months in Australia and New Zealand (and vice versa) and start research projects that otherwise would never have taken place. There were common research interests among the several partners involved in TRANZFOR but, in most cases, no common projects had yet started. Of particular interest for the TRANZFOR partners is the relationship between forestry and climate change, namely the potential for forestry to adapt to and to mitigate climate changes, for example through CO_2 sequestration in planted forests. Some of the ongoing collaborative actions in TRANZFOR will have impact on the definitions of future policies regarding measures related to forests and forest management.

Are any TRANZFOR partners conducting research into forestry and its relationship with climate change?

The fluxes of energy, CO_2, water vapour and other gases between forests and the atmosphere are a major component of the global exchanges between the atmosphere and terrestrial surface of earth. Indeed, it has been estimated that by 2030, forest ecosystems could provide abatement for about 25 per cent of the world's current CO_2 emissions arising from the combustion of fossil fuels through a combination of reduced deforestation, sustainable forest management and afforestation. Thus all five TRANZFOR partners have strong interests in addressing the relationship between forestry and climate change.

Have you identified any tree breeding or genomic strategies that have shown particular promise in each region?

All five TRANZFOR countries utilise non-native species as a component of their plantation forest systems (including biofuel crops) and a number of common species are used across TRANZFOR countries (eg. *Pinus radiata Pinus pinaster* and *Eucalyptus*). This is known to enhance productivity in managed forests allowing native and semi-natural woodlands to be protected. Now, as a result of climate change, the use of introduced species and adapted genetic material through novel breeding strategies has gained new importance because of the likely benefits to forest resilience and sustainability.

What would you identify as the greatest success of TRANZFOR to date?

The professional relationships between the organisations in Europe, Australia and New Zealand have strengthened during the course of the project and are excellent. This is a well-formulated project because it addresses issues which are of high priority to all partner countries and where there is genuine potential for benefits to arise from collaborative research. The distance between Europe and Australia and New Zealand are such that without the type of support provided by this project it is very hard to establish and maintain interactive working. The high calibre and motivation of those scientists involved has already led to significant achievements. I very much hope that the collaborations which have been established can be maintained beyond the end of the current project.

Distance is no barrier

One of the highest priorities on EU and Australasian political agendas is climate change adaptation. In response, **TRANZFOR** partners are collaborating to transfer research knowledge for the forestry sector

AS THE WORLD heads towards a low carbon economy, it is absolutely crucial to find ways to reduce the CO_2 being emitted. The flip side of this is the essential role performed by those systems where atmospheric CO_2 is reabsorbed. Otherwise known as carbon sinks, these are now recognised globally as one of the most important ways to offset carbon emissions. The two most important natural carbon sinks are absorption by the oceans through biological and physicochemical processes, and photosynthesis by terrestrial plants and forests.

A considerable amount of time and energy is being spent to investigate the importance of forests for managing the impacts of climate change and the crucial role they play in climate change adaptation. But one of the main barriers for experts working in this field is the ability to gain access to other research and study outcomes. A project called 'Transferring research between the European Union and Australia/ New Zealand on forestry and climate change' (TRANZFOR) is aiming to break down these barriers. The main objective of TRANZFOR is to promote research exchange in the sector through short- to medium-term staff exchanges at different research institutes in Europe, Australia and New Zealand.

Key work programmes being carried out as part of this project include genomics and tree breeding, forest models, environmental services, risk assessment and bio-energy. The priority of the TRANZFOR team is to document and discuss emerging issues and forest adaptation priorities within these key themes to support future exchanges as well as provide input into the EU's climate change related areas.

IMPROVED COLLABORATION LEADS TO INCREASED CAPACITY

New Zealand, Australia and the EU may have had informal collaborations in forestry in the past but TRANZFOR takes this collaboration to a much higher level, where the research and policy challenges concerning forests and climate change are all being faced in similar ways. The aim of TRANZFOR is to build long-term institutional collaboration with many follow-on effects. TRANZFOR Project Coordinator, Jean-Michel Carnus – based at the Institut National de la Recherche Agronomique in France – sees many similarities in knowledge and technological development and research organisation between Europe, Australia and New Zealand. However, he believes that one of the greatest challenges is to attract young people from outside the EU to come and work within an European research context and that the project is set to change this: "The TRANZFOR scheme has been quite successful with young researchers and PhD students who have been able to do part of their thesis or post-doctorate in the exchange country". This means that coordinating research partnerships and building relationships between Europe, Australia and New Zealand can only continue to improve.

Michael Battaglia, a researcher at the Commonwealth Scientific and Industrial Research Organisation in Australia, believes that the advantages of CSIRO's involvement in TRANZFOR is that they can now build teams which have a larger set of capabilities than single organisations working on their own can generally assemble: "This global capability should lead to individual partners being able to make more rapid progress on climate change issues". Being involved in the TRANZFOR project means that Tim Payn, based at the Scion Research Institute in New Zealand, now has the opportunity to tap into overseas expert knowledge that he may not have previously had access to. It is his opinion that TRANZFOR brings communication opportunities and capacity building in individual countries where there may have been little before: "A specific example of this would be in the area of physiological process-based modelling. The TRANZFOR collaboration has allowed New Zealand scientists to piggy-back off expertise in the EU and Australia," he highlights. Payn is in no doubt that this has resulted in a more rapid adoption of the approach in New Zealand, helped by easier access to collaborator's models and knowledge.

FINDING COMMONALITIES IN TREE SPECIES

It is not just New Zealand and Australia that are benefiting from TRANZFOR, the data and information coming out of these countries is helping to enrich EU research into climate change and its effects on forestry and vice versa: "Identification of the commonalities and differences between the countries was crucial

DISSECTING LOGS IN NEW ZEALAND

TRANZFOR

TRANSFERRING RESEARCH BETWEEN EU AND AUSTRALIA-NEW ZEALAND ON FORESTRY AND CLIMATE CHANGE

OBJECTIVES

To promote knowledge exchange in the general domain of forests and climate change between Australia and New Zealand and the European Union through short-to medium-term (2–12 months) staff exchanges.

PARTNERS

French National Institute for Agricultural Research, France • **Forestry Commission – Forest Research**, UK • **Instituto Superior de Agronomia, Universidade Técnica de Lisboa**, Portugal • **Commonwealth Scientific and Industrial Research • Organisation**, Australia • **SCION - The New Zealand Forest Research Institute Ltd**, New Zealand

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JEAN-MICHEL CARNUS is director at the INRA forest research site of Bordeaux Aquitaine. He has been involved internationally in forestry research in France and in New Zealand, has expertise in sustainable forest management of planted forests and experience in research network management. He is involved in the EU COST domain committee on forests, products and services, is chair of IUFRO Division 8 (Forest Environment) and vice-chair of the EFI regional office for Atlantic forests (EFI ATLANTIC).

FIELD VISIT, NORTHERN SCOTLAND

Coordinating research partnerships and building relationships between Europe, Australia and New Zealand can only continue to improve

in the design of the TRANZFOR programme," says Margarida Tomé, who works at the Instituto Superior de Agronomia in Portugal. One noteworthy example of the importance of collaboration is the opportunity for using web 2.0 technology in forestry. By linking together a Portuguese web specialist and spatial data specialists in New Zealand, a prototype web-based system for exploring the value of afforestation on ecosystem services and the impacts of climate change on those services has been developed. The next stage of this work is likely to be the adoption of the prototype in other countries.

Payn believes the example of the commonalities in forest tree species and the availability of data provides a great insight into what TRANZFOR achieves: "Douglas fir is one such species of common interest and access to growth data in the EU and in New Zealand will be part of a study to be done by INRA and Scion scientists in New Zealand in the second half of 2011". Access to datasets with and without a certain degree of disease incidence will enable the interaction of disease and Douglas fir productivity to be studied and then overlain with the possible impacts of climate change: "This should lead to the development of better adaptation strategies for planting Douglas fir, to take advantage of the opportunities offered by climate change for increased productivity while avoiding potential adverse impacts of increased disease levels," explains Tomé. Australia's expertise in *Eucalyptus* modelling will similarly aid efforts to maintain *Eucalyptus* species in Europe.

EVERYONE BENEFITS

Most of the milestones and deliverables that were due in the first couple of years have now been reached, including the preparation of joint publications, a successful mid-term workshop in Hobart, Australia and multilateral exchanges between five organisations, concerning 30 scientists and representing 73 man-months. With the project now two years in, the TRANZFOR team can look back at some of the great successes they have achieved. Many of the participants have enjoyed increased access to knowledge on forests and climate change globally that has helped to develop and direct work as well as facilitate international connections in the science and research world. Now into the second phase of TRANZFOR, Carnus is hopeful that the next couple of years will see increased exchanges of young researchers from Australasia to Europe and the focus being placed on the priority research topics discussed and agreed at the mid-term workshop. All going well, the results of their hard work will then feed up into climate change adaptation policy at national and international levels.

Growing pine sustainably

Professor of Biochemistry and Molecular Biology at the University of Malaga, **Francisco M Cánovas** explains how the SUSTAINPINE project's results will help to boost Europe's forest-based sector

Could you begin by outlining the overall purpose of SUSTAINPINE and what the project hopes to achieve?

The main objective of this project is to develop and integrate multidisciplinary genomic research in the maritime pine species. Our research activities aim to increase genomic resources and to study candidate genes involved in the regulation of maritime pine development, growth, and the response to environmental stress, capitalising on data from previous projects. The expected major outcome is to propose practical, market-based strategies to maintain the competitiveness of forest industries by improving biomass and wood productivity of conifer forests, even under stress conditions. We also aim to specifically provide new knowledge for the European forest-based sector, which promotes the use of renewable resources in the context of global climate change.

In what way does this project support the principles of the EU Forest-based sector Technology Platform (FTP)?

An important aim of this proposal is to promote the rapid transfer of knowledge to new and established industries in the forest sector, thereby increasing competitiveness and innovation within the EU. The project reinforces European leadership in conifer genomics, providing advantages to the European forest-based sector in the global market, as indicated in the research agenda of the FTP.

One of the project's two private partners is the support body of the FTP for France, who are directly addressing several key points of the strategic research agenda of the EU-FTP.

Could you outline the work you do at the University of Malaga and how you can relate it to SUSTAINPINE's goals?

Our research group has extensive experience in gene identification, and structural and gene expression analyses, which investigates the roles of key genes for plant growth and development. The laboratory has gained a reputable status in the study of nitrogen metabolism, with major contributions to the understanding of the molecular regulation of ammonium assimilation and amino acid metabolism. In the last few years we have also been studying the transcriptional regulation of this process. We integrate our expertise and experience with other partners in the SUSTAINPINE project to reach the proposed objectives.

What are some of the challenges or obstacles you expect to face and how will you work to overcome them?

An important challenge of this project is to incorporate genomic technologies into a maritime pine improvement programme, in order to efficiently capture genetic gain for relevant traits. The identification of genomic areas associated with a given trait is particularly challenging in conifers such as maritime pine, which have extremely large genomes. However, with the accumulation of information on pathways controlling important breeding characteristics, the candidate gene approaches we are following appear promising.

Do you hope to apply the project's work to forests outside of Europe and collaborate further internationally?

Yes, the integration of research capacities will strengthen the international position of European research in forest genomics in general, and in particular with the International Initiative for Conifer Genome Sequencing. The project also aims to strengthen an international collaboration with North American initiatives: research groups in the U.S. and Canada working in the genomics of conifers such as *Pinus taeda* or *Picea glauca*.

What have been the notable achievements of the project so far?

We now have a better understanding of the maritime pine transcriptome, and new advances have been made to determine the function of relevant genes involved in tree growth, wood formation and the response to environmental stress.

What possible economic benefits will the EU and the forest industry see as a result of SUSTAINPINE's work?

The project is generating novel genomics-based, bio-analytical tools that will improve our ability to assess tree growth and development. In the mid and long term, this will result in improved quantitative and qualitative sustainable wood production. It is expected that new knowledge and genomic technologies developed in this project will be easily transferred to other tree species of economic and ecological interest. The potential benefits of this project are scientifically and economically important to Europe.

A sustainable future

The SUSTAINPINE project aims to provide new knowledge for the European forest-based sector about the maritime pine tree; research hoping to overcome some of the effects of climate change on forest regions

MANY ENVIRONMENTS AND resources are facing new issues with the threat of climate change, and forests are amongst those most affected. Forests play a fundamental role in the regulation of the Global Cycle of Carbon, climatic change, control of erosion and biodiversity maintenance. Acting like sponges for excess carbon dioxide, they are a key factor in reducing global warming. The European forest-based sector has to cope with the progressive impact of global climate change in the context of increasing economic competition amongst industrial forest areas. There is also an ever-rising international demand for wood, as wood constitutes an attractive biomass as a sustainable energy source. In this scenario, genomics and biotechnology are needed to accelerate forest management in order to enhance sustainable and competitive production. Therefore the primary aim of SUSTAINPINE is the application of the latest technologies towards the identification of key genes determining adaptive traits in conifers, which are crucial for forest productivity, conservation and management.

THE PERFECT PINE

Pine trees are important for several reasons. They have a simple structural design, with straight trunks and an almost geometrical branching habitat that makes them ideal for timber production. They also grow faster than many other trees, and are therefore easier to manage in plantations. SUSTAINPINE focuses on the maritime pine – a model tree species of high ecological interest in nearly every Mediterranean and Atlantic country in Europe.

The French, Portuguese and Spanish maritime pine forests cover more than 4 million hectares and constitute a vital area for the strong integration of the forest industry and sustainable natural resources management, generating a range of scientific activities. In addition to this, more than any other species of tree, the maritime pine also has a capacity to sustain salinity and drought, making it increasingly important to countries outside of Europe such as South Africa, New Zealand and Australia. The tree's resin also confers a high calorific value to its wood, making it an excellent biofuel. Previous projects demonstrate that wood formation and drought tolerance could be efficiently described in trees by molecular biology and physiology tools.

BRANCHING OUT WITH KNOWLEDGE

SUSTAINPINE aims to identify the key genes that determine adaptive traits in the maritime pine, using the latest technologies available. The first aim is the isolation of novel maritime pine expressed sequence tags (ESTs), with the hope to extend the number of maritime pine ESTs from approximately 26,000 to at least 80,000. The second task will be to perform a large-scale expression analysis to identify candidate genes to determine the temporal and spatial distribution of transcripts. Next, functional studies of about 50 selected candidate genes will be performed, with the choice of genes determined by the regulation of development, growth, and response to environmental stress; these selected candidate genes will then be submitted to genetic mapping.

Work will subsequently be concerned with the exploration of natural diversity of the selected candidate genes in maritime pine populations, and finally candidate genes for growth and wood quality will also be selected for association mapping. The project will also apply bioinformatics methods to store, process and excavate all data delivered by the project. This will especially facilitate the coordinated analysis of structural, expressional and functional data.

The ultimate goal of the research is to deliver multiple integrated data from existing, or newly discovered, candidate genes. When applied practically, the results will benefit pine breeders, presenting them with new molecular selection criteria to ensure more efficient design of adapted varieties for increased productivity through improved growth and wood properties, as well as superior sustainability through adaptation to drought or nutritional stresses. This enhanced control of tree productivity will ultimately benefit the forest industries and other wood and biomass users. This project is strongly aimed at contributing to the development of a forest crop with the potential of resource cascading for different energetic and industrial applications in a sustainable bioeconomy.

EVERGREEN COLLABORATIONS

One key to SUSTAINPINE's success is the cooperation between those European laboratories with unique and complementary expertise to develop the proposed research, and subsequently a number of useful partnerships and collaborations have been put in place to ensure the project meets its aims. The research consortium is supported by wood-based industries of several countries and includes input from some of the top scientists from France, Germany, Portugal and Spain, including world leaders in different aspects of conifer tree biotechnology, such as nitrogen metabolism and photosynthesis, wood formation, stress, tissue culture and gene transfer, and bioinformatics. By combining all of its facilities, resources and technical expertise to study the problem, the consortium greatly increase the probability of significant scientific discovery. No single nation in Europe has the necessary expertise and technical infrastructure to carry out the proposed research programme alone, and subsequently a collaborative approach is the best strategy.

One of the most significant advantages open to the consortium is the availability of the research facilities of Andalucia Tech, an International Campus of Excellence with a sustainable impact on the cultural, social and economic environment. Andalucia Tech specialises in Communications and Information Technologies (CIT), Production Technologies (PT) and Biotechnology. Project Coordinator Francisco M Canovas is eager to stress the quality of the work carried out at the site: "Our laboratory has been involved for more than 20 years in functional genomics studies in higher plants by using a variety of experimental approaches and including biochemical, immunological, recombinant-DNA techniques and more recently transcriptomic, proteomic and bioinformatic analyses," he states. SUSTAINPINE is one of the most representative biotechnology projects of Andalucia Tech, and this research facility looks set to act as an important place hub to attract new scientific talent at international level.

The project expects to assemble a great deal of dispersed data. Successful coordination of data requires the integration of all datasets into a single database via a web interface where all project members can deposit and share information. The Second Work Package (WP2) of the project is concerned with this task, and is one of the major achievements of the project to date, with a web portal already online. The portal also provides useful links to the partners' pages and information about the project available for the general public. Database tables will be constructed using sequences as the key to build relations, and will be hosted by the 8 Oracle Database Servers at the PAB. The project is set to conclude in April 2013, by which time it is hoped that the objectives of the project shall be met, and the future of maritime pine, its productivity, and its role in helping with climate change will be greatly fortified.

INTELLIGENCE

SUSTAINPINE

GENOMIC TOOLS IN MARITIME PINE FOR ENHANCED BIOMASS PRODUCTION AND SUSTAINABLE FOREST MANAGEMENT

OBJECTIVES

To propose practical, marker-based strategies to maintain the competitiveness of forest industries by improving biomass and wood productivity of conifer forests even under stress conditions.

PARTNERS

Universidad de Malaga - Biologia Molecular y Bioquimica, Spain
Centro de Investigaciones Forestales, Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, Spain
Universidad de Alcala, Spain
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