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COFORD Council

Outgoing council:

Chairman: David Nevins

Malcolm Beatty, Forest Service Northern Ireland

Michael Bulfin, Teagasc

Angela Coffey, Irish Timber Growers' Association

Donal Fitzpatrick, Irish Forestry Contractors' Association

John Gardiner, University College Dublin

John Jackson, Irish Farmers' Association

Michael Lynn, Woodfab Timber Ltd.

Diarmuid McAree, Forest Service, Department of Agriculture, Fisheries and Food

John McCarthy, None-so-Hardy Nurseries

Gerard Murphy, Coillte

Pat Rath, Farmer representative

George Whelan, Smart*Ply*

Current council (appointed March 2008):

Chairman: Michael Lynn, Woodfab Timber Ltd.

Pearse Buckley, Sustainable Energy Ireland

Tim Crowley, Coillte Teoranta

Dympna Furlong, Forest Service, Department of Agriculture, Fisheries and Food

Willie Fitzgerald, Enterprise Ireland

Michael Glennon, Glennon Sawmills

Pat Hennessy, Irish Farmers Association

Diarmuid McAree, Forest Service, Department of Agriculture, Fisheries and Food

John McCarthy, None-so-Hardy Nurseries

Nuala Ní Fhlatharta, Teagasc

John Joe O'Boyle, Forest Service Northern Ireland

Donal Whelan, Irish Timber Growers Association

COFORD Executive

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Research Manager: Tree Improvement and Non-wood Forest Products
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Technology Transfer Co-ordinator
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Moira Rycraft and Mary Duggan
Office Administrators
Email: admin@coford.ie

Chairman's Report

Michael Lynn
COFORD Chairman

COFORD now plays a vital role in the forestry sector in Ireland, not only in funding national research and development, but also in providing a wide range of services and advice, right across the range of forestry activities. Comparing the level of funding, at just over €4.2 million, with the level of output and impact of COFORD's activities, the organisation provides very good value for taxpayers' money.

Key to successful forest research is effective implementation of findings in policy and practice. COFORD is fully aware of the fundamental importance of such an approach. Indeed, since taking up office as chairman in September, I have been impressed with the impact of COFORD's work within the forestry sector and on wider policy matters. To more fully demonstrate work areas and outcomes, we have expanded reporting on technology transfer and services under a new 'Services and Technology Transfer' section.

Arising from the growth in the range of services that COFORD provides, its role is also changing to more fully encompass the developmental aspects of its remit. While the funded research programme is fundamental to its work, the council is striking out in new directions allied to policy advice and industry development. These are areas that link directly to research and analysis, and need continued and expanded high quality work in COFORD itself to guide both industry and policy makers. Through the new COFORD council, with representation from agencies such as Coillte, Enterprise Ireland, Forest Services north and south, Sustainable Energy Ireland and the industry bodies around the table we will be addressing important aspects of the development agenda over the coming three years. Given these new directions, and conscious of sectoral needs, COFORD began to seek to expand its staffing in 2007. By year end this process was at an advanced stage, with additions to the COFORD team expected in early 2008.

Funding is, of course, vital to COFORD taking on new developmental directions and in sustaining research effort over the period of the current National Development Plan and beyond. While the economy as a whole is experiencing a slow down, particularly in the housing market, it is reassuring to hear the continued emphasis being placed by government on state investment in R&D. Sectors such as forestry, where the timeframe from the initial investment to the full realisation of capital returns is measured in decades rather than months or years, require sustained and long-term R&D funding to support added value and competitiveness right along the production chain.

An organisation that does not change in response to its customers' needs will not survive. COFORD's ability to understand and meet these needs was greatly facilitated by the outgoing chairman, David Nevins. I want to thank him for handing on a healthy COFORD and for his sterling work in guiding COFORD over his 8-year tenure as chairman. We acknowledged David's work during the year at a formal dinner in his honour. We wish him continued success in his many business endeavours.

Director's Report

Eugene Hendrick
COFORD Director

Forest research and development funded by COFORD is aimed at addressing the needs of policy makers and practitioners. It deals with both public goods and competitiveness in growing, harvesting and processing forest products. To achieve value for state investment, such a broad portfolio needs to be focussed on the important issues, well structured, with the results being clearly communicated to COFORD's customers.

Over the past 18 months COFORD has put in place a new funding structure that aims to provide better delivery of research and development results and continuity of effort and focus in chosen research themes. Calls for proposals have resulted in programmes of work in climate change, biodiversity, forests and water (jointly with EPA), renewable energy, forest policy and economics, forest planning and management, and harvesting and transport. While aspects of these topics have been addressed in previous projects, the new thematic approach is based on programmes encompassing a number of projects, lead by a programme leader. This approach is providing a critical mass of researchers in selected areas to address policy and practice needs. Outlines of the programmes and projects are provided in the report.

Input by end users is critical to the successful operation of the programmes. COFORD has set up programme advisory committees to facilitate end user input during all phases of the programmes' work. In addition, researchers continually contribute to policy and practice development through involvement with industry and agencies such as the EPA, Forest Service, SEI and NPWS. Some examples over the past year include estimation of climate change mitigation by Irish forests, development of silvicultural guidelines for broadleaves, control of grey squirrel and deer in forests, renewable energy policy, and impacts of felling on sediment and nutrient loads in surface waters.

COFORD's written communications – our newsletter, COFORD Connects, reports and other publications – continue to play a vital role in the business of adding value to research findings and outcomes. Almost all the information COFORD provides can be downloaded from the www.coford.ie website. Successful uptake of research and development results is also facilitated by workshops and seminars and by providing services and advice linked to research effort. COFORD has, over the past three years, built advisory services on wood product specification, climate change, forest growth modelling and financial appraisal, wood energy and windthrow prediction. All the services are based on research results and the expertise developed in nationally funded forest R&D programmes. Linking research to advice also provides useful feedback on the direction of research effort.

In conclusion, I wish to express my thanks and appreciation to the COFORD team and council for their work and support during the year, and to colleagues in the Forest Service for their help and advice.

SERVICES AND TECHNOLOGY TRANSFER

COFORD STAFF-DELIVERED SERVICES

Advice and input on economic and environmental matters

COFORD staff provided advice to the Forest Service and the Department of Agriculture, Fisheries and Food on:

- valuation of state investment in afforestation;
- water quality and the impact of forest location and operations;
- climate change measures;
- forest biodiversity measures;
- forest legislation.

Broadleaf silviculture

The increasing importance of managing broadleaved forests for roundwood production and wood energy is reflected in an ongoing programme of thinning demonstrations organised by COFORD with the support of Teagasc (BROADFORM project). In 2007 COFORD co-ordinated the first in a series of hands-on workshops on the early thinning of young ash stands with Teagasc and the Forest Service. COFORD also provided advice to the Forest Service on the design of tending and thinning systems for broadleaves. Outcomes from this work include:

- development of tending and thinning systems for broadleaf crops;
- development of systems for managing broadleaf/conifer mixtures.

Climate change and forests

COFORD's work in climate change includes the CLIMIT research programme, reporting on carbon stock changes in Irish forests to national and international processes, provision of forecasts of Kyoto eligible carbon sequestration, input to the development and implementation of forestry aspects of the National Climate Change Strategy, input to climate change aspects of national forest policy, COFORD staff involvement in forestry aspects of international negotiations under the United Nations Framework Convention on Climate Change, and provision of information on climate change aspects of forests to the agriculture and forestry sectors, government departments and agencies and to the public. Outputs include:

- quantification and valuation of forest carbon sequestration;
- afforestation programme scenario analysis in relation to potential climate change mitigation;
- elaboration of the role of forests and wood energy in mitigating climate change in the National Climate Change Strategy.

Forest statistics

Forest statistics play a key role in benchmarking the performance of the forest sector, and indeed in guiding investment decision-making. COFORD is responsible for the compilation of annual wood harvest and forest product trade statistics. Through the forest economics and policy research programme, COFORD is also estimating the macro economic contribution of the forest sector, in both tradable goods and services, and public goods. The main outputs in 2007 were:

- compilation of wood production and trade statistics for 2007 (in conjunction with the EUROSTAT/Food and Agriculture Organisation United Nations Economic Commission for Europe/Joint Forest Sector Questionnaire) and quantification of wood product flows in Ireland;
- compilation of 2006 wood energy harvest and use statistics (part of a Europe-wide wood energy enquiry, compiled on behalf of the UNECE, in collaboration with Sustainable Energy Ireland).

Reproductive material

In 2007 the Forest Genetic Resources Working Group concluded its task with the publication of *Sustaining and developing Ireland's forest genetic*

resources – An outline strategy. Covering the period 2007 to 2013, it was developed as a result of extensive consultation and examination of genetic resource issues over a 2-year period.

A working group to establish the research needs of the nursery sector was established by COFORD in 2007. It will conclude its work in early 2008.

Work on reproductive material includes monitoring, compilation and updating of the national catalogue of seed stands on an annual basis (required under EC regulation, including advice on felling licence applications in respect of each stand), on behalf of the Forest Service. COFORD staff also provide Irish input to international gene conservation and tree improvement processes (particularly EUFORGEN), and co-ordinate the Irish element of the British and Irish Hardwoods Improvement Programme (BIHIP). Work also includes input to the Department of Agriculture, Fisheries and Food Advisory Committee on Genetic Resources for Food and Agriculture. Outputs from the work include:

- review and updating of the annual national catalogue of seed stands;
- development of co-operative clone banks, seedling seed orchards and seed source field trials with UK partners in BIHIP;
- outline strategy for sustaining and developing Ireland's forest genetic resources.

Wood energy

The wood energy portfolio covers the COFORD-funded Forest Energy R&D and demonstration programme, advice on wood energy supply chain development and related matters through woodenergy.ie, joint hosting (with SEI) of the register of wood fuel quality testing laboratories, wood energy workshops (organised jointly by Waterford Institute of Technology (Forestry) and Danish Forestry Extension) and input to national renewable energy policies and measures through SEI and the Department of Communications, Energy and Natural Resources. Outcomes attributable to the work of COFORD, in conjunction with industry, Forest Service and other agencies include:

- a growing market and use of wood energy supply, particularly in the heating market;
- increased levels of early harvest in privately owned plantations (adding value to existing crops);
- increased levels of expertise and knowledge in the management of energy wood supply chains.

WEB-DELIVERED ADVISORY SERVICES

Web-delivered advisory services are available at the COFORD web site:

- CLIMIT - forests and climate change;
- GROWFOR – forest growth modelling and valuation;
- WINDTHROW – estimating windthrow probability in forest plantations in Ireland;
- Hardwood Matters – an online catalogue for buying and selling hardwood timber.

The GROWFOR service now features an on-line query service for licence holders. Queries generated through this facility are shown in Figure 1. Registered GROWFOR users can also download the latest version of the software whenever it is updated, as well as the User Manual. Up-to-date standing roundwood prices are also provided to users.

COFORD produces *Hardwood Matters*, the catalogue for advertising hardwood timber, twice yearly. Published in hard copy and available on the website, it attracts a wide and growing audience in the forestry and timber processing sectors. Those in the business of selling or buying hardwoods can avail of the service, free-of-charge, by contacting COFORD. *Hardwood Matters* is also carried on TIMBERWeb, the global timber eMarket, www.timberweb.com.

In all, the number of unique visitors to the COFORD website in 2007 was 47,000 - a substantial increase in traffic compared to 2006.

In addition to www.coford.ie, COFORD manages and maintains the www.woodenergy.ie and www.woodspec.ie sites. Both were completely revamped in 2007, using new content management systems to facilitate maintenance. During 2007 woodenergy.ie had 15,000 unique visitors, while woodspec.ie attracted 4,000 unique visitors. Numbers using woodspec.ie are expected to increase substantially in 2008. Both sites provide on-line advisory services; the breakdown of the queries generated in 2007 is given in Figures 2 and 3.

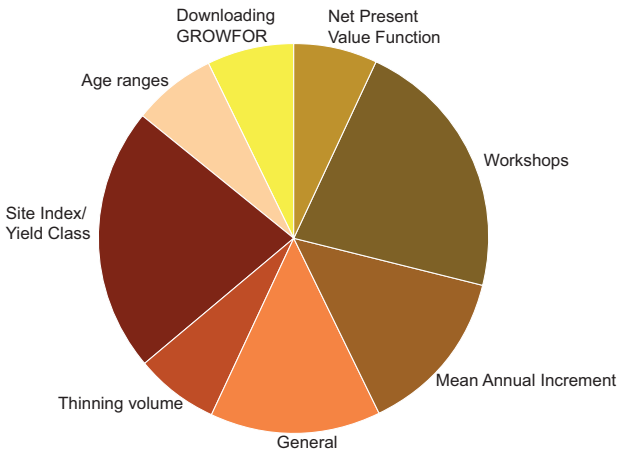

Figure 1: Query categories at GROWFOR on www.coford.ie during 2007.

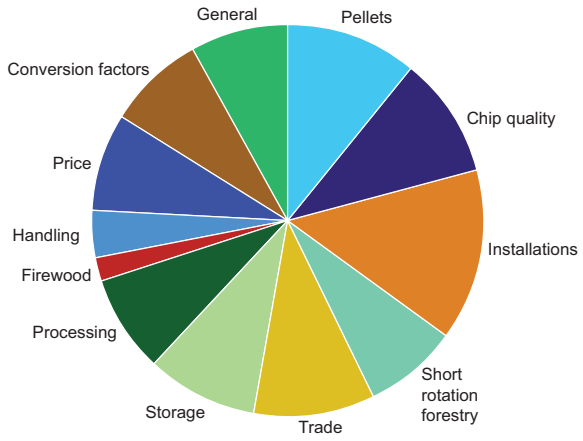

Figure 2: Query categories at www.woodenergy.ie during 2007.

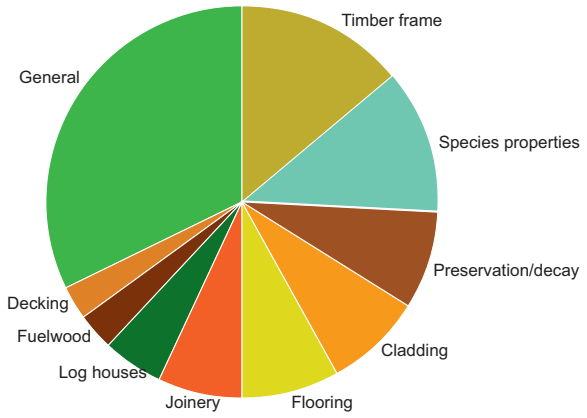

Figure 3: Query categories at www.woodspec.ie during 2007.

NETWORKING AND KNOWLEDGE TRANSFER

Support was given during 2007 to facilitate travel and mobility, seminars and workshops and working visits through the Networking and Knowledge Transfer Support Initiative. Eight travel and mobility grants, one working visit grant and two seminar grants were awarded. Reports on the visits and events are available on the COFORD website.

EVENTS

COFORD was involved in the organisation and hosting of conferences and workshops in 2007 as listed below. Presentations made at these events are available on www.coford.ie.

- The *National Forestry Conference*, co-hosted by COFORD, Irish Timber Growers Association, Society of Irish Foresters, and the Irish Forest Industry Chain, was held on 9 March 2007 in Portlaoise. The theme was *Technologies to Improve Forest Management.*
- *BioEnergy 2007 - Fuelling Ireland's Future* was organised by COFORD, Teagasc and Sustainable Energy Ireland's Renewable Energy Information Office on Thursday 30 August 2007 at Teagasc Oak Park, Carlow. This event was based on the 'Taking you from Know-How to Show-How' concept, combining a comprehensive technology and product exhibition with conference, seminar and workshop sessions, field excursions, site visits and practical demonstrations. The purpose of the event was to promote the use of solid biomass and raise awareness across all sectors from landowner to end user on the many uses and advantages in growing, harvesting and using wood fuels and energy crops for energy generation. Bioenergy 2007 provided access to the latest product innovation from suppliers within the national bioenergy sector, displaying machinery and equipment such as domestic pellet stoves and boilers, commercial wood pellet/chip boilers, chippers, residue bundlers, chippers, slash bundlers and other equipment. Over 7,000 visitors attended this event, at which 40 indoor and 35 outdoor exhibitors showed their products.
- An international conference on *Forestry, Carbon and Climate Change - Local and*

International Perspectives took take place on 19 September at the Glen of the Downes, Co Wicklow.

- A seminar on *Foliage from forests - A growing opportunity* took place on 18 and 19 October 2007 in Kilkenny.
- An open day on the *Potential of out-wintering pads* was arranged by COFORD and Teagasc on 7 November 2007 at the Teagasc Ballyhaise College, Co Cavan. This event demonstrated the planning and construction of out-wintering pads for dairy cattle and provided information on wood chip supply.
- The seminar on *Quality-based forest fuel supply chains - The ForestEnergy 2007 programme* took place on 12 December 2007 in Mullingar. The latest results from the Forest Energy 2007 programme were presented.
- Five *wood biomass harvesting and supply chain workshops* were held in 2007 at the following venues: 11 June - Westport; 27 August - Tullamore; 7 December - Portlaoise; 10-11 and 13 December - Mullingar. Due to popular demand, and the level of interest in this sector, this workshop has been extended to two days. Opportunities will also be provided for those who have already attended the one-day version, to attend day two only. Material now included in the second half of the programme includes:
  - Overview of biofuels, such as willow short rotation coppice and miscanthus;
  - Silviculture of willow short rotation coppice;
  - Establishment and harvesting of willow short rotation coppice;
  - Production of wood pellets;
  - Quality requirements for wood pellets;
  - Delivery of wood pellets;
  - Boiler types;
  - Economic appraisal of wood boiler solutions.
- Three *GROWFOR workshops* were held:
  - 15 March - Bandon, Co Cork.
  - 22 March - Mullingar, Co Westmeath.
  - 21 June - Athenry, Co Galway.
- COFORD continued the *ForestEnergy programme*, in collaboration with Teagasc and Waterford Institute of Technology. A national series of demonstrations of thinning systems and machinery for quality woodfuel production from forestry was held at:
  - 5 April: Killconnel, Co Galway.
  - 12 April: Abbeyfeale, Co Limerick.
  - 19 April: Bweeng, Co Cork.
  - 4 May: Stranorlar, Co Donegal.
  - 12 June: Aghagower, Co Mayo.
  - 20 June: Vicarstown, Co Laois

  Chipping operations were demonstrated at:
  - 4 September - Killconnel, Co Galway.
  - 11 September - Bweeng, Co Cork.
  - 14 September - Stranorlar, Co Donegal.

PUBLICATIONS

Reports

Seven reports were produced in 2007. These are available in hardcopy or can be downloaded free-of-charge as pdf files from the COFORD website.

- *COFORD Annual Report (Tuarascáil Bhliantúil) 2006*.
- *Engineered wood products in Ireland.* Edited by Bill Robinson.
- *Harvesting and Processing Forest Biomass for Energy Production in Ireland.* The ForestEnergy 2006 programme. Pieter D. Kofman and Tom Kent.
- *Mulch mats - their potential in establishing forest and other tree crops.* Nick Mc Carthy, Claire Mc Carthy and Milo O Rathaille.
- *Sustaining and developing Ireland's forest genetic resources - an outline strategy*. Gerard Cahalane, Pat Doody, Gerry Douglas, John Fennessy, Conor O'Reilly and Alistair Pfeifer.
- *The environmental impact of planting broadleaved trees on acid-sensitive soils.* Marcus Collier and Edward P. Farrell.
- *The Irish Squirrel Survey 2007*. Michael Carey, Geoff Hamilton, Alan Poole and Colin Lawton.

COFORD Connects

The following COFORD Connects notes produced in 2007 are available in hardcopy and can be downloaded from the COFORD website:

- Progress in the selection and improvement of Irish birch.
- Where should Washington and Oregon sources of Sitka spruce be planted in Ireland?
- Provenances of beech best suited for Ireland.
- The importance of seed stands in broadleaved forestry.
- Harvesting wood for energy from early first thinnings.
- Harvesting wood for energy from second and later thinnings.

- Firewood.
- Quality wood chip fuel.
- The potential of terrestrial laser scanning technology in pre-harvest timber measurement operations.
- Forest foliage.
- Structural timber design to Eurocode 5 (IS EN 1995-1-1) rules.
- Ordering and receiving wood chip fuel.
- Receiving and storing wood chip fuel.
- The production of wood pellets.
- Simple ways to check the quality of wood pellets.

E-Newsletter

The monthly email newsletter *Forestry and Wood Update* continued to be compiled and circulated. The new COFORD website facilitates online subscription, with the number of subscribers now standing at over 1,800.

COFORD INVOLVEMENT IN NATIONAL AND INTERNATIONAL ORGANISATIONS AND PROCESSES

Dr Eugene Hendrick is the Irish representative on the EU forest sink experts group in the international climate change process, and a member of the Heads of National Forest Research Institutes. He is the national statistical correspondent for UNECE/FAO/EUROSTAT Joint Forest Sector Questionnaire, and the Irish representative on the International Council of the International Union of Forest Research Organisations (IUFRO).

John Fennessy represents COFORD on the British and Irish Hardwood Improvement Programme (BIHIP) and is National Co-ordinator on European Forest Genetic Resources Network (EUFORGEN). He is also the Irish representative on the Stand-forming Broadleaves Network of EUFORGEN and is a member of the Advisory Committee on Genetic Resources for Food, Agriculture and Forestry of the Department of Agriculture, Fisheries and Food.

Lauren MacLennan is a member of the IUFRO Extension Working Group, IUFRO Technology Transfer Working Group, and the Forest Communicators Network (FAO/ECE).

PAPERS AND PRESENTATIONS

Eugene Hendrick:

- In press *Forests and the UNFCCC process - an overview*, presented at COFORD conference Forestry, Carbon and Climate Change - Local and International Perspectives.
- Articles in Sunday Tribune, Sunday Business Post, Farmers Journal, Irish Timber and Forestry and Irish Scientist.
- Presentation *Forest research in Ireland and its importance to the economy* to Irish Plant Scientists Association Annual Meeting.
- Presentation *Forests and water* at the Western River Basin District conference.
- Delivered a segment on climate change and aspects of the COFORD CLIMIT programme, along with Dr Kevin Black and Dr Ken Byrne, on the RTÉ EcoEye television programme.

John Fennessy presented *An update on COFORD broadleaved tree improvement programmes* at the Forest Service Inspectors' Conference in Wexford on 15 November. He also made a presentation updating the position of Ireland in relation to gene conservation activities at national level at the 5th EUFORGEN National Co-ordinators Meeting in Slovenia in May 2007.

Research Programme Thematic Areas 2007

FOREST REPRODUCTIVE MATERIAL		
	ASHGEN	Identifying the scale of suspected hybrid ash (*F. excelsior* x *F. angustifolia*) in Ireland and its potential for genetic pollution of indigenous ash germplasm
	ASHQUAL	Comparison of Irish ash seed sources
	BEECHQUAL	Testing seed stands of Irish beech
	BIHIP	British and Irish hardwood improvement programme
	BIRCH	Selection and improvement of Irish birch
	EUFORGEN	European Forest Genetic Resources Programme
	OAKPROV	Establishment of Irish oak seed stand and progeny trials
	QUALIBROAD	Improving the uniformity and quality of broadleaf planting stock
	SEEDSTANDS	The national catalogue of seeds
	XMASFIR	Trial of Danish noble fir Christmas tree sources
SILVICULTURE		
	BROADFORM	Silviculture of new broadleaved plantations: shaping and thinning
	CONTINUCOVER	An evaluation of continuous cover forestry in Ireland
	GBREVIEW	Growing Broadleaves review
	REDAREAS	Management options for forests on western peatlands
FOREST PLANNING AND MANAGEMENT		
PLANSFM	FORESTSCAN	Terrestrial laser scanning technology for multi-resource forest inventories
	NATFOREX	Establishing a national resource of field trials and a database for forest research and demonstration
	PRACTISFM II	PractiSFM - implementation, communication and optimisation
	STANDMODEL	Development of dynamic yield models for conifers, broadleaves and mixtures
	TREEMODEL	Development of single tree volume models and stem profile models
	CLUSTER	A cluster based approach for identifying farm forest resources to maximise potential markets
FOREST ECONOMICS AND POLICY		
FORPOLEC	FIRMEC	Modelling the economics of forestry in Ireland
	FORECON	An economic evaluation of the market and non-market functions of forestry
	POLFOR	Forestry in a changing policy environment
FOREST HEALTH AND PROTECTION		
	ABATE	Integrated reduced-chemical control of *Hylobius abietis* in Sitka spruce
	SQUIRRELSURVEY	Irish Squirrel Survey 2007

FOREST HARVESTING AND TRANSPORT		
WOODTRANS	GPSTRACK	Assessment of GPS tracking devices and associated software suitable for real time monitoring of timber haulage trucks
	LOADSENSOR	Evaluation of air bag pressure sensors / gauges as load weighing devices for use on timber haulage trucks
WOOD PRODUCTS		
	EWP	Engineered wood products – opportunities and threats for Ireland
	HEATTREAT	Heat treatment of fast-grown softwood
WOOD ENERGY		
	FORESTENERGY	Harvesting and processing forest biomass for energy production in Ireland
NON-WOOD PRODUCTS		
	FARM FUNGI	Production of edible fungi in the farm forest
	FORESTFOLIAGE	Management, screening and evaluation of a range of forest trees and associated ornamental species for suitability as cut foliage
	FORESTFUNGI	Assessment of wild edible fungal production in selected Irish forest sites and an evaluation of the commercial potential of harvesting
	WILDFUNGI	Wild fungi of Ireland
FORESTS AND CLIMATE CHANGE		
CLIMIT	CARBIFOR II	Carbon sequestration by Irish forest ecosystems
	CARBWARE	Development of tools and systems for reporting on forest carbon stocks and stock change under the Kyoto protocol and the UNFCCC
	CLIMADAPT	The use of Ecological Site Classification in adapting forests and their management to climate change
	FORESTSOILC	Soil carbon stock changes and greenhouse gas fluxes in Irish forests
FOREST BIODIVERSITY		
PLANFORBIO	FORESTBIO	Managing for biodiversity in a range of Irish forest types
	HENHARRIER	Optimum scenarios for Hen Harrier conservation in Ireland
	RHODO	Achieving effective rhododendron control
	FUNCTIONALBIO	Functional biodiversity in forests diversity of soil decomposers and predatory and parasitic arthropods
FORESTS AND WATER		
	FORFLUX	Biogeochemistry of Irish forests
	SANIFAC	Establishment of erodibility indices and soil and nutrients losses from forest soils
	SILTATION II	Quantification and management of erosion and siltation
FORESTS AND RECREATION		

Forest Reproductive Material (FRM)

Genetic diversity is the ultimate source of biological diversity, and genetic resources represent the useful diversity of forest trees and other living organisms. Forest genetic resources constitute the genetic resources of both native and exotic forest tree species found naturally in the country or introduced at some time in the past.

After centuries of over-exploitation of indigenous forests the original objective of the afforestation programme was to create a resource that would yield a sustainable supply of timber to satisfy the country's needs and reduce dependence on imports. Initially this led to the establishment of plantations of fast growing exotic conifers, mainly from western North America.

Recent years have seen a rapid rise in the use of native species, particularly broadleaved species, in both commercial afforestation and in the Native Woodland Scheme. It is important that the planting stock used should be genetically suited to the site. Attempts to rectify the planting of unsuitable or poorly adapted material is expensive and the returns on such crops will be below expectations. Costs associated with utilising the most appropriate forest reproductive material are small compared to forest establishment and management. Having forest reproductive material that is well adapted to Irish climate and edaphic conditions is fundamental to maintaining the sustainability of the forest resource. COFORD is playing its role in monitoring, testing and evaluating Irish forest reproductive material through a number of national and international projects.

National FRM projects:

- **ASHGEN** – Identifying the scale of suspected introduced hybrid ash (*F. excelsior* x *F. angustifolia*) in Ireland and its potential for genetic pollution of indigenous ash germplasm.
- **ASHQUAL** – Comparison of untested Irish ash seed sources with European controls.
- **BEECHQUAL** – Testing of stands of Irish beech with European controls.
- **BIRCH** – Selection and improvement of Irish birch (in association with alder improvement project).
- **OAKPROV** – Establishment of Irish oak seed stands and progeny trials with European controls.
- **QUALIBROAD** – Improving the uniformity and quality of broadleaf planting stock.
- **XMASFIR** – Field trials of improved Danish noble fir Christmas tree sources.
- **SEEDSTANDS** – Managing the national catalogue of seed stands.

International FRM projects:

- **BIHIP** - Co-ordination and participation in the British and Irish Hardwoods Improvement Programme.
- **EUFORGEN** – National co-ordination, with the Forest Service, of the European Forest Genetic Resources Programme.

ASHGEN

Identifying the scale of suspected hybrid ash (*F. excelsior* x *F. angustifolia*) in Ireland and its potential for genetic pollution of indigenous ash germplasm

PROJECT TEAM
Dr Gerry Douglas, Teagasc*
J. McNamara, Teagasc
Dr J. Fernandez, University of Paris
Dr N. Frascaria, University of Paris
Dr T. Hodkinson, Trinity College Dublin
M. Thomassett, Trinity College Dublin and Teagasc

** Address correspondence to:*
gerry.douglas@teagasc.ie

COMPLETION DATE
April 2010

OBJECTIVES
The overall objective is to provide a set of tests that can confirm the hybrid nature of ash present in suspect stands in Ireland and their potential to interbreed with indigenous ash.
The specific objectives are:

- to examine suspect material in Ireland using known morphological criteria;
- to examine suspect material in Ireland using known molecular criteria;
- to assess the potential threat of the confirmed hybrid material to further introgress with native stocks of ash.

PROGRESS
Samples collected from four sites are currently being analysed. Ten further suspect sites will be sampled for their morphological features and the presence of seeds and flowers.
The pilot work has shown that only small adjustments are needed before beginning the large scale evaluation of putative hybrid plantations. Trunk morphology measurement seems to be the priority for:

- tree pre-selection on the field;
- hybrid status not evidenced by leaf characteristics and/or molecular markers.

Leaf samples from each site were pressed for measurements of exceptional features. The University of Paris, with the aid of the other partners, proceeded to a first pilot sampling in two identified plantations in Ireland at Greenane and Kildalkey. The purpose of this pilot sampling was to:

- validate the overall sampling scheme;
- test the DNA collection technique;
- evaluate the morphological character recognition for field characters;
- evaluate the set of diagnostic molecular markers.

In total, 52 trees were sampled at the two sites and a set of morphological characters was recorded. Samples were sent to the laboratory at the University of Paris for DNA extraction. Two molecular diagnostic markers have already been tested (FemSat Long 19 and FAL757). Microsatellite genotyping standardization with 3100 Abiprism 16 capillary sequences has been initiated, showing adequate and precise resolution for a set of eight microsatellite markers with small non-significant modification of former protocols (genotyping was previously performed using a gel scanner). Size standard quantification, however, needs to be further examined as large inter-sample variation for the standard has been observed. Preliminary morphological analysis suggests that plantations include provenances with different types of hybrids, but that clear common ash individuals also exist. Tree form (not used before for natural population analysis) has been identified as a very relevant character and will be analysed during the winter period along with bud colour. These analyses, along with the next flowering evaluation in spring, will provide a general methodology ready to apply at a large scale as early as spring 2008.

ASHQUAL

Comparison of Irish ash seed sources

PROJECT TEAM
Dr David Thompson, Coillte*
Derek Felton, Woodstock Seeds Ltd.

** Address correspondence to:*
david.thompson@coillte.ie

COMPLETION DATE
October 2008

Planting stock from Irish ash seed stands will be compared in a series of trials.

OBJECTIVES
The objective is to establish a series of trials comparing the growth and form of a range of ash seed sources, including Irish roadside collected seed, with Irish seed stand collections, as well as several continental seed sources.

PROGRESS
Ash seed was obtained from 18 sources including eleven from Ireland, one from the Netherlands and two each from Denmark, Germany and the UK.
Ash seed requires a long stratification treatment, including four months of warm stratification followed by four months of cold stratification. Seed was placed in warm stratification in August 2007 and transferred to cold stratification in December 2007.

ACTIVITIES PLANNED
Seed will be ready for sowing in containers in the glasshouse in March 2008 and will be grown-on for one growing season. Plants should be ready for out-planting in spring 2009.
Sites will be identified during 2008.

BEECHQUAL

Testing seed stands of Irish beech

PROJECT TEAM

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COMPLETION DATE

March 2009

OBJECTIVES

The objective of this project is to establish a series of beech trials comparing the performance and quality of selected home-grown stands with selected continental seed sources.

PROGRESS

Seed was sown in containers in a heated glasshouse in the spring of 2007. The material originated from 17 sources, including twelve home-collected, as well as one source each from the Netherlands, Denmark, Belgium, Germany and the UK.

The plants have grown well and are a sufficient size for field planting in the spring of 2008, one year earlier than planned. At the end of the first growing season the containers were moved outdoors to allow plants to harden off.

ACTIVITIES PLANNED

Two field trial sites have been identified, while two others are being sought. Layout plans for each of the trials will be made and plants will be lifted, shipped to the sites and planted in the spring of 2008.

One-year-old beech seedlings will be out-planted in a series of field trials in 2008.

BIHIP

British and Irish hardwood improvement programme

PROJECT TEAM

BIHIP comprises seven species groups: ash, birch, cherry, oak, Spanish chestnut, sycamore and walnut. It is run by a Management Committee drawn from the chairs and secretaries of the species groups. A Finance Committee allocates funds, to which COFORD contributes, on an annual basis to the groups depending on current needs.

Irish representation on BIHIP species groups in 2007 comprised:

Ash group: Pat Doody (vice-chair);

Birch group: Dr Ellen O'Connor (member);

Oak group: John Fennessy (chair)*, Derek Felton (member);

Spanish chestnut group: Ted Horgan (member);

Sycamore group: Dr Michael Carey (chair), Dr Gerry Douglas (member).

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COMPLETION DATE

Long term tree improvement programme.

OBJECTIVES

To improve the quality and productivity of the main broadleaved tree species in Ireland and the United Kingdom.

PROGRESS

Plus tree selections took place in a number of species: ash, Spanish chestnut and sycamore. Over 350 ash plus trees have been selected. Most are in clonal genebanks at Kilmacurra in Ireland and at Bradbourne, Kent, in the UK.

Almost 200 sycamore plus trees were identified between 2006 and 2007 in Britain and Ireland. Scion collection is in progress for the establishment of conservation collections and the development of clonal and seedling seed orchards. This approach will lead to a greater improvement in planting stock quality than from using material from registered seed stands alone.

Members of the Spanish chestnut group visited Ireland to compare English and Irish stands and to select new plus trees. Plus trees were selected in Spanish chestnut stands in Coillte forests at Ballyhooley and Kilsheelan; both stands were rated as very high quality and have been registered as seed stands.

Ash and oak seedling seed orchards are being maintained, with individual progeny performance being assessed. Poorly performing individuals will be removed. Consideration is being given to establishing new seedling orchards, depending on mast years and availability of resources. All oak seed orchards were measured during the year (after five growing seasons). Results of the assessments are due for publication in 2008.

Fifteen delegates from Ireland and Britain attended the BIHIP study tour to Denmark in September to see broadleaved breeding programmes, compare progress and to create linkages with Danish work.

OUTPUTS

Work is well advanced on the new BIHIP website which is due to go live in early 2008. Plans are also well advanced for a new plus tree BIHIP database. This resource will contain the unique tree numbers of all plus trees identified in the seven species groups, as well as location, quality, sex, dimensions, ownership, etc. It will be updated as new plus trees are identified across the species range.

ACTIVITIES PLANNED

Work in 2008 will focus on continuation of the improvement work programme in the species groups. Most groups have put in place performance plans and targets. During 2008 work will commence on preparing breeding strategies for each group.

BIRCH

Selection and improvement of Irish birch and alder

PROJECT TEAM
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COMPLETION DATE
December 2008

OBJECTIVES
The overall objective is to provide improved planting stock of native tree species, given the increase in their use in recent years. The project continues the native birch improvement that began in 1998, with the addition in 2005 of work on alder (*Alnus glutinosa*).
Specific objectives of the current phase of work include:

- testing of the genetic diversity of Irish birch, with a view to selecting lines suitable for afforestation, by assessment of established field trials for productivity and form;
- selection of new superior birch phenotypes, with emphasis on *Betula pendula*, for inclusion in the improvement programme;
- identification of superior stands of Irish birch for registration as seed stands;
- selection of superior alder phenotypes, with a target of 200 trees in total;
- development of an alder clonal genebank to conserve the collected material;
- initiation of alder progeny trials to test the progeny of the selected plus-trees.

PROGRESS
Birch
Three birch breeding seedling orchards were established in 2001. Height and diameter were assessed at planting and after one, two, four and six growing seasons. Stem quality was measured, using a qualitative scale, after four and six growing seasons. During 2006/07 at the Castletown site both birch species had an annual height increment of about 0.87 m/yr. At Ballyredmond annual height increment was 0.80 and 0.78 m/yr for *B. pendula* and *B. pubescens*, respectively. Results indicate that there are differences in performance between the different groups: species/provenance/progeny. For example, Figure 1 demonstrates height variation among nineteen *B. pendula* provenances. New individuals have been earmarked for inclusion in the programme but *B. pendula* plus trees are scarce.

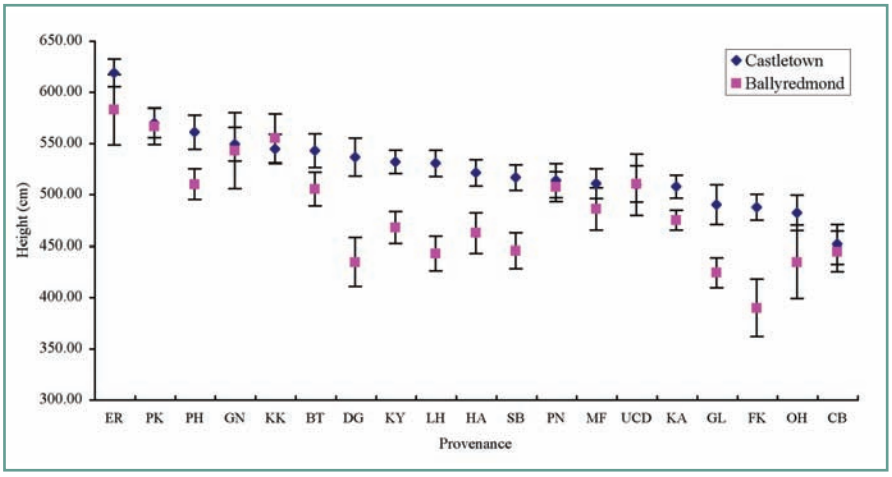

Figure 1: The mean height (cm ± se) of 19 *B. pendula* provenances after six years growth at two sites (Castletown and Ballyredmond).

Figure 2: Alder seedlings from selected plus trees at Teagasc, Kinsealy, Co Dublin.

Alder

Seed collected from alder plus trees in 2006 was germinated and grown-on for the establishment of progeny trials in 2008. About 70 new alder plus trees have been identified to add to 88 collected in 2006. Grafts of 73 of the original 88 are now available to initiate a clonal genebank to conserve collected material.

ACTIVITIES PLANNED

The best trees from the best families in the birch trials will be grafted to establish a birch seed orchard in each species. Grafts from the newly located birch plus trees will be added to the programme. Growth and quality will be assessed in the birch trials.

Three to four alder progeny trials will be established early in 2008. Grafts of newly selected alder will increase the genetic base of the improvement programme in the species and provide more material for the clonal genebank.

OUTPUTS

The two birch sites were visited by the Growing Broadleaves Review Group and a short report was prepared on each of the sites.

EUFORGEN

European Forest Genetic Resources Network

PROJECT TEAM

National Co-ordinator: John Fennessy, COFORD*
Species Networks:
Conifers: Alistair Pfeifer, Coillte;
Scattered broadleaves: Elaine O'Connor, University College Dublin;
Stand-forming broadleaves: John Fennessy, COFORD.
Thematic Networks:
Forest management: Noel Foley, Forest Service;
National Focal Point (EUFGIS Project): Cathal Ryan, Forest Service.

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COMPLETION DATE

This is an ongoing programme, with Phase III scheduled for completion at the end of 2009.

OBJECTIVES

The European Forest Genetic Resources Programme (EUFORGEN) was established in 1994 as an implementation mechanism for Resolution S2 (Conservation of forest genetic resources) of the first Ministerial Conference on the Protection of Forests in Europe (MCPFE) in 1990. EUFORGEN is co-ordinated by Bioversity International (www.bioversityinternational.org) and has participants in over 30 European countries. The programme operates through networks in which policy-makers, scientists and managers agree work programmes, exchange information and identify needs and priorities to enhance pan-European collaboration on forest genetic resources. In Ireland the programme is serviced by COFORD, in co-operation with the Forest Service.

PROGRESS

EUFORGEN Networks are developing common action plans for target tree species to strengthen gene conservation efforts on a pan-European basis. The action plans aim at sharing of responsibility for forest genetic resource conservation among European countries. During 2007 the EUFGIS (Establishment of a European Information System on Forest Genetic Resources) project, co-ordinated by Bioversity International and co-funded by the European Commission under the Council Regulation (No. 870/2004) on genetic resources in agriculture, initiated the development of an information system for dynamic gene conservation units of forest trees in Europe.

OUTPUTS

The fifth steering committee meeting, at Novo-mesto, Slovenia, reviewed progress of the EUFORGEN programme in mid Phase III (1 January 2005 - 31 December 2009) and discussed the outcomes of the MCPFE, addressing updates on activities and their implications to the EUFORGEN work programme.

The second Stand-forming Broadleaves[1] network meeting in Novi Sad, Serbia, progressed the common action plans for stand-forming broadleaves. Reports were presented on the development of technical guidelines for stand-forming broadleaves.

In October 2007, the focal points met representatives of the EUFORGEN Networks, invited speakers and the project partners at a workshop in Birkerød, Denmark. The workshop discussed the present documentation efforts of the gene conservation units in Europe, identified future needs and made recommendations for the development of the EUFGIS information system. The third meeting of the Forest Management Network was held at Rovaniemi, Finland.

ACTIVITIES PLANNED

Meetings are scheduled for all networks in 2008.

[1] *Stand-forming broadleaves are species such as oak and beech that are generally found as pure stands in their natural range throughout Europe.*

OAKPROV

Establishment of Irish oak seed stand and progeny trials

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COMPLETION DATE
June 2007

OBJECTIVES
The objective of this project is to establish a series of field trials to test both the quality of Irish oak seed stands as well as the offspring of some of the phenotypically selected plus trees (referred to as progeny tests) on a range of sites across the country. The results will identify the best seed stands for the production of home-collected seed as well as the best individuals for use in further breeding work. Their performance will also be compared with provenances from other parts of Europe and the UK and these overseas lots will be used as controls.

PROGRESS
Three field trials were established in spring 2006 at the Manch Estate (Co Cork), the Tullynally estate (Co Westmeath) and None-so-Hardy Nurseries (Co Wicklow). Survival was good. Height was assessed at the time of planting and at the end of the first growing season in each trial. Early results suggest that the progeny test material grew best but they had the added benefit that they were planted with the protection of tree guards. The None-so-Hardy site was the best overall, probably because it was kept completely weed free. Imported bare-root plants grew least; the tallest (90 cm +) German sources were the poorest performers, with many plants having to be replaced.
Damage and losses due to hares, competing vegetation and herbicides occurred in 2007.

ACTIVITIES PLANNED
This project covered the establishment phase of these trials and is now complete. A project proposal to continue the maintenance work on these trials is in preparation.

Oak seedlings in the nursery prior to being planted out in the field trials.

QUALIBROAD

Improving the uniformity and quality of broadleaf planting stock

PROJECT TEAM
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COMPLETION DATE
December 2008

OBJECTIVES
The overall aim is to improve seed germination, plant growth and planting stock quality in important broadleaf species, with the objectives:

- to develop pretreatments and storage methods to improved seed germination;
- to assess sowing date, seedbed covers (mulches, cloches, windbreaks), mini-plug transplanting and fertiliser amendments on seedling growth and quality.

PROGRESS
Research on oak acorns continued in 2007. The effect of freezing stress and moisture content (MC) on acorn viability was assessed in one study. In another study, the effect of drying and soaking treatment on seedling emergence and plant quality was assessed in the nursery. The results confirmed that the yield and quality of seedlings increased in beds sown with acorns that received this new pretreatment, compared with beds sown with acorns given the standard (dried only) treatment.
Work on ash involved experiments to evaluate the effects of priming, freezing and chilling pretreatments on laboratory germination. Ash seeds have a complex dormancy mechanism, requiring a warm phase, followed by a cold phase to break dormancy. Ash seeds responded better to warm phase treatments than to chilling, suggesting that the warm phase is more critical in dormancy development and release. The results also suggest that a longer warm phase may reduce the sensitivity of the seeds to post-germination temperatures.
Data from both the oak and the ash experiments are being analysed.

ACTIVITIES PLANNED
Research on ash and oak seed will be completed by mid-2008. Research on rowan (*Sorbus aucuparia*) and spindle tree (*Euonymus europaeus*) seed will commence in 2008. New field experiments are planned to assess the potential for using a miniplug system for transplanting alder seedlings, with the main aim of increasing the yield of planting stock from nursery beds. Miniplug seedlings will be grown in Sweden from seeds supplied from Ireland.

OUTPUTS
De Atrip, N. and O'Reilly, C. 2007. Effect of seed coverings and seed pretreatments on the germination response of *Alnus glutinosa* and *Betula pubescens* seeds. *European Journal Forest Research* 126: 271-278.

De Atrip, N. and O'Reilly, C. 2007. Germination response of alder and birch seeds to applied gibberellic acid and priming treatments in combination with chilling. *Annals Forest Science* 64: 385-394.

O'Reilly, C. and De Atrip, N. 2007. Seed moisture content during chilling and heat stress effects after chilling on the germination of common alder and downy birch seeds. *Silva Fennica* 41: 235-246.

De Atrip, N., O'Reilly, C. and Bannon, F. 2007. Target seed moisture content, chilling and priming pretreatments influence germination temperature response in *Alnus glutinosa* and *Betula pubescens*. *Scandinavian Journal Forest Research* 22: 273-279.

SEEDSTANDS

The national catalogue of seeds

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COMPLETION DATE
The national and EU seed stand listings are reviewed and updated at the end of each calendar year.

OBJECTIVE
- To provide adequate forest reproductive material for the national forestry programme based on the best adapted home sources.

PROGRESS
During 2007 new seed stands for the main commercial species were registered and work also continued on registering stands of species for the Native Woodland Scheme. Spanish chestnut was included for the first time in 2006 (see BIHIP) and a further stand of Spanish chestnut was added in 2007.

A significant area of broadleaved seed orchard has been established since 2003. This includes both clonal and seedling selected material and is categorised under the EU Forest Reproductive Material Directive as 'qualified'. Seed production commenced in both alder and birch seed orchards, with small commercial quantities collected. These orchards have been included in the current national list.

Since the 1970s an active Sitka spruce breeding programme has been ongoing and from an original collection of over 550 plus trees, 86 have been proven in field trials to have superior growth and quality characteristics. The parents of this material are retained at Kilmacurra and are now classified as 'tested' material in this year's National Catalogue. For the purpose of commercial production of this improved Sitka spruce a number of hedge orchards have also been established at Coillte nurseries at Aughrim and Camolin and have been added to the National Catalogue.

ACTIVITIES PLANNED
Broadleaved seed production was prolific in 2007 and oak seed requirements were fully satisfied by home-collected sources for the first time in the recent past. In order to further develop the full potential from Irish-sourced forest reproductive material from the seed stand resource it is proposed to establish a series of Pilot Management Plots in selected seed stands over the next three years.

OUTPUTS
The 2007 national and EU listings were completed (the current area of seed stands is shown in Table 1).

Cahalane, G., Doody, P., Douglas, G., Fennessy, J., O'Reilly, C. and Pfeifer, A. 2007. *Sustaining and developing Ireland's forest genetic resources - an outline strategy.* COFORD, Dublin.

Table 1: Area of seed stands as of 31 December 2007.

SCIENTIFIC NAME	COMMON NAME	AREA (HA)
Acer pseudoplatanus	Sycamore	7.0
Alnus glutinosa	Common alder	110.0
Betula pubescens	Common birch	26.0
Castanea sativa	Spanish chestnut	8.6
Fagus sylvatica	Beech	80.3
Fraxinus excelsior	Ash	155.8
Quercus petraea	Sessile oak	1381.3
Quercus robur	Pedunculate oak	737.9
Larix decidua	European larch	7.9
Larix x eurolepis	Hybrid larch	2.9
Larix kaempferi	Japanese larch	48.6
Picea abies	Norway spruce	439.4
Picea sitchensis	Sitka spruce	633.6
Pinus contorta	Lodgepole pine	13.0
P. nigra var. maritima	Corsican pine	63.1
Pinus radiata	Monterey pine	21.7
Pinus sylvestris	Scots pine	131.2
Pseudotsuga menziesii	Douglas fir	123.3
Abies procera	Noble fir	59.9
Thuja plicata	Western red cedar	8.9
Taxus baccata	Yew	33.1
Mixed species		36.0
TOTAL		**4129.5**

XMASFIR

Trial of Danish noble fir Christmas tree sources

PROJECT TEAM
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COMPLETION DATE
March 2008

OBJECTIVES
The objective of this project is to establish a series of field trials of Danish seed sources of noble fir in commercial Christmas tree farms around the country. Sources will be planted in replicated field experiments.

PROGRESS
Seed was obtained from eleven different sources, including eight Danish noble fir sources, known to produce high quality trees that have not been previously tested here, together with one previously untested Irish source and two sources used in an earlier trial, to allow a comparison between the two series of trials.
Plants were grown for one year in pots, which were subsequently lined-out in a nursery bed for the second growing season. In the spring of 2007 plants were lifted and used to establish five trials (including one in Northern Ireland).

ACTIVITIES PLANNED
In spring 2008 survival and growth will be assessed in all trials after the first growing season in the field. Dead plants will be replaced. A report will be prepared on the establishment of the trials which will complete the project. A new proposal will be prepared to cover assessment after three years and prior to harvest.

One-year-old noble fir Christmas tree trial.

Silviculture

Until recently Irish silviculture was developed for the commercial production of large volumes of fast growing conifer timber, grown on a plantation system and predominantly managed by clearcutting and reforestation. Today, however, forest managers are required to deliver a greater diversity of products and services from forests and, as a consequence, a wider range of silvicultural techniques and systems are required to enable them to manage their forests in a multifunctional way.

Three silviculture projects are addressing key issues facing foresters today namely:

- the establishment and management of a broadleaf resource that is economically sustainable;
- the necessity to maintain continuous forest cover in sensitive areas with high biodiversity, landscape and recreation values;
- options to redesign western peatland forests with emphasis on enhancing greater environmental and social benefits.

Since the start of the afforestation programme in the early 1920s, emphasis has largely been placed on growing of conifers. This was in response to the poor quality land that was available for forestry and the superior productivity of conifers over the native broadleaved species. Conifer silviculture is therefore well developed but with broadleaves today forming approximately 30% of the annual planting programme there is a need to provide management guidance based on sound scientific silvicultural practice. The BROADFORM project aims to address particular problems regarding the early growth and form of broadleaf plantations, so that they are managed in a way that will ensure that they are productive and will provide quality timber, thus making them more economically viable.

In Ireland, commercial forestry practice is based on a clearfelling and reforestation silvicultural system as the principal means of managing plantations for efficient timber production. This system has proven to be very successful. Today, however, with increasing emphasis on environmental and social aspects of forests, an expanded range of tools is required to deliver multifunctional outputs from forests. Less intensive, alternative silvicultural systems – called 'low-impact' or 'continuous cover' systems – practised in many European countries, have the potential to deliver these outputs, particularly for sensitive sites. The CONTINUCOVER project is evaluating the potential of these systems in Ireland.

Large areas of conifer plantations were established in the west of Ireland from the late 1950s to the end of the 1980s. Some of these plantations have proven to be uneconomic due to low productivity, and environmental concerns have been raised regarding impacts of forest operations on peat soils and water courses. However, as these plantations mature and are harvested there is now an opportunity to redesign them in a way that will enhance their environmental and social benefits for the future. The REDAREAS project is a multi-disciplinary approach to examine environmental and economic aspects of peatland forestry with the view to providing guidance on future alternative management options.

The projects included in this thematic area are:

- **BROADFORM**: Silviculture of new broadleaved plantations: shaping and thinning.
- **CONTINUCOVER**: An evaluation of continuous cover forestry in Ireland.
- **GBREVIEW** – Updating the COFORD publication *Growing Broadleaves* originally published in 1998.
- **REDAREAS**: Management options for forests on western peatlands.

BROADFORM

Silviculture of new broadleaved plantations: shaping and thinning

PROJECT TEAM
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COMPLETION DATE
December 2008

OBJECTIVES
To develop treatment protocols for the early management of broadleaved species to include:

- shaping methods to improve stem form up to 3 m;
- development of tending practice to favour the best quality stems.

PROGRESS
The final report was submitted to COFORD in November 2007. As a result of the BROADFORM project, the following shaping protocols have been produced:

Ash, sycamore and beech shaping protocols

- Shape when most stems are within the 1 – 2.5 m height range.
- If possible, shape again when the taller stems are 2.5 – 4 m in height.
- Shape only those stems above average height.
- Shape only potentially good quality trees.
- Shape approximately 30 – 35% of stems (800 – 1100/ha) during the first operation as required.
- During the second operation shape 700 – 800/ha of the stems already shaped as required.
- Shape from the leader downwards.
- Concentrate on removing branches derived from nodes and whorls.
- Remove incipient forks.
- Remove co-dominant branches if competing with the leading shoot.
- Remove disproportionately large branches.
- Half of the foliage can be removed without affecting growth.
- 80% of foliage can be removed from potentially good trees or those occupying canopy gaps.
- Shape in early June and July by preference, or else during the winter, i.e. November or December.

Oak shaping protocol
Oak is a difficult tree to shape due to the frequency of disproportionately large branches, forks, death of the leading shoot, and the development of a multiplicity of twiggy shoots with no discernible leader. Because some young oak retain their leaves during the dormant season, care should be taken in examining the stem for branches that may be concealed by the leaves.

- Shape at least 50% of stems on first shaping as required.
- Avoid shaping stems of very poor quality.
- For forked stems with a distinct leader, favour the side of the fork with the leading shoot.
- Pay particular attention to the removal of disproportionately large branches from the lower stem.
- Where the stem has lost its leading shoot and has developed a multiplicity of green shoots, there is little advantage in shaping.
- Where the shoots have lignified it is worthwhile to select the strongest and remove the rest.
- Shape any time except February and March.

The results from the project suggest that shaping should be carried out frequently, possibly biennially, to ensure that defects formed on latter years' growth do not reduce stem quality.

Ash pre-commercial thinning protocol
A pre-commercial thinning protocol for ash has been produced as a result of a literature search,

discussions held during COFORD field tours, and previous BROADFORM results. The precursor to this protocol was developed by BROADFORM staff during the Teagasc in-service training workshop, held in Donegal, November 2006.

- Select, and permanently mark, 300 – 400 Potential Crop Trees (PCT) per ha (12 – 16 stems in a 20 x 20 m plot)
- PCTs should be selected on the basis of:
  - Disease-free: no canker present.
  - Stem form: aim for 6 m of straight defect-free stem, then 5 m, then 4 m, etc.; no forks, no large branches.
  - Vigour: favour the more vigorous trees.
  - Distribution: aim to select at least one (preferably 2 or more) PCTs in each 10 x 10 m area.
- Retention of possible hurley butts may be considered.
- Select 1 – 2 stems per PCT to be removed.
- Select on the basis of: diseased; competing in the canopy with a PCT.
- Occasionally a stem selected as a PCT may need to be selected for removal due to competition with a more favourable neighbouring PCT stem.
- Wolves can be removed assuming that no more than 800 stems/ha in total are removed.
- Prune selected PCTs as required.

The removal of the stems selected for thinning will result in the greatest benefit to the potential crop trees. It should also be noted that the protocol does not include the introduction of extraction racks (racks 1:7 lines would remove approximately 500 additional stems/ha), although the protocol can be easily modified to take this into account. Extraction racks were not included in the protocol because the thinning is to be carried out manually and extracted with a quad or other suitable small-scale method. The majority of ash sites have insufficient numbers of quality sawlog PCTs to enable extraction racks to be installed at this stage. It is envisaged that extraction racks may be installed during the second thinning operation when it will be clearer which trees are likely to be final crop trees.

Discussion on thinning of ash.

ACTIVITIES PLANNED

- Conduct extension/outreach activities and ancillary activities related to the COFORD broadleaf forestry programme;
- Monitor the BROADFORM thinning sites and additional sites as applicable;
- Carry out final measurements of the poplar clonal trials;
- Initiate a thinning trial/demonstration in the Arklow Millennium woodland;
- Establish a pilot field study on the silvicultural management options for poor quality broadleaf plantations;
- Networking and fact-finding missions regarding state-of-the-art of broadleaf spacing trials, establishment of broadleaf mixtures, broadleaf thinning, agroforestry, shaping and pruning of broadleaves, and management of poor quality broadleaf stands.

OUTPUTS

Participation in the review of *Growing Broadleaves.*
Presentation at the Wood Energy 2007 demonstration at Stradbally, 20 June.
Presentation of the ash thinning demonstration, organised by ITGA, COFORD, FDA, SIF and Teagasc thinning, at Kilmeague, Co Kildare, 6 July.
Final report submitted to COFORD.
Dr Ian Short participates in COST Action E42: Growing Valuable Broadleaved Tree Species.

CONTINUCOVER

An evaluation of continuous cover forestry in Ireland

PROJECT TEAM
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Donal O'Hare, Field forester
Robert Tottenham, Forest owner

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COMPLETION DATE
December 2009

OBJECTIVES
- To assess the survival and growth of a number of tree species under various levels of canopy cover;
- To monitor throughfall, temperature, and rate of nutrient turnover (C and N) under these canopies;
- To establish plots to demonstrate the implementation of alternative silvicultural systems to clearcutting.

PROGRESS
An experiment was established in a pure Sitka spruce stand (planted in 1965) at Ballinagappoge in Aughrim Forest, Co Wicklow, in 2002. The main conclusion from this work is that understorey light levels in mature Sitka spruce canopies are too low to allow all but the most shade-tolerant species to survive.
A shadehouse experiment was established at UCD in 2002 to explore the impact of shade on the morphology, physiology and photochemistry of *Picea sitchensis, Larix* x *eurolepis* and *Thuja plicata* under controlled conditions.
A demonstration was established at Mount Callan in 2002 whereby four 20 m diameter coupes were opened in two Sitka spruce stands. Part of each coupe was seeded with Sitka spruce from the Coillte Seed Centre, Ballintemple, and compared with unseeded controls. Ground surface scarifying and fencing were also examined. Eight plots have been established. To date, successful regeneration has not been obtained.
A section of a pure Sitka spruce stand (planted 1975) adjacent to the Ballinagappoge site was selected to demonstrate diifferent approaches to thinning in a stand managed for continuous cover.

ACTIVITIES PLANNED
The growth and development of the stand within the demonstration plot at Ballinagappoge will be monitored for the occurrence of regeneration.
Mount Callan will be established as a demonstration forest for continuous cover forestry, to allow an examination of different thinning systems as part of the transformation process to continuous cover forestry. In addition, a plot established according to the principles of Association Futaie Irrégulière (AFI)[1] will be established.

OUTPUTS
Kennedy, S., Black, K., O'Reilly, C. and Ní Dhubháin, Á. 2007. The impact of shade on morphology, growth and biomass allocation in *Picea sitchensis, Larix* x *eurolepis* and *Thuja plicata. New Forests* 33: 139-153.

[1] *AFI is a French association, set up in 1991 by a group of private forestry consultants to promote the management of irregular-structure stands.*

GBREVIEW

Review of *Growing Broadleaves*

PROJECT TEAM

Editorial Committee:
Prof. Jürgen Huss
Prof. Padraic Joyce
John Fennessy*

Working Group:
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Dr Ian Short
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COMPLETION DATE

December 2008

OBJECTIVES

Since it was first published by COFORD in 1998, *Growing Broadleaves* has become the most widely used source for broadleaf silviculture and management in Ireland. The main objective of this phase of work is to review and update the publication based on research and practical experience gained with establishing and managing broadleaves in Ireland in the decade since 1998. The work will also greatly expand the number of species covered.

PROGRESS

Meetings of the Editorial Committee and the Working Group took place during 2007. Studies and evaluations were undertaken, combined with field visits to many stands during the year. A working draft of the second edition was completed.

OUTPUTS

A postgraduate study on Quantifying the development of oak/Scots pine and oak/European larch stands in Ireland was completed at Albert-Ludwigs University in Freiburg as part of the book review. The results will be presented in a COFORD Connects note in 2008.

ACTIVITIES PLANNED

It is anticipated that the second edition of *Growing Broadleaves* will be completed in 2008, to be launched at an international conference on broadleaved silviculture.

REDAREAS

Management options for forests on western peatlands

PROJECT TEAM
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Martin Brennan, Contract zoologist
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COMPLETION DATE
March 2008

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OBJECTIVES
This project aims to develop and demonstrate alternative management options on western peatland forests. A vision for peatland forests is that their primary objective will no longer be purely roundwood production but they will move towards delivering multiple objectives, with a strong emphasis on environmental services, including water protection, landscape and biodiversity. In realising this vision, it is necessary to explore different options for cost-effective regeneration, species choice and forest design.

PROGRESS
- *Assessment of factors affecting native tree natural regeneration*: Detailed analysis has been conducted and models have been developed to predict the extent of natural regeneration, based on site factors, for birch, holly, rowan and willow.
- *Retrospective field survey of natural regeneration potential*: Assessment of natural regeneration on recently felled areas has shown that it occurs sporadically and is difficult to manage. Fourteen sites were assessed, with regeneration occurring at only four.

A view of woodland at Loughaunierin, Co Galway, taken from the southwest - the main species in the canopy is birch.

- *Biomass trial assessments*: Biomass trials planted in 1979-1983 show the consequence of not re-spacing where there is prolific natural regeneration of south coastal lodgepole pine. With a current top height of 15 m and an average DBH of 11 cm, sawlog dimensions are unlikely to be attained, with energy wood and stakewood the expected end uses.
- *Review of existing broadleaf scrub cover*: While willow is the most commonly occurring species, there may be potential to establish birch, holly and rowan on shallower peats with a depth of less than a metre or so, providing grazing can be controlled.
- A summary protocol for alternative regeneration options is being developed, based on current understanding; further development is expected following research currently underway.
- A review of blanket bog restoration showed that success depends on having deep peat on relatively flat ground, preferably with young or poor crops, where the tree canopy has not closed and where bog vegetation exists. Where the canopy has closed, restoration will occur more slowly and will require tree removal, windrowing of brash and drain blocking will be required.
- A report on the effect of riparian enhancement during pre-clearfelling as a water quality protection measure is in preparation.
- *Riparian vegetation recovery following clearfelling*: successful vegetation recovery in riparian zones occurs in less than three years on mineral rich areas and over longer periods in mineral poor areas.
- Establishment and monitoring of broadleaf trial plots is ongoing. The trees are not yet at the free growing stage and further assessments are required. Birch, rowan and willow have shown the best survival rates so far.
- *Mammals and avifauna survey*: The diversity of birds and mammals was higher in more structurally diverse and habitat rich forest. A total of 59 bird species and eight mammal species were recorded during the surveys.

ACTIVITIES PLANNED

Reports will be finalised on the effectiveness of pre-clearfelling for riparian enhancement and water protection, and on alternative regeneration options.

A view of an unplanted and ungrazed riparian zone dominated by soft rush approximately 10 years after clearfelling.

Prolific natural regeneration of south coastal lodgepole pine at Lapallagh forest, Co Mayo.

Forest Planning and Management

PLANSFM

Programme leader: Prof. Maarten Nieuwenhuis

Two major changes that have taken place in Irish forestry have increased the complexity of forest management (planning). The first has been the introduction of Sustainable Forest Management (SFM) as the national standard. This requires taking into account relevant economic, social and environmental indicators during decision-making. This in turn necessitates the availability of a wide range of data and systems to collect, analyse and incorporate the information in management (planning) decision-making procedures. It has also introduced a need to widen the range of silvicultural and management practices, including the use of mixtures, diverse species, continuous cover systems and retention.

The second major change has been the increase in private forestry, resulting in the need for private owners and management companies to get access to tools to collect, store, analyse and use the information necessary for the management of their estates.

The PLANSFM programme consists currently of research projects that deal with a wide variety of data sources, data collection methodologies and data analysis methods. The programme objective is the production of information and decision-support systems required for the optimal and sustainable management of the Irish forest estate, both in the state and private sectors.

The projects all have an important involvement by University College Dublin (UCD), where a programme manager and a post-doctoral programme statistician will facilitate the co-ordination and integration of the research activities and optimisation of outputs and results. The UCD-based programme and project teams will create a critical mass of forest management (planning) expertise, which will facilitate the development of research proposals and involvement in further national and EU-funded research programmes.

Most of the industrial project partners have had previous involvement in forest research and have been selected based on their specific expertise. Several partners are involved in multiple projects, again facilitating the co-ordination of the programme.

The PLANSFM programme comprises the following projects:

- **FORESTSCAN**: Terrestrial laser scanning technology for multi-resource forest inventories.
- **NATFOREX**: The establishment of a national resource of field trials and a database for forest research and demonstration.
- **PRACTISFM II**: Implementation, communication and optimisation of the PractiSFM tool.
- **STANDMODEL**: Development of dynamic yield models for conifers, broadleaves and mixtures.
- **TREEMODEL**: Development of single-tree volume models and stem profile models.

In addition to the PLANSFM programme, this thematic area includes **CLUSTER**, a stand-alone project examining a cluster-based approach for identifying farm forest resources to maximise potential markets.

PLANSFM

FORESTSCAN

Terrestrial laser scanning technology for multi-resource forest inventories

PROJECT TEAM
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COMPLETION DATE
December 2011

OBJECTIVES
- An investigation of the basic principles of terrestrial laser scanning technology and its applicability to (multi-resource) forest inventories.
- An evaluation of existing data analysis software for forestry applications. Development of new software for a range of applications will be investigated.
- A cost-benefit analysis for the introduction and use of this technology over a range of potential inventory applications.

PROGRESS
Following the development of a detailed field work methodology, the first phase of the field work began in September 2007 with the selection and measurement of 20 experimental plots in Cos Laois and Waterford. This initial phase of measurement and scanning is focusing on mature coniferous crops approaching or at final harvest stage.
Each 15 m radius circular plot has been carefully set up with a detailed tree numbering system so that all manual and scanner measurement data compiled are accurately referenced and directly comparable. Each plot has been measured manually using traditional mensuration techniques (dbh, upper stem diameter (at 2.0 m) and total height) prior to laser scanning. Each plot is scanned at least once, with additional scans being taken in some plots depending on the level of stem occlusion and lower stem branching. Following scanning, a 10% sub-set of stems in each plot was felled and measured. The stem diameter of each felled sample tree has been measured at 50 cm intervals from base to tip in order to compile a detailed stem profile. Total height and crown height have also been recorded. The initial standing tree measurement and laser scanning is completed for the first 20 plots and the felled sample tree measurements are currently being completed.
The independently compiled data sets will be submitted to UCD for processing and comparative analysis. The primary focus of this initial analysis will be to make direct comparisons between timber measurement results from conventional mensuration techniques and developing laser scanning systems.

ACTIVITIES PLANNED
Research in 2008 will focus on the analysis of the initial 20 plots and the selection, measurement and scanning of a second phase of 30 to 40 plots. While it is planned to include different crop age classes and species classes in this phase of work, the selection of stand types will be somewhat dictated by the initial results from the analysis of the first 20 plots.
As field work progresses and comparative data sets are compiled, the team will begin to assess the potential for laser scanning technologies to measure additional tree, crop and environmental parameters, outside the scope of conventional mensuration techniques.

PLANSFM

NATFOREX

Establishing a national resource of field trials and a database for forest research and demonstration

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COMPLETION DATE
October 2013

OBJECTIVES
To maintain and manage a national network of field trials for the scientific study and demonstration of silvicultural and forest management treatments through:

- evaluating the relevance of existing trials in the Coillte experimental plot network and in the research sections of other organisations (Teagasc, NPWS);
- deciding on the feasibility of the analysis of the existing data and on the benefits of further data collection in the existing experiments, and on the need to establish new trials;
- carrying out necessary maintenance work on key field trials to improve access, signage and labelling, and to update the thinning and management status of the trials and to implement and continue the experimental treatments;
- collecting new data in trials where the development of the stand and the research objectives of the specific trial require this;
- integrating the findings and data from the trials into a publicly accessible database, in which the information from the relevant (active and closed) field trials, consisting of all details of the experimental site, the experimental design and the treatments and all available collected data and any analysis results that have been produced, is pooled with findings from a wide range of forestry related disciplines.

ACTIVITIES PLANNED
The project team will start to progress the inventory and evaluation of the first sets of experiments and the associated data. After evaluation decisions will be made on the maintenance and management of experiments. A start will be made on the database design and populating the database with data from approved experiments. Membership of NOLTFOX will be activated and data will be incorporated in the NOLTFOX[1] database.

OUTPUTS
Nieuwenhuis, M. 2007. NATFOREX – a national database of forest experiments and research. *Irish Timber and Forestry* 16(4): 20 - 24.

[1] *noltfox.metla.fi*

PLANSFM

PRACTISFM II

PractiSFM: Implementation, communication and optimisation

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COMPLETION DATE
December 2013

OBJECTIVES

- Field testing and validation of the system (the multi-resource inventory procedure and the decision-support component) with the help of management companies. The reporting requirements of those owners/managers who seek forest certification will be included in the validation process;
- Further development of the existing system in co-operation with management companies, including the reporting requirements for certification;
- The introduction of a wider range of management options that move away from the standard, static yield table based thinning and clearfell systems, towards flexible, user-defined management strategies, such as target diameter management, specified cash flow and rate-of-return generation, flexible thinning and rotation classifications, continuous cover management, and other non-standard or multi-resource management practices;
- The development of an optimisation component to the PractiSFM system, including an objective procedure to compare, weight and integrate the owner's objectives and requirements into the mathematical modelling process;
- The development of a communication system, enabling the uploading of PractiSFM management plan information into a central database, allowing for the development of multi-resource production forecasts for the private forest estate and for facilitating the day-to-day business contacts of management companies with the Forest Service in areas such as grant applications, felling licence approval and record keeping;
- The implementation of the completed system in the private forest management sector by providing a training and support service.

PROGRESS
The project started in January 2008. Preparatory work began in September 2007, including familiarisation of team members with the multi-resource inventory methodology and decision support software. The User Manual for PractiSFM has been updated.

ACTIVITIES PLANNED
It is planned to initiate the research work by introducing PractiSFM to the three management companies who are partners in the project. Feedback will be evaluated and, where possible, modifications will be made to the system to enhance its usefulness.
A start will be made with the development of the optimisation module by investigating methods to capture stakeholders' preferences and to translate these into optimisation goals and weights.

PLANSFM

STANDMODEL

Development of dynamic yield models for conifers, broadleaves and mixtures

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COMPLETION DATE
December 2012

Sectional measurement of a felled volume sample in a STANDMODEL Japanese larch plot, near Virginia, Co Cavan.

OBJECTIVES

- Produce new dynamic yield models for Japanese larch (thinned and unthinned) and ash (thinned) and integrate these into the existing Irish Dynamic Yield Model User Interface.
- Investigate the potential for generating growth forecasts for species mixtures using existing model combinations.
- Investigate the potential for utilising National Forest Inventory plot data in validating and strengthening existing dynamic yield models and in generating new ones.
- Develop additional functionality for the Irish Dynamic Yield Model User Interface in the form of user defined assortments, optimisation/goal seeking capability, and facility for mixtures.

PROGRESS

Collection of Japanese larch data

These data will be added to the national forest measurement database managed by Coillte. Data collection will be completed in 2008. Validation data will be collected in 2009. Collection of 2006/2007 data from 100 Japanese larch plots was completed in February 2007. These data have been verified and are now included in the overall database for Japanese larch. Collection of 2007/2008 data from these plots was completed in January 2008. A total of 350 stems from these plots have been marked as volume samples and will shortly be felled and detailed sectional measurement will be undertaken.

Collection of ash data

These data will be added to the national forest measurement database managed by Coillte. Data collection will be completed in 2010. It is planned that a further 3-year period of data collection will follow. A provisional sample of Coillte ash sites

was selected to generate a profile of the types of older and reforestation ash stands that are owned by Coillte. This also provides useful guidance, at an early stage in the project, on issues such as stratification, sampling, experimental design and measurement. A sample of 10 sites was visited and this, along with information from private sector sites, formed the basis of discussion during a week long visit by Dr Lance Broad from New Zealand. During this period a workshop and field day were held by the project team with representatives from linked research work. It was concluded that measurement should continue at the Coillte ash spacing trial at Knocktopher.

A stand selection protocol was agreed. Forty-one ash stands (each to host two plots), across a range of age classes, in Coillte forests were visited to ensure their suitability. In addition, nine ash stands in private ownership were selected, with age classes 1988 and 2000. Data collection from all 50 stands (100 plots) has commenced and will be completed, including volume sample measurement, by mid April 2008.

Japanese larch dynamic yield model

The Japanese larch models will be published in 2009.

Ash dynamic yield model

A preliminary ash model will be published in 2010. It is planned to update the model by 2013.

Development of yield model user interface

The user interface will be updated as new/refined models become available. The two new interfaces will be completed during the lifetime of the project. All updates will be circulated to registered GROWFOR users (see Services and Technology Transfer), with an updated user manual. In addition, user-defined assortments have been developed for Scots pine and lodgepole pine.

ACTIVITIES PLANNED

- 100 ash plots will be established with baseline measurements and a first round of destructive sampling completed in the winter of 2007/2008.
- Sample tree measurement will take place in the 100 Japanese larch plots in February/March 2008.
- There will be continued work on the user defined assortments and those for Scots pine and lodgepole pine will be uploaded into GROWFOR.

OUTPUTS

Nieuwenhuis, M. and Purser, P. 2007. STANDMODEL: Dynamic Yield Models for larch, ash and mixtures. *Irish Timber and Forestry* 16(5): 22 - 23.

Measuring ash in a new STANDMODEL ash plots, near Rathangan, Co Kildare.

PLANSFM

TREEMODEL

Development of single-tree volume models and stem profile models

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COMPLETION DATE
December 2010

OBJECTIVES

- Produce stem profile models for Sitka spruce, Norway spruce, Douglas fir, lodgepole pine, Japanese larch, Scots pine and ash.
- Validate these models with newly collected stem data.
- Describe the different inventory tools available for collecting necessary data for stem profile models.
- Develop recommendations for the integration of stem profile models into everyday private sector inventory and management practice.

PROGRESS

- Stem data provided from the Coillte measurement database will be compiled for analysis. This will be done on a species by species basis as data for some species will take longer to source than others. In particular, data for Japanese larch and ash will not be available until year three of the project. This cleaned database will be retained and made available for other COFORD projects, avoiding the need for future editing by other users. A short handbook to the database will be prepared to inform users. Stem data from the Coillte measurement database are available in several Access databases. These data were checked for inconsistency; missing, inconsistent or incorrect values were recalculated. All the databases have been combined, restructured and converted into the Field-Map database to be available for the StemProfiler software. As Field-Map enables visualization of stem profiles, data were also checked visually. The fully cleaned database will be available for future use by other research projects and there has been strong liaison with the CARBWARE project in this regard.
- Parameterisation of models will be carried out on a species by species basis. Parameterisation of the Sitka spruce model has been completed and is currently being tested with validation data recently collected. Models for other species have yet to be completed.
- Model validation will be carried out on a species by species basis. In collaboration with the FORESTSCAN project, 19 sample plots were established at Clonmel and Mountrath and validation data were collected for the Sitka spruce model. Data has been verified and are available for processing. It is planned to compare results of field measurement for both methods (laser scanner and field-map technology).
- A report will be prepared identifying how stem profile models can be utilised in everyday inventory systems.

ACTIVITIES PLANNED
The parameterised Sitka spruce model will be validated and then made available for use. Work on other species will commence. The integration of the new single models into practical inventory systems will be advanced. There will be further work on the development of a measurement equipment database.

CLUSTER

A cluster based approach for identifying farm forest resources to maximise potential markets

PROJECT TEAM
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COMPLETION DATE
August 2009

OBJECTIVES

- Development of methods to quantify the forest resource and produce a timber forecast at a local level.
- Development of cluster groups where forestry operations can be performed together to minimise cost.
- Development of cluster groups to facilitate combined sale of forest products from many farms.
- Scheduling harvesting to coincide with adjacent harvesting in similar locations based on demand for selected products.

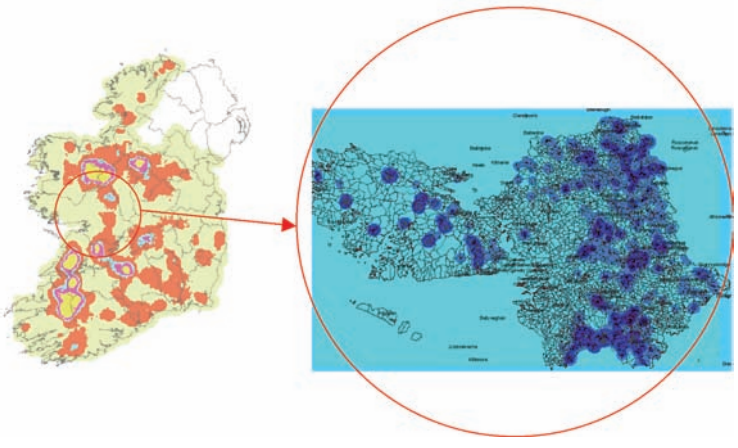
PROGRESS
The project is yielding very interesting results. Development and review of the methodology has been completed. Collation of locations of all farm forests in the study area (size, area planted, location) from the Forest Service database or grant maps is ongoing. Generation of forest clusters has been completed. Evaluation of advanced data captures techniques using aerial photography and Quickbird/IKONOS imagery in the pre-field data capture process is ongoing.

ACTIVITIES PLANNED
Stratification of plantations within clusters for field visit using aerial photography is ongoing. Landowner notification and field data collection will take place. Evaluation of advanced data capture techniques using aerial photography and satellite imagery and LIDAR will also be carried out in 2008.
A workshop to disseminate results is planned for 2008.

OUTPUTS
Farrelly, N. and Clifford, B. 2007a. *Using cluster analysis to identify forest resources.* Poster presentation, Bioenergy 2007, Teagasc Oak Park, Co Carlow, 30 August 2007.

Farrelly, N., Clifford, B. and Green, S. 2007b. *Identifying forest resources using GIS cluster analysis.* The Irish Scientist Yearbook, Oldberry Publishing, Dublin.

Forest density analysis performed for farm forest plantations in Co Galway is used to identify farm forest concentrations.



GIS cluster analysis used to locate large concentrations of farm forest plantations in Ireland, with more detailed analysis of Co Galway (circled).

Forest Economics and Policy

FORPOLEC

Programme leader: Dr Áine Ní Dhubháin

The policy arena in which forestry operates has changed dramatically in recent years. Increasingly, the public benefits that forestry delivers, such as recreation, landscape, water quality, biodiversity and carbon sequestration, are being recognised. Furthermore, the range of tradable goods and services generated in the forestry sector has expanded beyond timber production in Ireland to include, inter alia, cut foliage and marketed recreational activities. New policy initiatives such as the Rural Development Programme, the introduction of the Single Payment Scheme as part of Common Agricultural Policy Reform, the on-going review of the National Climate Change Strategyalong with the downturn in the construction sectormay all influence forestry. Alongside these policy initiatives is the need to meet the afforestation targets as laid down in the Government's strategic plan for forestry.

The FORPOLEC programme consists of three projects which set out to address some of the issues arising from this changing policy environment, including:

- How policy changes are likely to affect afforestation levels and planting objectives of farmers. The FIRMEC project will explore how policy changes are likely to affect afforestation levels using the RERC-FAPRI farm-level model. This will be expanded to include forestry and will be used to determine the optimum enterprise mix for each farmer subject to given constraints such as the availability of land and labour. The project will also identify the socio-economic characteristics of farmers who planted trees in the past. The POLFOR project will survey farmers to explore their reactions to the changing policy environment and to determine their planting intentions. The combination of the outputs of both projects should help to identify strategies to encourage afforestation by farmers in the context of the changing policy environment.
- The need to place a value on public goods provided by forestry. The FORECON project will explore the interaction between different approaches to forest management and the values assigned to recreation, biodiversity, landscape, water quality and carbon sequestration. The FIRMEC project will focus on modelling the demand for recreation using existing Teagasc data sets and the Teagasc RERC-SMILE model. The model will also identify where the demand for recreation in farm forests exists. The combination of both outputs will facilitate the generation of cost-benefit analysis of forestry recreation.
- The impact of forestry on regional and local economies. FORECON will estimate the value of all of the tradable goods of forestry. Input-output analysis will be used to calculate the direct and indirect contributions of tradable goods and services to national, regional and local economies. The FIRMEC project will project future afforestation levels under a variety of scenarios using the Teagasc RERC-FAPRI forestry model. The outputs of this process will feed into the input-output model to explore the economy-wide impacts of these scenarios (FORECON). The Teagasc RERC-SMILE microsimulation model, which contains a spatial and micro picture of where economic activity takes place in Ireland, will be used to identify the local impacts of these scenarios (FIRMEC).

The FOREPOLEC programme comprises the following projects:

- **FIRMEC**: Modelling the economics of forestry in Ireland.
- **FORECON**: An economic evaluation of the market and non-market functions of forestry.
- **POLFOR**: Forestry in a changing policy environment.

FORPOLEC

FIRMEC

Modelling the economics of forestry in Ireland

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COMPLETION DATE
December 2010

OBJECTIVES
This project assesses the actual and potential contribution of forestry to the national, regional and local economy, in terms of both tradable goods and services and in terms of public goods, as well as building up the capacity to assess the impact of policy reforms on the sector and assess its impact on the wider economy.

ACTIVITIES
Project commences in January 2008.

FORPOLEC

FORECON

An economic evaluation of the market and non-market functions of forestry

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COMPLETION DATE
June 2011

OBJECTIVES

- Provide strategic information by indicating the relative benefits of forest management practice directed at the outputs of recreation, biodiversity, landscape, water quality and carbon sequestration;
- Estimate the relative public benefits of public forestry and private forestry, including farm forestry;
- Determine the direct and indirect contributions of the tradable goods and services of forestry, including timber, game hunting, a small number of marketed leisure activities, cut foliage and forest food (berries and mushrooms) to the national, regional and local economies;
- Demonstrate the net public benefit of forestry in comparison with other land uses;
- Examine those factors which determine public benefits and determine if benefit transfer estimates from international literature are applicable to Ireland;
- Place values in a public cost-benefit framework by comparing policy cost with the social benefits and combine this information with the private costs and benefits motivating forestry uptake over time.

PROGRESS
Work has concentrated on reviewing the literature on valuing the non-market benefits of forestry and on reviewing work completed to date in this area.

ACTIVITIES PLANNED
Discussions groups will be organised with members of the public, including regular and irregular forest visitors. The objective of these discussions is to obtain information on what it is that motivates a value for forests or a desire to visit forests. The output from these discussions will also inform the development of a household questionnaire survey.
Forest users within a selection of forests will be surveyed. Their opinions of various types of forests and different approaches to forest management will be ascertained.

FORPOLEC

POLFOR

Forestry in a changing policy environment

PROJECT TEAM
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COMPLETION DATE
June 2011

OBJECTIVES

- Compare the relative returns from forestry and a number of different agricultural systems in the light of the introduction of the Single Payment Scheme (SPS) and analyse the impact at the level of the individual farmer and the wider economy;
- Examine the implications of the forestry-related measures to be introduced under the Rural Development Regulation (RDR) in Ireland for both the sector itself (including Coillte) and the wider economy, including, inter alia, the impact of revised payment rates for afforestation and the introduction of more specific 'forest-environment' payments;
- Explore the factors influencing a farmer's decision to plant using a combination of quantitative and qualitative research methods;
- Determine the impact of these reforms and farmers attitudes on land availability for forestry;
- Identify strategies to encourage afforestation by farmers in the context of the changing policy environment.

PROGRESS
Work on the project commenced in November 2007 when a student was appointed to review past and current forest policy in Ireland.

ACTIVITIES PLANNED
Focus groups will be held with farmers (including farm forest owners and non-farm forest owners). In these groups, farmers will be asked to identify what they think is inhibiting afforestation and to identify what can be done to encourage it. Similar meetings will be held with those working closely with farmers such as Teagasc and forestry contractors. Scenarios will be developed as to the factors influencing whether a farmer opts to afforest or not.
A desk-top study of the relative returns from a variety of agricultural systems and forestry systems will be conducted.

Forest Health and Protection

A useful definition of forest health has been proffered by the Society of American Foresters: *the perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance.*

Forest health and tree health are not the same thing: as forests grow some trees will die, mainly through competition. This is perfectly healthy.

A wide range of edaphic and environmental factors influence forest health. While all operate at the forest level, air borne influences, such as pollutant levels, originate outside the forest and are beyond the direct control of the forest manager.

Genetics also play an important role in forest health, and with the Irish forest resource comprised predominantly of plantations, this is mainly manifested in the need to match species and provenances to sites. Aspects of the COFORD programme, such as research on forest reproductive material and silviculture, therefore play an important role in supporting healthy forests. Indeed forest heath is central to all stages of the forest management cycle, from species selection to tending/thinning (removing poorly formed and diseased trees), to harvesting and final felling (avoiding and reducing soil and stem damage).

Forest health impacts on the economic and the public goods provision of forests. Unhealthy forests are generally a net source of carbon emissions, as well as being a diminishing economic asset.

Monitoring of forest health is funded separately by the Forest Service as a national follow-on to the Forest Focus Regulation ((EC) No 2152/2003)) concerning monitoring of forests and environmental interactions in the Community. The national forest inventory also monitors forest health.

Forest protection seeks to avoid or reduce damage to forests from species such as grey squirrel, deer and pine weevil and from invasive plant species such as rhododendron and laurel. Strategies to reduce damage from abiotic factors, principally fire, frost and wind, also need to be devised and applied. Research has provided ways to reduce wind damage to forests in Ireland (see Services and Technology Transfer), while avoidance and reduction of frost damage has been a significant part of the work of the BOGFOR project.

COFORD's main funding of forest protection to date has focused on biological control of large pine weevil, estimation of deer and grey squirrel population levels and refinement of windthrow damage avoidance models. Further work in forest protection is planned.

Currently, two forest health projects are underway:

- **ABATE**: Integrated reduced-chemical control of *Hylobius abietis* in Sitka spruce.
- **SQUIRRELSURVEY**: Irish Squirrel Survey 2007.

ABATE

Integrated reduced-chemical control of *Hylobius abietis* in Sitka spruce

PROJECT TEAM
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Dr Robbie Girling, NUI Maynooth
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COMPLETION DATE
February 2008

The large pine weevil, *Hylobius abietis.*

OBJECTIVES
The objective of the ABATE project is to reduce reliance on chemical insecticides in reforested sites by developing biological control measures for the major insect pest, the large pine weevil (*Hylobius abietis*). The organisms investigated as control agents are: insect-killing nematodes; stump-colonising fungi; insect-killing fungi and parasitoids (*Bracon hylobii*). The main objectives for 2007 were to:

- bring nematode control closer to operational level in Ireland.
- overcome barriers to success of Bracon augmentation programmes.

PROGRESS
Nematodes: large-scale field trials
The efficacy of two species of entomopathogenic nematode against weevil populations in spruce and pine stumps was investigated. The species tested were an indigenous nematode, *Heterorhabditis downesi*, and the exotic nematode, *Steinernema carpocapsae*. The latter is used by the Forestry Commission on a semi-operational level in the UK and in 2007 was applied to 150 ha of Coillte forests over 10 sites. Of these 10 sites, four were selected for destructive sampling of stumps to determine the percentage of weevils parasitised, and six were selected to monitor emergence of adult weevils and non-target beetles following nematode application.
Nematodes were applied to the soil around the stumps and made their way under the bark to parasitise the weevils. Destructive sampling of stumps three weeks after the nematodes were applied showed that on each of the sites the level of parasitism was highest in *H. downesi*-treated stumps. Overall *H. downesi* parasitised 49 and 42% of *H. abietis* in spruce and pine, while *S. carpocapsae* parasitised 12 and 15%, respectively.
Ten adult *H. abietis* emerged from each untreated spruce stump, while more than four times as

many emerged from pine (averaged across sites). There was a trend for a reduction in the number of *H. abietis* adults emerging from nematode-treated stumps on all sites tested. On one pine site, the number of weevils emerging from *S. carpocapsae* and *H. downesi*-treated stumps was reduced by 71 and 81%, respectively, relative to untreated stumps (Figure 1). Emergence data confirmed that nematodes are equally effective in stumps of both tree species, and that in general *H. downesi* is nearly twice as effective as *S. carpocapsae* for *H. abietis* control.

Three of the sites to which nematodes were applied in July 2007 were partially replanted within five weeks with approximately 500-1,000 Sitka spruce seedlings. The level of weevil feeding damage was disappointingly high. However, sites were only partially replanted, so weevils outside the replanted area may have moved in to feed, thus increasing the number of weevils feeding on each seedling. In order to adequately test whether entomopathogenic nematodes can reduce the number of *H. abietis* emerging from stumps sufficiently to prevent substantial seedling losses, entire sites will need to be replanted and the damage assessed.

Bracon hylobii

Natural population trends of *B. hylobii* were assessed using emergence traps in 2007. *B. hylobii* emerged from late-April/early-May to late November. There were two main peaks of emergence (mid May and late July) followed by a smaller peak in late August. A similar pattern was recorded in 2006.

A method of rearing large numbers of *B. hylobii* in pine weevil larvae in the laboratory was developed and proved a very successful and a relatively easy way of breeding large numbers of the wasp for inundative release.

An inundative release of *B. hylobii* was carried out during the second week of June. Cocoons (1,200 per site) were released onto four clearfell sites. Inundative release of wasps onto sites failed to raise the average percent parasitism in the release area above background levels. Reasons for this are still not fully understood but retention of wasps in a target area warrants further investigation.

In the laboratory, the life expectancy of female *B. hylobii* was increased approximately three-fold when food of a relatively low sugar concentration

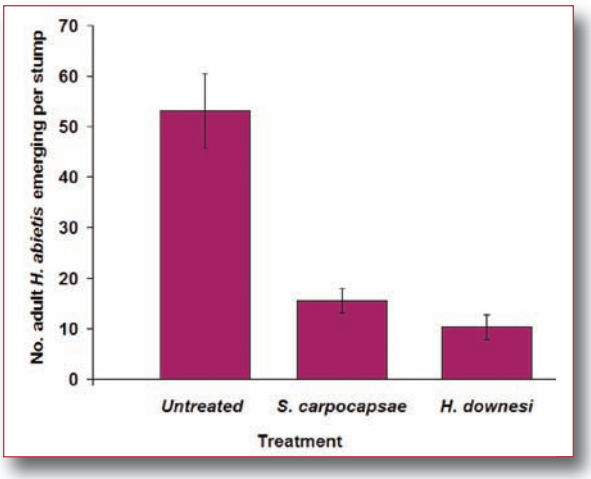

Figure 1: Number (mean ± SE) of *H. abietis* adults emerging from pine stumps at Glendine Forest, Co Laois. Tents were erected within one week of nematode application. Emergence was recorded over a 3-month period (n = 20 stumps per treatment).

(25% honey solution) was continuously available. There was a trend for unfed newly emerged female wasps to choose honey over a weevil larva (Figure 2a). These experiments suggest that newly emerged *B. hylobii* females may put the need for food before the need to parasitise. If this is the case it would also suggest that in a clearfell site where the availability of non-host food is limited *B. hylobii* may leave that site or area in search of food. This may in part explain why attempts to increase parasitism by enhancing populations have not proved successful.

There was no evidence of conditioning of oviposition choice in *B. hylobii*. Female wasps did not exhibit a preference for weevil larvae in bark of the tree species (Sitka spruce or lodgepole pine) in which they had themselves developed (Figure 2b).

ACTIVITIES PLANNED

- Completion of the analysis of non-target beetle biodiversity and abundance.
- *Bracon* diapause and the possible existence of hyperparasitoids will be investigated in 2008.

OUTPUTS

Dillon, A.B., Moore, C.P., Downes, M.J. and Griffin, C.T. 2007. *Integrated pest management of the large pine weevil – reducing breeding site suitability, inundative application of entomopathogenic nematodes, and the ensuing tritrophic interactions. Natural enemies and other multi-scale influences on forest insects*. IUFRO

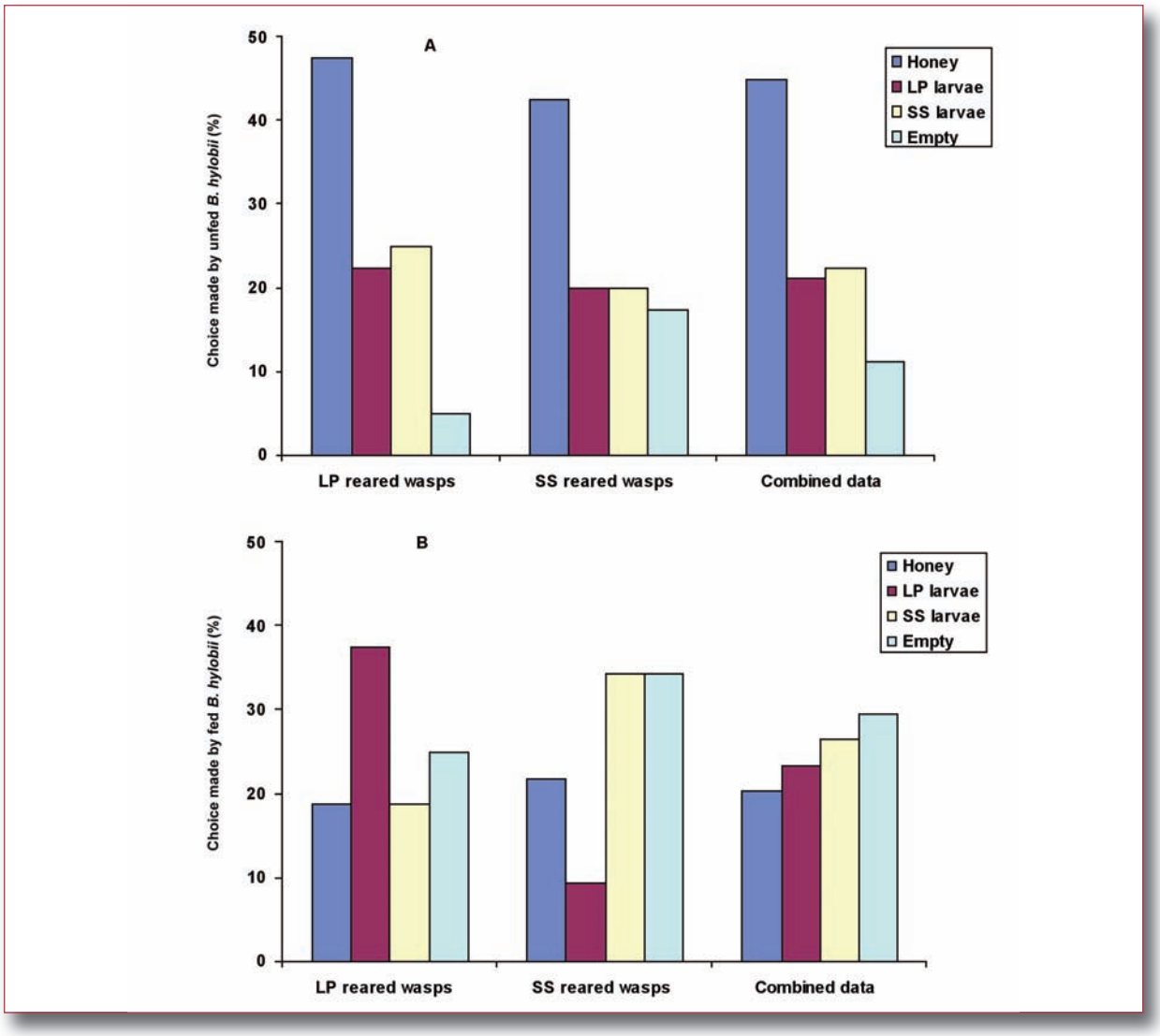

Figure 2: Choices made by (A) unfed and (B) fed (prior access to honey) female *B. hylobii* reared in Sitka spruce (SS) or lodgepole pine (LP) when exposed to volatiles from: *H. abietis* larvae feeding on SS or LP bark, honey or an empty chamber, in a 4-arm olfactometer (n = 32-40 wasps per tree species).

Meeting, Vienna, Austria 9-14 September 2007.

Dillon, A.B., Ward, D. Downes, M.J. and Griffin, C.T. 2007. Optimizing application of entomopathogenic nematodes to manage large pine weevil, *Hylobius abietis* L (Coleoptera: Curculionidae) populations developing in pine stumps, *Pinus sylvestris* L. *Biological Control* 40: 253-263.

Dillon, A. 2007. Coillte in-service training. *Assessment of H. abietis management options following application of nematodes*. Roscrea, Ireland, 17 October 2007.

Harvey, C., Ennis, D., Dillon, A.B., Meade, C.V. and Griffin, C.T. 2007. *Using AFLP to study coexistence of exotic and indigenous strains of Steinernema feltiae in a forest ecosystem*. Association of Applied Biologists Meeting London 11 December 2007.

Ennis, D., Girling, R.D, Dillon, A.B. and Griffin, C.T. 2007. *Do entomopathogenic nematodes reduce feeding by adult pine weevil?* Association of Applied Biologists Meeting London 11 December 2007.

Moran, M., Walsh, P. and Blaix, M. 2007. *Biological control of Hylobius abietis using the parasitic wasp Bracon hylobii.* Galway Science and Technology festival, 12-25 November 2007.

An outline of the work carried on *B. hylobii* by GMIT was given to Coillte area mangers on an ad hoc basis throughout the year.

Results from the ABATE project have been used during lectures and field trips in the Forestry and the Environment course at GMIT, and the Applied Ecology course at NUIM.

SQUIRRELSURVEY

Irish Squirrel Survey 2007

PROJECT TEAM
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COMPLETION DATE
September 2007

OBJECTIVES

- To update the records regarding the geographical distributions of red and grey squirrels in Ireland.
- To relate distribution patterns and changes to the presence of pine martens.
- To develop a survey methodology and data collation system that will facilitate the subsequent addition of new records without the need for entirely new large-scale surveys in the future.
- To generate up-to-date maps of these geographical distributions.
- To identify recent changes in the respective distributions via comparison with previous surveys.
- To promote red squirrel conservation and educate people on the threat posed by the grey through directly involving the general public with the survey.

left: Native red squirrel (*Sciurus vulgaris*).
Photo: © Niall Benvie (www.imagesfromtheedge.com)
right: Alien grey squirrel (*Sciurus carolinensis*).

PROGRESS

Records regarding the distribution of red squirrels and grey squirrels in Ireland were updated via a survey based on a widely circulated questionnaire during the period January – May 2007. Five thousand hard copies of a carefully designed survey form were widely distributed in both the Republic of Ireland and Northern Ireland, supported by a survey website (http://www.irishsquirrelsurvey.com). Overall 1,502 replies were received; this was considered to be a highly satisfactory return, in both number and geographic coverage of the 32 counties.

The questionnaire also enabled those making returns to comment on pine marten sightings, to investigate any potential impacts this predator may be having on the two squirrel species.

The data were collated using Recorder 6 software, a biological database management tool; this will allow data to be supplemented in the future and/or exported for use with other databases such as forestry GIS applications.

The degree of interest shown by the media and the general public was highly encouraging, and it is felt that the issues surrounding the conservation of the red squirrel and the threat posed by the grey were well communicated.

The updated 10 km distribution maps for the three species generated by the survey are shown in Figure 1.

When compared to the results of previous surveys, the red squirrel may still be considered to be widespread and is still common in many areas of the country, particularly west of the River Shannon and in areas of extensive commercial coniferous forestry. Some spread by red squirrels was also noted in a few regions, though in many other areas its habitat is now shared with the grey

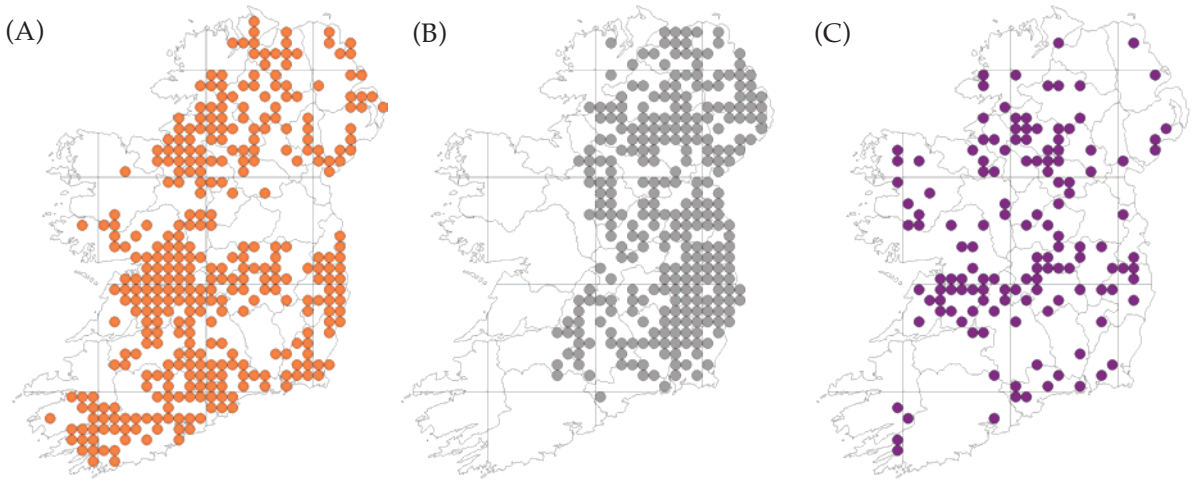

Figure 1: Updated 10 km distribution maps for (A) red squirrel, (B) grey squirrel, (C) pine marten.

squirrel. Unfortunately, it may now be considered extinct in Meath, and has become particularly rare in Westmeath, Kilkenny, Carlow and Louth. Red squirrels in areas where greys are already established are under particular threat, while other populations just beyond the current grey squirrel distribution (such as Cork, Limerick, Kerry and north east Antrim, where significant areas of mature broadleaf woodland exist) may also be considered at risk.

Grey squirrels have expanded their range dramatically in the past decade, and are now present in 26 counties. Most apparent is its spread in the counties along the east coast. It is likely that they will continue to spread in many areas of the country in the coming years; they have breached the river Shannon in a few locations and so may begin to extend their range west of the Shannon. However, given the unsuitable habitat that the region presents, the extent to which this will occur and the rate at which it will happen is unclear. Many young broadleaf plantations in the east and south of the country may now be considered to be at high risk from grey squirrel bark-stripping damage.

Pine martens have been recorded in many areas of the country, and appear to be spreading (presumably due to legislative protection and an increase in tree planting). The survey found some evidence of the persistence of red squirrels where pine martens are found, and in some cases the progressive decline of greys in such areas. However, it is difficult to say that this corresponds to the habitat preferences of the species concerned or if there is a direct relationship between the distribution of pine martens and the two squirrel species. More research in this field needs to be carried out.

OUTPUTS

- Carey, M., Hamilton, G., Poole, A. and Lawton, C. 2007. *The Irish squirrel survey 2007.* COFORD, Dublin.
- Popular articles were featured in the Irish Independent, Irish Times, Irish Examiner, Farming Independent, Farmer's Journal, BBC News Online, Irish Daily Mail, Meath Chronicle, Farmer's Monthly, Irish Timber and Forestry, Irish Mountain Log, The Local Planet and Science Spin, together with publicity in the journals and/or newsletters of CRANN, the Irish Wildlife Trust and Birdwatch Ireland. Publicity in the audio-visual media was also facilitated through interviews on RTÉ Radio 1 (Today with Pat Kenny and Morning Ireland), East Coast FM, Shannonside and Northern Sound, as well as appearances on Ear To The Ground and Eco Eye on RTE1.
- Stand and presentation at Dublin Zoo's Native Species Weekend, April 2007.
- Results were used in the drafting of All-Ireland Red Squirrel Species Action Plan.
- Poole, A. 2007. An investigation of translocation as a technique to conserve the red squirrel (*Sciurus vulgaris*) in Ireland. PhD Thesis, NUI Galway.
- www.irishsquirrelsurvey.com

Forest Harvesting and Transport

WOODTRANS

Programme leader: Dr Ger Devlin

Geographic information systems have long been recognised as a valuable tool for the representation and analysis of transportation networks and related activities. GIS for Transportation (GIS-T) is a broad expression that encompasses all of the activities that involve the use of geographic information systems for some aspect of transportation planning, management, or science. Government agencies, research institutions, and members of private industry are just some of the entities that routinely build GIS-T applications. These applications can involve any mode of transportation (truck, automobile, train, ship, bus, airplane, etc.) or may consider other transportation-related objects such as pavements, stop signs, or construction equipment. GIS-T applications can be used to plan for changes in the transportation network design for the future. The breadth of the field of GIS-T provides ample opportunities for the development of new and innovative applications. Since much transportation research has historically been conducted without the benefit of a geographic information system, it is assumed that a GIS-T application can benefit in some way from the added capabilities of a GIS. These include both spatial–analytical and cartographic capabilities. Increasingly, transportation professionals are finding that the synthesis of traditional transportation research methods with the added value of GIS resources provides a robust platform for both traditional and innovative transportation activities. The projects in the WOODTRANS programme have arisen as a result of COFORD's mid-term review and recommendations in the Forest Industry Transport Group (FITG) Code of Practice for Timber Haulage.

The WOODTRANS programme comprises the following projects:

- **GPSTRACK**: Assessment of GPS tracking devices and associated software suitable for real time monitoring of timber haulage trucks.
- **LOADSENSOR**: Evaluation of air bag pressure sensors/gauges as load weighing devices for use on timber haulage trucks.

WOODTRANS

GPSTRACK

Assessment of GPS tracking devices and associated software suitable for real time monitoring of timber haulage trucks

PROJECT TEAM
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Fionan Russell, PTR Ltd.
Donal Mortimer, Shredwood Ltd.

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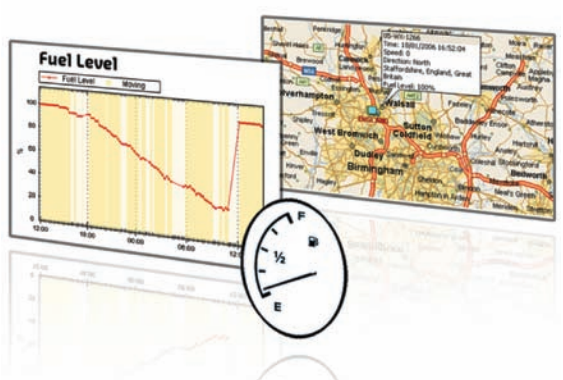
COMPLETION DATE
December 2007

OBJECTIVES
This is a study of the suitability, accuracy and efficiency of real-time GPS tracking of timber haulage trucks travelling on public and forest roads.

PROGRESS
The horizontal accuracy of the GPS data will be analysed on forest roads through the use of GIS. It has been well documented that GPS performance decreases under forest canopy. The project will determine how and if these effects extend to forest roads. Two trucks will used to determine GPS performance in relation to truck activities, routes taken, and loading and unloading locations. Results will be analysed and recommendations made to the haulage sector to determine whether GPS and GIS technology can be incorporated in a cost effective manner to help optimise the movements of timber trucks across Irish roads and within internal forest roads in terms of locating timber stock-piles. The technology can also be implemented in real-time to optimise the possibility of back-loading, depending on truck location, and thus help increase revenue per km.
To date, two GPS systems have been installed. Monitoring commenced on 29 October and ran consecutively for four weeks, with ongoing monitoring of trucks after the initial work period. Results will be analysed to determine system performance for GPS tracking, updating road vector maps and live feed of tracked trucks. In addition, the ability of the systems to analyse truck and driver performance and fuel consumption and efficiency are being determined.

OUTPUTS
Results of the study will be disseminated to the forestry sector at large and the Forest Industry Transport Group.
Results and workings of the study are to be presented to the Timber Transport Forum in Scotland in February 2008.

Vehicle tracking and mapping.



Engine diagnostics – fuel efficiency recording.

WOODTRANS

LOADSENSOR

Evaluation of air bag pressure sensors/gauges as load weighing devices for use on timber haulage trucks

PROJECT TEAM
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COMPLETION DATE
September 2008

OBJECTIVES
The objective of the project is to test the cost-effectiveness and accuracy of using load-weighing devices fitted to the truck air suspension system.

ACTIVITIES PLANNED
Trucks vary in configuration, and load sensors can be placed at different locations. The most common truck configurations are 5-axle (42 t g.v.w) and 6-axle (44 t g.v.w). All trucks and trailers are now air suspension as opposed to spring leaf suspension, which provides a higher design gross vehicle weight (d.g.v.w).
Weighing devices available on the market will investigated, following which sensors will be purchased or leased. The devices will be fitted to haulage vehicles. A sawmill with a fully tested and calibrated weighbridge will be chosen, whereby the weight of the truck will be recorded in the forest when it is loaded and when it arrives and departs the sawmill (to determine payload weight). All tests will follow normal daily operations. Monitoring of truck movements will be observed over a four week period.

Wood Products

Roundwood harvest in the Republic is currently running at around 3 million cubic metres per annum. Net roundwood imports provide a further 0.2 million cubic metres for processing. Sawn softwood and board products account for almost all processing. COFORD compiles wood harvest and trade data on behalf of EUROSTAT on an annual basis and has recently published the data in its COFORD Connects series (see Services and Technology Transfer).

R&D investment in wood products is funded in the main through company investment and R&D grant aid administered by Enterprise Ireland (EI). Most of the major sawmills and board mills are engaged in EI-funded R&D, and all are involved in process and product innovation and related R&D.

COFORD's involvement in wood product development has involved supporting the development of generic standards for wood products such as fencing, and in examining developing trends in wood product treatment and new applications.

COFORD is currently examining the need for further work in areas such as wood resource quality, the use of wood in medium and multi-rise construction, and the availability of wood testing facilities at a national level.

The projects in this thematic area are:

- **EWP**: Engineered wood products – opportunities and threats for Ireland.
- **HEATTREAT**: Heat treatment of fast-grown softwood.

EWP

Engineered wood products – opportunities and threats for Ireland

PROJECT TEAM
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Sean Moloney, University of Limerick
Yvonne Costin, University of Limerick
Vahik Enjily, BRE (GB)
Ed Suttie, BRE (GB)
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COMPLETION DATE
December 2007

OBJECTIVES
The objectives of the study were to:

- quantify the potential markets for engineered wood products in Ireland;
- assess the cost benefits from a construction perspective of using engineered wood products (including all costs – materials, handling, erection, skills etc.);
- assess the raw material requirements for the production of engineered wood products (I-beams, glulam and structural insulated panels);
- provide a comprehensive commentary on the threats and opportunities posed by the emergence of engineered wood products in Ireland.

OUTPUTS
A final report based on the outcome of four tasks addressing the objectives is in preparation.

The use of I-joists in masonry housing is on the increase.

HEATTREAT

Heat treatment of fast-grown softwood

PROJECT TEAM
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Daragh Thornton, University of Limerick
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Seamus Heaney, Coillte

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COMPLETION DATE
September 2007

OBJECTIVES
A previous report described the application of heat treatment to Sitka spruce and lodgepole pine and identified the advantages of improved moisture stability and fungal resistance, but a drawback of the heat treatment is increased brittleness of the timber. Cladding was identified as a potential application for heat treated timber but the question of fixing and resistance to nailing had to be addressed. Timber must be capable of withstanding power nailing under normal site conditions, without undue splitting or fracture. In the longer term it must not show any significant surface deterioration or mechanical failure when exposed to outdoor weathering. Consequent on these considerations a project to investigate the nailing and cladding performance of Irish heat treated Sitka spruce was established with the objective of comparing heat treated materials with untreated controls.

PROGRESS
Timber from two sources was used. The larger amount was material remaining from a large scale heat treatment trial carried out by the Wicklow Rural Partnership and consisted of Sitka spruce grown within that county. This timber was available as sawn boards with cross-section 150 x 20 mm. Machining to tongue and groove and to shiplap profiles was carried out at the Coillte Dundrum sawmills. Smaller amounts of timber remaining from the original University of Limerick heat treatment trials, and treated in the Netherlands using the Plato and Lignius processes, were also included. Power nailing was used and following insertion of each nail visual assessment of the quality of the fixing was carried out and judged as pass or fail on the basis of the quality of fixation and absence of splitting. Untreated controls were also nailed, along with the widely used western red cedar. Figures 1 and 2 show a typical panel and an edge nailing situation. Prepared panels are now undergoing

Figure 1: Nailed test panel prior to outdoor exposure.

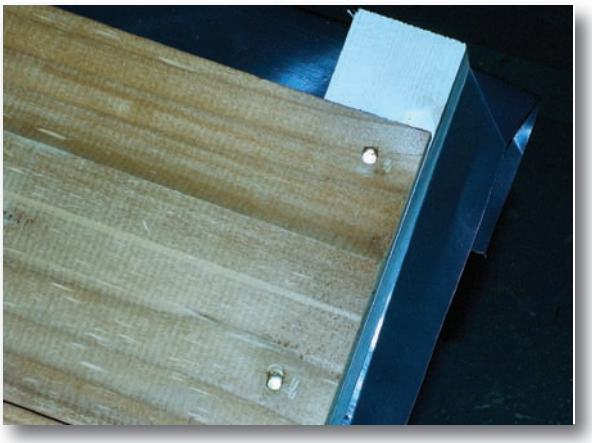

Figure 2: Extreme edge nailing presents the most severe fixing condition.

exposure trials at the Coillte mill in Dundrum. A small number of additional panels have also been included in an extended series of tests at the Building Research Establishment in the UK and Figure 3 illustrates these.

The results have shown that the heat treatment process does not increase the tendency of softwoods towards splitting when subject to nail fixing in cladding situations. Sitka spruce controls are somewhat more prone to splitting than western red cedar, an observation that is consistent with the grain structures present. With the softwoods examined the nailing outcome is substantially determined by the quality of the timber, and the care of the operative, rather than by the treatment received. Of the different profiles investigated it was clear that heat treated shiplap was the most prone to splitting and again this is consistent with the nature of the profile and the nailing stresses induced. As would be expected, heat treated rough sawn timbers nail well.

Three heat treatment processes were included in this work, although only small amounts of material were available from the Lignius and Plato processes. These latter processes are more severe in respect of total thermal exposure and this was reflected in a greater tendency towards splitting compared with Thermowood materials. However, it was still comparable with the controls.

Exposure trials are ongoing, but some bleaching out of the dark colouration resulting from heat treatment is apparent, as is some staining from plated nails. Stainless steel nails show no staining.

Figure 3: Panels undergoing exposure trials at the Building Research Establishment.

Wood Energy

Diminishing supplies of fossil fuel, allied to increasing prices and the need to drastically reduce emissions of greenhouse gases, are driving a world-world move to renewable energy sources. At national and EU levels these trends are manifested in the Energy Plan for Europe, whereby renewables are anticipated to account for 20% of energy requirements by 2020. Related policies in Ireland, the Energy White Paper and the Biomass Action Plan set ambitious targets for biomass use in heat, power generation and CHP (combined heat and power). Based on the policy targets, the demand for solid biomass could grow to over 4 million tonnes by 2020.

Forestry has a clear role to play in meeting part of future demand for solid biomass. Over 200,000 ha of new forests have been established since 1985, many of which have already entered the thinning stage, and some of which are already being harvested for wood energy.

Developing a wood fuel energy supply from Irish forests needs a concerted long term programme of research, development and demonstration, focussed on matching wood fuel supply and quality to end user demands. For example, heating and power generation have different fuel requirements, which translate back to how forests are thinned, and how the wood is harvested, stored and processed. COFORD has been funding a national programme of research and development in the wood energy area – FORESTENERGY – since 2006, and since its establishment has funded a number of projects on wood energy use.

The project in this thematic area is:

- **FORESTENERGY**: Harvesting and processing forest biomass for energy production in Ireland.

FORESTENERGY

Harvesting and processing forest biomass for energy production in Ireland

PROJECT TEAM

Tom Kent, Waterford Institute of Technology
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Sarah Cooley, Waterford Institute of Technology
Dr Eleanor Owens, Waterford Institute of Technology
Enda Coates, Waterford Institute of Technology
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COMPLETION DATE

December 2008

OBJECTIVES

To secure marketable wood fuel of acceptable moisture content for sale as wood chip and firewood, and specifically to:

- demonstrate harvesting systems for wood for energy with particular emphasis on the western region of Ireland;
- establish the productivity, fuel quality and delivered energy cost of these systems;
- investigate storage options and seasoning potential under various conditions over one and two summer seasons;
- track moisture content variation over the year in growing trees for a range of species;
- host public demonstrations of machinery and methods.

PROGRESS

Five softwood sites and two hardwood sites were harvested. Complete chipping was carried out at one site (Bweeng, Co Cork), partial chipping at three sites (Abbeyfeale, Co Limerick; Ballybofey, Co Donegal; Woodberry, Co Galway), and chipping of chemically thinned plots prepared in 2006 at Kilbrin, Co Cork, and Swan, Co Laois. Site, system and assortment measurements were taken on all sites. Physical and chemical parameters were analysed to CEN Solid Biofuel Technical Specifications.

A wood drying trial was established using specically designed and constructed bins at Rochfortsbridge. Smaller drying trials were also established at each of the softwood sites. Climatic and moisture content data were collected at all sites and development of a drying model began. Seasonal variation in standing tree moisture content of broadleaf and conifer species was investigated across seven sites.

Six public demonstrations were arranged in collaboration with Teagasc during the harvesting programme as well as three demonstrations during the chipping operation. A demonstration of wood chip production for cattle out-wintering pads was held, also in collaboration with Teagasc.

ACTIVITIES PLANNED

- Harvest final hardwood site (Tipperary).
- Further studies on firewood systems.
- Further studies on moisture content of standing trees.
- Complete the chipping of harvested wood at all sites.
- Complete system studies and fuel analysis.
- Assess storage options and effects on drying.
- Develop drying model to arrive at climatic indicators for predicting drying rate.

OUTPUTS

DVD: *Harvesting and Processing Forest Biomass for Energy Production in Ireland - The Forest Energy Programme.* Solutions for extracting wood for energy from first thinnings of conifer and broadleaf plantations in Ireland.

Kofman, P.D. and Kent, T. 2007. *Harvesting and Processing Forest Biomass for Energy Production in Ireland.* The ForestEnergy 2006 programme. COFORD, Dublin.

Seminar: *Quality-based forest fuel supply chains – the ForestEnergy 2007 programme.* 12 December 2007, with an excursion to the storage trial site at Rochfortsbridge.

Non-wood Products

Non-wood forest products in the Irish context mainly comprise foliage, hunting and recreational use of forests. While hunting can be seen as an end in itself, foliage is directly comparable with roundwood production and comprises procurement, harvesting, processing and marketing. Recreational use of forests is a developing area – with specialised facilities for activities such as bicycling being provided by Coillte. Opportunities exist to expand such activities and to extend them to privately owned forests.

Other non-wood forests products, principally fruits and fungi, are well established sectors in developed and developing countries with high levels forest cover. Many Nordic countries, for example, have well developed forest fungi collection and processing sectors.

Ireland's forests are predominantly plantations, mainly grown for wood; however, they are also providers of the many other goods and services now associated with forests and as the country becomes more urbanised, the need for these services is likely to continue to grow. Furthermore, as the wealth of the country increases, the demand for natural products from forests for decorating homes and workplaces continues to expand. With the growth of farm forestry, there is a need to develop the potential of non-wood products from forests to provide a sustainable and regular income stream for the owner.

In 2004 COFORD commissioned a report *Review of the market potential for non-wood forest products in Ireland* that explored the possibility of creating markets for some of these non-wood goods and services and examined their potential in an Irish context. Since the report the non-wood sector has continued to expand its level of activity, particularly in the foliage area, and in recreation provision by Coillte.

The projects in this thematic area are:

- **FARMFUNGI**: Production of edible fungi in the farm forest.
- **FORESTFUNGI**: Assessment of wild edible fungal production in selected Irish forest sites and an evaluation of the commercial potential of harvesting.
- **WILDFUNGI**: Wild fungi of Ireland.
- **FORESTFOLIAGE**: Management, screening and evaluation of a range of forest trees and associated ornamental species for suitability as cut foliage.

FARMFUNGI

Production of edible fungi in the farm forest

PROJECT TEAM
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Maria Cullen, University of Limerick
John O'Connell, private forest owner

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COMPLETION DATE
December 2010

OBJECTIVES
The objectives of this project are to:

- investigate outdoor forest production of oyster and shiitake mushroooms using cut stumps and logs derived from forest thinnings;
- determine whether inoculation of sawn logs and incubation in the forest will yield marketable quantities of oyster mushrooms and shiitake;
- determine whether inoculation of cut stumps will yield marketable quantities of oyster mushrooms;
- determine the influence of log type, size, and moisture content on mushroom yield in outdoor log cultivation of oyster and shiitake mushrooms;
- determine the influence of stump type, size and location on oyster mushroom yield;
- develop a protocol for log cultivation of mushrooms that will be applicable in farm-forest enterprises;
- explore the feasibility of producing home-grown inoculant;
- determine whether host trees inoculated with *Tuber aestivum* (summer truffle) will yield commercially viable quantities of truffles in Ireland;
- determine if inoculated host trees can be successfully established within existing ash plantations, and if commercial quantities of truffles can be harvested;
- compare the yields of truffles from inoculated oak (*Quercus robur*) and hazel (*Corylus avellana*).

PROGRESS
Three farm forests have been identified as experimental sites, the experimental trial protocol has been refined, and inoculum has been ordered.

ACTIVITIES PLANNED
The main activity planned for 2008 is to establish the oyster and shiitake mushroom production trial at three farm forests. Inoculation of oak, beech, ash, sycamore logs with oyster and shiitake mushroom spawn will take place at each of the three sites in spring. Eight hundred logs will be inoculated at each site: 200 each of the four tree species being investigated, half and half with oyster and shiitake spawn. In total, 2,400 logs and 300 cut stumps will be inoculated. Monitoring of environmental variables will also be carried out during the spawn run on logs, throughout 2008. Assessments will be made of tuber mycorrhizae on inoculated oak and hazel samplings.

FORESTFUNGI

Assessment of wild edible fungal production in selected Irish forest sites and an evaluation of the commercial potential of harvesting

PROJECT TEAM
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COMPLETION DATE
August 2010

OBJECTIVES

- To identify, for monitoring of wild edible forest fungi (WEFF) production, forest study sites that are representative of larger areas of forest in Ireland.
- To obtain quantitative information on WEFF production in these study sites over a 2/3-year period.
- To establish a framework for long-term monitoring of the selected sites beyond the lifetime of the project.
- To extrapolate WEFF production from the study sites to larger areas of similar forest in Ireland.
- To assess year-to year variation in fungal production.
- To correlate WEFF production with environmental and habitat variables.
- To analyse the community structure of ectomycorrhizal (EM) WEFF in the sample sites, and to relate WEFF production to EM abundance.

PROGRESS
The project commenced in September 2007, with the first year of the survey of wild edible fungal production. Fifty-three forest sites were surveyed in Cos Limerick, Clare, Cork, Kerry, Waterford, Tipperary, Wexford, Wicklow, Dublin, Westmeath, Mayo, Galway, Roscommon, Sligo, Leitrim, Cavan, Offaly, Laois and Donegal. The sites comprised replicate stands of the following tree species, generally in single-species, mature

Beefsteak fungus (*Fistulina hepatica*) on oak; Castlelough Wood, Co Tipperary.

Edible fungi from Curraghchase, Co Limerick: ceps, hedgehog fungus and winter chanterelle.

Ectomycorrhiza on oak roots.

stands: oak (*Q. robur* and *Q. petraea*), beech, hazel, birch, Sitka spruce, lodgepole pine, Douglas fir, Norway spruce and noble fir. Each site was visited and surveyed between three and four times between the first week in September and the last week in November.

Although the 2007 season was poor for woodland fungi, quantitative information was obtained on fungal production from those sites that produced edible fungi-approximately 33% of the sites. Hedgehog fungus (*Hydnum repandum*) and different species of chanterelle (*Cantharellus* species) were most abundant, of good quality and present at some sites in commercial quantities. Of the 40 edible species in Ireland, 29 were seen during 2007.

Voluntary surveyors were recruited in various parts of the country to establish a long-term network for monitoring edible woodland fungi.

Turkeytail (*Trametes versicolor*) rotting an ash log.

Ceps (*Boletus edulis*) from oak stand, Muckross, Killarney.

Beech woodwart (*Hypoxylon fragiforme*) rotting a fallen beech branch.

Highly-prized chanterelle (*Cantherellus cibarius*) left; inedible false chanterelle (*Hygrophoropsis aurantiaca*) right; Torc Wood, Killarney.

ACTIVITIES PLANNED

- The sites used in the 2007 survey will be critically re-examined for their suitability for further surveys. A core of 50 intensively monitored sites will be maintained, and the number of sites sampled by volunteers will be expanded. Site surveys will be carried out in the August to November period of 2008.
- Environmental data, such as stand composition and age, forest structure, ground layer composition, and selected soil factors will be collected at the sites. During the survey period, weather data will be collected at selected sites using on-site measurement of rainfall, soil moisture and soil temperature, augmented by data from Met Éireann.
- A project website will be set up in early 2008.
- The investigation of the structure of the ectomycorrhizal community of edible woodland fungi in the sample plots will commence in spring 2008.

WILDFUNGI

Wild fungi of Ireland

PROJECT TEAM

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John Fennessy, COFORD*

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COMPLETION DATE

August 2008

OBJECTIVES

To publish a book aimed at all those with an interest in Irish fungi, designed to highlight and promote edible Irish forest (running in tandem with FORESTFUNGI and FARMFUNGI).

PROGRESS

A draft outline of the publication has been produced.

ACTIVITIES PLANNED

The book is expected to be completed during 2008, for publication before the forest fungi collection season.

FORESTFOLIAGE

Management, screening and evaluation of a range of forest tree species and associated ornamentals for suitability as cut foliage

PROJECT TEAM
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COMPLETION DATE
January 2008

OBJECTIVES
The project comprises two parts : harvesting foliage from existing plantations, and foliage production from minor forest and ornamental species.
For established plantations the main objectives are to:

- determine the potential of harvesting foliage in association with timber production in three conifers: Japanese larch (*Larix kaempferi*), Monterey Cypress Goldcrest (*Cupressus macrocarpa* Goldcrest), western hemlock (*Tsuga heterophylla*).
- investigate the possibility of managing overmature noble fir (*Abies procera*) Christmas tree plantations for foliage production.
- evaluate forest foliage species.

For new species trials the main objective is:

- screen a range of ornamental tree and shrub species for suitability as cut foliage.

PROGRESS
Established plantations
The project has been extended to facilitate collection of data after two complete growing seasons from Japanese larch, Monterey cypress Goldcrest, western hemlock and noble fir. Data collected included height and diameter growth as well as foliage yield.

For the most part, foliage harvesting does not appear to have had a significant effect on tree growth after two successive harvests. To assess stem recovery rates, the number of commercial standard foliage stems (these meet criteria such as length, form, colour and volume) harvested per unit area was recorded for each treatment. Management recommendations for existing Japanese larch, western hemlock and Monterey cypress plantations will issue in the final report, which will also deal with the full range of new species tested.

ACTIVITIES PLANNED
All experimental work has been completed. Work in 2008 will focus on the analysis and reporting of results. Trial sites, especially new species, will continue to be monitored by the research team.

OUTPUTS

- On-site meetings were held with members of the project team, industry experts, and other interested individuals.
- COFORD Connects note – Forest Foliage.
- At the invitation Andy Whelton and Amy Costello were participants in COST Action E30 Economic Integration of Urban Consumers' Demand and Rural Forestry Production.
- *Foliage from Forests - a Growing Opportunity* – a two-day event was held in October 2007. The indoor session involved presentations from industry experts and researchers involved in the project as well as demonstrations of forest foliage products by two well-known designers. Day 2 involved a field visit to trial sites and foliage processing facilities at Foulksmills, Co Wexford. Seminar presentations are available on the COFORD website.

Forests and Climate Change

CLI-MIT (Climate change mitigation and adaptation in Irish forests)

Programme leader: Dr Kevin Black

There is now convincing scientific evidence that global climate change is occurring rapidly as a result of human activities, such as fossil fuel burning and deforestation. Global and regional climate change will create many challenges and opportunities for Irish forestry. However, the development of an adaptive strategic climate change plan for the forestry sector is dependent on the delivery of recommendations from the national forests and climate change research programme - CLIMIT (2007 to 2012). The objectives of the programme are based on national policy requirements and Kyoto reporting commitments. The programme includes five different projects, broadly divided into two core activities:

Mitigation and carbon sequestration

Newly planted forests (post-1990), in particular, offer the potential to offset CO_2 emissions by taking up and storing carbon in forest biomass and soils. The sequestration potential of these forest sinks has been substantially enhanced by the afforestatation of more than 250,000 ha since 1990 on foot of state and EU funded grant and premium payments.

Under the Kyoto Protocol, Ireland is committed, over the period 2008-2012, to reducing greenhouse gas (GHG) emissions to a level of 13% above the 1990-base year level. Currently, GHG emission levels are 23% above the 1990 level. Assuming business-as-usual it is estimated that the contribution of afforestation since 1990 (Article 3.3) can offset ca. 16% of the required GHG emissions for the first commitment period between 2008 and 2012. Estimation of the extent to which forests will sequester carbon in the mid to long term is more uncertain due to spatial heterogeneity and temporal variability.

The Irish forest carbon reporting system (CARBWARE) was initially implemented in 2004 to meet reporting requirements to the United Nations Framework Convention on Climate Change (UNFCCC) on all national forest sources and sinks. While CARBWARE indicates the likely contribution of forests to national carbon sink potential, the system has relied on the use of generalised stand growth models to describe changes in forest carbon stocks. The availability of detailed national forest inventory (NFI) data and new research information now provide the opportunity to redesign CARBWARE to improve estimates of national forest carbon stock changes. Experimental and observational research information, obtained from the CARBiFOR II and FORESTSOILC projects, will provide additional updated information to support CARBWARE. A further project, WOODCARB, will investigate storage of carbon in harvested wood products.

Adaptation to climate change

Given the predicted change in the Irish climate over the next century and the relatively long period between forest establishment and final harvest, some species may not be fully suited to future climate that will arise within one or two rotations. Clearly therefore, the suitability of forest species under future climate regimes requires consideration now. The aim of the CLIMADAPT project is two-fold. First, to develop a GIS decision support system for species selection and productivity based on current climate, site attributes and soil types. This system will be further developed to assess the sustainability of current forest species and suggest the introduction of new species or management strategies under future climate change scenarios. The sequestration potential of forests under future climate change scenarios will also be investigated and incorporated with the CARBWARE model.

In addition to research activities, the CLIMIT programme will also provide on-line advice on forestry and climate change for the public and forestry stakeholders. This will include the provision of decision-making tools such as the CLIMADAPT species selection and productivity software for forest management, and educational support, such as a carbon sequestration calculator. The website will also have Frequently Asked Questions and Answers, such as 'how is carbon taken up and stored by forests?' or 'how much carbon does a tree take up in its lifetime?'

The CLIMIT programme comprises the following projects:

- **CARBiFOR II**: Carbon sequestration by Irish forest ecosystems.
- **CARBWARE**: Development of tools and systems for reporting on forest carbon stocks and stock change under the Kyoto Protocol and the UNFCCC.
- **CLIMADAPT**: The use of Ecological Site Classification for productivity and species suitability under future climate change scenarios.
- **FORESTSOILC**: Soil carbon stock changes and greenhouse gas fluxes in Irish forests.
- **WOODCARB**: Carbon stocks and carbon changes in harvested wood products.

CLIMIT

CARBiFOR II

Carbon sequestration by Irish forest ecosystems

PROJECT TEAM
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COMPLETION DATE
December 2011

OBJECTIVES
The overall objective is to provide information to determine the influence of disturbance, land use change, soil type and forest age on carbon budgets relevant to reporting land use change and forestry (LUCF) activities under the Kyoto Protocol and the United Nations Framework Convention on Climate Change (UNFCCC).
Specific targets are:

- Provision of a harvested tree database for the development of biomass algorithm and allocation models for different species.
- Assessments of current annual increment (CAI) using repeat surveys and tree stem analysis on four afforested chronosequences.
- Validation of litter input models using litter traps and fine roots in growth bags over four afforested chronosequences.
- Estimation of emission factors associated with land use change to forestry on three soil types.
- Estimation of emission factors associated with deforestation of peat soils for the major forest species.
- Estimation of emission factors associated with thinning for major forest species.
- Development of decomposition models for woody debris (timber and coarse roots) and litter (brash, leaf and fine root inputs) to parameterise CARBWARE.
- Assessment of non-forest vegetation and soil C stock changes for four soil types and decomposition of non-forest vegetation over time (i.e. four afforested chronosequences).
- Assessment of soil C stock changes using paired plot comparisons of afforested and non-afforested areas based on national forest inventory (NFI) sample plots.
- Characterisation of non-CO_2 GHG fluxes over the three afforested chronosequences.
- Development of process-based climate change models using eddy-flux and NPP data.
- Validation of the CARBWARE model using eddy-flux and CAI assessments.

PROGRESS
Quantification of emission factors associated with change of land use to forestry
Management practices, species composition and soil type are being considered for the selection of chronosequences (age series) including Sitka spruce, ash and oak. Three sites have been tentatively selected for another Sitka spruce chronosequence. A Sitka spruce afforestation chronosequence, including an unforested site representing previous land use (grassland) on surface water gley soil has been selected. The approach adopted includes the measurement of current biomass annual increment and litterfall (≈ NPP), using repeat surveys, and eddy covariance, which measures the net annual carbon balance (NEP). The assessment of NEP of different aged forests will be achieved using a permanent eddy covariance tower, established since January 2001, and a roving tower (Figure 1). The difference between NEP and NPP reflects the emissions, which are otherwise difficult to measure at the site level, associated with land use change and

Figure 1: The roving eddy covariance system designed to move between selected sites to assess net C balance (NEP) of stands following afforestation, thinning and harvest. Insert shows the instrumentation attached to the top of the mobile tower.

management interventions, such as thinning and final harvest.

The provision of emission factors for the CARBWARE model will be an ongoing process; however, an initial emission factor estimate will be submitted to the model component after the first 12 months of the first roving chronosequence.

Litterfall, above- and below-ground decomposition and fine root turnover experiments are under development at the chronosequence sites, including a trenching experiment utilising the thinned forest stand to examine the relative decomposition over time of coarse, medium and fine root material.

The effect of thinning on carbon sequestration

The permanent reference eddy covariance tower and biomass surveys are being used to assess the impacts of forest management (thinning) on carbon fluxes. The site was thinned in late 2006, resulting in a reduction in basal area from 34 m^2/ha in the unthinned, to 25 in the thinned plots. Preliminary results suggest that the magnitude of the carbon fluxes has increased substantially, compared to those measured before thinning (Figure 2). This may be due to an increase in canopy photosynthesis (GPP) through increased light penetration/adsorption and light-use efficiency, or due to a lag response of the total ecosystem respiration (which is expected to increase) through the slow decomposition of thinning brash. However, NEP assessments do not account for the loss of carbon from harvested wood. If this were included in the estimate thinning would result in a substantial temporary loss of CO_2 (i.e. a net emission for 2007).

Paired plot sites

A protocol has been agreed for site selection of paired soil plots. The paired plot approach involves the selection of an afforested site and an adjacent site representing unafforested conditions. Differences in soil carbon content between the paired sites will be used to estimate soil carbon stock change following afforestation.

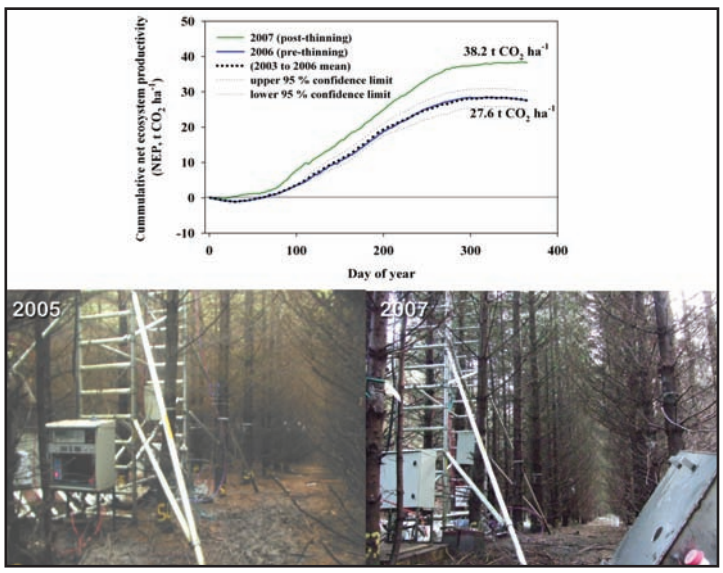

Figure 2: Changes in NEP and canopy characteristics before (2005/6) and after thinning (2007). Positive NEP values (excluding C losses in harvested wood) represent an uptake of CO_2. Note the reduction in green leaf area after thinning.

Using stratified sampling a series of stands on representative soils has been selected from the national forest inventory (NFI) database (Figure 3). Identification of a full set of sites will continue, as it will require site visits to ensure the selection of appropriate paired sites. A soil sampling protocol has been developed and agreed following collaboration with the FORESTSOILC project.

ACTIVITIES PLANNED

Work Package 1: Identification of chronosequences will be completed. Above-ground coarse wood debris (CWD) decomposition experiment will be set up. Four chronosequences will be surveyed before the 2008 growth season. The thinning experiment will be resurveyed (following first growing post-thinning operation). Litter collection will be set up in conjunction with WP 2. Biomass and CWD sampling will begin.

Work Package 2: The roving eddy covariance tower will be deployed at all chronosequence sites. Decomposition, litterfall and fine root turnover experiments will be finalised. Collars will be permanently installed at all chronosequence sites and N_2O and CH_4 measurements will start. Measurements of the species composition and biomass estimation of non-timber vegetation will be undertaken.

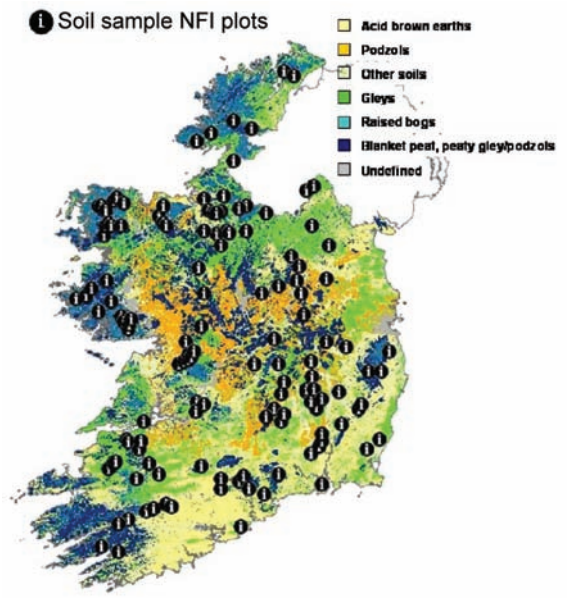

Figure 3: The selected paired plot sites to be used for the estimation of soil carbon stock changes following afforestation.

Work Package 3: Sampling of paired plots at NFI sites will commence. Discussion regarding cross collaboration with WPs 1 and 3 regarding the monolith experiments and below-ground decomposition experiments will refine what is planned for this study.

OUTPUTS

Papers and articles:

Tobin, B. and Nieuwenhuis, M. 2007. Mitigation of GHG emissions by forests – the CARBiFOR project. *Irish Timber and Forestry* 16 (3): 31-32.

Tobin, B., Black, K., McGurdy, L. and Nieuwenhuis, M. 2007. Estimates of decay rates of components of coarse woody debris in thinned Sitka spruce forests. *Forestry* 80 (4): doi: 10.1093/forestry/cpm024.

Tobin, B., Čermak, J., Chiatante, D., Danjon, F., Di Orio, A., Dupuy, L., Eshel, A., Jourdan, C., Kalliokoski, T., Laiho, R., Nadezhdina, N., Nicoll, B., Pagés, L., Sande-Silva, J., and Spannos, I. 2007. Towards developmental modelling of tree root systems. *Plant Biosystems* 141 (3): 481-501.

Conferences/meetings:

Tobin, B., Čermak, J., Chiatante, D., Danjon, F., Di Orio, A., Dupuy, L., Eshel, A., Jourdan, C., Kalliokoski, T., Laiho, R., Nadezhdina, N., Nicoll, B., Pagés, L., Sande-Silva, J. and Spannos, I. 2007. *Towards developmental modelling of tree root systems*. Presented at 4th International Symposium on Physiological Processes in Roots of Woody Plants. Bangor, 16-20 September, 2007.

Greenhouse gas fluxes in terrestrial ecosystems in Ireland. EPA, 20 September 2007, Ireland.

5th Annual CarboEurope-IP Project Meeting, 8-12 October 2007, Poland.

CLIMIT

CARBWARE

Development of tools and systems for reporting on forest carbon stocks and stock change under the Kyoto protocol and the UNFCCC

PROJECT TEAM
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COMPLETION DATE
December 2011

OBJECTIVES
The overall objective is to develop national forest carbon reporting systems, based on the agreed UNFCCC Common Reporting Formats *Land Use, Land Use Change and Forestry* (LULUCF) and the Intergovernmental Panel on *Climate Change Good Practice Guidance for Land Use, Land Use Change and Forestry*.
Specific targets are:

- Analysis of NFI and IFORIS (forest premiums) data to extract information in a format compatible with CARBWARE.
- Refinement and redevelopment of CARBWARE to include species and yield class (YC) specific or cohort biomass models and verifiable emission factors associated with management and site preparation.
- Sensitivity analyses to select a GPG-LULUCF compliant reporting procedure with low uncertainty and error. This procedure will also enable comparison of different tiers and selection of the best reporting approach.
- The creation of an input database to enable QA/QC and formatting for calculation routines in CARBWARE computations.
- Development of a Windows-based CARBWARE interface compatible with UNFCCC Common Reporting Formats for LULUCF activities, to include afforestation and harvest scenarios and uncertainty analysis.
- Incorporation of a Harvested Wood Product (HWP) C-store reporting procedure in CARBWARE.
- Independent peer review of forest sink reporting mechanisms.
- Issuance of a LULUCF reporting manual, compliant with IPCC GPG, for Irish forests.
- Implications of climate change scenarios on potential sequestration by Irish forests using an ESC yield-based model.

PROGRESS
Reporting LULUCF to the UNFCCC
CARBWARE submits national forest sink data to the EPA for the annual national inventory report to the UNFCCC. Significant modifications were made to the CARBWARE system to include forest fire in national reports as specified in IPCC GPG. A forest fire database was compiled from Coillte and Forest Service data sources. Emissions from fires and the indirect effect on biomass and litter C pools resulted in a small reduction in the CO_2eq sink over the period 1990 to 2006. The mean emission and stock change due to fire amounted to a reduction of -13 G g CO_2eq or 1.5% per year (Figure 1).

Refinements to Kyoto reporting
Work is underway on the refinement of growth models. This work was included in the Irish submission on the draft Kyoto reporting tables, together with a manual, in April 2007.
The extent to which new forest sequesters CO_2 over the Kyoto commitment period (2008-2012) and beyond will depend on the annual afforestation rate, species planted, harvest level and soil type. Assumptions regarding afforestation rate, soil/species breakdown and harvest levels are inherently uncertain. However, estimates will be refined as new information becomes available and models are improved.

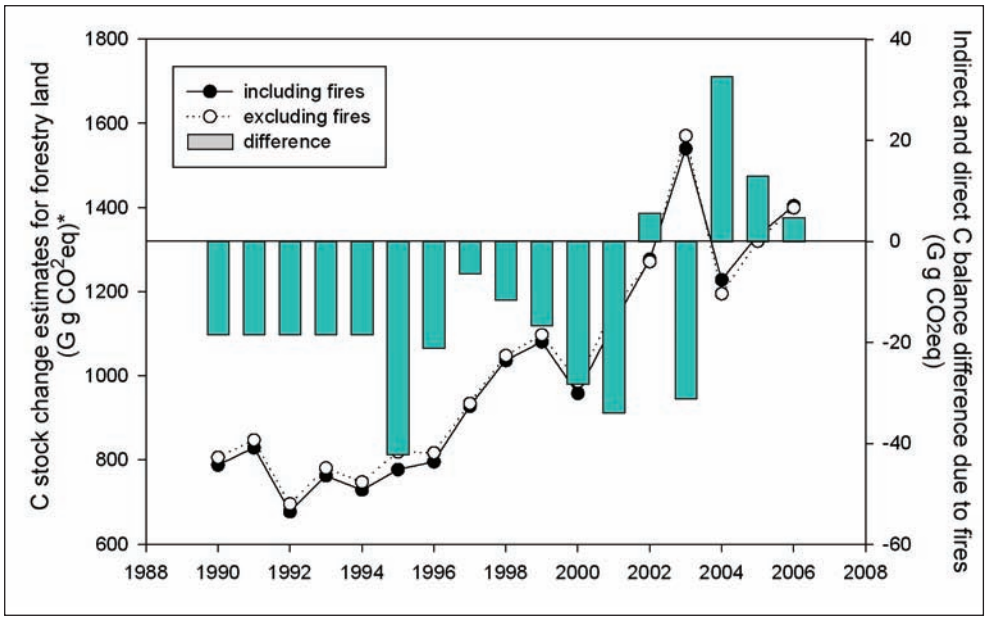

Figure 1: The affect of forest fire on carbon dioxide stocks of forests over the period 1990 to 2006 (estimates exclude soil C change).

Figure 2 shows the predicted sequestration rate of post-1990 forests over the three successive 5-year 'commitment periods' and four afforestation scenarios. Assuming that an afforestation rate of 10,000 ha is maintained, the annual sequestration rate is expected to rise from ca. 1.7 M t CO_2 in 2006 to 4.5 M t CO_2 by 2022. However, the actual sequestration rate will be lower (3.6 M t CO_2) if the afforestation rate declines to 3,000 ha per year. The afforestation rate over the past four years is running below 10,000 ha per year.

New developments include cohort models for six species groups based on yield tables. Work is now directed at redeveloping Irish models based on Coillte permanent sample plot and NFI data, using stand and tree level growth models.

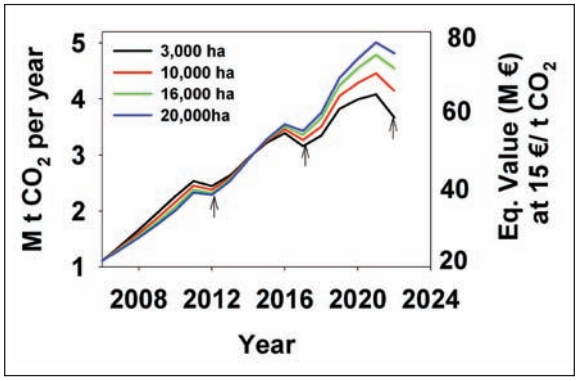

Figure 2: Annual carbon dioxide sequestration and estimated value of post-1990 forests over three successive 5-year periods: 2008-2012; 2013-2017; 2018-2022 (indicated by arrows) for four afforestation scenarios (roundwood harvest is assumed to be at marginal intensity).

Growth models

Work has been carried out using Coillte permanent plot and NFI data to develop tree level growth models. The spruce cohort is being developed. The models are based on PROGNOSIS, developed in Austria and North America. This is particularly suitable for application to NFI data, allowing growth and C forecasts to be undertaken.

Data have been extracted using specialised code and will form part of the QA/QC software system. The Coillte database has also been used to develop heuristic models and tree growth models.

Software development

The USA forest vegetation model (FVM) was scoped for use in Ireland but is not suitable due to unchangeable programming code relating to climatic conditions specific to the USA.

ACTIVITIES PLANNED

- Development of cohort models for spruce, including three publications.
- Development of pine cohort models.
- Software development and extraction of NFI data for growth model simulations.
- Inclusion of spruce growth models and biomass functions for Sitka spruce into software, validation and testing of software.
- Uncertainty analysis on spruce growth predictions.
- Assist FORESTSOILC and CARBiFOR II with selection of paired plots based on previous land use and soil type attributes.

- Submission of national LULUCF report 2006 including emissions due to deforestation and fire.

OUTPUTS

Peer-reviewed articles:

Black, K.G., Bolger, T., Davis, P., Nieuwenhuis, M., Reidy, B., Saiz, G., Tobin, B. and Osborne, B. 2007. Inventory and eddy covariance based estimates of annual carbon sequestration in a Sitka spruce (*Picea sitchensis* (Bong.) Carr.) forest ecosystem. *Journal of European Forest Research* 126: 167-178.

Saiz, G., Black, K., Reidy, B., Lopez, S. and Farrell, E.P. 2007. Assessment of soil CO_2 efflux and its components using a process-based model in a young temperate forest site. *Geoderma* 139:79-89.

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Tobin, B., Black, K., McGurdy, L. and Nieuwenhuis, M. 2007. Estimates of decay rates of components of coarse woody debris in thinned Sitka spruce forests. *Forestry* 80 (4): doi: 10.1093/forestry/cpm024.

Proceedings and conferences:

Black, K., Tobin, B., Neville, P. and Osborne, B. 2007. *Variations in annual carbon dioxide exchange over a Sitka spruce stand prior to and following canopy closure*. Proceeding to the conference on greenhouse gas fluxes in terrestrial ecosystems in Ireland, 20 September 2007, Delgany, Co Wicklow, EPA in press.

Black, K. and Gallagher, G. 2007. *Reducing uncertainties associated with the assessment of national forest carbon stock changes. Proceeding to the conference on greenhouse gas fluxes in terrestrial ecosystems in Ireland.* 20 September 2007, Delgany, Co Wicklow, EPA in press.

Black, K. 2007. *Scaling up from the stand to regional level: an analysis based on the major forest species in Ireland*. Proceedings for the 2nd International workshop on uncertainty in greenhouse gas inventories. Institute for Applied Systems Analysis A-2361 Laxenburg, Austria p 9-20.

Hawkings, M., Black, K., Gallagher, G. and Connelly, J. 2007. *Resolution of stochastic issues in estimating forest biomass carbon stock changes using non-linear mixed models*. Proceedings for the 2nd International workshop on uncertainty in greenhouse gas inventories. Institute for Applied Systems Analysis A-2361 Laxenburg, Austria p 97-100.

Black, K. 2007. *Ireland's forest carbon reporting system.* COFORD conference on Forestry, carbon and climate change - local and international perspectives. September 2007, Delgany, Co Wicklow.

Black, K. and Gallagher, G. 2007. *How can we see the carbon from the trees? Exploring the potential use of NFI data for the development of a state-of-the-art national forest carbon accounting system.* Proceedings to Ireland's National Forest Inventory Conference. Forest Service (in press).

CLIMIT

CLIMADAPT

The use of Ecological Site Classification in adapting forests and their management to climate change

PROJECT TEAM
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COMPLETION DATE
May 2009

OBJECTIVES

- Develop an Ecological Site Classification (ESC) system for Ireland to be used as a guide for species selection and the production of productivity maps based on soil, climatic and site specific data.
- Developing a knowledge-base of climate change adaptation strategies including species choice and silvicultural modifications, and climate change impact scenarios, such as change in the risk of pests and diseases.
- Validation of the ESC yield models for a limited number of species (possibly Sitka spruce, Norway spruce, Douglas fir, hybrid larch, oak, beech, sycamore) dependant on the availability and range of species included in the national inventory.
- Developing an internet-based end-user GIS system as a decision making tool for forest managers and policy makers.

PROGRESS

Productivity models

The suitability of forest species for specific sites and climatic conditions is based on knowledge based models. Using this information is the first step towards developing fine resolution productivity maps. A knowledge based species suitability model was developed
following a Delphi group meeting, which discussed how to adapt the guidance in the COFORD publication *A Guide to Forest Tree Species Selection and Silviculture in Ireland*[*] (Horgan et al. 2004) for the CLIMADAPT Decision Support System (DSS). Climate information will be added to guidance in the book to provide a DSS tool for forest planning, based on future climate scenarios (Figure 1).

The project will also investigate the use of statistical and process based productivity models as input variables for the DSS. A COFORD-funded CLIMADAPT PhD, based at UCD, will test the hypothesis that the productivity and suitability of drought sensitive species such as Sitka spruce and beech have not been constrained by climatic factors in Ireland. The approach will examine stands on similar soil types across a summer moisture gradient from the west of Ireland to eastern England/Scotland.

The classification of forest soil types on an edatopic grid, using ESC soil moisture regimes (SMR) and soil nutrient regimes (SNR), was completed following discussion by the Delphi group. The robustness of the classification will be tested from a re-assessment of forest soil surveys. A method for coupling climatic moisture deficit and soil moisture regime has been completed.

* *Horgan, T., Keane, M., McCarthy, R., Lally, M. and Thompson, D. 2004. A guide to forest tree species selection and silviculture in Ireland. COFORD, Dublin.*

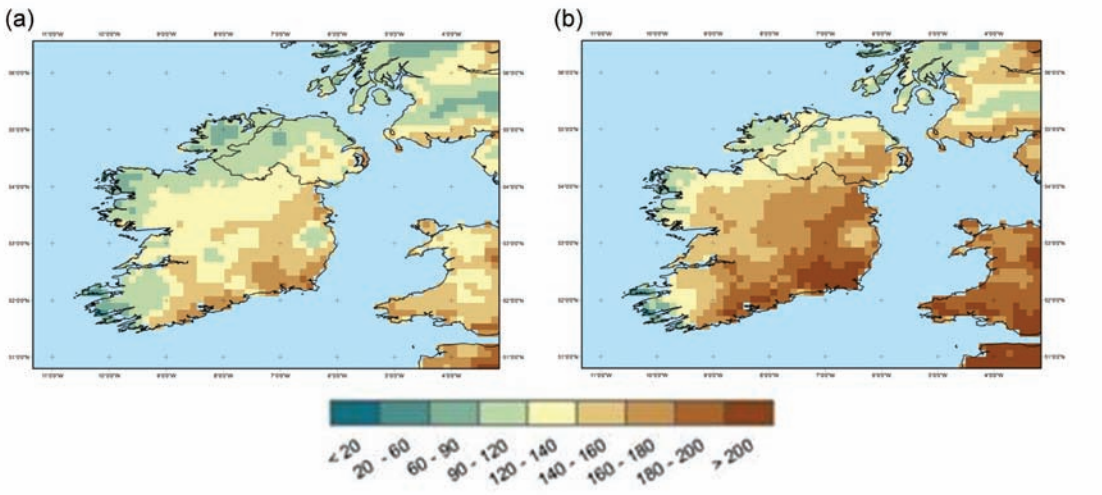

Figure 1: Average moisture deficit (mm) calculated for two 30-year climate periods from c4i regional climate model simulations, for a) the baseline period 1961-1990, and b) the period 2051-2080 for the medium-high carbon dioxide emissions scenario.

Climate change models

The spatial climate data have taken some time to compile. Since Met Éireann supplied gridded data in May 2007, the accumulated temperature index, and moisture deficit index for Ireland for the baseline period and for simulated climate change scenarios have been calculated. Major changes are expected in terms of warmth and summer drought; both factors are important for tree growth and survival. Figure 1 shows a comparison of the measured 30-year mean moisture deficit (MD - a droughtiness index) for the baseline period (1961-1990) and simulated for the period 2050-2080 for a medium-high carbon dioxide emissions scenario.

The impact on trees of frost, wind exposure and other factors needs further research. A wind exposure index calculation (DAMS) for Ireland was completed. The method must now be checked and validated, using daily point wind data from meteorological stations, from which wind speed distribution will be calculated.

ACTIVITIES PLANNED

- Completion and testing of the spatial climate data to be used.
- Description of the soil quality classification with the national soil map.
- Completion of the knowledge-based suitability and yield models.
- Completion of the functional and technical specification of CLIMADAPT for review.

OUTPUTS

Ray, D., Xenakis, G., Semmler, T. and Black, K. (in prep). *The impact of climate change on forests in Ireland and some options for adaptation.* Proceedings of the conference Forestry, carbon and climate change – local and international perspectives. 19 September 2007, Glenview Hotel, Co Wicklow, Ireland, COFORD.

Ray, D., Avery, R. and Xenakis, G. *Report of the expert workshop for tree species suitability in Ireland*. Held at University College Dublin, July 2007.

Ray, D. CLIMADAPT presentation to the CLIMIT international review team at Glenview Hotel in September 2007.

CLIMIT

FORESTSOILC

Soil carbon stock changes and greenhouse gas fluxes in Irish forests

PROJECT TEAM
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COMPLETION DATE
May 2011

OBJECTIVES
- To use the paired plot approach to investigate the effect of afforestation on soil C stocks at 60 forest sites.
- To determine the effect of afforestation and deforestation on CO_2 and CH_4 dynamics in peat soils and to develop CO_2 and CH_4 emission factors for afforested and deforested blanket peat.
- To determine the effect of broadleaf afforestation on mineral soils on soil C stocks.
- To investigate the effect of afforestation on CO_2 and N_2O fluxes in grassland.

PROGRESS
Paired plot sites:
This is being done in collaboration with WP3 from the CARBiFOR II project. The first task completed was the development of soil sampling and laboratory protocols for the mineral soil sites. Forty mineral soil, 10 peaty mineral and 10 peat sites will be sampled. Sites have been selected from National Forest Inventory plots (see CARBiFOR II). Mineral soil sites have been divided into four sampling groups based on soil type (brown earths, podsols, brown podzolics, gleys). At the mineral soil sites paired plots representative of pre-afforestation and post-afforestation conditions will be established. Peat sites will not be paired due to the level of variation in peat depth within sites.

Three National Forest Inventory mineral soil forest sites have been sampled: Killavullen (NFI ID: 6602), Charleville (Ballyhouras, NFI ID: 6610) and Ballingeary (NFI ID: 2769).
At two of the sites (Killavullen and Ballingeary) paired plots have been established. At each of the forest sites soil samples were collected and four soil pits were installed, from which bulk density depth profiles were obtained. Fine woody debris, litter, and humus were also assessed in the afforested plot.

CO_2 and N_2O fluxes in recently afforested grassland:
The eddy covariance CO_2 flux tower is under construction and is expected to be in operation by January 2008.

ACTIVITIES PLANNED
Analysis of soil samples from the paired plots and peat sites.
C stock change in mineral soils: begin after data collection for WP1.
CO_2 and N_2O fluxes in recently afforested grassland: data collection to begin early 2008.

OUTPUTS
Greenhouse gas fluxes in terrestrial ecosystems in Ireland. Poster presented at EPA conference, Delgany, Co Wicklow, September 2007.

Forest Biodiversity

PLANFORBIO

Programme leader: Prof. John O'Halloran

The PLANFORBIO research programme brings together researchers from University College Cork, Trinity College Dublin, Waterford Institute of Technology and Coillte in a multi-disciplinary study of the biodiversity of contemporary Irish plantation forests and native woodlands. This project is led by Professor John O'Halloran (UCC) and managed by Dr Sandra Irwin. The earlier BIOFOREST project provided much needed basic information on the biodiversity of Irish forest ecosystems, but a number of important subjects were outside the scope of that project. These included the study of biodiversity of reforested and intimately-mixed plantations, of native Irish woodlands and, more generally, of forest canopies. PLANFORBIO aims to address these fundamental gaps in our knowledge and also to conduct specific studies on Hen Harrier conservation and the control of *Rhododendron ponticum*. A primary aim of the programme will be to address forest diversity and management focusing on forest types that are currently being encouraged through State policies and financial incentives. These are the Irish forests of the future, and little is currently known about their capacity for biodiversity conservation. Having assessed the woodlands for diversity, the findings will inform management plans for Ireland's forest estate that allow maximum exploitation of their potential for maintenance and conservation of biological diversity. This programme will have a specifically focussed emphasis on outreach and information dissemination through workshops and seminars with target audiences such as forestry contractors and managers, and farm forest owners. PLANFORBIO also supports national strategic objectives of increasing the number of PhDs being trained in Ireland and will ultimately build research capacity that underpins a very important sustainable national industry.

Three projects in the PLANFORBIO programme got underway during 2007:

- **FORESTBIO**: Managing for biodiversity in a range of Irish forest types.
- **HENHARRIER**: Optimum scenarios for Hen Harrier conservation in Ireland.
- **RHODO**: Achieving effective Rhododendron control.

The first of these (FORESTBIO) aims to produce a comprehensive biodiversity survey of a number of Irish forest ecosystems. Forest species targeted by these surveys will include birds, invertebrates (both ground-dwelling and canopy invertebrates), ground-dwelling and epiphytic plants including those associated with the forest canopy. Biodiversity assessments will be conducted at a range of Irish forest sites including reforested plantations, mixed species plantations and native woodlands using a variety of specialist techniques. The RHODO project will address the complexity of the rhododendron control process and investigate ways to make this process more cost-effective. The project aims to tackle these issues in a practical manner that will safeguard environmental quality and to develop alternative methods and skills for controlling a non-native invasive species such as *Rhododendron ponticum*. The third of these projects (HENHARRIER) will look at Hen Harrier ecology, habitat requirements and foraging behaviour as well as compiling a GIS database as a tool to aid decision making in the management of Special Protection Areas for this species. Further information can be found on the programme website at www.ucc.ie/en/planforbio.

This thematic area is also addressed by a stand-alone project, **FUNCTIONALBIO**: Functional biodiversity in forests: diversity of soil decomposers and predatory and parasitic arthropods.

PLANFORBIO

FORESTBIO

Managing for biodiversity in a range of Irish forest types

PROJECT TEAM
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Dr Daniel Kelly, Trinity College Dublin
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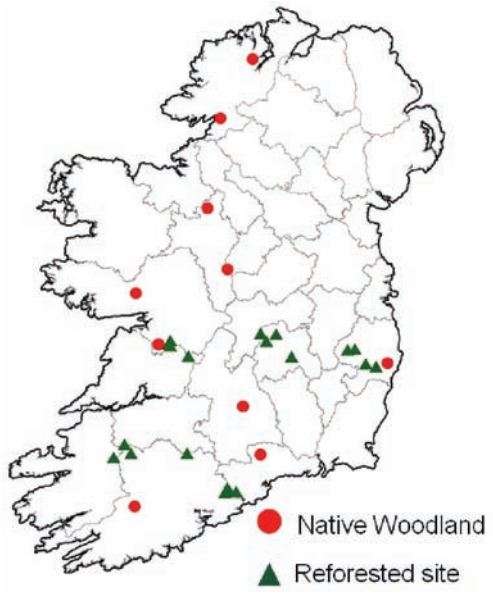
COMPLETION DATE
June 2010



Locations of study sites for 2007 surveys.

OBJECTIVES

- To determine the biodiversity of second rotation forests, forests composed of different mixes of tree species, forests under the Native Woodland Scheme and rehabilitated native woodlands at different stages of the forest cycle.
- To make inter-forest type comparisons and comparisons with data from BIOFOREST project sites to build a picture of the variety of forests in Ireland today.
- To identify indicators of biodiversity for different forest types and describe monitoring techniques for the future in permanently marked study sites.
- To identify measures which may be used to enhance the biodiversity of the different forest types, including second rotation forests, first rotation mixes under conventional afforestation and those under the Native Woodland Scheme.

PROGRESS

FORESTBIO aims to provide an inventory of the higher and lower plants, birds, beetles and spiders of a range of forest types in Ireland together with set of refined protocols for the study of these taxonomic groups. This will be achieved by conducting biodiversity surveys at representative forest sites throughout Ireland. Twenty sites each of three different forest types (reforestation sites, mixed tree plantations and native woodlands) will be surveyed focussing on the following target taxa:

- Birds;
- Ground-dwelling invertebrate animals;
- Canopy invertebrate animals;
- Lepidoptera;
- Ground-dwelling plants;
- Epiphytes.

The bulk of the project fieldwork has been split between two field seasons during the summers of 2007 and 2008. Twenty reforestation sites and

Canopy fogging in background with sample collectors in the foreground.

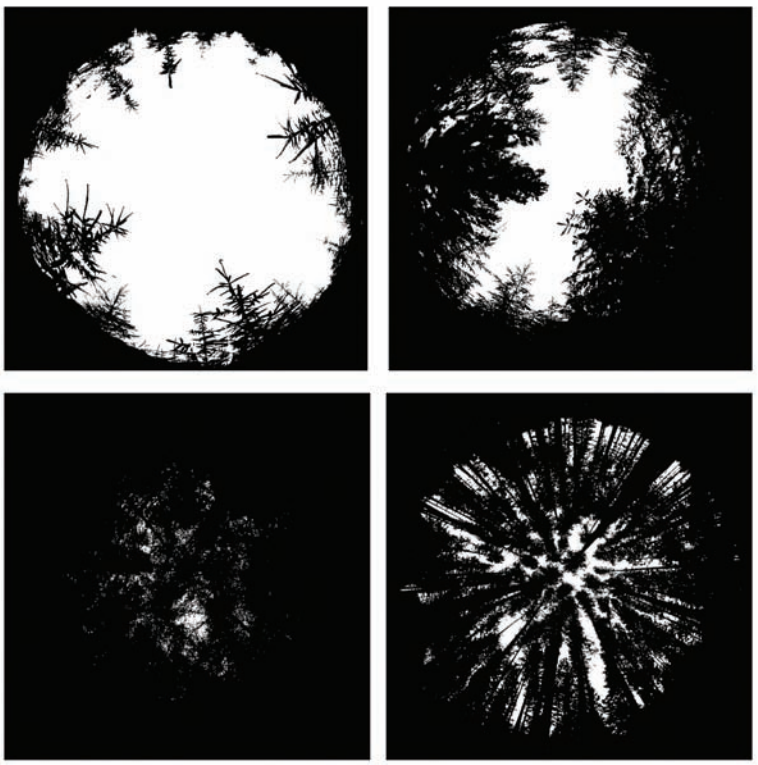
ten native woodland sites (five each of oak and ash) were surveyed during 2007.

Strict site selection criteria for each of the reforestation and native woodland surveys were compiled and used to select suitable study sites prior to commencement of the field season. Biodiversity surveys of a range of taxa were conducted at these sites using a variety of complementary methods:

- Ornithological surveys were conducted twice during summer at each site using point counts which were repeated at a subset of sites during winter.
- Pitfall traps were used to survey active ground dwelling spiders and Carabid beetles while thermal fogging and canopy beating were used to survey invertebrates of the forest canopy.
- Ground flora surveys focussing on cover of each species and including assessment of canopy cover using hemispherical photography and deadwood assessment were conducted in conjunction with epiphyte surveys at two heights, with tree climbing used to access the forest canopy.

ACTIVITIES PLANNED

Winter bird surveys will continue until February 2008. Sorting and identification of invertebrate samples collected during the 2007 field season will be completed where spiders and Carabid beetles from pitfall samples will be identified to species level and various invertebrate groups from the thermal fogging and beating surveys of canopy invertebrates will be sorted and identified. A special study of Lepidoptera will commence in 2008 using light traps and transect walks to survey Lepidoptera at all study sites. Identification of all plant specimens collected will be completed and hemispherical photographs analysed. In all cases priority will be given to samples from the reforestation survey. Data entry to the FORESTBIO GIS database will begin in early 2008 and preliminary data analysis will commence soon after. Analysis of reforestation survey data and comparisons with BIOFOREST



Hemispherical photographs from pre-thicket, thicket, mid-rotation and mature sites respectively.

data will be prioritised and followed by preliminary analysis of 2007 native woodland survey data, ahead of final native woodland surveys during the 2008 field season. Biodiversity surveys of the ten remaining native woodland sites and the twenty mix-species forests will commence in March 2008. Preliminary results from FORESTBIO will be presented at a number of national and international meetings during 2008.

OUTPUTS

Popular articles:

Irwin, S. 2007. Management for biodiversity in Ireland's contemporary forests. *Science Spin* 24:29.

Irwin, S. 2007. Woodland biodiversity v forest industry: Is there an answer? *UCC News* September 2007: 1.

Presentations at workshops and conferences:

Martin, R., Kelly, T., Oxbrough, A., Wilson, M., Irwin, S. and O'Halloran, J. 2007. *Assessing the biodiversity of canopy arthropods in a range of forest types.* Forest Task Force Annual Workshop, Białowieża, Poland, 24 –27 October 2007. (Poster presentation).

Sweeney, O., Kelly, T., Wilson, M., Irwin, S. and O'Halloran, J. 2007. *What affects bird diversity in native and plantation woodlands?* Institute of Ecology and Environment Management Irish Section Conference, Dublin, October 2007. (Poster presentation).

Sweeney, O., Kelly, T., Wilson, M., Irwin, S. and O'Halloran, J. 2007. *What affects bird diversity in native and plantation woodlands?* Forest Task Force Annual Workshop, Białowieża, Poland, 24 –27 October 2007. (Poster presentation).

Theses:

Moore, K. 2007. *Ground flora biodiversity of Sitka spruce reforestation plantations in comparison with afforestation plantations in Ireland*. MSc Thesis, Trinity College Dublin.

Vézeau, C. 2007. *Investigating the light regime over the forest development stages in second rotation Sitka spruce plantations in Ireland*. Project from UREKA site Integrating Ecology and Evolution in a Changing World, Trinity College Dublin.

Inputs to curriculum development and teaching:

Oxbrough, A. 2007. *Spiders as biodiversity indicators in Irish plantation forests*. Biodiversity Components of Forestry Certificate Course, UCC.

Wilson, M. 2007. *Hen Harrier and forestry*. Biodiversity Components of Forestry Certificate Course, UCC.

O'Halloran,J. 2007. *Introduction to biodiversity with particular reference to forests*. Biodiversity Components of Forestry Certificate Course, UCC.

O'Halloran, J. 2007. *Assessing biodiversity in forest: some approaches*. Biodiversity Components of Forestry Certificate Course, UCC.

O'Halloran, J. 2007. *Discussion session: Approaches and challenges in maintaining biodiversity in forests.* Biodiversity Components of Forestry Course, UCC.

PLANFORBIO

HENHARRIER

Optimum scenarios for Hen Harrier conservation in Ireland

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COMPLETION DATE
March 2012

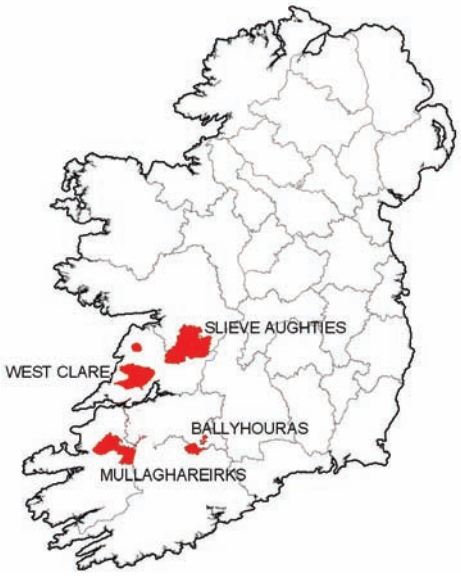

Figure 1: Sites selected for this study.

OBJECTIVES

- To increase our knowledge of Hen Harrier ecology and foraging behaviour.
- To determine the value to Hen Harriers of the main habitats in the SPAs.
- To improve our understanding of Hen Harrier habitat requirements at the landscape level, and revise recommendations accordingly, incorporating these into an Indicative Strategy for Hen Harrier management in the SPAs.
- To compile a GIS database of land use and habitat types within the SPAs, to function both as a tool for decision-making by SPA managers and stake-holders, and as a source of data for researchers.

PROGRESS

A geo-referenced database, with data on breeding Hen Harrier locations, has been compiled from the two national breeding surveys of Hen Harriers conducted in 2000 and 2005. Data from forest and land use databases held by Coillte, the Forest Service, and NPWS have been compiled into a habitat database for the Hen Harrier SPAs. These two databases have been used to conduct a preliminary analysis of Hen Harrier habitat preferences, which is being prepared for publication. The habitat database will ultimately be used to devise a GIS tool for assessing long-term impacts of specific land use changes on Hen Harriers. A review of remote tracking methodologies and capture techniques for Hen Harriers, including more than 400 papers using telemetry from the past two years, has been produced and will be submitted to *The Journal of Wildlife Management* for publication.

Four main sites were selected for the study of Hen Harrier breeding success (Figure 1) and the first fieldwork season was completed during the summer of 2007 in collaboration with the National Parks and Wildlife Service and the Irish Raptor Study Group. Fieldwork to locate nests began in late March when observers identified

Figure 2: Wing tag on Hen Harrier chick.

breeding pairs and pinpointed their nest sites and followed the fortunes of these pairs and their young throughout the summer. Where possible, nests were visited on three occasions to collect data on clutch size and laying date, brood size and fledging success. Following fledging additional information was recorded for each nest. The timing of breeding at each of the study locations differed slightly. The earliest observed hatch date occurred at a Hen Harrier nest in the Ballyhouras during the second week of May 2007, while hatching was completed in that area by the end of June. By contrast, the first chick did not hatch in the Clare study area until the first week of June, while hatching there was not completed until mid-July 2007. Timing of breeding in the Slieve Aughtys and Kerry study areas occurred between these two extremes.

Following training in tagging techniques during a study visit to Spain, tagging of Hen Harrier chicks at nests located in the four study areas was undertaken. A tagging scheme was drawn up to ensure that tag colour combinations were unique. The right wing tag represented the region of the nest from which the bird fledged (Ballyhouras – Yellow; Kerry – Red, West Clare – Green, Slieve Aughtys – Black). The left wing tag represents the year of tagging (2007 – Red). In addition an individual number was included on each tag to represent the individual bird. Each bird tagged was also fitted with a BTO ring on its leg, and several morphometric measurements (weight, wing length, tarsus length and tarsus width) were recorded. A total of 40 chicks were wing tagged during the 2007 season, and of these 15 sightings have been confirmed to date.

ACTIVITIES PLANNED

Fieldwork on Hen Harrier breeding success will proceed as in 2007, with some minor amendments arising from experience to date. Fieldworkers will again collect comprehensive data on breeding biology from the four sites in Figure 1. The Hen Harrier foraging ecology section of this project will get underway and GPS tags to be used for remote tracking will be trialled during 2008. The detachable harness mechanism is still in the developmental stage and so data retrieval will initially be conducted using Bluetooth technology allowing the first GPS data for Hen Harriers in Ireland to be collected. Nest cameras will be deployed at Hen Harrier nests to collect data on food provisioning.

OUTPUTS

Popular articles:

Irwin, S. 2007. Sky Dancer project. *Wings* 46: 17.

Presentations at conferences:

O'Donoghue, B. 2007. *Research on Hen Harriers in Ireland.* Institute of Ecology and Environment Management Irish Section Conference, Dublin, October 2007.

Inputs to curriculum development and teaching:

Wilson, M. 2007. *Hen Harrier and forestry*. Biodiversity Components of Forestry Certificate Course, UCC.

PLANFORBIO

RHODO

Achieving effective rhododendron control

PROJECT TEAM

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COMPLETION DATE

November 2011

OBJECTIVES

- Increase knowledge of rhododendron invasion through investigation of seed longevity, growth rates and soil characterisation.
- Investigate optimum control techniques for rhododendron including stem injection, stump treatment and organic methods.
- Produce a best practice manual for rhododendron clearance based on a set of judicious control trials, quantitative monitoring and planning tools.
- Economic assessment of clearance costs for rhododendron.
- Produce national policy recommendations based on the findings of the project.

PROGRESS

Signing of the project contract was delayed until October 2007.

ACTIVITIES PLANNED

A thorough literature review will be undertaken. Work will commence on the basic ecology of the invasion process of rhododendron, with identification of sites, setting up trials, soil sampling and analysis, and the commencement of the collection and collation of data. A best practice manual will be explored with the Advisory Committee to decide on the best way to progress this, but it is envisioned that work on identification of a biological control for rhododendron may also be carried out. Management, supervision and outreach will continue throughout the year.

FUNCTIONALBIO

Functional biodiversity in forests: diversity of soil decomposers and predatory and parasitic arthropods

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COMPLETION DATE
September 2010

OBJECTIVES
Work Group 1:

- to compile a literature review of previously conducted biodiversity studies that relate to this project.
- to select the forest sites in Ireland where field sampling will be conducted in collaboration with groups from UCC and TCD.

Porobelba spinosa - a species of mite found in the canopy of oak. Species from this genus have not previously been found in Ireland. The shed exuviae (skins) of the animal remain attached and can be seen in the photograph.

Work Group 2:

- to compile a macrofungal basidiomycete and ascomycete inventory of selected woodland sites encompassing the following functional groups: ectomycorrhizal fungi, saprotrophs, pathogenic wood-decay fungi.
- to obtain information on the abundance of fruiting bodies of edible forest fungi in the selected woodland sites.
- to relate fungal diversity to site and management factors such as native/non native broadleaf vs plantation conifer canopy, conifer/broadleaf mixtures, second rotation vs first rotation plantation, stand age, soil type, herb layer vegetation.
- to relate the efficiency of fungal biodiversity indicators to other biodiversity indicators in Irish forests.

Work Group 3:

- to assess additional aspects of biodiversity (Hemiptera, parasitic Hymenoptera, nematodes and soil microarthropods) in forests that have not been covered by the BIOFOREST project (2001-2006).
- to assess the below-ground biodiversity of forests in detail
- to provide inventories of the biodiversity in the habitats studied.
- to develop methodologies to assess biodiversity in forests.
- to draw up recommendations to enhance biodiversity in plantation forests.

PROGRESS
The literature review is ongoing. Lists of mite species recorded from forests have been compiled and reviews of the Collembola, Hemiptera, parasitic Hymenoptera and nematodes are ongoing.
Five sites have bee selected in each of the following general areas (Wicklow/Kildare, Laois/Offaly, Clare/Galway, Sligo/Roscommon

and Cork/Kerry). In each of these areas first and second rotation Sitka spruce, Scots pine, ash and oak are being selected. Nine of these sites were selected during 2007 and further potential sites will be visited.

Each site was visited a number of times during the autumn and all fungal species observed fruiting collected, enumerated (fruiting body counts where applicable, especially of edible species), and identified to species where possible. Digital photographs have been taken of most of the larger species, and voucher specimens of unidentified and critical species have been retained for confirmation by experts. Preliminary information on environmental factors such as substrate and vegetation were gathered.

The project achieved all of the objectives set out for autumn 2007, i.e. to commence compilation of a macrofungal basidiomycete and ascomycete inventory of the selected woodland sites, and data on abundance and environmental variables.

ACTIVITIES PLANNED

Sampling of sheathing mycorrhizas (primarily ectomycorrhizas) on roots of tree species will commence in late spring 2008. Sampling of ectomycorrhizas will involve collection of root samples from selected trees by soil coring. Ectomycorrhizal (EM) types will be extracted from soil cores and characterised on their morphology using the morphotyping protocols of Agerer (1991). Samples of characterised mycorrhizas will be preserved at -80°C for identification using DNA methods.

Commencing in September 2008, the sites first sampled in autumn will be re-sampled for functional groups of macrofungi.

The limited number of samples taken during 2007 have been sorted and are currently being identified. Due to poor weather conditions, this programme is behind schedule and will require increased activity during summer 2008. However, the samples collected have already provided interesting material which will provide useful baseline information and further experience with the identification of these animals.

Tree climbing was carried out at nine sites. This has proved successful and a number of species new to Ireland have already been identified.

Soil microarthropods sampled at nine sites were sorted and are currently been identified. Further sampling will be required at each of these sites.

These activities will contribute to the provision of inventories of the biodiversity in the habitats studied.

The experience gained with sampling and the selection of taxa to examine have already provided indications of the methods of sampling and taxa which could be used in the assessment of biodiversity in forests.

Further activities for 2008 will include the completion of the lists of the species of mites occurring in the samples collected by climbers, of springtails occurring in samples of all kind already collected, of parasitic hymenoptera and spiders from the limited number of fog samples collected during summer 2007; as well as final site selection and completion of soil and canopy sampling.

Preparing to fog the canopy.

Forests and Water

Since the 1920s the Irish landscape has undergone a unique transition from being virtually treeless to supporting a highly productive and intensively managed forestry sector, based on plantations. The establishment of these plantations has resulted in large scale land use changes. It is only in recent decades that we have we become more aware of the interaction between these new forests, the atmosphere, the soil and surface waters. In some cases, new forests have presented a threat to the sustainability of our soil and water resources. An understanding of ecosystem processes is essential for the successful implementation of sustainable forest management and the minimisation of potential negative impacts.

A number of scientific studies on the interactions between forests and surface water quality have been carried out since the early 1990s. These have provided us with a deeper understanding of these interactions and have led to the introduction and implementation of Forest Service guidelines on forest operations and water quality. There is, however, a need to understand the long term implications of these interactions and the projects described below are contributing to our knowledge in this regard.

The FORFLUX Project aims to develop a better understanding of biogeochemical cycles and the influence of forest cover on nutrient and water fluxes. The research will directly quantify nutrient inputs through weathering, and losses through leaching and uptake, allowing for a more complete assessment of the potential long-term impacts of changes in forest management practices. This information is fundamental to supporting critical load and dynamic geochemical model assessments aimed at defining long-term ecosystem sustainability. The results of the study will inform policy and practice in relation to forest location and practices.

Ground disturbing operations such as cultivation and harvesting, unless executed with due care, have the potential to cause release of solids and nutrients from soils, causing damage to receiving waters. The SILTATION project (jointly funded by Coillte, EPA and NPWS) has provided valuable insights into pattern and extent of sediment and phosphorus release, and the impacts on instream biota, following clearfelling in a peatland catchment. This work is continued and extended in the SANIFAC project. It has the objective of developing sustainability guidelines for clearfell-sizing and harvesting management of forest coupes within peatland catchments; so that losses from forestry activities are mitigated by dilution or buffer zones, in order not to adversely affect the biota in salmonid receiving waters. The guidelines will be based on comprehensive physical, chemical and biological novel experiments in the field and laboratory; and syntheses of fluxes of water, soil and nutrient inputs, uptakes/releases and outputs.

This thematic area comprises the following projects:

- **FORFLUX**: Biogeochemistry of Irish forests.
- **SANIFAC**: Establishment of erodibility indices and soil and nutrients losses from forest soils.
- **SILTATION II**: Quantification and management of erosion and siltation.

FORFLUX

Biogeochemistry of Irish forests

PROJECT TEAM

Prof. E.P. Farrell, University College Dublin*
Prof. Chris Műller, University College Dublin
Prof. Julian Aherne, Trent University, Canada
Dr Pat Neville, Coillte

** Address correspondence to:*
ted.farrell@ucd.ie

COMPLETION DATE

November 2010

OBJECTIVES

- To quantify major nutrient pools and fluxes at Irish forest monitoring plots.
- To develop tools to support the assessment of sustainable forest management.

Sub-objectives are:

- To quantify atmospheric ammonia concentrations at long-term monitoring plots;
- To analyse the trends in long-term records of rainfall, throughfall and soil water chemistry at forest monitoring plots;
- To model soil water percolation at forest monitoring plots;
- To estimate nutrient (nitrogen,) concentrations in Irish forests;
- To assess weathering rates (and release of base cations (calcium, magnesium, potassium and sodium) for forest soils.

PROGRESS

The project commenced in December 2007 and is at the initiation stage. Several meetings of the project team, including sub-contractors, have been held.

ACTIVITIES PLANNED

- Establishment of ammonia monitoring stations; SO_2 and NO_x monitors may also be included.
- Development of forest database and time-series analysis.
- Collection of data for the modelling of soil water percolation.
- Collection of data for the determination of nutrient pools.
- Preliminary work on the development of input-output budgets.

SANIFAC

Establishment of erodibility indices and soil and nutrients losses from forest soils

PROJECT TEAM
Dr Michael Rodgers, NUI Galway*
Dr Liwen Xiao, NUI Galway
Mark O'Connor, NUI Galway

** Address correspondence to:*
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COMPLETION DATE
July 2008

OBJECTIVES

- Establish the erodibility indices of at least six vulnerable forest soils – disturbed and undisturbed.
- Quantify the amount of sediment and nutrients leaving flume soil slabs during simulated flood events.
- Develop models from the flume data to estimate the amount of sediment and nutrients discharged from the Burrishoole catchment and compare this estimate with the results from the COFORD/EPA field study.
- Examine the effects of buffer strips and nutrient adsorption materials in the flumes.
- Assess the Forest Service *Forestry and Water Quality Guidelines* using results from this flume and field work.
- Continue to monitor the flows, and sample the waters for sediment and nutrient analyses in the SILTATION project area.

PROGRESS

A steel flume, 225 mm deep x 225 mm wide and 3 m long (Figure 1), is used in this study to simulate the overland flow process and to compare the effects of flow rate, slope and disturbance on the erosion of the Irish forest soils. Slabs of peat, of depth 200 mm, were excavated carefully with minimal disturbance from between the brash windrows at the Burrishoole study site, and placed directly into the flume. After saturation for 24 hours, tap water was pumped to a small reservoir at the head of the flume and from there it passed over a flat weir, the crest of which was 10 mm above the surface of the soil slab. The weir ensured an even distribution of the flow over the width of the sample. Runoff samples from the exit of the flume were taken every two to four minutes during a one-hour

Figure 1: The flume testing.

period. The samples of the runoff were tested for suspended sediment in accordance with the Standard Methods (APHA 1995) using Whatman GF/C (pore size 1.2 µm) filter paper. Figures 2 and 3 show the suspended sediment concentrations and the sediment loads released from the peat and sandy soil under different controlled conditions. For the slope of 15 degrees and a flow rate of 0.046 l/s, very little sediment was lost from the undisturbed peat; the maximum concentration and total loss were 5 mg/l and 0.037 g, respectively, during the one-hour test period. Under the same slope and flow conditions, substantially more sediment was washed away from the sandy soil; the maximum concentration was greater than 5100 mg/l and more than 200 g sediment was released.

ACTIVITIES PLANNED

- Soil samples from other forest catchments will be tested using the flume to establish their erodibility indices.
- Data collected from the flume study will be used to develop models to estimate the amount of sediment released.
- Continue to monitor the flows, and sample the waters for sediment and nutrient analyses in the Srahrevagh study area.

OUTPUTS

Michael Rodgers, Liwen Xiao, Mark O'Connor. *Phosphorus and sediment release from a forest catchment in Burrishoole, Co Mayo*. EPA Annual Conference. The Royal Hospital, Dublin. (February 6 – 7 2008) – Poster.

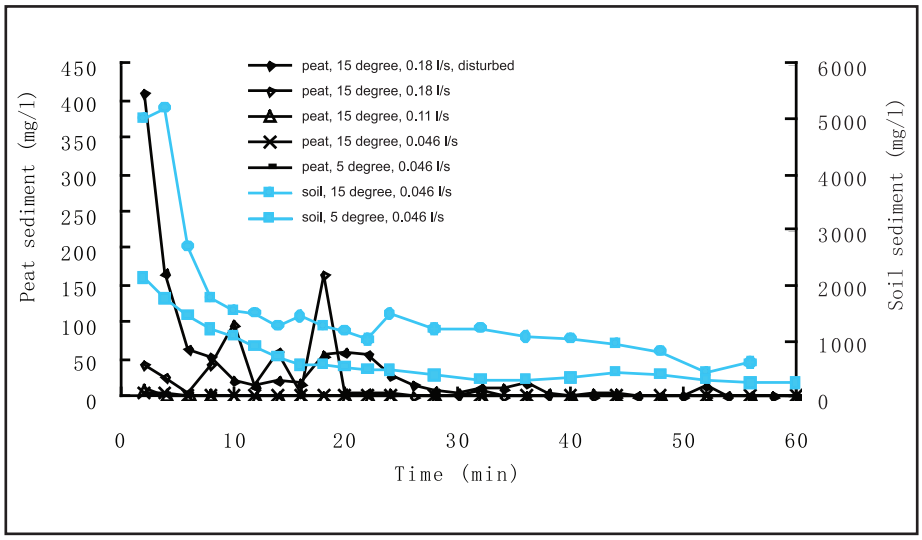

Figure 2: The suspended sediment concentrations recorded in the test.

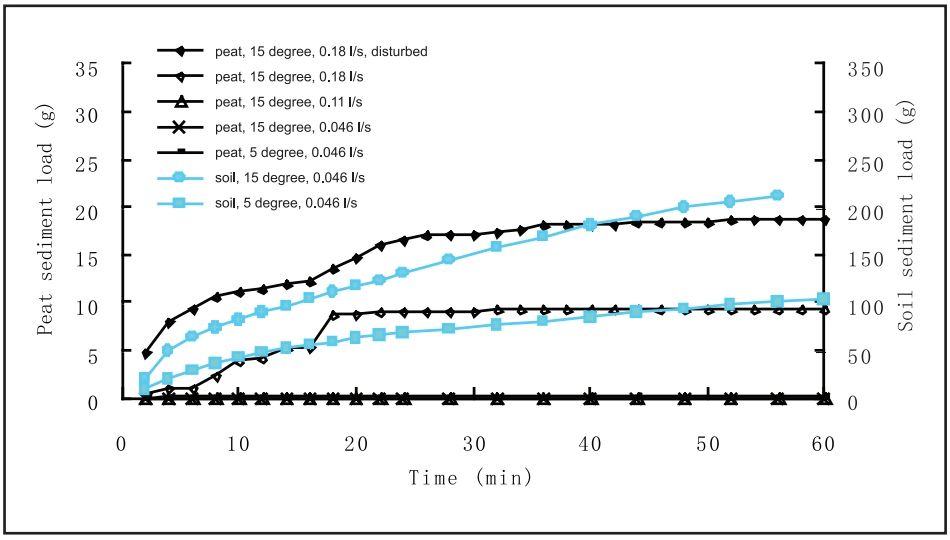

Figure 3: Sediment loss against time.

SILTATION II

Quantification and management of erosion and siltation

PROJECT TEAM
Dr Michael Rodgers, NUI Galway*
Dr Liwen Xiao, NUI Galway
Mark O'Connor, NUI Galway

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michael.rodgers@nuigalway.ie

COMPLETION DATE
July 2007

OBJECTIVES
To analyse the effects of forest clearfelling and harvesting operations on:

- the suspended sediment and phosphorus concentrations in a peat catchment drainage stream.
- other biological and physico-chemical parameters, e.g. pH and temperature in the catchment drainage stream.
- the hydrology of a stream draining a blanket-peat catchment.

PROGRESS
The project finished in July 2007. The final report has been submitted to COFORD and the EPA. The clearfelling and extraction operations in the Srahrevagh river catchment site (Burrishoole, Co Mayo) employed best management practices, which included not carrying out any field work during wet periods. The operations commenced on 25 July, 2005 and lasted for eight weeks. Two monitoring stations were established, one upstream (US) and the other downstream (DS) of the selected clearfell area, to study the effects of the operations on the hydrology, sediment losses, water phosphorus, water physico-chemical and biological parameters in the first order stream flowing through the blanket peat catchment site. Measurements were taken before clearfelling for about one year, during clearfelling and extraction, and post-clearfelling for about 19 months.

From the present analyses, clearfelling and extraction had very limited impact on flood risk downstream in this study (Figure 1). A similar study of felling has recently been reported from Wales where the site was physically similar to that at the Srahrevagh study site, Burrishoole, with a high annual rainfall (>2,000 mm) and peat soils with open drainage. The impacts on streamflow in the Welsh sites were closely monitored in nested catchments from 1 to 10 km^2 in size. Commercial felling followed the GB Forestry Commission's harvesting guidelines (Forestry Commission 2003). It was found that there was a significant increase in baseflows but a change in peak flows (Robinson and Dupeyrat 2005) was not detected. The similar peak flow result at Burrishoole may be due to the care taken to comply with the Forest Service guidelines (2000 a,b). Taken together, the results of the Welsh and Burrishoole studies, and that of more recent published literature indicate that properly conducted felling can have a very limited impact on flood risk downstream.
In base flow conditions, the suspended sediment (SS) concentrations at the US and DS stations were always low before, during and after clearfelling and extraction (Figure 2). From

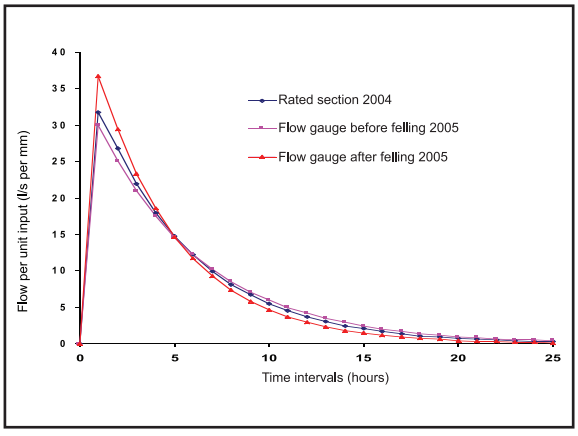


Figure 1: Storm unit hydrographs (one-hour) for the downstream gauge for the periods before felling (rated section and subsequent flow gauge) and after felling.

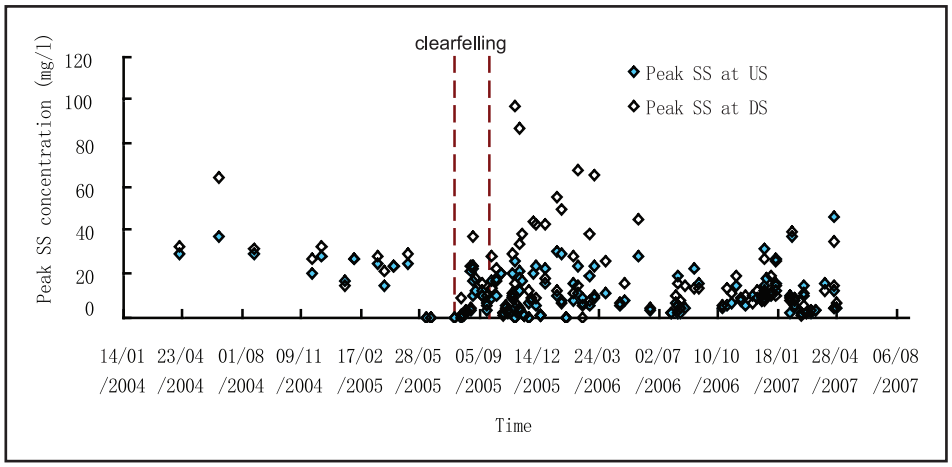


Figure 2: Daily peak suspended solid concentrations at the upstream (US) and (DS) stations during the study period.

November 2005 to April 2006 there were significant differences between the daily peak US and DS concentrations. From May 2006 to May 2007, the SS concentrations at the US and DS stations were similar, indicating that the effect of clearfelling and extraction on SS concentrations in the study stream appears to have ceased (Figure 2). During the clearfelling and extraction period (August and September, 2005), about 13 kg SS/ha were released from the undisturbed forest catchment and 25.8 kg SS/ha from the harvested catchment. In the first year after clearfelling and extraction (2012 mm rainfall), the net SS release rate from the harvested catchment was 272.6 kg SS/ha/year, which was greater than the 172 kg SS/ha/year released from the undisturbed forest catchment.

Measured P concentrations entering the harvested part of the study catchment through the US station were low, with average values of 14 µg TP/l and 6 µg TRP/l. The average P concentrations in the rainfall were 13 µg TP/l and 4 µg TRP/l (Figure 3). The P concentrations rose after clearfelling to a first peak daily average concentration of 187 µg TRP/l in November 2005, and then reduced, with temporal variations, to summer 2006. After a particularly dry spell in June and July 2006, the highest peak daily average concentration of 429 µg TRP/l was measured in August 2006, a year after clearfelling commenced. The daily average P concentration of about 100 µg TRP/l was recorded at the end of April 2007, 19 months after the operations were completed (Figure 3). During the clearfelling and

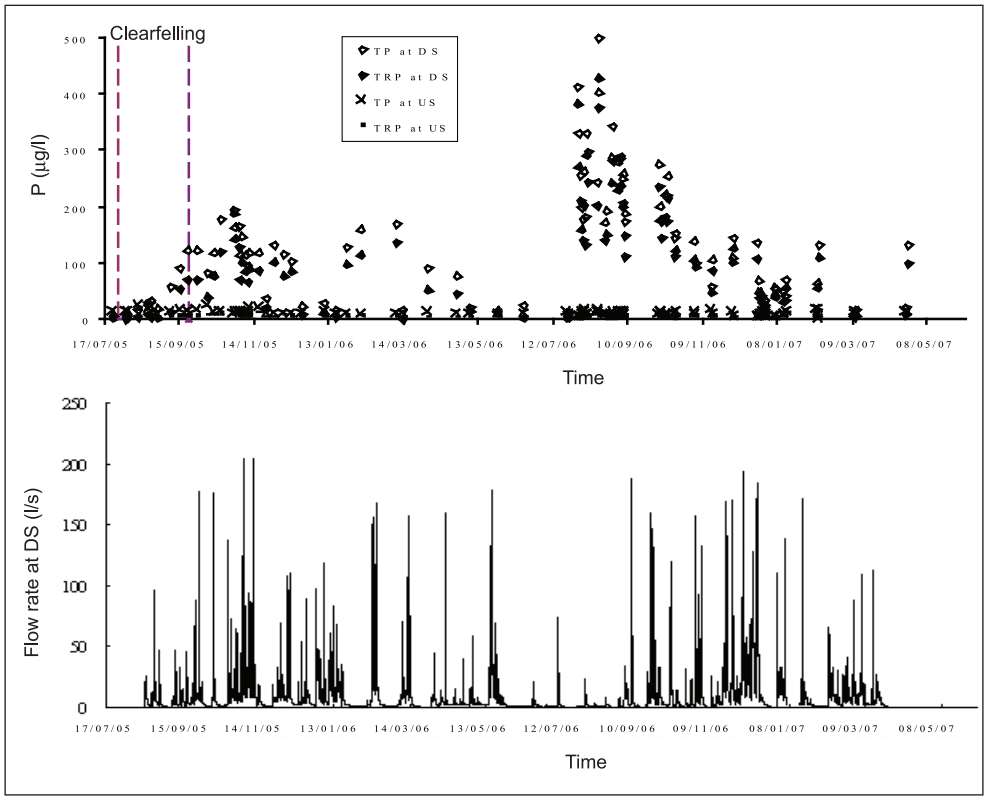


Figure 3: Average daily phosphorus concentrations at the upstream US and downstream DS stations and the flow rate at DS during the study period.

extraction period, an estimated net 120.6 g TRP/ha were released from the harvested area. In the first year after clearfelling - October 2005 to September 2006 - net P load release rates were estimated at 2243.9 g TRP/ha.year from the 10.5 ha harvested site and 20 g TRP/ha.year from the 7.2 ha forested upstream site. Because of the available dilution in the receiving river downstream of the study site - based on the relative sizes of the river and study catchments - phosphorus exiting the clearfelled area only slightly increased the phosphorus concentration in the receiving river. Average concentrations in the receiving river were 5 µg TRP/l above and 9 µg TRP/l below the confluence of the study stream and the river.

The macroinvertebrate survey of the study stream indicated that there had been no significant change in the assemblages following clearfelling (Figure 4). However, in coming to this conclusion, it must be acknowledged that the baseline assemblages (2004 and 2005) were fairly depauperate, comprising only small abundances of acid tolerant species. The plecopteran species, which are very sensitive to eutrophication, appeared to be unaffected by the clearfelling operations. The depauperate assemblages may be due to two factors – the acidification effects of the forest over the last three decades, or the temporal nature of water flow given the size of the stream. Long-term monitoring of this site will be useful in assessing whether the stream is capable of supporting a more diverse and abundant macroinvertebrate fauna without the influence of closed canopy forestry.

ACTIVITIES PLANNED

The project finished in July 2007.

OUTPUTS

Rodgers, M., Xiao, L. and O'Connor, M. The effect of clearfelling and harvesting operation on phosphorus release from soil to water (Submitted to *Journal of Environmental Quality*).

Xiao, L., Rodgers, M. and O'Connor, M. The effect of clearfelling and harvesting operation on suspended sediment release from soil to water. (Ready to be submitted).

Rodgers, M., Xiao, L. and O'Connor, M. The effect of clearfelling and harvesting operation on water quality: a literature review. (Ready to be submitted).

Xiao, L., Rodgers, M. and O'Connor, M. Preliminary model of phosphorus movement from a blanket peat catchment to water in the west of Ireland. (Ready to be submitted).

Rodgers, M., Xiao, L. and O'Connor, M. The effect of clearfelling and harvesting operation on river water temperature and pH. (Ready to be submitted).

Rodgers, M. and Xiao L.W. *Sediment and nutrient load patterns in forested streams*. In: National Technical Workshop for Programme of Measures National Study Forest and Water, Talbot Hotel, Wexford (March 2007).

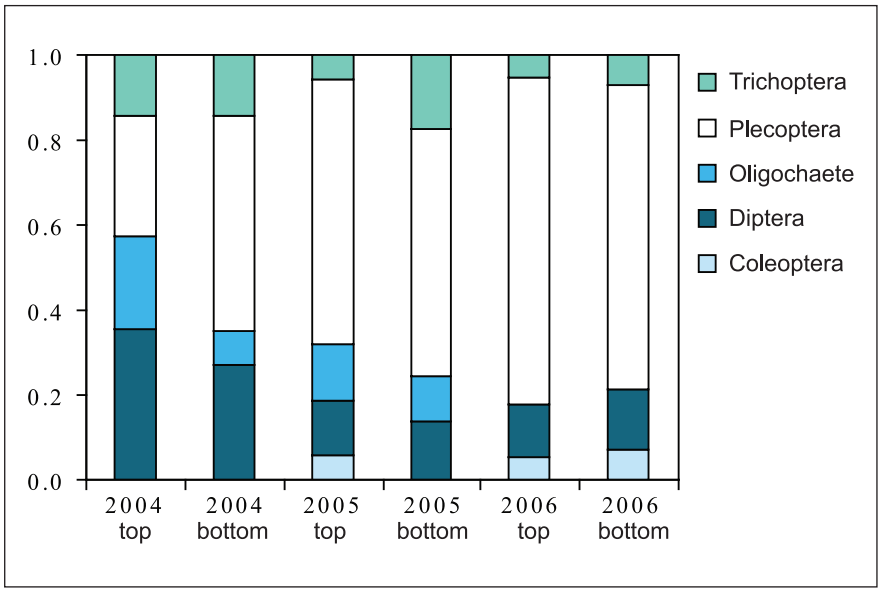


Figure 4: Percentage composition of macroinvertebrate samples taken from two sites of the experimental stream in the Srahrevagh River sub-catchment.

Forests and Recreation

Recreational use of forests, both state and private, is set to grow significantly as a result of increased levels of urbanisation, growing wealth and leisure time and increasing interest in outdoor pursuits, as well as the growth of special interests in all aspects of nature. The change in the forestry sector with diversification into recreation is creating a need for research, training, technical updates and special new skills development.

With the launch of the report *Review of Forest Recreation Research Needs in Ireland* COFORD acknowledged the role of an important non-timber forest product: forest recreation.

Forest recreation has been a management objective in the Irish forest estate since the opening of Ireland's first forest park at Gougane Barra in 1966; however, developments in forest recreation have not always had the highest priority in a developing forest industry. Clinch (1999) states that while there has been a serious deficiency in data on forest recreational use he estimated a total of 8.5 million annual visits to Irish forests at that time. More recently, the publication of Coillte's *Recreation Policy – Healthy Forest, Healthy Nation* in 2005 and the Forest Service's *Forest Recreation in Ireland – A Guide for Forest Owners and Managers* in 2006, have given a new impetus to the development of forest recreation in Ireland.

Today, forest recreation users are arguably more active and environmentally aware than those of a generation ago. Consequently there are new and increasing demands being made on the forest for recreation, and forest managers need to address a wide range of issues dealing with the provision of recreation. These can range from the impact that recreation usage can have on forest activities, biodiversity or indeed other users, to the need to create woodland amenities within easy reach of a growing urban population. Recreation also has an important part to play in education on several levels. Furthermore the relationship between forest design, town planning and the use of forests are all linked to recreation in one way or another.

Research is currently underway on specific aspects of forest recreation as part of two wider studies on forest economics funded by COFORD. The FORECON project aims to explore the interaction between different approaches to forest management and the values assigned to recreation; and also the inter-relationship between recreational motivations and site satisfaction. The FIRMEC project focuses on modeling where the demand for recreation, particularly in relation to farm forests, is likely to occur. The combination of outputs from these projects will facilitate the generation of cost-benefit analysis of forest recreation and quantify its economic contribution to national, regional and local economies (see the Forest Economics and Policy section of this report for further details).

COFORD will be funding further research on forest recreation and a call for project proposals is in preparation.

[1] *Clinch, J.P. 1999. Economics of Irish Forestry: Evaluating the Returns to Economy and Society. COFORD, Dublin.*

FINANCIAL STATEMENT

EXPENDITURE[1]

	2007 €'000	2006 €'000
1. Sectoral research and development		
Reproductive material and forest nurseries[2]	279	200
Silviculture and forest management[3]	892	514
Harvesting and transport[4]	143	9
Wood processing and product development[5]	491	172
Socio-economic aspects of forestry[6]	13	22
Environmental aspects of forestry[7]	969	226
	2,786	1,143
2. Linkages and technology transfer		
Linkages[8]	16	30
Technology transfer	886	816
	902	846
3. Salaries and running costs		
Salaries	268	260
Running costs	250	446
	518	706
TOTAL	**4,207**	**2,695**

INCOME[9]

	2007 €'000	2006 €'000
Income	22	51

1 *COFORD operates a cash-based accounting system, in keeping with Department of Agriculture, Fisheries and Food procedures.*

2 *Forest genetics and seed, nursery practice, micropropagation of planting stock, storage, handling and transport of planting stock, and seedling physiology.*

3 *Forest establishment and regeneration, spacing and thinning, decision support models, pruning and shaping of forest crops, short rotation wood fibre and energy crops.*

4 *Harvest scheduling and planning, harvesting methods, forest roads, wood transport systems and logistics, environmental aspects of forest harvesting and wood transport.*

5 *Wood properties, timber drying, finishing and preservation, strength properties of timber, timber grading, storage of timber, timber engineering and product development.*

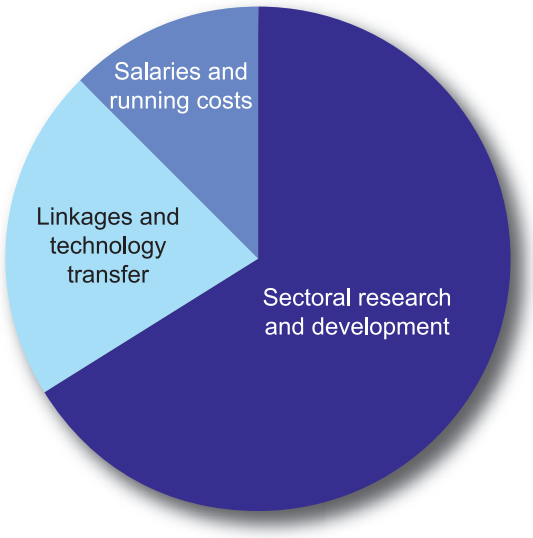
6 *Macro economics of Irish forestry, sociological aspects of forestry.*

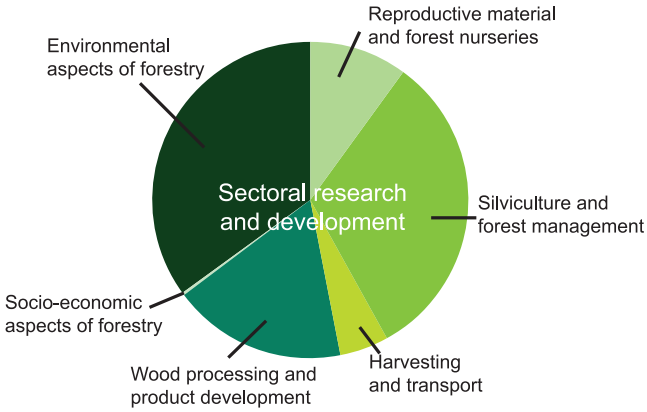
7 *Environmental aspects of forestry, biodiversity, water quality and carbon sequestration.*

8 *Attendance at conferences by COFORD, networking and knowledge transfer support initiative, COST meetings.*

9 *COFORD income is from sales of publications, attendance fees for conferences and workshops, and software licensing. Income in 2006 included payment for wood chip arising from forest energy demonstrations.*

COFORD EXPENDITURE 2007





INTERNAL FINANCIAL MANAGEMENT AND CONTROL

The COFORD Council approves in advance the yearly budget of expenditure under the research and development, technology transfer, researcher training and running costs sub-measures. All new research and development projects are approved by the Council. The executive reports to the Council on expenditure against budget.

The executive has delegated authority to approve projects up to a limit of €30,000 per project (COFORD contribution) and up to €150,000 in any one financial year. Approval of expenditure is by the Director.

Financial risks related to projects are appraised by the executive during project budget negotiations. Expenditure claims are assessed by the Financial Administrator and by the Accounts Division of the Department of Agriculture, Fisheries and Food. Performance against budget is assessed by COFORD staff prior to project expenditure approval. An in-house management information system tracks project expenditure. Expenditure against financial commitment items is also tracked on the SAP system of the Department of Agriculture, Fisheries and Food.

COFORD's accounts and financial procedures are subject to periodic audit by the Internal Audit Unit of the Department of Agriculture, Fisheries and Food. COFORD reports expenditure against budget on a monthly and quarterly basis to the Forest Service. Public procurement rules are followed for all COFORD expenditure.