COFORD Annual Report 2006
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COFORD Council

Mr David Nevins, Chairman

Mr Malcolm Beatty, Forest Service Northern Ireland

Mr Michael Bulfin, Teagasc

Ms Angela Coffey, Irish Timber Growers' Association

Mr Donal Fitzpatrick, Irish Forestry Contractors' Association

Professor John Gardiner, Head of Department, Department of Crop Science, Horticulture and Forestry, University College Dublin

Mr John Jackson, Irish Farmers' Association

Mr Michael Lynn, Irish Timber Council

Mr Diarmuid McAree, Forest Service

Mr John McCarthy, None-so-hardy Nurseries

Mr Gerard Murphy, Coillte

Mr Pat Rath, Farmer representative

Mr George Whelan, Smart*Ply*

The 45th COFORD Council Meeting was held on Friday 17 February 2006 at the Mill Park Hotel, Donegal. The 47th COFORD Council Meeting was held on Thursday 13 July 2006 at the Stillorgan Park Hotel, Dublin. The 48th COFORD Council Meeting was held on Friday 24 November 2006 at the Stillorgan Park Hotel, Dublin.

COFORD Executive

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CHAIRMAN'S REPORT

I am pleased to present this report on COFORD's activities during 2006 to Mary Wallace T.D., Minister of State for Forestry, at the Department of Agriculture and Food.

COFORD's 2006 expenditure of €2.7 m was below our indicative budget of €4.0 m due to staff shortages, which seriously curtailed our ability to call for proposals and fund research in important areas, including forest reproductive material, forests and water and silviculture. Projects in all of these areas were completed during 2006 but continued R&D investment is required to develop the knowledge and systems needed to underpin competitiveness and effective delivery of environmental services.

Despite severe staff shortages, a wide range of relevant R&D projects, outlined and reported on here, was funded. A new call for proposals was launched, with over twenty new projects being approved for funding by the council. Knowledge transfer continued across a range of areas from economics to climate change, to advice on forest practice. Six conferences and ten workshops were held during the year, addressing a range of topics and issues of direct relevance to the forestry sector. These activities took place against a background of COFORD staff involvement in many national processes, including genetic resources, renewable energy, forest carbon reporting, and national forest policy and legislation.

Year end also marked the final phase of the current COFORD funding programme under the National Development Plan, 2000-2006. During this period COFORD achieved and indeed exceeded most of the target indicators set under the programme – 60 companies involved in COFORD-funded projects, over 30 projects resulting in products, processes and services taken up by the industry, 53 publications, and close on 70 peer-reviewed publications arising from COFORD-funded work. But indicators tell only a part of the COFORD story – the organisation has been an instigator of innovation and change in the forest sector, has provided leadership in developing new practices and approaches, and has made a significant contribution to the policy arena. All this has been achieved with an overall programme expenditure of just over €12 million, an outcome that represents excellent value for money. It could not have been achieved without the support of the many companies and individuals in the forest sector who gave of their time and resources to COFORD, which I wish to acknowledge here.

Given the successful conclusion of the COFORD programme, I reluctantly decided to step down as chairman of COFORD at the final council meeting of the year, held in November. Since first assuming office in October 1998, I have seen the forest sector's annual output and grow to well over €1.7 bn in 2006. I have also witnessed the impact of COFORD-funded research right across the sector, and the contribution it is making to sustaining growth in output, not only in monetary terms but also to forest services, such as reducing the impact of climate change, and water quality enhancement.

Over the course of the last eight years I have been fortunate to work with a dedicated and committed council. All members have contributed to providing policy direction for COFORD, through open and full debate on the R&D and technology transfer programmes. I extend my thanks to them for their contributions and support. I also want to fully acknowledge the support I have had from the Department of Agriculture and Food at ministerial and official levels.

Without the full support of the COFORD executive we would not have been able to achieve what we did during the 2000-2006 programme. I extend my thanks to all members of the hard-working and dedicated team and I wish them every success in their important endeavours in the years to come.

David Nevins, Chairman

DIRECTOR'S REPORT

Transferring results into practice is one of the most important tasks undertaken by any research organisation. COFORD's close links to practice and the forest industry makes this role particularly important. Knowledge transfer, is, however, a two-way process, and to be effective it needs to be driven by demand from practitioners and policy makers, as well as by inputs from researchers. COFORD's clear role is to facilitate this transfer, champion new ideas and ways of working, and challenge convention.

Adapting to changing conditions and demands provides a dynamic in which demonstration and technology transfer play important roles. A good example was ForestEnergy 2006, a demonstration and technology transfer programme that was funded by COFORD. Most of the work was carried out by Waterford Institute of Technology and Danish Forestry Extension, in close collaboration with COFORD staff, and the Teagasc team of forestry advisors. The programme was geared to the needs of practitioners and forest owners who wanted to know how to go about producing quality wood fuel from forest plantations. It turned out to be a highly successful venture, in terms of attendances and providing much needed information for the rapidly developing wood energy sector. Data on machine productivity and performance and fuel quality were also collated throughout the programme and were disseminated at the final conference held in December. In commissioning and funding the work COFORD deliberately built on previous research carried out in Ireland, Denmark and elsewhere. Given limited resources, using research findings from abroad is an approach that extends and adds value to nationally-funded research.

Another example of a value-added approach has been the development of GROWFOR, a suite of dynamic yield models for the main conifer species in Ireland. This work builds on national programmes of research carried out by the Forest Service, and subsequently by Coillte, over a period extending back to the 1960s, as well as a number of projects funded by COFORD. During the year work on the GROWFOR interface has resulted in a fully fledged stand modelling and forecasting tool that now incorporates a very useful timber valuation module. Courses for registered users of the system were established and rolled out in 2006, as was an online advisory service. The system has been delivered by a collaborative partnership involving Coillte, Purser Tarleton Russell Limited and COFORD. The long-term objective is to develop, through continued investment in research and technology, a comprehensive national system of stand management and forecasting, based on new and updated models and interfaces.

COFORD's range of research-based advice at our websites now includes stand management, wood product specification and forest energy. During 2006 we began planning the addition of carbon sequestration and windthrow modules, which will come on stream in 2007.

COFORD's knowledge transfer policy is also closely tied to workshops on specific topics given by research project leaders, often with the input of outside experts. An example was the series of workshops on forests and siltation, aimed at forestry practitioners, organised by the Civil Engineering Department, National University of Ireland, Galway, with input by Professor Calvin Rose, Griffith University, Brisbane. Most of the information disseminated at the workshop has been developed in the course of the SILTATION project, being undertaken by NUIG, and funded by a number of government agencies, including COFORD. Work in the project is focusing on quantifying the impact of forest operations on water quality and biota in the Burrishoole catchment in Co Mayo, in co-operation with the Marine Institute.

University College Cork, on its own initiative, has taken the knowledge transfer process a stage further and runs a certificate level course on Biodiversity Components of Forestry, which builds on research funded by the EPA and COFORD. It is an excellent example of how research can feed into teaching and training, and in turn generate further ideas and topics for research.

COFORD continued and expanded workshops on wood biomass harvesting and supply chain, as outlined in this report.

Important as knowledge transfer is, it needs be complemented by continuing investment to generate new information and ideas. To this end, COFORD launched a call in May 2006 for research proposals in climate change, biodiversity and forest management and planning. The emphasis was on a programme-based approach, to develop in-depth research competence, as well as addressing important research topics, over the period of the National Development Plan (NDP) to 2013 and beyond. Experience has shown that many areas of forest

research are more cost-effective where sustained funding is provided, rather than a stop-start approach. This is particularly the case in areas such as silviculture, where trials may last for several decades, providing useful information throughout the period of investigation.

As this report goes to press COFORD has successfully concluded negotiations on a new forest-related climate change research programme, CLIMIT, which involves partners from University College Dublin (UCD) and University College Cork (UCC), as well as FERS Limited. In addition to improving estimates of carbon sequestration in Irish forests, the work will examine the implications of climate change scenarios for forest ecosystems, and how species selection and other polices can best adapt to changing weather patterns. Similarly structured research programmes in biodiversity and forest management and planning are in the final stages of negotiation, as are a number of stand-alone projects.

COFORD's role as a forest R&D funder and in technology transfer is assured under the new NDP 2007-2013. In preparing for future calls COFORD published in 2006 *A review of forest recreation needs in Ireland*, the result of an extensive consultation process. Work on developing a strategy for research in forest genetic resources was also advanced. Both areas will be the subject of calls for proposals in 2007, in addition to a number of other areas.

Achieving the level and quality of output outlined in this report is due to the talent and dedication of project leaders and a number of COFORD associates. Special thanks must also go the outgoing Chairman of COFORD, David Nevins, who over the past eight years has given freely of his time and wise counsel to all members of the COFORD team. His commercial knowledge and acumen have been a distinct asset to the organisation. We wish David well in his future business ventures.

Finally, I express my thanks and appreciation to all in the COFORD team and council for their work and support during the year, and to colleagues at all levels in the Forest Service for their help and advice.

Eugene Hendrick

Dr Eugene Hendrick, Director

ACTIVE PROJECTS 2006

FOREST REPRODUCTIVE MATERIAL

BIHIP	British and Irish Hardwood Improvement Programme
BIRCH	Selection and improvement of Irish birch
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 seed stands

SILVICULTURE AND FOREST MANAGEMENT

ABATE	Integrated reduced-chemical control of *Hylobius abietis* in Sitka spruce
BROADFORM	Silviculture of new broadleaved plantations: shaping and thinning
CONTINUCOVER	An evaluation of continuous cover forestry in Ireland
REDAREAS	Management options for forests on western peatlands

FOREST PRODUCTS AND PROCESS DEVELOPMENT

FORESTFOLIAGE	Management, screening and evaluation of a range of forest trees and associated ornamental species for suitability as cut foliage
OWP	Evaluation and development of the potential of forest residue as a bedding material for dairy and beef cattle on out-wintering pads
REPOTIM	Reinforced polymer timbers

ENVIRONMENTAL ASPECTS OF FORESTRY

BIOFOREST	Biodiversity in Irish plantation forests
CARBIFOR	Carbon sequestration in Irish forests
SILTATION	Forestry operations - Quantification and management of erosion and phosphorus release

British and Irish Hardwood Improvement Programme

BIHIP

PROJECT TEAM

BIHIP comprises seven species groups - Ash, Birch, Cherry, Oak, Spanish chestnut, Sycamore and Walnut - and is run by a Management Committee drawn from the chairs and secretaries of the species groups. A Finance Committee allocates funds on an annual basis to the various groups depending on current individual group needs. COFORD contributes to BIHIP funding.

Irish representation on BIHIP species groups in 2006:

- Ash group: Pat Doody (vice-chair)
- Birch group: Dr Ellen O'Connor (member)
- Oak group: John Fennessy (chair)*
- Spanish chestnut group: Ted Horgan (member)
- Sycamore group: Dr Michael Carey (chair), Dr Gerry Douglas (member)

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OBJECTIVES

The overall objective is to improve the quality and productivity of the main broadleaved species in Britain and Ireland through:

(1) identification and selection of new seed stands,

(2) continuation of plus tree selection programmes in the seven species, the testing of progeny, and the establishment of clonal (grafted) and seedling seed orchards.

Orchards are designed to increase the future supply of improved forest reproductive material on a sustainable basis. This is achieved by:

- the promotion of research in provenance testing, selecting and breeding the best trees;
- supporting the establishment of field trials;
- developing technologies to aid the rapid multiplication of improved material;
- promoting the use of improved material;
- undertaking education, publicity, fund-raising and lobbying to further the above aims.

PROGRESS

Selection and field testing continued in all seven species. Field trials were maintained and assessed for performance of individual progeny, with a view to roguing (removing) inferior trees. Seedling seed orchards have been established in ash and oak, with further orchards planned - establishing these is dependant on good seed years. Clonal seed orchards are also under consideration in some of the species that are easily grafted.

The 2006 BIHIP AGM took place in September at Ampleforth Abbey. It was followed by a field day at the Settrington and Parlington Estates in North Yorkshire, which included outstanding examples of ash and sycamore plus trees, which are part of the BIHIP improvement programmes.

ACTIVITIES PLANNED FOR 2007

Tree improvement programmes in the seven species, including maintenance and management of seedling seed orchards, will continue. Further plus tree selection in a number of species, and seed collection (depending on seed crops) will take place, with a view towards the establishment of clone banks and clonal seed orchards. It is planned to hold the 2007 AGM in Denmark, where broadleaved tree improvement and management of seed orchards and clone banks are highly developed.

COMPLETION DATE: These long term tree improvement programmes operate on a 30-40 year cycle.

BIRCH

Selection and improvement of Irish birch

PROJECT TEAM

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Dr Ellen O' Connor, UCD*

Dr Nuala Ni Fhlatharta, Teagasc

Jerry Campion, Teagasc

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OBJECTIVES

Demand for native species has increased in recent years. This project continues the work of the birch improvement project that began in 1998. In addition, the project was expanded in 2005 and work was initiated with *Alnus glutinosa* (alder). The overall objective of this research is to provide a source of improved planting stock of these native species for the Irish forestry industry.

The particular objectives for this phase are:

- To test the available genetic diversity of Irish birch with a view to selecting lines suitable for afforestation;
- Analysis of established field trials for productivity and form assessment;
- Selection of new superior birch phenotypes, with emphasis on *Betula pendula*;
- Expansion of the database of Irish birch phenotypes;
- Identification of superior stands of Irish birch for registration of selected seed stands;
- Selection of superior alder phenotypes;
- The development of an alder clonal genebank;
- To initiate alder progeny trials.

PROGRESS

Birch

Both birch species native to Ireland, *Betula pendula* and *B. pubescens*, are included in this project. Three field trials were planted in spring 2001; one of these was severely damaged by browsing and is no longer being assessed. The trials consist of a series of progeny tests, and include several hundred trees from 33 Irish provenances, seven Scottish provenances, one French provenance, two German breeding populations and from 37 controlled crosses of Irish plus trees (*B. pubescens*). Trees have been assessed for height and diameter at planting and after one, two and four growing seasons. Further assessment of height and diameter, and of stem quality were carried out in 2006, after six growing seasons. Based on these preliminary assessments some of the more promising material has been grafted for bulking up.

Six-year-old birch in the progeny trial at Ballyredmond, Co Carlow.

BIRCH

Alder

In 2004 the COFORD Alder Working Group initiated a national survey to examine the survival, health, vigour and quality of alder plantations of different ages. Based on the survey, 88 plus trees were selected at twenty sites, from which scion wood was collected and grafted to establish a clonal genebank. Seed has also been collected from these trees.

ACTIVITIES PLANNED FOR 2007

The assessment data collected from the birch trial in 2006 will be analysed. Grafted birch stocks will be used to establish an indoor seed orchard and a seed orchard management protocol will be developed. The expansion of the birch database and location of new superior phenotypes will continue.

Alder seed collected from plus trees will be germinated and grown on in the nursery before being deployed in progeny trials in 2008. Clones in the alder genebank will be further replicated for the development of untested clonal seed orchards. New alder plus trees will be located to increase the genetic base of the genebank.

OUTPUTS

Poster: Low input breeding and genetic conservation of forest trees species. IUFRO Division 2 Joint Conference, Antalya, Turkey, October 2006.

Presentation: Irish Plant Scientist Association Meeting (IPSAM), NUI Galway, April 2006.

COMPLETION DATE: June 2007

Grafted alder plus trees at Teagasc Kinsealy, Co Dublin.

OAKPROV

Establishment of Irish oak seed stand and progeny trials

PROJECT TEAM

David Thompson, Coillte R&D*

Derek Felton, Woodstock Seeds Ltd.

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OBJECTIVES

Seed source plays a significant role in the timber quality all forest crops. However, due to the long crop cycle of many broadleaved species, testing of seed source is not commonly undertaken. Nevertheless, given the high level of investment currently being made in establishing broadleaved plantations, testing of seed sources is a prudent undertaking.

Selected seed stands provide a source of home-grown material and are the first stage in the selection process. Typically, stands are selected mainly on the basis that they are above average in terms of growth rate and stem form, and are free from insect attack or disease. The quality (phenotype) of the trees in a seed stand reflects both the inherent genetic composition of the plant material (genotype), as well as environmental influences such as past management practices and site quality. It is therefore not a given that planting stock originating from a particular seed stand will perform equally well on other sites. Therefore to accurately determine if an individual is a good genotype it is necessary to grow it over a range of environments. Thus, the main purpose of this project was to establish a series of field trials to compare the performance of seed from a range of registered seed stands of Irish oak.

In addition, in the early to mid-1990s a programme was undertaken by Coillte R&D to select and preserve phenotypically superior individuals of oak, ash, sycamore and cherry in Ireland. This work was funded in part by the Forest Service and the EU. Branches (scions) were collected from these plus trees and grafted to establish a genebank of these phenotypically superior individuals for possible use in a broadleaf tree improvement programme. Again, the original trees were selected based only on their phenotype, and in order to determine their genetic superiority their progeny were tested in a series of replicated progeny trials, across a range of sites. One of the shortcomings of this approach is that while the identity of the seed (mother) tree is known the male parent is unknown. Nevertheless progeny testing is a reliable approach to testing and comparing genetic quality of the female parent. During the summer of 2004 it was observed that some of the grafted oak at one of the gene banks had flowered and were producing acorns. Because it is not possible to store acorns for any length of time, a decision was made to sow seed from 14 of the phenotypically selected trees. These were supplemented by seed from 13 registered oak seed stands in Ireland. All the acorns were sown in the spring of 2005 in containers in a glasshouse at the Coillte Tree Improvement Research Station in Kilmacurra. After germination, seedlings were grown on in a tunnel for a year to have them large enough for field planting.

Five overseas sources were also included to compare Irish material with established quality European seed stands.

PROGRESS

In the spring of 2006 oak seedlings from the sources indicated were established in a series of three field trials established at the Manch Estate near Bandon, Co Cork, Tullynally Estate near Castlepollard, Co Westmeath, and at None-So-Hardy Nurseries, near Shillelagh, Co Wicklow. COFORD wishes to thank the landowners concerned for providing sites for the trials and for their help and co-operation.

The trials comprise 25-tree square plots, planted at 2 m spacing, in a randomised block design with four replications. Not all sources could be at included all sites due to a limit in the number of plants available. However, each source is tested on at least two sites. Because the heights of the genebank plants were small, they were planted in tree guards. Heights were measured after planting in 2006.

ACTIVITIES PLANNED FOR 2007

All three trials have been successfully established. Filling-in of failures will take place in early 2007.

OUTPUTS

No outputs yet as the project is at initiation stage.

COMPLETION DATE: June 2007

Improving the uniformity and quality of broadleaf planting stock

QUALIBROAD

PROJECT TEAM

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OBJECTIVES

The aim of the research is to improve seed germination, plant growth and planting stock quality in common alder (*Alnus glutinosa* Gaertn.), birch (*Betula pendula* Roth and *Betula pubescens* Ehrh.), ash (*Fraxinus excelsior* L.), and pedunculate oak (*Quercus robur* L.) in Irish nurseries. The laboratory phase of the project is focussing on the effects of various pre-treatments and storage methods on seed germination in these species. In the field phase of the project, mostly carried out by Coillte, the effects of a variety of sowing dates, seedbed covers (mulches, cloches, windbreaks) and fertiliser amendments on seedling growth and quality are being evaluated.

PROGRESS

Most of the research effort in 2006 was directed towards oak and ash seeds. The new experiments in ash involved the used of priming and chilling pre-treatments to improve laboratory germination. In addition, a new experiment on oak acorns was initiated. The results of previous research revealed that soaking acorns (which are normally dried to 40-42% moisture content (MC) for storage) to >45% MC improved post-storage germination.

The objective of the new experiment was to determine if similar levels of improvement can be achieved by storing acorns just after harvesting (when MC is normally >45% MC), thus perhaps avoiding the need for soaking. The preliminary results from the first experiment revealed that soaking is beneficial, regardless of initial acorn MC level. Drying the acorns to 40-42% MC followed by soaking gave the best results (Figure 1). Furthermore, the preliminary results from a new field trial confirmed these findings (Figure 2). The morphological and physiological

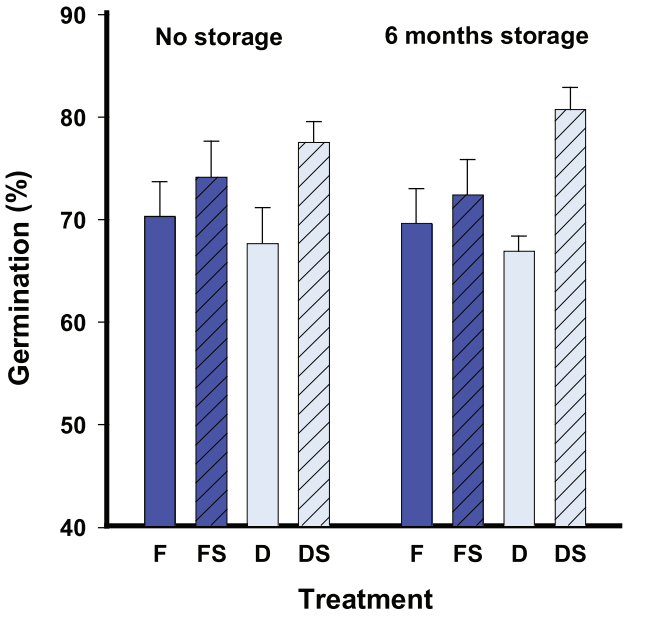

Figure 1. Effect of pretreatment on germination at 15ºC before and after storage at -3 ºC for six months. The acorns were treated in fresh (F) state (46-48% moisture content, MC) and following soaking in fresh state (FS); other acorns were dried back (D) to lower MC (40-42%) and then soaked (FS) to high MC (46-48%).

QUALIBROAD

Figure 2. The smaller oak seedlings (left plot) were derived from acorns that were given the standard treatment used in operational practice (dried to 40-42% moisture content), whereas the larger ones (right plot) were soaked for five days before storage.

quality of the seedlings in this trial will be evaluated in early 2007. The effect of acorn MC and freezing stress on acorn viability was assessed in another experiment, but the data have not been analysed yet.

All of the research experiments on alder and birch have been completed, and the data collected in previous years were analysed and prepared for publication.

ACTIVITIES PLANNED FOR 2007

No new field experiments are planned. Most effort will continue to be directed towards the collection of data in the oak field trial, the analyses of data and preparation of main findings for publication and presentation in the final report.

OUTPUTS

O'Reilly, C. and Doody, C. 2006. *Pre-treatment and storage protocols to improve germination in seeds of several European broadleaf species*. Paper presented at the IUFRO Tree Seed Symposium 'Recent Advances in Seed Physiology and Technology', held in Fredericton, New Brunswick, Canada, 18-21 July.

De Atrip, N. and O'Reilly, C. 2006. Effect of seed coverings and seed pretreatments on the germination response of *Alnus glutinosa* and *Betula pubescens* seeds. European *Journal Forest Research* 36: 749-760.

De Atrip, N. and O'Reilly, C. 2006. The response of prechilled alder and birch seeds to drying, freezing and storage. *Canadian Journal Forest Research* 36: 749-760.

O'Reilly, C. and Doody, P. 2006. *Reaping what you sow - seeds and plant quality.* In: Plant Quality - A Key to Success in Forest Establishment. COFORD, Tullow, Co Carlow. pp. 11-20.

COMPLETION DATE: June 2007

The national catalogue of seed stands

SEEDSTANDS

PROJECT TEAM

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OBJECTIVES

Updating the National Catalogue of Seed stands in compliance with the EC Directive on Forest Reproductive Material.

PROGRESS

The main emphasis in 2006 was the identification of broadleaf stands for seed production to meet the demands of the Native Woodland Scheme, as well as the maintenance and development of the seed stand portfolio for commercial afforestation for both broadleaves and conifers. The National Seed Stand Register, the European Union Irish Seed Stand Register and the Irish Seed Stand Database were updated.

ACTIVITIES PLANNED FOR 2007

Conifer stands to replace 2006 clearfells will be selected, and the overall area and number of broadleaf and conifer seed stands will be increased.

OUTPUTS

A total area of 270 ha of new seed stands (selected and source identified) covering ten species and including a new species – Spanish chestnut – were selected and registered. Other species included were beech, Douglas fir, European larch, Japanese larch, Norway spruce, pedunculate and sessile oak, Scots pine, and Sitka spruce. Multi-species stands were registered for the first time in 2006, in accordance with requirements of the Native Woodland Scheme. The current area of seed stands is shown in Table 1.

COMPLETION DATE:

The National and EU listings are reviewed and updated on an annual basis at the end of each calendar year. The next review will be done at the end of December 2007.

Table 1: Area of seed stands as of 31 December 2006.

Scientific name	Common name	Area (ha)
Acer pseudoplatanus	Sycamore	6.9
Alnus glutinosa	Common alder	109.8
Betula pubescens	Common birch	25.8
Castanea sativa	Spanish chestnut	6.2
Fagus sylvatica	Beech	80.3
Fraxinus excelsior	Ash	153.8
Quercus petraea	Sessile oak	1371.3
Quercus robur	Pedunculate oak	733.9
	Multi-species	36.0
Larix decidua	European larch	7.8
Larix x eurolepis	Hybrid larch	2.9
Larix kaempferi	Japanese larch	48.6
Picea abies	Norway spruce	438.3
Picea sitchensis	Sitka spruce	589.0
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	119.1
Abies procera	Noble fir	59.9
Thuja plicata	Western red cedar	8.9
Taxus baccata	Yew	33.1
		4060.6

ABATE

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

PROJECT TEAM

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Prof. Martin Downes, NUI Maynooth

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OBJECTIVES

The large pine weevil is the most important insect pest of reforested sites in northern Europe. The female lays its eggs in stumps of recently felled conifers, where the larvae and pupae develop under the bark over a number of seasons. When a site is replanted, adult weevils emerging from the stumps feed on newly planted seedlings. In the absence of control measures, up to 100% of seedlings can be killed. Currently, chemical insecticide is the main method of weevil control. The research team is studying the ability of a number of naturally occurring biological control agents to reduce weevil numbers.

PROGRESS

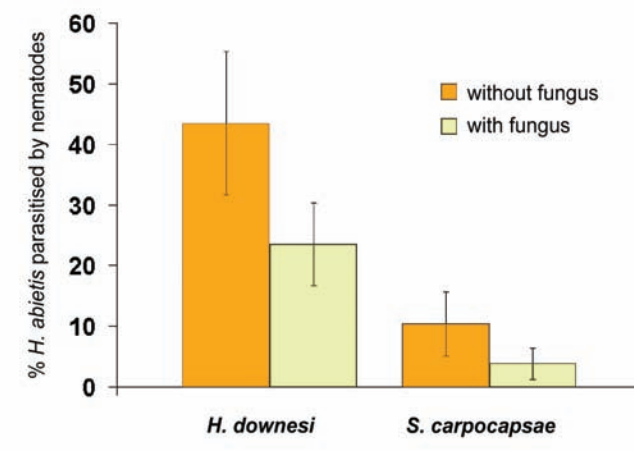
Biological control agents tested include: insect-killing nematodes, a parasitic wasp (*Bracon hylobii*), the insect killing fungus *Beauveria* sp., and fungi that decompose stumps, making them less suitable for weevil development. The ability of fungi to reduce adult weevils feeding, and thus protect seedlings from damage was also investigated.

Nematodes

The efficacy of two species of entomopathogenic nematode against weevil populations in Sitka spruce stumps on three sites was investigated. Trees were felled 18-24 months previously, and stumps harboured mature larvae and pupae at the time of nematode application. The species tested were an indigenous nematode, *Heterorhabditis downesi*, and the exotic nematode *Steinernema carpocapsae*. The former was chosen based on its superior efficacy against pine weevils developing in pine in a previous project (INTERREG), while the latter is currently used by the Forestry Commission on a semi-operational level in the UK. Nematodes were applied to the soil around the stumps. Destructive sampling of stumps four weeks after the nematodes were applied showed that the indigenous nematode *H. downesi* was superior to the exotic *S. carpocapsae*, parasitising three times as many immature *H. abietis* (30 and 10% respectively). The order was similar to that previously demonstrated in pine, where parasitism in *H. downesi* and *S. carpocapsae* treated stumps was 61 and 27% respectively. Larvae were more susceptible to entomopathogenic nematodes than pupae or adults. When the number of adult weevils emerging from stumps was assessed on two of these sites over a 2-year period following nematode application, the indigenous *H. downesi* consistently reduced adult emergence by approximately 45%. *S. carpocapsae* failed to significantly reduce adult emergence on either site. *H. downesi* is not currently commercially available; however, in collaboration with a German nematode producer (E-nema), NUI Maynooth initiated a preliminary evaluation of the amenability of *H. downesi* to mass production (COFORD-funded working visit grant).

Fungi and interactions

A wood-colonising fungus was applied to stumps on two sites. The objective was to colonise the stump early and accelerate decomposition. The entomopathogenic fungus, *Beauveria* sp., was also applied as a stump treatment on one of the sites. Facilitation of parasitism of *H. abietis* by entomopathogenic nematodes was also tested on both sites. The application of fungus to stumps did not appear to reduce the number of *H. abietis* developing in, and emerging from, the stumps. Parasitism of immature *H. abietis* by the parasitic wasp *Bracon hylobii* was unexpectedly high on one of the trial sites (19%). There was a trend for slightly higher parasitism of *H. abietis* by *B. hylobii* in fungal-treated stumps compared to stumps that were not treated with the fungus, suggesting that fungi may enhance host location by *B. hylobii*. Parasitism of *H. abietis* by entomopathogenic nematodes was lower in fungal-treated stumps compared to stumps that were not treated with the fungus, suggesting that the wood rotting fungus may adversely affect host finding or survival of the nematodes. Treatment of seedlings with fungal-colonised mulch repelled adult weevils in the laboratory,



Percentage of Hylobius parasitised by two species of nematodes in Sitka spruce stumps to which a wood rotting fungus was and was not applied at the time of felling.

but was unsuccessful as a plant protection tool when tested in the field. Timing and method of application require further development.

Environmental safety

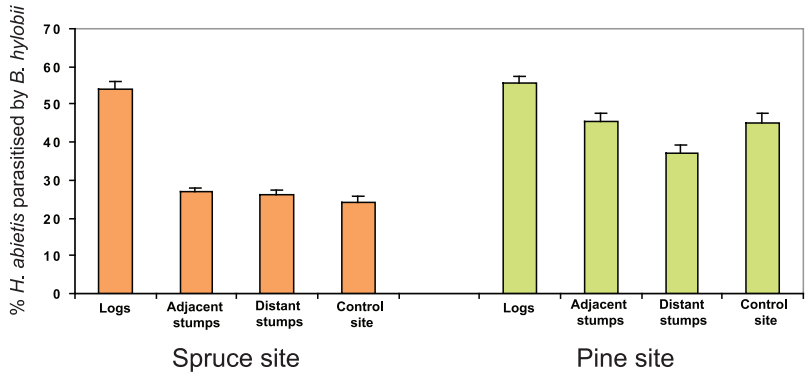
Application of fungi and/or entomopathogenic nematodes did not negatively impact on the number of non-target beetles emerging from stumps. *H. downesi* and *S. carpocapsae* both persist on clearfelled sites for up to three years following application, during which time we would expect stumps to remain suitable breeding sites for *H. abietis*. Neither nematode species was recovered when sites were sampled four and five years after application, and nematodes were not recovered outside the treated area (INTERREG). The findings suggest that entomopathogenic nematodes pose little environmental risk to non-target insect populations.

Parasitoids

The emergence pattern of *Bracon hylobii* from pine and spruce stumps was investigated. Emergence began in the first week of May and was followed by two major peaks: early June and mid to late July. A small peak was recorded during early September. *B. hylobii* were captured in the traps up to the third week of November.

An experiment was carried out involving the release of progressively higher numbers of female *B. hylobii* into breeding chambers to assess if parasitism rates would increase accordingly. Results showed a steady increase in the percent of weevils parasitised through the introduction of 1, 5, 10 and 20 female wasps. This increase was more pronounced in Sitka spruce logs (8 to 83%) than in lodgepole pine logs (30 to 73%).

The possibility of increasing the percentage of weevils parasitised by *B. hylobii* under natural conditions by increasing the number of parasitic wasps on a site was investigated. Logs containing immature weevils and *B. hylobii* were introduced onto clearfell sites with large populations of *H. abietis* larvae. Stumps around these 'infective units' were assessed and compared to control plots to gauge if there had been any increase in parasitism as a result of the introduction of the inoculated logs. Rates of parasitism by *B. hylobii* in the surrounding logs and control plots were similar. Factors that may have contributed to the failure to detect an increase in the rate of parasitism include a lack of an adequate food resource on site, the wasp entering diapause, the availability and accessibility of hosts, superparasitism, or the presence of a hyperparasitoid.



The distance from the source logs to the adjacent and distant stumps were 2-3 and 10 m, respectively. Levels of parasitism in stumps adjacent to source logs containing B. hylobii were similar to those observed on control sites (sites that received no infested logs, and therefore no additional B. hylobii).

ABATE

Artificial clearfell site. All logs were artificially infested with immature weevils. The central (horizontal) logs were also artificially infested with parasitic wasps, B. hylobii. Surrounding logs were assessed and the percentage of parasitised weevils recorded. Additional flowers were planted to provide the wasps with a source of nectar to encourage them to remain close to the point of release.

In an attempt to minimise the confounding factors encountered on an actual clearfell site, logs were inoculated with *H. abietis* and partially buried in a green field site to create an isolated clearfell. *B. hylobii* were introduced to the sites either by releasing adults, or through a combination of inoculated logs containing cocoons and released adults. After a period of time the surrounding logs were assessed. Rates of parasitism were very low (less than 2%).

Several unusual observations concerning *B. hylobii* phenology have indicated that there may be a cryptic hyperparasitoid present. If it is, then it may explain why a specific parasitoid is not as successful in controlling populations as one would expect from experience with other species specific *Braconidae*.

ACTIVITIES PLANNED FOR 2007

Nematodes: The main activity planned is assessment of the efficacy of nematodes in large scale field trials in Coillte forests. However, the suitability of the indigenous nematode *H. downesi* nematode for mass production and commercialisation will also be evaluated further.

Bracon: Some fundamental questions regarding the biology of the wasp will be addressed, including whether nectar source and quality affects the longevity and reproduction output of the wasp; whether tree species affects the searching behaviour of the adult wasp, and what conditions induce diapause. The presence of hyperparasitoids within the *Bracon* populations will be investigated using molecular analysis.

Interactions: Interactions between biocontrol agents, including effect of nematodes on the native populations of the parasitic wasp *B. hylobii*, will be investigated.

OUTPUTS

Dillon, A.B., Downes, M.J., Ward, D. and Griffin, C.T. 2006. Optimizing application of entomopathogenic nematodes to manage large pine weevil, *Hylobius abietis* L. (Coleoptera: Curculionidae) populations developing in pine stumps, *Pinus sylvestris*. *Biological Control* 40: 253-263.

Dillon, A.B., Ward, D., Downes, M.J. and Griffin, C.T. 2006. Suppression of the large pine weevil *Hylobius abietis* (Coleoptera: Curculionidae) in pine stumps by entomopathogenic nematodes with different foraging strategies. *Biological Control* 38: 217-226.

Dillon, A. 2006. *Using nematodes to feed on weevils*. Coillte Forestry Services. Establishment Newsletter No. 2.

Dillon, A. 2006. *Working towards sustainable management of the large pine weevil – biocontrol options*. Coillte in-service training 'Large Pine Weevil – Insecticides and Alternatives', Athlone, Ireland, 31 October 2006.

Ennis, D. and Griffin, C.T. 2006. *Behavioural interactions between the large pine weevil,* Hylobius abietis *and entomopathogenic nematodes*. 4th International Symposium 'Entomopathogenic nematodes and symbiotic bacteria' Salzau, Germany, 1-6 June 2006.

Dillon, A.B., Rolston, A.N., Meade, C.M. and Griffin, C.T. 2006. *Persistence and spread of exotic and indigenous nematodes applied to pine stumps for suppression of pine weevil.* 4th International Symposium 'Entomopathogenic nematodes and symbiotic bacteria' Salzau, Germany, 1-6 June 2006.

COMPLETION DATE: December 2007

Silviculture of new broadleaved plantations: shaping and thinning

BROADFORM

PROJECT TEAM

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OBJECTIVES

The main objective of this project is to develop silvicultural methods and protocols for the early management of broadleaved plantations up to and including pre-commercial thinning. Investment in early management of broadleaves lays the foundation for quality timber at later thinnings and rotation end, resulting in a plantation of increased value. Formative shaping and pruning decreases the volume of the log defect core. To realise the potential value, management should be aimed towards the first 3 to 6 m of the stem - the first commercial log.

This project has two strands of research:

- Shaping: To develop formative shaping methods to control defects in the lower stem of young broadleaves 1-3 m high;
- Thinning: To develop pre-commercial thinning practices to favour the best quality stems and the removal of the poorest quality stems.

PROGRESS

No new experiments were established during 2006. Work concentrated on measuring tree growth and form at the existing sites. Shaping protocols – one of the principal aims of this phase – have been developed for oak, ash, sycamore and beech. A preliminary pre-commercial thinning protocol has been developed for ash. A new categorical stem classification has been developed to assess potential timber quality of broadleaved plantations at the age of pre-commercial thinning and older.

Shaping

The shaping trial is at four locations in six plantations: ash, oak/Scots pine mixture, two beech and two oak. Six treatments were investigated:

- Control (C): No shaping;
- Yellow (Y): Shaping focussing on the tree leader. Remove up to 50% of the canopy as required;
- Blue (B): Remove all branches that interfere with the leader and defects along the main stem to a maximum of 90% of foliage;
- Blue Blue (BB): Remove only disproportionately large branches greater than one-third of the diameter of the main stem;
- Red (R): Shape only those trees above mean height; and
- Red Red (RR): Shape only those trees above mean height and with stem form equal to or better than quality category 3[1].

Initial analysis indicates that there was no effect of treatment on height at the end of 2006, except at the Legan oak site where the height increments of the R treatment during the second and third growing seasons were significantly less than those of the RR treatment. The analysis also indicates that there was no effect of the treatments on stem diameter. As expected, pruning increased the height to the first prunable defect.

[1] *Quality Category 3: Poor quality tree with poor apical dominance or poor stem straightness, One or more forks, whorls or strong co–dominants may be present.. One or more disproportionately large branches or a moderate kink could be present.*

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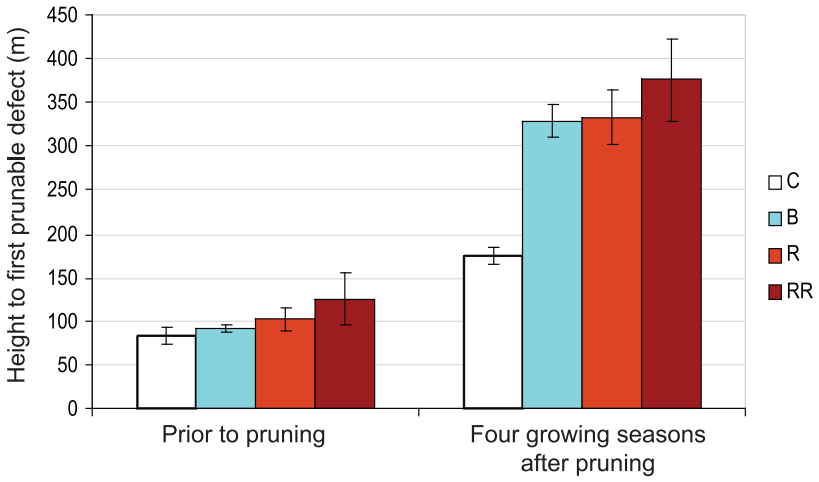


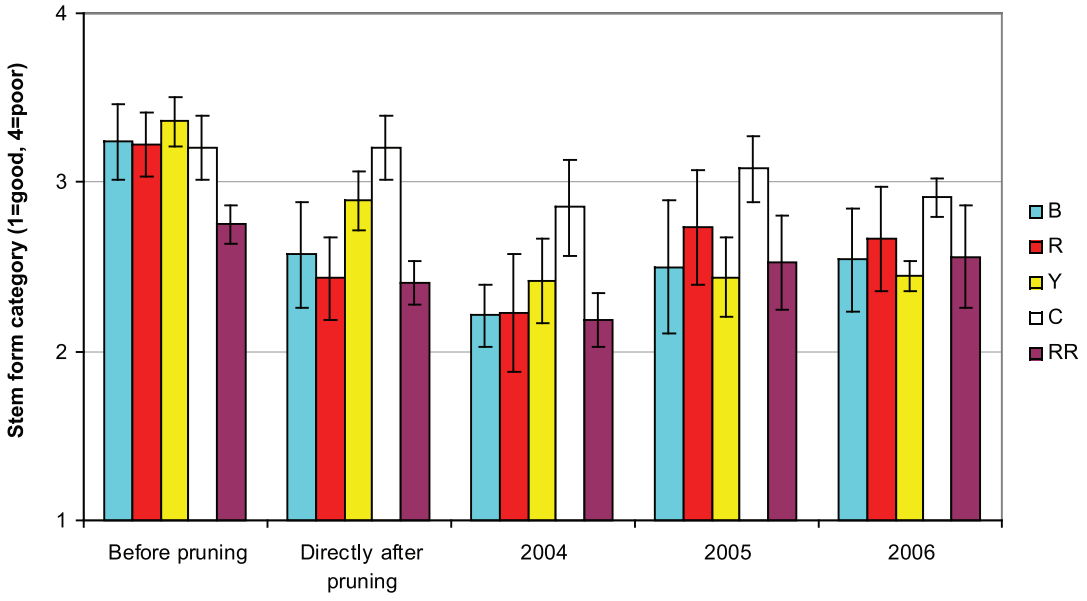
Effect of pruning on height to first prunable defect in ash

There was also a general trend for pruning to improve stem form[2]. However, there was a general trend for improvements in stem form to diminish gradually after pruning. This highlights the need for frequent pruning to maintain the potential for a high quality timber crop with a narrow defect core. It also highlights the need to retain a sufficient number of shaped stems so that any further reductions in overall stem quality can be redeemed. Based on these considerations, the recommendation is that 50% of oak stems and 30-35% of ash and beech stems should be shaped, always concentrating on those that have the potential to produce good quality stems.

Thinning

The thinning experiment was laid down at two 10-year old ash plantations in 2003. There were three treatments:

- Control: Approximately 850 candidate final crop trees/ha were selected and marked. No thinning and no pruning was carried out;
- 33% thin: Approximately 850 candidate final crop trees/ha were selected and marked. Thinning was carried out according to the recommendations in *Growing Broadleaves*[3] (33% of stems removed), with pruning of candidate final crop trees;



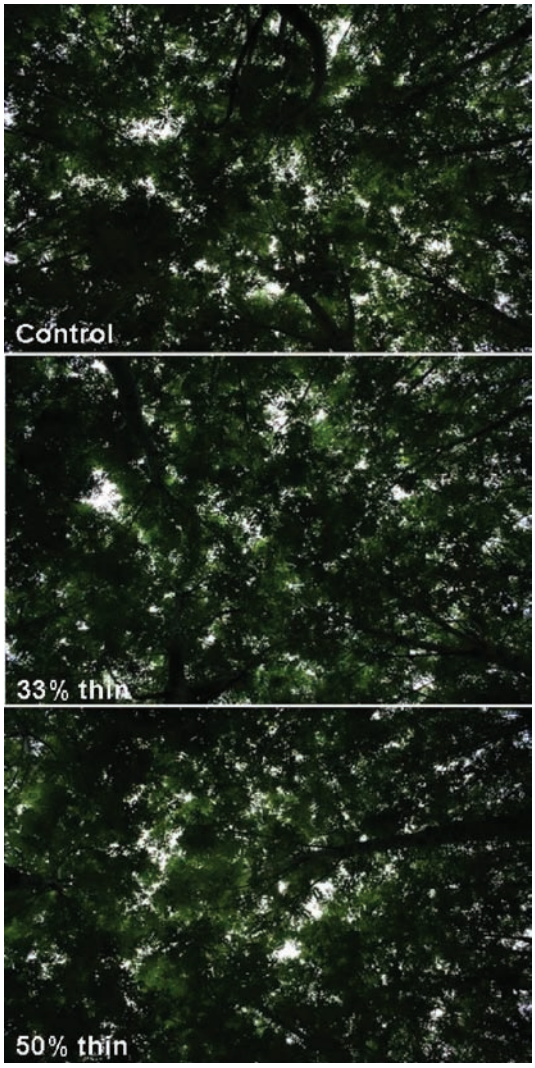
Stem form of beech resulting from pruning.

[2] *Means are presented for illustrative purposes only - categorical data are not analysed as continuous variables.*

[3] *Joyce, P.M. et al. COFORD, 1998.*

- 50% thin: Approximately 850 candidate final crop trees/ha were selected and marked. Half the stems were removed to release the canopy of the final crop candidates, which were also pruned.

Canopy density was measured in September 2006 with a GRS Densitometer. Three growing seasons after pre-commercial thinning, there was no difference in canopy density between the control and the 33% treatment at either site. The canopy density of the 50% treatment was significantly less than the control at one site, which was slower growing, while there was significant difference at the other site. This indicates that ash, on fast growing sites, requires thinning three growing seasons after pre-commercial thinning that follows the *Growing Broadleaves* protocol. This may also be the case when a very heavy pre-commercial thinning, removing 50% of stems, is carried out in fast-growing ash. Mean height at the end of 2006, at the faster growing of the two sites, showed no difference between treatments. However, the mean dbh in the 50% thinning was significantly greater than the control treatment, while there was difference between the 33% treatment and the control. There was no significant difference between treatments in either mean height or dbh at the slower growing site. These results indicate that pre-commercial thinning of other broadleaves should also be investigated in a similar manner.



Canopy cover of Castlefield ash experiment three growing seasons after pre-commercial thinning.

OUTPUTS

A poster was presented at the Farm Woodland Forum in the UK and at a number of agricultural shows attended by the BROADFORM team, including the National Ploughing Championships, Agrifood 2006, the Tullamore Show and Teagasc Grange Beef day.

Dr Ian Short gave a presentation on broadleaf thinning at the Teagasc open day at Piltown, Co Kilkenny.

The BROADFORM team also provided in-house training to the Teagasc Forestry Advisors on broadleaf pre-commercial thinning.

An article on the project was published in the November/December 2006 issue of the Teagasc publication *Today's Farm*.

COMPLETION DATE: December 2006

CONTINUCOVER

An evaluation of continuous cover forestry in Ireland

PROJECT TEAM

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OBJECTIVES

The main objectives of this project are to assess the survival and growth of a number of tree species under various levels of canopy cover in a 40-year-old Sitka spruce stand and to monitor throughfall, temperature, and soil nutrient dynamics under tree canopy.

PROGRESS

The main Sitka spruce stand has been thinned to different residual basal areas, resulting in varying levels of canopy cover. In another mature Sitka spruce stand, four canopy gaps were opened, and a number of scarification, fencing and seeding treatments installed. An experiment was established on the Belfield campus to investigate the impact of shade on the morphology and photochemical efficiency of three conifer species. Finally, plots have been established to demonstrate the implementation of alternative silvicultural systems to clearcutting.

Mortality, height increment and root collar diameter increment were assessed for four of the six species planted at the Ballinagapogue site. After two growing seasons, Sitka spruce showed 44% mortality in the areas with the least basal area and 91% in the areas with greatest basal area (Figure 1). Oak showed the lowest mortality (22%) in the treatments with the highest level of basal area (34 m^2 ha^{-1}). All of the species, with the exception of oak, exhibited dieback in the plots where basal area was highest.

Decrease in canopy cover (basal area) was associated with an an increase in total N, NH_4^+–N, NO_3^-–N concentrations and mineralisation rates in the organic horizon. There was, however, considerable variation in mineralisation rates within and between plots. A more detailed investigation of soil N concentrations was therefore conducted to see whether spatial patterns varied with time, or with scale of observation. This involved collecting and analysing 441 soil samples over a 100 m^2 grid, compared with 36 samples collected over the same area as used in previous years. The results indicate that soil NH_4^+–N concentrations were generally higher than NO_3^-–N concentrations but that over three summer sampling periods NH_4^+–N concentrations decreased whereas NO_3^-–N concentrations increased (Table 1). The spatial distribution of total N was consistent over the sampling periods (Figures 2a, b and c). In summer 2005 the pattern appeared to change (Figure 2d) but a more detailed study of the same plot (n=441) showed that the apparent change was a sampling artefact (Figure 2 e).

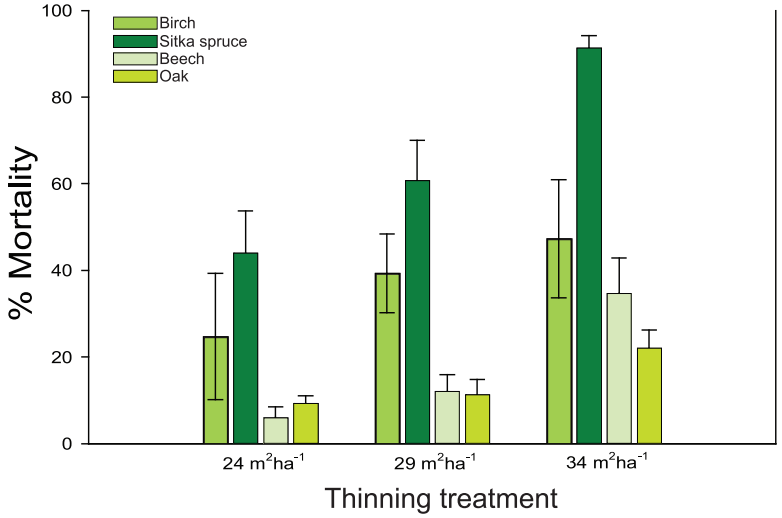

Figure 1: Seedling mortality after two growing seasons as associated with basal area after thinning (vertical bars represent standard errors).

Table 1: Average soil nitrogen concentrations (µg/g) (n=36) in Plot F (24 m^2 ha^{-1}) over four sampling periods.

	Summer 2003	Autumn 2003	Summer 2004	Summer 2005
Total N	51.50	55.42	59.41	33.50
Ammonium-N	44.74	48.09	39.79	22.98
Nitrate-N	6.75	6.5	19.61	11.01

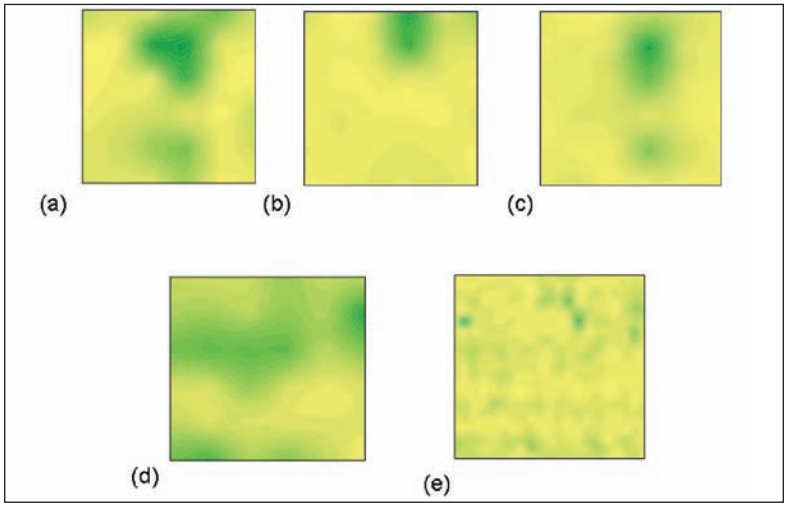

Figure 2: Spatial and temporal patterns of soil nitrogen concentrations from a 100 m^2 sampling grid in one plot.
(a) Summer 2003 n=36
(b) Autumn 2003 n=36
(c) Summer 2004 n=36
(d) Summer 2005 n=36
(e) Summer 2005 n=441
(the darker the colour the greater the N concentration).

A densitometer was used to record canopy density over each sample point in six of the plots. Analysis showed a significant negative correlation between the amount of canopy cover and soil N concentrations and mineralization rates suggesting that, at point scale, as the level of canopy cover increases, soil N concentrations and mineralization rates decrease as predicted because of reduced heat and water fluxes.

Point scale temperature measurements reported in previous results showed that areas with the lowest minimum soil temperatures also had the highest maximum temperatures demonstrating that, at point scale, some areas showed consistently large temperature fluctuations. This pattern was also apparent at a plot scale where plots with more open canopy (i.e. lowest basal area) had the highest temperatures in the summer months but the lowest temperatures in the winter months (Table 2).

Table 2: Monthly mean soil temperatures (°C) at 5 cm depth in plots with different levels of overstorey basal area.

	24 m^2 ha^{-1}	29 m^2 ha^{-1}	34 m^2 ha^{-1}
Month			
Nov 2003	6.8	6.9	6.9
Dec 2003	5.3	5.4	5.5
Jan 2004	4.0	4.1	4.2
Feb 2004	3.9	4.0	4.1
Mar 2004	4.1	4.1	4.1
Jun 2004	11.7	11.3	11.1
Jul 2004	12.4	12.0	11.8
Aug 2004	13.6	13.4	13.2
Sep 2004	11.8	11.7	11.6
Dec 2004	5.2	5.4	5.3
Jan 2005	4.9	5.1	5.0
Feb 2005	3.3	3.5	3.4
Mar 2005	5.0	5.1	5.0

ACTIVITIES PLANNED FOR 2007

Further thinning trials in another Sitka spruce stand to show different thinning approaches to facilitate continuous cover forestry (transformation of even-aged to uneven-aged continuous cover forestry stands) will be established. Demonstration sites of continuous cover forestry in a number of forests will also be established.

OUTPUTS

Seamus Kennedy and Áine Ní Dhubháin attended CONFOREST meetings in May and October 2006. Two papers were published on the shading experiment (in *New Forests* and *Forest Ecology and Management*).

COMPLETION DATE: December 2007

REDAREAS

Management options for forests on western peatlands

PROJECT TEAM

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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 timber 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

Native species establishment

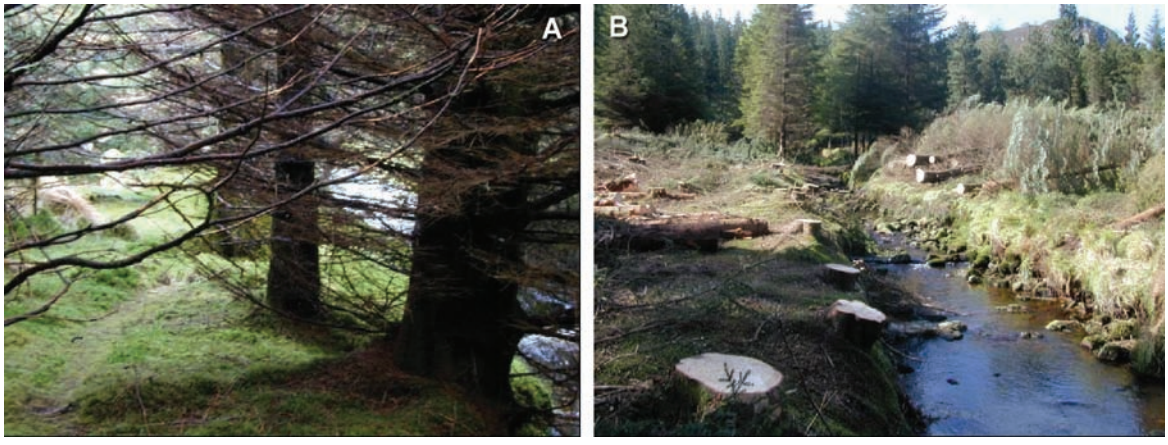
The series of trials established in 2005 was extended in 2006 with a further two trials at Coillte forests at Nephin Beg and Doolough to replicate treatments over time and on a wider range of sites. Assessments carried out in the 2005 trials showed successful direct seeding of birch and rowan and but not of alder. Significant weevil damage occurred on planted broadleaves.

In addition to the replicated trials, a survey of 23 clearfelled peatland sites in Counties Galway and Mayo was carried out to see if colonisation by native broadleaves was sufficient for natural regeneration. Data have yet to be analysed but observations suggest that there were differences between sites, in colonisation, with no regeneration occurring on some sites. Local seed sources, either from native species planted in the first rotation and/or their occurrence in the landscape, appear to be significant factors in their regeneration. Considerable short-term cost savings could accrue if adequate stocking could be achieved.

Enhancement of riparian zones prior to clearfelling

Clearfelling of the riparian zones in three of the four study sites (Altahoney, Glendahurk and Sheskin) took place during the summer period. Felling was undertaken mainly by processor using current best practice.

Hydrological and biological monitoring continued, with full hydrological profiles now available for the four locations. Site monitoring will continue until the end of



▲ *The site at Altahoney, Nephin Beg Forest, (a) pre-felling and (b) post-felling.*

Direct seeded birch during its second growing season.

the project. Calibration ratings curves are being developed using salt dilution to calculate flow and volume.

Sediment samples are being taken using Sigma automatic samplers. These are triggered to collect samples once the water level rises above 0.4 m/0.45 m in Glendahurk and Altahoney, 0.35 m in Sheskin and 0.3 m in Knockboy. A particular challenge in analysing sediment is to be able to account for the difference in organic and inorganic sediments and their settlement rate – this varies markedly between locations.

A full suite of invertebrate samples taken at each location and additional samples taken as part of an MSc project, will provide an indication of seasonal variation. Also, two annual fish surveys have been completed at all four locations.

Assessing fish stocks by electrofishing.

Bird and mammal surveys

Bird and mammal surveys were conducted in Coillte forests at Cloosh and Sheskin. In the 2005 breeding season a detailed survey of the birds of Cloosh forest was undertaken, including a raptor survey. Additional work outlined below was conducted in 2006, bringing to a conclusion the field work on this aspect of the overall project.

Birds:

- Winter transect surveys of the full range of terrestrial habitats occurring in both forests during the winter of 2005/06, aimed primarily at recording any migratory bird species, in addition to resident species.
- Winter wildfowl surveys of the lakes and ponds at both forests.
- Point count surveys of the full range of terrestrial habitats at Sheskin during the 2006 breeding season.
- Surveys of the wetland habitats (rivers and lakes) at both forests during the 2006 breeding season.
- Raptor surveys at both forests.

Mammals:

- Mammal surveys of both forests over the winter and summer seasons of 2005/06.
- In conjunction with the Waterford Institute of Technology, additional specific pine marten surveys and research was conducted at both forests. Hair traps were located in the forests and monitored over the summer of 2006. Hair and scats collected were subjected to DNA analysis as part of a separate research project on the pine marten.

Decision support system for forest planning

It is now widely accepted that many western peatland forests are not suitable for sustainable commercial forestry, and that the best management strategy may be to redesign them to provide environmental services. A multiple land use management approach is advocated and supported by all of the statutory stakeholders (including the Forest Service) as the best way forward. As part of the project A decision support system (DSS) developed

Table 1: Aquatic monitoring programme, 2006.

RA1- Glendahurk; RA2 – Altahoney; RA3 – Sheskin and RA4 - Knockboy

	Site	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06
Invertebrates	RA1		*		*		*		*			*	
	RA2			*	*			*		*		*	
	RA3			*	*			*		*		*	
	RA4							*					
Salt Dilutions	RA1	*	*			*	*		*				
	RA2	*	*		*	*	*		*				
	RA3	*	*			*	*		*				
	RA4	*								*			
GPS pre felling	RA1						*						
	RA2						*						
	RA3						*						
Felling	RA1						*						
	RA2						*						
	RA3								*				
GPS post felling	RA1									*			
	RA2									*			
	RA3									*			
Electrofishing	RA1									*			
	RA2									*			
	RA3									*			
	RA4									*			

as part of the project will contribute greatly to the drawing up of an integrated and sustainable land use programme for current and future activities on afforested western peatlands. The system is GIS-based and brings together data on a wide range of economic, environmental and social variables. It structures and processes this information to provide site sensitivity ratings, and recommendations for future management appropriate to each site. The DSS was successfully piloted and will be used by Coillte in a review of forest management plans for each western peatland forest.

ACTIVITIES PLANNED FOR 2007

Much of the work on the project planned for 2007 will be the analysis and reporting of results. However, field work will continue with the establishment of two further native species trials testing willow cuttings and the monitoring of water quality, post-clearfelling, in the riparian zone study sites.

COMPLETION DATE: December 2006

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

FORESTFOLIAGE

PROJECT TEAM

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Jim Kelly, Horticultural consultant

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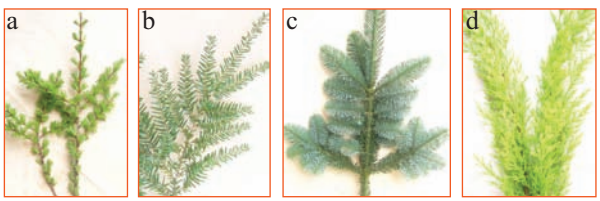
OBJECTIVES

The project looks at two different areas: the possibility of harvesting foliage from existing plantations and the foliage potential of other minor forest and associated ornamental species.

For established plantations, the main objectives are:

- to determine the potential of harvesting foliage in association with producing timber from a range of conifer species namely *Larix kaempferi* (Japanese larch), *Cupressus macrocarpa* Goldcrest (Monterey cypress Goldcrest), and *Tsuga heterophylla* (western hemlock).
- to investigate the possibility of managing old or overgrown *Abies procera* (noble fir) Christmas tree plantations for foliage production.

For new species trials the main objective is to screen a range of ornamental tree and shrub species for suitability as cut foliage.



Species included in the trial were (a) Japanese larch, (b) western hemlock, (c) noble fir and (d) Monterey cypress (Goldcrest).

PROGRESS

On existing plantations

Field trials have been established in selected plantations of western hemlock, Monterey cypress (Goldcrest), Japanese larch and noble fir. The possibility of a dual purpose (foliage and timber) management system is examined for all species with the exception of noble fir.

For the three species being examined for dual purpose production, trees were initially planted in straight lines at a spacing of 2 x 2 m. A total of 36 plots of 100 m² were fenced off within the experimental area for each species. In these trials, every second line was dedicated to foliage production instead of being removed as part of a thinning operation. From the remaining line, every second tree was marked and clearly identified as being part of the final timber crop. Thus the final crop spacing was approximately 4 x 4 m.

Four different treatments, including a control, were carried out. From the trees designated for foliage production, as well as final crop trees, all stems that had achieved commercial standard* were removed and counted. Treatment descriptions are presented in Table 1.

* To meet commercial standard, foliage stems must meet the following criteria:

- Achieve a length specified by the market (usually 55 cm).
- Must be straight, no bent stems.

Table 1: Treatments investigated in Japanese larch trials.

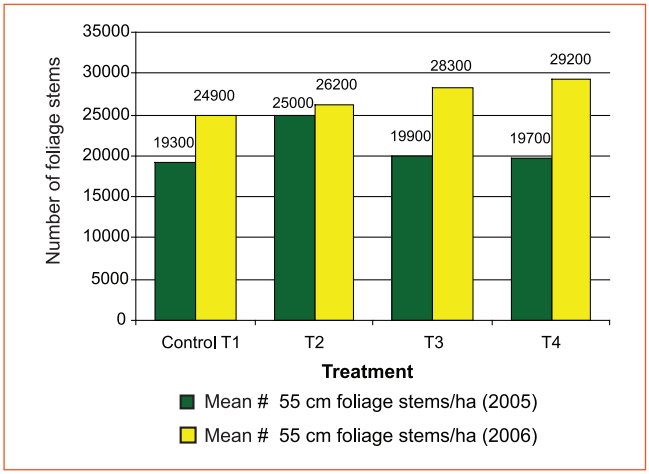
Treatment	Description
T1	Control
T2	Remove commercial foliage stems from all trees.
T3	Remove commercial foliage stems from all trees. Prune final crop trees according to Forest Service guidelines. Reduce height of foliage trees by cutting trunk at 2.3 m above ground level.
T4	Remove commercial foliage stems from all trees. Prune final crop trees according to Forest Service guidelines. At a height of 1.8 m, scar foliage trees by removing approximately 70% of the bark around the trunk.

FORESTFOLIAGE

▲ *Recovery of Japanese larch after harvesting foliage stems.*

▲ *Forest foliage screening trial.*

▲ *Hedera helix arborescens.*



▲ *Japanese larch foliage yields.*

- Possess adequate bulk or volume as required by the market.
- Be blemish-free with no damaged or decaying foliage.

Data collected after one year indicate that removing graded foliage stems has no apparent effect on height or diameter measurements. Encouraging foliage yields have also been recorded. Stem numbers harvested from Japanese larch show development of lateral shoots after foliage harvesting. Data from the other species will be presented in due course.

New foliage species

A series of discussions took place between the main foliage exporting company in Ireland and various plant experts and leading nurserymen on how species for testing should be selected and eventually chosen. The criteria used to select species for investigation. were leaf colour, leaf shape, known potential stem length and productivity information. Although plants are too young for commercial foliage harvesting, growth rates, potential foliage yields and pest and disease occurrence are currently being observed. Promising species will be subjected to further trials at a later date.

ACTIVITIES PLANNED FOR 2007

For existing plantations:

- Experiments established in existing plantations will be monitored and further data collected.
- The project team and other interested parties will continue to meet.
- Management protocols are to be finalised and written up for each of the forest tree species being examined.

For new species:

- A report detailing the foliage potential of each trial species will be prepared and 'winners' identified.
- Further trial work will be carried out on successful species to determine appropriate management practices.
- A series of shelf-life tests and market assessments will be carried out.

OUTPUTS

Throughout 2006, a series of on-site meetings were held where the project team and industry experts discussed results and how best to proceed.

A marketing questionnaire was distributed to 100 Irish florists. Full results will be available in due course.

On completion of trial work, a series of management notes are to be produced and results transferred via a series of on-site meetings.

COMPLETION DATE: April 2007

Evaluation and development of the potential of forest residue as a bedding material for dairy and beef cattle on out-wintering pads

OWP

PROJECT TEAM

Dr Padraig French, Teagasc*

Dr Laura Boyle, Animal Welfare scientist

Dr Owen Carton, Environmental scientist

Cara Augestenburg, Jane Hourihan and Keelin O Driscoll, Postgraduate students

Noel Byrne Farm Manager

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OBJECTIVES

To comprehensively evaluate the potential use of forestry residues in out-wintering pads (OWPs) with emphasis on issues important to animal welfare, production and environmental sustainability.

PROGRESS

During 2005 and 2006 two experiments were completed: the first evaluated the recycling of OWP effluent and the second quantified the impact on cow welfare and productivity of wintering on OWPs.

Study 1: Grass yield response following land application of effluent from out-wintering pads

Out-wintering pads (OWPs) are a low capital-cost cattle housing system, consisting of a layer of timber residue over an artificially drained surface that separates solid and liquid excreta created during animal confinement. Residues from OWPs that require management include liquid effluent (urine and water) and spent timber residue (timber soiled with manure). The current strategy for on-farm management of effluent and spent timber residue is to apply them to grassland used for the production of silage. As part of a four-year programme to determine the sustainability of OWP livestock housing systems, previous research examined the nitrogen (N) fertilizer potential of spent timber residue from OWPs. The objective of this study was to determine if effluent from OWPs can be utilized as a potential N fertilizer source on Irish grassland and to determine the dry matter (DM) yield and nitrogen (N) response of first and residual cut silage to three rates of OWP effluent applied. These results were compared to silage crop response to inorganic N fertilizer.

Three rates of effluent (15, 30 and 60 t ha^{-1}) and five rates of inorganic N fertilizer (25, 50, 75, 100 and 125 kg ha^{-1}) as calcium-ammonium nitrate (27.5% N) were applied to plots in April of each year. Control plots that did not receive effluent or inorganic N were also included

Effluent and slurry analysis: The effluent used in the 2004 trials contained 458 mg L^{-1} of total N, approximately 59% of which was in the plant-available, inorganic N form (NH4-N). The effluent used in the 2005 trials contained 343 mg L^{-1} of total N, approximately 63% of which was in the plant-available, inorganic N form.

Crop response: In 2004, there was significant ($p \leq 0.05$) DM yield response to increasing effluent application for first cut silage, while no response was observed in 2005. No significant response ($p \leq 0.05$) was observed in first cut silage N response with increasing effluent application in any trial. None of the trials demonstrated a significant response in residual cut DM yield with increasing effluent application with the exception of the Moorepark trial in 2005. The efficiency of OWP effluent ranged from 74 to 100% at the highest application rate (29 kg N ha^{-1}) compared to inorganic fertilizer for first cut silage DM yield.

Study 2: The effects of OWPs on dairy cow productivity

Out-wintering pads are associated with improved performance in beef cattle and more efficient use of feed energy in dairy weanlings than conventional indoor cubicle housing systems. However, out-wintered animals have higher energy demands during periods of adverse weather. Exposure to harsh weather may contribute to an increase in energy demand, and given the susceptibility of dairy cows to negative energy balance problems in early lactation, out-wintering on OWPs may have negative implications for productivity and reproductive performance during lactation. The objective of this study was to compare three OWP designs with indoor cubicle housing, with regard to dairy cow productivity, dry matter intake (DMI) and reproductive performance.

OWP

Spring calving dairy cows (n=96) were assigned to four treatments: indoor cubicle housing (IC), an uncovered OWP (UP), a covered sheltered OWP (CP), and an uncovered OWP with a self-feed silage pit (SP). Treatments IC, UP and CP were easy-fed silage with 0.6 m of head feed/animal. Animals were assigned to treatment on 17 November 2005 until calving, then turned out to pasture. Weekly milk yield and composition (fat, protein and lactose) were recorded from calving until the end of the lactation.

Winter accommodation had no effect on liveweight or body condition score (BCS) prior to calving or during lactation. On 5 February BCS was higher than on 1 January (3.1±0.04, 2.9±0.03, respectively $p \leq 0.001$). There was no difference in DMI between treatments. Animals from the SP treatment tended to produce milk with a higher protein percentage than animals on the CP treatment (Table 1). They also had the highest mean weekly milk yield over the entire lactation and during stage 1. Furthermore, the SP animals had the highest 21 d submission rate, first service pregnancy rate, and numerically the lowest calving to first service interval and the calving to conception interval (CCI). Improved reproductive performance and milk production in SP animals indicate that feeding schedule during the dry period may have a greater impact on post-calving dairy cow performance than shelter, in Irish conditions. However, the number of animals per treatment in this experiment were too few to make any definitive conclusion on reproductive performance

OWPs do not pose a threat to productivity or reproductive performance, or increase DMI. Furthermore, a system that facilitates the self-feeding of cows has the potential to reduce capital and labour input with no negative impact on animal performance Because of the significant improvement in animal performance it is necessary to repeat this experiment.

Table 1. Effect of winter accommodation on production, intake and reproductive performance.

	IC	*CP*	*UP*	*SP*
Weekly milk yield (kg)	*122.1*	*123.6*	*131.9*	*136.9*
Protein (g/kg)	*34.8*	*34.6*	*34.2*	*35.2*
Fat (g/kg)	*39.2*	*39.5*	*38.6*	*39.4*
Lactose (g/kg)	*45.2*	*44.9*	*44.6*	*44.5*
DMI (kg/day)	*10.6*	*10.5*	*11.3*	*10.0*
Calving to first service (days)	*76*	*75*	*80*	*70*
21d submission rate (%)	*70*	*67*	*68*	*85*
First service pregnancy rate (%)	*30*	*33*	*32*	*55*
Calving to conception (days)	*101*	*93*	*94*	*93*
Gestation duration (days)	*282*	*286*	*284*	*280*

OUTPUTS

French, P., O'Driscoll, K., Boyle, L. and Hanlon, A. 2006. *Alternative out-wintering pad systems for dairy cows*. Proceedings of the Agricultural Research Forum, Tullamore, Ireland, 15-16, March 2006.

French, P., Ryan, T. and O'Loughlin, J. 2006. *Cost-effective wintering options*. Proceeding of the Teagasc national dairy conference, Limerick and Cavan, 15 and 16 Nov. 2006

Hourihan, J., French, P., Berry, D.P. and Kenny, D.A. 2006. *Factors affecting the dirtiness of out-wintering pads and out-wintered cattle*. Proceedings of the Agricultural Research Forum, Tullamore, Ireland 15-16 March 2006.

O'Driscoll, K., Boyle, L., French, P. and Hanlon A. 2006. *The effects of design and management of out-wintering pads on the welfare of dairy cows*. Submitted to Acta Agriculturae Scandinavica, Section A, September 2006.

O'Driscoll, K., Boyle, L., French, P. and Hanlon, A. 2006. *The effects of design of out-wintering pads on the welfare of dairy cows*. Proceedings of the Agricultural Research Forum, Tullamore, Ireland 15-16 March 2006.

O'Driscoll, K., Boyle, L., French, P., Meaney, B. and Hanlon, A. 2006. *Effect of winter housing on cow dirt score, somatic cell score and mastitis incidence in dairy cows*. Proceedings of the ADSA/ASAS Joint Annual Meeting, Minneapolis, Minnesota, 9-13 July, 2006.

COMPLETION DATE: December 2006

Reinforced polymer timbers

REPOTIM

This project is co-funded with Coillte, National University of Ireland, Galway and the Irish Research Council for Science, Engineering and Technology (IRCSET).

PROJECT TEAM

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Gary Raftery, NUI Galway*

Dr Peter Rodd, NUI Galway

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OBJECTIVES

The overall objective of this research is to examine the possibility of producing a commercially attractive Fibre Reinforced Polymer (FRP) reinforced glue-laminated Irish-grown Sitka spruce composite beam. The feasibility of reinforcing the glulam beam with a number of different reinforcement materials and geometric configurations is being examined by experimental, analytical and numerical methods.

A further objective of the project is to add value to timber due to its increased structural performance. It is hoped that a replacement of conventional engineering materials by new-engineered wood products will be offered and that an improved understanding of the behaviour of new-engineered wood products will be gained. The project will also augment the knowledge base for a new CEN standard regarding the use of FRP reinforced timber materials.

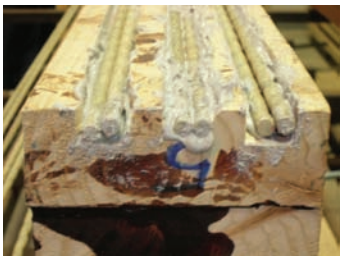
PROGRESS

Preliminary work on the project involved desk studies which were designed to highlight suitable and viable reinforcing techniques and materials as well as potentially compatible adhesives.

An intensive experimental test programme examined the quality of the bond developed in both the wood-wood interfaces and FRP-wood interfaces. This study was essential to the successful development of an FRP-glulam beam. Despite the presence of large juvenile wood content, conventional wood laminating adhesives obtained good quality bonds at the wood-wood interface.

For the FRP-wood interface, two pultruded reinforcing materials were selected for the study, comprising glass fibres aligned unidirectionally in a vinylester resin and an engineered thermoplastic polyurethane. Both non-moisture cycled and moisture cycled specimens were studied. Moisture cycling involved a five cycle vacuum-pressure soak-drying procedure to assess the resistance of the bond interface to hygrothermal stresses. It was seen that both adhesive and FRP type proved significant in ensuring the integrity of the bond. Strong durable bonds of high quality were formed using conventional wood laminating adhesive with specific FRP reinforcements. This provides an alternative to the generally accepted expensive structural epoxy adhesives that are used to bond FRPs to wood. In general, the shear strengths of moisture cycled FRP-wood bonded specimens were lower in comparison to non-moisture cycled FRP-wood specimens, wood-wood bonded specimens and solid control specimens taken from the same board.

Testing of full-scale beams has demonstrated that brittle tension failures initiating at defects regularly occur in solid wooden members. The location of such defects in the critical stressed tension region can be eliminated in Irish-grown Sitka spruce glue-laminated beams by strategically locating the higher strength laminations in the higher stressed zone. Laminations were initially mechanically graded using the Cook Bolinder stress grading machine.



▲ *Rod FRP-Glulam beam section.*

◀ *Plate FRP-Glulam beam section.*

▲ *Flexure testing of Irish-growing Sitka spruce glulam.*

REPOTIM

Optimum beam lay-ups were determined from a combination of the mechanical grading and visual grading procedures. The visual grading involved measurements of density, rate of growth, moisture content, grain angle, knot area ratios, knot location and size as well as distortional effects such as twist, bow, spring and cupping.

Theoretical increases in strength and stiffness due to the reinforcement in glulam beams have been determined by transformed section analyses and stress block techniques using the modulus of elasticity (MOE) of the individual laminations and the MOE of the FRP.

The use of reinforcement in the form of bonded-in glass FRP rods has demonstrated that significant increases in strength and stiffness can be obtained in comparison to unreinforced beams when using relatively low percentages of reinforcement. Increases in strength were observed with increased ductility in the compression zone. The FRP-wood interface adhesive that was selected from the results of the stress bond test programme formed bonds of a high quality. It has also been demonstrated that by repairing a failed glulam beam with glass FRP rods, the ultimate strength obtained by the initially failed unreinforced beam can be surpassed.

The development of a nonlinear stress strain, finite element, plane stress model using ANSYS is complete. This model is specific for plate reinforcement which is considered more compatible with the laminating process. The model incorporates anisotropic plasticity, accounts for crushing in the compression zone, the brittle behaviour in tension of the wood and the variability between the individual laminations. Yield stresses and tangential moduli were obtained from experimental data. The model incorporates orthotropic linear elastic material properties for the FRP material and isotropic adhesive properties. The load is progressively applied in increments of displacement.

At each load increment, the stresses in the model are computed. Elements are failed when the magnitude of the stresses exceed critical values established from experimentation.

The model has the capability to predict the location at which failure initiates, the mode of failure, the load displacement behaviour and the stress distribution at the FRP plate adhesive interface. Percentage increases in load carrying capacity and stiffness can be determined for FRP reinforced glulam beams in comparison to unreinforced beams.

Manufacture of glue-laminated beams.

Mechanical grading of laminations.

ACTIVITIES PLANNED FOR 2007

The remaining reinforced glue-laminated Irish-grown Sitka spruce beams will be tested subject to flexure for short-term static conditions. Further analyses are to be executed with the plane stress finite element model in order to optimise the curtailment of the FRP. Significant quantities of instrumentation, comprising strain gauges and linear variable displacement transducers (LVDTs) are being used in the testing of these beams. The results obtained from these must be analysed.

OUTPUTS

Raftery, G., Harte, A. and Rodd, P. Qualification of wood adhesives for structural softwood glulam with large juvenile wood content. *Journal of the Institute of Wood Science* (submitted for publication), IWSC, UK.

Raftery, G., Harte, A. and Rodd, P. 2006. *Durability assessment of adhesives and reinforcement at the FRP-Wood interface*. Proceedings of the Third International Conference on FRP Composites in Civil Engineering (CICE 2006), International Institute for FRP (IFIC) in Construction, Miami, Florida, USA.

Raftery, G., Harte, A. and Rodd, P. 2006. *Performance evaluation of adhesives and reinforcements in GFRP-wood connections*. Proceedings of the World Conference of Timber Engineering, Portland, Oregon, USA.

Raftery, G. and Harte, A. 2005. *Evaluation of wood adhesives for a glue-laminated softwood.* Proceedings of Wood Adhesives 2005, Forest Products Society, San Diego, California, USA.

COMPLETION DATE: July 2007

Biodiversity in Irish plantation forests

BIOFOREST

The project was advised by a Steering Group composed of experts from Irish and international bodies including COFORD, EPA, National Parks and Wildlife Service, Forest Service, Centre for Ecology and Hydrology (UK), Forestry Commission (UK), University of Helsinki and the European Environment Agency.

PROJECT TEAM

The BIOFOREST research team is constituted from the following organisations: Department of Zoology and Animal Ecology and Environment Research Institute (ERI), University College, Cork (UCC), Department of Botany, Trinity College, Dublin (TCD), Coillte (The Irish Forestry Board). This consortium brought together a team of researchers and partner organisations that have extensive experience in ecology, biodiversity assessment and forest biodiversity studies across a broad spectrum of botanical and zoological groups. The UCC group has been involved in large-scale biodiversity studies funded by the EU, COFORD and the Heritage Council and has been a partner in a large concerted action related to biodiversity indicators in forests (BEAR). The TCD group are one of the foremost forest plant ecology groups in the country and have wide experience in general botanical surveys, forest and woodland plant biodiversity studies and in production of forest biodiversity guidelines. Coillte is the primary forest owner and manager in Ireland, and the staff on the project have specific expertise in forest ecology.

Project participants

Department of Zoology, Ecology and Plant Science and the Coastal and Marine Resources Centre, University College, Cork: Prof. John O'Halloran*, Dr Tom Kelly, Dr Tom Gittings, Dr Mark Wilson, Dr Josephine Pithon, Dr Anne Oxbrough, Julianna O'Callaghan, Prof. Paul Giller; *Coastal and Marine Resources Centre, University College, Cork:* Valerie Cummins, Vicki O'Donnell; *Botany Department, Trinity College, Dublin*: Dr Daniel Kelly, Dr Fraser Mitchell, Dr Paul Dowding, Dr George Smith, Dr Laura French, Linda Coote, Dr Susan Iremonger, Dr Anne-Marie McKee and Saoirse O'Donoghue; *Coillte*: Dr Aileen O'Sullivan, Pat Neville, Alistair Pfeifer.

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OBJECTIVES

BIOFOREST was a large-scale research project running from 2001 to 2006 with the aim of providing much needed basic information on biodiversity in Irish plantation forests. The project was funded from the National Development Plan funds through COFORD and the Environmental Protection Agency (EPA) as part of the Environmental RTDI Programme 2000-2006.

Interest in biodiversity and its conservation has grown tremendously over the last decade, resulting in the UN Convention on Biodiversity (CBD), and EU and national biodiversity plans and legislation. Biodiversity serves a variety of functions and values, from aesthetic and recreational, to provisional (such as food, medicines, and building materials), to supportive (such as the various ecosystem functions that support and drive soil fertility, water quality, decomposition, biogeochemical cycles etc.). Knowledge of the nature and extent of biodiversity and how it is affected by anthropogenic activities is thus vital to sustainable development and living.

The BIOFOREST project focussed on forest biodiversity with the following three sub-projects:

- Biodiversity assessment of afforestation sites;
- Assessment of biodiversity at different stages of the forest cycle;
- Investigation of experimental methods to enhance biodiversity in plantation forests.

Together these projects contributed to a picture of biodiversity in a range of Irish plantation forests and how this is affected by previous land cover, land use and management methods. BIOFOREST has added significantly to our knowledge of the role of Irish forests in the overall biodiversity of Ireland and has helped guide future land use planning and forestry practices and contributed to approaches on how to maintain and enhance biodiversity. The main groups included in these projects were:

- *Animals*: Birds, hoverflies and spiders.
- *Plants*: Higher plants, ferns, mosses, liverworts and lichens.

BIOFOREST

PROGRESS

The project was completed in 2006. The final report will be published in 2007 and is a synthesis of five technical reports produced by the BIOFOREST project:

- *Biodiversity assessment in preparation for afforestation: a review of existing practice in Ireland and best practice overseas* (Gittings et al. 2004),
- *Biodiversity assessment of afforestation sites* (Smith et al. 2006),
- *Assessment of biodiversity at different stages of the forest cycle* (Smith et al. 2005),
- *Investigation of experimental methods to enhance biodiversity in plantation forests* (Iremonger et al. 2006).
- *The distribution of Hen Harriers in Ireland in relation to land-use cover in general and forest cover in particular* (Wilson et al. 2005).

For more information on a particular aspect of the BIOFOREST project, refer to these more detailed reports (see COFORD website www.coford.ie and the BIOFOREST website http://bioforest.ucc.ie)

OUTPUTS

Reports

Iremonger, S., Gittings, T., Smith, G.F., Wilson, M., Oxbrough, A., Coote, L., Pithon, J., O'Donoghue, S., McKee, A.-M., O'Halloran, J., Kelly, D.L., Giller, P., O'Sullivan, A., Neville, P., Mitchell, F.J.G., O'Donnell, V., Kelly, T. and Dowding, P. *Investigation of experimental methods to enhance biodiversity in plantation forests*. BIOFOREST Project 3.1.3. Final report January 2006.

Smith, G.F., Gittings, T., Wilson, M., Oxbrough, A., Iremonger, S., O'Donoghue, S., McKee, A.-M., O'Halloran, J., Kelly, D.L., Pithon, J., O'Sullivan, A., Neville, P., Mitchell, F.J.G., Giller, P., O'Donnell, V. and Kelly, T. *Biodiversity assessment of afforestation sites*. May 2006.

Iremonger, S., O'Halloran, J., Kelly, D.L., Wilson, M.W., Smith, G.F., Gittings, T., Giller, P.S., Mitchell, F.J.G., Oxbrough, A., Coote, L., French, L., O'Donoghue, S., McKee, A.-M., Pithon, J., O'Sullivan, A., Neville, P., O'Donnell, V., Cummins, V., Kelly, T. and Dowding, P. *Biodiversity in Irish plantation forests*.

Large Scale Project in the Environmental RTDI Programme 2001-2006 Synthesis Report.

Policy input

The BIOFOREST Team made a submission on Biodiversity and Environmental Measures for inclusion in the forestry aspects of the Rural Development Regulation in February 2006.

COFORD Connects notes

Mark Wilson, Tom Gittings, John O'Halloran, Tom Kelly, and Josephine Pithon, 2006. *The distribution of Hen Harriers in Ireland in relation to land use cover, in particular forest cover.* COFORD Connects Notes Series, COFORD, Dublin.

Theses

Coote, L. 2006. *Epiphyte diversity in Irish plantation forests*. Ph.D. Thesis, Trinity College, University of Dublin, Ireland.

Oxbrough, A.G. 2006. *The effect of plantation forests on ground-dwelling spiders,* Ph.D. Thesis, National University of Ireland, Cork.

Database

O'Donnell, V., Cummins, V., Wilson, M.W., Gittings, T., Iremonger, S., O'Halloran, J., Kelly, D.L., Mitchell, F.J.G., Giller, P.S., Smith, G., Oxbrough, A., Coote, L., French, L., O'Donoghue, S., McKee, A.-M., Pithon, J., O'Sullivan, A., Neville, P., Kelly, T. and Dowding. P. 2006. *The BIOFOREST Database*. DVD, COFORD and EPA.

Research papers

Buscardo, E., Smith, G.F., Kelly, D.L., Freitas, H., Iremonger, S., Mitchell, F.J.G., O'Donoghue, S. and McKee, A. Accepted for publication. The early effects of afforestation on biodiversity of grasslands in Ireland. *Biodiversity and Conservation*.

Coote, L., Smith, G.F., Kelly, D.L, O'Donoghue, S., Dowding, P., Iremonger, S. and Mitchell, F.J.G. Accepted for publication. The epiphytes of Sitka spruce (Picea sitchensis) plantations in Ireland and the effects of open spaces within them. *Biodiversity and Conservation.*

Gittings, T., Giller, P.S. and O'Halloran, J. 2005. Notable hoverfly (Diptera: Syrphidae) records, 2001-2002. *Irish Naturalists' Journal* 28: 132-133.

Gittings, T., O'Halloran, J., Kelly, T. and Giller, P.S. 2006. The contribution of open spaces to the maintenance of hoverfly (Diptera, Syrphidae) biodiversity in Irish plantation forests. *Forest Ecology and Management* 237: 290-30.

Oxbrough, A. 2006. Distribution records of some uncommonly recorded spiders in Ireland including a new Irish record: *Meioneta mollis* (O.P. - Cambridge, 1871) (Araneae: Linyphiidae). *Irish Naturalists Journal.*

Oxbrough, A.G,, Gittings, T., O'Halloran, J., Giller, P.S. and Kelly, T. 2006. The initial effects of afforestation on the ground-dwelling spider fauna of Irish peatlands and grasslands. *Forest Ecology and Management* 237: 478-491.

Oxbrough, A.G., Gittings, T., O'Halloran, J. and Giller. P.S. 2005. Structural indicators of spider assemblages across the forest plantation cycle. *Forest Ecology and Management* 212: 171-183.

Oxbrough, A.G., Gittings, T., O'Halloran, J., Giller, P.S. and Kelly, T. 2006. The influence of open space on ground-dwelling spider assemblages within plantation forests. *Forest Ecology and Management* 237: 404-417.

Smith, G.F., Iremonger, S., Kelly, D.L., O'Donoghue, S. and Mitchell, F.J.G. In press. Enhancing vegetation diversity in glades, rides and roads in plantation forests. *Biological Conservation*. In Press. Corrected proof available online 22 January 2007.

Wilson, M.W., Pithon, J., Gittings, T., Kelly, T.C., Giller, P.S. and O'Halloran, J. 2006. The effects of growth stage and tree species composition on breeding bird assemblages of plantation forests. *Bird Study* 53: 225-236.

Presentations

Kelly, D.L. 2006. *Can plantation forests be havens of biodiversity?* The Annual Augustine Henry Forestry Lecture 2006. Lecture to the Society of Irish Foresters, The Royal Dublin Society, 9 March 2006.

Iremonger, S., O'Halloran, J., Kelly, D.L., Mitchell, F.J.G., Giller, P.S., Smith, G., Gittings, T., Wilson, M.W., Oxbrough, A., Coote, L., French, L., O'Donoghue, S., McKee, A.-M., Pithon, J., O'Sullivan, A., Neville, P., O'Donnell, V., Kelly T. and Dowding P. 2006. The BIOFOREST Project 2001-2006. *Implications of results for policy and practice.* Presentation to the Irish Forest Service, Johnstown Castle, Wexford.

Inputs to teaching

Much of the research material has formed an important context and some materials for the UCC Certificate in the Components of Forest Biodiversity (BCF). Prof. John O'Halloran, Dr Aileen O'Sullivan, Dr Tom Gittings, Dr Mark Wilson and Dr Jonathan Humphrey participated in this course. The course is attended by Coillte, Forest Service, contractors and other stakeholders. The material derived from the project was also included in the research-led undergraduate teaching at UCC and TCD.

COMPLETION DATE: December 2006

CARBiFOR

Carbon sequestration in Irish forests

PROJECT TEAM

Working group 1: Ecosystem fluxes and modelling

Prof Bruce Osborne, UCD

Dr Kevin Black*, UCD

Working group 4: Biomass carbon stocks and expansion factors

Prof Maarten Nieuwenhuis, UCD

Dr Brian Tobin*, UCD

CARBWARE

Dr Gerhard Gallagher, Consultant

Dr Kevin Black, UCD

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OBJECTIVES

The CARBiFOR project was extended into 2007 with the following aims :

- Continued development and refinement of national forest carbon (C) stock change reporting procedures and software (CARBWARE) based on current and new research information.
- Continued eddy covariance measurements and growth increment surveys. This is important to validate national reporting estimates and identify emission factors associated with age or management-related influences.
- An assessment of changes in C sequestration associated with thinning.
- Development of models for the quantification of litter and woody debris at the national level.

PROGRESS

Improvements to CARBWARE

Carbon stock changes for the national forest estate from 1990 to 2022 were estimated using the CARBWARE model, developed as a tool to facilitate the reporting obligations to the EC and UNFCCC. Continued development and refinements to the CARBWARE model included:

- Refinement of generalised broadleaf and conifer current annual increment (CAI) biomass models;
- Calculation of C stock changes in the five major C pools as outlined by the UNFCCC good practice guidance documents (i.e. above ground biomass, below ground biomass, woody debris, litter and soils);
- Characterisation of forest C stock changes associated with land use and land use change (LULUCF) and provision of data in specified UNFCCC formats to the EPA (EPA National Inventory report, 2006) to meet EU and UNFCCC reporting requirements.
- Under the Kyoto Protocol, carbon sequestration by forests may be used for compliance purposes. For the first commitment period carbon sequestration by these 'Kyoto' (Article 3.3) forests include deforestation, reforestation[1] and afforestation activities since 1990. Assuming the business-as-usual scenario and an annual afforestation rate of 14,000 ha (average C sequestration rate of 2.06 Mt yr^{-1} for the first commitment period), it is estimated that the contribution of Article 3.3 forests may account for ~20% of the required reduction in national emissions for Ireland to meet its Kyoto target. CARBWARE is continuously re-evaluated and developed as new research and national forest inventory information becomes available.

Long-term eddy covariance measurements

The net C sequestration rate of a forest is the sum of current annual increment (CAI) minus losses associated with decomposition and management related changes (emission factors). These unknown emission factors

[1] *Reforestation is defined according to the Marrakesh Accords as* …the direct human-induced conversion of non-forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to the non-forested land. For the first commitment period [2008-2012], reforestation activities will be limited to reforestation occurring on land that did not contain forest on 31 December 1989. *In the Irish context the term reforestation is used differently, and refers to the regeneration of forest land after felling.*

cannot be determined using conventional inventory methods. Therefore, full accounting methods, such as eddy covariance, allow us to assess age-related, management or forest species-specific changes in emission. Based on long term (since 2002) information from eddy covariance measurement at Dooary (a site in the Midlands), it can now be illustrated that annual C sequestration rates generally decline after canopy closure due to suppression and competition prior to first thinning. However, it is also evident that inter-annual variations in climatic variables, such as temperature and rainfall, may influence forest C balance over the short term (Figure 1). For example, the observed decline in annual C sequestration for 2004 could be associated with periods of extended water deficits after bud break and lower temperatures over the 2004 growing season.

In addition to accounting for changes associated with stand age, there is a need to incorporate an analysis of the effects of disturbance, particularly those related to management practices (e.g. thinning), and land-use change, such as the transition from grassland to forest. The Dooary site was thinned in December 2006, and this work is ongoing.

Assessment of coarse woody debris

Methods to estimate litter and coarse woody C pools for LULUCF and Kyoto reporting based on NFI inventory data were developed and published.

Development of new techniques for assessing root biomass

An initial Ground-Penetrating Radar (GPR) scan, in conjunction with Fujikura UK, was conducted in the Dooary forest, and will be used to improve the calibration of the scanning sensor to allow better detection of roots. This process will lead to a further, more detailed scan of a number of separate and different aged sites. If successful, GPR might prove to be a useful tool in complementing and augmenting data produced by the more destructive and time-consuming techniques.

ACTIVITIES PLANNED FOR 2007

CARBiFOR research activities will be extended and incorporated with a new COFORD-funded programme aimed at the assessment of climate change impacts on productivity and emission mitigation in Irish forest ecosystems (CLI-MIT). The programme is divided into two core activities:

1) Assessment of the impact of IPCC climate change scenarios on forest ecosystems, the development of adaptation strategies, as well as the role of forests in overall climate change adaptation. Most of this work will be done under an ecological site classification and climate change project (ESC-Ireland). It will include collaboration with other projects in the programme, including CARBWARE, CARBiFOR2 and FORESTC for adaptation strategies for both future forest and carbon sequestration scenarios.

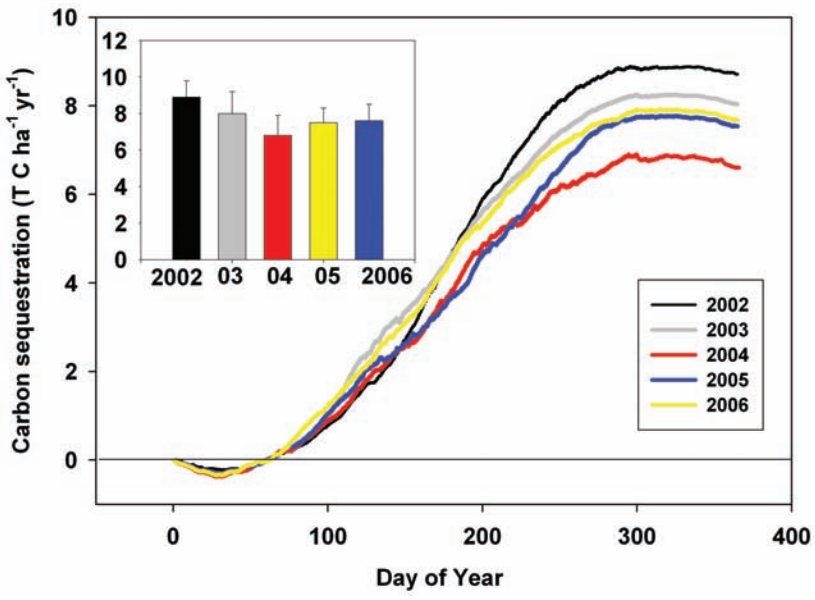

Figure 1: Cumulative (lines) and total (histogram) annual net C sequestration by a Sitka spruce canopy since 2002.

2) Strategic research and development of a carbon stock change reporting format for all Irish forests (reporting to the UN Framework Convention on Climate Change – 'convention reporting'), and specific reporting on afforestation and deforestation since 1990 ('Kyoto reporting'), in the five biomass pools outlined in the Marrakesh Accords. CARBWARE will form the focal point for dissemination of all research efforts (CARBiFOR II, FORESTC, HWP C-stores and ESC-Ireland). The objectives of the research programme are mainly based on national and international policy and reporting requirements (Figure 2).

OUTPUTS

Publications

Black, K., Davis, P., Lynch, P., Jones, M., McGettigan, M. and Osborne, B. 2006. Long-term changes in solar radiation and potential effects on gross primary productivity of three major land use categories. *Agricultural Forest Meteorology* 141:118-132.

Black, K.G. and Farrell, E.P. (Eds) 2006. *Carbon sequestration in Irish forest ecosystems*. Final Report. COFORD, Dublin.

Black, K. 2006. *Carbon sequestration in Irish forests*. Science Spin Magazine.

Mc Gettigan, M., Duffy, Connolly, O'Brein. 2006. *National Inventory Report 2006*. Greenhouse gas emissions 1990-2004. Reported to the UNFCCC, EPA, pp153, ISBN 1-84095-196-6.

Tobin, B. 2006. *Carbon sequestration in Sitka spruce in Ireland*. Ph.D. Thesis, School of Biological and Environmental Science. University College Dublin, Dublin.

Tobin, B., Black, K., Osborne, B., Reidy, B., Bolger T. and Nieuwenhuis, M. 2006. Assessment of allometric algorithms for estimating leaf biomass, leaf area index and litterfall in different aged Sitka spruce forests. *Forestry* 7(4): 444-463.

Tobin, B. and Nieuwenhuis, M. 2006. When is a stump really dead? *Irish Timber and Forestry* Volume 15 No. 1: 18-19.

Tobin, B. and Nieuwenhuis, M. 2006. *Evaluating forest coarse-root debris –very difficult!* Paper presented to 'Roots, mycorrhizas and their external mycelia in carbon dynamics in forest soil. COST E38 conference, Rovaniemi, Finland. 9-13 September 2006.

COMPLETION DATE: December 2007

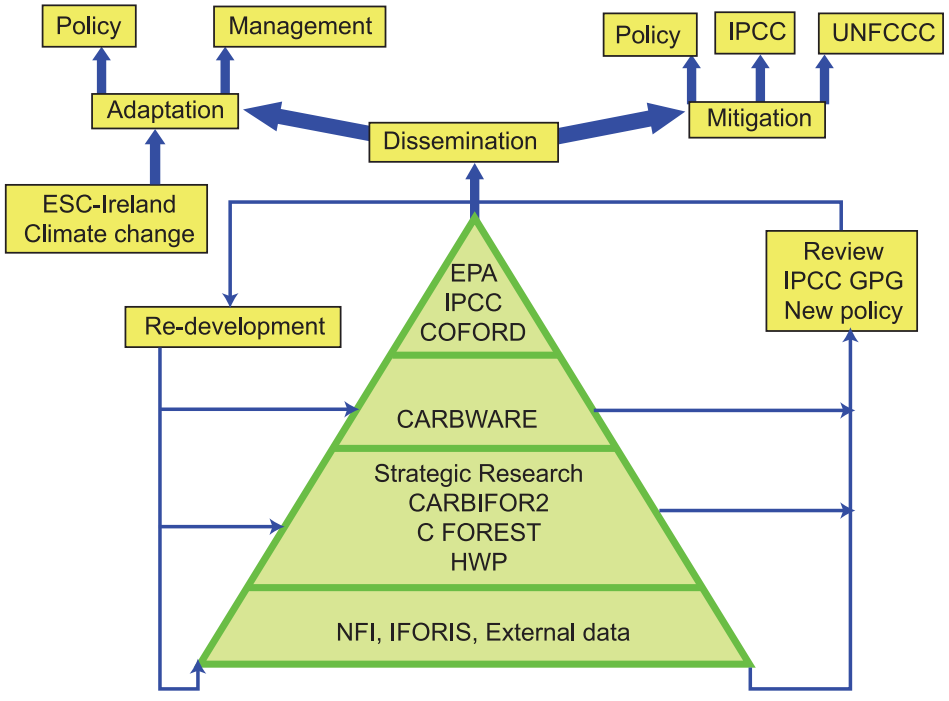

Figure 2: The CLI-MIT programme structure, outlining the flow of information between external data sources, individual projects and dissemination to stakeholders.

Forestry operations - quantification and management of erosion and phosphorus release

SILTATION

Co-funded by EPA, Coillte, Marine Institute and NPWS

PROJECT TEAM

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Markus Muller, NUI Galway

* *Please address correspondence to michael.rodgers@nuigalway.ie*

OBJECTIVES

The main aims of this study are:

- to quantify the amount of suspended sediment and phosphorus released from harvesting and reforesting operations on a representative forest catchment on peat;
- to evaluate and to make recommendations on, where appropriate, current best management practices in controlling erosion and phosphorus losses.

PROGRESS

The blanket peat forest catchment study site is located at Burrishoole, Co Mayo. The study catchment is drained by a first order stream (Figure 1), equipped with two monitoring stations, one upstream of the study area (US) and the other downstream of the study area (DS). The US station monitors flows from the forest Coupe A with an area of 7.2 ha and the DS station monitors flows from forest Coupes A, B and C with a total combined area of 13.2 ha. Clearfelling and harvesting commenced in Coupes B and C on 25 July 2005 and lasted eight weeks. Coupe A, which was not harvested, was used as a control site in this study since it has the same type of trees, similar soil, hydrologic characteristics and size, as the harvested Coupes B and C.

An H-flume, a water level recorder, a multichannel data logger and an automatic water sampler were set up at both the US and DS monitoring stations, along with a tipping bucket rain gauge at the DS station. The water levels in the H-flumes at the two stations are recorded every five minutes. As a result, the amount of water flowing into and leaving the felled area can be calculated. During flood events, water samples were taken hourly at the US and DS stations. Also, in base flow conditions, on one day per week, water samples were taken hourly for 24 hours. Grab samples were taken from above (AC) and below (BC) the confluence of the study stream and the main river about once every two weeks. The water samples were analysed for suspended solids (SS), total reactive phosphorus (TRP) and total phosphorus (TP) concentrations.

The research emphases during 2006 were to: (i) continue monitoring the suspended sediment and phosphorus releases from the study catchment and (ii) analyse and synthesise the release data.

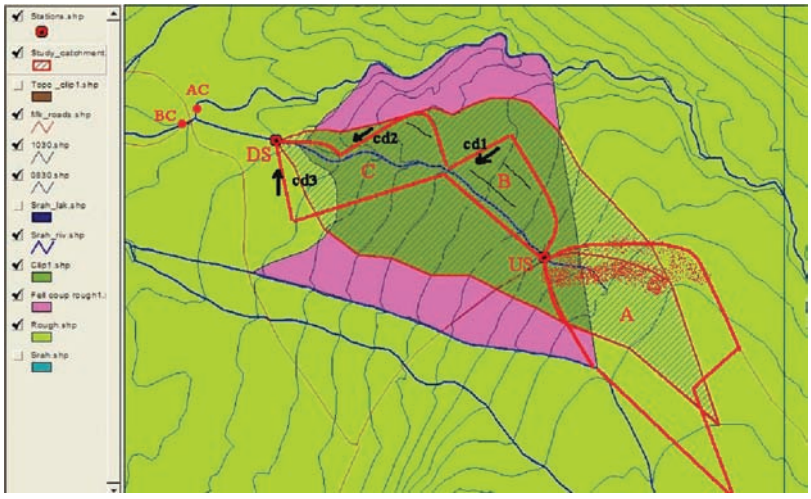

Figure 1: Contour plan of the catchment.

Hydrology analyses

The collected rainfall and flow rate data were analysed by Dr Mark Robinson, Centre for Ecology and Hydrology (CEH), UK. There is a very close relationship between the hydrological responses of the upstream and downstream catchments, which have a very rapid and direct response to rainfall. From preliminary analyses, harvesting the trees does not appear to have caused a significant change in the flow regime in the catchment. This provides evidence that compliance with the Forest Service Water Quality Guidelines during

SILTATION

clearfelling should not negatively impact on the flow regime.

Suspended sediment release

The suspended sediment (SS) concentrations and loads entering and leaving the 6 ha study site have been monitored before, during and after clearfelling and harvesting. The SS concentrations entering the study area from the upstream intact forested catchment area of 7.2 ha, were always low, and ranged from 0 to 5 mg L^{-1} during base flow conditions and from 5 to 30.6 mg L^{-1} during flood events. In low flow conditions, the SS concentrations leaving the study area were also low before, during and after clearfelling and harvesting. In a flood event, on 2 November 2005, just over one month after the clearfelling and harvesting operations were complete, the highest peak SS concentration at the downstream station (DS) was 97.5 mg L^{-1}. During the 8-week period of clearfelling and harvesting, about 13 kg SS ha^{-1} were released from the undisturbed 7.2 ha forest catchment and 45.1 kg SS ha^{-1} from the 6 ha harvested catchment. In the first year after clearfelling, from October 2005 to September 2006, the net SS load release rate from the harvested area was calculated at 450.4 kg ha^{-1} yr^{-1} in comparison with the release of 172 kg ha^{-1} yr^{-1} from the undisturbed upstream forest catchment.

Phosphorus release

The average recorded phosphorus (P) concentrations in the rainfall at the study site were 13 μg TP L^{-1} and 4 μg TRP L^{-1}. Monthly TRP loads from the rainfall ranged between 2.5 g and 10 g TRP ha^{-1} with an annual total of 80.4 g ha^{-1} for the period October 2005 to September 2006. TRP concentrations entering the study area from the 7.2 ha upstream forested catchment are low and reasonably uniform, reaching peaks of 24 μg TRP L^{-1}. The average P concentrations from the upstream catchment were 14 μg TP L^{-1} and 6 μg TRP L^{-1}. TRP concentrations leaving the study area increased from around 8 μg TRP L^{-1} immediately prior to and during the start of clearfelling and harvesting operations to 73 μg TRP L^{-1} by the end of clearfelling and harvesting. During the clearfelling and harvesting period from August to September 2005, an estimated net 211.1 g TRP ha^{-1} were released from the 6 ha harvested area. The recorded phosphorus concentrations leaving the study site increased to a peak average daily concentration of 187 μg TRP L^{-1} on 2 November 2005. From November 2005 to May 2006 the exiting phosphorus concentrations reduced to about 90 μg TRP L^{-1}. Following an exceptionally dry June and July in 2006, the downstream phosphorus increased dramatically to its highest concentration to date of 500 μg TRP L^{-1} on 1 August 2006, almost a year after clearfelling and harvesting commenced. In the first year after clearfelling and harvesting, from October 2005 to September 2006, net P load release rates were estimated at 3987.2 g TRP ha^{-1} yr^{-1} in the 6 ha harvested area and 20 g TRP ha^{-1} yr^{-1} in the 7.2 ha undisturbed area. Because of the dilution in the receiving river downstream of the study site, phosphorus exiting the clearfelled area only slightly increases the phosphorus concentration in the receiving river, where average measured concentrations in the receiving river were 5 μg TRP L^{-1} above and 9 μg TRP L^{-1} below the confluence of the study stream and the river.

ACTIVITIES PLANNED FOR 2007

- Literature review update.
- Complete hydrological analysis.
- Complete sediment analysis.
- Complete phosphorus analysis.
- Assessment of the erodibility of different soils.
- Guideline document review.

OUTPUTS

Liwen Xiao and Michael Rodgers. 2006. *Phosphorus release from a forest catchment in Burrishoole, Co Mayo.* The Faculty of Engineering's Annual Research Day, Galway Bay Hotel, Galway, 19 April, 2006. (Poster).

Markus Muller and Michael Rodgers. 2006. *Erosion and siltation from forest practices*. Management of soil and nutrient in river catchments. COFORD Workshop. Paper and Oral Presentation.

Liwen Xiao and Michael Rodgers. 2006. *P-release from Burrishoole Catchment.* Management of soil and nutrient in river catchments. COFORD Workshop. Paper and Oral Presentation.

COMPLETION DATE: December 2006

TECHNOLOGY TRANSFER

NETWORKING AND KNOWLEDGE TRANSFER SUPPORT INITIATIVE

Support was given to the following applicants during 2006 to facilitate travel and mobility, seminars and workshops and working visits through the Networking and Knowledge Transfer Support Initiative.

Travel and mobility grants

- Geraldine O'Sullivan and Ciaran Collins, SWS: study visit to investigate billet harvesting and natural drying technique for short rotation crop (SRC) willow developed by Renewable Energy Suppliers Ltd in the UK.
- Ted Horgan, Coillte: travelled to Sussex in the UK to attend the meeting of the BIHIP Spanish chestnut working group.
- Dr Conor O'Reilly, UCD: attended two major conferences in Canada – the IUFRO conference Recent advances in seed physiology and technology and the meeting of the Canadian Tree Improvement Association.
- Dr George Smith, Trinity College Dublin: attended the British Ecological Society annual meeting in Oxford, England.
- John Lyons and Myles Mac Donncadha, Coillte: visited Sweden to examine machinery for the mechanical application of fertiliser in semi-mature plantations.
- Maria Cullen, Committee for Forest Fungi: attended the International Truffle Orchards workshop at Juva, Finland.
- Dr Ian Hall, an international expert on forest fungi: spoke on edible mushroom and truffle propagation in Irish forests.
- John O'Connell, Working Group on Edible Forest Fungi: attended a seminar on the conservation of fungi in Wales at Bangor, UK.

Working visits

- Sean Kelly, WIT: visited the Department of Forestry and Wood Products at the Royal Veterinary and Agricultural University in Denmark, to study the size classification of wood chips.
- Dr Julian Aherne, Trent University, Peterborough, Canada: travelled to Ireland to work with UCD on collation, synthesis and interpretation of the long-term monitoring data from a number of forest monitoring plots, looking at chemical fluxes and pools.
- Dr Elizabeth Shotton, School of Architecture, Landscape and Civil Engineering, UCD: attended a workshop on documentation studies of landscape and build at Dalhousie, Canada, and a design build event involving a community building at Cheticamp, Cape Breton Island, Canada.
- Eugene Boyle, Michael Lyons and Aidan Burke: attended a week-long competition in construction of spatial structures using wood at the Bergen National Academy of Arts, Norway.
- Evelyn Gallagher, Walsh Research Fellow, Teagasc: visited the laboratory of Dr Frascaria Lacoste, University of Paris Sud, Orsay, France, to investigate parentage analysis of a naturally regenerating ash woodland and methodologies used.
- Aoife Dillon, NUI Maynooth: spent a month at the biological control company, E-nema GmbH, Raisdorf, Germany, to prepare the Heterorhabditis downsesi nematode for in vitro mass production – this is the biological control agent for the large pine weevil, Hylobius abietis.
- Prof. Calvin Rose, Griffith University, Queensland, Australia: visited Ireland to conduct two workshops on the management of soils and nutrients in river catchments, arranged by COFORD and the NUI Galway.
- Dermot O'Donovan, GMIT Letterfrack: visited the National Hardwood Centre, Sweden and the Due Rose spa in Pordonone, Italy, to study the supply and process chain of alder.

Seminars and workshops

- IUFRO 3.08 Small-scale Forestry International Conference 'Small-scale Forestry and Rural Development: The intersection of ecosystems, economics and society' hosted by Galway-Mayo Institute of Technology, Galway, Ireland.
- COST E39 meeting on Forests, trees and human health and wellbeing, held from 28 to 30 November 2006 at the National Botanical Gardens, Dublin.

TECHNOLOGY TRANSFER

EVENTS

COFORD was involved in the organisation and hosting of six conferences and ten workshops in 2006, as listed below. In addition, COFORD initiated the ForestEnergy 2006 programme - a national series of demonstrations of thinning systems and machinery for quality woodfuel production from forestry (see feature below).

- 9 February: Seminar on Wood Modification: Opportunities and Challenges. University of Limerick.
- 10 March: National forestry conference The National Forestry Resource: Market Opportunities – co-hosted by COFORD, IFIC, ITGA, SIF, and held at the Tullamore Court Hotel, Tullamore, Co Offaly.
- 12 May: Conference on Forest Vegetation Management: A World Perspective. Waterford Institute of Technology.
- 22-26 May: Wood energy week, including the annual Wood Energy conference, co-hosted by COFORD and SEI REIO on 25 May.
- 18-23 June 2006: Small-scale Forestry and Rural Development: The intersection of ecosystems, economics and society. IUFRO 3.08 Small-scale Forestry International Conference hosted by Galway-Mayo Institute of Technology and supported by COFORD and others. COFORD produced the proceedings of this event.
- 7 and 14 July 2006: Management of Soils and Nutrients in River Catchments. Two COFORD/ECI workshops led by Professor Calvin Rose¸ Griffith University, Australia were held at the National University of Ireland, Galway, and the Marine Institute, Newport, Co Mayo.
- 23 August to 1 September: ForestEnergy 2006 - National demonstrations of chipping systems and machinery for wood energy.
- Wood biomass harvesting and supply chain workshop. The workshops were held six times during 2006, at the following locations:
    - 30 March - Shinagh House, Bandon, Co Cork
    - 24 May – Mount Juliet Hotel, Kilkenny
    - 26 May – Bewleys Hotel, Ballsbridge, Dublin
    - 4 September – Corrib hotel, Galway
    - 5 September – Udaras na Gaeltachta, Galway
    - 15 December – Cork City
- 12 December 2006: Forest Energy 2006 conference, held at the Tullamore Court Hotel, Tullamore, Co Offaly.

FOREST ENERGY 2006

ForestEnergy 2006 aimed to provide forest owners, managers and contractors with systems applicable to different crop and site conditions. It was organised jointly by COFORD, Teagasc and Waterford Institute of Technology, in collaboration with Danish Forestry Extension. Quality was the key message of the programme, involving a concept new to Irish forestry: pre-felling to allow drying and needle loss before chipping.

Harvesting systems in first thinnings were demonstrated in March 2006 at six sites located throughout the country. Crops included a range of conifer and broadleaved stands, and birch and lodgepole pine stand on Bord na Móna cutaway peat. In addition, the programme documented the performance, productivity and cost of each system. Moisture content, the critical factor in wood chip quality, was tracked from felling, and over the summer drying period, until chipping in August/September.

Operations such as motor-manual felling by chainsaw, single-grip harvester and forwarder operations and a Danish feller-buncher were shown. The feller-buncher, a machine not currently used in Ireland, is a harvester base with an accumulating head that cuts and accumulates two to six trees at a time without any cross-cutting or delimbing before laying them on the ground. The trees are then allowed to dry in situ before being chipped and shipped to the heating or power plant.

All felled logs and whole trees were left in the forest to dry over the summer. Chipping commenced in late August. Three chippers were demonstrated: a tractor-mounted chipper with self-loading grapple and towing a chip trailer; a self-propelled terrain chipper with a chip forwarder; and a truck-mounted chipper. The tractor-mounted chipper and terrain chipper are capable of driving along the extraction racks, grabbing the felled trees and chipping into a trailer. The truck-mounted chipper was used to chip energy wood stacks at the roadside. Demonstrations were held at five sites across the country, and were open to all interested in the developing wood energy market. These demonstrations attracted in excess of 2,000 visitors.

TECHNOLOGY TRANSFER

The programme culminated with the presentation of all findings and related topics at a conference on 12 December 2006. This was one of the best attended events held by COFORD in recent years – a testament to the great interest in this important developing sector.

WEBSITES

The websites managed by COFORD are www.coford.ie, www.woodenergy.ie and www.woodspec.ie.

The COFORD website was completely updated and relaunched in June 2005, with a much improved content management system. The site has attracted substantial interest in 2006, with 35,175 unique visitors on 50,649 visits. The larger number of visits in 2005 was a consequence of testing during the development of the new site. Publications can now be ordered online, and the site has a powerful search function.

The woodspec and woodenergy sites contain on-line query services, serviced by Gordon Knaggs and Pieter D. Kofman respectively. The breakdown of these queries is given in Figures 1 and 2.

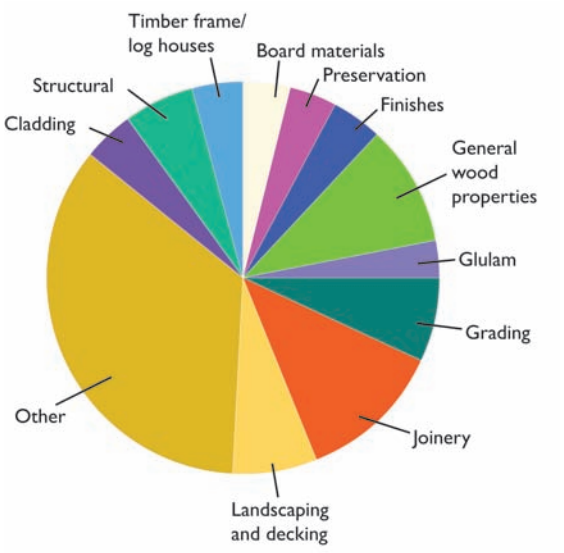

Figure 1: Breakdown of topics queried via www.woodspec.ie.

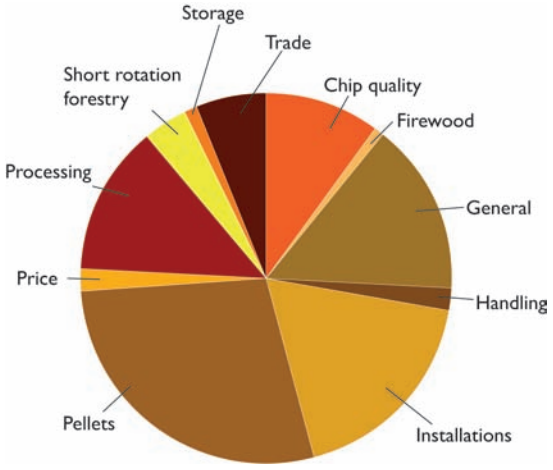

Figure 2: Breakdown of topics queried via www.woodenergy.ie.

PUBLICATIONS

Eight publications were produced and launched in 2006. These are available in hardcopy or can be downloaded free-of-charge as pdf files from the COFORD website.

- *COFORD Annual Report 2005.*
- *A review of forest recreation research needs in Ireland,* by Michael Cregan and William Murphy.
- *Brackloon - the story of an Irish oak wood,* by Deirdre Cunningham.
- *Carbon sequestration and Irish forest ecosystems*, edited by Kevin G. Black and Edward P. Farrell.
- *Handbook on structural timber design to Eurocode 5 (IS EN 1995-1-1) rules*, by James Harrington, Malcolm Jacob and Colin Short.
- *Plant quality - a key to success in forest establishment*, edited by Lauren MacLennan and John Fennessy.
- *Small-scale forestry and rural development - The intersection of ecosystems, economics and society.* Proceedings of the IUFRO 3.08 conference hosted by Galway-Mayo Institute of Technology (GMIT), Galway, Ireland, from 18 to 23 June 2006, edited by Sarah Wall.
- *The socio-economic contribution of forestry in Ireland*, by Áine Ní Dhubháin, Marie-Christine Fléchard, Richard Moloney, Deirdre O'Connor and Tim Crowley.

COFORD Connects

Three notes were produced in September 2006:

- *Fertiliser application to conifer plantations on oligotrophic peat sites* by Michael Carey.
- *The distribution of Hen Harriers in Ireland in relation to land use cover, particularly forest cover* by Mark Wilson, Tom Gittings, John O'Halloran, Tom Kelly and Josephine Pithon.

- *National Pine Marten survey of Ireland 2005* by Declan O'Mahony, Catherine O'Reilly and Peter Turner.

Hardwood matters

COFORD produces *Hardwood Matters*, the catalogue for advertising hardwood timber, twice yearly. Published in hard copy and is made 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.

E-Newsletter

The monthly email newsletter *Forestry and Wood Update* continued to be compiled. The new COFORD website facilitates online subscription and unsubscribe options. The number of subscribers has increased to over 1,500.

NATIONAL AND INTERNATIONAL ORGANISATIONS AND PROCESSES

Dr Eugene Hendrick is a member of the International Council of IUFRO, he is also the Irish representative on the forest sink experts group working in the international climate change process, as well as member of Heads of National Forest Research Institutes, national statistical correspondent for UNECE/FAO/EUROSTAT Joint Forest Sector Questionnaire, and a member of the Forestry Liaison Group of the Department of Agriculture and Food.

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.

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 MADE BY COFORD

Eugene Hendrick:

- *COST – the benefits for Irish forest research – and the forestry sector* – presentation at COST[1] Day Conference – 12 September 2006.
- *Economic, social and environmental performance of the Irish forestry sector* – reply to Byrne and Legge paper – presentation at Comhar Conference, 10 October 2006.
- *Growing for the Future – 10 years on, and the importance of sustained investment and clear policies to deliver goods and services from the forestry sector* – presentation at IFA Forestry Section/Pro Silva Conference, 10 November 2006.

John Fennessy:

- With Roy Tomlinson, Queens University Belfast, contributed to a joint chapter on "Forestry" in a new publication entitled '*A Living Countryside? The Politics of Sustainable Development in Rural Ireland*'. This contribution was made at the end of February 2006.
- Attended the Sixth EUFORGEN Conifers Network meeting in Reykjavik, Iceland from 7 to 9 September 2006 and presented the Country Report on Conifers Conservation Programme for Ireland at this meeting.
- Attended the COST Action E 39 meeting held on 28 November 2006 in the National Botanic Gardens, Glasnevin, Dublin on 'Trees, Forests and Human Health and Well-being' and presented a paper '*Introduction to Forest Research in Ireland*'.
- Prepared a BIHIP Oak Group draft business plan in December 2006 which is currently being reviewed by the members.
- With Jason Hubert, Sam Samuel and Peter Savill compiled *'Get your Potential Seed Stands Registered'* for *Woodland Heritage* published in December 2006.

Lauren MacLennan:

- Travelled to Freiburg, Germany, to participate at the meeting of the IUFRO Task Force on communicating forest science (22-24 October), the business meeting of the IUFRO Technology Transfer working group (25 October), and the international conference 'forestXchange - new approaches in knowledge management' (25-27 October).

[1] *European Co-operation in the Field of Scientific and Technical Research.*

FINANCIAL STATEMENT

COFORD EXPENDITURE ON R&D AND RUNNING COSTS IN 2005 AND 2006*

	2005	2006
	€	€
1. Sectoral research and development		
Reproductive material and forest nurseries[1]	226,252	199,969
Silviculture and forest management[2]	397,592	513,846
Harvesting and transport[3]	45,956	9130
Wood processing and product development[4]	122,549	171,947
Socio-economic aspects of forestry[5]	26,726	22,000
Environmental aspects of forestry[6]	503,646	226,150
	1,322,721	1,143,042
2. Linkages and technology transfer		
Linkages[7]	9,299	30,323
Technology transfer	279,136	815,671
	288,435	845,994
3. Salaries and running costs		
Salaries	310,912	136,865
Running costs	419,822	569,301
	730,734	706,166
TOTAL	**2,341,890**	**2,695,202**

* *COFORD operates a cash-based, as opposed to an accruals-based, accounting system, in keeping with DAF protocol. This may result in anomalies when comparing expenditure between years.*

(1) Forest genetics and seed, nursery practice, micropropagation of planting stock, storage, handling and transport of planting stock, and seedling physiology.

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

(3) Harvest scheduling and planning, harvesting methods, forest roads, wood transport systems and logistics, environmental aspects of forest harvesting and wood transport.

(4) Wood properties, timber drying, finishing and preservation, strength properties of timber, timber grading, storage of timber, timber engineering and product development.

(5) Macro economics of Irish forestry, sociological aspects of forestry.

(6) Environmental aspects of forestry, biodiversity, water quality and carbon sequestration.

(7) Attendance at conferences by COFORD, networking and knowledge transfer support initiative, COST meetings.

FINANCIAL STATEMENT

COFORD INCOME IN 2005 AND 2006*

	2005	2006
	€	€
Income	31,000	51,027

* *COFORD income is from sales of publications, attendance fees for conferences and workshops, and software licensing. Income for 2005 is an estimate from records. The 2006 income is net of credit and written-off debt. Income will be reported in full disaggregated form in 2007.*

INTERNAL FINANCIAL 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 proposals are approved by the Council. The executive has delegated authority to approve projects up to a limit of €30,000 per project (COFORD contribution) and €150,000 in any one financial year.

The executive reports to the Council on expenditure against budget.

COFORD's accounts and financial procedures are subject to periodic audit by the Internal Audit Unit of the Department of Agriculture and Food.

Financial risks related to projects are appraised by the executive at approval stage.

Approval for individual items of expenditure are made by the Director or the Operations Manager. Expenditure claims for projects are assessed by the Financial Administrator and by the Accounts Branch of the Department of Agriculture and Food. Performance against budget is assessed prior to approval.

Public procurement rules are followed for all COFORD expenditure.

COFORD reports expenditure on a quarterly basis to the Forest Service and the Managing Authority of the Productive Sector Operational Programme (PSOP) and on a six-monthly basis to the Monitoring Committee of the PSOP.

An in-house management information system to track project expenditure is in operation.

COFORD EXPENDITURE 2006