Forest Research

The Research Agency of the Forestry Commission

Ecotype

Winter 2012–13

Ecotype is the biodiversity and conservation newsletter produced by Forest Research's Centre for Human and Ecological Sciences.

IN THIS ISSUE

Credit: Forestry Commission/Dan Clegg

Red squirrel in snow

Red squirrels and their nests (dreys) are protected against intentional acts of damage or disturbance. The introduction of a new Act in 2011 now allows the licencing of qualifying forestry activities that could affect red squirrels.

Read further on page 3 to see what Forestry Commission Scotland, Forest Enterprise Scotland and Forest Research are doing to address this new Act.

Editorial

Welcome to the Winter 2012–13 issue of *Ecotype*, the biodiversity and conservation newsletter produced by Forest Research's Centre for Human and Ecological Sciences (CHES).

What's in this issue:

As mentioned on the front cover, Mark Ferryman starts off by introducing a new project with Forest Enterprise Scotland, focussing on red squirrels and their behaviour in relation to forestry activity.

Russell Anderson looks at a 'peat toolkit' produced by Forest Research in collaboration with Forestry Commission Wales, to help support peatland restoration.

Michal Petr studies natural hazards such as pests, drought and fire, and investigates how they are perceived by forest planners in Britain.

Alice Broome reviews a recent study investigating the effect of coppice management on moth species.

Following the article on FR's ESCv3 in the last issue of *Ecotype*, Jordan Chetcuti moves on to explain how Ecological Site Classification has been used as a starting point to develop tools to help with fine scale woodland planning.

FR's statisticians Thomas Connolly and Andy Peace team up and with a topical title have some fun with maths, showing how it can be applied to forestry.

Phil Taylor summarises work being carried out within CHES to increase the availability of climate variables necessary for various applications including ESC.

Our featured PhD student for this issue is Armand Tene. As mentioned in our last issue under News, Armand recently successfully completed his PhD at University College Dublin. He now takes this opportunity to summarise his studies from examining the response of Sitka Spruce, Scots Pine and Douglas Fir to drought stress.

We round the issue off with our news and conferences page which contains information on a number of publications and the first European conference on climate change adaption.

All together these articles highlight a small selection of the current projects we are working on at Forest Research. I hope you find this Winter 2012–13 issue of *Ecotype* informative and enjoyable to read.

Claire Noël
Editor

P.S. Forest Research is currently reorganising into a new structure. CHES scientists will join with colleagues researching tree health, soils and hydrology to form the Centre for Ecosystems, Society and Biosecurity. Find out more in the next issue!

Red squirrel response to forest operations

Mark Ferryman

The UK Wildlife and Countryside Act 1981, Schedule 5 and the Nature Conservation (Scotland) Act 2004 currently protect red squirrels and their dreys. With the introduction of the Wildlife and Natural Environment (Scotland) Act 2011 (WANE Act), Scottish Natural Heritage are now able to licence activities which will contribute a significant social, economic or environmental benefit. This covers a range of forestry activities, including felling as part of an approved forest plan.

Where operations are planned which might impact on squirrels, and particularly during the breeding season, current management practice (FCS Guidance Note 33) is to identify and retain trees containing active dreys and immediately adjacent trees. Where possible, canopy connectivity between dreys and adjacent woodland areas is retained. Dreys can be hard to see, particularly in dense spruce so it can be difficult to identify all of them. However, there is a lack of evidence to support those mitigation measures.

Red squirrels were captured and collared just prior to forest operations starting; Scots pine planted 1956

To address the WANE Act, Forestry Commission Scotland is working on guidance to licence forest operations which may disturb red squirrels, and in turn help reduce constraints in operations. This will be achieved by first obtaining a better understanding of how forest operations affect red squirrels, whilst they are being carried out and after completion. There is a lack of evidence on how red squirrels respond in these circumstances.

Harvester widening the powerline wayleave.

In the latter months of 2012 Forest Research embarked on a project with Forest Enterprise Scotland to assess the behaviour of red squirrels in relation to harvesting operations. A site was selected in Glenmore Forest Park in the Highlands, containing mainly mature Scots pine and Sitka spruce, where thinning and felling were planned. Drey trees were identified and retained, and the timing of felling avoided the spring breeding period. The behaviour of squirrels fitted with radio and GPS collars will be compared with the movement of operational machinery through the stands. Some preliminary observations suggest squirrels quickly move away from machinery that is operating, but remain within the locality. Data collected over the coming months should provide a better understanding of squirrel responses.

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Peatbog restoration - research into practice

Russell Anderson

Forest Research (FR) has been helping the policy team at Forestry Commission Wales (FCW) in deciding what to do about forests on deep peat. First we reviewed the scientific evidence on the benefits of peatland forests and from restoration of the peatland habitats.

The forests provide for recreation and produce timber, pulp and wood fuel, and fix carbon while they're at it. However, the carbon sink benefits are lower than for forests on non-peaty soils, sometimes even negative because the trees dry the top peat, causing it to release carbon dioxide. Restoring the peatland can, in some cases, give greater benefits. Peatbog ecosystems not only provide habitats for characteristic flora and fauna but also provide purer water, fix carbon and crucially, protect the enormous store of carbon in the peat.

Low-yielding Sitka spruce on peat 4 m deep at Tywi.

The team decided on a policy of encouraging carefully targeted peatland restoration and this can be found on the FCW website. Alongside this, FR produced a 'peat toolkit' to:

- Help forest managers and owners identify their afforested peatland.
- Indicate sites likely to provide greater net benefit through restoration.
- Allow forest managers to assess sites for themselves.

GIS maps of all peatland in Wales and of the afforested deep peat are now available via the FCW map browser. A GIS-based National Assessment has been used to produce a map of the potential of afforested deep peat to give a net benefit on restoration. A practical Field Assessment tool designed by FR was used to assess the top ten sites from the National Assessment and a series of training events were run on its use.

The peat toolkit is now in use on the Welsh Government woodland estate and FCW hope to provide it for use in other woodlands along with Glastir grants to support peatland restoration.

Measuring peat depth as part of the Field Assessment tool.

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Is the future risky? Risk perceptions among British forest planners

Michal Petr

Many of us make plans for the future, but sometimes we need to make changes when unforeseen events occur. Understanding the future and its uncertainty is particularly important for sustainable forest management as the consequences of making the wrong decision can extend over decades. Uncertainty may include that resulting from natural hazards such as wind damage or drought, and there are suggestions that these hazards are likely to increase as a result of climate change.

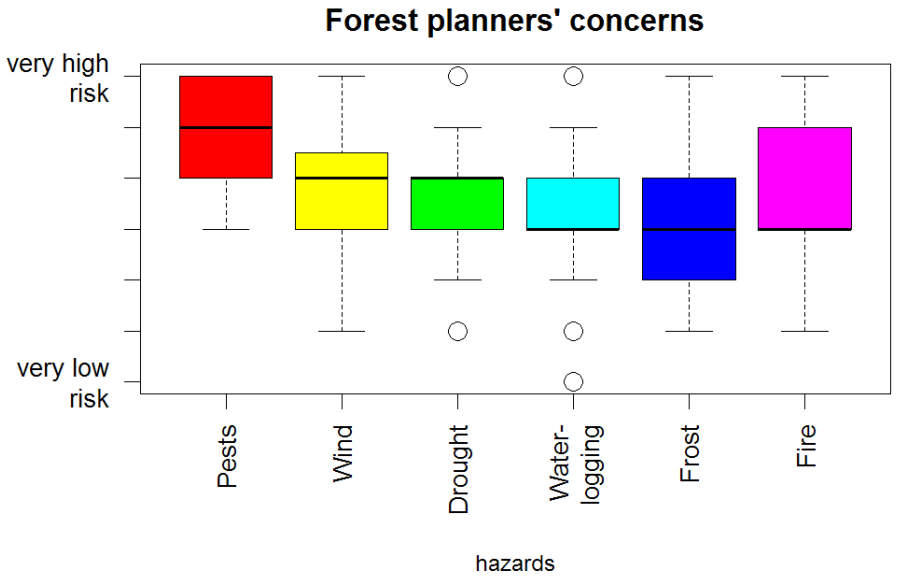

Figure 1. Risk perceptions for 6 hazards on concerns judgment scale over the next 30 years from 29 Forestry Commission's forest planners

A number of tools have been developed to aid decision making, such as ForestGales and Ecological Site Classification (ESC), but little is known about how forest planners use this information alongside their own perceptions. Risk perceptions have been shown to affect decision making, for example in cases when robust evidence suggests higher risks but perceptions suggest lower risk.

To gain a better picture of how forest planners perceive the range of risks posed by climate change, a series of questions were put to Forestry Commission planners across England, Scotland and Wales. The study found that forest planners viewed pests, wind and drought as higher threats to public forests than frost, water-logging and fire (see figure 1). Further analysis will compare the perceived risks with those estimated using decision tools. A preliminary conclusion is that future research should focus on risks about which we have a limited knowledge such as pests and drought and which are expected to be more harmful in the future due to climate change.

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Results of a moth study indicate the value of managing coppice woodlands

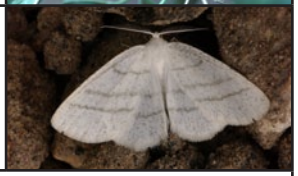
Alice Broome

The management of coppice woodlands in Britain may increase due to the rise in demand for woodfuel. Coppicing is known to benefit woodland butterflies but less is known about how moth species respond. A collaborative study between Forest Research, Butterfly Conservation and Forestry Commission England looking at the response of moth species has provided interesting findings supporting coppice management.

The study was carried out in an actively coppiced sweet chestnut (*Castanea sativa*) woodland in southern England. Coppice coupes with between one and 20 years of regrowth were systematically sampled each year, over three years, for night flying micro- and macro-moths. Coppice structure and ground vegetation of each coupe was also assessed.

It was found that;

- Three stages of coppice development are important. Distinct assemblages of moths are associated with one to four, five to nine and over 10 years of coppice regrowth.
- Differences in moth assemblage relate to habitat conditions within each stage (see box opposite).
- The assemblage of moth species change within individual coupes as the coppice re-grows and passes into the next stage.
- All three stages support species of listed conservation status but the mature stage contains a distinctive range of scarce and threatened species.

Young coppice stage (one to four years of coppice regrowth)	Moths within the young coppice stage assemblage tend to use herbs or grasses as their larval foodplants and are typically associated with grassland or other open habitat, often with some woodland/shrub cover, e.g. elephant hawk-moth (*Deilephila elpenor*, photo) whose larvae feed on willow herb, and dark arches moth (*Apamea remissa*) which feed on grasses.	 Photograph: Tim Winter
Middle coppice stage (five to nine years of coppice regrowth)	Moth species in the middle coppice stage assemblage use trees and shrubs as their main larval foodplants and have an association with open woodland or scrub habitats, e.g. the common white wave (*Cabera pusaria*, photo) or the peach blossom (*Thyatira batis*) feeding on bramble in areas of scrub.	
Mature coppice stage (more than ten years of coppice regrowth)	The moth assemblage associated with the mature coppice stage consists mainly of woodland associates which feed predominantly on trees. Some use herbaceous plants but several are associated with lichens e.g. the red-necked footman (*Atolmis rubricollis*), or fungus-infected wood or old, decaying leaves.	

The study shows that active coppicing promotes a change in moth assemblage, but consequently will temporarily eliminate many species of mature stage coppice. Management which provides a range of coppice age classes within a woodland appears key in promoting moth species diversity.

For a full account of this study: Broome, A., Clarke, S., Peace, A., & Parsons, M. (2011) The effect of coppice management on moth assemblages in an English woodland. *Biodiversity and Conservation*, **20**, 729–749.

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Developing high resolution ESC

Jordan Chetcuti

Forest Research's Ecological Site Classification (ESC) is suitable for planning at a regional scale, but outputs may be too coarse in resolution for fine scale planning. Current methods using National Vegetation Classification (NVC) in place of detailed soil data can potentially be developed using high resolution terrain models.

Individual NVC polygons are frequently labelled with multiple vegetation types to represent a mosaic of interspersed areas below a practical mapping threshold. The same is true of more detailed soil map data within the Forestry Commission, where each polygon can contain up to 3 different soil types, and the proportion is given.

In ESC, identification of the soil type provides soil moisture regime (SMR) and soil nutrient regime (SNR). Dividing each polygon into constituent soil types would allow an analysis to be conducted at a finer scale. As each soil type typically has a characteristic SMR, finding a way of estimating wetness could provide a means of dividing the polygon into the different soil types, each with a SNR. The Compound Topographic Index (CTI) is one way of estimating wetness of different areas of a landscape. CTI is calculated from a digital terrain dataset, specifically flow accumulation and slope within a GIS.

Soil polygons were divided into SMR values using the CTI method and the relative proportions of each soil type, together with 5m resolution terrain data (available for much of the United Kingdom). Figure 1 shows the original large 250m ESC pixels, the soil polygons, and the SMR showing the resolution achieved using the 5m resolution terrain data.

Other ESC input data values can potentially be modified using the information within FC Bulletin 124 (Pyatt, 2001). For example, adjusting the accumulated temperature and SMR based on slope and aspect, and the recalculation of windiness data using higher resolution terrain data.

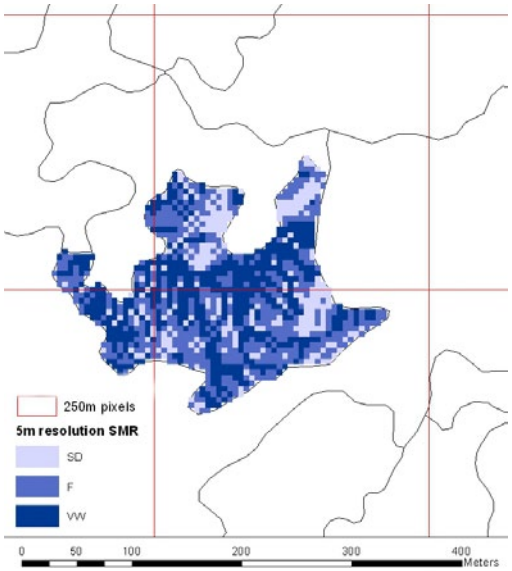

Figure 1: Example of 5m resolution SMR, in comparison to polygon and 250m resolutions.

The method is being applied in a trial area, where local district staff have an in depth knowledge of the chosen site. If predictions using this method closely correlate with the district's plans then it may prove a useful tool for use in other areas.

Pyatt, D.G., Ray, D., and Fletcher, J. (2001). An ecological site classification for Forestry in Great Britain. Forestry Commission Bulletin 124, Forestry Commission, Edinburgh.

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The Life of Pi (or how foresters can find mathematical enlightenment in the woods)

Thomas Connolly & Andy Peace

What is the chance that any people in a room share the same birthday? How many people do you need for this chance to be more likely than not? A "common sense" answer might be about 180 (since there are 365 days in the year and we should need about half that number of people before birthdays begin to coincide). It turns out, however, that with only 23 people the chance of two individuals sharing the same birthday is just over 50%, and for 50 people it is 97%.

The birthday problem translates readily to forestry. Suppose there are 20 equally abundant ground flora species. If a random sample plot contains one plant, how many plots are needed to have a reasonable chance of observing two similar species? With six plots the chance is 56% and with ten plots it is about 93%.

Another classic puzzle is Buffon's needle problem. Draw equidistant parallel lines on a floor and drop a needle. What is the chance that the needle crosses one of the lines?

Standing deadwood in old hornbeam coppice

Here the answer depends on π (and how big the needle is compared to the distance between the lines). In a woodland contect, if a forester walks along parallel transects as wide as deadwood on the ground the chance of crossing is about 64%. The forester could then estimate the total amount of deadwood (or a rough estimate of π, even).

Both puzzles share common themes: a fairly simple statement of the problem, a few initial assumptions and surprising solutions. In the birthday problem it is assumed that all birth dates are equally likely. In the needle/deadwood problem all deadwood is assumed to be the same length and to fall in a random pattern. The challenge for the forest statistician is seeing how answers change depending on what assumptions are reasonable, and the beauty of mathematics is how seemingly unrelated puzzles form the basis of solutions to real-world problems.

Footnote: The mathematical constant π is the ratio of a circle's circumference to its diameter. The value of π is 3.14159 (to five decimal places).

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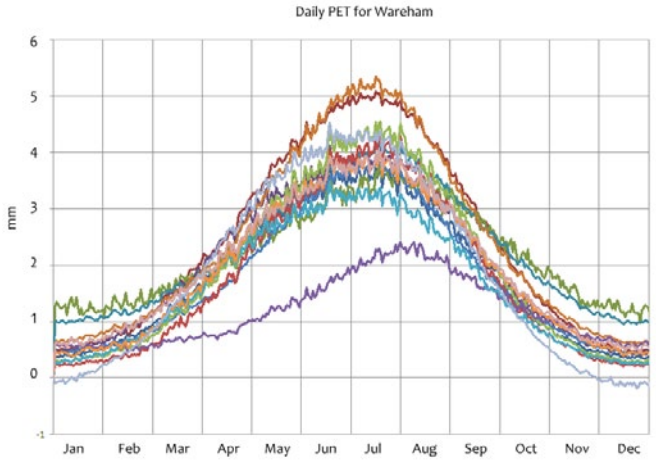
Using multiple climate datasets to predict Potential Evapotranspiration (PET) across Europe

Phil Taylor

Recent EU projects that Forest Research has worked on (MOTIVE, ForestClim) have called for the need to test forest management strategies in the future. For example, using Ecological Site Classification (ESC) and projected climate data to predict conditions and a forest's resilience to them. ESC relies on a value of Moisture Deficit (MD), which itself relies on knowledge of how much water could evaporate and transpirate from the ground (PET).

In projected climate datasets, this value of PET can be hard to obtain or may vary in quality or accuracy. Duncan Ray and Phil Taylor, along with a visiting student from the University of Freiburg, Sven Gebhart, are looking to analyse different PET calculation algorithms when PET isn't explicitly supplied.



Preliminary work has begun, analysing different PET algorithms using weather station data from across Europe. The coloured lines represent 14 different algorithms.

There are a number of techniques to do this, relying on different variables, and each has its own benefits and pitfalls. We are looking into assessing how well each technique predicts real-world values across Europe and whether adjustments can be made to better predict PET in specific countries, climate zones or differing terrain. The use of a large amount of projected climate datasets (~8, from the CCAFS data portal) and PET algorithms (~10) should give a comprehensive analysis of the usefulness of different techniques and how well they apply to differing data.

One of the key objectives for research involving climate projections is to use multiple-scenario datasets and often to analyse data from more than one source, especially for European or worldwide research. One of the aims of this work therefore is to increase the usability of available data for use with ESC and other applications relying on PET values.

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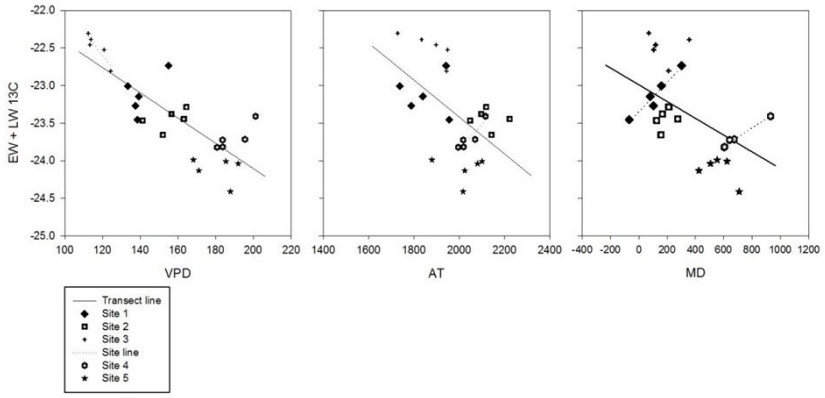
Understanding the response of Sitka spruce, Scots pine and Douglas fir to drought stress

Armand Tene

A PhD study to assess the response of Sitka spruce, Scots pine and Douglas fir to changes in the seasonality and extent of moisture deficit has been successfully completed. Using dendrochronology and isotope discrimination methods, interactions between species and site to past climatic drought conditions are helping to validate drought tolerant species in ESC in Britain, and Climadapt in Ireland.

Cores from sample trees in experiments and permanent sample plots along a transect from the west of Ireland to eastern England were measured for early-wood, late-wood and whole ring growth and analysed with climatic variables (MetEireann and British Atmospheric Data Centre - BADC). Cellulose extracted separately from early-wood and late-wood in years before, during and after each drought period were used in an analysis with climate (see Tene et al., 2011).



Variation of combined early-wood & late-wood ^{13}C with vapour pressure deficit (VPD), accumulated temperature (AT) & moisture deficit (MD), across Scots pine transect in Britain & Ireland

Results showed that the climatic factor limiting radial growth in periods of drought was not the same between sites for the same species, but was dependent on the timing, nature and intensity of a drought. All species responded to warmth in wetter climates, and rainfall in drier regions. Moisture stress causing drought conditions in the early part of the growth season had a more severe impact on growth in all species.

The ratio of oxygen/carbon isotopes analysed by a correlation analysis, confirmed a ranking of Sitka spruce as the more drought sensitive species, followed by Scots pine as an intermediate species, and Douglas fir as a less sensitive species. Differences between Scots pine and Douglas fir were marginal, but Sitka spruce showed a larger isotopic response to climatic variables. High moisture deficits do not affect the isotopic composition of cellulose sufficiently to be certain of the control mechanism in Scots pine and Douglas fir. We are continuing to analyse the data, and to research and describe these processes.

This study was funded by COFORD Ireland, Forestry Commission GB and the EU Interreg IVB project ForeStClim.

Tene A, Tobin B, Dyckmans J, Ray D, Black K, Nieuwenhuis M (2011) Assessment of tree response to drought: validation of a methodology to identify and test proxies for monitoring past environmental changes in trees. Tree Physiology 31 (3):309-322

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News and conferences

Publications

Fence marking to reduce grouse collisions. Roger Trout & Kenny Kortland. Forestry Commission Technical Note. FCTN019.

Social Media and Forestry: A Scoping Report. Amy Stewart, Bianca Ambrose-Oji & Jake Morris.

Forestry, sustainable behaviours and behaviour change – setting the scene. Summary Report. Jake Morris, Mariella Marzano, Norman Dandy & Liz O'Brien.

A Strategic Assessment of the Afforested Peat Resource in Wales. Elena Vanguelova, Samantha Broadmeadow, Russell Anderson, Sirwan Yamulki, Tim Randle, Tom Nisbet and James Morrison.

ECCA Conference

The European Climate Change Adaptation Conference 2013 is the first conference covering the broad range of issues related to climate change to take place in Europe. It will be held at the University of Hamburg, Germany, March 18th - 20th 2013. The main theme of the conference is 'integrating climate into action'. More information can be found on the website.

Paper selected as Editor's Choice

A paper co-written by CHES's Kevin Watts, 'A decision framework for considering climate change adaptation in biodiversity conservation planning' has been selected as Editors Choice for Volume 49, Issue 6 of the Journal of Applied Ecology.

The Editor commented '**This paper is an important contribution because it provides a robust set of tools that should impact biodiversity management and planning for climate change**'. You can read more and access a copy of the paper by following the link attached above.

About Ecotype

Ecotype addresses forestry practitioners and conservation professionals, in both the public and private sectors. Amongst our readership are people from:

- County and District Councils
- Natural England
- DEFRA
- Wildlife Trusts
- National Trust
- British Trust for Ornithology
- RSPB
- Woodland Trust
- Forestry Commission, Forest Enterprise
- Centre for Ecology & Hydrology
- Natural Environment Research Council
- Universities, Museums
- Private consultants
- Interested individuals

Who contributes

Most of the articles are written by people within Forest Research about work related to biodiversity and conservation management of forests and woodlands. Contributions may also be invited from other parts of the Forestry Commission, and others working within forest biodiversity and conservation, subject to relevance to the main themes of *Ecotype*.

Note that the editor reserves the right to edit, delay or reject articles depending on the space available and relevance of the subject.

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