

FORESTRY COMMISSION
Description of the Research Project or Services

1.	Research Purchasing Manager (C&FS)	Sallie Bailey
	Relevant PAG	Ecosystems & Biodiversity

2.	Name of FR Programme	Programme Habitat Management, Protected Species, Biodiversity, Genetic Conservation and FRM,
	Manager (PgM) or	PgM Joan Cottrell
	Project Manager (PM) and staff	PM Ralph Harmer (Habitat Management) Staff Colin Edwards Andrea Kiewitt
	Project Manager (PM) and staff	PM Alice Broome (Protected Species) Staff Georgiana Watson
	Project Manager (PM) and staff	PM Nadia Barsoum (Biodiversity) Staff Jacqui Brunt
	Project Manager (PM) and staff	PM Joan Cottrell (Genetic Resources) Staff Stuart A'Hara Tytti Vanhala
	Project Manager (PM) and staff	PM Stuart A'Hara (Forest Reproductive Materials) Staff Cathleen Baldwin (until Dec 11 then AN Other or move post to Silvan House?)
	Name of Institution/company	FR
	Official address	Alice Holt Lodge, Wrecclesham Farnham Surrey, GU10 4LH
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	Programme Life (years)	4 Years
Start Date	1 st April 2011	
Completion Date	31 st March 2015	
Revision Dates	31 st March 2012/2013/2014	

3. Title of Research Project or Service

Habitat Management, Protected Species, Biodiversity, Genetic Conservation and Forest Reproductive Materials

4. Abstract of proposed research (Summary to be used on website/FRCC etc) (200 words)

Genetic resources, species and habitats are key components of biodiversity. They supply stakeholders with a range of utilities which include forest products as well as fulfilment of cultural and spiritual needs by maintaining the delicate balance of nature. There is therefore clear economic merit in investing in the upkeep of these resources which make direct and indirect contributions to human wellbeing. Silvicultural or habitat management systems manipulate ecological processes to achieve a range of different objectives which influence the above components of biodiversity. The programme aims to provide solid data which will be urgently required in the LUES programme. This is a new programme and the first work area aims to develop within the participants an understanding of how the four components contribute to ecosystem services and biodiversity in its broadest sense.

The second, third and fourth work areas explore (i) the efficacy of silvicultural approaches, (ii) how they influence biodiversity and (iii) how they can be applied to benefit protected species.

The fifth work area deals with genetic resources. Once established, genetic resources continually evolve in response to the stresses they experience in different ecosystems. The genetic resources in a given ecosystem are a product of this evolution combined with the process of geneflow from other, connected ecosystems. As such, genetic resources are unique to different ecosystems and are a source of value to future generations. This work area aims to improve our understanding of the genetic resources present in our woodlands by investigating the distribution of adaptive and neutral genetic diversity and geneflow. As genetic resources do not respect national boundaries, the work area will also contribute to the EUFORGEN network which deals with similar issues on a European scale. It also includes providing scientific support to Forest Reproductive Material Regulations (FRM).

The results of the programme will generate key data to underpin land use and ecosystem planning decisions. They will allow informed policy to be developed on how to conserve these valuable components of the ecosystem.

5. Aims and objectives (word limit 500)

5.1 Aim of the research

This programme encompasses a broad area related to the functioning of ecosystems, their resilience and the conservation of habitats, species and genes which are key ecosystem components. There are considerable synergies and commonality within this topic which means that the work areas could have been formed in several different ways. However, for the meantime the original delineations have been retained with an additional work area included which has the objective of improving the integration of the topics. This structure seemed most sensible in view of the scheduled cessation of the Habitat Management work area in 2013.

WA1. INTEGRATION OF WORK AREAS 2-5 AND SEARCH FOR SYNERGIES AND COLLABORATIONS WITHIN THE NEW PROGRAMME

As this new programme represents a new grouping of work areas which were previously under different programmes we will meet to discuss how to establish more coherent groupings so that there can be greater interaction and collaborative working between the genetic resources, species and habitat aspects of the work.

WA2 HABITAT MANAGEMENT FOR WOODLAND BIODIVERSITY

Under current spending plans this work will cease in 2013. Ongoing experiments on PAWS, stand management, non-native species and deadwood dynamics will be brought to a suitable conclusion in order to write reports and aid the assessment of options for the work which will be continued.

WA3. PROTECTED SPECIES

Halting the loss of biodiversity remains key to the headline global targets set for 2020 in the Convention on Biological Diversity strategic plan (CoP 10). Preventing loss of threatened species, improving and sustaining species' conservation status and sustainable management of habitats are targets listed in the EU Strategic Plan for Biodiversity for 2020; Country administrations are aligning Country targets to these. There is currently a change in emphasis in protected species conservation within the UK from a focus on single species to a more holistic approach concentrating on the maintenance of healthy ecosystems. By maintaining or enhancing wild species diversity, ecosystems provide both provisioning and cultural ecosystem services; woodlands rank highly in their potential to deliver these benefits and delivery can be driven through management practices. However, for a number of species e.g. European Protected Species, their higher level of legal protection means that particular policy and practice responses are needed and these species may therefore require individually tailored research. Research will focus on protected species of relevance to UK forestry (both those where the Country administrations have a 'duty of care' and those with increased protection status) with the aim of providing knowledge to support forest management and forest policy decisions.

WP3.1 Species specific research This work area aims to conclude a number of single species research projects e.g. habitat management for twinflower and butterflies, resource provision for red squirrel but to sustain research on EPS e.g. dormouse.

WP3.2 Project/Customer interface and project capacity building The aim within this work area is to create a two-way flow of information between the research project and its customers. Research information will be disseminated in a variety of forms e.g. Contract reports, FC Notes, presentations and journal papers. Customer's needs for protected species research will be sought e.g. through contact with the Country Woodland Ecosystem Groups and Biodiversity leads. It is recognised that core funding will not be sufficient for many of the important research needs for protected species to be met; a combined approach of following research funding leads and networking within the research and forestry policy/practice arena will be used to seek-out external research funding and research partnerships.

WP3.3 Habitat, ecosystem and guild based research for protected species In response to the Convention on Biological Diversity signed at Rio in 1992, the UK Biodiversity Action Plan was developed. This identified 577 species for conservation action. A government-led review (2007) added a further 570 species to the list. For the woodland species, now totalling 450 species, notable increases have occurred in the fungi (28 species to 73 species), invertebrates (53 to 172 species) and bryophytes and lichens (28 to 117 species); these species now form the species lists associated

with the NERC Act (2006) (England and Wales) and the Nature Conservation (Scotland) Act 2004. Conservation delivery has necessarily shifted from single species to habitat/ecosystem management. This work area aims to develop research which will support the delivery of species conservation actions at this new scale. The 4 year Defra funded project (ending 2014) on woodland and deer management interactions with woodland birds will develop evidence to underpin guidance on woodland management by species guild and habitat type. The recent FR review of habitat and management requirements of 450 woodland priority woodland species has identified and several potential research areas which will build on the data collected for the review (see recommendations made within this report). These research areas range from assessing if habitat manipulations deliver for protected species, through climate change impacts on protected species, to valuing the cultural service provided by protected species.

WA4. BIODIVERSITY

Provide an improved understanding of the consequences of shifts in policy-driven forest management practice for forest biological and functional diversity. Also, provide robust monitoring and assessment 'biodiversity indicator tools' to allow for the evaluation and reporting of forest ecosystem condition. There are important linkages which we intend to explore between this work area and the Land Use and Ecosystem Services programme. The biodiversity monitoring and assessment tools that are developed in this work area will be used to help with ecosystem services evaluations of biodiversity gains or losses of different forested landscapes. This work area will also provide evidence for ecosystem service evaluations of the gains or losses under different forest management regimes of forest biodiversity and associated ecosystem function.

Within this context, specific proposed objectives of this work area can be grouped under two main headings and include:

WP4.1 Forest management for biodiversity This work area aims to provide an understanding of the biodiversity that is lost or gained by specific proposed forest management practices.

In particular it relates to the currently proposed novel practices of 'diversifying' forest stands by increasing the tree species and/or the age classes present. In addition it explores the biodiversity consequences of bringing unmanaged woodland and trees into active management for woodfuel production and the conversion of non-native woodlands into native woods.

Positive 'biodiversity' responses relate to the scope for a forest stand (or individual trees within a stand) to provide habitat (i.e. food, shelter) for native woodland species and particularly those with known important functional roles in forest ecosystems e.g. decomposers, pollinators, species facilitation nutrient uptake by trees.. The success of a forest stand in providing 'biodiversity benefits' is measurable in terms of the richness (number of species), and diversity (evenness of species) of native woodland species. Included in this measure is the typicalness, rarity and vulnerability of native woodland species that are found. It is possible only to survey a selection of species so the focus will be on species and species groups that are (i) cheap and easy to sample, (ii) informative about prevailing environmental conditions (e.g. ground flora, carabids, spiders show rapid and well understood responses to environmental conditions such as soil pH) and (iii) known to have a functional role in forest ecosystem processes.

Specific aims -Field experimental and review based research to compare forest ecosystem condition under different forms of management.

WP4.2 Measuring forest condition*

** Forest condition is understood here to be the biodiversity and associated structural and functional status of forest stands.*

The aim of this work area is to provide advice on sustainable forest management criteria (or indicators) that can be used for the monitoring of forest condition and contribute to forest ecosystem service identification across the range of different forest types in Britain. These criteria should provide a means of evaluating the biodiversity and associated structural and functional status of forest stands to allow for accurate monitoring and evaluation of forest condition by 1) forest managers, 2) auditors of forest certification and grant schemes (e.g. UKWAS) and 3) the three countries where there are national and international reporting obligations under the Convention on Biological Diversity. There is particular interest in using NFI attributes collected as part of the extensive surveying in the context of biodiversity and in interpreting the measures in a condition context.

Specific aims -

1. Review the existing suite of biodiversity criteria of forest condition in order to determine whether they are fit for purpose under existing reporting requirements (e.g. Habitats Directive, UKWAS). This will include reviewing the scope for reporting on forest condition based on existing data (particularly those from the NFI) that has been collected using these biodiversity criteria.
2. Refine and/or develop novel biodiversity indicators that will facilitate the low-cost and effective assessment of forest ecosystem condition (and forest ecosystem service provision) for different forest types at the stand, forest and landscape scales.

WA 5. GENETIC RESOURCES

WP5.1 Adaptive variation

High adaptive variation within an ecosystem confers resilience by providing the basic building blocks for adaptation to processes such as climate change. The work will be focussed initially on a set of established provenance trials based on rowan, ash and Scots pine. These trials compare performance of a range of provenances under a common set of conditions.

Such trials measure the amount of within and between population adaptive diversity, assess the degree of local adaptation and indicate the range of planting sites over which a given provenance may be expected to perform acceptably both now and in the future.

They provide evidence for the resilience of British woodlands under climate change and for the importance or otherwise of local adaptation. These two considerations can give rise to conflicting policy advice. Under climate change, guidance is required on the need to practice 'predictive provenancing'. Similarly, we lack scientific underpinning of the recommendation to plant locally sourced material and, if unavailable, to use material from the geographically closest population. Provenance trials of ash, birch and rowan have been established. The key traits under assessment are; survival, flushing, leaf senescence and height. When the trees have entered the reproductive stage, flower and seed production will also be assessed.

A CASE/NERC funded PhD studentship is examining neutral and adaptive variation in Scots pine. Provenance differences in susceptibility to drought and in basic morphology will be investigated. The origins of Scots pine in Scotland will be studied using mitochondrial DNA and methods will also be developed to study the degree of synchrony of flowering in Scots pine woods across Scotland. This group is collaborating with several others in Scotland to develop an overarching policy recommendation based on a synthesis of all the recent research on Scots pine.

WP5.2 Geneflow across landscapes

The concept of woodland habitat networks is based on the assumption that habitat corridors maintain genetic connectivity for all woodland species. Population differentiation and gene flow will be examined using molecular markers to test this assumption in woodland specialist species with different dispersal mechanisms. This work is ongoing and demands collaboration between molecular geneticists, landscape ecologists and statisticians.

WP5.3 Collaborative networks (EUFORGEN and LINKTREE)

This collaboration between European countries aims to promote conservation and sustainable use of forest genetic resources. It provides an excellent opportunity for interchange and development of ideas. FR will contribute to Phase IV which aims to develop a unified approach to current topics relating to European genetic resources of trees.

JC is a stakeholder in LINKTREE, a EU funded project which examines the importance of tree genetic diversity for the sustainability of forest ecosystems and how this variation is i) structured in nature and ii) will respond to environmental change.

WP5.4 Molecular tools in conservation

Insights from molecular tools are increasingly adding to our understanding of the dynamics of populations, how this reflects their conservation status and what measures might be taken for effective conservation. This element of the programme supports the development of techniques, which when applied become largely self-financing and which are available to underpin research in the work area relating to Ecosystem Management.

Bats-Advances in molecular techniques now provide powerful tools for species identification from DNA, e.g. scats or droppings and can be applied to determine the effect of management regimes on target species. Our aim is to develop such DNA-based methods for British bat species.

Black poplars-In collaboration with Woodland Trusts and local councils we genotype the native black poplars in their localities to improve their conservation strategies for the species. The results provide a rationale for the selection of genotypes on which to base a conservation genebank of British black poplars. This ongoing exercise is largely financed by local councils and conservation bodies.

Twinflower-We provide data on population structure, gene flow and clonality in rare target species e.g. twinflower.

Other applications- Although not part of this PAG, these techniques can also be used to provide information on the spread of pest and disease species. For example, these techniques are being used in the Tree Health Programme to determine the origins of pine lappet moth found in Britain and and this demonstrates the importance of maintaining a molecular capability for use by the FC.

WP5.5 Support for forest reproductive material regulations (FRM)

FRM regulations provide a system of labelling and control in the production and marketing of planting stock used for forestry purposes and the FC is the official body responsible for their implementation in GB.

This work package makes a major contribution to the implementation of these regulations and to the understanding and acceptance of their functioning in the wider forestry community. The work has three components (i) maintenance of the National FRM register (ii) field inspection of proposed and existing stands on National FRM register (iii) Scientific support and advice to C&FS, suppliers and members of the public on FRM implementation issues. There are plans to relocate component (i) to Silvan House once Cathleen Baldwin retires towards the end of 2011. There are currently major changes to the FRM rules being debated at EU level with the objective of devising a common set of rules for forest and agricultural crops. This will need scientific support if it is finally implemented. The FRM work is ongoing with a major annual reporting exercise on all aspects at the end of each year.

INTERLINKAGES

There are strong linkages between this programme and the following C&FS funded programmes

Land Use and Ecosystem Services –Landscape genetics

Vertebrate management-Identification of individuals and species using molecular methods

Tree selection and breeding-molecular approaches to tree breeding

Forest Climate Change adaptation strategies-Adaptive variation in native provenances

Advice and scientific support for tree health-molecular approaches to identify source of pests and diseases such as pine tree lappet moths.

5.2 Work Areas

Please list your work Areas as shown in the table below and show how they further sub-divide. Work Areas should be individually costed and be time bound – see 13. below. Please state key desired outcomes from each work area. First two years should be detailed, the next two in outline. See also Note for this Section below.

Work area 1	<p><u>INTEGRATION OF WORK AREAS 2-5 AND SEARCH FOR SYNERGIES AND COLLABORATIONS WITHIN THE GENETIC RESOURCES, SPECIES AND HABITAT ASPECTS</u> <u>Joan Cottrell, Ralph Harmer, Alice Broom, Nadia Barsoum, Stuart A'Hara</u></p>
	<p>Report on how to improve integration between the various work areas</p>
Work area 2	<p>HABITAT MANAGEMENT AND NATIVE WOODLANDS Ralph Harmer, Colin Edwards, Andrea Kiewitt in collaboration with statisticians and TSU staff Manage, assess and complete experiments and surveys, and prepare data for analysis. Knowledge exchange - Analyse data and write article on tree regeneration in Corsican pine PAWS – peer reviewed journal paper.</p>

Proposal for funding Agreement Number CFS 7-2011-15

	<p>Knowledge exchange - Analyse data and write article on vegetation development in PAWS – peer reviewed journal paper.</p> <p>Knowledge exchange - Analyse data and write article on beech PAWS. – peer reviewed journal article (plus possible popular article combining information from preceding papers if time allows). – internal report for Sallie Bailey.</p> <p>Knowledge exchange - Write report on potential new invasive non-native plant species and their likely impact on woodland biodiversity.</p> <p>Knowledge exchange - Analyse data and write article on oak deadwood dynamics in upland woods, – journal paper / popular article</p>
Work Area 3	PROTECTED SPECIES
WP 3.1	<p>Species specific research (declining species, legally protected species and those affected by legislative changes)</p> <p>Alice Broome, Georgiana Watson Brenda Mayle,</p> <p>Habitat management for butterflies- continue annual site monitoring and data analysis and produce report on findings for co-funders (FCS/Butterfly Conservation)</p> <p>Complete analysis of historical cone and seed data for inclusion in the Research Note “Factors Influencing Cone/Seed Provision</p> <p>Dormouse research- develop a plan for a refocus of research effort</p>
WP 3.2	<p>Project/Customer interface and project capacity building</p> <p>Alice Broome, Georgiana Watson</p> <p>Knowledge transfer services to the forestry sector (including publications)- capitalise on work carried out so far through publication of information (papers on lime bark beetle, juniper habitat management, twinflower habitat management Seeking external funds</p>
WP 3.3	<p>Habitat, ecosystem and guild based research for protected species</p> <p>Alice Broome, Georgiana Watson</p> <p>Woodland bird research (Defra contract)- co-ordinate FR’s input to the contract (site selection, intensive deer impact monitoring and interpretation of findings in the light of future forestry scenarios) and further complete a work package on the implications to ‘wider biodiversity’ of implementing management recommended for woodland birds (section of contract report)</p> <p>Research development – evaluate research areas identified as a result of the FR priority species review (2011) for their cost, tractability and value to the customer, and in the first instance, generate a delivery plan for the work.</p>
Work Area 4	BIODIVERSITY
WP 4.1	<p>Forest management for biodiversity</p> <p>Nadia Barsoum, Amy Eycott, Andrea Kiewitt, Jacqui Brunt</p> <p>Field experiment comparing forest ecosystem condition in mixed species stands and monocultures in years 1 and 2. Two peer-reviewed papers.</p> <p>Literature review of evidence of likely consequences for biodiversity of woodfuel extraction from unmanaged woods. Peer reviewed publication</p> <p>Conversion of 20th century plantations to native woodlands: Current levels of activity and implications for biodiversity. Literature Review (peer reviewed publication): Defining and exploring the feasibility of forest conversion in Britain. Case Study search and field work in years 3 and 4. The evidence gathering in this work area to better understand consequences of shifts in specific forest management practice for biodiversity will be used by the Ecosystem Services programme to identify biodiversity gains or losses in forested areas under similar management at the landscape scale.</p> <p>Communication: Webpage development.</p> <p><i>Pages to highlight work underway on benefits/drawbacks of different forest management practice on different taxa/ biodiversity.,</i></p>

WP 4.2	<p><u>Measuring forest condition</u> <u>Nadia Barsoum</u> Review of existing suite of forest ecosystem condition criteria in order to determine whether they are fit for purpose under existing reporting requirements. Report to CFS followed by peer reviewed publication. <i>This work has commenced in partnership with Irish counterparts who are also undertaking a similar review under the BIOPLAN project (FR is a project partner). A first draft is near completion (end of July 2011) and a final draft to be delivered by the end of the FY 2011-12. The final longer-term aim to produce a joint publication.</i></p> <p><u>Web page development:</u> Webpage development providing 'one stop shop' for indicators of forest ecosystem condition. List of forest biodiversity indicators, sources of assessment (NFI, UKWAS, DEFRA, BTO), indicators under development, trends based on indicators, links to relevant policy documents, references (inc links to relevant SOP's).</p> <p>Refinement of existing/ development of novel biodiversity indicators of forest ecosystem condition. Nadia Barsoum <u>Report to CFS:</u> Case study review of microhabitat influences on woodland ground beetle richness and diversity. This will be set in the context of a wider literature review of woodland microhabitats as indicators of woodland biodiversity.</p> <p><u>Report:</u> Literature review of indicators that could be used to provide information on the status of forest ecosystem <i>functional</i> processes such as the functional traits of flora/fauna. For example, the presence of ground vegetation species requiring pollination for regeneration could be an indicator of potential levels of pollinator activity. Report to CFS followed by Information Note</p> <p>The monitoring and assessment tools that are developed in this work area to assess forest ecosystem condition and biological and functional diversity responses to environmental change will help to provide tried and tested criteria that can be used for ecosystem services assessments of biodiversity in work areas 1, 2 and 3 of the Ecosystem Services programme.</p> <p>GENETIC RESOURCES</p>
WP 5.1	<p>Assess the distribution of adaptive variation through measurement of traits in common garden experiments of our native tree species. (Joan Cottrell, Rob Sykes and collaboration with TSU and Tom Connolly (Statistician)) Measure adaptive variation in ash and rowan trials at four trial sites in Britain. Devise and apply appropriate analytical methods to the data gathered ash and rowan trials. Knowledge exchange-Provide written report on the analysis of data obtained above Knowledge exchange-Prepare peer reviewed paper on adaptive variation in rowan.</p>
WP 5.2	<p>Supervise PhD student working on adaptive variation in Scots pine Joan Cottrell in collaboration with CEH and Edinburgh University Collaborate in design of water logging trial for Scots pine from a range of Scottish native provenances and development of appropriate methods to assess the susceptibility of provenances to water logging Collaborate in development of approaches to assess phenology in woods across Scotland Collaborate in development of methods to search for provenance based differences in leaf morphology.</p>

Proposal for funding Agreement Number CFS 7-2011-15

<p>WP 5.3</p>	<p>Collaborate in exploration of the feasibility of molecular methods to discover variation in the mitochondrial genome to try to clarify the origin(s) of Scots pine in Scotland. Co-supervise the preparation of a thesis for submission for PhD degree Co-author peer reviewed papers on topics covered in the project.</p> <p>Use molecular approaches to examine the effect of landscape on the genetic relatedness of model species to determine which features of the landscape act as barriers and corridors for gene flow.</p> <p>Tytti Vanhala and Joan Cottrell with collaboration from Kevin Watts (Landscape Ecologist) and Tom Connolly (Statistician). Maintain a modern, well equipped molecular laboratory. Analyse molecular and landscape data from wood cricket and wood ant studies Knowledge exchange-Provide a written draft of journal paper on wood cricket study. Knowledge exchange-Provide a written draft of journal paper on wood ant study.</p>
<p>WP 5.4</p>	<p>Provide a molecular service for the forest industry for identification of species and for identification of clones.</p> <p>Stuart A'Hara This is mostly self-funding but requires some support for development of methods. Collaborate with Cairngorm National Park to use microsatellites to fingerprint twinflowers to inform conservation policy. Continue to develop methods for scat analysis and clonal identification</p>
<p>WP 5.5</p>	<p>Knowledge transfer and project development</p> <p>Joan Cottrell, Stuart A'Hara, Tytti Vanhala Knowledge transfer in the form of workshops, information notes and formal discussions with FC customers on progress and implications of results of genetic conservation work</p>
<p>WP 5.6</p>	<p>Development of new and collaborative projects involving molecular and adaptive assessment of populations.</p> <p>Joan Cottrell and Stuart A'Hara Current interests are development of a PhD proposal for ant landscape genetics in University of York and scoping of a genomics of oak provenance trial within a EU proposal in collaboration with CEH. The application of second generation sequences to this work area needs to be considered e.g for whole mitochondrial genome sequencing in Scots pine to provide novel markers.</p>
<p>WP 5.7</p>	<p>Participation in EUFORGEN and LINKTREE</p> <p>Stuart A'Hara and Joan Cottrell Attend meetings as the British representatives and contribute to tasks set by the EUFORGEN network. Act as stakeholder in LINKTREE EU funded project.</p>
<p>WP 5.8</p>	<p>Forest Reproductive Materials</p> <p>Stuart A'Hara Maintenance of National Register, administration of all field inspection work (ongoing) Field inspection of new proposals and re-inspection of current National Register entries Scientific liaison with C&FS on implementation issues Advisory work for suppliers/public including presentations at meetings, specific publications etc. Provide a report on advisory work to CFS</p>

* Add new work areas and packages as required

1. Please indicate which of the FC's 6 Climate change priority actions this work fits into

Protect what we already have	<input checked="" type="checkbox"/>	Reduce deforestation	<input checked="" type="checkbox"/>
Restore the world's forest cover	<input type="checkbox"/>	Use wood for energy	<input type="checkbox"/>
Replace other materials with wood	<input type="checkbox"/>	Plan to adapt to our changing climate	<input checked="" type="checkbox"/>

7. Comment on how this research will address Country Strategy needs/targets (175 words)

General The programme will help to address the following objective in the government's new Natural Environment White Paper "Helping to deliver the Government's ambitions for resilient ecological networks, biodiversity recovery, sustainable agriculture, healthy woods and forests, an improved water environment and a better managed and protected marine environment."

Habitat management research will support the common aims of the country strategies to expand, restore and enhance woodland habitats by: providing data, information, reports and advice related to improving woodland condition and management practice; increase knowledge to underpin management decisions needed for important species such as UKBAP priority species, European protected species and woodland birds; address current policy priorities such as the restoration of PAWS.

Protected Species research will address the following needs

The FC is committed to the conservation of biodiversity; this is incorporated into policy statements on sustainable forest management (UK Forestry Standard), and all three country strategies. Each asserts that management should aim to conserve Priority species as defined in the UKBAP. Strategy Implementation Plans will provide more detail, e.g. for FCS, 7 species requiring particular attention (red squirrel, capercaillie, black grouse, pearl-bordered fritillary, chequered skipper and juniper) are identified.

Statutory duties exist for public office holders to 'further' and 'have regard' for biodiversity (Nature Conservation (Scotland) Act, 2004, and Natural Environment and Rural Communities Act, 2006 (Wales and England)). Legal requirements are imposed by the 2007 amendments to the Conservation (Natural Habitats, &c.) Regulations 1994, for managing habitats containing European Protected Species. The FC is engaged in drawing these amendments into best practice guidance for sustainable forestry.

Governance and delivery of conservation is now devolved, each country has Country Habitat Groups and Country Biodiversity Groups. In Scotland and Wales, FC leads the Woodland Ecosystem Groups and in England, FCE is represented on the Biodiversity Implementation Groups. These groups have the responsibility for addressing priority species requirements, as part of objective/target setting (duty of Country Habitat Groups), and implementation of conservation actions by the Country Biodiversity Groups.

Biodiversity

Conservation and enhancement of biodiversity is an important policy objective and component of sustainable forest management. There are specific country commitments to biodiversity, and established requirements for compliance and reporting; i.e. these include EU Directives, UK sustainable forestry indicators (Forestry Commission, 2002), and the UK's international reporting requirements with respect to biodiversity (UN ECE, FAO and MCPFE, 2006). In addition, the individual UK countries are currently seeking to assess the impacts and success of management activities and policy implementation in the conservation and enhancement of biodiversity (e.g. Scottish Executive, 2006). This work area has been identified as high priority by countries at

<p>recent Ecosystems and Biodiversity PAG and pre-PAG meetings.</p> <p>Genetic resources research will contribute to the formulation of policy or operational practice in the following ways</p> <p>1. General Woodlands for Wales 2009 “Provide guidance on improving the genetic diversity within tree species.” “We are committed to halting the loss of biodiversity from woodlands in Wales, with recovery underway in wildlife numbers, range and genetic diversity by 2026.”</p> <p>2. Climate change The Scottish Forestry Strategy 2006 “Genetic conservation in our native tree and shrub species is likely to become even more important as we try to adapt to climate change. The starting point is to improve understanding of the genetic resources in existing populations and to determine the presence of, and variation in, adaptive traits. Maintaining genetic diversity is likely to be an important adaptation requirement, as is the need to use planting stock suited to local conditions, both now and in to the future.”</p> <p>3. Conservation of rare species The Scottish Forestry Strategy 2006 “Ensure policy on genetic conservation in woodlands develops in accordance with latest scientific knowledge, and promote the supply and use of suitable planting stock for native species planting.”</p> <p>4. Statutory responsibilities The Scottish Forestry Strategy 2006 “The <i>Convention on Biological Diversity</i> and the <i>6th European Environmental Action Programme</i> (Gothenburg) committed the UK to the conservation of biological diversity.”</p> <p>FRM ‘The Forest Reproductive Material (Great Britain) Regulations 2002 regulate the marketing of FRM. These Regulations came into force on 1st January 2003 and implement EC Directive 1999/105. The Forestry Commission is the Official Body that is responsible for the FRM Regulations in England, Scotland and Wales.’</p> <p>5. <i>European agreements</i> The UK is a member of EUFORGEN (European Forest Genetic Resources Programme) as part of its commitment to the Ministerial Conference for the Protection of Forests in Europe process. FRM is dealt with as one of the major topics in the new framework of this network.</p>
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8. Identify and comment on any associated business risk of undertaking/not undertaking the research and how that will be managed

<p>Without the programme FR will not be in a position to provide advice to support the following areas:</p> <ul style="list-style-type: none"> • WA 2 Habitat Management Failure to improve and revise current guidance, provide advice, and to develop of methods of habitat management in woodlands for a range of biodiversity issues resulting in the continued use of methods that are not necessarily best practice. • WA 3 & 5 European agreements-Britain has obligations to conserve a number of rare woodland species and a considerable amount of money is being spent. Molecular tools can also enable practitioners to monitor the success of their approaches. The work on DNA identification of droppings can be helpful to woodland ecologists. Without an in-house research programme dedicated to performing Protected species research for forestry, FC would not be engaging in the area of Protected species conservation as fully as other organisations of similar standing and may/would not be obtaining information that might be critical to performing their function legally and economically. FC would be dependent on advice from external, single interest groups which may be strongly biased and may often be lacking the necessary forestry interpretation.
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<p>FC may struggle to commission high quality, reliable work externally that delivered information tailored to their needs.</p> <ul style="list-style-type: none"> • WA 4 -Failure to maintain and enhance forest biological and functional diversity will compromise the UK's ability to take environmentally sensitive action at the appropriate time, scale and cost with possible detrimental changes to forest ecosystems, and There is the additional likely risk that it would significantly hinder the UK's ability to participate in national and international reporting on indicators of sustainable forest management (e.g. in support of UKWAS, FAO, MCPFE and the EU Forest Action Plan), missed opportunities and damaged relationships with partner funding organisations. • WA 5 <ul style="list-style-type: none"> ▪ FR is uniquely placed to perform this essential long term GB wide research on provenance trials and adaptive variation. Without it strategies to deal with climate change will be unsupported by evidence. Also, policy on the recommendations for choice of planting stock have no underpinning evidence that locally sourced material is best. The terpene work which forms the basis of the pinewood exclusion zones is now rather dated and superior methods for examining the pattern of adaptive and neutral genetic diversity are now available and need to be used to check that the current system remains the most appropriate. ▪ Large grants are being awarded to promote habitat connectivity across the landscape and FC needs to know if such an approach is likely to be successful and provide value for money. We need evidence to assess the relative merits of habitat improvement through appropriate management and actions to improve woodland connectivity. There is a need within FR to provide a molecular service for FC and other customers when the need arises. ▪ FR needs to keep abreast of molecular developments so that the laboratory can be put to novel uses as the need arises. ▪ The UK is a member of EUFORGEN (European Forest Genetic Resources Programme) as part of its commitment to the Ministerial Conference for the Protection of Forests in Europe process. We need to participate in this to keep abreast of European developments in this area.. ▪ If we did not undertake work to support the FRM regulations FC would be failing in its statutory responsibilities. That part of implementing the FRM regulations with which FR is involved, relies heavily on knowledge of genetic variation, population genetics and tree breeding, expertise which is only available in the FC within FR. This type of work has been carried out over the last 6 decades and was well in hand before the statutory framework of the FRM regulations appeared. Implementation of the regulations without a firm scientific framework could lead to the use of inappropriate planting stock and a failure to fulfil forestry policy objectives. 	
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9. Research impact (economic, social, or biodiversity)

<p>Who will benefit from this research? This research will assist in the development of policy in the areas of climate change, conservation and landscape management. It will also assist woodland owners, forest managers and grant awarding bodies.</p>
<p>How will they benefit from this research? We will provide them with evidence to underpin the development of informed policies on questions such as: Which improved methods of habitat management will deliver objectives more effectively What planting stock should be recommended for planting in current and future climates?</p>

Do our current Regions of Provenance reflect the existing pattern of genetic diversity in our native woodland tree species?
 Do our native woodlands contain sufficient genetic diversity to enable them to adapt to climate change or is assisted migration required?
 Should we invest large amounts of money in planting corridors to encourage geneflow in the landscape?
 What is the most appropriate strategy for the conservation of rare woodland species in view of the current distribution of genetic diversity in the landscape?
 Are our rare woodland species genetically healthy?

What will be done to ensure that they have the opportunity to benefit from this research?

We will hold regular update meetings with our C&FS customer and FC country reps to keep them abreast of current progress. We will discuss with them the implications of our results on current conservation and planting policy.

We will ensure that the data are robustly analysed so that conclusions are sound.

We will publish the results in peer reviewed journals and will provide information notes to ensure that the industry and policy makers are aware and understand the practical implications of our findings.

Potential for innovation and new markets?

There is long-term potential for inclusion of advice on habitat management in decision support systems as they are revised or developed. The species and clonal identification service has some commercial potential. This has been confirmed to be the case in the two business scoping reports prepared under the PRSE project.

10. Communication Strategy

Publications:

FRM As the need arises, general and specific publications are produced. New regulations implemented in 2003 have been supported by an Information Note and a detailed set of Guidance Notes. FRM Newsletters are published at regular intervals and circulated to all known contacts.

Protected Species Coning and seed RN; Woodland bird RN; Priority species review RN

Biodiversity

Reports:

Habitat management Internal report to Sallie Bailey on invasive non-native species

Protected species Defra woodland bird contract reports, contract reports to FCW and FCS

Biodiversity Reviews on i. Effects of management on forest ecotype condition. ii. Evidence of likely consequences for biodiversity of woodfuel extraction in unmanaged woods. lii. Feasibility of conversion of 20th century plantations to native woodlands. Iv. Existing criteria for forest condition assessment at country level. v. Scoping for country level reporting on ecosystem criteria based on existing data. vi. Case study review of microhabitat influences on woodland ground beetle richness and diversity set in the context of wider literature review of woodland microhabitats as indicators of woodland biodiversity. vii. Review the potential to use indicators that provide information on the status of forest ecosystem functional processes (or the provision of forest ecosystem services)

Genetic resources-report on results of rowan provenance trial; FRM Publications are used to address specific issues when they arise; a current issue is the use of vegetatively propagated planting stock of native species.

Seminars/conferences:

Genetic resources Participation in Scots pine conference, Presentation at British Ecological Society meeting on Scots pine

FRM Presentations are provided for registered suppliers of planting stock and other involved in the nursery sector, FC Woodland Officers and staff involved in FRM inspections.

Presentations are used to address specific issues when they arise; a current issue is the use of vegetatively propagated planting stock of native species. A major part of communication is, nevertheless, with individuals in the wider FC and the general public, following specific enquiries.
Decision support systems: Protected species data could upgrade HaRPPS
Website: FRM National Register of Basic Material for Great Britain – public access via FC web-site is available. Protected species -SNH's Duty of care website; FCW's grant scheme information. Biodiversity Develop a one stop shop for indicators of forest ecosystem condition.
Peer review papers: Habitat management Papers on: regeneration in pine PAWS; vegetation development in PAWS; beech PAWS; oak deadwood dynamics. . If time allows these will be revised for publication in popular journals. Genetic resources Paper on landscape genetics of wood crickets, Paper on Landscape Genetics of Wood ants, Paper on development of microsatellite markers in twinflower. Protected species Papers on lime bark beetle; juniper habitat management; twinflower habitat management

11. Under government survey control procedures, Ministerial approval must be sought before statistical surveys of businesses or local authorities can proceed. Please indicate any intention to carry out a survey.

Yes No

- If yes please give brief details

12. Details of support agreed or to be sought from funding bodies for project (including in-kind support)

13. Resources (times and fees) requested from the Forestry Commission

Proposal for funding Agreement Number CFS 7-2011-15

14. Deliverables and associated costs to Forestry Commission

Work Area number	Output	Year 1				Year 2				Year 3				Year 4				Output	Total Cost
		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4		
WA1	Integration of work areas 2-5																		
	Report on discussions on how to improve integration of WA 2-5				x														
WA2	Habitat management																		
	Manage, assess and complete experiments and surveys, and prepare data for analysis.	x	x	x	x	x	x	x	x										
	Analyse data and write article on tree regeneration in Corsican pine PAWS.				x														
	Analyse data and write article on vegetation development in PAWS.				x														
	Analyse data and write article on beech PAWS.							x											
	Write report on potential new invasive non-native plant species and their likely impact on woodland biodiversity.							x											
	Analyse data and write article on oak deadwood dynamics in upland woods,							x											
WA 3	Protected species																		
	Coning and Seed RN				x		x												
	Report on dormouse work										x								
	Peer-review paper (first draft)-juniper			x															
	Peer-review paper(first draft)-lime bark beetle								x										
	Peer-review paper (first draft)-twinflower												x						
	Peer-review paper (first draft)-butterfly habitat																		
	Annual conference presentation	x				x				x				x					
	Report on new research development							x					x				x		

Proposal for funding Agreement Number CFS 7-2011-15

	<i>biodiversity indicators of forest ecosystem condition and ecosystem service provision.</i>																					
	Case study review of microhabitat influences on woodland ground beetle richness and diversity set in the context of wider literature review of woodland microhabitats as indicators of woodland biodiversity. Report to CFS First draft . Final draft.					X	X															
	Review the potential to use indicators that provide information on the status of forest ecosystem functional processes and provision of forest ecosystem services. Report to CFS. Information Note draft. IN Final version				X			X				X										
WA 5	Genetic resources																					
5.1	<u>Adaptive variation</u>																					
	Measurement and maintenance of provenance trials by TSU. Establishment of pot based trials as required.	x	x			x	x			x	x							x	x			
	Analysis of data from provenance trials																					
	Report on results of provenance trials																		x			
5.2	<u>Scots pine PhD</u>																					
	Design of drought trial for Scots pine provenances				x																	
	Exploration of techniques for recording Scots pine phenology				x																	
	Development of methods for assessing leaf morphology across Scots pine provenances				x																	
	Collaboration in method development for mitochondrial variation in Scots pine.								x													
	Co-supervision of Scots pine PhD thesis										x											
	Collaboration on preparation of peer-reviewed papers on Scots pine																			x		
5.3	<u>Geneflow across landscapes</u>																					
	Collection and analysis of molecular and landscape data from wood cricket and wood ant studies.				X																	
	Prepare written draft of journal paper on wood cricket study.								x													



Proposal for funding Agreement Number CFS 7-2011-15

	Development and scoping of new and collaborative projects involving molecular and adaptive assessment of populations. Keep abreast with developments in molecular genetic techniques			x																				
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Proposal for funding Agreement Number CFS 7-2011-15

Signed.....Research Provider/HOD Date.....

Signed.....C&FS Advisor Date.....

A handwritten signature in black ink, appearing to read 'Kerry Cappock', written over a horizontal line.

Proposal Approved

CFS

Date 31st August 2011

15. Agreed Changes

Description of change:	
Signed.....Research Provider	Date.....
Signed.....C&FS	Date.....
Signed.....Research Provider	Date.....
Signed.....C&FS	Date.....
Signed.....Research Provider	Date.....
Signed.....C&FS	Date.....

16. Detailed communications plan:
Year 1
Year 2
Year 3
Year 4