

FORESTRY COMMISSION

Description of the Research Project or Services

1.	Research Purchasing Manager (C&FS)	Vicky West
	Relevant PAG	Climate Change

2.	Name of FR Programme Manager (PgM) or Project Manager (PM) and staff	<p>Bruce Nicoll (PgM)</p> <p>PMs for Work Areas: Duncan Ray, James Morison (WA1 Vulnerability assessment) Bruce Nicoll (WA2,3,4,5,6) Bruce Nicoll (WA7 EC FP7 MOTIVE project) Nadia Barsoum, James Morison (WA8 EC MultiFor project) Andy Moffat, Bruce Nicoll (WA9 SG Centre Expertise Climate Change)</p> <p>PMs for cross-cutting projects: Anna Lawrence (Social aspects of adaptation) Gregory Valatin (Economics of adaptation) Barry Gardiner and Bruce Nicoll (Tree Stability and Climate) Duncan Ray (ESC for Climate Change)</p>
	Name of Institution/company	Forest Research
	Official address	Centre for Forestry and Climate Change Northern Research Station Roslin Midlothian EH25 9SY
	Telephone No.	
	e-mail address	bruce.nicoll@forestry.gsi.gov.uk
	Programme Life (years)	4 Years
	Start Date	1st April 2011
	Completion Date	31st March 2015
	Revision Dates	31st March 2012/2013/2014

3. Title of Research Project or Service

Forest Climate Change Adaptation Strategies

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

Adapting our forests and woodlands to the changing climate is challenging because of large uncertainties in the environmental and socio-economic changes, particularly when considering the long time scale of forestry planning. Adaptation therefore needs to include actions that both anticipate expected future conditions, and increase the ability to react to the unexpected, in order to minimise negative effects and maximise opportunities. Together such actions will

increase adaptive capacity. The uncertainty over future conditions over the next 50-150 years means that adaptation guidance and preparation needs a risk-based analysis framework and research needs to assess how best to deal with these uncertainties. This multi-disciplinary programme will assist in adaptation by a) developing tools for risk assessment using climate change scenarios to inform adaptation and for focussing adaptation action where most needed, b) providing recommendations and guidance for adaptation measures based on expert information and evidence trialled and examined at key case study sites, c) help the forest industry to work towards adaptive forest management using practical field-scale trials. The programme will work from the forest stand through to landscape and regional scale, will link several EC-funded collaborative programmes, and will feed into future country-scale and national adaptation programmes. The programme will draw on the experience of research staff from all three FR centres, will use data and findings from a range of other FR research programmes, and will collaborate where possible with external research institutes and universities.

5. Aims and objectives (word limit 500)

5.1 Aim of the research

To provide research, evidence and tools to assist and encourage forest planners, managers, and owners in adapting forests and woodlands to the changing climate, and using those woodlands to help society adapt.

This will be achieved by:

- Analysing future climate change projections for forest management use.
- Researching the impacts of climate change on trees, woodlands and forests.
- Developing tools for risk assessment and management that use climate change scenarios to inform adaptation decisions and focus action where it is most needed.
- Providing recommendations and guidance to support forest industry adaptation measures, trialled and examined at case study sites.
- Multidisciplinary collaboration to provide results, information and guidance at forest stand to landscape and regional scales.

Added value will be provided by linking with relevant ongoing and planned FC, Government agency and EC funded collaborative programmes, and by collaborating with researchers working on adaptation research in other research institutes and universities. Programme outputs will, where possible, feed into the development of national forest adaptation programmes.

Key research questions:

1. What do climate change projections mean for the future of trees and woodlands?
2. How can forest stands that are most vulnerable to climate change be identified?
3. What are the risks (abiotic and biotic) that climate change poses for forests in Scotland, England and Wales, and how can these risks be managed?
4. Which species and provenances match the future site types?
5. How effective is shortening rotation length as a strategy to minimise risk in future climates?
6. What evidence can be provided based on case studies, monitoring, experimental and modelling work, to assist the development of adaptive forest management?
7. How do we know we're increasing the resilience of the forests themselves?
8. How can forest adaptive capacity be increased, and how will the different approaches influence indicators of social, environmental and economic sustainability?
9. What are the tensions/ trade-offs between mitigation and adaptation/resilience measures to tackle climate change
10. Where should new woods be located and how can they be managed to contribute most effectively to landscape adaptation?

Links with other FR programmes:

The key research questions can not be answered by this programme on its own, and research relevant to the subject of climate change adaptation research spans work in all FR Centres and most research programmes. The Adaptation programme will develop tools, methods, and guidance to apply the findings of a range of FR programmes and from external collaborative projects to the development and assessment of risk aware adaptation strategies. In particular, strategies will be developed in collaboration with 'Alternative

<p>Management Approaches’, ‘Regeneration and Sustainable Silviculture’, ‘Managing Forest carbon and GHG balances’ and ‘Land-use and ecosystem services’. Key data on potential species and provenances for climate change adaptation will be provided by ongoing research in the Tree Breeding Programme.</p>
<p>5.2 Work Areas (with key research questions addressed – in red) 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.</p>
<p>Work Area 1 Vulnerability Assessment (key research questions: 1 & 2) Staff: CF&CC - James Morison, Bruce Nicoll; CH&ES - Duncan Ray, Michal Petr, Colin Edwards, Vadims Sarajevs, Gregory Valatin, CFR&M - Bill Mason,</p> <p>Vulnerability Assessment Tools are needed to target where adaptation action is critical. These will be developed incrementally over 2-3 years to include drought, frost and wind vulnerability. FR will collaborate where appropriate on vulnerability assessment with other bodies, for example Natural England. Various options for tool development including use of multi-criteria decision analysis (MCDA) will be tested.</p> <p>Work packages:</p> <ol style="list-style-type: none"> 1. Vulnerability assessment at broad scale 2. Economic assessment of vulnerability
<p>Work Area 2 Risk Assessment Tools (key research questions: 3 and 4) Staff: CF&CC - Bruce Nicoll, Matthew Wilkinson, Eric Casella, CH&ES - Michal Petr, Louise Sing, Duncan Ray, Vadims Sarajevs, Gregory Valatin, CFR&M - Barry Gardiner, Stefania Pizzirani, John Fonweban, Sophie Hale, Stephen Bathgate, TSU staff.</p> <p>Risk assessment tools will be developed or adapted to incorporate climate change and will be delivered at sub-compartment to landscape scales.</p> <p>Work packages:</p> <ol style="list-style-type: none"> 1. Risk assessment tools for forest design ESC and 3PG developments for risk assessment 2. Stability – ForestGALES developments 3. Economics of risk assessment 4. Risk perception
<p>Work Area 3 Adaptation Measures (key research questions: 5 and 6) Staff: CF&CC - Bruce Nicoll, Matthew Wilkinson, CH&ES - Philip Taylor, Michal Petr, Anna Lawrence, Vadims Sarajevs, Duncan Ray, Gregory Valatin, CFR&M - Sophie Hale, Barry Gardiner, Bill Mason, John Fonweban, Stephen Bathgate,</p>

Development of Adaptation measures will be informed by recent reviews, reports, data and expert judgement, exploiting links to other adaptation projects, including MOTIVE, ForestClim and MultiFor.

Work packages:

1. Adaptation measures development and application
2. ESC and 3PG for adaptation measures
3. Wind risk – ForestGALES for adaptation measures
4. Economics of adaptation measures
5. Social aspects of adaptation measures
6. ECHOES Cost action

Work Area 4 Case Studies & Supporting Experiments (key research questions: 6 and 7)

Staff:

CF&CC - Bruce Nicoll.

CH&ES - Michal Petr, Philip Taylor, Louise Sing, Vadims Sarajevs, Norman Dandy, Duncan Ray, Tom Connolly, Gregory Valatin.

CFR&M - John Fonweban, Stefania Pizzirani, Barry Gardiner, Stephen Bathgate, TSU staff.

Case studies and supporting experiments will be used to trial and explore multi-disciplinary aspects of adaptation, including management, scenario modelling and dissemination of ideas and results to stakeholders at regional level. Work will include scoping and developing an analysis of the costs & benefits of different options. This work will link closely with EC projects, especially ForestClim and MOTIVE. Tools and indicators developed in the EC case studies will be applied to the development of adaptation demonstrations in research forests.

Work packages:

1. Core experimental work and case studies
2. ESC application in case studies
3. Tree Stability – ForestGALES GIS application in case studies
4. Economic research within case studies
5. Social research within case studies

Work Area 5 Dissemination and Knowledge Exchange (key research questions: all)

Staff:

CF&CC - Bruce Nicoll, James Morison.

CH&ES - Michal Petr, Duncan Ray, Gregory Valatin.

CFR&M - Barry Gardiner, Bill Mason.

Adaptation dissemination and KE that cuts across work areas. This is in addition to specific dissemination and KE within work areas.

Work packages:

1. Core dissemination and KE
2. ESC KE & advice
3. Tree stability and climate KE & advice
4. Economics of Adaptation KE
5. Social aspects of Adaptation KE

Work Area 6 Programme Management & Development (key research questions: all)

Staff:

CF&CC - Bruce Nicoll, Andy Moffat, James Morison,

CH&ES - Duncan Ray, Anna Lawrence.

CFR&M - Barry Gardiner, Bill Mason,

Includes development of external (EC and other) funding bids.

Work packages:

1. Meetings, reporting, coordination, planning, QA
2. Development, Scoping and Collaboration

Work Area 7 MOTIVE (EC FP7) Models of Adaptive Forest Management (key research questions: all)

Staff:

CF&CC - Bruce Nicoll,

CH&ES -, Mariella Marzano, David Edwards, Duncan Ray, Louise Sing, Anna Lawrence, ,.

CFR&M - Barry Gardiner, Bill Mason, John Fonweban, Sophie Hale, Stephen Bathgate, Stefania Pizzirani, Philip Taylor, Mike Smith,

MOTIVE provides insights, data and tools to improve policy making and adaptive forest management (AFM) in the face of rapidly changing climatic and land-use conditions. One of the main deliverables will be an AFM tool box that provides up to date methods for planning and decision making in AFM for forest managers, planners and policy makers. FR activities are focussed around a Regional Case Study based on an examination of adaptation strategies in forest areas of Wales.

Work packages:

Project management

1. Base line trends and possible futures
2. Development of Improved models for adaptive forest management
3. Testing and evaluating management options and risks
4. Evaluating and selecting good adaptive management strategies
5. Improved decision support in adaptive forest management
6. Decision maker / stakeholder interactions and dissemination

Work Area 8 MULTIFOR (EC Interreg IV) Management of Multifunctional Forests (key research questions: 1, 4, 6, 7, 10)

Staff time:

CF&CC - James Morison, Nadia Barsoum

CH&ES - Duncan Ray, Matthew Wilkinson, Edward Eaton, Louise Sing

CFR&M - Shelagh McCartan, TSU staff.

Multifor develops a cross-border (England/France) strategy for understanding the climate change responses, multifunctional value and adaptive capacity of forest ecosystems.

Work packages:

1. Assessing the influence of climate change on forest ecosystems
2. Investigating mechanisms for improving forest ecosystem resilience to climate change

Work Area 9 Scottish Government - Centre of Expertise in Climate Change (key research questions: all)

Staff time:

CF&CC - Andy Moffat, Bruce Nicoll, James Morison

CFR&M - Stefania Pizzirani

Other FR staff to be decided.

CeCC coordinates and aligns activities from the wider research network to develop clear working practices and liaise with key policy areas in the Scottish Government. The Adaptation workstream has objectives including

Review the science of adaptation at the international level,

Develop options in terms of land use management to help reduce the impact of climate change and to enhance overall resilience,

Review existing approaches to adaptation,

Consider adapting existing monitoring programmes in a rapidly changing environment.

Work packages:

1. Adaptation
2. Risk and Uncertainty

* 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 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)

1. The UK Climate Change Act specified a national adaptation programme reviewed every five years. Defra's Risk Assessment programme (CCRA) is due to report Jan 2012, with a complementary Adaptation Economic Assessment (AEA). The proposed research will form an important input to the forestry section of these and future reports.
2. The programme targets key research recommendations in "Combating Climate Change" and directly addresses key country strategies:
 - a. FC England Corporate Plan objectives – protect, improve, expand (all with adaptation elements).
 - b. The FCS Climate Change Action Plan action on Adapting for Climate Change and 2 of the 3 areas in the Scottish Government Climate Change Adaptation Framework for Scotland: Exposure: the degree to which Scotland is exposed to change, and Adaptive Capacity: the ability of organisations and stakeholders to identify risks and take appropriate action.
 - c. Several of the 20 outcomes in the Woodlands for Wales strategy, including

healthy and resilient woodland ecosystems and better adapted woodlands and consequently fits well the FCW Corporate Plan 2009-2012.

8. Identify and comment on any associated business risk of undertaking/not undertaking the research and how that will be managed

Risks of not undertaking:

- 1) Poor assessment of the impacts of climate change on forests and forest productivity in GB.
- 2) Failure to provide research and scientific evidence to underpin adaptation measures leading to passive adaptation that is poorly targeted and timed.
- 3) Failure to provide guidance and advice as stated in the UKFS Climate Change Guidelines.
- 4) Delay in linking biotic and abiotic impact models to climate change projections to inform and improve active adaptation strategies for GB forests.
- 5) Not being able to provide information on the vulnerability and adaptive capacity of forests based on scientific evidence for the national adaptation programmes.
- 6) Not supporting country forestry policies and jeopardising their delivery .
- 7) Failure to link, complement and strengthen existing CFS co-funded programmes from EC and other agencies.

Risks of undertaking:

- 1) Too large a project resulting in fragmentation of effort.
- 2) Failure to deliver specified outputs.
- 3) Rapid changes in climate change field causing conflicting demands.
- 4) Failure to communicate useful results to stakeholders.

These risks are minimised by:

- 1) Close linkage of this programme with other related FR programmes and related externally-funded projects which both complement and provide resources to maintain impetus.
- 2) A specific programme management WP will help coordinate work and a steering group of key stakeholders including CFS purchasing manager will reinforce timetable, and steer the programme through changes required over its lifetime.
- 3) A dissemination WP which will also consult with stakeholders over what and how the information should be provided.
- 4) Development of coordination resources e.g. Meltwater drive shared spaces for FR and possible other key users.

9. Research impact (economic, social, or biodiversity)

Who will benefit from this research?

Whole UK forestry sector, focussing first on PFE, then adding private large-scale, then small scale woodland owners.
UK government and country policy makers will benefit from provision of evidence to support policy.

How will they benefit from this research?

Provision of information on adaptation preparedness and guidance on adaptation

measures that will be provided and expanded during the programme. Provision of information to underpin statutory reporting under the CC Act(s) etc.
<p>What will be done to ensure that they have the opportunity to benefit from this research?</p> <ol style="list-style-type: none"> 1. Extensive dissemination, consultation and outreach activities are planned from the start of the programme, including dialogue on what information to provide for practitioners and other stakeholders (in both the PFE and the private sector). 2. Production of adaptation reports, publications, research notes and scientific papers on climate change adaptation
<p>Potential for innovation and new markets?</p> <ol style="list-style-type: none"> 1. Development and application of DSS and other web-based or software tools for risk assessment. 2. Collation of numerous research data sets with potential to exploit directly or for future research bids with collaborators.

10. Communication Strategy

<p>Publications:</p> <ol style="list-style-type: none"> 1. Research Note – Drought vulnerability assessment tool to target adaptation planning. 2. FC Publication on Managing Risks to Forests in a Changing Climate. <p>Publication needs to be reviewed annually.</p>
<p>Reports:</p> <p>Quarterly updates with the purchasing manager; reports as requested to CC PAG.</p>
<p>Seminars/conferences:</p> <ol style="list-style-type: none"> 1. Adaptation and Risk Workshops for FC/FR and other key stakeholders 2. Links with European Cost Action (Echoes), FP7 project (MOTIVE), and EU Interreg Projects (ForeStClim and MultiFor) will provide substantial opportunity for international dissemination. 3. Input into FC training workshops on climate change.
<p>Decision support tools:</p> <p>Further development of ESC & ForestGALES and linkage through climatic factors to biotic models and link to productivity models.</p>
<p>Website: Re-development of FR climate change web resources to include ‘tiered’ information on Climate Change and Forestry e.g. FAQs, Adaptation Recommendations, Evidence, Programme Progress, Dissemination Events, and links to external resources (FC pages, other reports, publications etc).</p>
<p>Peer review papers:</p> <p>Peer reviewed papers and book chapters as appropriate, including</p> <ol style="list-style-type: none"> 1) analysing UKCP09 data and resources with modelling on abiotic and biotic risk, 2) development of risk and vulnerability analysis tools and predictions, organisational aspects e.g. assessment of attitudes and improving adaptation preparedness and role of adaptive management, reviews of adaptation measures appropriate for GB forestry.

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) £k

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

Please enclose a copy of page 1 of the FR Budget Spreadsheet compiled for each year of the proposed research

14. Deliverables and associated costs to Forestry Commission

Work Area number	Output	Year 1				Year 2				Year 3				Year 4				Output Unique Identifier	Total Cost (£k p.a.) (FC funding)
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Work Area 1 Vulnerability Assessment																			
1.1	Vulnerability assessment tools a. Prototype for drought complete by 12/2011. b. Extension to frost by May 2012. c. Extension to include wind in 2013/14.			x															
1.2	Economic components of vulnerability assessment and risk management a. Scoping report April 2011. b. Development and reporting	x			x				x										
Work Area 2 Risk Assessment Tools																			
2.1	Provision of climatic variables (UK wide) from BADC RCM, and for case study sites using the weather generator (UKCP09) a. UK wide scenarios for ESC, ForestGALES and other models. b. Draft paper by March 2012.				x					x									
2.2	Managing risk to forests in a changing climate. a. Complete report on abiotic and biotic risks in European forests (for MOTIVE project). b. Outline structure for FC publication on managing forest risk and plan by March 2012. c. Publish by 2013/14.	x																	
2.3	ESC site type identification and species choice guide. a. Prototype guide by Nov. 2011. b. Development and reporting.			x						x									
2.4	ForestGALES wind risk model - supporting research and development.																		

Proposal for funding Agreement Number CFS 4-2011-15

	<p>a. Sensitivity analysis of ForestGALES and use with climate change scenarios.</p> <p>b. Revise even-aged stand version of ForestGALES to incorporate recent scientific developments (in collaboration with INRA) and release as upgrade.</p> <p>c. Literature search for parameters for new species to be added, including broadleaves, and proposal for supporting research.</p> <p>d. Develop and test prototype of ForestGALES for forest management alternatives, including LISS/CCF (in collaboration with INRA).</p> <p>e. Climate change proofed ForestGALES including growth models for climate scenarios</p>				x																
2.5	<p>GB forest fire risk and management in relation to climate change.</p> <p>a. Collate FC and other research</p> <p>b. Publish review and recommendations</p> <p>c. Development and reporting</p>				x																
2.6	<p>Methods for climate modelling for tree health.</p> <p>a. Pine-tree lappet moth and RBNB by end Mar 2012.</p> <p>b. Development for other agents and reporting</p>				x																
Work Area 3 Adaptation Measures																					
3.1	<p>EC Interreg ForeStClim project outputs.</p> <p>a. Annual reports</p> <p>b. Deliverables for ForeStClim.</p> <p>c. Michal Petr PhD thesis and research papers</p>				x																
3.2	<p>Reports on survey of preparedness and adaptive capacity, and effectiveness of dissemination.</p>				x																
3.3	<p>Development of Adaptive Forest Management networks, and reporting. To be based initially on PFE and then extended to private sector.</p>				x																
3.4	<p>Links between Adaptation and Ecosystem Services Programme</p>																				



Forestry Commission

Proposal for funding Agreement Number CFS 4-2011-15

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

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

Proposal Approved...

CFS

Date 31st August 2011

15. Agreed Changes

Description of change:		
<p>Signed.....Research Provider Date.....</p> <p>Signed.....C&FS Date.....</p>		
<p>Signed.....Research Provider Date.....</p> <p>Signed.....C&FS Date.....</p>		
<p>Signed.....Research Provider Date.....</p> <p>Signed.....C&FS Date.....</p>		

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