

External review of Forest Research

Report of the Forestry Commission's
independent Expert Committee on Forest
Science

November 2017

EXTERNAL REVIEW OF FOREST RESEARCH

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1 Preamble

1.1 The Forestry Commission's (FC) independent Expert Committee on Forest Science (ECFS) was invited to review the work of Forest Research (FR). It is the first comprehensive science review of FR since that led by Sir David Read in December 2011. It is a quinquennial review that all government science and research bodies are subject to, including, of course, those within the Department of Environment, Food & Rural Affairs (DEFRA) family. Principally it is a science audit. Terms of Reference and membership of ECFS – the review team - are appended.

1.2 This report is in three parts: (1) outlines the approach the review team adopted, and provides brief background context to the review within the wider forestry sector and the many influences impinging on it and the pursuit of good science; (2) appraises FR's seven research programmes, technical support and development, and IFOS groups; and (3) draws to the Forestry Commission's attention a number of significant generic issues that emerged and includes a list of recommendations. The report is largely narrative based while offering constructive criticism of a world-renowned research agency - to cite the Ministerial Statement of 7 November 2017 about the future of the Forestry Commission.

2 Headlines

2.1 Several areas of FR's research are demonstrably world-class.

2.2 FR undersells itself and could substantially increase its engagement, visibility and impact.

2.3 FR's matrix structure is delivering the benefits of interdisciplinary working.

2.4 Going forward, the perception of FR must change:

2.4.1 it must not only pursue research of relevance to whole of GB and NI, but be seen to do so and engage in ways that demonstrate it;

2.4.2 FR clearly serves the whole tree and forestry sector, but it needs to be perceived to do so and take deliberate steps to work more with the private sector and non-government bodies – a key element of increasing impact.

2.5 FC's Inventory, Forecasting and Operational Support (IFOS) group have brought some outstanding competencies to FR. Their greater integration, in terms of scientists appreciating better what IFOS does and vice versa, will enrich both communities.

PART 1

Process and Context

3 Approach

3.1 The FC's Expert Committee on Forest Science was appointed in 2013. Since then it has met two or three times a year to conduct its business including visiting research trials, receiving presentations from scientists and meeting with customers of FR. This infrequent but intensive contact has enabled ECFS members to understand FR's complexities and better to 'take account of the institutional context' when conducting the Nov. 2017 review. And a key element of context for FR is the twin pursuit of first rate science and provision of practical advice on how best to care for and manage trees and forests. FR scientists are therefore expected to undertake high quality science that responds to current and anticipated needs of the forest sector as well as translating this research into policy and management relevant outputs.

3.2 The review team was based at the Northern Research Station of Forest Research (NRS) from 6-9 November 2017 and met with FC and FR staff, reviewed background material provided, evaluated evidence, and interacted with programme leaders and, in many instances, science group leaders. Presentations, followed by questions and discussion, of each programme and IFOS groups were attended by two or three review team members. The team conducted business as it saw fit while guided by the 'Guidance of research performance assessment' and the 'Science review assurance framework' agreed in advance with FC and FR (Annex 1). Towards the end of the formal review supplementary information was requested and provided. The principal review documents are referenced.

3.3 Throughout the process FC and FR staff were invariably helpful and supportive.

3.4 It is emphasised at this point that the four days at NRS – and the associated review of documentation provided - was not the only evidence for this evaluation. Over the four years of ECFS's existence it has held meetings and visited research centres and sites in England, Scotland and Wales. For example in the last two years ECFS have met with scientists and visited research relating to: ash dieback mass screening; acute oak decline; shelter and regeneration; underplanting of diseased pine; water quality amelioration at Llyn Brienne; emerging species at Brechfa Forest Garden; gaseous exchange tower and level II Environmental Change Network (ECN) site at Alice Holt Forest; laser survey for single tree metrics; recreational impacts and applied social science; and managing peatland for ecosystem services as well as staff, laboratories and facilities at both NRS and Alice Holt Research Station. This interaction has been invaluable.

3.5 This level of ECFS's engagement with the science and research carried out by FR allows this report to comment on process and impediments to its delivery in addition to the evaluation itself.

3.6 The review team chair also conducted semi-structured interviews with several of FR's customers and stakeholders in each of the devolved countries and a limited review of FR's outputs (and hence impact) picked up by membership organisations in the forestry sector. This small piece of research supplemented the major impact review of the 2015 Science and Innovation Strategy in (Meagher et al. March 2017) which ECFS had considered at its May 2017 business meeting.

4 Context – the tree and forestry sector

4.1 It is worth recognising at the outset the extent of change, some of considerable magnitude, that has affected forestry since the last external review in 2011. Quite apart

from BREXIT and continued funding constraints, they include:

4.2 **The forestry sector**

- Independent panel on the future of forestry in England.
- Establishment of Natural Resources Wales.
- Ash dieback (and other worrying 'new' pest and disease threats).
- Timber supply implications of decline in conifer afforestation and national forest inventory projections for 25 and 50 years.
- Emerging community of new owners of small woods (1–5 ha).
- Loss of key operational tools e.g. warfarin for grey squirrel control.
- Increasing evidence of links between human wellbeing and 'greenscape'.
- National policies for forest expansion.

4.3 **Within FC and FR**

- Science and Innovation Strategy – the new (2015) iteration with its strong programme led agenda and specified research challenges.
- IFOS joining the FR family in 2016.
- Departure of FC's long standing chief scientific adviser.
- Future of FC and arrangements for FR going forward.

4.4 FR has been adaptable and responsive to these changes. Forest management is, however, long-term as is much of forest-related science. The capacity to effect wholesale change is often of the order of decades or longer.

5 **Context – assessment of science quality**

5.1 Evaluation of science quality, the main focus of the review team's TOR, has several dimensions. But it is important to ensure that the research undertaken is relevant to the institution itself and the wide range of end users of the research that is generated. This has exercised ECFS since it was established and led to a paper specifically addressing the issue of how to evaluate science and impact when both first rate science and highly applied practical advice are sought from the same body – individual and institution (Ghazoul and Watkinson, unpub).

5.2 Measures of quality of science journal papers, including their citations and impact factor, must sit alongside and be balanced by other impacts and deliverables such as the reach and impact of published outputs in trade magazines, the number of website hits, social media exchanges and responses to enquiries etc. It is not one or other, but both. This report presents data to do this.

5.3 Other measures of quality include priority setting, the commissioning process itself, compliance with QA standards, such as in modelling and official statistics, rigour in experimental design and lab protocols, and in refereeing outputs whether for FC publications or submissions to journals. Exemplary ethical standards must be a given. High standards precede high reputation, which then lead scientists to receive invitations to collaborate from outside FR, to supervise or provide placements for PhDs, to address conferences both of their peers and of the wider sector, to give advice at national and international level and the related measures of esteem in awards and other recognition.

5.4 In reaching our judgments we have sought this balanced approach.

5.5 In presenting our report we have pursued a narrative approach building on the 'Guidance on research performance assessment', discussed by ECFS in May 2017, while cognizant of the 'Science Review Assurance Framework' as an aide-memoire without structuring the report criterion by criterion to ensure we did more than a tick-box exercise.

PART II

Evaluation of FR's Programmes and Services

6 Programme 1 – Assessing resilience & sustainability of urban trees, woodlands and forests

6.1 Overview and impact:

6.1.1 Staff are undertaking highly relevant research on urban trees, woodlands and forests. This is well illustrated by academic papers, and especially via FC publications. The programme has demonstrably valuable outputs to the forestry sector such as upgrades to Ecological Site Classification (ESC) and Forest Gales, and application of i-Tree urban tree mapping. Observing and recording forest change over time as part of UK Environmental Change Network (ECN) and GHG balance research are of international importance and relevance.

6.1.2 However, it was clear that there were issues with the initial planning of the programme. This appears in part due to shortage of time and in part to insufficient clarity concerning objectives. Also socioecological aspects appear not to have been included within the definition of resilience suggesting an overly narrow focus in what is a rapidly expanding area of interdisciplinary research and thus rather at odds with other groups working in this area.

6.1.3 A better strategy is needed for delivering impact, perhaps through a collaboratively constructed 'Theory of Change Approach', together with mechanisms for monitoring impact delivery. Links between deliverables and those of other programmes such as Programme 3 could be tighter. More meetings among the programme teams might achieve this. It is realised that with tight timeframes this might be difficult, but worth reviewing.

6.1.4 There are good links with the academic sector with success also in getting support for PhD studentships.

6.1.5 The programme is well managed, with a supportive steering group that meets twice a year.

6.2 Specific issues

6.2.1 **Long-term trials and plots:** While the review team applauds securing the legacy of long-term plots and experiments (Programme 3), there remains the challenge of conveying and communicating their importance and hence adequate funding for them. They are invaluable to Programme 1. As an aside, 30 years ago, who would have judged then that the Brechfa species plots would regain importance or that clearance of the phenology garden at Alice Holt would be regretted? Evidence of the scientific value of long-term trials and plots must be shown as well as achieving balance between desk-based models and collection of empirical data. FR needs to make a strong case for this. High profile publications will help convey importance and demonstrate one of FR's unique selling points – a rich and unparalleled resource. This is perhaps best addressed within Programme 3.

6.2.2 **Matrix system:** As with other programmes there is widespread recognition that the matrix structure – the ten science groups working across the seven programmes – is delivering real benefits from the interactions.

6.2.3 **Short-term contracts and issues of training:** Short-term contracts tend to place emphasis on short-term objectives. It may also lead to more 'synthesis' work rather than

research that delivers empirical data and the credibility this brings, for example for modelling work. Interactions with universities and the placement of PhDs is commendable and FR is valued for the training it brings to the next generation of forest scientists in applied research.

6.3 Going Forward

6.3.1 The science groups contributing to this programme will need access to suitable computers for the analysis of big data, especially for modelling and access to datasets of other institutions such as molecular bioinformatics. A link with IFOS data handling and needs may deliver complementarity.

6.3.2 The impact of the programme and how it might be measured needs to be addressed.

6.3.3 Consider better ways to maximise use of the unique suite of long standing experimental plots – also Programme 3.

7 Programme 2 – Understanding tree health and threats to resilience

7.1 Overview and impact

7.1.1 A flagship programme arising from the rapid increase in pest and disease threats. There is a strong focus on understanding biology. Research quality is impressive with scientific publications of a high standard flowing from this work. While all research activities can be well justified, some smaller scale investigations may be peripheral. The world leading Acute Oak Decline (AOD) research has, rightly, secured a high international profile for its work and this has resulted in sustained funding support from Woodland Heritage and others. Programme 2 addresses many important and relevant threats including research directed at Sitka spruce, GB's principal commercial species, and the increased pest and disease risks a changing climate may bring. Continued investment in and attention to Sitka spruce is crucial.

7.1.2 The programme illustrates well the active interactions FR staff have with academia and good links with joint PhDs. Interdisciplinary working is also a feature facilitated by the programme manager though we felt there was scope for more engagement with the small but growing number of social scientists working in this area – for instance, through combined work looking at an integrated way at the biology, epidemiology, prevention and management of emerging or established pest and disease outbreaks.

7.1.3 Having said that, the impact of Programme 2 on pest and disease prevention and management is already very significant. Alongside the impressive publication record, and frequent conference and workshop presentations, both within UK and internationally, a brief survey of e-news and other forms of communication within forestry membership organisations showed an encouragingly high use and uptake of FR outputs and evidence of a growing recognition of the importance of pest and disease issues. However, while there are many stakeholder engagement activities, there appear to be inadequate formal or planned pathways by which individual scientists network with high level stakeholders, relying heavily on personal contacts rather than more formal engagement through established networks. Indeed there is at times 'message dilution' with key messages sometimes failing to reach and impact policy sectors. Sometimes this is a matter both of profile and of inadequate representation/participation in official bodies, committees and groups.

7.2 Specific Issues

7.2.1 **Programme oversight.** Programme 2 appears to lack a steering group to help shape its research agenda. Such a group could also assist engagement with the wider

forestry sector and identify funding priorities.

7.2.2 Matrix structure While interdisciplinary working has been advanced, the lack of any budgetary control over the programme (as is case for all programmes) has led to frustration and a lack of funding flexibility. More could be done to foster interdisciplinarity among more junior staff. As noted above the review team were uncertain whether the social science aspects of the research were sufficiently embedded in the programme.

7.2.3 Outbreak management group Multiple stakeholders are involved in what is a logical first response and follow-up to new or emerging threats. However, few details were provided, yet it seems a mechanism for gaining rapid and high profile and hence impact.

7.3 Going forward

7.3.1 FR needs to increase even more its visibility and the impact of its scientific outputs. This is especially relevant for Programme 2 as the subject areas are topical and important to Defra, the research councils, the whole tree and forestry sector, and the wider public.

7.3.2 Measurement of impact, including citation analysis of scientific papers, will help raise FR's profile.

8 Programme 3 – Delivering resilient forests in a changing climate

8.1 Overview and impact

8.1.1 The largest and most applied research programme interfacing with almost every science group. It has great potential to influence practice in the forestry sector and appears to do so creatively and effectively. In many cases the Programme is the main channel for communicating and implementing research outputs from other programmes. That said, impact is different from communication and there are demonstrable examples of effecting change from research findings, viz. slow the flow, biosecurity of boot cleaning, emerging species for climate proofing, pesticide updates, sacrificial nurse species, advances in practical *Hyllobius* control, ecosystem services of urban trees, tree health diagnostics and advisory service with its public facing focus, to name just a few. Direct input to the New Forest design plans, authorship of practice guides and guidelines and themed advisory visits illustrate the diversity of call on FR scientists' time and competence.

8.1.2 Scientists working on this Programme participate in many national networks such as Defra's living ash project or the more informal collaboration on continuous cover forestry (CCF). They visit and give advice in each of the devolved nations. They are well connected internationally and collaborate transnationally across EU, within the International Union of Forest Research Organisations (IUFRO), with EFI, and in their respective professional disciplines.

8.1.3 The Programme is to be congratulated on achieving a mix of outputs in science journals, trade magazines, FC publications, conference and seminars events and face to face.

8.1.4 Despite its size and complexity the programme is well managed and has delivered successful integration across science groups. As in Programme 2, it was remarked that the programme manager lacks levers to ensure delivery, which can be frustrating.

8.2 Specific issues

8.2.1 Long-term forest experiments See notes under Programme 1, but the review team see this resource as so central to underpinning future research - to answer hitherto unasked questions in these times of change - that their funding be a priority.

8.2.2 Inadequate focus on private sector Inevitably location of trial sites and day to day contacts tend to be with other parts of FC. This has served forestry well in the past - the public forest estate acting as a surrogate for all GB forests, but this needs to change in order to better engage (and be seen to do so) with the private sector and other stakeholders. FR should be seen and known as the research agency for all trees and forests regardless of ownership.

8.2.3 Planned impact Scientists are well networked and attend many field meetings representing FR with opportunities to give briefings and research updates. A more structured approach, fostered by each of research centres and senior management, would further increase impact and raise profile.

8.2.4 Research QA There are effective data storage, data analysis and internal review processes. The internal peer review process can be cumbersome and a bit onerous, but it helps ensure delivery of high quality outputs.

8.2.5 Publication issues (1) Programme 3 has achieved a high output, including of FC publications, but both here and in Programme 5 the matter of slow processing of research and reports submitted for publication was raised. Causes for such blockages need attention to avoid demotivating authors and the passage of time dating the content. (2) Also scientists working on the Programme are the most likely to author or provide major input into the well-respected FC Practice Guides and similar policy focused publications, but there is often no mention of their contribution. This is very traditional and is a lost opportunity to show recognition and demonstrate importance. The 'silent civil service' is the old way.

8.2.6 Singleton expertise and succession This is a widespread issue well illustrated by this programme with upcoming retirements of top scientists whose value is unparalleled. There is no easy solution, but FR needs to address the issue of succession, perhaps by a more deliberate approach to supporting and developing young researchers wishing to pursue a career in forest science. We must be growing the next generation of champions now, both to pursue the science itself and to be FR's flag wavers.

8.3 Going forward

8.3.1 Addressing the question of greater private sector engagement and engagement GB wide is critical.

8.3.2 Research commissioning post CFS is important throughout FR, but the need for clarity, streamlining and a light touch balanced by creating good and robust contractual relations between the customer and FR researchers will be needed after April 2018 and into the next SIS. Both uncertainty and the need to be forever developing research proposals sap commitment and militate against good science.

9 Programme 4 – Valuing ecosystem services, forest governance and influencing behaviour

9.1 Overview and impact

9.1.1 Many projects within this Programme are of scientific and social importance. The ecosystem approach is now an established way of understanding, valuing and communicating environmental benefits and this Programme is likely to become increasingly central to FR's work. The review teams were therefore pleased to see that a broad range of disciplines has been brought together to work on issues around valuation, governance and management with the notion of forest ecosystem services widely recognised as an organising concept across all of FR's Programmes. While this is a

comparatively new area of work for FR, some good foundations are being laid through two EU COST Actions. There is also good evidence of network engagement e.g. via the COST Green Infrastructure which has resulted in an edited book. The group has a good link into the case studies (Programme 7) half of which come from Programme 4.

9.1.2 A clear measure of success is that some 60% of Programme 4's work is funded from external sources, though the review team felt there is scope to draw more funding into the Programme through joint research grant applications with researchers in UK universities and elsewhere.

9.1.3 The dual role of science team leader and programme manager in the same individual has helped with access to staff and budgets. This is also the case in Programme 5, and it might be a model to explore for other programmes/science groups, but the review team take no particular view.

9.2 Specific issues

9.2.1 **Core funding and short-term contracts** The success in attracting external funds brings the usual tension of who should fund the work in producing outputs from contracts and taking them forward in the development of new projects? It is too easy to fudge the issue and can lead to unreasonable reliance on core support.

9.3 Going forward

9.3.1 As noted above, we felt that there is considerable potential for FR staff to engage with the broader community of interdisciplinary researchers working on ecosystem valuation and the ecosystem approach in order to develop new projects. FR scientists are in a strong position to offer insights and case study material from the forest sector which can be integrated into successful large scale research grant applications. We note success in securing funding for COST Actions, but these must be seen as the first step towards securing funding for research projects that will advance understanding and applications. We note comments from staff regarding constraints on time but suggest that reallocating time from core support to working up new research ideas and proposals would be well justified.

10 Programme 5 – Tree breeding & developing sustainable markets, forest products and services

10.1 Overview and impact

10.1.1 While one of FR's smaller programmes it has potentially high impact across industry, especially the private and wood processing sectors. Exciting areas of science are being explored in tree breeding, such as use of genomic selection, with links to Oxford University and Roslin Institute. Indeed the 'Sitka spruced' BBSRC project working in partnership with Professor John McKay (Oxford) is an exemplar of how FR can be a primary driver without conducting much of the primary research. FR's contribution of the intensively monitored seed orchard of 22 year old SS is foundational and illustrates one of FR's USPs: without such a resource the high-tech research could not be done.

10.1.2 An upbeat and engaged team of scientists on this Programme managed to put across to the review team their work and achievements in a very positive way and gave an excellent perspective on the take up of their work by the forest industry in the UK and its beneficial impact.

10.1.3 The Programme is well engaged with and inputs scientifically to the National Tree Improvement Strategy (NTIS), Future Trees Trust and the Conifer Breeding co-op. This raises FR's profile as does its reputation internationally through this programme in its

interactions with research organisations in Canada, Ireland and France, EU links in Trees4Future etc.

10.1.4 The small investment in timber and wood properties focuses on practical developments and aids such as harvest-head assessments, working with hand-held laser scanners for rapid form and volume measurement, CT tomography of logs, acoustic stiffness assessment etc. There are productive collaborations with Napier University, Future Trees Trust etc. Being networked in the harvesting and processing sector enables FR to punch above its weight.

10.2 Specific issues

10.2.1 **Publications blockage** Concern was expressed over delays in internal editing and hence delays in publishing recommendations.

10.2.2 **High power computing (HPC) capacity** While there is access to HPC facilities in Surrey, having to go off line for big data is insecure, but should be resolved with use of the Cloud when central services cease to exist.

10.2.3 **Succession planning** The recurring theme of singleton experts and their retirement impacts this programme, in particular tree breeders of the future.

10.3 Going forward

10.3.1 Secure access to super-computing facilities will be essential.

11 Programme 6 – Innovation in forest modelling, data and tools

11.1 Overview and impact

11.1.1 In the 1960s and 70s FR's mensuration research led the world; today the work of Programme 6 is returning to being at the very forefront. There is excellent evidence of international standing such as contributing to IPCC core guidelines, development of CARBINE as one of only four models worldwide for carbon accounting, as well as requests for advice from across the globe. Use of CARBINE within GB is much valued by customers and stakeholders for understanding better carbon stocks in their woodlands. Support given them by the Mensuration and Modelling science group is particularly appreciated.

11.1.2 QA of data used in modelling is an absolute must. Scientists working on Programme 6 ably demonstrated their rigour in this area thus ensuring data are 'fit for purpose'.

11.1.3 Single tree metrics assessed through laser scanners offers both savings in tree and stand measurements and improvements in accuracy. Both lead to better predictions of outturn.

11.1.4 The matrix structure has led to an effective modelling community in FR leading to developing a modelling strategy. It was less clear about engagement with the scientific modelling community more widely.

11.1.5 New work on tariffing, permanent sample plots (PSP) in CCF stands and emerging species are in train. Links are now being built with the private sector e.g. Tilhill. The need to build non-carbon dioxide gases into models is recognised.

11.1.6 After some reluctance, Programme 6 has engaged well with Programme 7 through development of case studies. Appointment of a delivery manager in the Mensuration and Modelling science group and close working with the programme steering group have facilitated outputs and meeting objectives.

11.2 Specific issues

11.2.1 **PSP network** has reduced from a peak of about 1500 to around 300 owing to resource and operational reasons. Critical now is for PSP data release into the public domain and the need for strategy as to how data can be used, and to solicit collaboration to make best use of the resource in a changing climate and landscape.

11.2.2 **Stakeholder group** Should be extended to private sector.

11.3 Going forward

11.3.1 There are clear synergies between Programme 6 and IFOS which, while recognised by the Forest Mensuration, Modelling and Forecasting science group, could be substantially strengthened. Examples include handling big data sets (see also Programme 5 above), underpinning models for yield forecasting, and novel instrumentation for both data about tree and stand metrics and strategically e.g. NFI.

11.3.2 The Programme has a heavy work load to meet its objectives, and again the issue of succession planning is a concern.

12 Programme 7 – Integrating research for policy & practice to deliver resilient forests

12.1 Overview and impact

12.1.1 This small programme in resource terms has had a large impact across other programmes and science groups in FR chiefly because it is one of the key elements for integrating applied social science. Its inspired inclusion in SIS – to research how to demonstrate and deliver impact through innovative forms of management and collaboration – is informed by the idea that knowledge translation for impact is not a linear pathway, but a plurality involving complexities and feedbacks. SERG science group has a predominant place in Programme 7 with a strong emphasis on interdisciplinarity, for instance by emphasising the human well-being benefits of tree health. Many people conflate dissemination with impact, but they are different activities. FR is good at the first, but sometimes less effective in delivering impact. This Programme should assist in this endeavour.

12.1.2 *A posteriori* recording of impact utilised a questionnaire to 70 scientists, 2/3 FR and the rest FC but no private sector which could be criticised as not being sufficiently open to scrutiny. Impact pathways should be designed at project initiation with stage appropriate indicators to map impact outcomes. FR management should look at how their 'Research Impact Logic Model' or similar is used as a training tool to ensure better understanding of how FR data are used and by whom and then how this can be monitored to help improve impact as well as the research culture of FR. How do staff view their work and how do they record who uses their papers and reports, and other outputs that proceed from their work? This all relates to the Theory of Change Approach. It should be more than just a training tool, but also something that is embedded in strategy development for science responding to the needs of the sector, and to identify the pathways by which science outputs can be taken up and made relevant to the sector.

12.1.3 It is recognised that by no means all staff have the skills and confidence to translate research into impact. But there are already useful examples from within FR that could be looked to for insights. These would include Dr Tom Nisbet's 'Slow the Flow' work based largely on experience at Pickering and now being rolled out in 22 new catchments with very substantial funding from Defra and NERC's 'Woodlands for Water initiative, and Dr Sandra Denman's AOD research, so effectively supported by Woodland Heritage, leading

to far greater awareness by and engagement across the tree and forestry sector.

12.2 Specific issues

12.2.1 Central listing of all publications While relevant to all programmes and science groups, the publications spreadsheet provided to the review team was not very helpful with, for example, journal titles omitted. While papers can be accessed from personal web sites, FR needs an accessible and complete e-archive/database of all such outputs.

12.2.2 Monitoring impact There is little in the way of monitoring impacts of FR outputs in terms of behavioural change, an important focus of Programme 7. ECFS, in earlier meetings, have recommended 'Outcome mapping' as a helpful approach and is reiterated here. Comprehensive documentation of impact provides a powerful evidence base to demonstrate FR's role in developing the tree and forestry sector. It's effectively a cultural change moving from a focus on outputs to a focus on impact and embedding a shift from knowledge transfer to knowledge co-production.

12.3 Going forward

12.3.1 Programme 7 is an important development for FR, and we were pleased to be presented with a carefully justified series of priorities for future work. The ambition to further collaborate with the cultural sector is particularly exciting and should yield some important new forms of knowledge and outputs. More broadly, outputs from this Programme have the potential to significantly change the way FR demonstrates the impact of its work. ECFS looks forward to seeing increased impacts and benefits from this initiative in ways suggested above.

13 Technical support and development services

13.1 The review team were perplexed that neither in the self-evaluation document nor in the presentation at NRS that much was included about Business Development, FC Publications and Communication or investment in capital projects in FR's labs and facilities. All three are crucial to winning new research, its delivery, and achieving impact from good science. Some information was provided subsequently, but there was inevitably less opportunity to question and review in depth.

13.2 Technical Services Unit (TSU)

13.2.1 Underpinning first-rate research in the field is the ability to locate, establish, maintain, and assess experiments and trials efficiently and accurately. Sometimes this is called upon at short notice such as the huge ash dieback screening trials. In the TSU, FR competence is unrivalled anywhere in GB. Alongside the legacy holding of long-term experiments, it is one of FR's foremost USPs. It offers a resource scientists and researchers in other organisations and universities use and can rely on and so is a key element in collaboration with FR and hence funding opportunities. It also offers provision of service level agreements to meet specific customer needs such as plant health and tree pest surveys. The third of TSU income from such external sources is evidence of their value and ability to deliver. The three TSU teams are to be congratulated.

13.2.2 The review team endorse the view that TSU should remain an in-house competence; it is a critical part of QA of good forest science.

13.3 Technical Development (TD)

13.3.1 The small dedicated group continuing technical development is almost wholly funded through external income with all the challenges and uncertainties that brings, but which allows this part of FR to network and, as with timber properties research in

Programme 5, to punch above its weight. Examples include managing helicopter spraying, running training events - within and outside of FC, monitoring technical equipment such as sprayers, and aerial and soil surveys and assessments.

13.3.2 Technical Development by FC has a long history of success and innovation. It is recommended that a back catalogue of work by TD is preserved and accessible in an e-archive.

13.4 Capital investments

13.4.1 Upgrading of buildings and infrastructure have been achieved that were overdue, but particularly gratifying are examples of recent FR and Defra investments in new glasshouses at NRS and Alice Holt, the molecular genetics' laboratory at NRS, and the upcoming multimillion pound plant quarantine/biosecurity facility at Alice Holt. All speak of confidence and competence going forward. They are flags to wave, lift morale of staff, allow the latest research, and have impact beyond their immediate purpose – just as the GHG tower at Alice Holt (Straits Enclosure) attracts interest because it is itself impressive as well as serving science.

13.5 Communications and publications

13.5.1 The FC's own publications are very much its public face with a long and impressive tradition of high quality and diverse outputs targeted at varied and differing audiences from policy makers to practitioners, from books with in-depth analyses to pest and disease alerts and Observatree guides. By and large their quality is exemplary and it is not this review's role to focus on FC as publisher beyond the key role this plays as the final link in the chain of delivering the fruits of research: they are a major conduit for communicating science to GB and NI tree and forestry sector.

13.5.2 FR has in place well-structured internal vetting and refereeing processes for assuring quality of content, but (a) at times the 'pitch' expected from the staff is not always clear, and (b) at times delays between submission and final publication are too long leading to dated material and author frustration.

13.5.3 Use of FR's website and other social media avenues is reflected in dissemination of FR's research by all membership bodies in the sector.

13.6 Specific issues

13.6.1 Authorship of policy and practice guides

13.6.2 Already noted under Programme 3, anonymity of policy facing publications is no longer expected. Ways to indicate authorship or make it more obvious would appear a win:win.

13.6.3 Business development

13.6.4 Although not conducting science itself, the unit is key in supporting research in sourcing external funding and, very importantly, relieving scientists of some of the leg work. It will become increasingly critical post-EU as well as reducing reliance on central funding. Several initiatives building links, and ultimately funding, from private sector are in train (mentioned elsewhere).

13.6.5 The key issue going forward is both to continue, indeed, expand the good work in leveraging new opportunities and to further reduce the burden on the individual researcher. Few career scientists entered the profession to grow businesses, yet the flair of some and the communication skills of others make them highly marketable.

14 IFOS – Inventory, Forecasting and Operational Support

14.1 IFOS became a part of FR in April 2016. At that time three members of ECFS were invited to review its work and how it fits within the FR family and the synergies that could be built. This review, only 18 months later, is more like a work in progress report, though the review team have no doubts of the great benefits brought by the demonstrably competent IFOS groups joining with FR.

14.2 Also much of IFOS's work is not conventional science and research as such, but the application and use of it, often on a large-scale, to conduct robust surveys, gather data, and apply it locally, nationally and internationally. It relies on the same high standards of QA to provide the assurance of output reliability. Comment here concerns principally these aspects.

14.3 IFOS is treated here as a whole with specific points and recommendations at the end.

14.4 Inventory & Forecasting

14.4.1 The work is of a very high standard and extremely high impact. Uptake is massive evidenced by downloads of published documents and National Forest Inventory (NFI) information on FC's website and press interest, both of which enhance credibility and reputation of FR.

14.4.2 In terms of good science the double calibration technique in remote sensing that was highlighted appears new and unique, indeed world leading.

14.4.3 Working with an expert steering group, including private/commercial sector parties, has informed priorities in data gathering and, importantly, how useful it is.

14.4.4 The next cycle (5yr) of NFI will offer a unique opportunity as data are gathered, and every advantage should be taken. Can data be made available pre-release to FR?

14.5 Mapping & Geodata

14.5.1 A highly impressive resource providing crucial services in three areas: remote sensing tools, mapping and land registration, and the new Geostore facility. Future strategy was well articulated and the M&G team have a strong track record in meta-data handling.

14.5.2 M&G's competence in and strategy for big spatial data contrasts with the more project by project focus of much of FR.

14.5.3 Most of M&G's work is FE focused - essentially information management and transitioning to Cloud-based platforms. There appears little interface with FR to date, but there was a clear commitment to promoting the role of the group to FR more widely.

14.5.4 One of the principal challenges is to respond to government demand for open data. The NFI (above) is a flagship product and there is every intention to make this more available beyond FC and in a variety of products.

14.6 Operational Support

14.6.1 This group largely underpins FE operations through development and support of Forester Web – a GIS software asset management system. There is impressive QA documentation and protocols, and the small team are on schedule and on budget to migrate from desk-top to Cloud-based computing – and from tablet to mobile - by June

2018. System reliability is close to 100%. This achievement is a credit to all concerned.

14.6.2 This group is delivering all that is required of it, but how well-known is it outside IFOS and FE circles? Their governance and project board arrangements work well. Indeed can FR sell their services and Forester Web? There seem to be few contacts between them and FR. The team recognise that they do not do 'science' but they need scientific input and services and also to be used by scientists which is barely happening.

14.7 Official statistics

14.7.1 A small team responsible for generating UK's official statistics of the forestry sector. In achieving this, compliance with the government's code of practice for statistics is paramount. As a national service it is trusted across the sector and the team consistently meet publication deadlines.

14.7.2 Some issues to address include quantifying woodfuel, aspects of restocking data, woodland loss etc. Engagement with customers was unclear, and there is little evidence actually to demonstrate impact – though in the view of the chair of ECFS the FC's annual forestry statistics compendium (website and hardcopy versions) is arguably FC's most useful publication for students, the media and public at large for sketching out the entire tree and forestry sector.

14.8 Specific issues

14.8.1 **Closer working** IFOS has been part of FR for more than 18 months, yet despite informal attempts by both parties to be better briefed about the other, there is still a chasm in understanding. The review team were impressed by what IFOS are doing, by the scale of their work and by their potential value and usefulness to FR's research community and vice versa. It is recommended that senior management organise a one day seminar in both NRS and at Alice Holt where all heads of IFOS groups and all on-site Programme and Science Groups leaders are expected to attend and present overviews of their work. The review team has been privileged to experience just this in conducting their review: it should be replicated in FR to the greater benefit of all. We are not wishing to micro-manage, but think the benefits are potentially massive.

14.8.2 **Staff retention** Many IFOS staff possess highly transferable skills and their retention could be critical. It parallels the issue of 'singleton experts' in FR programmes and concerns for the future.

PART III
Some key generic issues, additional points relating to
the Science Review Assurance Framework Criteria,
and list of recommendations

15 Criterion 1 – Science used by the FC and other customers should be robust, relevant and high quality

15.1 Much of our commentary on Programmes and IFOS addresses this criterion. There are seven additional generic points or ones meriting further comment.

15.2 Engagement with CFS as intelligent customer

15.2.1 On the whole clear agreements and effective working relationships exist between programmes and CFS analysts group. The intelligent customer role is evident from the regular analysts' newsletters – which incidentally aid dissemination of FR outputs, and the stocktaking exercise earlier in 2017. This interaction along with informal contacts, participation in some programme steering groups, ensures that customers, within and outside FC are well linked to FR to influence priorities and receive scientific advice. Of course, with limited resources not every customer will find their priority addressed, but the commissioning system functions well enough while appreciating that some programmes would 'prefer' greater or lesser 'engagement'.

15.3 Science quality

15.3.1 The review team were impressed by FR's delivery of robust, quality science. There are effective procedures in place for QA, with a stringent internal refereeing process.

15.3.2 However there is the wider question of implementing a full Quality Assurance system across FR. An approved QA system could embed processes of which ISO 9001 is an example of a quality management standard. The standard defines the requirements to create a Quality Management System (QMS) so that an organisation creates a documented plan for delivering consistency of service or product. An ISO 9001 QMS helps to monitor and manage quality across a business and identify areas for improvement.

15.4 International reputation

15.4.1 Evidence of international reputation has been noted throughout Part II of this report, but we wanted also to examine it through analysis of recent scientific papers since within Criterion 1 the review team was invited to consider whether 'FR's applied science outputs (are) of, at least, equivalent quality to those expected from other providers'. In doing this we re-state our full recognition of the tension highlighted earlier of matching expectation to FR's unique remit.

15.4.2 We attach, as Annex 2, an impact factor analysis of scientific papers published since 2015, prepared by Professor Jaboury Ghazoul, which shows a creditable achievement in the light of the many calls on FR staff's time as scientists and, for many, advisers to policymakers and practitioners.

15.5 Short term and long term in forest science

15.5.1 In ensuring relevance of science undertaken one aspect, while not unique to forestry, is commonplace in forestry research. Quite often a new question or issue arises,

such as climate change or new disease or new analytical tool or technology becoming available, where an old experiment or abandoned trial can be revisited or reinstated. An agronomist can simply investigate the 'new' with the coming year's suite of crops to work on; the forest scientist more often than not goes to existing stands of trees. Crucially if their history is well-known, as in former experiments, this greatly enhances their new usefulness.

15.5.2 The point is obvious, but twice in this report the review team has applauded the fact that FR has taken steps to 'ring fence' this legacy of older experiments. We believe it is a sound investment. A further recommendation is to publish more explaining their importance and making a stronger and strategic case for how they will be used in the future.

15.6 Post of FC chief scientific adviser

15.6.1 The retirement of Professor Peter Freer-Smith just before this review began was unfortunate in terms of timing. However it does allow the review team to recommend strongly that the position is filled quickly, that it is a full-time post at the same level, and that the appointee should not only be a scientist of standing but one who can be ambassadorial for FR. The review team feel FR underplays its hand, and one important way of raising visibility and increasing impact is by having a respected champion to wave FR's flag – in government, across the forestry sector, and among academia (and probably in that order).

15.7 Matrix structure across programmes and science groups

15.7.1 Matrix working was introduced following the 2015 SIS. FR's research programmes reduced from 18 to 7, and the research communities with common interests and expertise professionally led to 10 science groups. Research by programme delivers against SIS targets and challenges, and is commissioned by CFS, while the science groups bring their skills to bear across various programmes. Programme leadership is supported by steering groups, while funds are held by science group leaders. This sounds and is complex but, owing largely to good leadership, works remarkably well.

15.7.2 The matrix working pattern has an interesting spin off. It helps ensure both relevance and underpins ethical considerations and QA. Working across programmes brings together scientists from different disciplines who, familiar with practices and standards in their professions, will look for it when collaborating with others. It acts like a safety valve or informal assurance mechanism.

15.7.3 The matrix structure is delivering new synergies and collaboration, for example FR's modelling group. Overall, although there are frustrations for some programme leaders over lack of funding control, it is functioning well. The review team strongly recommend that no change is made to the matrix system in the next quinquennium nor to the number of programmes. The organisational stability will be welcome.

15.8 Succession planning and singleton experts

15.8.1 Commented on several times in Part II. The issue applies across FR and particularly affects senior scientists, who are often also the key advisers to policy makers and practitioners, and also many IFOS staff with highly transferable skills.

15.8.2 Their leadership permeates throughout setting standards, providing role models, and helps immeasurably the visibility of FR, all of which are key to ensuring all science used by FC and others arising from FR is fit for purpose. There are examples within FR of

communities of PhDs, post-docs, and young scientists working with a high profile senior scientist which perhaps can be replicated more widely or, at least, used as a model.

15.9 Resources and capital investment as components of science quality

15.9.1 We remarked that the recent investments in buildings, facilities and refurbishments, all speak of confidence and competence going forward. To repeat, they are flags to wave and they motivate staff, but crucially they allow the latest research and to keep up-to-date. As is well-known, access to such facilities attracts and retains the best staff, there's no brain-drain, and they are almost as important a contributor to science quality as the staff themselves.

16 Criterion 2 - Science evidence should be publicly available

16.1 Customers and stakeholders and demonstration of impact.

16.1.1 Interviews with users and customers, as well as other evidence, all indicate the influence of FR on policy - their science underpinning issues with water, climate change and greenhouse gas emissions, forestry habitat networks, timber forecasting etc. Specific examples of changes in practice were many ranging from pine weevil control to advice on emerging species – even site specific recommendations - and how to diversify forests. There was specific welcome for IFOS joining FR and, interestingly, for the security of long-term experiments and their 'huge value', and the excellent Carbine model; the digitised yield models are now taken as read.

16.1.2 But the important point is that all customers unreservedly appreciate knowing that there was expertise in FR to call upon. All affirmed that links could be strengthened and benefits would flow from greater interaction. It was even asked, Can FR give early advice before the science has been fully refereed?

16.1.3 Inadequate input to priority setting, apart from specific service level agreements for commissioned work, was raised which is more a question for CFS and its successor.

16.1.4 FR's expertise was cited again and again and a 'consulting' or advisory visit by an expert often the most valued means of drawing upon it. Failing that, availability of hands-on guidance instructions or simple leaflets or outputs for practitioners was urged.

16.1.5 These views also imply a shortcoming on the part of customers. While the onus is plainly on FR to make available in accessible forms its research findings, it is incumbent upon the recipient – the customer, stakeholder and user – to take steps to ensure staff are kept updated with the latest science. FR can publish the work on its website, in newsletters and in all the other means available in the 21st Century, but steps need to be taken to ensure it is seen and read – the element of customer responsibility to ensure staff are up-to-date. The obvious route for forestry professionals is via ICF's CPD requirement and making one element of compliance by staff that of keeping abreast of science and research. Most interviewed - but not all - hadn't even considered this step which indicates something of a failure at the crucial final step of technology transfer; hence FR impact is weakened. It parallels the problem of message dilution mentioned in connection with policy.

16.2 Use of FR outputs

16.2.1 Many comments were made on FR outputs in Part II, but not enlarged upon is the observation that in 2017 all the following membership organisations referred specifically at least once, and most several times, to FR research on their websites, in e-news, and in magazines: Confor, Institute of Chartered Foresters, Royal Forestry Society, Royal Horticultural Society and their Garden magazine, Small Woodlands Association, and Small

Woodlands Owners Group. This is merely a sample of membership organisations, purely to illustrate FR's increasing reach, but it makes the point that they are passing on to their membership FR's outputs. FR's research is being made available in a timely manner.

16.3 Database of scientific publications

16.3.1 Public availability extends to scientific papers and, as recommended, a single accessible database or e-archive of all publications by FR's staff would facilitate this.

17 Criterion 3 - FR should ensure effective knowledge transfer and innovation through to the development of new technologies and services

17.1 Engaging with the private forestry sector

17.1.1 British forestry has been well served in the past by the policies and practices of the state forest sector acting as a surrogate and exemplar for the whole. This has included forestry research with the bulk of experiments and trials on FC land, but the results of which are relevant and applicable more widely. For reasons noted earlier, this paradigm is changing, a change that FR needs to embrace in practical ways to appear and be truly representative. This builds private sector links, may enhance funding opportunities including exploiting commercial development of FR outputs, as well as significantly aid effective knowledge transfer.

17.1.2 Regular contact between FR staff and the private sector builds trust and networking. A recent example is establishment of new permanent sample plots in Tilhill managed forests.

17.2 Engaging across GB and NI

17.2.1 In parallel with greater private sector engagement by FR is involvement across GB and NI. This brings special challenges as policies in devolved nations diverge and forestry and woodland programmes evolve. For all the common sense reasons of economy of scale and avoidance of duplication, FR is set to remain a GB agency, but clearly it needs to take deliberate steps to be present and seen to be so in all the countries. With the main research stations in England and Scotland capital investment and development of facilities in Wales appear a priority.

17.2.2 The review team is not making a political observation outside its remit, but highlighting the point of local relevance and hence increased uptake locally of research. Sufficient research is site specific – an old example is the unique South Wales valley's problem of poor (YC 8-10) Sitka spruce growth and 'bent-top' and a modern one of NRW's overarching focus on ecosystem services at the landscape scale and preference for CCF silviculture – that a local presence and the ability to deliver locally arguably has a role. The same can be said of Northern Ireland and the issues arising where the Forest Service commissions research, often from FR, to plug gaps in knowledge.

17.2.3 The commercial opportunities local expertise offers are self-evident.

17.2.4 FR needs to position itself even more strongly as the forestry science and research agency of choice for the whole country.

18 Criterion 4 - FR should be customer focused, high quality and responsive

18.1 Use of models for forecasting

18.1.1 Both Programme 6 and NFI furnish the forestry sector with data and tools for production forecasting, and related capabilities, which must work and service customer

needs. They patently do so, if not always as flexible as desired. New stands types, such as CCF and emerging species, bring demands that existing models are ill-suited to support. FR is responding subject to resource constraints.

18.1.2 At national level, the same applies to Official Statistics.

18.2 **Technical services**

18.2.1 Mapping and Geodata, Forester-Web, and the highly practical technical development team all show strong customer orientation and are responsive. Each has opportunities to explore greater commercial uptake.

18.3 **Going Forward**

18.3.1 **The Science and Innovation Strategy**

18.3.2 The present (2015) SIS has served Britain and FC well creating a framework and setting challenges for FR. It developed through wide consultation, but in its next iteration needs to embrace many of the issues raised in this review including those in Part III. In particular greater consultation with the private sector, and hence greater ownership by them, and resisting the temptation to introduce change for the sake of it are two key ones already enlarged upon.

18.3.3 Much of the present SIS remains fit for purpose.

19 Specific Recommendations

19.1 Management of research

19.1.1 **Matrix structure:** The review team strongly recommend that no change is made to the matrix system in the next quinquennium nor to the number of programmes. More could be done to foster interdisciplinarity among more junior staff.

19.1.2 **Singleton expertise and succession planning:** We recommend that FR address the issue of succession by a more deliberate approach to supporting and developing young researchers wishing to pursue a career in forest science so as to grow the next generation of champions, both to pursue the science itself and to be FR's flag wavers.

19.1.3 The issue applies across FR and particularly affects senior scientists, who are often also the key advisers to policy makers and practitioners, and to many IFOS staff with highly transferable skills.

19.1.4 **Closer working of FR & IFOS:** The review team were impressed by what IFOS has brought to FR and it is recommended that senior management organise a one day seminar in both NRS and at Alice Holt where all heads of IFOS groups and all on-site Programme and Science Group leaders present overviews of their work.

19.1.5 **Quality assurance:** FR consider a formal QA system, such as ISO 9001, to embed practices and processes throughout the organisation.

19.2 Science issues

19.2.1 **Securing legacy of long-term experiments:** We recommend funding is 'ring-fenced', that ways are explored to maximise their use, and that publications are written explaining their strategic importance.

19.2.2 **Sitka Spruce:** Many pests and diseases confront Britain's trees and attract a high profile, but we recommend that potential threats to the nation's principal commercial species continue to receive research investment and be given due attention.

19.2.3 **High power computing (HPC) capacity:** We recommend structured and dependable access to HPC facilities for analysis and modelling of big datasets.

19.2.4 **High quality fieldwork:** We endorse the view that TSU should remain an in-house competence; it is a critical part of QA of good forest science and field experimentation.

19.3 Impact and profile

19.3.1 **Planned impact and stakeholder engagement:** Scientists are well networked and have many opportunities to give briefings and research updates, but we recommend a more structured approach, fostered by each of the research centres and senior management, to further increase impact and raise profile. This is a matter both of profile and of adequate representation/participation in official bodies, committees and groups.

19.3.2 **Monitoring impact:** We recommend a greater focus on outcomes and 'Outcome mapping' as a helpful approach to monitor impact. Comprehensive documentation of impact provides a powerful evidence base to demonstrate FR's role in

developing the tree and forestry sector. It's effectively a cultural change from a focus on outputs to a focus on impact.

19.3.3 Visibility and profile: We recommend that FR strives to increase its visibility and the impact of all its outputs. This is a role the new Chief Scientific Adviser should embrace. Even measurement of impact, including citation analysis of scientific papers, will help raise FR's profile as do major capital investments in infrastructure and laboratories.

19.4 **Publication issues**

19.4.1 Occasional causes of blockages in the publishing process need addressing. FC Guides and similar policy focused publications should acknowledge authorship more directly. We recommend FR creates an accessible and complete e-archive/database to provide a central listing of all publications.

19.4.2 **Access to Technical Development outputs:** We recommend that a back catalogue of work by TD is preserved and accessible in an e-archive.

19.5 **FR the GB forestry agency of choice**

19.5.1 **Increased focus on private sector:** The old paradigm of the public forest estate acting as a surrogate for all forestry needs to change in both fact and perception. We recommend that FR should be seen and known as the research agency for all trees and forests regardless of ownership.

19.5.2 **A GB-wide agency:** We recommend that FR positions itself even more strongly as the forestry science and research agency of choice for the whole country with appropriate investments to demonstrate local presence.

19.6 **Chief Scientific Adviser:** We recommend that the post is filled quickly, that it is full-time and at the same level, and that the appointee should not only be a scientist of standing but one who can be ambassadorial for FR.

19.7 **Science and Innovation Strategy:** The 2015 SIS has served FC well and much remains fit for purpose, but in preparing for its revision (2019) we recommend that greater attention is given to engaging with the private forestry sector as well as wider interests concerned about trees, woodlands and forests.

20 ECFS membership

Professor Julian Evans OBE	ECFS chair
Professor Jaboury Ghazoul	ETH, Zurich
Professor Clive Potter	Imperial College, London
Professor Monique Simmonds	Deputy Director, RBG Kew
Professor Andrew Watkinson	UEA
Mr Peter Whitfield	Business Development Director, Tilhill Forestry
Mr Roger Coppock	Head of Corporate and Forestry Support, FC
Professor Peter Freer-Smith	(to August 2017) FC chief scientific adviser.
Mrs Katrina Gardner	Secretary, FC corporate support officer

Review team for November 2017

The non-FC members of ECFS conducted the in-depth assessment at NRS, but due to overriding personal circumstances neither Clive Potter nor Andrew Watkinson were able to participate. We are enormously grateful to Professor Morag McDonald, Bangor University, for joining the review team at short notice.

21 Acknowledgements

Many in FC and FR greatly facilitated the review, but the review team are especially grateful to Roger Coppock and Peter Freer-Smith (until he retired) - the official side members of ECFS – in preparation and smooth running of the exercise

James Pendlebury, Helen McKay, Chris Quine, Peter Weston and their FR staff invested considerable time and resources in preparation, presentation and in responding to questions.

We would like to single out for thanks Evelyn Hall and Claire Holmes for exemplary support in arrangements, dispatch of documentation, and keeping us well nourished: it made life easier.

22 References

Ghazoul, J and Watkinson, A (2014 & revised) *Guidance to reconcile the conflicting pressures of peer-review versus provision of technical and practical advice in research performance assessment*. Agenda paper ECFS (unpub).

Meagher, L, Inman, A, Reed, M and Hunter S (2017) *Impact evaluation of research undertaken to deliver the Forestry Commission's Science and Innovation Strategy for Forestry in Great Britain*. Ref. no. CFSTEN 2/16 Forestry Commission

Annex 1 - APPENDICES

Terms of reference

1. To review the research, advice, inventory and scientific services being provided by FR.
2. Based on its ongoing interaction with FR and on a visit in Autumn 2017, the Committee is asked to assess and report on the work being done by FR. The evaluation should consider all of FR's work except any contracts and grants which are commercially sensitive or confidential and where consortium agreements mean that FR does not have the authority to disclose information. There should be a strong focus on the seven FC funded research programmes and work of IFOS, Statistics, and Technical Support Services for which specifications were agreed in 2014 to deliver the Science and Innovation Strategy.
3. To make recommendations as necessary:
 - (a) to improve fitness for purpose and science quality; and
 - (b) to improve on knowledge exchange and delivery.

Written report and dissemination of the Review Group's findings

4. The Expert Committee on Forest Science is asked to meet at NRS to undertake the above review and to provide a written report within one month of the visit. The report should provide commentary, recommendations and overall comments as necessary.

The report will be presented by the chair of the Expert Committee to the Forestry Commission's Executive Board (FC EB). Once accepted by FC EB the report is presented to the FC's Research Strategy Management Board by the Head of CFS and will be made available to CFS and FR for implementation.

Guidance on research performance assessment. Summary of main points

Context

An institution therefore needs to develop a clear understanding of the purpose of performance assessment, and an appropriate set of performance indicators (quantitative and qualitative) that are useful for the purpose intended.

The purpose of performance evaluation

Relevant performance indicators should take account of the institutional context.

A process that involves participatory and reflective learning to identify areas for improvement is needed.

The outputs of performance evaluation should feed back into a system of research and organisational improvement. Performance indicators should be designed with this purpose in mind.

Performance evaluation should therefore provide a constructive basis for self-improvement.

Indicators of the uptake of research outputs by relevant stakeholders (rather than peers) outside the institution are also relevant.

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A mechanism for collaborative and constructive reflection should be in place prior to performance evaluation.

What is meant by research quality?

An institutional understanding of research quality needs to be developed.

Specifically, research quality might encompass the following aspects:

impact of research among peers, notably through substantial conceptual or methodological advancement

importance of research, i.e. relevance to target beneficiaries and society as a whole in terms of solutions and outcomes

cost-efficiency, particularly relevant in austerity

potential of research, insofar as it anticipates and responds to perceived future needs and challenges

Performance indicators for research

Quantitative indicators tend to emphasise performance assessment rather than improvement.

Another approach is to use indicators of good practice that describe attributes of the research process.

On this basis, evaluation of scientific excellence should serve a management purpose that meets the needs of the institution and the scientists who are being evaluated.

Designing the research evaluation process

A first step in developing a performance evaluation system is to define the purpose of the review.

This purpose needs to be understood across the institution.

Different indicator sets will be necessary at different scales of evaluation.

Performance indicators that generate information for personal and institutional development should be meaningful and useful to all involved in the evaluation process.

Conclusions

Clarity on the purpose of performance evaluation is needed. The process of research evaluation should aim to support institutional development, planning and accountability, as well as individual performance and career development. Evaluation indicators should therefore be constructive, not punitive.

Selection of appropriate indicators should be based on a dialog between institutional managers and researchers regarding institutional mission and research group objectives. Performance indicators can then be appropriately tailored to provide a fair and meaningful evaluation of performance.

Designing a set of performance indicators along the lines proposed above requires investment of time and effort.

Science Review Assurance Framework

(To be read and applied in conjunction with the Performance measures summary.)

Criterion 1: All science used by the Forestry Commission and other customers should be robust, relevant and high quality.
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a) **Ensure relevance of science work**

- i) Internal and external sources of science advice are recognised and drawn on;
- ii) Outputs support intelligent customers in CFS and the countries to enable interpretation of internal and external scientific advice;
- iii) Forest science work is clearly scoped and outputs agreed with policy customers;
- iv) Links to the activity and skills of other analytic professions should be established where relevant;
- v) Active horizon scanning through international links, such as IUFRO and EFI, ensures that science is relevant and proactive.

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b) **Maintaining excellence and robustness in science evidence and outputs**

- i) Forest science research has a clear, supportable methodology which is informed by current knowledge and acknowledges influences;
- ii) Governmental ethical guidelines are followed in undertaking forest science research;
- iii) Appropriate internal and external QA - scrutiny and challenge - is undertaken at all stages of the research process;
- iv) Forest Research applied science delivers outputs of, at least, equivalent quality to those expected from other providers;
- v) Applied research delivers against wider policy and operational requirements, and finds rapid adoption by devolved administrations and the forestry sector.

c) **Ethical considerations and risk are taken into account in the implications of science for society**

- i) [Governmental code of ethics for scientists](#) is followed in considering the social and ethical implications of all science research, and developing policy guidance.

Criterion 2: Science evidence should be made publicly available unless there is clear justification for not doing so.

a) **Clear publication strategies are articulated for science results/output.**

- i) There should be a presumption for public availability of research results from publically-funded research except where there are specific, and rationalised, exclusions;
- ii) Science results/outputs are made available in a timely manner;
- iii) Where appropriate, the use of social and other media should be deployed to disseminate research results.

Criterion 3: Forest Research should ensure effective knowledge transfer, innovation and pull through of its research to the development of new technologies and services.

a) **Sharing, transfer and management of knowledge includes the forest science evidence base**

- i) Adequate arrangements are in place for sharing and transferring knowledge within departments and externally with relevant stakeholders.

c) **Enable innovation, exploitation and commercial development of outputs of Forest research science.**

- i) Knowledge transfer processes provide opportunity for the commercialisation of research outputs.
- ii) Opportunities for innovation based on science outputs are actively identified and managed.

Criterion 4: Forest Research services should be customer focussed, high quality, and responsive to demand.

a) **Support the effective functioning of Forestry Commission, and other organisational activity.**

- i) Models for production forecasting and business planning are robust and their capabilities and limitations are well understood;
- ii) Official statistics are reliable, respected, and adhere to the UK Government's [code of practice for official statistics](#);
- iii) Mapping and geodata services ensure that customers have ready access to the wide range of high quality datasets owned by Forest Research.
- iv) Technical development and communication services support the efficient running of Forest Research, and the effective dissemination of research results.

List of documents (files, pdfs, spreadsheets & dropbox) provided to the Review Team

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External Review of Forest Research Programme

[FC Science & Innovation Strategy for forestry in Great Britain](#)

[FR Corporate Plan 2017-18](#)

FR Organograms

Details of CFS funding – FR Programme budgets

Current (non FC) contracts schedule

Service Level Agreement details

SGL/PMs matrix

Self-evaluations of each FR programme (1-7)

Self-evaluations of each IFOS team (4)

Science Group summaries (10)

Technical Support Services summary

Metadata of outputs since 2010 by Science Group and IFOS team

Summary of impact case studies

CFS/FR programmes (1-7) with updated output schedules (2015/16 to 2018/19)

IFOS specifications

List of knowledge exchange activities including publications

Impact case studies (full document)

Impact evaluation of research undertaken to deliver the FC's Science & Innovation Strategy for Forestry in Great Britain and Forestry Commission response to the evaluation.

Programmes (1-7) CFS stocktakes

Documents requested and subsequently provided

Review of Communication activity (focussing on FC publications)

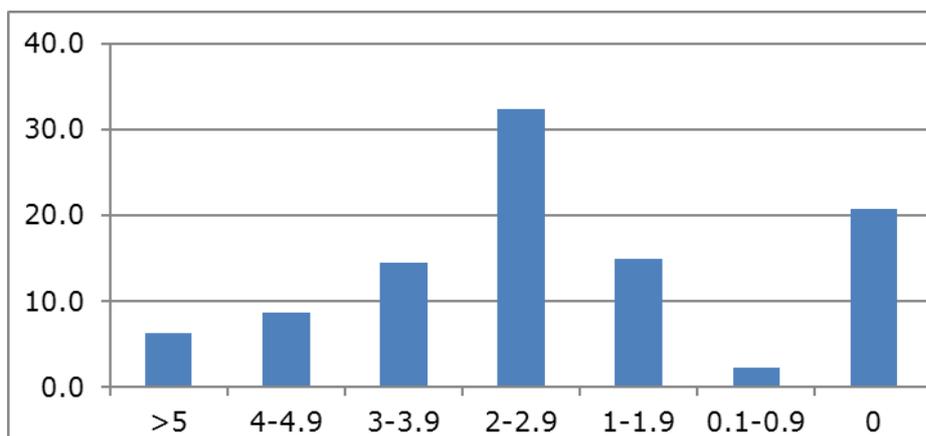
Recent capital investments in research facilities and buildings

Full details of all scientific papers 2015-2017

Publications by Programmes and Science Groups illustrative of their work and of which they are most proud.

A total of 173 journal papers were listed as being published between 2015 and 2017. A few of these publications are in relatively highly ranked journals based on Impact Factor (IF). The highest IF journals were *ISME* (Impact Factor of 9.7, one paper), and *Global Change Biology* (8.3, three papers). Six per cent of all listed articles were published in journals with IFs greater than or equal to 5.0, and almost 30% of papers were in journals with an IF exceeding 3.0, which is respectable (Figure 1). On the other hand, 21% of listed articles were published in journals with no IF, which implies very little recognition or science impact.

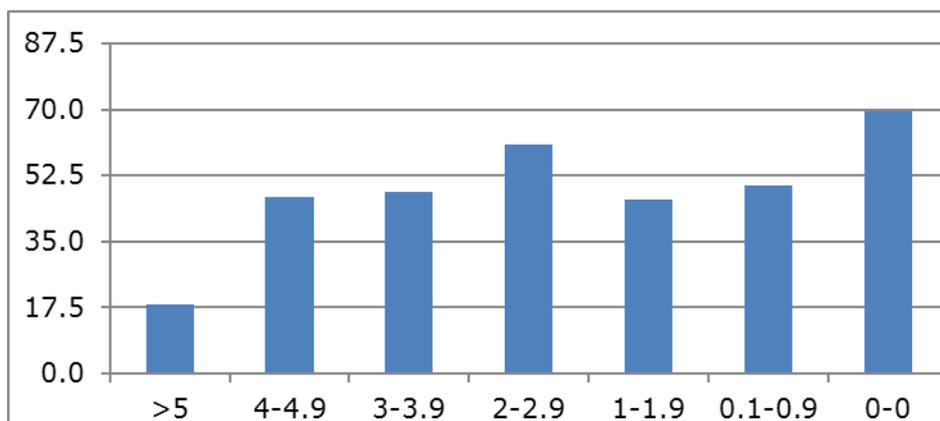
Figure 1. The percentage of FR journal articles by Impact Factor classes.



Overall this represents a good number of publications, though the number of high impact publications remains relatively low. The substantial number of papers in low (or no-) IF journals implies that much effort is being expended in publishing papers that might not be reaching a wide science readership. Their value might, instead, be in that they are reaching a more targeted and applied readership, but this is difficult to assess.

Another way of looking at the results is by authorship (Figure 2). Two of the 11 highest ranked papers (IF of more than 5.0) have a FR scientist as first author. Around half of the remaining papers in the other IF categories are first-authored by a FR scientist. This rises to 70% for no-IF journals. This suggests that the highest impact publications are not led by FR scientists, but by scientists from other institutions, and that much effort is invested in publishing in journals with low visibility.

Figure 2. The percentage of FR journal articles with FR scientists as 1st author, listed by IF classes.



We should be careful not to place too much weight on publication indices, especially given the nature of the applied research that FR is engaged with, and the primary remit of undertaking science for the forestry sector as opposed to the basic science that is often pursued in the university sector. Neither are journal publications necessarily the best way to disseminate knowledge to the rest of the FC or to the

forestry sector. Yet publishing in internationally recognised peer review journals will raise the profile of FR in the science community, and adds credibility to FR as a research institution. This credibility is necessary to lend confidence in the quality of research, which in turn improves possibilities for securing external research funding. A high-profile publication record also increases FR visibility and thus invitations to engage in collaborative research.

In view of an increasingly austere funding environment, I would recommend that more effort is given to publishing in the highest impact journals when possible. A shift in effort towards journals with IFs greater than 3.0 would increase credibility and visibility of FR science, and this would have benefits in the long term with respect to maintaining international recognition.

We should also note that many scientists within FR likely wish to develop their own research profile as part of their career development ambitions. The reality of the academic environment is that performance is judged on journal publication output. FR science leaders might need to consider how to create an enabling environment to allow all science staff to realise these ambitions.

I recognise that the push for high impact journal publications needs to be balanced with the dissemination of knowledge to other relevant audiences, which includes the commercial and policy sectors. To this end I would recommend the development of a dissemination and publication strategy that identifies what the appropriate emphasis on high-impact journals should be for FR, and charts a path towards this.