Institution: University of Stirling

Unit of Assessment: B7 Earth Systems and Environmental Sciences

a. Context

The on-going and long-term goal for our research is to ensure a sustainable, healthy future for humanity and the environments on which we depend. In doing so we develop and test policy and management solutions to give new approaches to natural resource management and to mitigate or reverse the impacts of human activities on biodiversity, environmental services and natural resources. Our research themes readily translate to impact and we deliver in the following broad areas: 1) *public sector*, in particular Statutory Nature Conservation Organisations, government agencies, regulatory bodies; 2) *private sector,* including the renewables and water industry; 3) *non-governmental organisations* including species conservation charities, heritage trusts and landscape partnerships; 4) *international organisations* including substantial interaction with European bodies (e.g. European Environment Agency, International Atomic Energy Agency), but also US environmental agencies and authorities in central America and Malaysia.

Our research groups work directly with non-academic user groups to ensure research is shaped to deliver appropriate impact. *Ecology, Evolution and Conservation* delivers policy and legal impact in relation to species and habitat management practice in developed and developing nations. *Environmental Systems, Change and Protection* delivers impacts on policy, land management, regulatory practice and enforcement on greenhouse gases, resource management and radioactivity assessments for humans and wildlife.

b. Approach to impact

We have explicitly defined, through extensive and continuing discussion with user groups, the generic impact areas to which each of our research groups will contribute. These areas are defined as *policy,* directly influencing new courses of action; *practice,* shaping new management adopted by user groups; *legal,* changing existing legal frameworks; and *standards,* defining new protocols to ensure appropriate levels of quality and safety. We engage and develop relationships with end-user groups in the following ways:

Direct collaboration with end users*:* We have well established and long-standing links with end users, and the charities British Trust for Ornithology, Bumblebee Conservation Trust, and the Royal Society for the Protection of Birds (RSPB) have offices within the School of Natural Sciences and work alongside our researchers. Partnerships are increasingly embedded within our research programmes primarily through government regulatory bodies and statutory agencies. The *Ecology, Evolution & Conservation* group actively works with national and international governmental agencies, and a range of conservation charities; **Jump** works in partnership with the RSPB on plant population genetics, assessing the effects of saltmarsh restoration schemes around the UK's coastline and developing guidelines for restoration and re-colonisation. **Vallejo-Marin** works with Botanical Society of the British Isles to increase our knowledge of plant ecology and biogeography. Working with a range of agencies and charities, **Bussière** and PhD student Rotheray led critical research on what may be Britain's rarest fly, the pine hoverfly *Blera fallax.* Their work, which included informing management and conducting translocations has probably forestalled the extirpation of *B. fallax* from the UK. Following research revealing the negative consequences of neonicotinoid pesticides on bumblebees, **Whitehorn** is now working with a task force on systemic pesticides headed up by the International Union for Conservation of Nature to develop new risk assessment protocols. In *Environmental Systems, Change & Protection* **Copplestone** leads international training courses in Australia and Malaysia for the International Atomic Energy Authority. **Billet** and **Subke** work closely with land managers to investigate the impact of management on greenhouse gas budgets and different pathways of carbon in vegetation, soils and streams. Their current collaboration with RSPB and local stakeholders is focussed on a large-scale peatland restoration project in the Flow Country (North Scotland), the UK's largest single terrestrial carbon store. **Billett i**s also a founder member of the Peatland Research Hub, which aims to establish the Flow Country as a UK focal point for peatland science, addressing contemporary

environmental and societal issues such as climate change, biodiversity, resource management and sustainability. In the Canadian Arctic **Billett** and **Subke** engage with local researchers, government agencies (Environment Canada, Aboriginal Affairs and Northern Development Canada) and local First Nation communities. **Schröder** works with the European Space Agency and NASA on surveying geologic evidence of water and geochemical interactions on Mars. Many of our staff contribute to advisory panels and commissions for governments, industry and charitable bodies and actively influence policy and practice. For example, **Bussière** is a member of the EU advisory Dung Organism Toxicity Testing Standards (DOTTS) group, which advises EU policy on testing non-target effects of new veterinary pharmaceuticals. DOTTS has been instrumental in developing industry protocols and experimental procedures essential in protecting the community of dung decomposers and their ecosystem services (Integr. Environ. Assess. Manag. 7:287-296). **Vallejo-Marin** is a board member of the local charity Forth Naturalist & Historian and is on the technical advisory committee of the American Society of Botany.

Providing the evidence base for policy: Through our research we aim to improve policy, legislation and practice from the local to the global scale. Locally, work by **Gilburn** highlighted the impact of beach cleaning practices on coastal biodiversity by Local Authorities in Scotland and, in doing so, successfully changed the methods used for this. Specifically Fife Council ceased beach cleaning as a direct result of this work and have recently reported increases in wildlife, including nesting birds, in adjacent dune systems. **Jump** is one of the co-authors of the IPCC-Catalunya which has influenced Catalan climate change policy with regard to the broadleaved temperate forest biome. **Copplestone** is a member of the International Commission on Radiological Protection, which reviews the evidence base and makes recommendations for the International System of Radiological Protection. His specialist contributions to these recommendations is through his expert advice on radiological risk assessment and effects on wildlife. He continues to provide technical expert input to the Oslo-Paris Convention for the North East Atlantic on behalf of the Department of Energy and Climate Change and Defra. Within the International Organisation for Standardisation (ISO 17025) accredited Environmental Radioactivity Laboratory (ERL; cf REF 3b) he provides analytical services and advice to government and private sector organisations on management of the risks associated with environmental radioactivity. **Whitehorn** and Goulson (now at Sussex) published one of two landmark papers in Science on bees and neonicotinoid pesticides which, in April 2013, led to a 2 year EU moratorium on use of neonicotinoids on flowering crops (cf REF 3b). **Dent** manages a research program in Panama that advises the National Environment Authority and the Panama Canal Authority on forest management for biodiversity conservation and carbon storage in disturbed tropical forests.

Profile raising: Contributing to public understanding of science is achieved via a highly visible external profile. For example, there was substantial international interest (e.g. Scientific American 12 July 2012) in the discovery of a new plant species in Scotland by **Vallejo-Marin**, a rare example of a new species originating in the wild in the last 150 years. Extensive publicity, including TV, radio and newspaper coverage, followed **Jump's** work on the legacy of the 1976 drought showing that extreme drought persistently alters relative competitive dominance within and among species in a mixed forest stand. Media coverage of the Bumblebee Conservation Trust founded by Goulson has substantially raised awareness of bumblebee declines in the public consciousness and how they may be reversed (cf REF 3b). Whilst at Stirling, he also wrote a popular science book on bumblebees which was serialised on Radio 4 and short listed for the Samuel Johnson prize for non-fiction. The publication of **Whitehorn** et al. (2012) on bumblebees and neonicotinoids was covered by major national newspapers across the world (e.g. Washington Post, Le Monde, Stern, New York Times), greatly increasing public and political interest in the role of pesticides in bee declines.

Outreach & public engagement: Within the submitted group and across the University as a whole staff are strongly encouraged to engage the wider public in our work, with training (e.g. media engagement) and support (e.g. drafting press releases) helping us to achieve high levels of public recognition. Citizen science schemes to map bumblebee distributions were set up and have so far involved over 10,000 members of the public. Engagement with children has also been facilitated through the development of a bumblebee conservation education pack for primary

schools; this has now been requested and sent out to over 260 schools (cf. REF 3b). The "Manuplants.org" website set up by **Paine** presents a photographic library of seeds, fruit and seedlings of the Peruvian Amazon. With the aim of improving our knowledge of tropical forest diversity through collaborative efforts between professional and amateur botanists, this unique resource for teaching, identification and research has provided information to visitors from 89 countries in the past year.

Impact mechanisms: Our current approach encourages and facilitates impact through: i) the Achieving Success appraisal system for staff that identify current/future impact plans, resource, training and support needs; ii) training in grant writing and in-house internal peer review processes provide expertise from appropriate Research Committees on maximising impact, including assessment of successful and unsuccessful submissions; iii) we have a full time colleague whose role is to articulate our activities and student research with end user employers; we are developing this post into a permanent position; iv) we support an active honorary staff system explicitly to foster collaborations and ensure the translation of research findings to real-world applications. The further potential of our impact agenda has been recognised with institutional support from the University Impact Fellowships Scheme from 2011 (5 submitted with this unit) and the Impact Studentship Programme (6 students currently with this unit). These positions promote research excellence within collaborative projects that include non-academic organisations.

c. Strategy and plans.

Our vision is to develop academic-end-user partnerships from the point of conceiving a new research idea and ensuring engagement at all stages of the proposal formulation and during the execution of successful projects. Our research will achieve creative tensions between academics, policy makers, end-users and local communities, and achieve tangible change. To further maximise potential we will: (i) working closely with the University's press office at the launch of a project to encourage and stimulate wide project engagement; (ii) including government, NGOs and industry membership on project advisory panels; (iii) collaborating with leading international non-academic partners; (iv) organising end-user workshops at critical points of the project to ensure a two way dialogue of understanding; (v) offer RPG and post-doctoral secondments with end-user organisations; (vi) develop project web pages and newsletters; (vii) exploit social media such as twitter; and (viii) contribute to local and nationally organised science day events. Further impact is secured by providing analytical services and consultancy as direct outputs from our research, supported where necessary by gaining laboratory accreditations to qualify for research and development monies from industry and the UK regulators. The outputs from these activities have direct impact as they are a required and critical contribution to effective decision-making and policy formulation.

d. Relationship to case studies

Our case studies exemplify the approach to impact outlined above, and provide a flavour of the range and geographical reach of impacts arising from our research. Development of impact strategy and approaches is explicitly shaped by experiences from case studies and existing end user partnerships. This includes the two presented in this unit and others from the School of Natural Sciences. They have been used to develop resource support for impact described above, notably in building impact contributions into staff workload modelling. Work on bumblebees at Stirling, and the launch of the Bumblebee Conservation Trust, demonstrates outreach and public engagement alongside substantial profile raising, and the use of research to provide the evidence base for policy changes at a European level. Research on environmental radioactivity and radioecology by the Environmental Radioactivity Laboratory is funded by end user groups and has provided the evidence base for the development of international standards, revision of international policy, the development of regulation and its interpretation and enforcement.