**Institution:** Canterbury Christ Church University

**Unit of Assessment:** Agriculture, Veterinary and Food Science (6)

**a. Context**

This submission is based on the research, knowledge exchange (KE) including consultancy activity of a cross-Departmental Unit of Assessment (UoA) within Canterbury Christ Church University (CCCU). The UoA was formalised in 2010 and developed from the Ecology Research Group (ERG), a research grouping established in 1989. The UoA aims to deliver 1) user-defined solutions via research and consultancy, and 2) fundamental research using a variety of model systems. Our activity is relevant to, and ideally also directly involves, the non-academic community. Further, and in agreement with the University's strategic plan, work prioritises stewardship of the environment and facilitates social, cultural and economic prosperity, and sustainability.

Research within the UoA spans multiple biological levels with a strong emphasis on sustainability. Historically, specific impacts of the research of the ERG have primarily related to the biocontrol of plant pests and to improving animal welfare. This work has delivered impact that has ranged from husbandry modifications that directly affect animal welfare to biocontrol solutions that have improved agricultural management regimes. Recent significant expansion in staff numbers has allowed the extension of the work of the UoA into wider aspects of parasite and pathogen control and of environmental management, and a greater focus on the molecular and biochemical sciences.

A wide range of non-academic user groups benefit from the research of the UoA. In recent years specific beneficiaries have included government agencies (e.g. Canterbury City Council, the Environment Agency, Natural England and the US Department of Agriculture), charities (e.g. the Aspinall Foundation, Kent Wildlife Trust and The Donkey Sanctuary), and commercial companies (e.g. BCP Ltd., Wyebugs, Algaecytes and Quex Park). In most cases, as per the strategy for developing impact, user groups are involved directly at each stage in the process so that activity is specifically directed to meet the users' needs.

**b. Approach to impact**

Impact on the non-academic community requires both A) understanding the specific needs of beneficiaries and B) addressing those needs via coordinated and sustained research activity. This allows both applied, and directly relevant, research to be undertaken, whilst also maximising the impact achieved from more fundamental research.

This approach to impact emerged prior to 2010 through the close, and highly interactive, relationships between staff and external partners. Hence, the ERG achieved significant impact because it clearly understood the needs of external partners and acted to address them. From 2010, when this strategy and the UoA were formalised, staff recruitment[1] has allowed the development of existing areas of expertise and the extension of that expertise to allow a greater degree of molecular and biochemical analyses. This has allowed the UoA's research to be undertaken in a more sustained manner, with the approach to impact facilitating both the development of collaborative research projects in response to user-defined needs, and the suitable targeting of fundamental level research.

The diversity of existing and potential partners is recognised in our approach to impact as staff have considerable flexibility and autonomy in the development of relationships with partners. Our general approach of the UoA is to build links with partners at multiple levels and to integrate such links with the fundamental-level research activity. As a consequence, links to an individual partner routinely extend across the whole range of activities undertaken by CCCU. For example, engagement with a single partner such as the Wildwood Trust encompasses undergraduate teaching, student research placements, KE activity, and collaborative research. This relationship therefore involves multiple staff (current staff with active links to Wildwood include **Burman**, **C Harvey**, **S Harvey**, **Osthaus** and **Ponsonby**) and builds our understanding of the partner's needs and their understanding of the capabilities and expertise of the UoA. This fosters the development

of targeted research and KE projects and facilitates the development and documentation of impact.

This approach is also illustrated in our long-standing relationship with Natural England. Currently, two separate collaborative projects with this partner are on-going, each supported by post-graduate research students funded by CCCU. In each case the projects have been developed in conjunction with Natural England staff to ensure results will be directly relevant. In one of these projects, a post-graduate research student (supervised by **Ponsonby**) is investigating the copper-accumulating invasive plant *Crassula helmsii*, a problem species in Kent. The project is therefore relevant to Natural England and to the needs of multiple additional users in the local area (e.g. Kent Wildlife Trust, KCC County Parks and the RSPB at Blean), and also to basic research in heavy metal accumulation and phytoremediation. To maximise the potential impact of the work, related fundamental research has also been initiated within the UoA to investigate the genetic basis of variation in copper tolerance (led by **S Harvey**) and how this is reflected in the underlying biochemistry and structural biology (**Byrne** and **Leslie**).

Similar themes are also apparent in a more recently developed relationship with the Powell-Cotton Museum at Quex Park (leads **S Harvey** and **Ponsonby**). This has involved meetings at multiple levels between UoA and Museum staff, the development of a collaborative research project supported by a PhD student (supervised by **S Harvey**), an on-going digitisation project, and a developing project linking the Powell-Cotton Museum, the UoA and the Sidney Cooper Gallery (led by **S Harvey**). This project aims to develop a follow-on public exhibition to the 2011 Red List exhibition[2] that was developed by the Gallery in conjunction with the UoA (involving **S Harvey** and **Ponsonby** from the UoA).

Another key part of our strategy is to provide and develop opportunities to bring multiple stakeholders together. External stakeholders are routinely invited to speak as part of the research seminar series and we have also established an annual meeting for agricultural stakeholders in the region, the HortAg Forum (leads **Byrne** and **Ponsonby**, with meetings held in 2012 and 2013). In 2013, the remit of the HortAg Forum was extended to target education within the plant sciences[3], an initiative that also demonstrates the liaison of UoA staff with colleagues in other Departments and Faculties of CCCU.

Hence, to maximise the impact of our research, the UoA gives a central role to engagement and interaction with partners at each stage in the process, from project planning through to support, as appropriate, in applying the results of the work. This interaction is extended, where appropriate, to the inclusion of stakeholders in the published output, e.g. multiple recent papers from **Osthaus** have included co-authors from the Donkey Sanctuary (see impact case study 1 for details). This applied work is, in turn, supported by fundamental research to allow the development of solutions that integrate work at different levels.

In order to facilitate and maximise impact, a dedicated Research and Knowledge Exchange Development Manager (RKEDM), located within the Research and Enterprise Development Centre (RED), supports staff. RED supports research and KE activity more widely both by provision of specialist services and advice. Additional support is also available via the Faculty Director of Research and KE, via the CCCU Partnerships Office and from experienced academics within the UoA. These resources support staff from the UoA in identifying external KE funding opportunities, by providing help with applications for funding, in disseminating research and in tracking and documenting impact.

[1] Nine of thirteen submitted staff were appointed since 2011; seven are early career researchers.
[2] Details of the exhibition can be found at http://www.canterbury.ac.uk/events/event-details.asp?eventId=2890 and at http://www.a-n.co.uk/interface/reviews/single/1582491.
[3] For external coverage of the 2013 HortAg Forum see, for example, the Horticultural Development Company website, http://www.hdc.org.uk/event/hortag-forum-2013

**c. Strategy and plans**

The UoA regards the relationship with external parties as a two way process. Impact is therefore contingent on undertaking research relevant to the needs of users, on supporting the exploitation

and use of the results of that research, and on aiming to develop impact from all research activity. Within this context, the UoA aims to build on and extend its current achievements and to expand research and KE/consultancy activity that meets users' needs and that delivers impact. To achieve this, the UoA's impact strategy is to:

**A) Support the research groups.** This will be achieved by supporting coordinated activity that allows for critical mass in the targeted research areas (see below). This will improve the quality and coherence of the UoA's research and foster the development of impact from that research in a more systematic way.

**B) Integrate research, KE and consultancy activity.** This will be achieved by extending current requirements that research planning, and research funding applications, include specific details of how such activity will generate impact. Similarly, consideration of the research potential of KE or consultancy activity will be required. Such consideration has also been integrated into the appraisal system, and will be facilitated by on-going changes to the research culture within the UoA.

**C) Support engagement with the non-academic community.** This will be achieved by both formal partnership arrangements (specifically in relation to the Powell-Cotton museum, FAST, and EMR), by continued support for the HortAg Forum, our annual conference for agricultural stakeholders in Kent, and by supporting responsive activity that meets the needs of new partners.

**D) Maximise impact and follow up projects.** This will be achieved by increasing the support, both from within the UoA and centrally from RED, for initiatives that maximise uptake and use of research, specifically by increasing the exposure of the UoA and the external, visible, presence of the UoA and the research, KE and consultancy activity undertaken by it. Support will also be targeted to activities that measure and evidence impact.

This strategy therefore aims to improve the quality and coherence of the UoA's research (**A**,**B**), the relevance of that research to beneficiaries (**C**), and our ability to document and evidence the impact that the research produces (**D**). Within the three key research groupings: 'Animal Behaviour, Welfare and Conservation'; 'Pests, Pathogens and Crop Protection'; and 'Applied Ecology and Environmental Management' this impact strategy has allowed us to define the following key priority areas:

**Animal Behaviour, Welfare and Conservation:** This group is extending previous animal welfare work to an analysis of captive British wildlife, a poorly researched area. In conjunction with the Wildwood Trust, the Aspinall Foundation and the Kent Mammal Group as stakeholders, this work is taking an integrated behavioural (**Hocking** and **Osthaus**) and molecular (**Bértolo** and **S Harvey**) approach to analysing stress with the aim of improving the welfare of captive British wildlife.

**Pests, Pathogens and Crop Protection:** Research in this group aims to develop methods to affect, both positively and negatively, interactions between host species and a variety of pests, parasites and pathogens. This work encompasses research on fungal and bacterial plant pathogens (**Byrne**), plant-parasitic and entomopathogenic nematode species (**C Harvey** and **S Harvey**) and a number of insect pests (**Burman** and **Ponsonby**). Much of this work is underpinned by fundamental research on both plant and animal model species and by work on both chemical signalling (**S Harvey** and **Leslie**) and toxicology (**Bértolo**, **Byrne** and **S Harvey**).

**Applied Ecology and Environmental Management:** This group is taking several coordinated approaches to the analysis, monitoring and assessment of managed ecosystems to address issues related to agricultural productivity (**Ponsonby** and **Rintoul**), to biodiversity (**Burman** and **Rintoul**) and to end-users and consumers (**Haddock-Fraser**). Much of this activity is focussed on informing and improving agricultural and environmental management, particularly in relation to Higher Level Stewardship schemes.

**d. Relationship to case studies**

This impact strategy is apparent in both case studies, with external partners involved from the outset of the work in both case studies. For example, in the 'Improving Captive Animal Welfare through Cognition-Related Research' case study, staff from the National Wildlife Research Center and from the Donkey Sanctuary were involved in the design of the studies and the research specifically aimed to address their needs. Similarly, for the second case study, external partners were involved in all stages of the work, with some of the research published with a stakeholder as a co-author and elements of the field work directly undertaken in conjunction with the Royal Botanic Gardens, Kew.