Institution: Nottingham Trent University

Unit of Assessment: C17 Geography, Environmental Studies and Archaeology

a. Context

Recognising worldwide concern for the sustainability of the natural world, the Unit conducts focussed research in areas of biodiversity conservation, sedimentary environments and sustainable environments for managed animals. The impact of our work contributes to sustainability both in terms of biodiversity and resource management. In particular it has informed **environmental policy** and **management strategies** in related areas, as well as improving **economic viability** and contributing to **environmental preservation**.

Commissioned research on the functioning, management and restoration of peatlands has informed the **management strategies** of organizations such as the National Trust and Severn Trent Water, with the aim of improving biodiversity and maintaining the quality of human water supplies. Research into the impact of managed burning on blanket bog by Clutterbuck has contributed to the phasing out of this management practice in the High Peak area of the Peak District, as recently announced by the National Trust. This research has also fed into the Natural England Upland Evidence review.

Nationally and internationally research findings have been used to improve the sustainability of environments for managed animals, including production animals. Collaboration with animal feed producers has resulted in both **commercial** and **management** impact from findings of Burton and associates with respect to optimizing poultry nutrition and management (BOCM Pauls Ltd, UK, Associated British Agriculture (Ab Agri), UK, Waltham Centre for Pet Nutrition, UK). The **management** of captive felids has been informed by the research of Whitehouse –Tedd, with changes in feeding practice being adopted by a range of institutions including Cheetah Conservation Fund, Namibia; Wellington Zoo, New Zealand; The Angel Fund, Cincinnati Zoo and Botanical Gardens, USA; Cheetah Outreach, South Africa; The Centre for Feline Nutrition, New Zealand.

Internationally, research findings have informed **biodiversity conservation strategies** and **human resource management.** This includes work by Phipps and Yarnell in Southern Africa where data is currently being used by the national power supplier (Eskom) to reduce vulture collisions with powerlines and the associated disruption to power supplies in areas where this endangered species is found. The conservation of endangered species is further informed by the research of Bremner-Harrison whose work on the effect of animal personality on re-introduction success has informed the **re-introduction** and **translocation strategies** of the Durrell Wildlife Conservation trust and the Mauritius Wildlife Foundation. The research and published management guidelines of Whitehouse-Tedd on the nutrition and feeding regimes for carnivores has informed **captive management** of animals prior to release, including those adopted by Cheetah Outreach, South Africa.

b. Approach to impact

Research impact is realized through **external engagement** and ranges from a direct influence on the behaviour of **individual** members of the public through to altering the **modus operandi** of **international companies** and **organisations**. NTU provides support for impact through ensuring the correct environment and facilities are available. Staff are supported by means of a research sabbatical system and opportunities for applying for university funding to purchase equipment, fund travel and collaborative opportunities, and employ fixed term research support staff. Outlined below are some examples of how this support has been utilized by the unit.

Funding for a bespoke **Rural Knowledge and Enterprise Centre** (**RKEC**, 2009-2012) created a primary route for delivering our research directly to end-users. The RKEC offered research-linked support in the development of new products and business processes, and access to relevant research expertise. The RKEC comprised partnerships with several major UK and European bodies, including the European Regional Development Fund, the National Farmers Union, and Women in Rural Enterprise (WiRE). The RKEC furthered both the economic and societal impact of research conducted within the unit, through the commercialisation of research and informing change of practices of end-users.

Access to **HEIF** funds to support work with external partnerships has enabled this unit to increase the impact of its research. Research conducted by Burton received project funding from the University's Stimulating Innovation for Success (SIS) programme which supported BOCM Pauls investigation of feeding sources contributing increased available phosphorus to poultry feed. Work with the NTU **Research Grant Capture Team (GCT)** to identify opportunities for collaborative research and commercial funding. This currently includes funding from William Sinclair Horticulture, Natural England, BOCM Pauls, KW Trident, AB Vista. Key IP outputs from such research include the generation of scientific data for patents (see d: CS 2). Researchers within the unit have engaged with the **GCT** to secure high-profile research funding, leading to international recognition. **EU FP7** funding was secured by Harrison (Marie Curie FP7 Reintegration Grant). The high profile achieved by such funding has resulted in the global development of the project and worldwide collaboration. This research is an investigation into factors affecting immune gene diversity in a global species (red fox *Vulpes vulpes*), the findings of which will have the potential for worldwide application in biodiversity conservation and human health.

Since 2008 there has been an active policy to **recruit researchers** with an established **external network** of end-users and industrial partners. Appointments within the last five years have included members of specialist advisory groups (e.g. those within the International Union for the Conservation of Nature (IUCN)) and further development of industrial collaboration has been supported with the development of specialist research resources such as the poultry unit at the Brackenhurst campus.

Active measures have been taken to **promote research** within this unit to **end users**, including presentations at specialist meetings (e.g. Twycross Zoo, National Equine Welfare Council), and the preparation and delivery of media coverage by the NTU Press office including radio broadcasts, web-based news items, press releases and lay press articles. Further links between researchers and end-users have been facilitated by attendance at workshops and symposia that bring together researchers and end-users including Sustainability Workshop (London), European Zoo Nutrition Conference (Switzerland), European Symposium for Poultry Nutrition (Turkey). The impact of the research in this unit has also been supported by other NTU initiatives including: NTU Showcase events and engagement with local environmental groups (most recently input from Labadz at the Southwell Flood Forum group). In 2013 Simmons was appointed by the Forestry Commission as one of 4 external members to a new Expert Committee on Forest Science established to support the delivery of the Science and Innovation Strategy. The Strategy provides the UK framework for forestry research and management standards set in the context of international policy and trade.

Increased **external input** to the annual **School Research Conference** from end-users (2013: Guest speakers from Edinburgh zoo and Team GB dog agility manager; 2012: representative from the dog's Trust; 2011: Grazing Animals Project representative). International collaborations and opportunities for research dissemination to a range of end-users are supported by internal funding at School level and by the research sabbatical scheme.

c. Strategy and plans

Research within this Unit is outward facing and generates high impact both nationally and internationally. The strategic plan for the next five years and beyond is to build on current strengths and good practice and to develop further external associations that will extend both reach and impact of our research. To accomplish this the following key initiatives are planned:

- To **support staff** in the development of their research and collaborative partnerships (including the incorporation of personal research plans into workload planning, continuation of the research sabbatical scheme, staff development to increase commercial funding applications and further exploration of external industry-based opportunities).
- The **development of roles** within the school that address the need to align research with end-users. For example, in October 2013 a new post was set up to further develop the links between research and commerce with greater emphasis on food sustainability and agriculture. The newly appointed **Head of Rural Academic Enterprises (HRAE)** will set up and lead a Rural Industries Group which will have a strong agriculture bias and more focused remit than the RKEC. The HRAE will work alongside the School Research Coordinator to facilitate research activity and commercial opportunities. This post is aligned

to planned developments within the Brackenhurst campus estate to develop a cross-university facility enabling the development of further links between research, education, community and commercial enterprise.
- The provision of **resources** and **equipment** that will support industry-led research developments (as noted above). Bespoke facilities are planned to provide an industry-standard basis for high impact research, for example a new poultry unit.
- **Funding** to support research will target **high impact** / **international projects** and be used to facilitate international travel associated with the development of collaborative research projects.
- Further work with the GCT to identify **commercial / industry-based** funding and **placement opportunities** for researchers.

Appointment of **industry-based research associates** to facilitate engagement with external end-users. Examples to date include Visiting Professor Doug Wilson, Head of Research and Monitoring at the Environment Agency and Visiting Research fellow Dr Sarah Hemstock who works with NGO's on the South Pacific island Tuvalu.

d. Relationship to case studies

***CS 1 Peatland Case Study*:** During the assessment period **commissioned research** on the functioning, management and restoration of peatlands (both lowland raised bogs and upland blanket bogs) has been funded by organisations including the International Union for the Conservation of Nature (IUCN), Defra, Natural England, the Environment Agency, the National Trust and Severn Trent Water, with a view to **informing** subsequent **management practice**. Research focuses on hydrology in relation to the preservation and restoration of peatland habitats and the impact of drainage on habitat conservation and human water supplies. In addition to the external funding university research funding was allocated to purchase equipment (Labadz and Clutterbuck), including current meters and water level loggers. Funding was also provided to employ two research assistants for this project. A School (ARES) PhD bursary was awarded for continuing research on the sites and as a result of this Natural England continued to fund the fieldwork for an additional 2 years (travel and equipment). Labadz was awarded a research sabbatical in 2011/2012 to support the peatland project work.

CS 2 Reduced environmental impact from meat poultry production through improved nutrition: The NTU Poultry Research Unit (PRU) established by Burton in 2007 works closely with both small and large stakeholders in the UK poultry industry to reduce the resources required by the poultry sector, and to reduce the pollution resulting from poultry manure by improving usage of dietary minerals by poultry and by evaluating plant-based by-products as feed materials. Impact of PRU research on the poultry industry has been:
- **Industry uptake** of a PRU-developed anti-lameness feed supplement (Silicon Project)
- Research leading to evidence resulting in a **bioethanol process patent** (Bioethanol Project)
- Industry **change in practise** resulting in improved efficacy of phytase (Phosphorus Project)

The PRU was designed and equipped to meet industry standards in order to facilitate commercial collaboration and potential impact. The unit was fitted with industry standard equipment, such as automated drinker lines, provided by NTU research funding. Laboratory equipment purchased by NTU ensures the integrity of the research and provides a high standard of service for commercial clients. Equipment purchased includes: a UV spectrophotometer, histology suite, freeze drier and automated plate reader. Further NTU funding was provided to employ a research assistant for 6 months to support this research.

Key IP outputs from this research include the generation of scientific data for patents. A process for recovering a protein-containing fermentation agent was developed by Burton (the invention also relates to a new yeast composition obtainable from the process). Data from the poultry research team was used to refine a patent submission for the invention of a novel form of bio-available silicon. The patent was used as IP to leverage the NTU shares when a spin out company was formed called Silicon Active that is part owned by the University and its staff and part by a venture capitalist. **Patents:** PCT/GB2009/00768 (bioavailable silicon), WO/2010/109203 (a novel process for separating yeast from bioethanol co-product).