Institution: University of Aberdeen

Unit of Assessment: 17 (Geography, environmental Studies and Archaeology)

Title of case study: The origins and spread of farming and its impact

1. Summary of the impact

The domestication of animals - some ten thousand years - ago has allowed important insights into the origins and spread of farming across the globe and the impact that had on human biology and culture. Research carried out by an international research group, led by Aberdeen and Durham Universities, has brought understanding of this fundamental change in human history to a broader public, resulting in impacts on culture and quality of life. The research findings have featured widely in TV and radio programmes, both in Britain and abroad. The main researcher was also invited to participate in a six-month (privately-funded) experimental sailing expedition that traced the migration route of ancient Austronesian settlers into the pacific, which led to the collection of unique samples for research. The voyage resulted in a film and a book.

2. Underpinning research

The change from hunting and gathering to farming is perhaps one of the most important milestones in human evolutionary and cultural history. The domestication of plants and animals led to a fundamental shift in human diet and health, an explosion of human population and culture, not to mention unprecedented changes to the animals and plants involved and on the environment. This transition has led to an irrevocable shift in how humans impacted the planet over the last 10,000 years, a process that continues to this day. The study of animal domestication is therefore crucial for gaining a fuller understanding of how it began, what were the processes involved, how it spread around the world and what was its impact? Such research provides key evidence for making more informed predictions about the future.

Keith Dobney, Sixth Century Professor of Human Palaeoecology at the University of Aberdeen since 2009, has dedicated a substantial part of his work to the study of bioarchaeology, with a particular emphasis on the domestication of two iconic animals: pigs and (more recently) dogs. This research - begun at the University of Durham in 2000 - has steadily built both an international and interdisciplinary research group that is one of the most productive and respected in the discipline. Underpinned by a number of research awards from the Natural Environment Research Council (NERC), Arts and Humanities Research Council (AHRC) and the Leverhulme Trust, Dobney has built a novel research model that integrates advances in genetics (specifically the field of ancient DNA) with morphology (advanced shape analysis through geometric morphometrics). Applying this approach to both fossil remains and recent populations has allowed Dobney's group to examine in new ways the factors that drove and shaped animal domestication. The findings challenge many previous assumptions about the biological and cultural basis for early animal domestication as well as prehistoric models of human migration and colonisation history across the globe.

A 2009 examination of pig taxonomy and domestication in Island South East Asia (ISEA) [1] found molar shape analysis to be a useful tool for providing a better understanding of the evolutionary history of wild pigs in what is an extremely important region for the study of early farming and human dispersal. A subsequent examination of early Neolithic pig domestication in China (2009-2011) confirmed the Yellow River region to be one of the earliest centres of independent pig domestication in the world. [2]

Also in 2009-2011, Dobney and colleagues from UCL examined existing published records of

400,000 animal bones from archaeological sites in South West Asia and South East Europe, using databasing and a variety of statistical techniques to evaluate earlier models of animal domestication history in the Near East and the spread of agriculture to Europe. The research demonstrated new evidence for regional variation in animal exploitation, and opened up important implications for understanding the domestication process itself. [3]

Two further research projects (2010-2013) provided detailed insight into the domestication process and dispersal of domestic and commensal animals into and across Europe, alongside early agriculturalists. The first [4] focused on pigs, resulting in new evidence for wild boar lineages involved in domestication, later wholesale genetic turnover of Near Eastern pig lineages and introduction of European domestic pigs into Asia Minor. The second [5] studied the Orkney Vole and revealed new evidence for both the timing of its introduction by Neolithic farmers to the Orkney Islands and its specific geographic origin in continental Europe.

In 2012, Dobney and colleagues revisited the evidence for dog domestication across the Old World (securing a major NERC grant in the process). Examining modern genetic data from dogs and wolves, alongside a worldwide assessment of the earliest dog remains, the group then matched the alleged geographic locations of so-called existing "ancient" breeds to the current zooarchaeological evidence for dog domestication. The results were counterintuitive, showing that none of the ancient breeds derive from the regions where the oldest archaeological remains have been found, and that three of them even originate from outside the natural range of *Canis lupus* (the dog's wild ancestor). These findings showed that most of the recent claims for dog domestication based on genetic data from modern breeds to be false. [6]

3. References to the research

References to support the case study include:

1. Cucchi T, Fujita M, and **Dobney K.** 2009**.** *"New insights into pig taxonomy, domestication and human dispersal in Islands South East Asia: Molar shape analysis of Sus remains from Niah caves (Sarawak)."* International Journal of Osteoarchaeology **19:** 508-530.

2. Cucchi, T., Hulme-Beaman, A., Yuan, J. & **Dobney, K.** 2011. *"Early Neolithic pig domestication at Jiahu, Henan Province, China: clues from molar shape analyses using geometric morphometric approaches."* Journal of Archaeological Science, **38**, 11-22. (IF=1.710).

3. Conolly, J., Colledge, S., **Dobney, K**.,Vigne, J.D., Peters, J., Stopp, B., Manning, K, & Shennan. S. (2011). *"Meta-analysis of zooarchaeological data from SW Asia and SE Europe provides insight into the origins and spread of animal husbandry".* Journal of Archaeological Science **38**: 538-545.

4. Ottoni, C., et.al. **Dobney, K.** & Larson, G. (2012). *"Patterns of pig domestication and long-term human migrations in Anatolia revealed through ancient DNA and geometric morphometrics."* Molecular Biology & Evolution doi:10.1093/molbev/mss261.

5. Martínková, M., et al. **Dobney, K**. and Searle, J.B. (2013). *"Divergent evolutionary processes associated with colonization of offshore islands."* Molecular Ecology.

6. Larson, G., et al., **Dobney, K.**, Vigne, J-D., Vila, C., Andersson, L. & Lindblad-Toh, K. (2012). *"Dog domestication revisited: A new genetic, archeological, and biogeographic perspective."* Proc. Natl. Acad. Sci. U.S.A. 109 (23): 8878-8883.

4. Details of the impact

The research described has had considerable impact through a wide range of TV and radio programmes, raising public awareness and understanding of the history of domestic animals – and what it reveals about human colonisation history - in Britain and abroad. Through these and other engagements, the research has contributed to culture and quality of life, as well as enabling economic impacts through film and book sales.

Dobney discussed his findings twice on BBC Radio 4's flagship science programme, *Material World* in June 2010, to explain how his findings on pigs have shed new light on how humans colonised islands in the Pacific; and in June 2013, to discuss the challenges and wider importance of new DNA sequences from a horse dating back more than 700,000 years. [1] As part of Radio 4's programme offer, *Material World* has a reach of nearly 11 million listeners, according to June 2013 Rajar figures. After each of these appearances, Dobney received 20-30 direct audience responses.

Dobney and colleagues in Durham also acted as consultants for the six-part BBC2 Horizon series, *The Secret Life of the Dog*, broadcast in January 2010 and repeated in October 2012. Drawing on their research, the group advised the programme makers on early evidence of the domestication of dogs. [2] The series was reviewed in *The Guardian* newspaper [3] and on online fora such as channelhopping.onthebox.com, both of which called it "fascinating". On YouTube, part 1 alone had attracted over 35,000 views by the end of July 2013. The series was also shown in Australia (latest repeat September 2011) and on the BBC HD Channel (October 2012).

Another BBC2 documentary, *A History of Ancient Britain* (series 1, part 2), drew on Dobney's research into commensal rodents (February 2012). The programme examined the story of how the first farmers arrived in Britain from Europe in 4000BC. [4]

A National Geographic programme, *How Man Tamed the Wild*, also relied on Dobney's research, using information he supplied to programme makers and featuring an interview with him [5]. The programme was broadcast on the National Geographic and History Channel in November 2010 and then released as a DVD and sold to French TV. Dobney received numerous emails from viewers in response, which were mostly very positive about his approach to viewing animal domestication. The Discovery Channel featured the group's research in a documentary entitled *Prehistoric Dog Domestication Derailed by the Ice Age* (July 2011). [6] Viewer feedback from the programmes above revealed both a widespread fascination with the subject matter, and a particular interest among people with a professional connection, such as dog breeders and farmers.

The research has also featured In newspapers, such as Aberdeen's *The Press and Journal* (May 2010), which focused on the research into pigs in South East Asia; and on a range of news programmes and outlets, including BBC North East Scotland (May 2012) and NBC News (July 2011). [7]

One particularly interesting impact involved the "Lapita Voyage" [8], a six-month voyage undertaken in Nov 08-April 09 following the migration routes of ancient Austronesian settlers. Dobney was invited to join five of the participating scientists because of his research expertise in this area. During the voyage, unique hair and feather samples were collected of domestic animals for genetic analyses. The voyage was accompanied by a film crew, who produced a feature-length documentary for German public broadcaster ZDF. *Wagnis in der Südsee: Das Rätsel der Polynesier* was first broadcast in 2010, repeated in July 2013 and is still available for online viewing [9]. A 2011 popular book by German expedition leader Klaus Hympendahl (featuring a

section written by Dobney) sold several thousand copies in Europe by June 2013, with sales revenues estimated to be between €50-100,000. The paperback edition was published in May 2013. [10]

Dobney has also engaged with the public through lectures on his work, e.g. a TechFest lecture in Aberdeen in September 2011. This was attended by a paying audience of around 200 people, many of whom told Dobney afterwards that he had encouraged them to look at domestic animals in a new way. Similar numbers attended Dobney's talk at the British Science Festival in Aberdeen in September 2012, and another at the University of Basle in May 2013, which attracted both members of the public and Swiss government officials.

Beyond this engagement at popular level, Dobney has contributed to a changing understanding of prehistory among those dealing with it professionally. His findings have helped create a new appreciation of the impact of humans on the early Holocene, or 'Anthropocene' as it is now more commonly called. This paradigm shift has begun to be reflected in public discourse and in new museum exhibitions around the world.

5. Sources to corroborate the impact

1. Evidence of Dobney's appearances on *Material World*, June 2010 http://www.bbc.co.uk/programmes/b00sjtb2 and June 2013 http://www.bbc.co.uk/programmes/b02yl46w

2. For *The Secret Life of the Dog*, http://www.bbc.co.uk/programmes/b00pssgh or the YouTube link http://www.youtube.com/watch?v=aDmzzREXI_g

3. Review of *The Secret Life of the Dog* from *The Guardian* http://www.theguardian.com/tv-and-radio/2010/jan/07/horizon-secret-life-of-dog

4. *A History of Ancient Britain* http://www.bbc.co.uk/programmes/b00ysr2l Episode 2.

5. For *How Man Tamed the Wild* http://shop.nationalgeographic.com/ngs/product/dvds/animals-and-nature/animals-and-wildlife/how-man-tamed-the-wild-dvd-r

6. For *Prehistoric Dog Domestication Derailed by the Ice Age* http://news.discovery.com/animals/dog-domestication-prehistoric-ice-age-110728.htm

7. News coverage: BBC North East Scotland http://www.bbc.co.uk/news/uk-scotland-18122309; Press and Journal http://www.pressandjournal.co.uk/Article.aspx/1740584; NBC News http://www.nbcnews.com/id/43946524/ns/technology_and_science-science/t/prehistoric-dog-domestication-derailed-ice-age/#.UgpcEpLqmSo

8. Link to Lapita Voyage http://www.lapita-voyage.org/en/scientific_objectives.html

9. Link to *Wagnis in der Südsee: Das Rätsel der Polynesier* http://www.zdf.de/Terra-X/Wagnis-in-der-S%C3%BCdsee-5362446.html Dobney and his work feature from around 27 minutes onwards.

10. Sales of the book, Die Lapita-Expedition, can be confirmed by Verena Pritschow, Programmleitung terra magica: http://www.herbig.net/dynamic/finden.html?tx_ttipcshop%5Bswords%5D=hympendahl&search=los%21