

Impact case study template (REF3b)

Title of case study: Aridification and Landscape Modification: Lessons from the Past

1. Summary of the impact

Palaeoenvironmental research in the Ica Valley of Peru's southern coast is revealing how agriculture acted with climate change to trigger major social upheaval in the past. This history is informing and educating people and policy-makers in the present, thereby sustaining sympathetic land use for the future. Specific impacts include a Defra-funded project on Peruvian biodiversity by the Royal Botanic Gardens at Kew (RBG), the implementation of Peruvian decrees regarding education and forest conservation, and the establishment of forest-management agreements with major landowners.

2. Underpinning research

Research by Charles French (Professor of Geoarchaeology, of the University of Cambridge since 1992) and David Beresford-Jones (employed by the University of Cambridge as a postdoctoral Research Associate 2005–2008 and 2011–present) has produced palaeoenvironmental, soil/sedimentary and archaeological data in Ethiopia, New Mexico and Peru indicative of a long-term climatic trend from a damper and well-vegetated environment to the currently prevailing semi-arid, almost desert-like, conditions (e.g. French *et al.* 2009; Beresford-Jones 2011). Throughout, people have learned to cope with the drying landscape in terms of subsistence agricultural life-styles. This research has informed modern education policy as well as land-use and policy decisions.

As one example, archaeological research in the lower Ica Valley carried out in collaboration with RBG (2005–2010: Beresford-Jones, researcher at Cambridge; Whaley, researcher at RBG) shows that the river valleys of the south coast of Peru were, prior to c. 2500 years ago, covered with riparian woodland, dominated by *Prosopis* and *Acacia* trees. The study combined satellite and ground survey and mapping of archaeological sites, geomorphological survey, archaeological excavation and archaeobotanical analysis (Beresford-Jones 2011; Beresford-Jones *et al.* 2011). These both relied upon, and informed, study of today's vegetation by RBG (Whaley *et al.* 2010).

Together, they reveal a history of gradual human-induced change whereby riparian woodland was cleared for agriculture, exposing this landscape to the effects of major *El Niño/La Niña* climatic perturbations. These led to erosion and de-watering on an extensive scale, forcing the abandonment of irrigation and agricultural systems that had flourished here for at least 500 years. They culminated in a period of major social upheaval with the collapse of Classic Nasca culture and the incorporation of the area into the Wari Empire c. 1300 years ago (Beresford-Jones 2011). Today, similar self-enhancing feedbacks between social and environmental changes are afflicting the Ica Valley (Whaley *et al.* 2010).

This initial research is now being expanded to encompass the whole of the Ica River Valley system from the high Andes to the Pacific coast in order to examine wider agricultural and settlement responses to this combined track of deforestation and aridification over the past three millennia (2012–2015: French, Beresford-Jones and Lane, PI and researchers, Cambridge).

3. References to the research (in alphabetical/chronological order)

Key Research Outputs:

1. Beresford-Jones, D.G. 2011. *The Lost Woodlands of Ancient Nasca: A Case-study in Ecological and Cultural Collapse*. (British Academy Postdoctoral Monograph Series.) Oxford: Oxford University Press. ISBN: 9780197264768
2. Beresford-Jones, D.G., Whaley, O.Q., Alarcón, C. and Cadwallader, L. 2011. Two millennia of changes in human ecology: Archaeobotanical and invertebrate records from the lower Ica Valley, south coast Peru. *Vegetation History and Archaeobotany* 20: 273–292. INT1* category peer-reviewed journal on the European Reference Index for the Humanities. DOI: 10.1007/s00334-011-0292-4
3. French, C., Periman, R., Scott Cummings, L., Hall, S., Goodman-Elgar, M. and Boreham, J. 2009. Holocene alluvial sequences, cumulic soils and fire signatures in the middle Rio Puerco basin at Guadalupe Ruin, New Mexico. *Geoarchaeology* 24(5): 638–676. INT1* category peer-reviewed journal on the European Reference Index for the Humanities. DOI: 10.1002/gea.20278
4. Whaley, O.Q., Beresford-Jones, D.G., Milliken, W., Orellana, A., Smyk, A. and Leguia, J. 2010. An ecosystem approach to restoration and sustainable management of dry forest in southern Peru. *Kew Bulletin* 65: 613–664. International peer-reviewed publication with an H Index of 19 according to the SCImago Journal and Country Rank. DOI: 10.1007/s12225-010-9235-y

Research Grants:

1. Beresford-Jones, D.G. 'Ica Valley, Peru', British Academy Postdoctoral Grant (RG42899), 2005–2008, £97,729.
2. French, C. (PI), Beresford-Jones, D.G. (PDRA), and Lane, K. (PDRA), 'Ica Valley, Peru', Leverhulme Trust, 2012–2015, £376,460.

*INT1 - International publication with high visibility and influence among researchers in the various research domains in different countries, regularly cited all over the world.

4. Details of the impact

David Beresford-Jones' postdoctoral research on the archaeology of the south coast of Peru informed and provided part of the scientific basis for a Defra-funded, Darwin Initiative Project (assisting countries rich in biodiversity but poor in financial resources – like Peru – to meet their biodiversity objectives) led by RBG: *Habitat Restoration and Sustainable Management of Southern Peruvian Dry Forest*. This project (2006–2009), in which Beresford-Jones was the archaeobotanical collaborator, has had impact of major reach and significance in the Ica province (c. 300,000 population) in the areas of education, environmental conservation and habitat restoration between 2008 and the present.

In the area of education the natural heritage of the Ica Valley and its intimate relation to the long cultural heritage of the region are now part of the school curriculum in Ica. Policy 27.5 of Peruvian government decree *Resolución Supremo* N° 001-2007-ED (January 2007) regarding the National Education Project to 2021 calls for the “making [of] permanent activities of

environmental education in the communities”, with the objective of the “promotion of healthy ecosystems viable in the long term and sustainable development of the community through prevention, protection and restoration of the environment”. This policy has been implemented in the REF period with, for example, use of the school textbook *Sembrando un Futuro* (co-published in 2010 by the Royal Botanic Gardens, Kew, and Borrador of Lima, Peru) and the initiation of annual huarango (*Prosopis*) festivals. The latter, attended annually by several thousand people, include exhibitions about sustainable products, desert ecology, local natural history and biodiversity – in addition to music, theatre, storytelling and competitions for poetry and drawing.

In the campaign against deforestation, the work of Beresford-Jones on the ecology and cultural importance of the genus *Prosopis* contributed to the latter’s inclusion on the list of endangered wild tree flora given statutory protection by the Peruvian government in 2007 (*Decreto Supremo* N° 043-2006-AG Annex 1). It revokes all permissions to make charcoal from *Prosopis* trees, and explicitly prohibits their felling for any purpose. The long-term impacts of the Cambridge research are becoming increasingly apparent in conservation and habitat restoration, particularly reforestation. For example, a 513 ha dry-forest reserve (National Conservation Area) in Tunga, Nazca has been established enabled by the *Resolución de Intendencia* N° 199-2007-INRENA-IFFS (5 September 2007), and tree-nursery and habitat-restoration areas have been established under management agreements with major landowners (e.g. Agrokasa S.A. fundo, 2008; Usaca, Nazca, 2008; Lanchas, Pisco, 2010; Samaca, Ica, 2006–2010 with 3000 huarangos planted).

Authorization to conserve the 513 ha reserve was granted by the Peruvian Government to the NGO *Asociación Civil Grupo Aves del Perú*. The NGO is, together with RBG, planting huarango trees in the area and educating local families regarding the negative environmental and economic consequences derived from the felling of these trees. Changes in locals’ attitudes towards huarango-cutting are already being felt, as illustrated by (1) an article in the *New York Times* in November 2009 about these conservation and education initiatives and their underlying research, (2) a report in *Correo* in April 2011 that the Ica Tourism Police took a coordinated response to stop charcoal production from huarango trees around Villacuri, and (3) the decision by a major local landowner to donate £376,460 to match the French/Beresford-Jones Leverhulme Grant (2012–2015) so that they can expand their work on deforestation and aridification in the Ica River Valley system.

Changing local attitudes to deforestation remains an ongoing challenge, but the growing local awareness of the effects of reforestation is allowing many of the newly planted trees to grow undisturbed, giving rise to ever more visible evidence for the local population of the long-term economic benefits for them of significant dry-forest habitat restoration.

5. Sources to corroborate the impact (in alphabetical/chronological order)

1. Local benefactor. *One River Project handling of funding and payment schedule* [letter]. (Personal communication, 27 November 2012).
2. Consejo Nacional de Educación. Ministerio de Educación, República del Perú. 2007. *Resolución Supremo N° 001-2007-ED. Proyecto Educativo Nacional al 2021: La Educación que Queremos para el Perú* (‘National Education Project to 2021: The education that we want for Peru’) [pdf]. Available at:

<<http://www.minedu.gob.pe/DeInteres/xtras/PEN-2021.pdf>> [Accessed 11 July 2013].

3. Conservamos Por Naturaleza. n.d. Asociación Civil Grupo Aves del Perú – Cuidemos el Bosque para los Niños ('Let's look after the forest for the children') [online]. Available at: <<http://www.conservamospornaturaleza.org/asociacion-civil-aves-del-peru/>> [Accessed 11 July 2013].
4. Department for Environment, Food and Rural Affairs. 2008. *Habitat Restoration and Sustainable Management of Southern Peruvian Dry Forest. Darwin Initiative Project Report* [pdf]. Available at: <<http://darwin.defra.gov.uk/documents/15016/18367/15-016%20FR%20-%20edited.pdf>> [Accessed 11 July 2013].
5. Edward, O. 2008. Getting to the root of the problem. *Geographical Magazine* [online]. June. Available at: <http://www.geographical.co.uk/Magazine/Kew_in_Peru_-_June_08.html> [Accessed 11 July 2013].
6. Grupo Epena. 2011. Destruyen horno de carbón de huarango. *Correo* [online]. 7 April. Available at : <<http://diariocorreo.pe/ultimas/noticias/CORREO-833473/edicion+ica/destruyen-horno-de-carbon-de-huarango>> [Accessed 2 July 2013].
7. Romero, S. 2009. Ecosystem in Peru is losing a key ally. *New York Times* [online]. 7 November. Available at: <http://www.nytimes.com/2009/11/08/world/americas/08peru.html?_r=0> [Accessed 11 July 2013].
8. Sistema de Información Ambiental. Ministerio del Ambiente, República del Perú. 2006. *Decreto Supremo N° 043-2006-AG. Aprueban Categorización de Especies Amenazadas de Flora Silvestre* (Regional Government ordinance revoking all permissions to make charcoal, and prohibiting the felling of *Prosopis* trees) [online]. Available at: <<http://sinia.minam.gob.pe/index.php?accion=verElemento&idElementoInformacion=158&dfformula=>>> [Accessed 11 July 2013].
9. Sistema Peruano de Información Jurídica. Presidencia del Consejo de Ministros. República el Perú. 2007. *Resolución de Intendencia N° 199-2007-INRENA-IFFS: 'Establishment of 513 ha. huarango forest reserve in the Tunga Usaca region of the Rio Poróma, Nazca'* (5 September 2007) [pdf]. Available at: <<http://spij.minjus.gob.pe/Normas/textos/031007T.pdf>> [Accessed 11 July 2013].
10. Whaley, O., Quinteros, Q., Álvarez, H., Borda, C. Tenorio, M., Pérez, E., Pecho, O., Orellana, A., Salvatierra, F. and Gómez, C. 2010. *Sembrando un Futuro – Restauración y Manejo Sostenible de los Bosques y la Naturaleza de Ica, Perú* [pdf]. Lima: Borrador/Royal Botanic Gardens, Kew. Available at: <http://www.kew.org/science/tropamerica/icaperu/restauracion_libro.pdf> [Accessed 11 July 2013].