Human adaptation to and impact on the Environment

Some lessons from the Past

Giulio Lucarini – CNR ISPC

Anita Radini – UCD School of Archaeology

La cooperazione bilaterale italo-francese nelle scienze per il patrimonio: il patrimonio culturale nella transizione verde

Coopération bilatérale franco-italienne en sciences du patrimoine : le patrimoine culturel dans la transition verte

Consiglio Nazionale delle Ricerche, Piazzale Aldo Moro 7, Roma

giovedì, 15 settembre 2022 / *jeudi, 15 septembre 2022*

Introduction

- From the (mis)use of water to the fashion industry – there is now no doubt that humans have become the cause of many of the environmental issues we witness in our modern World;
- Deforestation and the use of natural resources is at a point in which humans are causing climatic changes at local and global scales;
- Addressing catastrophic future scenarios is imperative, and relies on taking action and on building future models of human impact;
- Such models rely on deep temporal perspective of 'Environment-Human Interaction'. **Can Archaeology play an important role in making a better future?**

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The importance of the relationship between humans and environment over the deep history

Reconstructing the complex dynamics that regulate(d) the relationships between humans and environment over the *longue durée* can provide very useful information for possible solutions to current problems related to environmental and climate change today, thus helping policy makers and stakeholders to take proper action to address such issues.

The importance of a trans-disciplinary approach (towards a holistic vision)

Disciplines that can provide insights on human-environment relation over the Past

- Anthropology
- Archaeology
- Geography
- History
- Paleoecology
- Palaeoclimatology

Hussain & Riede 2020

Crutzen 2002

The Anthropocene: The human impact on Earth's geology and ecosystems

Antonio Stoppani (1873): The Anthropozoic era

Andrew C. Revkin (1992): The Anthrocene

Eugene F. Stoermer started using the term «Anthropocene» in the early 1980s without formalizing it;

Paul Crutzen (2002) popularized it


GLOBAL CHANGE NEWSLETTER

No. 41 May 2000

The International Geosphere–Biosphere Programme (IGBP): A Study of Global Change of the International Council for Science (ICSU)

The "Anthropocene"

by Paul J. Crutzen and Eugene F. Stoermer


nature

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Published: 03 January 2002

Geology of mankind

Paul J. Crutzen

Nature **415**, 23 (2002) | Cite this article

104k Accesses | **2191** Citations | **545**

The Anthropocene

The Anthropocene could be said to have started in the late eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane.

Anthropocene: Geologic period, epoch, or age? Still an object of debate, starting from its temporal limit

- **Early Anthropocene:** Appearance and spreading of food production economies (agriculture and pastoralism) in different areas of the Planet , during the Early/Mid Holocene (Ruddiman 2013);
- **Industrial Revolution:** 18° century (Crutzen 2002);
- **Great Acceleration:** Radionuclides released in the atmosphere after nuclear bomb blasts (1945), or Limited Nuclear Test Ban Treaty (1963) (members of the AWG, 2019);

When Anthropocene started and should it or should it not be officially recognised as a geologic epoch...

...what is obvious is that *we are certainly the first species capable of conscious recognition of our impact*[1], and that the effects of this impact on Earth's geology and eco-systems appeared through deep time in different parts of the Planet.

1: Boivin & Crowther 2021: 273

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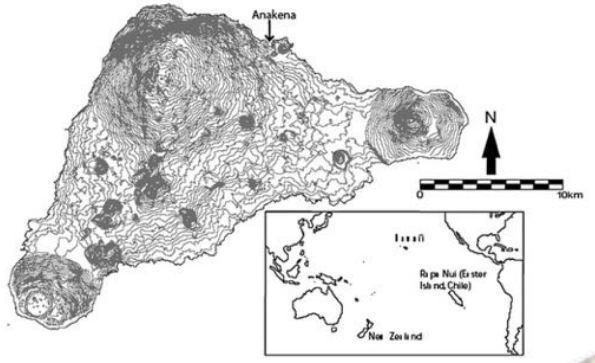
The challenges of data integration: The case of Rapa Nui's 'Ecocide'



Hunt 2007

- Easter Island - known as Rapa Nui - is home to the monumental anthropomorphic stone statues;
- The deforestation needed to transport the statues was thought to have led to the island's ecological devastation and the collapse of the ancient civilization;
- A number of authors, such as Jared Diamond (2005), have 'proclaimed' the case of the collapse of Rapa Nui's society 'an example of human induced Ecocide'.

newscientist.com

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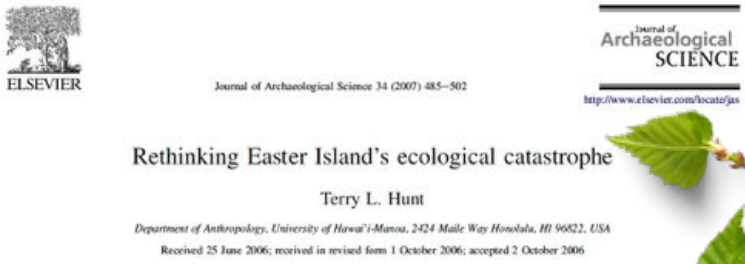
Moving towards a better integration of data

In the past 15 years, however, the case of Rapa Nui has been re-examined integrating and interpreting data in a wider perspective (see, e.g. Hunt 2007 and DiNapoli *et al.* 2020).

'The model of "ecocide" was constructed in part on the foundations of faith in a long chronology, speculation about prehistoric population size, and a remarkable, but still somewhat coarse-grained palaeo-environmental record for the island… the role of rats has often been underestimated, direct human actions of felling and use of fire likely have played a significant role as well' (Hunt 2007: 499).

Prehistoric rat-gnawed *Jubaea* endocarps from Rapa Nui (Hunt 2007: 496)



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Journal of Archaeological Science 34 (2007) 485–502

Journal of Archaeological SCIENCE

http://www.elsevier.com/locate/jas

Rethinking Easter Island's ecological catastrophe

Terry L. Hunt

Department of Anthropology, University of Hawai'i-Manoa, 2424 Maile Way Honolulu, HI 96822, USA

Received 25 June 2006; received in revised form 1 October 2006; accepted 2 October 2006

Integration of Archaeology and Palaeoecological disciplines

Greatly contributed to a better understanding of human responses to environmental changes, especially in terms of providing insights about:

- Demographic fluctuations;
- Migrations and dispersals;
- Cultural adaptations;
- Impact on ecosystems.

Let's see how

Homo sapiens in Australia by 65,000 years ago: Impact on the local species

Article | OPEN | Published: 20 January 2017

Humans rather than climate the primary cause of Pleistocene megafaunal extinction in Australia

Sander van der Kaars, Gifford H. Miller, Chris S. M. Turney, Ellyn J. Cook, Dirk Nürnberg, Joachim Schönfeld, A. Peter Kershaw & Scott J. Lehman

Nature Communications 8, Article number: 14142 (2017) | Download Citation

MENU nature International Journal of Science

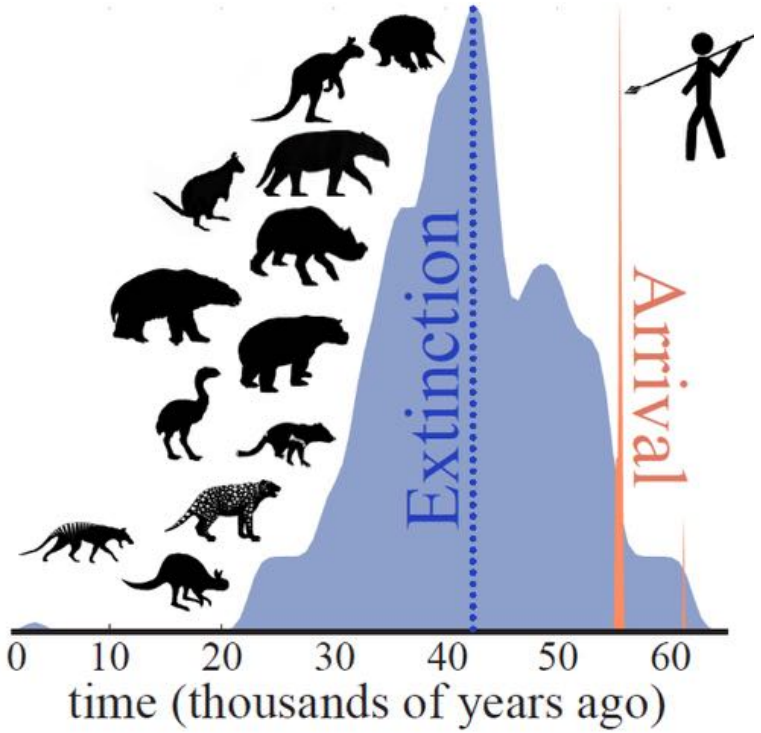
Article | Published: 19 July 2017

Human occupation of northern Australia by 65,000 years ago

Chris Clarkson, Zenobia Jacobs, [...] Colin Pardoe

Nature 547, 306–310 (20 July 2017) | Download Citation

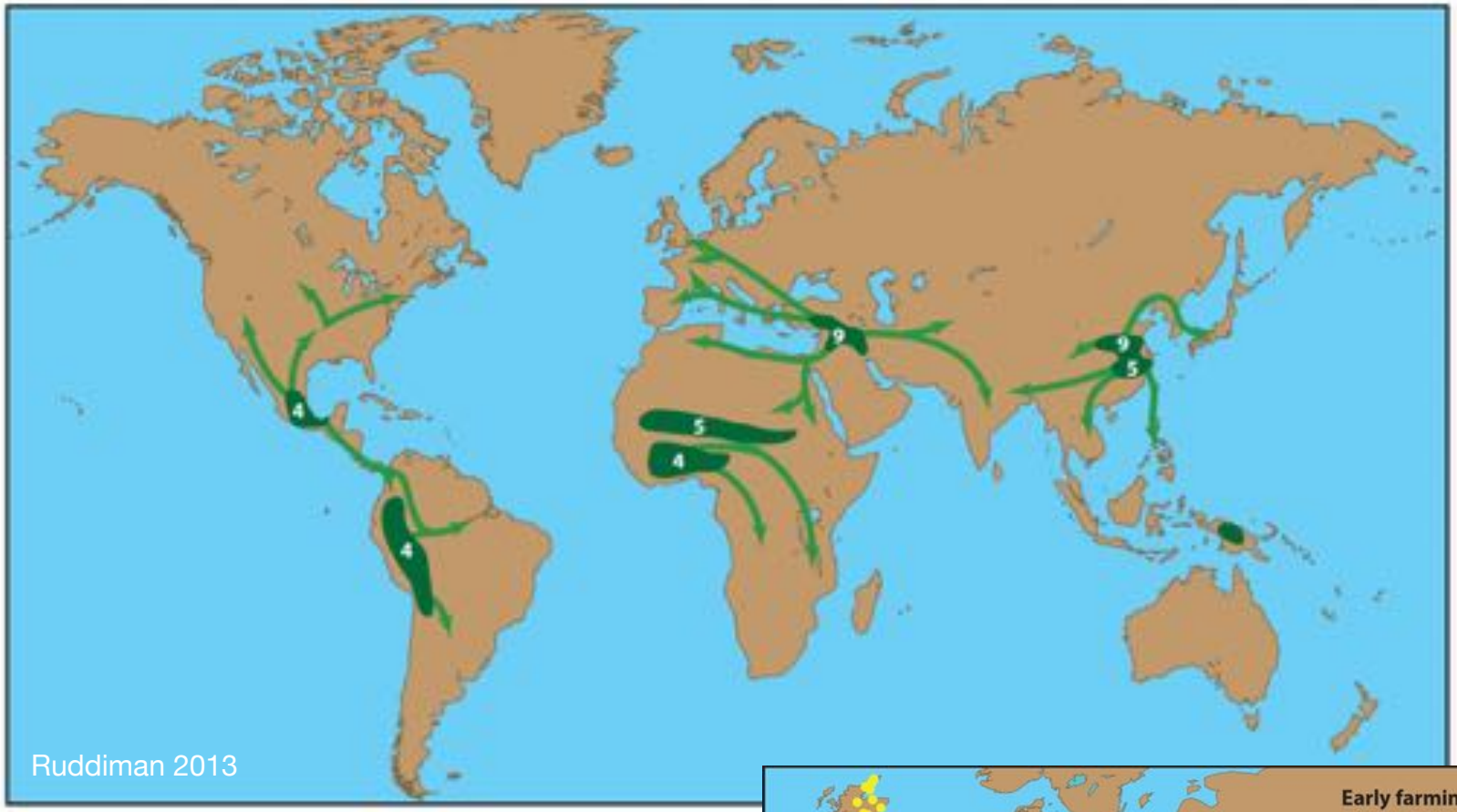
Rule et al. (2012) and van der Kaars et al. (2017) argue that the first Australians, through hunting and the use of fire, had a severe impact on local megafaunas, and caused the extinction of some species.



Early food production (ca.12k– 5k bp)

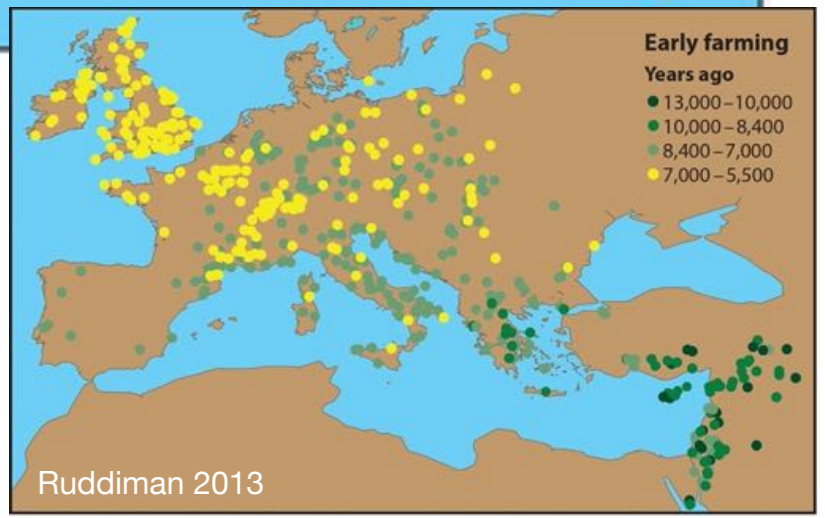
It is clear that effects of the early farming practices impacted the Planet much earlier than the Industrial Revolution, in terms of:

- Land use
- Greenhouse gas emissions
- Deforestation
- Temperature increase



Ruddiman 2013

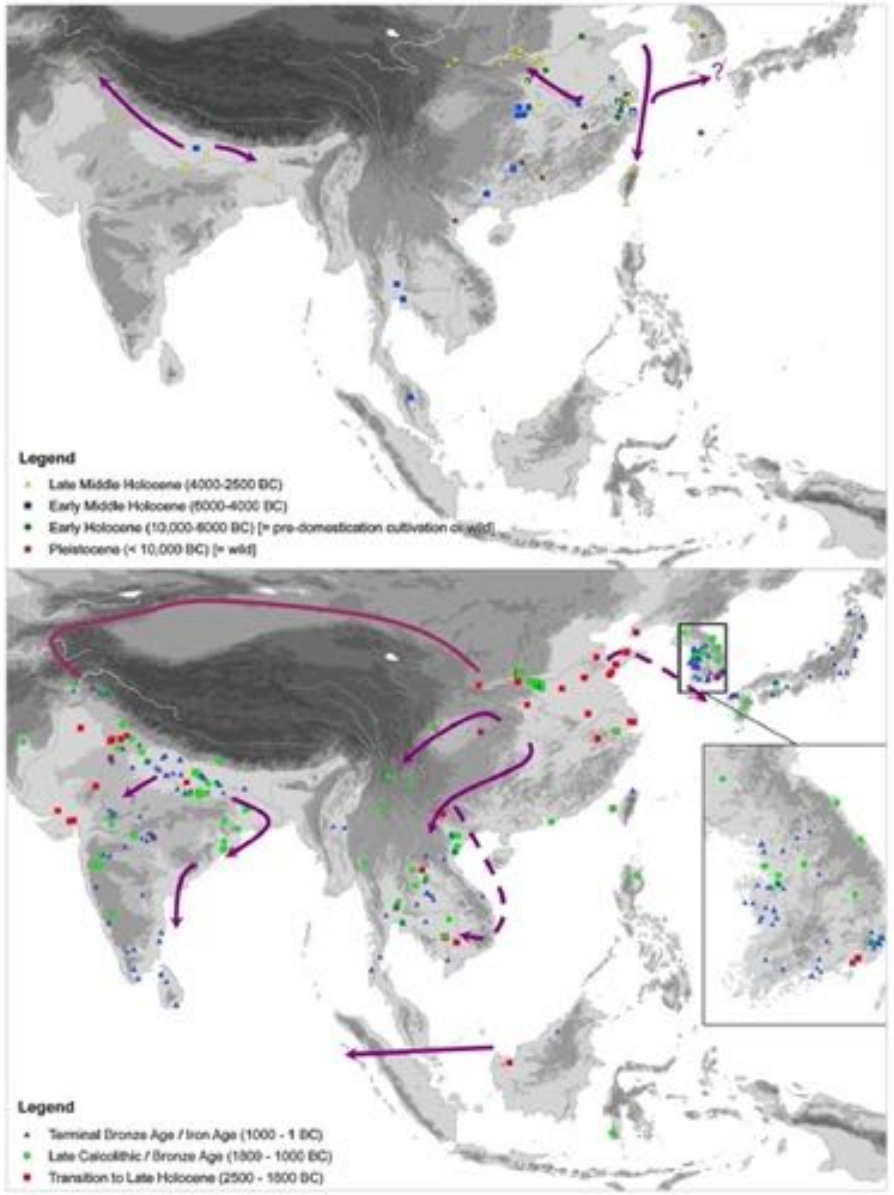

quora.com



Ruddiman 2013

Early land use

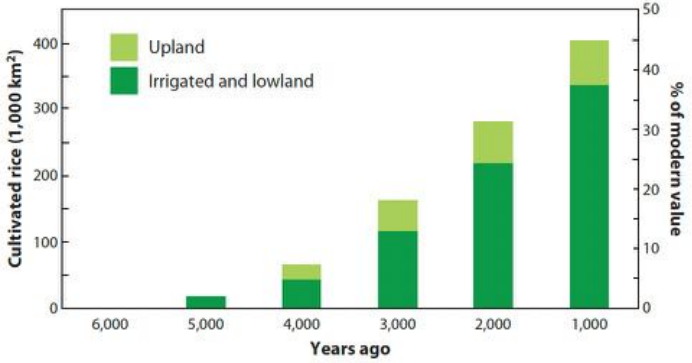
- Maps of diachronic distribution of rice presence in Asia, with major dispersal events;
- Estimated area of rice farming from 5,000 to 1,000 years ago.



Fuller *et al.* 2011

According to Fuller *et al.* (2011), 38% of the area currently destined to irrigated rice was already in use ca. 1,000 years ago, while global population at that time was only ca. 6% of the current one;

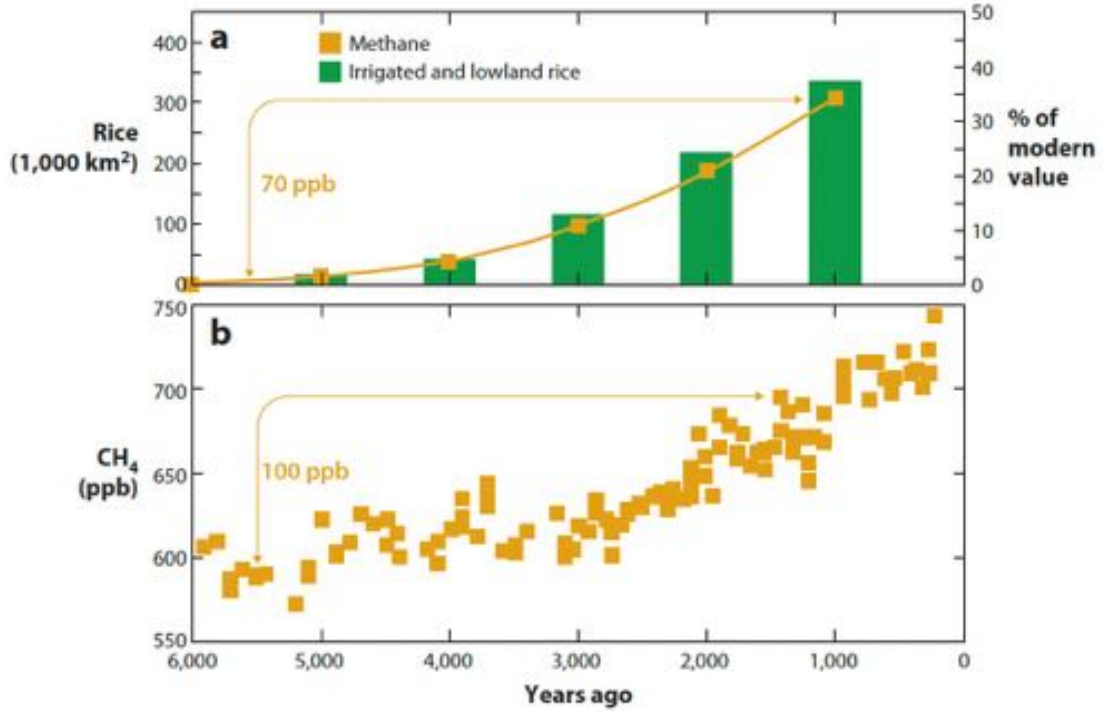
Assuming a constant land use per person, this means that they were using more than 6 times the amount of land, consequently with a higher deforestation rate.

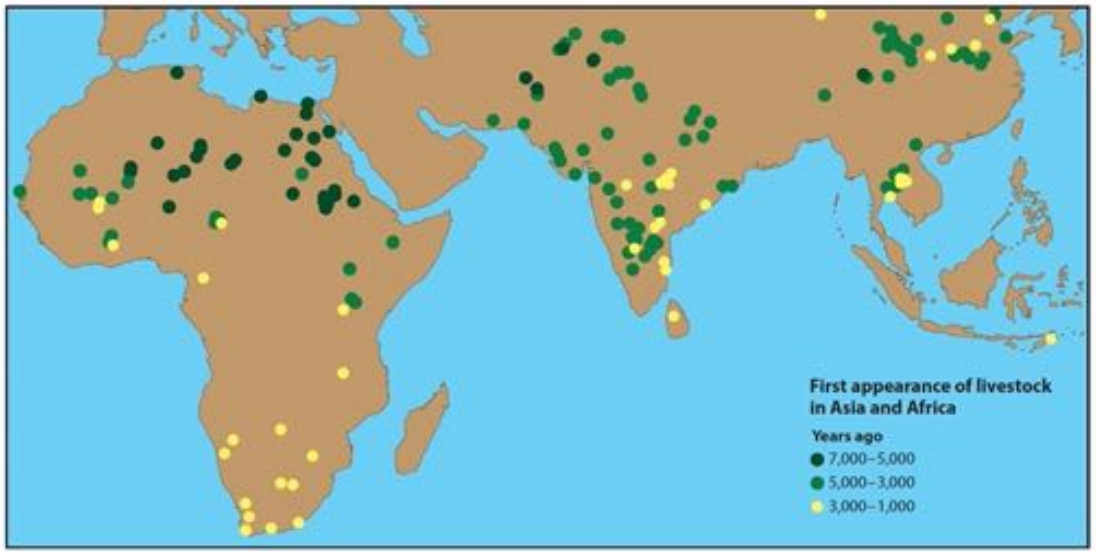


Ruddiman 2013. (after Fuller *et al.* 2011)

Greenhouse gas emissions CH_4 – CO_2

Increase of methane due to early farming practices in Asia and livestock herding in Africa and Asia



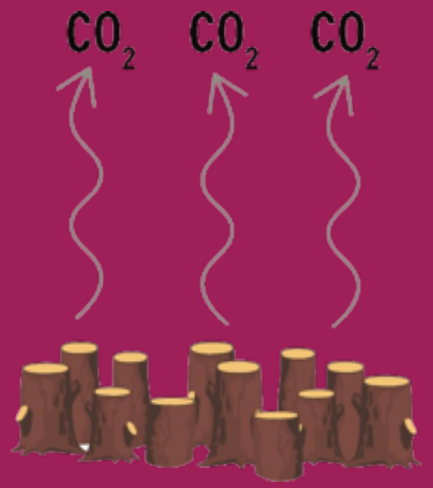


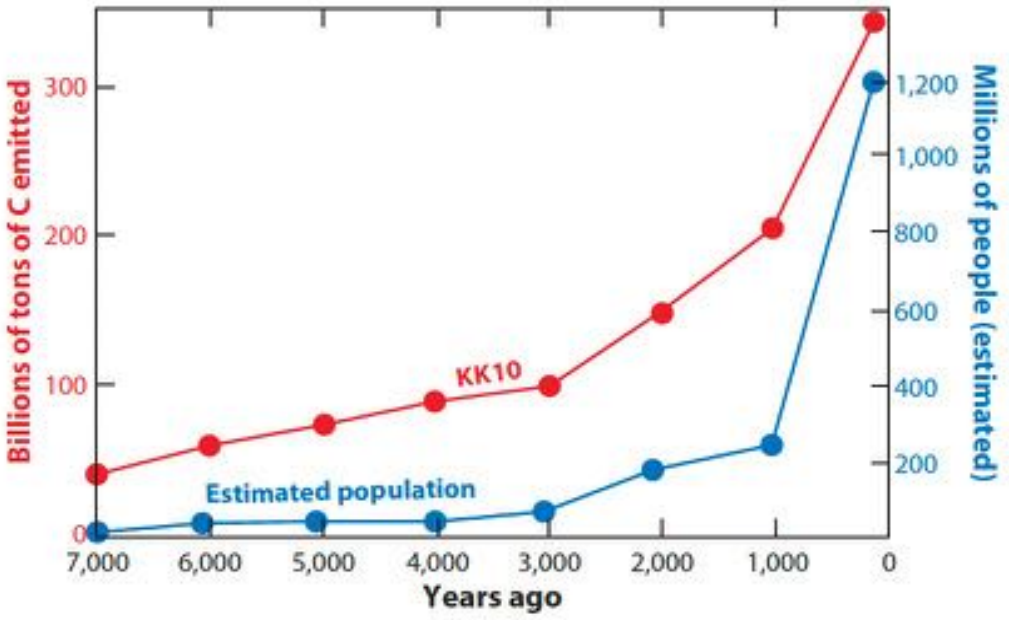
Rice irrigation (5000-1000 bp) caused an estimated atmospheric CH_4 increase of ca. 70 ppb (a), which is a large portion of the 100-ppb increase measured in Dome C ice core for the same time interval (b).

Ruddiman 2013

Greenhouse gas emissions CH_4 – CO_2

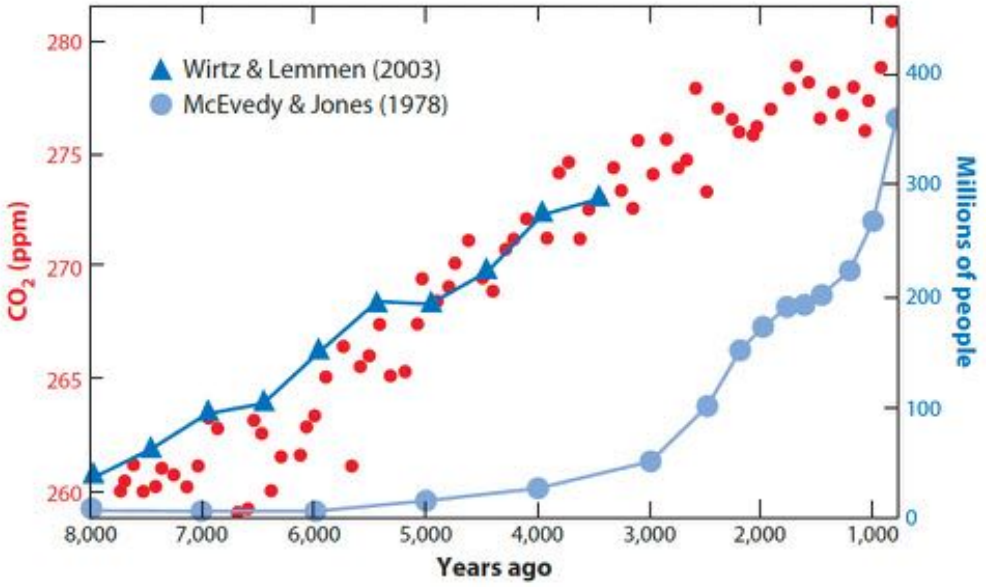
One of the main causes of CO_2 presence in the atmosphere before the Industrial Revolution was deforestation





Ruddiman 2013, from Kaplan *et al.* 2010

Model simulation of released carbon due to deforestation from ca. 7000 BP to 1850 AD, compared with estimated population trend;



Ruddiman 2013

Atmospheric CO_2 presence (EPICA Community members, 2004), compared with two different estimates of past population, one of which is consistent with the CO_2 trend.

Sustainable agricultural practices

By shedding light on traditional agricultural practices, Archaeology, Anthropology and Palaeoecological disciplines can greatly contribute in addressing current environmental issues affecting the Planet, especially in terms of:

- Greenhouse gas emission;
- Biodiversity and habitat losses;
- Water withdrawals and pollution;

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REVIEW ARTICLE

https://doi.org/10.1038/s41559-020-01361-4

Check for updates

Mobilizing the past to shape a better Anthropocene

Nicole Boivin[1,2,3,4] ✉ and Alison Crowther[1,2]

As our planet emerges into a new epoch in which humans dominate the Earth system, it is imperative that societies initiate a new phase of responsible environmental stewardship. Here we argue that information from the past has a valuable role to play in enhancing the sustainability and resilience of our societies. We highlight the ways that past data can be mobilized for a variety of efforts, from supporting conservation to increasing agricultural sustainability and food security. At a practical level, solutions from the past often do not require fossil fuels, can be locally run and managed, and have been tested over the long term. Past failures reveal non-viable solutions and expose vulnerabilities. To more effectively leverage increasing knowledge about the past, we advocate greater cross-disciplinary collaboration, systematic engagement with stakeholders and policymakers, and approaches that bring together the best of the past with the cutting-edge technologies and solutions of tomorrow.

The traditional use of «good fire»

Australian Aboriginal fire management:

- Increase habitat eterogeneity;
- Moderate the effects of climate instability;
- Fire suppression adopted during Post-colonian time set an end to these traditional practices, and increased the risk of destructive fires.

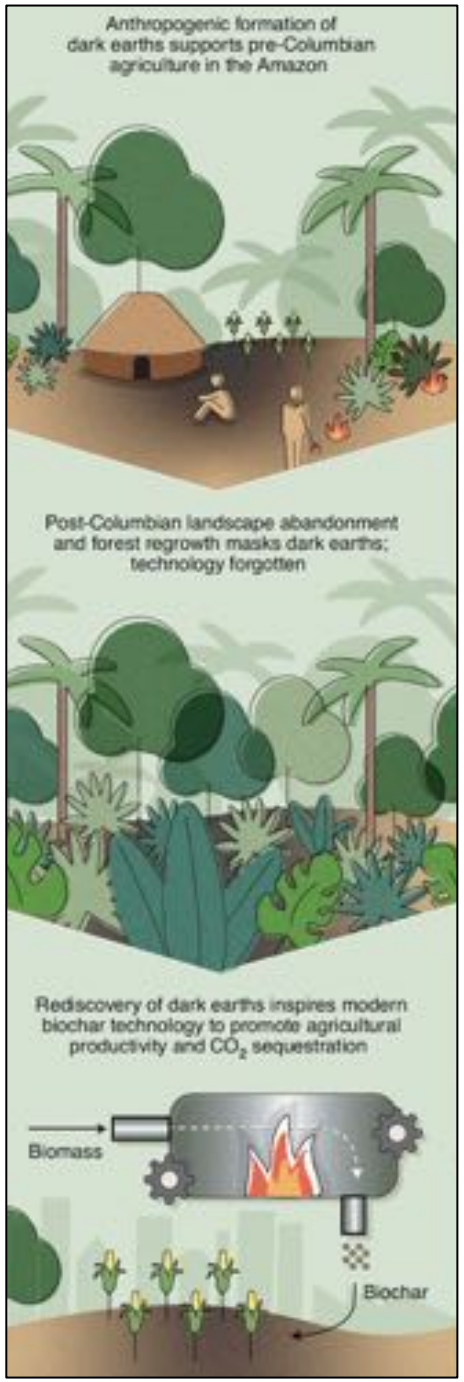


Boivin & Crowther 2021: 275

Archaeological Dark Earths

Creation of archaeological dark earths (ADEs); these soils that have been enriched by prolonged anthropic activity, and are composed by organic matter, including charcoal, are characterised by extra fertility. They lead to the development of modern biochar technology;

An example is the *Terra Preta del Índio*, in the Amazon forest. These soils have been enriched through the addition of charcoal, organic waste (domestic waste, animal bone and excrement), and through the effect of small, controlled fires.



Boivin & Crowther 2021: 275

Rediscovering the lost crops

Highly resilient, often wild, species, such as sorghum and other small millets, which are gluten-free and highly tolerant to drought and hot environments.

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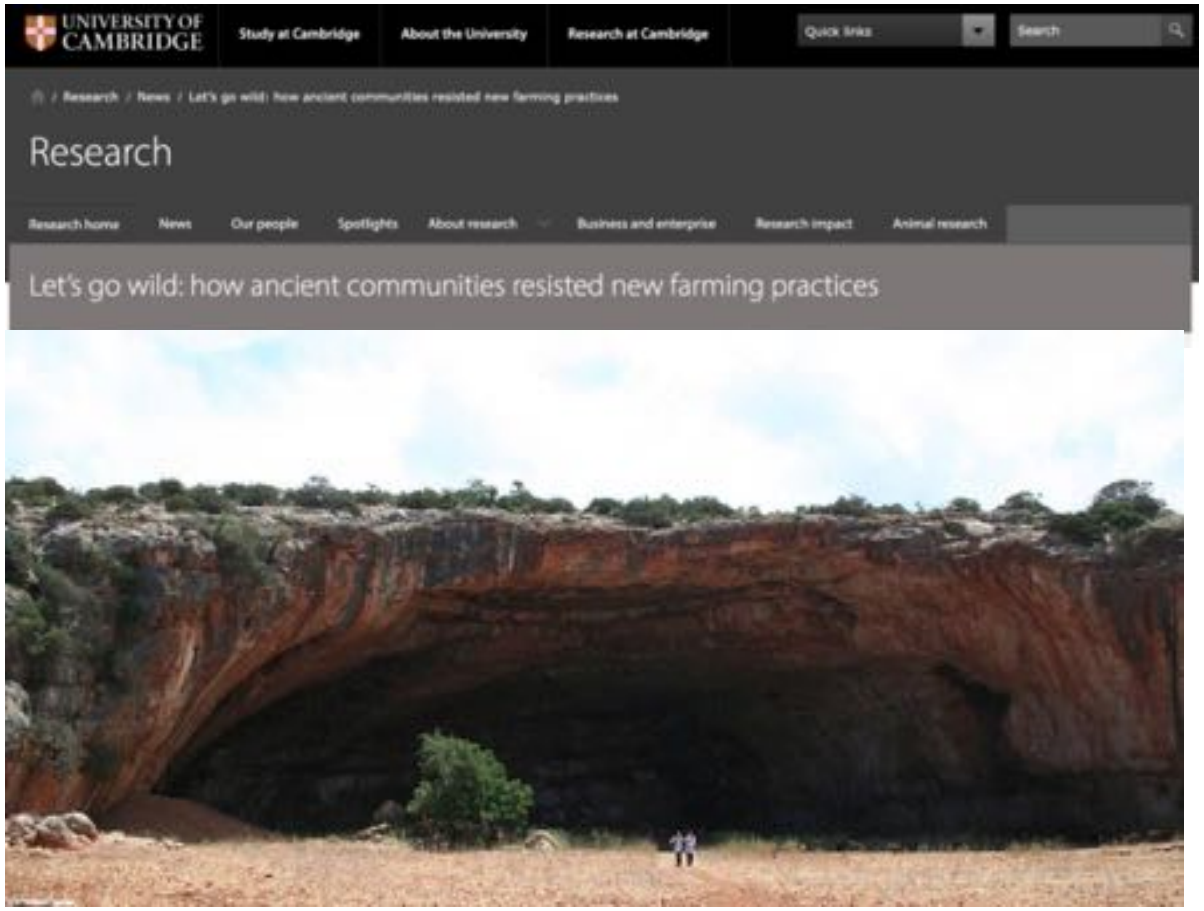
The exploitation of wild plants in Neolithic North Africa. Use-wear and residue analysis on non-knapped stone tools from the Haua Fteah cave, Cyrenaica, Libya

Giulio Lucarini [a,*], Anita Radini [b], Huw Barton [c], Graeme Barker [a]

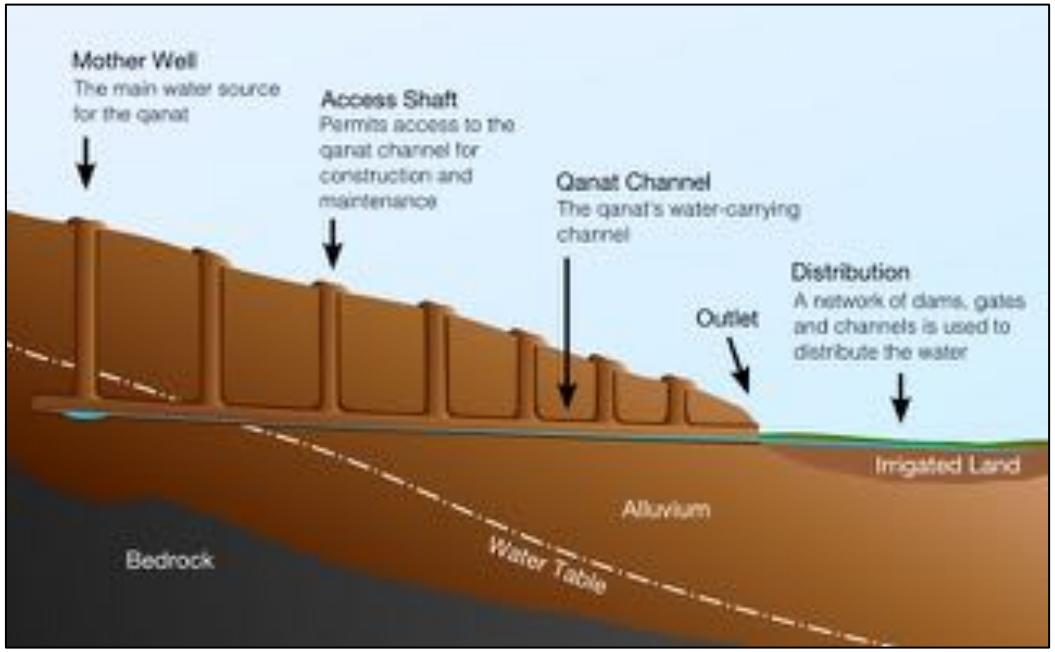
[a] McDonald Institute for Archaeological Research, University of Cambridge, United Kingdom
[b] Department of Archaeology, University of York, United Kingdom
[c] School of Archaeology and Ancient History, University of Leicester, United Kingdom



Analysis of grinding stones reveals that North African communities may have moved slowly and cautiously from hunter-gatherer lifestyles to more settled farming practices. Newly published research by Cambridge archaeologist Dr Giulio Lucarini suggests that a preference for wild crops was a strategic decision.

Qanat, Foggaras, Kariz, Puquios

Simple and low-cost water catchment systems, which first came into use during the 1st millennium BC, and are still functioning in a number of countries of the Near and Middle East, North Africa and Peru. The system is based on the excavation of a long tunnel and wells to access water from the underground acquifers in arid lands. *Qanat* work only by gravity and do not require any kind of fuel.



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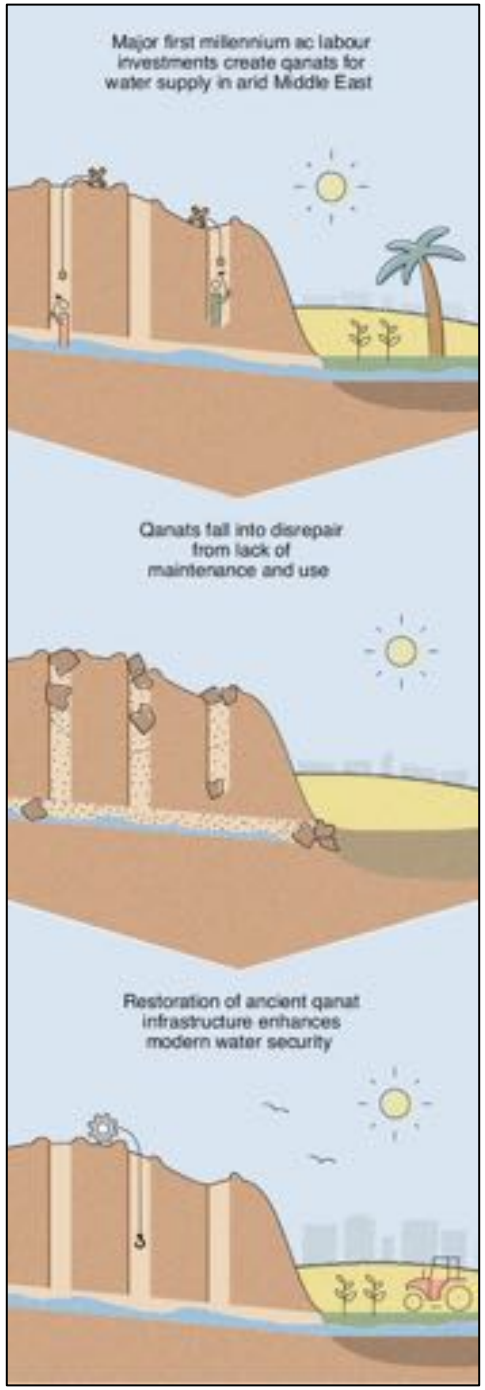


Boivin & Crowther 2021: 275

People and Water: The Garamantes of Libya

- The Garamantes populated the central Sahara between ca. 500 BC and 400 AD. After 400 AD their power and culture in the Central Sahara came to an end;
- They were farmers and merchants. Their diet consisted of grapes, figs, barley and wheat;
- They excavated *foggaras* to ensure availability of drinking and irrigation water.

Photos by David Mattingly (open access)

- The intensive use of underground water and the climatic deterioration are thought to have contributed to the collapse of this extraordinary culture;
- The use of *foggaras* and water wells continued until modern times;
- The water table is now moving deeper and deeper in the ground; today an average well may reach 200 mt in depth to access water;
- The oasis is therefore dying.

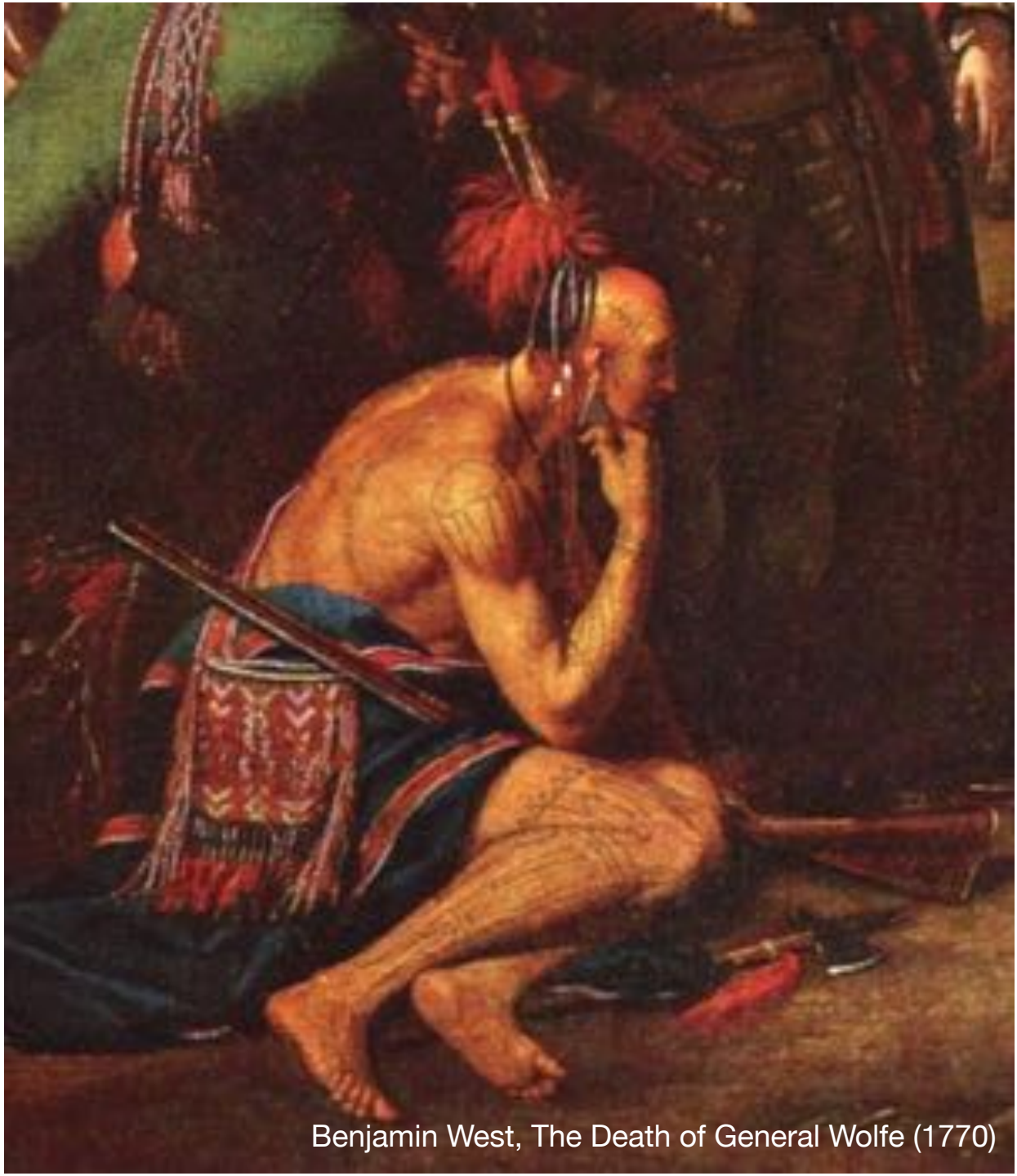
Old Garma (ancient Garama) (photos by D. Mattingly)

What can Archaeology do?

«While societies through time have shown remarkable resilience and developed extraordinary solutions, they have also caused extinctions…, deforested and degraded eco systems, and endured inequality, collapse and failure. We must refrain from romanticizing the past, and from searching for simple panaceas. ***We must establish the actual sustainability of past technologies and practices, which is sometimes far from clear and deeply contested.»***

Boivin & Crowther 2021: 279

Can Archaeology help in achieving this?



Benjamin West, The Death of General Wolfe (1770)

Archaeology: The Environmental Humanities

Archaeology can definitely provide hints on human responses to climate change, and in identifying the factors that can increase human resilience;

Archaeology today bridges human, natural, and life sciences;

The discipline has developed a number of fields that tackle essential environmental issues:

- Environmental archaeology;
- Bioarcheology;
- Geoarchaeology;

The integration and interpretation of such fields and their relevance to the modern ecological crisis is however not always straightforward.

How can Archaeology achieve this?

"The study of how Archaeology can contribute to shaping a better future is increasing but still not a regular feature of mainstream Archaeology. It should be… The discipline should focus more on systematic research to assess past solutions, practices and sustainability. This research should be ***multidisciplinary****, drawing archaeologists into* ***close engagement*** *with urban researchers, ecologists, agronomists, soil scientists, chemists, geneticists, anthropologists and sociologists.*

Archaeologists should also engage beyond academia, not only with those who can shape policy, but also those on the Anthropocene front lines, including farmers, rangers, conservationists, local communities and Indigenous peoples."

Boivin & Crowther 2021: 279

Further reading

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Thanks for your attention!

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