Late Holocene landscape disturbance and recovery: an East Mediterranean case study

Neil Roberts[1], Warren Eastwood[2], Ann England[2], Marc Waelkens[3], Etienne Paulissen[4], Simon Six[4], David Kaniewski[4], Véronique De Laet[4], Matthew Jones[1] and Peter Boyer[1]

[1] *School of Geography, University of Plymouth, Plymouth. PL4 8AA, U.K.* [2] *School of Geography & Environmental Sciences, The University of Birmingham, Birmingham. B15 2TT, U.K.*
[3] *Department of Archaeology, Catholic University, Blijde-Inkomststraat 21, B-3000 Leuven, Belgium* [4] *Inst. Earth Sciences, Catholic University, Redingenstraat 16, B-3000 Leuven, Belgium*

Past episodes of human-induced landscape transformation and abandonment can provide valuable "experiments" that allow an assessment to be made of

- how quickly degraded landscapes can recover,
- to what state they will return,
- what controls the recovery process.

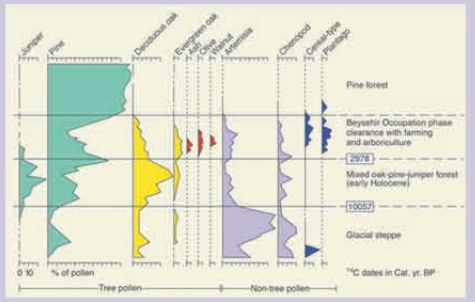
This poster reports the results of multi-disciplinary field research in Central and Southwest Turkey that links archaeological and historical surveys to analyses of palaeoecology, palaeoclimatology and erosion history (Fig. 1). Integrated field programmes have ensured a close spatial congruence between these different data sets (Fig. 2). The study region incorporates both the mountain and basin terrain of the Pisidian Lake District, and the drier, low-relief landscapes of the Anatolian plateau (Figs. 3a-3c).

Fig. 1 ▶ Location of study area, including archaeological survey areas, and pollen sites

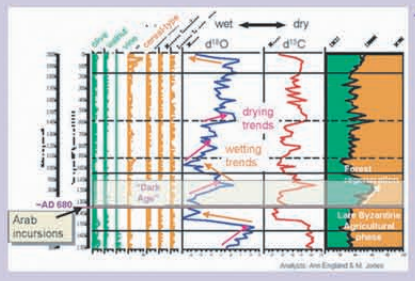
▲ Fig. 2 Lake Göhisar, showing pollen core site and adjacent archaeological settlement (Sinda)

▲ Fig. 3 a) Badland eroded in volcanic ignimbrite, Cappadocia
b) Lake Burdur in the Pisidian lake district
c) Classical city of Sagalassos

Systematic site surveys show that settlement density reached a maximum during the millennium-long Hellenistic-Roman-Early Byzantine era (HRB; 334 BC to ~680 AD), followed by widespread landscape abandonment associated with Arab incursions from the 7th century AD. This HRB cultural period is very well marked in pollen records in the form of the Beysehir Occupation (BO) phase, which shows evidence of cereal cultivation, viticulture and the growing of tree crops such as olive, walnut and manna ash (Fig. 4). At the annually-varved record from Nar Lake in Cappadocia, coupled high-resolution pollen (20 yr) and stable isotope (1-5 yr) analyses show that middle Byzantine cultural "collapse" did not coincide with a period of deterioration in climate, ruling out any simple cause and effect relationship between climatic and cultural changes (Fig. 5a and b).



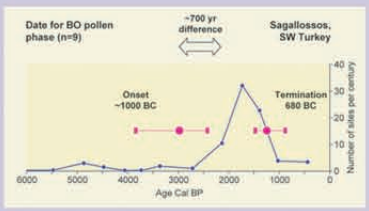
▲ Fig. 4 Summary Late Quaternary pollen diagram from Sögüt



◀ Fig. 5a Pollen and stable isotope record for the last 1700 years from varved crater lake sediments at Nar, Cappadocia

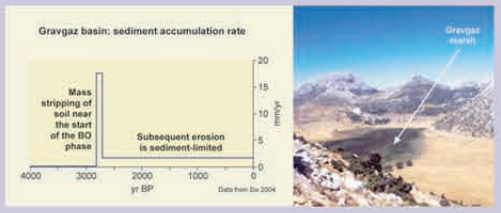
Fig. 5b ▶ Byzantine images of springtime activities in the countryside of Cappadocia (animal herding, ploughing, viticulture, etc); folio 34, Homilies of St Gregory of Nazianzo

While there is very close correspondence between the dates for the end of the long Hellenistic-Roman-Early Byzantine (archaeological) and Beysehir Occupation (pollen) phases at around 680 AD, this is not true for the timing of the onset of the cultural landscape period (Fig. 6). Pollen evidence indicates that large-scale human landscape transformation started between ~1200 and ~600 BC, whereas the Iron Age period (1200-334 BC) has low archaeological visibility. This difference may be partly explained by pre-Hellenistic site loss through erosion/burial; at Gravgaz, for example, there was rapid stripping of limestone soils during the 8th century BC (Fig. 7). Alluvial histories further downstream have aggregated changes over large catchment areas and have also been modified by delivery ratios and upstream sediment storage, but none the less show a shift from bedrock to topsoil erosion during the Late Holocene (Fig. 8).



▲ Fig. 6 Archaeological settlement numbers in the territory of Sagalassos, vs pollen record for the start and end dates of the Beysehir Occupation phase (in pink, means and ranges)

▼ Fig. 7 Erosion history of the Gravgaz basin from multiple dated sediment cores



The Holocene does not provide direct analogues for future landscape recovery but it can highlight potential landscape recovery times (typically decadal) and trajectories. Across the study region, the erosional response to human disturbance appears more heterogeneous than either land use or settlement, because of spatial variations in bedrock lithology and soil erodibility. Due to intervening non-reversible ecosystem changes, of which soil loss is particularly critical, pre-disturbance landscape states may not represent appropriate future restoration targets in regions such as the Mediterranean.

◀ Fig. 8 Alluvial stratigraphy on the Çarsamba fan, Konya. The Upper Alluvial unit has a higher silt content, lower organic matter content and higher magnetic susceptibility, consistent with a shift from bedrock to topsoil erosion

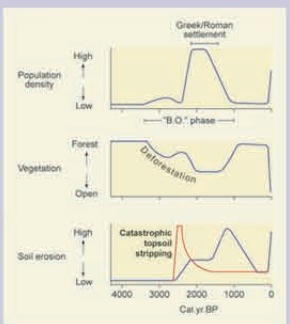


Fig. 9 ▶ Schematic changes in human land-use intensity, forest cover and erosion in SW Turkey during the Late Holocene

Further Information

Boyer, P., Roberts, N. and Baird, D. *(in press)* Holocene environment and settlement on the Çarsamba alluvial fan, South Central Turkey: Integrating Geoarchaeology and Archaeological Field Survey. *GeoArchaeology*
Eastwood, W.J., Roberts, N. and Lamb, H.F. 1998 Palaeoecological and archaeological evidence for human occupance in southwest Turkey: The Beysehir Occupation Phase. *Anatolian Studies* 48, 69-86.
Six, S. 2004 Holocene geomorphological evolution of the territory of Sagalassos. Unpublished PhD Thesis, Catholic University of Leuven, 2 vols.
Vanhaverbeke, H. and Waelkens, M. 2003 *The Chora of Sagalassos: the evolution of the settlement pattern from prehistoric until recent times.* Brepols, Belgium
Vermoere, M. et al. 2002 Palynological evidence for late-Holocene human occupation recorded in two wetlands in SW Turkey. *The Holocene* 12, 569-584.
http://www.sagalassos.be/index.htm

geography at Plymouth

The University of Plymouth