Environmental crisis in the Erhai catchment, Yunnan Province, China 2600 BCE to present

INTRODUCTION

The results here derive from a Leverhulme funded internationally driven inter-disciplinary project that critically evaluates the impacts of both global, regional and local change on vulnerable human communities by studying climate and **human impacts** over the past 6500 years in the Erhai catchment in Yunnan Province, China. A range of sedimentary sources and analytical techniques and methods are set against proxy records of temperature and precipitation and archaeological and documentary archives to reconstruct long-term hydrological trends in the Erhai catchment **(Figure 1).** In particular, this poster illustrates the evidence for major environmental changes occurring to the main tributary and inflow to Erhai the Miju River as a result of upland land use changes in the Eryuan basin, most notably signalled by evidence from the Baihan Dry Gorge. It is thought that this signal has wider ramifications indicating both long, medium and short-term environmental crisis throughout the wider Erhai catchment, the later starting in the Ming Dynasty still has ramifications for the decision makers of environmental managers and policy makers today.

Wanhua fan with apparent cultivated soil layers – stone-free and organic rich with pottery fragments. A radiocarbon date from charcoal at the base of the sequence is ~11k years ago suggesting cultivation of the fan surface throughout most of the Holocene, with sporadic flood events covering each layer.

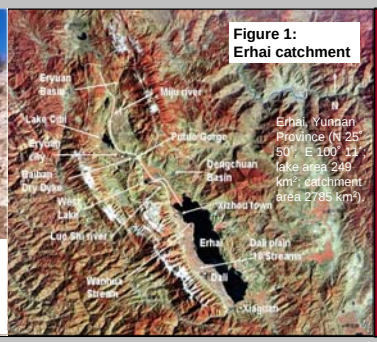


Figure 1: Erhai catchment

Figure 3: Analysis of the recent sediments from Lake Erhai highlights a marked increase in soil in wash over the last 2000 years. This is particularly evident within the magnetics record where a sharp rise in cFD% is recorded. (cFD% is sensitive to the presence of magnetic grains typically found in upper soil profiles and can therefore be used as a proxy for past soil erosion). The onset of this trend is broadly coincident with a further phase of deforestation driven it appears by increased agricultural activity. Areas of secondary pine woodland, which developed after the mid Holocene clearance phases appear to have been actively cleared. A sharp rise in the lead content of the lake sediment record at this time also points to an increase in industrial activity in the catchment, the increased demand for resources placing further stress on the landscape.

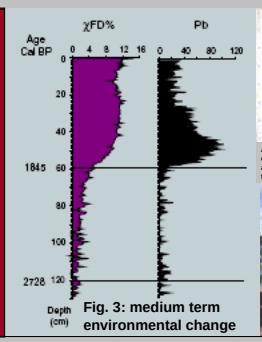


Fig. 3: medium term environmental change

A Map of the Dali plain sent to the British Government by an envoy of the Muslim Suliman c.1871 (British Library WLP5/5/94/6) allows comparison with contemporary environmental conditions on the plain.

Baihan Dry Dyke

Documentary Sources

An argument from silence is made for environmental and hydrological change based on the implications of the great travel writer Xu Xiake's description of the Miju River in 1639 (Elvin & Crook, 2003). From Xu Xiake's account it is noticeable that the key features of the hydraulic landscape that were to distinguish it during the century of hydraulic difficulties between about 1750 1850 were absent. Thus, documentary sources point to the onset of the environmental crisis, with its social and economic costs, as being rapid with the probable causes stemming from the extension of late traditional farming practices beyond sustainable limits particularly in the region of Tower Base Mountain that resulted in the construction of the Baihan Dry Dyke at the head of the Putuo Gorge (Elvin etal, 2003).

Outflow to Erhai

Short-term environmental change. This series of 12 impressionistic black & white pictorial maps (central image) pieced together in composite format with colour added (Crook *et al.*, forthcoming) is taken from a 19th century gazetteer in southwest China. Little is known about the exact origin of these maps, but clearly their drafting was driven by a state organised response to both population pressure and recently changed hydrological conditions. When compared with present day conditions and seen alongside environmental archives these maps help to support a hypothesis for a historical period of dramatic local environmental change originating during the late Ming dynasty (1368-1644) that resulted in the dramatic and rapid formation of the Miju delta.

Putuo Gorge

Fig:2 The long term record of environmental change

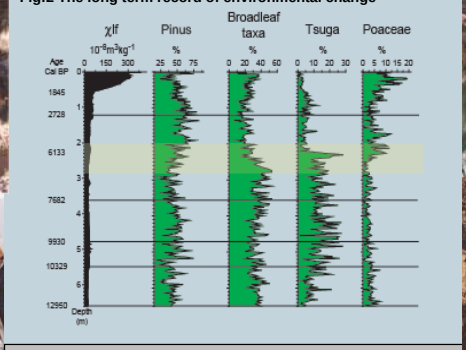


Figure 2: A marked decline in arboreal taxa coupled with increased levels of grass (Poaceae) and other disturbance taxa provides the first evidence for human impact in the catchment at ~ 6370 cal. yr. BP. This early phase of forest clearance is characterised by the selected removal of species in particular broadleaf species and then later Tsuga. This ultimately leads to the collapse of the natural altitudinal vegetation gradient that existed in the catchment from the Late-glacial. The subsequent expansion of secondary pine forest suggests that these early clearances were part of a sustained period of shifting agriculture.

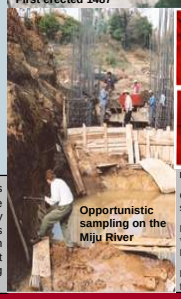
'Tianqu' Bridge of the Celestial Thoroughfare First erected 1487

Rubbersheeting

The ancient bridges (see plates) that span the Miju River provide benchmarks along the Miju river that allow us in the future to rubbersheet this map to current available maps and thus provide a measure of its historical accuracy and reliability when used as an indicator for environmental change in the catchment. Whilst other artefacts, such as a plate found on the Dali plain and ceramic drainage pipes on the Dengchuan plain (below), point to early human influence (c. late Nanzhao or Dali period) in other parts of the catchment.

'Deyuan qiao' Spring of Virtue Bridge

Erhai Eh2 core



Opportunistic sampling on the Miju River

The case-study presented here is a regional example of the S.E. Asian subtropical environment in the IGBP/PAGES programme entitled '*Human Impact on Terrestrial Environments*'. Lake sediment sequences, floodplain sequences, geomorphic erosional land forms, monitored records and documented environmental history from the lake-catchment system provide independent and complementary records of forcings and environmental responses, and may allow the unravelling of interacting effects of human actions and climate change.

References:

Crook, D.S., Elvin, M And Yee, S. (forthcoming) Reaction to sequential crises? Mid 19th century hydraulic maps of the Miju River in Yunnan Province, southwest China: Learning from the past.

Elvin M and Crook D 2003 "An Argument From Silence? The Implications of Xu Xiake's Description of the Miju River in 1639" in WU Xiaoliang, ed., "Collected Essays on Chinese History in Honour of Professor Li Yan on His Ninetieth Birthday and Sixtieth Year of Teaching" Yunnan University Press, Kunming, Yunnan, China.

Elvin, M., Crook, D.S., Shen Ji., Jones, R. and Dearing, J. 2002: The Impact of Clearance and Irrigation on the Environment in the Lake Erhai Catchment from the Ninth to the Nineteenth Century, *East Asian History*, 23, 1-60.

Dr Darren Crook, University of Hertfordshire, Division of Geography and Environmental Studies, Hatfield AL10 9AB, UK, d.crook@herts.ac.uk

with the help of…
Richard Jones, University of Exeter, Department of Geography, Exeter EX4 4RJ, UK, r.t.jones@exeter.ac.uk
Mark Elvin, Australian National University, Research School of Pacific and Asian Studies, Canberra ACT 0200, Australia, Mark.Elvin@anu.edu.au
John Dearing, University of Liverpool, Department of Geography, Liverpool L69 7ZT, UK, j.dearing@liv.ac.uk
Shen Ji, Chinese Academy of Sciences, Nanjing Institute of Geography and Limnology, Nanjing 210008, China, shenji63@hotmail.com
Yang Xiangdong, Chinese Academy of Sciences, Nanjing Institute of Geography and Limnology, Nanjing, 210008, China.
xdyang@niglas.ac.c