

'Here be dragons': Integrating scientific data and place-based observation for environmental management



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ABSTRACT

Yeak Loam is a volcanic crater lake in Cambodia's northeastern uplands, and represents an important economic and cultural resource for local ethnic minority groups. The lake and the surrounding crater rim are currently protected as part of a community based natural resource management scheme. Despite this, development pressure remains high, and visible deterioration of the lake's water quality is of great concern for the local community, visiting tourists, and the Cambodian Ministry of Environment. In this paper we blend scientific analyses with vernacular, place-based knowledge – coherent with the *critical physical geography* concept – to provide an integrated understanding of water quality change over more than 50 years. We find that changes in water quality have occurred episodically and irregularly over that period. Further, we find that these events are triggered by natural biogeochemical cycles within the lake, and in this instance are unlikely to be related to the type of land use within the protected area.

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1. Introduction

Yeak Loam is a deep, freshwater volcanic (maar) lake in north-eastern Cambodia (Fig. 1). The lake is a 'geosymbol' for the Tampuan ethnic-minority communities that have long resided around it, and it remains extremely potent in their religious, cultural and economic lives (McCann, 2011a, 2011b). The lake and the surrounding crater rim comprise the 3.6 km² Yeak Loam Protected Area (YLPA). The local community manages the YLPA, and the management committee is composed of representatives from the five villages that surround the protected area (Phum Chiree, Phum Lun, Phum Sul, Phum Phnom and Phum Lapol). The committee oversees the environmental management of the lake, as well as the tourism activity. The YLPA is a site of regional significance, regarded as one of the few successful examples of community management in the Province. The management committee is reported to be at odds with developers in the area, with significant agribusiness and tourism-related pressure (Borrini-Feyerabend & Ironside, 2013; Bottomley, 2002; Boyle & Sothoueuath, 2010).

In October/November 2011 changes were observed in Yeak Loam lake, with several observers reporting a distinct change in

water colour and clarity, as well as an increase in biological material (DAP News, 2011a; DAP News, 2011b). This abrupt change in water quality disrupted the activities of the local indigenous communities and the many Khmer and international tourists that visit the site. Concerns were raised over the safety of the lake water, as well as the cause of the deterioration, which ranged from tectonic activity to nutrient-enriched runoff from neighboring rubber plantations (DAP News, 2011c).

Given that these changes in water quality are dramatic and highly visible, the environmental knowledge of local communities surrounding the lake may represent an important archive of water quality information. Here, we record long-term, place-based knowledge to determine if changes in water quality have a precedent in the community memory and, if so, with what frequency and periodicity these events have occurred. We also present the results of a water-quality monitoring program that seeks to determine the status and dynamics of biogeochemical cycles within the lake. We argue that combining long-term place-based observation and instrumental data provides a more comprehensive view of environmental conditions than either approach can achieve in isolation, in keeping with many similar studies (Agrawal, 1995; Baker & Mutitjulu Community, 1992; Berkes, Reid, Wilbanks, & Capistrano, 2006; Bohensky & Maru, 2011; Mackinson, 2001; Raj, 2006; Silitoe & Marzano, 2009). Further, we argue that doing so provides a strong empirical basis for the management of this

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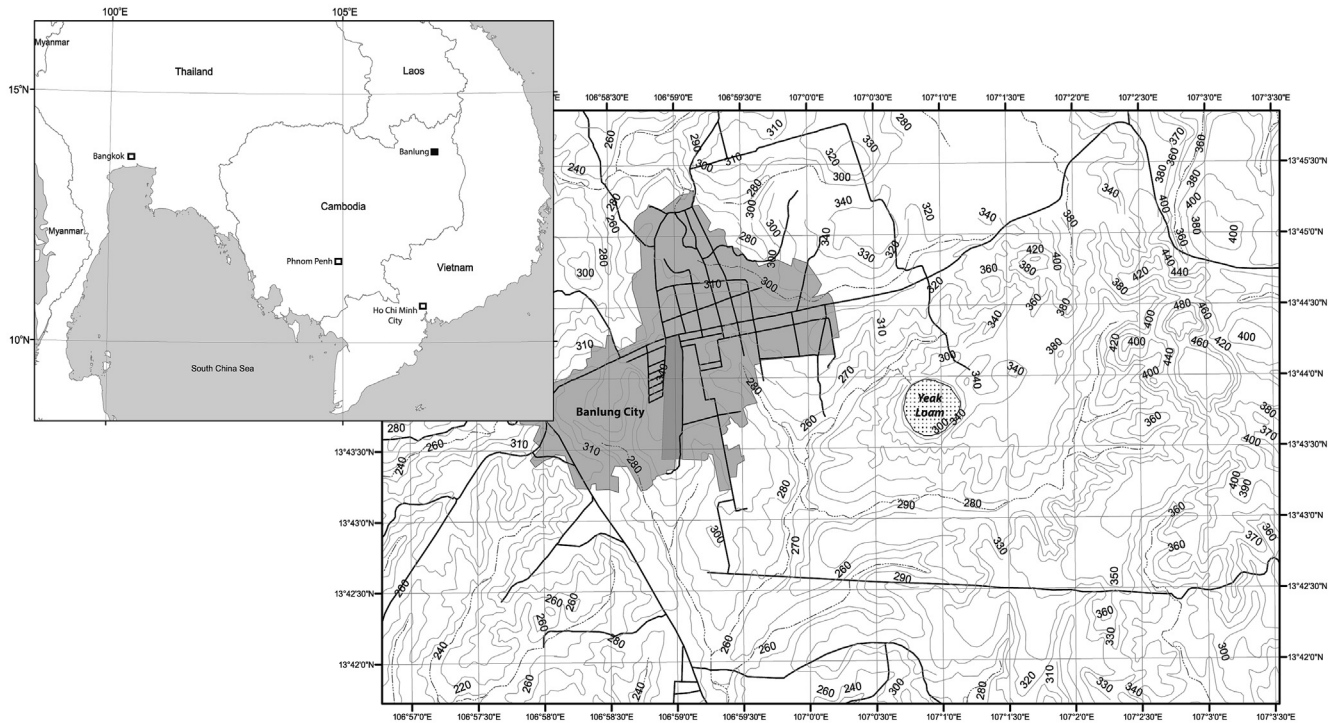


Fig. 1. Location map, showing the location of Banlung in NE Cambodia, the location of Yeak Loam lake in relation to Banlung, and the approximate location of the villages surveyed as part of this study. Contour lines in metres. Data source: Mekong River Commission.

important site.

1.1. Blending vernacular knowledge and empirical science

One question that exercises the minds of environmental decision makers is at what spatial scale does or should such decision making take place to maximize successful outcomes. For some, localized knowledge is essential to improving environmental outcomes at local and other spatial scales (localized adaptation to planetary change being the obvious example – see [Ostrom, Burger, Field, Norgaard, & Policansky, 1999](#)). [Bohensky and Maru \(2011\)](#), [Chalmers and Fabricius \(2007\)](#) and others, write that Local Ecological Knowledge (LEK) – or vernacular knowledge ([Bartel, 2013](#)) – may improve management effectiveness by providing fine-grained, context-specific perspectives that are often absent from centralized and (perforce) more generic management policies based, increasingly, on modeling. Researchers, policy makers and conservationists have increasingly sought participatory, empowering and democratic forms of knowledge to balance the priorities of environmental management ([Huntington, 1998](#); [Raj, 2006](#)).

To that end, the vernacular knowledge of people with meaningful connections to particular places may be valuable if those places are to be managed effectively. This is not restricted to knowledge related to social practices in the context of the biophysical world, but also to the observation of species, ecosystems, or physical environmental processes and patterns. [Semken, Miller, and James \(2011\)](#), for example, recorded an oral history of the Balcombe Estuary Reserve, located in a periurban zone on the Mornington Peninsula, Victoria (Australia), that facilitated more effective and holistic management, especially when complemented with scientific sources. [Mackinson \(2001\)](#) blended vernacular and scientific knowledge to enable more accurate spatial modeling of fish stocks in Canada and New Zealand. Similarly, [Schlarcher, Lloyd, and Wiegand \(2010\)](#) found that one of the most effective ways to

monitor algal blooms in a coastal waterway was to use LEK and oral histories to generate an historical record of the rate and extent of algal blooms. These, and many other studies (see [Freeman, 1992](#); [Leach, 2008](#), and the papers therein), demonstrate that local or vernacular knowledge can be valuable because it recognizes that people in particular places are often best situated to observe local conditions.

Geographers (among others) have long understood that human–environment interactions – incorporating both the biophysical world and the role and impacts of humanity in re-shaping it ([Harden, 2012](#)) – are central to the practices that create the places we inhabit. Using the phrase *critical physical geography*, [Lave et al. \(2014\)](#) argue that integrative perspectives must be embraced to enable more successful problem solving in an age of rapid change that is characterized by the demise of the inflexible nature: culture polarity ([Castree, 2014a,b,c](#); [Lorimer, 2012](#)). In this vein, [Castree \(2012\)](#) draws upon the idea of ‘engaged pluralism’ developed by [Barnes and Sheppard \(2010\)](#), and makes pertinent observations about the (predominantly Western) environmental policy discourse that permeates human–environmental applied research. [Berkes et al. \(2006\)](#) highlight the limitations of ‘conventional science’ and the critical importance of contextual knowledge in environmental management.

In a similar vein, [Wright et al. \(2015\)](#); alternatively this paper is cited as Bawaka Country et al. 2015) argues for a ‘relational understanding of place/space’ that emphasises the importance of humans in place-making, in addition to the non-human. Embracing ideas associated with ‘emergent’, ‘contingent’ and ‘relational’ understandings of place – informed by the intangible and more-than-human – these authors articulate place making as a phenomenon of ‘co-becoming’. This resonates strongly with [Wilcock et al.’s \(2013\)](#) “ethnogeomorphology” – an attempt to emphasise and enhance our understanding of land and water scapes as products both of physical and social processes (see also [Brierley et al. 2013](#);

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