

Descent with modification: critical use of historical evidence for conservation

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Running title: **Critical use of historical evidence**

Key words: Conceptual frameworks, environmental history, historical ecology, history, methods

Article type: Policy perspective

References: 34

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/conl.12437](https://doi.org/10.1111/conl.12437).

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Words: 135 (abstract); 2,439 (article); 835 (references)

Figures: one

Abstract

The clear evidence of the accumulating impacts of anthropogenic actions on the Earth system is driving researchers to look to historical data as a resource for understanding the present and predicting the future. In the conservation science literature, using historical sources usually refers to data mining ‘the past’ using the scientific methods of historical ecology. This paper considers the often overlooked methodological challenges of sourcing and interpreting historical data. A schema is provided for conservation scientists, summarising the kinds of questions and metadata required to work rigorously with historical data. This will improve the accuracy of the data we use to construct trends to inform our understanding of the conservation status of particular species and ecosystems. It will also deepen our understanding of the interplays of factors influencing policy and management in particular social-ecological contexts.

The growing sense of the planetary scale of human agency, the recognition that Earth Systems are social-ecological systems, and the clear evidence of the accumulating impacts of anthropogenic actions is driving more researchers to look to history as a resource for understanding the present and predicting the future (e.g. IHOPE 2016). Many papers use historical data to establish baselines or construct timelines and trends to inform our

understanding of contemporary or future environmental scenarios or the conservation status of particular species (see McClenachan 2012: 352), to study the responses of ecosystems to infrequent high intensity events (contingency) or reveal the causes and consequences of lagged interactions (Steen-Adams et al. 2015). In the conservation science literature the use of historical sources usually refers to data mining ‘the past’ using the scientific methods favoured by historical ecologists. This data can inform policy and management, for example, where to prioritise effort and limited resources in the current biodiversity crisis. This paper considers the methodological challenges of sourcing and interpreting such historical data.

History has many uses for conservation science, but this paper focuses on its contribution to working more effectively with historical data. The importance of the recovery of long-term ecological records (50 years and more) through analysis of tree rings, pollen, charcoal, ice cores and so forth is well established in mainstream ecology and conservation science (Willis et al. 2006). Such studies are often complemented in methodologically lax ways with, or are even grounded on, anecdotal evidence from historical textual and graphic sources (Wiersma and Sandlos 2011; Baisre 2015).

The rise of marine historical ecology is a relatively recent response to this attitude (McClenachan et al 2012). In a field where long-term data is sparse, and Pauly (1995) flagged up the issue of shifting baselines, researchers have resorted to the skilful investigation of historical sources – from skippers’ log books to restaurant menus (e.g. McClenachan et al. 2006; Holm and Bager 2001). Historical sources are equally important for restoration ecologists; to what period in time and thus to what ecological state should

we restore a landscape or ecosystem, for whom, and why, and what evidence do we have of the nature of that (by definition) past state (Higgs et al. 2014)?

Researchers acknowledge the challenges of integrating historical data into the practise of ecology (Delibes et al. 2015; Clavero et al. 2015), and some have criticised overreach in the use of anecdotes to reconstruct historical distributions and densities of species (Baisre 2015; Taylor 2012). However, the role of history as *method* is little discussed.

Ferretti et al. (2015), for example, specifically acknowledge the role of historians in interpreting what may be usable ecological data, and what is merely ‘mythology’ or symbolism. However, they conceive of historical method as a tool for interpreting data already extracted and organised by computer science methods, and analysed statistically. The role of history in interrogating the framing and collection of data is seldom explored. Where historical ecologists use scientific methods to interpret time series data, and tend not to focus on (or necessarily include) human influences, environmental historians develop synthetic narratives explaining historical changes in social-ecological systems through (usually) close attention to the contexts of such changes (and continuities). It is a goal of the latter field to study the natural world in *interrelation* with human societies. Both fields retrieve and analyse data from historical sources, but it is the reflexivity of historians about the contextual factors shaping the production of such data which is central to the purposes of this paper.

Ecologists need not strive to become historians (or vice versa) – in fact interdisciplinary collaboration is preferable to attempts to selectively appropriate the tools of other disciplines (Pooley et al. 2014). However, historical ecologists and conservationists should

also not be naive about the challenges of using historical data. This paper outlines the most important of these, summarised in a conceptual framework for collecting metadata on historical sources (figure 1). Careful attention to these can improve the practise of historical ecology, and therefore the basis for the policies and management actions it informs.

Dimensions of historical data

As thoughtful restoration ecologists acknowledge, history is not ‘the past’, and the interpretation of the past is ‘always contingent on the kinds of evidence available ... and on the person who interprets that evidence’ (Higgs et al. 2014). When interpreting either quantitative or qualitative data, two interrelated dimensions shape the nature of historical data: the circumstances and tools of data production, and conceptual frameworks.

Why, how and by whom data is collected (figure 1 (a))

For data production, which data is gathered and how it is recorded and interpreted varies in space and changes over time. There are discontinuities in units and methods of measurement, in reporting periods, and the quality of data recorded. Choices about which experiments are performed or which observations are prioritised and where, are influenced by personal preferences, aptitudes and training, and by socio-economic, sectoral and political priorities and constraints. All data must be interpreted in historical context (Alagona et al. 2012; Taylor 2012).

Historical data may be ignored, or it may be withheld or massaged to better serve particular agendas or protect certain interests, with profound consequences for assessments of trends

in biodiversity. In Australia, crocodiles were protected from the early 1970s, and initially the science informing conservation was based on mathematical population models generalised from field observations (Messel et al. 1981 [2001]). When populations of saltwater crocodiles (*Crocodylus porosus*) rebounded, and public opinion turned against them, Northern Territory conservationists proposed sustainable use as a management response. However, the population models suggested that the recovering populations were only 1-2% of their pre-exploitation size. Webb et al. (1984) conducted extensive historical research, consulting explorers' publications, trade records, and interviewing former crocodile hunters, showing that pre-exploitation population densities had varied considerably between different river systems (lack of crocodiles didn't necessarily signify local extinctions from hunting). They argued that populations had recovered to 30-50% of pre-exploitation levels, leading to a policy shift from total protection to sustainable use, which has proven to be a durable and successful management approach (Saalfeld et al. 2014).

An example of withholding or massaging data is the falsification of whale catch data by the USSR and Japan in the postwar period (Ivashchenko and Clapham 2015). Another is scepticism about the honesty of market fishers whose records were used to reconstruct the profile and harvesting capacity of the Scotian Shelf cod fleet in the 1850s (Taylor 2012).

The philosophical and sectoral perspectives of individuals and institutions, and the theories and methods they favour, importantly shape data collection and interpretation (Khagram et al., 2010). Such frameworks change over time, and vary from observer to observer, institution to institution, region to region. Historians consider the individuals (or teams) collecting the data, their backgrounds, training, and intellectual and career trajectories. As

shown in figure 1, it is recommended that datasets include metadata on all these aspects of the collection process, including how the data was recorded and/or published. This information should inform a consideration of the biases and omissions of the data collection and presentation processes.

Measurement, space, and time (figure 1 (b))

Long-term data series often draw on data not originally collected to serve this purpose: they are artefacts driven by present concerns which often elide significant differences in the various sources they combine. The most obvious discontinuities are the result of differences in measuring equipment, units of measure and observational techniques. This complicates the standard approach to measurement error, i.e. applying statistical techniques to multiple measurements.

The precision of recorded locations of physical features, and natural history observations varies widely for large parts of the globe outside of Europe prior to 1900. Political and administrative units seldom remain unchanged for long, and maps project creations like ‘Thailand’ (c.1900) into past eras – when they did not unite any such territorial schemas (Livingstone 2003).

The determination of dates and comparison of data organised into units of time is also not straightforward: the Gregorian Calendar was initiated in the 1580s, but patchily implemented across Europe, with Britain and its colonies (including America) finally adopting it from September 1752 (‘losing’ 11 days from that year). The Greek Orthodox countries of the Balkans and China waited until the 1910s to adopt the Gregorian system, and Russia until 1918 (Duncan 2011): in each case, days were ‘won’ or ‘lost’. In official

records, reporting periods change: for e.g., analysis of state forestry reports of fire in South Africa is complicated by such shifts, with anomalous 'long' or 'short' years where adjustments to new systems were made.

Conceptual filters (figure 1 (c))

A less obvious challenge to interpreting historical data is the theory-ladenness of observation, and how this changes over time. This operates at the theoretical level, and Worster (1994) provides an overview of key developments in twentieth century ecological thought. History of science, environmental history, and science and technology studies journals provide more specific guidance on particular themes and regions.

Powerful metanarratives of deforestation and desertification – which originated in European ecological thinking and colonial forestry and agriculture and were disseminated across colonial networks – continue to distort contemporary thinking on environmental change and management. Davis (2007) argues that outmoded biogeographical ideas in combination with racist attitudes influential during the French colonial period still shape contemporary conceptualisations of land degradation and prescriptions for environmental management in the Sahel. Fairhead and Leach (2000), Kull (2004) and Pooley (2014) have shown how conceptions about fire, climate and vegetation formulated during colonial times deeply groove recent thinking about fire management and vegetation change in Guinea, Madagascar and South Africa, respectively.

Changes to conceptual frameworks and units like taxonomies, species definitions, and biome and ecosystems definitions, over time complicate estimates of long term trends in abundance and distribution (Keith et al. 2015). Examples include the conservation

consequences of how steelhead trout (*Oncorhynchus mykiss*) were classified by American conservationists (Alagona et al. 2016), or more generally, the reclassifications of species in accordance with phylogenetic rather than biological species definitions (Agapow et al. 2004).

Terminology may vary subtly over time, and is often contested. Examples include shifts in the definitions and connotations of terms like ‘balance,’ ‘equilibrium’ and ‘disturbance’ (Worster 1994). ‘Savanna’ only emerged as a biome in the 1970s, gathering up a range of previously recognised and separately studied categories of vegetation ranging from grassy woodland to wooded grassland known internationally as cerrado, caatinga, chaco, miombo, mopane, mulga, and brigalow (Huntley and Walker 1982).

An example of where historical terminologies and vegetation categorisations have serious policy and management impacts concerns tropical grassy biomes (TGBs). As noted, savanna is a recent coining, and in many regions (notably Africa and India) colonial scientists and managers considered such landscapes to have been degraded by indigenous practices, notably burning. Parr et al. (2014) argue that many TGBs are still misclassified as degraded woodland, with serious implications for their management (notably large scale reforestation which is actually afforestation).

Human influences, anomalies and exceptional events (figure 1(d))

In order to make useful inferences from trends in historical data, it is necessary to understand the range of independent variables affecting natural variations in space and time of the parameter in question. Human influences have too often been excluded from

attempts to factor in such independent variables (Szabó & Hédl 2011). This is sometimes because they are the agents behind infrequent or even unique events, as are extreme geophysical events like volcanic eruptions.

The official report on the unprecedentedly large bushfires on South Africa's Cape Peninsula in January 2000 concluded that 'there is little to suggest that the fire regime has changed much over the past 50 years or more' (Kruger et al. 2000). An environmental history of fire on the Peninsula (Pooley 2014) shows that on a local scale nearly all dimensions of the Peninsula's 'natural fire regime' had been influenced by humans in this period. Considering human influences on fire regimes in developing conservation policy should for instance include considering how different temporal patterns like holidays and weekends influence 'natural' fire seasons.

The schematic presentation in figure 1 of course conceals considerable complexity. An expert's published theories don't always match what they recommended for implementation 'in the field'. In South Africa in the 1950s, researchers argued in scientific journals that fire in humid grasslands was natural and ecologically necessary, but in the face of official intransigence also developed rotational grazing schemes to replace burning as a management strategy (Pooley, 2017). While experimental work proved fire was ecologically necessary for fynbos (macchia) in South Africa's Cape region by the late 1940s, powerful narratives of fire as an agent of desiccation and destruction blocked implementation until the 1970s. While prescribed burning of South Africa's fynbos mountain catchments was official policy from the 1970s, economic and labour strictures meant prescribed burning had all but ceased by the late 1980s (Pooley 2014).

Historians unravel the ways in which these dimensions of conservation – relating to research, policy and management (each with their own periodicities and significant events) – intermesh or fail to engage over time. Steen-Adams et al. (2015) offer a model of how historical methods can improve managers’ understanding of the evolving dynamics of the coupled human and natural systems they manage through revealing legacy and time-lag effects.

Conclusion

We neglect the methodological challenges of ‘data mining’ and interpreting historical sources at our peril. Triangulation can too easily be impressionistic: historical evidence that ‘fits’ with data collected with more familiar scientific methods is often not subjected to appropriate methodological scrutiny. The use of historical approaches as summarised in figure 1 could improve the accuracy of the data we use to assess the conservation status of species and ecosystems, and prioritise conservation action. More profoundly, historical methods reveal the specific interplays of factors influencing policy and management in particular social-ecological contexts, at a range of spatial and temporal scales (Pooley 2014, Steen-Adams et al. 2015). Recognising this could generate fruitful interdisciplinary work and inform more reflexive, and successful, conservation science.

Darwin (1859: 485-6) urged us to ‘regard every production of nature as one which has had a history ... nearly in the same way as when we look at any great mechanical invention as the summing up of the labour, the experience, the reason, and even the blunders of numerous workmen.’ There is nothing inevitable about evolution; humans and other living beings, and

the landscapes and earth systems we depend upon, are the outcomes of particular histories of entanglement. The data we record to comprehend these trajectories, whether qualitative or quantitative, are abstractions shaped and framed by humans; we should remember this when trying to learn from the past.

Acknowledgement

The author is grateful for constructive comments from the anonymous reviewers.

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Figure 1 provides a conceptual schema for thinking about the kinds of metadata to collect and consider when working with historical datasets. The letters (a) to (d) above the left hand column of panels cross-refer to where these issues are discussed in the text. Historical analysis is a process of synthesis as much as analysis, and involves consideration of these variables in interrelation (it is not as linear a process as the figure implies).

