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Pooley, Simon (2018) Descent with modification: critical use of historical evidence for conservation. *Conservation Letters* 11 (4), e12437. ISSN 1755-263X.

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Descent with modification: Critical use of historical evidence for conservation

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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 article considers the often overlooked methodological challenges of sourcing and interpreting historical data. A schema is provided for conservation scientists, summarizing 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.

KEYWORDS

conceptual frameworks, environmental history, historical ecology, history, method

1 | INTRODUCTION

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 (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 (McClenachan, Ferretti, & Baum, 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, Langston, Adams, & Mladenoff, 2015). In the conservation science literature, the use of historical sources usually refers to data mining “the past” using the scientific methods favored by historical ecologists. These

data can inform policy and management, for example, where to prioritize effort and limited resources in the current biodiversity crisis. This article considers the methodological challenges of sourcing and interpreting such historical data.

History has many uses for conservation science, but this article 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 (Baisre, 2015; Wiersma & Sandlos, 2011).

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 are sparse, and Pauly (1995) flagged up the issue of shifting baselines, researchers have resorted

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to the skillful investigation of historical sources—from skipper's log books to restaurant menus (Holm & Bager, 2001; McClenachan et al., 2012). 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, Falk, & Guerrini, 2014)?

Researchers acknowledge the challenges of integrating historical data into the practise of ecology (Clavero, Nores, Kubersky-Piredda, & Centeno-Cuadros, 2015; Delibes & Delibes-Mateos, 2015), and some have criticized 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, Crowder, and Micheli (2013), 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 organized by computer science methods, and analyzed 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 analyze 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 article.

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, Mendelsohn, & Milner-Gulland, 2014). However, historical ecologists and conservationists should also not be naive about the challenges of using historical data. This article outlines the most important of these, summarized in a conceptual framework for collecting metadata on historical sources (Figure 1). Careful attention to these can improve the practice of historical ecology, and therefore the basis for the policies and management actions it informs.

2 | 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.

2.1 | Why, how, and by whom data are collected (Figure 1, a)

For data production, which data are gathered and how these are 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 prioritized 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, 2012; Taylor, 2012).

Historical data may be ignored, 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 generalized from field observations (Messel, Vorliceck, Wells, & Green, 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, Manolis, Whitehead, and Letts (1984) conducted extensive historical research, consulting explorers' publications, trade records, and interviewing former crocodile hunters. This showed 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, Delaney, Fukuda, & Fisher, 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 & Clapham, 2015). Another is skepticism 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 favor, importantly shape data collection and interpretation (Khagram et al., 2010). Such frameworks change over time,

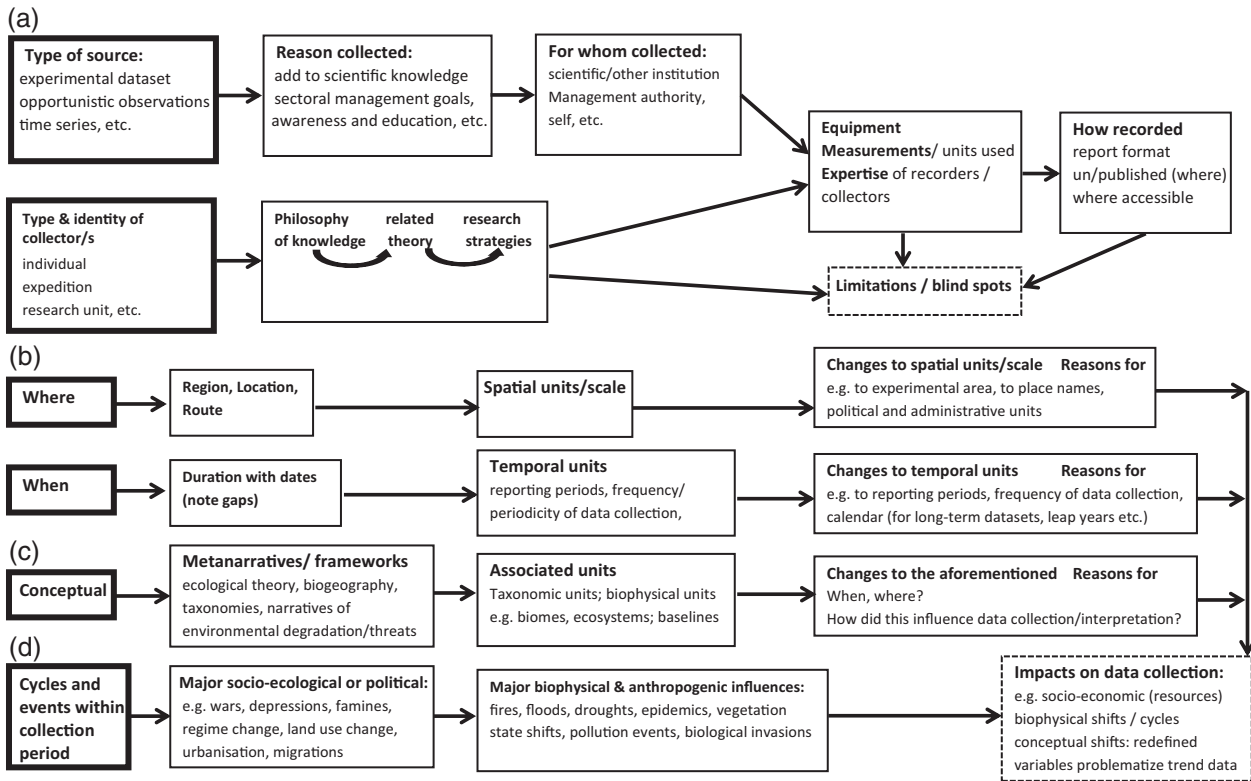


FIGURE 1 Provides a conceptual schema for thinking about the kinds of metadata to collect and consider when working with historical data sets. The letters (a) to (d) above the left-hand column of panels cross-refer to where these issues are discussed in the text. Historical analysis is a process of synthesis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

and vary from observer to observer, institution to institution, and region to region. Historians consider the individuals (or teams) collecting the data, their backgrounds, their training, and intellectual and career trajectories. As shown in Figure 1, it is recommended that data sets include metadata on all these aspects of the collection process, including how the data were recorded and /or published. This information should inform a consideration of the biases and omissions of the data collection and presentation processes.

2.2 | Measurement, space, and time (Figure 1, b)

Long-term data series often draw on data not originally collected to serve this purpose: they are artifacts 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 organized 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 example, 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.

2.3 | 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 20th-century ecological thought. History of science, environmental history,

and science and technology studies journals provide more specific guidance on particular themes and regions.

Powerful meta-narratives 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 conceptualizations 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, 2016), or more generally, the reclassifications of species in accordance with phylogenetic rather than biological species definitions (Agapow, Bininda-Evans, & Crandall, 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 recognized 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 & Walker, 1982).

An example of where historical terminologies and vegetation categorizations 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, Lehmann, and Bond (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).

2.4 | 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. Factoring in human influences on fire regimes when developing conservation policy should, for instance, include consideration of 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, 2018). 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 labor 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.

3 | 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 summarized in Figure 1 could improve the accuracy of the data we use to assess the conservation status of species and ecosystems, and prioritize 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). Recognizing 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 labor, 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.

ACKNOWLEDGMENT

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

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How to cite this article: Pooley S. Descent with modification: Critical use of historical evidence for conservation. *Conservation Letters*. 2018;11:e12437. <https://doi.org/10.1111/conl.12437>