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Contributed Paper

Advancing the Integration of History and Ecology for Conservation

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Abstract: *The important role of humans in the development of current ecosystems was recognized decades ago; however, the integration of history and ecology in order to inform conservation has been difficult. We identified four issues that hinder historical ecological research and considered possible solutions. First, differences in concepts and methods between the fields of ecology and history are thought to be large. However, most differences stem from miscommunication between ecologists and historians and are less substantial than is usually assumed. Cooperation can be achieved by focusing on the features ecology and history have in common and through understanding and acceptance of differing points of view. Second, historical ecological research is often hampered by differences in spatial and temporal scales between ecology and history. We argue that historical ecological research can only be conducted at extents for which sources in both disciplines have comparable resolutions. Researchers must begin by clearly defining the relevant scales for the given purpose. Third, periods for which quantitative historical sources are not easily accessible (before AD 1800) have been neglected in historical ecological research. Because data from periods before 1800 are as relevant to the current state of ecosystems as more recent data, we suggest that historical ecologists actively seek out data from before 1800 and apply analytic methods commonly used in ecology to these data. Fourth, humans are not usually considered an intrinsic ecological factor in current ecological research. In our view, human societies should be acknowledged as integral parts of ecosystems and societal processes should be recognized as driving forces of ecosystem change.*

Keywords: driving forces, environmental history, historical ecology, interdisciplinarity, restoration, scaling

Avanzando en la Integración de la Historia y la Ecología para la Conservación

Resumen: *El papel importante de los humanos en el desarrollo de los ecosistemas actuales fue reconocido hace décadas; sin embargo, la integración de la historia y la ecología para poder informar a la conservación ha sido difícil. Identificamos 4 temas que limitan la investigación ecológica histórica y consideramos posibles soluciones. Primero, se piensa que las diferencias en conceptos y métodos entre campos de la ecología y la historia son grandes. Sin embargo, la mayoría de las diferencias se derivan de la falta de comunicación entre ecólogos e historiadores y son menos sustanciales de los que generalmente se piensa. La cooperación es posible mediante el enfoque en atributos que la ecología y la historia tienen en común y mediante el entendimiento y aceptación de puntos de vista diferentes. Segundo, la investigación ecológica histórica a menudo es obstaculizada por diferencias en escalas espaciales y temporales entre la ecología e historia. Argumentamos que la investigación ecológica histórica solo puede ser desarrollada en extensiones para las que fuentes en ambas disciplinas tienen resoluciones comparables. Los investigadores deben comenzar por definir claramente las escalas relevantes para el propósito determinado. Tercero, los períodos para los que no hay fuentes históricas cuantitativas fácilmente accesibles (antes de 1800 AD) han sido desatendidos en la investigación ecológica histórica. Debido a que datos de períodos previos a 1800 son tan relevantes para el estado actual de los ecosistemas como los datos actuales, sugerimos a los ecólogos historiadores que*

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busquen datos previos a 1800 y les apliquen métodos analíticos utilizados comúnmente. Cuarto, los humanos generalmente no son considerados un factor ecológico intrínseco en la investigación ecológica en curso. Desde nuestra perspectiva, las sociedades humanas deben ser reconocidas como parte integral de los ecosistemas y los procesos sociales deben ser reconocidos como fuerzas conductoras del cambio en los ecosistemas.

Palabras Clave: ecología histórica, escalamiento, fuerzas conductoras, historia ambiental, interdisciplinariedad, restauración

Introduction

In an editorial in this journal, Meine (1999) called for closer cooperation between conservation biologists and historians. He argued that "far from being an esoteric concern, the development of an historic sensibility ought to be considered fundamental to conservation biology. In fact, any teaching or practice of conservation biology that neglects history is incomplete." The important role of humans in the development of current ecosystems was recognized decades ago, and this recognition has affected conservation theory and practice. Despite recent progress, however, the "significant gap in the interstices of the disciplines" (Meine 1999) has only slightly narrowed. We believe the slow progress in bridging this gap is rooted partly in the differences between social and natural scientific discourse.

That history matters in ecology and nature conservation has been expounded on many times (e.g., Rackham 1998; Foster et al. 2003; Szabó 2010*b*). There are a number of disciplinary approaches to the study of historical interactions between humans and nature (Szabó & Hédl 2008). Here, we focused on environmental history (Worster 1988; Winiwarter & Knoll 2007) and historical ecology (Russell 1997; Bürgi & Gimmi 2007). Archaeology is closely allied to environmental history and historical ecology, but we did not consider this field in detail (e.g., Lambert et al. 1960).

Environmental history tends to consider ecological issues from the perspective of human society. By contrast, historical ecology focuses on past ecosystems and usually regards humans as one of the many factors that influence such systems. There is a branch of historical ecology, most prevalent in the United States, that embraces the tenets of ecological anthropology to a higher degree than other branches (Crumley 1994; Balée 2006). Here, however, we did not treat historical ecology from this perspective. In our view, environmental history and historical ecology recently have developed in separate directions and lost many of their previous commonalities. This same divergence has occurred between archaeologists (with the exception of palaeoecologists) and environmental historians and historical ecologists. Furthermore, although environmental history is a subject that garners international cooperation, historical ecologists on different continents and in different subdisciplines have so far largely disregarded each other's work (but see e.g., Bürgi & Russell 2001). Historical ecology, especially in the United States and Australia (Egan & Howell 2001; Lunt & Spooner 2005), is closely linked to conservation biology and restoration ecology. Several authors claim that restoration ecology is in fact applied historical ecology (Swetnam et al. 1999; Rackham 2003).

In a review of how ecologists relate to the social sciences, Lowe et al. (2009) argue that in ecology people are construed in three ways: as an ecological audience, as ecological agents, or as ecological subjects, or objects. Although the first of these constructions sharply separates nature and culture and therefore renders social scientific investigations moot, the second and third assume people play an active role in ecosystems, either as external factors or as integral elements. In historical ecology, much work is based on the assumption that people are external factors in ecosystems. For example, many researchers describe the historical distribution of land use types on the basis of old and recent maps (Eriksson et al. 2002; Herben et al. 2006). However, researchers who go beyond such a mechanistic approach and include people as integral elements of ecosystems are rare. In addition, it is apparent that although some social scientists, especially economists and environmental policy researchers (Røpke 2005; Lawton 2007), regularly collaborate with ecologists, historians in general do not.

We sought to identify why history and ecology have not been integrated to inform conservation efforts and to offer some suggestions for historians and ecologists on how to cooperate. We recognize that our characterization of ecologists and historians is oversimplified; nonetheless, our characterizations represent existing perspectives. We focused on academic researchers in ecology and history. Many others involved in these disciplines (especially in conservation) do not encounter the obstacles we describe. We considered why history lags behind other social sciences in cooperating with ecology and why historical ecological studies that consider human society an integral part of ecosystems are rare. We believe there are four key issues that are likely responsible for this lack of integration: miscommunication between natural scientists and historians, differences in the spatial and temporal scale of research, neglect of periods for which quantitative historical sources are not easily accessible, and lack of research into the social forces that drove past changes in ecosystems.

Communication between Two Cultures

A general problem that hinders the successful integration of history and ecology so that these fields of study can inform conservation efforts ultimately stems from what C.P. Snow calls "two cultures" (Snow 1959), that is, the dichotomy between social and natural scientists. The first field of study in which ecologists and social scientists cooperated successfully was economics, probably because ecology and economics share an interest in competition and quantitative research approaches (Lowe et al. 2009). History, however, has no such obvious similarities with ecology. Moreover, communication between historians and ecologists is made difficult by "the different ways [they] see the world, that is [their] constitutive metaphors" (Wear 1999). In interdisciplinary research the usual peer review process is often inadequate (Naiman 1999; Wear 1999). Ingerson (1994) summarized the dichotomy between history and ecology, from her perspective as a long-term editor of the journal *Forest & Conservation History*: "science was read as bad humanities research, and work in the humanities as bad science." Despite the obstacles, we think the divide between ecology and history is mostly due to difficulties in communication rather than to fundamental differences between the two disciplines (Carr 1961).

Generality versus Particularity

Every scientific discipline has its own pattern of development. In some disciplines, various phenomena are seen as manifestations of general underlying rules. Searching out such rules is not encouraged in all disciplines.

In contemporary ecology, there is an apparent tendency toward generalizability. Even if results are derived from few data, the authors aim to provide and interpret results with the widest possible applicability. The foremost ecologists of today seek to discover the general laws of nature's functioning. The most simple and universally valid patterns and relations are sought, which could align ecology with other natural sciences, such as physics (May 2007). Macroecology (Brown & Maurer 1989), for example, is closely connected with the aspiration to generalizability (Lawton 1999; Whittaker et al. 2001). This tendency toward generalizability is also evident in the well-established use of mathematical and statistical approaches in ecology, which aim to assess the general value of a particular set of observations through statistical methods (e.g., Vernier et al. 2008).

Current historical research, by contrast, focuses on specific cases and approaches the study of general patterns with caution. Partly, this may be a reaction to grand theories of the past (e.g., Marxism), which—usually in their simplified versions—attempted to explain the entire history and future of humankind. Quantitative approaches have had a small (although not negligible, especially in social and economic history [e.g., Hudson 2000]) role in the study of history.

We think the present state in the development of history and ecology should be considered part of a long process in which the focus on the general or the particular alternates. In ecology the current search for general laws grew out of efforts by leading ecologists of the mid-20th century (e.g., Whittaker 1965). In history, a strong tendency to generalize in the first half of the 20th century was based on the French sociologist Durkheim's ideas about "social facts" (Durkheim 1982). Through a critique of Durkheim, the historian Bloch promoted an individualistic approach to the study of history in the 1940s (Bloch 1949). Furthermore, even now some research focuses on the particular in ecology and the general in history. In ecology a widely acknowledged research aim is to identify singularities, unique phenomena, or extremes, situations in which generalizability is not relevant. An example from plant ecology is the recently reported absolute elevational maximum for vascular plants (Klimeš & Doležal 2010). In history a controversial new approach is cliodynamics, which mathematically models historical dynamics in social processes (Turchin 2008). There are approaches that combine rather than mutually exclude the general and the particular. For example, microhistory is a research direction in history that focuses on case studies. However, its explicit goal is to arrive at general conclusions, which—so it is argued—can paradoxically be achieved only through the detailed analysis of particular events (e.g., Gray 2001).

Research Methods

Historians and ecologists think that their research methods are very different. Indeed, there is apparently a major difference in analytic techniques. Generally ecologists test hypotheses and analyze their data with mathematical statistics. By contrast, historians do not use hypotheses and usually employ inductive reasoning with a relatively free structure of argumentation. These differences often lead to misunderstandings between ecologists and historians. Some historians fail to see the original ideas behind mathematical statistics, whereas some ecologists dismiss historical research as subjective, descriptive, and lengthy storytelling (i.e., they do not view it as science). Despite the differences, good research in any discipline has similarities. High-quality research consists of forming a meaningful story.

Ecologists and historians conduct research in basically the same way. First, they identify a question. To answer this question, they establish some facts (which ecologists call data). These facts are recognized as such as long as they are established in accordance with the accepted methods of the discipline. In history, the most fundamental research method to establish the reliability of information is source criticism (Howell & Prevenier 2001). To a

large extent this is similar to designing a sampling method in ecology, which requires that data be collected in a way that is amenable to statistical analyses and repeatable.

Through their data both ecologists and historians try to find an answer to their original question. This often takes the form of hypotheses testing in ecology, in which methods receive considerable attention, because they often bring new insights (Freckleton & Iossa 2010). In history, methods are not a central issue. Nevertheless, there is a history journal that focuses on methods and has the subtitle *A Journal of Quantitative and Interdisciplinary History*.

The last step in research is interpretation of the results, which can take various forms, from discourse involving the findings of other authors to speculation. In articles ecologists call this *discussion*, whereas historians use the term *narrative* when talking about the interpretation of their results (Cronon 1992; Munslow 2007). In historical research, results and discussion are often not distinguished formally, whereas in ecology papers they are usually strictly separated. In the past decade, the role narrative can play in ecology and conservation policy has been increasingly recognized (Allen et al. 2001; Armitage 2004; Zellmer et al. 2006). In a wider context, postnormal science (Funtowicz & Ravetz 1993) acknowledges the similarity in the interpretation of results between social and natural sciences. "Although the calibrations in science may not be richly narrative, the synthesis that is the raison d'être of the calibration is in fact a narrative, even if the scientist does not normally think of it that way" (Allen et al. 2001).

Publication Strategies

Publication strategies differ in the natural and social sciences. In short, historians write books and ecologists write journal articles. This difference has far-reaching consequences. Historians believe that anyone who has not produced a book in his or her career is not a serious scholar. For historians articles are usually preliminary stages in a book project. Ecologists in academia, by contrast, are trained and required to produce articles in peer-reviewed journals, preferably with a high impact factor.

Information flow has accelerated and become automated in the past few decades. Articles and journal rankings are accessible online. Bibliometrics provide much useful information, but they can also be controversial (e.g., Brumback 2008). The keystone of the system is the number of citations of individual articles. Scientific success through citation frequency requires the broadest possible audience, a requirement that favors articles on general topics with relatively widely applicable results. This situation largely determines where, what, and how natural scientists publish. The need for publications and citations has led to a fast turnover of information and its partitioning into many short articles with a quickly recognizable message. The structure of papers is consequently inflexible.

By contrast, the content of most books is not accessible online. Historians therefore do not usually know how many times their books have been cited. However, they do not see this as a disadvantage and find internet-based indexing and impact factors largely unnecessary and irrelevant even in the case of journals. In March 2010, the Journal Citation Reports of ISI Web of Knowledge contained only 22 journals in the history category, and although some of the journals are indeed prestigious, this is by no means an exhaustive list of the most respected history periodicals. Within current institutional systems the publication strategies of ecologists and historians are unlikely to change in the short term. However, the difference in publication strategies does not have to be an obstacle to successful cooperation between historians and ecologists because this difference stems from tradition and is not related to research quality.

Scale and Precision

The scale at which phenomena occur is considered a principal issue in ecology (Storch et al. 2007). Scale includes extent and resolution. The former comprises the spatial and temporal area of a study. Resolution or grain refers to the minimum area in which data are recorded (Wiens 1989). Fine resolution traditionally allows only for small extents, whereas large extents are usually linked with coarse resolutions. However, these relations are slowly changing through the use of automated recording devices, such as remote sensing instruments, which allow researchers to sample large extents at fine resolution. The spatial extents of ecological research are extremely variable, from microscopic to worldwide (Wiens 1989). Variation in temporal extent is similar: ecology studies can address seconds or evolutionary periods (Fig. 1).

Both the spatial and the temporal extents of history are more limited. Nonetheless, they are neither uniform nor problem free. History has to do with humans; therefore, its spatial extent cannot be microscopic. However, many extents are possible, from households to the world. The temporal scope of history is restricted. Most of human history is within the domain of archaeology and anthropology, whereas historians usually focus on the past several thousand years, from which written evidence survives (Fig. 1). Perhaps the most ambitious conceptual framework within which to interpret historical space and time in modern historical research was put forward by Braudel (1958), who argued there are three temporal extents (event, *conjoncture* [≈ trend], and the long term), which correspond to spatial extents from small to large.

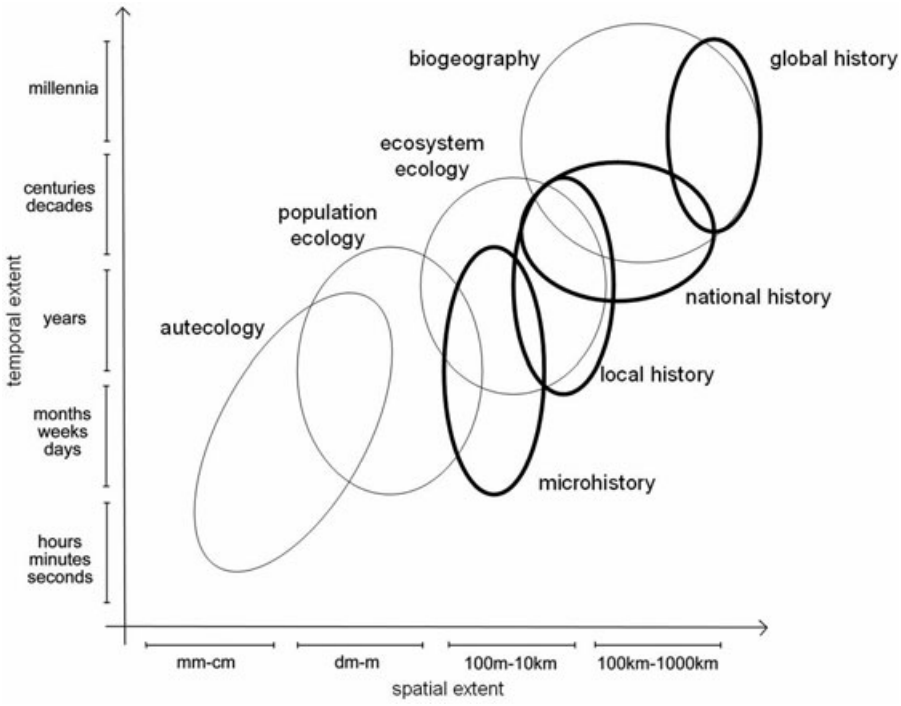

Figure 1. The typical spatial and temporal extents of research in the main historical (dark ovals) and ecological (light ovals) subdisciplines.

A connection between historical and ecological data can be achieved when sources of comparable resolution exist in both disciplines. The overlap in spatial and temporal extents of ecological and historical research delimit the extent of research in historical ecology (Fig. 2). Before historical ecological research begins, historians and ecologists must develop a spatial and temporal framework suitable for their investigations.

Another aspect to be addressed when integrating historical and ecological research is precision of sources. Historical sources are usually precisely defined in time, but not in space. Much historical information is neglected in ecology on the grounds that it does not meet the precision requirements set for ecological research (Whitney 1994; Bürgi et al. 2004). The precision of ecological sources is extremely variable, largely depends on

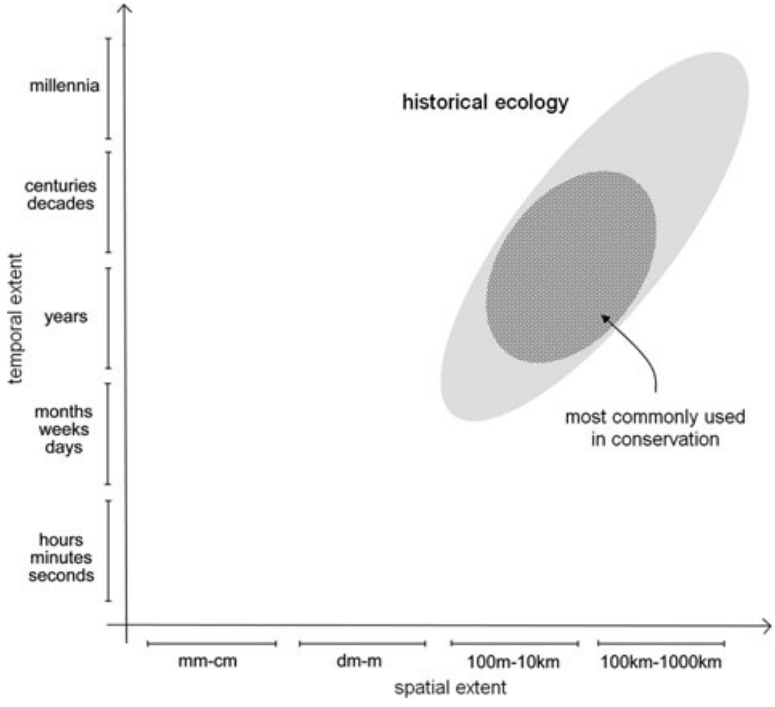

Figure 2. The potential range of historical ecology research on the basis of the overlap between history and ecology from Fig. 1.

the focus of the research, and is thus closely related to scale. The apparent spatial imprecision of historical data often results from the researchers' attitudes rather than the sources themselves. The kind of spatial precision required by ecological investigations is often thought of as unnecessary for historical studies and is therefore neglected. However, the use of geographic information systems (Gregory & Ell 2007) is helping historians develop new ways of expressing historical data more clearly in space.

The Pre-1800 Dilemma

A major obstacle to successful cooperation between history and ecology is that most of the period historical investigations cover is not addressed in current historical ecological research. With few exceptions (e.g., Verheyen et al. 1999; Rackham 2003), historical ecological investigations do not cover more than the past 200 years. In the United States and Australia this coverage may seem justifiable because European settlement brought about radical environmental changes and systematic written evidence for earlier periods does not exist. However, decades of environmental historical research (e.g., Denevan 1992) demonstrate that the precolonial landscapes on these continents were not unaffected by humans. In Europe most landscapes have been heavily influenced by humans for millennia (Birks et al. 1988). To appreciate the effect of humans on the world's ecosystems, one needs a perspective longer than two centuries. Palaeoecology partially addresses the long-term development of ecosystems (Berglund 1987; Willis & Birks 2006). However, palaeoecological studies usually focus on distant time periods. High-resolution studies in which more recent written and archaeological sources are compared are relatively rare (e.g., Davies & Dixon 2007).

Nevertheless, in general the majority of historical ecological studies pertain to only the past 200 years. The reasons for this are simple: data from the last 200 years (in the form of maps and written sources) are numerous, relatively easily accessible, and compatible with freshly collected ecological data. Such data fit well into ecological and conservation biology studies (e.g., Verheyen et al. 2003; Herben et al. 2006; Wulf & Rujner 2011). Sources earlier than AD 1800 are, however, more difficult to work with. They were written in dead languages (usually in Latin) or in early versions of modern languages (such as Old English, Middle High German, or Byzantine Greek), which require special training to understand. They were written on a case-by-case basis through nonstandardized procedures and are therefore not ideal material for the creation of large databases. Furthermore, early sources are difficult to interpret. They are usually connected to social, economic, and legal phenomena (such as land tenure systems) that are impossible to understand without a deeper knowledge of the historical context. In addition, pre-1800 sources usually contain measures that are hard to translate into SI units. At the time, many measures were defined locally or by methods unfamiliar to the modern mentality (e.g., defining the size of a wood by the number of pigs it can support). Moreover, early sources are often difficult to associate with a location because of the poor preservation of place names.

Nonetheless, it is a fallacy that sources on ecosystems before the nineteenth century, at least European sources, are not available in relatively large quantities. Archives are full of useful information; however, it needs to be located, interpreted, and turned into data for ecological studies. This requires the involvement of historians with the necessary skills. For example, environmental historians began to conduct successful quantitative work on past climates in the 1960s (e.g., Le Roy Ladurie 1967; Pfister 1984). What can be achieved in historical ecology is illustrated by the study of medieval account books by a forest ecologist and a medievalist to glean information on historical fire regimes. Lloret and Marí (2001) analyzed the annual account books of the Spanish town of Tortosa between AD 1370 and 1466. The books contain hundreds of entries about daily payments for firefighting in the Middle Ages. Because local place names have survived, the authors were able to identify locations of historic fires. They were also able to estimate the magnitude of these fires on the basis of the number of work days invested in suppressing them. The data were statistically evaluated and compared with data on fires that occurred between 1966 and 1996.

Societal Processes as Driving Forces in Past Ecosystems

Perhaps the most challenging task in historical ecological research is to move beyond construing people as external factors of ecosystems. In a survey of ecologists actively cooperating with social scientists, Lowe et al. (2009) found that a minority of these ecologists (who are, in turn, a small minority among all ecologists) are willing to embrace the concepts and methods of social science in their work. However, for historical knowledge to have a useful connection with ecology and conservation biology, it is essential to consider past societal processes as ecological driving forces (phenomena that lead an event in a specific direction) with direct relevance to current ecosystems (McDonnell & Pickett 1993). To do this, ecologists need to examine compatible data and establish common conceptual bases with historians. In turn, historians need to seek out where and how current historical concepts mesh with ecological concepts.

Conservation professionals realize that the successful implementation of conservation policies depends to a large extent on social, economic, political, and cultural

circumstances. Typically, the reintroduction of abandoned management forms—a key aspect of conservation in many parts of the world—depends on outside (usually governmental) funding until it is more strongly embedded in local society (Berkes 2004). Understanding social, economic, and other societal forces that drove past ecosystem and landscape patterns (Bürgi et al. 2004; Szabó 2010*a*) can help conservation professionals inform policy decisions. Past social and economic situations may be analogous to current situations; therefore, knowledge of the past may be useful in predicting possible effects of policy decisions (Crumley 1994). Current ecosystems and current societies have developed over long periods. How a society is likely to behave in the future is strongly connected to its past. By integrating historical concepts into ecological research, conservation professionals may come to a much better understanding of the possible future consequences of their efforts.

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