

# Historical Ecology in Brazil

Subjects: [Anthropology](#) | [Environmental Sciences](#) | [Archaeology](#)

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The term “Historical Ecology” has been defined by two different research scholarships: (1) as a field that draws upon diverse evidence to trace complex, long-term relationships between humanity and Earth; and (2) as a field related to evolutionary ecology and the use of phylogenetic systematics, which may or may not involve anthropogenic agency. Here we embrace and refer to the first definition. Hence, Historical Ecology is a multidisciplinary field (or research program) that investigates human-environment relationships resulting in continuous spatial, environmental, historical, and cultural interactions. Its primary focus is the physical evidence etched in the landscape. The use of landscape as an analytical framework and spatial unit is valuable and widely used in Historical Ecology.

biomes

historical approach

multidisciplinarity

research gaps

methodologies

## 1. Introduction

Historical Ecology recognizes that human activity can be considered an ecological factor influencing the biophysical environment <sup>[1]</sup>. Nature and culture are impossible to tell apart, making it challenging to define a “natural” landscape <sup>[2]</sup>. Balée <sup>[3]</sup> proposes four central postulates to the research program of Historical Ecology. One of those considers that humans have affected every environment on Earth. Changing one part of a system (e.g., species composition, management system, settlement pattern) inescapably influences all other factors since the variables are intertwined <sup>[2]</sup>. In understanding, Carole Crumley’s definition of Historical Ecology best encapsulates how we understand this field: “Historical Ecology traces the ongoing dialectical relations between human acts and acts of nature, made manifest in the landscape. Practices are maintained or modified, decisions are made, and ideas are given shape; a landscape retains the physical evidence of these mental activities. Past and present human use of the Earth must be understood in order to frame effective environmental policies for the future”<sup>[4]</sup> (p. 9).

According to William Balée <sup>[3]</sup>, Historical Ecology received contributions from many fields such as environmental history, historical geography, palaeoecology, and landscape archaeology <sup>[5]</sup>. Solórzano, Oliveira, and Guedes-Bruni <sup>[6]</sup> also identify bridges between Historical Ecology, environmental history, and historical geography in their goals to investigate the relationships between humans and nature in landscapes throughout time with different interconnections among these three fields. Historical Ecology, on the one hand, has roots in European (paleo)ecology and landscape history/archaeology, and on the other hand, roots in North American

cultural/historical geography, specifically Carl Sauer's Berkeley school, and also in environmental anthropology, especially in the 1990s [2][5][7].

As a multidisciplinary field [8], Historical Ecology does not have a single research methodology [5][7]. Instead, it aggregates several methods from various academic disciplines that incorporate cultural, historical, linguistic, biological, and environmental data [9]. These include the use of natural (e.g., palynology, packrat middens, dendrochronology) and documental (e.g., forest inventories, climate records, remote sensing) archives [10]. Historical Ecology also integrates different sources, including physical evidence such as archaeological relics of material culture or pollen records, and references from the humanities like oral history or historical archival consultation [11]. In any case, an essential characteristic of the methods is the spatio-temporal component, necessary when investigating a specific landscape and its historical processes [8].

In Brazil, Historical Ecology was addressed initially in studies located in the Amazon region [12], for example, in the course of the Xingu River [3][13]. Several Historical Ecology publications have appeared in the last twenty years, not only for the Amazon but also for other biomes—especially the Atlantic Forest—with diverse temporal, spatial scales and methodologies.

## 2. A Systematic Mapping of Scientific Articles (1998–2021)

In order to depict the Historical Ecology in Brazil, it is used a method called systematic mapping. It consists of a description of the literature across a broad subject of interest. It does not attempt to answer questions that require critical analysis. Instead, it describes available evidence; this is useful to identify general patterns and knowledge gaps about the research topic [14]. Systematic mapping formulates a narrative description of the state of the evidence base [15]; this descriptive approach is similar to other published review studies [15][16][17]. It could conduct a systematic mapping to catalog all the published scientific articles about Historical Ecology in Brazil in Portuguese, English, and Spanish until May 2021. It designed the variables to overview by whom, where, when, what, and how Historical Ecology research was conducted in Brazil.

## 3. Whom

It is found that 43% of the articles were written by one author, 13% by two authors, 14% by three authors. The articles with the most authors have 14 and 16. There are a total of 264 authors, 158 men researchers (60%), and 106 women researchers (40%). Concerning the gender perspective, men make up a higher proportion of historical ecology researchers in Brazil within our study period compared to women. Considering only the researchers with Brazilian affiliation, it is found a slightly more equitable ratio of 58% men and 42% women.

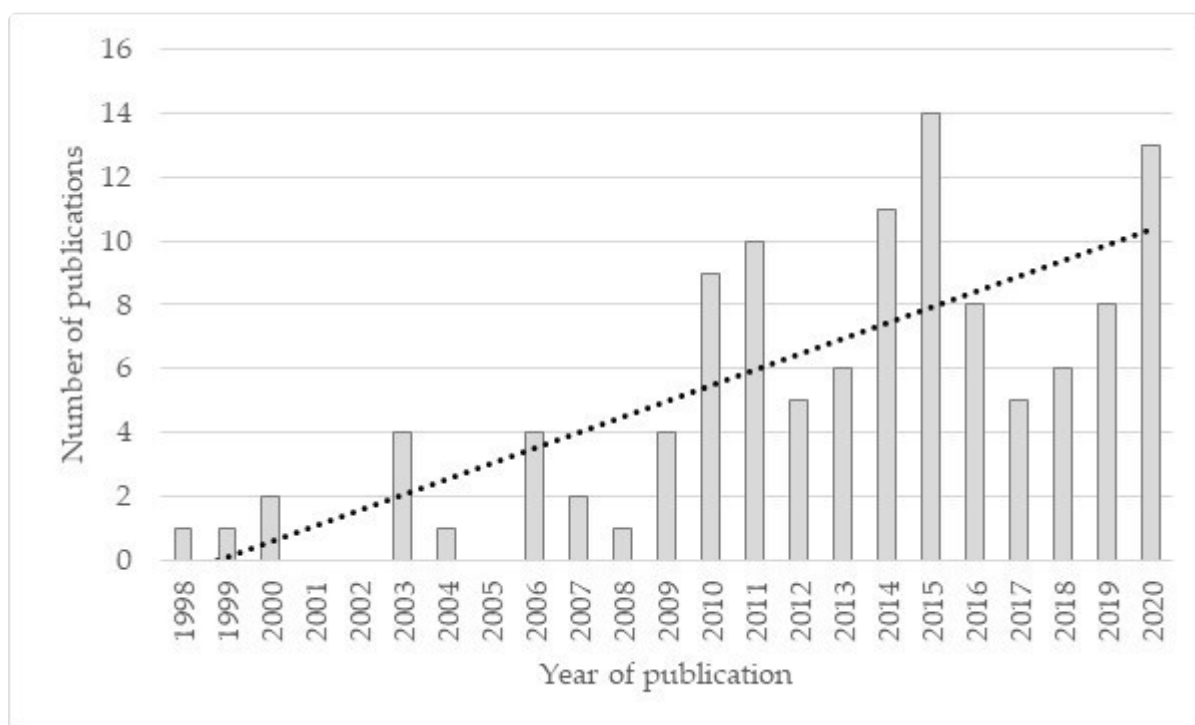
Concerning the country of affiliation of the authors: 68% belong to Brazil, 11% to the United States of America, 6% to the United Kingdom, 3% from The Netherlands, and 2% from Argentina, and Spain each. There is relevant participation of authors affiliated with foreign countries doing Historical Ecology in Brazil, especially in the Amazon biome, though the Brazilian affiliations still hold the majority. This shows the importance of the Amazon biome for

international research due to it historically being regarded as the largest tropical forest remnant in the world and its relevance to global ecology and climate change [\[18\]](#).

There is a participation of 34 Brazilian universities (state, federal, communitarian, and private) and other affiliations, including federal institutions. The cities of Rio de Janeiro and São Paulo are the main centers of research aggregating different institutions in the southeastern region. The results showed the participation of many public universities. Sedrez and Nodari [\[19\]](#) explained that the federal universities in Brazil were strengthened by federal government funding and the creation of new universities in the early 2000s with a pro-science and education platform (Lula and Dilma era). The ample funding opportunities and science-friendly scenario (different from Brazil's current research funding policy) increased research agendas in federal universities and improved their research outcomes.

## 4. When

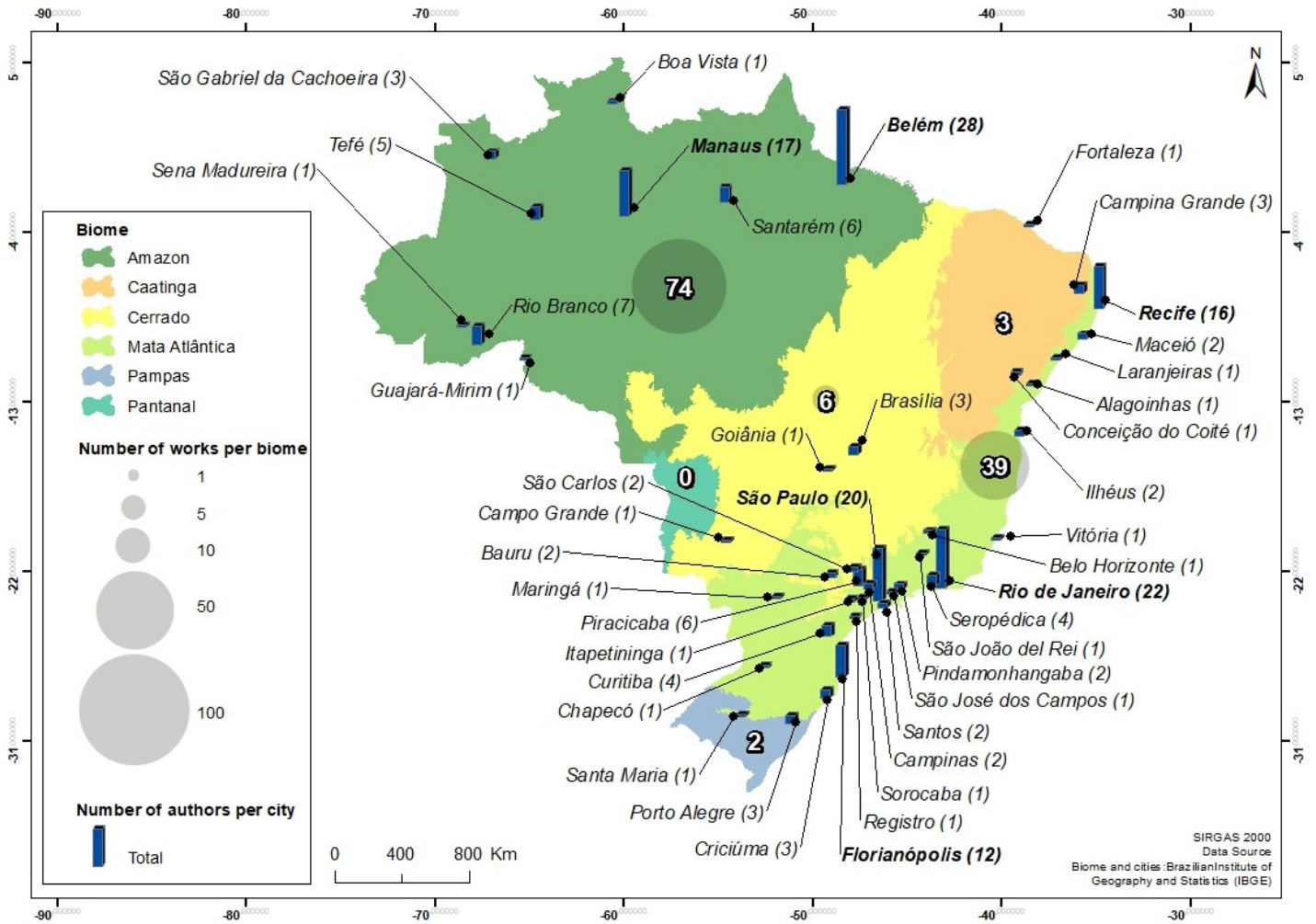
Figure 1 shows the number of articles published per year, the oldest we found is from 1998 [70], and 2015 reached the highest number of publications. There is a trend of increasing the number of Historical Ecology publications, as shown by the trend line. Concerning the historical periods investigated, a total of 90% of the articles study the 21st century, whereas 83% study the 20th century, 56% refer to the time before the 16th century, 44% to the 19th century, around 30% consider the 16th, 17th and 18th centuries, and 8% point out different geological eras. We must remember that the articles often refer to various periods. In the matter of the temporal scale in the papers, it is interesting to observe the capacity of Historical Ecology to address and answer questions in a lengthy scope of time. It also demonstrates the necessary collaboration with fields such as archaeology or geology. Some methodologies like palynology, anthracology, or C14 dating can bring data from thousands of years ago. In contrast, some other methods like hemerographic consultation or analysis of photographs show information on the contemporary period.



**Figure 1.** Year of publication of 115 articles until 2020. There is an increasing trend in the number of publications. For 2021, it was found three publications but did not include them here, as the yearly data is incomplete.

## 5. Where

It registered in which Brazilian biome researches were conducted. It's important to highlight that there were cases where the research dealt with more than one biome. It was found that five articles did not work with any biome: two of them are studies about marine environments, and therefore, the terrestrial biomes classification could not be used. In total, 60% worked in the Amazon and 31% in the Atlantic Forest, making 91% of the articles (including those studying one or more biomes). Five works study the Amazon and the Atlantic Forest [\[20\]\[21\]\[22\]\[23\]\[24\]](#); three pieces study the Cerrado Biome (Brazilian savannah) and the Atlantic Forest [\[25\]\[26\]\[27\]](#); one studies the Amazon, the Atlantic Forest, and the Cerrado [\[28\]](#); one studies the Atlantic Forest and Pampa [\[29\]](#); two studies the Cerrado [\[30\]\[31\]](#), one the Pampa [\[32\]](#) and three the Caatinga [\[33\]\[34\]\[35\]](#). There are no articles about Pantanal. Figure 2 shows the number of works per biome, the number of authors per affiliation in Brazil, and the city of localization.



**Figure 2.** Informative map of the number of works per biome and number of authors by city according to affiliation in Brazil.

One of the most evident results of our paper is the small number of articles in the biomes different from the Amazon and the Atlantic Forest. It do not underestimate the merits of the research in these biomes; it is necessary and useful. There is still much room for further research questions and tackling contemporary problems. However, given Brazil's biomes' biocultural diversity and ecological importance, it is essential to indicate the spatial gaps to encourage more research in the Pantanal, Pampa, Caatinga, and Cerrado.

## 6. What

The keywords show the essential topics of an article (Figure 3). The words with at least ten mentions were historical ecology, Amazon, forest, archaeology, landscape, environmental, indigenous, conservation, dark-earth, Amazonian, Brazil, management, and traditional.



There is a vast opportunity to research different species in Historical Ecology. It can be thought about the footprints in the landscape derived from the relationship between the history of Brazil and the brazilwood tree (*Paubrasilia echinata* (Lam.) Gagnon & H.C.Lima & G.P.Lewis). There is much to do considering animals, plants, and organisms from other kingdoms like fungi, algae, bacteria, or even viruses. Ironically, it are confined in the houses while writing this paper due to the global expansion of a zoonotic virus that is forcing humanity to change our ways of working, organizing, and relating to each other. The socio-environmental effects of Covid-19 constitute an attractive raw material for Historical Ecology.

## 7. How

It differentiated between explicitly using Historical Ecology as the primary research topic or as an auxiliary notion to support or dialogue with an investigation topic in a correlated field. It included both in this entry and determined that 37% of the publications had Historical Ecology as the main topic and 63% as auxiliary. It also distinguished between practical and theoretical works. Practical studies -using in situ fieldwork methodologies- represent 57% of the works, whereas theoretical ones use only ex-situ methodologies- represent 43%.

It identified more than 35 different methodological procedures used in the 118 articles. It is worth stressing that many studies comprised more than one method to achieve their objectives. Some of the methodologies used are: traditional literature review, interviews, Geographical Information Systems (GIS) and remote sensing techniques, floristic and phytosociological analyses, including botanical collections, collection of archaeological materials, soil analysis, analysis of laws and decrees, material dating (including C14), free listing, oral history, and historical archives consultation including hemerographic material (newspaper files) and commercial shipping records. Other methods used were participatory research techniques –including participative cartography and participative archaeology–, travelers’ journals consultation, anthracological analysis (analysis and identification of charcoal based on carbonized wood anatomy), water analysis, participative observation, guided tour, linguistic analysis, archaeology of the landscape, photographic sequences analysis, discourse analysis, among others.

The results confirmed the multidisciplinary nature of Historical Ecology. Some methodologies have an obvious disciplinary origin, such as archaeological material collection, stratigraphic excavations, shovel tests coming from archaeology, or Geographic Information Systems, and cartography coming from geography. However, other methods are used across various disciplines, such as interviews and statistical analysis. Szabó highlights that “the higher variety of sources of information, the more secure knowledge about the past (and therefore about the present) is”<sup>[1]</sup>(p. 384). That opens the possibilities to search not only for documental sources but also for other historical data corresponding with periods during which human impacts were not registered as ecological data <sup>[10]</sup>. Social perception studies can be helpful when no official data is available or incomplete <sup>[47]</sup>.

It learned about the importance of the participation of local people in different research approaches, given the various participatory research methods reported. More concealed (often considered in the Acknowledgements section of published articles) and yet essential is the local people collaboration as guides localizing research sites, identifying species, protecting from local dangers, helping with local remedies, leading to key informants, and so

on. Teaming up with local populations, not only as informants but also as colleagues for exchanging ideas, recognizing the value of empirical knowledge, is required to conduct field research in Historical Ecology.

## **8. Conclusions**

This study provided a comprehensive overview of the scientific articles on Historical Ecology in Brazil, informing by whom, when, where, what, and how research has been conducted. It also found achievements, research gaps, and opportunities for this field.

Some of the achievements in the field of Historical Ecology in Brazil are the generation of a large body of knowledge of anthropogenic dark-earth and the anthropogenic forests/landscape domestication in the Amazon. That could be used as a solid scientific argument to demonstrate how indigenous populations have historically shaped the Amazon forest, harboring rich biocultural diversity. There is still much to be done regarding the conservation of its biocultural patrimony. Brazil's Historical Ecology has grown in diverse research topics, methodologies, departments, national and international institutions in the last two decades.

Some of the research gaps and areas of opportunity are: Historical Ecology research brings a perspective that valorizes landscapes' environmental and cultural importance. This approach could be helpful to make better management decisions, for example, in environmental restoration, and become a more policy-driven applied science. In terms of the spatial gap, more research is needed in the Pantanal, Caatinga, Pampa, and Cerrado biomes. Research in these biomes is crucial because they are reservoirs of unique biodiversity and provide particular environmental services on the local and regional scales. That implies the need to strengthen institutions and research groups promoting cross-disciplinary research located in these biomes. More research is needed focusing on animal species. This would require social scientists to work with experts in zoology, biology, ecology, and vice versa. Other life kingdoms should also be explored. Particular attention should be paid to marine environments, especially the interface between the land and the ocean, which is key to understanding the dynamics of the Brazilian population in the coastal Atlantic Forest. Given Brazil's dimensions, diversity, and accessibility, there is a need for generous funding for conducting in situ fieldwork research, both with national funds and with international collaborations, given the biocultural importance of all Brazilian biomes not only for the country but also at a global level. Cooperation with neighboring countries for research in biomes such as Amazon, Pampa, and Pantanal is necessary, as demonstrated in the Pampa region. The overview presented by whom, when, where, what, and how research has been conducted in Historical Ecology in Brazil. It showed a great diversity of authors, institutions, journals, study sites, study periods, research topics, and methodologies. The further development of Historical Ecology research in Brazil, valorizing the achievements and considering the research gaps and opportunities, can provide solid scientific evidence to support informed actions towards the urgent need for better conservation and management of the biocultural patrimony in all biomes.

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