American Journal of Qualitative Research
2025, Vol. 9 No. 3, pp. 162-181
https://doi.org/10.29333/ajqr/16541

AMERICAN JOURNAL OF QUALITATIVE RESEARCH

ISSN: 2576-2141

Researcher Perceptions of Historical Knowledge for Ecological Research: A Case Study in the Southeastern U.S.

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ABSTRACT
A growing trend favors holistic approaches to understanding and producing knowledge about the natural world, such as social-ecological systems (SES) and interdisciplinary fields like environmental history and political ecology. Similar to many other fields, the ecological sciences increasingly recognize the importance of site-specific history. However, research addressing scientists' perspectives and practices concerning historical knowledge within their research is lacking. This study addresses that gap by interviewing 14 researchers who have published ecological or natural sciences projects at a single long-term research site, the Duke Forest, regarding their understanding of Duke Forest's history and perceptions of its role in scientific research. The resulting data show that, among our interviewees, (1) all had more knowledge of ecosystem history than social history; (2) many did not consider site history a necessary component of their research; (3) opinions varied about the relevance of history in different stages of the scientific method; (4) many considered long-term ecological research sites such as the Duke Forest to be valuable. This research contributes to the evaluation of research practices in order to support more holistic research in the ecological sciences.

KEYWORDS: Historical ecology, environmental history, ecology, succession, natural sciences, research process

Introduction

In recent years, the social-ecological system (SES) framework, which describes the interconnected nature of human societies and the nonhuman environment, has gained widespread support in both academic and non-academic settings (McGinnis & Ostrom, 2014; Ostrom, 2009; Partelow, 2018). This comprehensive view of the world has made it clear that it is neither desirable nor possible to separate natural and human systems (Gunderson & Holling, 2002). For example, the lasting effects of human activity over millennia are now recognized as major components of the planet's ecological cycles (Foster et al., 2003). Researchers have documented pervasive impacts on the physical landscape, biodiversity, vegetation patterns, and soil composition throughout Central America as a result of Mayan activities 3,000 to 1,000 years ago (Beach et al., 2015; Hightower et al., 2014; Islebe et al., 1996). Freschet et al. (2014) examined former Sami settlements now considered 'pristine' Scandinavian forests and found that even the low-intensity

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land use from over a century ago left profound changes in vegetation composition and soil characteristics. On a global scale, warming effects from anthropogenic greenhouse gas emissions are predicted to persist centuries after their release (Matthews & Caldeira, 2008; Solomon et al., 2010). From fundamental changes in biodiversity to physical changes in forest composition, the legacy effects of ancient and modern human activities underscore the relevance of the comprehensive SES framework (Cuddington, 2011).

Acknowledging the complex, feedback-dependent nature of social-ecological systems suggests that our methods of understanding the natural world must reflect this holistic outlook. Among the numerous disciplines that are involved in SES research, history stands out as an especially important field. A review of journal articles involving the SES framework found that 'historical profiling & reconstruction' was the overall second-most popular method after spatial mapping and analysis and the most popular method for topics such as conservation, adaptation, climate change, and resilience (De Vos et al., 2019). Due to time lags in systemic disturbance responses, past events from a surprisingly broad timescale can hold great explanatory power in understanding the constant flux of ecosystems today (Bürgi et al., 2017; Dupouey et al. 2002; Foster et al., 2003; Lenzner et al. 2022).

The fields of historical ecology and environmental history have made strides in investigating past relationships within and between SES (Berkes et al., 2003; Hughes, 2016; Meyer & Crumley, 2012; Szabó, 2015; Worster, 1990). For example, case studies show that learning from past hazards and historical experiences is crucial in both studying natural hazards in mountain areas and building social resilience (Gardner & Dekens, 2007). Beyond resilience studies, understanding human and biophysical history plays a crucial role in a wide range of fields concerned with SES such as urban ecology, aquatic system management, agricultural science, and conservation (Bergman et al., 2022; Nayak, 2014; Roman et al., 2018). Building on this bevy of research, ecological, conservation, and restoration sciences are increasingly drawing from historical knowledge and the SES framework to inform their understanding of the present and future states of ecosystems (Bürgi et al., 2017; Foster et al., 2003; Higgs et al., 2014; Swetnam et al., 1999; Szabó, 2010). Although some environmental history scholars examine the effects of past global patterns such as ocean currents and tides (Worster, 1990), this paper focuses on 'history' as past events, states, and interactions localized to a site of interest (Rackham, 2004). Given that the site of interest is Duke University's Duke Forest Teaching and Research Laboratory, located in the Piedmont of North Carolina, particularly relevant histories include those of Indigenous people, European settlers, and enslaved people and their descendants, as well as the ecological and land use histories.

The Duke Forest's rich history shows inextricable relationships between people and the landscape. Located across Durham County, Orange County, and Alamance County of North Carolina, the Duke Forest today is surrounded by the Sappony Nation, the Occaneechi Band of the Saponi Nation, and the Haliwa-Saponi Nation (*About Our Tribe*, n.d.; Cagle et al., n.d.; Hazel & Dunmore III, 2015; *History - OBSN*, 2021; *Sappony History Timeline*, 2023). European settlers began farming present-day Duke Forest land in the mid-1700s, by which time Indigenous populations in the area had been decimated by disease and forced removal (Cornes, 2023; Lawson, 1984). Records show that some farms were worked by enslaved people for generations, and it has been suggested that a full accounting of enslaved individuals may not have been included in legal documents (Frankel, 1984; "William A. Couch Papers" as cited in Cornes, 2023). Agricultural practices in this region during the 18th and 19th centuries often involved intensely farming small patches of land until yield declined, then abandoning that patch and clearing a new one (Frankel,

1984; Oosting, 1942). This practice led to significant topsoil loss and soil degradation, eventually leading to widespread farm abandonment in the 19th century (Lynch, 2007; Silkenat, 2022). Abandoned clearings were immediately dominated by grass and annual forb communities, later replaced by pines and subsequently hardwoods (Christensen, 1977; Oosting, 1942). Agents of the Duke family and Duke University began purchasing adjacent farms and abandoned land in the early 1920s, founding the Duke Forest in 1931 as an education and research facility (Lynch, 2007). The Forest has detailed data on sample plots dating back to the 1930s, which has distinguished Duke Forest as a valuable, long-term research site for ecological change and succession in the Piedmont (Xi & Peet, 2008). The Duke Forest continues to serve as a thriving hub for research, education, and recreation.

Scientists can only incorporate such impactful site history into ecological research if they recognize history as a critical component of their work, possess adequate historical knowledge of the research site or the means to acquire it, and have available methods to incorporate this information into their research frameworks. In general, however, very little is documented regarding how or if the humanities and social sciences are considered within the scientific process, especially when projects are not explicitly interdisciplinary. Specifically, we have not found existing literature on natural scientists' knowledge of the social-environmental histories of their study sites and how they use such information in their research. This study aims to address this paucity of research by exploring ecologists' knowledge of the history of their research sites and the perceived role of site history in their research. We focus on scientists who have conducted ecological research at the Duke Forest and explore their perceptions of the role of site history in their work and knowledge of the Duke Forest's past.

Research questions of how forests respond to disturbances and how communities interact with different drivers are inherently historical because they require a thorough examination of intra- and inter-system interactions over the long timescales of ecosystems (Schwartz, 2007). The Duke Forest is a valuable case study because it has been a leading research site for forest succession and community ecology for decades (Christensen & Peet, 1984; Lynch, 2007; McDonald et al., 2007; Oosting, 1942; Payne & Peet, 2023; Schwartz, 2007). Therefore, exploring Duke Forest researchers' perceptions and knowledge of Duke Forest history can inform broader patterns of the treatment of site history in the ecological sciences. This understanding is an essential step for researchers and institutions to promote a wider incorporation of history in ecological research. More broadly, this work can also add to the body of literature assessing the challenges of interdisciplinary inquiry.

Methods

We conducted semi-structured interviews with 14 ecology or environment-focused natural scientists who have conducted field research in the Duke Forest. Interviewees were identified through a Google Scholar search for natural science articles published after 1960 with the phrase "Duke Forest" in the abstract, and through snowball sampling from interviewees and Duke Forest staff. 1 out of 14 interviewees was identified exclusively through snowball sampling. We contacted first authors and co-authors of more than one publication to select for a greater degree of intellectual involvement in the research process. Modeling studies were excluded. Only studies published in English were considered. Interviewees' research topics at the Duke Forest include but are not limited to: seed dispersal, vegetation composition, effects of elevated carbon dioxide, soil carbon accumulation, forest succession, and transpiration. These topics encompass the wide range

of research conducted at the Duke Forest. Importantly, these topics tend to fall in the domain of disciplinary ecology and environmental science rather than interdisciplinary fields. These topics encompass the wide range of research conducted at the Duke Forest. All interviewees were randomly assigned a number to ensure confidentiality, and are subsequently denoted as Interviewee 1, Interviewee 2, and so forth.

The semi-structured interview was designed to elicit flexible responses from the interviewees. Interviewees were not further pressed to elaborate on aspects they had not spoken about. Follow-up questions were asked as needed for clarifying purposes. All interviewees were asked five questions. Four questions were always the same:

1. Tell us about your time doing research in the Duke Forest. How did you come up with your research? What was your process for creating research questions, and what background or skills did you use to do this?
2. Can you tell me what you know about the land use at your research site at Duke Forest? What is your knowledge of its history and peoples?
3. How did you learn about the history of the land of the Duke Forest, if at all?
4. In what ways has the history of Duke Forest influenced you and your research?
5. The final question was different based on the interviewee's response to the previous question about their knowledge of Duke Forest's history.
    a. If the interviewee had little knowledge about site history, as self-assessed in their response to the previous question, they were asked: 'If you had learned and implemented this knowledge into your research practices and findings, would anything have changed?'
    b. If the interviewee had strong knowledge about site history, they were asked: 'Since it did influence you, could you imagine how your research would have changed if you hadn't implemented that knowledge?'

In two of the interviews, a question was either omitted by the interviewer or posed with incorrect wording. The response to the incorrectly posed question was excluded from data analysis.

All interviews were conducted via Zoom™ from January to February 2024 and lasted from 8 to 33 minutes depending on the length of the interviewees' responses. Consultation with institutional IRB staff indicated that since interview questions were based solely on researchers' professional experiences rather than personal or demographic questions, additional IRB approval was not necessary. Interviews were recorded on Zoom™ and transcribed using online software Otter.ai (2025), and a researcher manually verified and edited all transcripts for errors. Transcripts were read multiple times to perform open coding, which allowed conceptual themes to emerge inductively from the data (Strauss & Corbin, 1998; Thomas, 2006). We then coded the data under hierarchical themes and subthemes using the qualitative research software NVivo 14 (Elliott, 2022). For example, a response of site history having a large influence on the research process was coded under the theme 'Large influence'. It was tagged with subthemes such as 'Guide and context' when the interviewee considered site history as contextual information that shaped the analysis of results, and 'Expansion' when the interviewee described how historical knowledge of the area allowed broadening research insights and applications.

We pursued our question with a constructivist approach in which meaning is created from subjects' interactions with objects and the world around them writ large (Crotty, 1998; Moon & Blackman, 2014). We referenced the tradition of narrative inquiry to draw meaning from interviewees' retrospective accounts of their experiences (Cortazzi, 1993; De Fina &

Georgakopoulou, 2015). As such, we posit that the recounting of real-life experiences by the interviewees reveals constructed meanings and beliefs held by the interviewees.

Results

We identified four key themes from our interviews. The themes deal with knowledge of forest site history, education about site history, incorporation of site history into the research process, and the history of ecological research itself. Specifically, our interviewees noted:

Knowledge of Duke Forest History

When asked about their knowledge of the history of their research site at the Duke Forest, interviewees defined the research site differently. Some interviewees interpreted the research site as the entire Duke Forest, while some only spoke about the specific areas within the Duke Forest where they located research plots. Interviewees who reported a broad interpretation of their research 'site' also had some of the longest research experience out of all interviewees:

> *My research site in the Duke Forest is the Duke Forest. so we have those 200 odd plots that [name redacted] and I put down that I mentioned are all over the place. And so I'm looking at the Forest writ large.* (Interviewee 5)
>
> *So the only hint of history that I have or two hints that I have in my research sites are the undulations of the surface which typically tells you that somebody was plowing it and because the forest can be quite old you know that it has been a long time ago. The second thing that I know ... is that we have a clay pan that is typically ... in this area associated with somebody plowing the soil to a certain depth.* (Interviewee 2)

Interviewees exhibited different extents of historical knowledge about the Duke Forest. Overall, interviewees had more knowledge of land use and ecological history than of the past and present Duke Forest residents. Three interviewees showed rich knowledge of land use in the Duke Forest from European settlement to the present, and five interviewees noted some knowledge of 20th-century land use in the Duke Forest. One interviewee extensively described rich knowledge of the ecological history of Duke forest: about the vegetation composition and distribution.

Many interviewees explicitly noted a lack of knowledge about the history of Indigenous peoples and formerly enslaved peoples in what is now the Duke Forest. Two interviewees reported some knowledge of Native nations whose ancestral and present lands encompass the Duke Forest, but no specific details were disclosed. Even if the interviewee did not mention a lack of knowledge of the peoples' history in the Duke Forest, no interviewee explicitly mentioned having rich knowledge about the Indigenous peoples who had lived or currently live around Duke Forest.

> *And I know Duke Forest ... belonged to the Native Americans. ... but I don't know anything specific really outside that.* (Interviewee 6)
>
> *You know, people lived there originally ... Still, [we] don't know a lot about exactly how the Sappony Nation and other Native peoples used the land.* (Interviewee 9)

Some interviewees noted that the extent of their historical knowledge changed over time. One interviewee said that she has forgotten the history of the Duke Forest since her research period. In contrast, one interviewee explicitly described learning more about the Sappony nation's

relationship with the Duke Forest after his research period had ended, because he has lived in Orange County since then.

> *I still live in ... Orange County. So since then I know a little bit more about the Native people, the Sappony nation peoples that lived in this area.* (Interviewee 9)

Many researchers described how they learned about Duke Forest's history during the research process through various methods instead of starting out by first studying history as a foundation.

Learning Duke Forest History

According to the interviewees, there were several methods through which some natural science researchers proactively learned Duke Forest's history. Many interviewees had read scholarly literature from both the social and natural sciences. Most researchers had read literature on the history of Southeastern forests and Orange County, with only one researcher having learned indirectly from writings on Duke Forest history in other dissertations.

Some interviewees also mentioned having used Duke University sources such as maps, books, datasets from past research, and aerial photos in order to learn land use history. One interviewee also used government census records and tax data to study Duke Forest's past social composition.

Some interviewees described learning about history from other researchers, Duke Forest staff, and residents. Other academics and Duke Forest staff were the main informants, with only one interviewee saying that he gained more historical understanding from interacting with residents as he was living near Duke Forest. While one interviewee explicitly mentioned consulting other researchers to learn about Duke Forest history, others said history arose organically during discussions with Forest staff and academics. This element of auxiliary learning was common throughout many responses regarding lessons from other experts.

> *[Land use history] was often something that he would talk about when we would have meetings, and I would be chatting about the data set and what I was seeing. He would often bring up ... land use and how that might affect the kind of results we're seeing.* (Interviewee 11)

This theme of auxiliary learning continued in firsthand exploration as a method of obtaining historical knowledge. For example, one interviewee mentioned learning components of family history and the history of formerly enslaved people from encountering cemeteries and mills.

> *I could see places where we know when the land is abandoned and what was done there. So that wooden bridge near there, there's the old mill. And if you go look at the foundation of the old mill, you can look at where the dam was. ... You can see trees that became established around 1916, when [people] abandoned that land and then grew trees, we could see the cemeteries where Robsons were buried, and cemeteries [where] their small population of slaves were buried.* (Interviewee 5)

Many interviewees also mentioned inferring ecological history such as forest succession and land use history from examining present conditions such as soil type and location, vegetation composition and distribution, and general landscaping.

> *We dug ... 90 centimeters from the surface. We get into some layer that feels like cement. The tree roots can absolutely not grow through it. What*

> *could be that? ... It must be as a result of the fact that it was used in agriculture for a very long time.* (Interviewee 2)
> *There's one place where they cut out all of the ash because they're trying to get hickory and oaks to grow there, so I could see how that has changed.* (Interviewee 5)

Some interviewees regretfully noted a lack of past documentation on fine-grain land use and peoples who have lived in and around Duke Forest. One person described an improvement in the rediscovery and documentation of people's history around the Duke Forest area.

> *In that time, we learned more also about the Indigenous people on the land, which, ... when I first came here, was very little ... It was not proper scholarship. ... That's less true now. We know an awful lot more.* (Interviewee 3)
> *You don't think of fire in the Piedmont very much, but there was an awful lot of Indigenous burning to keep the forest open and huntable and traversable like this. And again, unfortunately, we don't really know where that was done, at least not in a kind of spatial detail. But we know it has been don*e. (Interviewee 13)

Influence of Duke Forest History on Scientific Research

When asked about the influence of Duke Forest history on their research, researchers' responses varied greatly. Some researchers did not place significant weight on history for the purpose of their research. One interviewee said that she saw her research site as being unaffected by recent human activity and therefore did not consider history relevant to her research project.

> *A lot of the plots that I use data for ... hadn't really been used by people other than for collecting data for at least a few decades before we started collecting data on it. ... I was considering the plots to be like natural forest plots that we were just measuring. Whatever the land use history was, I wasn't considering it explicitly in my research.* (Interviewee 11)

Some interviewees emphasized focusing on present conditions instead of past ones. According to them, history is only relevant as a precursor to the current conditions that contextualize their scientific research, but not an object of interest in itself. These comments indicate a conceptual separation between the present physical states of matter and the historical processes that gave rise to them. In particular, we see a distinction between past physical conditions of the research site and past human activity. These interviewees did describe Duke Forest's ecological history before characterizing it as irrelevant to their research but did not describe the human history of their site.

> *I think for me, the history did not matter as much simply due to the fact that most of the measurements were done under current conditions compared to elevated atmospheric CO2... So the history as to the extent that it affects the soil processes in terms of what was there as carbon stores and what was the nitrogen status of the soil. These were the key parameters for us.* (Interviewee 1)
> *What was important to us was that [the soil layer] was there. We could quantify the characteristics of this layer in terms of the physics. How quickly can moisture penetrate it? Would it actually generate a saturated layer above it? All those physical questions about the soil rather than*

> *who'd done it or why or when. ... I have no other knowledge of who was there before and what they [did]. I know that if we go far enough it was not people with our color that were here before and that we took their land and all of that stuff but has really no implication to my research whatsoever.* (Interviewee 2)
>
> *[The history of the Duke Forest] hasn't [influenced my research]. ... What we are looking at is how trees that were planted at [a] given time ... interact with the environment. So what we need to ... know is: is there anything in the ... past management that affects soil properties? That would be something that we would be concerned about. Other than that, not really. ... Being an old field does have some legacy effects, but we are not really able to discern those.* (Interviewee 6)

On the other hand, some researchers placed significant weight on history. Many interviewees described the importance of history in the scientific research process itself. Specifically, some interviewees said history had served as an important guide and context in formulating research questions and conducting analysis.

> *As we go back deeper before that, there's what I mentioned about the early Europeans and their land uses. When we try [to] interpret why this forest is different from that, we try [to] look back to see if there is an explanation like this ... when we're seeing a broad transition in the landscape, such as the replacement of oaks and hickories…* (Interviewee 5)
>
> *So those in a way, because I was using the long-term vegetation data, were like background info, right? So trying to understand how past land use influenced current composition. And that, by the way, was still a theme in my work ...* (Interviewee 4)
>
> *The other thing about the land use history was the fact that the rooting zone of the trees was very shallow. In other words, because of farm practices [the] soil was compacted and there was a hard clay pan at some 50 centimeters below the ... surface of the soil, where basically the roots could not penetrate much deeper. So that part of it we were aware of when we did some initial surveys and caught samples and extracted basically the profiles of soil composition.* (Interviewee 1)

Three interviewees said that knowledge of past land use in the Forest provided direct clues in interpreting data and drawing conclusions. One researcher described the direct relationship between previous cattle presence and present vegetation patterns. Another researcher described forest succession research as asking "fundamentally a historical question", emphasizing the importance of historical background for a more comprehensive analysis of data.

> *You know, the question of ecological succession is fundamentally a historical question. We're asking: how does what happened before shape the processes that are undergoing right now? And I guess I would say that I'm actually growing a greater appreciation for the role of history in ecological studies… more as sort of an essential lens that if you don't know about the history of the site where you're working, you're likely to misinterpret the results or at least you're missing the potential for understanding some critical variation that might underlie the results.* (Interviewee 12)

In some cases, history also appeared to play a role in determining researchers' intellectual paths after the research project had ended. One interviewee described how reading about the past residents of the region and their farming practices sparked his next research question.

> *... agriculture in the Southeast ... became very intensive maybe a thousand years ago as corn had been domesticated and matched with beans and squash and tomatoes and potatoes and it was a very diverse set of crops. ... that agriculture, according to the anthropologists, is practiced mainly on the flood plains. So that's only 5% of the landscape region-wide... . Most of our work had been in the uplands where these European and African Americans were cultivating cotton and tobacco and wheat and corn. So that got me into the 'Oh, let's go down to the flood plains'.* (Interviewee 10)

Another three interviewees said their knowledge of Duke Forest's history and past research activities had a large influence on their research trajectory: it led to starting different research projects or expanding and generalizing pre-existing ones.

> *From a generic point of view if you take your question ... and take Duke Forest out, it is such an exciting question ... . I could see the historical past that led directly to this interest we have in the city soils because what we're trying to do is uncover past contamination that's no doubt throughout the city ... but yet to be found.* (Interviewee 10)
>
> *I sort of started here in North Carolina, in the Duke Forest. My perspectives have broadened rather considerably, but those earlier years in the Duke Forest influenced what I've done elsewhere. So, for example, we established something we call the Carolina Vegetation Survey, where we've been trying to document the compositional variation of the forest ... across North and South Carolina. [We go] out and [record] vegetation similar to what we did in the Duke Forest in the seventies, but probably a little more sophisticated in that we're making sure that we get document variation and spatial scale, etc. But we now have maybe 6,000 of these plots sprinkled across the Carolinas, where we can ... get more generality at what drives the natural vegetation of the region. ... And as we've accumulated those data, I've also become engaged in other activities which might use them. And gone on to look even more broadly, globally.* (Interviewee 5)

An interesting theme apparent in the above quotation is that some researchers have a strong understanding of the history of their discipline and the research that has been conducted at the Duke Forest. Notably, the same interviewee had also commented that "the history of Duke activities" had had an impact on "how we see forest dynamics". However, this awareness of past research activities was not accompanied by attempts to further explore other aspects of the Duke Forest's history.

One researcher described an increasing appreciation of history throughout his career. He described how he had become interested in Duke Forest's human history and landscape history and had incorporated historical projects into his career. This interviewee was the only respondent to indicate history becoming an intellectual focus in itself and not just as supplementary knowledge to support science.

> *So we [have] been involved in thinking about this notion of human history, landscape history, how we interchange, that became a really important theme in my research and some of the things that I've written over time. Some of them were lay oriented than scientifically oriented so in that time some of that history was, I would say, maybe anecdotal, some of it less than that. ... So you know, I am first and foremost a botanist, a forest ecologist, and I would never claim to be a historian as such, but it's something that is really, it has really interested me and I have done some writing on it.* (Interviewee 3)

When asked whether anything about their research might have changed had they had a different level of historical knowledge about the Forest at the time of research, interviewees again gave a great variety of responses. For instance, some interviewees said having had more historical knowledge would not have influenced their study at all because it was not relevant to their question. In those responses, it was clear that the interviewees had completely precluded possible historical effects on their study sites from an early stage.

> *If we had known that there's something specific on those specific spots that we had our plants, our plots, if something had happened to the soil at some point, in principle, yes, there could have been something that ... happened that would have affected our results. But I doubt that this would have been anything so drastic.* (Interviewee 6)

In contrast, other interviewees said that history had played a role in their research. A few interviewees noted history was too ingrained in the setup of their study for them to imagine having conducted the same project without that historical knowledge.

> *[Without history] it would have been hard to find areas to do my research. I guess I wouldn't know what to look for or where to find my study organisms so ... I guess you could say it's knowing that level of history is almost necessary for doing my research.* (Interviewee 7)
>
> *A lot of my work has been on habitat connectivity. ... If you work at spatial scales like that, you can't get away from history. You can't know the forest history of those systems without knowing that they were, for example, grazed by sheep herders ...100 to 50 years ago. So all of my work has at least touched on history.* (Interviewee 13)

Some interviewees did say that their project would have been written differently had they had more historical knowledge at the time of working actively in the Duke Forest. A few interviewees said they may have made changes in the background and discussion to mention more historical facts about the peoples who had lived in Duke Forest. One interviewee regretfully noted that, according to the past and present culture in academia, many papers completely omit Indigenous history or only discuss it in a very limited scope.

> *I don't think [historical knowledge] would have necessarily changed the plots that I decided to use, the statistical approach I used, or the research question. But I think it could have added some more interesting context and discussion to my dissertation chapters and articles.* (Interviewee 11)
>
> *I didn't read [Indigenous history] in other papers ... I still probably don't see very much. It's in papers when people have their little method section or their background of a place that they're researching in ecology. You know, most people just talk about the agricultural history, ... but not really very far back. ... So I think now, if I were to*

> *do a research project there, I would probably do more background research on the entire history ... about the people that have been there. And more acknowledging that I'm doing research on land taken from someone else.* (Interviewee 9)

Importance of a Long-Term Ecological Research Site

In the responses, another theme emerged separate from the original questions: the importance of having a long-term ecological research site with an extensive historical record and unfragmented, accessible forest (n=5). Interviewees noted that historical knowledge enriches the ecological research possible in Duke Forest.

> *The history of the forest as created by Duke for Duke University has had an impact, because they made a piece of land. It's incredibly valuable, preserved ... in an area that's otherwise becoming houses and urban development. So just the opportunity to have a large tract of protected land, and in some cases well-documented history is unique and wonderful.* (Interviewee 5)
>
> *But to forest ecologists, having that long-term perspective on populations and using that to understand causation is really, really important. And Duke Forest has one of the better long-term records…. So …it was valuable for that.* (Interviewee 4)

In particular, one interviewee elaborated on the value of having a rich body of academic work completed in the same forest by previous researchers, and being able to add to the knowledge.

> *So this giant bevy of research ... put Duke on the map as a place to do ecology. ... Well, I think that's where people like [name redacted] and I might have felt like we really inherited this wonderful measure. And we pretty much worked on it all of our careers. ... that history, which we've been able to add to, hopefully, ... has made the forest almost... invaluable… . [We] not only have a beautiful place, but we know an enormous amount about that.* (Interviewee 3)

Summary and Discussion

Knowledge of Duke Forest History and the Learning Process

The extent of researchers' knowledge of the history of their research site varied greatly depending on the type of history considered. While many interviewees had significant knowledge about the past land use and ecological history at Duke Forest, nobody reported rich knowledge about the past and present residents of Duke Forest. In fact, several interviewees specifically noted a lack of knowledge about the many layers of diverse human histories of the Duke Forest. The prioritization of physical and ecological history over social history suggests that many scientists may not practice the social-ecological perspective in their research, focusing mostly on their field sites as natural systems instead.

Many researchers considered the history of a research site irrelevant or subsidiary for their research questions. Some interviewees had not explored possible historical effects in their study site at all, even though they acknowledged the potential existence of lasting effects from previous land use. While some interviewees had proactively read historical literature, many interviewees

reported having incidentally learned about the Forest's history. Juxtaposed with the wealth of available information about the Duke Forest (Christensen, 1977; Frankel, 1984; Lynch, 2007; Xi & Peet, 2008), these data indicate that history was not a key area that informs ecological research within the interviewee cohort. There was no correspondence between the timing of an interviewee's research in the Duke Forest and their knowledge of site history. As described by one interviewee, the academic tradition of either omitting historical information or relegating it to a small section of the background section may have contributed to this phenomenon.

The potential of history to significantly enrich scientific inquiries in a holistic and arguably more accurate manner underscores the importance of exploring its current treatment within the scientific field. For example, conservationists now commonly use the concept of 'historical range of variability'(HRV) that reflects the range of past conditions instead of a set of baseline values (Higgs et al., 2014; Morgan et al., 1994; Szabó, 2010). Understanding processes that have been 'normal' for a system can help scientists and policymakers restore ecosystems and prepare for potential reactions to disturbances (Higgs et al., 2014). They can also help restorationists identify "reference sites" against which to compare focal sites for restoration (Brudvig et al. 2014). This concept is a small part of a larger paradigm shift in conservation and restoration sciences that has brought the focus away from static metrics to dynamic processes as markers of healthy, resilient systems (Sellberg et al., 2018; Walker & Salt, 2006). Although profound climate and environmental change may diminish the predictive power of HRV, its value in informing management decisions is widely recognized (Bürgi et al., 2017). Given that this comprehensive perspective requires understanding the social and ecological past of a system, this shift demands the study of history.

Place-based historical knowledge holds great cultural and social value that supports scientific inquiries. As argued by Higgs et al. (2014), understanding our intertwined ecological and social history can confer humility that can deter harmful environmental management strategies and strengthen environmental behaviors. Historical understanding of a place can also strengthen cultural ties and preserve place-based cultural heritages (Bürgi & Gimmi, 2007; Masterson et al., 2017). These outcomes both hold inherent value for local communities and can be manifested in the form of pro-environmental behavior and support for scientific research (Higgs et al. 2014; Masterson et al., 2017).

Despite the suite of reasons (see Introduction) that illustrate the importance of history in the ecological sciences, we have not found efforts to examine the representation of history in scientific research practices. Although this study can begin filling this gap, much more research is needed to explore scientists' understanding of the history of their research sites and how to best support them in adopting more holistic research methods.

Influence of Duke Forest History on Research

Interviewees presented different perceptions of the role of history in different stages of the scientific research process. Some researchers said history did not play an important role in their research or were only interested in the present conditions of their sites. In a few cases, history was considered background information that may supplement writing but is not essential in scientific inquiry. On the other hand, several researchers said that their understanding of land use history played a key role in formulating research questions and interpreting data. Furthermore, some interviewees described how their knowledge of the Forest's history and past research in the Forest shaped future research paths. These results are summarized in Table 1.

The finding that many interviewees were inspired by the Duke Forest's land use history suggests that history may play an underexplored yet crucial role from the beginning of the scientific research process. Observation is a key tenet of the scientific method that gives rise to research questions and forms the basis of analysis (Gauch, 2012). As exemplified in our results, historical knowledge can enrich the observation stage to inspire diverse research questions. Moreover, the history of a research site and its collection of past research can illuminate previous assumptions about landscapes and thus equip today's scientists to build on past works critically and transparently (Higgs et al., 2014).

Table 1

Interview Results on the Role of Site History in the Scientific Research Process

Steps of the scientific process	**The role of a research site's history, according to some interviewees**
Step 1. Focus areas of curiosity into specific research questions based on observations and background research	(+) Land use history as background information helped form research questions. (n= 4)
Step 2. Construct hypotheses	Not mentioned
Step 3. Define methods	(+) Regional history guided site selection. (n=2) (-) History did not play a role in site selection. (n=2)
Step 4. Collect (experimental) data	Not mentioned
Step 5. Analyze data against hypotheses and draw conclusions	(+) Land use history helped identify baseline values for analysis and draw conclusions from data. (n=2) (-) Site history did not play a role in statistical analysis or in drawing conclusions. (n=5)
Step 6. Communicate findings	(+) Historical knowledge supplemented the introduction and final discussions of a paper. (n=2)
Step 7. Determine next steps	(+) Personal research experience and past research at the [anonymized forest] helped generalize results and identify new study interests. (n=2)

Note. (+) represents responses that indicate site history was beneficial to the particular research step, and (-) represents responses that indicate site history was not beneficial to that research step.

These results can inform studies of interdisciplinarity as an example of the current treatment of history in the ecological sciences. Interdisciplinarity is now commonly recognized as a key element of novel, high-impact research about the world's complex problems and realities (Okamura, 2019). Scientific research has also become more interdisciplinary in the last few decades (Porter & Rafols, 2009). In response to the growth of interdisciplinary practices in academia, many studies have examined their challenges and opportunities. Notably, some studies of interdisciplinary knowledge production have documented researchers' lived experiences throughout the research process through anthropological traditions and cognitive ethnography (Haapasaari et al., 2012; MacLeod & Nersessian, 2014; Villeneuve et al., 2020). The narratives

compiled by this study can provide a more detailed insight into how and why scientists draw from historical knowledge, as well as their reasons for not doing so. For example, we find that many scientists did not consider site history as a source of aid for their research because they either considered their sites to be unaffected by anthropogenic activity in the recent past or because they considered past events uninformative in the examination of present conditions. These attitudes could reflect a lack of emphasis in the ecology graduate curriculum on the importance of site history for ecological patterns and processes or robust methods for incorporating it into the research process. This adds to current research on epistemological barriers to interdisciplinarity that finds domain-specificity in many scientific fields to be an obstacle to researchers' ability to productively draw from other methodologies and bodies of work (MacLeod, 2018; Pooley et al., 2014). Identifying these barriers is an essential step in better supporting interdisciplinary research.

Importance of a Long-Term Ecological Research Site

The importance of long-term research sites such as the Duke Forest emerged as another strong theme in the data. Many interviewees spoke about the value of an accessible research site with an illustrious database of past research and site historical information. This finding is in concurrence with much of the literature documenting the value of long-term ecological research. The unique contributions of long-term ecological research include: facilitating studies of slow ecological processes intertwined with often unexpected actors, providing insight into future ecological responses and trajectories, containing strong bases of background information, and serving as platforms for interdisciplinary collaborations (Lindenmayer et al., 2012; Turner et al., 2003; Vucetich et al., 2020). The fact that many interviewees mentioned their appreciation of Duke Forest's longevity independently of the main interview questions emphasizes the significance they attribute to long-term research sites. This indicates value placed on research history, another kind of site history. As such, this study contributes to the body of knowledge on scientists' perceptions of the benefits of long-term ecological research.

Conclusion

In summary, the data reveal that within the cohort of Duke Forest researchers we interviewed: (1) all had more knowledge of ecological history than social history; (2) many did not consider site history a necessary component of their research; (3) opinions varied about the relevance of history in different stages of the scientific method; (4) many considered long-term ecological research sites such as the Duke Forest to be valuable. (1) indicates that many interviewees consider anthropological influences on ecosystems to be less important or relevant than environmental drivers. Although inferred land use history was often used as a proxy for considering past anthropogenic influence, many interviewees did not demonstrate active initiatives to learn who had used the land before the formation of the Duke Forest. (2) and (3) represent important contributions to historical ecology and interdisciplinary studies as a description of some scientists' current perceptions of site history. (4) demonstrates scientists' recognition of the unique values of long-term ecological research outlined in the literature such as the ability to study slow processes and serve as a platform for robust research.

We cannot draw generalized claims from this research as it was conducted with a small group of scientists who have worked in a common location. Additionally, we limited our questions to the research process rather than personal or demographic questions, and we did not collect

demographic data on the interviewees. We expect concerns associated with snowball sampling, including information withholding and unintended informant characteristics (Johnson, 2014), to be minimal for our study, as interviewees were aware their identities would remain confidential and we only included interviewees who conducted an ecological research project at the Duke Forest.

This work can contribute to the discussion on evaluating current research practices to facilitate more holistic research in the ecological sciences. For example, the result (2) that site history was not perceived as an essential component in ecological research by many interviewees suggests that perceptions of the role of historical knowledge may be a major barrier to holistic ecological research. Coupled with (3), this finding indicates that updating researcher perceptions of the benefits of historical knowledge at different stages of the scientific process may facilitate more holistic research in the ecological sciences that adopt an interdisciplinary lens. In particular, incorporating information about the usefulness of historical information and methodological training in the undergraduate and graduate ecology curriculum could improve ecologists' interest and ability to historicize their research sites. Future studies will benefit from working with a larger cohort of scientists from a wider range of disciplines and research sites to enhance their applicability.

Acknowledgments

We would like to extend our gratitude to the Office of the Duke Forest Director Sara Childs for her feedback on the manuscript, Maggie Heraty from the Office of the Duke Forest, and the John Hope Franklin Humanities Institute for supporting our research, and the Unearthing Duke Forest project team whose work provided a foundation for this research. We would like to thank our interviewees for generously contributing their time.

Funding Details

This project was made possible by a Duke Endowment Reckoning with Race, Racism, and the History of the American South grant by the Office of the Provost.

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