Received: 14 September 2021 | Revised: 18 April 2022 | Accepted: 6 July 2022

DOI: 10.1002/eap.2748

ECOLOGICAL APPLICATIONS
ECOLOGICAL SOCIETY OF AMERICA

ARTICLE

Special Feature: Advancing ecology through Black voices

The history of natural history and race: Decolonizing human dimensions of ecology

Maria N. Miriti[1] | **Ariel J. Rawson**[2] | **Becky Mansfield**[2]

[1]Department of Evolution, Ecology and Organismal Biology, The Ohio State University, Columbus, Ohio, USA

[2]Department of Geography, The Ohio State University, Columbus, Ohio, USA

Correspondence
Maria N. Miriti
Email: miriti.1@osu.edu

Funding information
U.S. National Science Foundation, Grant/Award Number: 2018939

Handling Editor: Gillian Bowser

Abstract

Natural history, loosely defined as the observational study of organisms in the habitats where they occur, is recognized at the roots of ecology. Although the centrality of natural history in ecology has shifted over time, natural history is currently in resurgence: many again consider it to be the foundation of ecological and evolutionary inquiry and advocate the value of organism-centered approaches to address contemporary ecological challenges. Educators identify natural history as the foundational entryway into the practice of ecology, for example in the Ecological Society of America's Four-Dimensional Ecology Education (4DEE) framework. A strong natural history foundation can help generate testable hypotheses to refine mechanistic understanding of the drivers regulating species distributions and abundances and to inform restoration and conservation efforts. Given the resurgence of natural history as the foundation for ecological knowledge and practice, it is important to recognize that natural history has a long history of racism that has impacted ecological thought and priorities. This history shapes not only who conducts ecological science but also foundational ecological concepts. For example, natural history's emphasis on pristine nature untouched by humans disregards or appropriates stewardship and knowledge of most of the world's population. Because of the legacy of chattel slavery, this exclusion is particularly strong for people of African descent. This exclusion narrows ecological inquiry, limits the capacity to find solutions to ecological problems, and risks interventions that perpetuate the relation between eugenics, ecological knowledge, and natural systems. If ecology is to become an inclusive, responsive, and resilient discipline, this knowledge gap must be addressed. We here present the colonial and racist underpinnings of natural history and offer strategies to expand inclusion in the study of nature. Natural history was steeped in racism, providing a hierarchy of cultures and a taxonomy of races. Complementing growing interest in traditional and Indigenous ecological knowledge, we focus on Black ecological knowledge, for example in the study of "maroon ecologies." Addressing the racist history of natural history is necessary for removing

structural and racist barriers to diverse participation and expanding ecological knowledge bases in service of better and more just science.

KEYWORDS
Black, Black ecology, Buffon, colonialism, Haeckel, Humboldt, inclusion, Indigenous and People of Color, Linnaeus, maroon ecologies, natural history, race and ecology, socio-ecological knowledge

INTRODUCTION

As natural history experiences a current revival, it is especially important to acknowledge that natural history is not race-neutral and has exploited the knowledge systems of Black, Indigenous and People of Color (BIPOC). Until the field grapples with this, a call to elevate natural history is a call to elevate ecology's racist, exclusionary origins. In general, skewed racial participation in academia, such as is seen in ecology (Beck et al., 2014), reflects racial biases in institutional cultures (Corneille et al., 2019; Henry, 2015; Tate & Page, 2018), and implicates institutional reticence to confront embedded racialized systems, particularly in Science, Technology, Engineering, and Math (STEM) (Miriti, 2020). As Vakil and Ayers (2019) caution, STEM is not independent of socio-political and cultural biases. Scientific values and knowledge production frequently omit the contributions and experiences of those outside the dominant culture (Longino, 1990; Taylor, 1997) and typically ignore racial and gendered assumptions and practices inherent to conducting science (Prescod-Weinstein, 2020; Trisos et al., 2021). Low diversity in individual disciplines or institutions perpetuates this disregard (Espinosa, 2011; Mascarenhas, 2018; McGee, 2016) causing implicit support of biased systems. To promote just inclusion and diverse participation, ecology must come to terms with how rationalizing or burying racist activities and beliefs of coveted and beloved founders of the science has whitewashed the role of racism and colonialism in shaping the discipline.

Some ecologists are beginning to acknowledge the association between ethnicity, class, and gender and disciplinary values and practice as reflected by terms such as "biocultural homogenization" (e.g., Rozzi, 2012). This term identifies the dominance of Anglo-European perspectives and disregard of diverse environmental knowledge stemming from different cultural heritages or from non-English speakers when determining ecological priorities. Unfortunately, presentations of how gendered (Mallory, 2013), or otherwise privileged concepts of nature compromise environmental justice (Kingsland, 2015; Rozzi, 2012; Uriarte et al., 2007), ethical environmental education (Poole et al., 2013), or communication with non-scientists (Nadkarni, 2013; Nadkarni et al., 2019) are typically encased in arguments that emphasize how ecology can better serve society. Less consideration is given to the ways in which ecology is narrowly defined to serve Anglo-European interests (Schell, Guy, et al., 2020; Trisos et al., 2021). Without explicitly changing biased systems, such efforts are insufficient to promote ethical inclusion.

Here we focus on ways natural history embedded notions of European superiority into ecological knowledge in ways that continue to shape pedagogy and conservation research. Even as natural history is focused on careful observation, description, and basic knowledge, it is not without cultural bias. In fact, it was not only steeped in but contributed to racism through the colonial mindsets and protocols of natural historians (e.g., Arnold, 1999; Arteaga, 2017; Diaz, 2015; Pratt, 1992). The legacy of racism involved in obtaining and maintaining collections persists not just in campus climate for students and faculty, but in how racialized ideas are baked into ecological concepts and understanding (e.g., Cronin et al., 2021; Pausas & Bond, 2019; Schell, Dyson, et al., 2020; Trisos et al., 2021). For example, (Bailey et al., this issue) present the racial history of the idea of "wilderness." This is reflected in the ideology behind the formation of American national parks as leisure areas for the White elite (Cronin et al., 2021; Taylor, 1997). In other areas, emerging Indigenous scholarship on "decolonization," intervenes in the relationship between colonization and ecology by explicitly seeking the return of native land (Box 1). We show in this paper that natural history entrenched ideas about a global hierarchy of cultures; naturalists treated this hierarchy as an entirely natural taxonomy of races that they found and merely described instead of something they actively invented and produced.

The paper is organized as follows. We start with a summary of the relationship between ecology, natural history, and race and the renewed significance of natural history in ecology today generally and in the context of concerns about recruitment and retention of racially diverse ecologists. We then present two sections on the

BOX 1 Resources for centering BIPOC perspectives and ecological knowledge

PLANTATION ECOLOGIES

What does it mean to study today's global ecological challenges as an outcome of the colonial re-making of the world? How does taking colonialism as a starting point, change how we think about today's global ecological challenges?

Concepts

Plantation Legacies, by Sophie Moore, M. Allewaert, Pablo Gómez, and Gregg Mitman (2019) Edge Effects, January 22. https://edgeeffects.net/plantation-legacies-plantationocene/

Anthropocene, Capitalocene, … Plantationocene?: A Manifesto for Ecological Justice in an Age of Global Crises, by Janae Davis, Alex A. Moulton, Levi Van Sant, and Brian Williams (2019) Geography Compass 13 (5).

The Plantationocene: A Lusotropical Contribution to the Theory, by Wendy Wolford (2021) Annals of the American Association of Geographers 111 (6): 1622–39.

Case studies

Sweetness and Power: The Place of Sugar in Modern History, reprint edition, by Sidney W. Mintz (1986) New York: Penguin Books.

Crimes, Cropland, and Capitalism, by Ruth Wilson (2007) *Golden Gulag* (pages 128–180). Berkeley: University of California Press.

Empire of Rubber: Firestone's Scramble for Land and Power in Liberia, by Gregg Mitman (2021) New York/London: The New Press.

The Oil Palm Complex: Smallholders, Agribusiness and the State in Indonesia and Malaysia, by Robert Cramb and John F. McCarthy, eds. (2016) Chicago, IL: University of Chicago Press.

DECOLONIZATION, SCIENTIFIC RESEARCH AND EDUCATION, AND NATURE

What does it mean to intervene in the relationship between colonialism and how we teach and study nature? What do calls to "decolonize" nature seek to do? What do debates on the term teach us about the relationship between research, teaching, and governance structures? Why are the politics of land ownership inseparable from conservation and environmental education?

Land-Grab Universities: Expropriated Indigenous Land Is the Foundation of the Land-Grant University System, by Robert Lee and Tristan Ahtone (2020) High Country News, March 30, 2020. https://www.hcn.org/issues/52.4/indigenous-affairs-education-land-grab-universities

Decolonization Is Not a Metaphor, by Eve Tuck and K Wayne Yang (2012) Decolonization: Indigeneity, Education, and Society 1 (1): 1–40.

On the Importance of a Date, or, Decolonizing the Anthropocene, H Davis and Z Todd (2017) ACME: An International E-Journal for Critical Geographers 16: 761–80.

Decolonizing Extinction: The Work of Care in Orangutan Rehabilitation, by Juno Salazar Parrenas (2018) Durham, N.C.: Duke University Press.

Pollution Is Colonialism, by Max Liboiron (2021) Durham, N.C.: Duke University Press.

FUGITIVITY, FREEDOM, AND ECOLOGY

How are ecologies and ecological knowledge linked to liberation, empowerment, and Black resistance? How have ecologies created refuge and subversion under colonialism? What alternative ecologies and ecological knowledge already exist?

Food

On the Origins of the Counter-Plantation System, by Jean Casimir (2020) in *The Haiti Reader*, edited by Laurent Dubois, Kaiama L. Glover, Nadève Ménard, Millery Polyné, and Chantalle F. Verna, 61–66. Durham: Duke University Press.

Freedom Farmers: Agricultural Resistance and the Black Freedom Movement, by Monica M. White and LaDonna Redmond (2018) Chapel Hill: University of North Carolina Press.

Prophetic Black Ecologies: Liberatory Agriculture on Beulah Land Farms, by Priscilla McCutcheon (2020) AAIHS blog, July 27, 2020. https://www.aaihs.org/prophetic-black-ecologies-liberatory-agriculture-on-beulah-land-farms/#.

Fugitive Seeds, by Christian Brooks Keeve (2020) Edge Effects, 25 February. https://edgeeffects.net/fugitive-seeds/

Experiments in Freedom: Fugitive Science in Transatlantic Performance, by Britt Rusert (2017) in *Fugitive Science: Empiricism in Early African American Culture* (pages 113–148). New York: New York University Press.

Black Rice: The African Origins of Rice Cultivation in the Americas by Judith Ann Carney (2001) Cambridge: Harvard University Press.

Marronage

Slavery's Exiles: The Story of the American Maroons, by Sylviane A. Diouf (2014) New York: NYU Press.

Swamp Sublime: Ecologies of Resistance in the American Plantation Zone, by M. Allewaert (2008) Journal of the Modern Language Association of America 123 (2): 340–57.

A Totally Different Form of Living: On the Legacies of Displacement and Marronage as Black Ecologies, by Justin Hosbey and J. T. Roane (2021) Southern Cultures 27 (1): 68–73.

Plotting the Black Commons, by J. T. Roane (2018) Souls 20 (3): 239–66.

A Desolate Place for a Defiant People: The Archaeology of Maroons, Indigenous Americans, and Enslaved Laborers in the Great Dismal Swamp, by Daniel O. Sayers (2014) Gainsville, FL: University Press of Florida.

history of natural history as a European practice since around 1500 in the context of early colonialism and how, as it developed across Europe over the next several 100 years, it justified racial hierarchies in support of European domination. The first describes links between natural history and colonial extraction and the second presents natural history's role in creating and naturalizing ideas about racial hierarchy. The following section turns to Black ecological ways of knowing that have been excluded in and because of this history, focusing on two examples: foodways and marronage. Finally, we provide lessons for a more inclusive discipline, with special attention to conservation and education.

We show that natural history was not only central to the colonial, imperial project that led to the domination of Western cultures but was constituted by it. In other words, there is no field of natural history outside this racist history: they are fully intertwined. Early natural historians, even early ecologists, did not make the distinctions between nature and culture/society/human that we currently debate. Understanding this is key to understanding how natural history contributed both to the exploitation of nature for the benefit of colonial powers with ongoing legacies and practices today, and to universal ideas about humans, culture, and knowledge that are racist and exclusionary. While speaking to "Indigenous knowledge" as a broad category, we emphasize the less recognized environmental knowledge grounded in Black histories, experiences, and perspectives and we conclude with examples of ways to promote a more diverse, productive, and just discipline.

NATURAL HISTORY, ECOLOGY, AND RACE

Human-nature relations

Since ecology emerged in the late 19th century, it has grappled with its relationship to natural history, from which it arose. Central to this tension are the importance of descriptive studies and the role of humans in the natural world. Naturalists combined fascination about the rare and exotic with detailed description based on careful observation, the hallmark of natural history. As naturalists developed useful knowledge about the interconnected order of nature, *description* of natural objects also served as a form of *explanation*.

While today ecologists debate the relationship between humans and nature in terms of the relevance of the "pristine" or providing new histories of human-nature interactions (e.g., Ducarme et al., 2021; Ellis, 2015; Ellis et al., 2021; Kareiva & Marvier, 2012), study of the order of nature by early naturalists included humans

in that order. Recognizing this is crucial to understanding the pervasiveness of racialized, Eurocentric bias embedded in natural history. Projecting a bifurcation between nature and humans onto the past erases ways that natural history was also and sometimes especially about society. From the 1500s, natural historians valorized Greek scholars such as Pliny the Elder, who put humans at the center of a divinely created world (Ogilvie, 2018). This ideology is strongly represented in ideas about the Great Chain of Being, attributed originally to Aristotle, which posited a continuous and natural hierarchy among forms of life (Figure 1). As we will show, in natural history of the past 500 years, it is this idea of a natural hierarchy that shaped ideas about the superiority of "civilized" Europeans over "primitive" or "savage" Asians, Americans, and Africans (Wood, 1996; Wynter, 2003).

The emergence of ecology

The term ecology traces to the prolific German naturalist and scientific illustrator—and eugenicist—Ernst Haeckel (1834–1919), who in 1866 defined ecology as the study of the relationship of organisms with their environment. Haeckel's scientific studies depended on colonial expeditions, starting with the HMS Challenger in 1876. A scholar specifically of marine and microscopic life, he is especially famous for his broader ideas, including his theory that "ontogeny recapitulates phylogeny." Haeckel applied these ideas to human races too, ranking them from higher to lower according to how culturally and intellectually advanced he considered them to be. Positioning civilization as a graduated achievement, the pinnacle of evolution and development was embodied by the European male as the ideal rational scientist (Jackson, 2020).

It was not until the work of Warming in 1896 that the term "ecology" was widely embraced among botanists. This inspired Cowles's (1899) formative ecological presentation of succession in dune communities, which placed vegetational studies at the forefront of ecology. Histories of early ecological studies distinguish ecology from natural history by emphasizing novel integration of physiological strategies with plant distributions that began with Cowles (Mitman, 1992; Tansley, 1987). Nevertheless, in the mid-20th century, A. G. Tansley quipped that skeptics at that time still considered ecology to be, "the old natural history masquerading under a high-sounding name-and not always very good natural history at that!" (Tansley, 1987, reprinted from a 1951 pamphlet). This statement reflects an aversion to the descriptive character of natural history that persists to this day (see Able, 2016; Greene, 2005). Tansley eventually distinguished ecology as "systematized" natural history, in so doing elevating the discipline to more rigorous, objective, and therefore scientific standards.

Succession, holism, and race

From these beginnings, many students of ecology are taught about the subsequent advancement in understanding vegetational distributions in terms of conflicts among early presentations of succession, most notably between Clements's (Clements, 1916, 1936) organismal view of communities and Gleason's (1926) individualistic concept of community development. Students rarely learn the racialized underpinnings of this debate (but see Box 2 for an inclusive example).

Clements's views of the natural world were shaped by the racist, holistic perspectives of South African Jan Christian Smuts, who in 1926 coined the term holism to reflect the inherent connectedness between social relations, nature, and society (see Bellamy Foster & Clark, 2008 for an extensive review). General Smuts was a central figure in the formation of South African apartheid, which was in part bolstered by scientific support of holism that rationalized suppression of Africans. Smuts notably influenced the work of another South African, John Phillips, a champion of Clements who embraced holism in his ecological descriptions of biotic communities; Phillips not only included human societies as part of the natural order but also strongly emphasized succession as "progressive," always improving in development (Phillips, 1931, 1935). What is important to appreciate is that the ensuing discussions surrounding the validity of holism, organismal, or individualistic organizations of vegetation were intertwined with racist theories about natural causes of human differences (Anker, 2002; Bellamy Foster & Clark, 2008). Ideas about both holism (human-nature unity) and dualism (human-nature separation) privileged Europeans and subjugated all others. That is, while today holistic advocacy for re-integrating humans and nature is sometimes offered as an antidote to problems of dualism, such as considerations of the Anthropocene (e.g., Kareiva & Marvier, 2012), human dimensions of ecosystems (e.g., Redman, 1999) or coupled human and natural systems (Liu et al., 2007), these are not inherently anti-colonial and can therefore retain implicit or explicit racism (Trisos et al., 2021).

Tansley's (1935) critique of organismal conceptualizations of vegetation in many ways silenced the decades long debate regarding holism and communities, and promoted the term "ecosystem" to refer to regional assemblages of organisms and the physical environment. This is not to say that we should, inversely, celebrate individualistic conceptions of community development as

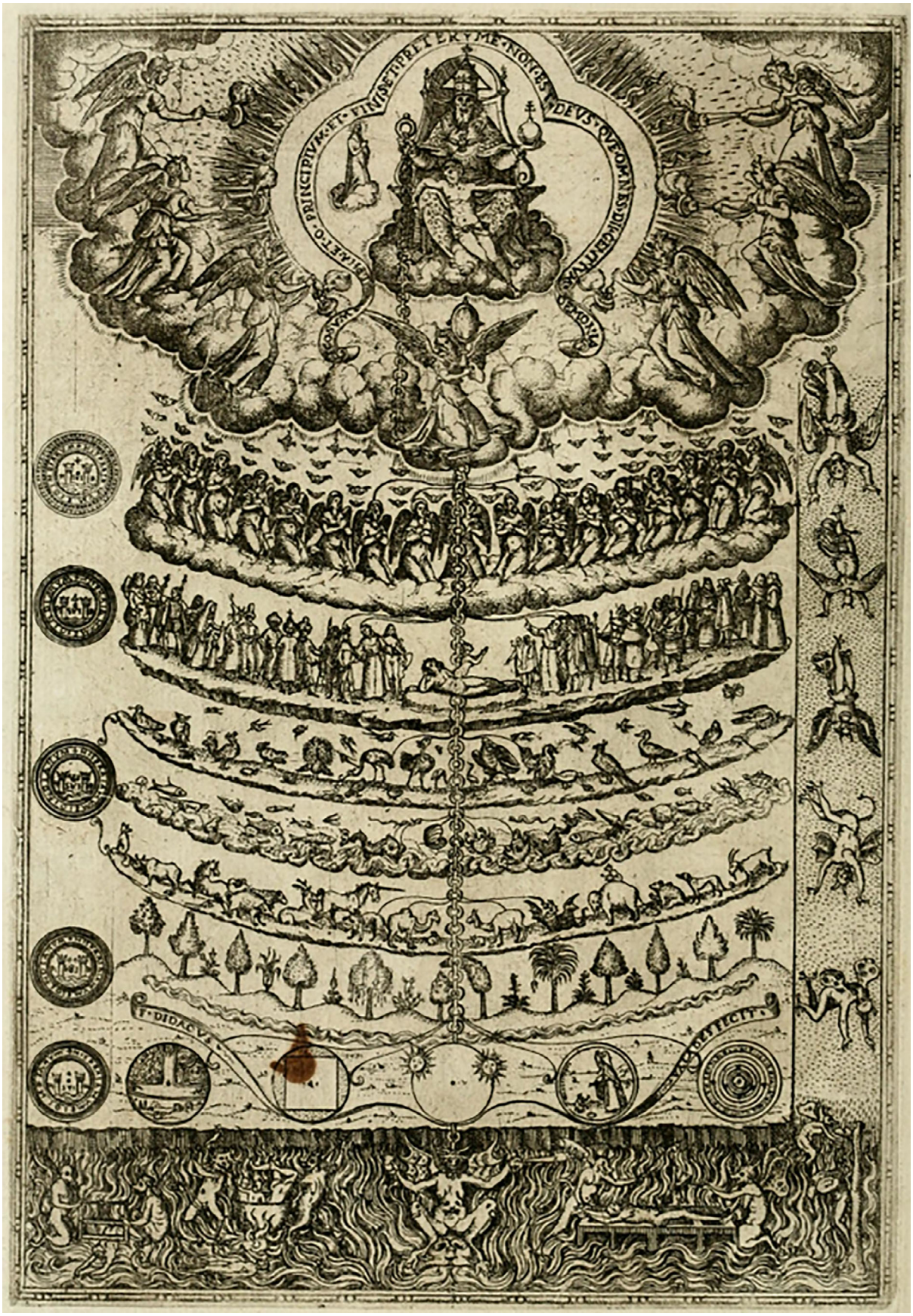

FIGURE 1 Legend on next page.

BOX 2 Teaching decolonized ecological foundations. These examples are not comprehensive lessons but provide ideas for including important historical and social context about ecology's intellectual foundations

What is natural history?

Natural history can be defined as understanding plants, animals, and other organisms in the context of the habitats in which they occur. Historically, natural history was created and dominated by Europeans, who aimed to catalogue all living things, including humans, into ways that served European colonial interests. Although these efforts can reveal important ecological and evolutionary relationships among living things that occur in very disparate locations, such as that among grizzlies and pandas, the activities of colonial natural historians also redistributed common economically important species such as rice, horses, and rubber that supported the plantation agriculture system. Treating humans as part of the order of nature, natural historians also created racial hierarchies among humans, placing White Europeans at the top and Black Africans at the bottom, closest to animals. The ecological and evolutionary importance of natural history resides in the place-based understanding of the relationships between organisms and the communities in which they occur. To be beneficial, natural history requires the contributions of Black, Indigenous and People of Color whose local knowledge has been largely disregarded by the scientific community.

Introduction to ecological communities

Early ecology emphasized the distribution of vegetation. Henry Chandler Cowles, 1899 description of shifting vegetational distributions along a horizontal gradient along the sand dunes of Lake Michigan became formalized with the term ecological succession. Ecologists have long debated the process of succession as a progressive or random dynamic. Early presentations of succession, such as the organismal concept advocated by Frederic Clements, were influenced by the term holism, which posited inherent connections between nature and human societies. Advocates of holism included the early ecologists Clements, John Phillips and notoriously Jan Christian Smuts, who is considered to be the architect of apartheid. These figures applied ideas of successional development to human society, which they viewed in terms of progressive, orderly improvement of communities. This progressive conceptualization contrasts with an individualistic concept of community development initially advocated by H. A. Gleason. By emphasizing probabilistic dispersal of propagules and continuous environmental variation, Gleason's approach is amenable to the emphasis of the physical environment on species associations that the ecosystem concept, first proposed by A. G. Tansley in 1935, asserts. The tension between orderly development of communities and probabilistic species assemblages persists in ecology as evidenced by ongoing ecological research and discourse on the validity of topics that include the existence of community assembly rules, the neutral theory of biodiversity. Although ecologists do not examine the socio-ecological contexts of these positions on community development, science does not exist within a void. Collaborations between ecologists and social scientists, and inclusion of diverse ways of knowing, can help advance ecological understanding in a just manner.

inherently antiracist. Gleason's individualistic concept was not widely embraced until the 1950s (reviewed in McIntosh, 1995). This period is punctuated by a long series of empirical ecological milestones that include the growth of mathematical and theoretical ecology (McIntosh, 1995), the rise of animal ecology (Mitman, 1992), and a

FIGURE 1 A "medieval" representation of Aristotle's "Great Chain of Being," from the text *Rhetorica Christiana*, which was published and illustrated by Diego de Valadés in 1597. This image presents an early missionary perspective on the conversion of indigenous peoples it the Americas. At the top of the image is a depiction of god, underneath is the tier of angels. As more-than-earthly creatures, the angels are unchanging, in already perfect form they remain fixed in the layer of the clouds. Although on the right side of the image we also see the "falling" or declension of angels into devils, losing their wings as they approach the ground, the subterranean world of the devil. Below the tier of angels are the tiers of earthly life, starting with humans and then birds, fish, land animals, plants, and lastly stone and minerals. Beings of the earthly hierarchy are imperfect and thus changeable. Earthly beings can move up or down the hierarchical ladder based on their relationship to the divine, god, and thus Christianity. *Source*: https://commons.wikimedia.org/wiki/File:Great_Chain_of_Being_2.png.

retreat from natural history. From the 1950s to the present, the value and sophistication of empirical and theoretical studies increased, and that of descriptive studies diminished (Able, 2016; Dayton & Sala, 2001; Greene, 2005). Ecology advanced from a largely descriptive field to a discipline that demanded experimental and theoretical rigor.

The resurgence of traditional natural history perpetuates racism in ecology

Despite ecological distancing from natural history, the racist and colonial underpinnings of natural history and natural historians and their influence on ecology linger as evidenced by continuing discussion surrounding the relationship between concepts such as social Darwinism and sociobiology and ecology/evolution. Ecologists often acknowledge Haeckel's coining of the word ecology but ignore his support for social Darwinism, which is implicit in debates surrounding sociobiology. Similarly, ecologists celebrate the intellectual contribution of selfish genes (e.g., Dawkins, 2006; Yanai & Lercher, 2016) while forgiving unsupported links between genes and behavior (but see Lewontin, 1977, 1991) and with little concern for popular, destructive interpretations of such science (see Cronin et al., 2021; de Chadarevian, 2007). One response to such "straying from such scientific rigor," as Ricklefs (2012) states, is to adhere to the scientific method. However, this practice alone does not improve the climate for BIPOC who are targeted by the vitriolic pseudoscience embedded in social Darwinism, nor does it promote a safe climate to recruit BIPOC students. This is in part because it does not address the reality that "good science" can also be racist. It is problematic to ignore racism among prominent scientists now and in the past.

Natural history is in resurgence in part due to increased recognition of human dimensions in the functioning of nature. This is explicitly stated in conservation (Anderson et al., 2021; Greene & Losos, 1988; Noss, 1996) and education (Klemow et al., 2019) contexts. Cumulative effects of habitat fragmentation and burning of fossil fuels are causing accelerating species loss and changes to ecosystem functioning at a rate that outpaces ecological understanding. At the same time, increased drought, severe storms, and intense fires punctuate the interdependence of human activities and the nonhuman world. It is in the context of these global ecological challenges that calls to ground empirical and theoretical research in natural historical understanding have increased (e.g., Ricklefs, 2012; Wilbur, 1997).

Our point is that asserting the de facto value of natural history implicitly undermines efforts to improve diverse participation in ecology. Not only does it fail to recognize the racist and colonial underpinnings of natural history and—by extension—ecology more broadly, but it thereby also fails to recognize broader, more global understanding of the nonhuman world. Improving ecological knowledge today can only happen with a reckoning of the racist history of natural history, for while natural history has always presented itself as a detailed, objective understanding of natural things, their distribution, and their relationships, it is not as merely descriptive or disinterested—lacking political, economic, racial, or other interests—as it seems.

In what follows, we draw on decades of scholarship that has shown that natural history both enabled and was enabled by European colonial endeavors to generate wealth and global power by mapping, describing, collecting, and moving plants, animals, people, and minerals across the globe. As such, we also provide context for recent calls to *decolonize* ecology (Trisos et al., 2021). For detailed accounts of the history of natural history, including how it changed over the centuries, see two related edited collections: *Cultures of Natural History* (Jardine et al., 1996) and *Worlds of Natural History* (Curry et al., 2018). We draw on these and other sources to outline ways natural history contributed both to racial inequality and to racist notions about human hierarchy.

HISTORY OF NATURAL HISTORY 1: EXTRACTION, VIOLENCE, AND RACIAL INEQUALITY

Over centuries, colonial natural history caused ecological degradation and human suffering, especially for BIPOC people who were killed, enslaved, and had land and resources degraded and stolen. Moreover, it was through their comprehensive study of the world, including classification and study of interdependence, that naturalists helped justify degradation and suffering by generating racist ideas about hierarchies among humans, which they treated as part of the order of nature.

Natural history as we think of it today dates to about 500 years ago when early modern European men (and few women) attempted to develop and compile comprehensive knowledge of the natural world (Jardine & Spary, 1996). These men fanned out across the countryside of Europe and around the globe developing in-depth knowledge of individual places and the plant, animal, and mineral objects that comprised them. While drawing on the ancient Greeks, the rise of natural history 500 years ago coincided with early colonialism, which refers to European efforts, after 1492, to find and exert power over non-European people and places, sometimes as settlers but often not. As a project of rearranging the human and nonhuman world, colonialism fed the wealth

and global power of European nations and their successors, including the United States, to the detriment of the colonies, not only through extracted wealth but through direct violence, including genocide.

Naturalists studied nature directly, both in the field and, as they gathered specimens from the field, in various personal and institutional collections. The foundational role of observation, collection, and producing texts are demonstrated in Conrad Gesner's oft-cited, lengthy, and lavishly illustrated publications from the mid-1500s on Renaissance natural history (Ashworth, 1996). Collection and the field provide two different lenses on natural history's practices and effects.

Collections are about knowledge of separable objects, whether individual specimens or collective types such as species. These objects, or a sample of them, can be removed from their environments and then rearranged to various purposes both within and well beyond the collection itself. Indeed, natural history drove the rise of museums, herbariums, botanical gardens, and zoos, all of which were sites not just for aesthetic enjoyment but were, and remain, centers of scientific study (Cunningham, 1996; Findlen, 1996). *The field* is not just the origin of all these objects but is about environmental knowledge in place including distributions and interrelationships.

While much field work and collection of specimens occurred within Europe, its development and success were attached to colonial voyages and motivations, and vice versa, naturalists' object-based and place-based knowledge were crucial for colonial expansion in different but interconnected ways. Enabling and enabled by colonialism, natural history contributed to inequality between White Europeans and everyone else.

Natural history as we know it would not exist without colonialism

From Columbus's first reports of the Caribbean islands where he landed and immediately declared ownership for Spain and kidnapped indigenous people, colonial endeavors opened the world to exploration. Initially along the coastlines and later in the interiors, European explorers sought to travel to these new, strange-to-them places seeking wealth, adventure, knowledge, or a combination (Pratt, 1992). But it was not just that natural historians found new, exciting places through colonial efforts. More pointedly, colonial endeavors provided almost all the infrastructure for traveling to and learning about these places as naturalists traveled with the hundreds of state-sponsored colonial "voyages of discovery." Sponsored by multiple European countries, most famously the British, French, and Dutch, many of these voyages lasted several years and visited multiple continents. Such voyages took up the mantle of exploration and discovery to justify their motivations, as though knowledge for its own sake, not conquest and mercantilism, was their main motivation. Naturalists' travels, as well as their subsequent collections, presentations, and publications, were often funded by the colonial interests behind these voyages, as well as by new institutions of natural history, such as Britain's The Royal Society, founded in 1660. One prominent example is the renowned British natural historian Joseph Banks, who was president of the Royal Society for 41 years and advisor for the Kew, Royal Botanical Gardens. Banks brought over 30,000 specimens back to the metropole, including 1400 that were novel to Europeans, by joining British colonial expeditions such as Captain Cook's voyage to Tahiti on the HMS Endeavor (Lotzof, 2018).

Once in these new-to-them places, naturalists were then able to identify, describe, collect, and classify local plants, animals, and minerals. Indigenous people and their ways of life were also described and sometimes were among the new, exotic "objects" that were "collected" and brought back to the home country, to be displayed among the other "curiosities" gathered on these voyages (Beer, 1996; Qureshi, 2018). All these plants, animals, minerals, people, and places were then integrated into naturalists' existing knowledge of the order of nature as a global, integrated place, thereby allowing them to continually revise their knowledge.

Colonialism as we know it would not exist without natural history

It is not just that naturalists were complicit with colonialism by benefitting from it, but that colonialism was dependent on natural historical practice and knowledge (Brockway, 1979; Browne, 1996; Miller & Reill, 1996; Ogborn, 2018; Pratt, 1992; Schiebinger & Swan, 2005). The first role of naturalists was to map and study places, making them open to future exploration and control, for example mapping transportation routes, trade possibilities, and resources including minerals such as gold and silver that could be appropriated. Naturalists were often explicitly seeking useful objects, especially species that could be used for food, fiber, and medicine, as well as aesthetic enjoyment.

Exploration, mapping, and discovery of species and their uses were often dependent on local people, from whom naturalists appropriated knowledge, even as they saw indigenous people as inferior, thus obscuring their contributions to science (Prescod-Weinstein, 2020; Sobrevilla, 2018). Treating these as their own discoveries,

naturalists extracted both the knowledge and the specimens, collecting them in the museums, zoos, and botanical gardens of Europe. While this was often done without knowledge of indigenous people, there are many documented cases in which people sought to protect their resources from appropriation and dispossession; Europeans responded with herculean efforts in which they outright stole useful plants, in what have been called operations of *Bondian intrigue* (Kloppenburg, 1988).

Place-based knowledge remained important even in this context, as natural histories of nature in situ provided knowledge about the necessary conditions for the survival and usefulness of collected plants and animals. Paradoxically, this enabled colonial efforts to relocate these species around the world, acclimatizing them to new environments (Browne, 1996). This role for place-based knowledge was reflected in the global network of botanical gardens that developed outside Europe over the 18th and 19th centuries; located in the colonies, these new tropical gardens allowed naturalists to bypass the climate of Europe (Brockway, 1979).

All of this leads to one of our key points: *the activities of naturalists were required for the plantation agriculture system that drove colonial wealth and power, and which was based on stealing land and labor from Black and Indigenous people, including through slavery*. They found economic species by appropriating local knowledge, extracted those species from their original places while also extracting knowledge about the necessary conditions for growing those species, and brought those species to collections from which they could be redistributed around the world. This included some of the most notorious plantation crops, including tea, sugar, rubber, and cinchona (Brockway, 1979; Mintz, 1985). Cinchona served imperialism not only as a crop but as a medicine; it is the origin of the anti-malarial drug quinine, on which conquest of the interiors of Africa and Asia depended. It also includes most of the crops grown commercially today in North American and Europe: in recent decades, over 90% of the crops grown in the global North originated as species domesticated by indigenous people from the South, that is, from colonized areas (Kloppenburg, 1988). Colonial plantations systems generated wealth for colonial powers and their settler descendants by stealing land, labor, and species of animals and especially plants and recombining them across the globe.

Humboldtian "planetary consciousness" as a civilizing mission

As world-altering as the colonial plantation systems were, natural history played another overarching role in colonialism and its violent inequalities. Circling back to the earlier point about how mapping places made them available to colonial interest, naturalists played this role even when they were not explicitly seeking useful resources. What European naturalists did was claim the entire planet as theirs to study and survey, to bring order to what was disordered. They developed what Mary Louise Pratt (1992) called a "planetary consciousness," which marks the idea that the world was available to them, through travel, and that they alone as scientists without other interests could take a planetary view to uncover the secrets of nature (see also Outram, 1996).

This is especially evident in the work of the Prussian naturalist and explorer Alexander von Humboldt (1769–1859), who transformed natural history in the early 19th century. "Humboldtian science" treated the earth as an organic, interdependent whole and focused on measuring and integrating across space (Pausas & Bond, 2019). For Humboldt and his followers, this was itself a civilizing mission: their role as scientists was to extend European civilization, which was explicitly conceived as progress (Dettelbach, 1996). In this view, order exists yet it is not simply waiting to be found; it is something that European natural history could achieve through integrating chaos into a single system. By claiming to have no interests other than knowledge, European naturalists imposed their own sense of order on the world while defining it as universal, not culturally specific. This normalization of European knowledge continues to define ecological research priorities (e.g., Pausas & Bond, 2019) and exclude knowledge of BIPOC globally (Ducarme et al., 2021; Trisos et al., 2021).

HISTORY OF NATURAL HISTORY 2: THE FORMALIZATION OF RACIAL HIERARCHY AND RACISM

Even before Humboldt, 18th century naturalists used their status as experts on nature to make claims about what was proper in society, seeking to make order in human communities just as they did in the natural world (Spary, 1996; Wood, 1996). Naturalists developed a taxonomy that considered humans as animals with bodily and cultural traits who were embedded in their environment (Müller-Wille & Rheinberger, 2012). This application of natural history formulated and elaborated White supremacist ideas about racial difference and hierarchy.

Prior to the colonial era and rise of natural history, elite Europeans had a supernatural notion of existence that posited divine origins of the earth and an exalted origin and role for humanity, which was mostly limited to Europe. However, colonialism brought Europeans into

contact with very different people, who they initially treated as monstrous or mythic (see Rozzi, 1999 for a Darwinian example). The subsequent shift from human-as-Christian to human-as-*Homo* led to the development of racial hierarchies (Wynter, 2003). In this view, unfamiliar people encountered during colonial voyages, although human, were "savages" as a function of their native habitats while natural conditions in Europe allowed people there to develop into "civilized" rational, political humans (Soper, 1995; Wood, 1996; Wynter, 2003). Placing themselves at the apex of the Chain of Being, naturalists explained European supremacy as an outcome of nature: each place has its own characteristics, which both reflect and create differences in climate, minerals, plants, and animals, including humans. By providing the schema for identifying what they considered to be natural and hierarchical races of humanity, naturalists treated colonial domination as the natural outcome of this hierarchy: the birthright of superior people who could bring knowledge, order, and wealth to the world.

In this natural schema, Black Africans were treated as the most savage humans (Wynter, 2003). For example, in 1699, the Oxford physician Edward Tyson (1651–1708), published *Orang-outang, Homo sylvestris: Or the Anatomy of a Pygmie Compared with That of a Monkey, an Ape, and a Man*, which treated the pygmy not as "man" but the as missing link in the chain of being, between human and animal (Sloan, 1995). Just a few decades later, the naturalist Carl Linnaeus elaborated this natural notion of man in his world-changing taxonomy, which included humans, as *Homo*, for the first time.

Linnaeus and the Systema Naturae

A well-known Swedish iconoclast, Linnaeus generated vast collections of objects from his own local and students' global travels (Koerner, 1996). Even those who disagreed with him were captured by the idea of a universal system for classifying life (Pratt, 1992). While about identifying the divisions between objects such as species, these classification systems were also relational. Objects became different by virtue of comparison among them, as parts of the integrated whole of life. As described by Müller-Wille (2015), Linnaeus placed humans in his *Systema Naturae*, and ascribed species variation to the environment (Figure 2). He divided humans into four varieties: *Homo sapiens europaeus albus* (White European), *Homo sapiens americanus rubescens* (red American), *Homo sapiens asiaticus fuscus* (tawny Asian), and *Homo sapiens africanus niger* (Black African). This nomenclature explicitly linked geography and skin color, tying characteristics to the imprint of the external environment. At the continental scale, this exemplifies how European biases about what is "normal" become embedded into knowledge formations: "temperate" (mild and well-mannered) Europe was contrasted with the "torrid" tropics and deserts, which were seen as seductive yet menacing, even pestilential, and these characteristics were ascribed to people in those places (Arnold, 2006; Gregory, 2001). Environmental scientists have long based ideas about indigenous "mismanagement" and land degradation on these ideas about normal nature (e.g., Voyles, 2016).

Linnaeus reformulated the Aristotelean chain of being in new terms based on reason. His descriptions of varieties of *Homo* included a wide array of "characteristics" that moved from morphological features to temperaments and psychological dispositions, social and cultural practices, and political organization (Müller-Wille, 2015). This classification system formalized the position of White Europeans at the top of the human hierarchy and that of Black Africans at the bottom, closest to animals (Sloan, 1995). It also provided a schema that justified enslaving Africans for European wealth for White Europeans were "ruled by intelligence" while Black Africans were governed by *arbitrio*, mastery by others (Müller-Wille, 2015).

Buffon and the Histoire Naturelle

White supremacy was further justified by contemporaries of Linnaeus who provided scientific explanations for environmental determinism of racial degeneration. The French naturalist Georges-Louis Leclerc, Comte de Buffon (1707–1788) brought the question of time and racial differences to the forefront (Figure 3). Administrative head of the Jardin du Roi and natural history collections in Paris from 1739 to 1788, Buffon's seminal text *Histoire Naturelle* was published across 36 volumes from 1749 to 1804, with the last eight being published posthumously by Bernard Germain de Lacépède.

Arguing that classification based on visible characteristics was arbitrary, Buffon drew on the principles of probability theory to argue that the only material connection between individuals is their capacity to successfully reproduce, which attributed the existence of species to evolutionary transformations in nature itself rather than a singular act of divine creation (Sloan, 1995). By emphasizing local conditions such as climate and cultural practices, Buffon, too, reformulated the chain of being. He placed European people higher on the chain than other cultures and considered European domesticated animals to be more closely related to European humans than European humans were to wild primates (Hartigan, 2017; Sloan, 1995). Geography reflected not just the pattern of

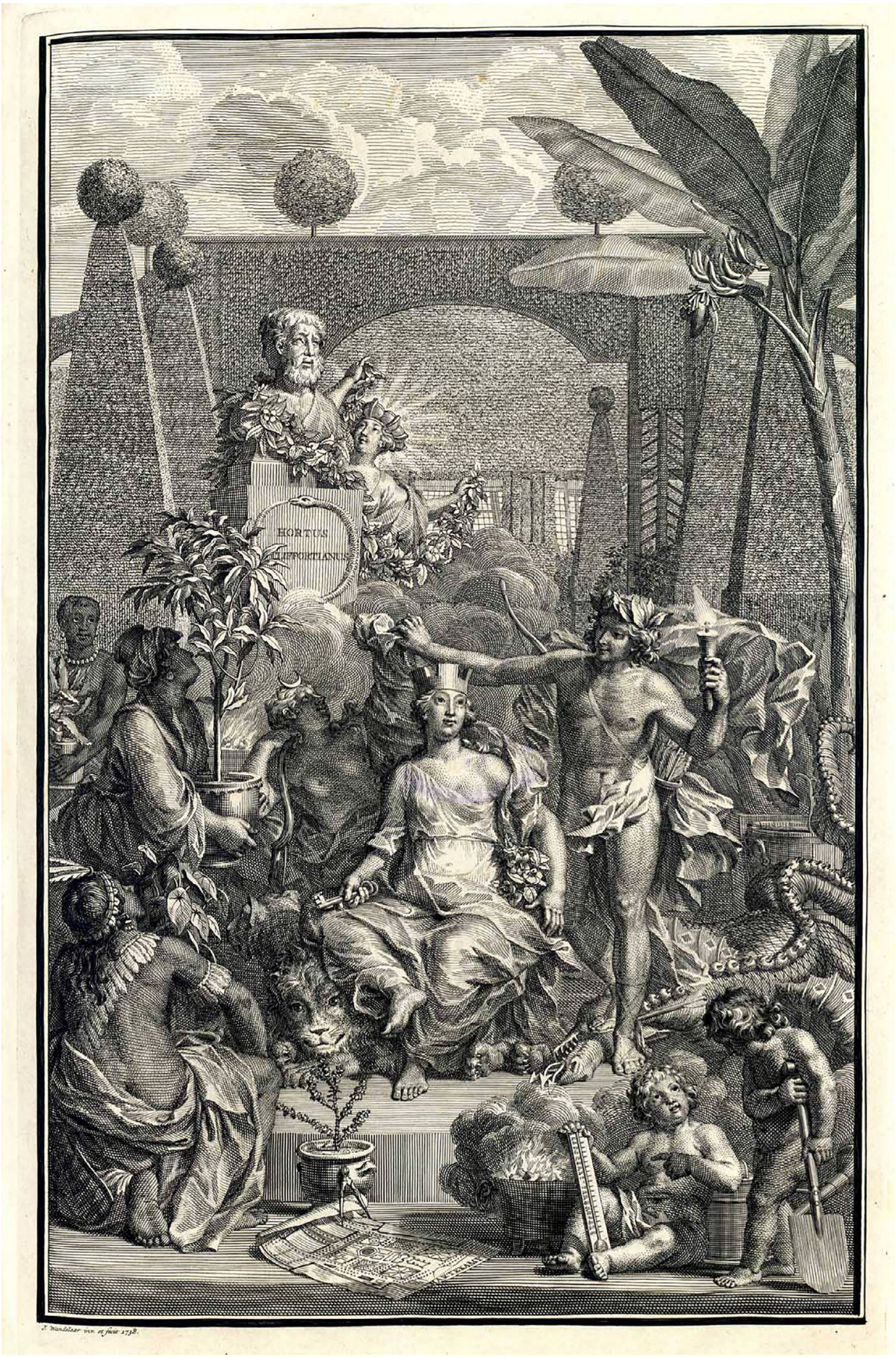

FIGURE 2 Legend on next page.

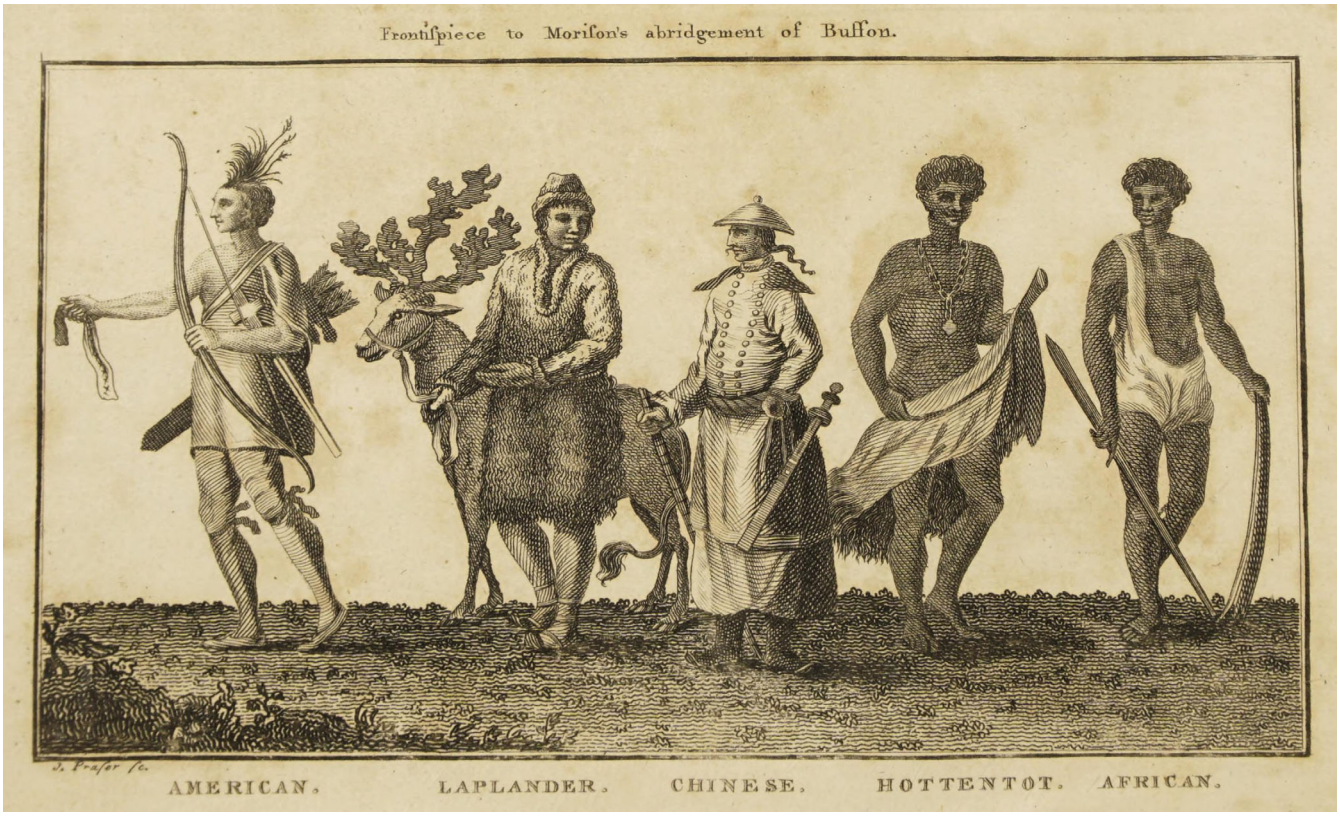

FIGURE 3 The frontispiece from the first edition of both volume I and II of *histoire Naturelle* by Comte de Buffon published in 1791. The English title of this version is called "The System of Natural History." in this image are depictions of five different "races," defined by local environmental conditions and cultural practices according to his natural history of man. From left to right are depictions of an American, Laplander, Chinese, Hottentot, and African. *Source*: https://archive.org/details/b28759163/page/n5/mode/2up.

varieties but the process of variation, offering a historical explanation to species variation. Environmental variation determined why varieties emerged over time, transforming Linnaeus's classification table of rationally gridded empty space into explanatory spatial and temporal coordinates.

However, where Linnaeus provided a *progressive* account of nature, culminating with reason in civilized humans, Buffon provided a *regressive* account of nature that could lead to degeneration. Buffon thought humanity originated in its most perfect form in the high latitudes of Asia and Europe, and then degenerated into distinct yet malleable "races" as people migrated to Africa and the Americas (Sloan, 1995). Despite his overall focus on degeneration, Buffon shared with Linnaeus the idea that European nature fosters improvement. In this paradigm, temperate nature fosters human abilities to cultivate and domesticate nature, whereas less temperate climates deter civilization and promote degeneration (Sloan, 1995). Therefore, as with Linnaeus, it was not the fixity of races that structured human differences but rather the relationship between organisms and their

FIGURE 2 The frontispiece of the 1737 publication Hortus Cliffortianus by Carl Linnaeus. Following W. T. Stearn's 1957, description of the image in Ray Society, Species Plantarum, the Hortus classifies the botanical gardens of the Hartecamp estate, owned by George Clifford, a wealthy banker and governor of the Dutch East India company. This frontispiece, by illustrator Jan Wandelaar, graphically demonstrates the entanglement between natural history and colonial projects. At the center is a depiction of "mother earth" with "keys to the garden" in her hands and the rose varietal named after George Clifford, Cliffortia at her feet along with a map of the Hartecamp estate. To the right is a figure with Linnaeus' head and the body of the Greek god Apollo, who thwarts darkness encroaching upon mother earth and in his left hand holds a lit torch as the promise of enlightenment. To the left are three feminized and darkened human figures, each representing different continents, who offer crops to mother earth. The figure at the front represents America and provides the plant *Hernandia*; next is Asia holding *Coffea arabica*; last, and most peripheral, is Africa, holding the *aloe* plant in her hands. At the top of the image is a sculpture of the head of George Clifford, placed on a pedestal and overlooking the entire scene. *Source*: https://commons.wikimedia.org/wiki/File:Linnaeus_Hortus_Cliffortianus_frontispiece_cropped.jpg.

environment that enabled both racial improvement and racial degeneration.

In these ways, both progressive and regressive accounts of human difference are central to the racist 18th century development of the natural sciences. Natural historians situated White European men as the apex of the chain of being and Black Africans, especially Black women (Morgan, 2004), as the missing link between brute animal and civilized human. In so doing, they not only imposed a racial hierarchy, but they expanded the European imperative for chattel slavery. These ideas were then influential a century later, at the dawn of ecology. Racial taxonomy was an organizing principle of 19th and 20th century empirical science, in which Black people were systematically classified as racially inferior and other colonized dark-skinned, indigenous people were arrayed between Black and White (Jackson, 2020; Wynter, 2003). The result is a scientific rationale for racial subjugation, one legacy of which is persistently skewed participation in science.

BLACK ECOLOGICAL KNOWLEDGE IN THE AMERICAS

As we have elaborated, European natural history developed a scientific worldview that placed European civilization, with rational science as one of the key markers, at the top of the hierarchy of life. In so doing, it racialized others, often through ecological knowledge about environments, which were seen to "naturally" create different types of people. In this way, Western ideas about both race and science were naturalized, made to seem universal and objective when they were not. For natural historians, their ideas were not "Western" or culturally influenced, and certainly not ethnocentric or racist, but instead were part of the order of nature they were studying. For them, civilization emerged from nature to control nature.

Since the mid-1800s this has also been accompanied by awareness of the ways that controlling nature can also destroy nature (Marsh, 1864), yet the role of race has yet to be reckoned with. And our point, at least in part, is that *ecology must reckon with race not only to do the right thing and address the low diversity in the discipline, but also to address and better understand ecological function as well*. The Western view of nature as distinct from "civilization" even if it itself created civilization is impoverished.

At the intersection of these points are the ways that other forms of knowledge were discounted as knowledge in natural historical practice. By presenting itself as universal even as it was not, European natural history was able to dismiss various other forms of knowledge—even as it sometimes took advantage of those other forms of existing knowledge. Work in recent decades has tried to "provincialize" European knowledge by showing that it is specific, not universal, and to highlight other forms of knowledge (Lee, 2018; Qureshi, 2018). Within ecology, many are familiar with "traditional ecological knowledge" (TEK) of indigenous people (see Albuquerque et al., 2021 for a recent review).

Here, we focus on Black ecological knowledge in the Americas. While some of this might be included in TEK, some does not pre-exist colonial violence and especially slavery, but is borne of and fostered by surviving slavery. We have already alluded to the ways that colonial natural history appropriated the ecological knowledge of indigenous people around the world, including in Africa. Colonial-era explorers and natural historians who arrived in new places often found local people to serve as guides, either voluntarily or through coercion and violence. It was these guides who introduced naturalists to species and told them about their various uses as food, dye, medicine, and so forth. That is, naturalists' discoveries were forms of bioprospecting: the appropriation of local knowledge for the profit of the appropriator. But such appropriation can occur without explicit bioprospecting, and this is our first example of explicitly Black ecological knowledge in the context of slavery.

Black ecological knowledge via foodways

The foodways of western Africa—some indigenous, some adapted from Asia—contributed in myriad ways to survival and culture across the Atlantic Americas (Carney, 2001; Carney & Rosomoff, 2011). Slavers filled their ships not only with kidnapped people but with food to survive the Atlantic crossing. These foods were then planted across the Caribbean, including what became the southern United States, in enslaved people's kitchen gardens, in plantation owners' gardens, and as minor and major economic crops (Table 1). Rice is the most economically important example, but there are at least thirty other African plants established in the plantation era, including millet, plantain/banana, black-eyed peas, okra, and watermelon (Carney & Rosomoff, 2011).

The key point is not just that traditional food stuffs of Africa were incorporated into the slave trade and slave-based plantation economy, but that it was the ecological knowledge of enslaved people that made this possible (Carney, 2001; Carney & Rosomoff, 2011). While transfer of crops such as rice is often seen as a European accomplishment, the innovations were those of enslaved Africans, especially women, who knew about these

TABLE 1 Sampling of the African introductions found in slave subsistence sites.

Category	Common name	Species
Vegetables and spices	Guinea pepper	*Xylopia aethiopica*
	Guinea squash	*Solanum aethiopicum*
	Melegueta pepper	*Aframomum melegueta*
	Okra	*Abelmoschus esculentus*
	Plantain/banana	*Musa* spp.
	Vegetable amaranth/ callaloo	*Amaranthus* spp.
Cereals	Millet	*Pennisetum glaucum*
	Rice	*Oryza* spp.
	Sorghum	*Sorghum bicolor*
Tubers	Taro/eddo	*Colocasia esculenta*
	Yam	*Dioscorea cayenensis*
Legumes	Bambara groundnut	*Vigna subterranean*
	Black-eyed pea/cowpea	*Vigna unguiculata*
	Lablab/hyacinth bean	*Lablab purpureus*
	Pigeon pea	*Cajanus cajan*
Oil plants and fruits	Ackee	*Blighia sapida*
	Castor bean	*Ricinus communis*
	Muskmelon	*Cucumis melo*
	Oil palm	*Elaeis guineensis*
	Sesame/benne	*Sesamum radiatum*
	Watermelon	*Citrullus lanatus*
Beverages	Coffee	*Coffea* spp.
	Kola nut	*Cola* spp.
	Roselle/hibiscus	*Hibiscus sabdariffa*
	Tamarind	*Tamarindus indica*
Utility	Bottleneck gourd	*Lagenaria siceraria*
	Jute mallow/bush okra	*Corchorus olitorius*
	Kenaf	*Hibiscus cannabinus*
Fodder	Bermuda grass	*Cynodon dactylon*
	Guinea grass	*Panicum maximum*
	Pará/Angola grass	*Panicum muticum [Brachiaria mutica]*

Note: Adapted from Carney & Rosomoff, 2011, who say "The African botanical introductions initially gained their New World footing in the food plots of enslaved Africans ... [who] organized cultivation for their own purposes ... As informal experimental stations for the transfer, establishment, and adaptation of African food crops and dietary preferences, these plots became the botanical gardens of the Atlantic world's dispossessed... Africa's botanical legacy in the Americas is built upon this unacknowledged foundation."

plants and animals, how to keep them alive, how to grow them, and how to use them.

Even as some of that knowledge ended up propping-up slavery, some was also essential for survival and resistance. For example, foods were grown in the kitchen gardens of enslaved people, where they provided not only calories and nutrients that were missing in the food provided by slave owners, but also the cultural, natural historical, and *ecological* connection to ancestors and Africa. This is celebrated today in the foodways of the South, which are being recognized more widely for their connections to Africa and African Americans (e.g., Harris & Angelou, 2012 which is now a Netlix documentary series with the subtitle, "How African American cuisine transformed America."). In other words, not only Black Indigenous people in Africa but enslaved Black people in the Americas had ecological knowledge of a unique set of plants and animals that was appropriated by the dominant, White culture and economy for its own benefit and provided physical and cultural sustenance that helped many people survive slavery and its ongoing aftermath.

Maroon ecologies

Our second example is about Black ecological knowledge that was developed in the Americas, and rather than being appropriated, largely has been missed. This is the ecological knowledge associated with marronage and maroon communities comprised of people who escaped from slavery and their descendants; such communities often also included free Blacks, Native Americans, and poor Whites, who joined maroons for the spaces of freedom they created (Bledsoe, 2017; Diouf, 2014; Golden, 2021; Winston, 2021; Wright, 2020). The survival of these communities, some of which still exist today, was dependent on multiple forms of ecological knowledge. For one, the foods of African origin just discussed were not only important on the plantation, but people escaping slavery often brought seeds of these plants with them: these foods of African origin provided sustenance not only during escape but as crops in maroon communities (Carney & Rosomoff, 2011). In addition, long-term survival was often dependent on location: areas that were remote from White people, usually rugged terrain such as steep mountains, dense forests, and extensive wetlands. Examples of such places in the United States include the "Great Dismal Swamp" of North Carolina and Virginia (now protected as a Fish and Wildlife Service refuge, for its ecological value) and the sea islands of the southeast, where the Gullah Geechee people lived (now recognized by the National Park Service as a cultural heritage corridor, for this Black history). Other long-standing communities

existed across the Americas, with especially well-known examples in Haiti, Jamaica, Brazil (the quilombos), and the western hemisphere's largest maroon population, in Suriname and French Guiana.

Scholars today are studying the "Black ecologies" of marronage: the ecological knowledge that allowed people to survive the difficult conditions that enabled their freedom, and which today can continue to foster both freedom and environmental protection (Connell, 2020; Hosbey & Roane, 2021; Malm, 2018; Roane, 2018; Torre, 2018). People living in these maroon communities not only needed knowledge to survive in such rugged, undeveloped terrain, but also needed forms of ecological knowledge that allowed them to *maintain* these environments, to maintain their remoteness (Hosbey & Roane, 2021). This included not just broad knowledge of living conditions and the plants and animals needed for food, medicine, and shelter, but more specific knowledge, for example of live fencing (Duvall, 2009) or of sea currents and conditions that allowed people to escape from one Caribbean island to others (Dunnavant, 2021). This is as much an ecological ethic as it is about specific bits of ecological knowledge. Our point is not to romanticize marronage but to highlight explicitly Black forms of ecological knowledge and ethics.

LESSONS TO INFORM INCLUSIVE ECOLOGY

As we have presented, for centuries natural history was the dominant form of natural science, developing knowledge of natural objects in the name of understanding the Order of Nature. During that time, natural history benefited from, justified, and provided essential practices and knowledge for colonial endeavors that enriched Europe and European descendants around the world. The same practices and knowledge created ecological degradation, impoverishment, and violent living and dying conditions for BIPOC around the world. The ways natural history contributed to violence and inequality is especially evident in the centuries-long, global endeavor of plantation agriculture. At present, the legacy of these activities remains in the uneven distribution of wealth extracted from the nonhuman world, in the imposition of Western ways of knowing on global cultures, and in the racist legacies of European domination of the Americas, including poverty of indigenous peoples and institutional racism.

Ecology is not exempt from these legacies. It is imperative that ecologists understand racialized biases in our descriptions and management of the global ecosphere. If natural history is to be justly centered in ecological decision-making, it must reckon with racist legacies and integrate global cultural knowledge. In the context of what we have presented, we revisit the relationship between natural history, conservation, and education.

Conservation

Conservation biology has been characterized by debates over the position of natural history in ecology. A classic example is seen in reserve design, which involves setting aside potentially large tracts of land for the preservation of biodiversity. This activity is challenged from both scientific and social vantages. Scientifically, reserve dimensions and distributions can influence the number of and traits of species that are protected (Diamond, 1975; McCarthy et al., 2011; Soulé, 1991). Assessment of biodiversity outcomes often requires the use of sophisticated mathematical models, which potentially positions natural historians as second class to theoretical practitioners (Noss, 1996). Knowledge of species and habitats is required for robust model outcomes, but natural history alone cannot effectively anticipate species composition in response to rapid changes in state variables such as temperature and disturbance frequency.

Socially, land preservation may be in conflict with economic interests or advocate for displacement of people, activities that commonly advantage the globally wealthy at the expense of the globally poor (Díaz et al., 2019) and contribute to perverse environmental injustices (Miriti et al., 2021; Montgomery et al., 2020; Murphy et al., 2021). That human displacement is entertained as an ecological solution reflects the legacy of natural historians positioning Europeans at the apex of the natural world and Western understanding as objective.

A separate important legacy from the history of natural history is that to this day expectations of ecosystem function are set by the extensive information collected in temperate systems, a practice that can be traced to the influence of Humboldt (Pausas & Bond, 2019). This is evident in yet to be resolved explanations of latitudinal gradients of biodiversity that emphasize hyperdiverse tropical regions rather than depauperate temperate regions (e.g., Brown, 2014; Rangel et al., 2018). In other words, ecological understanding of tropical systems is limited by biased expectations for function derived from the legacy of colonialism and natural history.

Tropical regions are vast and remote; relatively undescribed by classical ecological methods, they are estimated to contain nearly half of remaining global biodiversity (Montgomery et al., 2020; Rivas, 1997). In support of reintegrating natural history within conservation, Rivas (1997) concludes that scientific growth should not

disregard "original sources" of knowledge, by which he refers to the knowledge of naturalists. Yet the tropics and other developing regions are inhabited with a wide range of people who possess diverse and complex understanding of the world around them who are not included in this notion of natural history.

TEK is gaining recognition with a growing number of advocates for its formal inclusion in conservation practice (see Albuquerque et al., 2021 for a recent review) but Agrawal (1995) warns of the dangers of power imbalances that can relegate such knowledge as secondary to Western knowledge systems. A further caution is warranted, however, because TEK can be vulgarized to represent aboriginal practices as harmonious with Western concepts of nature, that is, outside of civilization (Agrawal, 1995). Such presentations trivialize the dynamic resilience of TEK (Agrawal, 1995; Albuquerque et al., 2021; Rozzi et al., 2015), perpetuating racist, exclusionary conceptualizations of natural history. Ecologists must be extremely careful about how to integrate TEK into ecological practice.

Considering Black ecologies as discussed previously, Black ecologies are not born of the transcendence of experience that is presupposed but not actually achieved by European natural historians. Instead, they are forged through and in resistance to conditions of extreme violence: they are born of experience, including the experience of bondage. Nor does this knowledge reflect an arbitrary and racist distinction between those embedded in nature as "savage" and those who transcend it as "civilized." Quite the contrary, these are forms of knowledge born of efforts to escape from the barbarism of civilization, and which therefore challenge the equivalency between knowledge and freedom.

In highlighting both TEK and Black ecologies we are not advocating a return to the colonial practice of appropriating local knowledge and incorporating it into a comprehensive planetary view (Liboiron, 2021). Rather we are interested in how ecological process, especially in vast remote areas across the tropics, can be understood, modeled, and even catalogued without reference to Linnean systems of naming. This issue is gaining momentum (Albuquerque et al., 2021; Montgomery et al., 2020; Trisos et al., 2021) and its resolution is a step towards decolonizing ecology with outcomes that justly incorporate diverse knowledge.

Education

Consistent with current initiatives to address diversity in STEM education (McGee, 2020; Taylor & Dewsbury, 2018), ecologists are beginning to connect the role of cultural biases and the diversity of students who enter and remain in the discipline (Bowser & Cid, 2021; Miriti, 2019, 2021). In lieu of considerations of why BIPOC are not interested in "nature" (e.g., Mohai, 2003), the racialized histories embedded in ecology, such as that of natural history, must be included in ecological curriculum (see Box 1 and Box 2 for examples) to provide a proper context for the uneven distribution of natural resources and White supremacy in the ecological academy.

Taking cultural and racialized issues seriously requires institutional transformation to achieve sustainable interventions on behalf of minoritized people (Corneille et al., 2019; DeAro et al., 2019; Shaw et al., 2019). To promote diversity, common "deficit approaches" that emphasize educational limitations (e.g., Gutman et al., 2002) must be augmented with consideration of how cultured biases influence recruitment, retention and disciplinary priorities that define ecological practice.

Broadly speaking, colorblind perspectives maintain racial hierarchies that exist in STEM (Miriti, 2020). Racialized biases in ecology have been presented in educational (Nxumalo & Ross, 2019; Stapleton, 2020) and societal (Hickcox, 2018) contexts. Such biases can also influence outcomes of ecological research (Borderon et al., 2021; Schell, Dyson, et al., 2020). Consistent among these studies is recognizing the value of multiple forms of ecological knowledge. Just as with efforts that incorporate community knowledge and greater public engagement with ecology (e.g., Nadkarni et al., 2019), educators can modify curriculum in ways that include BIPOC ecological understanding (e.g., Stapleton, 2020). However, such curricular reforms do not override the need to be willing to confront and eradicate racialized disciplinary biases, such as what we presented here, in service of broader participation in ecology.

CONCLUSION

Recognizing Black ecological knowledge is important in the context of decades in which Black people, especially, are stereotyped as lacking knowledge and interest in the environment. The incorrectness and danger of these stereotypes have received both scholarly (Finney, 2014; Miriti, 2019) and popular attention (for example in the *New York Times* articles "Black Bodies, Green Spaces" in 2019 and "How Black Foragers Find Freedom in the Natural World" in 2021). Beyond countering pernicious stereotypes, addressing the role of natural history in racial taxonomies is a way to grapple with the roots of anti-blackness in scientific thought.

Recognizing multiple forms of in-depth, largely descriptive yet still integrative, and useful knowledge is one way for ecology today to be more inclusive. The

lesson is not that these other forms of knowledge are the same as either ecological science or natural history: we want to highlight the "difference" from ecology and natural history while highlighting their "relevance." The lesson is that there have been multiple pathways into the sorts of knowledge about nature that are the hallmark of natural history and which people are seeking in ecology today. Colonial forms of knowledge production are not required! Moreover, being open to such pathways and the unique knowledge of different people with different histories is a way to be more welcoming to BIPOC people and start to overcome the blind spots of Western forms of natural history and ecology. This is a win-win situation: addressing racism does not distract from ecological science but is a way to improve ecological knowledge itself.

ACKNOWLEDGMENTS

As members of The Ohio State University community, we would like to acknowledge that the land The Ohio State University occupies is the ancestral and contemporary territory of the Shawnee, Potawatomi, Delaware, Miami, Peoria, Seneca, Wyandotte, Ojibwe and Cherokee peoples. Specifically, the university resides on land ceded in the 1795 Treaty of Greeneville and the forced removal of tribes through the Indian Removal Act of 1830. We want to honor the resiliency of these tribal nations and recognize the historical contexts that have and continue to affect the Indigenous peoples of this land. We would also like to recognize the Black Ecologist section of the ESA for its advocacy and invitation to participate in these submissions elevating the Black experience in ecology. We thank the special editors K. Bailey, M. McCary and C. Hawn, for their support for this manuscript. Support for this collaboration was also provided by the NFS RCN: The Undergraduate Network for Increasing Diversity of Ecologists (UNIDE), NSF 2018939.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Empirical data were not used for this research.

ORCID

Maria N. Miriti https://orcid.org/0000-0002-6976-0265
Ariel J. Rawson https://orcid.org/0000-0002-4789-3622
Becky Mansfield https://orcid.org/0000-0003-2120-462X

REFERENCES

Able, K. W. 2016. "Natural History: An Approach whose Time Has Come, Passed, and Needs to Be Resurrected." *ICES Journal of Marine Science* 73: 2150–5.

Agrawal, A. 1995. "Dismantling the Divide between Indigenous and Scientific Knowledge." *Development and Change* 26: 413–39.

Albuquerque, U. P., D. Ludwig, I. S. Feitosa, J. M. B. de Moura, P. H. S. Gonçalves, R. H. da Silva, T. C. da Silva, T. Gonçalves-Souza, and W. S. Ferreira Júnior. 2021. "Integrating Traditional Ecological Knowledge into Academic Research at Local and Global Scales." *Regional Environmental Change* 21: 45.

Anderson, S. C., P. R. Elsen, B. B. Hughes, R. K. Tonietto, M. C. Bletz, D. A. Gill, M. A. Holgerson, et al. 2021. "Trends in Ecology and Conservation over Eight Decades." *Frontiers in Ecology and the Environment* 19: 274–82.

Anker, P. 2002. "The Context of Ecosystem Theory." *Ecosystems* 5: 611–3.

Arnold, D. 1999. *The Problem of Nature: Environment, Culture and European Expansion*. Oxford: Blackwell.

Arnold, D. 2006. *The Tropics and the Traveling Gaze: India, Landscape, and Science, 1800–1856*. Seattle, WA: University of Washington Press.

Arteaga, J. S. 2017. "Biological Discourses on Human Races and Scientific Racism in Brazil (1832-1911)." *Journal of the History of Biology* 50: 267–314.

Ashworth, W. 1996. "Emblematic Natural History of the Renaissance." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 17–37. Cambridge: Cambridge University Press.

Beck, C., K. Boersma, C. S. Tysor, and G. Middendorf. 2014. "Diversity at 100: Women and Underrepresented Minorities in the ESA." *Frontiers in Ecology and the Environment* 12: 434–6.

Beer, G. 1996. "Travelling the Other Way." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 322–37. Cambridge: Cambridge University Press.

Bellamy Foster, J., and B. Clark. 2008. "The Sociology of Ecology: Ecological Organicism Versus Ecosystem Ecology in the Social Construction of Ecological Science, 1926-1935." *Organization & Environment* 21: 311–52.

Bledsoe, A. 2017. "Marronage as a Past and Present Geography in the Americas." *Southeastern Geographer* 57: 30–50.

Borderon, M., K. B. Best, K. Bailey, D. L. Hopping, M. Dove, and C. L. Cervantes de Blois. 2021. "The Risks of Invisibilization of Populations and Places in Environment-Migration Research." *Humanities and Social Sciences Communications* 8: 1–11.

Bowser, G., and C. R. Cid. 2021. "Developing the Ecological Scientist Mindset among Underrepresented Students in Ecology Fields." *Ecological Applications* 31: e02348.

Brockway, L. 1979. *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens*. New York, NY: Academic Press.

Brown, J. H. 2014. "Why Are there So Many Species in the Tropics?" *Journal of Biogeography* 41: 8–22.

Browne, J. 1996. "Biogeography and Empire." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 305–21. Cambridge: Cambridge University Press.

Carney, J. A. 2001. *Black Rice: The African Origins of Rice Cultivation in the Americas*. San Francisco, CA: Academia.

Carney, J. A., and R. Rosomoff. 2011. *In the Shadow of Slavery*. Berkeley, CA: University of California Press.

Clements, F. E. 1916. *Plant Succession: An Analysis of the Development of Vegetation*. Washington: Carnegie Institution of Washington.

Clements, F. E. 1936. "Nature and Structure of the Climax." *Journal of Ecology* 24: 252–84.

Connell, R. 2020. "Maroon Ecology: Land, Sovereignty, and Environmental Justice." *The Journal of Latin American and Caribbean Anthropology* 25: 218–35.

Corneille, M., A. Lee, S. Allen, J. Cannady, and A. Guess. 2019. "Barriers to the Advancement of Women of Color Faculty in STEM: The Need for Promoting Equity Using an Intersectional Framework." *Equality, Diversity and Inclusion: An International Journal* 38: 328–48.

Cowles, H. C. 1899. "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan. Part I.-Geographical Relations of the Dune Floras." *Botanical Gazette* 27: 95–117.

Cronin, M. R., S. H. Alonzo, S. K. Adamczak, D. N. Baker, R. S. Beltran, A. L. Borker, A. B. Favilla, et al. 2021. "Anti-Racist Interventions to Transform Ecology, Evolution and Conservation Biology Departments." *Nature Ecology & Evolution.* 5: 1213–23.

Cunningham, A. 1996. "The Culture of Gardens." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 38–56. Cambridge: Cambridge University Press.

Curry, H. A., N. Jardine, J. A. Secord, and E. C. Spary, eds. 2018. *Worlds of Natural History*. Cambridge: Cambridge University Press.

Dawkins, R. 2006. *Selfish Gene: 30th Anniversary Edition*. Oxford: Oxford University Press.

Dayton, P. K., and E. Sala. 2001. "Natural History: The Sense of Wonder, Creativity and Progress in Ecology." *Scientia Marina* 65: 199–206.

de Chadarevian, S. 2007. "*The Selfish Gene* at 30: The Origin and Career of a Book and its Title." *Notes and Records of the Royal Society* 61: 31–8.

DeAro, J., S. Bird, and S. Mitchell Ryan. 2019. "NSF ADVANCE and Gender Equity: Past, Present and Future of Systemic Institutional Transformation Strategies." *Equality, Diversity and Inclusion: An International Journal* 38: 131–9.

Dettelbach, M. 1996. "Humboldtian Science." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 287–304. Cambridge: Cambridge University Press.

Diamond, J. M. 1975. "The Island Dilemma: Lessons of Modern Biogeographic Studies for the Design of Natural Reserves." *Biological Conservation* 7: 129–46.

Diaz, D. 2015. "White Voices, Black Silences and Invisibilities in the XIX Century Travel Narratives." *Palabra-Escuela De Idiomas-Maestria En Literatura* 26: 17–29.

Díaz, S., J. Settele, E. S. Brondízio, H. T. Ngo, J. Agard, A. Arneth, P. Balvanera, et al. 2019. "Pervasive Human-Driven Decline of Life on Earth Points to the Need for Transformative Change." *Science* 366: eaax3100.

Diouf, S. A. 2014. *Slavery's Exiles: The Story of the American Maroons*, Edition Unstated ed. New York, NY: NYU Press.

Ducarme, F., F. Flipo, and D. Couvet. 2021. "How the Diversity of Human Concepts of Nature Affects Conservation of Biodiversity." *Conservation Biology* 35: 1019–28.

Dunnavant, J. P. 2021. "Have Confidence in the Sea: Maritime Maroons and Fugitive Geographies." *Antipode* 53: 884–905.

Duvall, C. S. 2009. "A Maroon Legacy? Sketching African Contributions to Live Fencing Practices in Early Spanish America." *Singapore Journal of Tropical Geography* 30: 232–47.

Ellis, E. C. 2015. "Ecology in an Anthropogenic Biosphere." *Ecological Monographs* 85: 287–331.

Ellis, E. C., N. Gauthier, K. K. Goldewijk, R. B. Bird, N. Boivin, S. Díaz, D. Q. Fuller, et al. 2021. "People Have Shaped Most of Terrestrial Nature for at Least 12,000 Years." *Proceedings of the National Academy of Sciences* 118: e2023483118.

Espinosa, L. 2011. "Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences that Contribute to Persistence." *Harvard Educational Review* 81: 209–41.

Findlen, P. 1996. "Courting Nature." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 57–74. Cambridge: Cambridge University Press.

Finney, C. 2014. *Black Faces, White Spaces: Reimagining the Relationship of African Americans to the Great Outdoors*. Chapel Hill, NC: University of North Carolina Press.

Gleason, H. A. 1926. "The Individualistic Concept of the Plant Association." *Bulletin of the Torrey Botanical Club* 53: 7–26.

Golden, K. B. 2021. ""'Armed in the Great Swamp": Fear, Maroon Insurrection, and the Insurgent Ecology of the Great Dismal Swamp." *The Journal of African American History* 106: 1–26.

Greene, H. 2005. "Organisms in Nature as a Central Focus for Biology." *Trends in Ecology & Evolution* 20: 23–7.

Greene, H. W., and J. B. Losos. 1988. "Systematics, Natural History, and Conservation: Field Biologists Must Fight a Public-Image Problem." *Bioscience* 38: 458–62.

Gregory, D. 2001. "(Post)Colonialism and the Production of Nature." In *Social Nature: Theory, Practice and Politics* 84–111. Malden, MA: Blackwell.

Gutman, L. M., A. J. Sameroff, and J. S. Eccles. 2002. "The Academic Achievement of African American Students during Early Adolescence: An Examination of Multiple Risk, Promotive, and Protective Factors." *American Journal of Community Psychology* 30: 367–99.

Harris, J. B., and M. Angelou. 2012. *High on the Hog: A Culinary Journey from Africa to America*. New York, NY: Bloomsbury USA.

Hartigan, J. 2017. *Care of the Species: Races of Corn and the Science of Plant Biodiversity*. Minneapolis, MN: University of Minnesota Press.

Henry, A. 2015. "'We Especially Welcome Applications from Members of Visible Minority Groups': Reflections on Race, Gender and Life at Three Universities." *Race Ethnicity and Education* 18: 589–610.

Hickcox, A. 2018. "White Environmental Subjectivity and the Politics of Belonging." *Social & Cultural Geography* 19: 496–519.

Hosbey, J., and J. T. Roane. 2021. "A Totally Different Form of Living: On the Legacies of Displacement and Marronage as Black Ecologies." *Southern Cultures* 27: 68–73.

Jackson, Z. I. 2020. *Becoming Human: Matter and Meaning in an Antiblack World*. New York, NY: NYU Press.

Jardine, N., J. A. Secord, and E. C. Spary. 1996. *Cultures of Natural History*. Cambridge, New York: Cambridge University Press.

Jardine, N., and E. Spary. 1996. "The Natures of Cultural History." In *Cultures of Natural History*, edited by N. Jardine, J. A.

Secord, and E. Spary, 57–74. Cambridge: Cambridge University Press.

Kareiva, P., and M. Marvier. 2012. "What Is Conservation Science?" *Bioscience* 62: 962–9.

Kingsland, S. E. 2015. "Ecological Science and Practice: Dialogues across Cultures and Disciplines." In *Earth Stewardship: Linking Ecology and Ethics in Theory and Practice*, edited by R. Rozzi, F. S. Chapin, III, J. B. Callicott, S. T. A. Pickett, M. E. Power, J. J. Armesto, and R. H. May, Jr., 17–26. Cham: Springer International Publishing.

Klemow, K., A. Berkowitz, C. Cid, and G. Middendorf. 2019. "Improving Ecological Education through a Four-Dimensional Framework." *Frontiers in Ecology and the Environment* 17: 71–1.

Kloppenburg, J. R. 1988. *First the Seed: The Political Economy of Plant Biotechnology, 1492–2000*. New York: Cambridge University Press.

Koerner, L. 1996. "Carl Linnaeus in his Time and Place." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 145–62. Cambridge: Cambridge University Press.

Lee, J. 2018. "Provincialising Global Botany." In *Worlds of Natural History*, edited by E. C. Spary, H. A. Curry, J. A. Secord, and N. Jardine, 433–46. Cambridge: Cambridge University Press.

Lewontin, R. C. 1977. "Caricature of Darwinism." *Nature* 266: 283–4.

Lewontin, R. C. 1991. *Biology as Ideology: The Doctrine of DNA*, Reprint ed. New York, NY: Harper Perennial.

Liboiron, M. 2021. *Pollution Is Colonialism*. Durham, NC: Duke University Press.

Liu, J., T. Dietz, S. R. Carpenter, C. Folke, M. Alberti, C. L. Redman, S. H. Schneider, et al. 2007. "Coupled Human and Natural Systems." *AMBIO: A Journal of the Human Environment* 36: 639–49.

Longino, H. E. 1990. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, NJ: Princeton University Press.

Lotzof, K. 2018. *Endeavour 250: Natural History through Colonial Encounter*. London: Natural History Museum. https://www.nhm.ac.uk/discover/hms-endeavour-250.html.

Mallory, C. 2013. "Environmental Justice, Ecofeminism, and Power." In *Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action*, edited by R. Rozzi, S. T. A. Pickett, C. Palmer, J. J. Armesto, and J. B. Callicott, 251–8. Netherlands, Dordrecht: Springer.

Malm, A. 2018. "In Wildness Is the Liberation of the World: On Maroon Ecology and Partisan." *Nature i. Historical Materialism* 26: 3–37.

Marsh, G. P. 1864. *Man and Nature*. Cambridge, MA: University of Washington Press.

Mascarenhas, M. 2018. "White Space and Dark Matter: Prying Open the Black Box of STS." *Science, Technology, & Human Values* 43: 151–70.

McCarthy, M. A., C. J. Thompson, A. L. Moore, and H. P. Possingham. 2011. "Designing Nature Reserves in the Face of Uncertainty." *Ecology Letters* 14: 470–5.

McGee, E. O. 2016. "Devalued Black and Latino Racial Identities: A by-Product of STEM College Culture?" *American Educational Research Journal* 53: 1626–62.

McGee, E. O. 2020. *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation*. Cambridge, MA: Harvard Education Press.

McIntosh, R. P. 1995. "H. A. Gleason's 'Individualistic Concept' and Theory of Animal Communities: A Continuing Controversy." *Biological Reviews* 70: 317–57.

Miller, D. P., and P. H. Reill, eds. 1996. *Visions of Empire: Voyages, Botany, and Representations of Nature*. Cambridge: Cambridge University Press.

Mintz, S. W. 1985. *Sweetness and Power: The Place of Sugar in Modern History*. New York, NY: Penguin Books.

Miriti, M. N. 2019. "Nature in the Eye of the Beholder: A Case Study for Cultural Humility as a Strategy to Broaden Participation in STEM." *Education Sciences* 9: 291.

Miriti, M. N. 2020. "The Elephant in the Room: Race and STEM Diversity." *Bioscience* 70: 237–42.

Miriti, M. N. 2021. "The Identity Crisis of Ecological Diversity." *Ecological Applications* 31: e02352.

Miriti, M. N., G. Bowser, C. R. Cid, and N. C. Harris. 2021. "Overcoming Blind Spots to Promote Environmental Justice Research." *Trends in Ecology & Evolution* 36: 269–73.

Mitman, G. 1992. *The State of Nature: Ecology, Community and American Social Thought 1900–1950*. Chicago, IL: The University of Chicago Press.

Mohai, P. 2003. "Dispelling Old Myths: African American." *Environment: Science and Policy for Sustainable Development* 45: 10–26.

Montgomery, R. A., K. Borona, H. Kasozi, T. Mudumba, and M. Ogada. 2020. "Positioning Human Heritage at the Center of Conservation Practice." *Conservation Biology* 34: 1122–30.

Morgan, J. 2004. *Labouring Women: Reproduction and Gender in New World Slavery*. Philadelphia, PA: University of Pennsylvania Press.

Müller-Wille, S. 2015. "Linnaeus and the Four Corners of the World." In *The Cultural Politics of Blood, 1500–1900*, edited by K. A. Coles, R. Bauer, Z. Nunes, and C. L. Peterson, 191–209. London: Palgrave Macmillan UK.

Müller-Wille, S., and H.-J. Rheinberger. 2012. *A Cultural History of Heredity*. Chicago, IL: University of Chicago Press.

Murphy, M. W., G. Weddington, and A. Rio-Glick. 2021. "Black Ecology and Critical Environmental Justice." *Environmental Justice* 14(6): 393–7.

Nadkarni, N. M. 2013. "Not Such Strange Bedfellows: Underserved Public Audiences as Collaborators for Ecologists." In *Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action*, edited by R. Rozzi, S. T. A. Pickett, C. Palmer, J. J. Armesto, and J. B. Callicott, 333–47. Dordrecht: Springer Netherlands.

Nadkarni, N. M., C. Q. Weber, S. V. Goldman, D. L. Schatz, S. Allen, and R. Menlove. 2019. "Beyond the Deficit Model: The Ambassador Approach to Public Engagement." *Bioscience* 69: 305–13.

Noss, R. F. 1996. "The Naturalists Are Dying off." *Conservation Biology* 10: 1–3.

Nxumalo, F., and K. M. Ross. 2019. "Envisioning Black Space in Environmental Education for Young Children." *Race Ethnicity and Education* 22: 502–24.

Ogborn, M. 2018. "Vegetable Empire." In *Worlds of Natural History*, edited by E. C. Spary, H. A. Curry, J. A. Secord, and N. Jardine, 271–86. Cambridge: Cambridge University Press.

Ogilvie, B. W. 2018. "Visions of Ancient Natural History." In *Worlds of Natural History*, edited by E. C. Spary, H. A. Curry, J. A. Secord, and N. Jardine, 17–32. Cambridge: Cambridge University Press.

Outram, D. 1996. "New Spaces in Natural History." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 249–65. Cambridge: Cambridge University Press.

Pausas, J. G., and W. J. Bond. 2019. "Humboldt and the Reinvention of Nature." *Journal of Ecology* 107: 1031–7.

Phillips, J. 1931. "The Biotic Community." *Journal of Ecology* 19: 1–24.

Phillips, J. 1935. "Succession, Development, the Climax, and the Complex Organism: An Analysis of Concepts: Part III. The Complex Organism: Conclusions." *Journal of Ecology* 23: 488–508.

Poole, A. K., E. C. Hargrove, P. Day, W. Forbes, A. R. Berkowitz, P. Feinsinger, and R. Rozzi. 2013. "A Call for Ethics Literacy in Environmental Education." In *Linking Ecology and Ethics for a Changing World: Values, Philosophy, and Action*, edited by R. Rozzi, S. T. A. Pickett, C. Palmer, J. J. Armesto, and J. B. Callicott, 349–71. Dordrecht: Springer Netherlands.

Pratt, M. L. 1992. *Imperial Eyes: Travel Writing and Transculturation*. London: Taylor & Francis [CAM].

Prescod-Weinstein, C. 2020. *The Disordered Cosmos*. New York: Bold Type Books.

Qureshi, S. 2018. "Peopling Natural History." In *Worlds of Natural History*, edited by E. C. Spary, H. A. Curry, J. A. Secord, and N. Jardine, 363–78. Cambridge: Cambridge University Press.

Rangel, T. F., N. R. Edwards, P. B. Holden, J. A. F. Diniz-Filho, W. D. Gosling, M. T. P. Coelho, F. A. S. Cassemiro, C. Rahbek, and R. K. Colwell. 2018. "Modeling the Ecology and Evolution of Biodiversity: Biogeographical Cradles, Museums, and Graves." *Science* 361: eaar5452.

Redman, C. L. 1999. "Human Dimensions of Ecosystem Studies." *Ecosystems* 2: 296–8.

Ricklefs, R. E. 2012. "Naturalists, Natural History, and the Nature of Biological Diversity: (American Society of Naturalists Address)." *The American Naturalist* 179: 423–35.

Rivas, J. A. 1997. "Natural History: Hobby or Science?" *Conservation Biology* 11: 811–2.

Roane, J. T. 2018. "Plotting the Black Commons." *Souls* 20: 239–66.

Rozzi, R. 1999. "The Reciprocal Links between Evolutionary-Ecological Sciences and Environmental Ethics." *Bioscience* 49: 911–21.

Rozzi, R. 2012. "Biocultural Ethics: Recovering the Vital Links between the Inhabitants, their Habits, and Habitats." *Environmental Ethics* 34: 24–50.

Rozzi, R., F. S. Chapin, J. B. Callicott, S. T. A. Pickett, M. E. Power, J. J. Armesto, and R. H. May. 2015. "Introduction: Linking Ecology and Ethics for an Interregional and Intercultural Earth Stewardship." In *Earth Stewardship*, edited by R. Rozzi, F. S. Chapin, III, J. B. Callicott, S. T. A. Pickett, M. E. Power, J. J. Armesto, and R. H. May, 1–14. Cham: Springer International Publishing.

Schell, C. J., K. Dyson, T. L. Fuentes, S. Des Roches, N. C. Harris, D. S. Miller, C. A. Woelfle-Erskine, and M. R. Lambert. 2020. "The Ecological and Evolutionary Consequences of Systemic Racism in Urban Environments." *Science* 369: eaay4497.

Schell, C. J., C. Guy, D. S. Shelton, S. C. Campbell-Staton, B. A. Sealey, D. N. Lee, and N. C. Harris. 2020. "Recreating Wakanda by Promoting Black Excellence in Ecology and Evolution." *Nature Ecology & Evolution* 4: 1285–7.

Schiebinger, L. L., and C. Swan, eds. 2005. *Colonial Botany: Science, Commerce, and Politics in the Early Modern World*. Philadelphia, PA: University of Pennsylvania Press.

Shaw, S. M., M. Bothwell, K. Furman, L. Gaines, D. John, C. Lopez, N. Osei-Kofi, et al. 2019. "Advancing Women in STEM: Institutional Transformation." *The Lancet* 393: e17–8.

Sloan, P. 1995. "The Gaze of Natural History." In *Inventing Human Science*, edited by C. Fox, R. Porter, and R. Wokler, 112–51. Berkeley, CA: University of California Press.

Sobrevilla, I. M. 2018. "Indigenous Naturalists." In *Worlds of Natural History*, edited by E. C. Spary, H. A. Curry, J. A. Secord, and N. Jardine, 112–30. Cambridge: Cambridge University Press.

Soper, K. 1995. *What Is Nature?* Oxford; Cambridge, MA: Blackwell.

Soulé, M. E. 1991. "Conservation: Tactics for a Constant Crisis." *Science* 253: 744–50.

Spary, E. 1996. "Political, Natural and Bodily Economies." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 178–96. Cambridge: Cambridge University Press.

Stapleton, S. R. 2020. "Toward Critical Environmental Education: A Standpoint Analysis of Race in the American Environmental Context." *Environmental Education Research* 26: 155–70.

Tansley, A. 1987. "What Is Ecology?" *Biological Journal of the Linnean Society* 32: 5–16.

Tansley, A. G. 1935. "The Use and Abuse of Vegetational Concepts and Terms." *Ecology* 16: 284–307.

Tate, S. A., and D. Page. 2018. "Whiteliness and Institutional Racism: Hiding behind (Un)Conscious Bias." *Ethics and Education* 13: 141–55.

Taylor, C., and B. M. Dewsbury. 2018. "On the Problem and Promise of Metaphor Use in Science and Science Communication." *Journal of Microbiology & Biology Education* 19: 19.1.46.

Taylor, D. E. 1997. "American Environmentalism: The Role of Race, Class and Gender in Shaping Activism 1820–1995." *Race, Gender & Class* 5: 16–62.

Torre, O. d. l. 2018. *The People of the River*. Chapel Hill, NC: UNC Press.

Trisos, C. H., J. Auerbach, and M. Katti. 2021. "Decoloniality and Anti-Oppressive Practices for a more Ethical Ecology." *Nature Ecology & Evolution* 5: 1205–12.

Uriarte, M., H. A. Ewing, V. T. Eviner, and K. C. Weathers. 2007. "Constructing a Broader and more Inclusive Value System in Science." *Bioscience* 57: 71–8.

Vakil, S., and R. Ayers. 2019. "The Racial Politics of STEM Education in the USA: Interrogations and Explorations." *Race Ethnicity and Education* 22: 449–58.

Voyles, T. B. 2016. *Wastelanding: Legacies of Uranium Mining in Navajo Country*. Minneapolis, MN: University of Minnesota Press.

Wilbur, H. M. 1997. "Experimental Ecology of Food Webs: Complex Systems in Temporary Ponds: The Robert H. MacArthur Award Lecture *Presented 31 July 1995 Snowbird, Utah* by." *Ecology* 78: 2279–302.

Winston, C. 2021. "Maroon Geographies." *Annals of the American Association of Geographers* 111: 2185–99.

Wood, P. 1996. "The Science of Man." In *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. Spary, 197–210. Cambridge: Cambridge University Press.

Wright, W. J. 2020. "The Morphology of Marronage." *Annals of the American Association of Geographers* 110: 1134–49.

Wynter, S. 2003. "Unsettling the Coloniality of Being/Power/Truth/Freedom: Towards the Human, after Man, its Overrepresentation–an Argument." *CR: The New Centennial Review* 3: 257–337.

Yanai, I., and M. J. Lercher. 2016. "Forty Years of the Selfish Gene Are Not Enough." *Genome Biology* 17: 1–3.

How to cite this article: Miriti, Maria N., Ariel J. Rawson, and Becky Mansfield. 2023. "The History of Natural History and Race: Decolonizing Human Dimensions of Ecology." *Ecological Applications* 33(1): e2748. https://doi.org/10.1002/eap.2748