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Shaping Landscapes: Environmental History, Plantation Management and Colonial Legacies in Mauritius

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Abstract
In this study I trace the historical political ecology of Bras d'Eau, a nineteenth-century colonial sugar estate, twentieth-century forest plantation, and contemporary National Park in Mauritius. Via archaeological studies, documentary records, reconstruction of ecological landscapes, and ethnographic interviews, the study shows how environmental and climatic ideologies, structures of power and inequality, and community values intersected to produce the built environment of today's National Park. Despite massive deforestation and degradation caused by colonial and post-colonial ecological strategies, newly formed forest reserves have become integral to island and community resilience.

Keywords Plantation · Forest · Sugar · Indenture · Historical political ecology · Indian Ocean · Mauritius

Introduction

This article presents the archaeological landscape of the Indian Ocean island-nation of Mauritius as a case study on the impact and legacy of historical exchanges between diverse colonial systems and the people who lived within them. Mauritius was successively settled from 1598 onward by Dutch, French, and English colonizers and exploited laborers from Africa, Asia, and the Arabian Peninsula. Situated 1,000 km from the East African coast and on the East India trade route, seventeenth- to early nineteenth-century colonial interest in Mauritius centered on its usefulness as a resupply and military station. The island came to play an important role in the global plantation-based sugar industry beginning in the nineteenth century. Two different colonial plantation landscapes existed within Bras d'Eau in different periods:

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a nineteenth-century sugar estate and a twentieth-century plantation forest. This paper describes changing colonists' and laborers' perceptions and manipulations of the local environment and how the legacy of their strategies is seen in the present-day national park.

The history of the Bras d'Eau plantation complex is a microcosm of larger empire-building processes and ecological imperialism of the nineteenth and twentieth centuries. In this study I reconstruct colonial-era historical and political ecology to examine the ways in which human action influences and interacts with ecological systems and non-human entities. This work provides the foundation for my ongoing study of the organization of plantation households and the inequities colonial processes generated through built environments (Haines 2020; see also Braje et al. 2017; Wu 2019). In Mauritius, forms of labor exploitation in successive colonial and nationalist eras changed from slavery to indenture to leased land (Haines 2019b). The plantation complex thus intertwined local ecologies and spatial practices variably over time, related to labor practices, land management, and racial inequality. This paper explores the impact and legacy of those varied practices.

By connecting documentary records, archaeological and ecological landscapes, and ethnographic interviews, different aspects of how the site held unique meaning to the plantation owners, colonial managers, and the enslaved and indentured men, women, and children of Bras d'Eau can be observed. I integrate the historical archaeology of everyday life at Bras d'Eau with an analysis of the forest itself as an artifact, arguing that the living ecology is, in part, a legacy of the earlier plantation landscape and associated social and cultural activities. Considering the history of the forest and the living trees as artifacts imbued with social and cultural meaning deepens our understanding of Mauritius's historical and contemporary political ecology. Additionally, this approach has relevance for the study of other plantation colonies, as it shows that the social, cultural, and ecological practices of plantations are interrelated and inseparable in the past and the present.

The Political Ecology and Ecological Imperialism of Plantation Colonies

The global distribution of the plantation complex has left legacies of social and cultural inequities that endure to the present. We see these legacies through the persistence of anti-black and brown racism, the long-term social and cultural consequences of Indigenous land dispossession, and more broadly, the intersection of racial/global inequality with the global labor market. Historic systems of labor exploitation, such as slavery and indenture, and the plantation systems' rapid and massive impact on local ecologies, were connected and integral parts of European colonial and capitalist expansions. Crosby (1986:296) called European colonization "ecological imperialism" because settlers brought entirely new biota to colonized lands; they spread deadly diseases and introduced invasive plants and animals that displaced native species, intentionally and unintentionally. Crosby (1986: 141–142) emphasizes that the quality of colonial settlement largely depended on whether the biogeography of a place lends itself to the prevalence of diseases. Similarly,

Morrison (2018:198) describes empires as "ecosystem engineers," arguing that the politics of power over humans and non-human agents is an integral part of imperial landscape anthropogenesis.

In this article, I use *historical political ecology* to refer to the political relationships that shaped human and non-human interactions over time and resulting historically layered landscapes (Morehart et al. 2018; Offen 2004; Robbins 2012). Archaeological studies of political ecology often focus on unequal access to resources such as water (Hauser 2017, 2021; Holt 2018; Preto and Valenzuela 2019), mining (Lawrence et al. 2016; Sironi 2019), land (Kosiba and Hunter 2017; Rosenweig 2018), roadways (Johnson and Hamarnşah 2019), or pottery (Rice 2013). In this study of a Mauritian sugar estate, while agricultural land is the obvious primary resource of concern, access to *time* on such land also plays a role in the sociopolitical dynamics between property owners and land workers. Morehart et al. (2018) suggest that political ecology is also useful for archaeologists to interpret the complex cycles of action and reaction that occur between human and non-human entities that become layered on the landscape; recognizing palimpsests of anthropogenic landscape transformations helps to determine how those earlier histories influence subsequent actions. Lastly, archaeological perspectives on historical political ecology also have important relevance for human–environment relationships today (Robbins et al. 2015), which I return to in the conclusion. This article builds on previous anthropological and geographical studies of historical political ecology that have shown the destructive consequences of colonial forested landscape ideologies for colonized people and local biota (e.g., Offen 2004:28–29). There is a historical relationship between the development of the plantation complex and colonial forestry management, both functioning within the same political and ecological ideological systems.

It is important, then, that we look also at the legacies of plantation systems as entangling diverse human and non-human entities into relationships of power. Mitman et al. (2019) argue that plantations not only disciplined people, but also nature. Human involvement in the management of land previously thought to be "virgin" or "untouched" has been demonstrated throughout multiple and diverse environments (Clement et al. 2015; Hecht et al. 2014; Heckenberger et al. 2003; Ishikawa and Soda 2020; Östlune et al. 2002). Plantation complexes differ from other human-environmental interactions because they require a disciplining of nature by simplifying the landscape to promote the success of a single crop (Mitman et al. 2019). Scott (1998) interprets this "administrative ordering of nature and society" as the state's desire to create a legible and abridged map that simplifies and produces the same categories—land owners and property, for example—that can then be subjected to state power. In his discussion of western forestry science and state forest management, Scott argues that old-growth forests were transformed into "scientific forests" or "fiscal forests." He further posits that forests designed by the state are at odds with both a naturalist's forest and local or indigenous engagement with the land. To control such landscapes, forests needed to be simplified, literally by limiting the number of species promulgated. Transforming the forest also renders it legible and quantifiable through maps and other documents, which simultaneously makes local foraging both illegible and unsustainable, thus defining both the landscape and the social behavior that occurs within it (see also Wolf and Mintz 1957). A

similar argument can be made of the colonial-era plantations that replaced native biodiversity with monocrop agricultural fields and can still be defined by property boundaries on maps, as well as by the recorded number of laborers who worked on them in archival documents.

These top-down narratives provide a useful framework to understand how the spread of the plantation complex radically changed the political ecologies of colonies like Mauritius and highlights the importance for archaeologists to consider the legacies that plantations have had on "non-binary socionatures" (Morrison 2018:196; see also Ishikawa and Soda 2020 on plantations and the society/nature dichotomy). Intersecting processes of production, labor exploitation, and ecological transformation became entangled under European colonialism, but it is also important to consider how people responded within these larger systems. As Stoler (1989:135) points out, when anthropologists conceptualize colonialism as a homogeneous, "abstract force, a *structure* imposed on local *practice,*" the overemphasis on world systems overshadows nuances in specific colonial contexts and differences in the day-to-day experiences of colonized people.

Archaeology provides an avenue through which to examine the ways in which enslaved and indentured laborers responded to the local environment and contributed to the built environment based on their own ideologies and identities. The rich body of archaeological research on plantation complexes has revealed common spatial patterns that emerged as this mode of production spread across the globe. We should not take for granted the fact that the landscape encompassed not just fields and agricultural infrastructure, but the domestic spaces for field workers, overseers, managers, and occasionally plantation owners. The quarter or domestic village and agricultural/industrial structures were typically situated in close proximity to one another. Battle-Baptiste (2011) posits that any adjacent "wilderness" was an important fourth sphere of plantation life, where people could forage, hunt, or escape the gaze of enslavers. In the following sections, I examine the ways in which French, Dutch, and British colonizers conceptualized the environment and their actions that altered it; the indentured laborers' construction of place within the plantation and in the larger island environment; and finally the labor involved in the reforestation of the site.

Environmental History of Mauritius

Mauritius initially was valued for its abundance of untouched natural resources and strategic location in the Indian Ocean. The first Dutch settlers cut down most of the ebony forests and introduced sugar cane in 1639 (Floore and Jayasena 2010). Human settlement, accompanied by the introduction of other non-native species such as rats, precipitated the mass extinction of native flora and fauna including the dodo (Cheke and Hume 2008). Under French colonial rule (1715–1810) sugar production gradually increased, eventually producing enough to exceed local demand (Allen 1999:12). France's loss of their main sugar producing colony, St. Domingue, following the Haitian Revolution (1791–1804) further encouraged

other colonies to increase production (Vaughan 2005:257). Throughout the eighteenth and early nineteenth centuries, land concessions were offered for free to French settlers to encourage local cultivation (Grove 1995:173).

Sugar cane cultivation *and* the demand for timber for buildings and railways deforested colonies in the Indian Ocean (Griggs 2007). Keeping sugar mills running during harvest season required fuel as well. Grove (1995) argues that, despite the fact that Dutch and French colonists deforested so much of the island, there were hints that they recognized the economic and environmental cost for removing old-growth forest. He suggests that restrictions on hunting and documented observations of the soil changes due to human intervention were a form of early conservationist attitudes among French colonists and administrators. Colonial ideas around forest, deforestation, and ecology were grounded in technical studies of soil erosion, sedimentation, and reduced flow of waterways, aridity, rainfall, and botany. They were also, however, deeply intertwined with capitalist ideologies of profit, power, and the future security of both. For example, eighteenth-century Mauritian colonist Pierre Poivre raised alarms over the connection between climate and settler-driven changes to the island ecosystems, such as deforestation and reduced rainfall. Underlying his concerns over the drying climate was how it might negatively impact the colony's ability to grow spice trees, for the purpose of ending Dutch dominance over the spice trade (Grove 1995:169). The French colony, navy, and military also relied on Mauritian timber for shipbuilding and repair, leading to concerns over deforestation and slow tree regrowth on Mauritius beginning in the mid-1700s (Grove 1995:175–176). Different policy decisions attempted to address the conflicting sugar production, lumber production, and deforestation issues. As the French colonial government granted land concessions, they simultaneously enacted laws that protected forests around streams and rivers. The government protected mountain slopes from being converted into cane plantations, to preserve soils from erosion and ensure the formation of rain clouds (Grove 1995:257). Colonists and planters across the Indian Ocean also became aware of some unintended consequences of plantation ecology simplification, noting that land aridification, reduced river flow, reduced biodiversity, and increased erosion, weeds, and frost were a result not only of deforestation, but of sugar cane fields replacing those forests (Griggs 2007:256; Grove 1995:261).

Nevertheless, the conversion of arable land into sugarcane plantations increased rapidly under British colonial rule (1810–1968). Sugar became a major export item in the nineteenth century particularly after the British equalized sugar taxes across the empire in 1825 (Vaughan 2005:260). By 1848, 80% of all Mauritian factories were steam-powered, but the majority were still using inefficient open-fire boiling pans to evaporate water from the sugar, burning wood and bagasse, the fibrous remnants of cane stalks after the pressing (Storey 1997:40).

Into the second half of the nineteenth century, Mauritians saw that large-scale deforestation for the creation of sugarcane fields was starting to threaten the security of the colony after a series of droughts and malaria epidemics devastated the population (Storey 1997:72). The colonial government responded by again transforming previously cultivated lands, including reforesting sections of former sugar

estates. In the twentieth century, the relationship between water resources and plant life became of even greater concern as stagnant water came to be associated with multiple infectious diseases, breeding grounds for mosquitos, and by proxy, malaria (Haines 2019b).

Labor

Mauritius thus became a plantation colony with both enslaved and indentured people powering this transition (Barker 1996:4–5). When slavery was abolished in 1838, some 77,000 enslaved people gained their freedom and most left the plantations where they had been held captive (Vaughan 2005) but remained on the island. To replace their labor, more than 450,000 indentured laborers migrated to the island between the 1830s and 1920s. Of those who landed in Mauritius, some 13,000 came from China, East Africa, and the Arabian Peninsula, but 97% came from India. European indentured servants who voyaged to North America and Caribbean colonies in the 1600s and 1700s laid the legal groundwork for the large-scale migration of South Asians to sugar colonies after the abolition of slavery (Handler and Reilly 2017). Similar to earlier indentured people, nineteenth-century Indian workers were provided passage on ships to the colony. Typical contract agreements stated that adult male laborers would work for five years, receiving a wage of 5 rupees per month and the option to withhold one rupee for return passage (HC 1875:28, 244). Adult women and adolescents aged 15–18 (presumably male) were paid 2–3 rupees less (HC 1875:244). They received housing, board, and healthcare, though the quantity and quality of food varied greatly from estate to estate (Kumar 2017). About 150,000 indentured laborers returned to India at the end of their contracts or would travel back and forth between the island and the subcontinent on a series of contracts. The remaining 65% stayed on in Mauritius, their descendants becoming the majority population on the island today. As such, this Asian migration is at the intersection of what are often considered two distinct types of racialized labor movements: diaspora, or the settlement of a group of people away from a collectively identified homeland on the one hand, and transregional migration, which suggests continuous movement across borders or boundaries, on the other.

The Sugar Estate

This examination of the archaeology of Bras d'Eau is a study of the land ideologies, structures of power and inequality, and community values that influenced human action within the local environment. Bras d'Eau was a French land concession, first settled in the last quarter of the eighteenth century by a property owner and at least 60 enslaved men, women, and children from the African continent. In the next century, following island-wide transition from an economy centered on trade and maritime traffic, to a plantation economy, indentured laborers terraformed the Bras d'Eau sugar estate into a productive sugar estate (Haines 2019b). This process altered plant and animal populations living on the land and drastically altered the island's fabric. Underlying vesicular

basalt is close to or at surface level across Bras d'Eau. Growing sugarcane on such a landscape meant boring holes in the rocky ground and displacing 162 ha (400 ac) of boulders into long neat rows. The sugar mill closed in 1868 during a period when there was also island-wide consolidation of cane milling. A private residence for the owner was maintained, however the sugar fields were ultimately abandoned over the next 34 years.

The colonial government purchased Bras d'Eau in 1904 and set about reforesting it. As the twentieth century progressed, forested crown lands took on an increasingly important role in public health and for local community resilience specific to tropical ecology and climate. Forested crown lands provided resources to assist in rebuilding after cyclones and helped to manage infectious disease outbreaks through a third phase of terraforming of the land. While the sugar industry was integral to shaping Mauritius's political ecology, even after the sugar cane fields and mills were abandoned at Bras d'Eau, the political and ecological consequences of the sugar industry were intimately intertwined with the transformation of Bras d'Eau into a forestry plantation.

Excavating the Indenture Period

Archaeological research on nineteenth-century indentured laborers and plantations within the Indian Ocean has begun to reveal how plantation landscapes and the material culture of everyday life shifted under new power dynamics of the indenture system and cultural frameworks of immigrants and migrants (Armstrong and Hauser 2004; Croucher 2015; Haines 2020; Seetah et al. 2018). More than 140 stone features and structures were identified and documented using GIS on the site, providing a detailed map of estate's configuration (Haines 2019a). We have yet to identify the function of many structures and how the use of space may have changed over time. However, the main domestic quarter (Area 2B) was identifiable through the configuration of the features within the 4-ha area; four line barracks, and clusters of 54 detached dwellings with enclosed yards resemble a small village (Haines 2019a). The 17 × 80 m stone-and-mortar sugar mill is the largest structure on the property. The mill would have housed a steam engine fed by boilers and a firebox, which ran machinery to extract juice by crushing cane stalks. The juice was further heated to thicken it into a syrup, which would ultimately result in crystalized sugar. In a structure known as a purgery adjacent to the mill, crystallized mixtures were left in containers from which molasses could drain from the sugar.

Looking at the broader landscape the lands surrounding the eastern side of the ruins in Bras d'Eau are close to a coastal brackish inlet and prone to flooding. In addition, a large lake and swamp, Mare Sarcelle, is located on the northern boundary of Bras d'Eau (Fig. 1). Believing that noxious miasmic air in marshes caused disease, the plantation owners would have avoided constructing living quarters close to such areas.

Domestic Life under Indenture

The domestic life was an integral part of the plantation landscape, and is a critical space for understanding how laborers navigated such disciplined contexts (Haines

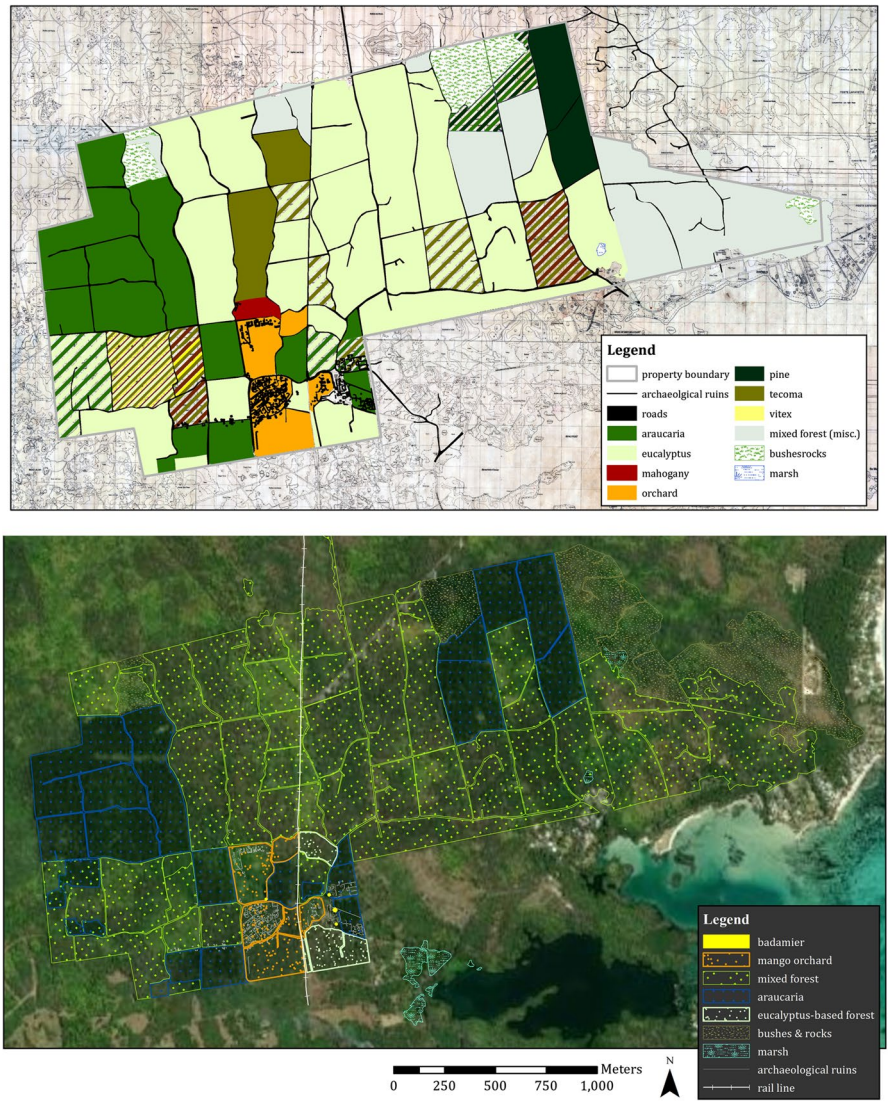

Fig. 1 Top: Digitized data from maps dating to 1982 show sectors of different tree species in Bras d'Eau, including the wetlands that surround the Bras d'Eau Estate's eastern half. (Mauritius Ministry of Housing and Land Use). Bottom: Modern satellite imagery shows the estate's property lines, roads, and sections of araucaria forest still define the landscape

2020). The housing configuration and household assemblages shows us not only what indentured life was like, but also us how people interacted with, responded to, and conceived of the local environment beyond the sugar fields. The numerous archaeological features present at Bras d'Eau today are not described in documentary sources, which include government surveys of the state of the colony and of working conditions of indentured people, and inventories for the sugar estate that

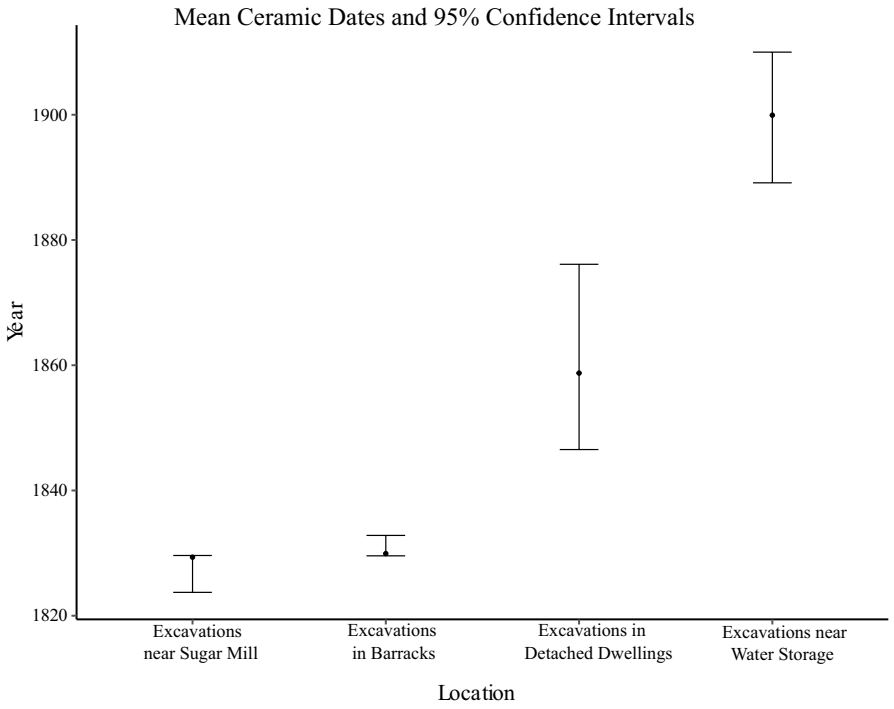

Fig. 2 Mean Ceramic Dates (MCD) show that the barracks were occupied before the detached dwellings

came up for auction (HC 1847; 1875; Pragassa 1860). For example, the road network, the largest single feature on the estate, which perhaps required the greatest amount of labor second to the agricultural work itself, are not mentioned in any reports or maps of the property. This discrepancy in itself is not particularly surprising; multiple features may have been deemed too unimportant to document, were built later in the life of the plantation, or had fallen into disrepair at the time of writing. Comparing the existing archaeological landscape and the written documentation of laborers' dwellings points to the ways in which the owners, who did not live full-time on the estate, and laborers, placed different values on domestic spaces. It further suggests they held different attitudes about the climatic environment.

Five excavation units placed in Area 2B further confirmed the use of the barracks, detached dwellings, and yards as domestic spaces. Mean ceramic dates for imported European ceramics recovered from excavations situate the occupation of these structures to ca. 1825–1900 and show that the barracks' occupation was slightly earlier than the detached dwellings (Fig. 2) (Haines 2020). It is likely that the communal housing was originally planned by the estate owners either late in the period of enslavement or the beginning of the indentured period, when the experience of indenture on the estate was still heavily shaped by the earlier system of slavery (Haines 2020). In addition to the ceramic dates, inside the longest barracks the most recent stratigraphic layer contained discarded heavy metal machinery parts and horseshoes (Fig. 3). This refuse layer was on top of compact clay flooring that

adjoined and filled gaps in the bedrock. Therefore, the barracks appear to have been abandoned before the detached dwellings, and either used as a dumping ground or repurposed as a stable or other type of storage facility. In contrast, there was no similar waste layer in the detached dwellings. Additional excavations within the quarter would further refine our comparative understanding of the occupational histories of different dwellings.

These preliminary indications of a transition from barracks to detached dwellings over the first four decades of indenture suggest laborers preferred the smaller residential units. They were also interested in usable exterior spaces next to these homes, shaping the yards through the construction of serpentine stone enclosure walls. The configuration of the detached dwellings also shows that the laborers who built and live in the structures were more attuned to the local environment than the plantation managers. The majority of the doorways on the detached dwellings face between north and west, pointing away from the dominant southeasterly winds in order to shield the threshold, yard, and residents (Haines 2019b). As noted earlier, coastal wetlands are situated directly southeast of Bras d'Eau's mill and domestic quarter. It is possible that the cold winds were seen as insalubrious because they passed over possibly miasmic wetlands. Overall, the detached dwellings reflect how those living on the estate constructed the landscape in order to care for themselves and their community, integrating their knowledge of the local environment into configuration of social life.

While the spatial complexity of the domestic quarter is evident through the archaeological record, written descriptions of the labor camp refer only to the number of dwellings and room size. For example, in 1846 the Stipendiary Magistrate of Flacq, the large eastern district of Mauritius, surveyed the living conditions of "Coolies" on plantations and provided a report for Mauritius's Colonial Secretary. He quantified the quality of life in the village based on the ratio of the number of houses to number of laborers on the estate. Five barracks "part stone and part wood," and 54 "palisade huts" (the detached dwellings) are listed to house 414 men, 70 women, and 61 children (House of Commons 1847:187). When the property was advertised for auction in 1860 in the Mauritius Government Gazette for $90,000, along with the industrial features of the estate, the structures within the living quarter were advertised as follows: "The Indians' camp is composed of 50 huts of various sizes divided into 118 rooms, built with palisades and covered with straw" (Pragassa 1860:329). Although five line-barracks are mentioned in earlier site descriptions, they are not mentioned in the 1860s advertisement, which corroborates the timeline of the transition from the barracks to detached-dwelling determined by the ceramic data. The documentation of rooms was clearly a way to quantify the laboring bodies they could contain. From the estate owner's perspective, the advertisement demonstrates that existing infrastructure dedicated to supporting large numbers of laborers was seen to increase the estate's property value. This comparison therefore also allows us to recognize some of the additional labor unrelated to sugar production that both enslaved and indentured people put into plantations that added value for the owners.

The colonial commodification of domesticity is at odds with the importance indentured laborers saw in shaping a comfortable home for themselves and their kin. The construction of the intimate, private detached dwellings and adjoining yards

Fig. 3 Excavations in the longest barracks uncovered heavy iron machinery deposited on top of the living surface

was an act of long-term care for the residents themselves and their cohabitants, and for future indentured workers who would occupy the structures.

Indentured labor in Mauritius ended in 1924, though the number of new migrants had been declining for decades. Former indentured laborers and their descendants who remained on the island rather than returning to India became wage workers and small land and business owners. They also leased land to grow their own crops, including sugar.

Transitions: Sugar to Trees, Indenture to Wages

The following considers how Bras d'Eau was transformed from a sugar estate to a forest and how the shift from indentured laborers to local wage-workers is reflected in the domestic landscape on the plantation. After the Mauritian colonial government purchased the estate in 1904, it became crown lands under the management of the Forestry Department. More than a century of annual reports (AFS) from the Colonial Forestry Department provide a rough timeline for modifications made to the estate landscape. These reports are enriched with an analysis of the existing landscape, and with stories collected from current park rangers and detailed ethnographic interviews conducted with two Mauritians who lived and worked in Bras d'Eau in the latter half of the twentieth century and who have agreed for their names to appear here in print.

Unfortunately, annual reports were missing for the years from 1896 to 1905; thus direct documentary evidence has not been recovered to explain why the colonial government was motivated to acquire the abandoned sugar fields, mill, and stone structures. Situating the ruins and trees within the broader historical colonial context suggests that climatic, economic, and public health concerns all motivated the reforestation efforts. In the beginning of the nineteenth century the forest was a dynamic space for experimental plant propagation. In a departure from the monocropping of sugar cane, several different species of tree were grown in Bras d'Eau. A variety of lumber and fruit-bearing trees were raised in the nursery and saplings were

transplanted from the botanical gardens in Pamplemousse, about 22 km west of Bras d'Eau. The forestry personnel experimented with propagating seeds or seedlings of at least 50 different species, many of which came from other tropical or subtropical locations across the British Empire, including Natal (South Africa), Trinidad, British Guiana, Djibouti, Rhodesia (Zimbabwe), and Madras (India). Only a few native Mauritian tree species were selected for cultivation: Bois de Fer (*Sideroxylon boutonianum*), and Tatamaka (*Calophyllum inophyllum*). The choice in species themselves shows the ways in which the empire was interconnected through forestry science and botanical globalism. Over time, the list of propagated species was reduced; eucalyptus (*Eucalyptus tereticornis*), filao (*Casuarina equisetifolia*), and pines (*Cryptomerias Araucarias*) remained the most common trees used by the colonial government to reforest crown lands.

As shown in the forest policy in the annual report of 1955, by the twentieth century the Department's ability to generate lumber was only one goal in a much longer list of objectives related to the preservation of existing reserves, soils, water, and climate:

> to reserve in perpetuity as a forest estate sufficient land, either already forested or capable of afforestation, in order to safeguard and maintain water supplies, to preserve the climatic and physical conditions of the Colony; to prevent erosion and the silting up of reservoirs; to provide forest produce for domestic, agricultural and industrial requirements; and to maintain soil stability in areas where the land is liable to deteriorate if put to other uses;… to set aside in perpetuity as 'national reserves', suitable areas of the native forests of Mauritius and to preserve such areas of native forests in their natural state by controlling and preventing, if possible, the intrusion and establishment of other-than-native trees and plants (AFS 1955:2).

This list of priorities harkens back to earlier French concerns over deforestation. Perhaps most critically from an ecological perspective, reports from the second half of the nineteenth century begin to include indigenous plants that had survived mass extinction and were growing wild as the Forestry Department took the responsibility to care for the last 2% of native forests on the island which had survived.

Living Artifacts and Landscapes

Bras d'Eau is a living landscape, however this landscape is also representation of the past if we consider the trees as archaeological artifacts, and the forest as an assemblage. Maps of the region from 1982, satellite imagery, and on-the-ground observations enable the identification of many tree species that form the forest's upper canopy. While the documentary sources reveal which species were planted and when, the satellite imagery allows us to see patterning in their distribution (see Fig. 1). Layering the tree distribution over the sugar estate ruins reveals that the zones of activity established during the preceding century provided a template within which the imported tree species were organized. Most of the trees were segregated into field blocks created by roads, maintaining the process of ecological simplification (see Fig. 1). Though many

sections have a dense understory, one can still see that the largest trees are spaced at regular distances from one another. This pattern is most evident within the sections of araucaria, where individual trees were clearly planted in rows following the old basalt field stone lines. These areas are the most evident from satellite imagery, appearing as very dark green blocks in the westernmost sides of the property. The mango orchards are the second most homogenous blocks, planted within what was once the domestic quarter of the estate and adjacent fields, though the foliage renders ruins invisible from above. Other sections of the park contain both single species and mixed species forest. Sections with mixed-growth eucalyptus trees are situated around the sugar mill ruins and the new center of operations and living quarters for forestry workers. Based on oral accounts from current and former park rangers, crown lands that were on or near swampland with species that have deep-penetrating roots, such as eucalyptus (Haines 2019b). This vegetation favors the drying of the land and reduces mosquito breeding grounds and the proliferation of miasmic (malarial) air in the region (Beattie 2012:110; Bennett 2011:129). Thus, forested lands were potentially important in reducing waterlogged lands.

On the ground, the presence of tree species not mentioned within the reports indicates that undocumented and potentially unsanctioned activities occurred in the park. Three badam trees (*Terminalia catappa)* are situated along the main road that connects the domestic quarter and adjacent fields to the sugar mill at several crossroads: the entrance to the domestic quarter, north of the mill, and at the crossroad of the train tracks (Fig. 4). Also called Indian almond or Malabar almond, these trees produce long, slender nuts harvested when the dried pods fall to the ground. It is unknown when the trees were planted. The tropical species typically grows quickly (Orwa et al. 2009); it is possible the first seed was planted by a nineteenth-century indentured laborer who lived a few steps away, a twentieth-century farmer who lived on the estate, or forestry officer post-independence when there was renewed interest in diversifying the forest ecosystem to support a wider range of Mauritian plants and animals. Trees growing in tropical regions without distinct annual dry seasons do not have distinct annual growth rings, which makes it very challenging to conduct traditional dendrochronology. Future research might integrate promising alternative methodologies to estimate the age of tropical trees, such as Ng's (2013) use of

Fig. 4 Crossroad at one of the entrances to the domestic quarter with a large badam tree (*Terminalia catappa)*

gradual decay, that would further elucidate the historical ecology of the site. These trees do not fit in to the plantation planning. Occupying marginal spaces along roads adjacent to swaths of plantation forest, the badam tree represents subversive planting activity.

The process of transforming Bras d'Eau from sugar cane fields into an imported plantation forest reflects continuity in the colonial process of using imported species as tools to enact ecological change. This forest comprises individual trees like an archaeological site contains artifacts: as an assemblage they reveal that on the ground, people made choices different from those which the processes colonial planters and administrators set in motion.

The Labor of Reforestation

The plantation complex's organization reflects how the British functioned to redistribute not just plants, but ideas from across the globe and to reorganize social relationships. Originally the Forestry Department intended for forest plantation workers to live within the park, as enslaved and indentured laborers had done for centuries when the estate was growing sugar. As soon as the Forestry Department acquired the property, they instituted a *taungya* system: a land-use practice originating in the hill farms of Myanmar. Cleared land was planted with crops between young trees, allowing the forest to regenerate while also providing subsistence for farming villages (Win and Kumazaki 1998). Seen as a highly efficient use of land, European colonial foresters latched onto the indigenous practice, first adapting it in the 1860s to produce teak and other timber species in Myanmar and India, and in African regions later on (Jha 2012; Win and Kumazaki 1998).

Jha (2012:113) argues that anthropologists have mistakenly described *taungya* as an example of colonial recognition of Indigenous knowledge, when instead it was an exploitative system that took advantage of villagers' free labor under the guise of "cooperation." In West Bengal, Jha (2012:112–114) explains that colonial foresters first displaced forest villages in order to implement the *taungya* system, such that those who worked under the system had little choice in how they lived and worked on the land. Colonial governments relied on the lessee's free labor to clear, plant, weed, water, and protect the growing plantation forest as they tended their own crops, and to managing the reforesting project as a whole (Jha 2012:114; see also Imo 2009 on *taungya* in Kenya; Walker 2004 on colonial reforestation using Indigenous labor in Malawi). *Taungya* keeps farmers in a state of precarity, requiring them to move their families about every five years when the trees reached full height, thus preventing them from establishing long-term, intergenerational ties to the land. Farmers can find ways to subvert the system such as sabotaging the trees so they took longer to grow, thus extending their lease on the land, but reforestation could also fail if farmers were not supplied seedlings and other tools to support regrowth (Hellermann 2007).

Based on current knowledge of the Forestry Report, the land management in Bras d'Eau is only referred to as *taungya* once, in 1946, but other written descriptions and oral accounts suggest that a similar system was in place throughout the majority of the

twentieth century. The Mauritian Forestry Department reportedly leased ~ 12 ha plots of land for 3 rupees a month to two "Indian[s]…with the task of raising vegetables, whilst upkeeping the forest plants" (AFS 1910). The lessees were responsible for the care of the developing forest. They weeded and watered thousands of plants by hand. They also harvested and sold wood bundles from coppiced trees, a cutting method that provides a rotation of young harvestable wood every year, and cords of lumber, but the income from these harvests went back into the hands of the Forestry Department. The segregation of different species in the modern forest landscape suggests that the lessees had to juggle propagating a variety of trees in the field and nursery.

With the documentation of forested land, foraging and local use of forest resources became both visible and transgressive. The Forestry Department kept records of a range of infractions and income from fees, including unauthorized removal or possession of forest products, illegal cultivation, animal trespassing or grazing, and illegal depositing (dumping) of materials, and encroachment. This also begs the question as to whether lessees in Mauritius were also expected to police transgressors on lands like Bras d'Eau. The colonial government had thereby formulated a new form of the plantation labor after both the abolition of slavery (1838) and indenture (1917).

It is unclear how the Mauritian lessees' experience compared to others working with the *taungya* system in South Asia or Africa and how the balance of labor changed over the course of the twentieth century. For one, it is still unclear whether lessees and their families and other field laborers lived in the same area together or moved around within Bras d'Eau. Dating of surface and excavated sherds from the domestic quarter indicates these areas were not occupied into the twentieth century (Haines 2020).

Mr. Premchand Chuckun grew up in the nearby village of Roches Noir. His father worked in Bras d'Eau as a woodcutter, and Mr. Chuckun was 10 or 11 years old when he first visited the forest with his parents in the 1950s to obtain water for their plants. He worked for the Forestry Department for his entire life, starting as a guard in 1962 and ultimately retiring as a deputy forest officer. Mr. Chuckun describes the forest as being managed like a garden; daily tasks included weeding, watering, and weeding to make room for tree seedlings. As described in the first few annual reports, he also remembers planting corn, manioc, and vegetables between the trees for about five years until the trees grew too large and shaded the ground. Thus, trees were not the only crop grown in Bras d'Eau. Several preexisting sisal-hemp (used for weaving bags or baskets), manioc, and sweet potato fields were also harvested for animal feed, though eventually all these fields were reforested. Mr. Chuckun recalls that domestic housing was situated to the south of the old sugar mill building. Vestigial corner foundations were identified in this area through surface survey. He also remembers that foresters made use of some stone structures next to the sugar mill as offices.

Mrs. Sarita Boodhoo also lived in the park as a child when her father worked as an officer for the National Forest for several years, working to plant new trees. She similarly remembers living on the north side of the mill and describes her childhood as peaceful and rich, surrounded by nature. Her mother and grandmother would collect bags of almonds from the badam trees to make sweet almond paste. Being

isolated from any nearby towns, Mrs. Boodhoo lived part of the time with another family in Roche Noir, the closest town to the north about 4 km away, so that she could attend school. These oral accounts show that the focus of life shifted from the laborers' quarter to the areas around the sugar mill and suggest that lessees stayed in the same housing near the mill even after trees reached full height.

During the second half of the twentieth century, the laborers' relationship to the plantation shifted. The following passage—discussing the construction and repair of quarters for "subordinates" at Bras d'Eau in 1954—departs from the formal and quantitative tone typical of the Forestry Department's annual reports:

> It is somewhat disquieting to have to record that many subordinates do not live in the forest quarters allotted them; they pay the rentals but prefer to live in towns and to journey daily to and from their work in the forests. This state of affairs has necessitated a re-orientation of our overall future building programmes [sic] which have had to be amended to meet the situation. Those who know local conditions will appreciate the difficulties which confront subordinates living in isolated, out-of-the-way places, who have children to send every day to schools situated at considerable distances from their homes (AFS 1954:8).

Therefore, managers within the Forestry Department assumed they could maintain continuity of the plantation model where laborers would both live and work on the land. Presumably, the movement of laborers away from the plantation to villages with greater resources was "disquieting" to Forestry Department managers because of the time, labor, materials, and money that went into constructing and maintaining housing within the estate itself. This also suggests that lessees were rejecting not only the *taungya* system but the entire live-work plantation model. After independence in 1968, the Forestry Department became the Forestry Service of the Ministry of Agriculture and National Resources and the Environment and continued to hire laborers to work in the park. Mr. Chuckun and other rangers recall that in the 1980s, from 200 to 500 laborers worked in the park as wage-earners. There was a substantial shift in the way proprietors and managers had to conceptualize the laborers they managed and perhaps the degree of control the government had over their employees' personal lives. Similarities in the temporal nature of both 5-year indenture and *taungya* contracts meant that power within this plantation landscape included combined access to land and *time*. Mauritian laborers' choices in everyday life were disruptions to the continuity of processes in terms of time and space.

Modern Significance and Future Research

The historical ecology of Bras d'Eau serves as a poignant metaphor for the archaeological and environmental changes that island colonies such as Mauritius underwent in the modern era. In sum, the continued cultivation of introduced species by coerced laborers was part of a colonial system in the Indian Ocean that intertwined capitalist ideological practices with local ecosystems. The forest, like all plantations, encroaches on, destroys, and displaces native ecologies, but it also serves to protect

the island's climate and inhabitants. It sustained newly established ecologies associated with the sugar and trade economy by producing lumber, fuel, animal feed, rainfall, and climatic stability. As new people, animals, materials, plants, and diseases arrived in continuous waves on the island, Mauritian laborers shaped it into a home that incorporated these imports and conceptions of the local environment into their practices. In doing so, they disrupted established top-down cultural norms of the plantation complex. While the Forestry Departments' annual reports present an inward-facing perspective of the forest—bookkeeping of select propagated trees and cash crops, occasional pests, and infractions based on illicit trespassing to gather resources from state-owned lands—plantations had an impact beyond their boundaries. Forest managers expected to follow earlier plantation models where laborers both lived and worked within the estate, but this conflicted with the desires of the latter who preferred to support their families within the growing urban centers.

Interdisciplinary studies of historical ecology and political ecology have significant implications for modern food and water security and community resilience and recovery, and influence current policies around resource management and biodiversity (Braje et al. 2017; Douglass et al. 2018; Robbins et al. 2015; Shaw 2018). For example, in 1955 the Forestry Department reported a deficit of almost 1.2 million rupees; the state must have recognized alternative benefits to maintaining forested crown land despite these losses. Indeed, Cyclone Carol which devasted Mauritius in 1960, the worst cyclone in living memory, killed 42 people and rendering more than 100,000 people homeless. Thousands of trees fell and nursery plants were lost, but the Forestry Department was able to harvest lumber, nursery plants, and poles to provide to hurricane victims to rebuild their homes. Similar support was provided to communities after the less deadly Cyclone Gervaise hit in 1975. Despite the massive deforestation and degradation caused by human settlement, newly formed forest reserves had become integral to island and community resilience.

Under the current management of the Mauritius National Parks and Conservation Services, the existing forest has largely been left to grow wild with limited intervention in terms of the eradication of non-endemic species. Though their mandate is to promote Mauritian plants and animals, the rangers and managers who work in the park appreciate that the imported forest ecosystem provides a home for endemic birds and introduced species. Their perspective highlights the forest as an artifact of the past, a product of intermingling cultural and ecological processes. Divisions between conservation efforts geared towards "cultural" heritage and conservation of "natural" heritage collapse with this view of the landscape.

The trees planted in and among the ruins have become the single most destructive element to the preservation of buried archaeological deposits; however, the continued use of Bras d'Eau as a plantation site over the last 200 years means that the transformations in the site are visibly layered on the landscape. The modern national park forest holds a paradoxical position of having protected the standing ruins of former sugar plantations from development, while the roots of the trees have and continue to significantly disrupt the archaeological context.

By considering the site from archaeological and environmental perspectives, a broader range of spatial and chronological dimensions can be woven together to form a deeper appreciation for the social processes that led to the creation of

this multifaceted island. From this fragmentary historical ecology of the reforestation of Bras d'Eau, it is clear that all of the various forms of land cover on the island—the last native forests, plantation forests, sugar fields, urban spaces—have historical and political meaning on the island. These spaces were defined not only by their own internal ecologies or biodiversity but by their relationships to one another. Forests were conceptualized as tools that supported sugarcane fields; growing villages redefined laborers' relationships to the agricultural land they worked. This work has set the foundation for a larger examination of settlement patterns and historical ecology across Mauritius during the earlier slavery period and later post-emancipation indenture period. Future work will focus on how plantation systems also defined marginal land, and urban landscapes, providing the opportunity to incorporate models of environmental inequality and differential access to community resources into existing historical archaeology methodologies. As archaeological research in Mauritius continues to expand, we will gain a more nuanced, in-depth, and interdisciplinary understanding of the island's rapidly transformed landscape.

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