Deforestation, Erosion, and Fire: Degradation Myths in the Environmental History of Madagascar

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ABSTRACT

Mention of the island nation of Madagascar conjures up images of exotic nature, rampant deforestation, and destructive erosion. Popular descriptions of the island frequently include phrases such as 'ecological mayhem' or 'barren landscape'. This paper compares this common wisdom and conservation rhetoric about the environmental history of Madagascar with the results of recent research by paleoecologists and others. Deforestation and erosion, while very real trends, are exaggerated due to mistaken ideas about pre-settlement forest extent and the eye-catching red soils and erosion gullies. The role of fire, principal tool of landscape change and pasture maintenance, is unnecessarily demonised. Blame is placed on the Malagasy people and problems of poverty and population growth, ignoring economic interests, historical political contexts, community politics, and the potential of the people to manage their resources positively. Finally, drawing from the recent school of thought that recognises the role of narratives, discourses, and representations in the politics of conservation, this paper concludes by illustrating the political nature of the oft-repeated story of environmental degradation in Madagascar.

KEYWORDS

Madagascar, environmental narratives, degradation, forest history

> Tany mena tsy mba mirehitra
> The red earth isn't on fire, it just looks like it
>
> (Malagasy proverb)

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INTRODUCTION

Madagascar receives enormous amounts of attention as a hot spot of biological diversity, environmental degradation, and conservation action. As a result of rapid deforestation and species extinctions, the islands hosts a frantic effort by development and environmental organisations to establish protected areas and improve resource management (Kull 1996). Accompanying this conservation effort is a specific narrative, a story of exotic nature and environmental destruction, which is used to justify conservation fundraising, policies, and actions. This story – promulgated in the media, travel guides, television documentaries, song lyrics, environmentalists' writings and agency documents – rests on several problematic assumptions and outdated facts (Jarosz 1993; Hardenbergh et al. 1995), yet it persists due to its compelling story line and its usefulness in gaining public and government support. As a result, historical and current processes of environmental transformation in Madagascar are often misunderstood. The task of this paper is to highlight six of the errors, assumptions and rhetorical ploys in the story of Madagascar as an environmental hotspot. Deforestation rates, species extinctions and soil erosion are dramatic enough that the story of environmental degradation need not be overstated.

The past decade has seen a growing academic concern with re-evaluating received wisdoms about the human role in environmental change and analysing the importance of such stories in shaping or justifying environmental politics (Dove 1983; Watts 1985; Showers 1989; Denevan 1992; Kummer et al. 1994; Fairhead and Leach 1996, 1998; Leach and Mearns 1996; McCann 1997; Perevolotsky and Seligman 1998; Batterbury and Bebbington 1999; Bassett and Koli Bi 2000). Fairhead and Leach (1996, 1998), for example, demonstrate that colonial-era assumptions about the forest history of West Africa were incorrect. They expose problems with widely cited statistics of forest decline and describe mistaken assumptions in forest history analyses. For instance, forest islands in savanna zones were previously seen as relics of ancient forests, when they are actually anthropogenic creations. The above studies also discuss the ideologies and political-economic contexts which permit the creation and persistence of these stories and assumptions. Dove (1983), for example, shows how assumptions about slash-and-burn cultivation have facilitated the expansion of state control and market exploitation into new territories. By bringing these concerns to Madagascar, I hope to help reshape our understanding of environmental transformations in the island's past and present.

A DOMINANT NARRATIVE

A tropical island, Madagascar has a variety of different ecological zones (Figure 1). The humid east coast is separated from the highlands by an abrupt

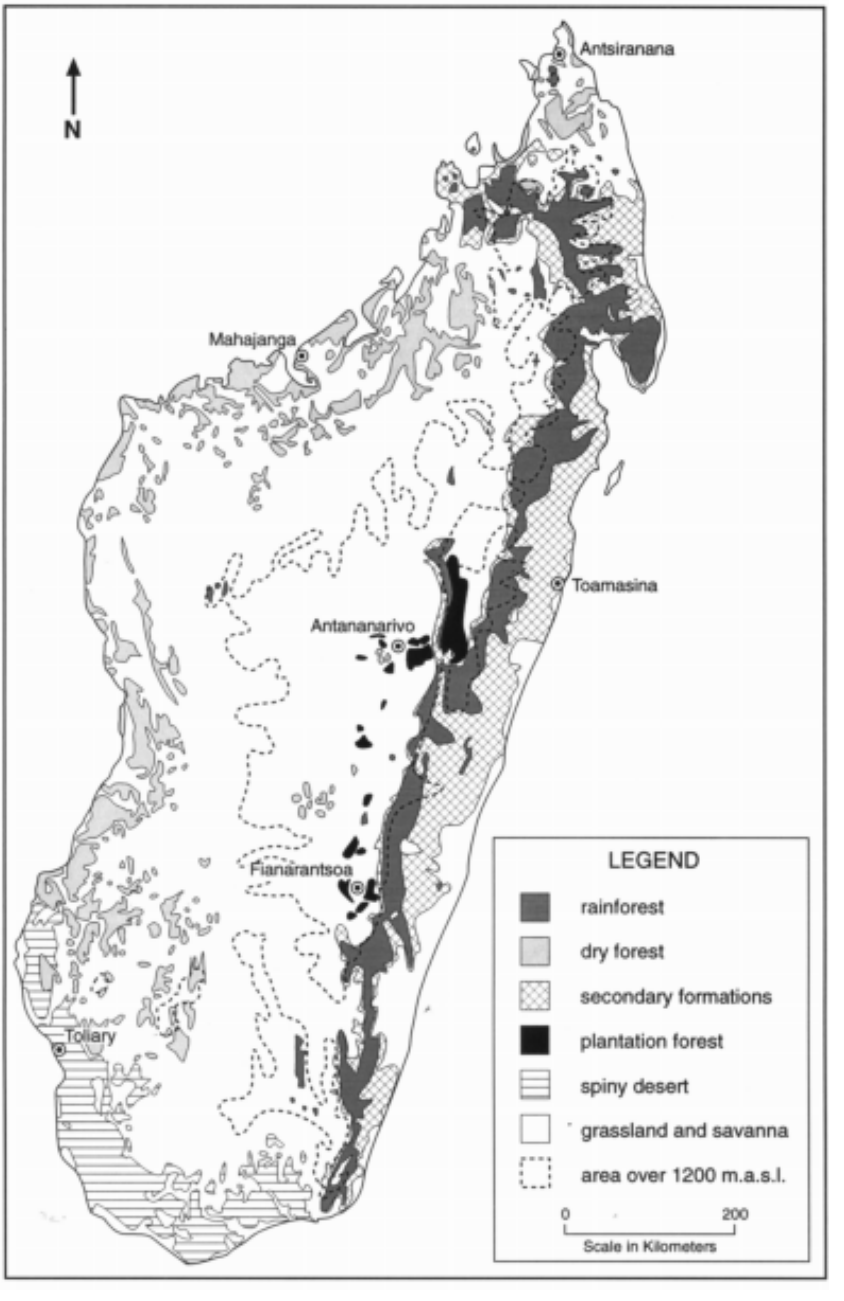


FIGURE 1. Current vegetation zones of Madagascar. Based on AGM (1969), Green and Sussman (1990), and Conservation International et al. (ca. 1995).

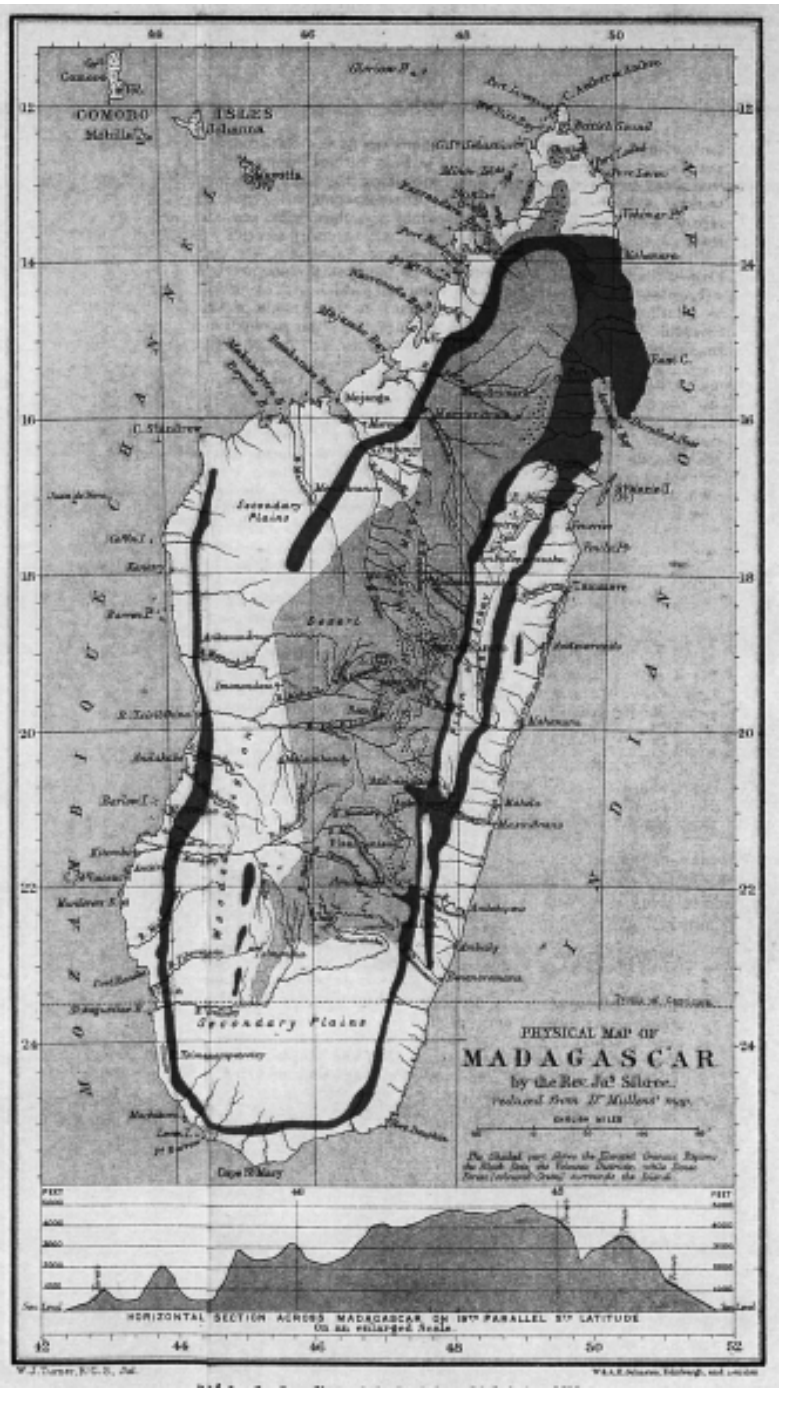
escarpment. The temperate and mountainous highlands have a winter dry season which lasts four to eight months. The west is characterised by gentler, sedimentary relief and a longer dry season. Currently, dense endemic rainforest covers only 10 per cent of the island, while total forest cover is about 23 per cent (DEF 1996). A band of rainforest hugs the eastern escarpment and continues up to the north, while patches of xerophytic forest and spiny brush exist respectively in the west and south. Large expanses of grazed grassland dominate the interior and highlands. Irrigated rice fields, dryland crop fields and orchards account for about five per cent of the surface area.

Early explorers enthusiastically described the island's highly diverse and endemic flora and fauna, a result of 175 million years of tectonic isolation and a wide range of climates and soils. Of the island's approximately 200,000 plant and animal species, three-quarters are found nowhere else, including 97 per cent of non-avian wildlife (Bradt et al. 1996). Missionaries and explorers in the nineteenth century marveled at the biological wonders, but noted with disdain the slash-and-burn cultivation in the eastern region (e.g. Baron 1890, 1891; Elliot 1892) and lamented the treeless 'barren hills' or 'desert' of the highlands (Sibree 1870; Price 1989; see Figure 2). The French conquered the island in 1896 and throughout their 64-year rule criticised Malagasy vegetation burning practices.

It is out of this context that French naturalists Henri Humbert and Henri Perrier de la Bâthie developed the hypothesis that came to dominate discourse about the island's natural history (Perrier de la Bâthie 1921, 1927, 1936; Humbert 1927, 1949, 1955; see also Burney 1997). Their central assertions, summarised and paraphrased from Humbert (1927, 77-8), are as follows.

> Forests covered nearly all of Madagascar before human settlement. Now only a few natural forests remain; by studying these one can see the alarming progress of deforestation, which is caused by *tavy* (shifting cultivation), logging and grassland fires. Instead of establishing permanent plots and irrigated rice fields, the natives cut the remaining forest for *tavy* in order to cultivate temporary crops. Short-sighted commercial logging is no less harmful, impeding regeneration just like *tavy*. Deforestation was begun by *tavy* in the humid regions and advanced by rapid-spread fires into the easily flammable forests of the drier highlands and west. The destroyed forest was replaced by grasses which the natives burn annually to renew pastures for their cattle. These fires cause a retreat of forest edges and lead inescapably to the sterilisation of immense areas. The lateritic soils

FIGURE 2 (opposite). James Sibree's (1879) physical map of Madagascar emphasizes the extent of barren hills encountered by early visitors ('desert' and 'high moors') and gives a potentially reasonable, albeit rough, representation of the distribution of 'dense forests' (dark shading) at the time. Light shading denotes the 'elevated granitic regions'; black dots are the 'volcanic districts'.


COMORO ISLES
Mohilla
Johanna
Secondary Plains
Desert
Secondary Plains
PHYSICAL MAP OF
MADAGASCAR
by the Rev. Jas Sibree.
Cape St Mary
HORIZONTAL SECTION ACROSS MADAGASCAR ON 19TH PARALLEL S. LATITUDE

> are slowly impoverished, especially in the interior, where the scouring of erosion is rapid after deforestation. The degradation of old pastures pushes the natives to create new ones at the expense of the remaining forest. To avoid the disappearance of the native flora and fauna we must create nature reserves. The reserves will have scientific interest as well as economic interest, since they are refuges of precious seeds and species for industry and pharmaceutics.

Perrier and Humbert's story had a great influence on contemporary writing; Madagascar became considered a type locality for the destruction of indigenous flora by fire and shifting agriculture (Bartlett 1955). The narrative continues to be repeated nearly word-for-word, with only a few modifications, in popular publications (e.g. Murphy 1985; Swaney and Wilcox 1994; Bradt et al. 1996; Holmes 1997; Morell 1999) and by development and environmental organisations (e.g. World Bank 1988; Falloux and Talbot 1993; ONE/Instat 1994; USAID 1997a, 1997b). Meanwhile, scientific understanding of environmental change in Madagascar has continued to evolve. In press and agency documents, however, the Perrier-Humbert story has become a dominant narrative, one that shapes the discursive field within which policy occurs (Ferguson 1990; Roe 1994; Escobar 1995). The story has evolved, of course, since Humbert's day. First, commercial logging is no longer seen as a major threat to forests; instead, attention is focused on *tavy*. Second, the narrative no longer implicitly blames farmer ignorance for *tavy* and grassland fires; instead it sees farmers as squeezed by population growth and poverty, which forces them to make short-term resource-use decisions and ignore long-term sustainability. Finally, scientific evidence from the 1970s that climate desiccation probably played a role in Malagasy vegetation change has recently entered the popular story (e.g. Morell 1999).

The story reaches the public through the media, where journalists use artistic license to dramatise Madagascar's environmental degradation. A particularly effective image is the blood-red, iron oxide-laden rivers and estuaries that 'bleed' into the ocean, visible even from space (e.g. Helfert and Wood 1986; Apt 1996; Holmes 1997; Gallegos 1997; Morell 1999). Another recurrent image is the 'gangrenous wounds' of *lavaka*, the island's erosion gullies (Murphy 1985: 68), also described as 'gaping amphitheatres gouged from barren hills once draped with lush soil-preserving vegetation' (Swaney and Wilcox 1994: 10). These culminate in statements such as 'ravaged by fire, overgrazing, and erosion, the mountains are often entirely devoid of vegetation' (Allen 1995: 4) and 'more than a millennium of slash-and-burn agriculture has produced 100,000 square miles of virtually useless space where people once encountered forest' (ibid.: 13). Such popular accounts of environmental change in Madagascar are full of errors, exaggerations and unquestioned assumptions. The following section seeks to reinterpret the environmental history of the island, addressing both factual discrepancies and explanatory debates, in an attempt to push the dominant narrative towards more defensible claims.

THE MYTHS AND THE DEBATES

The island-wide forest

The narrative asserts that forests once covered the entire island, except for the spiny bush of the desertic southwest, the heathlands of the highest peaks, and the granitic inselbergs of the highlands. Humbert and Perrier's island-wide forest hypothesis is the basis for statements that Madagascar is 90 per cent deforested (see Perrier 1921: 3) and the foundation for much of the dominant narrative. Recent evidence, however, shows convincingly that while humans have dramatically altered the island's vegetation, Holocene forests never covered the entire island.

The Perrier-Humbert island-wide forest hypothesis rested on both empirical observations and inherent assumptions. In the east, the naturalists saw *tavy* eating away at the rainforest, leaving behind fire-climax grasslands. As a result, they concluded that the fire-prone grasslands of the highlands and west must also once have been forested, but had already disappeared due to their drier, more vulnerable characteristics. This logic draws from a Clementsian ecological succession model and a European bias towards forests as the climax vegetation. Maps of climatically-determined 'potential' vegetation zones dominated ecological descriptions of Madagascar; in describing the island's land cover history, it was assumed that each zone used to carry its potential climax vegetation (see Fairhead and Leach 1998: 165).

Empirical observations supporting the Perrier-Humbert hypothesis included forest islands in grassland zones, the testimony of farmers, place names which refer to no-longer extant forests, and the fact that the typically brick- or adobe-built houses in the highlands were constructed of wood until the last century (Parrot 1924; Deschamps 1965; Battistini and Vérin 1967, 1972; Raison 1972). Biogeographical evidence, e.g. from insect distributions across the island (Battistini 1976), also suggested an island-wide forest. Other authors cited the legend of a 'great fire' which seared the highland forests (Savaron 1928; Battistini and Vérin 1967, 1972; Jolly 1980) and statements in the oral history of the central highlands, the *Tantaran'ny Andriana*, which imply that highland forests were more abundant (Berg 1981). Perrier's strongest evidence came from the stratigraphic analysis of highland fossil beds. At Ampasambazimba, near Lake Itasy, burned wood was found among subfossil skeletons, while west of Antsirabe, the Marotampona marsh included a buried layer of tree trunks, branches and fruit that matched the closest existing forests, 80 km to the east (Perrier 1917; Deschamps 1965; MacPhee et al. 1985).

The narrative asserts furthermore that continued burning and a paucity of colonising species prevent the island-wide forest from re-establishing itself. Ecologists theorised that the island's native forest flora evolved in a non-competitive environment, and would thus struggle to regenerate in deforested areas in the face of non-native competitors (Perrier 1936; Koechlin 1972;

Koechlin et al. 1974; Gade 1996a). However, Malagasy farmers have names for several pioneering endemic tree species (Rakoto Ramiarantsoa 1995a), and fire exclusion does lead to the growth of woody species (Parrot 1924; Koechlin et al. 1974).

The Perrier-Humbert hypothesis did not convince all contemporaries. Grandidier (1898) argued that the highlands had always been prairie, as did naturalist Baron (see Deschamps 1965) and geographer Gautier (1902). Grandidier based his argument on the fact that highland soils lack a humus horizon typical of forest soils, on the vastness of the grasslands, and on Mayeur's 1777 account of barren highland hills. The debate continued for years, as isolated challenges to various parts of the thesis were raised. Bartlett (1955, 1956) reviewed the literature and decided that there must have been some bushland and savanna before humans arrived – he argued that the extinct three meter high Aepyornis birds probably lived in prairies or open savannas – and that climatic aridification played a role in deforestation. Dez (1970) reached the same conclusion from an alternative reading of the *Tantaran'ny Andriana*, suggesting that the highland landscape in the 13th century consisted of vast grasslands, occasional hillside forests and riparian forests and marshes.

At a widely-attended 1970 conference on conservation in Madagascar, Battistini (1972) posited that the small human population – while perhaps the principal factor for deforestation – could not be held completely responsible, suggesting that climate variations could have contributed. Battistini later suggested that the primeval forest of the highlands was 'perhaps very heterogeneous with vast natural clearings' (Battistini and Vérin 1972: 324). Around the same time, Bourgeat and Aubert (1972) argued from pedologic evidence that highland and western soils are not necessarily relict forest soils, and that the vegetation has changed in the past due to climatic fluctuations. Koechlin (1972) acknowledged that the evidence for an island-wide forest was inconclusive. Soon thereafter Koechlin et al. (1974) argued that the diversity of the flora suggests that forest patches had existed in relative isolation from each other for a long time. They also noted that in the savannas of the southwest, for example, the distribution of vegetation zones including grasslands were closely related to the underlying soils and geology. More recently, Dewar (1984) contended that the central highlands and western regions were originally covered by a mosaic of woodland and savanna, not by a continuous forest. He defended this statement by describing the diverse nature of the highland sub-fossil fauna, including terrestrial herbivores, which suggests a variety of habitats, not just forest.

The evidence that finally overturned the island-wide forest hypothesis appeared in the late 1980s. Palynologist David Burney took cores from several highland lakes and bogs and analysed pollen and charcoal deposits in the sediments. Burney's team has now cored two dozen sites in central, western and northern Madagascar, and similar research has been undertaken by a team of French scientists (Gasse et al. 1994) and by pioneering pollen expert Herbert

Straka (1993, 1996). The research shows unequivocally that the highlands and west were never all forest, and instead were a spatial and temporal mosaic of riparian forest, woodlands, heath and grassland. The island's vegetation cover has always been changing; areas covered today by montane rainforest were once heathlands during the last ice age. Charred grass cuticles and woody materials in the sediment cores show that fire was common on the island long before humans arrived around 1500 years ago. However, the arrival of humans is clearly marked in the sedimentary record with a dramatic increase in fire frequency and a significant spread of grasslands (Burney 1987a, 1987b, 1987c, 1993, 1996, 1997; Burney and MacPhee 1988; Dewar and Burney 1994; MacPhee et al. 1985; Matsumoto and Burney 1994).

Where does that leave us? The anthropogenic transformation of Madagascar's environment follows different trajectories in different regions. In the *eastern humid zone*, satellite data show that 66 per cent of the 'original' rainforest has been logged or converted to agriculture and not allowed to re-establish itself, and that at 1980s rates, this rainforest will remain only on the steepest slopes by the year 2025 (Green and Sussman 1990; Sussman et al. 1994). Deforestation is proceeding most rapidly from the east; the western forest boundary near Antsirabe has only retreated 10 km in the past 150 years (Ramamonjisoa 1995), and has remained essentially unchanged from 1950 to 1985 (Green and Sussman 1990: 215n). In the *highlands*, the trajectory of change over the last centuries is from monotonous grasslands towards increasingly imbricated cultural landscapes of irrigated rice, orchards, woodlots and rainfed crop fields. Riparian zones, often the only place where trees were found in the nineteenth century highlands, have been increasingly converted to irrigated rice fields. In the *west*, the boundaries of many forests have remained stable, contradicting assertions that pasture fires eat away at the forest edge (e.g. Chauvet 1972; Roffet 1995). Philippe Morat studied 400 km of forest edge in the west, near Ankazoabo, between 1949 and 1970, and found only three cases of forest decline, the largest of which covered a mere 32 ha (Koechlin et al. 1974). Bertrand and Sourdat (1998: 137) report a study in the Menabe region which documents only minor forest reductions in the past half century. A more recent satellite-based study in the northwest also documents forest stability (Andrianarivo 1990); on the contrary, however, the Ambohitantely forest of the northwestern highlands has clearly shrunk in the face of fire. In the *north*, Gezon and Freed (1999) show that the forests in the Ankarana region have seen pockets of both expansion and decline between 1949 and 1990.

While understandings vary in the environmental community, old ideas based on the Perrier-Humbert hypothesis persist. As a result of the above revisions of the island-wide forest idea, however, one need no longer tolerate the frequent statements that 80 or even 90 per cent of Madagascar's once island-wide forest has been destroyed (e.g. Helfert and Wood 1986; WWF 1992; Bradt et al. 1996; Gade 1996a, 1996b; USAID 1997a). It is simply a fallacy to conclude from the

statistic 'Madagascar is 11% forested' that the island is therefore 89% deforested. Similarly, the evidence contradicts assertions that grasslands could not have predated human arrival (e.g. Battistini 1996; Gade 1996a; Lowry et al. 1997). Unfortunately, however, reliable statistics of whole-island deforestation rates since 1900 (or other specified moments in history) will remain unavailable until a baseline is established through careful triangulation between historical maps, explorer's accounts, archival sources and additional paleoecological research.

Causes and causers of deforestation

Deforestation is a critical issue in eastern Madagascar. The popular narrative's analysis of the causes and of the actors in this process contains several oversimplifications and misunderstandings. It asserts that the forest is being decimated by the rural Malagasy, pushed by population growth and poverty to expand and intensify *tavy* agriculture further into the forest (e.g. World Bank 1988; WWF 1992; Allen 1995; Gallegos 1997; USAID 1997b; Webster 1997). The rural Malagasy are portrayed schizophrenically as both ignorant, backward farmers without a care for biodiversity and as potentially wise indigenous resource managers. In this section, I seek to complicate the story of deforestation causality and to contribute to a more realistic picture of the actors.

Population growth is clearly an important factor in pushing farmers to expand *tavy* further into the forest and to reduce fallow periods between *tavy* cycles. Sussman et al. (1994), for example, show that deforestation rates from 1950 to 1985 and population density are positively correlated in the eastern rainforest. Care should be exercised, however, when applying a population-based model of deforestation, for it is the context, not population growth *in itself*, which determines the trajectory of change. In a context of abundant, unregulated resources, population growth will likely cause expanding use of those resources, as it has in eastern Madagascar. However, where population growth is associated with limited resources – whether physically finite or constrained by access and tenure laws – it can, under the right conditions, facilitate landscape enhancements, like aforestation or soil conservation (Tiffen et al. 1994; Fotsing 1992; Fairhead and Leach 1996; Kull 1998; Gray 1999). In the Malagasy highlands, a densely-settled region, vast lands once maintained as grassland now sport imbricated crop fields, rice terraces, woodlots and fruit trees (Ramamonjisoa 1995; Bertrand 1995; Rakoto-Ramiarantsoa 1995a, b; Kull 1998). In these cases, the impact of population pressure was shaped by limited resources, market opportunities, tenure incentives and government policies, resulting in constructive environmental transformations. Therefore, one should be careful in placing blame on population growth; the story can be more complicated.

Poverty is also blamed for forcing rural Malagasy to sacrifice nature for short-term needs. This logic does not hold for two reasons. First, wealth can also

produce degradation. Give the average Malagasy *tavy* farmer more money, and deforestation may just as well *increase* as they utilise better tools and pay for additional labour. Second, poverty or no poverty, in their own perspective, Malagasy farmers are not sacrificing nature for short-term needs, they are instead transforming nature to be of more use to them. It is a matter of perspective. Much of Madagascar is a lightly-populated resource frontier, where extensive land-use strategies such as *tavy* and pasture-burning may be both economically and agronomically logical (Boserup 1965; Dove 1983). Poverty does not drive the system, farmer rationality does.

The causes of deforestation, while currently heavily related to population growth near an open resource frontier, deserve additional complication: the story of deforestation should be historically and regionally contextualised. Many specific cases of deforestation involve not just *tavy* farmers, but also commercial interests or political factors. Several examples follow. In the first 30 years of colonial rule, population was stable, and deforestation was largely caused by logging concessions and agricultural displacement for cash-crop cultivation (Jarosz 1993). In this period, between one and seven million ha of primary eastern rain forest were logged, out of an estimated eleven million ha (AOM 1922–30; Humbert 1927, 1949; Heim 1935; Guillermin 1947; Chauvet 1972; Jarosz 1993). Unfortunately, reliable statistics on the nature and extent of the forest cutting, as well as on forest regeneration since that period, do not exist. Today, intensive logging does not threaten Malagasy forests as it does in southeast Asia, yet it does have local impacts. In the 1970s and early 1980s, eleven concessionaires and hundreds of porters operated in the town of Ranomafana, logging the hardwood timber *Dalbergia baroni* (Peters 1994). Other regional forest impacts include commercial cash crop production and timber harvesting in the Ankarana region of the northwest, export maize production in the forests near Tulear, and 1970s famine alleviation policies legalising additional *tavy* in the southeast (Hardenbergh et al. 1995). The Amoronkay region, southeast of the capital, suffered serious deforestation before colonisation due to the charcoal needs of the iron industry (AOM 1900; Dez 1970). In the 1940s, 40,000 ha of forest near Morondava were sacrificed to cultivate corn for World War II; during the 1947 rebellion, rebels hid and farmed in the forests at Betampona and Zahamena (Humbert 1949). Finally, significant deforestation in the Mahafaly spiny forest occurred due to government angora goat raising and missionary successes in fighting traditional beliefs including superstitions which protected the forest (Esoavelomandroso 1986).

The actors in this story of deforestation also need to be better understood, both for their environmentally constructive potential and the constraints placed upon them by the socio-political and economic context. The environmental history of Madagascar stars the Malagasy people as its principal characters. In this story, however, the *tantsaha* (agriculturalists) are both the antagonists, the primary enemies of the environment (Hardenbergh et al. 1995; Hanson 1996),

and the protagonists, the wise indigenous people with whom conservationists must work in order to safeguard nature. Morell's (1999) piece is a good example of the two-faced picture of the Malagasy: she describes their 'poor agricultural practices' and features miners who strip and scour the land, but also highlights the potential of working with rural Malagasy to protect forests through traditional *dina* agreements, ecotourism and butterfly farming. Both the antagonist and the protagonist roles are flawed. The antagonist role implies a mistrust and denigration of the *tantsaha* as trespassers and pyromaniac destroyers in an ecological paradise. The *tantsaha* are like farmers and herders the world over, making use of available technologies and resources to gain their livelihoods. Instead of seeing the *tantsaha* as ignorant or desperate, we should recognise their ability to manage resources to their advantage (Esoavelomandroso 1989), whether in expanding *tavy* cultivation, managing their soils for nutrients and erosion (Rakoto Ramiarantsoa 1995a), or maintaining their woodlands for forest products (Gautier 1902: 262; Parrot 1924; Koechlin et al. 1974; Kull 1999b). Sometimes these resource uses can be short-sighted or contrary to environmental goals, yet often they are productive and constructive transformations, at least from the perspective of the *tantsaha*. Rarely would *tantsaha* continue practices clearly detrimental to their own livelihoods! The protagonist role, on the other hand, may excessively romanticise the local people. While the *tantsaha* are generally very experienced in the local conditions of resource management, this does not imply that all can exercise this knowledge equally, nor that a community is homogenous and will make conflict-free decisions. Land distribution, class splits and ethnic or gender differences affect the ability of people to control and manage resources (Schroeder 1993; Suryanata 1994; Peluso 1996), or how market incentives and national politics shape local patterns of resource use (Blaikie 1985; Hecht 1985; Grossman 1993).

The *tantsaha* are experienced resource managers, constrained by socio-political struggles over resource control, by market demands, and by government policies, not ignorant destroyers pushed by hunger and poverty. Their contributions to deforestation vary from place to place and time to time. While population growth fuels much of the phenomenon in the second half of the Twentieth Century, the story of deforestation should include regional exceptions or complimentary factors, as described above, in order to be more accurate.

From incendiarism to fire ecology

In the dominant narrative, fire is the primary tool of deforestation and biological impoverishment and an evocative symbol of destruction. Fires of all types, from contained *tavy* burns in the forest to vast pasture fires in the grasslands, are often lumped together. In this section, I emphasise grassland burning and argue that these fires should be seen as an integral part of Malagasy ecological and agropastoral systems, not as a 'national scourge' (RDM 1980). There has always been, and should always be, fire in Madagascar.

The popular narrative decries the fires which, it writes, 'blacken the hills, sterilise the soils, erode the land, and decimate the forests'. The basic assumption, based on old Western ecological thought, is that fire is external to normal ecosystem processes (Pyne 1995). Burney (1987b, 1996, 1997), however, has demonstrated that fires frequently burned in Madagascar long before humans arrived, ignited by lightning and volcanism. As a result, several endemic species exist that demonstrate adaptations to fire, including the trees *Agauria salicifolia*, *Uapaca bojeri*, *Uapaca densifolia* and *Ziziphus mucronata* (Koechlin et al. 1974; Gade 1985; Rakotoarisetra 1997). Unfortunately, most literature on Madagascar has not come to terms with the huge body of ecological work on fire's role in ecosystems, especially from Australia, South Africa and the United States (see e.g. Goldammer 1990; Braithwaite 1996; Pyne et al. 1996). This literature demonstrates the importance of fire in habitat and species diversity, nutrient cycling and plant reproduction in a wide variety of ecosystems, including tropical grasslands, savannas and woodlands. For example, fires and grazing in the alti-montane prairie of Madagascar's Andringitra mountains have been shown to increase the diversity of terrestrial orchids (Rabetaliana et al. 1999).

The natural role of fire in the highland and western ecosystems of Madagascar was modified when humans arrived. Since settlement, the Malagasy have controlled fire and used this powerful tool to their advantage, as have humans across the globe. Whether to simplify hunting, to increase habitat for favoured species, or to increase grass production for domesticated ungulates, periodic burning is a well-established practice throughout history, from British moorland herders to Australian aborigines, to Maasai pastoralists, and to modern ranchers in Kansas (Homewood and Rodgers 1991; Pyne 1995). In California, up to 13 per cent of all non-desert lands – including forests – may have burned yearly before white settlement (Martin and Sapsis 1991); in Australia's Northern Territories, two-thirds of the land is burned annually (Braithwaite 1991). In Madagascar, one-fourth to one-third of the grasslands are burnt each year (Jolly 1980). These fires primarily serve to renew pastures for cattle grazing, by removing unpalatable lignified grasses and encouraging early sprouting. Many authors call these fires irrational (Bosser 1954; Murphy 1985; Neuvy 1986), yet prescribed burning every one to three years is an accepted management technique in some grasslands, and pasture fires do not necessarily increase erosion (Pyne et al. 1996). The *tantsaha* in the highlands and west also use fire to clear fallow fields or grasslands for plowing, to encourage fertilisation of downslope paddies by erosion, and to control pest populations such as rats and locusts.

Clearly, fires are the main tool by which humans long ago transformed the mosaic vegetation of the highlands into vast grasslands, and by which the *tantsaha* maintain these pastures in their present state. The dominant narrative views these fires as inherently destructive, only rarely allowing for their legitimate role in the agropastoral system (e.g. Jolly 1990; Bloesch 1999). As I described earlier, grassland fires are in general not eating away at forest edges;

in the case of the *Uapaca bojeri* woodlands of the highlands, fire may even aid forest maintenance (Kull 1999b). The consequences of *not* burning are even more dramatic: the build-up of fuel could engender destructive wildfires, and the loss of pasture would damage an already fragile rural economy. Fire deserves to be recognised as a key management tool used by the *tantsaha* for hundreds of years in maintaining their landscapes for productive use (Kull 1999a).

Perspectives on erosion

Along with deforestation and fire, soil erosion is a key refrain in the environmental discourse on Madagascar. The World Bank crowned the island 'world champion of erosion', and accounts ceaselessly describe the red, sediment-laden rivers. The consequences of erosion are locally quite severe (Tricart 1953; Le Bourdiec 1972; Rossi 1979; Randrianarijaona 1983; Paulian 1984). The irrigation works at Lake Alaotra, the nation's principle rice-producing area, fill up with 30 to 60 million tons of soil each year. Siltation of the Ikopa River near the capital led to devastating floods in 1982 which left 70,000 people homeless; siltation of the western port of Mahajanga proceeds at almost one metre per year, necessitating costly dredging. In some spots, the deeply incised *lavaka* erosion gullies exceed 30 per km^2 and threaten roadways (Wells and Andriamihaja 1993). In the face of these serious examples of harmful erosion, however, the narrative makes several errors of exaggeration or misinterpretation (Dez 1966: 1227n).

First, the narrative focuses on the visually compelling *lavaka* erosion gullies and thus is prone to over-dramatising erosion. *Lavaka* are vertical-walled gullies in lateritic substrate, reaching 300 m in length and 70 m in width. While *lavaka* are obvious, their contribution to overall erosion often pales compared to the more insidious process of sheet erosion (Stocking 1987, 1996). In addition, *lavaka* in Madagascar are a natural part of this active landscape's evolution in response to tectonism and climatic aridification; they existed before human settlement on the island. Human activities – including pasture burning, cattle grazing, trails, hillfort trenches, canal construction and hillslope cultivation – unequivocally cause only one-quarter of *lavaka* (Wells and Andriamihaja 1993).

Second, authors frequently report shocking statistics of erosion rates without placing them in context. To begin with, statements – such as 'Environmental degradation also results in a rapid loss of an estimated 200 tons per hectare each year' (USAID 1997b: 1) – are misleading, for the figure of 200 t/ha represents extreme cases of erosion and not a widespread situation as implied in the text. Other authors cite rates varying from 25 to 250 t/ha/yr in the highlands (Randrianarijaona 1983), or 30 t/ha/yr on eastern escarpment *tavy* plots (Roffet 1995). In addition, soil erosion figures are meaningless without a consideration of regional climate, background erosion rates and soil formation rates (Stocking 1986). A soil suffering high rates of erosion in one region may be less degraded

than a different soil undergoing light erosion elsewhere, for soils can vary widely in their tolerance to erosion (Hurni 1983).

Third, the sedimentation rates of Madagascar's major rivers are frequently cited as indicators of environmental crisis. The Betsiboka estuary receives 15-50 million t/yr of sediments annually, while the Mangoky River deposits 19-20 million t/yr at its mouth (Randrianarijaona 1983; Paulian 1984). While the rates may appear extreme, they match well with a comparison of sediment yields with drainage basin area of all major sediment-discharging rivers (Ritter 1986; see Figure 3). Based on Figure 3, one concludes that the Malagasy rivers do not represent exceptional soil erosion; rather, their sediment load is comparable to other areas of high sediment yields.

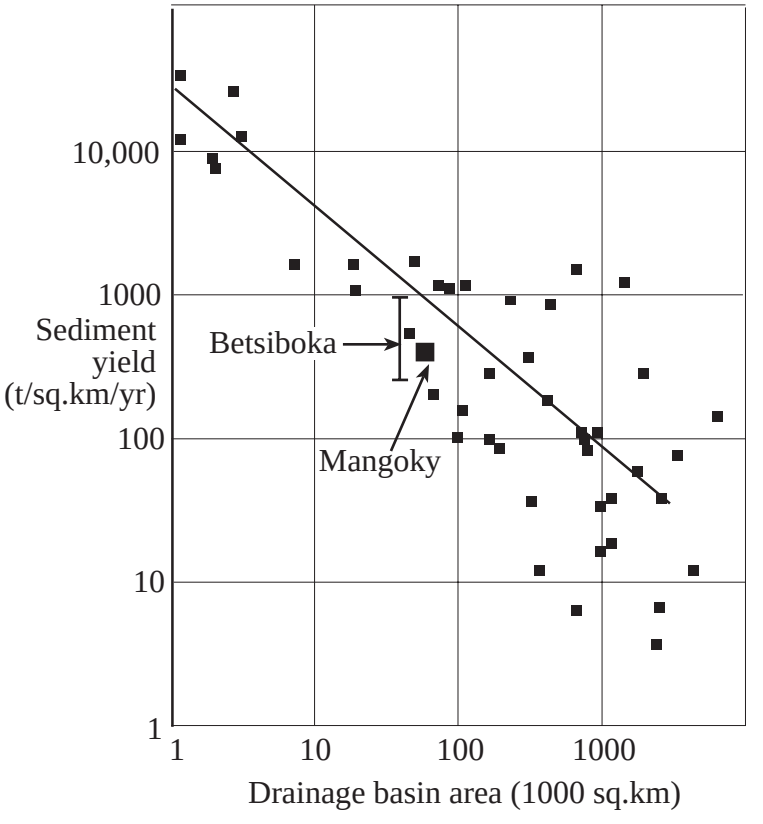


FIGURE 3. A comparison of Madagascar's sediment-clogged rivers with global rivers shows that they are nothing out of the ordinary. Graph plots sediment yields and drainage basin areas for all major sediment-discharging rivers (greater than 10 million t/yr). The Mangoky River drains 55,750 km^2, and deposits 19-20 million t/yr. The Betsiboka River drains 49,000 km^2 and deposits between 15-50 million t/yr (Randrianarijaona 1983; Paulian 1984; Ritter 1986: 195).

Fourth, the narrative misunderstands the human role in erosion. As mentioned earlier, theories linking dense populations to erosion have recently been contested (Blaikie and Brookfield 1987; Fotsing 1992; Tiffen et al. 1994). More importantly, soil and nutrients lost from one place can either benefit or harm downstream resource users, and this process is well understood by farmers. Farmers in the alluvial *baiboho* of northwestern Madagascar depend on the fertile soils eroded from the uplands (Rabearimanana 1994). Fieldwork in eastern Madagascar demonstrates that *tantsaha* actively manage locally for upslope erosion in order to fertilise rice fields and improve swamp soils (B. Locatelli, pers. comm., 1996), a trend documented elsewhere in Madagascar and the tropics (Wells and Andriamihaja 1993; Rakoto Ramiarantsoa 1995a; Stocking 1996). In sum, the above lacunae in the collective environmental understanding of Madagascar's erosion leads to the over-dramatisation of a phenomenon that is locally destructive yet also 'one of life's certainties' (Stocking 1996: 140).

Woodfuel, agriculture and grazing

The environmental narrative also makes problematic statements and exaggerations with regards to Madagascar's woodfuel supply, agricultural potential and grazing management.

First, woodfuel has been called the most crucial future environmental issue for the island (Vérin 1994; Richard and O'Connor 1997; Gade 1996b). However, the woodfuel crisis expected across the globe during the past 15 years has largely failed to materialise, as prognosticators underestimated alternative fuel supplies, market responses and the ability of trees to grow (Foley 1987; Leach and Mearns 1996; Ribot 1996). In highland Madagascar, the woodfuel 'crisis' has lasted 200 years, spurring the use of alternative fuels, higher prices and tree planting. Nineteenth-century observers noted that highlanders relied on crop residues, cattle dung and dried grass due to wood scarcity (Ellis 1859; Berg 1981; Gade 1996a). Likewise, Sucillon (1897) and Parrot (1924) both commented on the rising and prohibitive cost of fuelwood in the highlands. Instead of a worsening crisis, however, the situation has improved. Today, private eucalyptus woodlots cover 70 per cent of the Manjakandriana region, east of the capital, once described as barren hills of grass (Bertrand 1995; Rakoto Ramiarantsoa 1995a, b), and similar spontaneous zones of woodfuel production are scattered throughout the island.

Second, Madagascar is sometimes portrayed as a nation which cannot feed itself, with poor soils, little agricultural potential and few natural resources (e.g. Neuvy 1986; Gade 1996b). However, only one-tenth of arable lands are cultivated (Allen 1995), including only one-fifth of the *baiboho* alluvial plains of the northwest (Rabearimanana 1994), and a 1961 report from the UN Food and Agriculture Organisation posits that the island has enough resources to support 200 million people (J. Randby pers. comm).

Finally, some authors complain of degradation due to overgrazing (e.g. Allen 1995; Wells and Andriamihaja 1997). Gade (1996b) paints an image of ever-growing cattle herds. Assessments of overgrazing are contested across Africa (Behnke and Scoones 1992) and elsewhere (Perevolotsky and Seligman 1998), and have not specifically been demonstrated in Madagascar. While the human population doubled between 1960 and 1990, the bovine population has hovered around seven million since at least the 1920s (Perrier 1921; Ramaroson and Razafindrakoto 1972/3; ONE/Instat 1994).

Confusion and conflation

Finally, the popular story of Madagascar is often guilty of geographic confusion and conflation. The storytellers forget that the situation in the humid, tropical eastern zone deserves a different analysis than processes in the highlands or west. First, *tavy*, the slash-and-burn cultivation typical of the eastern rainforests, is blamed for consequences elsewhere. Allen (1995) and Berg (1981), for example, blame *tavy* for highland deforestation, when in all likelihood repeated fires related to cattle-raising converted the majority of the highland vegetation mosaic into grasslands (Dewar 1984). *Tavy* is blamed for the siltation of rivers and bays (e.g. Roffet 1995; Apt 1996), yet the rivers experiencing siltation originate in non-*tavy* areas. Others (e.g. Helfert and Wood 1986; Gallegos 1997) imply that *tavy* leads directly to the *lavaka* erosion gullies typical in various parts of the highlands, yet most of these areas are outside the zone of present or historical *tavy*.

Second, the pasture fires of the highlands and west receive blame for deforestation of the eastern rainforest. The 1994 'State of the Environment' report from ONE/Instat, for example, includes an assessment of pasture fires within the section titled 'deforestation'. Ironically, the statistics presented in this assessment show that only 0.1% of the yearly fires, or 2000 ha, occurred in forests! Such confusion and conflation are no doubt often a result of poetic puffery on the part of the authors, yet behind them stands a muddled conception of environmental change in Madagascar shaped by the politics of environmentalism. It is to these politics and to the power of narrative which I turn in the following sections.

NARRATIVES, POWER AND POLICY

Our views of Madagascar as an environmental basket-case are intricately bound up in our cultural imagination, in a colonial and post-colonial history of power and influence, and in real trends of forest loss and extinctions. Many of the errors and misperceptions I highlighted above resulted from the particularities of a Western encounter with an exotic land. Adams and McShane (1992) have shown

how our images and preconceptions of Africa – the myths of wildness and of backwards and destructive natives – developed into narratives of degradation that necessitated top-down, reserve-based conservation action. In Madagascar, the story was shaped by outdated ecological notions of climax vegetation and the mistrust of fire, both outgrowths of the ecological context of northern Europe and eastern America (Pyne 1995). The story was developed with a Western bias towards settled, permanent agriculture over swidden techniques. In an era of technocratic modernism and scientific forestry, foreign expertise was valued over local experience (Peluso 1992; Fairhead and Leach 1996; Ribot 1996).

There are a variety of stories possible for Madagascar's environmental history, not all equally valid. The dominance of a certain narrative depends on its correspondence with observed facts, yet also on the power of those telling it. The interpretations of colonial botanists Perrier and Humbert were heard over the stories of the colonised, and this dominance was maintained up through the 1960s. During the early years of socialism, President Ratsiraka used his power to promote an alternative view of resource abundance. Then, as Madagascar suffered in debt and asked for foreign assistance, environmentally-minded donor countries gave the Perrier and Humbert narrative new credence. In the early 1990s, conservation bureaucrats gained unprecedented stature in national politics, especially with the adoption of the Environmental Action Plan. It is telling that the government's *Office National pour l'Environnement* occupies some of the most visible real estate in downtown Antananarivo. The narrative of environmental degradation now serves as a useful means to justify policy interventions as varied as reserve establishment, privatisation of land tenure and agro-technology support, and in fact has become central to the dominant neo-liberal economic development narrative (Bassett and Koli Bi 2000).

The dominant narrative is bound up in the politics, values and structure of the group spreading the story, as well as in the facts of the matter. As Leach and Mearns (1996) point out, received wisdoms are resistant to change not because the facts are not known, but due to political-economic and institutional factors. Received wisdoms are always politically convenient for one interest group or another. Berg notes that deforestation was seen by some as 'a myth invented by colonial administrators intent on agrarian reform' (1981: 295). The more dramatic the story, the more support and conviction can environmentalists bring to their task.

As in the case of eastern Madagascar's deforestation, there are often stark truths embedded within the story and one might ask why a little exaggeration matters. I have been warned several times to be extremely careful in writing this paper, lest it lead to the rethinking of environmental policies in Madagascar. Yet that is my intent, for policies based on myths can be harmful and unproductive. For example, biases about pastoralists led to policies which denied critical resources to the Maasai in the Ngorongoro Conservation Area of Tanzania (Homewood and Rodgers 1991; McCabe et al. 1992). In Madagascar, environ-

mental myths historically contributed to the conclusion that protected areas are the best strategy for conservation, *tavy* and grassland fires should be banned, and land use should be put under more 'rational' management (Dez 1968; Jarosz 1993; Hardenbergh et al. 1995). Humbert (1949) called for increased enforcement power for the Malagasy forest service. The traditional protected areas approach that arose from such ideas has been strongly criticised in Madagascar and elsewhere for leading to resource scarcity, marginalisation of the poor and problems of coercion and resistance. Some projects have the result of decoupling local people from their livelihoods and cultural resource base instead of reinforcing their relations with their environment (Adams and McShane 1992; Hardenbergh 1993; Peluso 1993; Ghimire 1994; Sussman et al. 1994). In the words of Fairhead and Leach (1998: 192):

> ...inhabitants are denied not only their claims and control over valued resources, but also their own understandings of vegetation dynamics and the ecological and social histories with which these are intertwined.

Conservation projects, of course, evolve with the times as they gain experience and take account of new ideas. In Madagascar, the incorporation of local people in conservation actions has been standard policy for ten years now. More recent legislation paves the way to decentralise resource management and transfer to local communities direct control over renewable natural resources such as *tavy* forests and pastures. Finally, conservation programs have moved beyond a strict protected areas focus to an approach based on ecoregions.

However, while agencies adjust their approaches to accommodate new understandings, the stories which appear in the first pages of agency documents, in fundraising letters, and in the popular press continue to replicate the old myths. These are the stories that sell. As Bill McConnell writes (unpub. manus. 1998): 'unfortunately, the declared rationale for continued, and indeed expanding, international efforts at biodiversity conservation stubbornly clings to turn-of-the-[last]-century explanations'. Like Fairhead and Leach (1996) and Roe (1994), I propose the creation of an alternative narrative based in a greater share of 'objective truths'. I aim to accelerate the absorption of this alternative narrative – based on new theories and revised understandings already prevalent in the scientific community – into the world of environmental operators and the popular press.

CONCLUSION

Received wisdoms about the environmental history of Madagascar include much confusion, misunderstanding and misrepresentation. Deforestation and erosion, while very real trends, are exaggerated due to mistaken ideas about pre-settlement forest extent and the eye-catching red soils and erosion gullies. The

role of fire, principal tool of landscape change and pasture maintenance, is unnecessarily demonised. Blame is placed on the Malagasy people and problems of poverty and population growth, ignoring economic interests, historical political contexts, community politics and the potential of the people to positively manage their resources. Of course, myths and poetic license are nothing new to the literature on Madagascar, dating back to Marco Polo's roc and the story of the man-eating tree (Dahle 1884). However, as advances in science and painstaking work have increased the scope of our knowledge, we ought to separate myths from fact. New facts, like Burney's paleoecological data points, make a great difference in our understanding of Malagasy environmental history. As these new facts come to light, an alternative story needs to be told, one that is self-reflexive and open to revision. The chapters of the new story are there – in this paper, in the work of Madagascar scholars and in the memory and experience of the *tantsaha* – all that remains is the writing.

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