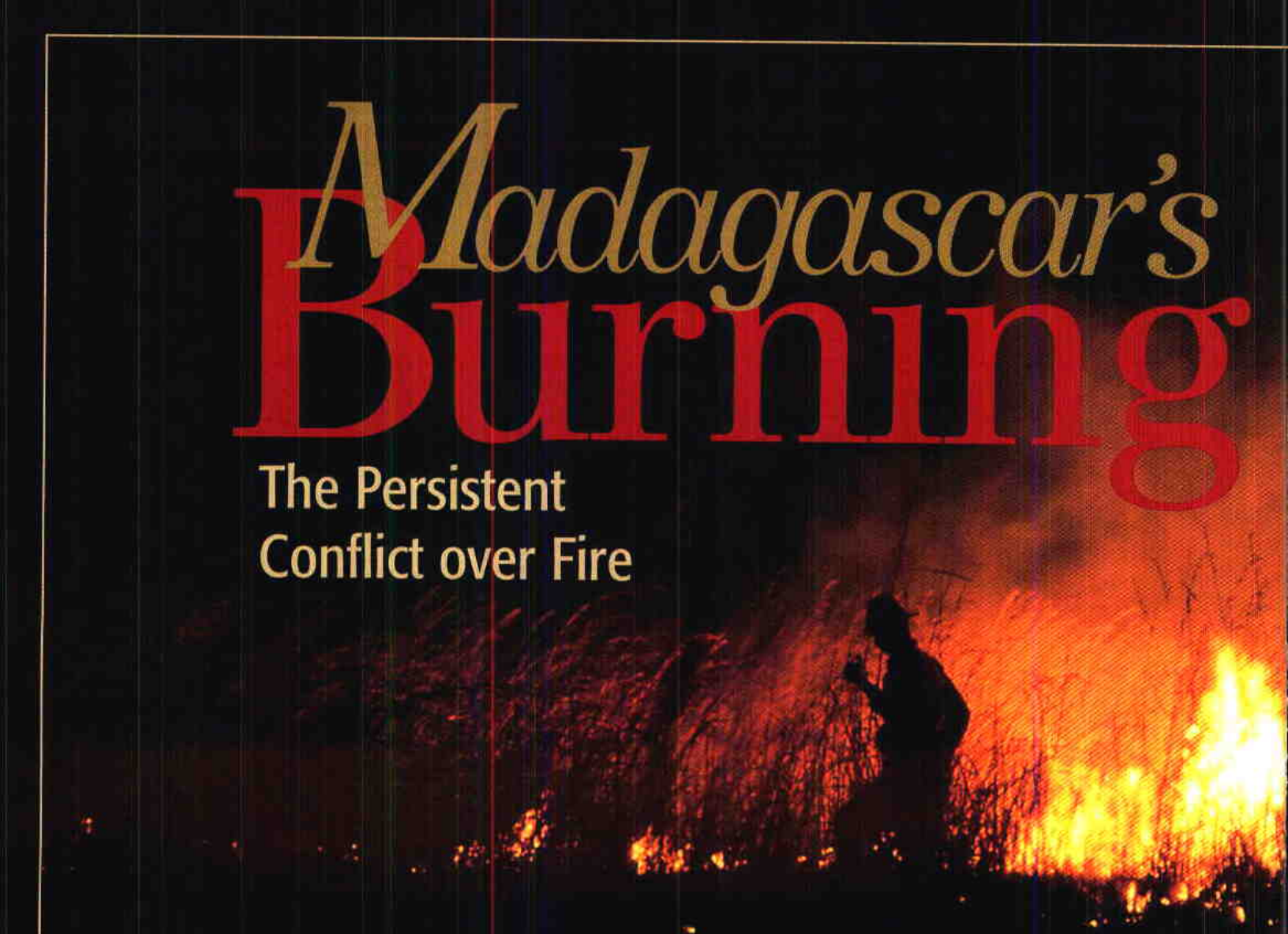
Madagascar's Burning

The Persistent Conflict over Fire



by Christian A. Kull

Madagascar is aflame. Every year, fires consume up to half of the island's vast grasslands and thousands of square kilometers of its rainforests and secondary brush.[1] A visitor to this 587,041-square-kilometer island off the eastern coast of Africa cannot escape the signs of fire: vast hillsides blackened to charcoal, flames flickering on the night horizon, or haze created by distant plumes of smoke. These fires contribute to the rapid loss of unique rainforest habitat and

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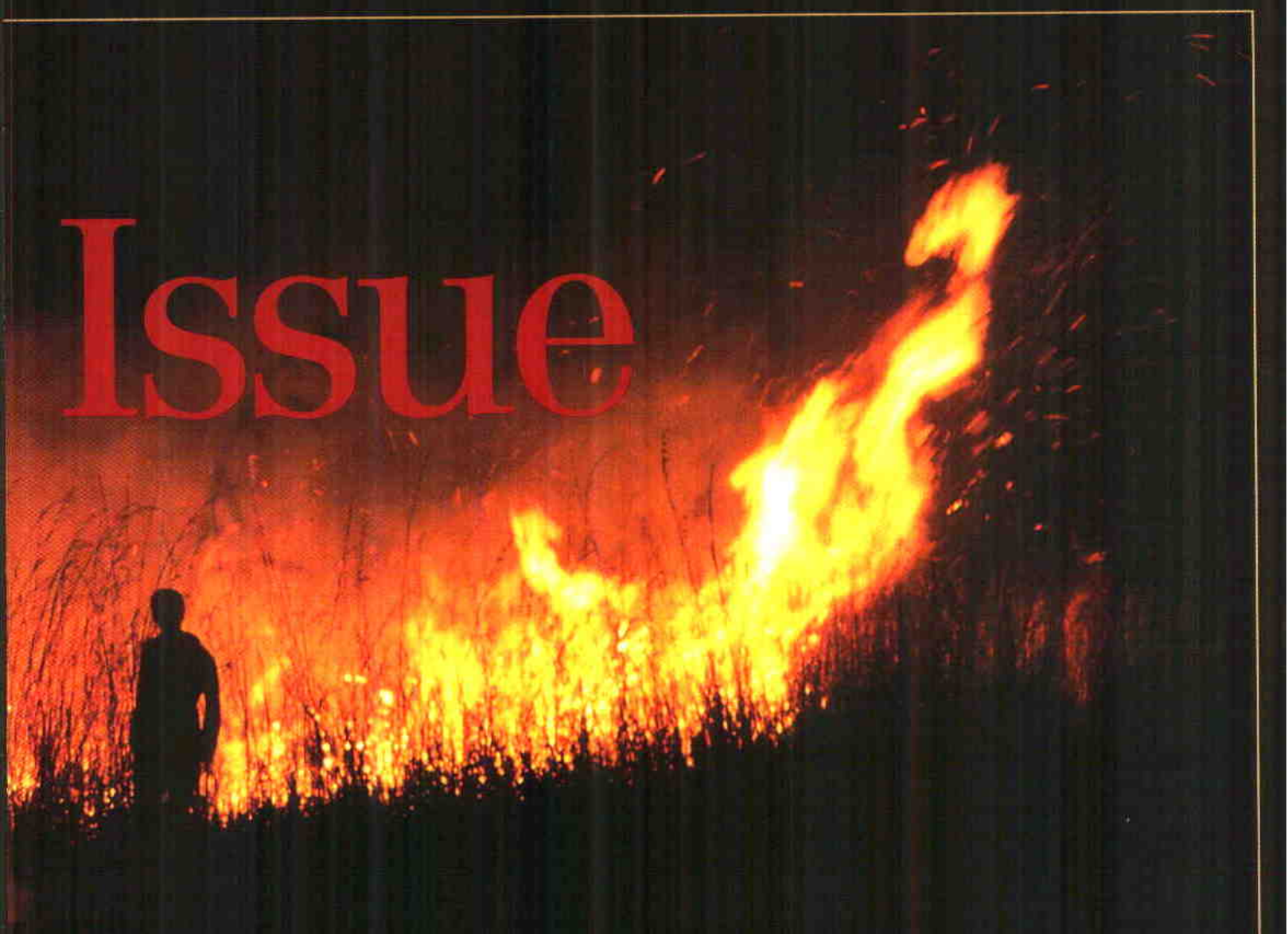
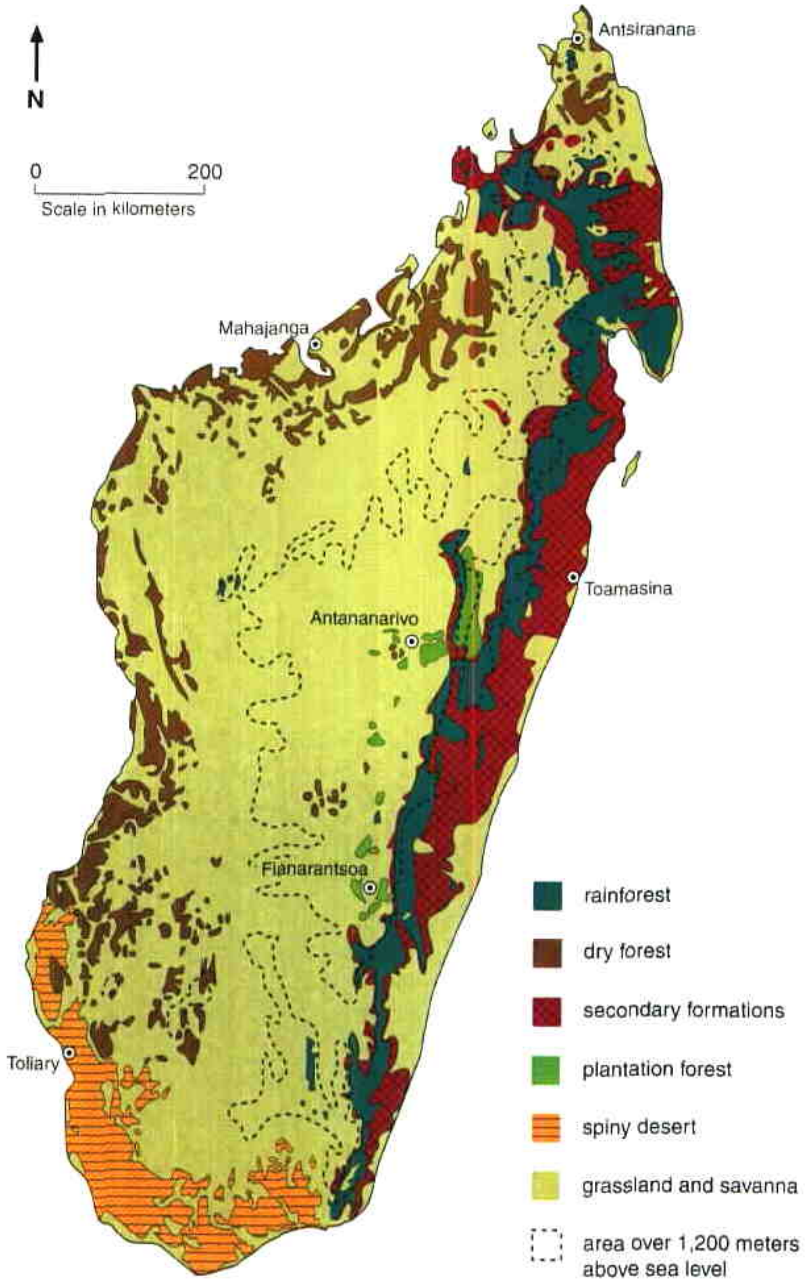


the transformation and often degradation of woodland and grassland zones. However, they also are crucial techniques that the *tantsaha*–the Malagasy farmers and herders–use to manage their lands.

Madagascar's fire problem is a source of long-standing conflict between the state and the *tantsaha*. For more than a century, both the French colonial administration and the independent Malagasy state, together with outside conservation interests, have attempted

Figure 1. Madagascar's vegetation zones



NOTE: Secondary formations include cut forest and various stages of forest regrowth (largely corresponds to area of slash-and-burn farming).

SOURCE: Map adapted from Association des Géographes de Madagascar (Madagascar Association of Geographers), *Atlas de Madagascar* (Tananarive, Madagascar: Bureau pour le Developpement de la Production Agricole Madagascar (Office for the Development of Agricultural Production), 1969); G. M. Green and R. W. Sussman, "Deforestation History of the Eastern Rain Forests of Madagascar from Satellite Images," *Science*, 13 April 1990, 212–15; and Conservation International, DEF (Water and Forest Agency), CNRE (National Environmental Research Center), FTM (National Cartographic Institute of Madagascar), *Formations Végétales et Domaine Forestier National de Madagascar* (Vegetation Zones and National Forests of Madagascar) (Antananarivo, Madagascar, ca. 1995).

to stop or at least slow the widespread burning to protect this naturalist's paradise. But the *tantsaha* continue to burn the land for purposes such as pasture renewal and cropfield preparation.

How has this natural resource conflict persisted so long? What explains the impasse, when the state repeatedly bans burning, yet fires continue to blacken the hills and light up the sky every year? To understand this inflammatory situation, it is not sufficient just to chronicle the actors—the anti-fire state and the pro-fire *tantsaha*—and their interests. It is necessary to consider the arena within which this natural resource conflict occurs. The natural and political contexts fundamentally shape the stalemate. The characteristics of fire (a natural process only partially controlled by humans), together with the character of state institutions (composed of different people and different interests), give the *tantsaha* the opportunity to continue burning despite years of prohibition.

Natural resource conflicts are fundamentally shaped by nature, society, and history. As the case of Madagascar exemplifies, the solutions to many of the world's natural resource conflicts lie not only in understanding the interest groups but also in understanding the contextual factors that shape or limit the way in which a conflict unfolds.

The Isle of Fire

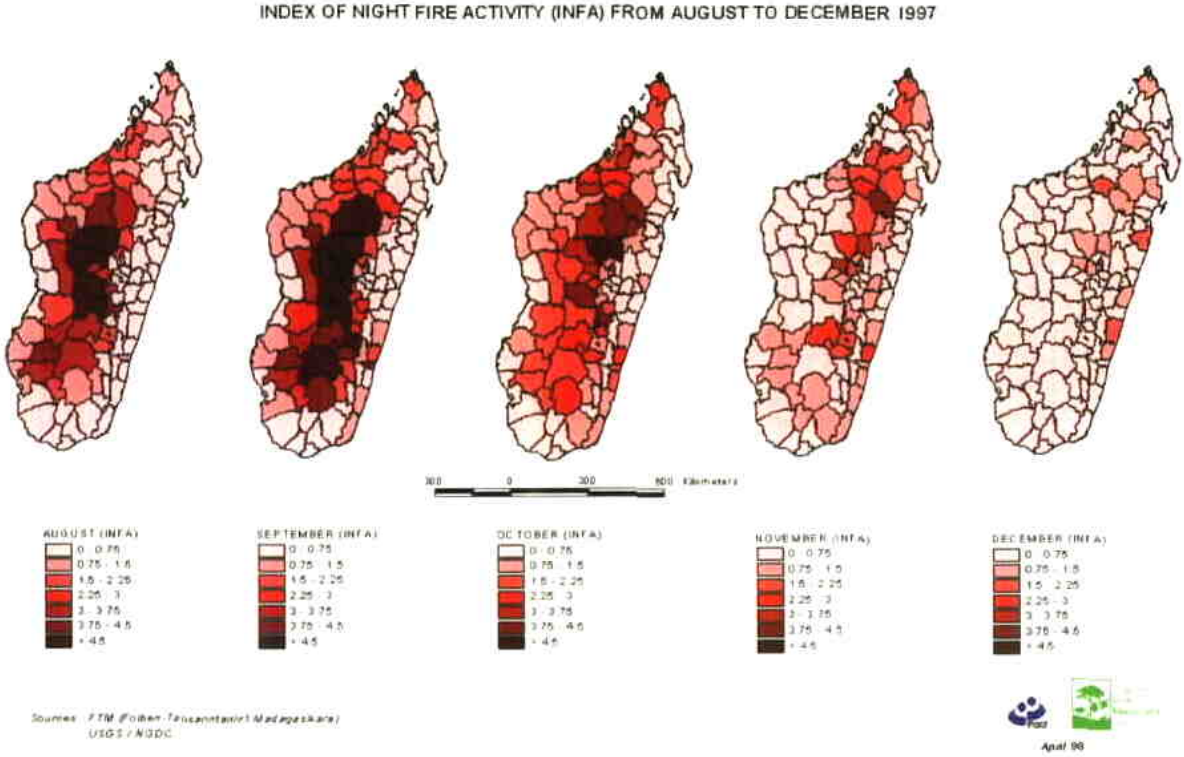
Anthropogenic fires have been ubiquitous in the Malagasy landscape since human settlement began nearly 2,000 years ago, and they continue to char millions of hectares each year.[2] In the drier western zones, most burning commences in May, peaks in August, and continues into November. In cooler highland areas, due to the chill and occasional drizzle of the austral winter, most fires burn in the spring, from August to October. In the humid eastern zone, the *tantsaha* burn during the drier months, from September to November.[3] Figure 1 on this page displays Madagascar's vegetation zones. Figure 2 on page 11 shows monthly fire activity.

Fires affect the island's vegetation patterns, nutrient cycles, and soil erosion rates. In forest zones, fire is the chief tool used for deforestation. Farmers cut a patch along the forest frontier, allow the slash to dry, and then burn it in preparation for cultivation. The patch is subjected to a new slash-and-burn cycle every five years or so, until degrading soil quality necessitates longer and longer fallows. When the soil is exhausted, frequent grass fires set by the *tantsaha* inhibit the re-establishment of forest vegetation, and the cycle must be started again in a new area. Together with extractive logging, slash-and-burn cultivation and subsequent grass fires have led to the loss of some 67 percent of the island's humid eastern forests since 1900, sparing only the steepest slopes, remote areas, and nature reserves.[4]

In drier grassland and woodland areas, the impact of burning is complex. A variety of factors—including fire frequency and timing, weather, vegetation characteristics, and land use—determines the spatial extent and intensity of fires, their effects on standing vegetation and soil microfauna, and whether one vegetation community gives way to another. (For example, one kind of grassland that is well suited to wet-season grazing may give way to another that is better suited for late dry-season grazing.) During the Holocene, the highlands were a dynamic mosaic of riparian forest, woodland, heath, and grassland, while western zones were largely dominated by dry forest and woodland. Lightning and volcanism ensured the presence of fire. However, human arrival marked a dramatic increase in fire frequency, which caused grasslands to spread significantly.[5] While some fire-tolerant highland and western forests now have relatively stable boundaries, others continue to shrink in the face of agriculture or excessive burning.[6]

Due to the impact of fire on forest resources, the state has long sought to control burning and forest clearance, but it has been inspired by other reasons as well. One reason is that escaped or uncontrolled fires frequently damage property, including grass-roofed houses, standing crops, fruit trees, and pine and eucalyptus plantations. Second, fires can cause soil degradation and accelerated erosion. Erosion rates increase in burned areas, at least for the first year after a fire, and consequences are severe, including siltation, flooding, and gullying.[7] Third, smoke chokes highland cities, especially during the slash-and-burn season from October to November

Figure 2. Monthly intensity of fires in Madagascar by *fivondronana* (districts)



NOTE: Based upon an index of night fire activity from the U.S. Air Force Defense Meteorological Satellite Program/U.S. National Oceanographic and Aeronautic Administration satellite data. INFA is calculated based on satellite observations of visible and near-infrared emissions.

SOURCE: Pact Madagascar/U.S. Geological Survey, by permission.

Table 1. Purposeful uses of fire in highland Madagascar

Sector	Purpose	Specific task or use
Cattle raising	Pasture maintenance	Fight bush encroachment Renew pastures (green shoots)
	Pest control	Control tick populations
	Cattle control	Facilitate observation and mobility Attract free-ranging cattle to pasture
Agriculture	Field preparation	Clear brush for plowing/spade work Fertilize fields
	Downhill transfers	Encourage erosion to fertilize downstream fields Encourage runoff to speed up irrigation
	Cleaning	Clean out irrigation canals Remove pest habitat around fields (rats and birds)
Other	Wildfire prevention and control	Set fires early in the dry season to manage fuel Burn firebreaks Set backfires against wildfires
	Pest control	Ward off and/or collect locusts Control rats, ticks, and mosquitos
	Tapia woodland management	Maintain dominance of *Uapaca bojeri* Control silkworm parasites
	Woodlots and woodfuel management	Encourage pine regeneration Create dead branches for woodfuel collection
	Travel	Clear trails and roadsides Light the way in the dark
	Ground clearance	Make mineral outcrops and wild tuber crops visible
	Grass species management	Encourage *A. rufescens*, used for brooms and roofing
	Celebration/spectacle	Light natural firecrackers for entertainment
	Protest/revenge	Burn for symbolic protest or arson

NOTE: Pasture maintenance, field preparation, and wildfire prevention are by far the most common uses of fire. One fire often accomplishes several purposes. A backfire is a technique in which a controlled fire is set from a defensible firebreak (such as a road bed) to burn toward the approaching wildfire, so that it will not jump the firebreak.

SOURCE: C. Kull.

in the upwind eastern forests. Fires release particulates, carbon monoxide, carbon dioxide, hydrocarbons, and tropospheric ozone.

Uses of Fire

The *tantsaha* burn vegetation for a wide variety of tasks related to their livelihoods (see Table 1 on this page). Most importantly, burning is central to extensive range management, as it is the most efficient way to manage pastures with small numbers of cattle over large areas and with low inputs of capital and labor. It is a tool used by ranchers and pastoralists from Kansas to California and from South Africa to Norway.[8] Fire serves two roles in range management. First, it maintains grass dominance, avoiding range degradation from bush encroachment. (Without periodic burning, Malagasy highland pastures are invaded by woody species such as heather or wattle.) Second, fire renews grassland vegetation. During the rainy season (from December to March), grasses grow too fast for cattle to eat, resulting in undergrazing. During the dry season, these grasses lose their nutritional value and the cattle graze elsewhere, especially on cropfield stubble and streamside vegetation (they are sometimes also fed rice straw, cassava, or hand-cut grasses). Then, in the late dry season, the cattle must leave the fallow cropfields as farmers plow them for the upcoming season. The cattle are forced back onto upland pastures, where fires, increased warmth, and the first tentative rains give the cattle a "green bite." Fires remove the old, dry, unpalatable grass stalks and release nutrients, fertilizing new growth. They override the competitive effects of selective grazing, giving favored forage species a better chance.[9] Finally, they can accelerate the growth of resprouts in areas of sufficient moisture by exposing the soil to the sun. This green bite is critical to cattle health—the protein-rich grass resprouts carry the cattle through the late dry season.[10]

In the highlands, the *tantsaha* burn different areas in succession, filling in gaps by burning 0.5 to 100 hectares (ha) at a time (see Figure 3 on page 13). The resulting patchy grassland includes unburned zones (used for collecting roofing thatch) and multiple zones with grasses in various stages of development. This patchiness serves to ensure resprouts throughout the hungry season and to protect against wildfires. Easily controlled, patchy, low-intensity annual fires reduce fuel loads (dry, easily ignitable vegetation), diminishing the danger of massive wildfires.[11]

Pasture management is not the only use of fire. The *tantsaha* set numerous small-scale fires in standing grassland, fallow vegetation, or cut forest plots to prepare cropfields. Such burns typically take place in October and November and range from 0.01 to 0.5 ha in size. In

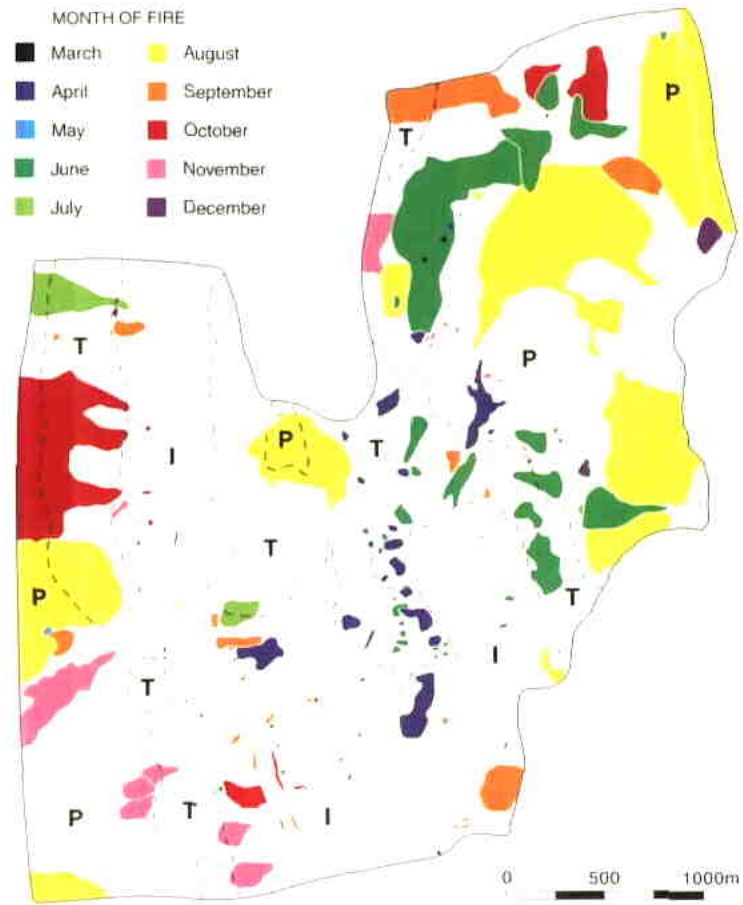
some cases, *tantsaha* collect additional fuel to burn in their cropfields, such as rice stalks or cut grasses. They also use fire to clean irrigation canals and field edges, and in some rare cases, to encourage nutrient transfers (or even water runoff) to downhill rice paddies.

Burning controls a wide variety of pests. Small "cleaning" fires around cropfields and homes help reduce rat populations and destroy the brush in which rice-stealing birds such as the red fody perch between raids. Fires help control cattle ticks, mosquitos, and locusts. People burn vast areas during locust invasions because smoke wards off locust swarms in flight and fire kills the resting locusts (allowing people to collect them for food or to use as pig feed).

In certain woodlands found only in drier highland areas, villagers burn to promote the dominance of the pyrophytic (fire-resistant) tapia tree (*Uapaca bojeri*), which serves the local economy by providing fruit and by hosting an endemic silkworm.[12] Fires in these woodlands may also reduce populations of silkworm parasites. In highland pine and eucalyptus plantations, some tree growers burn to provoke regeneration and clear out undergrowth, taking advantage of the pyrophytic nature of these exotic tree species.

Of course, not all fire use is constructive. Revenge, protest, jealousy, land ownership conflict, and personal gain can promote criminal fires in houses, cropfields, and woodlots. Many fires are purportedly associated with cattle-thieving bandits. In addition, numerous fires escape control each year, whether from intentional agropastoral fires or cigarette butts or campfires.

Figure 3. Areas burned by month



NOTE: This map shows areas burned in an 18-square-kilometer area of the southern highlands, in the Manandona-Sahatsiho valley, and demonstrates the spatial and temporal mosaic of burning. The precise location is not indicated to preserve anonymity of informants (none of these fires were officially authorized).

SOURCE: C. Kull, 1998 field observations.

The Struggle

With such pervasive reasons to employ fire, the *tantsaha* have collided for more than a century with the state and other actors trying to stem further environmental degradation and deforestation. Policy makers and state technical agents, especially foresters, have long considered burning a backward technique.[13] They have favored permanent intensive farming practices (including fertilization, irrigation, and leveling) and intensive cattle husbandry (including fenced grazing, hay mowing, stall-feeding, and fodder cultivation) and regarded extensive slash-and-burn agriculture and fire-based pasture management as wasteful. The *tantsaha*, mirroring farmers and ranchers around the world, use these intensive techniques only when pushed to do so by scarcity of land or economic incentives, because these techniques require significantly higher inputs of time, labor, and money. In Madagascar, such a transition is evident in densely populated farming zones and market garden and woodfuel production zones around cities.[14]

Each attempt by the government to stop or limit burning has been met by resistance and continued burning.

A highland hillside in Madagascar shows the annual cycle of fires and long-fallow cropping.

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April 1998, end of the rainy season: *The area under the pine had burned a month earlier.*

June 1998, early winter dry season: *The grasses lignify, and the rear area had burned four days earlier.*

August 1998, late winter: *The foreground area had burned a few days earlier.*

French colonial administrators sought to limit burning shortly after the island's conquest in 1896. While some officers argued for the need to burn for pasture maintenance, colonial scientists argued that burning destroyed valuable forests and impoverished the soil. A decree in 1900 and legislation in 1907 banned all fires except those used for locust control and pasture renewal, with the understanding that these would be phased out in favor of intensive ranching methods. New laws in 1930 tightened the screws yet still allowed for pasture fires upon authorization (the inset on page 17 shows some of the pastures that could be burned). In 1960, the legislation of newly independent Madagascar echoed colonial laws, banning most fires but allowing for "exceptional" pasture fire authorizations. In the 1970s, the government sponsored anti-fire propaganda programs and stiffened penalties for illegal fires, but enforcement did not keep up. Anti-fire efforts again intensified in the late 1980s as environmental money began to pour into the country. The forest service stopped issuing fire authorizations in many regions.[15] Despite these contentious efforts, fires continued to ravish the island. Slash-and-burn practices inexorably pushed back the forest frontier, while pasture and cropfield fires—often unauthorized and frequently out of control—reduced the hills to an annual cover of black ashes.[16]

Why has this problem persisted? Why is the situation still as inflammatory as it was a century ago? It is necessary to look beyond the interests of the state and the rural people to the natural and political arena within which the conflict occurs. The colonial and independent states, largely through their forestry and environmental services, have tried repeatedly to protect the island's forests and soils by severely limiting fire use. From the perspective of the farmers and herders who rely on fire as an efficient and inexpensive tool for resource management, these efforts criminalized their livelihood activities. So they resisted state restrictions by using the opportunities present in the natural and political context, and they have been able to prolong the fire stalemate indefinitely.

The Nature of Fire

Fire is not like an axe, nor is it like rain. Fire and an axe can both be used as resource-management tools, but an axe needs a human hand to chop trees. A fire does not need human ignition—lightning does the job equally well, especially after a long dry season and years of fuel buildup—nor does it stop working after the person who started the fire has gone home. But neither is fire wholly natural, like rain. Save for occasional cloud-seeding efforts, humans hardly control rain in the way a match-holder controls fire. The character of fire—its ambiguous agency, the easy anonymity in lighting fires, its self-propagation, the unpredictability of cause and effect (a small cropfield fire may also escape and renew a pasture)—provides the window of opportunity for the *tantsaha* to burn and escape enforcement. In addition, fire is inevitable in a biome characterized by furious vegetation growth in a rainy season followed by a long dry season.

As a result, people burn as they have before—they just take care not to get caught. They burn at night or out of sight, sometimes by using time-delay ignition techniques. One technique involves placing a few matches and some dry grass over one end of a dried patty of cow dung and then igniting the opposite end. By the time the smoldering fire reaches the matches, the arsonist is well away from the scene. The *tantsaha* rarely monitor fires, allowing them to escape and run their course. Finally, they piggyback one fire onto another, making a series of planned fires seem like one large wildfire. Frustrated colonial authorities, foresters, and even private tree growers have complained of the impossibility of apprehending fire starters for precisely these reasons.[17]

The State and Its Institutions

Another contributing factor to the fire stalemate is the nature of state politics. The *tantsaha* take advantage of disunity and weaknesses in the state machine as well as moments of distraction. The state is full of competing personal, institutional, and political agendas. It is a complex arena for contesting power—a set of

December 1998, early rainy season: *The "green sprout" grows in.*

April 1999: *Several areas are prepared for cultivation.*

institutions with goals that do not always overlap—and is composed of individuals seeking to support their families on often paltry salaries.[18] This disunity, in spite of a common anti-fire rhetoric at the official level, goes a long way toward explaining the fire impasse. In essence, the *tantsaha* have taken advantage of sympathetic officials, interagency disagreements, and their own political influence to continue burning.

Different branches of the Malagasy state conflict with each other. The general administration has sometimes been caught between pro-fire populist leaders and anti-fire technocratic agencies. For example, foresters accused the court system of lax enforcement of fire charges.[19] The forest service also clashed with some officials from the livestock ministry who saw fire as a necessary evil for extensive pasture renewal and tick control.[20]

The political voice of the pro-fire majority (including nearly all of the *tantsaha*) is significant. Elected rural officials cannot afford to decry burning to their constituents. While they may do so in the presence of environmental agencies, they let the *tantsaha* know through other channels that they will not interfere. If foresters push anti-fire rules too hard, local political officials, reflecting public will, may threaten to have them reassigned or demoted.[21]

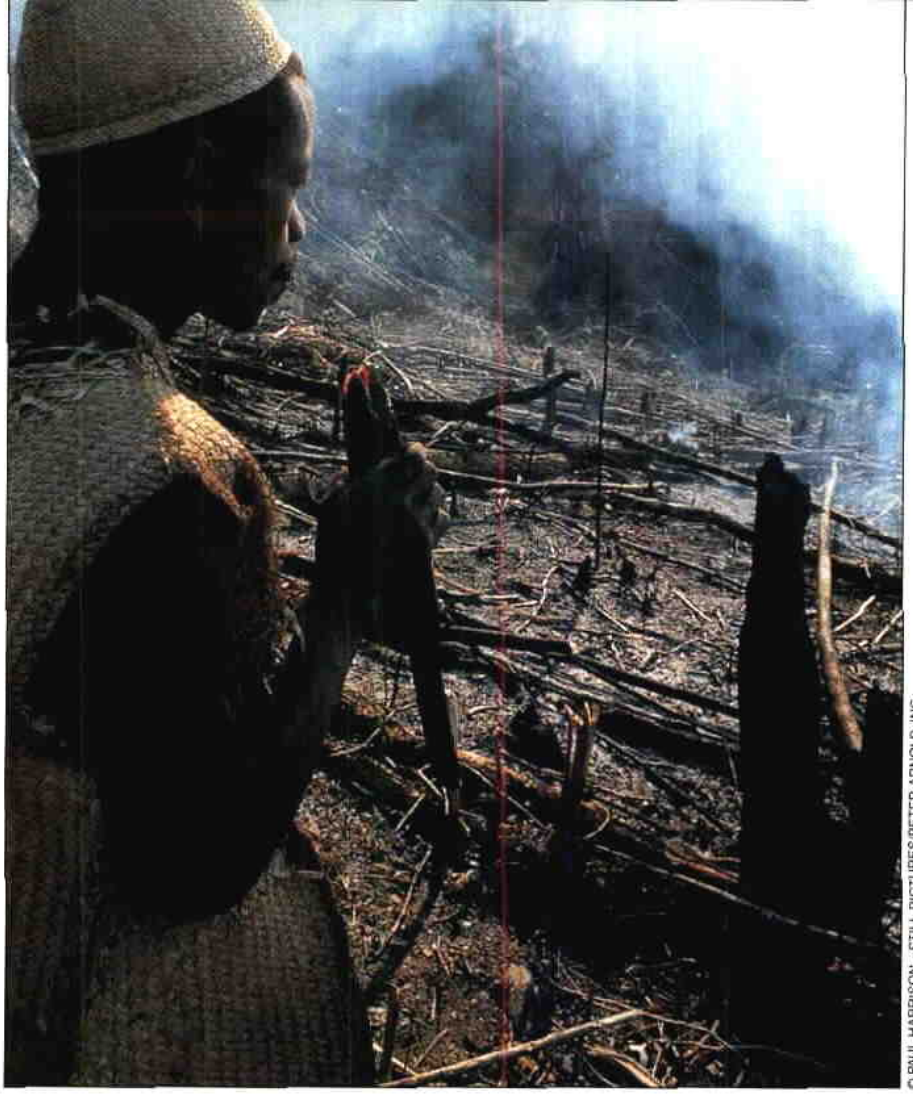
Field agents often apply a watered-down version of state mandates. These lower-level state agents must answer both to their superiors and to the *tantsaha* as neighbors and friends. They may turn a blind eye to less egregious practices and "hesitate to punish the poor devil who burned the forest to grow the rice necessary to feed his family."[22] Central authorities have historically noted their frustrations with lenient field agents. In 1929, Governor Hugues Berthier complained of the "indifference of the authorities in the face of the ruin of the Colony" and called for stricter enforcement.[23] These practices continue today, as some field foresters and other local officials only selectively enforce the rules. In fact, the *tantsaha* pressure these state agents through coercion, and several foresters have reported receiving threats. State agents may also operate for their own personal gain, accepting bribes in return for dropping charges. Such petty corruption often occurs when livelihood activities are criminalized in any domain.[24]

In addition to state disunity, the Malagasy government faces a relative lack of power, money, and staff to adequately control national territory. Forest service staff numbered far fewer than 100 for the first half of the twentieth century; in 1948, a year after an important anticolonial rebellion, the chief forester in Tulear province wrote, "In the current situation and due to the lack of personnel, the Forest Service is powerless to repress the destruction."[25] Forest service staff has grown to more than 1,000 in past years, but budget constraints imposed on the government by the International Monetary Fund leave the agency with drastically limited means. The number of field agents outside park areas has dropped; in pasture zones, a single agent can be responsible for up to 800,000 ha. Due to desk responsibilities (giving permits to tree-cutters) and financial limitations, this agent cannot tour the zone very often. As a result, the *tantsaha* know they can escape control.

There are specific moments when the *tantsaha* can light fires precisely because they know the state is distracted. A prime example is during locust invasions, when the state faces a conundrum: to enforce anti-fire laws or to allow the *tantsaha* to fight the crop-destroying pests with fire. As a result, the arrival of locusts offers a kind of amnesty. Fire laws are also less likely to be enforced during election periods (as politicians court rural favor), times of social unrest (as the state is otherwise occupied), and bonfire celebrations on the eve of the national holiday.[26]

The Context of Natural Resource Conflicts

Conflicts over the use and management of natural resources abound across the globe—the fire problem in Madagascar is but one example. In the United States, a conflict over private grazing rights on federal lands has simmered for years. In Kenya and Tanzania, the pastoralist Maasai have struggled for most of a century against appropriation of their lands for national parks. In



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In slash-and-burn agriculture, farmers cut a patch along the forest, allow the slash to dry, and then burn it in preparation for cultivation.

Indonesia and other Southeast Asian countries, villages have competed with state-run forestry agencies for control of forest resources. In maritime Canada, Micmac natives have clashed violently with New Brunswick fishermen over access to lobster fisheries.[27]

Madagascar's fire problem is helpful in understanding other conflicts over natural resources. Simply chronicling different interest groups and their points of view is insufficient. Knowing that the Malagasy state has long sought to snuff out the island's fire habit and that the *tantsaha* depend upon fire for their agropastoral livelihoods does not explain the persistent impasse over fire. In the same way, just knowing the interests of the Micmac and the New Brunswick fishermen—or the Maasai and the Kenyan Wildlife Service—is not sufficient to explain the character of the conflicts, nor to develop solutions.

Crucial to understanding and solving these conflicts is an appreciation of their broader context. The ecological or natural context of a conflict shapes the paths and directions it may take. In Madagascar, fire's ambiguity, anonymity, and self-propagation distinguish it from other contested management techniques such as hunting, timber harvesting, grazing, or fishing. Furthermore, the ecosystem within which the practice occurs bounds the conflict. For example, Madagascar's fire ecology, with one long dry season, differs from that in Kenya, which has two dry seasons. Different soils and plant communities lead to different grazing impacts around the American West. The ecology of lobster along the coast of New Brunswick—found near the shore (where the Micmac live) in the fall and then offshore in the spring—shapes the parameters of that conflict. Each case has a basic ecological context that can both limit possibilities and provide opportunities for resolution.

The nature of state power and institutions shapes the parameters of natural resource conflicts that involve the state (as most do). Madagascar's nonmonolithic state (with multiple viewpoints hidden behind an official anti-fire policy) is relatively weak and provides some of the opportunities exploited by the *tantsaha*. Elsewhere, the specific character of institutions, such as state authoritarianism, determines the character of the playing field. Canada's attempts to improve its legacy of relations with its native people, for example, led its Supreme Court to side with the natives in treaty disputes over resource rights. When Java achieved independence, changes in political regimes became opportunities for farmers to assert additional resource claims. Both the institutional character and history of state intervention influence the path of resource conflicts.

Other important factors in the Malagasy case include the political economy (from local differences between "haves" and "have-nots" to the global economic system) and the ideologies that frame policy debates.[28] In Madagascar, an anti-fire ideology dominates policymaking to the extent that many of the lessons of fire management from other incendiary regions of the world have only slowly entered into local discussions. Fire, after all, has long been used in land management around the globe, particularly in grassland and woodland zones. Experience in such fire-prone places as Australia, California, and South Africa has long demonstrated the usefulness of fire as a resource-management tool, the integral role of fire in regional ecosystems, and the dangerous effects of removing fire from the landscape—wildfires that result from fuel buildup.

British moorland herders, Australian aborigines, Maasai pastoralists, Kansas ranchers, and Indian foresters have all championed fire's usefulness as a resource-management tool. For example, at South Africa's Kruger National

Park, park managers throughout the first half of the 1900s considered the burning of old, tall grass to be essential to maintaining ungulate habitat. Wild ungulates, like cattle, prefer the short grasses produced by burning—the new green shoots are nutritious, and predators are easier to see in the absence of tall grass. In 1946, a new warden restricted fires (inspired, in part, by a new national policy on soil conservation), and as a result many game animals migrated away, bushes encroached, and catastrophic wildfires ensued. Park managers then reversed the restrictive policy, and new burning strategies were developed. Current fire management divides the park into some 400 burning blocks and rotates fires throughout the year in a cycle designed to mimic natural fires, following rainfall patterns and ecological needs.[29]

Practical experience with fire's usefulness has been matched by changes in ecological theory. Ecologists, once wedded to strict concepts of succession, now accept fire and other disturbances such as floods and hurricanes as integral parts of the functioning of many ecosystems. They document the important role of fire in creating habitat diversity, in rejuvenating different ecosystems, and in avoiding the potentially harmful buildup of flammable fuels. As a result, away from the urban fringe (where homes are directly threatened by fire), fire has come to be seen as a valuable, if sometimes capricious, management tool.[30] In Madagascar, many of these lessons have been considered only recently, if at all.

Toward Secure Local Management

In a significant step forward, a recent policy in Madagascar has sought to move past the fire deadlock by addressing the political and ideological factors blocking progress. Inspired by the growing international consensus on the importance of local and community participation in conservation, as well as by the trend of decentralization of state power, the government and international conservation and development agencies brought in a team of consultants in the mid-1990s to come up with a new approach. Their proposal took note of the nature of fire, especially its ecological inevitability, and accepted it as a crucial agropastoral technique.[31] The proposal also recognized the history of state ineffectiveness, with the government's repressive approach, and suggested that fire management be transferred to rural communities.

After a series of workshops and reports, the proposal quickly became law in September 1996. Called GELOSE (an acronym for *gestion locale securisée*, or secure local management), the law lays the groundwork for local communities to gain management responsibilities for their local renewable natural resources such as forests, rangelands, and lakes. GELOSE is based on the negotiation of three-way contracts between the state (represented by its technical branches such as the forest service), the rural municipality (known as the *commune rurale*), and a voluntary association of community residents or resource users. These community associations gain legal rights to the resource (which usually had been state-held) and regulate resource use through local institutions and rules.

The original plans were for GELOSE contracts to be implemented in 400 of all 1,100 rural municipalities by 2001, but there have been several administrative and political delays. Only a dozen official GELOSE contracts existed by the end of 2000. The 22-step process for negotiating such contracts is long and expensive. In consequence, the only contracts that have succeeded were facilitated by the financial and logistical

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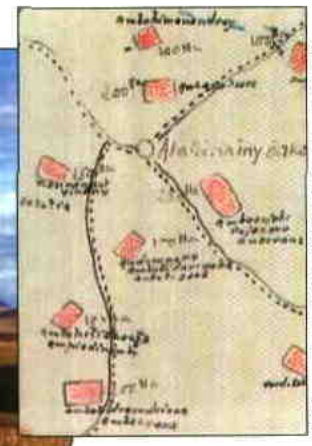

NATIONAL ARCHIVES OF MADAGASCAR, FOLDER NO. D91S

Administrators of Ambatolampy district ruled in 1942 that one or two pastures per village could be burned annually (marked in red).

A pasture renewal fire burns in the vast grasslands of midwest Madagascar, a region noted for cattle raising.

support of a foreign-sponsored conservation or development project. For example, one of the longest-running GELOSE pilot projects has taken place in several villages around the Marojejy National Park in northeastern Madagascar. A park conservation project, run by the World Wildlife Fund, funded and aided the establishment of several GELOSE contracts beginning in 1997. These contracts give local villages the responsibility of managing the forest and agricultural lands adjacent to the park's rainforests. The contracts cover the management of all local resources and empower villagers to keep outsiders from clearing plots in their forests.

Unfortunately, in the realm of fire management, GELOSE risks failure—or at least very uneven application—because it does not remove the strict anti-fire laws of the state, it continues to give the state the final word, and it does not always engage effective and legitimate community institutions. Pilot efforts indicate that GELOSE is more likely to succeed when applied to village logging cooperatives than when applied to the management of slash-and-burn or pasture fires, because influential foreign funding agencies are most interested in forest conservation—not forest conversion to agriculture or the management of grasslands. In addition, applying GELOSE to sustainable village-based logging does not conflict with state laws and ideologies such as the anti-fire policy. Finally, there is a palpable financial interest to local communities participating in such village logging cooperatives—in the form of access to timber revenues that used to go to the state—but this is not the case with fire management. People would continue to burn with or without GELOSE.[32]

What, then, should be done about Madagascar's fires? Instead of arguing against burning, the most realistic stance is that there has always been fire in Madagascar and there always should be. In the vast highland and western parts of the country with an extended dry season, fire is both a natural part of landscape processes and a key cultural landscape-management tool. Fire is an efficient and inexpensive means of pasture, woodland, and cropfield management that is appropriate in lightly settled zones (uncontrolled fire use is rare in densely settled zones). If humans do not burn uncultivated lands, nature eventually will, especially if years of protection allow fuel to accumulate. As a result, communities should be allowed to manage their own lands with fire, with the blessing of the state and without the restrictions of top-down rules or anti-fire rhetoric.

In the humid forest zones of the east, fire is less common in natural systems and, when used by the *tantsaha* as part of slash-and-burn agricultural practices, contributes directly to dramatic levels of deforestation. Here, the critical policy question is not over fire per se but over the political control of remaining forests. The *tantsaha*, the government, and the global environmental community are in effect negotiating over the control of these resources by using protected-areas legislation, project funding, and physical acts of cutting and burning. Region by region, these groups are struggling to delimit which forests are to be conserved and which zones may be used for agriculture. Fires will continue to be a key tool for agricultural management, and local communities should be given an important role in this process.

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NOTES

1. The precise area burned each year remains unknown. The size, extent, and intensity of fires vary by geographic region, by month, and from year to year. Government statistics report annual burned areas varying between 0.5 and 5 percent of the island's surface. In highland Antananarivo province, where grasses dominate, these statistics show annual burned areas ranging from 0.5 to 43 percent of provincial surface area. Unfortunately, these statistics are unreliable and probably underestimate the actual extent of fires. For a full discussion of the statistics, see C. Kull, *Isle of Fire: The Political Ecology of Grassland and Woodland Burning in Highland Madagascar* (Ph.D. diss., University of California at Berkeley, 2000), 388–91.

2. D. A. Burney, "Climate Change and Fire Ecology as Factors in the Quaternary Biogeography of Madagascar," in W. R. Lourenço, ed., *Biogéographie de Madagascar* (Paris: Editions de l'Orstom (French Institute for Scientific Research on Development), 1996), 49–58; and D. A. Burney, "Theories and Facts Regarding Holocene Environmental Change Before and After Human Colonization," in S. M. Goodman and B. D. Patterson, eds., *Natural Change and Human Impact in Madagascar* (Washington, D.C.: Smithsonian Institution Press, 1997), 75–89.

3. T. Randriambelo, S. Baldy, M. Bessafi, M. Petit, and M. Despinoy, "An Improved Detection and Characterization of Active Fires and Smoke Plumes in South-Eastern Africa and Madagascar," *International Journal of Remote Sensing* 19, no. 14 (1998): 2,623–38.

4. L. Jarosz, "Defining Deforestation in Madagascar," in R. Peet and M. Watts, eds., *Liberation Ecologies* (London: Routledge, 1996), 148–64; C. Kull, "Deforestation, Erosion, and Fire: Degradation Myths in the Environmental History of Madagascar," *Environment and History* 6, no. 4 (2000): 421–50; G. M. Green and R. W. Sussman, "Deforestation History of the Eastern Rain Forests of Madagascar from Satellite Images," *Science*, 13 April 1990, 212–15; J. Brand, "Das Agro-Ökologische System am Ostabhang Madagaskars: Ressourcen-und Nutzungsdynamik unter Brandrodung" (The Agro-Ecological System of Madagascar's Eastern Slope: Resource Use Dynamics with Slash-and-Burn Cultivation) (Ph.D. diss., Universität Bern, 1998); J.-L. Pfund, "Culture sur Brulis et Gestion des Ressources Naturelles" (Slash-and-Burn Cultivation and Natural Resource Management) (Thèse no. 13996, Ecole Polytechnique Fédérale de Zurich (Swiss Federal Institute of Technology, Zurich), 2000); D. Coulaud, *Les Zafimaniry: Un Groupe Ethnique de Madagascar à la Poursuite de la Forêt* (The Zafimaniry: An Ethnic Group in Pursuit of the Forest in Madagascar) (Antananarivo, Madagascar: Fanontam-Boky Malagasy, 1973); and A. Jolly, P. Oberlé, and R. Albignac, *Key Environments: Madagascar* (Oxford: International Union for the Conservation of Nature/Pergamon Press, 1984).

5. Burney, note 2 above.

6. Forest clearance in the west is largely associated with maize cultivation for export; see M. Genini, "Deforestation," *Primate Report* 46, no. 1 (1996): 49–56; B. Réau, "Dégradation de l'Environnement Forestier et Réactions Paysannes: Les Migrants Tandroy sur la Côte Ouest de Madagascar" (Forest Degradation and Peasant Reactions: Tandroy Migrants on the West Coast of Madagascar) (Ph.D. diss., Université Bordeaux III, 1996); and A. P. Smith, "Deforestation, Fragmentation, and Reserve Design in Western Madagascar," in W. Lawrence and O. W. Bierregard, *Tropical Forest Remnants* (Chicago: University of Chicago Press, 1997), 415–41. The highland Ambohitantely forest has shrunk in the face of repeated fires; see J. Ratsirarson and S. Goodman, *Monographie de la Forêt d'Ambohitantely* (Monograph on the Forest of Ambohitantely) (Antananarivo: CIDST (Center for Scientific and Technical Information and Documentation), 2000). Other forest boundaries have remained stable; see Kull, note 4 above, page 431; and C. Kull, "Silk, Fruit, and Fire in the Tapia Woodlands," in S. Goodman and J. Benstead, eds., *Natural History of Madagascar* (Chicago, University of Chicago Press, forthcoming).

7. P. le Bourdiec, "Accelerated Erosion and Soil

Degradation" in R. Battistini and G. Richard-Vindard, eds., *Biogeography and Ecology in Madagascar* (The Hague, Junk Publishers, 1972), 227–59; P. Randrianarijaona, "The Erosion of Madagascar," *Ambio* 12 (1983): 308–11; G. Mottet, "Quelques Exemples d'Érosion Anthropique dans une Montagne Tropicale: L'Ankaratra (Madagascar)" (Some Examples of Human-Caused Erosion on a Tropical Mountain: The Ankaratra of Madagascar), in *L'Homme et la Montagne Tropicale* (Humans and Tropical Mountains) (Bordeaux, France: SEPANRIT (Society for the Study, Protection, and Management of Nature in Intertropical Regions), 1988), 143–46; and N. A. Wells and B. R. Andriamihaja, "Extreme Gully Erosion in Madagascar and Its Natural and Anthropogenic Causes," in S. M. Goodman and B. D. Patterson, eds., *Natural Change and Human Impact in Madagascar* (Washington, D.C.: Smithsonian Institution Press, 1997), 44–74.

8. S. J. Pyne, *World Fire* (New York: Henry Holt, 1995); S. Sandford, *Management of Pastoral Development in the Third World* (Chichester, U.K.: Wiley, 1983); H. H. Biswell, *Prescribed Burning* (Berkeley: University of California Press, 1989); and J. Mistry, "Decision-Making for Fire Use among Farmers in Savannas: An Exploratory Study in the Distrito Federal, Central Brazil," *Journal of Environmental Management* 54 (1998): 321–34.

9. In light grazing systems with lower numbers of cattle per unit area, cattle eat only their preferred forage grasses. This favors the growth of less nutritional grass species. Fire overrides these competitive effects by reducing all grasses to ashes. In essence, this creates a clean slate for all grass species.

10. P. Granier and H. Serres, "A Propos de l'Incidence des Feux de Brousse sur l'Évolution des Pâturages" (On the Effects of Bush Fires on Pasture Evolution), *Bulletin de Madagascar* 16, no. 243 (1966): 789–91; and G. Cori and P. Trama, *Types d'Elevage et de Vie Rural à Madagascar. Travaux et Documents de Géographie Tropical* (Types of Animal Husbandry and Rural Life in Madagascar. Tropical Geography Research Paper Series), no. 37 (Bordeaux: Centre d'Etudes de Géographie Tropicale (Tropical Geography Research Center), Centre National de la Recherche Scientifique (National Scientific and Research Center), 1979).

11. For other mentions of such patch-based strategies, see H. T. Lewis, "Ecological and Technological Knowledge of Fire: Aborigines versus Park Rangers in Northern Australia," *American Anthropologist* 91, no. 4 (1989): 940–61; B. W. van Wilgen, C. S. Everson, and W. S. W. Trollope, "Fire Management in Southern Africa: Some Examples of Current Objectives, Practices, and Problems," in J. G. Goldammer, ed., *Fire in the Tropical Biota* (Berlin: Springer Verlag, 1990), 179–215; and P. Laris, "Burning the Seasonal Mosaic: Preventative Burning Strategies in the Wooded Savanna of Southern Mali," *Human Ecology*, forthcoming in 2002.

12. D. W. Gade, "Savanna Woodland, Fire, Protein and Silk in Highland Madagascar," *Journal of Ethnobiology* 5, no. 2 (1985): 109–22; and Kull, note 6 above.

13. S. J. Pyne, *Vestal Fire* (Seattle: University of Washington Press, 1997); and K. Sivaramakrishnan, "The Politics of Fire and Forest Regeneration in Colonial Bengal," *Environment and History* 2, no. 2 (1996): 145–94.

14. E. Boserup, *The Conditions of Agricultural Growth* (Chicago: Aldine, 1965); R. M. Netting, *Smallholders, Householders* (Stanford: Stanford University Press, 1993); and Kull, note 1 above.

15. Fire legislation, even in grassland areas, has long been the responsibility of the *Service des Eaux et Forêts* (Water and Forest Service—more recently, the *Direction des Eaux et Forêts* and the *Ministère des Eaux et Forêts*), referred to here for simplicity as the forest service.

16. J. Dez, "Les Feux de Végétation: Aperçus *Psycho-Sociologiques*" (Vegetation Fires: A Psycho-Sociological Survey), *Bulletin de Madagascar* 247 (1966): 1,211–29; J. Dez, "La Limitation des Feux de Végétation" (The Control of Vegetation Fires), *Tany Malagasy/Terre Malgache* (Malgasy Land) 4 (1968): 97–124; Rapport du Groupe Interministeriel d'Etudes sur les Feux de Brousse (Report of the Interministerial Study Group on Bush Fires) (Repoblika Demokratika Malagasy, November 1980); R. Rakatonindrina, "Les Grands Problemes Actuels de la Conservation des Ecosystemes: Defrichement et Feux de Brousse" (The Major Current Issues in Ecosystem Conservation: Forest Clearance and Bush Fires), in M. Maldague, K. Matuka, and R. Albignac, eds., *Environnement et Gestion des Ressources Naturelles dans la Zone Africaine de l'Ocean Indien* (Environment and Natural Resource Management in the African Zone of the Indian Ocean) (Paris: United Nations Educational, Scientific and Cultural Organization, 1989), 111–22; G. Rambeloariso, "Etude des Feux de Brousse dans Trois Firaisampokontany d'Antananarivo-Atsimondrano Concernés par le Reboisement Villageois" (A Study on Bush Fires in Three Rural Municipalities South of Antananarivo, Site of Village Reforestation Efforts), *Akon'ny Ala* (Echo of the Forest) 17 (1995): 4–13; and U. Bloesch, "Fire as a Tool in the Management of a Savanna/Dry Forest Reserve in Madagascar," *Applied Vegetation Science* 2 (1999): 117–24.

17. Letter from the chief of Betroka province to the central government, 8 February 1913, and letter from the chief of Fianarantsoa province to the central government, 9 November 1956 (National Archives of Madagascar, folder no. D196); and multiple interviews with farmers, village leaders, forest service agents, and rural development project workers in Madagascar, 1998, 1999, and 2001.

18. A. Gupta, "Blurred Boundaries: The Discourse of *Corruption, the Culture of Politics, and the Imagined* State," *American Ethnologist* 22, no. 2 (1995): 374–402; D. Moore, "Marxism, Culture, and Political Ecology: Environmental Struggles in Zimbabwe's Eastern Highlands," in R. Peet and M. Watts, *Liberation Ecologies* (London: Routledge, 1996), 125–47; K. Sivaramakrishnan, "A Limited Forest Conservancy in Southwest Bengal, 1864–1912," *The Journal of Asian Studies* 56, no. 1 (1997): 75–112; T. M. Li, *Transforming the Indonesian Uplands: Marginality, Power, and Production* (Amsterdam: Harwood Academic, 1999), and N. Sundar, "Unpacking the 'Joint' in Joint Forest Management," *Development and Change* 31 (2000): 255–79.

19. The first to note this clash was Dez, "La Limitation des Feux de Végétation," note 16 above. Other examples include Sivaramakrishnan, note 18 above; and R. L. Bryant, *The Political Ecology of Forestry in Burma, 1824–1994* (Honolulu: University of Hawai'i Press, 1997). Regarding forester complaints of lax enforcement, evidence shows that one-third to one-half of forestry infractions result in out-of-court settlements of payment in bricks, labor, a small fine, or tree-planting, far below the strict punishments outlined in the legislation. See Kull, note 1 above.

20. Dez, "La Limitation des Feux de Végétation," note 16 above; Service de l'Elevage de Madagascar (Madagascar Livestock Service), "Les Feux de Brousse à Madagascar" (Bush Fires in Madagascar), *Bulletin Agriculturel du Congo Belge* (Agricultural Bulletin of the Belgian Congo) (June 1949): 1,945–50; G. Metzger, "Les Feux de Prairie et l'Elevage Extensif a Madagascar" (Prairie Fires and Extensive Cattle Husbandry in Madagascar), *Bulletin de Madagascar* 28 (1951), 17–21; and Kull, note 1 above, pages 266–68.

21. Interviews with foresters, including an acting *chef de cantonnement* (sector chief) and a retired forester who had been secretary-general in the Ministry of Water and Forests.

22. J. Coudreau, "La Forêt Malgache: Son Rôle dans l'Economie Générale du Pays, Sa Conservation, Son Amélioration" (The Malagasy Forest: Its Role in the *National Economy, Its Conservation, Its Improvement*), *Bulletin Economique du Gouvernement Général de Madagascar et Dépendences* (Economic Bulletin of the General Government of Madagascar and Dependencies), 1 trimester 1937 (Antananarivo: Imprimerie Officiel), quoted in A. Bertrand and M. Sourdat, *Feux et Déforestation à Madagascar* (Fire and Deforestation in Madagascar) (Antananarivo: CIRAD (Center for International Cooperation in Agronomic Research for Development)/ORSTOM (Office for Overseas Scientific and Technical Research)/CITE (Center for Information and Technology), 1998): 117.

23. H. Berthier, "Circulaire a/s des Questions Agricoles et Forestieres" (Circular on the Subject of Agricultural and Forestry Issues), *Journal Officiel de Madagascar*, 9 February 1929, 237–38. His call was echoed by forest service chief L. Lavauden, in "Histoire de la Legislation et de l'Administration Forestière à Madagascar" (History of Forest Legislation and Administration in Madagascar), *Revue des Eaux et Forêts* (Water and Forests Review) 72: 949–60. For additional examples, see Kull, note 1 above.

24. D. Klooster, "Community-Based Forestry in Mexico: Can It Reverse Processes of Degradation?" *Land Degradation and Development* 10 (1999): 365–81; Gupta, note 18 above; D. Prochaska, "Fire on the Mountain: Resisting Colonialism in Algeria," in D. Crummey, ed., *Banditry, Rebellion and Social Protest in Africa* (London: James Currey, 1986), 229–52; and Dez, "La Limitation des Feux de Végétation," note 16 above, page 123.

25. National Archives of Madagascar, file no. IVD73/3; see also Lavauden, note 23 above.

26. For example, during the 1991 political unrest, a general strike paralyzed the nation, and people no longer feared enforcement. The number of fires was astounding in many areas. See Kull, note 1 above, pages 225–30.

27. These global examples are respectively based upon J. P. McCarthy, *The Political and Moral Economies of Wise Use* (Ph.D. diss., University of California at Berkeley, 1999); R. P. Neumann, *Imposing Wilderness* (Berkeley: University of California Press, 1998); N. L. Peluso, *Rich Forests, Poor People* (Berkeley: University of California Press, 1992); and Sarah Curry, McGill University, personal communication with author, November 2001.

28. The field of political ecology considers many of these factors in depth. See P. Blaikie and H. Brookfield, *Land Degradation and Society* (New York: Methuen, 1987); R. Peet and M. Watts, eds., *Liberation Ecologies* (London: Routledge, 1996); and R. L. Bryant and S. Bailey, *Third World Political Ecology* (London: Routledge, 1997).

29. D. Gillon, "The Fire Problem in Tropical Savannas," in F. Bourlière, ed., *Tropical Savannas* (Amsterdam: Elsevier, 1983), 617–41; van Wilgen, Everson, and Trollope, note 11 above; and Pyne, note 8 above.

30. Pyne, note 8 above; Pyne, note 13 above; Biswell, note 8 above; Goldammer, note 11 above; Sandford, note 8 above; Sivaramakrishnan, note 13 above; and M. Parfit, "The Essential Element of Fire," *National Geographic*, September 1996, 116–39.

31. B. Rajaonson et al., *Élaboration d'une Politique et d'une Stratégie de Gestion des Feux de Végétation à Madagascar* (Elaboration of a Policy and Strategy to Manage Vegetation Fires in Madagascar) (ONE (National Office for the Environment) and OSIPD (Statistical and Information Service Office for Development), January 1995).

32. C. Kull, "Empowering Pyromaniacs in Madagascar: Ideology and Legitimacy in Community-Based Natural Resource Management," *Development and Change* 33, no. 1 (2002): 57–78; and C. Maldidier, *La Decentralization de la Gestion des Ressources Renouvelables à Madagascar* (The Decentralization of Renewable Resource Management in Madagascar) (Antananarivo: ONE, 2001).