

# Unlikely Alliances

## Encounters between State Science, Nature Spirits, and Indigenous Industrial Forestry in Mexico, 1926–2008

by **Andrew S. Mathews**

Indigenous community leaders and conservationists in Oaxaca, Mexico, believe that deforestation causes streams to dry up and threatens rainfall, authorizing popular mobilizations against industrial logging. This belief was produced by a combination of indigenous beliefs in nature spirits and early-twentieth-century state-sponsored desiccation theory, which was brought to the Valley of Mexico in the 1920s. Desiccation theory acquires political significance because it allows rural people to build political and epistemic alliances that bypass industrial forestry institutions and find sympathetic urban audiences and environmentalist allies, undermining state claims to reason and scientific authority. These alliances require the skillful translation and mistranslation of local environmental concerns by activists and conservationists, who link the concerns of urban audiences with those of rural people. Popular beliefs about climate and forests in Mexico structure the authority and credibility of the state and will powerfully affect efforts to protect forests to mitigate climate change.

*ASTROV: Man is blessed with intellect and creative powers, so that he might enhance that which he is given. But he doesn't create, he only destroys. Forests become smaller and smaller, rivers run dry, wildlife populations leave, the climate is ruined, and with each day the earth becomes poorer and more horrible. (Chekhov 2002 [1899], 25)*

*When there is enough forest the winds lift up the clouds in their due time, and it rains, but when one ridge has trees and one has been converted to desert, the clouds pass by, you see the water come but it doesn't rain there, and when it rains it rains very little and the soils are eroded, human lives, homes and goods are lost; also, it rains when it shouldn't. The reason the rains fail is excessive logging. . . . We have to understand that cutting trees doesn't just hurt a state or a country, but the whole world.<sup>1</sup> (Environmental Activist Rodolfo Montiel; Jimena 2004, 52)*

Across Mexico, sporadic road blockades and protests against logging have joined indigenous environmental activists, urban-based environmentalists, and concerned citizens in a common vision of logging as immoral, corrupt, and envi-

ronmentally destructive. Rural and urban people have come to share ways of describing environmental degradation, allowing environmental activists such as Rodolfo Montiel<sup>2</sup> to explain their hostility to logging in terms that urban and international audiences find comprehensible and sympathetic. How have rural people been able to appropriate a language of environmental degradation and access to knowledge of the natural world that urban and international audiences find so compelling? In this paper I argue that although opposition to logging has many components, including its apparent destructiveness,<sup>3</sup> it is concern over the links between deforestation and climate change that has unified these disparate actors. The theory that deforestation causes declines in rainfall and streamflow, the drying up of springs, and disastrous flooding, which was a globally traveling scientific theory during the nineteenth and the first half of the twentieth centuries (Saberwal 1998), has come to be part of popular beliefs about nature, cementing political alliances across enormous divides of livelihood, culture, and place. This is a relatively new event. Desiccation theory has historically been used by the Mexican

1. All translations are my own.

2. Rodolfo Montiel and Teodoro Cabrera are antilogging indigenous environmental activists from Guerrero who were tortured and imprisoned by the army in 1999. They became a national and international cause célèbre, received the Goldman Environmental Prize in 2000, and were finally released by the Mexican government in 2001 (Jimena 2004).

3. Most ecologists and foresters believe that logging can be sustainable, but in Mexico, as in many other countries, it has come to be popularly seen as uniformly destructive.

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state in order to justify government control and regulation of forests, pitting the state against the livelihood practices of rural people. Other environmental discourses continue to depict rural Mexicans as the authors of environmental destruction, as when rural people are represented as ignorant and environmentally destructive fire setters (Mathews 2003). How then has the belief that deforestation causes climate change come to be so different? Why have rural people been able to make use of this theory as agents who can build alliances with outsiders rather than as the subjects of state projects of governmentality and control of natural resources?

In this article I will describe how the internationally circulating scientific theory of desiccation was brought to Mexico in the early twentieth century and how it was used to drive state efforts to control forests and people, first in the Valley of Mexico and then in the southern state of Oaxaca. Desiccation theory was official science, justifying the Mexican state as the controller of reason and knowledge of forests, which were represented as being degraded by the irrational rural poor. State science gave access to knowledge of nature in the form of forests, streams, and climate, while it asserted the ability of the state to restore and manage nature. Before the arrival of state desiccation theory and industrial forestry in the 1930s, the Zapotec indigenous people of the Sierra Juárez of Oaxaca had quite a different understanding of nature and of forests and streams. They believed in nature spirits who had to be placated, and they made little mention of environmental degradation. Over the course of the twentieth century, these beliefs in nature spirits have been submerged by narratives of environmental degradation, and desiccation theory has been appropriated as part of a powerful popular scientific belief deployed in political conflicts over forests. Indigenous beliefs in nature spirits did, however, create powerful associations between mountains, streams, and forests, so that the places where forests are now protected for water are the same places once associated with the supernatural spirits who controlled rain and water.

In the 1940s, the Mexican state turned decisively away from desiccation theory in favor of concerns over soil erosion, flooding, and large-scale watershed protection. Rural people and, later, urban environmentalists have continued to believe that deforestation causes climate change and, especially, that it causes springs to dry up and rains to fail. Environmental scientists no longer believe most elements of desiccation theory, leading to a clash in beliefs between scientists and their state sponsors on the one hand and popular audiences on the other. It is this tension between governmental and vernacular belief that has made a broad-based popular opposition to logging both thinkable and practicable; this movement has succeeded in bypassing the spatial and conceptual authority of state forestry institutions, building conceptual and material linkages between streams, forest landscapes and logging practices, global environments, and urban water supplies. Desiccation theory has come to provide a relatively stable "boundary object" (Star and Griesemer 1989; Tsing 2005)

across the social worlds of urban audiences, conservationists, and rural people, allowing unlikely alliances between urban elites, environmental activists, and rural people who otherwise might have little in common.

These forms of nature are not just "local"—on the contrary, like other localisms, they are engaged in producing other scales, from regional to global (Tsing 2000). It is precisely the ability of desiccation theory to make links with other scales and audiences that stabilizes relatively vague popular beliefs about tree cutting, streams, and climate. Desiccation theory therefore bypasses the scales and forms of authority and knowledge authorized by state forestry institutions. It is the possibility of building links with other scales, natures, and institutions that allows popular theories about forests and waters to make imaginative and normative connections with globally threatened climates and degraded urban environments. This connection making in turn allows intermediaries such as environmentalists and indigenous activists to engage in translations and mistranslations that link forests to waters in ways that elude the grasp of state institutions.

## Summary of Desiccation Theory

At this point it is appropriate to outline classic desiccation theory and to emphasize that most environmental scientists now disagree with many or all of its predictions (FAO 2005). Somewhat confusingly, desiccation theory links deforestation not only to declining rainfall and streamflow but also to the opposite problem of torrential floods caused by soil-filled streams. The three main predictions of desiccation theory are that deforestation will (1) cause rainfall decline, vaguely stated as being at local, regional, or larger scales; (2) reduce streamflow in the dry season; and (3) cause soil erosion, which will clog streams and cause flooding in the rainy season. A recent literature review by the eminent tropical hydrologist L. A. Bruijnzel expressed considerable skepticism about each of these three theses (Bruijnzel 2004).

The weakest thesis is the link between deforestation and rainfall. Although some computer models suggest that large-scale deforestation may cause declining rainfall, most models have assumed total deforestation replaced by bare soil, whereas replacement of forests with grasslands would cause only a relatively modest rainfall decline of around 8%, greatly diminishing the likely impact of deforestation. In relatively rare montane cloud forest types, up to 60% of precipitation may come from "fog stripping," i.e., from condensation onto the leaves and branches of trees (Ataroff and Rada 2000; Cavellier and Goldstein 1989). This may be one of the few cases where deforestation would cause a reduction in effective precipitation, but it would not apply to the vast majority of Mexican pine-oak forests.

Regarding impacts of deforestation on streamflow, the situation is less clear; in general, deforestation increases water yield and streamflows because trees pump water into the atmosphere, reducing the flow of water into streams or

groundwater. However, where logging operations damage the soil severely, the infiltration and storage capacity of soil could be permanently reduced, resulting in long-term streamflow declines. These processes are not well understood and are the subject of current research, but they appear to depend greatly on soil and subsoil type and on logging techniques.

Finally, deforestation can cause streams to be filled with eroded soil, which can in turn cause flooding, but the amount of erosion depends greatly on local ecology, logging conditions, climates, soil types, and the timing of rainfall events. In any case, the greatest cause of flooding from storm events is the underlying soil type rather than the forests themselves: forests cannot absorb the intense rainfall events that produce most floods (this is contrary to the largely discredited “forest as sponge” thesis advocated by many environmentalists).

This brief summary of desiccation theory and relationships between forests and waters cannot do justice to this complex and hotly contested field: interested readers may turn to review articles by Bruijnzeel (2004), Calder and Aylward (2006; see also Forsyth and Walker 2008, 87–116). For the present, what is of interest is not so much the empirical validity of desiccation theory but the dramatic tension between the opinions of officials, environmental scientists, and popular audiences in Mexico.

## Contemporary Debates about Desiccation Theory

Theories about relationships between forests and climate are ancient, reaching back to ancient Greece (Grove and Rackham 2001), but desiccation theory became a coherent modern science only during the eighteenth century (Grove 1995). Desiccation theory circulated globally and was hotly debated during the nineteenth and much of the twentieth centuries (Andréassian 2004; Fairhead and Leach 2000a; Grove 1995; Saberwal 1998), forming one of the main environmental rationales for modern forest management (Rajan 2006). More recently there has been a vigorous critique of the empirical basis for desiccation theory and of the negative impacts of the environmental policies it has been used to justify (Calder and Aylward 2006; Forsyth and Walker 2008). Various aspects of desiccation theory have come to play an important role in the politics of nature in places as far-flung as India and Nepal (Ives and Messerli 1989), Thailand (Forsyth and Walker 2008), and Central America (Kaimowitz 2004). In each place, one or another aspect receives more weight; at times it has justified state control (India, Thailand, Central America), while at others it unites popular opposition to logging, as in Mexico.

The persistence of desiccation theory cannot be explained by an appeal to the empirical observation that rainfall increases at higher elevations, where forests are often also found, or indeed, by an appeal to the collective experience of drought or deforestation. On the contrary, a well-understood principle of science studies emphasizes that beliefs in empirical facts

about the world must be explained not by appeal to how good the data are empirically but by a symmetrical use of sociological and natural scientific data (Bloor 1991 [1976]). There is, after all, much knowledge about nature that does not command widespread assent; what needs to be explained is why this set of facts has come to be socially accepted. Accordingly, in this essay I describe how desiccation theory has gained its authority in contests between scientists, officials, and rural people, and I ask what implications this has for our understandings of environmental politics.

## The Setting

In 2001 I stood in a meeting hall in the town of Ixtlán de Juárez, a Zapotec indigenous municipality in the state of Oaxaca in Southern Mexico. I had come to present the results of my research on the history of logging, agriculture, and forest fires to a dozen community leaders. This forest history was of consuming interest to my audience; a shared experience of working for and struggling against a logging concessionaire had united the community, and the now-independent community logging business was the main support of the town economy. Many of these elders had told me on other occasions of the deep sense of anger they felt about the degradation and “irrational” tree cutting by the timber company, which they felt had “taken the best” of the forest. Community members incorporated this narrative of environmental degradation in their claims for autonomy from the Mexican state. My intervention therefore encountered a landscape layered with meanings: of warfare, mining, industrial logging, and, most recently, community forestry and conservation (Mathews 2003). During the course of the meeting, an important topic of conversation was a recent outbreak of pine beetles in an area of watershed protection forest. Community leaders feared that cutting and removing diseased trees could threaten town water supplies, but they were also concerned that the outbreak could spread:

*Comunero:* How much would it affect that area, where there is that disease? We all know that this is the area of the springs. . . . We decided in an assembly that that area could not be touched, above all to protect the layers of water. How much would it damage [the water supply] to attack this outbreak [of pine beetle]?<sup>4</sup>

My friend Martín Gómez, a research biologist employed by the Mexican government, replied that this dilemma had come up in several nearby communities.

Gómez: What must be done? Obviously, even if there is a [community] regulation or agreement that these areas have to be kept forested, those damaged trees will have to be removed. . . . There are certain myths about the areas of

4. Sound recording, Ixtlán de Juárez Oaxaca, July 1, 2001. All community members' names are pseudonyms.

water production: it is not sufficient just to protect the edges of the stream; it is more important to protect the whole slope because that is where it is capturing the water which comes out down here later.

Gómez referred to a rule forbidding logging within 20 m of streams and to the complete protection of more than 700 ha of Ixtlán's most productive pine forest. Community members (*comuneros*) firmly believed that this logging ban protected water supplies, as did their careful protection of streamsides in other, logged parts of the forest. Gómez was politely contradicting a deeply held belief—which he called a “myth”—about forests and logging.

His audience was similarly polite—a few minutes later the elder Epifanio Perez thanked Gómez and me profusely for our expertise and then told a story that undermined our defense of logging by insisting on local knowledge and agency. “Knowledge is not just cutting trees,” he said, recounting the role of a community leader in insisting on protecting streams when logging began in 1948. “That was the situation that I lived,” he said, “and I interpret very well what you tell us.” Perez was not against logging per se, but he insisted on community knowledge, and he was politely criticizing our expert authority. How did this difference of opinions between conservative community leaders and outside experts such as Gómez and me arise? Why did locals so tenaciously and politely defend environmental theories that were contrary to the accepted scientific point of view? And how did they feel authorized to contest the authority of science?

How has this belief come to be so firmly held? Part of the answer lies in the way that desiccation theory provides a way to link local environmental concerns to larger scales and to faraway places, providing apparently remote forest communities with a way to criticize state power and to seek out allies among urban audiences in Mexico City and Oaxaca.<sup>5</sup> As a former mayor of Ixtlán told me a year later:

People say that there is no more water, but I don't agree completely, because here, where we have taken care of the forests, it carries on raining, as here [in Ixtlán] where the rains have been good. On a world level, the water is finishing, on a world level, but not here, because we have cared for our forests; maybe in other places the water is finishing, but not here.<sup>6</sup>

Graciano Torres creatively linked community protection of Ixtlán's forests with the preservation of local climate, pointedly comparing the negative effects of global climate change with the benign effects of local control of forests, repeatedly emphasizing community members' *technical* knowledge of forestry. Ixtlán's leaders have continually made use of their claim to protect water, winning national and international

attention, bolstering their control of community forests, and strengthening their ability to attract state support.

## State Formation, Popular Resistance, and Traveling Theories

How do popular political movements gather the discursive and material power to undermine apparently hegemonic state projects, which can appear overpowering, both ideologically and practically? How did globally circulating desiccation theory come to allow moments of alliance between urban and rural people in early twenty-first-century Mexico? How did the well-intentioned Doctor Azov, the environmental activist Rodolfo Montiel, and the mayor of Ixtlán come to share a belief that forests produced rainfall? What does this mean for our understandings of local agency before apparently authoritative scientific discourses? I suggest that it is by a close study of the practices of state making and the construction of authoritative knowledge that we can understand the ways in which institutions push new theories about nature on the subjects of rule, how these theories come to be added to preexisting understandings of place and landscape to help form new identities, how new forms of nature and landscape are produced, and how these understandings of place and nature can produce new identities, new practices, and new networks of alliances that can bypass or penetrate the state.

Much recent theorizing on the nature of state power has hinged on the insight that the state is fragmented and often conflicted and that the unity of the state is itself an ideological construct deployed by powerful elites. This directs attention to the concrete institutions that assert rule, underlining the materiality and coercion of state domination (Abrams 1988).<sup>7</sup> Similarly to Abrams, Foucault focused on widely spread techniques of power/knowledge rather than on the structure of the state (Gordon 1991). This critique has shifted the analytical focus to the mundane “everyday forms of state formation” described by Joseph and Nugent (1994). Attention to the mundane practices of state making also allows a focus on connections between the documentary and discursive exercise of bureaucratic power and deep cognitive structures such as national identity and kinship (Herzfeld 1992).

Attention to the micropolitics of state making has been particularly fruitful in the field of studies of governmentality, focusing on the ways in which a constellation of discourses, institutions, and practices leads to the formation of new subjectivities (Rose 1999); in the environmental field, Arun Agrawal (2005) has traced the formation of environmental subjectivities in the Indian state of Kumaon over the past century, and Sivaramakrishnan (1994, 2003) has shown how state theories of natural resource management were transformed by local practices of rule in rural Bengal. A key insight of the

5. Desiccation theory is also important in intracommunity politics, as it can be used to control the authority of “scientific” or development-oriented community elites who seek to exploit forests.

6. Interview notes, Graciano Torres, Ixtlán de Juárez, July 25, 2002.

7. There is a large literature on anthropology of the state and state formation. See the collection of essays in Sharma and Gupta (2006a; see also Sharma and Gupta 2006b; Sivaramakrishnan 1994).

literature on state making has been to recognize that the relationship between state power and local agency is not a zero-sum game and that power can be generative of new understandings of self and of political possibilities (Agrawal 2005, 123; Rose 1999). This is paralleled by theories of articulation that point to the relationship between official discourses that find subjects who can then make political claims based on new identities (Li 2000).

These approaches provide a good model for the ways in which rural people in the Sierra Juárez and elsewhere in Mexico have come to see themselves as both subjects and opponents of state-sponsored environmental degradation. This new identity and set of political practices has been produced partly in response to the environmental degradation rhetoric produced by the state and the forest service, partly in response to practices of state making through forestry regulations and state forestry institutions and partly through the experience of working as employees of logging companies (Mathews 2003). However, this governmentality literature often overemphasizes the power of traveling discourses and underemphasizes the materiality of power and the material resistance of the natural world. In the Sierra Juárez, a key element in contests over forests is the materiality and coercive power of the state: governmentalizing discourses require concrete institutions and practices if they are to produce new identities, political practices, and forms of knowledge.

What is required to make sense of these official projects of governmentality, then, is an emphasis on the power of state actors to apply coercion to back them up; thus, political economic inequality and state violence are implicated in projects of domination, discourse alone is insufficient to inculcate state ideologies, and practices of domination must be substantiated ethnographically (Moore 2005; Sivaramakrishnan 2003). This emphasis on coercion *and* on political economy and culture arises from the various currents of scholarship that derive from the work of the Marxist scholar Antonio Gramsci (2001), leading historians and anthropologists to consider within the same framework both domination and resistance, complicity and co-option, and elite and popular culture (Moore 2005; Roseberry 1994). These approaches take seriously the cultural work required to produce state power, the material and coercive practices, official rhetorics, discourses, and representations that are required to produce the state idea and make it, even if only momentarily, believable.

## Science, State, and Nature

As suggestive as this is, the literature on state making pays relatively little attention to the importance of nature in practices of state making (for a rare exception, see Sivaramakrishnan 1994) nor to how representations of nature come to gain cognitive, political, and material power. This is surprising as ideologies of reason, science, and nature protection are central to the rhetorical presentation of modern states (see also Scott 1998). It therefore becomes critically important to

understand how reason and the production of scientific knowledge are implicated in the production of political order. A number of scholars of science and technology studies (STS) have argued that the authority of scientific knowledge is linked to that of the state through practices of public reason, expertise, and witnessing (Jasanoff 2005; Shapin and Schaffer 1985) and that the boundary between science and nonscience is itself contested, shifting, and culturally produced (Gieryn 1995), so that boundary-making practices are critical to asserting the contours of the state itself. The idea of the state, which is the product of so much work, therefore also contains understandings about reason and science that are used in attempts to produce political order.

These arguments have resonance with environmental anthropologists, who have long drawn attention to the ways that encounters with nature produce political and social identities and how representations of nature and people can come to gain political or social power (Dove 1983); however, they have been perhaps more concerned with the assertion of state or scientific discourses of nature (Fairhead and Leach 2000*b*) than with how people contest, subvert, or evade these official representations. How, then, can local environments and knowledges be brought within the same frame of analysis as apparently authoritative global sciences? A possible analytical framework comes from the school of actor-network theory (ANT); the best known of these theorists is Bruno Latour. ANT theorists emphasize the materiality of scientific knowledge: the documents, graphs, instrumental observations, rhetorical strategies, and visual technologies and how the circulation and translation of these representations produces authoritative knowledge (Latour 1990). ANT approaches emphasize the materiality of knowledge and make clear that science and technology provide alternative bases for authority beyond the state itself. Nevertheless, in some ways, earlier formulations of ANT substituted the structurally unified state with a unified actor-network, without ever explicitly confronting the role of state power in stabilizing scientific knowledge or the normative and political conflicts that exist within networks (Jasanoff 2004*a*, 21). The recent literature on state making suggests a way out of this dilemma. Just as dissolving the unitary state allows us to see the diverse array of performances, institutions, rhetorics, coercions, and representations that go into producing state power, so too does dissolving the overly structural aspects of ANT allow us to look less at the network and more at the nodes, at the places and moments where the network is performed, where facts about nature and its human allies are made manifest. These are the “articulated assemblages” described by Donald Moore (2005), where various visual technologies, institutional power, material objects, discourses, and identities are brought together to make places. Crucially, the theories and practices through which places are made also produce different natures—place making is a kind of production of nature.

More flexible and performative understandings of ANT *and* of state help make sense of how rural people in Mexico have

come to deploy new discourses and theories about forests largely outside the direct control of government officials or logging company foresters. Forests have become a political and experimental space for producing knowledge and political alliances that can reach urban and international audiences. Governments and foresters may seek to control the practices and understandings of rural people through the science of forestry, but scientific theories are very poor at specifying detailed local practices of producing technology, as traveling scientific theories are transformed by local practices, alliances, and interests (Pinch and Bijker 2002). Further, the resistance of nature to human intention itself becomes a material and symbolic resource for the *comuneros* of the Sierra Juárez, who have produced new kinds of natures by logging forests, marking trees, and protecting community water supplies.

### Background: History of Forest Management in Mexico

At present, as over the past century, the vast majority of Mexico's industrial timber has come from pine species that grow in the temperate climates along the principal mountain ranges (see fig. 1). Most of these forests passed into the hands of rural, mainly indigenous communities in several waves of

land reforms during the 1930s and 1970s (Klooster 2003), resulting in a level of community title to forests that is unique in the world (Bray et al. 2003). Although forest land theoretically belonged to rural communities, from the 1940s to the 1980s the federal government awarded de facto control over commercially attractive forests to private and then nationalized logging companies. In the 1980s, broad-based opposition to logging caused the government to cancel logging concessions and give forest communities the right to manage their own forests, so that, at present, forest communities employ foresters to write and implement forest management plans and exercise varying degrees of control over forest industrialization (Bray et al. 2003). Forest communities in Mexico have attracted international interest for their sustainable forest management practices and relative stability, and a number of leading communities have been able to incorporate the concepts of industrial forestry into traditional communal governance systems (Alatorre Frenk 2000; Antinori 2000; Matthews 2003).

### Bringing Desiccation Theory to Mexico

The Valley of Mexico is a high-altitude "island" of relatively favorable climate, surrounded by forested mountains to the

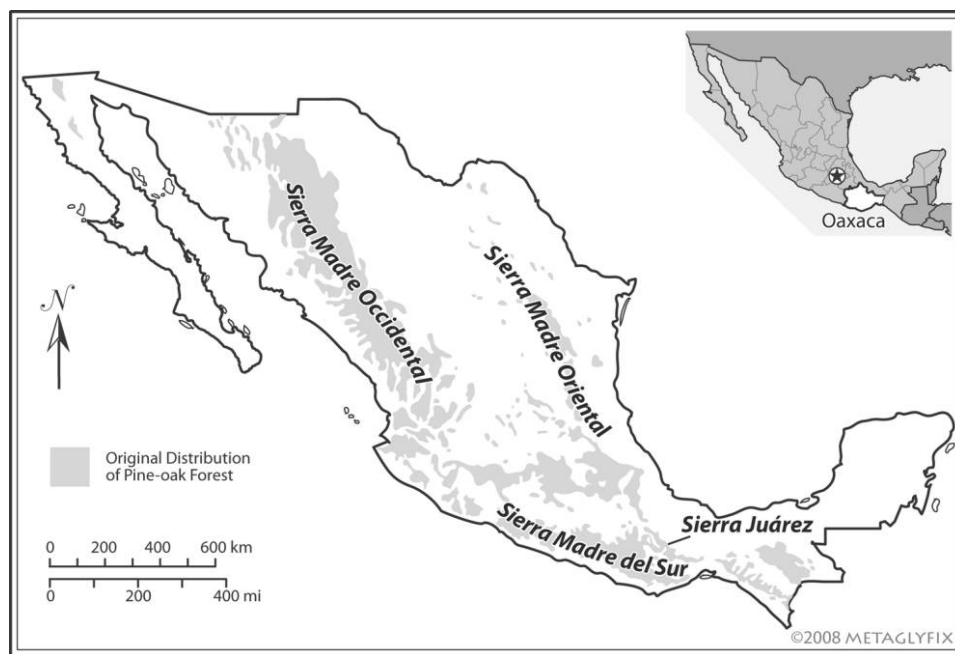


Figure 1. Original distribution of pine and pine-oak forest types in Mexico. Mexican forests are very diverse ecologically, ranging from tropical moist forests in the lowlands of Chiapas to various forms of pine and pine-oak forest on the higher elevations of the Sierra Madre Oriental, Sierra Madre Occidental, and the Neo Volcanic Axis. For economic and ecological reasons, logging and state attention have always been focused primarily on the pine and pine-oak forest types. (Maps by H. G. Salome of MetaGlyfix, Lincoln, VT.)

east, south, and west and by semiarid areas to the north. The environment of the Valley of Mexico has been the subject of extensive manipulations as far back as the pre-Hispanic era, with the building of extensive dikes to prevent floods and to provide water for the “floating island” *chinampa* agriculture (Whitmore and Turner 2001). Repeated floods during the colonial and national periods inspired centuries of attempts to drain the lakes, a project that was finally completed in 1900 and that resulted in the disappearance of much of the lake of Mexico (Connolly 1997). Paradoxically, removing excess water immediately created excess dryness; the recently drained lake beds were alkaline and uncultivable, and dust storms became a serious problem. This environmental history gave Mexican natural scientists and intellectuals an interest in climactic and environmental change as far back as the sixteenth century (Musset 1991) and made them all the more receptive to the desiccation theories of the eighteenth and nineteenth centuries. The dramatic environmental changes of the late nineteenth century, with the rapid urbanization and industrialization of the Valley of Mexico, presented the spectacle of massive state projects of environmental control and of local desiccation and deforestation, producing the Valley of Mexico as a site of environmental degradation and of state control.

By the late nineteenth century, a group of engineers, meteorologists, and scientists based in Mexico City were concerned about the impact of deforestation on climate, water supplies, and flooding. The leading light of this circle was the wealthy engineer Miguel Angel de Quevedo.<sup>8</sup> During 40 years of publication and advocacy, he produced a coherent scientific discourse of public reason and of environmental degradation, deploying visual representations of degraded landscapes and poor farmers to represent the Valley of Mexico as degraded and in need of restoration and protection (de la Vega 1933; Quevedo 1926*a*, 1926*b*, 1933), advocating for rational, technical, scientific management. Quevedo (1935 [1910]) was particularly concerned about the negative effects of deforestation on climate and water supplies, but he also warned of the negative psychological and physical effects of deforestation on urban residents, arguing for the creation of parks and green spaces. Quevedo and his associates believed that poor peasants were converting forest lands to agricultural uses on slopes so steep that the soil would soon be washed away. Between 1900 and 1940 they produced a coherent narrative of environmental degradation through deforestation and desiccation, blaming this degradation on the ignorance of rural people and arguing that state intervention and modern science were required to restore and protect the environment. Through skillful performances of public reason and rural ignorance, Quevedo and his circle linked policies of state environmental control to the concerns of urban audiences about the environment of Mexico City and the Valley of Mexico, linking these places to remote and uncontrollable rural people.

This campaign resulted in a new forest law in 1926 that

asserted the right of the federal government to regulate forestry activities on both private and communal lands (Calva Tellez et al. 1989). As desertification and desiccation were some of the principal justifications for the law, streamsides, watersheds, and areas near cities were particularly protected, and in these areas only marked trees were supposed to be cut. Enforcement efforts gradually spread from Mexico City to the provinces; as we shall see in the case of Oaxaca, forestry officials were usually located in state capitals and restricted their efforts to controlling firewood cutting and logging in the immediate vicinity.<sup>9</sup>

With the presidency of Lázaro Cárdenas (1935–1940), protection of forests took on national importance. In a radio speech to the nation in 1935, Cárdenas announced that forest resources were necessary for national economic development and that forest protection could restore climactic equilibrium and the flow of streams and springs (Cárdenas 1935). Cárdenas appointed Quevedo to be head of the autonomous Department of Forest, Hunting, and Fishing, where he initiated a program of tree planting and public education. However, Quevedo’s principal efforts were concentrated on fire suppression, the establishment of protected areas, and logging regulations (Calva Tellez et al. 1989; Quevedo 1938). He severely restricted logging in many parts of the country through the creation of forest protection zones, e.g., the forests of the Valley of Mexico (1933) and the watersheds of irrigation projects in the whole country (1934), while he promoted the example of model management plans, as at Atlamaxac in Puebla (Treviño Saldaña 1937), which visually depicted a legible and controllable nature (Scott 1998). These initiatives aimed to produce and control new places such as model forests, streamside protection areas, and degraded lands. The cultural representation of the state as the source of order and science required the production of eminently local natural objects, mostly in the Valley of Mexico and neighboring states.

Quevedo’s attempts to enforce forestry regulations and limit agricultural expansion soon encountered opposition from the ministry of agriculture and from the agrarian reform movement. In 1940 Cárdenas closed the Department of Forestry, Fish, and Game and transferred responsibility for forests to the Ministry of Agriculture. Subsequent to Quevedo’s loss of power, desiccation theory was attacked by agronomists whose central focus was agriculture and who supported land reform and agricultural development (Contreras Arias 1950*a*, 1950*b*). From the 1940s onward, the principal role of forests became erosion prevention and flood control, and desiccation passed from being a theory that justified state control to a popular environmental theory used by rural communities to protest industrial logging and find allies among urban audiences.

9. However, see Boyer (2007) for an account of Quevedo’s efforts to set up forestry cooperatives in Michoacan.

8. See Simonian (1995) for the life and work of Quevedo.

## Translating Urban Nature to the Countryside: Bringing Forestry and Desiccation Theory to Oaxaca, 1922–1956

Federal forestry officials began to apply forestry regulations over firewood sales in markets immediately around the city of Oaxaca in the early 1920s.<sup>10</sup> With modestly increasing manpower, they attempted to control industrial logging in the pine forests to the north and south of the city during the early 1930s but were frustrated by limited resources and local opposition. The material impact of official fire control and logging regulations was therefore largely restricted to urban firewood markets and forest communities immediately around the city of Oaxaca. Broadly speaking, the detailed forestry regulations issued by Quevedo and his successors in Mexico City were unenforced and unenforceable. The ideological impact of official environmental theories and forestry regulations was much more powerful; through contact with forestry officials and state rituals of tree planting, forest communities learned that cutting trees could dry up springs and threaten the climate, that selective logging would protect forests, and that forest fires were officially forbidden. Rival communities increasingly began to use accusations of clear-cutting and illegal burning to involve the state in long-standing land disputes.

The Oaxaca State Archive (*Archivo General del Estado de Oaxaca* [AGEO]) contains many cases where one community accuses another of setting fires, either deliberately or through carelessness, and complains that this will threaten water supplies. A typical example is the case of San Pedro Teococuilco, which was accused of burning forests on its boundaries with San Juan Guelache, San Miguel Etla, and San Gabriel Etla (Lopez Cortes 1930). The forestry department sent a letter to the municipal authorities of Teococuilco, telling them to cease burning because they were not supposed to convert forests to agricultural uses, as this would “surely damage the springs in this region.” Another case arose between La Trinidad and Xiacui, near Ixtlán (Various 1945). Xiacui accused La Trinidad of “cutting immoderately” and of setting fires that were a threat to the water supplies of the hydroelectric plant at La Natividad. In these and other cases, the negative effects of cutting trees on streams and climate were a key justification for forest protection. Contemporary Oaxacan newspaper accounts universally condemned deforestation because of its effect on rainfall (Anonymous 1959; Conzatti and Bradomin 1953 [1913]), and forest communities seem to have adopted this theory quite rapidly, both because it was politically useful in getting the state to intervene in intercommunity conflicts

10. This section draws on the *Archivo General del Estado de Oaxaca* (AGEO), contemporary newspaper accounts from the state newspaper archive, the *Hemeroteca Estatal de Oaxaca* (HEO), contemporary ethnographic data, and oral histories I collected in Oaxaca and the community of Ixtlán de Juárez in 2000–2001 and 2008.

and because it accorded with their own theories about the relationship between forests and climate.

### *Zapotec Environmental Beliefs and the Arrival of Industrial Logging*

The indigenous people of the Sierra Juárez (see fig. 2) brought their own understanding of forests and landscapes to their encounter with the forest service and the logging companies.<sup>11</sup> Because the introduction of industrial forestry had such an overwhelming effect on local people’s understandings of the forests, it is impossible to reconstruct from present-day interviews exactly what *serrano* beliefs about forests and agriculture were before the arrival of state-sponsored forestry in the 1930s. However, Julio de la Fuente’s (1949) classic ethnography *Yalalag: Una Villa Zapoteca Serrana* contains detailed accounts of Sierra Zapotec understandings of agriculture, forests, and climate immediately before the arrival of industrial logging, strongly suggesting that present-day beliefs in desiccation and environmental degradation are the product of encounters with logging and state desiccation theory.

De la Fuente (1949, 256–266, 303–308) tells us that ceremonies to ask for rain were already a dim memory when he carried out his fieldwork in 1937–1941. He found that people had a vague belief that witches could ask for rain by carrying out ceremonies near springs high in the mountains and near carved stones associated with pre-Christian “idols.”<sup>12</sup> High and forested places were inhabited by the supernatural lord or lords of the mountains (*dueños del cerro*), who could be associated with good crops, rain, witchcraft, or good luck. Springs (*manantiales*, *ojos de agua*) and waterfalls were both appropriate places to ask for rain, because they connected with places inside or above the earth. Human intervention such as charcoal burning could anger the earth, so ceremonies had to be carried out in the mountains<sup>13</sup> to placate supernatural entities. This suggests a concept of human society as separate from a powerful nature that could punish transgressions but also that such punishments could be avoided by rituals that placated natural forces through the consumption of food and drink and perhaps also by sacrifices of animals. The association between water and the spirits of mountains, springs, and caves continues to be widespread across central Mexico (Glockner 1999; Goloubinoff, Katz, and Lamme 1997; Hémond and Goloubinoff 1997; Rivera Flores and Pourrut 1997; Villela F. 1997), while weather prediction practices are apparently examples of syncretism of Spanish and pre-Hispanic beliefs about climate.

The meticulous detail of de la Fuente’s ethnography allows

11. Local environmental theories are themselves the product of the centuries-long encounter between indigenous and Spanish theories about environment and health.

12. That is, with remnants of pre-Colombian settlements, which are scattered throughout the Sierra.

13. De la Fuente says “*en los cerros*,” which may have meant specific places in the mountains as opposed to mountaintops proper.

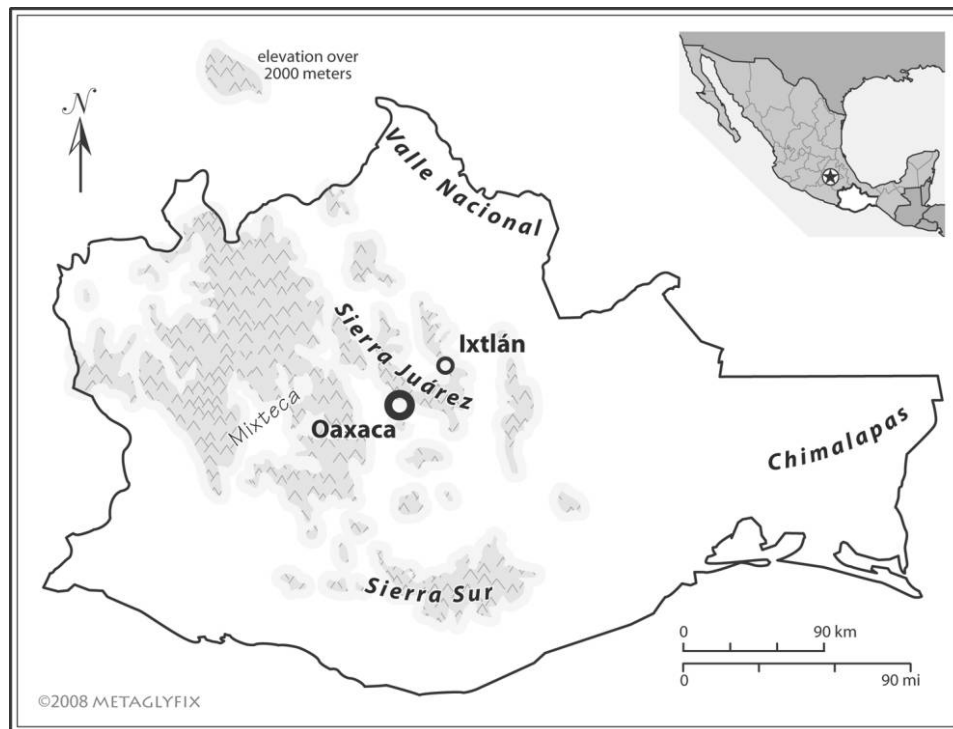


Figure 2. Location of Sierra Juárez and State of Oaxaca.

a comparison of the kinds of reasons people gave for droughts in the 1930s with the kinds of reasons they give now. It is highly significant that although people told de la Fuente that the rains were not as regular as formerly, they did not attribute this to the effects of logging or deforestation. Possibly they still believed that nature spirits and their management were more important than secular events such as logging. By comparison, at present in Ixtlán everyone except elders told me that deforestation could cause climate change by reducing rainfall. They were less sure that rainfall declines had actually taken place in the Sierra Juárez, but they were deeply concerned that springs (*manantiales*) might dry up if nearby forests were logged.

At present, for most people in Ixtlán rainmaking rituals are a distant memory; however, in interviews with four elders in the community of Ixtlán in 2008, I heard consistent accounts of former rainmaking rituals. They told me that until the late 1940s, when rains failed, believers from the community would lead a pilgrimage from the town church to an area of springs called *Los Pozuelos* (little wells), near a small lagoon on a mountainside far above the town. Doña Pérez told me:

They would go out from the church singing, praying [to the *Pozuelos*, to the lagoon]. They would do their ritual. That is where they asked for water. I don't know with what prayers the ritual was done, but they would come back

singing, and halfway down, the drizzle would start. By the time they were back in town, the water [rain] had arrived.<sup>14</sup>

When I asked Pérez why people thought the climate was changing, her reply summarized the divergent views of community members and suggested the effect of outside ideologies on understandings of nature:

It depends upon whom you ask. We *ancianos* [elders] say it is because of the will of god. Younger people say it is because trees have been cut. Others say it is because of the ozone layer.<sup>15</sup>

Pérez also suggested that climate change was due to the religious and moral failings of the younger generation, coming close to a view of nature as powerful and depending on moral behavior rather than the nature degraded by logging described by working-age people.

14. Interview notes, Sra. Pérez, Ixtlán de Juárez, August 6, 2008.

15. This statement resonates with a study by Lazos and Paré (2000), who found that older *Nahua* indigenous people in a community in Veracruz were more likely to believe that degradation was the result of improper relations with nature spirits and that nature was too powerful for humans to degrade it. Younger people were more likely to attribute degradation to deforestation and saw nature as threatened, suggesting that belief in the fragility of nature is the product not only of environmental degradation itself but also of the cultures of modernity and progress.

Although rainmaking rituals are no longer practiced in Ixtlán, they appear to be widespread in other communities in Oaxaca and may motivate local defense of forests. Similarly to the Sierra Zapotec described by de la Fuente in the 1930s, rainmaking rituals are currently carried out in caves and springs and on mountains in the nearby *Valles Centrales* region (M. Rees, unpublished manuscript). In the summer of 2008, the president of San Baltazar Loxicha, a community south of Oaxaca, told me that people continued to carry out rainmaking rituals in his town; I also heard of continuing rituals in the community of Jaltianguis, close to Ixtlán.

#### *Watershed Protection and Industrial Logging*

Between the late 1940s and the late 1980s, the forests of the Sierra Juárez largely ceased to be linked to rainfall decline and water supplies: the Mexican state instead constructed forests as the subject of industrial logging and large-scale flood protection. Industrial logging was organized through concession of logging rights over 139,000 ha of community forests to a logging company, FAPATUX (1956). Significantly, FAPATUX documents make no mention of desiccation theory, justifying industrial logging on grounds of national economic development and the need to prevent soil erosion and forest destruction caused by indigenous farmers (FAPATUX 1956, 11–12). The other state environmental agency present in the Sierra Juárez was the Papaloapan Commission (*Comisión del Papaloapan*), which sought to prevent downstream flooding, first by banning all private logging and then through the promotion of soil conservation practices such as contour plowing and terrace building. Like FAPATUX, the *Comisión* was concerned with controlling soil erosion so as to prevent floods, and official documents make no mention of the effects of forests on streamflow, springs, or rainfall (*Comisión del Papaloapan* 1965; Tamayo 1982 [1954]).

Between 1956 and the cancellation of the FAPATUX timber concession in 1983, *serranos* learned the techniques of industrial logging, gradually mastering the use of trucks, winches, and chain saws and ultimately training community members to take on forest management responsibilities. It is telling of the discursive shift in official representations of the environment that protests against the logging company turned from the accusations of burning, illegal logging, and climate change prevalent during the 1930s to protests over labor conditions and rates of pay during the 1960s and 1970s. The limited documentation shows contending parties referring to forests as economic resources and makes little mention of streams, springs, or climate (*Autoridad Municipal of Yavesia and Others* 1970; Various 1957, 1970). Similarly, during the final struggle to cancel the logging concessions (1980–1983), abundant newspaper reports and documents published by allies of the forest communities made no mention of streams or climate, denouncing the logging companies for pillaging timber and paying community members poorly (Anonymous

1983a, 1983b; Leon 1983; Martínez Luna 1977; Ortega Pizarro and Correa 1983).

Members of forest communities now recall industrial logging as illegitimate and violent, and present-day narratives of environmental degradation and threatened streams convey some of this sense of immorality, injustice, and violence. Throughout the FAPATUX concession period, the various state agencies responsible for forests continued to emphasize erosion prevention and flood control rather than the protection of water supplies, as reflected in the forest management plans applied first by FAPATUX and then by the community itself (from 1983 onward). Partially as a result of pressure from environmentalists during the 1980s, biodiversity and watershed considerations came to have increasing importance, but desiccation theory was never officially supported. When Ixtlán commissioned its first management plan in 1993 (TIASA 1993), the plan contained detailed classifications of watersheds and soil erosion potential. As recounted to me by several people in 2008, it was the community that decided to protect 723 ha of forest specifically in order to protect the town water supply—something not considered in the plan itself.

#### The Underground Streams Resurface: Present-Day Cultural Politics of Forests and Waters in Oaxaca

The pine and pine-oak forests of the Sierra Juárez are owned and logged by forest communities that are currently a global flagship of sustainable community forestry, supported by two consecutive World Bank projects, and widely considered to be one of the best examples of community forest management in the world.

#### *Forest Management in Ixtlán*

I spent much of the summer and fall of 2000 in Ixtlán, accompanying forestry technicians and loggers to the forests and interviewing community leaders and elders in the town of Ixtlán. At this time, the community logging business of Ixtlán employed a forester and several forestry technicians, a dozen two-man logging crews, and machine operators and workers in a timber processing complex and a small furniture factory. This industrial complex employed around 170 people out of a total population of around 2,000 and drew on around 10,250 ha of commercial pine forest out of the 19,000 ha of community forests (TIASA 1993).<sup>16</sup> Community members I talked to regarded the forestry business as legitimate because it was the main economic support of the town, but a significant number were concerned that logging could threaten biodiversity and the town water supply. Community members

16. Much of the community forest is either inaccessible or of the cloud forest or tropical forest types, which contain few commercially attractive species.

repeatedly told me that the community forester would be heavily criticized if he allowed logging near streams and explained that many of them understood the technical details of the forest management plan.

It was common sense among the young forestry technicians who I accompanied to the forests that the elders would not allow this area of forest to be logged because it was “the place where the water is born,” the area of the *veneros de agua* (streams) that supplied the town aqueduct. This was not the same area as the *Pozuelos*, where rainmaking rituals used to be carried out, and none of the half a dozen younger forestry technicians mentioned nature spirits or indigenous knowledge; rather, they saw this as a technical decision that had been made by their seniors. The community elders I talked to about forests and waters similarly never referred to nature spirits; although they recalled former rainmaking rituals at the *Pozuelos*, they justified forest protection on technical grounds. The closest of my older informants, Zenaido Pérez, was a devout Catholic who described the rainmaking rituals as superstition and justified the eventual decision to log watershed forests on technical grounds.<sup>17</sup> Even an elder who believed in the effectiveness of rainmaking rituals explained the protective effect of trees in secular terms, telling me that watershed forests were protected because the shade of overhanging oak branches prevented them from being dried up by the sun.<sup>18</sup> The springs that provided the main town water supply were high on the mountainside to the northwest of town. No one mentioned any religious associations with this area, and the former connection of supernatural entities with mountains, caves, streams, and springs appeared to have been almost completely submerged beneath more recent layers of environmental theories. Nevertheless, the shared memory of predatory logging and environmental degradation, the association of forests and water with high places and springs, and the belief that logging should be controlled to protect water suggest that folk and state environmental theories have linked the observation that rainfall increases with altitude with places connected with water, forests, and springs.

Generalized concern over water supplies continues to be the most likely reason to block logging: conflict over the logging of the watershed protection forests in 2005–2006 caused deep internal dissent. Following orthodox environmental science, the then–community forester tried to convince the assembly that selective sanitation logging would have no effect on water supplies, that trees “sucked” water rather than attracting it, as desiccation theory predicted. As recounted to me in 2008 by various participants in this controversy, opponents of logging sought support from foresters and biologists within the community, seeking the authority of global science in order to question the technical knowledge of the community forester and the economic power of the pro-logging faction. Although the watershed forest was eventually

logged, the authority of the forester was gravely undermined, and he was dismissed in 2007. Community members felt able to question the technical knowledge of outsiders (the forester was not from Ixtlán) by appealing to technical knowledge of their own and by finding scientist allies.

#### *Contemporary Politics of Forests and Waters in Oaxaca*

By 2000–2001, the theory that forests protected water supplies and could affect rainfall was widely shared in the Sierra Juárez and the city of Oaxaca, allowing forest communities to build discursive alliances with urban audiences and institutional alliances with environmentalists. A good example of this is the case of the forest community of Yavesia, about an hour’s drive from Ixtlán, which made use of desiccation theory to build an antilogging alliance with environmental NGOs in Oaxaca. During my time in Oaxaca, I became friendly with members of the environmental NGO *Sierra Norte A.C.*, which was composed of a small group of idealistic young biologists who were opposed to logging and were trying to sponsor forest protection and ecotourism. I spent much time discussing forest protection and logging with Sergio, a young biologist who worked for *Sierra Norte A.C.* Sergio saw all logging as suspect (on one occasion he told me that the only honest forester he knew was the community forester of Ixtlán), and he believed that deforestation had profoundly desiccated the climate of Mexico, including the Valley of Oaxaca. Sergio and his friends at *Sierra Norte A.C.* advised the nearby community of Yavesia in a series of petitions against the logging of its forests, helping community leaders to frame their opposition to logging in terms of biodiversity protection and prevention of climate change (Autoridades Comunes de Yavesia 1999).

The community of Yavesia has been trying to remove its forest land from an unusual pooled ownership structure since the 1950s<sup>19</sup> and, especially, to secede from a communal logging business that many people from Yavesia see as corrupt and environmentally degrading.<sup>20</sup> In a series of documents prepared with the assistance of *Sierra Norte A.C.* and presented in a public forum in 2001, Yavesia accused the logging business of threatening water supplies, rainfall, and streams. The accusations were well designed to appeal to urban audiences in Oaxaca. Yavesia’s leaders claimed that these forests were valuable as a source of biodiversity and water and that deforestation would reduce rainfall and threaten the city of Oaxaca (Municipio de Santa María Yavesia 1999). The belief that the forests of Yavesia were critical to the water supply of the city of Oaxaca was shared by urban environmentalists present

19. Interview notes with Roberto Olivares, legal representative of the community of Yavesia, February 7, 2001, Oaxaca.

20. This unusual pooling of communal lands unites the forests of Yavesia, Lachatao, and Amatlan and is known as the *Pueblos Mancomunados*. *Pueblos Mancomunados* is one of the flagships of sustainable community forestry in Mexico, with modern management plans and its own sawmill (CEMASREN 1999).

17. Interview notes, Ixtlán, August 7, 2008.

18. Interview notes, Bulmero Pérez, Ixtlán, August 7, 2008.



Figure 3. Slogans in a Mexico City park, 2008. “Urgent warning from nature! You cut trees, you steal water! Stop, or you will have drought and death.”

at the meeting, who later told me of the importance of Yavesia’s forests in attracting rain clouds.<sup>21</sup>

In this conflict between community loggers (in Lachatao and Amatlan) and community conservationists (in Yavesia), environmental NGOs provided Yavesia with an alternative alliance that could be used to escape from the institutional connections of the Mancomunados logging business, which was closely affiliated with foresters in the Ministry of Environment, Natural Resources, and Fisheries (SEMARNAP).<sup>22</sup> The biodiversity/water protection faction in Yavesia could not supply the income that industrial logging could, but it could provide a glamorous and charismatic connection that provided an alternative means of linking the forests of Yavesia with national institutions and urban audiences and, possibly, of gaining allies in a decades-long dispute over land.<sup>23</sup>

21. Interview notes, Leo Schibli, SERBO, Oaxaca, January 8, 2001.

22. SEMARNAP is the *Secretaria de Medio Ambiente, Recursos Naturales y Pesca*. After 2001 this became SEMARNAT, the *Secretaria de Medio Ambiente y Recursos Naturales* (Ministry of Environment and Natural Resources).

23. The conflict between Yavesia, Lachatao, and Amatlan continues to take surprising twists, with contending parties making creative use of environmental language and seeking outside allies (see Poe 2006).

As in many other cities in Mexico, water supplies in Oaxaca are a constant concern, and communities around the city of Oaxaca often play on the presumed influence of their forests on urban water supplies, allowing rural communities to build alliances with urban audiences. People in Oaxaca were well aware of this long-standing connection between forests and water: the principal water supply for the town came from the community of San Felipe del Agua, which has historically also been a firewood and charcoal supplier to the city market. Although most of my fieldwork concerned forestry officials and rural people, numerous conversations with people living in Oaxaca revealed a widespread belief that the climate had changed, perhaps as a result of logging and deforestation, perhaps due to pollution. At a national level, the strength of popular belief in the relationship between forests, rainfall, and water supplies has forced officials to emphasize the link between forests and rainfall in public declarations and policy decisions, even as government scientists no longer believe that this is correct. This can be seen in material produced by the *Cruzada Nacional por los Bosques y el Agua* (Crusade for Forests and Water) of the Fox administration of 2000–2006 (SEMARNAT 2006) or the more recent decision to pay forest

landowners for watershed protection services (Muñoz Piña et al. 2008).

*Translation, Mistranslation, and the Building of Alternative Alliances*

Sergio and the environmental NGOs that sought to help prevent logging in Yavesia were trying to build new political alliances between local forests and global climate. In doing so, they translated *and* mistranslated local concerns over the impact of logging on springs and streams into concerns over global climate change and the impact of deforestation on rainfall. As we saw in the epigraphs to this article, this link between global environmental change, deforestation, and declining rainfall forms part of the powerful political rhetoric assembled by environmental activists such as Enrique Montiel and his allies. This is a framing of environmental degradation that is sympathetic to urban Mexican audiences who are concerned about threats to their own water supplies and who have a shared experience of urban environmental degradation.

In moving from local community concerns over environmental degradation caused by logging and the concrete concern to protect streams and springs (*veneros, manantiales*), the environmental NGOs made a translation from locally specific and territorialized concerns to a much stronger link between deforestation, declining rainfall, and declining water supplies for urban residents. This reframing of local interests sought to produce a new set of discursive and institutional relationships that connected a heterogeneous array of actors and scales, from logging practices in the forests, state-level political discourse about urban water supplies and state biodiversity protection institutions, and fears of global climate change, drought, and floods. This reframing appealed to the charisma of the global (*globally* threatened biodiversity and climate) and pointed to the threatened water supplies of the state capital, Oaxaca. These new scales challenged the territorialization of the community logging business that was supposed to be administered by foresters allied with the state natural resources agency, SEMARNAP. Although they could not compete with the economic weight of the logging business, environmental NGOs supported an alternative set of nature and scale-making projects, conservation areas, economic alternatives, and institutional connections. For example, *Sierra Norte A.C.* was involved in supporting a community water bottling business and an ecotourism project in Yavesia and tried to act as an interlocutor with such outside institutions as the National Institute of Ecology.

In addition to deploying desiccation theory and biodiversity, Sergio often used the language of indigenous ecological wisdom and spirituality in his efforts to build alliances with outside institutions. As we have seen, no one in Ixtlán claimed to protect forests in the name of nature spirits: in fact, it was only intermediaries such as Sergio, or even outright outsiders, who made this claim. Sergio was keen to argue that Ixtlán's desire to protect nature arose from the indigenous ecological

knowledge and spiritual beliefs of elders. He told me on my first visit in 1998 that the Zapotec are also known as the "Cloud People" and that the community elders protected "the place where the water is born" because of their spiritual beliefs and concern to protect nature. This was probably a recycling of the international discourse of indigenous ecological wisdom<sup>24</sup> described by Peter Brosius (1997) in Malaysia or by Tania Li (2000) in Indonesia. An intermediary such as Sergio had to be alert to urban and international environmental discourses if he was successfully to engage the interest of outsider institutions and traveling researchers such as myself. Other outsiders who attributed indigenous people's desire to protect forests to religious beliefs included forestry officials in Oaxaca: one of them complained to me in exasperation that it was indigenous beliefs in "water snakes" found on sacred mountains that caused people to block logging in the name of their "famous springs."

Sergio's interest in articulating a discourse of indigenous ecological knowledge marked his own positioning with respect to an international and national discourse about indigenous people as part of the politics of making sense of and claiming control of forests. It is striking, therefore, that people in Ixtlán spoke of the technical reasons for protecting forests and that it was outsiders or intermediaries such as Sergio who spoke of spiritual associations of indigenous beliefs about forests and waters. For the present, it seems that most people in Ixtlán prefer to claim practical knowledge and science, rather than spirituality or indigeneity, as the basis for their knowledge of nature. They have succeeded in domesticating the science of forestry within relatively stable community institutions, and they have been able to build solid relationships with outside institutions such as SEMARNAT. For now at least, in Ixtlán, popular science trumps spirituality and indigenous ecological wisdom. However, this is the product of a specific articulation between local practices of nature making through logging and marking stand boundaries, community forestry institutions, their identities as forest managers, traveling scientific theories, and outside institutions. It is perfectly conceivable that broader discursive and institutional shifts would bring to the fore specifically *indigenous* knowledge within Ixtlán.

## Conclusions: Popular Desiccation Theory and State Science

In this article I have drawn on the classic ethnography of Julio de la Fuente to argue that in the Sierra Juárez of Oaxaca, the encounter between state and indigenous environmental theories during the 1930s produced a dramatic transformation in popular understandings of the relationship between forests,

24. The international discourse about indigenous ecological wisdom is strikingly vague and tends to spiritualize indigenous ecological knowledge: it is therefore quite different from actual indigenous ecological knowledge (see in particular Brosius 1997).

springs, and nature spirits. The currently popular belief that deforestation causes declining streamflow and rainfall combines former state environmental theories with preexisting indigenous theories about the relationship between mountains, forests, nature spirits, and waters. Although nature spirits are no longer much discussed in Ixtlán, ritual practices of rainmaking on mountaintops and in caves appear to be widespread in other parts of Oaxaca and possibly in other parts of Mexico. It seems likely that the former association of spirits of water and rain with forested watersheds made desiccation theory attractive to Zapotec people and explains why these theories were so rapidly accepted in the 1920s and 1930s. For a long period between around 1940 to 1990, desiccation theory made little appearance in environmental politics, as the scale-making projects of industrial forestry made deforestation and labor conditions of more importance to *serranos*. Increasingly, since the early 1990s, desiccation theory has provided a means of critiquing state forestry and building alliances with other places, people, and scales. *Serranos* have combined the formerly state-sponsored scientific theory of desiccation with preexisting indigenous beliefs about the relationship between forests and waters; these theories inform present-day practices of forest management and streamside protection during logging.

A key reason for the stability of popular desiccation theory at present lies in its ability to build connections and to reach faraway places and audiences. Just as desiccation theory facilitated former state efforts to control remote forests, it now helps rural people resist the state and find urban allies. The public performance of desiccation theory performs a network that asserts global significance and can reach urban audiences. From its earliest days, desiccation theory has been vague as to exactly which scales of deforestation would have negative effects; the precise scale is specified in the routine practices of daily work in the forests (protecting streams, areas of forest) and in incipient institution building through the construction of political alliances. Activists and rural people can form networks of alliances between local natures and new environmental and development institutions, in order to destabilize dominant scales and forms of nature (such as forests to be managed for timber). It is precisely the vagueness of desiccation theory that allows it to appeal in different ways to rural people (who worry more about streams), environmentalists such as Sergio (who worry about biodiversity and climate change), environmental activists such as the Montiel brothers, and urban audiences who worry more about water supply and climate change. There are numerous translations and mistranslations across the networks that support representations of nature. In this sense, it is *vagueness* and mistranslation that make alliance building possible (Van der Sluijs, Shackley, and Wynne 1998) and that have come to cement popular beliefs into a relatively stable construct that is quite impervious to state critique.

Popular beliefs in climate/forest connections in Mexico are of more than local significance; they structure the texture of

encounters between state and civil society, they affect the ways that scientific knowledge and expertise are asserted, contested, or denied, and they alter understandings of the very nature of state power. Existing studies of popular beliefs about climate tend to concern themselves with local weather prediction techniques or local climate knowledge (Goloubinoff, Katz, and Lammel 1997; Orlove, Chiang, and Cane 2002) or with the likely impacts of climate change on “local societies.” However, beliefs about climate and local environments have distinctly extra-local political effects. As numerous scholars have pointed out, local places and scales are produced in relation to other places and scales (Jasanoff 2004a, 58; Tsing 2000); these affect the forms of political engagement in which people will engage. Stands of timber in Ixtlán are linked to the forest service in Oaxaca and then to the national level; it is the existence of these multiple scales that allows for political alliances between urban audiences, environmentalists, and rural institutions. Further, local beliefs about climate are critically important because they encode powerful framings of expertise, science, and state, enabling “local” people to form extra-local alliances that destabilize the credibility and authority of state forms of knowledge and power.

The discourse of desiccation has traveled far in time and space—from Doctor Azov in Chekhov’s *Uncle Vanya*, to environmental activists such as Montiel, to the mayor of Ixtlán. Are we to see this as the imposition of a state environmental discourse on the subjects of rule? Foucauldian understandings of power would perhaps emphasize that although there is contestation, the deep structure of epistemes nevertheless tends to strengthen states and bureaucrats over indigenous people and peasants. Similarly, discourses of indigeneity represent Western imaginings of the “other”—and various authors have worried that indigenous peoples’ appropriations of indigeneity may give too much power to extra-local actors, who retain control of conceptions of modernity (Brosius 1997; Conklin and Graham 1995). Like discourses of indigeneity or modernity, discourses of desiccation have an ancient pedigree; desiccation discourse has remained remarkably unchanged over the past 2,000 years, and it too has often been deployed by states against their subjects. However, an overly discourse-centered approach may pay too little attention to local constellations of institutions, discourses, identities, and practices of producing nature, of building new alliances and forms of knowledge. Peoples’ adoption of desiccation discourse in the Sierra Juárez and in other parts of Mexico does not necessarily indicate state domination, nor does it necessarily make people in the Sierra Juárez vulnerable to outsiders’ development projects. On the contrary, in this case it marks a claim for popular scientific knowledge that undermines state knowledge and expert authority.

State or international climate change science and policy will not encounter passive local subjects: on the contrary, they are but the latest entanglement between traveling theories, fractured states, and continually shifting alliances of humans and nonhumans. As Sheila Jasanoff (2005) points out, socially

accepted knowledge is the product of practices of participation, deliberation, and representation. The texture of state-society relations profoundly affects the status of knowledge, the legitimacy of the state, and the credibility of official knowledge claims. In Mexico, existing framings of the state as corrupt, of water supplies and forests as threatened, and of official knowledge as untrustworthy will be brought to bear on future policies. It would be easy to think that climate change is a global science, a discourse that will remain in the hands of distant officials who will seek to impose it on more or less passive local actors, who at best will receive or reject state science. I suggest, on the contrary, that the travels of desiccation theory into the environmental politics of waters and forests in Mexico show how people who produce new local natures are also engaged in producing new forms of state power and in building alliances with distant outsiders. If forest protection policies inspired by fears of climate change are to be relatively stable and legitimate, they will have to confront popular understandings of states and of forests, of institutions, and of streams and waters.

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## Comments

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Andrew Mathews’s paper offers an extremely insightful exposition of how a global alliance comes together through—not despite—cultural, epistemological, and geographic difference. Catalyzing this coalition is an object (Mexico’s forest and trees) and a loose concept (linking the cutting of trees

with negative impacts on water, the drying of streams, and the cessation of rainfall) through which that object comes to straddle the social worlds of forest dwellers, urban environmentalists, global environmental activists, and more. Through this wide-ranging analysis of cultural encounter, historical change, translocal alliance, and the scaling of political claim and community, Mathews pushes us to think about science and government together, attending to the ways forest management became a mode of state making and rural subject definition while at the same time being careful to show us how those who are ostensibly made subjects of the state and its sciences of government in fact recast its idioms in generative ways. The paper is backed by rich evidence, including Mathews’s detailed account of the rise and fall of Quevedo and his desiccation theories; moments from the archive showing how, after encountering Quevedo’s forestry officials, forest communities came to adopt their desiccation discourse to involve the state in land disputes accusing their rivals of endangering local water supplies by cutting trees; and ethnographic accounts wherein Mathews realizes to what extent community foresters in Ixtlán regard the forest as crucial to the protection of water.

Mathews self-consciously presents his analysis through an encounter narrative: a precontact image of Zapotec beliefs about nature spirits gleaned from a classic ethnography, another precontact image of Quevedo’s beliefs and policies, the resulting cultural change among Zapotec people, and the unexpected afterlife of such change in which the very cultural forms of state science imparted to Zapotec people a half-century ago become tools in current struggles against state authority. In fact, the analysis works through several encounters. There is the midcentury encounter, where Quevedo’s forest scientists meet forest communities. There is the encounter in 2001 between Mathews and a state biologist on the one hand and community members in Ixtlán de Juárez on the other, in which community members easily differ with their visitors’ efforts to convince them that cutting down trees will not threaten their water supplies, prompting Mathews to muse, “Why did locals so tenaciously and politely defend environmental theories that were contrary to the accepted scientific point of view? And how did they feel authorized to contest the authority of science?” And, finally, there is the encounter between forest communities and environmentalists from urban Mexico, in which they find common ground in the equation between forest protection and the protection of weather/climate but where the urban environmentalists mistakenly attribute forest communities’ care for the forest to a concern for nature spirits when in fact they typically cite technical explanations.

The theme of encounters, and the power-laden contexts they reflect and generate, is crucial for any analysis of the effects of state science, not to mention studies of global environmental activism. But I wonder whether there is inadvertently threaded through Mathews’s rich account of meanings and politics that are made in encounter an asymmetry—

one built into some of its idioms of description and analysis. Is there implicit in such terms as “belief” and “mistranslation” an opposition between falsity and truth, one in tension with the thrust of Mathews’s larger critical project? Mathews has critical arguments to make about asymmetrical relations between state science and local knowledge, about the remarkable capacity of local communities (including forest dwellers and urban activists) to contest the scientific claims made by industrial foresters, and a nuanced tale about how alliance occurs that exceeds the idea of what we find to be simply common ground in some transparent way. And, yet, the very terms with which the paper distinguishes the emergent knowledges and political forms in question risk marking them, negatively, as mistakes. Certainly they are, from the point of view of the environmental scientists Mathews knows. But might the scholarship in science and technology studies cited by Mathews suggest that the very spaces of scientific consensus are themselves constituted through mistranslations and loosely compatible projects? I pose the question sympathetically—I share these challenges in writing about the politics of knowledge in environmental arenas. How might we write a bottom-up history of alliances such as this, an account of the things different people know and say about trees, rain, air, and climate and the ways these generate new modes of alliance and scale, as well as knowledges other than scientific consensus, without a connotation of lay mistake?

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**Michael R. Dove**

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When I first carried out fieldwork in the interior Kalimantan, Indonesia, in the 1970s, I was told a story of a cockfight (a traditional method of dispute settlement) that had been fought between tribal elders and the first generation of government-schooled boys, to settle a debate over where rain came from: the former said that it came from the sky, while the latter, based on the theory of the hydrologic cycle that they had acquired in school, insisted that it came from the earth (the latter lost the cockfight!). Mathews’s wonderful article deals with a similar confrontation between modern and premodern theories of weather and climate, at the same time that it challenges our understanding of these theories. Studies such as this by anthropologists are sorely needed today, given the enormous and ever-increasing attention both within the academic world and in the public at large to the issue of global climate change. To date, most observers of the field agree that scholarship on global climate change has been marked by the relative dearth of contributions by social scientists, including anthropologists. Mathews’s article is an excellent example of how anthropology can contribute and can

do so by playing to, but also challenging and transcending, its traditional strengths.

Mathews begins with an ethnoclimatological analysis of indigenous, non-Western views of deforestation, groundwater, and climate in Oaxaca, but then he goes on to reveal a more complicated picture. Whereas the indigenous Zapotec of the Sierra Juárez formerly had rainmaking beliefs and rituals, today they have a theory of “desiccation,” which links deforestation to the drying up of surface waters and the diminution of rainfall and is invoked by them to argue against logging. The original source of this theory was the Mexican state itself, which had promulgated it early in the twentieth century only to move away from it by midcentury just as the folk theory of desiccation began to take hold. Today the most ardent proponents of indigenous “spiritual ecology” are metropolitan elites who are retrieving and reviving these beliefs in their efforts to combat logging. Over time, therefore, there has been a partial exchange of positions between local and extra-local actors.

Mathews analyzes how climate theories change through time, how they circulate across the landscape, and how they articulate (or not) with the belief systems of potential recipients. Scientific desiccation theory was adopted by both native and urban audiences at the same time that it was falling out of favor with its original forestry/science proponents, and indigenous beliefs were adopted by the environmentalist/NGO audience at the same time that they were disappearing in native communities. The study of these shifts is a new type of historical project for anthropology, a history not just of the environment but of environmental beliefs and theories. It is made possible by Mathews’s robust combination of fieldwork, archival research, and engagement with both policy and activist communities.

The specter of global climate change is already being deployed by the Zapotec communities in their efforts to limit logging. This is the coming face of the lived, local-level reality of climate change: namely, its discursive incorporation into ongoing contests and collaborations between communities, forestry departments, interested urban publics, and environmental and community advocates. This ideological dimension of climate change has received some attention at the global level (e.g., Adger et al. 2001), less at the national level (e.g., Lahsen, forthcoming), and none at all at the local level, as here. Local-level studies of the implications of climate change have focused on its impacts on agriculture, health, and natural hazards (e.g., Eakin 2006) but not on political discourses of climate, changes, causes, and culpability. Understanding this latter set of impacts will be key to designing successful interventions in local systems of adaptation to climate change.

One challenge in designing such interventions is how to deal with nonorthodox theories of climate change, such as the folk Zapotec theory of desiccation. General consensus regarding the seriousness of the threat facing humanity, some sort of “ethnographic refusal” (Ortner 1995), seems to govern treatment of dissent in international academic discussions of

climate change (cf. Latour 2004b). But it is less clear what should be done at the local level. Mathews shows how the Zapotec put to constructive use the now-discredited theory of desiccation. In this way, among others, Mathews helps to expand the horizons of what research lies ahead for us in studying the looming question of the twenty-first century: how will climate change, how will our understandings of climate change, and how will these two sets of variables interact?

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### Tim Forsyth

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The beauty of Andrew Mathews's ethnographically rich examination of science and politics in Oaxaca, Mexico, is that it provides a much-needed demonstration of how scientific "facts" are not universal truths somehow separated from society but instead are shaped and upheld by social solidarities who use scientific discourses to enhance other political contests. Mathews's distinctive contribution to this debate is to provide a valuable case study where an "epistemic alliance" has emerged between unlikely actors to uphold desiccation theory and to demonstrate—in complex ways—how these actors have transformed simplistic statements about forests and rainfall into "convenient truths."

I would still like to question Mathews on two points. First, the paper tends to portray desiccation theory as a fixed item that different actors use for political purposes. (For example, the state used it for rationalizing local behavior some decades ago; local people now use it to gain legitimacy and support from the state.) I propose that this is not always so. The "theory," or its proposed factual accounts of nature, reflects the alliances that uphold it and consequently transforms according to local contexts. In Oaxaca, Mathews tells us that today's context is largely a moral concern about logging from people negatively affected by it. According to research in other contexts, these concerns might be, say, reforestation or resettlement, and accordingly, the "theory" is not necessarily the same in each location because different concerns or constellations of actors influence which "facts" are used to serve politics. As with so-called Himalayan environmental degradation theory (another scientific discourse critically examined by anthropologists), the word "theory" invokes an image of universality, yet the crucial lesson is that such things are not universal.

This observation is important because it influences how state–society relations occur or how science evolves as politics. Should we see state–society engagement in terms of different actors (or nodes of power) looking for tools (in this case desiccation theory) to strengthen their battles with each other? Or is power best understood in more prevalent and shifting terms—in the manner of Foucault—where actors themselves

are shaped by the discourses and tools they adopt? In the case of Oaxaca, community leaders invoke desiccation discourses to seek alliances with the state and to empower themselves against logging. Yet choosing this discourse also forecloses other activities (including forms of agriculture or forest clearance) for local people, even though these activities might not be as environmentally damaging as the discourse implies. Empowering a dominant scientific discourse such as desiccation theory might therefore risk adopting one set of benefits at the same time as some restrictions.

The second point follows from this discussion. What is the best way to rethink science–society relations? Mathews uses the words "translations and mistranslations" to refer to how "popular science" might be similar to or different from accepted explanations from hydrological science. I suggest that this frame overlooks the shifting way that knowledge is made authoritative. It also implies, optimistically, that political debates one day might converge on the accepted authority of hydrologists as the best available indication of how forests and climate are really linked.

Again, I suggest that the power of the scientific discourse is stronger than Mathews proposes and that the work of hydrologists—excellent within their own contexts—can still be linked to social solidarities. More work needs to be done on how and why different truth claims about hydrological explanation emerge as politically authoritative rather than just on how different actors use these discourses. For example, Mathews writes that "governmentalizing discourses require concrete institutions . . . discourse alone is insufficient to inculcate state ideologies." Yet, to my mind, when actors present desiccation theory as a universal truth (even though it shifts between contexts), this effectively makes it a "concrete" institution. Consequently, I suggest that there is still a need to understand scientific discourse as a mobile source of political authority and as a disciplining force in its own right.

The wider point of my comment is that scientific statements (whether from formal science or within popular narratives) are more powerful and more contingent on political action than commonly thought. Dissecting these truth claims, to demonstrate the contingency of values, political agency, and science, offers the opportunity to address social inequalities arising from unexamined discourse and the chance to understand environmental change better. Mathews's paper demonstrates various reasons why discourses are upheld in ways that do not make them transparent. This is an important lesson. More effective environmental policy, arguably, might need to consider why—and on whose authority and values—scientific statements might be considered true. Such a process might not only challenge popular discourses such as desiccation theory but also allow hydrologists to learn.

In my view, Mathews's paper is a useful contribution to understanding the dynamics of how biophysical explanations of environmental change are reified and amplified through political conflicts. Power is both located in and expressed by scientific discourse. Mathews's combination of local ethnog-

raphy and concepts from science and technology studies is both useful and timely.

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**David Kaimowitz**

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The central tenets of Andrew Mathews's paper, which say that different social actors adopt scientific narratives to meet their own needs and that local actors do not simply incorporate state-sponsored or global discourses but rather shape them to suit their purposes, are undoubtedly true. Nor can there be much doubt that discourses about the complex links between vegetation and water present an excellent example of this.

Just about everything Mathews says in this paper has some truth to it. Nonetheless, in various instances he takes his argument too far to make his point. Specifically, he overstates the extent to which current conventional scientific wisdom has discarded desiccation theory. It is probably more accurate to say that the current consensus is that the impact of vegetation on rainfall, dry season streamflow, and flooding is likely to be very location and scale dependent. Consequently, there are probably many contexts in which deforestation or logging has little or no impact on rainfall, dry season streamflow, or flooding or in which it actually increases the first two of these. On the other hand, there are probably other situations where the opposite holds. Mathews may underestimate the extent to which these latter situations provide empirical evidence that reinforces the existing belief systems. Even though deforestation and logging probably have little or no impact on large-scale floods that cause massive damage to large areas, they probably can, in fact, significantly contribute to small-scale flooding. Similarly, growing evidence suggests that relatively small-scale changes in land use influence precipitation patterns more than previously believed. Mathews says that whether desiccation theory is false is not really central to his argument, but that is not entirely true.

Similarly, the paper fails to consider the possibility that one major reason that people have come to believe desiccation theory is that, in many regions, declines in forest cover and quality have occurred contemporaneously to declines in the streamflow and the availability of water. In many, if not most, of those cases, it is likely that other factors explain the declining supply of water—such as greater competition for water by various types of upstream users. This provides potential alternative explanations for communities' thinking beyond those offered by Mathews.

Mathews also overstates his argument that government officials and the forestry science establishment in Mexico have abandoned desiccation theory. Many Mexican government officials, professional foresters, and academics continue to actively believe and promote this theory in their public state-

ments, and that no doubt also helps reinforce local communities' beliefs in those theories. Less than five years ago, the Mexican government adapted a program to pay communities to conserve forests so that they would continue to provide hydrological services such as the ones Mathews says do not exist—so these ideas are by no means dead within the Mexican government. (However, it should also be acknowledged that there are groups within the Mexican government that do not believe desiccation theory but nonetheless continue to espouse it or keep quiet because they feel it is politically expedient to do so.)

The two examples Mathews discusses of Yavesia and Ixtlán demonstrate the complexity of these processes. In Yavesia it is relatively evident that adopting desiccation theory has helped local groups who oppose logging, who do not want the larger territorial authority of which they are part to dominate them, and whose positions help them to obtain prestige and material benefits, to justify their positions and find urban and international allies. On the other hand, in Ixtlán desiccation theory actually makes life more complicated for a community whose livelihoods depend largely on logging and wood processing, yet, nonetheless, they have not abandoned it, despite the fact that they sometimes lose income as a result. So it is clearly more complex than simply being a matter that the communities adopt these views to meet their immediate interests.

Mathews's paper addresses important issues, makes relevant arguments, and provides useful data. I just would not take it too far.

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Political ecologists, among others, have made it their business to demonstrate how governments have a tendency to use outdated, debatable, or mistaken scientific theories to justify interventions in environmental management, generally to the detriment of the resource access rights and livelihoods of rural farmers or herders (Fairhead and Leach 1996; Laris 2004; Forsyth and Walker 2008; Kull 2004). While attentive to peasant resistance, few political ecologists aside from Andrew Mathews have investigated the ways in which rural communities may make use of such scientific theories themselves, particularly ones that scientists deem no longer valid.

The theory the rural Mexican community Mathews studies has latched on to, desiccation theory, is popular in many places around the world (both in the public and in governments) and is very relevant to policy, given global and regional concerns over water supply. For instance, desiccation theory lies behind ideas of "desertification" in the Sahelian zone of West Africa, helping to inspire interventions such as fire bans and green belts (Laris and Wardell 2006). It is called on, in

one way or another, to justify forest conservation or tree planting, usually by the state, with attendant controls on local access. That a rural community is using it to its own advantage demonstrates the way in which a decade or two of “community-based natural resource management” has, in some places, turned the tables.

One of the few countries where desiccation theory is popularly held to be false (in accordance with most hydrological studies) is South Africa. Here, vast stands of eucalypts, pines, and wattles are accused of reducing streamflows by almost 7% (Le Maitre et al. 2002). Arguably, a key reason that scientists were able to turn the public against desiccation theory was the presence of another ascendant narrative, that of “invasive alien” species. Almost all forestry species in South Africa are introduced; several are declared invasives, and they have demonstrable impacts on fire regimes and on the biodiversity of the grassland and fynbos communities they replace. This case shows that popular narratives about the place of trees in landscapes is shaped not just by hydrological theories but also by ecological concerns that in many cases bleed into social sentiments about plants belonging (or not) in particular places or, for that matter, in particular national identities (Head and Muir 2004; Kull and Rangan 2008).

The way in which Mathews brings scale into this analysis is intriguing. He demonstrates that desiccation theory works because it allows for the building of links between actors operating at different levels of governmental or environmental scales (i.e., between villagers concerned with their forests, city dwellers concerned with their water supplies, politicians concerned with their national environments, or environmentalists concerned with the global environment). He points out how desiccation discourse aids villagers in taking the thunder away from powerful forestry interests located at a particular level of institutional and environmental scale. Yet he also asserts that different actors, such as Sergio and the environmental NGOs, used desiccation discourse to reframe local interests together with urban and global ones to make “new scales.” I am unconvinced by this language, as well as that of “scale-making projects.” Humans do create scales through their institutions and observational methods (such as municipalities-districts-provinces, communities-ecosystems-biomes, or pixels and quadrats). Yet the moments Mathews alludes to seem to me not to be scale-making projects but instead projects to *translate between* extant levels of scale or projects that *highlight* particular levels of scale by attaching values to them or making them particularly powerful. Industrial forestry or NGO campaigns, in this case, have not made new scales; instead, they place value on certain processes and certain categories that already sit at particular levels of scale.

Discourses such as desiccation theory can be seen as vehicles that allow us to translate between the ontological scales at which social and natural processes occur and the epistemological scales that humans create to order, control, and analyze these processes. They are ways in which people seek to make sense of the world and to communicate sensibilities

over changes to social and ecological landscapes. By invoking normative judgments, they also politicize such changes (Rangan and Kull 2008). Mathews has shown how the desiccation discourse is mobilized to assert control over forests and how it flexibly allows villagers to seek allies with other actors working at different political and environmental levels of scale. What remains to be seen is whether and how villagers, their NGO allies, and the discourse itself can adapt in any way to the competing idea of “trees as water suckers,” which has become prominent in South Africa. On the basis of that comparison, one might expect a turn toward the ascendant discourse of nativism—as in protecting native biodiversity—as the next way in which communities defend their forests. Can the nature spirits, the *dueños del cerro*, be mobilized to support this discourse, as for desiccation theory?

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#### Andrew Walker

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Andrew Mathews’s is an engaging and historically rich account of the role of desiccation theory in local and national debates about forest management in Mexico. Mathews shows us that indigenous activists in Mexico have been able to use desiccation theory to form discursive and practical alliances with conservationists, NGOs, and urban residents in various campaigns against industrial logging. The idea that cutting down forests reduces rainfall and streamflow has been around in Mexico, and elsewhere, for a very long time. What Mathews demonstrates is that desiccation theory flows in and out of environmental debates according to specific intersections between actors, institutions, and nature itself. He does this by productively following links that take him, spatially and temporally, well away from his primary field site in the southern Mexican town of Ixtlán. It is a fascinating journey.

Mathews’s examination of the historically uneven contribution of desiccation theory to the forest policies pursued by various Mexican governments is an important contribution, but I have a more general reservation about his treatment of the state. Like many of the writers he cites, Mathews is aiming for a more fragmented and flexible approach to the state. He aims to explore the locally specific mixes of discourse, coercion, and performance that “produce new identities, political practices, and forms of knowledge.” This makes a lot of sense. However, to my reading, Mathews persists with a binary model that pits states against subjects. Of course, he goes to great lengths to show that the forest dwellers of southern Mexico are far from passive subjects. Popular desiccation theory itself emerged as an amalgam of state policy, science, and local ideas about nature spirits, mountains, and springs. This is a nuanced account of the unruly middle ground of state

formation. But too often the discussion slips into more simplistic statements, whereby local knowledge and practices “undermine,” “bypass,” “penetrate,” “contest, subvert, or evade,” “critique,” “destabilize,” and “resist” state power. I have no doubt that some forest management disputes involve specific confrontations between readily demarcated “local” and “state” interests, but I would have liked to have gotten a stronger conceptual and ethnographic sense of the interpersonal domain in which officials, loggers, farmers, community leaders, and NGOs negotiate policies and play with different forms of environmental knowledge.

The “local” and the “popular” could also have been addressed with more critical precision. At some points the paper gives the impression that popular desiccation theory is widespread in the places where Mathews worked. But I did not get a clear sense of just how widespread and locally influential it is. I had a lingering feeling throughout the paper that this was a theory most actively (and selectively) promoted by “indigenous community leaders” and, in particular, their allies in urban-based NGOs. Whose knowledge is this? Mathews takes up this issue by referring to “translation and mistranslation” of local environmental concerns by NGO activists. The “mistranslation” is most evident in NGO framing of desiccation theory in terms of indigenous beliefs about nature spirits. Mathews tells us that such beliefs now have very little local currency. Nevertheless, he is sympathetic to the “skillful” NGO linking of local beliefs to international discourses about “indigenous ecological wisdom,” and he seems keen to contribute to the process by uncovering remnants of spirit belief and rainmaking ritual. He suggests that more specifically “indigenous” forms of local knowledge may emerge in the future.

I would have appreciated a more critical engagement with this sort of mistranslation, “reframing,” and, perhaps, misrepresentation. Mathews clearly shows that there are active local disputes about the costs and benefits of logging, and presumably quite different forms of knowledge are deployed in these disputes. But his priority focus is on the desiccation alliance between “indigenous leaders,” NGOs, and urban residents on the basis that it enables “forest communities” to promote forms of knowledge that “destabilize dominant scales and forms of nature.” But what are the local social and political impacts of these sorts of alliances? Logging, in its various “industrial” and community-based forms, clearly has its local opponents, but what about its role in supporting local livelihoods? Mathews indicates that the timber industry employs a substantial percentage of the workforce of Ixtlán. What do these workers think about the promotion of desiccation theory? Are they comfortable with the alliances between local “leaders” and NGOs? Who do the “leaders” lead? And, as Mathews demonstrates, environmental arguments directed against industrial logging can also be readily deployed against farmers, especially those who opt for the more commercial forms of agriculture that many conservation-oriented NGOs find distasteful.

Mathews has done an excellent job of exploring desiccation

theory across various spatial and temporal scales. But the local scale and the micropolitics of environmental debate in divided “communities” could have received more critical attention. Unlikely alliances can also be high-risk ones.

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## Reply

I thank the commentators for their generous and thoughtful comments. I have learned a great deal from the variety of readings that they have given my arguments and from the additional directions that they suggest. My response is necessarily selective: in what follows I have linked themes that were touched on by several readers, followed by my response to more specific points. I have grouped their remarks into discussion of (1) translation/mistranslation, (2) the empirical validity of desiccation theory, (3) states and communities, and (4) the power of publics.

*Translation/Mistranslation.* “Translation” and “mistranslation” are dangerous and powerful words. As Choy insightfully points out, their connotations of a binary between truth and falsehood are at odds with my larger critical project. Similarly, Forsyth worries that I see popular science as a “mistranslation,” implying an eventual possible clarification or unification when the authority of hydrologists is finally accepted. Walker too wants more detail on the translations/mistranslations carried out by local NGOs and leaders, probing a little to see whether these might be opportunistic misrepresentations.

I should perhaps have avoided “mistranslation” entirely and accompanied the linguistic sense of “translation” with metaphors such as “weaving,” “entangling,” and “transforming.” I had thought of translation/mistranslation not in terms of truth and falsehood but in terms of the frustrations and pleasures of translating, the perennial sense that the translation betrays our best efforts and intentions. My goal was to highlight how environmentalists engaged in a productive weaving and braiding of epistemic alliances. When I say that NGO representatives “skillfully” translate and mistranslate, my intention is to highlight the practical knowledge and political judgment they use, not to accuse them of intellectual dishonesty. We do not think it dishonest of scientists to weave together material and political alliances to support their facts, and I do not think environmentalists and community leaders are dishonest for doing so either.

Within science and technology studies, translation is used in both a linguistic and a spatial sense, where actors seek to “cut” the networks supporting competing forms of knowledge and to translate allies toward their own preferred interpretations (Callon 1986). Translation, then, is creative and always provisional: “Translating interests means at once offering new interpretations of these interests and channeling people in different directions” (Latour 1987, 118). This sense of trans-

lation is not of a true/false opposition, describing rather the creative practice of making knowledge, persuading people, and finding material allies. Translating, blurring, and transforming meanings are activities carried out by environmental scientists (Van der Sluijs, Shackley, and Wynne 1998) and are not the actions of politically motivated environmentalists or misguided rural people. In these accounts, translations are incomplete; they are acts of knitting, weaving, and tying together that are in a final sense provisional and open to challenge or unweaving.

*On the Empirical Validity of Desiccation Theory.* A number of the commentators are concerned that I imply that the knowledge of environmental scientists is correct, while that of environmental activists and rural people is incorrect, and that some future unification at the expense of rural people is to be hoped for. Forsyth and Choy were both, in different ways, worried that my usage of the term “translation” implied a lay mistake, that popular belief in desiccation is a “mis-translation” of state science. I want to link these concerns constructively to Kaimowitz’s concern that I do not consider “the possibility that one major reason that people have come to believe desiccation theory is that, in many regions, declines in forest cover and quality have occurred contemporaneously to declines in the streamflow and the availability of water.” I disagree with his immediate point, but I think that he has put his finger on the larger structural question of how we should write and think about the natural sciences, a question that is central to this essay and to environmental anthropology and anthropology of science and technology more generally.

First on where we disagree: I do not think that it makes Zapotec peoples’ knowledge about forests and water scarcity either more or less empirically correct when I point out the long historical and cultural history of desiccation theory and the particular contingencies that brought it to the Sierra Juárez. This is the difference between “explaining” and “explaining away”: all people everywhere, including hydrologists, bureaucrats, and farmers, bring culture and history to the making of knowledge. By linking history and culture to local peoples’ understanding of forests, I seek to add rather than to subtract, to explain *how* people believe in desiccation theory without explaining it away as a product of discourse, class, institutions, culture, or economic interests. Latour (2004b, 246) suggests this approach when he remarks: “The critic is not the one who debunks, but the one who assembles. The critic is not the one who lifts the rugs from under the feet of the naïve believers, but the one who offers the participants arenas in which to gather.” If rural people note water scarcity and blame it on deforestation rather than on construction, development, and increased water abstraction, this does not undermine the validity of their experience and knowledge of water scarcity.

My project in this essay was not to compare the “good knowledge” of scientists with the “bad knowledge” of others but to show how people with different kinds of knowledge go about forming alliances. I am asking not “Is this true or

false knowledge?” but “What kind of knowledge is this, and how was it produced?” This directs analysis toward who holds knowledge and the kinds of practices, material relations, institutions, alliances, and networks that hold their knowledge together and give it its particular heft and meaning. In this sense, I agree with Kaimowitz when he says that the empirical validity of desiccation theory does affect my argument. I should have spelled out the material, cultural, and institutional location of current hydrological research more clearly, in order to avoid the appearance of comparing the solidity of scientists’ knowledge with the illusion of rural beliefs in desiccation. This is what Forsyth calls for when he says that we need more work on “how and why different truth claims about hydrological explanation emerge as politically authoritative.”

Kull correctly situates my work in conversation with political ecologists and anthropologists who have described how governments use “outdated, debatable, or mistaken scientific theories” in order to assert control and claim resources from rural people. Valuable and politically important as this body of work is, it can have a flavor of debunking official knowledge in favor of the critic’s “better knowledge,” of comparing the bad ecological or hydrological knowledge of certain states or institutions with the critic’s own rather better, more up-to-date ecological knowledge. Often, such criticisms are “unmasking critiques” that reveal that the apparently technical is really a mask that reveals various forms of material and discursive domination. Although I did want to introduce readers to hydrologists’ rather surprising lack of agreement with desiccation theory, my larger project was not to engage in a “debunking” of Mexican state science or popular belief. I am concerned not with describing discursive domination but with tracing transformations in official and popular environmental theories over the twentieth century. I have tried to move beyond understandings of scientific knowledge as an authoritative discourse that is homogeneously shared by officials who seek to impose state power, focusing rather on the contingent and unexpected ways that scientific theories are mobilized and applied to new places and produce new kinds of knowledge and new forms of political alliance and opposition. Here, Kull’s comparative examples from Africa (a region about which I know little) are particularly helpful, emphasizing that knowledge of the relationship between forests and climate is stabilized not just by hydrology but also by its articulations with ecological science, social sentiments about plants, and even national identities.

Kaimowitz is concerned that I overstate the extent to which current scientific thinking has discarded desiccation theory, pointing to recent studies that show that relatively small-scale changes in land use influence precipitation patterns more than previously believed. There is no last word on the relationship between deforestation, floods, and climate, and I defer to his account of the latest research (see Bonell and Bruijnzeel 2004; Kaimowitz 2004). However, I suggest that the fervor and determination of scientists’ continued search for a relationship

between forests, climate, and floods is partly a product of their cultural, political, and institutional locations. After more than a century of research, the results are startlingly contradictory; hydrologists and other researchers might not have continued in the face of so much contrary evidence if their questions were not guided partly by cultural commitments. This does not in any way undermine the empirical validity of hydrological science. No one thinks that America's cultural love affair with the motor car weakens the quality of amateur car racers' mechanical knowledge; no more should we think it a scandal that cultural commitments to a relationship between forests and climate affect hydrologists' research decisions.

Kaimowitz and I agree that there is some disagreement about desiccation theory within official and scientific circles in Mexico. He sees more scientific agreement with it; I see rather less. I agree with him that many (perhaps most) policy makers in Mexico affirm some version of desiccation theory; I suggest that this is partly because they are attuned to the beliefs of popular audiences, who emphatically do believe in some form of desiccation theory. There is, in contrast, much difference of opinion in scientific circles: it is not so much that desiccation theory is entirely discarded as it is that some scientists hold very much qualified and transformed aspects of it and that they do so with considerable qualification and much debate. I should add, however, that foresters almost unanimously and rather strongly regard desiccation theory as false and are willing to openly state that rather than attracting water, trees suck it out of the ground.

In this regard, it is helpful to compare the fervor, confidence, and unity of policy makers and scientists during 1930s with the more nuanced position of policy statements in the present. Although forests are firmly linked to water in national policies such as the *Cruzada Nacional por los Bosques y el Agua* (Crusade for Forests and Water), to which I briefly referred, the scientific explanations on the *Cruzada* Web pages emphasize that forests assist water infiltration into the water table and that forest soils "absorbed four times as much rain as pastures, and eighteen times as much rain as bare soil" (SEMARNAT 2006). The link between forests and rainfall that was so clear in the 1930s is now much muted: in an illustration on another page, the *Cruzada* claims that "the freshness of forested areas attracts rain and protects the soil" (SEMARNAT 2006). The composers of the *Cruzada* pages had to juggle their commitment to current scientific thinking, in which forests may protect water supplies through water infiltration into soils, while simultaneously appealing to popular beliefs, which see forests as preservers of the climate through their ability to attract rain. This tension between the present state of global environmental science, which is to say at least rather equivocal, contrasts with the political realities of a Mexican public that is largely certain that forests attract rain and supply water. Writers of public relations manifestos such as the *Cruzada* are forced to skillfully elide this gap between state and popular environmental theories. It is interesting to compare

this rather nuanced linkage of forest and water with the unambiguous rhetoric of popular environmental campaigns. In a park in Mexico City in 2008, slogans tied to trees warned: "Urgent warning from nature! [When] You Cut Trees, You Steal Water! Stop, or you will have Drought and Death!" (See fig. 3.)

Another example of the way that popular beliefs affect official policy declarations is the payment for hydrological services program that Kaimowitz mentions. According to one participant, the decision to pay for forests' hydrological services was taken in spite of scientific uncertainty and partly as a result of the belief among policy makers, politicians, and the public that forests produce water (Muñoz Piña et al. 2008).

*States and Communities.* Walker is concerned about the lack of detail I provide on politics within communities and on their relationship with the state. He points out that my usage of words such as "undermine," "bypass," and "subvert" may suggest a simple demarcation of opposed state and local interests. I am sympathetic to this argument, and I agree that much writing on state-community relations takes for granted these kinds of oppositions. Communities in Oaxaca are deeply imbricated with state power and often in alliance with state institutions, while individual community leaders may piece together careers that move back and forth between community and government service. I have addressed these particular points in other writings (Mathews 2003, 2008), but in this essay I emphasized opposition, with its associated metaphors of contestation and subversion, because at present in Mexico desiccation theory is so often used in moments of opposition to the state. People who wish to ally themselves with the government are more apt to talk of scientific forestry or development. I agree with him also that communities are of course not unified, harmonious, or virtuous: they have internal hierarchies and conflicts of their own, and one such conflict is that between pro- and antilogging factions.

*The Power of Publics.* Dove insightfully locates my essay in conversation with anthropological research on climate change. He highlights the separation between a small but growing body of research on climate change policy makers, industry leaders, scientists, journalists, and financial elites (Lahsen 2004, 2008) and a rather larger body of research that focuses on local impacts, knowledge, and adaptation to climate change (e.g., Crate 2008). Dove has long argued that we need to carry out research that links and compares elite and popular beliefs (Dove 1983, 1986), while Lahsen (2007) has written on the problematic links between international and local climate change science. In this essay I have proposed two ways that "local" beliefs about climate can affect apparently extra-local knowledge of scientists and policy makers: first, through the unwillingness of audiences to passively accept official knowledge, and, second, through the ability of "locals" to forge extra-local political and epistemic alliances. The arrow of influence is not one way: local beliefs affect national policy audiences in Mexico.

The science and technology studies literature on copro-

duction (Jasanoff 2004a, 2004b), suggests that publics have a powerful role in the making of socially accepted knowledge, that they are not passive subjects or audiences, and that public conceptions of knowledge and the state in turn affect the formation of environmental policy itself. Science and technology studies scholars have long argued that knowledge and political order are always produced together (Latour 2004a; Shapin and Schaffer 1985); Zapotec loggers who remake knowledge of climate and forests are also engaged in re-imagining the state, so that local knowledge has powerful extra-local effects. Epistemic alliances between rural people, urban publics, and well-meaning environmentalists do political work and limit the formation of official environmental policies. However, as Tsing (2005) warns us, collaborations can be dangerous or immoral as well as productive and positive; they are essentially ambiguous. The urban-rural alliances I describe are similarly ambiguous and possibly dangerous: they may one day allow urban environmentalists to block logging in forest communities in the Sierra Juárez. Like Walker, I am worried about the possible cost to community livelihoods, and I find the pervasive antilogging politics of some conservationists in Mexico deeply troubling. I agree with him that “unlikely alliances may also be high-risk ones.” I would add, however, that rural people are probably better off having two sets of possible alliances than one and that communities that can play the forest service off against environmentalists may be in a better position than communities that have no choice of allies.

I have argued that alliances between rural audiences, environmentalists, and urban publics are forms of scale jumping and of scale making. Kull suggests that there is more scale jumping than scale making here. Scale jumping is certainly a large part of the story, as when environmental NGOs helped the community of Yavesia appeal to audiences in the city of Oaxaca in order to undermine the community logging business. However, there is also new scale making going on. Watershed protection forests and water bottling plants are linked to urban water buyers through markets, protection of endangered species is linked to ecotourism lodges and walking trails, and none of these scales fits within the existing nested bureaucratic/legal scales of state/community/forest management plan. A map of an endangered species cuts across all administrative lines and allows environmentalists to appeal to audiences who have no formal status in the conversation at all but who may form alliances with actors at any scale. The relevant scale at which environmentalists and urban audiences operate is also rather poorly defined and certainly does not fit state efforts to keep things at their proper national/state/local scales. But I would not want to push this too far: my key point is that political/epistemic alliances are being created across scales.

In conclusion, I would like to amplify on Choy’s insightful remark that my article describes “how a global alliance comes together through—not despite—cultural, epistemological, and geographic difference.” The history of desiccation theory

in Mexico is indeed a story of disconnection between state representations and popular understandings and practices, but it is also a story of alliance building across these differences of knowledge. In developed countries, states may face difficulty in producing credible public knowledge, but they are relatively successful in doing so (Jasanoff 2005). This contrasts strongly with Mexico, where there is widespread popular distrust of the state, including state claims to control reason and science. Forestry officials’ claims to manage forests responsibly are widely disbelieved (Mathews 2008), while threats to water supplies receive media attention and can give rise to protests. Popular desiccation theory is science that has escaped state control and is now used to critique state environmental projects and to undermine or temper official claims to expertise and knowledge. Framings of nature, culture, human agency, and moral responsibility can easily be linked to desiccation theory in order to provide the resources to undermine expert authority and to represent the Mexican state as morally bankrupt and environmentally destructive.

—Andrew S. Mathews

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