

Socially Explicit Fire Regimes

BRUCE EVAN GOLDSTEIN

School of Public and International Affairs, Virginia Tech, Blacksburg,
Virginia, USA

R. BRUCE HULL

Department of Forestry, Virginia Tech, Blacksburg, Virginia, USA

Fire regime classifications are established and proven tools that guide fire policy, management, and science. They summarize and organize complex information into a concise measure of the timing, intensity, and distribution of fire. The idea of fire regime deserves careful examination because it provides the guiding rationale for managing vast acreage. We identify and unpack two fire regimes articulated in the intense public, professional, and scientific debate that following the 2003 “Cedar” fire outside San Diego, one of the largest and fastest moving fires in California history. We contrast these two regimes and describe their implications for science, management, policy, and land use.

Keywords co-production, FRCC, nature, policy, science, social construction

The crux of most disputes—the bottlenecks in moving plans into the field—lies in a politics charged by disputes over ethics, economics, and esthetics, with uncertainties over the proper place of humanity in nature, over nature’s rights and humanity’s responsibilities. . . . The fire guild, however, too often treats public opinion as though it were an overgrown woods, needing only a suitable prescription for silvi-social thinning in order for an agreement to emerge. (Pyne 2004, 141)

“Fire regime” classification systems condense vast amounts of information about fire behavior and fire history into a simple, easy-to grasp tool for land management (National Wildfire Coordinating Group [NWCG] 2003; Hann et al. 2003). Fire regimes have become the basis for prescribing management over vast acreages. The Healthy Forest Restoration Act of 2003, for example, mentions specific Fire Regime Condition Class (FRCC) conditions as triggers for management and funding. As its name implies, FRCC uses fire regimes as an organizing concept and as a baseline for goal setting. Large departures from idealized fire regimes imply poorer ecological integrity and/or higher fire risk. Either implication can trigger management intervention. Thus, the descriptive fire regime is sometimes a

Received 13 June 2006; accepted 4 May 2007.

We acknowledge funding from the Northern Research Station of the USDA Forest Service.

Address correspondence to Bruce Goldstein, Urban Affairs and Planning (0113), Virginia Tech, Blacksburg, VA 24061, USA. E-mail: brugo@vt.edu

prescription for management. It is not surprising that a concept so powerful has become the subject of intense study and debate (Dellasala et al. 2003; Morgan et al. 2001; Stephens and Ruth 2005).

This article deconstructs and exposes the social context of fire regimes. Studies similar to this one have examined ecological constructs such as biodiversity (Takacs 1996), ecological integrity (Westra and Lemons 1995), exotic species (Lodge and Schrader-Frechette 2003), and salmon (Scarce 1999). These studies help researchers, managers, and public stakeholders by acknowledging the social implications of natural resource management frameworks.

Fire scientists and managers have a stake in resisting this trend toward deconstructing ecological constructs. If fire regimes can be defended in realist terms as things-within-nature, then they remain a management tool that can be calculated far from the complexity and potential chaos of a political arena by experts deploying a delimited collection of disciplinary tools. By implying that nature is an outcome of social relations, deconstruction seems at odds with the commitment of fire scientists and managers to address and respect natural conditions and it reinforces the concern that deconstructionism will weaken and thereby threaten the role of science in management (Soule and Lease 1995).

This article takes a different approach by exploring the multiplicity of fire regimes through the analytic lens of the co-production of science and the social order (Jasanoff 2004). This approach carries fewer liabilities for the fire community. It assumes that fire regimes are generated by embodied subjects—knowing agents located in specific institutional space and time, who play a critical role in maintaining social practices and the social order (Latour 1993). These social relationships are not a sign of inadequacy—they are the work that sustains fire regimes as meaningful truths through associations between the natural and the social that are impossible to reduce to essential elements within either category. Nature is assumed to have agency that must be respected by the scientific constructions produced to represent it. Not all scientific understandings are equally good, and distinct knowledge practices within each fire regime lead to ever-greater degrees of precise description and explanation of the ecological features. Different communities of stakeholders may develop different understandings, each internally consistent within its own set of knowledge practices. As a result, they struggle to comprehend one another and coordinate policy or action.

Our purpose in this study is to describe alternative fire regimes produced and articulated during the intense public debate about community restoration following a wildfire. We suggest how this research can be helpful to fire managers who increasingly find themselves in situations where multiple parties demand a voice in land management decisions, with each party having access to its own base of knowledge and its own conception of an appropriate fire regime.

Methods

This study takes advantage of the introspection and social mobilization that occurs in the wake of disasters (Stallings and Quarantelli 1985), specifically the interactions within and between two distinct groups: (1) the San Diego Fire Recovery Network (SDFRN) that emerged following the 2003 wildfires near San Diego, and (2) the established federal, state, and county fire agencies. While the Cedar fire was still burning, a flurry of e-mails were exchanged within a loose network of conservation

activists, land managers, and biological scientists who had cooperated over the past decade in regional natural lands management and endangered species planning efforts. Eighty such people attended a hastily assembled meeting on October 30, just five days after the fire began, to form SDFRN. About 10 individuals agreed to coordinate the efforts of this emergent group and for the next 4 months remained in nearly daily contact, guiding the remainder of their coalition in creating action plans, posting draft articles and editorials for review on their web site and listserv, sharing their impressions of initiatives to address landscape hazards caused by the fire and efforts to mitigate future fire risk, and conducting a regional assessment of flora and fauna.

The county, state, and federal agencies associated with fire management also generated multiple reports, position papers, and public statements describing and defending their understanding and response to the 2003 fires. The California Department of Forestry and the USDA Forest Service (2004) prepared an account of the wildfire and their management actions during the event. The State of California (2004) and the San Diego County Wildland Fire Task Force (2003) convened formal commissions composed of fire officials, elected representatives, and community officials to address similar issues and provide policy recommendations.

Our understanding of these fire regimes was informed by meeting summaries, e-mail listservs, planning documents, and newspaper articles and editorials. We supplemented this material with extensive interviews, in person and by phone, with key informants associated with these organizations. In-person interviews were recorded and transcribed. Text files of all documents were entered into NVIVO qualitative analysis software (QSR International 2002), which facilitated use of a grounded theory methodology in which data collection and analysis proceed simultaneously and initial theoretical concepts are continuously modified to reflect and interpret the data (Strauss and Corbin 1990). Documents were analyzed using a common set of codes, which were then clustered according to whether they came from an SDFRN or management source. While our method of data collection and analysis is guided by the work of numerous discourse scholars, a valuable reference text is the work of social psychologists Potter and Wetherell (1987). Finally, we sent preliminary drafts of this manuscript to two key informants within each of the respective positions and incorporated their responses and corrections.

Discussion of Results

The largest of the 2003 wildfires in southern California began on October 25, when a lost hunter set a signal fire in a steep roadless area of dense chaparral in rural San Diego County. The conditions were ideal for the outbreak of fire—low humidity, high temperatures, and gusty Santa Ana winds—in a landscape already parched by years of drought. County and state firefighters were stretched thin by 11 other recent fire ignitions in southern California. This particular fire—called the Cedar fire—was difficult to control because it occurred in the outer edges of San Diego's wildland-urban interface, with its narrow, twisting roads and patchwork of houses, many of which were built with highly flammable materials such as cedar-shake roofs. By the next morning the Cedar fire had grown to 40,000 hectares—a growth rate of 2,000 hectares per hour—and began burning into the City of San Diego's suburbs. Local and national media were saturated with dramatic stories and images showing burning homes and landscapes. When it was finally controlled 3 days later after the winds died down and rain began to fall, the Cedar fire had become the largest fire

recorded in California history at over 113,500 hectares. Fourteen lives and 2,232 homes were lost, and control efforts required 1,478 personnel at a cost of \$27 million. It was a scary and emotional time for area residents, who demanded that fire agencies explain why the fires weren't controlled, and even channeled their anger at firefighters, who were surprised and disheartened by this unaccustomed criticism.

Our analysis revealed two competing fire regimes. What we call the "Management" regime was reflected in many, but not all, of the positions taken by established federal, state, and county fire and resource management agencies and programs. What we call the "Restoration" regime was reflected in many, but not all, of the positions taken by members of the San Diego Fire Recovery Network. The following text compares and contrasts these two regimes along three dimensions that emerged through analysis: (1) science, knowledge, and nature, (2) government and citizenry, and (3) land use planning.

Science, Knowledge, and Nature

Most fire regime classification systems characterize the timing and intensity of fire by describing how hot, how destructive, how fast, how often, where, and when fires burn (Morgan et al. 2001; Pyne, Andrews, and Laven 1996). It is tempting to present these measures as complete representations of the biophysical reality that is fire. But a "regime," like a "climate," is merely a statistical abstraction. Just as a given "climate" has many different types of storms, so can a "regime" have many different types of fires. As a result of being statistical abstractions, seemingly minor methodological decisions—such as estimating historic fire frequency at a specific point/tree versus estimating it for a larger area/stand—can produce dramatically different regime characterizations (Morgan et al. 2001).

Fuel loads and climate conditions are two biophysical attributes commonly used to describe and explain fire. Both the Management and Restoration fire regimes propose that dead, dry, standing vegetation is likely to burn, and thus the 5-year drought preceding the Cedar fire created conditions making the conflagration likely. Both regimes also are similar in that they attribute most fire ignitions in Southern California to human causes. However, the regimes differ in another equally fundamental dimension of fire—the relative contribution of fuel and wind.

The Management regime emphasized fuel loads. According to this regime, the chaparral-filled landscape surrounding San Diego is suffering from the ill effects of a century of fire suppression, yielding an unhealthy accumulation of fuel—overmature chaparral stands—that is susceptible to huge and ferocious fires. It describes a history of frequent burning during the calm, humid months of midsummer, burning that consumes old, highly flammable chaparral and creates a patchwork pattern of small areas (less than 2,000 hectares) in various stages of regrowth distributed across the landscape. The younger chaparral is considered somewhat resistant to fire, and thus constrains the spread of fire and replicates the patchwork pattern.

While the Management fire regime places the conditions leading to the Cedar fire well outside the natural range of variability due to years of fire suppression and fuel accumulation, the Restoration regime suggests that the Cedar fire was part of a normal historical continuum of ecosystem-defining catastrophic fires that are driven largely by climate, not fuel accumulation. In particular, it emphasizes the infrequent convergence of drought conditions with hot, dry, strong, Santa Ana winds that blow through the canyons and can fan small flames into huge fires.

Both the Restoration and Management regimes agree that manageable fires occur during conditions other than drought and high winds, but the Restoration regime suggests that fire policy and management must incorporate the realization that inevitable wind and drought will occasionally create fire conditions that cannot be managed by fuel reduction, except at enormous expense using aggressive vegetation management that risks disrupting ecological systems.

The credibility of each of these contrasting fire regimes was defended using respected peer-reviewed science: The Restoration regime referenced the work of Keeley et al. (e.g., 1999) and the Management regime referenced the work of Minnich (e.g., 1983). Scientists working in different disciplines and starting from different assumptions often reach different interpretations of the same situation because they employ different theory, methods, and evidentiary standards. Dueling experts and arguments about what counts as credible, defensible knowledge are common features of environmental disputes (Nelkin 1975). These differences often hinge on fundamentally different conceptions of nature and human agency that underlay the wide range of knowledge practices that fall under the umbrella of science.

The loosely linked community that articulated the Management regime shared common points of reference, such as forestry, agronomy, hydrology, and related professions based in agricultural sciences. Their language and action reveal a mechanistic perspective in which nature is composed of parts that can be redesigned, discarded, or exchanged in order to fine-tune the outputs of the ecological system to optimally satisfy human wants and needs, in this case maximizing public safety through manipulation of vegetation (fuel). This mechanistic characterization of nature has dominated the agricultural sciences and is reflected in the policies and practices of the USDA Forest Service for the first half of the 20th century (Botkin 1990; Worster 1994).

Within the mechanistic–agricultural framework, science provides the capacity to describe landscape conditions in increasingly standardized and generalizable terms, which enables the distribution of tested and approved management techniques. For example, a Burned Area Emergency Response (BAER) team was formed after the Cedar fire, as is standard protocol with the USDA Forest Service. The team consisted of 32 professionals from around the country with expertise in hydrology, geology, soils, engineering, botany, recreation, and heritage resources. Their interim report was filed 3 weeks after the fires started (USDA Forest Service 2003). They identified threats such as heavy rains that could wash out roads and trails, cause sheet erosion jeopardizing residential property, and increase sedimentation in a major water supply facility for the City of San Diego. The report recommended aggressive treatments such as “Aerial Hydromulching—a wood and paper mulch matrix with a non water-soluble binder” and “fiber rolls . . . to protect homes which abut upslope Forest Service land.”

Those who advanced the Restoration regime shared conservation biology and restoration ecology as common points of reference. They saw chaparral not as a fuel source, but rather as an element of biodiversity whose complex dynamics were shaped not only by present conditions but also by a specific ecological history. Fire in the region was impossible to reliably control because of stochastic processes inherent to the nonlinear, dynamic, disturbance-based system. For example, unpredictable climatic factors caused the chaparral system to burn, regardless of all but the most extensive and intensive fuel reduction efforts. Restoration regime advocates argued that frequent and repeated burning and other fuel reduction efforts proposed by the Management regime were ill-advised. Such practices might dramatically and

permanently alter the ecological character of the region. As Botkin (1990) and Worster (1994) suggest, this characterization of natural systems as nonlinear, dynamic, and chaotic reflects the rise of disturbance-based ecology in the 1960s and the systems-based thinking of ecosystem management that began to influence land management agencies in the 1980s.

Proponents of the Restoration regime found the BAER team recommendations incompatible with their own understanding of a dynamic nature. They argued that broad-scale erosion control through seeding and mulching ignored the fact that native vegetation had evolved with infrequent, large fires, and could quickly recolonize burned areas. Intervention with mulch and grass seed or repeated prescribed fire for fuels reduction could actually retard native, natural growth and cause “type conversion,” a new self-reinforcing system characterized by “reduced sprouting and seed availability from frequent fires, then successful invasion of exotic grasses, then higher ignition risks.”

Advocates of the Restoration regime shared a common interest in regional flora and fauna, and many of them were part of San Diego’s active community of naturalists, whose dedication was shown in the publication of a 645-page bird atlas of San Diego County (Unitt 2005) produced by 400 volunteers who spent over 55,000 hours conducting field observations between 1997 and 2002. Their knowledge practices emphasized a fine grained spatial and temporal understanding of nature. Both in practice and language the Restoration regime demonstrated a respect for knowledge about local conditions collected by locally knowledgeable people. For example, after the Cedar fire, SDFRN’s conservationists, consultants, and land managers synthesized hard-to-find sources of information and years of local field experience using locally refined assessment methods to produce an ecological report about the location and vulnerability of species and habitats in the region (Betzler et al. 2003). The report was intended to assist the BAER team efforts (described earlier) documenting the condition and location of environmental qualities that SDFRN feared might be deemphasized or overlooked because of the perceived erosion management orientation and rushed timetable of the BAER process. However, the BAER team rejected SDFRN’s ecological compilation as an inappropriate public comment rather than a scientific contribution, explaining that the material/information in the report jeopardized the integrity of the federal agency-led team of scientists drawn from throughout the country and chosen for their knowledge of the agency methods. The BAER team instead emphasized detailed information about soil, slope stability, and erosion potential—environmental attributes important to managers of recently burned areas anywhere in the country.

In summary, while both regimes drew on the legitimacy of peer-reviewed science, they were grounded in different scientific disciplines and professions. They also emphasized different biophysical explanations of fire in the region, conceptualizations of nature, and environmental attributes. Both regimes valued local knowledge as evidenced by the deployment of research teams to collect and compile data immediately following the fire. The two regimes differed, however, in their emphasis on unique local qualities versus generalizable properties.

Government and Citizenry: Civic Environmentalism Versus Agency Protectionism

Both regimes expect citizens to take responsibility for fire management around their homes. The regimes differ, however, in the roles that government and local citizens

are expected to play managing fire on the regional landscape. While both regimes agree that neighbors put neighbors at risk by not implementing fire-safe landscaping, they differ in whether the government should police bad actors and protect people that locate themselves in harm's way—and that difference influences their understanding of fire on the land. The Management regime assumes more of a caretaker role by administering programs that take actions if landowners do not. The county's Removal of Combustible Vegetation and Other Flammable Materials Ordinance employs professionals to inspect properties and private firms to implement desired landscape conditions. One administrator at the California Department of Forestry explained that his agency had to protect residents who did not know how to survive a fire, noting that, "50 years ago we had . . . [residents with a] . . . basic understanding of natural events and what could bite you out there, including fire . . . we have gone away from that" (2004).

The Restoration regime, in contrast, explicitly articulates a more accountable and involved local citizenry that is expected to accommodate their lifestyles to fire. The Restoration regime reflects a trend toward civic environmentalism, devolving centralized decision making to local authority, voluntary associations, and personal responsibility (Agyeman and Angus 2003; Landy 1999). According to the Restoration regime, living with fire is a civic responsibility: People should intentionally adapt their land uses to the dynamic and unpredictable chaparral fire system. As one SDFRNER wrote, residents who build structures "in a place that burns" need to "accept the reality" that these structures are "going to burn" and not expect government programs to protect or reimburse them from inevitable fires. "Chances are, firefighters are not going to be able to get to your home in time during a large event. Make it safe. Make it defensible. Let the fire burn around you. It's your responsibility."

The Management regime by no means absolves citizens of responsibility or ignores community action. But its programs do provide backup capacity to address expected failures on the part of a few bad actors and to correct problems (such as sprawl) that emerge from numerous independent decisions—a classic tragedy of the commons problem justifying government intervention to protect the public good (Hays 1959). It makes sense, within the logic of the Management regime, to request and spend public resources to extend fuels management and fire suppression programs wherever sprawl places structures and people in harm's way. Agency staff and other fire professionals should reduce fuel loads, build fire breaks around communities, deliver professional expertise to landowners, encourage fire-safe landscaping with incentives, and police bad actors with regulations and law.

For example, homeowners are urged to enroll in neighborhood FireSafe Councils advised by professional and agency staff. Groups that hire a state-licensed professional are rewarded with chipping and brush removal services paid for by multi-million-dollar grants that southern California's congressional representatives have steered to their districts. As a result of these efforts by agency personnel and other fire managers, San Diego County had a greater density of FireSafe Councils than anywhere in the country.

SDFRNERs supported these programs, but argued that they did not go far enough. They wanted fire issues addressed prior to locating neighborhoods in places that burn. FireSafe Councils, they worried, instill a culture of dependence on fire suppression because the councils emerge after structures have been placed in harm's way. The Restoration fire regime places responsibility on residents to not locate homes where risk of fire is significant, thereby greatly reducing the impact and

expense of reducing fuel loads and controlling fire. SDFRN's position on this topic is discussed in detail later, in the land use planning section of this article.

The two regimes' positions on funding firefighters provide another illustration of the contrasting views of citizen responsibility. SDFRN expressed concern on its list-serv that popular proposals to increase firefighting capacity reinforced the mindset that residents need not worry about fire because experts employed by government agencies would protect them during an emergency. Firefighters have a great deal of social standing, even panache, so SDFRN worked hard to frame an argument that honored firefighters while opposing increased firefighting budgets. They did this by arguing that the real solution to the problem of fire lies not in increased firefighting capacity but in land use planning.

Consistent with the Restoration regime's understanding that major fires are inevitable, climate-driven, and uncontrollable, members of SDFRN rejected the supposition that aggressive fuel reduction and suppression policies will always succeed. They acknowledged that fire-safe landscaping and suppression activities work most of the time, even "99% of the time," but occasionally and inevitably firefighters will confront large, wind-driven conflagrations such as the Cedar fire. Such fires cannot be controlled except through expensive large-scale fuels management activities that risk changing the region's ecological character. Therefore, policies that expect firefighters to control wind-driven conflagrations are putting heroic lives at risk for minimal chances of success. As one SDFRNER put it:

"We cannot ask our firefighters to risk their lives defending homes placed in harms way. A mistake was made when they were allowed to be built in the first place. We have neither the ability nor resources to defend them safely. Steve Rucker, the fireman who died defending a house near Julian, must be remembered, especially by those who place private property rights ahead of the lives of those who we have asked to protect us."

Representatives of the Management regime show the utmost respect for firefighters. They repeatedly appealed for increased firefighting budgets to enhance protection and suppression capabilities. The commissions and reports that followed the fire contained proposals for increased resources to improve fire-fighting capability and enhance the agency-based, professional infrastructure that would manage fires in the region. These proposals implied that firefighters could have controlled the fire and reduced losses to an acceptable level if only there had been better radio technology, better staffed command and control centers, more equipment, and more people on the ground. As one San Diego county supervisor put it in her constituent newsletter:

Someone, somewhere, somehow left our region virtually naked against brushfire. Visiting with unincorporated-area victims that terrible first day, one after another, their stories were the same. "Where are the planes?" "Where are the fire engines?" "We've had aerial support in the past. Why not now?" (Jacob 2003, 2)

Land Use Planning and Community Form

While the two regimes agree that the most significant fire-related challenge is land development practices that sprinkle structures across a landscape that burns, they

have different expectations about the potential of land use planning to address this challenge. The Restoration regime explicitly locates development patterns within its definition and understanding of fire. It assumes that neither the characterization of fire nor the solution to fire problems can be accomplished without addressing land use. The Management regime, in contrast, is much more reserved about making land use planning a defining feature of fire management, and focuses instead on reducing fuel and suppressing fire.

Some advocates of the Management fire regime explain that influencing local land use politics is not practical: Experience has taught them that lightning-rod political issues such as private property rights and free market economic development trump efforts to plan fire-safe communities. The Management fire regime has come to accept that development on privately owned lands will continue at the discretion of the landowner and that there is insufficient political will to manage the resulting sprawling development pattern, leaving after-the-fact fuels reduction and fire control the only option. As one county fire manager concluded, "The planners are all at the mercy of the politicians . . . If I was going to predict something in 100 years from now [it is that] we are going to build in all these open spaces."

This difference between the two regimes is perhaps most clearly illustrated by their differing expectations for FireSafe Councils, introduced earlier in this article. SDFRNers accept the value of FireSafe councils for preexisting communities but want preemptive community participation to address the problem of fire before neighborhoods get designed, located, and populated. Their proposals reflect the ideals of transit-oriented and cluster-oriented planning approaches that create a system of compact urban areas and connected open spaces (Conroy and Berke 2004; Garde 2004). The Public Outreach and Education subcommittee of SDFRN developed and presented at several public venues a presentation specifically opposing dispersed, exurban, ranchette development. One of the slides explains their concern:

With respect to urban development, dispersed settlement in wildlands should be discouraged. The most dangerous scenario is scattered houses in a sea of chaparral, virtually a lake of gasoline. If the terrain is too rugged to permit consolidated development, then it should not be developed at all.

The two fire regimes also differed in their advocacy of defensible fuel profile zones (DFPZs) and buffers built around communities for their protection. These zones and buffers require management to greatly reduce fuel loads over large areas so that fire cannot cross or can be safely controlled. Rather than build housing developments right up to the edge of public lands and then asking public land managers to clear a natural ecosystem and create protective buffers on public lands, the Restoration regime would have land developers place protective zones and vegetation controls on their private holding and be responsible for their maintenance. As one contributor to the SDFRN listserv put it:

It seems unfair to use our public lands to create buffers that should have been included by the developer in the design plan, and should have passed planning review boards without them. I personally feel that planning boards hold no small responsibility for the loss of structures at the urban/wildland interface.

When fire professionals that we associate with the Management regime were asked about privately funded and maintained DFPZs, they agreed that the approach was theoretically feasible, even desirable, but not practical. Experience had taught them that efforts to manipulate community form are often ineffectual and can even backfire. One informant described experience with the perverse impacts of land use planning ordinances requiring developers to leave open space for buffers. Developers prefer locating houses high on the slopes that capture views and raise property values. The open space buffer requirement was satisfied by leaving undeveloped the canyons where narrow, steep topography makes fire management difficult and perhaps impossible, thereby having the unintended impact of increasing fire risk. Another informant described efforts to work with developers to plan roads and open space buffers in accordance with DFPZ and FireSafe principles, only to see these early design efforts reversed when presented to development investors who did not understand the relevance of these principles for their ultimate purpose of turning over the property and making a profit. Still, informants acknowledged that the situation is changing and new developments are increasingly required to have approved fire protection plans.

Conclusion

Institutions structure landscapes as fully as mountains and seasons . . . the means by which they decide what to do powerfully influence how fire appears on the land. (Pyne 2004, 189)

The Management and Restoration fire regimes present alternative ways of describing and understanding fire. Both of them are based on scientific understanding of fire ecology but differ in the biophysical attributes and implications they emphasize. The Restoration regime emerges from the social context of conservation biologists and community activists sitting outside land management agencies. This regime emphasizes fire's overwhelming complexity and power within a dynamic system: Large, climate-driven fires will inevitably sweep through the landscape and cannot be suppressed. Therefore, from this perspective, policies should discourage, not enable, land use patterns that place structures where fires will burn and necessitate expensive, draconian fuel reduction measures likely to fail or dramatically change the region's ecological character. The Restoration fire regime also emphasizes local, rather than generic, ecological qualities that make a landscape special and perhaps unique to the people that live there.

The Management fire regime emerges from within the protectionist-oriented and agricultural science-based professions of land management agencies. From this perspective, fire must be controlled to maximize public welfare, and fire safety is a public good provided by publicly subsidized agencies, just like clean water and police protection. Sprawl is inevitable, a serious problem that can be solved with additional resources and new techniques. This regime also emphasizes standard methods for environmental assessment that can be applied across the nation, even at the risk of ignoring locally valued conditions and cultures.

Policies consistent with the Management fire regime include more capacity to control fires, stronger programs to clear fuels near structures, greater funding to reduce fuel loads in DFPZs, more funding to apply erosion control measures, and

better science to explain (and hence control) fire, smoke, and erosion. Policies consistent with the Restoration regime included less intervention in natural/native revegetation, less subsidy of the protectionist umbrella that allegedly encourages sprawl by not charging exurban landowners the full cost of fire protection, less emphasis on fuel reduction, and greater emphasis on land use politics. Both regimes demonstrate respect and appreciation for brave firefighters.

Although we are demonstrating that multiple ways of knowing fire exist, we are not presenting a relativist argument suggesting that any and all proposed fire regimes are equally valid and useful. Far from it. Nature has agency, form, and function that are described through observation and explained using theory. The descriptions and explanations that are better than others at corresponding to and predicting observed phenomena are retained and privileged, while others are discarded. Different legitimate descriptions and explanations can emerge from communities that legitimate knowledge in different ways.

Agency authority to prescribe management rests in part on its claims of scientific expertise. While this analysis focuses on the co-production of scientific expertise and the social order, it still can be interpreted as hostile to the dominate Management regime because it implies that multiple interpretations are both plausible and legitimate, an implication that tends to be more useful to those advancing alternative interpretations (Martin and Richards 1995). Fire management agencies that typically justify their policies using their science must accept that alternative knowledge communities can generate alternative fire regimes, thus opening up another front for negotiation and conflict that further diminishes agency authority. This leveling effect is especially difficult to accept during an era when agency critics already enjoy considerable success preventing agency action (Rosenbaum 2006). Equally, it is difficult for those who feel charged with the urgent task of protecting public safety and improving forest health to delay action while negotiating through a multitude of competing fire regimes.

However, the co-production of multiple fire regimes does not imply that unilateral action by the fire agencies is impossible or even undesirable. Inaction is often worse than partially informed action, especially given the urgency of the circumstances. Unfortunately, the prospects for consensus formation are often dimmer within a co-productionist perspective than within a realist perspective. A co-produced unity tends to change slowly and with difficulty because the social identities of adherents of different productions are assembled around their knowledge practices and perspectives on responsibility and governance (Agrawal 2005). Even much-hailed multi-stakeholder collaborative processes (Wondolleck and Yaffee 2000) may simply be a recipe for time-consuming inaction, and may only be warranted when transaction costs of collaboration exceed that of alternative strategies (Weber 1998). Perhaps the fastest and most efficient thing to do is to vanquish alternative fire regimes and assimilate their adherents, an approach that was successfully pursued in this case by the adherents of the Management fire regime in San Diego (Goldstein 2007).

The co-productionist approach opens up the possibility that fire managers could join with the adherents of alternative fire regimes to create new biocultural arrangements through a creative dialectic of nature and social order (Hull 2006). This approach recognizes the failure of definitive scientific expertise to resolve controversies (Goldstein 2004). Instead of expecting science to silence critics, fire managers could organize communities of practice (Lave and Wenger 1991) that engage critics

in the tasks of developing knowledge, methods, and policies. Through this shared practice, fire managers might be able to peaceably “assimilate” antagonists like SDFRN, with the inevitable and even desirable possibility that they themselves will be transformed by the experience.

A nationwide fire planning initiative that could achieve these objectives has been underway since 2000. Called the “Fire Learning Network,” this joint effort of the Nature Conservancy and the Forest Service brings together experts and land managers to develop a shared conception of fire regimes and to project desired future ecological conditions, as well as to prepare operational plans to restore fire-adapted landscapes (The Nature Conservancy 2007). Their commitment to mutual learning enables agency managers and conservationists to discuss organizational objectives and understand the rationale for one another’s actions, laying the groundwork to develop jointly crafted expertise that is mutually meaningful, relevant, and credible.

References

- Agrawal, A. 2005. *Environmentality: Technologies of government and the making of subjects*. Durham, NC: Duke University Press.
- Agyeman, J. and B. Angus. 2003. The role of civic environmentalism in the pursuit of sustainable communities. *J. Environ. Plan. Manage.* 46(3):345–363.
- Betzler, J., J. Diffendorfer, S. Fleury, M. A. Hawke, M. Klein, S. Morrison, G. Nichols, T. Oberbauer, C. Rochester, M. Webb, and K. Williams. 2003. *A summary of affected flora and fauna in the San Diego County Fires of 2003* (BAER Report). November 14. <http://www.sdfirerecovery.net/documents/BAER%20Team%20reports/BAER%20Team%20Report.htm> (accessed 30 December 2004).
- Botkin, D. 1990. *Discordant harmonies*. London: Oxford University Press.
- California Department of Forestry and Fire Protection and USDA Forest Service. 2004. *The 2003 San Diego County Fire Siege Fire Safety Report*. <http://www.fs.fed.us/r5/cleveland/documents/documents/sandiegocountyfinal.pdf> (accessed 5 January 2006).
- Conroy, M. and P. Berke, 2004. What makes a good sustainable development plan? An analysis of factors that influence principles of sustainable development. *Environ. Plan. A* 36:1381–1396.
- Dellasala, D. A., J. E. Williams, C. D. Williams, and J. Franklin. 2003. Beyond smoke and mirrors: A synthesis of fire policy and science. *Conserv. Biol.* 18(4):976–986.
- Garde, A. M. 2004. New urbanism as sustainable growth? *J. Plan. Educ. Res.* 24:154–170.
- Goldstein, B. E. 2004. *War between social worlds: Scientific deadlock during preparation of an endangered species habitat conservation plan (HCP) and the co-production of scientific knowledge and the social order*. Doctoral dissertation, University of California, Berkeley.
- Goldstein, B. E. 2007. The futility of reason: incommensurable differences between sustainability narratives in the aftermath of the 2003 San Diego Cedar Fire. *Environ. Plan. Policy.* 9(4):227–244.
- Hann, W., D. Havlina, A. Shlisky, K. Schon, S. Barrett, T. De Meo, K. Pohl, J. P. Menakis, D. Hamilton, J. Jones, and M. Levesque. 2003. *Fire regime condition class definition*. Interagency and The Nature Conservancy fire regime condition class web site. USDA Forest Service, U.S. Department of the Interior, The Nature Conservancy, and Systems for Environmental Management. <http://www.frcc.gov/docs/FrccDefinitionsFinal.pdf> (accessed 5 January 2006).
- Hays, S. P. 1959. *Conservation and the gospel of efficiency*. Pittsburgh: University of Pittsburgh.
- Hull, R. B. 2006. *Infinite nature*. Chicago: University of Chicago Press.
- Jacob, D. 2003. Flames are out, serious questions remain. *Jacob’s journal: A newsletter from Supervisor Dianne Jacob*. November.

- Jasanoff, S. 2004. Ordering knowledge, ordering society. In *States of knowledge: The co-production of science and social order*, ed. S. Jasanoff, 13–45. London: Routledge.
- Keeley, J. E., C. J. Fotheringham, and M. Morais. 1999. Reexamining fire suppression impacts on brushland fire regimes. *Science* 284:1829–1832.
- Landy, M. 1999. Local government and environmental policy. In *Dilemmas of scale in America's federal democracy*, ed. M. Derthick, 227–260. Washington, DC: Woodrow Wilson Center Press.
- Latour, B. 1993. *We have never been modern*. Cambridge, MA: Harvard University Press.
- Lave, J. and E. Wenger. 1991. *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.
- Lodge, D. M. and K. Schrader-Frechette. 2003. Non-indigenous species: Ecological explanations, environmental ethics, and public policy. *Conserv. Biol.* 17(1):31–37.
- Martin, B. and E. Richards. 1995. Scientific knowledge, controversy, and public decision making. In *Handbook of science and technology studies*, eds. S. Jasanoff, G. E. Markle, J. C. Petersen, and T. J. Pinch, 506–526. Thousand Oaks, CA: Sage.
- Minnich, R. A. 1983. Fire mosaics in southern California and northern Baja California. *Science* 219:1287–1294.
- Morgan, P., C. C. Hardy, T. W. Swetnam, M. G. Rollins, and D. Long. 2001. Mapping fire regimes across time and space: Understanding coarse and fine-scale fire patterns. *Int. J. Wildland Fire* 10:329–342.
- National Wildfire Coordinating Group. 2003. *Fire Regime Condition Class definition*. <http://www.nwcg.gov/teams/wfewt/message/FrccDefinitions.pdf> (accessed 5 August 2005).
- Nelkin, D. 1975. The political impact of technical expertise. *Social Stud. Sci.* 5:35–54.
- Potter, J. and M. Wetherell. 1987. *Discourse and social psychology: Beyond attitudes and behaviour*. London: Sage.
- Pyne, S. J. 2004. *Tending fire: Coping with America's wildland fires*. Washington, DC: Island Press/Shearwater Books.
- Pyne, S. J., P. L. Andrews, and R. D. Laven. 1996. *Introduction to wildland fire*. 2nd ed. New York: John Wiley and Sons.
- QSR International. 2002. *NVIVO*. Doncaster, Victoria, Australia.
- Rosenbaum, W. 2006. *Environmental politics and policy*. 7th ed. Washington, DC: CQ Press.
- San Diego County Wildland Fire Task Force. 2003. *Mitigating strategies for reducing wildland fire risks*. San Diego, CA: San Diego County.
- Scarce, R. 1999. Who—or what—is in control here? Understanding the social context of salmon biology. *Society Nat. Resources* 12:763–776.
- Soule, M. E. and G. Lease (Eds.). 1995. *Reinventing nature? Responses to postmodern deconstruction*. Washington, DC: Island Press.
- Stallings, R. A. and E. L. Quarantelli. 1985. Emergent citizens groups and emergency management. *Public Admin. Rev.* 45:93–100.
- State of California. 2004. *Governor's Blue Ribbon Fire Commission report*. Sacramento: State of California.
- Stephens, S. L. and L. W. Ruth. 2005. Federal forest-fire policy in the United States. *Ecol. Appl.* 15(2):532–542.
- Strauss, A. and J. Corbin. 1990. *Basics of qualitative research; Grounded theory procedures and techniques*. Newbury Park, CA: Sage.
- Takacs, D. 1996. *The idea of biodiversity: Philosophies of paradise*. Baltimore, MD: Johns Hopkins University Press.
- The Nature Conservancy. 2007. *The U.S. Fire Learning Network*. http://www.tncfire.org/training_usfln.htm (accessed 4 April 2007).
- Unitt, P. 2005. *San Diego County bird atlas: Proceedings of the San Diego Natural History Museum Number 39*. Temucula, CA: Ibis.

- USDA Forest Service. 2003. *Burned Area Emergency Response (BAER) team report for Cedar, Paradise, Otay, and Old Fires of 2003 (FSH 7509.13)*. Unpublished report. San Diego, CA: Department of Geography, San Diego State University.
- Weber, E. P. 1998. *Pluralism by the rules: Conflict and cooperation in environmental regulation*. Washington, DC: Georgetown University Press.
- Westra, L. and J. Lemons. (Eds.). 1995. *Perspectives on ecological integrity*. Dordrecht, the Netherlands: Kluwer Academic.
- Wondolleck, J. M. and S. L. Yaffee. 2000. *Making collaboration work: Lessons from innovation in natural resource management*. Washington, DC: Island Press.
- Worster, D. 1994. *Nature's economy: A history of ecological ideas*. Cambridge, UK: Cambridge University Press.