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Mountain Pine Beetles and Ecological Imaginaries: The Social Construction of Forest Insect Disturbance

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1 Introduction

Forest insect disturbances bear attributions at multiple scales, from the practices of local extractive industries to the politics of state and federal forest management to global climate change (Bentz et al. 2010; Dale et al. 2000, 2001; Müller 2011; Petersen and Stuart 2014). In the late 1990s and early 2000s, an outbreak of mountain pine beetle (MPB) (*Dendroctonus ponderosae*) swept through north central Colorado forests with an unprecedented scope and intensity, leaving massive swaths of red, beetle-killed trees throughout the landscape and precipitating community responses reflective of their unique economic bases, histories,

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and biophysical attributes (Colorado State Forest Service [CSFS] 2016). Such a setting provides an opportunity to examine how institutional forces pattern experiences of the natural world and responses to an ecological event or disturbance (Flint et al. 2012).

While other visual blights such as litter or pollution from industry are clearly attributable to human activity, the rust blanketed mountainsides appear perplexing to say the least. In the eyes of many local residents, the mountains are just not supposed to look this way, and yet there is no single perpetrator to blame. Reconciling such a shocking image with the knowledge that it is largely a natural event, demands attention to the way that such a disturbance is influenced by various political, market, and community factors.

Community responses to outbreaks are structured by local economies and the priorities of community members with access to local decision-making power, the policies of management officials and politicians, and the biophysical characteristics of the region itself (Flint et al. 2012). With the knowledge of how the responses of local communities have been patterned by broader socioeconomic and historical forces, it is important to also examine the competing conceptions of nature inherent in such responses and the discursive practices surrounding ecological events. While other studies of the human dimensions of insect disturbances explore how landscape and socioeconomic heterogeneity inform community responses to outbreaks (Flint et al. 2012; Qin and Flint 2010; Qin 2016), there has been insufficient attention to the ecological imaginaries that underpin these responses, and the way that culturally embedded conceptions of the natural world create context for the construction of and response to environmental events.

This work engages a political ecology perspective in order to consider the role and power of environmental narratives, and the various environmental identities of actor groups that emerge in relation to prevailing institutional power structures and to a constructed environmental problem. Since fixed assumptions about what the relationship between the human and non-human world "should be" become dogmatic and may even lend themselves to becoming the basis for exclusion and marginalization, this process of discursive analysis can be useful as a means of detaching knowledge claims from institutional structures of privilege,

and evaluating environmental narratives on the basis of the subjectivities that simultaneously construct and are constructed by them.

2 Mountain Pine Beetles and Ecological Relationships

To adequately evaluate how communities and other human actor groups participate in unique constructions of MPB disturbances, it is first necessary to understand the ecology of the MPB and how it functions in the context of Colorado forest communities as a distinct, non-human actor group.

The MPB issue is endemic to Colorado forests. Moreover, insect disturbances play a critical role in maintaining forest ecosystems and are crucial to the process of forest succession (Dale et al. 2000). What has proved variable in outbreaks throughout North America in recent decades has been both the scope and the intensity of outbreaks (Dale et al. 2000; Petersen and Stuart 2014). Insect outbreaks that are deemed to exceed their natural range of variation can alter natural processes, such as nutrient cycles, and precipitate or further the extent of future disturbances such as wildfires, which represent a major challenge and destructive force for Colorado communities (Dale et al. 2000). Ironically, it is the suppression of wildfire and resultant processes of regeneration that is associated with the unique susceptibility to insect outbreaks seen in dense, homogenous forests (CSFS 2005).

Adult MPB preferentially seek out mature lodgepole (*Pinus contorta*) and ponderosa pine (*Pinus ponderosae*) trees to bore into, mate, and deposit eggs. Once in a tree, beetles emit aggregation pheromones that attract other beetles, and after many beetles have attacked the tree, they emit an anti-aggregation pheromone to ensure their eggs have sufficient resources (Petersen and Stuart 2014; Raffa et al. 2008). The beetles carry a fungus that stains the wood of the affected trees blue and obstructs the trees' water-transporting vessels while beetle larvae eat the trees' inner bark (CSFS 2005). Forests with an abundance of mature trees provide an ideal opportunity for beetles to reproduce and reach epidemic levels (Petersen and Stuart 2014).

Aside from the direct effects to beetle populations associated with the age of the available trees, epidemic-level outbreaks of MPB are attributed to more complex and broader climate-related variables, including drought and warming average temperatures (Bentz et al. 2010). Even with an abundance of prime host material, extended periods of cold temperatures have historically served as an effective regulator of MPB populations (Carroll et al. 2003). Warming temperatures speed up the life cycles of beetles, leading to increased numbers of individuals in populations and reducing generation times. In the context of disturbance events of unprecedented scope and intensity, the resilience boundaries of the rest of the forest ecosystem are under threat (Bentz et al. 2010).

3 Human Dimensions of Forest Insect Disturbances

Exploration of the human dimensions of forest insect disturbance represents a burgeoning area in the study of human–environmental interactions. Existing work examines the linkages between disturbances and broader socioecological systems at multiple scales; considering how local disturbances are informed by global forces including the market and changing climate (Bentz et al. 2010; Dale et al. 2000, 2001; Petersen and Stuart 2014), and how disturbances affect the attitudes and risk perceptions of local communities (Chang et al. 2009; Flint and Luloff 2007; McFarlane and Wilson 2008; Müller and Job 2009; Parkins and MacKendrick 2007; Qin and Flint 2012; Qin et al. 2015).

There is a discernible link between global climate change and forest disturbances including insect outbreaks (Bentz et al. 2010; Dale et al. 2000, 2001). While disturbances have always served an important role in shaping the composition and functional processes of forests, the frequency, intensity, and magnitude of recent disturbances are traced to changes in climate. Given the tendency of disturbances to interact and cascade within ecosystems, their increased prevalence represents a unique and unprecedented challenge for forest-dependent communities (Dale et al. 2001).

While the link with global climate change is important to consider, it is insufficient as a sole explanation for insect disturbances as it neglects the specific socioeconomic, political, and cultural forces that contribute to disturbance events and human community responses. Recognizing this deficiency, Petersen and Stuart (2014) engage a political ecology perspective to consider an MPB outbreak in British Columbia, which was regarded as the most severe beetle infestation in recorded North American history. They argue that too simplistic a link has been drawn between global warming and bark beetle outbreaks, effectively removing attention from global market pressures and local extractive industry practices that exacerbate outbreaks. In the case of British Columbia's outbreak, Petersen and Stuart argue that the scope and intensity was due to the timber industry's privileging of short-term economic gains by seeking to harvest unaffected old growth stands over the less profitable, beetle-affected timber, thus inhibiting the potential for timely regeneration and exacerbating the effects of the outbreak to forest communities.

Within the broader global context, much of the existing work in the human dimensions of forest insect disturbances is focused on community perspectives and responses (Chang et al. 2009; Flint and Luloff 2007; Kooistra and Hall 2014; McFarlane and Wilson 2008, 2012; Müller and Job 2009; Parkins and MacKendrick 2007; Porth et al. 2015; Qin and Flint 2012). Community contexts illustrate the collective and variable responses to natural events and the specific effects of tree health management on a local level. Disturbance-affected communities offer sites at which it is possible to see the interaction between local residents and management entities and the relations of trust and power implicit in these interactions (Porth et al. 2015). The community interactional perspective is engaged to explore the spruce bark beetle (*Dendroctonus rufipennis*) outbreak on the Kenai Peninsula in Alaska and the MPB outbreak in Northern Colorado (Flint 2006; Flint and Luloff 2007; Flint et al. 2012; Qin and Flint 2010; Qin et al. 2015). In these cases, risk perceptions and attributions vary by affected community, illustrating each community's unique and collective experience of the disturbance (Flint et al. 2012). As insect disturbances usher in further disturbance regimes, the shifting priorities of community members

indicate the extent to which environmental problems and vulnerabilities are socially constructed as "social, institutional, environmental and cultural processes shape the way society experiences risk," with these forces and processes coming to coalesce at the community level (Flint 2006, p. 1598).

The fluidity in value-laden community experiences of, and responses to, insect disturbances is globally visible in a synthesis of forest insect disturbances in Canada, the USA, and the Bavarian forests in Germany (Flint et al. 2009). The synthesis notes the extent to which disturbances, as all ecological events, are viewed through complex cultural and economic lenses. Combined with local political and legal frameworks that work to create and constrain management opportunities, these broader forces ultimately determine how communities are moved to respond in the face of threats (Flint and Luloff 2007; Tomlinson et al. 2015). This process is inherently dynamic and shown to change over time as a community's economic history, amenity status, and biophysical features inform perceptions of risk, responses to disturbances, and ultimately a specific ecological imaginary, or idea about what the landscape should look like (Flint et al. 2012; Qin et al. 2015). Illustrating a similar fluidity, in national studies in the UK, attitudes about management are shown to vary by demographic factors, with men and older people favoring more aggressive management and women and young people more targeted management (Fuller et al. 2016).

Though the political ecology perspective is relatively underutilized in the study of the human dimensions of insect disturbances, Müller (2011) focuses on landscape as a cultural object and the symbolic meaning of disturbances and the sociocultural reverberations of bark beetle outbreaks. His case study explores the symbiosis between landscape ecology and sociopolitical forces in discussing how the image of the disturbed landscape becomes symbolic of the political process of forest management, and the deep cultural, identity-based significance of landscapes to local groups.

Inherent in both the social forces that precipitate forest insect disturbances and the perceptions of and responses to those disturbances are embodied conceptions and experiences of nature, or environmental subjectivities that coalesce at the community level. Considering the existing

literature on the human dimensions of forest insect disturbances and the important role of communities in filtering both individual experiences and systemic forces, there is a need to further understand and empirically investigate the political and psychosocial, structurally entrenched forces that inform community perceptions of nature and emergent environmental narratives.

4 Environmental Narratives

Environmental discourses and the individual narratives they are composed of are fundamentally discourses of power, producing particular environmental subjectivities and individual-level experiences of environmental phenomena in the course of their exercise. This perspective, which draws on a Foucauldian interpretation of disciplinary power, has been referred to as "green governmentality" (Rutherford 2011, p. xvi). It seeks to interrogate the sort of stories that are being told about an environmental event, in this case an outbreak of MPB, and more importantly the consequences of those tellings for understanding how individuals and communities interact with environmental disturbances, and the various structural factors that inform the attribution of causality. Such discourses and narratives then, in line with a Foucauldian understanding of power, are fundamentally productive (rather than repressive) forces, producing understandings and subjectivities. Furthermore, local narratives and the broader global discourses they uphold are not simply stories, but are created relationally by the interaction of individuals and communities with their material and institutional contexts.

Within this conceptual framework, this work seeks to investigate how the MPB outbreak in northern Colorado during the early 2000s functioned as a site for the emergence and deployment of various environmental narratives, and how these narratives are nested within broader institutional and power arrangements within the area and globally. When evidently natural ecological events prove disruptive to the habitual flow of local society, an official narrative of explanation emerges alongside competing local narratives that are framed according to the

vital interests of different actor groups, which are themselves positioned in complex and contested political, socioeconomic, and ecological contexts (Bixler 2013). Jasanoff (2010) writes that the competition between scientific and local narratives and conceptions of the non-human world are contentious because they separate the epistemic from the normative, or global fact from local value and issue a totalising image of reality without due consideration of the nuanced, complex, and culturally embedded investments communities have made in constructing reality as they know it. This work seeks to begin to untangle some of these nuanced investments in reality and how they vie with "official" explanations for recognition as truth.

Communities in the MPB-affected areas offer sites to capture the interaction and competing influence of various socioeconomic and political influences in determining emergent environmental narratives. The local community is recognized as situated at the nexus of broader society, and the lived, local environment, and community contexts, or the socioeconomic and biophysical features of local places, provide filters for individual experiences (Qin and Flint 2010). The local community is the conduit whereby individual social identities are established through social interaction and the place where people encounter the physical environment as part of their lived reality. It is where life is "least abstract," and where broader issues of market-driven inequality and power discrepancies that occur on a national or international scale converge to define individual experience (Wilkinson 1991, p. 24). Furthermore, the community's locality is the plane at which the effects of disturbances are most immediately felt and where successful work to mitigate their damages is most visible (Bridger and Luloff 1999). The social and biophysical community context effectively mediates both the construction of and response to an environmental event.

In the interactional framework, the physical place of a community constitutes the "spatial manifestation of a fundamental organization of interdependencies among people" (Wilkinson 1991, p. 53). While abstraction of the particular to the generalizable may be regarded as the method by which science achieves its universality and weight, communities are undeniably specific: constituted by specific people living grounded and particular lives in identifiable places (Jasanoff 2010).

With such an understanding, communities provide a compelling context in which to consider environmental identities and the exchange between official and local narratives, and the local-level implications of systemic power structures.

5 Study Area and Methods

Between 1996 and 2007, a massive outbreak of MPB (*D. ponderosae*) swept through north central Colorado, killing upwards of 3.4 million acres of primarily lodgepole and ponderosa pine trees and priming the landscape for further ecological disturbances in the forms of invasive species and fire (CSFS 2016; Qin and Flint 2010; Qin 2016). Although MPB are endemic to Colorado forests, this particular outbreak was unprecedented in both spatial extent and tree mortality; leaving massive swaths of dead, rust-colored trees throughout the northern part of the state and affecting communities throughout the region (Flint et al. 2012).

The research combines an interpretive approach based on understanding contextualized values, meanings, and representations of experiences conveyed in organization documents with results of interviews and a household survey in nine study communities in north-central Colorado: Breckenridge, Dillon, Frisco, Granby, Kremmling, Silverthorne, Steamboat Springs, Vail, and Walden. The analysis draws on a tri-part knowledge framework to integrate scientific, local and professional perspectives to address research questions, interpret the implications of the findings, and frame their local and extra-local applications. The various methodological components are integrated for their complementarity rather than for strict triangulation (Greene 2007). In other words, different forms of data drawing on different knowledge networks are integrated to tell a holistic story of the social construction of the MPB forest disturbance.

The empirical basis for this work begins with an analysis of the environmental narratives conveyed in organizational documents of purposively selected community and regional actor groups including CSFS, the Colorado Timber Industry Association (CTIA), and the Sierra Club

and Wilderness Society, the two preeminent environmental advocacy organizations in the area. Organisations were selected to represent diverse institutional perspectives on the local environment and to assess the linkages between institutional narratives and the environmental subjectivities of community residents.

Colorado Forest Service annual reports for the outbreak period, CTIA outbreak period newsletters where MPB is discussed, and beetle-related literature disseminated by the Sierra Club and Wilderness Society during the 5-year period around the survey time, 2004–2008 (near the MPB outbreak peak period), were analyzed to assess: (1) whether, and the extent to which, the outbreak is problematized, (2) the attribution of the outbreak, and (3) the proposed course of action. Documents were collected for the indicated time period, read for discussion of MPB (one among many perceived threats to the health of Colorado forests), and those areas where the MPB outbreak was discussed were coded according to the above criteria. As nearly 60% of land in the Colorado mountains is owned and managed by the state or federal government (Riebsame et al. 1996), the Forest Service reports offer the dominant narrative of the outbreak and hold a position of authority in determining action plans for the majority of the affected area. Thus, much attention in this work is devoted to analyzing these reports. The Forest Service's narrative is countered by the voices of industry and environmental groups.

The area affected by the outbreak is home to a spectrum of socioeconomic and amenity characteristics, containing two distinct clusters of communities: high amenity resort communities with a large proportion of high socioeconomic status absentee property owners, and lower-amenity, lower socioeconomic status communities characterized by their recent roots in extractive industries and agriculture (Flint et al. 2012). To contextualize the outbreak in the specific places of communities and balance the critique of disembodied interests operating at the state and regional scales, interviews with community members and the results of a survey from the study communities were analyzed to further assess the features of narrative framing and environmental subjectivity listed above.[1]

A total of 165 key informant interviews were conducted in the Summer of 2006 to explore the range of experiences across the study area. To draw on multiple perspectives, key informants included individuals from schools, businesses, libraries, government, clergy, fire or police, community organizations, logging industries, environmental organizations, forest management agencies, and newspapers. These interviewees included both longtime residents and newcomers. The interviews focused on interviewees' attribution of the MPB outbreak, perceptions of land management entities, how the community experienced and responded to the outbreak, and the extent to which they felt their community was able to coalesce and act collectively. Interviews were recorded, transcribed, and thematically coded. Quotations that typify emergent themes are included in the results below.

A mail survey was developed based on the preceding key informant interviews and was administered to 4027 randomly selected households in nine study communities in the Spring of 2007, with a total of 1346 surveys completed and returned. The survey included questions that focused on respondents' environmental subjectivities and the features of narrative framing listed above, including perceptions of forest risks, faith in the forest industry, and trust in forest management (e.g., agreement/disagreement with statements dealing with inherent versus use value of forests and citizen representation in management decision making), support for forest industry options (e.g., biomass/biofuels power generation and small-scale timber processing), as well as satisfaction with land managers (e.g., private individuals and landowners, local fire departments, city and county governments, the US Forest Service). Risk perception was measured by asking respondents how concerned they were about a series of forest risks for their community, including fire, decline in wildlife habitat, increased erosion and runoff, loss of forests as an economic resource, loss of scenic/aesthetic quality, and loss of community identity tied to the forest (possible responses ranged from 1 (not concerned) to 5 (extremely concerned)). The survey also assessed attitudes about the values of forests and forest management. The level of agreement or disagreement was measured with a series of thirteen statements on a scale from 1 (strongly disagree)

to 5 (strongly agree). Examples of statements include "forests should be managed to meet as many human needs as possible," "forests should be left to grow, develop and succumb to natural forces without being managed by humans," "the present rate of logging is too great to sustain our forest in the future," and "forestry practices generally produce few long-term negative effects on the environment." Respondents were also asked to indicate their attitudes from 1 (strongly oppose) to 5 (strongly support) about different forest industry options and levels of satisfaction from 1 (very dissatisfied) to 5 (very satisfied) with main natural resource management entities. The survey data also included information on the main sociodemographic characteristics of respondents such as age, gender, ethnicity, education, annual household income, political views, and employment in the forestry or agricultural sector. Key variables were explored with one-factor analysis of variance to assess variations across the study communities. In the comparison of newer and longer-term residents on major survey variables, two-tailed independent t-test, two-sided Mann–Whitney *U* test, and chi-square tests were used for numerical, ordinal, and categorical variables, respectively.

6 Results

6.1 Organizational Narratives

6.1.1 Colorado State Forest Service

In 2004 the Colorado Forest Service's annual report specifically focused on the ecology, condition, and management of ponderosa pine forests. At this time aerial surveys had recorded approximately 1.2 million trees killed by the MPB—nearly one hundred times the mortality at the beginning of the outbreak, in the mid-1990s (CSFS 2005). The MPB outbreak in affected areas was called "the most damaging insect and disease situation affecting Colorado's state and private lands," and the report emphasises the increasing insect populations and activity periods and the drought conditions that made trees particularly susceptible (CSFS 2005).

In this and subsequent years, the Colorado Forest Service annual reports make calls for thinning and diversifying forest stands to pre-settlement densities and diameter distributions as a substitute for the natural processes of forest succession that have been suppressed since settlement in the late 1800s (CSFS 2005). The MPB outbreak is held up as an example of the consequences of reactive rather than proactive management. In the 2005 issue specifically devoted to the health and management of aspen forests, the authors write that, "unlike the mountain pine beetle situation, we still have the opportunity to be proactive in the management of Colorado's trademark aspen forests" and later, "less than a quarter of Colorado's lodgepole pine trees are small enough to be resistant to MPB. Without forest management, future landscapes will be vulnerable to another widespread outbreak" (CSFS 2005). In this way, the outbreak is framed to encourage wider public acceptance of a more aggressive management paradigm in Colorado forests. This treatment of the MPB outbreak as an example of inadequate management appears consistently throughout the report, as other disturbances are linked to the MPB and the limitations of curbing an outbreak once it is underway reinforce the Forest Service's belief in proactive, aggressive management. An admonishing tone emerges at the end of a letter from the chairperson of the Colorado Forest Advisory Board appearing in the issue:

> As members of Colorado's Forestry Advisory Board, we encourage all Coloradoans to better understand the natural processes and human decisions that influence the condition of our forests – and support proactive treatments that improve that condition before negative impacts occur. (CSFS 2005, Introduction)

At the height of the MPB outbreak in Colorado in 2006 and 2007, the Forest Service's annual report on the health of Colorado forests details the extent and anticipated effects of the outbreak (CSFS 2008). The outbreak is contextualized as part of a complex set of issues threatening the future of Colorado forests, including forest fragmentation due to rapidly increasing development, fire suppression, and climate change. The authors of the report write that:

> Two features of the current outbreaks appear to be unprecedented: (i) mountain pine beetle is now killing lodgepole pine at higher elevations than previously seen; and (ii) several different species of bark beetles are undergoing outbreaks at the same time, simultaneously affecting several different forest types and regions of the state. (CSFS 2008, p. 6)

The most emphasized risks associated with the outbreak by the Forest Service are the loss of clean air and clean water, particularly for the increasingly populated Front Range metropolitan area which relies on watersheds in affected areas for drinking water, and the loss of revenue for local, forest-dependent economies. The unprecedented scope and intensity of the outbreak is attributed to warmer temperatures associated with climate change, and a lack of effective forest management which has resulted in overgrown forests of older, less resilient trees (CSFS 2008).

While the outbreak is problematized in its own right (trees are dying and trees are vital to forest ecosystems), the Forest Service's report repeatedly emphasizes the precipitous effects that the outbreak can have in creating ripe conditions for wildfires that are predicted to exceed historic levels and intensities. The report contains images of huge swaths of beetle-killed forest alongside images of thriving young pine and aspen trees in actively managed areas.

A clear link between beetle kill, fire, and the potential for drinking water contamination in an area with a booming amenity migrant population is also emphasized. As described in the 2006 report, most of the MPB activity is located at the headwaters of Colorado's and many other Western state's drinking water supplies. To this end, the Forest Service promotes the need for more aggressive management throughout Colorado forests, including "harvesting timber, removing poor quality or low-value trees, forest thinning, prescribed fire and regulating development within fire prone forest types" (CSFS 2008, p. 6).

With a growing sense of urgency, the changing image of the landscape is noted as cause for concern. The 2006 report reads, "the resulting landscapes may not meet society's desires and needs and could be even less appealing than those created by the current mountain pine beetle epidemic" (CSFS 2006, p. 3). While the outbreak is a natural event,

the consequent image of the landscape conflicts with the prevailing ecological imaginary, or idea of what the land should look like.

In the 2007 report, a management paradigm favoring a higher degree of intervention is framed as the most near-term solution for beetle-related issues, with a special role to be played by industry. The state has never had a large forest timber industry, and in 2007 only around 5% of available timber was being actively harvested, with only 5 mills in the state employing more than 50 people (CSFS 2008). Although sustainable harvesting is framed by the Forest Service as an integral part of working to regenerate forests and add diversity to the landscape, in 2007 at least 90% of all wood products used in Colorado were imported from other states or foreign countries (CSFS 2008). According to the Forest Service, obstacles to the implementation of more sustainable harvesting include funding shortfalls, a lack of processing facilities, and a lack of social acceptance for the necessary harvesting.

6.1.2 Colorado Timber Industry Association

CTIA describes themselves as a trade association that advocates for Colorado's forest products, companies, and for scientific, sustainable forest management (CTIA 2016). It is composed of nearly 50 forest product and logging companies from throughout the state.

As with the Forest Service annual reports, CTIA newsletters were collected for the outbreak period and examined for discussion of the MPB outbreak. In the Spring 2006 edition of the association newsletter, the president describes how he is often confronted with the question, "where is the timber industry and why aren't they cleaning up this big bug mess?" (CTIA 2006, p. 2). In response, he writes:

> The same people who spent 25 years trying to put me out of business have been spending the last 5 years trying to work me to death! When we the people chose not to properly manage the forest, Mother Nature takes over and many of those who pressured the Forest Service not to allow any tree cutting seem to be changing their tune. (CTIA 2006, p. 2)

The CTIA newsletter cites an as yet undiscussed contributor to the dense forest stands that were instrumental in the scope of the outbreak: the Forest Service's decision to limit pre-commercial thinning of lodgepole pine trees. According to the organization, this decision can be traced to the US Fish and Wildlife Service's classifying the lynx as an endangered species. As the Endangered Species Act requires the maintenance of critical habitat for designated species, this decision meant the prioritization of lynx management over other aspects of forest management. The industry argues that the Forest Service has "abdicated their forest management responsibilities to wildlife biologists and the US Fish and Wildlife Service" (CTIA 2006, p. 4). In the eyes of the timber industry, the best way to avoid future insect outbreaks is to reverse this prioritization of lynx management over timber management and thinning of regenerated lodgepole pine stands (CTIA 2006).

The Winter 2006 edition of the association newsletter emphasizes the role to be played by industry in maintaining the forest as "Mother Nature's healthy alpine garden" (p. 2). Accordingly, the bark beetle epidemic is framed as symptomatic of an unhealthy, unmanaged forest. The CTIA president writes in his newsletter message, "we must realize that we are a tool to be used to prevent the over aged, overstocked, and generally unhealthy conditions which have promoted such outbreaks as the present bark beetle epidemic" (CTIA 2007, p. 2). This narrative appears consistently throughout the text: that the beetles are the consequence of a diminished industry presence and that the timber industry is the true caretaker of Colorado forests.

The newsletter also contains a comic depiction of a forester, equipped with a chainsaw, pressing a stethoscope to the trunk of a tree inscribed with the words *National Forest*. The caption reads: "You're in terrible health!! You have heart rot, root rot, bugs and more! Who's taking care of you?!" (CTIA 2006, p. 6).

Later in the newsletter, the executive director of CTIA laments the plummet of North American lumber markets that began in the Summer of 2006. While Colorado markets were not as affected by the downturn as others, he contextualizes the market downturn within the Forest Service's call for the increased role of industry saying:

> The fall in lumber prices has coincided with increased public support for increasing timber harvest levels to respond to overall forest health concerns, especially the mountain pine beetle and spruce bark beetle epidemics in Colorado's national forests. But the current lumber markets make it harder for sawmills to respond as aggressively as they, or the public, would like. (CTIA 2006, p. 6)

As a fundamentally economic interest, the constraints of the market necessarily inform the critical position the timber industry adopts in responding to the outbreak. This management constraint is added to those presented by the Forest Service.

6.1.3 The Sierra Club and Wilderness Society

Throughout the timber industry's newsletters, there is a clear frustration with the environmentalist, preservationist ethos that has informed the management of Colorado forests. A dominant voice of this environmentalist perspective, and one directly criticized by the industry, is that of the Sierra Club. In a special newsletter that examines the MPB outbreak, the Sierra Club emphasizes that the bark beetle is native and that insect disturbances play an important role in forest succession. In contrast to the Forest Service and the timber industry, the Sierra Club argues that fire suppression has *not* altered the frequency of fires or the density of the forests. Instead, to account for the scope and intensity of the MPB outbreak, they point to more global environmental phenomena, specifically drought and warmer temperatures (Bidwell 2008).

While the Forest Service raised alarms in their reports about beetle-killed trees being a catalyst for catastrophic wildfires, the Sierra Club argues that the risk posed is minimal, and at the most merely one of many fire threats faced in Colorado forests (Bidwell 2008). Looking forward, the thinning of forests is deemed an impractical response and a risk factor for crucial wildlife habitat.

The Wilderness Society describes itself as the leading American conservation organization working to protect wilderness areas. Though it is a leading environmentalist voice, there is relatively little literature

devoted to the MPB outbreak, indicating that despite the alarm raised by the Forest Service and timber industry, it is not of great concern to environmental entities. In an article about the MPB outbreak, the author distills the organization's position on the outbreak, the extent to which it constitutes a problem and the proposed course of action into several talking points, which emphasise that despite the scope and scale of the outbreak the forests are resilient and sufficiently diverse to endure, and that beetle-killed trees do not pose any significant or particular danger in terms of erosion or fire (Aplet 2009).

The prevailing tone from both organizations is one that lacks the alarm and outrage apparent in the literature of the Forest Service and the timber industry, ultimately arguing that the beetle outbreak is a natural event, and the forests will "recover relatively quickly" (Aplet 2009).

6.2 Community Perspectives

While the above-organizational narratives illustrate the interaction of various local and regional interests with the MPB outbreak, the histories, biophysical, and socioeconomic contexts of the communities themselves produce distinct ecological imaginaries and environmental narratives. Interviews and findings from the 2007 survey of MPB-affected communities illustrate how experiences of the outbreak are informed by community contexts (Flint et al. 2012). Survey findings indicated that respondents in the lower-amenity communities of Granby, Kremmling, and Walden were relatively older, of lower income and education and had resided in the communities for a longer period of time than residents of the other communities. Relative to other communities in the beetle-affected area in north central Colorado, Vail, Steamboat Springs, Frisco, Breckenridge, Silverthorne, and Dillon are distinguished by high average household income, high educational attainment, low levels of employment in forest management, forest industry or agriculture, and relatively liberal political views.

This clustering according to sociodemographic and economic indicators corresponds to a clustering of attitudes and ascriptions to particular paradigmatic views about the health and appropriate management of the

forests: a more preservationist, minimal intervention approach among the more affluent and liberal communities, and an approach that supports a greater degree of intervention and utilization of industry options among the less affluent, more timber-dependent communities. The relationship between Walden, Kremmling, and Granby and the timber industry proves a strong one with regard to levels of trust in land managers and perceptions of outbreak response options. Survey respondents from these communities were highly supportive of pursuing all industry options, including biomass and biofuels power generation, large- and small-scale timber processing and niche marketing/production of wood products, and were characterized by high levels of trust in private logging companies, relative satisfaction with the work of local land managers and markedly low levels of trust in environmental organizations and the Forest Service.

The role of the timber industry in defining community perspectives and approaches to MPB is clear in interviews with residents of these communities. As a Walden resident described:

> It's what we have been raised in, we know more about managing the forests than half of the people living in the city. And we respect the land.

These sentiments are echoed by residents in similar communities, with a Kremmling resident saying:

> …our roots are in logging and our roots are in timbering. So we feel that the government has ignored this issue to the point where it's gotten to the point of an epidemic and now uncontrollable […] They're all tree-hugging bastards. I'm a tree-hugger. I love trees, there's a need for them, but they don't look at the all-around picture.

There is a tangible and at some points visceral frustration with the outbreak as an unnecessary consequence of the diminished role of loggers and industry in forest management. Many residents who were interviewed saw the outbreak as a direct effect of the decline of the logging industry and the ascension of a management paradigm of minimal intervention and preservationist attitudes that reflect the priorities and interests of more amenity-oriented and affluent communities.

In reflecting on the economy and general quality of life in these communities with less amenity orientation, clear correlations are drawn between the health of the forest and the socioeconomic stability of the town, which one Walden resident describes as, "a real crisis area." The closing of local sawmills followed by the closing of the railroad in the early 1990s was referred to as major catalysts for the economic downturn, and multiple residents refer to the challenges associated with keeping public schools open. One resident summarized the challenge of remaining in Walden saying:

> We've got 3 kids and found ourselves many, many, many times at the end of the month with not enough money to pay bills and thought, you know, this is a great place to live, but you can't eat the scenery.

A nearer-term solution for residents in these communities was removing affected trees as swiftly as possible. Looking more long term, residents saw the potential expansion of the forest products industry as something important for the vitality of the forest, the town economy, and to keep young people from leaving when they graduate high school.

By contrast, more amenity-oriented communities had considerably lower levels of faith in the forest industry and relatively higher levels of trust in prevailing management regimes. Looking at community variations in support for forest industry options in responding to the outbreak, these respondents were generally less supportive, and particularly opposed to large-scale timber processing. For resort towns, the aesthetic loss associated with beetle kill was frequently cited as a problem for vacationers, and for residents who depend on tourism revenue. As a resident in Vail described, "it's really the visual as opposed to the potential danger." When it comes to devising a plan for dealing with the outbreak, residents in these communities generally favored a more restrained approach to management, with one Steamboat Springs resident saying:

> I don't think anybody likes to see logging trucks go into the wilderness, because we're all really avid outdoor enthusiasts here and we like to enjoy our forests.

While individual responses to the outbreak, such as taking specific action on private land or attending community informational meetings, were only moderately variable between communities, the differences in attributions of the outbreak, feelings of trust in local and state management, and support for industry options suggest fundamentally different experiences and vulnerabilities. Residents with histories in extractive industries felt constrained and marginalized in decision making, ultimately seeing the outbreak as a consequence of their diminished role in forest management. Nevertheless, in resort towns where the landscape has been commodified to fuel a tourism industry and draw amenity migrants, the aesthetic loss associated with beetle kill was a dominant concern among respondents.

For more amenity-oriented community participants, perspectives focused on the economic ramifications and uncertainty caused by the MPB outbreak, and these interviewees noted the way that responses throughout the region were economically constrained. A Vail resident pointed out that those with the means to do so can engage in more mitigation work:

> It's really driven by both economics, size of the organization and its ability to address issues. If you've got a poor homeowners association with a lower economic scale, they are less likely to do something. If you've got a homeowners association that is in a trendy mountainside tree surrounded environment, they are probably a little more attuned to what needs to be done. More buck to bang with.

A Breckenridge resident said, "Our economic base is basically tourism and we're 70% national forest land in the county. Anything that affects 70% of the county is obviously going to be a very important thing in the county." Noting that not all people appreciated risks, a Vail resident said, "There's so many billions of dollars of infrastructure at risk that people don't seem to be aware of although I think they're getting there."

Additionally, better relationships between local residents and resource management agencies were described in higher amenity communities, including more understanding of the limitations faced by local forest managers:

> We have a good collaboration with the Forest Service. They have the technical…they virtually have no dollars to help with actual cutting, but they have helped us a lot with the technical aspects of it. (Vail)

> No local community will be able to get anything done. I don't even think any single state will be able to get anything done. The only way we will see something done is if the affected western states pull together. (Breckenridge)

6.3 Newcomers and Old-timers

A further area of difference among residents' experiences of the outbreak and perceptions of appropriate responses was the time they had resided in the affected communities. As a natural amenity destination, northern Colorado has seen a marked influx of migrants in recent decades. US Census data for the five non-metropolitan counties in the study area (Eagle, Summit, Grand, Routt, and Jackson) show that local population increased more than four times from 22,673 to 119,937 between 1970 and 2010 (Qin 2016; US Census Bureau 1970, 2010). This influx of new residents implies an influx of unique, culturally situated attitudes about the local environment.

A longtime resident of Steamboat Springs spoke of the changing demographics of the community:

> 30 years ago when I first moved to Steamboat […] We got together and had potlucks and made songs about the ski area and the coal mines. We were just poor and we didn't really care. For $50 a month, you could have a place to stay. Now, you're lucky to find something for $400 a month. So, as we sold our town as a commodity not a community, there's a huge monster comp up here, we have simply discounted the future. We discounted our kids, so they can't even live here, because we're a single economy environment […] we sell our community, with family values to the tourists as a commodity.

Resort town status also means unique obstacles to eliciting a cohesive community response to the outbreak. In the eyes of longer-term

residents, the increasingly fragmented socioeconomic base of the town is problematic for trying to catalyze community action. Residents commented on how second homeowners were less aware of the causal complexities of the beetle outbreak, had less investment in local life, and indicated that those who vacationed in the town were less likely to be supportive of management entities taking aggressive steps to mitigate fire risks like cutting trees or having controlled burns:

> It takes a lot of time for a second homeowner to understand the social and economic and environmental issues here because they're only here two or three weeks out of the year, and while they're here they want to ski… In the older days, even the rich people met a lot with the working people and the poor people. Nowadays, it's divided.

In reference to the MPB outbreak, 1980 was used as a cutoff date to compare the attitudes of longtime and newer full-time residents in the analysis of the community survey data. This cutoff meant that "oldtimers" already lived in the area prior to or in the early stage of the recent amenity in-migration and would have lived in the communities for more than 15 years at the start of the outbreak. As shown in Table 1, differences between the two groups were highly significant, illustrating both a demographic division and differences in environmental attitudes. On average, longtime residents were older, less educated, had lower household incomes, were more politically conservative, and were twice as likely to be employed in forestry-related occupations or agricultural production as compared to newcomers.

In terms of perceptional differences, newer residents had higher levels of perceived forest risks, less faith in the forest industry, and relatively more trust in forest management than longer-term residents. Newcomers were also less satisfied with local land management entities (private individuals and landowners, local fire departments, private logging companies, developers, and private homeowners associations), but comparatively more satisfied (or less dissatisfied) with government land managers (city and county governmental, the CSFS, the Bureau of Land Management, and the US Forest Service). Related to industry options for dealing with beetle-killed trees, newcomers were generally

Table 1 Differences between newer- and longer-term residents in sociodemographic and perceptional variables. Given as means of variables except for gender, ethnicity, and the two employment measures. No significant difference was found between the two resident groups in terms of gender or ethnical composition and support for biomass/biofuels power generation. Both categories included relatively more male than female respondents, were mostly white, and generally supported this forest industry option

Variable	Newer-term residents (Max $N = 894$)	Longer-term residents (Max $N = 323$)
Sociodemographic characteristics[a]		
Age	49.48***	57.56***
Gender	40.4% female	44.6% female
Ethnicity	95.6% white	96.5% white
Education	4.51***	3.91***
Household income	5.39$^{(*)}$	5.14$^{(*)}$
Political view	2.93***	3.29***
Forestry employment	13.2% yes***	27.3% yes***
Agricultural employment	20.0% yes***	41.3% yes***
Composite perceptional indicators[b]		
Risk perception index	3.67**	3.80**
Faith in the forest industry	2.65***	3.12***
Trust in forest management	2.65***	2.29***
Satisfaction with local land managers	2.88**	3.01**
Satisfaction with governmental land managers	2.71***	2.49***
Support for biomass/biofuels power generation	3.67	3.74
Support for large-scale timber processing	2.59***	3.24***
Support for small-scale timber processing	3.52***	3.98***
Support for niche marketing/ production of wood products	3.74***	3.97***

$^{(*)}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

[a]Variable measurement: gender (male or female), ethnicity (white or non-white), education (from "1" less than a high school degree to "6" advanced degree, i.e., Master's, JD, Ph.D.), household income (from "1" less than $15,000 to "8" $150,000 or more), political view (from "1" liberal to "5" conservative), and employment in the forestry/agricultural sector (yes or no)

[b]Computed as the averages of responses (on 1–5 Likert scales) to relevant survey questions following exploratory factor analysis. See Sect. 5 for further detail

less supportive of small-scale timber processing and niche marketing/production of wood products, and much more opposed to large-scale timber processing. These differences, occurring across the study area, illustrate the extent to which the local environment is constituted by and interacts with varying culturally and historically situated identities and interests.

7 Discussion and Conclusions

In analysing the above narratives, special attention was paid to the way organizations and respondents took part in the active construction of the pine beetle outbreak and the extent to which it constituted an environmental problem. Analyzing narratives from diverse stakeholders allows for the emergence of distinct story lines and attributions that can be linked to larger global environmental discourses. Such stories elucidate the interconnections and interactions between biophysical, social, economic, and political realms and structures (Bixler 2013). People from each organization and each community demonstrated particular understandings of the local environment and an emergent, socioeconomically and politically nested narrative of explanation.

With the exception of environmental organizations, consistently within their narratives, the Colorado Forest Service, the CTIA, and the less amenity-oriented communities faulted the restricted role of forest managers and industry in maintaining forest equilibrium; linking this diminished management role to the ideals of politically powerful, and largely newcomer residents. This is evidenced by the industry's complaints about decades of public pressure to diminish harvesting and later by the assertion that the Forest Service abdicated its role in managing forests to the Fish & Wildlife Service's efforts to leave forests undisturbed to protect the endangered lynx. Such an ascendant preservationist ethos is common in the American West, where amenity migrants are increasingly seeking a pristine, commoditized landscape (Walker and Fortmann 2003).

The Forest Service narrative is one that promotes the need for more active management, but is constrained by bureaucracy and public wariness about what such management entails. The industry narrative is one of systemic marginalization in the wake of market constraints and shifting public opinions about what sorts of activities should be permitted in Colorado forests. Within affected communities, the narratives surrounding the beetle outbreak are structured by socioeconomic characteristics and by varying ecological imaginaries, or conceptions of what constitutes a legitimate image of the landscape. This conflict is common in Western lands, which are increasingly sought out by amenity migrants seeking to consume an "imagined idyllic landscape" (Walker and Fortmann 2003). The conception of a humanless and pristine nature is starkly at odds with the ecological imaginaries and environmental subjectivities of longtime residents currently or historically engaged in extractive industries, as indicated in attitudes about the cause of the outbreak, appropriate levels of management, and the role of industry in maintaining Colorado forests. For them, the relationships with and expectations of the land are based around "work, management and ongoing transformation" (Robbins 2011, p. 206). Such a conflict is represented in the interaction of new migrants and long-time residents with the MPB outbreak. These groups vary significantly in terms of socioeconomic indicators but also in terms of attitudes about the roles of forest industry and management, levels of satisfaction with land managers and support for industry options moving forward. These differences indicate broader, culturally situated differences in beliefs about what should constitute people's relationship with the environment, and who can be trusted in critical decision making.

While other political critiques of MPB outbreaks attribute them to the prioritization of economic gains through overharvesting (see Petersen and Stuart 2014), the role of the logging industry in Colorado seems to have been constrained by the relatively privileged attitudes about what forested landscapes should look like, and what kinds of use are deemed socially desirable due to an increasingly tourism

and amenity-based economy. Given their economic histories, residents of less amenity-oriented, resource extractive communities have experienced the loss of a livelihood opportunity in the timber industry given the changing economy and the emergence of a specific, powerful ecological imaginary. Those in amenity-based resort communities are threatened by the loss of a particular, commodified image of the forest inconsistent with beetle-affected landscape.

Moving beyond the level of environmental subjectivities and ecological imaginaries, it is possible to discern linkages between the more systemic causal factors of narratives. Narratives consistently attributed the scope and intensity of the outbreak to insufficient management and global warming, yet in the context of the local logging industry's decline, and a period of massive population influx for the Colorado Front Range, at least 90% of all wood products used in Colorado were imported from other states or foreign countries, constituting an enormous expenditure of fossil fuels (CSFS 2008). Such an example shows the extent to which causal factors overlap and are fueled by the commodification of a particular ecological imaginary.

In conclusion, this work has sought to engage in a discourse and narrative analysis of the MPB outbreak in northcentral Colorado to consider the relationships between power, environmental narratives, and a constructed environmental problem. Intrinsic to these narratives are distinct and sometimes overlapping conceptions about what natural spaces should look like and what sorts of activities should constitute people's relationship with the environment. These narratives reveal the contested nature of nature in the discursive practices of actor groups. Tracing the narratives and the framing of environmental issues is an important part of developing empathy for different needs and vulnerabilities with respect to the environment, and can help shed light on how broader structures are implicated in environmental subjectivities. This sensitivity to unique environmental subjectivities and vulnerabilities is essential to the development of management regimes that are considerate and inclusive and ultimately, sustainable.

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Note

1. For detailed description of interview and survey methodology, see Qin and Flint (2010) and Flint et al. (2012).

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