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Chapter 7

The Role of Place-Based Social Learning

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> [Even] after the best of scientific studies a judgment must be made about the relevance of a piece of scientific research to a manager's . . . practical question at hand. In this judgment science is not at all helpful. . . . How to integrate the kind of knowledge that science can give with the practical judgment about what the [managerial] situation requires [remains one of the] great unresolved questions.
>
> —Hummel, *Public Administration Review*, 1994

Hummel's observations on the limits of science to inform practice provides a useful starting point for a book chapter devoted to examining post-normal environmental policy where the "facts are uncertain, values in dispute, stakes high, and decisions urgent" (Funtowicz and Ravetz 1993, 739, 744). Central to the argument here is that the integration of science with practice requires greater attention to the science of practice, and not just the practice of science. In particular, a geographic or place-focused approach can help explain why the science-practice gap persists and why efforts to close the gap often fail (Williams 2013). A place-focused approach helps us appreciate the inevitably incomplete and uncertain character of knowledge when applied to land management practice and highlights the way emplaced, networked practitioners can build a shared understanding of the situation. That is, rather than trying to solve wicked land management problems with an integrated top-down, or "normal," science-based view of knowledge, effective action can be conceived as the outcome of a social learning process that operates within a networked set of actors and institutions governing complex systems. In short, social learning can produce a collaborative form of rationality that operates both

horizontally (place-to-place) and vertically (upward and downward in scale) to achieve a more sustainable form of landscape governance.

The kinds of post-normal conditions noted by Funtowicz and Ravetz (1993) are emblematic of the modern challenges faced by many public land management agencies. In recent decades the practice of public natural resource management has shifted from the long-standing multiple-use, commodity production paradigm to a multiscaled ecosystem management perspective that emphasizes the sustainable provision of a much wider assortment of ecosystem services embedded in complex sets of social-ecological interactions at multiple spatial scales (Williams et al. 2013). This has made fact-finding all the more complex and uncertain and has further amplified the competing values at stake.

A typical response to the growing complexity of these problems has been to focus on synthesizing the burgeoning body of scientific knowledge as a way to better inform managers on the best available science. Driven by unrealistic ambitions to close the gap between science and practice, these efforts routinely fail to achieve their stated goals because they assume the solution to complexity and uncertainty resides in the availability, communication, or application of science rather than in how to organize or improve practice. In addition, these efforts largely ignore the political or institutional context—steeped in value conflict and controversy—within which this practice must be carried out. The more fundamental problem is that the character and conduct of "normal" (context-independent) science does not lend itself to coherent, ready application in a post-normal world marked by complexity, uncertainty, and controversy. This chapter therefore explores an alternative perspective on science and practice that emphasizes place-oriented (context-dependent) knowledge production and application for improving sustainable landscape governance. It begins with a case example that tries to close the gap through "normal" science synthesis, followed by an explication of a spatial/relational view of knowledge that emphasizes bottom-up social learning strategies for landscape governance. These strategies are then illustrated through two case examples to show how informed practice can be conceived as a collaborative form of rationality that emerges within place-based networks of actors and institutions.

FISH, FIRE AND THE CONUNDRUM OF "NORMAL" SCIENCE

An effort to synthesize the available science related to protecting the endangered bull trout provides an apt illustration of the problems posed by

knowledge complexity in pursuit of a "normal" top-down landscape-scale solution. The bull trout is native to much of the Pacific Northwest and western Canada. Ecological studies point to various conditions necessary to maintain the population, including maintaining habitat refugia, promoting episodic debris flows while avoiding chronic sedimentation, and regulating water temperatures within tolerance limits (Isaak et al. 2009). Numerous factors have contributed to local declines, including invasions by nonnative trout species, degradation and fragmentation of stream habitats, depletion of food supplies, warmer stream temperatures, more variable stream flows, and increased wildfires and stream channel changes. Moreover, addressing these threats to bull trout in concert with other land use considerations, and in ways that are financially and socially acceptable, creates an extremely difficult management environment.

To address one of the main threats to bull trout, in late 2007 the Pacific Northwest Research Station of the US Forest Service convened two workshops to assess the state of knowledge and identify research needs to support land management practices aimed at maintaining fish populations in fire-prone landscapes. The meetings were motivated by a widespread belief that "despite a growing body of empirically-sound but still disparate scientific studies," current policies and practices regarding fish and fire were based on "intuition, opinions, and informed guesses" (USDA 2008, 1). The first meeting brought together experienced land managers and fire practitioners to identify their information needs. The second meeting brought together an interdisciplinary group of research scientists from several federal land management agencies to assess and synthesize existing science relative to those needs.

The stated goal of both workshops was "to advance useable and applicable knowledge on how fish might best be managed in fire prone areas and how fire might best be managed in areas with important fish populations" (USDA 2008, 1). The research needs assessment coming out of the first workshop identified eight priority elements of a potential research program to "help policy makers, managers, and practitioners make more informed choices." These elements included aquatic/riparian ecosystem functionality, integration, risk assessment, monitoring, rapid assessment capabilities, public engagement, riparian areas, and invasive species. Each element was described in terms of a problem statement, information needs, existing knowledge, and current knowledge gaps. The problem statements were typically framed as "looking for well informed, science grounded guidance," applying the

"soundest available science" and "integrating current information from multiple scientific disciplines." For scientists the central task was to generate and communicate the relevant scientific information to managers. But aside from grudging admission that managers lack the time to read scientific articles and reports, little attention was devoted to the everyday challenges faced by managers, who are ultimately responsible for integrating specific information on fish and fire with all the other informational, institutional, and practical demands that the managerial situation presents.

The scientific workshop devoted two and one-half days to discussing the state of knowledge on the topic. Building on complexity theory in ecology, landscape ecologists highlighted the need to identify criteria for defining a resilient landscape. At the same time, ecologists pointed to the complexity of the phenomenon (patchy, multiscaled, dynamic landscapes) in which the best prescription for any one-stream network was elusive if not unknowable. According to these ecologists, no singular riparian condition could be described as necessarily better or healthier than another because the viability of endangered fish populations depended on dynamic spatial variation in which some patches (streams) were in the process of becoming improved habitat for a given species and some in becoming worse habitat. The role of discipline and problem framing in synthesizing knowledge was also evident, as current science could support contradictory recommendations depending on one's primary focus. For example, because stream culverts are impediments to the adaptive dynamics sought by systems ecologists (culverts disrupt the movement of fish populations through a watershed), removing them would increase the connectivity of streams and thus enhance the survival of the endangered fish species. On the other hand, if the biggest threat to the endangered bull trout is the spread of invasive aquatic species, removing culverts would make it easier for such species to spread, to the detriment of bull trout.

From a fire-management perspective, there is a good bit of irony in the basic conclusion that management prescriptions for what to do with wildfire on the landscape are elusive and highly dependent on the specific historical and spatial context. Early in the twentieth century, the advice to fire managers would have seemed universal and precise: put the fire out and do it, preferably, by ten o'clock in the morning. In other words, instead of clarifying best management practices, a contemporary synthesis of one hundred years of additional science appears to have increased the uncertainty about best practice for any one location. In managing habitat for endangered species, best

practice nowadays is increasingly understood as contingent on current local conditions as well as conditions in adjacent landscapes. The post-normal challenge then is figuring out how to coordinate each local manager's actions in a way that, at a larger scale, produces the kind of patchy dynamic system that supports healthy habitat for bull trout. A synthesis of the science is ill-suited to a problem that requires a network of managers sharing information and experience to produce dynamic coordination across the larger landscape.

Rather than providing actionable clarity, the ever-expanding body of scientific knowledge magnifies the complexity of practice. This is the central conundrum of normal science when applied to wicked-problem situations. On the one hand, the presumed power of scientific expertise to reduce uncertainty and complexity remains widely accepted within the professional ranks and institutions of environmental management. On the other hand, the gap between science and practice seems to defy most attempts to close it. Despite our best efforts at synthesis, most efforts to integrate, synthesize, and communicate the growing body of science fail to simplify practice (Collins 2014; Flyvbjerg 2001; Sarewitz 2004; Scott 1998).

For example, Scott (1998) illustrates how most attempts to impose a top-down planning mentality fail because they typically exclude local knowledge from consideration. He attributes this to the hegemony of a "high modernist" ideology that promotes overconfidence in scientific and technical progress. Similarly, Fischer (2000) attributes planning failures to the "over-application of scientific rationality to public policy making" (*x*). Collins (2014) makes the case that scientific integration is not some missing "ingredient" that can be applied to the situation by researchers (e.g., by organizing a synthesis workshop), but is instead a potentially emergent characteristic of a specific social-ecological context. For him the problem is how to better design social learning processes to make integration more likely to emerge. Others have gone so far as to suggest that science can actually make environmental controversies worse by providing contesting parties with their own bodies of relevant and legitimate facts (Sarewitz 2004). Scientific uncertainty persists and grows because of a lack of coherence among these competing scientific understandings, with conflicts further amplified by the various political, cultural, and institutional contexts within which the science is carried out. In sum, the science-practice gap persists because science aspires to produce context-independent principles, whereas practice requires context-dependent synthesis (Williams 2013).

Thus, rather than conceiving knowledge as the integration of an ever-expanding collection of facts and findings into a grand unifying model—presumably one that any practitioner could easily and effectively apply—in wicked-problem conditions knowledge can be understood more contextually as the accumulated wisdom that comes from shared social learning and the emergence of communities of practice organized not by discipline or algorithms, but by place-based interdependences. What might we gain by comprehending the structure of knowledge as embedded in and distributed across places and the people who occupy and interact with those places? Next we examine the potential of a spatial/relational model in which knowledge is produced, applied, and refined within a network of embedded, partially informed practitioners.

PLACE AND POST-NORMAL SCIENCE

In contrast to widely accepted views of science that presuppose a fundamental unity underlying all knowledge—for example, as embodied in E. O. Wilson's (1998) concept of consilience—a number of scholars point to a spatial, or relational, view of knowledge marked by an inherent *positionality* of observer-actors embedded in both vertical and horizontal relations to the world (Finnegan 2008; Livingstone 2003; Powell 2007; Rose 1997; Whatmore 2009; see also chapter 1 this volume). Unlike the naturalistic (positivist) epistemology guiding most ecological science (e.g., Lowe et al. 2009) some forms of constructivist epistemology regard knowledge as *ecologically* relational (situational and relative) to where one is positioned within a social-ecological field (see Allen et al. 2001; Hayles 1995). Accordingly, every observer of the world occupies a somewhat unique (subjective) position or place within that world by virtue of varying culture, history, training, embodiment, and personal experience that limits and conditions that observer's knowledge of it (Livingstone 2003). Likewise, in the real world of action where citizens and practitioners are embedded, knowledge is similarly partial and incomplete and likely over time to grow more fragmented than integrated (Hummel 1994; Whatmore 2009).

Given the inevitably varied positioning of each observer of the world, there is no unified platform from which all knowledge can be integrated into a single understanding: hence there will always be multiple forms of knowledge and competing understandings of particular situations. Rather than viewing this plurality as a failure, in post-normal situations recognizing

competing vantage points may actually enrich each perspective and expose assumptions that may have otherwise remained hidden, especially to those who have dominant roles in mapping knowledge (Hayles 1995).

The concept of place in geography provides a powerful lens for understanding this kind of epistemic pluralism (Williams 2014). Place functions not only as a location or container of material and social phenomena, but also as a way of seeing and thinking about the world (Cresswell 2004; Entrikin 1991; Sack 1992, 1997). As Sack (1992) argues, individual awareness and knowledge of the world is necessarily a spatial awareness, informed by the particular cultural, experiential, temporal, and spatial positions that we happen to occupy. Taking an epistemological perspective on place helps transcend what some geographers regard as a deep and long-running tension within Western intellectual traditions between universalist (context-independent) and particularist (context-dependent) views of knowledge (Entrikin 1991; see also Flyvbjerg 2001; Williams 2013). This tension has been particularly salient within natural resource management, where the progressive/scientific view of resource management inherited from Pinchot—built on the universalist impulse of science and knowledge—has always collided with land management practice, which by necessity operates in the arena of the particular (Williams et al. 2013).

When dealing with wicked-problem conditions, all attempts to close the gap and overcome plurality and uncertainty ultimately rely on being able to attain some universal, context-independent, god's-eye view of reality. Alternatively, adopting a spatial or place-based perspective helps us recognize that all knowledge—even exalted scientific knowledge—is to a significant degree local or context-dependent because all observers and actors, by virtue of their biography and geography, occupy a particular, delimited position from which to observe the world. Though pluralism is also unavoidable in the realm of practice, recognizing and profiting from different kinds of knowledge and skills can become an advantage. As the fish and fire example shows, natural resource practice requires the cultivation of a capacity for collective sense-making that moves beyond the mere application of science and technical information. In other words, it is through real-world practice, embedded in actual places, that knowledge pluralism and value differences are ultimately reconciled.

The principles of pluralism and positionality underscore the value of emplaced practitioners learning and operating in real places and developing

context-dependent knowledge. This is not to argue against investing in science, only that it is unreasonable to expect those investments alone to deliver efficient and effective solutions to the post-normal conditions of high complexity, uncertainty, and value controversy. At the very least we need to recognize that those who are engaged in practice cannot be expected to readily absorb the ever-expanding, often conflicting science that might apply to their practice. Rather, what is being argued here is that we need to develop more adaptive strategies for using and accessing the accumulated wisdom of the practitioners themselves as they go about their work, and help them harmonize their local efforts across adjacent spaces and at multiple spatial scales. Addressing the science-practice gap requires a rethinking of how practical knowledge is produced and applied in dynamic, adaptive systems. This brings to the fore questions of how individual practitioners might learn and apply local experiential knowledge.

PLACE AND THE SCIENCE OF PRACTICE

One place-based strategy for addressing the chronic insufficiency of knowledge in the face of unrelenting complexity, uncertainty, and conflicting values has been to adopt some version of adaptive management (Stankey et al. 2005). In theory, adaptive management involves multiscalar, place-sensitive policy experimentation (and by implication more case/context-sensitive knowledge) as a way to mitigate scientific uncertainty. As actually practiced however, it hasn't lived up to its promise (Allen and Curtis 2005).

First, as a pragmatic approach to sorting through competing management prescriptions for a place or landscape, adaptive management still tends to privilege formal scientific knowledge over other forms of knowledge held by local practitioners and residents (Stankey et al. 2005). Second, it hasn't been adaptive enough with respect to questions of value (Norton 1999). Third, it pays insufficient attention to the types of institutional structures and processes necessary for it to work on a large-scale basis (McLain and Lee 1996). Thus, as a potential post-normal strategy for addressing the science-practice gap, it hasn't fully embraced different ways of knowing and acting that emphasize local experiential knowledge and values of embedded practitioners (Fischer 2000). A number of social scientists (Collins 2014; Fischer 2000; Flyvbjerg 2001; Scott 1998; Wenger 1998) make the case that more could be done to integrate and profit from the practical and informal knowledge that exists among both occupants/users of places and emplaced professional practitioners.

Flyvbjerg (2001) builds his argument on the value of context-specific knowledge and practice by reference to the Aristotelian distinction among three forms of knowledge: *episteme*, *techne*, and *phronesis*. Whereas *episteme* refers to knowledge that is abstract and universal and *techne* describes the know-how associated with practicing a craft, Flyvbjerg seeks to resurrect Aristotle's idea of *phronesis* (practical wisdom) as the unique domain of the social sciences. In contrast to the natural-science model, which is rooted in *episteme* and *techne*, Caterino and Schram (2006, 9) describe *phronesis* as the practical wisdom that comes from "an intimate familiarity with the contingences and uncertainties of various forms of social practice embedded in complex social settings." In addition, *phronesis* concerns the kinds of value judgments and decisions that are so interwoven with political and administrative practices that any attempt to comprehend them in terms of *episteme* or *techne* seems misguided (Flyvbjerg 2006). According to Flyvbjerg, Aristotle put *phronesis* above the other modes of knowledge because it balanced instrumental rationality with value rationality, a balance Aristotle saw as crucial to the sustained happiness of citizens but that, according to Flyvbjerg, is currently undermined by the dominance of the instrumental rationalities of *episteme* and *techne* relative to *phronesis*. To achieve more balance, Flyvbjerg recommends an approach to social science that focuses on context-specific, case-study knowledge instead of trying to imitate the generalizable and predictive power of natural science.

Also drawing on Aristotle, Scott characterizes local, practical knowledge as something akin to *mētis*—a form of local, experiential knowledge that resists simplification into deductive principles that can be readily transferred through book learning. Scott documents numerous examples of "natural and social failures of thin, formulaic simplifications" imposed on society through the hegemony of state power. One of his main examples deals with the failures of the utilitarian logic that encouraged mono-cropped, even-aged forestry in early modern Europe. He notes that large-scale processes and events are inevitably far more complex than any models experts can devise to map them. What these schemes "ignore—and often suppress—are precisely the practical skills that underwrite any complex activity . . . variously called know-how . . . common sense, experience, a knack or *mētis*" (2008, 311). Instead of promoting an interchange between local or practical knowledge and formal scientific knowledge, he argues that governments often seek to constrain the former as a form of social control.

The two concepts, *phronesis* and *metis,* have much in common. That said, *phronesis* appears to be more closely linked to the political or administrative skills involved in reasoning about values, the good life, and the exercise of power. *Mētis* comes closer to the idea of *local* knowledge or wisdom. It is not as refined and systematized as *techne* (which, by Scott's reckoning, is more universal, organized, and ultimately expressible in the form of rules, principles, and propositions), but rooted in a history of local problem solving. In any case, both emphasize *emplaced* knowing over the "thin simplifications" of instrumental rationalities that "can never generate a functioning community, city or economy" (Scott 1998, 310). Both kinds of knowledge exist among practitioners and can be cultivated within organizations and institutions.

For example, as understood in the field of knowledge management, practice communities constitute groups of people who share a concern or interest in some domain of activity and learn how to do it better through regular interaction (Wenger 1998). According to Wenger, three characteristics are crucial to distinguishing communities of practice from other kinds of communities. First, their identity as group is rooted in shared competencies that distinguish members from nonmembers. Members value their collective competence and learn from each other, even if few people outside the community value or even recognize their expertise. Second, they act as a community with respect to their knowledge domain by engaging in joint activities and discussions and forging relationships that enable members to learn from each other. Third, members of a community of practice develop a shared repertoire of resources, experiences, stories, tools, and ways of addressing recurring problems. For many professional fields, including business, law, medicine, and planning, this repertoire is transmitted through case-based learning. For example, in a profession such as medicine, clinical knowledge is built up through the accumulation of experience from the careful analysis and treatment of many actual cases. Over time the practitioner is expected to learn how to diagnose and treat conditions by drawing on case-based experience. In important ways, what distinguishes such professions from the academic disciplines is their relatively greater emphasis on learning from real-world practice. Professional knowledge builds much more on inductive, situational, bottom-up learning than from top-down, deductive extension of theory to practice.

In sum, in a truly adaptive approach to knowledge production and management, it is at least as important to help practitioners better organize themselves into communities of practice as it is to produce the new scientific synthesis of knowledge or deploy adaptive management experiments. Practice communities draw from members' knowledge and experience to advance situation-specific problem solving. They might do this by requesting information from community members, seeking out people with specific experiences suited to a particular problem at hand, making site visits, documenting cases and solutions, or mapping knowledge and gaps in knowledge. Collins and Ison (2009) equated communities of practice to a form of social learning that occurs through situated and collective engagement with others. They argue that post-normal conditions of complexity, uncertainty, and controversy require an epistemic reframing of adaptation to embrace new forms of (social) learning that explicitly recognize and make sense of the partial understandings and varying norms and values of the stakeholders embedded in the situation.

PLACE-BASED SOCIAL LEARNING AND ADAPTIVE LANDSCAPE GOVERNANCE

A post-normal conception of knowledge gives greater recognition to the wisdom and experience of emplaced practitioners (and citizens), learning and operating in real places, and developing context-dependent knowledge. However, advancing social learning and practical knowledge may be insufficient for addressing post-normal conditions. According to Scott (1998) there is also a need for *mētis*-friendly institutional designs that emphasize plurality, diversity, and decentralization. Much like resilience in natural systems, institutional diversity is "demonstrably more stable, more self-sufficient and less vulnerable" (Scott 1998, 353).

By emphasizing institutional diversity, wider public participation, and enlarged social capacity and flexibility to respond to unplanned change, adaptive governance involves a shift from traditionally top-down, expert-driven decision-making structures to a multilevel and polycentric approach to governance that emphasize inclusiveness, collaboration, local knowledge, and identities (Bartel 2014; Wyborn and Bixler 2013). In other words, post-normal conditions require intuitional designs and practices that encourage more bottom-up forms of adaptive governance, in which individuals, organizations, agencies, and institutions at multiple organizational levels come together to transform management organizations toward a learning community drawing on various forms of knowledge, expertise, and experience for developing

common understanding and policies (Brunner and Lynch 2010; Folke et al. 2005; Ilcan and Phillips 2008).

These forms are particularly important in dealing with large-scale ecological disturbances such as wildfire and climate change, and situations in which the scale and complexity of the issues exceed the capacity of existing organizations to address the problem on their own (Flint 2013). Adaptive forms of governance are most likely to emerge at a local scale because the consequences of decisions begin to matter to local constituencies in ways that, at a larger scale, they are often too obscure and remote to engage all but the most committed interest groups (Williams and Matheny 1995). At a local level, shared propinquity (common habitation in a geographic space) helps establish a workable polity as people find "themselves in geographic proximity and economic interdependence such that the activities and pursuits of some affect the ability of others to conduct their own activities" (Young 1996, 126). In these contexts, adaptive, place-focused collaboration promotes finding commonality among diverse stakeholders by encouraging them to "make sense together" in spite of their different, often conflicting, values and ways of life (Healey 1997). Whatever social differences exist regarding local uses and values for a landscape, there is at least the possibility of a shared concern for particular places from which new governance structures may emerge (Kemmis 1990).

CASE 1: PINE BEETLE INFESTATION IN COLORADO

A good illustration of the role of shared propinquity in promoting an emergent and adaptive governance regime is the work by Flint and colleagues (Flint 2013; Flint et al. 2009), which examines the way regional-scale collaboration emerged in response to a massive mountain pine beetle infestation in Colorado that devastated over 1.4 million hectares of high-altitude coniferous forests in the central Rocky Mountains. They describe how, in the context of such large-scale ecological disturbance, new governance relationships were forged involving both large-scale regulatory institutions at the state and federal level and locally emplaced residents, interest groups, government agencies, and organizations drawing on existing and emerging networks to address place-specific issues in response to the regional beetle outbreak. Historically rural communities in the western United States, where federally managed lands are the dominant form of ownership, have often been dependent on the federal government to address natural resource issues. In

this instance, however, the scale of the mountain pine beetle outbreak (also referred to as the bark beetle outbreak) exceeded the institutional capacities of federal agencies to prescribe and implement landscape-scale solutions in a top-down manner, as has been the history of their management in the past.

One specific example of the emergence of an adaptive governance network was the formation in 2005 of the Colorado Bark Beetle Cooperative. This multilevel intergovernmental cooperative brought together three federal land management agencies, as well as the Colorado State Forest Service and the Northwest Colorado Council of Governments (itself a nonprofit organization created to facilitate multijurisdictional projects among local governments and nonprofit organizations and community members, including representatives of utility and water providers, the wood products industry, and conservation and public interest groups). Flint (2013) shows how through regular, open meetings, the Colorado Bark Beetle Cooperative encouraged regular dialogue among public and private landowners, major utility companies, conservation districts, water districts, and industry leaders. In the process, local representatives were able to learn how different places in the region were coping with similar ecological processes and management challenges, despite differences in their perceptions and attitudes about what needed to be done. In addition, Flint found that community representatives were able to identify shared regional and place-based strategies for promoting and locating commercial forest management options in more extractive-resource tolerant communities, while protecting aesthetic and conservation strategies around tourist- and amenity-oriented communities.

Beyond the regional organization, new forms of place-based interaction have also flourished at a smaller, grassroots scale. Flint (2013) describes one Colorado county where local citizens formed a task force called the Forest Health Task Force as part of an initiative called Our Future Summit. This local group hosted regular meetings in which local citizens, homeowner associations, and nonprofit organizations from communities within and beyond the county could interact with and learn about forest health issues and initiate local and regional efforts to manage risks. In effect the Task Force provided a spatial context for local residents to do the social learning necessary to enhance the protection of their respective places from the effects of a large-scale landscape disturbance.

The bark beetle example shows how social systems can self-organize to adaptively respond to complexity and uncertainty and address the challenges

of governing complex social-ecological systems tailored to specific contexts. Networks of actors and institutions were identified as key factors facilitating the emergence of self-organized governance structures. Examined in light of emerging theories in public administration (Pierre and Peters 2005), the bark beetle case shows that landscape governance can emerge outside formal government institutions and bureaucracies and involves increasingly complex linkages and collaborations among multiple public and private organizations.

CASE 2: ADAPTIVE GOVERNANCE, CONTEXT, AND CLIMATE CHANGE

Adaptive governance for climate change is another example of a post-normal problem amenable to a place-based social learning approach (Adger et al. 2011; Brugger and Crimmins 2013; Lyon 2014). Despite technical advances in climate science, enormous uncertainties remain regarding the impacts of climate change, especially when downscaled to particular landscapes where adaptation strategies are most likely to be enacted. In keeping with the "normal" science model, the existing literature on social vulnerability and adaptation in natural hazards and climate change has been criticized for emphasizing static profiles of human resources and quantitative indicators of community characteristics at various discrete scales to assess social vulnerability and adaptive capacity (O'Brien et al. 2007). Such studies tend to limit climate change to a generalized, distant environmental stressor. In contrast, some have called for contextual approaches that pay attention to the complex relationships and interactions among formal and informal networks, institutions, and organizations that produce vulnerability and enable and constrain adaptation (O'Brien et al. 2007; Murphy et al. 2015).

To illustrate how a contextual approach might be applied to climate change adaptation, Murphy and colleagues conducted two case studies (Big Hole Valley, Montana, and Grand County, Colorado) that used a collaborative scenario-building methodology as a tool to promote social learning (Murphy et al. 2015; Wyborn et al. 2014). The scenarios presented three alternative story lines written in accessible lay language (three hundred to four hundred words each) to depict the range of possible climate changes. The initial scenarios were local in scale and developed by experts using climate change projections to describe how local landscapes might change over the next twenty years in response to temperature and precipitation trends. By describing alternative plausible futures, these scenarios allowed locally situated

stakeholders to consider potential climate change adaptation strategies in the context of uncertainty regarding exactly how local landscapes will change in response to climate trends. The scenario-building process started with individual interviews in which the scenarios were presented to stakeholders from different sectors (e.g., business owners, private landowners, elected officials, and public land managers) to generate diverse views on possible adaptation strategies. These interviews were followed by a round of sector-specific focus group sessions wherein participants reacted to and revised the scenarios in a group process, and a follow-up session composed of stakeholders from different sectors brought together to learn from each other as they explored the implications of the various scenarios.

These cases illustrated how adaptation actors and their potential adaptation strategies were situated within interacting social, political, and economic forces operating at multiple scales. In particular, stakeholders drew from their own experience of past landscape change (including the previously described bark beetle challenges) to suggest they could work together to find common solutions. In addition, the detailed and tangible descriptions of local landscape changes provided in the scenarios created a platform for even self-identified skeptics to discuss vulnerabilities and potential adaptations. Inviting participants to respond to recognizable and tangibly relevant narratives of local change legitimized their knowledge and experiences, and enabled them to move beyond dominant discourses about climate change. Some participants also expressed appreciation that the method explicitly acknowledged uncertainty and the limits of current scientific knowledge; this acknowledgment actually made the science behind the scenarios seem more credible for these participants. Engaging stakeholders in collaborative scenario-building exercises helped them move beyond the perception that uncertain science was a barrier to adaptation action and allowed them to focus instead on collaborative social learning with potential impacts to community, landscape, and sense of place serving as points of shared concern (Wyborn et al. 2014).

In the context of high complexity, uncertainty, and controversy, scenario approaches to planning and policy offer promising ways to advance social learning (Murphy et al. in review; Wyborn et al. 2014). The scenario method in particular combines the strengths of case-study methods and contextual approaches by focusing on a "landscape of change" rather than a specific problem such fish and fire; building deeper appreciation for the social and community dynamics involved, including the role of meaning and identity

in place-making; attending to broadscale governance and institutional issues; engaging a diverse array of participants in a social learning process; and showing how these forces affect the perception of risk, uncertainty, vulnerability, and possible adaptive pathways available at a local scale (Murphy et al. in review). The end goal of the process was not the scenarios themselves, but using them as a tool to support social learning about possible future vulnerabilities and adaptation. The scenarios enabled participants to articulate these issues in their own language without being guided by a preconceived framing of an issue. Collaborative scenario-building enabled participants to learn about other stakeholders' adaptive responses; identify potential feedbacks, synergies, and conflicts between these responses; and generate the type of reflexive and relational dialogue deemed foundational to social learning (Collins 2014; Collins and Ison 2009).

CONCLUSION

One of the legacies of the "normal" science approach to problem solving in natural resource management is the inability to close the science-practice gap. When applied to specific local contexts, normal science often struggles to clarify best practice because it expands rather than reduces knowledge complexity, increases scientific uncertainty, provides contesting parties with competing sets of facts, and amplifies policy conflict. In its stead, place-oriented inquiry and practice offers a post-normal context-dependent problem-solving strategy by emphasizing bottom-up social learning for the adaptive, sustainable governance of complex dynamic landscapes. Epistemic theories of place provide conceptual tools to help scientists, practitioners, and embedded stakeholders recognize plural forms of knowledge that include local, context-dependent knowledge. In addition, by thinking about practice as a form of emplaced knowing, the practitioner or local stakeholder becomes part of a potential learning system in which knowledge and learning are spatially distributed processes.

Post-normal problem-solving requires professional practices and governance strategies that capitalize on the emergent wisdom of spatially networked actors and institutions engaging in a collaborative form of rationality. This emplaced form of adaptive social learning emerged on its own in the mountain pine beetle example and was expressly designed into the collaborative scenario-building exercises for climate change adaptation. One model of this type of practice can be found in fields such as law, medicine, and business,

where members learn through sharing case-based knowledge. Another model involves less formally organized actors engaging in social learning to exploit the different forms of knowledge and values that make up important parts of the system. Both models showed how stakeholders can move beyond complexities, uncertainties, and even conflicting values and begin to govern the system through collaborative social learning with potential impacts to community, landscape, and sense of place serving as points of common interest.

A place-based approach suggests that the problem of sustainable governance is not one of insufficient science to inform policy and practice, but a failure to develop an adequate science of practice to address the inexorable knowledge complexity and uncertainty that arises when applied to specific places or contexts. In such contexts, the resilience of the social-ecological system depends on the knowledge and combined actions of many practitioners and stakeholders, each familiar with and responsible for various parts of the overall system. Specifically, place helps to address the growing complexity and uncertainty of knowledge, bridge the epistemological divide between local/contextual knowledge and global/generalizable knowledge, and validate and organize social learning and knowledge formation originating in a bottom-up synthesis of networks of actors.

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