Chapter 9.6—Collaboration in National Forest Management

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Summary

National forest management efforts have generally moved toward collaborative and participatory approaches at a variety of scales. This includes, at a larger scale, greater public participation in transparent and inclusive democratic processes and, at a smaller scale, more engagement with local communities. Participatory approaches are especially important for an all-lands approach to managing forest ecosystems across ownership boundaries.

Despite the challenges (reviewed in this chapter), participatory approaches to national forest management have the potential to provide a number of benefits, including:

- Yielding more information for decisions so that they can better meet the ecological and socioeconomic goals of forest management.
- Sharing data, analysis, and other information more broadly within and among communities.
- Reconciling the technical language and outlook of the Forest Service with the place-specific knowledge and perspective of communities.
- Enhancing the legitimacy and acceptability of decisions among stakeholders.
- Providing opportunities to redress underrepresentation in resource management.
- Incorporating traditional and local ecological knowledge to enhance forest restoration and monitoring.
- Creating multi-stakeholder ownership of forest management processes, outcomes, and measures of success.

A number of models for collaborative national forest management, management across ownerships, and knowledge integration are presented in this chapter, along with insights from the literature about how to develop successful collaborative efforts that may be useful in forest management and planning.

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Introduction

The Forest Service 2012 Planning Rule calls for greater public participation in the planning process. It requires the Forest Service to work with interested members of the public, partners, tribes, affected private landowners, and other government agencies in each phase of this process (assessment, plan development, revision or amendment, and monitoring), using collaborative approaches where feasible and appropriate. The rule also proposes an "all-lands approach" to planning, putting national forest lands in the context of the larger landscapes in which they are situated in order to improve understanding of management issues that cross ownership boundaries, including fire, invasive species, water, and wildlife. In addition, the rule directs officials to request information about native knowledge, land ethics, cultural issues, and sacred and culturally significant sites from tribes as part of the tribal participation and consultation process in land management planning. Accordingly, this chapter focuses on processes and models for collaboration in national forest management using an all-lands approach and incorporating traditional and local ecological knowledge.

The chapter begins with a discussion of processes for collaboration that can be used in national forest management, and key characteristics that lead to success. It follows with a discussion of the all-lands approach, the challenges managers may face in taking such an approach, and potential ways to address those challenges. The chapter then provides several models of collaboration associated with national forest management, with examples from California, which forest managers in the Sierra Nevada may consider in developing and engaging with collaborative processes. It also addresses the role of geographic information systems in collaborative planning. This is followed by a discussion of traditional and local ecological knowledge and models for integrating these forms of knowledge into collaborative forest management. The chapter concludes by discussing the role of collaboration in adaptive management and monitoring.

Collaboration in National Forest Management

Collaboration can be defined as "an approach to solving complex environmental problems in which a diverse group of autonomous stakeholders deliberates to build consensus and develop networks for translating consensus into results" (Margerum 2011: 6). Consensus can range from a simple majority to unanimous agreement among stakeholders regarding a decision, but it usually means reaching a decision that everyone can live with. The more complete the consensus, the more likely that stakeholders will support implementation of the decision that is reached (Margerum 2011). Collaboration in national forest management often takes place through community-based collaborative groups, which are local groups that come together at the community scale to address natural resource management issues associated with public lands and resources that affect the environmental or economic health of the community (Firehock 2011). These groups are composed of a diverse group of local stakeholders who make decisions and recommendations to influence the management of public lands and resources, and take actions to implement them.

The Quincy Library Group (QLG), based in Plumas County, California, was one of the first community-based collaborative groups in the Western United States to form around national forest management issues. It began in the early 1990s in response to changing national forest management policy that aimed to protect the California spotted owl, but threatened the timber industry in the northern Sierra Nevada (see chapter 9.5, "Managing Forest Products for Community Benefit").

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Figure 1—Pacific Southwest Research Station and Natural Resources Conservation Service scientists, staff from the Sierra National Forest, and members of the North Fork Mono Tribe, North Fork Mono Rancheria, and Chukchansi Tribe met to discuss opportunities to promote tribal cultural resources using traditional knowledge.

The QLG's ultimate goal was to draft a plan for forest management that would sustain both the ecological and economic health of national forest lands and forest communities locally (Bernard and Young 1997). In 1993, the QLG produced its "Community Stability Proposal," which recommended a forest restoration program that would lead to "an all-age, multi-story, fire-resistant forest approximating pre-settlement conditions" (Bernard and Young 1997: 160). The QLG was unsuccessful in getting the Forest Service to adopt and implement their plan through administrative avenues, however (London et al. 2005). Thus, in 1997, U.S. Representative Wally Herger (R-Calif.) introduced a bill to Congress that would require the Forest Service to implement the Community Stability Proposal. The bill received wide support in both the House and the Senate, resulting in the Herger-Feinstein Quincy Library Group Forest Recovery Act (HFQLG), which was signed into law in 1998 (Marston 2001). The act provided for a 5-year pilot project to carry out select plans outlined in the Community Stability Proposal on roughly 1.5 million ac of the Plumas, Lassen, and Tahoe National Forests.[4]

The HFQLG Act has been subject to continual lawsuits since the time of its passage over questions pertaining to protection for the California spotted owl, thinning methods used for hazardous fuels reduction, and proposed clearcuts (Bernard 2010, Marston 2000). These lawsuits have contributed to delays in implementing forest management projects under the act, resulting in extensions in 2003 and again in 2008. Despite these delays, a number of forest restoration and fire hazard reduction projects have occurred, along with research to study the effects of these projects on wildlife, watershed health, and wildfire risk (see footnote 4). But the management plan failed to provide long-term economic stability associated with forest-based jobs (Bernard 2010). These problems have been attributed to the failure of the QLG to represent the full range of community interests and stakeholders, despite strong community support at the outset (Colburn 2002); to mixed support for the management plan among Forest Service administrators (London et al. 2005); and to strong opposition from many national environmental organizations who opposed the use of federal legislation to mandate adoption of a locally developed management plan on national forest lands (Hibbard and Madsen 2003).

Ingredients for Successful Collaborations

Community-based collaborative groups have sprung up all over the West since the 1990s to engage with national forest management issues (see Dukes 2011 for examples). Over time, extensive research has been carried out to identify how collaborative institutions and processes can work best, whether in association

[4] http://www.fs.fed.us/r5/hfqlg/news/2011/HFQLG%20Fact%20Sheet%202011.pdf.

with Forest Service lands or broader, multi-ownership landscapes. McDermott et al. (2011) group the features that lead to successful collaborations into three broad categories. The first concerns external sources of support, which include involvement in and support from elected officials, agency leaders, and key decisionmakers in the group; legal authority and supportive laws and policies that make it possible to accomplish the actions proposed; and community involvement. The second category pertains to access to resources, including sufficient and stable funding, adequate staffing, and access to and exchange of information. The third category has to do with the capacity to act. This capacity includes effective leadership, trust among participants, and social capital (networks of social relations among people and groups that enable them to coordinate and cooperate for mutual benefit).

Harmony among stakeholders is not a key ingredient for success, but stakeholders want to be confident that working relationships will be productive before investing in collaboration.

Harmony among stakeholders is not a key ingredient for success, but stakeholders want to be confident that working relationships will be productive before investing in collaboration (Bergmann and Bliss 2004). Perhaps counterintuitively, solutions may become more attainable where there is a combination of conflict and cooperation between stakeholders (Scheffer et al. 2002). Even though command-and-control approaches commonly fail, the success of some decentralized collaborative networks has been associated with the incentive provided by having the threat of regulation as an alternative (Dasse 2002, Scholz and Wang 2006). Having a regulatory backstop may help to allay concerns that local collaborative groups may compromise national-scale priorities (Bergmann and Bliss 2004, Hibbard and Madsen 2003).

Another factor that may open windows of opportunity for collaborative approaches is the perception of an impending crisis, as described by Moir and Block (2001). During times of "crisis, breakdown, and reorganization"—which would include the aftermath of unusually large and severe wildfires—resilience theory suggests that moving beyond conventional decision support systems to decentralized, participatory, and collaborative approaches can help build adaptive capacity (Nelson et al. 2007, Walker et al. 2002).

Cheng and Sturtevant (2012) propose a framework for assessing the collaborative capacity of communities in the context of federal forest management. Their framework identifies six arenas of collaboration and associated capacities: organizing, learning, deciding, acting, evaluating, and legitimizing. They note that the three categories identified by McDermott et al. (2011) affect all six of these arenas. They suggest that their framework can be used to evaluate what capacities exist within local collaborative groups, and what capacities could be enhanced, so that investments in building and sustaining these groups can be targeted. For example, because government resource management agencies are typically strong in biophysical expertise, universities or nongovernmental organizations could be encouraged to join local collaboratives to contribute economic and social expertise.

Benefits of Collaboration

Several scientists have documented the social benefits of collaborative natural resource management. These include (1) creating a sense of shared ownership over large and complex environmental problems (Bryan 2004); (2) combining different forms of ecological knowledge and promoting better and shared understanding of natural resource management issues (Ballard et al. 2008a, Bryan 2004); (3) integrating economic and social concerns together with ecological concerns so that they can be addressed together; (4) enhancing opportunities to pool resources and assets in addressing resource management issues (Cheng and Sturtevant 2012); (5) improving working relationships between agencies, members of the public, and other stakeholders; (6) increasing community understanding of and support for land management (Firehock 2011); and (7) building community resilience (Goldstein 2012).

The environmental benefits of collaborative forest management are not well documented. It remains to be seen to what extent collaborative processes will improve environmental conditions (Koontz and Thomas 2006). Nevertheless, many groups have documented environmental accomplishments resulting from collaborative forest management—such as acres of forest restoration treatments, and education and policy changes—that are anticipated to positively affect environmental conditions over the longer term (Fernandez-Gimenez and Ballard 2011). And collaborative groups often engage in monitoring and evaluation, producing information that can be used to improve environmental management, with positive implications for the environment (Fernandez-Gimenez and Ballard 2011).

Lessons Learned From the Dinkey Creek Collaborative

Bartlett (2012) provides lessons learned from a collaborative process used for hazardous fuels reduction projects at Dinkey Creek on the Sierra National Forest that may be useful elsewhere in the science synthesis area (see also the section on Collaborative Forest Landscapes Restoration projects in this chapter). The Dinkey Creek North and South project was a 3,000-ac project designed to restore diverse, healthy, and fire-resilient forest conditions while protecting California spotted owls and Pacific fishers (North and Rojas 2012). The project was located in an area having a long history of conflict and litigation owing to concerns over project impacts on threatened wildlife species (Bartlett 2012). Successful collaboration at Dinkey

Susan Charnley

Figure 2—Sign at a collaborative fuels reduction project.

Creek was based on a five-stage process: assessment, organization, education, negotiation, and implementation (see Bartlett 2012 for a description of these stages). Key elements that helped facilitate successful collaboration during this process included:

- Bringing a broad range of participants to the table, which helped them understand each other's values;
- Developing a common conceptual framework for management actions, including purpose and need and desired conditions over the long term, which helped to align knowledge systems;
- Involving scientists to provide technical expertise during group meetings;
- Willingness and ability to move forward in the face of disagreement;
- Conducting site visits during project development;
- Engaging stakeholders in a timely way;
- Taking actions to build trust, such as finding areas of conceptual agreement, designing projects to meet multiple objectives, and engaging stakeholders in project monitoring;
- Testing project implementation methods when developing new approaches, and sharing them with the collaborative;

- Project monitoring to demonstrate a commitment to learning from what worked and what didn't, and to adapt future management actions to improve forest conditions; and
- A willingness to be patient with the process.

Another critical ingredient for success was the use of a professional, impartial mediator to facilitate the collaborative process, though a mediator may not always be necessary. In this case, the mediator played an important role in organizing the collaborative process, helping build trust among participants, normalizing conflict and promoting problemsolving, managing timeframes, and helping the group reach outcomes (Bartlett 2012).

All-Lands Approach to Forest Management: Opportunities and Challenges

Under the Forest Service Planning Rule, the all-lands approach proposes to "feature collaboration engaging the public early and often to build a common understanding of the roles, values and contributions of National Forest System (NFS) lands within the broader landscape."[5] An all-lands approach to forest management is argued to be important for promoting the health and productivity of forest ecosystems, conserving biodiversity, and sustaining critical ecosystem services (Lindenmeyer and Franklin 2002). Forest restoration and fire management, like many environmental management activities, entail large-scale ecological processes and mixed land ownership patterns (Bergman and Bliss 2004, Cortner and Moote 1999). Hazardous fuels reduction, timber management, and other forest restoration activities also occur (to different degrees) on other land ownerships, with Forest Service management potentially affecting adjacent jurisdictions, and vice versa. An all-lands approach to forest management calls for cooperation and collaboration with other landowners, creating an opportunity for the Forest Service to build relationships with its neighbors and to promote broad, landscape-scale restoration. Yet managing across ownership boundaries remains challenging.

There is a proliferation of opportunities for cross-boundary collaboration to manage forested ecosystems for public benefits. Some of these initiatives are being led directly by the Forest Service, such as the Collaborative Forest Landscape Restoration Program (see next section). Others are made possible under federal laws, such as the Tribal Forest Protection Act of 2004,[6] which authorizes the Forest Service to give special consideration to tribally proposed projects on agency

[5] http://planningrule.blogs.usda.gov/2010/07/16/all-lands-approach/.

[6] http://www.fs.fed.us/restoration/documents/stewardship/tfpa/TribalForestProtectionAct2004.pdf.

lands bordering Indian trust lands (see chapter 9.4, "Strategies for Job Creation Through National Forest Management"). Still other opportunities are being created outside the Forest Service. For instance, the Pacific Forest and Watershed Lands Stewardship Council plans to transfer tens of thousands of acres of forested parcels throughout the science synthesis area from private ownership by Pacific Gas and Electric Company to other entities, which may include local governments, tribes, CAL FIRE, or the Forest Service itself. In addition, private land trusts are acquiring land for conservation purposes, in some cases in collaboration with tribes (Middleton 2011). Many of these nonfederal holdings are embedded within a larger matrix of Forest Service lands. Burgeoning opportunities to collaborate across boundaries and to acquire additional lands pose challenges for agency staff who engage in these processes. These challenges include how to meet the demands associated with collaboration in light of existing workloads, and how to allocate resources among efforts. Further developing the agency's institutional capacity to collaborate across boundaries may be an important strategy for increasing its ability to collaborate in these and other endeavors.

Another challenge associated with the all-lands approach to forest management is how to resolve mismatches of scale between ecological and social processes. Many chapters of this synthesis report emphasize the importance of natural resource management across boundaries at large landscape scales and over long time horizons. But socioeconomic values, economic and political interests, policy incentives, and institutional structures all influence whether and how this can occur (Cortner 2000, Pritchard and Sanderson 2002). Commonly, ecological processes operate at a different scale from the institutions responsible for managing them (Cumming et al. 2006). For example, in the Sierra Nevada, there are federal, state, and local institutions that have some responsibility for managing fire-prone forests, but their jurisdictions do not necessarily align with the spatial units at which fires must be managed—for example, "firesheds" (areas that fires are likely to burn across) or "smokesheds" (areas where smoke from such fires is likely to go). These scale mismatches make it difficult to negotiate tradeoffs between the benefits and costs of managing fires within a fireshed versus a smokeshed. An advantage of collaborative processes is that they enable individuals and organizations to think at a regional scale, and act at whatever spatial scale is appropriate, often through nested efforts that address issues at different scales within the broader landscape (Kemmis and McKinny 2011).

How do we build a "nonbureaucratic bureaucracy" that makes the relationship between the agency and communities more workable, while increasing capacity to operate at multiple and dynamic scales? An overall strategy is to cultivate flexible institutional arrangements that operate at different scales and can adjust and reorganize in response to changes in ecosystem conditions and associated management challenges.

These challenges require agencies like the Forest Service to innovate and evolve in ways that can be daunting and perhaps paradoxical, raising the question: How do we build a "nonbureaucratic bureaucracy" that makes the relationship between the agency and communities more workable, while increasing capacity to operate at multiple and dynamic scales (Pritchard and Sanderson 2002)? A general trend has been to move from systems dominated by expert bureaucracy toward expanded public participation to help balance competing interests. Another less common approach has been to move toward more decisionmaking by communities about natural resources management (Pritchard and Sanderson 2002). Although there are no simple solutions to governance challenges, an overall strategy is to cultivate flexible institutional arrangements that operate at different scales and can adjust and reorganize in response to changes in ecosystem conditions and associated management challenges (Cumming et al. 2006, Koontz and Thomas 2006, Margerum 2011, Pritchard and Sanderson 2002). The various models of collaboration provided in this chapter offer examples of these kinds of arrangements.

Cooperation entails working jointly with others to solve a problem or carry out an activity (Agranoff 2006). Cooperation can be formal or informal, occur on an occasional or regular basis, and take place inside, outside, or between organizations (Agranoff 2006). In the case of cross-boundary cooperation between federal agencies and nonindustrial private forest owners for fire hazard reduction in eastern Oregon, Fischer and Charnley (2012) identified rural social organization (characterized by isolation and few opportunities for interaction), high rates of absentee land ownership, gulfs in values and goals relating to fire management, and fear of bureaucratic and regulatory burdens among nonindustrial private forest owners as barriers to cooperation. Nevertheless, they found that roughly one-third of surveyed forest owners had cooperated with public agencies in the past to plan, pay for, or conduct practices that reduce hazardous fuels, and that owners expressed strong willingness to cooperate with public agencies in the future. They also found that owners who perceived a risk of wildfire to their properties, and perceived neighboring public lands as contributing to that risk, were more likely to cooperate with agencies to reduce fire risk. These findings suggest that building a common understanding of fire risk across property boundaries and among landowners may increase the likelihood of their cooperation (Fischer and Charnley 2012). The authors identify several models of cooperation between nonindustrial private forest owners and public land management agencies that could potentially be used to reduce fire risk across ownership boundaries, and that may be relevant for the Sierra Nevada synthesis area (see box 9.6-1 below). These models are also relevant for cross-ownership boundary cooperation in forest management more broadly. However, the balance between the costs and benefits of cooperation with the agencies like the Forest Service must be favorable to private landowners if they are to engage in it (Fischer and Charnley 2012).

Box 9.6-1

Models of Cooperation Between Agencies and Private Nonindustrial Forest Owners

Informal	
Over the fence	Neighboring landowners observe each other's management practices and do something similar, encourage neighbors to do more, or undertake a management activity together.
Wheel and spoke	A contractor or natural resource professional works with multiple landowners to help them learn from each other, leverage resources, access services and markets, and address management problems and concerns.
Local group	A local "change agent" creates a forum in which landowners come together to discuss common management issues, thereby promoting communication, learning, cooperation, and leadership.
Formal	
Agency-led	A natural resource agency provides education and/or technical or financial support to help landowners interact around management issues, learn from each other, and implement activities.
Collaborative group	Landowners commit to a process and product, are organized by a coordinator, and are guided by policy documents.

Ferranto et al. (2013) surveyed private forest and rangeland owners in 10 California counties, including Plumas, Sierra, and Eldorado, to investigate their willingness to cooperate in ecosystem management on their properties across ownership boundaries. They found the strongest support for cross-boundary cooperation to reduce fire hazard (relative to other environmental management issues). They also found that landowners were most willing to cooperate with neighboring private landowners in management activities, and least willing to cooperate with federal agencies, though they were not unsupportive of the notion of private-federal cooperation. Finally, they found that landowners whose main motivation for owning forest or range land was for its natural amenity values expressed more support for cross-boundary cooperation in ecosystem management than owners motivated by rural lifestyle, working landscape, or financial investment reasons for land ownership. They point out that willingness to cooperate is not the same as intent to cooperate, however; just because landowners express support for the idea doesn't mean that they will actually do it.

A study of cross-boundary cooperation in fire management in eastern Oregon (Bergmann and Bliss 2004) identified deterrents to cooperation that could also be operating in California (Ferranto et al. 2013). These include (1) short tenures and high turnover of federal staff; (2) concerns about accountability of managers when rural people believe that their livelihoods are at risk; (3) strong ideological differences among stakeholders; (4) concern about administrative burdens and regulatory limitations imposed by the National Environmental Policy Act (NEPA) and other federal environmental laws; (5) skepticism among environmental groups about local collaboratives; and (6) differential risks to landowners and managers owing to scale. This last concern is reflected in the statement: "A prescribed fire that burns too hot and damages standing timber might have little impact on a national forest unit of which it is a small part. A similar fire on a private ranch might eliminate college funds and retirement savings and destroy family landmarks and special places" (Bergmann and Bliss 2004: 385).

Special roles, skills, and tools that could facilitate successful cross-boundary cooperation between the Forest Service and other landowners include boundary spanners, mediators, cultural competencies, and agreements with cooperators.

Many of these deterrents may be beyond the ability of the Forest Service to control. Nevertheless, special roles, skills, and tools that could facilitate successful cross-boundary cooperation between the Forest Service and other landowners have been identified and include:

- Dedicated boundary spanners with special skill sets and incentives to facilitate cross-boundary collaboration (Rickenbach et al. 2011);
- Skilled, neutral party facilitators or mediators for collaborative groups (Bartlett 2012, Cheng and Mattor 2010);
- People who have cultural competencies in establishing and managing collaborative efforts, including respect for local knowledge, flexibility, humility, and understanding of the importance of long-term commitments (Fortmann and Ballard 2011);
- Memoranda of understanding between the Forest Service and cooperators (Fischer and Charnley 2012).

Models for Collaborative Forest Management

Cortner and Moote (1999) note that models for collaboration should be selected based upon the context of the challenge to be addressed. This section describes a number of models for implementing collaborative forest management taking an all-lands approach that could be fruitful for management efforts in the synthesis area. The models are summarized in box 9.6-2 and discussed in more detail in the following sections.

Box 9.6-2

Models for Collaborative Forest Management Using an All-Lands Approach

Model	Description
Fire Safe Councils	Community-based, collaborative groups that form to address wildfire risks on private lands in their communities through education and outreach, hazardous fuels reduction projects, creating defensible space around structures, and increasing fire preparedness and emergency response capacity.
Fire Learning	Collaborative groups that form at the landscape level in fire-prone ecosystems, and that are connected to one another through regional and national networks. They develop and implement strategies for hazardous fuels reduction and restoring fire to forest ecosystems locally, and share their knowledge, experiences, and best practices with other members of the network to encourage learning and innovation in fire management and ecological restoration.
Community Wildfire Protection Plans	Plans that communities create in collaboration with land management agencies and others that lay out a framework and strategy for managing wildfire risk on federal and nonfederal lands locally. They identify priority areas to receive hazardous fuels reduction treatments, and recommend types and methods of treatments.
Collaborative Forest Landscape Restoration Projects	Collaborative, science-based forest restoration projects that are developed in collaboration with local stakeholders, take place on Forest Service lands, and promote both ecological restoration and economic benefits for local communities. Projects are funded through the Collaborative Forest Landscape Restoration Program and facilitate development of restoration projects across ownerships, helping to leverage resources to support such projects.
Prescribed Fire Councils	Prescribed fire councils are groups that include multiple entities (e.g., local, state, and federal agencies, tribes, nongovernmental organizations, academic institutions, and private individuals) and facilitate collaboration among members who have an interest in applying prescribed fire.
Stewardship Contracting	An administrative tool for accomplishing forest restoration that fosters collaboration in project development and implementation, makes it possible to exchange goods for services and to retain timber receipts on a national forest to spend on restoration activities, creates local community benefit, and can be used for cross-boundary restoration projects on Forest Service and Bureau of Land Management lands and private lands (under the Wyden Authority).

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Wyden Authority Projects	Projects funded and implemented under the Watershed Restoration and Enhancement Agreement, which gives the Forest Service authority to enter into cooperative agreements with partners to undertake activities that protect, restore, and enhance resources on public or private lands if they benefit a watershed that contains federal lands and contribute to Forest Service management goals.
Participatory Action Research	A form of systematic inquiry involving collaboration among people affected by an issue—such as scientists, researchers, managers, community members, and resource users—so that they can share their knowledge and skills, generate new knowledge, jointly solve problems, educate, take action, and effect change.
Educational Outreach	Education and outreach programs that engage members of the public with science information about forest ecosystems are not a form of, collaboration but can lead to collaborative ecological restoration projects.

Fire Safe Councils

In 1993, the California Department of Forestry and Fire Protection established the California State Fire Safe Council, which became an independent, nonprofit organization in 2002 (Everett and Fuller 2011). The mission of the Fire Safe Council is to help Californians mobilize to protect their homes, communities, and surrounding lands from wildfire. It does so by providing educational information to, and serving as a grants clearinghouse for, individual county and community-level fire safe councils (FSCs) that have formed across the state through local, grassroots efforts to address community-level wildfire risks (Everett and Fuller 2011). Local FSCs promote emergency preparedness, the creation of defensible space, and offer a forum in which community members can discuss their concerns about forest health and wildfire safety (Sturtevant and McCaffrey 2006).

Research indicates that FSCs are effective community-based, collaborative organizations that help serve as a bridge between agencies and community members in fire hazard reduction efforts, and work to effectively define and address local priorities for wildfire mitigation (Everett and Fuller 2011, Sturtevant and McCaffrey 2006). They do this in multiple ways, ranging from education and outreach, to implementing fuels reduction projects on private lands, to creating defensible space around homes, to increasing fire preparedness and emergency response capacity, to leveraging local funds and volunteer hours that supplement federal grants for fuels reduction. Contributing to their success is the fact that FSCs operate at three scales (state, county, and community), which allows for the development of locally appropriate approaches to wildfire protection in the context of a broader support network that provides access to funding, technical assistance, and other resources (Sturtevant and McCaffrey 2006). Key challenges they face are sustaining community members' interest and participation in FSC activities, sufficient funding for fuels reduction projects and operations, and implementing fuels projects on private lands (Everett and Fuller 2011).

Everett and Fuller (2011) found that there is an important role for agencies like the Forest Service in helping support community- and county-level FSCs. This role includes (1) actively partnering with them to help support their activities; (2) developing memoranda of understanding between the agency and the councils to formally recognize a cooperative relationship, and to legitimize agency employee participation in their activities; (3) coordinating with the California FSC to make funding available through its clearinghouse to help streamline the grant application process; (4) recognizing their achievements; and (5) providing consistent engagement and support.

Box 9.6-3

Example of Success: Fire Safe Councils

One example of success for community wildfire preparedness in partnership with the Forest Service is from Grizzly Flats, near the Eldorado National Forest. "The Fire Safe Council secured more federal grants to support residents' efforts to reduce fire hazards, turning their homes into models of wildfire safety and inspiring neighbors to take similar steps. They also aligned their efforts with Forest Service work on nearby public land so the projects would complement and strengthen each other" (Jakes et al. 2012: 10).

Fire Learning Networks

The U.S. Fire Learning Network (FLN) was created by The Nature Conservancy, the Forest Service, and Department of the Interior land management agencies in 2001 to foster collaboration across organizations and administrative boundaries in developing landscape-scale ecological restoration plans for fire-prone ecosystems (Butler and Goldstein 2010, Goldstein et al. 2010). The FLN is one type of "conservation learning network," a community of people who organize around a core issue, have common objectives, and share their expertise, skills, methods, and techniques to solve problems (Goldstein et al. 2010). Conservation learning networks promote learning among members by fostering the spread of best practices based on lessons learned from members' experiences, and identifying barriers and solutions to problems. Fire learning networks can improve forest management decisionmaking and increase the capacity of fire managers to manage fire and other landscape-scale ecological processes (Goldstein et al. 2010).

The national FLN has three levels of organization: national staff, regional networks, and local landscapes—the majority of which are affiliated with a regional network. Between 2002 and 2011, 15 regional networks formed nationwide, encompassing 163 landscapes (not all of which are currently active) (TNC 2012). In California, one regional network is operative: the California Klamath-Siskiyou (encompassing the Trinity and West Klamath Mountains). There is also one "demonstration landscape" in the state (unaffiliated with a regional network): FireScape Monterey (focused on the Monterey District of the Los Padres National Forest) (TNC 2012).

By promoting the sharing of resources among participants and the dissemination of ideas, experiences, and lessons learned, fire learning networks are an effective institution for adaptive management and can contribute to socioecological resilience. The Sierra Nevada is a region in which a fire learning network could be developed to address fire management issues.

The goals of fire learning networks are to develop strategies for reducing hazardous fuels and restoring fire to forest ecosystems in ways that are ecologically meaningful and socially acceptable, and to create local, regional, and national linkages between collaborative groups involved in these efforts to facilitate dissemination of knowledge and innovation throughout the network (Butler and Goldstein 2010). At the landscape level, diverse stakeholders that are involved in fire management collaborate to set ecological restoration goals, create fire restoration plans, identify priority treatment areas, and develop models and mapping tools that can be used to inform implementation of treatments. These activities occur through workshops, field trips, collaborative planning exercises, meetings, and Web- and print-based communication. To date, fire learning networks have been effective in informing agency fire management plans, influencing where fuels reduction work takes place on national forest and private forest lands, guiding requests for federal funding to support treatments, and influencing policy (e.g., the Forest Landscape Restoration Act). By promoting the sharing of resources among participants and the dissemination of ideas, experiences, and lessons learned through the regional and national network, they are an effective institution for adaptive management and can contribute to socioecological resilience (Butler and Goldstein 2010). The Sierra Nevada is a region in which a FLN could be developed to address fire management issues.

Community Wildfire Protection Plans

The Healthy Forests Restoration Act of 2003 spurred the development of community wildfire protection plans (CWPPs), which communities create in collaboration with land management agencies and others that lay out a framework and strategy for managing wildfire risk on federal and nonfederal lands locally (Jakes et al. 2012). CWPPs identify priority areas to receive hazardous fuels reduction treatments, and recommend types and methods of treatments. They are developed through a collaborative, multi-stakeholder-driven process that produces plans appropriate to local social and ecological circumstances, and at a scale that makes it possible to take action to reduce wildfire risk and enhance the resilience of forest ecosystems (Jakes et al. 2011). See Jakes et al. (2012) for a guide to best management practices for creating a CWPP. Developing CWPPs not only helps communities address fire risk locally, but it also helps community members build their social networks, enhance learning, and build community capacity—all of which foster community resilience (Jakes et al. 2007).

Frank Lake

Figure 3—Fuels reduction using prescribed burning organized through the Lomakatsi Restoration Project, a forest restoration collaboration organization in Oregon.

Federal forest managers can support the CWPP process by (1) participating as partners in development of CWPPS, providing leadership if needed; (2) providing data, information, and expertise; (3) providing funding to support development of CWPPs; (4) facilitating network building between stakeholders; (5) helping lower capacity communities mobilize to take action; (6) working with communities to set fuels treatment and fire mitigation priorities; and (7) considering plan priorities and recommendations in implementing fuels treatments (Fleeger and Becker 2010, Jakes et al. 2007).

Collaborative Forest Landscape Restoration (CFLR) Projects

Title IV of the Omnibus Public Land Management Act of 2009 on Forest Landscape Restoration established a fund and a program to support collaborative, science-based forest restoration projects (called CFLR projects) in priority landscapes on Forest Service lands. The CFLR Program has a number of goals: to encourage social, economic, and ecological sustainability; to support forest restoration activities that meet ecological objectives and ultimately reduce fire management costs; to encourage investments in capturing the value of restoration byproducts that help contribute to local economies while reducing the costs of fuels treatments; and to leverage resources to help support social, economic, and ecological goals associated with forest restoration across ownerships (Schultz et al. 2012).[7] Although the fund can only be used on NFS lands, project proposals can be for a landscape that includes other federal, tribal, state, or private lands. Thus, the CFLR program may facilitate development of collaborative forest restoration projects across ownership boundaries, helping to leverage resources to undertake such projects. To be eligible for funding, projects must be developed collaboratively and provide economic benefits to local communities.

One criterion for evaluating CFLR proposals is that they build on past collaborative efforts having a demonstrated record of success. Bartlett (2012) and North and Rojas (2012) provide detailed descriptions of a forest restoration project that took place in the Dinkey Creek area of the Sierra National Forest that was developed and implemented through a successful collaborative process (described in the preceding section). This project led to the Dinkey Collaborative Forest Landscape Restoration Project, one of the original CFLR projects selected for funding in fiscal year 2010 following passage of the act. The project includes 130,000 ac of the Sierra National Forest and 24,000 ac of private land.[8] The project is one of three CFLR projects in

[7] http://ww.fs.fed.us/restoration/CFLRP/;
http://www.fs.fed.us/restoration/documents/cflrp/titleIV.pdf.

[8] http://www.fs.fed.us/restoration/documents/cflrp/2010Proposals/Region5/Sierra/Sierra_NF_CFLRP_Proposal.pdf.

the Sierra Nevada currently. The others are the Burney-Hat Creek Basins Project on and around the Lassen National Forest, and the Amador-Calaveras Consensus Group Cornerstone Project on and around the Eldorado and Stanislaus National Forests (see fig. 1 in chapter 1.5).

It is too soon to tell how successful the CFLR projects will be in meeting their objectives. A number of challenges exist (described in Schultz et al. 2012). Nevertheless, they represent an innovative new collaborative approach to forest management that holds promise for achieving forest restoration at a landscape scale and across multiple ownerships.

Prescribed Fire Councils

Prescribed fire councils are collaborative groups that include multiple entities, such as local, state, and federal agencies, tribes, nongovernmental organizations, academic institutions, and private individuals who have an interest in using prescribed fire for forest restoration (Costanza and Moody 2011, Quinn-Davidson and Varner 2012). In California, these councils are new or just beginning to form. They aim to increase the application of prescribed fire in a responsible manner, and overcome constraints to its use. Prescribed fire councils serve as forums for disseminating knowledge, keeping people who undertake prescribed burns current with information about new research and technological advances, and informing members about training opportunities and local fire issues (Wade et. al 2006). The recently formed Northern California Prescribed Fire Council seeks to connect interested persons and groups and foster discussion about possible barriers to prescribed fire application in northern California, where its use is highly constrained by narrow burn windows, air quality regulations, lack of personnel, and environmental laws, among other things (Quinn-Davidson and Varner 2012).[9]

Stewardship Contracting

As described in chapter 9.4, stewardship contracting is an administrative tool for accomplishing community-based forest restoration work that fosters collaboration in project development and implementation. This collaboration can take many forms. In some cases, local collaborative groups form, or if they already exist, morph into stewardship groups to develop projects that contribute to both forest restoration and local economic development. The White Mountain Stewardship Project on the Apache-Sitgreaves National Forest in Arizona is one example of a landscape-scale collaborative restoration effort taking place through the use of a 10-year stewardship contract. Although it has been extremely successful in building

[9] For more information, see http://www.norcalrxfirecouncil.org.

social agreement around forest restoration activities in the region, increasing community capacity to engage in forest restoration, and accomplishing hazardous fuels reduction treatments, it has fallen short of its goals with regard to the latter because of a shortage of federal funding to plan, administer, and implement projects (Abrams 2011). The use of stewardship contracting and utilization of restoration byproducts have helped cover the cost of fuels treatments, but not completely; a funding gap remains that has been challenging to fill in the context of dwindling federal funding for forest management (Abrams 2011).

Stewardship contracting authorities apply to the Forest Service and Bureau of Land Management (BLM); thus, stewardship projects using these authorities typically take place on Forest Service and BLM lands. Stewardship contracting can be used to achieve forest restoration across the administrative boundaries of these two agencies to achieve broader landscape-scale restoration goals, as in the case of the Weaverville Community Forest in Trinity County, California (Frost, in press). Stewardship contracting authorities can also be used together with other authorities (such as the Watershed Restoration and Enhancement Agreement, and the Tribal Forest Protection Act) to develop forest restoration projects across federal and private or federal and tribal boundaries.

Watershed Restoration and Enhancement Agreement (Wyden) Authority

The Watershed Restoration and Enhancement Agreement (Wyden) Authority became permanent in 2011. It gives the Forest Service the ability to enter into cooperative agreements with partners in order to undertake activities that protect, restore, and enhance habitat and other resources on public or private lands, including activities that reduce risk from natural disasters that threaten public safety. These activities must benefit the resources within a watershed and contribute to Forest Service goals and objectives.[10] Under the Wyden Authority, federal funding can be used to implement projects and carry out activities on private lands within watersheds that include Forest Service lands in order to achieve watershed restoration goals. This authority makes it possible to collaboratively plan and implement projects across ownership boundaries to achieve common management objectives that improve watershed health.

[10] https://www.cfda.gov/?s=program&mode=form&tab=step1&id=73c38aa3683fc789cedce7aa16f1df53.

Participatory Action Research

Participatory action research (PAR) is a form of systematic inquiry that entails collaboration among people who are affected by an issue being studied so that they can educate, take action, and effect change (Ballard and Belsky 2010). It emphasizes joint problemsolving and reflection by collaborative groups that can include scientists, academic researchers, managers, community members, and natural resource users who share their site-specific knowledge, skills, and expertise in solving natural resource management problems (Everett 2001). Models of PAR to address natural resource management on Forest Service lands can be found from the Shasta-Trinity National Forest in northern California (Everett 2001) and the Olympic National Forest in Washington (Ballard and Belsky 2010, Ballard and Huntsinger 2006). Examples of participatory action research on tribal lands come from the Olympic Peninsula in Washington (Ballard et al. 2008b) and from Arizona (Long et al. 2008). Because of its emphasis on environmental learning, Ballard and Belsky (2010) argue that participatory action research can promote socioecological resilience in forests and forest communities. A substantive body of research provides guidance for how to conduct participatory action research, and reflects on its challenges and benefits (Fortmann 2008, Wilmsen et al. 2008). Participatory action research is a tool that could be used by researchers, Forest Service managers, and others in forest management and planning by (1) inviting people affected by an issue—such as scientists, managers, community members, and forest users—to share their knowledge; (2) treating that knowledge with respect and considering it in decisionmaking; and (3) actively engaging stakeholders as colleagues in scientific inquiries and experiments designed to promote sustainable forest management.

Educational Outreach to Promote Collaboration

One means of engaging local community members in collaborative efforts on national forest lands is through educational outreach. The Sagehen Experimental Forest, part of the Tahoe National Forest and administered together with the Forest Service's Pacific Southwest Research Station, provides an excellent example of this approach. At Sagehen, school children, university students, and community members participate in education and outreach programs related to watershed restoration and hydrologic systems (Cerveny and Charnley, in press). For example, 16 ha (40 ac) were committed to the local school district for science programs. A partnership between the University of California–Berkeley and local elementary schools, as well as a summer speaker series that engages the public in science, has also been established. Sagehen staff members collaborate with the Truckee River Watershed Council on watershed restoration projects. And the Sagehen website has links to a "Fish Cam," news blogs, and podcasts about ongoing research. Each fall, 500 to 600 community members work together on a variety of watershed restoration projects on the Sagehen (Cerveny and Charnley, in press). Thus, active outreach and education programs, and an emphasis on citizen science, can lead to collaborative projects and build support for collaborative forest restoration.

GIS as a Tool for Collaborative Land Management

Over the past decade, geographic information systems (GIS) have been increasingly used to broaden public input into land management processes. The term GIS describes computer applications with which spatial data can be stored, manipulated, displayed, and analyzed (Dunn 2007, Gonzalez 2002). Since its inception in the 1960s, GIS has developed into a valuable tool for incorporating local knowledge, public opinion, human values, and community concerns into land management and conservation projects (Gonzalez 2002). Public participation GIS (PPGIS), also termed participatory GIS or community-integrated GIS, seeks to involve communities in the production and use of geographic information (Dunn 2007). It is one form of human ecology mapping, which aims to map the relations between people and landscapes (for an overview of spatial approaches to integrating social information into environmental planning, see McLain et al. 2013).

By mapping areas of potential conflict over multiple uses and the nature of those conflicts, agencies may be able to target resources to address land use conflicts through collaborative processes.

Several methods of PPGIS have been used in the context of national forest planning and management in the Western United States (Brown et al. 2013). It has most often been used to identify places in national forests that have important values to members of the public, helping to inform planning, and to assess whether the uses and activities being managed in these locations under the forest plan are compatible with the values identified by members of the public (Brown et al. 2013). By mapping areas of potential conflict over multiple uses and the nature of those conflicts, agencies may be able to target resources to address land use conflicts through collaborative processes (Brown and Donovan 2013). PPGIS also has the potential to help forest planners conducting suitability analysis during forest plan revision identify areas suitable for different forest uses, as is called for in the 2012 Forest Service Planning Rule (Brown and Donovan 2013). In 2012, a PPGIS pilot study was carried out on the Sierra, Sequoia, and Inyo National Forests to test an Internet-based PPGIS method using a Google Maps™ interface, and to provide spatial data pertaining to national forest values and use preferences to inform the forest plan revision process (Brown et al. 2013).

Researchers and facilitators often rely on a combination of methods in PPGIS projects. Participation can take many different forms, and can be based on either face-to-face participation or distributed participation, which is typically undertaken using Web-based tools (Jankowski 2009). For instance, participatory rural assessment methods may be used to collect social and environmental data from participants, whereas GIS may be used to organize, display, and analyze those data (Ahamed et al. 2009). Other methods employed in PPGIS projects include the identification of features in aerial photographs (Gonzalez 2002); interviews or focus groups during which socially significant locations are identified and mapped (Hall et al. 2009); email and Internet surveys containing maps that ask respondents to mark meaningful locations on them, which are later digitized and displayed (Beverly et al. 2008, Brown 2004); and the digital placement of markers on maps via Web-based GIS applications (Brown and Weber 2011). Like all participatory work, PPGIS projects range from high participation to low participation, depending on the resources available, public interest in the project, the capacity of individuals to participate, and other variables.

Prior to the development of more participatory approaches, GIS had been used primarily by highly educated individuals who were responsible for producing and synthesizing spatial information for academic or government institutions (Dunn 2007). Public participation GIS has made these technologies accessible to a more diverse audience, and provided a new medium for land managers seeking public input or local knowledge for integration into land use planning and management. As a result, PPGIS enables nontechnologically skilled members of the public to contribute their spatial knowledge to projects that can benefit from local input, augmenting the knowledge of experts. It provides a new avenue for citizen involvement in decisionmaking, community empowerment, and legitimacy for local forms of geographical and spatial knowledge (Dunn 2007, Jankowski 2009).

Despite these benefits, there remain some lingering challenges with PPGIS and human ecology mapping efforts more broadly (summarized in McLain et al. 2013). For instance, there are inherent issues with applying technology such as GIS to projects involving local stakeholders; some people believe that GIS inevitably requires too much expert knowledge to be a truly bottom-up tool in land management (Bussink 2003, Dunn 2007, Kyem 2000). This concern has prompted innovation, with more easily accessible Web-based tools arising as a step toward democratization (Dunn 2007, Jankowski 2009). Free and open-sourced GIS software has also become more ubiquitous, increasing the accessibility of technologies that were once limited to expensive commercial products (Dunn 2007, Jankowski 2009). Technological innovations such as microcomputers have also been crucial in bringing GIS technologies to developing countries and low-income communities (Mersey et al. 2002). Another concern is that through the conversion of indigenous knowledge to spatial data, that knowledge becomes vulnerable to extraction and exploitation (Dunn 2007, Kyem 2000). Following PPGIS guidelines for good governance can help to address this problem (e.g., by recognizing intellectual property rights), as can maximizing participants' control over the data and maps produced (McLain et al. 2013). The specific methods used to gather spatial information from members of the public have been found to influence who participates in producing that information, and the results (Brown et al. 2013). This finding means that land managers may get different signals about what uses and values are important where, with implications for future land management decisions (Brown et al. 2013). These disparities may be addressed by focusing data collection on values rather than land use preferences, allowing managers to make decisions about land uses based on their compatibility with mapped values, and through defensible sampling strategies that include randomly sampling members of the public (Brown et al. 2013). Although concerns surrounding the use of GIS for more collaborative approaches to land management remain, PPGIS presents an opportunity for forest managers to obtain valuable spatial information pertaining to human uses and values of national forests from members of the public that can be integrated with biophysical GIS data layers, and that might not otherwise be represented during the planning process.

Traditional and Local Ecological Knowledge

As noted earlier in this chapter, one of the benefits of collaboration is that it creates an opportunity to combine different forms of ecological knowledge to improve understanding of natural resource management issues. Every society and culture has knowledge systems that guide their interactions with their environment, including utilization of natural resources. Local ecological knowledge (LEK) is defined as "knowledge, practices, and beliefs regarding ecological relationships that are gained through extensive personal observation of and interaction with local ecosystems, and shared among local resource users" (Charnley et al. 2008: 2). Traditional ecological knowledge (TEK) is defined by Berkes et al. (2000: 1252) as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment." Tribal TEK is intergenerational knowledge derived from long-term relationships with places, but it is also dynamic, adapting to conditions of resources and ecosystems (Berkes et al. 2000). Native Americans view many aspects of the natural environment as vitally important to the perpetuation of tribal cultures, economies, and societies. The special relationship between the federal government and tribes provides opportunities and responsibilities to cooperatively protect and restore those values. In 2006, the Forest Service adopted an interagency policy to support traditional gathering of culturally important plants to promote ecosystem health using traditional management practices through collaborative relationships with tribes, tribal communities, tribal organizations, and native traditional practitioners.

Relevance of TEK/LEK

Traditional and local ecological knowledge can facilitate understanding of the objectives, location, frequency, seasonality, and other characteristics of practices by indigenous people and more recent settlers who have influenced ecological characteristics across the landscape. Uses of these forms of knowledge for forest biodiversity conservation in the Pacific Northwest are discussed in detail by Charnley et al. (2007, 2008). Ecological baselines are often founded upon conditions that prevailed prior to Euro-American settlement, so an understanding of past uses and management can provide information valuable in restoring ecosystems (Charnley et al. 2008). A theme that emerges from this science synthesis is the importance of reestablishing reference fire regimes. In many areas, indigenous burning practices were an important part of those reference conditions (Van de Water and Safford 2011). Therefore, traditional burning practices are important to consider in formulating strategies to restore fire regimes and the numerous species that depend on fire, whose abundance and quality likely suffer owing to the legacy of widespread fire suppression (see chapter 4.2, “Fire and Tribal Cultural Resources”).

Traditional and local ecological knowledge may also be used to complement and refine monitoring efforts to understand changes in culturally important resources, especially those that are harvested, and their broader environments. As an example, Shebitz et al. (2008) described how TEK practitioners identified beargrass as a culturally important plant undergoing declines owing to changes in fire regimes and the impacts of commercial harvest, and they applied their knowledge in restoration projects. In collaboration with Forest Service managers or researchers, tribal practitioners who have TEK pertaining to species, habitats, or ecological processes could use it to help improve monitoring, restoration, and conservation activities. Traditional knowledge of phenology could also be valuable in identifying environmental responses to climate change (Nabhan 2010). In addition, collaborations among Forest Service managers, researchers, and tribal practitioners holding TEK may suggest appropriate metrics for evaluating socioecological resilience, such as the quality and quantity of acorns, basketry materials, or other key resources derived from “cultural keystone species” (Garibaldi and Turner 2004) that support community health and livelihoods.

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Engagement With TEK/LEK Holders and Practitioners

The Sierra Nevada is the aboriginal territory of dozens of Indian tribes and other Indian communities (Reynolds 1996). Because of the unique status of Indian tribes as sovereign entities, their special government-to-government relationship with the federal government, and the federal trust responsibility, Indian tribes are distinct from all other stakeholders (Getches et al. 2011).[11] The Leadership Intent document regarding ecological restoration policy in Forest Service Region 5 notes that collaborations with regard to TEK are particularly important. Tribal communities within the Sierra Nevada present distinct opportunities for mutually beneficial partnerships to restore ecologically and culturally significant resources, and to promote socio-ecological resilience (Reynolds 1996). Culturally appropriate communications and procedures for information management are important to maintain trust, respect, and productive relationships between the agency and tribes.

Efforts to engage TEK and LEK in forest management are more likely to be successful when the knowledge holders are directly engaged as active partners in pursuit of mutual goals. Charnley et al. (2008) noted that engaging local forest users in "joint forest management" will aid in the practical application of these forms of knowledge. An example of this type of partnership is a collaborative forest restoration project involving the Maidu community and the Plumas and Lassen National Forests (Charnley et al. 2008, Donoghue et al. 2010). As demonstrated by this example, possible tools to facilitate partnerships may include stewardship contracts or other agreements that allow tribes to have sustained access to resources for an extended period in order to engage in long-term ongoing management (Charnley et al. 2008). The models for Collaborative Forest Management described in the previous section of this chapter can be extended to include tribes and tribal traditional ecological knowledge. Additional examples of collaborations between the Forest Service and tribes are included in chapter 4.2.

Efforts to incorporate TEK and LEK into forest plan revision will be easier where local collaborations are already underway and can overcome many of the challenges to sharing information in productive ways. In suggesting strategies to incorporate TEK into environmental plans, Usher (2000) explained that treating TEK as a dataset may decontextualize the information and is likely to be viewed as disrespectful. He recommended using multiple methods that are complementary, including interviews, reports, and direct statements at public hearings, to include information at different stages of the assessment and planning process. Similarly, Raymond et al. (2010) emphasized the importance of integrating TEK into

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[11] http://www.fs.fed.us/people/tribal/trib-1.pdf.

management as a cyclical process for solving problems rather than as a product. These findings reinforce the importance of successful collaborations, which can help to overcome communication challenges by developing shared understandings of key terms, and the different decisionmaking processes of TEK/LEK holders and the Forest Service. A series of case studies on the role of TEK in tribal-federal collaborations reported by Donoghue et al. (2010) highlight a variety of approaches, and some of the benefits that can be achieved through tribal-federal collaborations when the parties share in project implementation, and the transfer of knowledge is ongoing throughout the process.

Filling Gaps in Knowledge

Charnley et al. (2008) noted that present models and examples for integrating TEK and LEK into forest management focus mainly on Native Americans. More detail is needed about the degree of integration of TEK and LEK held by forest workers, immigrant harvesters of nontimber forest products (NTFPs), ranchers, and other forest users into management, as well as information about variables that are either barriers to or facilitate successful knowledge integration. Although Donoghue et al. (2010) started to fill this gap, additional research would address the diversity of communities and issues in socioecological restoration in the Sierra Nevada.

The first priority research area regarding Native American land use practices identified by Anderson and Moratto (1996) in the Sierra Nevada Ecosystem Project report to Congress was whether Native American uses of fire and other forms of vegetation management should be reintroduced. Additional participatory research partnerships in this vein would help answer important conservation questions, including the expected effects of traditional light burns, as well as more severe wildfires, on valued resources. The Forest Service and many indigenous groups are likely to have mutual interests in restoration using fire for a number of plants valued for their cultural and ecological significance. Several examples in chapter 4.2, "Fire and Tribal Cultural Resources," show that progress is underway on national forests in the Sierra Nevada and surrounding regions.

Research is also needed to go beyond describing ecological knowledge systems to understanding how TEK and LEK are implemented, and what the associated ecological outcomes are in order to determine their potential contributions to conservation and restoration (Charnley et al. 2008). It is important to consider how adaptive learning will be perpetuated over the long term when establishing partnerships intended to share information to address complex sociocultural and environmental issues. Turner and Berkes (2006) highlighted the need to practice incremental learning and knowledge dissemination. Promoting systems to track partnerships and their outcomes throughout the region would provide data to evaluate success of those efforts and would facilitate social learning about incorporating TEK and LEK into management strategies.

Collaboration in Monitoring and Adaptive Management

Adaptive management is broadly characterized as learning through management, with adjustments made as understanding improves (Williams 2011). Adaptive management is commonly conceived as a structured approach that involves cycles of planning, action, monitoring, and evaluation. Adaptive management is often described along a continuum from passive to active, with the more active formulations involving management interventions implemented as experiments (Williams 2011). A core characteristic of adaptive management systems is a design that facilitates responses based upon previously tested policies and accumulated knowledge, and that promotes social learning as a way to respond to novel challenges (Berkes and Folke 2002).

Components of adaptive management systems, such as modeling and stakeholder collaboration, can facilitate learning and adaptive responses; however, feedback processes are particularly critical for facilitating effective responses to and learning from surprises (Berkes and Folke 2002). These processes may include formal monitoring of quantifiable indicators, such as counts of species, as well as more qualitative and integrated socioecological indicators that are embedded in traditional and local ecological knowledge systems, including the accumulated knowledge of long-time agency employees, harvesters and other forest resource users, and local residents (Berkes and Folke 2002). Both approaches may be complementary, because systems based upon traditional or local ecological knowledge may be well attuned to recognizing perturbations that portend major shifts in system function (Berkes and Folke 2002). As an example from the Sierra Nevada, the invasion of Asian clam into various locations in Lake Tahoe was detected both by researchers conducting routine near-shore monitoring and by citizens who recognized the clams as unusual and alerted specialists.

Critics have noted that initiatives labeled as adaptive management often do not address underlying problems, and that despite the rhetoric around the concept, it has rarely been implemented on the ground in the context of forest management (Stankey et al. 2003). Costs are often steep if active adaptive management, with the research it entails, is the goal. For the Forest Service, the annual appropriations model severely constrains the ability to sustain major projects. An important demonstration project in the region is the ongoing Sierra Nevada Adaptive Management Project, a regionally based, well-funded endeavor to practice project implementation through the collaborative study of forest land management by researchers, personnel from multiple public agencies, and stakeholders.[12] Chapter 1.2, " Integrative Approaches: Promoting Socioecological Resilience," points out that this and similar research projects provide valuable opportunities to advance learning, but they have not sustained sufficient funding and support to evaluate long-term ecological responses.

There may be numerous barriers, including funding and bureaucratic resistance, to transitioning from relatively short-term projects to long-term and larger adaptive management systems. Pritchard and Sanderson (2002) suggest that when adaptive management is adopted by bureaucracies, there are strong tendencies to revert back to more conventional technocratic approaches. Barriers to adaptive management within the Forest Service include dwindling resources, growing workloads for staff, lack of leadership, and institutional and regulatory constraints on innovation (Stankey et al. 2003). Nadasdy (2007) noted that many current management frameworks pay insufficient attention to the social and political dimensions of who the winners and losers are under different management approaches; these frameworks may winnow consideration of baselines and approaches based upon present political factors, rather than long-term sustainability.

Barriers to adaptive management within the Forest Service include dwindling resources, growing workloads for staff, lack of leadership, and institutional and regulatory constraints on innovation.

Another critique of adaptive management is that monitoring is often not done well enough and for long enough periods to evaluate important and potentially surprising effects of management (Moir and Block 2001). Because management systems are typically scaled to the immediate future, they may not be well suited for dealing with slower, long-term ecosystem responses and surprises (Moir and Block 2001), both of which may be expected under climate change. As a result, combinations of different types of monitoring and even some research applications may be needed to evaluate impacts and outcomes across different scales. The challenge of developing science capacity is even more important when trying to address complex, long-term changes in ecological systems. A key knowledge gap is to identify likely thresholds that should be the target of monitoring, even if they have not been encountered (Walker et al. 2002), and the appropriate response if monitoring suggests that a threshold has been reached (Moir and Block 2001).

Collaborative, multiparty monitoring of select key indicators has been recommended as an approach to tracking long-term ecological changes, the outcomes of restoration projects, and changing views of forest management (Bliss et al. 2001, DeLuca et al. 2010, Moir and Block 2001). Multiparty monitoring entails community members or groups of interested stakeholders who organize to monitor forest resources or forest management activities and their social or ecological

[12] http://vtm.berkeley.edu/.

effects (e.g., Bliss et al. 2001, Charnley 2008). It is also a way to allow verification of Forest Service findings, build confidence in Forest Service management, reduce the cost of monitoring to the agency, and promote mutual learning (DeLuca et al. 2010). There are several examples of multiparty monitoring for national forest management (see Charnley 2008 and Fernandez-Jimenez et al. 2008). Several organizations have developed handbooks to guide the participatory monitoring process (e.g., Davis-Case 1998, Moseley and Wilson 2002, Pilz et al. 2006, USDA FS 2005).[13]

Participatory monitoring initiatives face many of the same fundamental challenges of time, funding, and staffing as does agency monitoring. They also face added challenges in obtaining broad-based and sustained community participation for long-term monitoring, and in securing technical assistance and science capacity to ensure data validity and credibility (Fernandez-Gimenez et al. 2008). Emerging technologies and accompanying paradigm shifts are aiding development of capacity to facilitate these efforts (Newman et al. 2012).

Although collaborative approaches have been considered a means of reducing the high costs of monitoring required for certain regulatory approaches (Dasse 2002) and a means to facilitate community participation, case-control comparisons of costs and benefits of collaborative versus conventional agency monitoring are needed (Fernandez-Gimenez et al. 2008). Therefore, although scientists studying resilience have suggested important elements of robust adaptive management systems, it would be difficult to quantify the benefits of incorporating them, especially given the short amount of time that has passed since more modern systems of adaptive management have been established.

Despite these potential problems, studies have documented that collaborative monitoring can yield social benefits, such as improved relationships and trust that build social capital to make collaborative natural resource management more successful (Fernandez-Gimenez et al. 2005, 2008; Kusel et al. 2000). It also leads to shared understandings of ecosystems and increased ecological knowledge among participants, social learning, community building, greater adaptive capacity, communication of monitoring results, and to some degree, adaptive management (Cheng and Sturtevant 2012, Fernandez-Gimenez et al. 2008). Increasing attention is also being given to various "citizen science" projects and other forms of public participation as opportunities to conduct monitoring and research, especially at broad spatial scales, and to better engage the public (Dickinson et al. 2012).

[13] For more resources relating to monitoring socioeconomic indicators in the context of restoration on Forest Service lands, go to http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP_36.pdf.

Conclusions

A critical ingredient for increasing the rate and scale of forest restoration in the Sierra Nevada is social agreement about how to carry it out. Community-based collaborative processes have been successful in many places at addressing the social and ecological issues associated with national forest management so that social agreement can be reached and management actions implemented. This chapter has synthesized recent scientific literature on a range of topics relevant to collaboration in national forest management. This information may assist Forest Service managers, community members, and interested stakeholders in becoming more informed about options and approaches for collaboration to help them engage in more successful collaborations and better achieve their forest management goals. Collaborative efforts may focus on NFS lands or extend across multiple ownerships to achieve landscape-scale objectives; take many different forms; incorporate a mix of knowledge types from different stakeholders; and coalesce around different stages of the forest planning process. The nature of collaboration will vary by place and circumstance, depending on local issues and capacities.

A critical ingredient for increasing the rate and scale of forest restoration in the Sierra Nevada is social agreement about how to carry it out.

The 2012 Forest Service Planning Rule—with its emphasis on greater public participation in the planning process, an all-lands approach to planning, considering native knowledge and cultural issues, and monitoring—points to a growing role for collaboration in the national forest planning process in the future. Not only does this trend hold promise for improving national forest management; it may contribute to socioecological resilience in the Sierra Nevada by facilitating the development of trust, leadership, and social networks; by building community capacity to work together to solve problems, enhancing adaptive capacity; by increasing knowledge, skills, and learning among participants; by deepening the connections between people and places to build a stronger sense of place; and through engaged governance (Ballard and Belsky 2010, Berkes and Ross 2012, Walker and Salt 2006).

Literature Cited

Abrams, J. 2011. The policy context of the White Mountain stewardship contract. In: Egan, D.; Hjerpe, E.E.; Abrams, J., eds. Human dimensions of ecological restoration: integrating science, nature, and culture. Washington, DC: Island Press: 163–176. Chapter 12.

Agranoff, R. 2006. Inside collaborative networks: ten lessons for public managers. Public Administration Review. (Special Issue): 56–65.

Ahamed, T.; Khan, M.I.N.; Takigawa, T.; Koike, M.; Tasnim, F.; Zaman, J.M.Q. 2009. Resource management for sustainable development: a community- and GIS-based approach. Environment, Development and Sustainability. 11(5): 933–954.

Anderson, M.K.; Moratto, M.J. 1996. Native American land-use practices and ecological impacts. In: SNEP Science Team and Special Consultants, eds. Sierra Nevada ecosystem project: final report to Congress. Vol. II: Assessments and scientific basis for management options. Report No. 37. Davis, CA: Centers for Water and Wildland Resources, University of California–Davis: 187–206. Chapter 9.

Ballard, H.L.; Belsky, J.M. 2010. Participatory action research and environmental learning: Implications for resilient forests and communities. Environmental Education Research. 16(5–6): 611–627.

Ballard, H.L.; Fernandez-Gimenez, M.; Sturtevant, V.E. 2008a. Integration of local ecological knowledge and conventional science: a study of seven community-based forestry organizations in the USA. Ecology and Society. 13(2): 37.

Ballard, H.L.; Huntsinger, L. 2006. Salal harvester local ecological knowledge, harvest practices, and understory management on the Olympic Peninsula, Washington. Human Ecology. 34(4): 529–547.

Ballard, H.L.; Joyce, A.T.; Collins, D. 2008b. Comparing participatory ecological research in two contexts: an immigrant community and a Native American community on Olympic Peninsula, Washington. In: Wilmsen, C.; Elemendorf, E.; Ross, L.; Sarathy, B.; Wells, G., eds. Partnerships for empowerment: participatory research for community-based natural resource management. London, United Kingdom, and Sterling, VA: Earthscan: 187–215. Chapter 9.

Bartlett, G. 2012. Developing collaboration and cooperation. In: North, M., ed. Managing Sierra Nevada forests. Gen. Tech. Rep. PSW-GTR-237. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 81–88. Chapter 7.

Bergmann, S.A.; Bliss, J.C. 2004. Foundations of cross-boundary cooperation: resource management at the public-private interface. Society and Natural Resources. 17(5): 377–393.

Berkes, F.; Colding, J.; Folke, C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications. 10 (5): 1251–1262.

Berkes, F.; Folke, C. 2002. Ecosystem dynamics and local knowledge. In: Gunderson, L.; Holling, C.S., eds. Panarchy: understanding transformations in human and natural systems. Washington DC: Island Press: 121–146.

Berkes, F.; Ross, H. 2012. Community resilience: toward an integrated approach. Society and Natural Resources. 26: 5–20.

Bernard, T. 2010. Hope and hard times: communities, collaboration, and sustainability. Gabriola Island, BC: New Society Publishers. 234 p.

Bernard, T.; Young, J. 1997. The ecology of hope: communities collaborate for sustainability. Gabriola Island, BC: New Society Publishers. 325 p.

Beverly, J.L.; Uto, K.; Wilkes, J.; Bothwell, P. 2008. Assessing spatial attributes of forest landscape values: an internet-based participatory mapping approach. Canadian Journal of Forest Research. 38: 289–303.

Bliss, J.; Aplet, G.; Hartzell, C.; Harwood, P.; Jahnige, P.; Kittredge, D.; Lewandowski, S.; Soscia, M.L. 2001. Community-based ecosystem monitoring. In: Gray, G.J.; Enzer, M.J.; Kusel, J., eds. Understanding community-based forest ecosystem management. Binghamton, NY: Food Products Press: 143–167.

Brown, G.G. 2004. Mapping spatial attributes in survey research for natural resource management: methods and applications. Society and Natural Resources. 18(1): 17–39.

Brown, G.G.; Donovan, S. 2013. Escaping the national forest planning quagmire: using public participation GIS to assess acceptable national forest use. Journal of Forestry. 111(2): 115–125.

Brown, G.G.; Kelly, M.; Whitall, D. 2013. Which 'public'? Sampling effects in public participation GIS (PPGIS) and volunteered geographic information (VGI) systems for public lands management. Journal of Environmental Planning and Management. doi:10.1080/09640568.2012.741045.

Brown, G.; Weber, D. 2011. Public Participation GIS: a new method for national park planning. Landscape and Urban Planning. 102(1): 1–15.

Bryan, T.A. 2004. Tragedy averted: the promise of collaboration. Society and Natural Resources. 17(10): 881–896.

Bussink, C. 2003. GIS as a tool in participatory natural resource management: Examples from the Peruvian Andes. Mountain Research and Development. 23(4): 320–323.

Butler, W.H.; Goldstein, B.E. 2010. The U.S. Fire Learning Network: providing a narrative framework for restoring ecosystems, professions, and institutions. Society and Natural Resources. 23(10): 935–951.

Cerveny, L.; Charnley, S. [In press.] Public use and citizen outreach at experimental forests and ranges. In: Hayes, D.C.; Stout, S.L.; Crawford, R.F.; Hoover, A.P., eds. USDA Forest Service experimental forests and ranges: research for the long term. New York: Springer.

Charnley, S. 2008. Socioeconomic monitoring and forest management. In: Donoghue, E.M.; Sturtevant, V., eds. Community-forest connections: implications for research, management, and governance. Washington, DC: Resources for the Future Press: 45–65.

Charnley, S.; Fischer, A.P.; Jones, E.T. 2007. Integrating traditional and local ecological knowledge into forest biodiversity conservation in the Pacific Northwest. Forest Ecology and Management. 246(1): 14–28.

Charnley, S.; Fischer, A.P.; Jones, E.T. 2008. Traditional and local ecological knowledge about forest biodiversity in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-751. Portland, OR: Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p.

Cheng, A.S.; Mattor, K.M. 2010. Place-based planning as a platform for social learning: insights from a national forest landscape assessment process in western Colorado. Society and Natural Resources. 23(5): 385–400.

Cheng, A.; Sturtevant, V.E. 2012. A framework for assessing collaborative capacity in communtiy-based public forest management. Environmental Management. 49: 675–689.

Colburn, C.H. 2002. Forest policy and the Quincy Library Group. In: Brunner, R.D.; Colburn, C.H.; Klein, R.A.; Olson, E.A., eds. Finding common ground: governance and natural resources in the American West. New Haven, CT: Yale University Press: 159–200. Chapter 5.

Collaborative Forest Restoration Program. 2005. Monitoring social and economic effects of forest restoration. Handbook 5, the multiparty monitoring handbook series. Flagstaff, AZ: Ecological Restoration Institute. 55 p.

Cortner, H.J. 2000. Making science relevant to environmental policy. Environmental Science and Policy. 3: 21–30.

Cortner, H.J.; Moote, M.A. 1999. The politics of ecosystem management. Washington, DC: Island Press. 181 p.

Costanza, J.K.; Moody, A. 2011. Deciding where to burn: stakeholder priorities for prescribed burning of a fire-dependent ecosystem. Ecology and Society. 16(1): 14.

Cumming, G.S.; Cumming, D.H.M.; Redman, C.L. 2006. Scale mismatches in social-ecological systems: causes, consequences, and solutions. Ecology and Society. 11(1): 14.

Dasse, C.M. 2002. Adopting collaborative management programs. International Journal of Economic Development. 4(3–4). http://www.spaef.com/article/670/Adopting-Collaborative-Management-Programs. (16 June 2014).

Davis-Case, D. 1998. Community forestry: participatory assessment, monitoring and evaluation. Rome, Italy: Food and Agriculture Organization of the United Nations. 150 p.

DeLuca, T.H.; Aplet, G.H.; Wilmer, B.; Burchfield, J. 2010. The unknown trajectory of forest restoration: a call for ecosystem monitoring. Journal of Forestry. 108(6): 288–295.

Dickinson, J.L.; Shirk, J.; Bonter, D.; Bonney, R.; Crain, R.L.; Martin, J.; Phillips, T.; Purcell, K. 2012. The current state of citizen science as a tool for ecological research and public engagement. Frontiers in Ecology and the Environment. 10(6): 291–297.

Donoghue, E.M.; Thompson, S.A.; Bliss, J.C. 2010. Tribal-federal collaboration in resource management. Journal of Ecological Anthropology. 14(1): 22–38.

Dukes, E.F. 2011. The promise of community-based collaboration: agenda for an authentic future. In: Dukes, E.F.; Firehock, K.E.; Birkhoff, J.E., eds. Community-based collaboration: bridging socio-ecological research and practice. Charlottesville, VA: University of Virginia Press: 191–216. Chapter 7.

Dunn, C.E. 2007. Participatory GIS a people's GIS? Progress in Human Geography. 31(5): 616–637.

Everett, Y. 2001. Participatory research for adaptive management: a case of nontimber forest products. Journal of Sustainable Forestry. 13(1/2): 335–357.

Everett, Y.; Fuller, M. 2011. Fire safe councils in the interface. Society and Natural Resources. 24(4): 319–333.

Fernandez-Gimenez, M.E.; Ballard, H.L. 2011. How CBCs learn: ecological monitoring and adaptive management. In: Dukes, E.F.; Firehock, K.E.; Birkhoff, J.E., eds. Community-based collaboration: bridging socio-ecological research and practice. Charlottesville, VA: University of Virginia Press: 45–80. Chapter 3.

Fernandez-Gimenez, M.E.; Ballard, H.L.; Sturtevant, V.E. 2008. Adaptive management and social learning in collaborative and community-based monitoring: a study of five community-based forestry organizations in the western USA. Ecology and Society. 13(2): 4. http://www.ecologyandsociety.org/vol13/iss2/art4/. (26 December 2013).

Fernandez-Gimenez, M.E.; Ruyle, G.; McClaran, S.J. 2005. An evaluation of Arizona cooperative extension's rangeland monitoring program. Rangeland Ecology and Management. 58(1): 89–98.

Ferranto, S.; Huntsinger, L.; Getz, C.; Lahiff, M.; Stewart, W.; Nakamura, G.; Kelly, M. 2013. Management without borders? A survey of landowner practices and attitudes toward cross-boundary cooperation. Society and Natural Resources. 26(9): 1086–1100. doi:10.1080/08941920.2013.779343.

Firehock, K.E. 2011. The community-based collaborative movement in the United States. In: Dukes, E.F.; Firehock, K.E.; Birkhoff, J.E., eds. Community-based collaboration: bridging socio-ecological research and practice. Charlottesville, VA: University of Virginia Press: 1–18.

Fischer, P.A.; Charnley, S. 2012. Risk and cooperation: managing hazardous fuel in mixed ownership landscapes. Environmental Management. 49(6): 1192–1207.

Fleeger, W.E.; Becker, M.L. 2010. Decision processes for multijurisdictional planning and management: community wildfire protection planning in Oregon. Society and Natural Resources. 23(4): 351–365.

Fortmann, L. ed. 2008. Participatory research in conservation and rural livelihoods: doing science together. Oxford, United Kingdom: Wiley-Blackwell and Zoological Society of London. 284 p.

Fortmann, L.; Ballard, H. 2011. Sciences, knowledges, and the practice of forestry. European Journal of Forest Research. 130(3): 467–477.

Frost, P. [In press]. Stewardship agreements: the Weaverville Community Forest, California. In: Charnley, S.; Sheridan, T.E.; Nabhan, G.P., eds. Stitching the West back together: conserving working landscapes. Chicago: University of Chicago Press.

Garibaldi, A.; Turner, N. 2004. Cultural keystone species: implications for conservation and restoration. Ecology and Society. 9(3): 1.

Getches, D.H.; Wilkinson, C.F.; Williams, J.; Robert, A.; Fletcher, M.L.M. 2011. Cases and materials on federal Indian law. St. Paul, MN: West Publishing. 1088 p.

Goldstein, B.E. 2012. Collaborative resilience: moving through crisis to opportunity. Cambridge, MA: MIT Press. 424 p.

Goldstein, B.E.; Butler, W.H.; Hull, B. 2010. The fire learning network: a promising conservation strategy. Journal of Forestry. 108(3): 120–125.

Gonzalez, R. 2002. Joint learning with GIS: multi-actor resource management. Agricultural Systems. 73: 99–111.

Hall, G.B.; Moore, A.; Knight, P.; Hankey, N. 2009. The extraction and utilization of local and scientific geospatial knowledge within the Bluff oyster fishery, New Zealand. Journal of Environmental Management. 90(6): 2055–2070.

Hibbard, M.; Madsen, J. 2003. Environmental resistance to place-based collaboration in the U.S. West. Society and Natural Resources. 16(8): 703–718.

Jakes, P.; Burns, S.; Cheng, A.; Saeli, E.; Nelson, K.; Brummel, R.; Grayzeck, S.; Sturtevant, V.; Williams, D. 2007. Critical elements in the development and implementation of Community Wildfire Protection Plans (CWPPs). In: Butler, B.W.; Cook, W., comps. The fire environment—innovations, management, and policy; conference proceedings. Proceedings RMRS-P-46CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 613–624.

Jakes, P.J.; Esposito, C.; Burns, S.; Nelson, K.C.; Cheng, A.S.; Sturtevant, V.E.; Williams, D.R. 2012. Best management practices for creating a Community Wildfire Protection Plan. Gen. Tech. Rep. NRS-89. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 27 p.

Jakes, P.J.; Nelson, K.C.; Enzler, S.A.; Burns, S.; Cheng, A.S.; Sturtevant, V.E.; Williams, D.R.; Bujak, A.; Brummel, R.F.; Grayzeck-Souter, S.; Staychock, E. 2011. Community wildfire protection planning: Is the Healthy Forests Restoration Act's vagueness genius? International Journal of Wildland Fire. 20(3): 350–363.

Jankowski, P. 2009. Towards participatory geographic information systems for community-based environmental decision making. Journal of Environmental Management. 90(6): 1966–1971.

Kemmis, D.; McKinney, M. 2011. Collaboration and the ecology of democracy. Sustainable Development Law & Policy. 12(1): 46–50, 69–70.

Koontz, T.M.; Thomas, C. 2006. What do we know and need to know about the environmental outcomes of collaborative management? Public Administration Review. 66(s1): 111–121.

Kusel, J.; Kocher, S.; London, J.; Buttolph, L.; Schuster, E. 2000. Effects of displacement and outsourcing on woods workers and their families. Society and Natural Resources. 13(2): 115–134.

Kyem, P.A.K. 2000. Embedding GIS applications into resource management and planning activities of local and indigenous communities: A desirable innovation or a destabilizing enterprise? Journal of Planning Education and Research. 20(2): 176–186.

Lindenmayer, D.B.; Franklin, J.F. 2002. Conserving forest biodiversity: a comprehensive multiscaled approach. Washington, DC: Island Press. 351 p.

London, J.; Starrs, P.F.; Fortmann, L. 2005. Power plants and forest plans: two decades of mobilization in a mountain forest community. In: Lee, R.G.; Field, D.R., eds. Communities and forests: where people meet the land. Corvallis, OR: Oregon State University Press: 116–137. Chapter 7.

Long, J.; Burnette, M.; Endfield, D.; Lupe, C. 2008. Battle and the bridge: using participatory approaches to develop community researchers in ecological management. In: Wilmsen, C.; Elemendorf, E.; Ross, L.; Sarathy, B.; Wells, G., eds. Partnerships for empowerment: participatory research for community-based natural resource management. London, United Kingdom, and Sterling, VA: Earthscan: 217–237. Chapter 10.

Margerum, R.D. 2011. Beyond consensus: improving collaborative planning and management. Cambridge, MA: The MIT Press. 395 p.

Marston, E. 2000. The Quincy Library Group: a divisive attempt at peace. In: Brick, P.; Snow, D.; Van de Wetering, S., eds. Across the great divide: explorations in collaborative conservation and the American West. Washington, DC: Island Press: 79–90.

McDermott, M.H.; Moote, M.A.; Danks, C. 2011. Effective collaboration: overcoming external obstacles. In: Dukes, E.F.; Firehock, K.E.; Birkhoff, J.E., eds. Community-based collaboration: bridging socio-ecological research and practice. Charlottesville, VA: University of Virginia Press: 81–110. Chapter 4.

McLain, R.; Poe, M.; Biedenweg, K.; Cerveny, L.; Besser, D.; Blahna, D. 2013. Making sense of human ecology mapping: an overview of approaches to integrating socio-spatial data into environmental planning. Human Ecology. 41: 651–665. doi:10.1007/s10745-013-9573-0.

Mersey, J.E.; Millward, A.A.; Martinez, L.M. 2002. Realizing the potential of GIS in community-based management of protected areas. International Journal of Sustainable Development and World Ecology. 9(3): 208–222.

Middleton, B.R. 2011. Trust in the land: new directions in tribal conservation. Tucson, AZ: University of Arizona Press. 352 p.

Moir, W.H.; Block, W.M. 2001. Adaptive management on public lands in the United States: Commitment or rhetoric? Environmental Management. 28(2): 141–148.

Moseley, C.; Wilson, L.J. 2002. Multiparty monitoring for sustainable natural resource management. Eugene, OR: University of Oregon, Institute for a Sustainable Environment. 93 p.

Nabhan, G.P. 2010. Perspectives in ethnobiology: ethnophenology and climate change. Journal of Ethnobiology. 30(1): 1–4.

Nadasdy, P. 2007. Adaptive co-management and the gospel of resilience. In: Armitage, D.; Berkes, F.; Doubleday, N., eds. Adaptive co-management: collaboration, learning, and multilevel governance. Vancouver, BC: University of British Columbia Press: 208–227. Chapter 11.

Nelson, D.R.; Adger, W.N.; Brown, K. 2007. Adaptation to environmental change: contributions of a resilience framework. Annual Review of Environment and Resources. 32: 395–419.

Newman, G.; Wiggins, A.; Crall, A.; Graham, E.; Newman, S.; Crowston, K. 2012. The future of citizen science: emerging technologies and shifting paradigms. Frontiers in Ecology and the Environment. 10(6): 298–304.

North, M.; Rojas, R. 2012. Dinkey North and South Project. In: North, M., ed. Managing Sierra Nevada forests. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 117–126. Chapter 11.

Pilz, D.; Ballard, H.; Jones, E.T. 2006. Broadening participation in biological monitoring: handbook for scientists and managers. Gen. Tech. Rep. PNW-GTR-680. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 131 p.

Pritchard, L.; Sanderson, S.E. 2002. The dynamics of political discourse in seeking sustainability. In: Gunderson, L.; Holling, C.S., eds. Panarchy: understanding transformations in human and natural systems. Washington, DC: Island Press: 147–172.

Quinn-Davidson, L.N.; Varner, M. 2012. Impediments to prescribed fire across agency, landscape, and management: an example from northern California. International Journal of Wildland Fire. 21(3): 210–218.

Raymond, C.M.; Fazey, I.; Reed, M.S.; Stringer, L.C.; Robinson, G.M.; Eveley, A.C. 2010. Integrating local and scientific knowledge for environmental management. Journal of Environmental Management. 91(8): 1766–1777.

Reynolds, L.A. 1996. The role of Indian tribal governments and communities in regional land management. In: SNEP Science Team and Special Consultants, eds. Status of the Sierra Nevada, Sierra Nevada ecosystem project: final report to Congress. Vol. II: Assessments and scientific basis for management options. Report No. 37. Davis, CA: Centers for Water and Wildland Resources, University of California–Davis: 207–233.

Rickenbach, M.; Schulte, L.A.; Kittredge, D.B.; Labich, W.G.; Shinneman, D.J. 2011. Cross-boundary cooperation: a mechanism for sustaining ecosystem services from private lands. Journal of Soil and Water Conservation. 66(4): 91a–96a.

Scheffer, M.; Westley, F.; Brock, W.A.; Holmgren, M. 2002. Dynamic interactions of societies and ecosystems—linking theories from ecology, economy, and sociology. In: Gunderson, L.; Holling, C.S., eds. Panarchy: understanding transformations in human and natural systems. Washington, DC: Island Press: 195–240.

Scholz, J.T.; Wang, C.L. 2006. Cooptation of transformation? Local policy networks and federal regulatory enforcement. American Journal of Political Science. 50(1): 81–97.

Schultz, C.A.; Jedd, T.; Beam, R.D. 2012. The Collaborative Forest Landscape Restoration Program: a history and overview of the first projects. Journal of Forestry. 110(7): 381–391.

Shebitz, D.J.; Reichard, S.H.; Woubneh, W. 2008. Beargrass (*Xerophyllum tenax*) on the Olympic Peninsula, Washington: autecology and population status. Northwest Science. 82(2): 128–140.

Stankey, G.H.; Bormann, B.T.; Ryan, C.; Shindler, B.; Sturtevant, V.; Clark, R.N.; Philpot, C. 2003. Adaptive management and the Northwest Forest Plan—rhetoric and reality. Journal of Forestry. 101(1): 40–46.

Sturtevant, V.; McCaffrey, S.M. 2006. Encouraging wildland fire preparedness: lessons learned from three wildfire education programs. In: McCaffrey, S.M., ed. The public and wildland fire management: social science findings for managers. Gen. Tech. Rep. NRS-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 125–136.

The Nature Conservancy [TNC]. 2012. U.S. fire learning network field guide. Arlington, VA. 102 p.

Turner, N.; Berkes, F. 2006. Coming to understanding: developing conservation through incremental learning in the Pacific Northwest. Human Ecology. 34: 495–513.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2005. Southwestern Region State and Private Forestry—Collaborative Forest Restoration Program. http://www.fs.usda.gov/detail/r3/workingtogether/grants/?cid=fsBdev3_022022. (7 March 2013).

Usher, P.J. 2000. Traditional ecological knowledge in environmental assessment and management. Arctic. 53(2): 183–193.

Van de Water, K.M.; Safford, H.D. 2011. A summary of fire frequency estimates for California vegetation before Euro-American settlement. Fire Ecology. 7(3): 26–58.

Wade, D.; Miller, S.; Stowe, J.; Brenner, J. 2006. Rx fire laws: tools to protect fire: the ‘ecological imperative’. In: Dickinson, M.B., ed. Fire in eastern oak forests: delivering science to land managers, proceedings of a conference. GTR-NRS-P-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 233–262.

Walker, B.; Carpenter, S.; Anderies, J.; Abel, N.; Cumming, G.; Janssen, M.; Lebel, L.; Norberg, J.; Peterson, G.D.; Pritchard, R. 2002. Resilience management in social-ecological systems: a working hypothesis for a participatory approach. Conservation Ecology. 6(1): 14.

Walker, B.; Salt, D. 2006. Resilience thinking: sustaining ecosystems and people in a changing world. Washington, DC: Island Press. 174 p.

Williams, B.K. 2011. Passive and active adaptive management: approaches and an example. Journal of Environmental Management. 92(5): 1371–1378.

Wilmsen, C.; Elmendorf, W.; Fisher, L.; Ross, J.; Sarathy, B.; Wells, G., eds. 2008. Partnerships for empowerment: participatory research for community-based natural resource management. London, United Kingdom, and Sterling, VA: Earthscan. 292 p.