Title
The Politics of Collaboration: Producing Restoration Knowledge and Practice in the Feather River Headwaters

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Publication Date
2014

Peer reviewed|Thesis/dissertation

The Politics of Collaboration:
Producing Restoration Knowledge and Practice in the Feather River Headwaters

By

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A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Environmental Science, Policy, and Management

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor J. Keith Gilless (Chair)
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Spring 2014

Abstract

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Sarah Ann Bickel Di Vittorio

Doctor of Philosophy in Environmental Science, Policy, and Management

University of California, Berkeley

Professor J. Keith Gilless, Chair

This research project situates a long-term collaborative effort to restore headwaters meadows within the political, institutional, and historical contexts that have shaped relations of power over watershed resources in the Feather River region. The study addresses a need in the literature for more nuanced studies of the ways that collaborative environmental governance takes shape within and engages these contexts and what the implications are for resource control and access. Using a grounded approach, informed by several bodies of theory from governance, political ecology, and science and technology studies, the project first locates collaboration as part of an ongoing history of resource politics in the United States and then identifies three key loci where collaboration catalyzed renegotiations of politics and power in the Feather River case. These loci are 1) the collaborative production of restoration knowledge and practice in response to both biophysical and social conditions of the watershed, 2) the development of new policy frames that enabled members of the headwaters community to challenge the invisibility of watersheds in California water supply policy and make new political claims against historically powerful downstream interests, and 3) the participation of the U.S. Forest Service, which facilitated collaborative restoration projects and efforts to increase the visibility of headwaters but declined to take on more controversial policy changes. Taken together, these findings portray a complex relationship between collaboration, power, and politics. Knowledge production and policy reframing were important sources of power that grew from collaboration. Although limited by the durability of long-standing relations of resource control in wider institutional and political contexts, collaboration created power for headwaters actors to effect innovative restoration solutions and motivate wider policy changes with benefits to headwaters communities and ecosystems.

To my daughter, Eleana Rose, whose delightful smile,
infectious laughter, and playful spirit brighten my days and my life.

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Acknowledgments

I have many people to thank for their unwavering and vital support during this project. My advisor, J. Keith Gilless, provided not only insightful mentorship and generous funding support; he also taught me to trust my ideas and abilities and to see challenges in proper perspective. Jeff Romm directed my interest to the Feather River watershed and helped me locate the broader historical and political significance of its story; his kind humor and affection for his students make Berkeley a better place. With great enthusiasm and intellectual curiosity, Chris Ansell challenged me to clarify my goals, improve the rigor of my conceptual frameworks, and spell out the significance of my findings. David Winickoff's course on science and technology studies fundamentally transformed my view of this project; he took sincere interest in my ideas and helped me figure out how to pursue them. Louise Fortmann was a rock of encouragement and confidence; the oasis of her lab facilitated valued friendships, and her insight, openness, and generosity helped me learn what it means to be a good scholar and colleague.

Many people in the Feather River watershed and beyond made this dissertation possible by generously sharing their time, work, passion, and stories. I am especially, deeply grateful to Jim Wilcox, Gia Martynn, Leah Wills, Brian Morris, and the Feather River Coordinated Resource Management group staff. Many others provided invaluable insights and aid. It is one thing to write about people who are changing the world; it is quite another to go out and do it. I am humbled and inspired by your example.

I could not have completed this journey without the friendship and help of fellow graduate students, other colleagues, and friends. Abigail Martin and Kendra Klein read many early (and some terrible) drafts, and always greeted my work with enthusiasm and encouragement. The amazing women of the Louise Lab, especially Clare Gupta, Mez Baker, Alice Kelly, Margot Higgins, Esther Conrad, and Heather Lukacs, provided humor, inspiration, and sage advice. I leaned on many other colleagues along the way, including Sang Lee, Chris Lever, Megan Ybarra, Juliet Christian-Smith, Graham Bullock, and Federico Castillo, and enjoyed the camaraderie of many more. Writing a dissertation while managing the exhaustion, sleep deprivation, and life transformations that arrive with a new baby is not a recipe for sanity. I could not have done it without the laughter and love of a wonderful community of friends, and the companionship and example of fellow moms Caterina Meyers, Diane Lever, Sikina Jinnah, Sarah Thomas, Freya Knapp, Elizabeth Allison, Abbe Solomon, Sarah Koch-Schiller, Sara Nelson, and Nicole Snow.

I am deeply grateful to my family for their emotional and material support. My parents, Ann and Gary Bickel, believed in me from start to finish and helped in more ways than I can count. My sister and brother, Katie Goldman and Geoff Bickel, and their spouses Jeff and Marie, were likewise steadfast in their love and support. My in-laws, Vince and Vicki Di Vittorio, fed, housed, and kept me company on many field trips. Jimmy and Sara Di Vittorio were (and are) the best friends that a sister-in-law could hope for. Last but not least, I am so very fortunate that my husband, Alan Di Vittorio, has walked alongside me every step of the way. Thank you for that first backpacking trip to Rock Lake and for all of the adventures, in the Sierra and beyond, ever since. I could not ask for a more loving, kind, and supportive companion in life.

CHAPTER 1. INTRODUCTION

Alternative arrangements for governing resources and the environment have emerged in recent decades amidst a backlash to centralized, bureaucratic approaches. In forests and watersheds of the American West, collaborative, community-based, and market-based approaches have excited interest from policy-makers, academics, conservation groups, and communities. Despite their popularity, these new approaches have met with mixed success. Scholars increasingly suggest that this patchy record derives, in part, from inattention to how new governance approaches take shape within historical, political, and institutional contexts (Armitage, 2008; Carpenter et al., 2009; Vatn, 2010; Walker & Hurley, 2004). There thus remains a need in the academic literature for more nuanced accounts of the political dimensions and significance of collaborative governance. To address this need, this research project investigates collaborative efforts to restore California's Feather River watershed within the politics and power relationships that have long shaped control of the region's rich resources.

THE HEADWATERS IN BIOPHYSICAL AND SOCIAL CONTEXT

Northern California's Upper Feather River watershed is a key source of water supply and hydroelectricity production in California. A long history of resource extraction and export from the region has impacted watershed hydrology. The practices of fire suppression, timber harvesting, overgrazing, mining, agriculture, and road and railroad construction, particularly in the late 19th and early 20th centuries, resulted in gullied stream channels, erosion, conversion of lush meadows to dry sagebrush plains, and high density, fire-prone forests.

A coalition of watershed residents has worked for several decades to restore these headwaters through a community-led, collaborative effort called Feather River Coordinated Resource Management (Feather River CRM). The focus of this effort evolved over time, from an initial effort to restore eroding meadow stream channels to a more comprehensive focus on meadow floodplain restoration. These meadows play an important though not fully understood role in regulating watershed hydrology. The meadow restoration work overlaps with a parallel and controversial community-driven effort to thin the watershed's forests to reduce fire hazards. Both efforts have occurred amid larger social interest in how restoring forests and meadows – and altering practices such as road building, timber harvesting, and livestock grazing – might enhance the supply and quality of water flowing from forested landscapes (National Research Council, 2008). Water from the Feather River watershed is extraordinarily valuable to the state. It sustains fisheries in the California Delta, produces hydroelectricity that powers California's cities, and supplies water that helps grow the nation's food.

But restoration of the Feather River watershed has been controversial. The downstream effects of specific upstream management interventions are contested and difficult to assess. Region-specific studies of how restoration projects affect hydrology, including timing and quantity of water flows, are few. A dramatic meadow restoration approach pioneered by the Feather River CRM has attracted praise and resources from beyond the watershed but angered some of the watershed's ranchers, who fear impacts to their water supplies. At larger scales, restoration brings to the fore difficult political questions about control over the state's natural resources and responsibility for sustaining the landscapes that produce them. Downstream of the headwaters, the Feather River was engineered to provide water supply and hydropower to distant farms and cities. Although these practices produce wealth and power for hydropower utilities, water retailers, and consumers including industrial-scale agriculture, these groups resist calls to fund the watershed's restoration. The notion of restoring headwaters to improve California's water supply also confronts a deeply embedded history and logic of controlling rivers through engineering approaches. These practices have been important not only biophysically, but also socially and politically, as they have inscribed cultural beliefs about human-nature relationships into the landscape and generated uneven power relationships over nature and its resources.

As such, headwaters management practices today are important sites of challenge in the Sierra Nevada, on at least two levels. First, they are sites where new cultural and scientific understandings of nature – themselves often contested – are taking form on the landscape. These include, for example, the understanding of meadows as "sponges" that regulate watershed hydrology and the understanding of ecosystems as producers of "goods and services" for human consumers. These concepts underpin the development of new practices of headwaters restoration with goals that include climate change adaptation, flood protection, enhancement of wildlife habitat and livestock forage, and water supply enhancement. Second, changes in how we manage the headwaters also reflect larger shifts in contemporary approaches to governing nature, including a decentering of the role of public agencies, an expanded role for citizens, and a diversifying array of market and network-oriented policy tools. These shifts are not merely organizational; they also change the dynamics of decision-making in ways that legitimize access by new voices that may challenge longstanding relationships of resource control. Restoration of the Feather River headwaters has taken place largely through community-led collaboration with state, federal, and non-governmental entities. Some members of the headwaters community have also advocated new payment-for-ecosystem services (PES) policy instruments that would require downstream hydropower producers, water retailers, and the consumers they serve to "reinvest" in the headwaters through financial contribution to restoration and management. These community-led efforts have at times challenged the technical autonomy and neutral identity of the U.S. Forest Service, the primary federal land manager in the watershed.

The headwaters are thus a nexus of multiple, overlapping tensions, where collaborative governance efforts are asserting new influence over how to restore nature; the distribution of resources, wealth, and risk; the trade-offs between different values and interests; and the obligation of distant water users to sustain the system from which they derive their wealth and livelihoods.

Chapter preview

This dissertation situates collaborative headwaters restoration within a larger political history of resource control in the Feather River region. It focuses in particular on the ways that community-led collaboration has generated new knowledge and practices for managing and restoring headwaters that have challenged existing configurations of resource control and access and thus generated an array of contests among watershed stakeholders. In doing so, it fills a need in the academic literature for more nuanced views of the political dimensions of collaborative governance in the United States. Chapters are laid out as follows:

Chapter 2. Environmental governance, politics, and power: Theory, approach, and case. In this chapter, I first review relevant theories of environmental governance to identify how they have addressed the issues of power and politics. Next, I draw on work in political ecology, science and technology studies, and environmental governance to characterize three key loci where power relationships are renegotiated through collaboration in the Feather River case. These loci are: the production of restoration knowledge and practice, negotiations over new policy tools to support headwaters restoration, and federal agency efforts to define their role and respond to conflicts amidst a changing watershed governance landscape. In this chapter, I also I describe my approach to data collection and analysis and how it evolved through the course of my study, and I provide an overview of the watershed and its salient social and biophysical features.

Chapter 3. Changing logics for governing nature since the Progressive Era. This chapter contextualizes the Feather River watershed within broader historical currents of resource management and governance in the U.S., particularly since the Progressive Era. Relying mostly on secondary sources, my aim is not to produce a comprehensive history but rather to draw out the key elements of the conservationist logic for managing nature and to identify the political work that this logic accomplished in the Feather River region and beyond. Doing so sets the stage for understanding contemporary strategies of governance as part of this political history.

Chapter 4. Contested terrain: The knowledge politics of collaborative meadow restoration. This chapter narrates the collaborative emergence of a novel, controversial meadow restoration technique called pond and plug in the Feather River watershed. Existing literature on collaboration often portrays “social learning” as a relatively apolitical process of generating shared knowledge in pursuit of better environmental agreements. In contrast, this chapter shows how the ongoing production of new knowledge and techniques for restoring headwaters is a socially embedded process, particularly within the politics, history, and power relations of resource management in California and the Feather River region. The chapter concludes with a discussion of how the social learning literature might better address the political and power dimensions of environmental knowledge production.

Chapter 5. Upstream water, downstream wealth: The politics of reinvestment in the Feather River watershed. Payment for ecosystem services (PES) is an increasingly popular, market-oriented policy tool that aims to compensate people who provide a conservation service. In this chapter I look at how PES, or “reinvestment” as it is known in this case, has been advocated, negotiated, and contested in the Feather River watershed. I conceptualize “reinvestment” as a policy frame: a way of representing a problem in order to influence collective views of that problem and encourage some desired policy solution or outcome. This chapter shows how the collaborative effort to restore the watershed’s degraded meadows provided the conceptual framework for developing the reinvestment frame, and how the headwaters coalition strategically used this frame to challenge California’s dominant water supply approach and power landscape. Findings reveal both the strengths and limitations of this reframing strategy.

Chapter 6: Navigating conflict, scientific uncertainty, and political risk: Headwaters restoration and the Forest Service. Collaborative governance places public agencies like the Forest Service in a new role of deliberation alongside stakeholders to solve problems from the bottom up. At the same time, the Forest Service has increasingly emphasized the role of national forests in producing the nation’s water supply and focused its management efforts on watersheds. Chapter 6 investigates how the agency has defined and negotiated its new role amidst this changing landscape and in the context of watershed politics. My findings reveal that the forces acting on the agency in collaboration are quite similar to the forces acting on it in any conflict over national forest management. How it responds to these forces is also similar, including a preference to avoid political risk and conflict and to focus on finding technical solutions. I suggest that this stance tends to reinforce the historical status quo and limit the power of the collaborative effort to make substantial political change.

Chapter 7. The politics of collaboration in the Feather River headwaters: Conclusions and recommendations. The concluding chapter reviews the key findings of the dissertation and discusses their implications for research and practice. Findings portray a complex, multi-directional relationship between collaboration, power, and politics. Knowledge production and policy reframing are important sources of power that grow from collaboration. Politics and historical power relations do not wholly undermine collaboration, but do limit its power to make substantial political interventions, as do federal agencies reluctant to invite political risk. While these findings help reveal the politics of collaboration, collaboration should not be seen as just another form of politics. Collaboration can be a powerful tool for addressing complex environmental issues in ways that recognize system complexity and that confer democratic legitimacy. Additional research across a wider range of cases could provide a more comprehensive picture of the mechanisms, strategies, and significance of political renegotiation in collaborative processes. Such research would shed needed light on collaborative governance and its significance as part of an evolving political history of American resource control. It could also provide practitioners, resource managers, and policy makers with a larger perspective on the challenges and possibilities of collaboration for achieving social and ecological goals.

Chapter 2. Environmental governance, politics, and power: Theory, approach, and case

> *If, as we have argued, collaborative natural resource management is inherently political, this suggests that careful assessment of the political terrain is at least as critical to the success of collaborative programs as assessment of appropriate procedures and institutional requirements. (Walker & Hurley, 2004, p. 748)*

Soon after the passage of new sweeping environmental laws in the 1960s and 1970s, strong regulatory approaches to protecting the environment began to lose favor in the United States. The search for alternatives that could better manage social and ecological complexity has generated experimentation with a wide variety of novel policy tools and governance arrangements such as community-based conservation, collaborative conflict resolution, and market-based policy instruments. These approaches to environmental governance encourage participation and collaboration by state, private sector, and civil society actors and focus on new strategies that deemphasize centralized, technocratic management by the state (Lemos & Agrawal, 2006). They change the incentives for environmental management, deemphasizing punishment for regulatory incompliance in favor of conferring benefits, such as financial rewards or decreased litigation risks, for desired behaviors. They often take a decentralized approach by focusing on problems within a specific, cross-jurisdictional geographic area such as a watershed, ecosystem, or urban region.

Collaborative and community-based approaches in particular have been advocated for their potential to resolve the conflicts that often plague natural resource management issues such as forest management, water supply management, and endangered species conservation. Similarly, watershed collaboration has been seen as a way to improve integration and problem solving capacity within systems with connected hydro-ecologies but fragmented ownership patterns. Yet researchers and practitioners have, in focusing on process and design principles for governance, often skirted discussion of the ways that politics and power dynamics continue to infuse collaborative, community-based, and watershed approaches, or have assumed that power imbalances can be dealt with internally. More recent literature, drawing on political ecology insights, has stressed the need to understand the embeddedness of these efforts in wider social and political contexts and the implications for power and control over nature and resources. Using a political ecology lens, I define politics as: "the exercise of power as a social relation built on asymmetrical distributions of resources and risks" (Paulson et al., 2003; Walker & Hurley, 2004, p. 737).

In this dissertation, I look at how a collaborative watershed restoration effort intersects with the larger historical, epistemological, political, and administrative contexts within which it is embedded, and in particular how power operates at these intersections. What effect does collaboration have on the balance of power in natural resource management issues? Do collaborative efforts moderate power imbalances? Do they create power? If so, how and for whom? As collaboration becomes an expected way for federal administrative agencies to carry out their missions, how does it change their decisions about how to allocate public resources and make trade-offs between conflicting interests and values?

In this chapter, I first review relevant literatures and theories of environmental governance to identify how they have addressed the issues of politics and power. Next, drawing on work in political ecology, science and technology studies, and environmental governance, I propose several points where collaborative governance intersects with context in ways that can alter relations of power and control over resource management. In the second half of the chapter, I describe my analytical approach to data collection and analysis and how it evolved through the course of my study. In doing so, I also introduce my case study site in the Feather River watershed.

THE NEW POLITICS OF ENVIRONMENTAL GOVERNANCE

Early scholarship on emerging resource governance approaches such as collaborative decision-making, adaptive co-management, and community-based management sought mainly to understand how institutional, design, and process features relate to effectiveness. While offering mixed assessments of effectiveness and outcomes, this literature generally expressed optimism for the potential of these governance approaches to produce more environmentally sustainable and socially just outcomes. Scholars increasingly recognize the need to expand our understanding of decentralized governance by situating it within multiple scales of social organization and within larger contextual forces. In particular, critical perspectives are needed to better account for how power, politics, and social and historical contexts shape outcomes (Armitage, 2008).

The primary research focus in the U.S. has been on collaborative processes in which groups of representative stakeholders use face-to-face dialogue, consensus-building, and interactive learning processes to overcome conflicts, find shared solutions, and reduce fragmentation. Such efforts are typically organized at local or regional scales. For example, they may address a particular ecosystem, watershed, or resource issue across a fragmented landscape with multiple owners (Brunner et al., 2005; Caves et al., 2013; Hughes & Pincetl, 2014; Imperial, 2005; Margerum, 2008; Sabatier, 2005; Weber, 2000; Wondolleck & Yaffee, 2000).[1] Scholars have advanced multiple, similar terms and conceptualizations of this trend. Early terms included collaborative resource management or planning (Innes & Booher, 1999b; Singleton, 2002; Wondolleck & Yaffee, 2000); grassroots ecosystem management (Weber, 1999); adaptive governance (Brunner et al., 2005); and community-based natural resource management (Lurie & Hibbard, 2008). Each emphasizes different features and needs, such as adaptation, learning, integration across a complex landscape, place-based orientation, civic engagement, or empowering marginalized communities. Overall, this literature is quite optimistic regarding the potential of collaboration, though many authors have raised issues regarding equity, representativeness, distributive impacts, accountability, and poor environmental outcomes

[1] A related body of research has addressed the emergence of large-scale regional collaboration across landscapes such as the Florida Everglades and California's Sacramento-San Joaquin Delta (Gerlak & Heikkila, 2006; Layzer, 2008).

(e.g., Brower et al., 2001; Coggins, 1998; Kenney, 2000; Layzer, 2008; McCloskey, 1996; Rhoads et al., 1999; Singleton, 2000).

More recent conceptualizations reflect the convergence of multiple disciplinary perspectives, experiences in non-U.S. contexts, and relational concepts including systems- and network theories. According to a 2008 review of this literature by Derek Armitage, literatures on commons governance and complex adaptive systems have been particularly influential in shaping current ideas. The first lineage derives from the well-known work of Elinor Ostrom (1990), who identified the institutional properties of effective common pool resource governance. These included enforceable boundaries, collective-choice decision-making arrangements, effective monitoring, and graduated sanctions for violating community rules. Ostrom's work challenged Hardin's (1968) "Tragedy of the Commons" assumption that shared ownership would lead to environmental degradation, as each individual pursued his or her own interests to the detriment of the group as a whole. Ostrom's work has provided theoretical grounding for a broad array of related scholarship on collaboration, conflict resolution, community-based natural resource management, civic engagement, deliberative planning, and commons governance, both domestically and internationally. Traditionally concerned with form and function in local governance forums, this body has more recently expanded its attention to how governance is embedded in in multiple levels of scale and has advocated more effective horizontal and vertical linkages and institutional variety (Cash et al., 2006; Dietz et al., 2003; Young, 2006).

The second body identified by Armitage views natural resource governance as a complex systems problem, with properties including "cross-scale dynamics and feedback, self-organization, multiple domains of attraction, emergence, uncertainty and change" (2005, p. 8). This work, which he dubs "resilience thinking," has roots in the field of ecology and tends to view the problem as one of managing "social-ecological systems." Scholars in this vein often emphasize the goal of system resilience, i.e., the ability to withstand disturbance, to be learning and adaptive, and to integrate multiple scales through collaboration. Others have pointed out that resilience is a normative goal with potential pitfalls; for example, resilience of some properties like systemic poverty is not desirable (Lebel et al., 2006; Nadasdy, 2007). Resilience thinking also borrows the concept of networks, as used by political scientists and sociologists to identify and characterize the interconnections and relationships between people, groups, and organizations. Attention to network dynamics facilitates a relational understanding of environmental governance. This scholarship, for instance, looks at how networks may increase coordination between government agencies, levels of government, experts from different fields, and opposing ideological camps (Schneider et al., 2003); generate learning, leadership, trust, and norms of cooperation (Bodin et al., 2006; Schneider et al., 2003); and provide groups the power to collectively address shared problems (Booher & Innes, 2002).

These multiple theoretical influences are visible in recent terminology describing governance, such as "collaborative resilience" (Goldstein, 2012) and "complex adaptive networks" (Booher & Innes, 2010). Armitage identifies multiple terminologies deriving from resilience thinking and/or commons governance, including adaptive co-management (Armitage et al., 2007) and polycentric or multi-layered governance (Ostrom, 2005; Ostrom et al., 2002). (To avoid the normative connotations of these terms, I tend to use the terms "collaborative" or "decentralized," following Lemos & Agrawal, 2006, to refer in a generic way to these types of arrangements.) These literatures share in common a critique of centralized, government-led, scientific management approaches for their failure to resolve complex environmental problems. Instead, they tend favor alternative approaches that engage multiple stakeholders, including traditionally marginalized people, in dialogue and problem-solving efforts, integrate multiple forms of knowledge, are adaptive, and are often locally grounded. Studies increasingly recognize and attend to the problems of scale, in particular calling for better cross-scale linkages, both horizontally and vertically, and nested or polycentric systems that incorporate institutional diversity and the capacity for analytic deliberation (Dietz et al., 2003). Together these literatures offer a model of governance that challenges traditional assumptions about governing the environment in democratic societies. At this core of this model is some form of collaborative decision-making involving joint problem solving by multiple stakeholders who often have competing interests.

Many of these theories assume that scientific expertise alone cannot accurately depict reality or resolve environmental conflicts. Rather, the search for common interest solutions requires dialogue and the integration of multiple perspectives and epistemologies, or ways of knowing, in addition to science. In doing so, this model advances a different notion of rationality, i.e., how to legitimately use information and facts to make decisions:

> In collaborative decision making, knowledge is at least as central as it is in other modes of policy making, but this type of inquiry values many kinds of knowledge and sorts through them in different ways from the more conventional inquiry of the lone analyst….Western thought typically assigns rationality to a sort of scientific inquiry, whereas collaborative policy making relies heavily on interpretive, pragmatic and dialectical ways of knowing. (Innes & Booher, 2010, p. 17)

This process of "collaborative rationality" demands different forms of organizing, as it takes place not in technical bureaucracies but in civic-oriented forums of dialogue among representative stakeholders. In this way, dialogue becomes the central tool of integrating facts, knowledge, and values, rather than technical analyses such as cost benefit analysis, risk assessment, and environmental impact assessment. Whereas centralized, government-led approaches have been criticized for a narrow focus on technically-oriented goals like maximizing efficiency, in the collaborative model, stakeholders seek shared solutions that advance broader ecological and social goals. Finally, recognizing the unintended ecological and social consequences wrought by traditional modes, this model adopts an ecological perspective that values complexity and is skeptical of human efforts to control and simplify nature through engineering technologies.

Many academics and practitioners argue that these collaborative, decentralized models of governance have potential to reverse environmental degradation, democratize natural resource management, empower marginalized communities, find novel solutions, or achieve sustainability. Such accolades can be well deserved, but can also mask an essential truth: these new approaches also rearrange patterns of decision-making power and resource control, and are therefore fundamentally political. They do not transcend or get rid of politics, rather they simply create a new form of politics (Walker & Hurley, 2004). For instance, when community members collaborate to exert new influence over resource management, it poses an intrinsic challenge to existing regimes and configurations of control that have often historically favored extractors of commodity resources. As Armitage, drawing on the field of political ecology, writes: "Inequities are intrinsic to shifting relations of status, power and knowledge, culture and history" (2008, p. 11). But beyond a growing attention to linking actors through improved coordination at institutionally defined levels of scale, existing scholarship has inadequately characterized the embeddedness of decentralized governance within these broader political and historical contexts and power relations. And normative assumptions have sometimes precluded critical attention to how political dimensions can and do undermine decentralized governance approaches (Armitage, 2008; Blomquist & Schlager, 2005; Lemos & de Oliveira, 2004).

Armitage (2008) suggests that apolitical leanings spring from the literature's grounding in institutionalist theoretical perspectives, rational-actor models of behavior, and normative narratives of resilience, transformation, and learning. As a result, current literatures tend toward "instrumental and historically de-contextualized analyses" of new forms of governance (p. 8). The result is a focus on prescriptive principles and structural design that "render technical" (Li, 2007) processes that are rightly understood as infused with power, culture, and politics (Armitage, 2008). Ostrom's institutionalist approach to commons governance, for instance, relies on a rational model of individual choice that can mask the role of cultural influences. While implying a universally positive goal, the "resilience" narrative also in fact can obscure political questions: resilience of what system properties, and for whose benefit? (Lebel et al., 2006; Nadasdy, 2007).

Finally, in focusing on design, literature has tended to neglect the importance of broader ideological shifts concerning legitimate governance. The trend toward collaborative and decentralized environmental governance is just one outcome of a wider societal shift increasingly favoring market-based, non-regulatory, and non-state approaches to governing. Research on collaborative environmental governance is quite detached from literatures on other new tools such as payment for ecosystem services, tax incentives, and NGO-led eco-labeling programs. The disconnection likely results from the focus on design principles within all of these literatures; if one's concern is how to create effective institutional forms, there may be little reason to look at approaches that operate according to quite different goals and rules. But if the concern is with understanding how shifting modes and norms of governing alter relationships of power and control over resources, as mine is, then it is essential to understand the broader discourses legitimizing these changes and whose interests they might serve. This contextualization is lacking in current environmental governance literature.

THE ROLE OF GOVERNMENT IN COLLABORATIVE GOVERNANCE

Early literature looking at contemporary shifts in governance foresaw a new era of "governing without government" in the emergence of approaches characterized by self-organizing networks (Innes & Booher, 1999a; Rhodes, 1996). But continued scholarship in political science made clear that government remains an important actor in new forms of governance, though its role changes in ways that demand new organizational capacities (Kettl, 2005; Schout & Jordan, 2005). These shifts pose organizational challenges for technical agencies including those tasked with resource management. Relatively little scholarship has addressed the ways that agencies adapt to these challenges, or how their efforts to do so might shape, or be shaped by, larger contexts and patterns of resource control and access.

Literature on network governance has usefully defined the role of the state in new forms of governance. Ansell (2000) suggests the state's role in networked governance is to "empower stakeholders and facilitate cooperation among them" (p. 303). Network governance thereby shifts the role of the traditional bureaucratic state away from single-handedly developing and implementing plans and programs to building and managing networks (Bogason & Musso, 2006; Stoker, 2006). As network managers, civil servants forge relationships, motivate others, build shared perception of problems, manage conflicts, and identify missing or disempowered stakeholders (Klijn & Koppenjan, 2000). Despite the increased role of civil society, the state remains a central player for many reasons: it has legal authorities and resources – budgets, personnel, and democratic legitimacy – that others lack (Klijn & Koppenjan, 2000); it can incentivize cooperation through the threat of legal action; and it can create legitimate forums for dialogue and decision-making (Schneider et al., 2003). When environmental and resource issues are concerned, the state is also frequently the largest land "owner" (although technically the land is owned by the public and managed in trust by the government).

In recent decades, leaders of U.S. natural resource agencies have embraced collaborative approaches for their potential to resolve conflicts, improve understanding, address shared uncertainties, coordinate joint or cross-boundary activities, and to mobilize resources toward solving shared problems (Scarlett, 2013; Wondolleck & Yaffee, 2000). The U.S. Forest Service is the primary resource agency in the Feather River headwaters, and in fact in most of the upper watersheds where the water supplies for the Western U.S. originate. The agency operated for most of the 20th century according to a technocratic model that vested control of resource management in centralized agencies employing scientific management. Although tasked with managing resources in the public interest, in reality the technocratic approach often served the interests of power and privilege in the American West, producing unintended and negative consequences for rural communities, laborers, and ecosystems (Espeland, 1998; Hirt, 1994; Romm, 2002; Worster, 1985). A backlash to technocratic resource management began to emerge in the 1960s and 1970s, spurring passage of new federal environmental laws requiring that agencies allow for meaningful public involvement in resource management decisions. The emergence of ecological science, recognition of the complexity and unpredictability of managing social-ecological systems, and many contentious resource conflicts across the West further spurred efforts to address problems through more collaborative approaches. But the transition from expert-management to situated problem-solving with public involvement has often been difficult for agencies like the Forest Service.

Barriers emerge from a number of factors. The technocratic logic remains embedded, to varying degrees, in resource agencies, and can thwart more effective and meaningful agency engagement with civil society (Fairfax, 2005). Employees may fear change, loss of control, and taking risks. There can exist mutual mistrust between agencies and publics, or turf wars between competing public agencies. Competing views or goals held by individuals or groups within agencies can create internal struggles over how or whether to engage in collaborative resource governance. In the Bureau of Reclamation, for example, a contest between internal coalitions with different identities and logics for managing water resources critically shaped implementation of new public involvement requirements under the 1970 National Environmental Policy Act (Espeland, 1998). The Forest Service has faced similar internal struggles between traditional resource managers, like foresters and engineers, and the newer "ologists" that represent environmentally-oriented disciplines like wildlife biology, ecology, and hydrology (Salka, 2004).

Public-sector organizational change is also notoriously difficult and unpredictable (e.g., Barnett & Coleman, 2005; Durant, 2007; Terriff, 2006; Wilson, 1989). Typical organizational barriers to collaboration in resource agencies include rigid policies, lack of people and process-facilitating skills, fragmented and stove-piped management approaches, frequent staff turnover, shifting agency priorities, and lack of resources, incentives, and opportunities for collaboration (Fernandez-Gimenez et al., 2008; Thomas, 2003; Wondolleck & Yaffee, 1994, 2000). Rigidity and fragmentation are echoed in agencies' external and political environments. For example, Forest Service employees can feel their hands are tied by Congressional direction that emerges from national political dynamics. Collaboration can offer agencies a way to move past intractable conflicts that have impeded their ability to effectively manage resources (Wondolleck & Yaffee, 2000). But given the complex, "wicked" nature of many environmental problems, Lach et al. (2005b) conclude that agencies may collaborate as much to diffuse accountability as to resolve conflicts or effect integrated solutions. Collaboration may thus allow agencies to avoid politics.

Christopher Ansell (2011) argues that in collaborative governance "public agencies become the linchpins of [a] more compound democracy" that balances top-down authority through representative government with local-problem solving efforts (p. 192). This "linchpin" role enables agencies to achieve public accountability in a world of complex problems. In the past several decades, agencies like the Forest Service have often attempted to find this balance, amidst declining faith in American bureaucracy and a context of increasing polarization and conflict between competing interests groups. Placing the shift to collaborative governance in this context makes evident the need for deeper inquiry into the role of government in collaboration and other forms of governance. This deeper inquiry should move beyond a focus on organizational and institutional barriers and should instead ask how the shifting backdrop of resource politics in the U.S. shapes agency and employee incentives and decisions vis-à-vis collaboration.

In this context, this research asks how the Forest Service defines its role and goals in collaborative headwaters restoration, and how these choices are influenced not only by organizational factors but also by the political environment within which the agency operates.

Secondly, it asks how the agency's choices about collaboration might, in turn, influence dynamics of political control over decision-making and resources.

UNDERSTANDING POWER AND POLITICS: CONCEPTS AND ANALYTICAL TOOLS

Collaborative environmental governance operates within existing social, political, and organizational contexts. Yet the interface between governance and context has been little studied in the United States. Research has tended to focus on one or the other: resource politics at macro- (state and national) levels or the form and function of specific approaches at local levels. Macro-level research says little about the important trend of rescaling governance toward local approaches, whereas local-level research tends to neglect broader politics by focusing on group dynamics of decision-making and conflict resolution in collaborative and other multi-party venues. But often the largest barriers to more collaborative, ecologically sustainable, or socially just environmental governance emerge from beyond the group itself. For example, political maneuverings at state and national scales have often undermined – and sometimes advanced – efforts to collaboratively manage and resolve conflicts in the Klamath River basin and the California Delta. Powerful local pro-growth interests derailed a collaborative natural resource planning effort in Northern California (Walker & Hurley, 2004). Thus collaboration outcomes often depend on dynamics that are external to the decision-making forum. Infusing the interface between decentralized governance efforts and wider contexts are dynamics of power and politics that remain under-theorized. Because the literature on decentralized governance has thus far been weak on understanding politics and power, bringing these multi-sited politics into focus requires looking elsewhere for helpful theories and methods.

Political ecology, which has long been concerned with how contextual forces shape regimes of local environmental control and management, provides a useful set of concepts for theorizing this interface. Derek Armitage (2008) identifies complementarities between political ecology, resilience thinking, and common property theory for understanding the rise of decentralized governance approaches, and particularly their political dimensions. He uses findings from political ecology to problematize the tendency of other literatures toward normative prescriptions. Political ecology helps him identify the contextual forces that tend to favor entrenched, top-down management systems: "power, scale and levels of organization, knowledge valuation, the positioning of social actors and social constructions of nature,...policy narratives that shape governance, and the dialectic relationship among ecological systems and social change" (Armitage, 2008, p. 7).

Ribot and Peluso's (2003) theory of access provides another conceptual foundation for understanding the politics of governance. Ribot and Peluso argue that "access" to natural resources is mediated not just through formal or property rights. Rather, people derive benefits from resources through multiple channels, or "mechanisms." These mechanisms include rights-based access (whether legal or illegal), as well as structural and relational mechanisms "established by the specific political-economic and cultural frames within which access to research is sought" (p. 164). These mechanisms include "technology, capital, markets, knowledge, authority, social identities, and social relations"(p. 165). Access to *technologies* such as extraction tools, to the *capital* to finance resource extraction or the purchase of formal rights, and to *markets* where one can engage in exchange relations all shape the ability to benefit from natural resources. *Knowledge* also shapes access regimes; this includes information, e.g., about where resources are located, scientific knowledge, and other shared systems of meaning shaped through discursive and cultural practices. Access to *authority*, i.e. to the "individuals or institutions with the authority to make and implement laws" (p. 170) shapes access to resources. Individuals may gain or lose access to resources and their benefits because of their *social identities*, for example age, gender, religion, ethnicity, or profession. And people may use *social relations* such as trust to gain or maintain access. This view of access brings to light the ways that broader cultural, economic, and political forces mediate peoples' ability to derive benefits from resources.

Analyzing access can provide insight into peoples' interests and incentives, for example in attempting to shape legal regimes, governance arrangements, or discursive frameworks in particular ways. This type of analysis thus helps illuminate a wider set of ways, compared to legal resource regimes, through which resource politics manifest. Ribot and Peluso propose that "access analysis involves 1) identifying and mapping the flow of the particular benefit of interest; 2) identifying the mechanisms by which different actors involved gain, control, and maintain the benefit flow and its distribution; and 3) an analysis of the power relations underlying the mechanisms of access" (p. 161). This type of analysis needs to address wider social, political, and economic contexts as well as historical contexts, since social relations and the positions of actors in relation to resources change over time. Finally, "Access analysis can be focused on the policy environments that enable and disable different actors to gain, maintain, or control resource access or the micro-dynamics of who benefits from resources and how" (Ribot & Peluso, 2003, p. 173).

The increasing preference for collaborative governance, as well as for market-oriented governance, is profoundly altering these policy environments, and thus changing the dynamics of access to decision-making processes and, ultimately, to resources themselves. For example, Bryson and Crosby (1993, p. 184) write that "rules governing *access* to participation in [governance] forums strongly influence who speaks what, where, when, why, and how, and who listens. In so doing they strongly influence which decisions, conflicts, issues, and policy preferences get discussed and which do not." Shifting approaches to governance may also reflect changes in actors' beliefs about what are legitimate goals of governing (for example, social justice versus profit maximization).

Access is negotiated across scales, a factor that adds complexity to understanding new governance arrangements and their politics. For example, governance of the headwaters links local forest communities, downstream cities, powerful irrigation interests, hydroelectric utilities, state-level policy-makers, and federal forest managers. Scalar conflicts, as between upstream residents who bear the burden of conservation and downstream residents who benefit, can undermine collaborative watershed planning efforts (Singleton, 2002). On one hand, encouraging governance linkages across multiple levels of scale – spatial, administrative, temporal, and ecological – may build social capital and ultimately achieve better social and ecological outcomes (Brondizio et al., 2009). But scalar fragmentation also provides opportunities for political maneuvering. For example, Lebel and colleagues posit a *politics of scale* by which actors use discourse and social practices to “shift the levels of study, assessment, deliberation and decision-making authority to the level and scale which most suits them, that is, where they can exercise power more effectively” (Lebel et al., 2008, p. 129; Lebel et al., 2005). In other words, they strategically manipulate scale to maximize their own access while minimizing that of others.

Besides political ecology, the field of science and technology studies (S&TS) provides a second body of literature that I use to conceptualize the operation of power in collaborative and decentralized environmental governance. In particular, the co-production framework elaborated by Sheila Jasanoff posits that social factors such as culture and power influence the development of new science and technology, which in turn feed back to reshape human societies and beliefs. Science/technology and human social organization are thus mutually constitutive in an ongoing, iterative relationship, i.e., the “co-production” of natural and social orders. Concerned with how social features influence shared understandings, for example about nature, co-production thus draws attention to the roles of power and politics in shifting human beliefs and approaches to environmental management (Jasanoff, 2005). Using coproduction as a tool of inquiry, the analyst traces the different claims about nature made by different groups with competing political agendas (David Winickoff, personal communication). Next, the analyst asks how those claims, in turn, shape social and physical reality in new ways, in an ongoing “co-production” of natural and social orders.

The theory of co-production is consistent, more broadly, with the “argumentative turn” in the social sciences, which has focused attention on the power of language and cultural ideas in shaping human institutions and relationships with nature. This turn has prompted scholars concerned with planning, policy analysis, and environmental politics to ask how new understandings of policy problems arise through discourse and in turn affect the dynamics of decision-making (Fischer & Forester, 1993). *Discourse* is the “ensemble of ideas, concepts, and categorizations that are produced, reproduced, and transformed in a particular set of practices and through which meaning is given to physical and social realities” (Hajer, 1995, p. 44). Discourses are active sites of political contestation, but the conflict is often hidden in the ways that actors construct forums, frame issues, use language, define problems, and attend to or neglect certain facets of those problems (Hajer, 1995; Lakoff, 2006). Jesse Ribot and Nancy Peluso (2003) argue that: “Discourse and the ability to shape discursive terms deeply influence entire frameworks of [natural] resource access” (p. 169). Discourses operate both within particular policy and governance forums as well as in broader societal contexts; in this way, they can be an important bridge linking broader politics to local outcomes in specific cases.

S&TS has focused in particular on how cultural influences shape the practice and products of science, and vice versa. This field has challenged the notion that science objectively describes a universal reality that is “out there,” separate from human experience. But science is also not purely a social construct. It is practiced, and knowledge thereby produced, through a complicated interplay between phenomena of study and the culturally embedded humans that are observing them. Some S&TS scholars additionally argue that actors' interests shape the ways that they perceive and characterize the world; thus understanding knowledge-making processes as socially embedded can highlight their political dimensions. It helps to explain why the production of scientific facts and deployment of technological approaches, such as for restoring meadows, takes place on contested ground.

For example, Takacs (1996) shows how conservation biologists adopted the term "biodiversity," putting "a scientific spin on [the value-laden term] *nature*" that helped legitimize their conservation goals (p. 79). An all-encompassing term, "biodiversity" has proven difficult to define scientifically. Yet this broadness can actually give biologists more power in advocating for and justifying a wide range of policies addressing both ecosystem and species conservation. Thus the appeal of "biodiversity" for biologists may lie more with its political utility than its scientific value.

Such scholarship reveals science and technology as central devices for ordering society-nature relationships. When society grants legitimacy to certain claims, technologies, and experts, it also grants these power to order the material and social world. This form of power is often unrecognized, since modern humans are accustomed to looking at the world through a scientific lens they believe to be "objective," i.e., untainted by messy human politics and power struggles. When humans uncritically adopt scientific representations and technologies into their basic assumptions and organizing logics about the world, the ways that science and technology realign power distributions and produce inequalities go unattended and unrecognized. These social orders are resistant to change because their supporting logics are so deeply embedded in our cultural beliefs, institutions, and even physical landscapes.

This research project draws on these concepts from environmental governance, political ecology, and science and technology studies to understand the political and power dimensions of community-led, collaborative governance in the Feather River watershed. Specifically, I identify and examine three important loci where power relationships and politics are renegotiated in this governance effort: 1) in the production of environmental knowledge, particularly about watershed restoration, 2) in the development of new policy frames for defining policy problems and devising solutions, and 3) in the ways that a federal agency, the Forest Service, defines its role in collaboration in the context of scientific uncertainties and tensions over watershed resources. In the chapters that follow, I provide more detailed discussions of relevant theories and academic debates for each of these three loci.

ANALYTICAL APPROACH AND METHODS

A full explanation of my analytical approach requires a discussion of my initial findings upon entering the field, and how these unexpected findings influenced the direction of the project. I did not approach my research with a fixed, a priori theoretical framework. Instead, I chose my site and entered the field with an open-ended, qualitative approach informed by multiple disciplinary and theoretical lenses: governance and network studies, organizational theory, public administration, environmental politics, and political ecology. I was interested in the relationship between upstream headwaters management and downstream water supply issues, and in the evolution of new watershed governance approaches within the policy and political environments of California water supply and national forest management. I soon found that many of my initial hypotheses about what was happening in the headwaters were entirely off course. For example, I hypothesized that the U.S. Forest Service, as the predominant landowner, would be playing a major role in headwaters management and actively shaping new governance approaches according to evolving organizational norms and leadership imperatives. But in reality the major player in this work was a small collaborative organization concerned primarily with restoring the watershed's large, degraded meadows. Unexpectedly, I found that the politics of governing the headwaters manifested most prominently in conflicts over the science and practice of restoring nature, specifically through the controversial technique for restoring meadows called pond and plug.

I was compelled to study the headwaters not only because I wanted to say something about the politics of collaborative governance, but also because I was interested in the substantive problem of where California's much-contested water comes from and how these watersheds ought to be managed. I suspected that looking upstream – relative to the California Delta, the main battleground in the state's perpetual water wars – might offer some new insight or opportunity for California water supply policy. I was not wrong, but reconciling these substantive environmental policy issues with academic theories of governance proved challenging. My research never fit in a neat conceptual package and instead comprised a large bundle of tangled threads both theoretical and substantive, with many loose ends. I tried on and discarded many different framings of the problem as I attempted to make sense of these phenomena.

It took many months to realize that the pond and plug conflict was not merely an interesting subplot. Rather, the controversy over this meadow restoration technique embodied the many tangled threads of my research questions in a way that no other headwaters issue that I encountered did. I gradually adjusted my analytical approach by tossing out some theories I had planned to use – particularly, network theory – and adopting some new, unanticipated ones: particularly, the theory of co-production and the concept of access. I pared down from three case studies to two, and then to one, as a comparative approach proved untenable in light of the complexity I found within just one site and as I focused in on the meadow restoration issue.

Adopting the co-production framework, I began to understand the "technology" of pond and plug – and the collaborative, community-led organization from which it grew – as embodying a different epistemological orientation than did historically dominant approaches to headwaters management. Historically, hydropower producers and water managers have engineered downstream reaches to maximize resource production while largely neglecting the headwaters, as long as water flowed downhill into their dams and reservoirs. More recent environmental regulations have required managers to consider environmental impacts of these operations within the river channels and within the "footprints" of the hydropower operations themselves. However, there has remained a disconnect between the management of broader headwaters ecosystems, such as forests and meadows, and downstream water supply considerations.

By contrast, the collaborative effort seeks to restore meadows to a state closer to pre-European conditions in order to provide a wider suite of beneficial "ecosystem services" to humans. The collaborative group's goals of social and ecological health are more expansive than the historically dominant goals of water supply and hydropower production. Their goals also include realignments in existing political orders over resource control and profit, specifically by seeking to compel downstream commodity producers to fund restoration. Meadow restoration efforts have also sparked a backlash by some local downstream actors, primarily ranchers, concerned about the water supply impacts of pond and plug. Observing these issues, I saw that disagreements over technical principles and hydrological outcomes of meadow restoration belied larger contests about ideologies and social structures of resource control, access, and decision-making in the watershed. And these technical conflicts provided a window for looking at how larger politics were playing out through negotiations over governing nature in new ways: through the cooperative restoration of the headwaters with pond and plug, through the proposal of new payment for ecosystem services mechanisms, and through the efforts of the Forest Service to find its new role among this changing landscape.

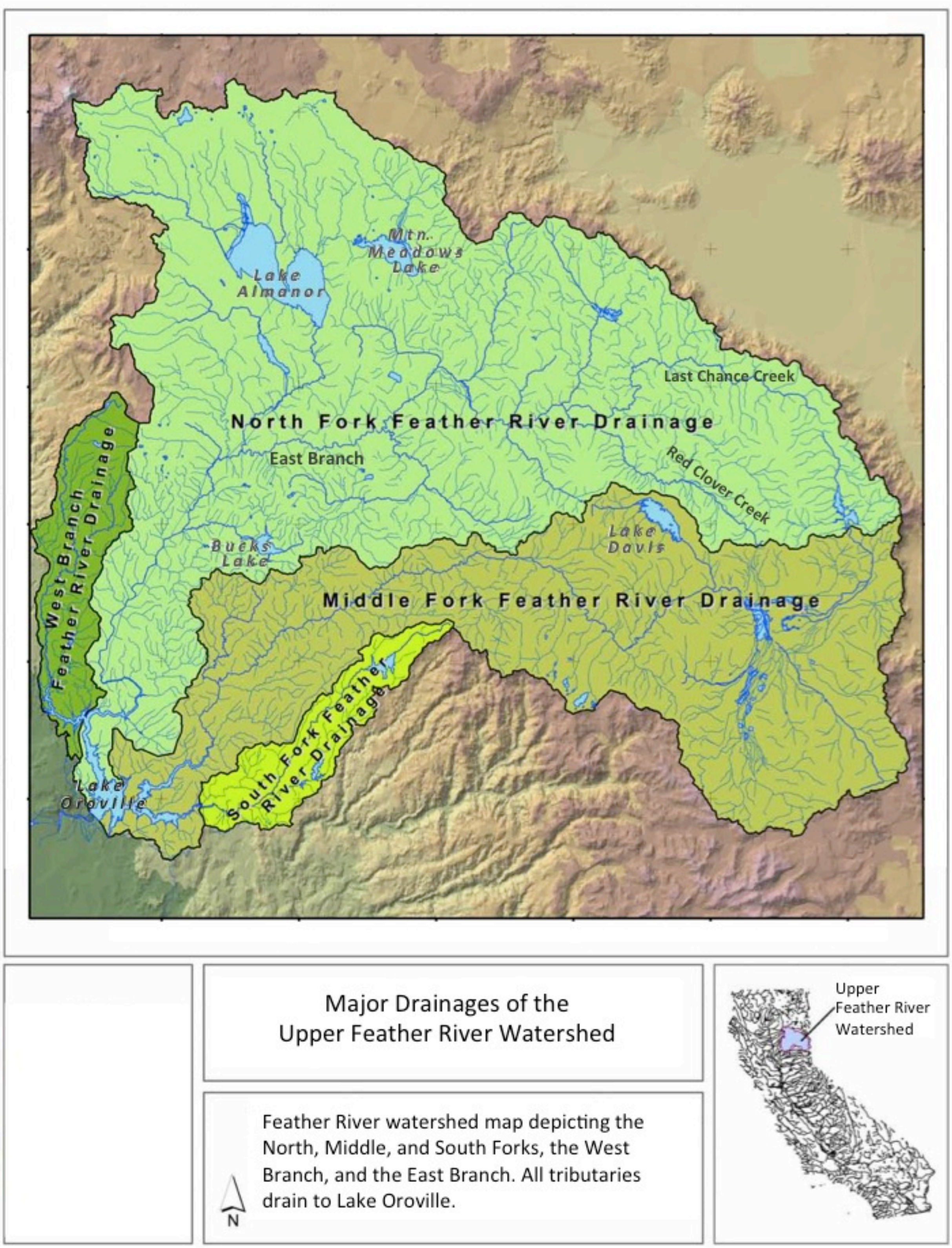
Finally, the co-production and access lenses also drew into focus the ways that recent events in the Feather River have been shaped by historical context. The history of resource extraction in the watershed institutionalized both technological approaches and differential access to resources and their benefits. To really understand the social and political significance of contemporary negotiations about how to govern nature, I had to locate them within a broader sweep of history, a treatment that I attempt in the following chapter. Historic contextualization makes clear the ways that pond and plug and its champions, in challenging dominant technologies of resource management, also challenge the power relations embedded within them over time. It reveals how social relations derived from historic decision points remain embedded in today's social orders, bounding the political and institutional limits of contemporary challenge.

Consistent with a coproduction framework, my main analytical approach is to trace the different claims about nature made by different groups with competing interests. Specifically, I use a ground-up, case-study approach to trace how key actors make claims about nature as they seek to negotiate governance arrangements in the Feather River watershed. Case studies allow researchers to answer *how* and *why* questions within real-life contexts where the investigator cannot control events in an experimental setting. Because case studies retain the holistic context within which real-life events take place, they can explain social complexity and generate surprising results (Yin, 2003). Qualitative methods enable a deep understanding of the multifaceted social dynamics of my case. For example, they help to reveal how actors use competing representations of reality as political tools to advance their desired policy outcomes (Yanow, 2000). I conducted one year of fieldwork in which I gathered documents, observed at meetings and events, and conducted interviews and site visits in the Feather River watershed and in broader arenas of forest and water policy. I obtained interviews from a diversity of interests, including watershed groups, environmentalists, hydropower producers, water agencies, forest managers, local governments, and others. I transcribed and coded my 50 interviews using qualitative techniques, including iterative application of my research questions to these data (Miles & Huberman, 1994).

Case study site and background: The Upper Feather River watershed

As an early adopter of collaborative environmental governance approaches in both forest management and watershed restoration, the Feather River watershed community provides an ideal case for this study: it seems to presage the future direction of environmental governance and Western watershed management in the United States. A vital supplier of water and hydropower to California's farms and cities, the watershed is located in a mountainous, sparsely populated area of Northern California with a long resource extraction history (Figure 2-1). The Feather River has four main forks: the North, Middle, and South Forks, and the West Branch, all of which empty into the massive, man-made Lake Oroville. From this confluence, the Feather River flows another 71 miles to meet the Sacramento River, which in turn meets the San Joaquin River in the Sacramento-San Joaquin Delta, then flows to the Pacific Ocean through the San Francisco Bay. The drainage area above Lake Oroville comprises 3,222 square miles; this area is technically considered the Upper Feather River watershed (in this dissertation, the terms "Upper Feather River Watershed" and "Feather River Watershed" both refer to the upper watershed).

Figure 2-1. Map of the Upper Feather River Watershed. Adapted from the Upper Feather River Watershed Integrated Regional Water Management Plan (Ecosystem Sciences Foundation, 2005)



Though generally considered part of the Sierra Nevada range, the Feather River watershed technically sits at the confluence of three ranges: the Sierra Nevada, Cascades, and Diamond Mountains. The Diamond Mountains form the east side of the watershed and give rise to the North and Middle Forks of the Feather River (Ecosystem Sciences Foundation, 2005). An ancient range, the Diamond Mountains have a long history of tectonic faulting and erosion that have imprinted the east side landscape with large, relatively flat alluvial meadow valleys (Wilcox, 2003b). Their alluvial origins increase these meadows' vulnerability to gullying and erosion but also enable them to store water. This unique geology today makes the east side of the watershed uniquely suited to large-scale meadow restoration projects with potential implications for downstream water supply and flow regimes.

An eastward detour of the Pacific Crest makes the east side drier than typical Pacific-draining Sierra watersheds and connects it to California's water supply politics. The Pacific Crest is the watershed boundary that divides Pacific-bound rain and snowmelt from runoff bound for the Great Basin to the east. It creates the dramatic rain shadow effect that leaves the eastside high and dry while the west slope experiences frequent wet, winter storms.[2] Through most of California, the Pacific Crest follows the main Sierra and Cascade crests, running roughly northwest to southeast. But through the Feather River region, the Pacific Crest separates from the Sierra Crest to veer eastward to the Diamond Mountains, extending the watershed east. (The Feather River's North and Middle forks are the only westward-draining Sierra rivers that originate east of the Sierra Crest.) This quirk of geology helps make the rural east side, including its meadow valleys, the headwaters of a key source of California's water and hydropower supplies. The east side constitutes about two-thirds of the upper watershed's land area and is characterized by rolling forested ridges with sparse Jeffrey pine forests. These ridges are interspersed with long, gently sloping meadows in extensive valley bottoms. The west side, by contrast, is more typical of west-slope Sierra drainages: wet and densely forested with tall, fast-growing, commercially valuable species of the Sierran mixed-conifer forest, interspersed with steep, rugged, V-shaped river canyons. Precipitation varies from more than 70 inches annually on the west side of the watershed to less than 12 inches on the east side (Lindquist et al., 1997, p. 2-1). Typical of Mediterranean climates, annual precipitation is highly variable, and patterns can swing on decadal or longer cycles. Nearly all precipitation derives from Pacific frontal storms during the wet season from approximately October to May. The watershed is comparatively low in elevation for the Sierra, and average temperatures hover around the freezing point, so rain is common even in winter. The winter snowpack melts throughout the spring and summer months, providing water to downstream hydropower facilities and water consumers throughout California.

The Feather River watershed is the source for the State Water Project (SWP), the largest and most expensive water and hydropower project ever built by a U.S. state. The SWP provides

[2] The "rain shadow" effect refers to the phenomenon where, as the land surface pushes air upwards to travel over the mountains, moisture in the air condenses and falls as precipitation. Because the prevailing winds are from west to east, the vast majority of precipitation falls west of the Sierra Crest, creating a dry, near-desert rain shadow along the eastern slope and eastward into the Great Basin.

some 25 million Californians with a portion of their drinking water and irrigates 750,000 acres of farmland. Working with 29 State Water Project Contractors, the SWP delivers this water supply throughout the state, primarily to Southern California, and as far south as San Diego. Originally, the SWP optimistically promised 4.2 million acre-feet (MAF) of total water deliveries each year, but actual deliveries are much lower due to a number of factors, including dry years, regulatory restrictions to protect the Delta environment (from which water is pumped for export to Southern California), and the fact that other planned SWP facilities were never built (California Department of Water Resources, 2012; O'Connor, 1994). Allocations to the contractors, however, remain based on the 4.2 MAF figure. By far the largest allocation – about 2 million acre-feet, or 48% of the total – is to the Metropolitan Water District of Southern California, which is a wholesaler for cities throughout coastal Southern California. The second highest allocation – about 1 million acre-feet, or 24% of the total – is to the Kern County Water Agency, which provides water for irrigated agriculture in the southern San Joaquin Valley. All runoff from the watershed is captured at Oroville Dam, the tallest in the U.S., which the SWP also manages for flood control, recreation, and hydropower production.

The SWP is not only a critical source of California water supply; it is also the "largest single power consumer in the state and the fourth largest energy producer" (California Energy Commission, 2014). Transporting water requires massive energy inputs, primarily for pumping water uphill. To help meet this need, three SWP hydropower plants located at the Oroville complex provide about 5% of California's total hydropower production capacity. In addition, Pacific Gas & Electric Company (PG&E) owns and operates hydropower facilities – comprising six dams and reservoirs and eight powerhouses – on the North Fork of the Feather River, in the deep rugged canyon through which the river descends to Lake Oroville. These facilities, collectively known as the "Stairway of Power," provide an additional 5% of California's hydropower production capacity. Hydropower is a significant source of energy for California, which contains a total in-state hydropower production capacity of over 14,000 megawatts (MW).[3] Combined, the SWP and PG&E facilities contain 1432 MW of California's total of 14,000 MW, or 10.2%, of California's total hydropower generation capacity. The South Feather Water and Power Agency operates an additional 117.3 MW capacity facility on the South Fork, making the production capacity in the watershed 11.1% of California's total.[4]

The Feather River watershed's nearness to the threshold between snow and rain increases its vulnerability to climate change. Already, scientists have observed an increase the ratio of rain to snow in the northern Sierra, as well as higher intensity storms throughout California, generating more winter flood events. Other observed and predicted effects in the Sierra region include less precipitation overall, decreased snowpack storage, more extreme flood events,

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[3] "On average, hydropower provides 15 percent of the electricity used in the state, although historically this can range from 9 to 30 percent dependent on hydrologic conditions" (Aspen Environmental Group, 2005, p. 1). Moreover, "due to its use predominantly during on-peak periods, hydropower's value outweighs its simple energy contribution" (p. 6).

[4] Figures calculated from decisions issued by and documents filed with the Federal Energy Regulatory Commission regarding hydropower facilities licensing (Federal Energy Regulatory Commission, 2005, 2006, 2007a, 2007b, 2009).

earlier spring runoff resulting in drier summer and fall conditions, higher climate variability, and more prolonged droughts (Ficklin et al., 2012; Miller et al., 2003). The Sierra snowpack is the state's largest aboveground water storage reservoir, and its vulnerability to small temperature increases is extremely troubling for California's water future. Moreover, because California's major reservoirs must remain partially empty during the winter to protect against floods, a shift to an earlier runoff pattern actually decreases the capacity of this reservoir system to store water for use by consumers during the rest of the year, including the dry summer and early fall months.

Climate change is merely the most recent manifestation of human impact on the watershed. Native Americans have lived in and managed the landscape for at least 1000 years and possibly much longer (Dixon, 1905a; London, 2001). Fur traders reached the region as early as 1820. California's mid-19th century Gold Rush brought an influx of European and other non-Native settlers. Since then, humans have practiced extensive resource extraction including mining, grazing, agriculture, and forestry, the region's economic foundation for much of the 20th century. Extensive road and railroad networks were constructed to facilitate these activities. The effects of intensive logging, wildfire, and fire suppression are evident in the upland forests, where the build-up of fuels from a century of fire suppression has increased the risk and incidence of severe wildland fires. Much of the watershed remains forested with valuable timber species. The U.S. Forest Service, predominantly the Plumas National Forest, manages about 65% of the watershed. The rest is mostly under private ownership, with some state and other federal land, including Lassen National Park. Private holdings, particularly ranches and industrial timberland, comprise 24% of the land base of Plumas County, which is nearly contiguous with the watershed. The meadow valleys, which provided early settlers with attractive sites for practicing agriculture and raising livestock, have a higher incidence of private land ownership.

These meadow valleys are characteristically gullied throughout the watershed, particularly on the east side (Ecosystem Sciences Foundation, 2005), due primarily to resource extraction practices including overgrazing that took place between 1880-1940. Gullied meadows pose a number of issues, including water quality problems due to ongoing erosion, habitat degradation, ecosystem conversion of valley floors from wet meadow to dry sagebrush plain, reduced forage for livestock, and flashier hydrographs with higher peak runoffs and lower base flows. Since 1985 a collaborative group called the Feather River Coordinated Resource Management (Feather River CRM) has worked to restore these meadows, focusing in particular on a large-scale floodplain based approach called pond and plug. The CRM and other headwaters restoration advocates argue that hydrologically functioning meadows are like natural "sponges" that can store water, buffer floods, and release water slowly through the dry summer months. They suggest that restoration of degraded meadows can help the state improve the health of its natural water supply infrastructure and adapt to climate variability and warming.

The forest and valley environments of the Upper Feather River watershed are important to residents in different ways that generate competing claims about how or whether to restore them. Ranching and farming livelihoods depend on access to water supplies extracted from reaches downstream of the degraded meadow sites (George et al., 2007). Environmental advocates in the watershed and beyond take issue with forest management practices and development trajectories, including the proliferation of golf courses across the watershed to attract vacationers and retirees. The high proportion of public land, managed by the federal government, makes for important linkages between economic development opportunities and national forest management. About 50% of the Feather River CRM's restoration projects take place partially or wholly on Forest Service land. Despite steep declines in timber extraction from national forest land, and a decrease in the economic importance of this sector, community identity remains linked to logging and milling.

Forest management today is focused primarily on reducing fire hazards. During the time when this study was conducted, forest management was implemented through a unique partnership between the Forest Service and a community-based group called the Quincy Library Group that emerged to resolve earlier conflicts between timber and environmental interests. The group achieved federal legislation, the Herger-Feinstein Quincy Library Group Act (HFQLG) of 1998, to manage the Plumas and sections of two adjacent national forests according to a community-based plan that sought economic stability and ecologically healthy, fire-resilient forests. Originally authorizing a five-year pilot project, the HFQLG Act was extended twice by Congress and expired in 2012. Besides forest ecosystems, the Plumas National Forest also encompasses significant reaches in the meadow valleys and manages them for multiple values including habitat and grazing.

With just 33,000 residents, the Upper Feather River watershed is one of the most sparsely populated regions of California. Although the watershed includes portions of five counties, Plumas County is by far the most significant, lying almost wholly within the upper watershed and accounting for 72% of its area (Ecosystem Sciences Foundation, 2005). Once dominated by natural resource industries, the economy is increasingly dependent on retail, services, and construction, particularly to serve an influx of retirees and vacationers. The region has long suffered from high unemployment and economic insecurity, exacerbated by the economic recession that began in 2007. This context of economic insecurity provides an important backdrop for the community's ongoing efforts to alter headwaters management and governance arrangements in the watershed.

CONCLUSION

Scholarly interpretations of the rise of collaborative environmental governance have tended to neglect the importance of political and social contexts. As a result, they may overestimate the degree to which institutional design can overcome politics and power differentials. While I view politics as central, I do not view them as negative. On the contrary, it is through political struggle that those who lack power can gain it, by challenging and changing the rules of the game. A more "political" understanding of collaboration can be useful in revealing the deeper implications of these governing arrangements, including the mechanisms they can provide to reinforce, or even to challenge, historical relations of control and access over natural resources. In the next chapter, I develop the idea of collaboration as a continuation of the political history of resource management in the United States. The chapters that follow analyze the ways that collaborative meadow restoration in the Feather River region has engaged, challenged, and at times renegotiated the politics of resource control in the watershed.

Chapter 3. Changing logics for governing nature since the Progressive Era

> *Conservationists envisaged, even though they did not realize their aims, a political system guided by the idea of efficiency and dominated by the technicians who could best determine how to achieve it.* (Hays, 1959, p. 3)
>
> *Conservation meant, to a great extent, the pursuit of technological dominance. It meant putting rivers, and eventually their entire watersheds, to work in the most efficient way possible for the purpose of maximizing production and wealth. (Worster, 1985)*

This chapter connects the history of the Feather River watershed with broader philosophies of resource governance in the U.S. since the Progressive Era. Laws and agencies created during the Progressive Era remain the dominant institutional forces in management of forests and water, and thus headwaters, in the West. But their ecological and social impacts have sparked environmental and community challenges that are reshaping notions and approaches to environmental governance. Relying mostly on secondary sources, my aim in this chapter is not to produce a comprehensive history but rather to draw out the key elements of the Progressive Era logic of governing nature and to identify the political work that this logic accomplished in the Feather River region and beyond. Doing so sets the stage for understanding contemporary strategies of governance as part of this political history.

The legacy of Progressive Era conservation

The conservation movement of the late 19th and early 20th centuries provided the central philosophical and organizing principles for resource governance in the U.S. for the past century. The conservationist logic and the broader Progressive Era are too complex to paint with a broad brush. The Progressive movement, and the reforms it animated, grew from and intertwined, sometimes uncomfortably, many messy and competing threads of American political culture as the nation transitioned from a largely agrarian to a more urban and industrial society (Hofstadter, 1955; Kelley, 1998). Progressives, including the influential conservationists, are remembered for their efforts to rein in the monopolistic trusts, which wastefully exploited resources and exercised growing power over key elements of the industrializing American economy, including railroads and electric power. But Richard Hofstadter (1955) argues that the Progressives, led mainly by the professional and elite middle classes, were also motivated by fear of the radical left and the specter of mass populist revolt. Seeking a politically neutral path toward progress, the conservationists adopted a technocratic approach: entrusting a professional cadre of trained scientists, working in government bureaus, to develop resources efficiently, sustainably, and in the public interest. But this technocratic approach ultimately proved favorable to powerful interests.

George Perkins Marsh in his 1864 book *Man and Nature*, helped lay the early philosophical groundwork for later Progressive Era reforms in conservation (Jacoby, 2001). Marsh warned that human-caused environmental degradation could bring about the demise of civilizations, and he suggested that Europe had recently devised a good solution: centralizing control of nature in national bureaucracies led by scientific experts. Jacoby shows how this narrative informed the conservationist logic:

> The discourse's essential ingredients were a natural world that was stable, predictable, and manageable; a rural populace engaged in "unwise" environmental practices that would have potentially catastrophic ecological consequences if left unchecked; and an interventionist state armed with technical and administrative expertise. Combined with one another, these narrative elements formed the central story of conservation – a tale that prophesied imminent ecological doom, unless natural resources were removed from local control and placed in the hands of scientifically trained governmental managers. (Jacoby, 2001, p. 15)

The writings of Gifford Pinchot, the influential conservationist, friend of President Theodore Roosevelt, and first Chief of the U.S. Forest Service, offer additional insight into the logic that drove Progressive Era reforms in natural resource management toward an embrace of technocracy. The principles of conservation expressed a moral imperative to apply "foresight, prudence, thrift, and intelligence in dealing with public matters," including the development and use of the nation's resources (Pinchot, 1910, p. 48). The destruction and "waste" of resources occurring under unchecked, private development, motivated by profit, horrified Pinchot and his contemporaries. The proper approach was to develop resources through orderly control, to use them to forward progress, and to manage them efficiently so as to ensure their availability in perpetuity: "There may be just as much waste in neglecting the development and use of certain natural resources as there is in their destruction" (Pinchot, 1910, p. 41). Pinchot's regard for the agrarian myth is evident, and he linked the success of the noble citizen farmer to the success of the nation as a whole. He is clear that development was to be pursued for the benefit of the citizen and the nation, and not to serve powerful and wealthy interests:

> If we succeed, there will exist upon this continent a sane, strong people, living through the centuries in a land subdued and controlled for the service of the people, its rightful masters, owned by the many and not by the few. If we fail, the great interests, increasing their control of our natural resources, will thereby control the country more and more, and the rights of the people will fade into the privileges of concentrated wealth. (Pinchot, 1910, p. 25)

To many conservationists, this "sane, strong people" was presumed to be white and Anglo Saxon. In fact, an ugly undercurrent of racist white nationalism, justified through appeal to the pseudoscience of eugenics, was present in the thinking of prominent Progressives and conservationists, some of whom were also leaders in the eugenics movement (Brechin, 1996; Spiro, 2009). The influx of non-English immigrants during the late 19^{th} century had provoked racial anxieties and fears of "race suicide." Progressives also feared "the poverty and restlessness of the masses," and the possibility of socialist revolt (Hofstadter, 1955, p. 238). A national report requested (and praised) by Theodore Roosevelt advocated improvement of the genetic population via eugenics as part of the conservation policy agenda; it spoke of limiting reproduction not just of undesirable races but also of "paupers" and criminals (National Conservation Commission, 1909, p. 673). During this period, multiple states passed eugenics laws.[1] Charles Wohlforth (2010) writes that, though later in life Pinchot's views softened, during the years in which he was influential: "eugenic ideas slid frictionlessly into Pinchot's worldview, a rigidly moralistic construct of conservation, efficiency, and merit."[2]

Consistent with this worldview was the empowerment of elite experts to manage the nation's resources. A rethinking of the role of government and civil servants was necessitated by the expansion of federal government that occurred during this era. Pinchot advocated broad discretion for public servants, particularly of the Forest Service: "I hold it to be the first duty of a public officer to obey the law. But I hold it to be his second duty, and a close second, to do everything the law will let him do for the public good, and not merely what the law directs or compels him to do" (Pinchot, 1910, p. 56). For, "Their care for our forests, waters, lands, and minerals is often the only thing that stands between the public good and the something-for-nothing men, who, like the daughters of the horse-leech, are forever crying, 'Give, Give'" (Pinchot, 1910, p. 58). But while Pinchot was "hostile to private business power, he also admired bigness, efficiency, and success" (Hofstadter, 1955, p. 244). This vision and goal of progress steered him toward a technocratic approach to resource management that further disempowered already marginalized people and ironically, in time, came to serve the privileged interests Pinchot feared. In theory, experts were tasked with managing public resources to obtain "the greatest good to the greatest number for the longest time" (Pinchot, 1910, p. 46). However, this most famous maxim of Gifford Pinchot obscured the complexities inherent in identifying just who to include in the "greatest number" and how to define the "greatest good." Pinchot's faith in experts' ability to control nature to produce this good would also prove misguided.[3]

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[1] "More than a dozen legislatures passed eugenic laws over the next ten years [after 1909], which, by 1970, had authorized forced sterilization of sixty-four thousand Americans with mental illnesses, epilepsy, disabilities, or criminal records, or who were simply poor. At least thirty states passed laws forbidding marriage of eugenically unfit men and women and twenty-eight outlawed interracial marriages, including six that put antimiscegenation in their constitutions" (Wohlforth, 2010).

[2] "By the 1930s Pinchot had become a champion of the poor and admirer of indigenous cultures, and he spoke out early against German anti-Semitism" (Wohlforth, 2010).

[3] For example, the following quote reveals the optimism with which Pinchot approached the issue of fire. Today, in light of the impacts of 100 years of fire suppression policy, this optimism appears wholly naïve:

> I recall very well indeed how, in the early days of forest fires, they were considered simply and solely as acts of God, against which any opposition was hopeless and any attempt to control them not merely hopeless but childish. It was assumed that they came in the natural order of things, as inevitably as the seasons or the rising and setting of the sun. To-day we understand that forest fires are wholly within the control of men. So we are coming in like manner to understand that the prevention of waste in all other directions is a simple matter of good business. The first duty of the human race is to control the earth it lives upon. (Pinchot, 1910, p. 44-45)

It is easy, from the vantage of hindsight, to critique Pinchot and his contemporaries, to see the blind spots and prejudices in their logic.[4] Hofstadter, insightful historian of the Progressive Era, writes: “But we must be wary of falling too readily into that easy condescension which one may feel when speaking with hindsight about the problems of an earlier age” (Hofstadter, 1955, p. 245). Conservation policies responded to the conditions of the age, and they did so imperfectly. But they also created a unique American legacy: the protection of vast swaths of natural landscapes and resources, in perpetuity. In the late 1800s, dispensation of public domain lands to settlers and corporations slowed as the federal government began withholding large swaths as permanent public lands, including National Parks and the forest reserves that would later become national forests. Congress centralized control over federal lands in expert-based agencies including the U.S. Forest Service, founded in 1905 and the National Park Service founded in 1916. In 1946, remaining public domain lands were put under Bureau of Land Management jurisdiction.

The primary reasons for creation of early forest reserves, under the Forest Reserve Act of 1891, were to protect future timber supplies and to protect watersheds critical to downstream water supplies in the dry Western states. Protection of habitat and of scenic landscapes for recreational use also factored in (Muhn, 1992). However, according to historian Samuel P. Hays, who highlights the linkage between water and forest policy in motivating the conservation movement: “The primary intent of Congress in setting aside forest reserves in fact was watershed protection;” additionally, “Western irrigators played a major role in establishing the national forests and in defending them from attack” (Hays, 1959, p. 23). Commercial uses of the forest reserves were initially restricted, as irrigators argued that such activities as logging and particularly grazing were incompatible with watershed protection. However, the 1897 Forest Management Act, also knows as the Organic Act, opened the door to more commercial uses, allowing the creation of national forests: “to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States.” After Pinchot consolidated control over the forest reserves in the Department of Agriculture’s Forest Service, he shifted their management to emphasize resource development, including grazing and logging, in accordance with his utilitarian philosophy (Hays, 1959).

Meanwhile, Western rivers were proving resistant to private dam and irrigation schemes aimed at “reclaiming” arid lands for agriculture and human settlement. Although at first anathema to the individualist sentiment of the Western settler and entrepreneur, demand for a leading federal role in water supply development grew. Following vigorous debate between Western interests and eastern farmers, who opposed federal subsidies for Western agriculture, Congress responded in 1902 with the Reclamation Act. The Act founded the precursor agency to the modern U.S. Bureau of Reclamation, tasked with damming the West’s rivers to supply water for irrigation and other purposes. Historian Donald Worster argues persuasively that the Act was a tool in the quest for profitable American empire. Senator William Stewart of Nevada, for example, declared: “’Here is a vast store of wealth almost incomprehensible if irrigation can be

[4] Actually, the prejudices of race and class are seldom mentioned in histories of the Progressive Era.

carried on,' and it will 'increase the grandeur and power of this Republic'" (Worster, 1985, p. 165). Appeals to the public invoked Jefferson's agrarian ideal and the promise of a home to anyone hardy enough to go out West and build it. But to Worster, this idea was a foil for Congress' true goal: to develop the West's vast resources to enrich the wealthy and ensure the nation's power.

The twin impulses of American political culture – local agrarianism and commercial enterprise – that shaped debate over the Reclamation Act were also at play in California's early efforts to reign in frequent, devastating floods in the Sacramento Valley (Kelley, 1998). Before the Gold Rush and the subsequent arrival of non-native settlers, massive floods spread across the valley annually, rendering it an "inland sea." The arrival of hydraulic mining in the 1850s, particularly in the Feather and Yuba watersheds, compounded the flooding problem; massive amounts of debris from upstream hydraulic mining settled in the river channels of the more placid valley reaches below. The debris raised the channel elevations so that high flows more easily topped the banks, flooding adjacent farms and settlements that were farming the valley to feed the miners. Communities organized to protect themselves, but locally built levees regularly failed; when they did hold up, by diverting water downstream they simply compounded flooding in neighboring areas. Ultimately, with the national ascendance of the conservationists, the ongoing failure of local flood control efforts, and the recognition of the need for a basin-wide approach, a large-scale, engineering approach emerged in the 1910s. The champions of this plan were large landowners and powerful players in the state's business community, who were animated by their faith in the expertise of the water engineers and who stood to gain the most from establishing in the rich valley a stable agricultural economy (Kelley, 1998).

Though Western water development and forest management grew from somewhat different impulses, they nonetheless proceeded along similar paths. Both tended to consolidate control of public resources in technical agencies whose methods – in pursuit of efficient resource development – came to favor powerful interests, a dynamic that was obscured by assumptions of rationality in the experts' scientific methods. Meanwhile, the quest to control nature through engineering and science wrought unintended and sometimes disastrous consequences. Scientists overestimated their ability to understand phenomena by breaking them down into pieces and studying them individually, removed from the larger context. This machine-model view simplified nature to render it legible, and it gave experts a misplaced faith in their ability to control it (Langston, 1995; Scott, 1998). The machine-model view encouraged specialization of expertise into narrow fields with little understanding of complexity and interdependency that characterize environmental issues.[5] Scientists' theories also embodied cultural values that sometimes blinded them to the actual forces shaping Western landscapes.

For example, early foresters drew on universal scientific theories such as competition and succession to manage for clean, orderly forests: fast growing, and free of disturbances like

[5] This was true beyond the management of such resources as forests and water; by revealing the unintended environmental causalities of chemical pesticides, a narrow technical solution the problem of pest management, Rachel Carson's *Silent Spring* famously helped spark the environmental movement.

insects, fire, and disease (Langston, 1995). But the orderly forest was a cultural construct; it did not represent actual forests, and particularly not Western forests. In the Blue Mountains of Eastern Oregon, foresters' "visions of natural order precluded disturbance, making it hard for them to see that frequent fires could have shaped the forests they loved" (Langston, 1995, p. 28). Foresters eliminated aspects of the forest they found messy or redundant – for example, dead trees that actually harbored insect-devouring birds, and understory shrubs that fixed the nitrogen for growing trees. Their theories did not account for how complexity, disturbance, diversity, and contingent local histories had produced forest mosaics, in ways that were not scientifically predictable. Guided by their theories, the foresters misread the forests and pursued interventions that yielded, rather than their intended outcomes, nearly the exact opposite: more firs, insect infestations, and disease epidemics; fewer pines; and more catastrophic fires. What happened in the Blues was not unique. Timber production increased nationwide to unsustainable levels throughout the 20th century despite growing evidence of unsustainability. To be sure, not just misguided scientific theories were to blame. People and institutions also "selectively adapted and distorted the science in pursuit of economic or political agendas" (Hirt, 1994, p. xlvii). But the science itself, not just its application, also reflected cultural biases and political orders.

New government agencies also displaced local people, their resource practices, and livelihoods. Conservationists were, on the whole, an elite group; most harbored a mistrust of local people and their unscientific resource management practices (Baker & Kusel, 2003). Foresters, for example, were hostile to the idea that humans could manage forests through light burning because: "If light burning was an Indian practice, then by definition it was superstition, not science" (Langston, 1995, p. 250). Fire exclusion changed ecosystems in ways that often reduced the plant species that Native Americans desired. Rural people lost access to newly delineated federal lands through outright exclusion and criminalization: "For many rural communities, the most notable feature of conservation was the transformation of previously acceptable practices into illegal acts: hunting or fishing redefined as poaching, foraging as trespassing, the setting of fires as arson, and the cutting of trees as timber theft" (Jacoby, 2001, p. 2). Progressive reforms also weakened existing community-based approaches to managing shared resources such as forests, water, and grazing lands (Baker & Kusel, 2003). These included various Native American practices; communal irrigation systems, forests, and pastures of the Southwest's Hispano communities; and communal woodlands in New England. The benefits of federally led conservation, in theory to achieve "the greatest good," eluded local people and communities who lost access to the landscapes that had previously sustained them. Exclusion also happened at broader scales, as formal scientific education became a necessary, legitimizing criterion to allow one to speak for nature.

Guided by faith in economic efficiency and integration, conservationists sought large-scale, multi-purpose resource development approaches. In political context, however, integration proved difficult to implement. Single-purpose approaches gave local interests a degree of control over projects and benefits, secured autonomy for agencies that did not wish to coordinate with others, and allowed Congress to garner more widespread support by sprinkling project funding throughout multiple localities (Hays, 1959). Conservationist approaches also structured access to and control of resources toward actors and corporations with large capital resources (Hays, 1959; Langston, 1995; Reisner, 1986). Pursuing efficiency, projects like large dams and timber sales reorganized nature and the West's political economy to maximize commodity outputs in ways that mostly enriched a powerful few and degraded forest and water ecosystems. Sustained yield forestry favored an industrial, corporate approach with little regard for social impacts; it resulted in uncertainty and instability in rural communities, marked by boom and bust cycles, often dangerous and unfair labor practices, and a high degree of poverty (Baker & Kusel, 2003). Irrigation water created by damming the West's rivers was too expensive for small farmers and instead served the growth of large-scale, industrial agriculture notoriously exploitive of farm laborers (Reisner, 1986; Worster, 1985). As with disposal of the public domain more generally, widespread speculation, graft, and fraud allowed the private acquisition of vast tracts of land whose irrigation would be subsidized by U.S. taxpayers. The optimistic belief that science, insulated in technical agencies, could serve as an apolitical means to manage nature in the shared interest of the nation, proved misguided.

The political neutrality of science and engineering was a central tenet in legitimizing the new logic and social order of American conservationism. But in hindsight, neither science, nor scientists, nor the technical agencies that employed them, were in fact apolitical. Conservationists' science reflected cultural desire for a clean, orderly, machine-like nature that would produce a predictable flow of resource outputs for stable markets and human use. Best carried out in centralized, hierarchical bureaucracies, it could not account for or legitimize local contexts, ecological values of complexity and uncertainty, nor the practices of Native Americans or backwoodsmen. It was determinedly blind to its social impacts on forest laborers,[6] rural people, and communities. Written into centralized bureaucratic decision-making processes, scientific management privileged economic efficiency in ways that favored elite interests. Science also became political as agencies used it to ward off threats to their power and influence. In her case study of the history of forest management in the Blue Mountains, Nancy Langston writes: "Every time the Forest Service's authority was challenged, its response was to consolidate its own power by appealing to its status as an organization of nonpolitical, disinterested scientists with the best interests at heart" (1995, p. 296-297). Similarly, in the Bureau of Reclamation, the means became the ends: as the agency reified a mythology of progress and civilization that celebrated the grandeur and engineering achievement of dams, it began to build dams merely for the sake of building dams (Espeland, 1998).

Baker and Kusel (2003, p. 36) helpfully identify three core themes of the Progressive Era legacy, particularly as it affected local forest communities: First, "the consolidation of power and authority…within centralized public agencies and nonlocal interest groups at regional and national levels" marginalized workers and local communities lacking the resources to organize at national scales. Second, "the high valuation of knowledge based on the dominant models of scientific research and the importance accorded to those who possess that knowledge (i.e., scientists and 'experts')" delegitimized local forms of knowledge and input into resource management decisions. Third, a rendering of nature and labor as primarily financial capital

[6] And still is.

obscured the ecological and social impacts of such a view, enabling practices that ultimately undermined local communities and environments in linked ways that resource bureaucracies largely ignored as beyond their missions. These three themes – centralization of power in technical agencies, legitimizing of science over other knowledges and practices, and pursuit of economic goals to the neglect of social and ecological impacts – reflect the core legacy of the conservationist logic, and consequently of dominant resource management approaches for the past century.

Environmentalism, gridlock, and the search for new approaches

The transformations of nature under scientific management helped to fuel the emergence of an environmental movement in the 1960s. Environmentalists were concerned about a wide range of environmental impacts including polluted air and water, the extinction of species, the drowning of spectacular river canyons, the widespread application of chemical pesticides, and the terracing of national forests into clear-cut rotation tree farms. The movement successfully challenged the outcomes of many conservationist approaches, particularly the logic of controlling nature, and it brought about reforms that required agencies to address potential impacts through more democratically accessible environmental planning. But reforms largely carried forward a Euro-centric and expert-based management model, limiting their capacity to address social justice concerns or to resolve the political and values-based conflicts that typify contemporary natural resources issues.

Major new environmental laws of the 1960s and 1970s included the National Environmental Policy Act (NEPA), the Clean Air and Clean Water Acts, the Endangered Species Act, and the National Forest Management Act (NFMA). These laws gave critics powerful leverage to challenge questionable federal environmental projects by setting both substantive standards for environmental protection and procedural requirements for environmental planning and review. A major centerpiece of these laws, particularly the more procedurally oriented laws (NEPA and NFMA) most relevant to resource management, comprised opportunities for public participation in federal environmental planning and decision-making processes, such as national forest planning. In practice, however, public participation often was, and still is, pro forma; agencies use public hearings and comment periods "to meet the letter of the law regarding public participation without seriously engaging groups and people external to the organization" (Baker & Kusel, 2003, p. 52).

National environmental laws also sustained a pluralist model of democracy that is most easily accessible to nationally organized, relatively powerful interests (Baker & Kusel, 2003). In this model, interest groups compete at state and national levels to influence policies and decisions, which are then implemented by bureaucratic agencies. This process works well for industry and environmental groups with the resources to organize at these scales, but it can provide major barriers to people and groups who lack such resources, including workers, small rural communities, grassroots environmental groups, and marginalized people. When conflicts arise, the pluralist model generates a game of competing experts, where each side calls upon his or her experts and science to make their case, in ways that are often highly abstracted from grounded realities.

National environmental laws largely continued the scientific management model, where decisions are made according to the best available science. Environmental reforms did shift the composition of the experts and force agencies to adopt a more ecologically informed orientation. An infusion of "ologists" – biologists, ecologists, hydrologists, etc. – into the Bureau of Reclamation and the Forest Service challenged the long-standing prominence of engineers and foresters. Agencies had to broaden their decision-making criteria as the rational planning model in new laws forced them to consider and compare various alternatives. But, in practice, these expanded planning processes continued to privilege expertise over local people, knowledge, and concerns in problematic ways, even when they took public participation seriously.[7]

For example, Wendy Espeland (1998) shows how a rational planning process under NEPA, carried out by the Bureau of Reclamation, perpetuated a long-standing silence about the impacts of dam construction on Native Americans. Objections by the Yavapai tribe to a dam that would drown their lands hardly registered in the rational planning process, which could not quantify and thereby easily compare these objections to other values. In this way, the NEPA model and its newly legitimized experts excluded a history of injustice faced by the Yavapai, tribal struggles with the U.S. government over territory, and the tribe's cultural connection to the land. The "rational" way that NEPA did so served to mask the operation of power in the decision-making process. Ultimately, the dam was not built, and the Yavapai retained their land. But the Bureau made the decision not in response to Yavapai objections but based on economically rational criteria: a less expensive, more efficient dam site was found. The problem was not with the scientists, nor even with the science itself; the new "ologists" acted in good faith to create a "rational" process. Exclusion was perpetuated by an assumption of "objective rationality" that was, in fact, culturally biased: this notion of rationality produced a way of measuring and comparing that excluded history and non-quantifiable values.[8]

Environmental reforms in the management of public lands and other environmental resources have been highly contested in the United States. Contemporary conflicts over resource

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[7] However, different agencies responded differently. Today, many expert observers credit the Bureau of Land Management, for example, with more genuine public involvement than the notoriously unresponsive National Park Service; the Forest Service lies somewhere in between.

[8] The early environmental movement has, in fact, been widely critiqued for reliance on white, Euro-centric assumptions that neglect other cultural perspectives, experiences, and relations with nature. These critics argue that the goal of preservation – i.e., saving nature in a pristine and timeless state, free of human influence – is a uniquely privileged western view underlain by a nature-human dichotomy utterly foreign to indigenous and subsistence cultures, whose livelihoods and daily experience depend on close interaction with and tending of surrounding nature. Western environmentalism, like its conservationist predecessors, too often erased people from landscapes, both literally and figuratively, by overlooking the ways that human practices like burning and horticulture in fact shaped "nature." In the U.S., the movement tended to neglect Native Americans, African Americans, Latinos, and other disenfranchised groups, and to remain ignorant to how their relationships to nature differed from white experiences. Preservationism has also justified the removal of people with subsistence-based livelihoods from their lands, to create "protected" areas, particularly in developing countries of Africa, Asia, and the Americas

management often reveal fundamentally different values and belief systems as well as resource scarcities and competing economic interests. The Progressive Era legacy of federal resource management also plays a role. Even where visible conflict is relatively low, local communities (which, it must be noted, are not heterogeneous in interests or values) often feel ignored and excluded by agencies pursuing national-level agendas while managing local landscapes. Social and ecological problems are also exacerbated by agencies with overlapping jurisdictions, competing mandates, and specialized experts with different methods and incompatible assumptions. These problems have come together in varying combinations to prompt well-known conflicts in many places such as the Klamath Basin, California Delta, and national forests of the Pacific Northwest. Such contests typically play out through combative planning, appeals, and litigation processes under environmental laws including the Endangered Species Act and the National Environmental Policy Act.

This context of conflict and fragmentation has, in recent decades, given rise to a movement toward collaborative decision-making: efforts that bring together multiple stakeholders in ongoing deliberative forums to solve shared problems and/or resolve conflict through approaches that emphasize dialogue, learning, and integration of knowledge and values (Brunner et al., 2005; Innes & Booher, 2010; McKinney & Harmon, 2005; Wondolleck & Yaffee, 2000). In a sense, this movement attempts to reconcile the disparate goals of past eras – resource extraction and profit, the greatest good for the greatest number, and ecological values and health – within localized democratic institutions more sensitive to local contexts and communities as well as complexity and uncertainty. It shifts from a narrow focus on natural resource "management," which highlights the technical aspects of human-nature relationships, to natural resource "governance," a broader conception that includes human cultural, political, and economic institutions (Brunner et al., 2005). This conception highlights the use of adaptive and integrative methods in order to cope with the high degree of complexity – social, ecological, economic, political – that characterizes contemporary environmental problems.

The durability of the Conservationist logic

As this review shows, Progressive Era institutions for managing nature, though based on an ideal of neutral scientific expertise, were in fact neither ideologically nor politically neutral. Scientific management in practice tended to serve powerful interests and large-scale resource development at the expense of local resource users, workers, disenfranchised groups, and the environment. Assumptions about managing resources cohered into an overall logic that fed exclusionary practices; these included, in particular, assumptions about how to manage nature, by whom, for what purposes, and according to what beliefs. This logic performed political work in the ways that it shaped the configurations of access to and control over nature and resources and in the ways that it tended to favor some groups and people over others. But the political work it accomplished was obscured by discourses of scientific objectivity and bureaucratic neutrality.

The Progressive Era logic has proven extremely durable in contemporary institutions of resource management. This is, in part, because logics are not merely mental maps; rather, they also come into being in the world as we apply them to social and physical activities like structuring organizations, engineering cities and landscapes, and crafting laws and policies. These material and institutional formations make the underlying governing logics durable, and this stability helps humans make shared sense of the world. But their stability also encourages us to take what we observe and believe we know for granted; our basic assumptions about the world, and about the ways we ought to interact with nature and each other, recede into the background and become mostly invisible in our daily lives. This stabilizing tendency can obscure the power inequities embedded in our logics, and limit the possible trajectories for change or impede it altogether. Yet even deeply held assumptions are mutable. Human perceptions and ideas are ever-shifting, open to the influence of social relationships and the everyday processes by which we navigate the world, make meaning from it, and apply that meaning in new situations.

Although codified in institutions such as laws and agencies, conservationist assumptions were neither permanently fixed nor universally shared. Institutionalization gave the conservationist logic prominence and legitimacy, but there remained influential figures that disagreed, at least on certain points. The preservationist John Muir famously fought Gifford Pinchot over the damming of Hetch Hetchy, contesting the conservationist principle that nature should always be harnessed for human use. Although the Progressive forester Benton MacKaye shared the conservationist abhorrence of waste and faith in science and efficiency, he criticized the inattention to social issues and advocated approaches that linked social, ecological, and economic goals (Baker & Kusel, 2003). Such disagreements preview later critiques of Progressive Era institutions by environmentalists and many rural residents, who have sought to remedy histories of conflict and disenfranchisement. Even deeply embedded logics are thus contestable.

NATURE AND POWER IN THE FEATHER RIVER REGION: A HISTORY

The history of resource extraction and management in the Feather River region enacts this larger narrative of American environmental history, revealing the social and environmental outcomes of the Progressive Era logic. In the Feather River and Sierra Nevada region more broadly, historic natural resource practices have inscribed cultural beliefs about human-nature relationships into the landscape, and they have engraved unequal power relationships in the institutions – agencies, policies, and laws – that today allocate natural resources and their benefits to different groups (Jasanoff, 2005). Contemporary restoration advocates fight this deep historical precedent.

For more than 150 years, private actors, often with the aid of local, state, and federal government, have extracted and profited from the Sierra's rich resources, typically with minimal obligation for their stewardship or regard for the region's inhabitants. Grey Brechin (2006) shows how California's rich cities were built, its elite citizens' fortunes made, by tapping the rich resources of its rural hinterlands, particularly gold and water. Historic resource extraction practices set in motion patterns of resource control that continue to this day, and they degraded watershed hydrology and ecology, creating today's characteristically erosion-prone gullied stream channels, dried-out meadows, and dense, fire-prone forests. The origin of these problems in the distant past complicates the assigning of responsibility for contemporary redress; nonetheless, contemporary actors have sought to restore the watershed using novel restoration techniques and community-led governance approaches.

Incursions: From the fur trade to the Gold Rush

> *Mining cemented the relationship between city and country. (Teisch, 2001, p. 230-231).*

According to restoration advocates, at the core of today's headwaters politics is a lopsided relationship between upstream watershed residents and downstream water retailers and consumers. While downstream beneficiaries profit from water and hydropower, upstream communities struggle with economic insecurity in the form of poverty, unemployment, and out-migration. Contemporary institutions favor powerful downstream beneficiaries – hydropower utilities, water retailers, and consumers including industrial-scale agriculture – who profit from Sierra Nevada water without sustaining the ecological or social health of the headwaters that provide it. This status reflects more than institutional circumstance; rather, it is the product of the mutual shaping, over time, of beliefs, practices, technologies, and institutions that co-produce nature and social order in the rural landscape. The relationship between upstream and downstream thus has deep historical roots.

On an expedition up the Sacramento Valley in 1821, Spanish explorer Captain Luis Arguello became the first non-Indian to reach the mouth of the Feather River, which he named "Rio de las Plumas" (River of the Feathers). Though historical records are elusive, fur traders were probably the first non-Indians to enter the upper watershed, likely in the 1820s and 1830s. Compelling the voracious fur trade in California were not just profit motives but also political interests in securing claims to new territory in Alta California, which became a Mexican territory upon that country's independence from Spain in 1821. By the 1820s, Canadian companies including Hudson's Bay Company sought to stifle American interest in the region by trapping fur-bearing mammals including the beaver to extinction (Scaglione & Ogden, 1949). The success of this effort at extirpating beaver in the high Sierra likely perpetuated the persistent belief that the species is not locally native, despite physical, historic, and ethnographic evidence to the contrary (Lanman et al., 2012).[9] Renowned engineers of dams and ponds, beavers likely played a keystone role in shaping upper Feather River tributaries, valleys, and ecosystems. Their decimation by the fur trade may have triggered the first European-induced changes to watershed processes.[10]

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[9] There is evidence of multiple historic beaver dams in the watershed (specifically, in the East Branch of the North Fork) that predate European arrival. One of these has been radiocarbon dated to 580 A.D. (James & Lanman, 2012). The local Mountain Maidu tribe also has a pre-contact word for beaver, hi-chi-hi-nem, as do at least two other Sierra-dwelling tribes (Lanman et al., 2012).

[10] Beavers manage landscapes by felling trees and building their lodges and dams, which raise the water table, create ponds for their winter food storage, and create habitat for other species. For these activities, beavers are still at times managed as a pest species.

But Europeans were not the first to re-organize nature to suit their needs in the Feather River region. Indeed, human occupants have managed the upper Feather River watershed for thousands of years. The Mountain Maidu people, who have inhabited the region for at least 1000 years and possibly much longer (Dixon, 1905b) historically used fire to manage the landscape, including to create meadows and to regenerate shoots "for eating and basket weaving" (London, 2001, p. 39). One of my interviewees described this history in the local lore:

> There's a story…of the runner who used to run over the mountain to see his girlfriend in Susanville. He used to run from [near Greenville] to Susanville, which is not a short run. And then he'd run back home…. Some people say that he used to sort of drop fire along the way. Maidu traveling through the landscape would just light fires. So there was consistent low intensity burning and that's why the Sierra has the debated story of riding the horse through these large trees with a fairly clear or virtually, very little understory. It's just repeated management of that understory.

The Mountain Maidu's permanent, winter settlements were at lower elevations in Indian Valley, American Valley (now Quincy), and Big Meadows (now Lake Almanor), and they migrated up into the higher valleys during the summer months. The Maidu's predecessors, as well as Paiute and Washoe peoples whose permanent settlements were east of the Sierra, also used the high valleys seasonally (George et al., 2007, p. 11). Archaeological evidence in the high-elevation Last Chance Valley, for instance, suggests "long-term, intensive, seasonal occupation by Native American peoples, possibly dating back as far as 9,000 B.P." (Wilcox, 2003a, p. 4).

Native influence on the landscape waned after the mid-19th century. Reduced by earlier disease epidemics that travelled up the river canyons, the Maidu were decimated – possibly losing as much as 95% of their population— in the 1850s by the diseases and violence of the Gold Rush era (Middleton, 2008, p. 122). In the early 1900s many remaining Maidu lost their claims to their ancestral homelands in Big Meadows as the Great Western Power Company dammed and flooded the valley to make Lake Almanor in 1914 (Middleton, 2008; Teisch, 1999). Others lost their lands following the 1958 Termination policy by the U.S. government. Today, some Maidu belong to federally recognized Rancherias, but as a whole the Mountain Maidu remain unrecognized and lack the rights and protections of recognized tribes.

California's Gold Rush set in motion the Sierra's modern fate: "successive waves" of capital-fueled resource extraction and export to distant markets (London, 2001, p. 41). Following on the heels of the fur trade, the Gold Rush began in earnest in 1849, and the entire Feather River watershed was "overrun" with miners by 1850 (Selverston, 2006). Though the Gold Rush was concentrated farther south in the Sierra's mother lode region, miners swarmed the Feather River watershed in part due to mythic accounts of a "Gold Lake" in the Northern Sierra (Fradkin, 1995). (Although Gold Lake was never found, the watershed did in fact prove very rich in gold.) The Gold Rush catalyzed development of the watershed's agricultural, range, and forest resources, which were quickly tapped to supply first the mining operations and camps and later expanding regional and state markets. Sierra-wide, by the 1860s easily accessible surface gold had been extracted and placer mining gave way to more capital-intensive, and environmentally destructive, hydraulic and hardrock mining technologies. The era of the rugged individual gold miner popularly depicted in California history, kneeling streamside with his pan, was over, as mining companies developed and deployed technologies to tap less accessible deposits of gold in ancient buried streambeds, at great environmental cost.

Brechin (2006, p. 33) describes the transition to river mining and then hydraulic mining:

> As surface gold ran out, investors in San Francisco and Sacramento pooled capital or channeled it from Eastern and European cities to build enormous wooden flumes capable of lifting entire rivers out of their channels. For a few frenzied months, gangs of Chinese coolies tore apart the riverbeds in search of precious metal. Speed was essential, since winter floods frequently wrecked the flumes, flushing them downstream along with masses of debris loosened by the workers. The structures themselves required trees stripped in a widening radius from the mining operations, releasing in turn an even greater surge of sediment into Sierran streams. Destructive as it may have been, however, river mining couldn't match the alterations wrought by hydraulicking.

These placer mining approaches, and the ways they moved water, laid the engineering groundwork for hydraulic mining and its reorganization of Sierra hydrology:

> A ramifying network of dams, flumes, and ditches reached higher into the Sierra to give the mines their necessary head of hydrostatic pressure. Engineers lifted streams out of their watersheds and moved them across canyons on suspension bridges and spectacular wooden trestles; water surged through inverted iron siphons and tunnels chiseled through granite…. A mere decade after the gold rush began, 5,726 miles of flumes, canals, and ditches had radically altered the hydrology of the Sierra. (Brechin, 2006, p. 34-35)

Hydraulic mining obliterated hillsides, which washed down streams and canyons in debris-choked torrents and settled in Sacramento Valley's river channels. As the channels filled up with sand, gravel, and rocks, the streams began to more frequently overflow their banks, engulfing farms and towns in floods of mercury-laced muck and slime (Alpers & Hunerlach, 2000). Hydraulic mining was prominent in the Feather River region, particularly in the foothills, though it was most concentrated in the Yuba River region, just to the south. Eventually, valley farmers at the confluence of the Yuba and Feather rivers became sufficiently outraged to press legal action against the hydraulic mining outfits, which had become more capitalized, large, and destructive year by year. The California Supreme Court's 1884 Sawyer Decision, though confined to the Yuba River watershed, effectively ended hydraulic mining in the Sierra. A later crash in the world gold market and exhaustion of accessible deposits ended gold mining's direct impact in the Feather River watershed by the late 1880s (London, 2001). Mining of copper, made into wire for electricity transmission as the state's grid expanded, peaked in the Feather River region in the 1920s and 1930s (Young, 2003). The economy transitioned to logging, ranching, and agriculture, activities that often further accelerated watershed erosion and ecological transformations.

The legacy of the Gold Rush still lingers in the biophysical and cultural contours of the Sierra and California more broadly. In the Sierra, including the Feather River, forests are dotted with old mine shafts, small mountains of mercury-laced hydraulic tailings sit perched above rivers, boulders and gravel from hydraulic mining shape river beds, and small-time prospectors prowl streams for bits of gold. In some rural counties, water supply transport still depends on Gold Rush era infrastructure.[11] Gold mining depended on water and its transport, needs that gave rise to the legal and engineering systems that still provide the bases for California's water supply and hydropower systems. Rules worked out in the mining camps were foundational to the State's complicated water rights system. And the sophisticated systems engineered to control water for mining laid the groundwork for later methods of producing hydropower and transporting water on a massive scale.

If the fur trade set in motion a pattern of resource extraction and export to distant markets, it was the Gold Rush that first institutionalized the relationship between California's rural hinterlands and its urban financial centers, particularly San Francisco. As Teisch (2001, p. 230) writes of the mining era: "San Francisco colonized Plumas County's natural wealth," in turn generating mining enterprises that spread across the globe. The era of rich placer mining was short-lived and brutal for individual miners, and few actually struck it rich; "the real fortunes were made by city-based financiers in hardrock mercury mining, by commission merchants, and, above all, by those speculating in land and engaging in fraud on an epic scale" (Brechin, 2006, p. 31). Where government intervened, it often helped to facilitate these activities in the interest of efficient resource development, technological progress, and wealth creation.

This patterning in the relationship between city and country was repeated in the Sierra region throughout the late 19th and early 20th centuries through waves of extensive mining and logging, the construction of roads and railroads to haul out timber and other resources for export, and river engineering for water supply and hydroelectricity production. Contrary to the popular image of the rugged pioneer settling the West through diligent hard work, those who profited most were typically far removed from the dangerous and difficult labor involved in these pursuits, which was often undertaken by immigrant labor from China, Mexico, and elsewhere.

Hydro-Power

> *The destiny of Big Meadows as Lake Almanor reveals the ways that the local, state, and federal government facilitated private capitalist development in California, redefining what constituted the "highest and best use" of natural resources. By invoking the power of eminent domain for its "quasi- public" project and receiving indirect federal subsidies, [Great Western Power company] rerouted the Feather River's natural flow into urban markets. (Teisch, 1999, p. 34)*

[11] The Tuolumne Utilities District, for example, still relies on 57 miles of open ditches, built in the 1850s, to transport water to residential and agricultural customers in the Central Sierra.

Log trucks and hydraulic scars are iconic images of resource extraction in the Sierra, but hydropower has derived far more sustained profit, particularly on the North Fork of the Feather River. Hydropower development derives from the Gold Rush era, emerging in the 1890s with the decline of hydraulic mining and built on the era's technological, capital, and even physical foundations. Early hydropower fed local mine operations and then towns; exports to cities began later with the development of technology for long-distance transmission (Brechin, 2006). Sierra hydropower was tied to urban financial centers through bonds formed during the Gold Rush:

> The methods used for extracting gold from ancient riverbeds and mountainsides had produced a vast financial and technical infrastructure for water power. Mining, which attracted heavy San Francisco and New York investment to rural northern California, promoted ancillary industries: canal building, logging, and railroad development. In the 1900s power companies built upon these earlier landscapes of resource extraction and allied with these industries in order to send electricity…to distant cities. (Teisch, 2001, p. 222)

California rapidly became the epicenter of hydroelectricity generation in the United States, generating more hydroelectricity and technical expertise than anywhere else in the country (Teisch, 2001).[12]

Great Western Power (GWP) and its predecessor, Western Power Company, spearheaded hydropower development of the Feather River. In its quest to light up the Bay Area and Sacramento Valley with hydroelectricity, GWP displaced rural residents and livelihoods. Like the other "electric power titans" operating in the Sierra, the company was backed by East Coast financiers, an arrangement necessary to meet the high capital requirements of hydropower development at this scale (Teisch, 2001). With this backing, in 1902 GWP set to work to obtain contiguous water rights on the North Fork and title to 30,000 acres of land in Butt Valley and Big Meadows, which the company planned to flood under Lake Almanor. GWP was secretive about its plans. To keep land prices down, GWP agents at first led Big Meadows residents to believe that lands were being consolidated for a ranching enterprise (Teisch, 1999). When owners would not willingly sell, GWP filed condemnation suits, and, in a series of decisions from 1902-1914, the Superior Court of Plumas County sided with the company. Many settlers thus lost farms and ranches to condemnation. Consistent with the Progressive Era enthusiasm for harnessing nature to serve the greater good: "The court thus cemented the supremacy of urban growth over the local economic welfare and the generation of electricity over agricultural activities" (Teisch, 2001, p. 240). At Prattville, where ranchers and residents had long held out against selling to GWP, a suspicious fire that razed the town finally prompted the resisters to give up. Although many locals were against the project, "Resistance to the dam by farmers, ranchers, and town residents did not cohere into a set of consistent arguments that could effectively challenge the company's powerful ideology about technological progress" (Teisch,

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[12] The engineers that built the water supply and hydroelectricity industry in California would go on to export the technologies overseas, to semiarid regions including Australia, South Africa, Hawaii, and Palestine (Teisch, 2011).

1999, p. 38). This ideology lives on, and it continues to render rural landscapes invisible to urban consumers of their resources.

Maidu also lost their lands in Big Meadows through condemnation suits. (This later caused headaches for GWP, as the lands had been held in trust for, and thus were not technically owned by, the Maidu; Congress later sorted the matter out, but only after the lands were submerged under Lake Almanor) (Teisch, 2001). Or tribal allotments were obtained by GWP after being cancelled by the state for various, often mysterious, reasons (Middleton, 2008). State and federal governments were thus complicit in transferring lands from the Maidu to GWP. Middleton (2008, p. 277-278) explains:

> …nearly just as fast as the State distributed these lands [to the Maidu], they helped investors' [sic] obtain them for State-sanctioned development projects. Allottees that applied for lands in areas deemed more valuable for hydropower received trust patents, but, within 1-5 years, also received cancellation notices and their lands were transferred to hydroelectric and timber companies. Often, the timber company would purchase the land first, clear it of vegetation and sell the lumber, and then sell it to the hydroelectric company. Lands valuable for their hydroelectricity generation potential were often in the watered valleys where Maidu lived and stewarded resources such as water-loving edible bulbs, cattails and tules, various fish species, and berries. As such, they were natural sites that Maidu would select for allotments.

The original design would have made the dam that backed up Lake Almanor the largest in the world, but a smaller design was substituted after questions of dam safety surfaced. Upon its completion, the downscaled dam nonetheless had the highest hydroelectricity capacity in the world (Teisch, 2001). But it was just one piece of the vast hydropower infrastructure of the Feather River's North Fork, whose steep drop from the shoulders of Lake Almanor to the floor of the Sacramento Valley makes it ideal for hydropower production. The Feather River as a whole is by far the largest of the 11 west slope Sierra rivers in terms of average annual runoff, and the North Fork is the largest of the Feather's three forks (Stewart, 1996, p. 22). Nearly all west slope Sierra rivers are plumbed and piped for hydropower production, the North Fork extensively so. From about 1900 through the 1920s, GWP engineered the North Fork into the "Stairway of Power." When Pacific Gas & Electric Company (PG&E) purchased GWP in 1930, it acquired in the Feather River one of the largest hydropower systems in the Sierra. Today, it is less a river than a series of placid lakes pooled behind steep hydropower dams, its profile indeed the image of the giant Stairway its moniker implies.

Today, the Stairway of Power accounts for about 5% of California's in-state hydropower production capacity, with an additional 5% contributed by State Water Project (SWP) facilities at Lake Oroville. The SWP uses its hydropower to transport Feather River water throughout the state, while PG&E supplies the energy needs of its customers. It is an extraordinarily lucrative system. A 1996 economic assessment calculated that water accounts for 60% of all natural resource related revenues produced annually from the Sierra Nevada. Water supply and recreation contribute to this value, but most derives from hydropower. Moreover, between

1970 and 1994, the Feather River watershed alone generated on average $143 million/year of profit from hydropower, the most of any Sierra watershed (Stewart, 1996). Although requiring a large initial investment for construction, hydropower facilities require relatively little maintenance, so the return on investment is very high (William Stewart, personal communication).

The genesis of Lake Almanor and the Stairway of Power exemplifies the region's history: how powerful commercial interests, often with the backing of the state, have reorganized rural nature, industry, and society to feed urban needs and fortunes. This remaking of nature was further facilitated by cultural beliefs about harnessing science and engineering to control nature, for human benefit. The Feather River's engineered infrastructure, begun during the mining era and further cemented as the river was engineered for hydropower, today allows engineers to manipulate the river's every movement. These technologies physically inscribe into the landscape cultural beliefs about human-nature relationships that have historically privileged control, commodification, and profit over local community and ecological well-being. The physical permanence of these technologies helps existing configurations of power and control endure.

We are all "downstream:" The Feather River as California's watershed

Not just its gravitational drop, but also Feather River water itself has been instrumental in the making of modern California. The watershed is the source for the State Water Project (SWP), which provides some 25 million Californians with a portion (24% or less) of their drinking water and irrigates 750,000 acres of farmland.[13] The colossal Oroville Dam – tallest in the U.S. at 770 feet high – pools all of the runoff from the Feather's North, Middle, and South Forks into Lake Oroville, located at the base of the Sierra where it meets the Sacramento Valley. Water released from the Oroville complex flows south to the Sacramento River and to the Sacramento-San Joaquin Delta, undisputed ground zero in California's perpetual water wars. Feather River water leaves its geographical watershed when it is pumped out of the Delta and exported through the SWP infrastructure to other parts of the state, as far as San Diego and the border with Mexico. Indeed, Feather River water is sprinkled throughout the state, reflecting the political calculus that was required to bring the controversial project to fruition. While some water goes to four counties in the San Francisco Bay-Delta region, most goes south.[14] Water not pumped out at the Delta flows on to the San Francisco Bay and ultimately the Pacific Ocean.

Constructed in the 1960s, the SWP is a massive feat of water supply engineering that includes a vast, statewide system of aqueducts, pumps, and water storage facilities, as well as hydropower facilities that help power the transport of water throughout the state: "Beginning [in the Upper Feather River watershed] at Lake Davis, spanning 600 miles south to Southern California, it includes 34 storage facilities, 20 pumping plants, four pumping-generating plants, 5 hydroelectric power plants, and about 700 miles of canals, tunnels and pipelines"(Aquafornia, 2008). SWP pumps, whose energy requirements make the SWP the state's largest energy

[13] The "25 million" figure is a little misleading. No region actually gets more than 24% of its water from the Delta, and most get much less, relying instead on local sources and groundwater.
[14] These counties are Napa, Solano, Alameda, and San Jose.

consumer, lift the water uphill and over mountain ranges, like the Tehachapis that separate the Los Angeles Basin from the San Joaquin Valley. Like many western water supply projects, the SWP complicates the notion of "watershed," as people throughout the state and far removed from the Feather River watershed in fact consume its water.

The SWP reorganized nature to help make Southern California – a desert or semi-desert by way of average annual precipitation – bloom with orchards, agricultural fields, and housing subdivisions. The SWP is one of three major water projects, with the Owens Valley project and the Central Valley Project, that move water from Northern California south.[15] It would be difficult to overstate the scale of development of Sierra water or its economic value for California. Bill Stewart (1996, p. 21-22) writes:

> The extensive infrastructure now controlling the distribution of water flowing from the Sierra Nevada includes two of the world's largest irrigation projects, nearly 500 reservoirs, and over one hundred hydroelectric generation facilities. The enormous investments in water moving infrastructure made over the past one hundred and fifty years highlight western water's peculiar distinction of having its greatest value at considerable distances from its area of occurrence. Water diversions have allowed for the residential and industrial growth in California's distant urban centers and made the Central Valley the most productive agricultural region in the world.

An oft-cited statistic – that two-thirds of California's water is in the North, while most of its population is in the South[16] – makes the transfer of water from north to south seem a logical strategy. But it glosses over the social and economic ramifications of who gains from this water, and who loses, a calculus that hasn't much changed since the controversial debate over the project's approval. The SWP's strongest supporters were large landholders, particularly in the San Joaquin Valley, including not just growers but also railroads and oil companies with vast tracts that were nearly worthless without irrigation. Groundwater pumping was rapidly depleting the region's aquifers, and growers saw the North's rivers as salvation. But they also recognized the difficulty of financing the project and winning the necessary support of the state's voters. Growers wouldn't be able to afford the water produced by such an expensive project, but urban users could. So these interests elicited the support of the Metropolitan Water District of Southern California (the "Met"), a wholesaler that supplies water to districts throughout Southern California. Although initially reluctant to support the scheme, the Met and its allies wanted to secure water for future urban growth; they ultimately offered their support when they lost future access to more Colorado River water. Opponents of the project included farmers in the Delta and Northern California residents concerned about the prospect of a water grab by southern California (Reisner, 1986).

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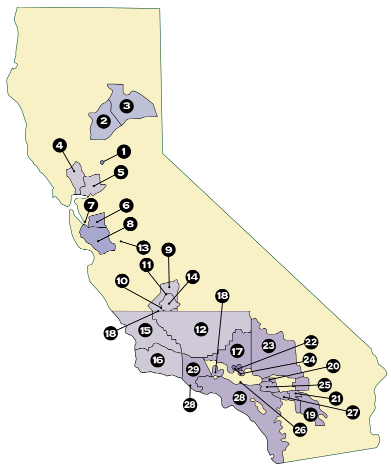
[15] Los Angeles' Owens Valley Project transports water from the east side of the Sierra Nevada to the Los Angeles basin. The federal Central Valley Project diverts water from five major rivers – the Trinity, Sacramento, American, Stanislaus, and San Joaquin Pit River, American River – to the Central Valley and the Bay Area.

[16] E.g., see the description of the SWP on the Department of Water Resource's website at: http://www.water.ca.gov/swp/geography.cfm.

In 1959, the California Legislature enacted the Burns-Porter Act authorizing $1.75 billion (in 1960 dollars) in general obligation bonds to construct the SWP. California voters gave their required approval in 1960, but on strikingly regional lines: the southern counties in favor, the northern counties nearly all against. (The northern exceptions were the counties of Yuba and Butte – the site of Oroville Dam – both of which eagerly sought the project's flood control benefits following a history of devastating and deadly flooding including in 1955). Thus did voters authorize the largest bond measure in the nation's history to fund the largest and costliest water project ever undertaken by a U.S. state (Hanak et al., 2011).

Figure 3-1 shows the delivery areas and maximum entitlements of the 29 state water contractors that today deliver Feather River water throughout the state. Plumas County Flood Control and Water Conservation District, which delivers SWP water to upper watershed residents, holds the smallest allocation, 1750 acre-feet. The largest allocations go to Southern California, particularly the Met at just over 2 million acre-feet (MAF), nearly half of the SWP's total 4.2 MAF. The Met, a consortium, distributes this water to its 26 member cities and water districts throughout southern California. The next largest allocation is to the Kern County Water Agency at just below 1 MAF, which primarily feeds large-scale industrial agriculture in the San Joaquin Valley. Because urban water fetches a higher price that agricultural water, the urban residents of Southern California have actually footed most of the bill for the SWP. (The contractors are required to repay the state for the project's construction and maintenance costs, and they do so through the fees they charge their customers.)

Water Contractors	Contracting Agency	Maximum Annual Entitlement (acre-feet)
	Upper Feather River	
	1. City of Yuba	9,600
	2. County of Butte	3,500
	3. Plumas County Flood Control & Water Conservation District	1,750
	Subtotal	**14,850**
	North Bay Area	
	4. Napa County Flood Control & Water Conservation District	21,850
	5. Solano County Water Agency	47,206
	Subtotal	**69,056**
	South Bay Area	
	6. Alameda County Flood Control & Water Conservation District, Zone 7	80,619
	7. Alameda County Water District	42,000
	8. Santa Clara Valley Water District	100,000
	Subtotal	**222,619**
	San Joaquin Valley	
	9. County of Kings	9,000
	10. Dudley Ridge Water District	57,343
	11. Empire West Side Irrigation District	3,000
	12. Kern County Water Agency	998,730
	13. Oak Flat Water District	5,700
	14. Tulare Lake Basin Water Storage District	106,127
	Subtotal	**1,179,900**
	Central Coast	
	15. San Luis Obispo County Flood Control & Water Conservation District	25,000
	16. Santa Barbara County Flood Control & Water Conservation District	45,486
	Subtotal	**70,486**
	Southern California	
	17. Antelope Valley-East Kern Water Agency	138,400
	18. Castaic Lake Water Agency*	82,500
	19. Coachella Valley Water District	23,100
	20. Crestline-Lake Arrowhead Water Agency	5,800
	21. Desert Water Agency	38,100
	22. Littlerock Creek Irrigation District	2,300
	23. Mojave Water Agency	75,800
	24. Palmdale Water District	17,300
	25. San Bernadino Valley Municipal Water District	102,600
	26. San Gabriel Valley Municipal Water District	28,800
	27. San Gorgonio Pass Water Agency	6,000
	28. The Metropolitan Water District of Southern California	2,011,500
	29. Ventura Country Flood Control District	20,000
	Subtotal	**2,559,200**
	Total State Water Project	**4,116,111**



**Note: Castaic Lake Water Agency acquired Devil's Den W.D. entitlement in 1992.*

Figure 3-1. Water allocations for the State Water Project (California Department of Water Resources, 2014b). Although SWP water is distributed throughout the state, nearly three-quarters of it is allocated to just two entities: the Kern County Water Agency and the Metropolitan Water District of Southern California.

Current efforts to restore the Feather River headwaters intersect conflicts and politics over the State Water Project, including who is allowed to control and profit from Feather River water and how to mitigate the environmental impacts of the project. Actual water deliveries from the SWP have always fallen short. The State promised a yield of 4.2 million acre-feet (MAF) from the project, but full build-out of other planned SWP facilities, which would have tapped California's North Coast rivers, never occurred due to economic, environmental, and tribal opposition. Total deliveries have ranged from 1.2 MAF in dry years to almost 4.0 MAF in wet years. From 1990 to 2000, they averaged just 1.9 MAF (California Water Impact Network, 2014), while from 2001 to 2010 they averaged 2.5 MAF (California Department of Water Resources, 2012). The discrepancy between the 4.2 MAF and the actual water deliveries is known as "paper water." The State has never addressed the perpetual shortfalls, for example by lowering the allocations. Real estate developers in Southern California rely on paper water to show there is enough water to supply planned developments. Because clauses in the original agreements gave precedence to urban deliveries in times of shortages, a clause known as the "urban preference," agricultural users in the San Joaquin Valley, have at times suffered severe restrictions in their deliveries (California Water Impact Network, 2014).[17]

Perpetual delivery shortfalls prompted a controversial 1994 agreement between the California Department of Water Resources (which manages the SWP) and four of the SWP Contractors (including the two largest: the Met and the Kern County Water Agency) to revise the SWP contracts. Although legally complex, these revisions, known as the Monterey Amendments, did four basic things: removed the "urban preference" clause, removed a clause that was supposed to lower the promised amount of water if it turned out that the SWP could not deliver the full 4.2 MAF annually, privatized the Kern Water Bank (a state-owned and developed groundwater recharge aquifer), and green-lighted the pumping of so-called "surplus" water from Delta during periods of heavy flow, a practice that has increased exports from the Delta and that opponents argue has hastened the demise of Delta fisheries. Some SWP contractors not involved in the Monterey Amendments, including the Plumas County Flood Control and Water Conservation District, sued the DWR for negotiating these agreements in secret, contrary to state law. As part of the settlement agreement, the DWR and the State Water Contractors funded the Plumas Watershed Forum, an effort to conduct numerous restoration projects in the Feather River headwaters. Following its expiration, the DWR and the Contractors declined to continue this restoration program voluntarily.

[17] According to Marc Reisner, growers in the San Joaquin Valley irrigating with SWP water were never supposed to plant crops that required annual irrigation – such as orchards that die if not watered every year – but rather more flexible crops that could be planted in wet years and not in dry years. Nonetheless, the delivery shortfalls to agricultural users are an issue of great contention in California and a key reason for Governor Jerry Brown's current proposal to build the controversial twin tunnels. The tunnels would route Sacramento River water around the ecologically sensitive Delta to ensure deliveries to the South while attempting to minimize ecological harm. Delta farmers and many Northern California residents and farmers oppose the project, fearing it would constitute a water grab by powerful water interests to the South and would further undermine Delta ecology.

Food and timber production in the headwaters

Above the water and hydropower infrastructure of the Feather River Canyon and Lake Oroville, the watershed's high valleys are predominantly sites of food and timber production. The Gold Rush spurred an influx of settlement in the 1850s and drove the early agriculture, livestock, and timber production, which at first supported the mines and camps and later fed export markets in Reno and the Sacramento Valley. Early settlers began cattle and sheep ranching, dairying, and agriculture in the watershed's many fertile alluvial valleys (Young, 2003).[18] The large, gentle meadow valleys of the Feather River region are unique in the Sierra, and this geography allowed for the cultivation of a wide diversity of crops. Agricultural production in American Valley (present-day location of Quincy), for example, included "beef and dairy cattle, hay, wheat, oats, barley, potatoes, vegetables, and fruit orchards" (George et al., 2007, p. 20, citing Young 2003). Settlers often drained wet meadows to provide access for cattle, or for growing irrigated crops including hay, which were crucial for over-wintering livestock (George et al., 2007).

Overgrazing, particularly by sheep, was rampant in the Feather River watershed and Sierra-wide in the late 1800s and early 1900s (McKelvey & Johnston, 1992). Sheep grazing in the Feather River region was concentrated in the uplands, and cattle grazing in the meadow valleys. The following 1894 quote by Acting Superintendent of Sequoia and General Grant National Parks, although from the Central Sierra, is illustrative of the severe hydrological impacts of sheep grazing that stripped the land of vegetation: "The soil being denuded of grass is broken up by thousands of sheep tracks, and when the rains come this loose soil is washed down the mountainsides into the valleys, covering up the swamps and meadows, destroying these natural reservoirs" (McKelvey & Johnston, 1992, p. 20). In meadows of the Feather River watershed, overgrazing altered species composition and compacted soils, and it often triggered down cutting of meadow stream channels, prompting erosion as well as ecosystem conversion to arid sagebrush plain; today, these conditions still characterize the watershed's alluvial valleys. The permitting system established under the 1934 Taylor Grazing Act helped alleviate pressure on grazed federal lands in the Sierra, and efforts to implement better practices and restore past damage began in the 1970s and 1980s. The Soil Conservation Service (now Natural Resource Conservation Service) entered the region in the mid-20th and has worked since with private landowners to improve natural resource practices on private lands. As of 1996, grazing remained the most extensive land use in the Sierra (Stewart, 1996). But it has become harder for ranchers to return a profit, and the Forest Service increasingly retires allotments.

Harvests of the watershed's rich timber first supplied the gold mines and camps, and later supported the needs of ranchers and farmers. Wood was used to construct homes, businesses, and vital mining infrastructure, including for moving water: "flumes, wing dams and ditches, rockers, sluices, tunnels" and mills (Teisch, 2001, p. 231-232). Fuel wood met mining's large energy requirements, particularly for the stamp mills that processed ore (McKelvey & Johnston, 1992). Early logging comprised small, local operations: "the wood was mostly worked by hand,

[18] These included Sierra Valley, Indian Valley, Genesee Valley, American Valley, Big Meadows, and many smaller valleys scattered throughout the watershed.

with four to eight oxen mules, or horses pulling logs cut from nearby timber stands to the mills" (Young, 2003, p. 80). Exports began as early as 1856 when logs were floated downstream to fast-growing Sacramento and Marysville, and increased near the turn of the century, particularly as railroad construction in the West "created a tremendous demand for California pine"(Teisch, 2001, p. 232). Railroad construction in the watershed facilitated more logging, as railroads were used both for exports and to extract timber more easily from the forest: "When the [Western Pacific Railroad] was finished in 1909…timber replaced gold as the county's principal industry. Nine or ten standard and narrow-gauge railroad lines worked their ways from the sawmills into the forest" (Young, 2003, p. 88).

While the extensive meadow valleys provided rich opportunities for ranching, dairying, and agriculture, they also served as transportation routes for hauling logs, first via horse teams and railroads and later via tractors, log trucks, and roads. Meadows, relatively flat and treeless, were the easiest place to build these spur lines. Railroad logging had major hydrological impacts in the watershed, particularly in these east side valleys. The Clover Valley Lumber Co. railroad, for example, likely "triggered the extreme systemic incision found along much of the mainstem" of Last Chance Creek today (Wilcox, 2003b, p. 2). Log trucks were introduced in the 1910s, and gradually replaced railroad logging. Particularly during the timber heyday that followed WWII, dense road networks were built for forest access by log truck: "Frequently these roads were in, or immediately adjacent to, the nearly continuous meadow systems. These roads were ideally located to serve as channel capture sources and created local channel incision responses" (Wilcox, 2003b, p. 2). Streams were also channelized to make room for roads and railroads on valley floors. Best management practices have reduced the direct watershed impacts of logging today, and the Forest Service tries to reroute or eliminate poorly placed roads whenever possible. But the dense network of forest roads and trails – which are extremely popular for recreation, particularly by off-highway vehicle enthusiasts – remains the largest water quality problem in the watershed. This problem is shared throughout national forests in California and the West.

Federal laws for transferring public domain lands to private ownership facilitated the growth of logging, ranching, and agriculture in the Feather River region. Agricultural and ranch lands in the meadow valleys were transferred primarily through the Homestead Act of 1862 (Young, 2003). Most of these lands remain in private ownership and support small-scale ranching and farming, mostly of livestock feed. Logging was at first the purview of small-scale operators. As it attracted larger operators and outside finance, "Large absentee investor-led partnerships and corporations began to buy up vast tracts of forestlands" via sometimes dubious transactions under the Forest Reserve Act of 1887 and the Homestead Law of 1862 (London, 2001, p. 41).

The dynamics of land ownership in the watershed shifted with President Theodore Roosevelt's 1905 designation of the Plumas Forest Reserve, which later became Plumas National Forest. Timber corporations, with their allies in Congress, vigorously opposed Roosevelt's act, which left most of the meadow valleys in private ownership and the surrounding forests under mostly federal control (London, 2001).[19] The Plumas National Forest represents "70 percent of the county's land base and 75 percent of its productive timber lands" (London, 2001, p. 41). Despite public ownership, the Plumas National Forest has provided opportunities for commercial uses, particularly logging, grazing, and hydropower development, throughout its history.

Although timber was the region's primary industry from the 1910s through the 1970s, other sectors of the economy have since grown more important (Kusel, 1991). These particularly include retail and service, which support tourism and a growing retiree community. The reasons for the decline in the timber industry are complex. They include labor, technical, and market shifts in the timber industry (London, 2001); and increased environmental scrutiny since the early 1990s, which drastically reduced timber availability from the national forest. "Despite this decline, Plumas County remains one of the major timber producing counties in California, producing just under eight percent of the volume of timber harvest and representing about five percent of the value of the timber harvested in California" (Plumas County, 2013, p. 96).[20]

Despite declines, logging in the watershed remains controversial. A community-based effort, the Quincy Library Group (QLG) emerged in the early 1990s to forge a compromise between warring local environmental and timber interests. In 1998, the QLG successfully lobbied Congress to pass the Herger-Feinstein Quincy Library Group Forest Recovery Act (HFQLG), directing a reluctant Forest Service to implement the group's compromise plan. Forest management under HFQLG, which prioritized hazardous fuels reduction, was extremely controversial, and non-local environmentalists often stalled implementation of HFQLG projects through appeals and litigation. Although HFQLG expired in 2012, it dominated management priorities for the Plumas National Forest during the time period of this research. Consistent with the Multiple Use Sustained Yield Act of 1960, the Forest Service manages the Plumas for multiple uses including timber, grazing, fire protection, mining, hydropower production, watershed health, and recreation.

CONCLUSION

Since European settlement, the Feather River watershed has been a site of resource development and export that fed California's growing economy and wealth. Dispossessing the native Maidu of their lands and livelihoods, the new Californians transformed the watershed to produce minerals, timber, agricultural products, and, finally, hydropower and water. While environmental impacts accrued locally, the benefits of these transformations often (though certainly not always) flowed to people outside of the watershed. The arc of resource development in the watershed largely reflects the larger American pattern. Conservationist policies of the Progressive Era aimed to reign in the exploitation and waste of resources by private entities, but their preference for economic efficiency, order, and technical solutions, and the mistrust of local people and their unscientific resource management practices, had unforeseen consequences for both nature and people. Efforts to control nature through

[19] The watershed also includes small portions of the Tahoe and Lassen National Forests, also created in 1905. Eighty-five percent of the Plumas National Forest lies within the Feather River watershed.
[20] Plumas County (2013) cites the California State Board of Equalization, Timber Tax Section, Report YT-36, April 8, 2011, for these figures.

scientific management proved overconfident, while the moralistic goal of harnessing nature to secure “the greatest good” actually neglected the differentiated and unequal ways that resource benefits accrued to the powerful and the powerless. Current tensions over resource management in the watershed emerge both from the uneven ways that this history allocated natural resources and their benefits and from the growing concern about ecological and hydrological deterioration of the watershed and its landscapes.

Attention to the historical relationships between the conservationist philosophy, institutions, and social relations of control over nature lends a new perspective on the contemporary emergence of decentralized and collaborative governance. Environmental governance shapes the levers of control over nature and its valuable resources, and these relationships have always been contested. Emerging approaches that empower local citizens, communities, and environmentalists may succeed at making decision-making fairer and more democratic, at distributing resource control more equitably, and at widening the criteria for managing nature, as from efficient commodity extraction to social and ecological health and sustainability. They may even help to resolve long-standing resource conflicts. Yet even as they do so, they threaten wider logics for managing nature and the interests who benefit from the status quo. Understood in this light, collaborative governance might manifest, not a transcendence of conflict, but rather a new front in a long history of political challenge over control of the West’s rich resources. The specific ways that this political challenge plays out are the topics of the following chapters.

CHAPTER 4. CONTESTED TERRAIN: THE KNOWLEDGE POLITICS OF COLLABORATIVE MEADOW RESTORATION

The Feather River Coordinated Resource Management group (CRM) is a collaborative organization that has worked since 1985 to restore Northern California's Upper Feather River watershed. The group first convened to address erosion from upstream meadow gullies into downstream reaches and reservoirs on the North Fork of the Feather River. Through a process of collaboration among multiple stakeholders and experimentation with various techniques, the CRM gradually adopted a dramatic meadow restoration technique called pond and plug, which enables the group to restore many miles of degraded meadow at once. In addition to halting erosion, the technique brings about rapid transformations of meadow ecology and hydrology. The CRM's hydrologists pioneered the use of pond and plug in California. Beyond the Feather River watershed, they have frequently consulted on pond and plug projects in other parts of northern and central California, and have earned national recognition for their work. These successes, along with the efforts of a wider group of watershed residents, have also helped to shape evolving state policies toward headwaters regions.

Understood within the growing movement toward decentralized, collaborative, and community-based approaches to governing the environment, the CRM experience with pond and plug at first glance seems a quintessential example of social learning: collective learning by groups of people who interact to address a shared issue or problem. Despite conceptual variations, the literature proposes a common understanding of the process of social learning and its relation to collaborative natural resource management: "At the core of these models is a process of collective and communicative learning, which may lead to…new knowledge, the acquisition of technical and social skills as well as the development of trust and relationships". These competencies, in turn, "may form the basis for a common understanding of the system or problem at hand, agreement and collective action" (Muro & Jeffrey, 2008, p. 330). Social learning is often viewed as essential to successful collaboration (Schusler et al., 2003).

The story of pond and plug, however, evolves in a way that offers a different interpretation of the relationship between social learning and environmental problem solving in collaborative forums. Pond and plug emerged from a collaborative social learning process that engaged multiple interests to solve the shared problem of watershed erosion. Yet the technique ultimately came to embody a political challenge by some group members – residents of the upstream community – against other, more powerful members located downstream. Pond and plug became a vehicle for the upstream residents to articulate a challenge to a deeply, historically embedded status quo: the rights of the downstream entities to profit from Feather River water with minimal obligation to headwaters ecosystems or communities. As its reach grew, the technique also gradually gained critics in the upper watershed concerned with a variety of issues including potential ecological impacts, risks, and, most importantly, water supply disruptions. A technique born of apparently collaborative social learning in fact surfaced deep tensions among actors with different interests in the watershed.

These divergent accounts suggest a need for better accounts of the relationships between collaborative learning, power, and social and environmental change. How does social context, including uneven distributions of power, influence the production and content of new knowledge in collaborative forms? How does that knowledge gain traction and legitimacy in the world, and how might it be used to reshape nature and human institutions? To address these questions, this chapter narrates the story of pond and plug's emergence and evolution in the Feather River watershed. The narrative portrays the production of new knowledge and techniques for restoring headwaters as responsive to more than just the biophysical issues of concern; it is also a socially embedded process shaped by the politics, history, and power relations of resource management in the Feather River region.

The following section discusses how theory on the politics of knowledge-making can enhance concepts of social learning. Then the case study details how pond and plug emerged from the Feather River's biophysical and social landscapes: first, through a collaborative process that experimented with various restoration techniques and learned from the results, and second as a strategic tool that allowed upstream residents to make new claims to the water and hydropower wealth derived from the watershed. Next, the case study examines technical disagreements about pond and plug in the upper watershed and how they reflect wider conflicts over community values, risk, and identity. The case ends by summarizing recent efforts to clarify stream flow dynamics below restored meadows, a key point of contention in the upper watershed. The chapter concludes with a discussion of how the social learning literature might better address the socially embedded nature of environmental knowledge-making in collaborative contexts. Findings point to the need for analysis over longer timeframes and in relation to multiple scales of resource control: temporal, geographic, institutional, and political.

THEORY: SOCIAL LEARNING IN COLLABORATIVE ENVIRONMENTAL GOVERNANCE

Departing from a century of centralized and technocratic approaches, environmental governance increasingly occurs in decentralized forums that engage a range of state and non-state stakeholders in collaboration. Ansell and Gash (2008) define collaborative governance as:

> A governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets (p. 544).

The institutional forms and features of these forums vary, as do the terms used to describe them, which include collaborative governance, adaptive governance, deliberative governance, reflexive governance, community-based natural resource management, and co-management. All typically aim to address complex environmental problems and/or conflicts through greater awareness and integration of multiple knowledges, perspectives, and capacities. In contrast to representative forms of democracy that aggregate citizen preferences through voting, these forums often promote a civic vision that engages citizens and other stakeholders in ongoing, situated problem solving and negotiation. As they typically operate under situations of high environmental complexity and uncertainty, learning is often a fundamental goal.

In practice, however, collaborative governance has a mixed track record for achieving on-the-ground outcomes (Armitage, 2008), a finding echoed by political scientists on deliberative democracy more generally (Ryfe, 2005). Scholars have identified social learning and scale, and specifically the ways that these two factors intersect with power, as important yet under theorized dimensions that shape the outcomes of collaboration. First, although many studies lend support to the importance of social learning in collaboration, a normative focus has precluded critical attention to how power asymmetries and conflicting interests can limit or challenge learning processes (Armitage et al., 2008; Muro & Jeffrey, 2008). Second, studies have focused primarily on the form and function of collaborative forums themselves; the interface between collaborative governance and broader geographic, political-economic, administrative, and temporal scales and institutions remains little addressed, although many key barriers derive from these contexts (Armitage, 2008; Mostert et al., 2007; Voß & Bornemann, 2011). Scholars have begun to address the institutional linkages, but there has been less attention to the political interplay between collaborative governance forums and broader contexts (Armitage, 2008). This chapter asserts that these two dimensions – social learning and scale – are linked in ways that are fundamental to understanding the politics of collaborative governance.

Social learning theories and critiques

Theories of social-ecological systems, adaptive management, commons governance, and co-management frame much of the current academic discussion about environmental governance and its new forms. These literatures tend to view learning as fundamental to collaboration, where learning applies both to ecological understanding and institutional approaches, and where both are improved through ongoing experimentation, or "learning-by-doing" (Berkes, 2009). In collaborative river basin management, for example, social learning may help groups to "deal effectively with differences in perspective, to solve conflicts, to make and implement collective decisions, and to learn from experience" (Pahl-Wostl et al., 2007, p. 2). But others fault the "social learning" literature for lack of critical reflection.

Scholars have differently identified the factors that lead to social learning. In a study of collaborative wildlife management planning Schusler et al. (2003, p. 309) found that: "Eight process characteristics fostered social learning: open communication, diverse participation, unrestrained thinking, constructive conflict, democratic structure, multiple sources of knowledge, extended engagement, and facilitation." A study of participatory river basin management in Europe identified 71 factors that could aid or hinder social learning, grouped into eight themes: "the role of stakeholder involvement, politics and institutions, opportunities for interaction, motivation and skills of leaders and facilitators, openness and transparency, representativeness, framing and reframing, and adequate resources." (Mostert et al., 2007, p. 1). The study offers a mixed assessment of ten cases and concludes that social learning is promising approach but that the roles of power and political and institutional contexts demand more research.

Several reviews conclude that the concept of social learning still lacks the analytical heft to pinpoint "the factors that determine if, who, how, when and what type of learning actually occurs" (Armitage et al., 2008, p. 87; also, Muro & Jeffrey, 2008; Reed et al., 2010). Critics charge that the social learning literature may be overly optimistic about the ability, willingness, and capacity of participants to experiment and learn and overcome conflicting interests, economic differences, and education and status differences (Armitage et al., 2008; Muro & Jeffrey, 2008). Collaboration may favor industry groups over environmental interests with fewer resources and capacities to participate (Ansell & Gash, 2008). And social learning can pose livelihood risks, particularly for subsistence-based users, as they test or adapt to new practices (Armitage et al., 2008). Learning processes face challenges in overcoming very different knowledge systems, such as indigenous knowledge and Western science, and risk the unethical imposition of one knowledge system over another (Nadasdy, 2007; Weiss et al., 2012). Deeply embedded asymmetries may enable powerful actors to influence the learning process in ways that favor their own interests. For example, in a participatory planning process regarding community food and nutrition policies in upstate New York, the less powerful group members came to adopt the cognitions and concerns of the more powerful participants (McCullum et al., 2004; Pelletier et al., 1999). (However, the limited timeframe – just 2.5. days – of this participatory process likely impacted the capacity for social learning.)

Process dimensions can help determine whether collaborative forums exacerbate or mitigate power asymmetries among participants. These include the presence of a good facilitator, active inclusion of the full diversity of interests including the less powerful, a transparent process that ensures all participants' ability to speak and be heard by others, and the equalizing force of interdependence: the condition that no single actor or group can achieve a better outcome by exiting the process and pursuing their own interest (Ansell & Gash, 2008; Innes & Booher, 1999a).[1] Yet crafting rules of inclusion and interaction that minimize power differentials is exceedingly difficult (Ryfe, 2005).

Knowledge production and power

Although many authors – both critics and optimists – note power as an issue, the social learning literature has limited theoretical engagement with this important concept.[2] There is thus a clear need to better conceptualize the operation and significance of power asymmetries in collaborative social learning processes. This paper contributes to this task by engaging with various literatures on knowledge, power, and politics.

Literatures on collaboration and social learning often focus on technocratic knowledge as a key source of dominating power in environmental management. Technocratic knowledge derives legitimacy from the western belief that scientific knowledge reflects universal truth, abstracted from culture (Nader, 1996). The perceived neutrality of science obscures the ways that technocratic knowledge can, in fact, serve power. As the dominant basis of western natural resource management since the Progressive Era, technocratic knowledge in the form of expert or scientific management has indeed often impacted marginalized groups and the environment

[1] For example, in collaborative forums in the U.S., interdependence is often provided by the looming force of the Endangered Species Act, which threatens strict limitations on development absent broader consensus on how to achieve species protection.
[2] See Voß and Bornemann (2011) for an exception focused on applied adaptive management.

(Espeland, 1998; Scott, 1998). In contrast, many scholars argue that collaboration can produce knowledge through dialogue, role playing, story telling, and reframing; this knowledge is not universal and abstract but contextual, arising from a specific situation and the embodied experience of the observers (Hajer & Wagenaar, 2003; Innes & Booher, 1999b). Along these lines, many authors propose that collaborative learning can transcend power asymmetries by challenging technocratic knowledge; by reframing problems to reflect wider perspectives; and by inducing transformative learning, dramatic shifts in the ways that people understand a problem and their own relationship to it (Muro & Jeffrey, 2008).

These perspectives hold at least two problematic underlying assumptions. First, they assume that the better knowledge produced through social learning will lead seamlessly to changes in policy or action. This straightforward path between knowledge and policy rarely exists, particularly when policy disagreements reflect deep differences in interests and values. Powerful actors have deep incentives to sustain the conditions from which they benefit. Second, they tend to assume that power operates mostly externally in macro social structures, rather than being embedded in the micro-level interactions of actors in collaborative processes. From this view follows a notion that equal participation in collaborative forums is sufficient to overcome uneven power distributions (Pahl-Wostl et al., 2007).

Cultural and interpretive accounts point to a more nuanced view of power and the ways that it manifests in social learning forums. Foucault conceptualized power as “a disciplining force dispersed throughout society and implemented by many kinds of institutions” (Jasanoff, 2005, p. 14). In this view, power is everywhere: in the everyday instruments of social interaction that include discourses, cultural practices, scientific knowledge, and technologies. In modern societies, science and technology – how we understand and intervene in the world – are particularly central instruments of power and therefore sites of politics (Jasanoff, 2005). Thus collaborative forums, even when they guarantee equal participation, cannot exclude power from the room. Foucault’s work has been foundational to how many scholars understand power and knowledge. Critical policy analysts and scholars of Science & Technology Studies (S&TS), for example, assert that processes of knowledge-making are never politically neutral. Hajer (1995) adopts this view to conceptualize environmental conflicts as ongoing, discursive struggles to define the meaning of environmental problems. In his analysis, not learning but language, ideas, and discourses, such as “ecological modernization,” are the mechanisms of policy change and stability.

Scholars critique Foucault’s accounts of power, however, for failing to explain or even allow for social change: “If power is so entrenched and so hierarchical, replicates itself so freely and reinscribes itself so effectively, then where does the impetus for change come from, and why are old orders sometimes suddenly overthrown?” (2005, p. 36). Jasanoff and her colleagues are acutely concerned with the knowledge-power relationship and the implications for social change. They elaborate a co-production analytical framework to elucidate how social factors such as culture and power influence the development of new knowledge and technologies, which in turn reshape human societies and beliefs in an on-going cycle. Co-production draws attention to the roles of power and politics in shifting human beliefs and approaches to environmental management. In addressing the tension between stability and change, Jasanoff asks:

> Should power be seen as lodged in obdurate social structures which…constrain the production of potentially dissident knowledges; or is it fluid, immanent, and continually renegotiable, so that it can be captured or reformulated by inventive, upstart knowledge communities? (2005, p. 36)

These ideas resonate with findings about how deliberative governance may produce social change. A recent special issue on power and deliberative democracy in the journal of Policy and Society points to the importance of discursive practices in challenging dominant policy regimes and injecting new ideas, both inside and outside of the deliberative process itself (Dodge, 2009; Metze, 2009). This review also suggests that deliberative democracy operates with respect to multiple forms of power, including both power-over—i.e., coercive or dominating power—and power-with—i.e., a positive and creative energy that emerges from communal activity (Hendriks, 2009).

These insights about power provide new perspective on what happens in collaboration to inform social change. When decision-making takes place in deliberative forums, politics do not disappear but manifest in new ways, including in the micro discursive interactions of participants as they reframe problems and create alternatives to challenge dominant discourses (Hajer & Wagenaar, 2003; Metze, 2009). The hope "is that democracy might be enhanced not against or in spite of policy discourse, but through it" (Torgerson, 2003, p. 113). In addition, the co-production framework highlights the ways that, not just ideas, but also new material practices of environmental management, are socially embedded: they emerge in conversation with existing cultural understandings and relationships of power and politics.

Scale, power, and knowledge production

The embeddedness of collaboration within wider contexts that may derail it poses major challenges:

> This is especially true in the (many) cases that concern migratory resources and 'nested watersheds', which test the viability of 'community control' when both the causes and effects of environmental problems reach beyond local boundaries (Singleton, 2002, p. 54).

A useful concept for understating these contextual challenges is vertical power, which refers to the ability of marginal actors and organizations to access the levers of political power and to steer decision-making to favorable venues. A study of collaborative urban transportation policy found that, although collaboration may connect stakeholders horizontally, these members must also be able to exercise "vertical power" to truly shape decision-making (Weir et al., 2009). Transportation policy reform was more successful in Chicago, where the network linked reform advocates with powerful and politically connected economic interests, than in Los Angeles, where horizontal ties linked primarily weak actors and left them disconnected from the levers of power. The authors conclude: "No matter how inclusive and collaborative the networks…, they will produce little real change if not backed by vertical power" (Weir et al., 2009, p. 31).

Knowledge may also be a key component of this interface between collaborative governance and larger social, political, and biophysical scales. But different literatures suggest different theories to explain the underlying mechanisms and resulting influence of collaboratively produced knowledge. The process of knowledge production clearly transcends the collaborative forum itself: first, as participants draw on prior knowledge to understand and frame issues through deliberation, and second, as they attempt to use collaboratively produced knowledge in the outside world. To be useful in resolving environmental problems, knowledge must somehow gain legitimacy and traction within larger social and political contexts.

Sounding a pessimistic note, some authors point to the likelihood for conflict between collaboratively produced knowledge and dominant technocratic knowledge systems and the power relations they embed: "broader political contexts are…linked to specific epistemological cultures that define the kind of knowledge and procedures of knowledge production that are accepted to provide a relevant and valid basis for policy making" (Voß & Bornemann, 2011, p. 15). Similarly, Armitage (2008) identifies knowledge and its production as key contextual forces that shape regimes of local environmental control and management and tend to reinforce entrenched top-down approaches.[3] These politics of knowledge operate through social constructions of nature, narratives of policy and governance, and the valuation of "'science' and 'modernization' that have led to the marginalization of certain groups and the devaluation of local knowledge systems" (p. 19). They also operate via technologies of environmental management, such as dams and logging roads, inscribed physically and enduringly upon the landscape (Jasanoff, 2005). Privileging of technocratic knowledge and practices often serves to uphold existing relations of social inequality and environmental degradation.

In contrast, more optimistic views suggest the possibility that collaboratively produced knowledge can help solve joint problems and even create power. Berkes (2009), for example, views co-management as a "knowledge partnership," where social learning is an essential task in joint problem solving.[4] Although a challenge in practice, co-management can bridge participant knowledges derived from different scales, experiences, and sources, such as local knowledge and science. Through an iterative process, "learning networks" integrate lessons from experience and gain the capacity to address problems at increasingly larger scales. Similarly, communicative planning theorists argue that collaboration can produce "network power:" "a shared ability of linked agents to alter their environment in ways advantageous to these agents individually and collectively" (Booher & Innes, 2002, p. 225). These authors also advance a concept of "collaborative rationality" to describe the knowledge produced through collaboration and to identify its sources of power and democratic legitimacy, particularly as collaborative knowledge challenges dominant technocratic orders (Innes & Booher, 2010).

[3] The other key contextual forces are: "power, scale and levels of organization," "the positioning of social actors" and "the dialectic relationship among ecological systems and social change" (Armitage, 2008, p. 7).

[4] Co-management is a form of collaboration with explicit sharing of power and authority between a local community and the state.

Collaborative knowledge can challenge even deeply embedded, dominant epistemological cultures. To explain how, Innes and Booher (2010) draw on ideas, developed by Bryson and Crosby (1993), about the multi-dimensionality of power in contemporary public policy making. Bryson and Crosby argue that – unlike formal decision-making arenas and courts – interactive and collaborative forums derive power from the ability to create meaning: "What forums do is to link speakers and audiences through discussion, debate, and deliberation.... Forums distribute and redistribute access to the creation and communication of meaning, and thereby help to maintain or change symbolic orders and modes of discourse" (1993, p. 181). The power of collaborative forums thus derives from the ability to direct public and policy-maker attentions, shape the terms of a policy debate, and alter collective understanding of a problem or issue. Through these capacities, collaboration can gain a measure of power in larger policy arenas: "Collaborative dialogues, while not being deterministic or authoritative, do have the capacity to establish agendas for decision makers, norms, priorities and new shared meanings and even language for discussion of issues" (Innes & Booher, 2010, p. 110).

Key points for a theory of power and social learning

While most scholars view social learning as an essential task in resolving shared environmental problems, there exist multiple perspectives on the relationships between collaborative social learning, power, and policy change. The more optimistic view is that new knowledge can integrate the perspectives of multiple participants in ways that minimize power imbalances and can generate more equitable policy outcomes. Learning networks can address issues at increasingly wider scales by improving understanding of the social-ecological systems, and network power and shared knowledge can help create policy change at wider scales. More pessimistic views cite the many ways that power can undermine collaborative processes even when social learning is present. These include the potential that: powerful interests will shape knowledge production in ways that support their own desired outcomes; engrained technocratic knowledge systems will resist change by devaluing collaborative knowledge; and collaborative processes will lack the necessary "vertical power" to effect broader policy change.

For both optimists and pessimists, an important function of collaboration is the creation of new understandings or framings of environmental problems. In terms of scale, new knowledge can travel beyond the confines of collaborative forums and shape how actor-groups in larger social and political contexts notice, understand, and address environmental issues. But this process of knowledge creation, and subsequent policy change based on it, is neither straightforward nor objective. New knowledge derived in social settings (or any setting, for that matter) is not merely objective scientific truth, and policy change based on it is rarely neutral. Rather, new knowledge is co-produced with changes in societal beliefs and institutions, and this co-production process is not shaped simply by scientific advancement, but also by culture and power and the strategic needs of different actors to advance their interests. Thus the process of knowledge production is never removed from social or political context.

This review makes clear that social learning and its importance to environmental governance cannot be understood absent contextualization of these processes within larger social, political, and biophysical processes. The Feather River case offers a unique opportunity for such a contextualized reading of knowledge production in collaborative governance. The CRM experiment in collaboration began in 1985 and continues to this day, and has been influential both locally and in wider conversations about California water supply policy. Moreover, headwaters management and restoration touches on multiple issues with high political stakes in California, including water supply, hydropower, and national forest management.

CASE STUDY: THE SOCIALLY EMBEDDED EVOLUTION OF HEADWATERS RESTORATION TECHNIQUES

The Feather River CRM, a multi-agency, community-led collaborative watershed restoration effort in the Upper Feather River watershed, was the first to use the pond and plug technique in California. Today, this restoration technique has been applied in this watershed more than anywhere else in the world, and the CRM has become well-known for its expertise in using it (Plumas National Forest, 2010). The CRM began as an effort to address erosion from meadow gullies using conventional stream channel restoration techniques. Learning from their efforts, the group eventually adopted pond and plug for its utility as a more comprehensive floodplain-based restoration approach. Although biophysical conditions played a key role in the embrace of pond and plug, this evolution was also socially embedded.

In the following account, I use a longitudinal case study approach to show how this evolution occurred and to highlight the significance for our understanding of social learning in collaborative governance processes. I first provide relevant social and biophysical context, then show how pond and plug emerged through social learning to address a particular shared problem in the watershed. I proceed to show how pond and plug became a vehicle through which upstream residents could articulate a challenge to powerful downstream actor-groups. Finally, I discuss how pond and plug continues to embody conflicts over environmental risks, uncertainties, trade-offs, and community livelihoods and identities. I conclude by proposing wider insights about the politics of social learning in collaborative processes.

The Feather River watershed as the unique setting for pond and plug

Biophysically, the Feather River watershed's extensive and characteristically gullied meadow valleys make it a prime site for restoration via pond and plug. Most target meadows are located on the watershed's "east side," which constitutes about two-thirds of the watershed's land area (Ecosystem Sciences Foundation, 2005, p. 2-1). Unusual for the Sierra Nevada, the east side contains an extensive system of large, relatively flat meadows that owe their existence to the region's unique geology, which reflects a confluence of several mountain ranges. Alluvial origins increase these meadows' vulnerability to gullying and erosion but also enable healthy meadows to store large quantities of water in meadow aquifers. Treatment with pond and plug replaces the gully with a series of ponds and plugs that slow the flow of surface water through the meadow, encourage infiltration of water into the meadow aquifer, and "rewater" the meadow by raising the water table to the surface elevation.

Most of the gullies were initiated between 1880-1940 through resource extraction practices including grazing, mining, logging, agriculture, and road and railroad construction (Ecosystem Sciences Foundation, 2005; Plumas National Forest, 2010). Overgrazing was likely the key driver at most sites. Settlers used meadows extensively for ranching and dairying, usages that often entailed both overgrazing and draining to increase accessibility for livestock. Farmers also drained meadows to grow crops. Construction of railroad grades and, later, roads to access timber – the region's economic mainstay for most of the 20th century – also impacted meadows, which provided a relatively easy site for construction of transportation infrastructure but were highly vulnerable to resulting soil compaction and stream channelization. Meadow streams had evolved to accommodate relatively placid flows, accessing broader floodplains when necessary to buffer high precipitation and runoff events. But with new practices came degradation of meadows and diversion of streamflows, intentionally or not, to artificial channels such as roads, drainage ditches, cattle trails, or trenches (made, for example, in the process of constructing a railroad grade or levee). Such practices often initiated a process of stream channelization, loss of floodplain access and anchoring riparian vegetation, and gullying. When flows are concentrated in-channel, particularly during high-runoff events, they increase in velocity and stress the channel banks. Scouring of the banks and bed by the churning water soon creates a headcut – a rapid drop in channel elevation. As scouring continues, the headcut propagates upstream, growing a gully along with it. Localized beaver extinction due to the early 19th century fur trade likely exacerbated these hydrological changes.

Today, typical meadow gullies are 3-10 feet deep, although some are 12 feet deep or more (Plumas National Forest, 2010). Channel incision has lowered subsurface water tables, causing ecosystem conversion from wetland meadows to xeric sagebrush plains, which produce less forage for grazing cattle and wildlife (Ecosystem Sciences Foundation, 2005). With minimal riparian shading and groundwater connectivity, water warms rapidly as it flows through the gullies. Gullies continue to erode, and gullied meadows are less able to filter sediment loads from upstream weathering, as would non-degraded meadows. These changes produce sedimentation and elevated temperatures that pose water quality problems for downstream habitats and reservoirs. Finally, the disconnection of the stream channel from the meadow aquifer and the more rapid movement of water through the incised, straightened gully alter the stream's annual hydrograph, the timing and amount of runoff that occurs through the year. The specific nature of these stream flow and hydrograph alterations, and how they are in turn changed by restoration, is a key point of scientific uncertainty and controversy regarding the pond and plug technique.

The gullied meadows are uniquely suited to large-scale restoration projects that, supporters argue, have potential benefits for downstream water supply, timing of flows, and hydropower production. As described in previous chapters, the Feather River headwaters are a key source of California's water and hydropower supplies. The watershed is the source for the State Water Project (SWP), which provides some 25 million Californians with a portion of their drinking water and irrigates 750,000 acres of farmland, mostly in the southern San Joaquin Valley (California Department of Water Resources, 2014a). All runoff from the watershed is captured at Oroville Dam, where three hydropower plants with a combined generating capacity of 762 megawatts produce power to transport the SWP water throughout California. The SWP is the "largest single power consumer in the state and the fourth largest energy producer" (California Energy Commission, 2013). Upstream, PG&E generates hydropower in the highly engineered canyon of the North Fork, dubbed the "Stairway of Power," with 671 megawatts of generating capacity. Together, these SWP and PG&E facilities provide 10% of California's in-state hydropower production capacity.[5] Facilities owned by the South Feather Water and Power Agency provide an additional 117 megawatts of capacity in the South Fork (Federal Energy Regulatory Commission, 2009).

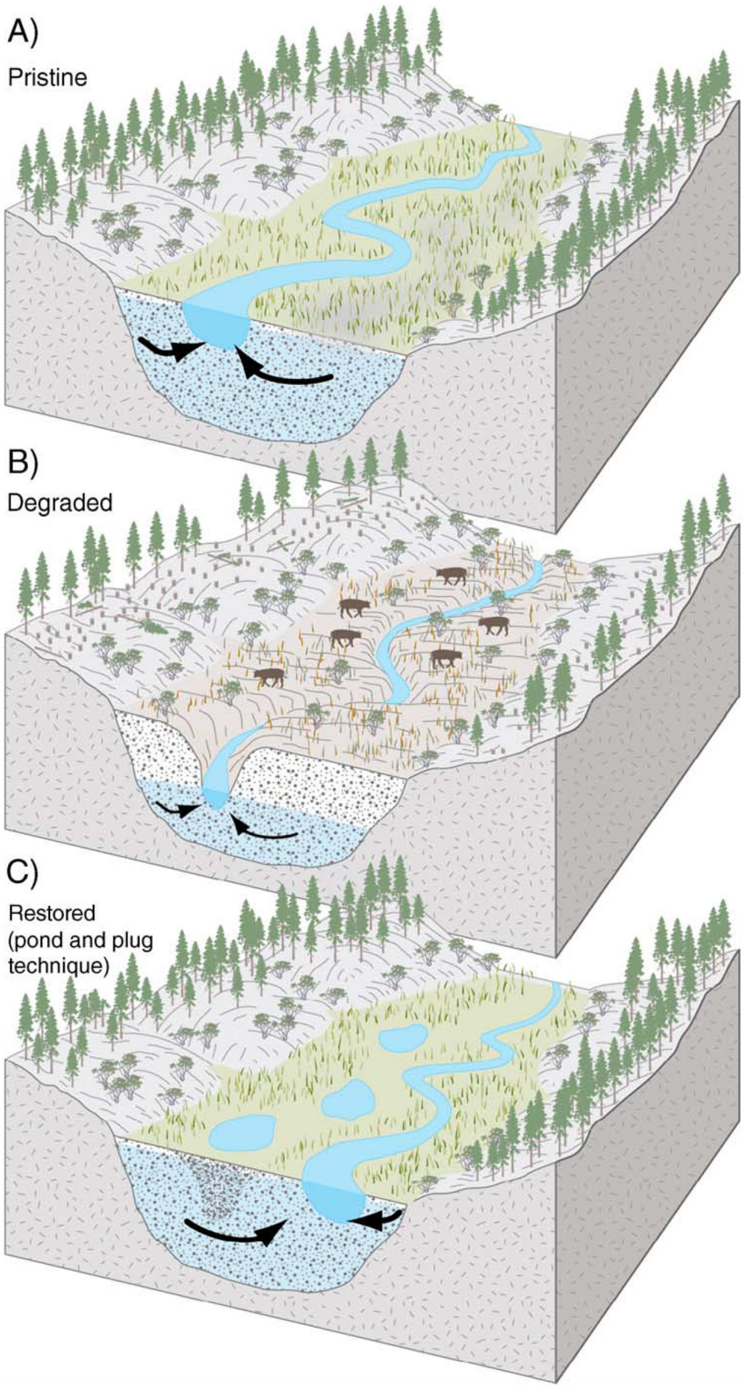
Within this context, pond and plug emerged as a technique for restoring meadow floodplains by eliminating deep gully channels that had lowered meadow water tables and accelerated erosion (Figure 4-1). Specifically, hydrologists replace the meadow gully with a series of ponds and plugs. The plugs, which may be likened to porous earthen dams, are formed from alluvial materials excavated from the meadow. After being constructed across the gully channel, the plugs are planted with meadow vegetation. Once constructed, they slow the flow of water through the meadow, raising the water level to the meadow grade and encouraging water to saturate the meadow soil and groundwater table. As the water table rises, the excavated holes fill with water and become ponds. The ecosystem changes rapidly as wet meadow flora return to the meadow surface, replacing sagebrush and other upland species more suited to the xeric conditions created by the gullies. Pond and plug enables large-scale floodplain restoration projects: the largest project completed to date addressed a nine-mile long section of Upper Last Chance Creek. The on-site benefits for erosion reduction and riparian and meadow vegetation, including for livestock forage, are clear. However, the ecological and hydrological changes brought about by this technique have turned out to be more complex, and controversial, than the CRM members first believed.

The CRM as a collaborative, learning organization

A collaborative, community-led organization, the Feather River CRM has been the main force behind watershed and meadow restoration since 1985. Early projects focused on in-channel techniques to control erosion, primarily from the East Branch tributaries, which was causing a build up of sediment in PG&E's downstream hydropower reservoirs. Within ten years, the group began to pursue a geomorphic approach using the pond and plug technique. A geomorphic approach treats the channel and floodplain simultaneously, reconnecting the channel to the floodplain where possible, and thereby addresses a broader suite of goals. The CRM has earned regional, state, and national commendation for its pioneering work applying the pond and plug restoration approach to headwaters meadows. Through this work, the CRM tailored pond and plug and its other projects to the biophysical and social conditions of the Feather River region and the diverse needs of many stakeholders. The CRM's long-term, community-led, multi-agency collaborative approach supplied democratic legitimacy that likely helped to make the relatively rapid adoption and wide deployment of pond and plug possible, particularly since many people perceive this technique as a fairly radical intervention.

[5] This figure is calculated from documents filed with the Federal Energy Relicensing Commission (FERC) for relicensing of hydropower facilities. See Chapter 2 for more details on these calculations.

Figure 4-1. Conceptual model of hydrological changes in a Sierra Nevada wet meadow, from pristine (i.e., pre-European), to degraded, to restored using pond and plug. A) The pristine meadow contains a meandering, shallow channel, shallow water table, and vegetation adapted to mesic (relatively moist) conditions. B) Land use practices cause stream channel incision and gully formation, groundwater levels drop, and the meadow shifts to xeric conditions with sagebrush scrub vegetation. C) Restoration replaces the gully with a series of ponds and plugs, groundwater levels rise, mesic conditions and meadow vegetation return, and surface water flow shifts to a remnant (natural, pre-gully) channel. Figure is from Booth and Loheide (2013) and is reproduced here according to the terms of the Creative Commons License for http://serc.carleton.edu/.



The CRM originated and continues to operate as a collaborative organization that brings together multiple stakeholders in the watershed, providing a way to pool resources and expertise and to develop a shared vision for watershed restoration and stewardship. There were 13 signatories to the 1987 Memorandum of Agreement that established the effort. Today, the CRM comprises 25 partner organizations, including relevant local, state, and federal agencies, several NGOs, and PG&E (Table 4-1). Though established under the auspices of the federal Coordinated Resource Management and Planning framework, the group elected to drop "planning" from its name to emphasize its focus on action, and it is became known as the Feather River CRM (pronounced "crim"). Although the group's jurisdiction is the entire Upper Feather River watershed above Lake Oroville (excluding the West Branch), it has been most active along the East Branch, a tributary to the North Fork that drains much of the east side.[6] Erosion issues on the East Branch's tributary streams catalyzed the group's creation and focused its mission. The East Branch accounts for about half of the drainage area of the North Fork, which is the largest of the Feather River's three main forks and drains 60% of the total watershed (Ecosystem Sciences Foundation, 2005). The CRM has also been active in the Middle Fork basin, which accounts for 32% of the watershed.

Table 4-1. **Feather River CRM Partners** (as of March 12, 2014).
California Department of Conservation
California Department of Fish and Game
California Department of Forestry and Fire Protection
California Department of Parks and Recreation
California Department of Transportation
California Department of Water Resources
California Regional Water Quality Control Board
Farm Services Agency, U.S. Department of Agriculture
Feather River College
Feather River Resource Conservation District
Natural Resource Conservation Service
North Cal-Neva Resource Conservation and Development District
Pacific Gas & Electric Company
Plumas Audubon
Plumas Corporation
Plumas County
Plumas County Community Development Commission
Plumas National Forest, U.S. Forest Service, U.S. Department of Agriculture
Plumas Unified School District
Salmonid Restoration Federation
Sierra Valley Resource Conservation District
Trout Unlimited
University of California Cooperative Extension
U.S. Army Corps of Engineers
U.S. Fish & Wildlife Service

[6] Only a smattering of CRM projects, none pond and plug, have occurred in the North Fork basin outside of the East Branch, or in the South Fork basin.

The initial organizers sought a neutral location for the group, separate from any of the member agencies and any existing conflicts with one another. Consequently, the CRM was housed under the Plumas Corporation, a private, non-profit, 501(c)(3) economic development organization in Plumas County. In practice, the CRM has operated fairly autonomously from the Plumas Corporation. CRM signatory members make decisions through a process laid out in the organization's governance structure. A small core group carries out much of the planning and project work, in particular the CRM's five full-time employees. This structure has evolved over the years to adjust to changing institutional needs and stakeholder concerns, and it continues to evolve. CRM structure, membership, and mission are currently being renegotiated among a wider group of stakeholders in the wake of controversies over downstream flow effects of pond and plug projects and potential impacts to downstream irrigators in the watershed.

Observers have applauded the CRM for its unique ability to implement projects on the ground, a capacity lacking in many collaborative efforts. Indeed, one of the main criticisms of collaborative environmental governance is a preponderance of time and energy spent on planning, with few on-the-ground projects or results. By contrast:

> Over the last 26 years the CRM has implemented a total of 118 projects. Of this total, 68 projects have been on-the-ground restoration, 13 studies/strategies, 19 planning/coordination projects, and 18 education projects. On-the-ground projects have treated approximately 47 miles of stream, directly restoring approximately 4,100 acres of meadow/floodplain and riparian habitat within the Feather River watershed (Feather River CRM, 2012a, p. 4).

The CRM's 25 pond and plug projects since 1985 account for 2871 of these restored acres and 26.5 of channel miles treated (70% and 56.5%, respectively). Other techniques include rock vanes or weirs, channel or bank reconstruction, rock dams, headcut or inset step pools, fish ladders, riffle augmentation, bank stabilization, vegetative stabilization, tailings stabilization, channel structure, headcut treatment, sediment traps, and woody debris dams (Feather River CRM, 2011). About half of CRM projects have occurred on private lands, and the other half on public lands managed by the U.S. Forest Service.

The CRM has been widely recognized as a successful example of collaboration. This success derives from how the group effectively convened the various parties with fragmented jurisdictional responsibility in the watershed, pooled resources to achieve a greater impact, provided a forum for local involvement that cultivated community and landowner support, and engaged in an ongoing collective learning process that added multiple perspectives and learned on a project-by-project basis (Chang, 2002). Chang (2002) evaluated the institutional evolution of the CRM as a collaborative learning organization, particularly how the CRM overcame bureaucratic fragmentation in the watershed. He concluded that collective learning enabled the group to build a foundation of shared understanding of the problem and possible solutions; this foundation in turn helped the group anticipate each others' concerns and needs, streamline project design and deliberation processes, secure joint commitments, and pursue technological innovation that would have been difficult within the confines of the individual bureaucracies.

But the significance of new restoration methods pioneered by the CRM goes far beyond technical innovation. Building on Chang's insights and my own fieldwork, in the following sections I elaborate a more contextualized account of the specific technical evolution of CRM restoration methods to show how collective learning also emerged from the region's history, politics, and lopsided relations of resource management and control. Without this contextualization, collective learning appears as a relatively straightforward path from problem, to joint learning, to better solutions, i.e., technical innovation. By contrast, a contextualized account reveals how collective learning is also shaped by the strategic needs of actors within their social and political context.

Learning from experience: toward a floodplain approach to restoration
Erosion and resulting downstream sediment pollution drove the CRM's founding in 1985 and provided its initial focus. Sediments produced from eroding meadow gullies, primarily in the East Branch, were filling downstream PG&E reservoirs on the main stem of the North Fork, causing significant operations problems. Internally, PG&E managers debated what to do: "While many managers within PG&E favored a $7 million reservoir dredging project…, a handful advocated an upper watershed management approach to address the problem at its source" (Chang, 2002, p. 13). Thus PG&E began meeting with state and federal agencies in the upper watershed in 1984 to discuss the potential for upstream erosion control (Clifton, 1994). Meanwhile, landowners including ranchers and the Forest Service were alarmed about erosion occurring on their lands, and community leaders saw an opportunity to create jobs through an erosion control program. A County Supervisor convened the concerned parties at a meeting at his kitchen table in the spring of 1985, a significant moment in CRM lore that speaks to the group's grassroots origins. An informant vividly describes the founding impetus: "We don't want to lose our land, PG&E doesn't want to catch it. So that was sort of the genesis of the initial effort was to find ways to work collaboratively to solve this huge problem."

The group initiated a study of erosion and sediment production in the East Branch watershed and found that the East Branch was producing about 940,000 tons of sediment each year, mostly from a few particularly problematic subwatersheds. The main sources of erosion were streambank erosion (55%) and erosion from road cut/fill slopes (43%); about 90% of erosion was human-induced through land use practices. (USDA Soil Conservation Service, 1989). The group also undertook a pilot project at an eroding East Branch site. This project, the Red Clover Creek Demonstration Project, employed conventional restoration techniques of the time: four in-channel check dams, constructed with imported rock, and revegetation with willows and grasses. The check dams, designed to catch sediments and gradually raise the channel elevation, successfully halted erosion here, and the CRM went on to use them at several subsequent sites. But through these projects, the CRM found that the check dams were expensive to install, required regular maintenance, presented barriers to fish migration, and were quite slow to address the underlying hydrological impairment of the meadows.

Thus restoration techniques evolved as the group conducted more projects, observed the effects, and adjusted their strategies. At first, the CRM concentrated its efforts within the incised gullies using traditional channel design, meander reconstruction, and grade control structures like check dams. But group members soon perceived the limits of this approach. Whereas in a non-degraded system, the water surface would be at the same elevation (i.e., “grade”) as the meadow surface, the CRM was working down in the gully and not addressing the larger meadow/floodplain system. A CRM document explains the limitations of traditional techniques for addressing headcuts in the Feather River’s sensitive alluvial meadows (Feather River CRM, Year Unknown):

> There are many "standard" headcut treatments in use today, such as check dams, or sloping the face and laying in fabric and rock. These and similar treatments date back to the 1930's in the Feather River watershed….Some of these treatments are still evident and functioning. However, the vast majority were unsuccessful in halting this persistent and pernicious process [of headcutting]. These failures were not attributable to 'weak' structures, but because they do not address the underlying hydraulic discontinuity between the static hydraulic elevation of the entrenched gully and the higher hydraulic elevation above the headcut.

Similarly, following the 1990-1993 construction of the Wolf Creek project in Greenville, where the group built meanders into the channel to try to slow the flow of water and halt erosion:

> Right off the bat we began to notice that…everything was under an awful lot of stress. You could see it out here, in high water. Even in the normal high water, there was a lot of energy being exerted against everything we were doing. And so it just didn’t feel right. And we were addressing the erosion issue - we could see that - but not much else.

Because post-project streamflows remained concentrated in an incised gully, without access to the floodplain, even moderate flows continued to place high stress on the channel banks. In March 1995, flooding from a winter storm destroyed a section of the Wolf Creek meanders, triggering a large erosional event that buried the bottom of the project (Feather River CRM, 1996).

This project became an important learning opportunity that moved the group toward adopting a geomorphic, floodplain-based approach. Before the failure, the CRM got a bird’s eye view of the aftermath of the Wolf Creek project: “It was an aerial [photo] right after we’d finished work, and here was this down cut channel in the middle of Greenville, and it showed the whole town, and it was like the light went off [an aha moment]: wow, this was all floodplain at one time, made by the river…. We’d lost 90% of the floodplain.” Moreover, the down cut channel, where the group had constructed meanders and built rock weirs, was not the original (remnant) channel: “Here’s the old remnant channel over here. High and dry, half bisected by the railroad, but you could see it. And then here’s this little dinky floodplain [within the incised channel] that we have to work with now.... Wow, ok, here we are trying to stabilize an artificial system in an artificial setting…. Well, you know, it’s actually pretty limited.”

The group also learned to become more attuned to the particularities of the specific reaches they were working on. According to another member:

> …we didn't recognize at the time [that projects] could be built with different reach dynamics, different flexion points at the stream. It really showed you have to be a lot more sensitive and careful about the geometries and dimensions in what you're working with and put it in context again. You know, we did this [specific] reach, and if we looked more upstream and downstream, we'd have seen a different context than what we saw in the reach. Everyone is focused on keeping this house from falling in the creek and that created a pretty narrow focus. And a little broader focus would have given us a better project.

When the Forest Service approached the CRM about restoring Big Flat Meadow in the early 1990s, the group realized it had a chance to utilize these insights by trying a new geomorphic approach: "Taking [the stream channel] out of the gully and taking putting it back on top of the meadow, and reconnecting it with its…naturally evolved, full floodplain." This approach would have broader implications for the system, marking an important evolution and broadening of the CRM's goals:

> And so, wow, just think of all the erosion controls. Not only are we stopping it at the source; [the floodplain will] filter sediment from the upper watershed. And we're likely to store water and have higher base flow. And we're likely to have colder water. As well as fish habitat, and just think of the ducks that are going to move in. And it just kind of snowballed from there…. It was an evolution of the group's focus. And still erosion control was important. But it was an evolution in how we address that focus and as we better understood what really happened in this watershed.

With this broader set of goals in mind, the CRM built its first pond and plug project – and the very first in California – at Big Flat Meadow in 1995. The project design moved Cottonwood Creek from a down cut channel into a new channel that the group constructed on top of the 47-acre meadow, and it used pond and plug to convert the abandoned gully into a series of small ponds. Like at Wolf Creek, the CRM learned from their post-project monitoring, which revealed that because the constructed channel was too deep, it was preventing full re-watering of the meadow and was also exhibiting erosion and gullying (Plumas National Forest, 2010). Nine years later, the group fixed the problem by raising the channel bed, allowing high surface flows to access the floodplain. This experience convinced the CRM that pond and plug projects should utilize remnant channels whenever possible, rather than constructing new ones. When a remnant channel remains on the landscape (and they often do), it can usually resume its old function with little intervention when the gully is removed.

The CRM has gone on to conduct 25 pond and plug projects in the watershed, an extremely impressive track record. The CRM had a unique opportunity to adopt this floodplain approach, owing to its geographical location high in a sparsely populated watershed with relatively little floodplain development. But given that thousands of meadows in California's Sierras and Cascades are similarly undeveloped, this historic-floodplain approach is potentially broad, and the idea has spread beyond the watershed. Excited by the ecological and hydrological benefits of pond and plug, many conservation groups and observers in state and federal agencies applaud the CRM for this work. The CRM's work also helped to inspire a broader Sierra Nevada Meadow Restoration initiative started in 2009 by the National Fish and Wildlife Foundation, which aims to award $10-15 million in grant funding to protect and restore meadows Sierra-wide (National Fish and Wildlife Foundation, 2010).

The pond and plug technique also gained traction within the watershed through the CRM's community-based roots and efforts to foster positive relationships with landowners. The CRM has worked with ranchers to ensure continued use of treated meadows for forage production and grazing, today the most common use of these lands.[7] Grazing livestock in restored areas is not a simple endeavor. While increased soil moisture brings about lush forage growth, it also increases soils' susceptibility to compaction under the hooves of grazing animals. Grazing thus requires elaborate fencing and animal rotation schemes, which are expensive in terms of materials and work time. Landowners (on private lands) and permittees (on public lands) normally contribute to project expenses for fencing materials. Ranchers here, as across the West, are typically land-rich but cash-poor; they operate on the margins of profitability, and their willingness to invest time and money speaks to their high regard for CRM projects and the resulting benefits for forage production and erosion control. The group's community-based origins and relationships also have tended to invite landowners' trust, which is sometimes lacking for the Forest Service. Neighboring landowners, after seeing the results of CRM projects on their neighbors' and friends' properties, often request CRM assistance on their own lands. However, not all of the watershed's landowners are supportive; a group of Indian Valley ranchers, in particular, have reported disruptions to their water supplies and have recently challenged upstream projects. These tensions are discussed later in the chapter.

The emergence of pond and plug as a socially embedded process

Evolution of the CRM's approach and understanding of meadow restoration was also grounded in the social context of the watershed. In particular, economic shifts have influenced upper watershed actors' interests in and advocacy for meadow restoration. PG&E was the first to propose upstream erosion control in the mid-1980's, as a way to solve its sedimentation problems; but Plumas County leaders – seeing an opportunity for economic development and job creation in the declining natural resources sector – quickly jumped on board. It is no accident that the CRM is housed in the Plumas Corporation, whose mission is county economic development. This goal provides an important backdrop upon which approaches to watershed restoration have evolved through the years, as the CRM, in cooperation with county leaders, has strategically positioned itself to attract restoration funding amidst a changing funding landscape. Thus pond and plug has been a key strategy not only because of its biophysical results, but also because of the ways that it could help the county economically. Moreover, through pond and plug, the headwaters community also articulates a challenge to long-standing relationships of resource control, relationships that many watershed residents believe favor large-scale resource extractors and perpetuate community economic insecurity.

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[7] Because of the destructive legacy of overgrazing of the West's arid landscapes, some environmentalists advocate the end of grazing on public lands. But such a policy would have far-reaching impacts on ranchers and ranching communities (ranchers with private landholdings often depend on access to grazing allotments on public lands).

As detailed in Chapter 3, the Feather River has since the 19th century been a site of profitable resource development that has tended to direct wealth to far-off cities, most notably San Francisco, rather than within the watershed (Brechin, 2006; Teisch, 1999). Meanwhile, watershed residents have experienced high rates of unemployment and economic insecurity, fostering in some residents' a sense that the pattern of exporting the watershed's wealth is unfair. A decline in timber industry jobs since the late 1960s has exacerbated the feeling of economic vulnerability and the sense that outsiders control the region's fate. This decline was hastened by new environmental regulations and legal battles that reduced harvests from national forest lands and by changes in the timber industry, including consolidation and the loss of milling jobs due to automation and residual overcapacity (London, 2001).

The Feather River watershed is nearly contiguous with Plumas County, which in recent decades has seen high rates of unemployment and out-migration. The county's population declined by 3.9% between 2000 and 2010, with an additional estimated 3.0% decline from 2010-2012 (U.S. Census Bureau, 2013). Interviewees attribute these losses to high unemployment, as job seekers leave to find work elsewhere, particularly since the 2007 recession.[8] Plumas County's unemployment rate has been consistently higher than California's average for the past two decades (Figure 4-2). Median household income between 2007 and 2011 was just $44,151 in Plumas County compared to $61,632 for California overall. However, the county's overall poverty rate of 13.5% is slightly lower than California's 14.4% rate, and is also lower than most of the other rural counties in Northern California, although pockets of much higher poverty exist within the county (U.S. Census Bureau, 2013). This relatively high standard of living likely owes to an influx of retirees from other parts of the state.

As of 2011, the four highest employment industries were government (especially local), retail trade, services, and construction, consistent with an economy that is increasingly geared toward retirees and tourism. Since data became available in 1969, employment in the natural resource sector – farming, mining, forestry, fishing, and related activities (but not including Forest Service employment) – has fluctuated, declining overall from 5.9% in 1969 to 3.5% in 2009 (Figure 4-3). Manufacturing jobs – which in Plumas County are primarily lumber mill jobs – have declined even more steeply, from 19.5% in 1969 to just 6% in 2009, reflecting lumber mill closures and automation. Despite the region's identity as a logging and ranching community, employment in these industries today is relatively low as a percentage of overall employment.[9]

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[8] Age distribution data support this idea: "Since 1990, the number of people between the ages of 50-59 increased 74 percent, while those between 30-39 decreased 50 percent, causing a 31 percent decrease among children between 0-9. This may indicate that the number of jobs for those between 30-39 has declined, while people looking towards retirement are migrating into the area" (Center for Economic Development, 2010, p. 7).

[9] However, it is notable that two timber companies – Collins Pine and Sierra Pacific Industries – remain among the county's largest employers (Center for Economic Development, 2010).

Figure 4-2. Average annual unemployment in California and Plumas County. (Data are from the State of California Employment Development Department, accessed May 22, 2013, at http://www.labormarketinfo.edd.ca.gov.)

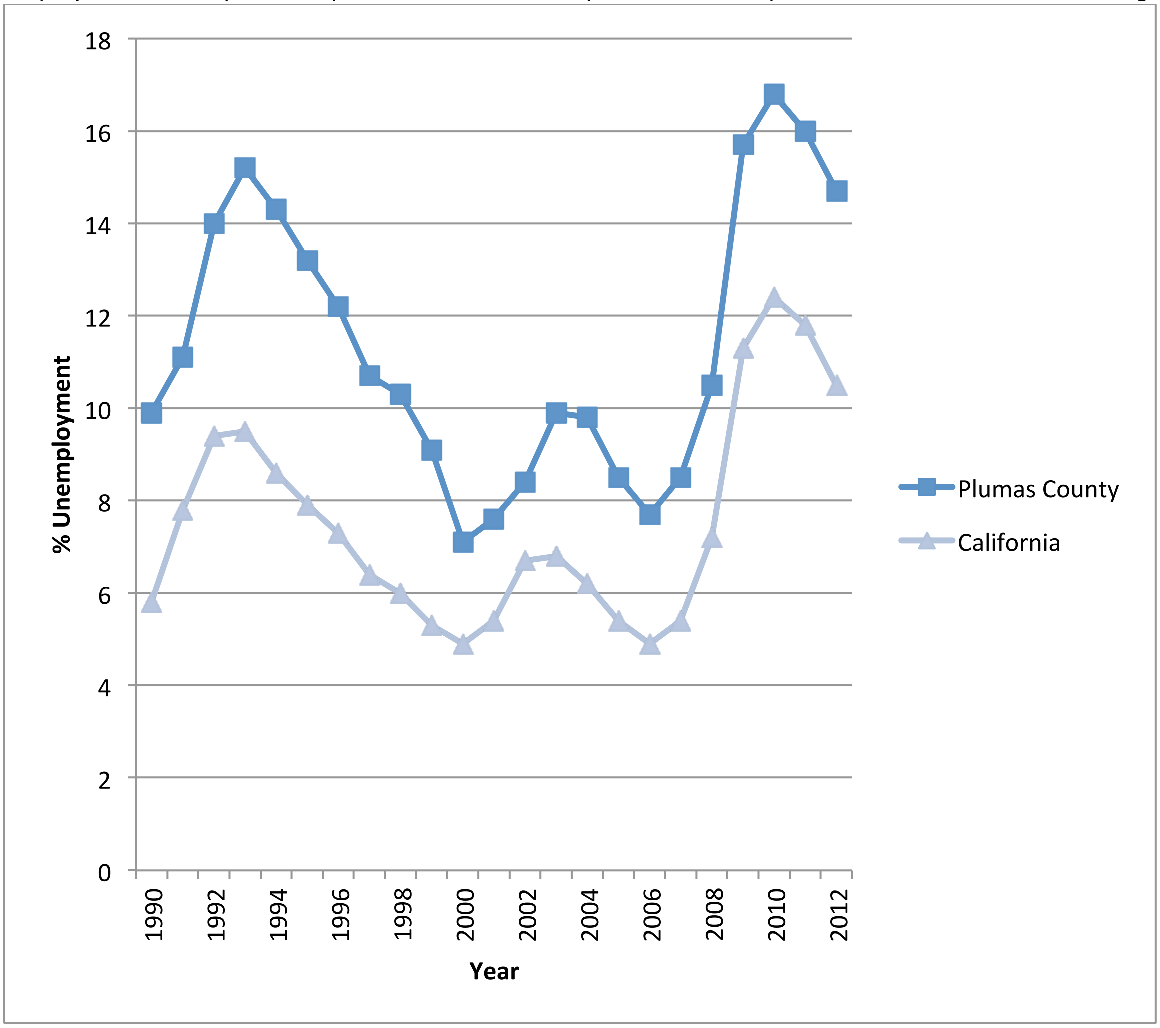
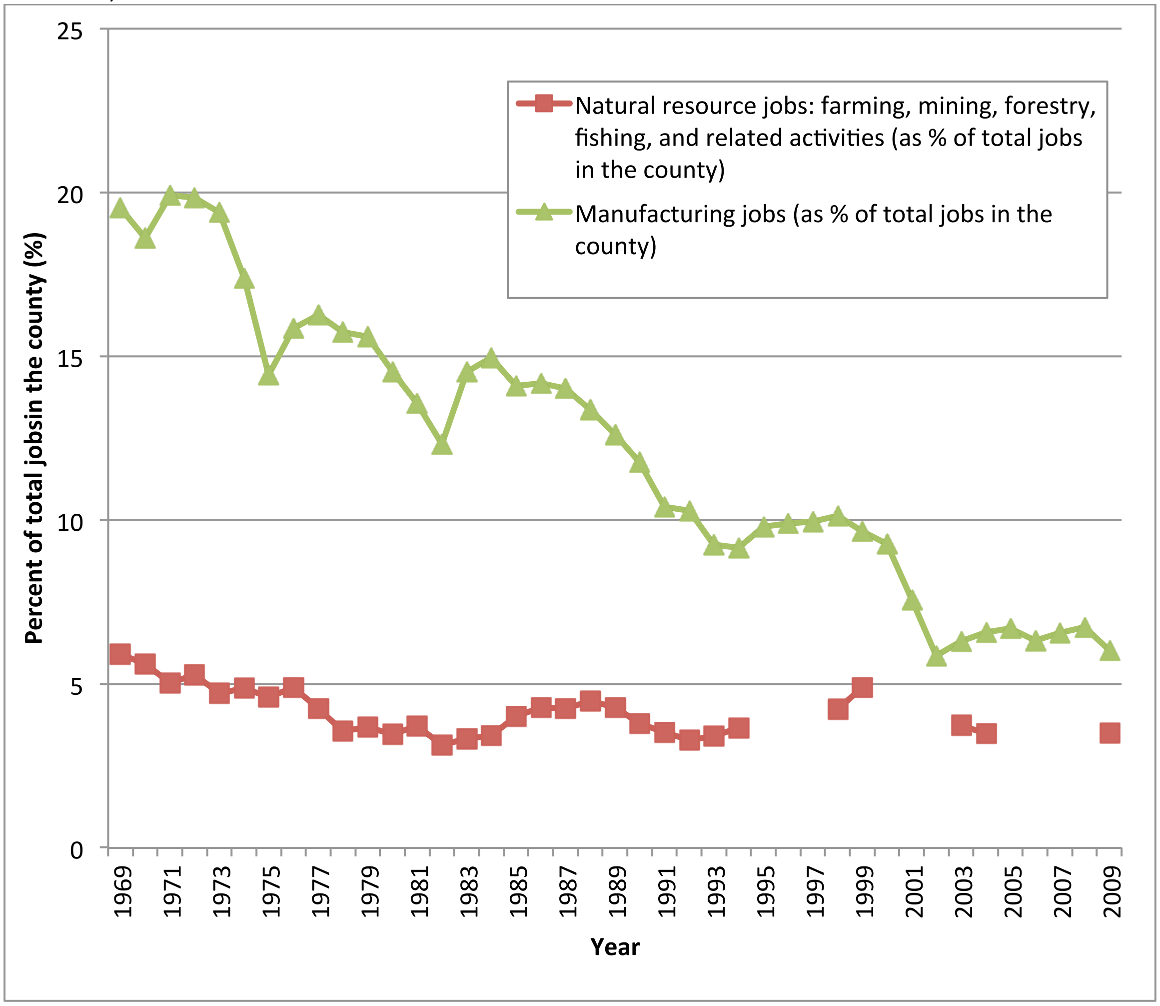


Figure 4-3. Employment in the natural resources and manufacturing industries relative to total employment in Plumas County. (Data are from U.S. Department of Commerce, Bureau of Economic Analysis, accessed May 22, 2013, at http://www.bea.gov/. Gaps are years for which the Bureau did not report data due to confidentiality concerns.)



Community leaders have pursued watershed restoration as an economic development strategy within both this larger economic context and in response to more specific shifts in availability of restoration funds. Key shifts in restoration funding sources and strategies occurred in the mid to late 1990s, around the time that the CRM was building its first pond and plug project at Big Flat Meadow and monitoring the results. Due to PG&E's interest in erosion control upstream of its hydropower reservoirs, the company had provided the initial funding to launch the CRM effort and had been a very active early member. Through the mid to late 1990's, PG&E subsequently withdrew most of its financial support and participation for several reasons. First, it developed a cheaper solution to the sedimentation problem: flushing sediments downstream through its turbines (Chang, 2002). Second, the 1996 deregulation of California's energy markets "fueled pressures to increase short term economic efficiency" and led PG&E to consider selling off its Feather River facilities (Chang, 2002, p. 81). These developments further discouraged PG&E's investment in the long-term watershed restoration effort. A third factor was the retirement of a key PG&E engineer who had championed the watershed restoration approach against the skepticism of some colleagues.

The capacity of key government funding sources to meet CRM needs was also decreasing. Stagnating funding levels for the Clean Water Act's 319 program for nonpoint source pollution – an important early source of CRM funding – were by the mid 1990s insufficient to meet the CRM's growing needs. Also in the mid-1990s, two other important funders, the U.S. Forest Service and the California Department of Fish and Game, suffered budget cuts that forced them to reduce their support. For the Forest Service, these cuts resulted in a downsizing process that reduced local staff time for working on CRM projects, including doing the required environmental analyses. Remaining Fish and Game funds were focused on salmon and thus not applicable in the upper Feather River watershed, which had lost its salmon with the construction of Lake Oroville.

However, new state funding sources were also coming on line, particularly a series of state bond measures for water-related projects that included ecosystem restoration goals. The first of these was Proposition 204, passed by voters in 1996. In 2000, the CRM was awarded a Proposition 204 grant through CALFED for $980,000 to restore a nine-mile segment of the upper Last Chance Creek watershed using pond and plug (Plumas Corporation, 2004). The CRM has also won grant funding through the four subsequent, and increasingly larger, state water bonds (Table 4-2). These water bonds were not written with the express goal of funding headwaters restoration. Nonetheless, the CRM was able to successfully pursue these funding sources in part because of the lobbying efforts of Plumas County Supervisors and allies in the legal world.

Table 4-2. **California bond measures that have funded watershed restoration projects.**			
Proposition	**Ballot Title**	**Year**	**Amount**
204	Safe, Clean, Reliable Water Supply Act	1996	$995 million
13	Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Bond Act	2000	$1.97 billion
40	Clean Water, Clean Air, Safe Neighborhood Parks, and Coastal Protection Act	2002	$2.6 billion
50	Water Quality, Supply and Safe Drinking Water Projects Act	2002	$3.4 billion
84	Water Quality, Safety and Supply. Flood Control. Natural Resource Protection. Park Improvements. Bonds. Initiative Statute.	2006	$5.4 billion

A growing recognition of the value of Sierra-derived water accompanied these changes in funding sources. In 1996, a comprehensive economic assessment of the Sierra Nevada, undertaken as part of the Sierra Nevada Ecosystem Project, revealed the immense profitability of Sierra-derived water for California. The assessment calculated that water then accounted for an astounding 60% of the total $2.2 trillion in natural resource related revenues produced annually from the Sierra Nevada. Most of the value of water was derived from hydropower, followed by water supply and recreation. Moreover, according to the report, the Feather River watershed alone generated an annual average of $143 million in hydropower profit, the highest of any Sierra watershed.[10] Equally concerning for the headwaters community, only "Around 2% of all resource values [were] captured and reinvested into the ecosystem or local communities through taxation or revenue sharing arrangements. The declining status of some aspects of the Sierra Nevada ecosystem suggests that this level of reinvestment is insufficient to ensure sustainable utilization of the ecosystem" (Stewart, 1996, p. 2). This arrangement – the flow of profits derived from watershed resources to outsiders while communities suffered from economic insecurity – also struck many in the headwaters community as deeply unfair.

Within this changing funding landscape, the CRM, county supervisors, and other allies began to make new arguments about how and why to restore headwaters meadows and to appeal to new venues for support. This group of actors – whom I call the headwaters coalition – began to argue that, in addition to water quality and habitat improvements, meadows restored with pond and plug have clear downstream benefits for California's water supply. That is, acting like sponges, restored meadows absorb spring runoff and release it during the dry summer months, thus tempering the peaks and valleys in the Sierra Nevada's increasingly flashy hydrograph, alleviating downstream flood risks, enabling more hydropower production on downstream reaches, and relieving stress on downstream water storage reservoirs. Due to flood management requirements, California's reservoirs cannot capture all of the Sierra's winter and spring runoff, so delaying runoff to later in the dry season would, in theory, create more usable water supply. This framing, and the efforts of the broader headwaters coalition, aided the CRM in securing new funding sources including state, federal, and foundation grants. The CRM benefited in particular from grants awarded by the State to the Feather River IRWMP program, which serves as an umbrella effort for multiple watershed management efforts in the region.

[10] This number is an annual average based on data for the years 1970-1994.

However, future availability of these grants, which were funded through voter approved state water bonds, is uncertain, and the headwaters coalition has sought a more permanent, stable funding source.[11] The 1996 Stewart report, in particular, became a key reference for the headwaters coalition, which began to reframe watershed management in relation to downstream water supply benefits and to advocate for policy changes that would require the entities that profit from Feather River water – namely, PG&E and the State Water Contractors – to “reinvest” in the watershed. For example, drawing on newly popular notions of ecosystems as “natural capital”, Wills and Grey (2001, p. 398) argued that “beneficiaries” of ecosystem goods and services such as water ought to “invest a fair share of their economic gains for ecosystem restoration and maintenance.”

Armed with the Stewart report, the headwaters coalition could articulate a compelling – even intuitive – new logic for the upstream-downstream relationship. But if enacted in policy it would in fact mark a substantial, even radical, change in the relationship. This is because it would set a precedent of downstream responsibility for headwaters and an obligation to pay for a resource that has always been free.[12] In this way, though initially a product of collaborative social learning that included downstream beneficiaries and particularly PG&E, pond and plug morphed into a vehicle of political challenge: by the upstream community to downstream beneficiaries of the water, of the restoration projects, and of the historical status quo. Downstream beneficiaries have retained the upper hand, successfully resisting pressure to reinvest in the watershed, primarily by invoking scientific uncertainties about the downstream benefits of meadow restoration. The following chapter explores these negotiations between upstream and downstream, and their outcomes, in more detail.

In summary, the loss of PG&E and government agency funding sources, coupled with new evidence of the economic value of Sierra-derived water and new water-related grant programs, prompted the CRM to reframe the significance of its meadow restoration work to attract new funding sources. This strategic shift was also part of a larger effort by headwaters actors, particularly at the county level, to highlight the role of the watershed in producing California’s water. Through this effort, county leaders pushed for policies more favorable to the watershed and its residents, which they perceived had long suffered from unfair arrangements that allocated outsiders with control of the region’s resources and access to the financial wealth produced by those resources.

[11] Headwaters actors are skeptical that California voters will approve yet another water bond measure, given public concern about government debt. The CRM and the Feather IRWMP effort at times had trouble accessing even promised funding following the 2007 economic downturn and California’s subsequent budget problems.

[12] PG&E and the State Water Contractors have financed the engineering infrastructure for the Stairway of Power and the State Water Project, but have not had to purchase the water itself. They have also financed many improvement projects within the “footprints” of their reservoirs, but have not been required to address the larger watershed

Upper watershed controversies: Uncertainties, risks, and community identities
Pond and plug is controversial within the upper watershed for multiple reasons. Most people agree that restored systems demonstrate striking benefits: more biodiversity, biomass production (i.e., for livestock and wildlife forage), reduced erosion, and water quality improvements. But critics invoke uncertainties and tradeoffs including the large scale of ecological disturbance, potential habitat impacts, long-term project durability, and stream flow alterations in immediate downstream reaches, to argue against wide scale application of the technique.[13] These contests are grounded in more than just dispute of scientific facts: they are also proxies for political contests over the watershed and its resources, as well as cultural contests over the community's identity and future.

One set of tensions comprises the effects of pond and plug on native and non-native species habitats. Despite their degraded state, unrestored systems do support fish and wildlife. Project construction is a dramatic intervention during which workers use heavy machinery such as excavators and loaders to obliterate gullies. This process includes excavating large holes that will become ponds, using the excavated material to construct plugs across the gully, and transplanting vegetation from the gully bottom to anchor the new plugs. Among watershed residents, there is both concern about short-term ecological disturbance from construction and about long-term habitat changes for trout, including the potential for impairment of fish migration and increased competition (Knadler, 2012). Gully obliteration can also reduce habitat for the bank swallow, a state-listed species, which has taken up residence in some gully walls in the watershed.

By all accounts, the projects do create habitat for many desired species – songbirds, waterfowl, mammals, and plants. But they also create habitat for non-native species, in particular the bullfrog, a highly invasive species that preys on sensitive native frogs. Bullfrog populations can thrive in restored sites (although the CRM argues that they are unlikely to migrate into restored sites if not already present). In addition, seeds and spores of invasive weeds can enter project sites on construction machinery, and once there can rapidly colonize soils disturbed during construction. These concerns reflect different risk tolerance regarding invasive species as well as tensions over what should be considered "natural" in these systems. For example, one Forest Service critic, although appreciative of the project's benefits to wildlife and waterfowl, expresses concerns that the constructed ponds are not "natural" features of the watershed. Concerned about both bullfrog habitat and the potential for evapotranspiration and elevation of surface water temperatures, he prefers more conservative restoration approaches such in-channel meander reconstruction or placing trees and boulders to slow erosion and flow velocities. He suggests that, although historic beaver activity likely created ponds similar to the ones that result from pond and plug, those would have been less durable, more temporary

[13] These disagreements about water supply are largely separate from concerns about water supply further downstream, in the North Fork canyon, Lake Oroville, and the Sacramento-San Joaquin Delta.

landscape features.[14] The following exchange reveals this employee's preference for letting "natural" processes run their course:

> Interviewee: Also beavers do a great job of making their own little pond and plug. Obviously its not very well engineered although they are pretty adept at it.
> Author: If a beaver comes in and builds a dam and a pond, does it get some of the same bullfrog and invasive species?
> Interviewee: Potentially, yeah. It's not as permanent though. Eventually those dams do wash out and it returns to more of just a natural river habitat, versus ponds on the landscape.

A second set of critiques involves the pace of change and the potential vulnerability of the pond and plug projects to failure, or "blowout," under high flow events. The CRM can cover many miles of stream in a single project. Working at this scale strikes some concerned observers as risky. One informant summarized the debate and the different risk tolerances of the CRM and some of the Forest Service hydrologists:

> The success of the projects hinges on just a few geographic spots that you can point to. So if those blow out, everything else will follow….So there's a lot of concern among some [Forest Service] hydrologists….They have a different philosophy for what really needs to be done as far as: go slowly, start at the top, work your way down, go slowly. Put something in, see how it reacts, what needs to be changed in order to get the outcome. And then keep moving down that way, kind of at that pace. So there seem to be two different philosophies between hydrologists about how much is acceptable, how much, how fast.

To date, there has only been one instance of a total pond and plug project failure in the watershed, at a site called Willow Creek; the CRM attributes this failure to site characteristics that undermined multiple restoration attempts.[15] Red Clover Poco, a site treated in summer 2010, underwent major damage during the following wet season. Initial flood flows stressed a plug that had not been constructed according to design, and a headcut propagated upstream during sustained flood flows in the early spring, damaging 16 more plugs. According to the

[14] There is strong evidence that beaver were native to the high Sierra and would have historically built dams and therefore ponds in these areas. But intense trapping in the 1820s and 1830s apparently induced local extinction and perpetuated the popular belief that beaver are not locally native.

[15] According to one CRM member, this project, at Willow Creek, was known to be risky from the beginning. The site is on Forest Service land, and the agency approached the CRM about a pond and plug approach after other attempts to halt heavy erosion from a 20-foot gully and multiple headcuts in the meadow had failed. With a 3-7% grade, the meadow was steeper than typical for a pond and plug, which means higher water velocities and therefore greater stresses on the system. As with most pond and plug sites in the watershed, the decomposed granite substrate at Willow Creek is relatively unstable. This instability complicates the critical step of anchoring the project at the bottom end, which slows the water's elevational drop from the restored site to the immediate downstream reach and prevents development of a new headcut. Anchoring is achieved with a "valley grade" structure; at Willow Creek, this structure failed, due to both design and siting problems (Plumas National Forest, 2010). The CRM no longer uses this particular valley grade design. The project, the CRM's second pond and plug, was built in October 1996 and failed just three months later during a major January 1997 flood. Projects strengthen over time as vegetation becomes established and anchors the plugs and valley grade structures, and the flood event may also have happened too soon for this to occur.

CRM, "This one project sustained more damage than all previous projects combined" (Plumas Corporation, 2013, p. 19). As of 2014, just 27 of 380 total plugs the CRM has constructed in the watershed have required repairs.

Larger conflicts over expertise and legitimacy in the field of river restoration also infuse debates over how pond and plug is used here. The CRM's evolution toward pond and plug was influenced by a relationship with Dave Rosgen, a well known but controversial hydrologist.[16] While some experts applaud Rosgen's approaches, others cite failures of Rosgen meander reconstruction projects to argue that his approaches are over simplistic and potentially dangerous (Woelfle-Erskine, 2008; Zaffos, 2003). Some academic geomorphologists also regard pond and plug as a heavy handed treatment that might not address the underlying drivers of system degradation. Most of these critiques have receded as the CRM has proved largely successful using the pond and plug technique, if not winning the approbation of key critics at least quieting their disapproval and generating a more wait-and-see attitude.

Critiques about invasive species, surface water warming, what is "natural" for the watershed, and the proper pace, scale, and approach to restoration reflect both scientific uncertainties and, unavoidably, different notions of appropriate risks and trade-offs. Restoring nature is a messy, unpredictable job, and these trade-offs are real and tangible. On a visit to one restored meadow, for example, I saw bullfrog tadpoles and beaver sharing the very same pond. The Forest Service is far more risk adverse than the CRM, owing at least in part to its entrenchment in litigious conflicts over forest management. The Forest Supervisor for the Plumas National Forest recently asked for a moratorium on large-scale pond and plug projects on its lands, citing the need for more monitoring and knowledge of ecological effects (Feather River CRM, 2012b).

But different employees express different risk tolerances, and there is disagreement about pond and plug within the agency. While acknowledging the technique's usefulness and appropriateness in some cases, one interviewee complained that the CRM sometimes seems like a "one-trick pony" for its focus on pond and plug over other approaches. Another said of pond and plug: "Sometimes I just get the feeling that it's the blanket treatment and it kind of just gets implemented without regard for other disciplines a lot of times." Multiple Forest Service employees suggested that slower restoration approaches – for example placing grade control structures within the stream channel to gradually raise the elevation of the stream – would reduce risks and allow for more careful study of the technique's effects. These employees view risk as a reason to diversify approaches and move more slowly. On the other

[16] The CRM brought Rosgen to the watershed for a week long, intensive training course, an experience that CRM members, who came from different organizations and with varying backgrounds in stream restoration, cite as an important transformation in helping the group develop a common language and philosophy about watersheds and restoration. He provided advice on early CRM projects including Wolf Creek, and the CRM decision to implement their first pond and plug at Big Flat was informed by Rosgen's concurrent experimentation with the technique in Nevada. "Beginning in 1990, Rosgen was frequently involved with the group as a project designer and a trainer of local resource professionals in geomorphic restoration techniques and classification system use" (Benoit & Wilcox, 1997).

hand, other employees said that the pond and plug projects provide such an immense improvement that they are work the risk:

> Personally, I LOVE the work that the CRM does. I think it's a great answer because everywhere they are working the creeks are in terrible conditions. It's like, [pond and plug isn't making it] any worse. There are some questions about [whether the projects] might weather really big storm events. Well even if it all blows out and goes to hell it's not going to be any worse than it was before a project, honestly.

Concern about blowout is also entangled with contentious, complex forest management politics. Invoking the threat of blowout provides ammunition to advocates of forest thinning against persistent environmentalist opposition to thinning projects implemented by the agency under the community-derived Herger-Feinstein Quincy Library Group (QLG) Act. These advocates argue that thinning reduces the threat and severity of fire and thereby reduces the risk that fire-induced debris flows will destroy downstream pond and plug treatments. While CRM members and other headwaters advocates share the QLG's support for forest thinning and frustration with the environmental appeals, they resent claims that their projects are vulnerable to blowout.

The CRM's efforts, symbolically if not materially, in some ways challenge the community's long and deeply held logging identity. Some local residents who are vested in the community's logging identity bristle at suggestions of a declining timber economy, and are hesitant to embrace the CRM's alternative conception of the region's importance as a source of water rather than wood. They express concern that focusing too much on the water benefits of watershed restoration will detract from momentum to thin forests to reduce fire risks. These sentiments are entangled with resentment toward the Forest Service for its regulatory and legal gridlock on thinning projects. In contrast, some watershed residents, both CRM members and others, suggest that the QLG was misguided in aligning at the outset with Sierra Pacific Industries, a controversial logging company. While both the CRM and the timber community value watershed health, their visions of what this is and how to achieve it are rooted in different notions of the community's identity and future.

In practice, the small population of the Feather River watershed means that membership in these different groups overlaps significantly, and an overall shift to a water stewardship framing is taking place as different actors realize its strategic value. Both the meadows and the forests are important for hydrologic functioning, and both need restoration attention. In terms of framing how that work should be done and why, the water argument is increasingly visible, even among core QLG members, who increasingly argue that forest thinning also produces water supply benefits. Local, regional, and national Forest Service leaders also increasingly emphasize the water-production values (and associated management techniques) of national forests. This framing also reflects the need to conform to a changing policy landscape at the state level, where guiding documents like the California Water Plan (influenced in part by the successes of meadow restoration in the Feather River watershed) increasingly consider the connections between upstream and downstream.

Conflicts and uncertainties about stream flow effects

The most crucial point of controversy regards the effects of pond and plug on the timing and quantity of downstream flows. As the pond and plug technique became more widespread in the watershed, some downstream landowners became concerned that the projects reduced water supply in reaches they used for irrigation and ranching. Even small changes in surface water availability, particularly during the late summer dry season, can impact irrigation. In 2012, simmering tensions between the CRM and these downstream ranchers boiled to the surface. Although the parties are seeking to resolve these issues, tensions continue to run high and have delayed or halted implementation of some projects. This conflict has the potential to reduce, or even end, future pond and plug projects in the watershed.

As the bulk of my fieldwork was completed in 2009-2010, prior to the main conflicts, and as resolution remains a work in progress, my dissertation does not detail these conflicts or how they are reshaping restoration efforts in the watershed. Here, I summarize the existing state of knowledge and discuss some implications for collaboration and social learning in this case. Efforts to better understand the hydrological effects of pond and plug were already underway but accelerated in light of the ranchers' concerns. New knowledge coming to light makes clear that the relationship between pond and plug and downstream flow effects is more complicated than previously believed, particularly with respect to late summer flows. To summarize the current knowledge, this section draws both on the cited studies below and on a 2013 review of these and other studies and monitoring data on the effects of restoration on stream flows in the Feather River watershed (Hoffman et al., 2013).[17]

When the CRM began using pond and plug, it was a brand new technique, and there were no studies of its downstream hydrological effects. CRM observations of early restored sites and a later study of a site outside the watershed showed that, during the main wet season (winter and early spring), projects dampened flood peaks and created longer and more frequent floodplain inundation during precipitation and runoff events. These changes are due to decreased channel capacity, increased groundwater storage capacity, and the connection of the channel and floodplain (Hammersmark et al., 2008). Monitoring of the first project at Big Flat Meadow found increased storage in meadow aquifers in winter and early spring (and therefore reduced runoff), with augmented runoff in both the late wet season (late spring and early summer) and the late summer (Lindquist & Wilcox, 2000). A 2005 model of the Last Chance Creek restoration project (Kavvas et al., 2005) and a study of a project in an adjacent watershed (Tague et al., 2008) also found increased late season flows. While findings about changes in flooding and runoff during the wet season have held up, understandings of late season (i.e., summer) stream flow effects have changed.

Reviewing existing studies and monitoring data from the Feather River watershed, Hoffman et al. (2013, p. iii) conclude: "In retrospect, it appears that it was mistakenly assumed that the increase in spring flows would extend late into the season and increase baseflow at all project

[17] Two Forest Service managers and a consultant authored the review, and multiple CRM and agency personnel reviewed or contributed to it.

sites." Late season flows are of the most concern to downstream irrigators and are also "the most difficult hydrologic change to assess, due to their low magnitude, annual variations in precipitation, variation in ET [evapotranspiration], and the uncertain nature of meadow-groundwater interactions" (Hoffman et al., 2013, p. 12). There are very high measurement uncertainties associated with stream flow data, particularly at low magnitudes. Site variability and uncertainties about groundwater flows in meadow aquifers and interactions with bedrock aquifers complicate understanding of these dynamics. Yet another complexity derives from the fact that it may take several years or even decades for the floodplain aquifer of a restored meadow to be filled to capacity, and measurements taken in the meantime may not reflect the long-term equilibrium.

Hammersmark et al. (2008) analyzed both surface and groundwater dynamics at a site restored using pond and plug in the Fall River watershed in Northern California. In addition to an overall 1-2% decrease in annual flows from the meadow, the authors found reductions in baseflows (i.e., late summer channel flows) due to increased evapotranspiration and to changes in how water moved through the meadow. Specifically, the higher channel elevations of restored sites received less inflow from the meadow aquifer and induced more water to move through the meadow as groundwater. This water appears to resurface downstream via groundwater flow paths: "Increased baseflow levels occurred downstream of the restored reach" (Hammersmark et al., 2008, p. 747).

Similarly, in the Feather River watershed, statistical analysis of 11 years of continuous streamflow data on two main tributaries to the East Branch North Fork found no differences between pre- and post-project late season flows 8 and 6 miles downstream of large-scale pond and plug treatments, despite stream flow reductions detected at the restoration sites (Cawley, 2011; Hoffman et al., 2013). These gauges are well upstream of irrigation diversions. As in the Fall River case, it appears that restoration may have shifted surface flows to groundwater flows, which then resurfaced farther downstream. Finally, the analysis concluded that annual variation in stream flow was associated mainly with precipitation and snowmelt patterns rather than restoration projects.

Climate change effects, combined with high annual precipitation variability in California, further complicate detection and explanation of stream flow trends. Because of its relatively low elevation, the Feather River watershed is particularly vulnerable to climate change. Analyzing runoff data for the East Branch North Fork Feather River since 1950, Freeman (2010) found a long-term increase in March runoff and a decline in spring runoff (from April-June). He attributes these shifts to climate change effects, specifically earlier snowmelt and a shift in wet season precipitation from snowfall to rainfall. July-September flows have also declined, although at lower magnitudes. Finally, total annual stream flows have declined by 23%, possibly due to increased evapotranspiration caused by the longer growing season.

Given these many uncertainties, a Forest Service briefing paper on pond and plug concludes:

> More monitoring and investigation is necessary to better predict the effects of evapotranspiration and meadow storage of water in relation to stream flow

> timing. Flow timing effects will vary from project to project, depending upon several site-specific attributes. Flow timing effects due to pond-and-plug could represent a benefit or impact, depending upon the season and the beneficial use identified (Plumas National Forest, 2010, p. 12)

Hoffman et al. (2013) further stress the importance of site variability: variations in site geology, project design, and watershed characteristics mean that the effects of restoration on flows will vary.

The parties are currently attempting to work together to resolve these uncertainties and pursue restoration in ways that are amenable to everyone. However, the conflicts are not purely factual, either; swirling below the surface are the currents of competing belief systems and visions of the watershed's future. The concerned landowners tend toward a conservative worldview that prioritizes private property rights and is suspicious of both environmentalists and government; the CRM and its allies, by contrast, tend to adopt more environmentally oriented worldviews and more moderate or left-leaning political stances. Finally, it's worthwhile to note that, beyond political differences, these tensions also reveal the practical difficulties of representing all interests in the watershed via collaboration. The water supply concerns surfaced only after pond and plug had become widely used. Ranchers allege that the CRM has enjoyed too much autonomy and has ignored the growing concerns of the ranchers, who have had difficulty accessing decision-making processes regarding the use of pond and plug in the watershed. How the actors involved address and resolve these issues, and the ultimate effect on headwaters restoration, will represent a fascinating next chapter in the story of collaboration and social learning in the watershed.

Discussion

In the headwaters of the Feather River, a collaborative effort initially facilitated shared learning about watershed erosion and how restoration of degraded meadows could address the problem. This story reveals pond and plug as a product of social learning in a successful collaborative environmental governance effort. Yet the long-term story is more complicated and has lessons to offer about the ways that learning processes are also socially embedded. As the technique evolved, upstream residents gained new perspective on the relationship between upstream and downstream and the larger hydrological, historical, and economic significance of meadow restoration. In time, and motivated by the need to attract new funding sources, they began to draw on pond and plug and its capacity to address downstream water supply issues to articulate a political challenge to the downstream beneficiaries of the water resources. In this way, collaborative restoration served as a platform for advocacy effort with political goals. In particular, pond and plug has helped the upstream community challenge the rights of powerful downstream actors to profit freely from Feather River water, with minimal obligation to the watershed that serves as the basis of this wealth. It also has helped the upstream community challenge the invisibility of the headwaters in California water policy and thus attract government resources – which ultimately derive from taxpayers, including water users – to aid in restoration work that supports community economic development.

As pond and plug gained traction in the county, it also sparked a range of controversies that reveal this product of "social learning" as, in fact, a vehicle for multiple social conflicts in the upper watershed. These include different values regarding the risks and trade-offs of environmental restoration, different visions of the community's future, and struggles over the legitimacy and credibility of different actors. Only some of these conflicts comprise scientific questions that ongoing studies and monitoring may addresses. Many emerged only as pond and plug became more established in the watershed, attracting the attention of actors, particularly ranchers, who were often not involved or represented in the initial CRM effort. These conflicts are ongoing, and the CRM is currently working to resolve the most contentious issues with the ranchers. If they succeed, this conflict and its resolution may in the long term be read as part of an ongoing narrative of successful social learning and collaborative governance in the watershed. This remains to be seen.

There are several implications for our understanding of social learning in collaborative processes. First, knowledge is socially embedded in that it emerges not only from multiple perspectives on the issues at hand, but also from the real need of stakeholders to make political claims about resources and resource management. Social learning takes place within dynamic historical and social contexts that influence what knowledge is actually produced and legitimized. Moreover, although it is easy to fault the powerful for attempting to exert undue influence on collaborative processes and their creation of new knowledge, all actors have strategic interests. In this case, the adoption and proliferation of pond and plug meets not the needs of the more powerful downstream hydropower producers and water retailers, but rather of the upstream community that is attempting to challenge their control over watershed wealth. Pond and plug gave this headwaters community a powerful way to reframe their relationship to downstream. Moreover, owning this knowledge, making it their own, also gained them recognition in California policy circles and wider national forums that increased their credibility and legitimacy to intervene in and speak for nature. This supports the notion that collaboration and learning can produce a new kind of "network power" for the group and its members, but also shows that this "network power" is not equally shared: in fact, it may work to the advantage of some group members against the interests of others.

Second, and relatedly, knowledge is contingent and mutable. It is contingent in the sense that its production lacks a straightforward path toward "true" or "correct" knowledge; many outcomes are possible. One could argue that knowledge derived collaboratively reflects a more consensus-based, wider "truth" than technocratic ways of knowing. This truth might challenge sources of dominating power and prove more conducive to social justice or environmental sustainability. Yet this knowledge is also contingent: it grows from the culturally and politically embedded ways that people perceive and interact with the world. The group's experience with surface flow effects – and the late recognition that initial hypotheses about restoration effects were too simplistic – reflects this contingency. While the group is currently undergoing a course correction to address the issue, this experience shows how knowledge production takes uneven and socially embedded paths, and moreover these paths have social consequences.

Relatedly, knowledge is mutable. Once it exists in the world, knowledge can be taken up, transformed, and used by actors in various ways, to advance particular interests. In this way, knowledge produced collaboratively to suit the particular needs of a particular situation may be used in entirely different ways, and toward entirely different ends, as that knowledge travels in the world. This was true of pond and plug, which began as an effort to reduce upstream erosion into downstream reservoirs and became a way for the headwaters community to recast the relationship between upstream and downstream. Acknowledging the socially contingent, mutable, and political nature of knowledge, I have come to prefer the term “knowledge making” or “knowledge production” over “social learning,” which implies a more straightforward path toward “true” understanding.

Third, these findings suggest that knowledge making in collaborative forums of environmental governance can, under some conditions, heighten or create political conflicts between stakeholders, rather than resolve them. Theories of social learning typically assume that more shared knowledge opens up paths to agreement. But collaborative knowledge can also induce conflict. In this case, pond and plug posed a threat (whether real or perceived) to established ranching livelihoods in the watershed and also to the ability of downstream entities to profit freely from Feather River water without obligation to the watershed. Pond and plug reflects a more integrated social-ecological epistemology of water supply that runs contrary to dominant, engineering approaches based primarily on an epistemology of nature control. As I’ll discuss in this next chapter, this challenge has enjoyed some success in reframing the conversation about water policy and headwaters in the state.

Fourth, these findings suggest that current work on social learning may be constrained by a narrow definition of collaborative governance and by short timeframes of analysis. Contemporary mistrust for government has precipitated a diverse and messy range of institutional arrangements, not all of which conform to strict criteria of collaboration elaborated in the literature. For example, Innes and Booher (2010) emphasize that, to be collaborative, a decision-making process must meet three key criteria: interdependence, authentic dialogue, and representative diversity of interests. Yet, driven by normative preferences for citizen engagement and distrust of government-led approaches, new spaces of governance take a variety of forms ranging from “true” collaboration to looser efforts at coordination and public participation. It is important to understand the full political ramifications of this trend. Moreover, conditions can change over time, as they did in the Feather River case. The effort started as a collaborative effort to deal with the erosion problem, and the parties were interdependent in their interests and need to solve the problem together. However, that changed when PG&E devised a technical means to deal with the sedimentation problem that no longer required cooperation with other stakeholders. Thus this case also points to the need for better typologies of the multiple new institutional arrangements for governing the environment, and investigations of the significance of these diverse arrangements for social and environmental outcomes.

Fifth, regarding the capacity of social learning in collaboration to bring about better approaches to environmental management, this case offers a mixed assessment. Social learning did advance a new understanding of the system, the causes of erosion, and how to address it. But far from minimizing power asymmetries, this process in fact highlighted them, clarifying for the upstream community the need to pursue their interests in opposition to the downstream actors who began as part of the collaborative. The knowledge created through this process – the technical approach to restoring meadows via pond and plug – did gain traction and legitimacy within the watershed and mobilized state support; the technique has been implemented elsewhere (often with CRM help) and helped inspire wider policy changes and restoration efforts. The upstream community has in some ways successfully achieved "vertical power," strategically accessing the levers of power to advocate these changes, specifically by using County Supervisors and other officials to lobby in wider policy efforts and to exert challenges through other means, including legal. And this knowledge has helped initiate policy changes that direct needed attention to the headwaters. But the degree of change in terms of the institutional and political relations of natural resource control, and access to the wealth generated by the watershed, is small, if any: funds for headwaters management come increasingly from the state, but not from downstream beneficiaries. And the attention attracted to the headwaters may not be all positive, as some upstream stakeholders view their interests in opposition to pond and plug, and this technique has generated new conflict within the watershed community.

Despite this mixed assessment, I wish to make clear that I do not seek to cast doubt on the value of social learning processes for addressing complex and contentious environmental problems. The interconnected, dynamic, and uncertain nature of environmental problems demands collaboration, learning, and participation by a wider range of stakeholders. Yet the hope for more democratic ways of governing has sometimes eclipsed academic attention to the very real challenges of deliberation and learning, including the new ways that they manifest conflicts rooted in uneven power distributions. The Feather River case reveals a complex, multi-faceted relationship between collaboration, knowledge production, and political change. Normative accounts of such processes fall short when they fail to acknowledge the social embeddedness of these processes, the ways they can support diverse political ends, and the possibility of failure. Yet pessimistic accounts may also understate the capacity of the less powerful to use these forums to their advantage, and, ultimately, the potential for these efforts to induce positive changes.

Chapter 5. Upstream water, downstream wealth: The politics of reinvestment in the Feather River watershed

> *Water in the capitalist state has no intrinsic value, no integrity that must be respected. Water is no longer valued as a divinely appointed means for survival, for producing and reproducing human life, as it was in local subsistence communities. Nor is water an awe-inspiring, animistic ally in a quest for political empire, as it was in the agrarian states. It has become a commodity that is bought and sold and used to make other commodities that can be bought and sold and carried to the marketplace. It is, in other words, purely and abstractly a commercial instrument. All mystery disappears from its depths, all gods depart, all contemplation of its flow ceases. It becomes so many "acre-feet" banked in an account, so many "kilowatt-hours" of generating capacity to be spent, so many bales of cotton or carloads of oranges to be traded around the globe. And in the new language of market calculation lies an assertion of ultimate power over nature – of a domination that is absolute, total, and free from all restraint.*
>
> *– Worster (1985, p. 52)*

Chapter 4 showed how development of a new restoration technique enabled a coalition of Feather River watershed residents to assert a positive linkage between headwaters restoration and downstream benefits for California water supply and hydropower production. To make this linkage, the coalition drew upon the popular policy concept of "payment for ecosystem services," asserting that meadow restoration has tangible, financial benefits for downstream beneficiaries, for which they ought to pay, i.e., to "reinvest" in the watershed.

Payment for ecosystem services (PES) is a conservation policy tool that aims to compensate people who provide a conservation service. PES enjoys current popularity, in part, because it taps both contemporary understandings of the vital links between ecosystems and human social well-being, and current sociopolitical preferences for market-oriented forms of governance. PES is increasingly advocated in watersheds in the American West and elsewhere to align upstream conservation with downstream water supply and quality. But less attended is the fact that PES has vey real political implications that stem from its potential to intervene in long-standing relationships that determine who benefits from and controls watershed resources and the wealth they create. Proponents hail PES as a technical tool for quantifying and making explicit the value of nature for human societies and for aligning the interests of upstream and downstream populations in a watershed. And indeed, successful examples do exist. But the Feather River case tells a more cautionary story.

In this chapter I ask how PES has been advocated, negotiated, and contested in the Feather River watershed. I contextualize this analysis within the historical relations of resource control in the region (Chapters 3 and 4) and the increasing societal preference for market-based approaches to environmental governance (Chapter 2). I conceptualize PES, or "reinvestment" in the language of the headwaters coalition, as a policy frame. A policy frame is a way of representing a problem in order to influence collective views of that problem and encourage some desired policy solution or outcome. I show how the headwaters coalition has developed the reinvestment frame and strategically used it to challenge California's dominant water supply approach and resulting power relations.

My findings show that, while the reinvestment frame helped the coalition increase the visibility of headwaters in California water policy and attract resources for restoration, efforts to levy a PES charge on downstream water users were thwarted by the more powerful downstream entities' denial of responsibility for the headwaters and appeals to scientific uncertainties about the benefits of restoration. The success of the downstream entities' appeals to scientific uncertainties reveals an important limitation of PES as a policy frame: that it renders a complex social-historical upstream-downstream relationship into a technical accounting between resource producers and consumers. This technical rendering ultimately limits the extent of policy change by necessitating reliable quantification and by obscuring issues of equity. These findings reveal important limitations and political implications of the PES concept when translated into practice.

CONCEPTS: POLICY FRAMES AND PES

In this chapter, I draw on the concept of "policy frames" to highlight the political dimensions of PES policy tools. This concept helps bring into focus the larger social, political, and historical contexts within which new public problems, policies, and governance configurations emerge. In this light, PES becomes more than just a new policy and governance approach; rather it becomes a way of framing watershed problems and solutions to advance political goals.

Policy frames

A policy frame is a way of representing a policy problem. Dayton (2000, p. 73) describes policy frames as "…fluid processes of issue conceptualization, which are transmitted via language and are constructed through social interaction, reaction, and adjustment" (citing Putnam & Holmer, 1992). Components of a policy frame include:

- Is there a problem?
- What is the problem?
- Who or what is to blame?
- What is the solution?
- Who is responsible for fixing the problem?
- Who is empowered to fix the problem?

Social and political issues are often highly complex, and policy frames reduce ambiguity and point the way toward solutions. But policy frames are not "rational;" rather, they tap into cultural beliefs, values, models, and stories about the world to focus actors' attention in specific ways (Dayton, 2000). Policy frames are useful political tools. That is, actors may strategically frame issues in ways that challenge the dominant social order or defend the status quo, assign blame or causality, promote particular solutions, empower and legitimize problem fixers, and create new political alliances (Roggeband & Verloo, 2007; Stone, 1989). On the other hand, policy reframing can also help fragmented or competing actors come to consensus about the nature of a problem and pursue solutions jointly.

My conceptualization of “policy frames” draws on Hajer’s (1995) work on the politics of environmental discourse. Although Hajer’s “discourses” are broader than my “policy frames,” the two concepts nonetheless share conceptual similarities. Hajer views environmental conflicts as a continuous struggle to define the problems themselves. In this contest, actors may devise policies to solve problems. But they may also identify and define problems in order to justify desired policies. Hajer employs a social constructivist approach which assumes the meaning we give environmental problems depends on our cultural conceptions. These conceptions and meanings become embedded in our institutions and policies via argumentative struggle; and individuals play an active role in this struggle by producing and transforming discourses. Although discourses are active sites of political contestation, these politics can be hidden in the ways that actors construct forums, frame issues, use language, define problems, and attend to or neglect certain facets of those problems (Hajer, 1995; Lakoff, 2006). In analyzing discourses, Hajer attends particularly to the construction of storylines, discourse coalitions, and emblems (or symbols) that mobilize bias and spur action.

Environmental discourses are inherently contradictory, and this ambiguity can be a source of power: for example, Hajer shows how ambiguity, or “multi-interpretability,” in the *ecological modernization* discourse enabled institutions to thwart reforms to manage the acid rain problem more holistically. Moreover, by adopting the ecological modernization discourse, the environmental movement restricted itself and undermined its own capacity to question larger societal goals such as unbridled economic growth. Quoting Davies and Harre (1990, p. 59), Hajer concludes: “the taking up of one discursive practice or another…shapes the knowing or telling we can do” (1995, p. 102).

The rise of non-state forms of governance necessitates shifts in the ways that actors conceptualize, define, and frame public policy problems. For example, if the state no longer enjoys legitimacy as the dominant policy actor, then issues must be reframed in order to define solutions and problem fixers as arising from non-state sources such as civil society and business sectors. This case illustrates how this type of reframing can shift the dynamics of power over nature and its benefits.

Payment for ecosystem services

PES is an increasingly popular policy concept for watershed management in the U.S. and beyond. Scholars first used the term “ecosystem services” in the 1970s as a metaphor to communicate human dependence on nature and attract support for its conservation. The 1997 publication of a controversial article by Constanza et al., who estimated the dollar value of global natural capital stocks and ecological services, was a major turning point in the “mainstreaming” of the ecosystem services concept, attracting the attention of scientists, economists, and policy-makers (Gómez-Baggethun et al., 2010).

This widespread attention translated into increasing promotion of policy approaches utilizing payment for ecosystem services (also called markets for environmental services) for conservation. Since the 1990s, and particularly since the 2003 Millennium Ecosystem Assessment, policy-makers have tried to establish PES approaches that characterize ecosystem functions as services, value them in monetary terms, and incorporate them into markets or other payment mechanisms that reward desired behaviors (Gómez-Baggethun et al., 2010). Such policies may take a wide variety of forms. Economists and ecologists are generally optimistic about the potential of PES as an economic and conservation tool, but they acknowledge barriers including scientific understanding, ecological heterogeneity, policy and finance mechanisms, and societal values (Chichilnisky & Heal, 1998; Costanza et al., 1997; Daily et al., 2009). Critics of PES are more pessimistic. Many warn that PES could exacerbate disparities in access to natural resources (Kosoy & Corbera, 2010; Pascual et al., 2010) or, by further commodifying nature, undermine moral and ecological bases for preservation (Gómez-Baggethun et al., 2010; McCauley, 2006; Robertson, 2004). PES instruments that function effectively across ecological and institutional scales have proven elusive (Carpenter et al., 2009; Redford & Adams, 2009; Vatn, 2010).

Norgaard (2010) critiques the "stock-flow" model of ecology that undergirds PES approaches as over-simplistic both ecologically and socially. In reality, ecological flows are complex, often non-linear, and difficult to measure, so that ecosystems do not create service outputs on a sufficiently predictable basis for establishing PES market relationships. Most ecological theories and concepts do not translate readily into stock-flow accounting, making the science of PES tenuous. Finally, these models neglect institutional contexts and failures. For example, Norgaard argues that cap and trade systems for managing carbon and mitigating climate change are based on stock-flow concepts of carbon management and naïveté about institutional contexts. He cites new approaches being developed under the global UN-REDD program[1] for reducing carbon emissions, which "largely ignore both the long history of institutional failure in stemming tropical deforestation and the vulnerability of biocarbon stocks themselves to climate change." Moreover, REDD programs are driven not only by the goal of stabilizing biocarbon stocks, but also by unacknowledged social factors including "the desire of rich nations to continue combusting fossil hydrocarbons and the poor to receive compensation for protecting nature," motivations that increase institutional complexity and raise the potential for abuse (Norgaard, 2010, p. 125). The REDD example also illustrates Norgaard's final critique of PES as a policy tool: although most examples derive from the developing world, PES may be most appropriate in the United States and other developed nations, where more ecological data exist and where cultural beliefs are more consistent with the instrument's market orientation.

Critiques aside, PES is increasingly invoked in policy conversations about managing watersheds both abroad and in the U.S., and an increasing array of cases employ watershed investment mechanisms. The most well known case, and widely viewed as successful, is New York City's PES

[1] United Nations Collaborative Programme on Reducing Emissions From Deforestation and Forest Degradation in Developing Countries

approach for improving its water supply quality. Instead of building expensive new treatment plants to comply with new water quality regulations, the city invested in a watershed protection program comprising strategies such as land acquisition, conservation easements, and payments to farmers to protect waterways through setbacks and buffers zones (Pires, 2004). The New York case is one of 21 source water protection programs identified by Bennett et al. (2013) that actively invest in "natural water infrastructure" in the United States.

Primarily led by municipalities concerned with protecting drinking water sources, these efforts are geographically diverse and distributed throughout many states. Although some are funded directly by downstream users through rates and/or specific watershed protection fees, other funding sources include government grants and funds, new taxes, and bond funds. In the West, emerging programs are often concerned with thinning forests to reduce fire risks and thereby minimize the potential impact of catastrophic fires to water supply sources (Bennett et al., 2013; LaRubbio, 2012). For example, Denver Water (a public utility that serves Denver and surrounding suburbs) and the city of Santa Fe, New Mexico, have each partnered with the U.S. Forest Service to thin and restore fire-prone forests in national forest watersheds that provide municipal water supplies (LaRubbio, 2012). Government grants and water user rates and fees fund these efforts.

Larger shifts in how societies conceptualize water supplies, watersheds, and the relationships between the two are facilitating the emergence of new PES policy tools. That is, PES is more than just a policy tool, it is also a policy frame. In the examples above, actors have invoked a PES frame to link upstream watershed treatments with downstream water quality and, to a lesser degree, supply. Doing so has expanded the conversation about water supplies to include a wider set of stressors, actors, funding sources, and problem-solving approaches. Though in ways that may be less obvious, this expansion also intersects with the politics of water: that is, the incorporation of new policy frames and the solutions that they prescribe can challenge existing policies, the actors who benefit from them, and the power relations they uphold. In the remainder of this chapter, I show how the headwaters coalition in the Feather River watershed has invoked PES as part of a political strategy to reframe and renegotiate the terms of the relationship between their upstream community and downstream users of Feather River water.

Competing policy frames in California water supply policy

Ideologies grounded in history, and deployed physically on the landscape, bound societal approaches to contemporary problems like headwaters degradation and threats to water supply. In this section, I first identify key elements of the policy frame that underlies California's dominant, historical approach to water supply management. I then identify an alternative framing that the headwaters coalition has advanced in recent decades, and finally I discuss the political aims that this alternative framing has advanced.

Engineering solutions: moving water

For the past century, the dominant frame for California water policy has rested on the need for human ingenuity to tame and improve nature by engineering large-scale water storage and transport systems. This frame gained traction through a combination of factors affecting

California since the Gold Rush: a series of devastating floods in the Sacramento Valley, the depletion of local surface and groundwater sources for irrigation in the San Joaquin Valley, and burgeoning urban populations in the dry southern areas of Los Angeles and San Diego. In response, water supply policy since the early 1900s has largely taken the form of transporting water from wetter to drier regions via the construction of large scale water projects that employ dams, reservoirs, aqueducts, and pumping systems.[2] The DWR today continues to frame this solution as the logical response to the fact that Northern California is wet and Southern California is dry. But this "logic" belies the deeply political work and outcomes that this policy frame effected.

In this framing, California's central water problem is a geographical disconnect between where the water is (largely, the north and the Sierra Nevada) and where people need it (on farms and in cities to the south). A pamphlet about the State Water Project characteristically explains: "To address nature's water imbalance and allow for growth, water has to be transferred from where it is plentiful to where it is needed" (California Department of Water Resources, 2011).[3] A second major problem is that high precipitation in the north can produce devastating floods. This frame blames the problem on nature, its variability, and its unpredictability, and advances human ingenuity as the solution. In particular, the frame endows the state and its engineers with the responsibility for fixing the problem by building large dams, reservoirs, and transport systems to move water from wet areas to dry areas.[4] This policy frame has not only helped convince the voting public of the necessity of building and funding gigantic water projects; it has also obscured their true costs and benefits. Thus the frame is significant not only for what it includes, but also what it leaves out: particularly, an awareness of the social and environmental contexts of water supply management including the role of watersheds.

While the delivery of water from the wet north to the dry south has often been advanced as a critical imperative for California as a whole, in fact the people who have most benefited have been large industrial-scale agriculture interests, particularly in the San Joaquin Valley, and Southern California real estate developers and speculators, who owned lands that were worthless without water (Reisner, 1986). Thus, the dominant policy frame has helped increase the power and wealth of key water actors who stood to benefit from a centralized engineering approach capable of transporting vast quantities of water throughout the state. To be sure, cities and their economies have also benefited from the availability of ample, cheap water. However, social and environmental impacts have been significant and often largely invisible to

[2] The State Water Project, which taps the Feather River, was the last of the state's five largest water projects to be built. Construction of the original Los Angeles Aqueduct, which transports water from the Eastern Sierra Nevada to the Los Angeles area, began in 1908. Construction of the Hetch Hetchy Project began in 1914, and the project began to deliver water from Yosemite National Park to San Francisco in 1934. Construction of both the Colorado River Aqueduct and the Central Valley Project commenced in the 1930s.
[3] Displays at the Vista del Lago Visitor Center, which features educational material for the public about the State Water Project, also frame the problem and solution this way (visited by the author in April, 2013).
[4] A 2010-2011 exhibit at the California Museum in Sacramento was entitled: "Extreme Engineering: The Past, Present, and Future of the California State Water Project." The title is suggestive of the centrality of the engineering logic that continues to drive the project and motivate its supporters.

most consumers of California water. The iconic example is how the Los Angeles Aqueduct destroyed the ecology and vibrant farming economy of the Owens Valley when it took the valley's water away. Large-scale water development has also favored the interests of large industrial agriculture to the detriment of small farmers and impoverished communities of agricultural laborers in the San Joaquin Valley. Environmentally, among other impacts, the damming of Sierra rivers blocked salmon migration and irrevocably altered watershed ecologies. It also drowned ecosystems, towns, and scenic landscapes such as the Hetch Hetchy Valley in Yosemite National Park and Big Meadows in the Feather River watershed, where Lake Almanor sits today. The transport of State Water Project and Central Valley Project water through the Sacramento-San Joaquin Delta has contributed significantly to ecological decline of that unique system and today serves as the focal point of California's ongoing water wars. Finally, the transport of water, which often includes pumping it uphill, consumes more energy than any other single activity in California.

The dominant policy frame also neglects watersheds as the source of California's water supply, a tendency perhaps epitomized by the State Water Project, which taps the Feather River watershed. In this frame, water originates in the rim dams at the base of the Sierra that capture the runoff of the state's rivers and direct it into water transport systems.[5] As a result of this logic, California water policy has largely neglected the upper watersheds including the Feather River's, while resource extraction practices have impacted their hydrologic functioning. Many of these hydrologic impacts originated in the hydraulic mining era, which produced massive flooding and debris impacts downstream.[6] But wildfire, poorly managed grazing, and timber harvesting, with associated construction of roads, railroads, and skidtrails, have also impacted downstream waterways in the Feather River watershed and elsewhere. The national forests that cover much of California's headwaters were actually born from an awareness of intact forests' role in watershed and flood protection. Downstream irrigators recognized these functions and were influential in convincing Congress to create the national forests around the turn of the 20th century (Hays, 1959).

But the large-scale water engineering approaches that followed soon rendered watersheds, their role in the water cycle, and their human residents largely invisible. Engineers captured the flow of entire watersheds behind large dams, began to precisely control downstream releases from these reservoirs, and established complex plumbing and accounting systems for inter-basin water transfers. Beginning in the mid-1980's, growing public concern about non-point source pollution, including high sediment loads from forest management activities, prompted Congress and the Environmental Protection Agency EPA to direct more attention to the problem (Sabatier, 2005). Sabatier views EPA's decision to adopt a watershed-based strategy, and to encourage the formation of watershed partnerships for managing point source pollution, as an important contributor to the rise of the "watershed collaboration era" in the United States. Indeed, efforts to control sediment in the upper watershed first spurred creation

[5] The rim dam for the SWP is Lake Oroville, which sits behind the massive Oroville Dam.
[6] Litigation brought by a downstream landowner against the hydraulic mining companies led to the 1884 Sawyer decision that effectively ended hydraulic mining in California.

of the Feather River Coordinated Resource Management group (CRM) in 1985. But California's overall water supply policy frame continues to simplify the state's complex water history and its social, political, and environmental consequences. In this frame, California's water future holds more large dams and better piping systems, necessary to adjust to population increases, climate change impacts, and the probability of more drought and water scarcity.

Yet while water interests currently push for more engineered dam and transport projects, awareness has grown about these impacts and spurred a backlash and a search for new solutions and approaches. In this search, we can see the efforts of different actors to reframe California water policy. For example, the Pacific Institute, a well-known water think tank in California, has called for a reorientation of the state's water policy – still largely based on a "hard path" of centralized, engineered water delivery infrastructure – around a "soft path" approach utilizing a broader array of water financing, treatment, and supply strategies (Christian-Smith & Gleick, 2012). The "soft path" also better acknowledges the links between water and both social and environmental conditions. Another example of reframing comes from the state's Integrated Regional Water Management (IRWM) program, which has spurred efforts for collaborative regional water governance to improve regional self-sufficiency and minimize the need for increasing future water imports. The California Department of Water Resources (DWR) has undergone organizational restructuring according to the IRWM approach, which appears to be changing the policy frame within that organization. Reframing strategies in the Feather River headwaters are consistent with this larger reframing effort in California water policy. Restoration advocates argue that, although not a solution to California's water woes on its own, pond and plug can be part of a larger suite of approaches that consider water supply management in a more systemic context: of social, ecological, hydrologic, and watershed systems.

"Reinvestment:" The emergence of a new policy frame in the Feather River watershed

The Feather River headwaters coalition has sought to modify the state's water policy frame to recognize the contribution of watersheds and headwaters communities in producing the state's water supply. This coalition mainly comprises actors involved in watershed restoration (most but not all of whom are watershed residents), other watershed residents, and Plumas County actors including current and past County Supervisors and county-employed attorneys.[7] This coalition is motivated not just by concern about the degraded environmental quality of the watershed relative to pre-European conditions, but also by residents' social and economic struggles and by concern about the potential for California's powerful water interests to undermine the community's ability to access the water it needs for future growth. Reframing has been a central component of the coalition's efforts to obtain funding and policy changes that advance headwaters restoration. The roots of this reframing effort lie in the collaborative meadow restoration efforts of the Feather River CRM. As funding needs of this effort changed and grew, the collaborative group and its allies began to construct a "reinvestment" policy frame based on the idea of PES.

[7] Plumas County is largely though not wholly contiguous with the upper Feather River watershed (above Lake Oroville).

As detailed in Chapter 4, PG&E provided much of the early funding for headwaters restoration in the Feather River watershed because their downstream hydropower reservoirs were filling up with sediments that they believed were eroding from extensive upstream gullies. PG&E largely withdrew that funding when its engineers figured out how to pass the sediments downstream through their turbines. This withdrawal prompted the collaborative group to reframe the significance of its restoration work, which had already expanded to focus on multiple benefits besides erosion reduction, in order to attract new funding sources. This is how one informant explained it to me:

> [At first] nobody was thinking about augmented water supplies, or attenuating floods. All we wanted to do was deal with erosion. It was when we finally decided to move to the pond and plug type model – restoring the hydrologic function of that landscape feature – that, wow, this is gonna have many other benefits and we should see if those beneficiaries are willing to invest in it.

Thus the headwaters coalition began to construct a "reinvestment" policy frame drawing on the concept of PES. This policy frame reflects a new problem definition, which evolved from erosion to impaired hydrologic functioning of a meadow-floodplain landscape. While the former is a water quality problem, the latter is more expansive; in addition to water quality, impaired hydrology affects additional parameters including water supply, timing of flows, habitat value, and livestock forage.

Several simultaneous developments contributed to this reframing, including: the emergence of the ecosystem services concept among ecologists and economists; examples emerging from places like New York city and the Chesapeake Bay; the growing societal interest in market based forms of environmental governance; and a new recognition of the economic value of Sierra water, which is quite significant. As discussed in Chapter 3, Feather River water plays a vital role in California's economy, feeding its agriculture empire in the Sacramento and San Joaquin Valleys, its explosive urban growth, particularly in Southern California, and its vast requirements for energy. The economic value of water from the Feather River, and other Sierra watersheds, is enormous. Specifically, a 1996 economic assessment calculated that water accounts for 60% of all natural resource related revenues produced annually from the Sierra Nevada (Stewart, 1996). The calculated value includes water supply, recreation, and hydropower, but most of it is derived from hydropower. Between 1970-1994, the Feather River watershed alone generated an average annual profit of $143 million from hydropower, the most of any Sierra watershed. The assessment also concluded that only around 2% of all resource values were reinvested into the ecosystem or local communities (and this was primarily in the Feather River and arose from PG&E's collaboration with the CRM at that time).[8]

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[8] Interestingly, Gifford Pinchot foresaw the value of hydropower generated on public lands and advocated for policies requiring the hydropower companies to pay some kind of fee or royalty on the resource: "The water-power sites now in the public hands are enormously valuable. There is no reason whatever why special interests should be allowed to use them for profit without making some direct payment to the people for the valuable rights derived from the people" [Pinchot 1910, p. 85-86]. He discussed the "water-power" issue at some length in *The Fight for Conservation*.

This information served as a key resource for the coalition in making new arguments about headwaters and why and how we should restore them (e.g., see Wills & Gray, 2001). The headwaters coalition drew on the power of language to begin reframing the issue, invoking new words and concepts to make visible the role of the headwaters in producing California's water supply. In this reframing, restored meadows became "sponges" that retain water during the wet season, then release it during the summer dry season, when California most needs it. Downstream hydropower producers and water retailers became "beneficiaries" of the water and of the restoration projects. And funding restoration became "reinvestment" in the watershed. More recently some coalition members began referring to trees as "water pumps" to link high forest density with downstream water supply impacts and to argue for more active forest thinning projects to reverse the effects of historic fire suppression.[9]

The headwaters coalition has used the idea of "reinvestment" since at least 1997. Actors may have originally borrowed the concept from the 1996 Sierra Nevada Ecosystem Project (SNEP), a comprehensive review of the Sierra Nevada's natural and social systems that included Stewart (1996). A SNEP chapter focusing on institutions similarly cited lack of investment by "beneficiaries" of Sierran resources as a key reason for ecosystem decline: "Many Sierran ecosystem declines are due to institutional incapacities to capture and use resources from Sierran beneficiaries for investment that sustains the health and productivity of the ecosystems from which benefits derive" (Sierra Nevada Ecosystem Project Team, 1996, p. 48). The notion of ecosystem services was also gaining wider prominence at the time among ecologists and economists. Since adopting the term, coalition members have elaborated this concept in policy documents, interviews, public meetings, and articles published in academic journals.

An early example is worth quoting at length for its illustration of the roots of "reinvestment." In this quote, Robert Meacher, a Plumas County Supervisor involved in 1995 negotiations over control of the state's water supply related that he and leaders of other rural counties grew concerned when they realized that most of the state's water managers knew next to nothing about the upper watersheds where the water originates:

> It became clear early on that there was something very wrong with the picture held by most of the state's water managers. Practically everyone believed the water they are so dependent upon begins at the reservoirs where they collect it, and their maps failed to include the upstream areas where the rivers originate. Managers assumed no responsibility for the quality or quantity of the water that fills their reservoirs. It was as if the flow from someplace beyond their imagination was a God-given right for which they need take no action. That's clearly wrong.

If California's water supply begins at the rim dams, then upper watershed degradation is not a problem. In contrast, Meacher and other members of the coalition have sought a reframing that brings upper watersheds into focus as part of the water supply infrastructure. Reinvestment is a concept that helps make that connection. Meacher goes on to explain that he

[9] These coalition members are primarily aligned with the Quincy Library Group.

joined with leaders of other rural counties to press for policy changes, including reinvestment mechanisms, to address the restoration and management needs in the headwaters:

> Timber harvests historically have funded any work done to restore watersheds. With the reduction in timber harvests, other players need to get involved in reinvestment. They include the hydroelectric industry throughout the Sierra Nevada and, in the Feather River watershed, the State Water Project—far and away the primary beneficiary. To date these groups' contributions have been negligible.

This framing portrays the issue as one of responsibility and fairness:

> Those larger populations receiving benefits downstream can no longer dismiss their responsibility to our much smaller rural populations by saying they didn't cause the problems upstream. Those problems started 150 years ago, but the responsibility today lies with all Californians—and all Americans—who derive any value from the water that flows from the mountains to the rest of the state. All of us must contribute our fair financial share in maintaining the integrity of these watersheds (Meacher, 1997, p. 18).

Other coalition members invoked the notion of "natural capital" to characterize the problem of watershed degradation and the need and responsibility for restoration. For example, Wills and Gray (2001, p. 387) describe reinvestment as a matter both of fairness and of ensuring long-term flows of economic value:

> The term ''reinvestment'' affirms ecological systems' capacity, as natural capital, to produce economic value, expressing the need to maintain rather than diminish that capacity. The term describes the financial flows that are generated by an ecological system and returned to that system by those who obtain the economic benefit, often users located ''downstream'' or beyond the ecosystem's boundaries. The term incorporates both the need for investment in natural capital, so it will not be degraded, and the need to ensure that those who derive economic benefit from an ecological system pay their fair share in maintenance costs.

Reinvestment explicitly connects ecosystem stewardship with beneficiaries: "To be effective, reinvestment must function as a continuous and integrated loop where the economic values of ecological services are recognized and the beneficiaries, both within ecosystem boundaries and beyond, invest a fair share of their economic gains for ecosystem restoration and maintenance" (Wills & Gray, 2001, p. 398). Finally, the coalition's use of "reinvestment" rather than "payment" (i.e., for ecosystem services) also downplays the overt reallocation of financial wealth that such a policy entails. Instead "reinvestment" benefits everyone by improving the watershed's "natural capital" and enabling sustained flows of economic benefits.

"Reinvestment" thus serves as the basis of a new policy frame. It identifies a new problem – the impact of degraded headwaters hydrology on downstream water supply – where one previously did not exist. It characterizes the problem in multiple ways: as an issue of historical disconnection of upstream and downstream, as an issue of fairness, and as an issue of ensuring sustained financial flows by restoring natural capital. While the reinvestment frame does not blame the downstream water retailers and hydropower producers for creating the problem, it does – by portraying these entities as "beneficiaries" – link them to the fate of the watershed and endow them with responsibility for fixing it by funding restoration. It also empowers the upper watershed communities as watershed stewards, i.e., problem fixers. In this conception, ecosystem stewardship is to be done largely by residents of the upper watershed, in collaboration with relevant government agencies including public lands managers. The "reinvestment" frame thus enables the coalition to insert the upstream community, which is wholly absent from California's dominant water policy frame, into the policy solution. The roles of public and private landowners and managers are also reframed to be less about compliance with regulatory requirements and more about proactive watershed stewardship. This reframing opens the future possibility that public lands agencies like the Forest Service would, as the coalition has advocated, actively pursue policies to extract payment from downstream beneficiaries for watershed management.

The "sponge" metaphor is a key component of the reinvestment frame and also emerged early on. A typical example is this quote from a 1999 funding application for the Last Chance Creek watershed restoration project utilizing the pond and plug method (Feather River CRM, 1999):

> Prior to Euro-American settlement the ecosystem functioned as a hydrologic sponge, absorbing and storing water from winter rains and spring snowmelt in subsurface aquifers, soils and streambanks, then slowly releasing this retained water as high quality, cold temperature baseflow to the river system through the summer and fall.

The sponge was a useful metaphor for communicating, in lay terms, the (hypothesized) hydrologic function of the watershed's meadows, and restoration advocates and practitioners frequently invoked it for this purpose. A degraded meadow carries water in a gullied channel many feet below the elevation of the meadow. This prevents the water from running over the meadow and soaking into the dry soil. In contrast, the pond-and-plug restoration technique "re-waters" the meadow by raising the elevation of the channel so that water can percolate downward into the "sponge." The idea makes intuitive sense, and with some simple back-of-the-envelope calculations, one could predict how much water a newly restored meadow "sponge" could hold.[10] The assertion that meadow sponges play a critical role in regulating the hydrograph – the timing of river runoff throughout the year – was an important component of this reframing. If meadows absorb water during the wet winter season and release it during the dry summer months, then they can store excess winter precipitation that currently must be released to the ocean to protect against flooding. For this reason, the sponge concept also appears in recent discussions of how pond and plug and other headwaters restoration techniques – and a reinvestment mechanism to pay for them – might help California adapt to climate change. (As detailed at the end of Chapter 4, some of these hypotheses about how meadow "sponges" function, particularly the implications for timing of flows, have more

[10] In reality there are significant uncertainties associated with these predictions. The equation is (meadow area) x (depth to bedrock) x (soil porosity) = (volume of water supply storage). By substituting total area of degraded meadow in the watershed for the area of a specific meadow, one can expand this equation to estimate potential water supply storage gained from restoring all of the meadows in the watershed.

recently been called into question. While it appears that pond and plug does shift peak runoff to later in the year, this benefit does not extend into the late summer and early fall, and may in some cases even reduce baseflows during those months. High climate and meadow variability, measurement challenges, and lack of data hinder resolution of these uncertainties.)

Finally, the notion of overstocked trees as "water pumps" emerged more recently as community members involved in the Quincy Library Group began to focus more of their attention on the relationships between forest management and water. Invoking both water quality and timing of flows as issues, one QLG member explained (USDA Forest Service, 2009):

> You've got too many fir trees pumping water too fast where they shouldn't be, they're not natural to be there…. They can only be removed by heavy-duty management intervention and that has to be done. But the key is to improve the water flow or at least sustain it, to do the best you can to stop it from deteriorating, to improve its quality, above all to improve the timing of the delivery. Reducing the heavy flows at wintertime and increasing the late flows at summertime are keys to optimizing the value of the water. And then the biggest problem of all probably, is to figure out how to tap the value of that water to pay for the work it takes to deliver that water.

Some CRM members are sympathetic to the "water pumps" imagery as a way to overcome environmentalist opposition to forest thinning projects, opposition that they (with QLG) perceive has contributed to increasing severe fires and resulting watershed impacts.

But the "water pumps" metaphor is not universally accepted among CRM members, a fact that reveals some tensions and highlights the messiness of policy frame construction and coalition building. When I asked one CRM interviewee about the "water pumps" imagery, he replied:

> Yeah, and I think that's bullshit…. The forest creates a certain local climate, microclimate, that produces rainfall and snowfall and if you thin too much, you get too much ground radiation back off. So there's a balancing there and to sort of vilify trees as water pumps is pretty simplistic and narrow-sighted; it's just playing to that urgency, critical problem…, selling your program kind of thing. It gives them another…cause to go after: we got to get rid of these water pumps because it's critical we get water…. And they say, 'look, you clear-cut and you get all this water yield that you wouldn't get otherwise because all these trees are pumping water out of the ground. Let's get rid of all those trees.'[11]

[11] The entire quote is illuminating on this issue. It reads: "Yeah, and I think that's bullshit. I think there is actually probably an optimum stand density for water infiltration and water capture, but I don't think anyone's identified what that is. And I suspect it's lower than what the fuel load is now, lower stand density than what we have now in a lot of places. But if you go into a little more detail about topographic-climate interactions and how you get rainfall to happen and how you get snowfall to happen, if you thin the forest too much, you lose rain and water. And if you clear-cut, you lose a lot of water, I mean you get an initial surge of water out in the watershed in the first year or two and then after that it loses water because it doesn't rain out in the forest. The forest creates a certain local climate, microclimate, that produces rainfall and snowfall and if you thin too much, you get too much ground radiation back off. So there's a balancing there and to sort of vilify trees as water pumps is a pretty

In other words, these coalition members use the “water pumps” metaphor to define a problem (too many trees) that supports a solution they already desire: thinning the forest. Numerous analyses have concluded that effects of forest harvests on water yield are minimal and likely undetectable given high climate and streamflow variability (Troendle et al., 2007). But few data exist for the Sierra, and some scientists argue that using forest management to increase water yields is a feasible strategy (Bales et al., 2011).

During my fieldwork, the reinvestment frame was nearly ubiquitous among headwaters coalition members, including actors working in watershed and forest restoration efforts, and in legal settings on behalf of the county. Elements of this frame also appeared frequently in broader meetings that I observed about managing the Sierra Nevada as the source of California’s water supply. These meetings included, in particular, efforts convened under the Sierra Water Workgroup to advance the interests of the Sierra region under the IRWM program, as well as meetings of other regional IRWM groups in the Sierra Nevada. The Sierra Nevada Alliance, an organization that brings together conservation groups throughout the Sierra with interests in sustainable communities and ecosystems, has been an ally of the headwaters coalition in this reframing effort.[12] Thus, although I focus on the dynamics within one watershed, the reframing I observed in the Feather River watershed is part of broader efforts, led by a coalition of actors across the Sierra Nevada region, to shift California water policy toward greater focus on watersheds and headwaters. Actors from the Feather River region were among the first to pursue this strategy and have been influential in inspiring and aiding these larger efforts.

Outcomes of the reinvestment reframing strategy

As a political strategy, the reinvestment frame challenges state and federal laws and institutions that reinforce headwaters invisibility, and challenges the terms of the current relationship between upstream and downstream. Thus the frame is not just a new way of understanding a public policy problem, but also an attempt to shift the historical balance of power and distribution of resources between upstream communities and downstream water users. The headwaters coalition has been using the reinvestment frame for about 15 years, and these efforts have helped increase awareness about headwaters in state and federal policies and attract government and foundation grants for restoration.

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simplistic and narrow-sighted; it’s just playing to that urgency, critical problem programmatic, selling your program kind of thing. It gives them another tool to- another cause to go after; ‘we got to get rid of these water pumps because it’s critical we get water.’ There’s been, for several years, as long as I’ve been doing this stuff, there’s been people championing clear-cutting as a water saving strategy. And they say, ‘look, you clear-cut and you get all this water yield that you wouldn’t get otherwise because all these trees are pumping water out of the ground. Let’s get rid of all those trees.’”

[12] The Sierra Nevada Alliance helped spearhead the Sierra Water Workgroup and has advocated for headwaters restoration and reinvestment. For example a 2009 publication entitled “Investing in California’s Headwaters: The Sierra Nevada” uses the reinvestment frame to call for increased funding and attention for the headwaters in state and federal policies, though it stops short of calling for a public goods charge or tax levied on downstream water users (Sierra Nevada Alliance, 2009).

Coalition actors have invoked reinvestment as a central idea in ongoing policy advocacy efforts and strategies that include education, litigation, lobbying, and collaborating. These efforts have included:

- Developing education programs to educate watershed residents and downstream citizens and institutions about the watershed's role in providing water resources to the state.
- Working with state agencies to shape key policies and programs such as CALFED, the California Water Plan, and the IRWM program to better reflect the needs of mountain counties and watershed communities.
- Educating agencies and lawmakers on the importance of headwaters and lobbying them for programs and funding to support watershed management.
- Pressing the U.S. Forest Service to adopt more watershed-oriented policies, for example toward hydropower generation, at local, regional, and national levels.[13]
- Participating in regional organizations that advance the interests of mountain counties and watershed communities; these include the Regional Council of Rural Counties, the Sierra Nevada Alliance, and the Sierra Water Workgroup.
- Pursuing lawsuits against entities including the State Water Contractors and the Department of Water Resources to force more watershed-friendly alternatives to resource management decisions.
- Lobbying downstream beneficiaries (PG&E and the State Water Contractors) and state regulatory bodies to institute a public goods charge to provide for "reinvestment" in the upper watershed.

Several factors have aided the coalition in achieving notable successes from these efforts, outlined below. The watershed's small population and interconnectedness (i.e., people know each other and often encounter each other in multiple settings, both professional and personal) seems to have enabled the coalition to undertake these reframing strategies in an integrated and intentional manner. County leaders have largely, though not entirely, been supportive. For a small rural county, residents enjoy a surprising degree of access to lawmakers at state and national levels, a fact that may be attributed at least partially to the high visibility of local forest management efforts under the Herger-Feinstein Quincy Library Group Act. The Feather River CRM is also well known among California's resource managers for its meadow restoration efforts and pioneering use of the pond and plug method.

Members of the headwaters coalition report that they were involved in drafting the legislation that created the IRWM program in 2002, which seeks to significantly change how water supply

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[13] For example, in comments to the Forest Service regarding the development of a policy framework for conservation in the Sierra Nevada, the Quincy Library Group (1998) argued:

> [The] Forest Service should give very high priority to analyzing the economic value of water as a potential source of re-investment in the health of upland watersheds and riparian areas. Historically the Forest Service has not exercised its full power to influence that reinvestment, but …it is necessary to reconsider that history and develop a more productive plan for Forest Service participation in water supply issues, and to take a more active role in seeking reinvestment through the FERC and CAL-FED processes.

management planning is conducted in California. Informants relate that one of the goals has been to open up access to water resource planning for groups that have been traditionally left out, including environmental groups and disadvantaged communities. The DWR, which manages the IRWM program, describes it as a collaborative, integrated approach to water resources that engages multiple stakeholders and agencies, spans jurisdictional and watershed boundaries, and seeks to address supply, quality, treatment, and flood and storm water management issues in a region (California Department of Water Resources, Year Unknown). The Upper Feather River watershed, led by Plumas County, was one of the first to develop an IRWM plan and win state water bond funds for a variety of water-related projects. The Upper Feather River IRWM plan has served as a model for other Sierra watersheds and for the Forest Service, as the local Plumas was the first national forest signatory to an IRWM in California. Prior to the IRWM grants, County Supervisors and attorneys also successfully applied legal pressure to make watershed restoration eligible for funding from the state water bonds approved by voters between 1996-2006.

Coalition members have also helped shape revisions of the California Water Plan, which serves as a "collaborative planning framework" for California water policy. Updated every five years, the plan evaluates "regional and statewide resource management strategies to reduce water demand, increase water supply, reduce flood risk, improve water quality, and enhance environmental and resource stewardship" (California Department of Water Resources, 2014c). Through the efforts and advocacy of coalition members, the 2009 update for the first time included a Forest Management chapter addressing the relationships between headwaters management and water supply issues. The cover featured a photo of a restored meadow in the Feather River watershed, and the chapter (and the more recent 2013 draft update) included a lengthy discussion of the importance of meadows as "sponges" and "valves" that regulate watershed hydrology (State of California, 2009, 2013).

The spread of this imagery into high levels of the U.S. Forest Service is also evident. When asked in a publicly available interview about how the agency "can protect and enhance water resources on National Forests in California," the Regional Forester[14] replied by talking about the importance of restoring meadow sponges (USDA Forest Service, 2009):

> We're restoring those wetlands and riparian areas, those low lying areas on the landscape mainly because those are the areas that acts [sic] as a sponge in this whole ecosystem where water, as it's melted from the snowmelt or as it rains, the meadows act as a sponge which absorbs the water to keep it from running downstream too fast, creating erosion and timely releasing it downstream.

The Chief of the Forest Service and recent agency publications have also emphasized the importance of forest management for downstream water supply and quality.

Efforts to link Sierra meadow and forest restoration to downstream water supply beneficiaries are being pursued more broadly in the state by a mix of actors and organizations including the Sierra Nevada Conservancy (a state agency), the Sierra Nevada Alliance, The Nature

[14] The Regional Forester directs the agency's Pacific Southwest Region, which comprises California and Hawaii.

Conservancy, the National Fish and Wildlife Foundation, and others. In 2012, Coca-Cola funded a pond and plug project in the headwaters of the Mokelumne River, in the Central Sierra; the Feather River CRM provided technical assistance on this project and others throughout the Sierra. With a focus on fire-hazard reduction to benefit downstream water supply, the collaborative Mokelumne Watershed Environmental Benefits Program is working to develop market-based programs for watershed management and restoration that link public and private sectors (Sustainable Conservation et al., 2012). The Sierra Water Workgroup, which began coalescing in 2009, similarly includes "reinvestment" as part of its mission statement: "to assist regional efforts to protect and enhance water quality, water supply, and watershed health; to develop cooperative regional responses; and to facilitate reinvestment in our watersheds and water resources by all beneficiaries" (Sierra Water Workgroup, 2014). In 2012, this group hosted a conference session on "alternative investment platforms" that explored the potential for market-based ecosystem restoration strategies in the Sierra Nevada following the decline of bond-funded state grant programs. It is hard to pinpoint exactly why and how these efforts have emerged. However, actors pursuing them frequently reference the Feather River restoration efforts and notions of "reinvestment," and Feather River coalition members have been often involved at some stage.

Finally, a 2013 policy statement by the Association of California Water Agencies (ACWA), a statewide coalition of 440 public water agencies that deliver 90% of the state's water supply, shows an increasing acknowledgement of the need to address headwaters:

> Ultimately, managing California's headwaters is integral to optimizing the water supplies that nature provides. Increasing water yield and quality; reducing the risk and impacts of catastrophic wildfire; and enhancing natural features and functions; are all benefits to be derived, locally and statewide, from improved headwaters stewardship. Enhancing the resiliency and adaptability of headwaters is overdue.

Although the statement outlines a number of planning, management, research, and financing mechanisms to achieve this goal, it does not mention funding mechanisms from downstream beneficiaries. Instead, ACWA calls for increased funding from Congress and the state, which ACWA says has "historically underinvested in headwaters stewardship" (Association of California Water Agencies, 2013).

THE LIMITS OF "REINVESTMENT"

Although these efforts have attracted grants and other sources of temporary funding for watershed restoration, a stable funding base – one of the coalition's main goals – has remained elusive. This uncertainty has at times impacted the CRM's ability to do restoration projects. For example, in 2009, when grants the CRM had won from the state failed to materialize due to California's budget woes, its employees were laid off for 6 months. Coalition members argue that the restoration needs in the headwaters are far greater than the resources available to address them, and that degraded ecosystems continue to threaten the integrity of the water supply system. Thus the coalition continues to press for a locked in funding source from downstream beneficiaries: PG&E and/or the state water contractors.

They propose that such reinvestment funds could derive from a small monthly fee on consumers' bills. One coalition member said that analyses conducted on the issue showed that $0.25/month would raise sufficient revenue. Another coalition member explained in a public interview (USDA Forest Service, 2009):

> …the money from the bond propositions really is not constant enough or large enough to do the work that needs to be done on the landscape. We really need some longterm investment mechanisms. Whether it's a penny a month on a person's water bill in Los Angeles you know, that amount of money, when you aggregate it on the scale of people receiving water from the state water project, would be enough to have an ongoing, meaningful program in the watershed to keep their water clean and coming to them.

Revenues might address a variety of watershed-related projects: not only restoring meadows but addressing high forest densities, toxic threats from hydraulic mine tailings and resort development, needed road and trail maintenance, and critical habitat protection. They could also address social needs such as public education and signage, establishment of cultural heritage areas, and improved coordination between public and private landowners (Wills & Gray, 2001). The idea of a public goods charge is the clearest instance of how the coalition uses the reinvestment frame as a political strategy to link headwaters restoration projects with downstream benefits, and thereby access some of the wealth that this watershed produces and that historically flowed to beneficiaries outside of the watershed.

The remainder of this section details how PG&E and the State Water Contractors have resisted contributing to the watershed restoration program, via a public goods charge or other permanent funding mechanism, by invoking scientific uncertainties about the quantifiable benefits of watershed restoration. This resistance is reinforced by an embedded engineering logic at odds with the watershed-based approach. The reinvestment frame itself, by posing a "stock-flow" model of ecology under which the services nature provides are predictable and quantifiable, may ultimately aid in limiting the extent of achievable policy change.

PG&E: It's not our responsibility

Although an early major funder of the CRM efforts, PG&E later minimized its participation and contribution to the effort. To justify this position, the official interviewed for this project invoked the company's responsibility to its ratepayers and scientific uncertainties regarding the benefits of restoration, while also emphasizing that the state of the upper watershed is not the company's responsibility.

Seeking to control erosion into its downstream reservoirs, PG&E was a major early funder and participant in the CRM, and this financial support was critical to effort's early success (Chang, 2002, p. 14). By the early to mid-1980's sedimentation at PG&E's Rock Creek and Cresta Reservoirs on the North Fork, constructed less than 40 years prior, had displaced 50-55% of water storage capacity and was impacting hydropower operations (Harrison, 1991). Dredging the sediment would be costly, and the problem was impacting the facilities' hydropower operations.[15] PG&E turned to watershed restoration as a potentially beneficial investment: "PG&E's hydroelectric generation output and efficiency depend on the health of the watershed in which it operates. Overuse and mismanagement of watershed resources can lead to serious problems throughout the watershed, including problems for PG&E's hydroelectric facilities located downstream" (Lindquist et al., 1997, p. 2-5).

In the mid 1990s, however, the company drastically reduced its support and involvement in the CRM, a move that PG&E documents and representatives attribute to the development of a new method for flushing trapped sediments from reservoirs during high flow events.[16] Without a rationale for upper watershed erosion control, PG&E minimized its involvement in and contribution to the CRM. Although the CRM and the larger headwaters coalition began to highlight other benefits of meadow restoration, including water supply timing and quality improvements, PG&E argues that there are no significant, detectable benefits to their facilities. PG&E has particularly cast doubt on the water supply benefits, invoking scientific uncertainties about how much water supply is produced through headwaters restoration and what happens to it in between the high meadows and the hydropower facilities down in the canyon.

The PG&E official interviewed for this study said that the company could, in theory, support activities that would increase "water yield" from the watershed, since that would allow them to generate more hydropower. If restored meadows release water later in the year when energy prices are higher, this could also benefit PG&E. But he repeatedly invoked scientific uncertainties about whether these and other restoration outcomes would benefit PG&E's operations. For example, he minimized the amount of water that restored meadows can hold, calling the idea that a watershed-wide restoration program could yield hundreds or thousands of acre-feet a year "a pipe dream."[17] He argued that if restored meadows store water and release it later in the year – in late spring and summer rather than winter or early spring – irrigation on intermediate stream reaches would withdraw most of it before it could reach PG&E's facilities, which are as far as 40 miles downstream. Coalition members, in contrast, argue that since it is a watershed, this irrigation water eventually returns to the channels and runs downstream. Finally, while coalition members argue that water temperature reductions

[15] Specifically, "The sediments [were] being drawn through the turbines, accelerating wear, decreasing efficiency, and increasing maintenance costs. Sediment deposits [were] obstructing the dams' low-level outlets, streamflow release systems, and water inlets for operation of the spillway drum gates" (Lindquist et al., 1997, p. 2-2).

[16] Some community members also believe that the corporation's motives changed as it went through bankruptcy and divestiture proceedings after deregulation of California's energy markets, an assertion echoed by Chang: "the utility increasingly restricted spending to actions that would produce short run cost-benefit payoffs in response to changing competitive pressures in state and national energy markets" (Chang, 2002, p. 18). The PG&E official interviewed for this study rebuts this claim.

[17] A 2008 independent evaluation estimated that a watershed-wide restoration program would generate 110,000 acre-feet of water storage in meadows and augmented dry season streamflow (Jones & Stokes, 2008). PG&E's facilities are located in the North Fork watershed, the largest of the three main sub-watersheds, and would receive a significant proportion of this amount. There are, however, significant uncertainties regarding these figures. A study of a pond and plug project in the Pit River watershed, to the north, suggests that overall water yield may actually decline by 1-2% following implementation (Hammersmark et al., 2008). See Chapter 4 for a more detailed discussion of these uncertainties.

achieved through pond and plug can help PG&E meet regulatory requirements for fish habitat in the North Fork Canyon, this official highlighted the distance and the potential for evaporation and warming in the hot, narrow Feather River canyon to reject this claim.

Beyond these technical arguments, for this official the bottom line was about PG&E's responsibility to its ratepayers, and not to the watershed:

> And we've kind of looked at it as an issue, too, that that silt and sediment issue upstream of our facilities, it's not our responsibility. It's a nice thing to do, [but it's] not our responsibility, and so we have to be careful with spending ratepayer money on activities that are not our responsibility. That's a key thing, spending ratepayer money on activities that aren't our responsibility.

The existing regulatory structure for licensing of non-federal dams, including PG&E's, supports this notion that downstream entities do not bear responsibility for the watershed: "And FERC has been pretty consistent with that, is that that's not the responsibility of the licensee."[18]

In this formulation, the precondition for an ongoing PG&E contribution to restoration efforts is a direct, measurable, and positive relationship between the restoration projects and the availability of water for hydropower production. Moreover, the water yield would have to be sufficient to produce a net positive return on PG&E's financial investment in restoration. Given the high degree of variability inherent in California's climate and precipitation patterns, and the number of intervening irrigators and other confounding factors between the pond and plug sites in the high valleys and the hydropower facilities downstream on the North Fork, this is a very difficult, if not impossible, relationship to prove. The scientific uncertainty furthermore helps PG&E discount moral or ethical framings of the utility's relationship to the watersheds within which it operates: if there is no tangible, wealth-enhancing relationship between upstream watershed restoration and downstream hydropower production, then "It's a nice thing to do, [but it's] not our responsibility." Today, PG&E continues on as a signatory member and occasionally requests CRM help with specific problem sites, but is neither a core member of the group nor a significant funder.[19]

State water contractors: What about the Delta?

The California state water contractors, the water agencies that sell Feather River water throughout the state, have similarly invoked scientific uncertainty about the downstream benefits of watershed restoration to dismiss coalition members' calls for reinvestment. Through the terms of a legal settlement with Plumas County known as the Monterey Settlement Agreement, the contractors and DWR were required to contribute $8 million to watershed restoration in the past decade.[20] But they declined to continue funding for this program absent

[18] FERC is the Federal Energy Relicensing Commission, which is responsible for licensing non-federal hydropower generation facilities and overseeing their environmental compliance.

[19] FERC licensees are required to pay a fee to the federal government for the use and occupancy of federal lands. These fees are minimal and accrue to the U.S. Treasury. In Plumas County in 2014, the fee is $14.15/acre/year.

[20] The legal settlement resolved a lawsuit brought by Plumas County and others against DWR and the contractors for secretly renegotiating the terms of the state water contracts in a complex (and according to Plumas County, illegal) agreement called the Monterey Amendment in 1994. Plumas County – more specifically, the Plumas County

more conclusive evidence of climate change adaptation benefits and ecological benefits far downstream in the California Delta that would support their operations.

Through the terms of the Monterey Settlement Agreement, the Plumas Watershed Forum was created in 2003 to distribute $8 million in funds for watershed management and restoration projects in the upper Feather River Watershed "for the mutual benefit of Plumas County and the State Water Project" (Jones & Stokes, 2008, p. 1-1).[21] This funding supported a variety of watershed improvement projects by the CRM and other organizations, including several pond and plug projects. Members of the headwaters coalition also used the program as an opportunity to build relationships with the contractors, specifically through visits and tours of the restoration projects. Coalition members report that these tours were productive and that visitors were enthusiastic and supportive. After the first half of the program funds had been spent, the contractors hired the consulting company Jones & Stokes to conduct an independent review of the program. The review concluded that the program provided a positive return on investment in terms of delivering water to Lake Oroville, and that, if implemented watershed-wide, the meadow restoration program could provide an additional 110,000 acre-feet of water storage and provide for enhanced seasonal baseflows in stream and river channels during the drier months (Jones & Stokes, 2008). (A more recent review by Hoffman et al., 2013, casts doubt on these figures.)

Despite this positive finding, the state water contractors chose to cease funding of watershed restoration projects following expiration of the terms of the settlement agreement. A Plumas County insider attributes this decision partly to the fact that the contractors did not enter the relationship voluntarily: "That's one of the downsides of any arrangement that comes out of a lawsuit. It's kind of a shotgun wedding, and what do you do when the shotgun goes away?" But in explaining the decision to the county, the state water contractors invoked scientific uncertainties. Specifically, following the review, the contractors requested further analysis demonstrating benefits for climate change adaptation and for diverting State Water Project water downstream from the Delta, a practice that has impacted Delta hydrology and ecology and fueled California's ongoing water wars (Plumas County, 2008). The Plumas County insider relates:

> Then as soon as they…got this program review from Jones & Stokes, they turned around and came back with a whole list of new questions they wanted us to answer about how do we get the water across the Delta: "Just because you're generating it, how can we use it?" You could do that analysis, but if you look at all the effort, time, and money that has gone into modeling the Delta and still all

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Flood Control and Water Conservation District – itself is one of the 29 state water contractors since it distributes Feather River water for municipal and other use in the watershed. However, it was not invited to the Monterey negotiations. Among other issues, county attorneys were concerned about the implications of the Amendment for area of origin protections that guarantee the county's access to water for future growth.

[21] The program's four specific goals were to improve: 1) water retention, for augmenting stream baseflows, 2) water quality (particularly reduced sedimentation) and protection of streambanks, 3) vegetation management in upland forests, and 4) groundwater retention and storage in major aquifers (Jones & Stokes, 2008, p. 1-2).

> the uncertainty that you have, there's a point where they're reasonable questions and there's a point where people are just stonewalling.

The response of both PG&E and the state water contractors points to the difficulty of changing long-standing relationships that allocate wealth from natural resources, particularly when those relationships currently favor powerful interests. And the state water contractors include some extremely powerful interests, including the Metropolitan Water District of Southern California and the Kern Water Agency, which together control 73% of the water delivered by the State Water Project (which is the second largest water project in California, behind only the Central Valley Project). Although PG&E and the state water contractors paid for the infrastructure to generate hydropower and store and control the water, the water itself has always been free.[22] Watershed restoration likely would provide some tangible benefit to these operations, but for the beneficiaries, the setting of a new precedent of responsibility for the headwaters might outweigh this benefit. According to one CRM member:

> PG&E had to be real cagey about their involvement with us because they didn't want to set a precedent for any of the other hydro outfits that somehow the upper watershed was somehow their responsibility and they needed to invest in it. And they have fought tooth and nail, along with FERC, to keep upper watersheds out of the licensing process in terms of something…that the utility needs to invest in. And the water contractors are the same way. They do not want to get in the habit, or have the habit forced on them, that they have to reinvest in this place [the upper watershed] where gravity gives them the water for free.

Technocratic knowledge and the limits of PES

Whatever their motivations, downstream beneficiaries have invoked scientific uncertainties regarding the outcomes of meadow restoration as a central justification to oppose reinvestment. Moreover, as detailed in Chapter 4, the science is, in fact, uncertain: a number of factors make it difficult to quantify the hydrological effects of meadow restoration. These include climate variability, meadow variability, and uncertainties about groundwater movement and evapotranspiration in restored meadows. Downstream ranchers have recently called into question the initial hypothesis that the CRM and the headwaters coalition advanced about the hydrological effects of meadow restoration, particularly regarding the effects on late summer baseflows. PG&E and the state water contractors have debated these effects all along.

To make the case for reinvestment, headwaters actors drew on early data that suggested watershed restoration had benefits for water storage and runoff timing. But more recent analyses have painted a more complex picture, particularly by indicating that restoration may actually decrease stream flows in the summer late season – a critical time for downstream

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[22] According to DWR: "the contractors repay principal and interest on both the general obligation bonds that initially funded the Project's construction and the revenue bonds that paid for additional facilities. The contractors also pay all costs, including labor and power, to maintain and operate the Project's facilities" (California Department of Water Resources, 2013).

irrigators – and, by increasing evapotranspiration, slightly decrease overall runoff. Ongoing studies may help clear up some of these uncertainties. But it is questionable, even if the findings favored the coalition's position, whether they could achieve sufficient certainty to force policy change. The scientific uncertainties are daunting and complicated even further by climate change. Historically, the downstream beneficiaries have received the water with little requirement for upstream investment, so the status quo is highly favorable to their interests.

From the perspective of coalition members, the downstream beneficiaries' resistance to reinvestment reflects their political interests and an engineering worldview deeply embedded in current water supply management institutions in California. CRM members say that the state's water engineers routinely dismiss the notion that watershed restoration in the Sierra can provide tangible water supply or flood protection benefits downstream, instead putting their faith in engineering approaches. One informant explains:

> Even if the watershed isn't working right, it doesn't matter. They are engineers. All that water comes down and when it ends up in Oroville, they can count it. They've got that reservoir parsed to the gallon…. They're like Midas; they can count it. If it's up here in these meadows, even though our data shows it coming down later, they can't count it. They just can't count it as engineers, and so they're nervous.

To be sure, the pond and plug technique substantially re-engineers meadow systems. But unlike dominant approaches to water supply management, it does so at multiple, decentralized sites and in ways that seek to mimic a more "natural" (i.e., pre-European) state, with multiple benefits. The CRM perceives that, accustomed to controlling nature at large scales, engineers distrust methods that rely on nature to do the job of storing or moving water. Debates over vegetation on project plugs are a good example. During pond and plug construction, the CRM plants vegetation to anchor the plugs. As one CRM member explains: "The engineer mentality doesn't like this because it views vegetation as a hazard: plants can undermine engineered structures. But in pond and plug, vegetation growth on the structures [plugs] provides armoring that gets stronger every year, as the plants grow." Echoes of this same debate have played out recently on a larger scale downstream, as a conflict between the Army Corps of Engineers and the state over vegetation on the levees in the Sacramento-San Joaquin Delta.

Institutions of state and federal government reinforce a piecemeal and engineering logic. For example, budgeting incentives in California's state government tend to reward crisis-driven programs rather than those that aim for long-term, multi-benefit integration, like CALFED's watershed program. Water governance is also extremely fragmented in California, so that different entities deal with water supply, quality, flood protection, and habitat. This fragmentation, and turf battles to secure funding and autonomy, limit program integration and the development of larger systems perspectives. Fragmentation is enhanced geographically by the rim dams, located at the base of the mountains, that pool Sierra rivers into huge reservoirs and effectively sever the ecological and hydrological connections between upstream and downstream. For example, when CALFED was issuing grants for floodplain restoration under its Ecosystem Restoration Program, officials resisted funding a pond and plug project in the Feather River watershed because they did not believe that headwaters restoration could have beneficial effects for California water supply downstream. In 2000, CALFED finally awarded the money for the Upper Last Chance Creek Project, but only in response to the threat of legal action by the County.

Within this institutional and ideological context, powerful downstream beneficiaries have successfully resisted the pressure to fund headwaters restoration on an ongoing basis. Moreover, the reinvestment frame itself has provided an escape hatch. This is because, as conceived in this case, a public goods charge (or other reinvestment funding mechanism) opened the door for the beneficiaries to demand a technical accounting of the "services" produced by watersheds and of the specific, quantifiable financial benefit they would receive from restoration. Scientific uncertainty makes this difficult, if not impossible. The most recent analyses cast significant doubt on the existence and magnitude of water supply benefits although some runoff timing benefits may occur. The lack of quantifiable restoration benefits also helped downstream beneficiaries reject claims that they bore ethical responsibility for the watershed's condition.

In contrast, the coalition's efforts to make California water policy (and to a lesser degree national forest management policy) more attentive to watersheds and headwaters have been more successful, in the form of revised policies, new policy initiatives, and grant funding for watershed restoration. These latter reforms do not depend on quantification of water supply benefit to justify spending money. It is enough to convince policy-makers that restoration work is probably good for water supply and flood protection and certainly provides a host of other ecosystem benefits.

CONCLUSIONS: THE POLITICS AND PITFALLS OF REINVESTMENT AS A FRAMING DEVICE

This chapter has shown how the headwaters coalition used the reinvestment frame as a political strategy to link restoration projects with downstream benefits and thereby access some of the wealth created by their watershed. This frame used the sponge metaphor to evoke the hydrologic services that headwaters meadows provide for California. And it invoked a market-based logic, consistent with recent societal preferences for non-state and market-oriented policy approaches, to describe downstream actors as beneficiaries who should reinvest in the watershed. This frame successfully highlighted the connections between upstream and downstream and has helped garner significant restoration funds and some favorable policy shifts for watershed communities. But it also largely rendered the upstream-downstream relationship as a financial exchange dependent on a technical accounting of the water supply service provided. Scientific uncertainties impeded this technical accounting and provided an escape hatch to reluctant downstream buyers. This section concludes by discussing the politics of this interaction between upstream and downstream in the context of the increasing popularity of PES approaches.

First, this case shows that history matters: that is, historically structured relations of resource control shape the possibilities for PES policies today. The historic relationship between headwaters communities and downstream beneficiaries of water and hydropower resources is a critical piece of the larger context within which Feather River headwaters restoration takes place. Extraction of natural resources – water, hydropower, timber, minerals, and agricultural products – has long shaped the social and biophysical landscape of the Feather River. As with other resources, the export and distant consumption of water and hydropower have made the headwaters virtually invisible to downstream water and hydropower consumers today. This invisibility has supported the beneficiaries' efforts to avoid responsibility and authority for the watershed's social or environmental wellbeing.

Second, in this case, a policy frame resting on PES gives the more powerful actors an unexpected advantage in controlling the debate. The market-based logic of PES legitimates a particular kind of knowledge – a technical accounting of water supply "services" provided by a watershed and enhanced through restoration projects. This knowledge overshadows other forms of knowledge – like an understanding of inequitable social-historical relations between people and places, or a notion of social or corporate responsibility to natural systems for providing the resources that create profit and sustain societal well-being.

Third, on a policy level, this case suggests that voluntary investment in the headwaters via PES instruments is unlikely absent unambiguous evidence for financial benefits to downstream entities. What is more, this evidence may be virtually impossible to amass – even with sustained and comprehensive monitoring – in an environment as variable as the Sierra Nevada and in the context of climatic disruptions caused by global warming. This case does not contraindicate PES in all cases, but it does cast doubt on the breadth of its applicability. It suggests that PES approaches are better suited to situations where scientific uncertainties are fewer and that, if headwaters restoration is a priority, government action will be necessary to ensure sufficient funding for it.

Fourth, a focus on water as a particular ecosystem service has potential to undermine other reasons to restore these ecosystems: in this case non-water related benefits such as habitat value, cultural significance of meadows, and moral or ethical reasons, i.e., because it is the right thing to do. These reasons do not factor in to a PES logic because they do not generate payments in return for services. PES also obscures other ways of understanding the upstream-downstream relationship: for example, a sustenance-based understanding that people who live downstream depend on Feather River water to sustain their physical bodies through consuming water and the food that is grown with it. This sustenance relationship may be more intimate, meaningful, and grounded than the abstracted financial relationship implied by PES, yet has no relevance in any existing policy frame, PES or otherwise.

Finally, this study takes place at a moment when environmental governing philosophies are shifting and unsettled. It thus provides perspective on PES as a political tool in the ongoing American competition over control of natural resources. This case makes clear that PES is not just a conservation tool but also a political strategy. It is invoked and negotiated in ways that are strategically political, as different actors try to challenge or uphold existing policies and the resulting relationships of control over nature and access to the financial wealth it creates.

Chapter 6: Navigating conflict, scientific uncertainty, and political risk: Headwaters restoration and the Forest Service

This chapter examines the role of the U.S. Forest Service in collaborative headwaters restoration, particularly in the context of scientific uncertainties and tensions over watershed resources. The Plumas National Forest manages approximately 50% of the Upper Feather River watershed and has been a key partner in headwaters restoration efforts led by the CRM.[1] With a long history of collaboration, the Feather River case offers unique insights into the role of Forest Service participation at a time when the agency increasingly stresses collaborative approaches and highlights the role of the national forests in producing the nation's water supply. These two new emphases, on collaboration and water, stand in contrast to the agency's historical autonomy and its tendency to prioritize extractive uses of the national forests, particularly for timber, in the latter half of the 20th century.

The Forest Service has traditionally viewed itself as a technical agency that uses its scientific expertise to manage forests in ways that are politically neutral and that serve the public interest. Restoration of the Feather River headwaters challenges this identity because it is not merely a technical affair; rather, like many resource management issues, it is bound up with questions of decision-making power and distributions of risks and resources. For example, the headwaters coalition has invoked the downstream benefits of meadow restoration to challenge downstream beneficiaries' lack of financial responsibility for the watershed. But other watershed residents have raised concerns about restoration risks; most notably, downstream ranchers fear that pond and plug projects decrease stream flows for irrigation and have challenged the legitimacy of the Feather River CRM to conduct these projects. Contentious national forest management politics in the region have also affected watershed restoration efforts. Public lands and resource management are often characterized by conflicts and politics like these. Yet few studies have contextualized public agency engagement in collaborative, cooperative, or community-led management efforts within such political contexts. Instead, most research has viewed the government role in collaborative governance primarily in light of organizational and institutional challenges.

To better characterize the multiple forces acting on agencies in collaboration, this chapter asks how the Forest Service has engaged in collaboration in the Feather River case and how this engagement intersects with watershed politics. It also places this case in the wider context of national forest management, conflict, and the agency's increasing embrace of various forms of collaboration and partnership. First, I briefly review the academic literature on the role of government in collaborative governance. Second, I provide context on the agency's evolving approach to resource management, including an emerging focus on headwaters and collaborative governance, and I discuss how collaboration departs from the agency's traditional scientific management approach. Third, I detail how the Plumas National Forest has

[1] In total, federal lands comprise roughly 65% of the watershed, including small portions of the Lassen and Tahoe National Forests and Lassen Volcanic National Park (Ecosystem Sciences Foundation, 2005).

participated in collaborative watershed restoration efforts in the Upper Feather River watershed, and how intertwined organizational and political forces shape the agency's engagement. My findings reveal that the forces acting on the agency in collaboration are quite similar to the forces acting on it in any conflict over national forest management; how the agency responds to these forces is also similar, including a preference to avoid political conflict and to focus on finding technical solutions. While collaboration provides a form of democratic legitimacy that can aid the agency in making decisions in the midst of conflicts, the messiness of long-term collaboration, with its shifting political implications, also complicates the agency's position.

LITERATURE STRESSES ORGANIZATIONAL BARRIERS TO GOVERNMENT COLLABORATION

Since the 1990s, and accelerating in the past decade, Forest Service leaders have emphasized collaborative approaches to forest management. This trend is a significant departure from prior approaches emphasizing scientific management (or its more recent incarnation, ecosystem management). Most research on how agencies engage in collaboration has focused on institutional and organizational barriers. But researchers across a range of environmental governance subfields increasingly recognize the political dimensions of collaboration. At the same time, there is increased recognition that government agencies have an important role to play in collaboration. As such, it becomes necessary to understand how political context, alongside organizational and institutional factors, shapes agency engagement in collaboration.

Christopher Ansell (2011) suggests that in collaborative governance, "public agencies become the linchpins of [a] more compound democracy" that balances traditional, top-down authority through representative government with local-problem solving efforts (p. 192). In this view, accountability derives not just from top-down policy implementation but also from the bottom-up efforts of agencies to resolve problems and conflicts with local constituents. This kind of bottom-up, context-sensitive accountability can serve as a kind of counterweight to the problems of top-down accountability: its susceptibility to pathological contemporary national politics and its unrealistic separation of politics and administration (Ansell, 2011; Brunner et al., 2002). As such, it also suggests the need for more agency discretion in decision-making and management of complex and wicked problems, compared to top-down command and control approaches that have proven ineffective (Ansell, 2011).

Research has showed that collaborative resource governance poses many challenges to Progressive Era agencies like the Forest Service, emanating in large part from their technocratic, fragmented, and bureaucratically rigid institutional features. Collaboration requires new skill sets, resources, and time; supportive leaders, agency policies, and procedures; and navigation among a diverse set of roles, including convener, stakeholder, leader, technical expert, and decision maker (Yaffee & Wondolleck, 2003). In contrast to creative problem-solving and diverse participation, "bureaucratic styles are more likely to emphasize hierarchies, maintenance of organizational mission, and standard operating procedures and control" (Yaffee & Wondolleck, 2003, p. 66). These styles derive largely from the separation of politics and administration in traditional models of bureaucracy. Collaboration can also challenge a technical agency's authority and identity by opening decision-making to non-experts. Finally, problems can arise from how agencies view their role in collaboration relative to the public interest: “Their role is not solely to facilitate a balance between the interests at stake, but to contribute to and legitimize the best solutions to public problems as framed by their missions,” and “These solutions are not necessarily defined by any balance point that can be agreed-upon by the parties” (Yaffee & Wondolleck, 2003, p. 67).

Despite recognition that collaboration takes place in a complex political landscape, existing research, particularly in the U.S., has focused primarily on micro-level group processes rather than these macro-level influences. Supporters often view collaboration as a way to move beyond the pathologies of resource management politics and the intractable conflicts they breed. They suggest that collaboration can produce a shared understanding of complex systems that allows for creative problem-solving and positive-sum solutions that rigid bureaucratic decision-making processes are unlikely to find. They tend to view competition between interests with unequal power, and between interests at different scales (i.e., local, regional, national), as reconcilable, if imperfectly, through the group process. In this view, participation by government actors further ensures accountability to multiple constituent groups at different scales. Yet few studies have actually detailed agency actions in collaboration and how they are informed by larger political contexts and by such imperatives as avoiding political risk, appearing neutral, and retaining decision-making power. This bias perhaps derives from the early tendency to view collaboration as a shift “from government to governance,” which downplayed the role of government or framed its participation as primarily an organizational challenge (Getches, 2000).

Martin Nie charges that: “collaboration can be oversold by its proponents, usually by oversimplifying the larger political context” (2008, p. 254). Some scholars of watershed governance have long warned of this problem, and scholars of commons governance and adaptive management increasingly share the critique (Armitage, 2008; Blomquist & Schlager, 2005; Singleton, 2002). They point out that normative preferences for collaboration and lack of attention to political context may contribute to a high rate of failure and generate unintended negative consequences. In a case of collaborative resource management failure in Northern California, Walker and Hurley (2004) write: “collaboration is best understood not as a way to get ‘beyond’ politics but as a different form of environmental politics. Because it makes choices that determine how resources will be used, [collaboration] is inherently political” (p. 737, citing Amy, 1987). They conclude that critiques emphasizing institutions and processes of collaboration overlook the importance of politics, defined through a political ecology lens as: “the exercise of power as a social relation built on asymmetrical distributions of resources and risks” (p. 737, citing Paulson et al., 2003).

Inequitable power distributions and self-interest, including among government actors, may pose more problems than often acknowledged: “While some view collaboration as a totally voluntary and cooperative act, that perspective often misses an important point. People act collaboratively largely as a strategy for achieving their own interests” (Yaffee & Wondolleck, 2003, p. 69). Moreover, these interests may include retention of power and control (Brower et al., 2001; Singleton, 2002). Interests that benefit from entrenched, top down management systems often resist decentralization, particularly: “Local elites and businesses...; large resource users; government technocrats wary of ‘external’ interference…; and public officials at higher levels of government” (Lemos & de Oliveira, 2004, p. 2125). Collaborative efforts may have a tendency to exclude some voices, particularly environmental ones (Coggins, 1998; Kenney, 2000). For government actors, incentives to collaborate may include spreading political risk, diluting accountability, and replacing disruptive conflict with some sort of process, even a faulty process with questionable outcomes (Brower et al., 2001; Lach et al., 2005a).

Despite the complicated position from which they engage, agencies are powerful actors in collaborative governance, with resources, democratic legitimacy, legal authorities, and jurisdictions over large swaths of territory. As such, they can serve as “focal points for the creation of problem-solving publics” (Ansell, 2011, p. 18). But how they choose to use these resources in collaboration may also play a decisive role in the outcomes and thus matters, not just in an organizational sense, but also in a political one. In this context, this chapter asks how the Forest Service has engaged in collaborative headwaters restoration, and how its actions are influenced not only by organizational factors but also by the political environment within which the agency operates. Secondly, it asks how the agency’s choices about collaboration might, in turn, influence dynamics of political control over decision-making and resources in the watershed.

CONTEXT: EVOLVING AGENCY APPROACHES TO RESOURCE MANAGEMENT

The Forest Service is the most significant manager of headwaters regions in the Western United States. In the 11 coterminous Western states, Forest Service lands occupy about 21% of total surface area but serve as the origins for 51% of total water supply runoff. Similarly, California’s national forests comprise 20% of the state’s land area and produce about 47% of the state’s water supply runoff (Brown et al., 2008).[2] This water supports not only human communities but also aquatic ecosystems and species. The agency’s prominent position in the headwaters reflects its genesis under 1897 Organic Act, which specified that national forests (then forest reserves) be managed for two primary purposes: to “[secure] favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States.”

However, critics charge that the Forest Service lost sight of its water mandate as it prioritized commodity production throughout most of the in the 20th century. In 1994, in his history of national forest management since World War II, Paul Hirt wrote: “Despite the obvious social and ecological centrality of watersheds, the most neglected of all national forest management programs is soil and water protection” (Hirt, 1994, p. 103). In contrast, recent Forest Service reports, statements by agency leaders, and interviews conducted for this research indicate that the agency increasingly highlights the production of high-quality water as a central management goal (Furniss et al., 2010; Sedell et al., 2000). A Forest Service report released in

[2] Other federal agencies also manage significant headwaters regions. In the Western U.S. and California, respectively, 66% and 61% of the water supply originates on federal lands.

2010 named watershed services as the most important ecosystem service that national forests provide (Furniss et al., 2010).

The agency has typically interpreted its water mandate as concerned primarily with quality. The quality of water deriving from national forests is generally high, but “forest management can have major effects on water quality—affecting temperature, nutrient loadings, sediment yields, and toxic contaminants” (Sedell et al., 2000, p ii-iii). Drivers of these impacts vary but often include abandoned mining sites, silvicultural practices, intense fires, and extensive road networks, which pose a major sedimentation issue in California’s national forests. Road-induced sedimentation, streambank erosion, and old mining sites are the largest water quality concerns for the Plumas National Forest. Nationwide, road construction in national forests accelerated in the 15 years after World War II, when 65,000 miles of roads were constructed, primarily to facilitate timber access (Hirt, 1994). The timber sale receipts that funded maintenance for these roads declined in the late 20th century with the drop in harvest levels.[3] While the agency has taken steps to minimize the impacts of forest roads, plans to shrink the road network throughout California’s national forests have met strong resistance from vocal off-highway vehicle enthusiasts. The California regional office of the Forest Service (Region 5) updated its water quality management practices in 2011 in collaboration with the State and Regional Water Boards. The agency’s approach to protecting water quality relies primarily on implementing best management practices, such as buffer zones around riparian corridors during forest harvest operations.[4] It also directs national forests to identify priority watersheds for improvement work.

While water quality remains the agency’s central focus, climate change and water scarcity have also piqued interest in the relationships between national forest management and downstream water supply. Noting the lack of paired-watershed studies in the Sierra, one recent review suggests that a sustained 40% reduction in forest cover in Sierra watersheds could increase average water yield by 9% (Bales et al., 2011). This finding contrasts with earlier analyses, including one of the Plumas National Forest, that have concluded that effects of forest harvests on water yield are likely minimal and short-lived (Sedell et al., 2000; Troendle et al., 2007). More research is also needed to understand the relationships between management practices and timing of flows. Timing effects are complicated and likely highly variable from site to site, but may prove significant in the light of the need to adapt to climate change, which is resulting in more rainfall and less water storage in snowpacks. Water quality and supply are also interdependent in some respects; for example, reducing sedimentation into downstream reservoirs can increase water supply capacity.

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[3] Timber sale contracts required a road maintenance package, in which the timber operator would make needed road improvements such as culvert cleaning, grading, putting in rolling dips, and watering the road to reduce erosion. With decline of the timber sale program, the Forest Service lost its primary mechanism for maintaining forest roads. One long-term Plumas National Forest employee says: “I think sometimes when we had a robust timber economy, we were doing a much better job of maintaining our roads and reducing sediment in one aspect because our roads…we regularly maintained them. Now that we’re relying on appropriated dollars to maintain roads, we may actually be losing ground.”

[4] See the Region 5 Water Quality Management Handbook (USDA Forest Service, 2011).

The agency's renewed focus on watershed management coincides with an emphasis on collaboration with other agencies, stakeholders, and partners: "Only through collaborative efforts can watersheds be restored and managed to be resilient in the face of climate change" (Furniss et al., 2010, p. 42). Partnerships between the Forest Service and downstream entities are emerging across the West to enhance headwaters' capacity to provide high-quality water supplies. For example, Denver Water, a municipal water provider, and the Forest Service in Colorado have developed a "Forests to Faucets" partnership program to conduct forest management and wildfire protection treatments on national forest lands that supply Denver's water. Previous fires in the watershed filled Denver Water's reservoirs with sediments and debris and increased water treatment costs. The agency also emphasizes techniques including market valuation and connecting downstream water users to the fate of their watersheds (Furniss et al., 2010). More generally, the agency has advocated partnerships and collaboration as tools to leverage financial and other resources, address complex management problems using integrated and context-sensitive approaches, promote more democratic decision-making, and improve relations with local communities. For example, the new Planning Rule, finalized in 2012 after decades of contention, emphasizes collaborative approaches in developing new national forests plans.

Yet, as many scholars have pointed out, the turn toward collaboration runs contrary to the Forest Service's historical approaches based on scientific management (Brunner et al., 2002). Founded in 1905, the agency operated for much of the 20th century under a philosophy of scientific management: that neutral government experts could best promote conservation through rational management and by prioritizing efficiency as a central principle (Fairfax, 2005; Hirt, 1994). The technocratic logic remains embedded and may undermine more effective and meaningful agency engagement with civil society (Fairfax, 2005). Moreover, the agency's competence as a technical agency has been challenged. Historical accounts have shown that the focus on technical efficiency facilitated deference to extractive industries, which could operate on large economies of scale to efficiently produce resources, and that the ideal of scientific management ironically fed the politicization of forest science (Langston, 1995; Schiff, 1962). In practice, technocratic approaches often served the interests of power and privilege in the American West, producing unintended and negative consequences for rural communities, laborers, and ecosystems (Baker & Kusel, 2003; Espeland, 1998; Hirt, 1994; Langston, 1995; Romm, 2002; Worster, 1985).

The agency's structures, norms, and operating procedures in many ways seem anachronistic. Early agency leaders were attuned to the administrative and political challenges of managing a far-flung, diverse land base; dangers particularly included bureaucratic fragmentation and "capture" of officials by local interests. Kaufman (1960) showed how the agency managed these dangers with structural and procedural approaches that included issuance of direction and authorities from the national level, inspections of local units, uniform reporting requirements, and centralized budgeting procedures. Thus while forest supervisors and district rangers enjoyed decentralized decision-making authority that enabled them to deal with the complexity of local issues, these "line" positions were also in a direct, hierarchical chain of command going up to the Chief, and agency structures and procedures served to limit their actual discretion. The agency also cultivated employees with "the will and capacity to conform," for example by hiring foresters for nearly all (Kaufman estimated 90%) of its resource management positions, by developing a sense of personal identification with the agency, and by frequently moving forest supervisors, district rangers, and other resource managers. This approach prevented "capture" by local interests and generated organizational loyalty, further ensuring that line officers' decisions would reflect the agency's positions and interests.

While Kaufman largely viewed the Forest Service as a case of administrative success, he noted some potential dangers. First, frequent transfers of personnel could prevent sufficient familiarity with local contexts, including social, to inform proper management. Second, through "indoctrination" and uniformity of organizational values: "An organization can be afflicted with a paralyzing rigidity, a stubborn clinging to tried and true methods, familiar goals, established programs. If conditions were stable, this policy would be perfectly adequate. But conditions change. Organizations, to survive, must change with them" (Kaufman, 1960; 2006, p. 235-236). Kaufman was optimistic about the agency's capacity to adapt; similarly, Clarke and McCool (1996) viewed Forest Service power, compared to other natural resource agencies, as flowing from its ability to adapt to changing circumstances. But by 2006, Kaufman saw that the agency's uniform identity had become a liability: viewing themselves as crusaders against political whim and "special interests" (environmental, recreational, and civil rights), employees resisted adaptation to contemporary contexts and the agency lost public legitimacy (Kaufman, 2006).

Throughout its history, but particularly since the 1960s and 1970s, the Forest Service has struggled to meet the competing demands of different interest groups. These contests play out not just locally, but across multiple political venues including Congress, the courts, and the Executive Branch, each of which gives orders (often conflicting) to the agency. This political context complicates the tension between local agency discretion and top-down, prescriptive decision-making (Nie, 2008). From the top-down, public land laws are characterized by ambiguity and contradiction, often because politicians wish to avoid making difficult political decisions. In practice, this ambiguity tends to give agencies the difficult and contentious job of making decisions with political trade-offs between different values and interests. For example, the 1969 National Environmental Policy Act (NEPA) and the 1976 National Forest Management Act (NFMA) established a new model of forest planning under which "the venue of conflict has shifted from Congress to the bureaucratic arena" (Nie, 2008, p. 172).

Yet the "scientific management" paradigm under which the agency has traditionally operated and the "rational-comprehensive" model of the modern environmental planning paradigm undermine the agency's ability to successfully manage conflict. Specifically, both have a tendency "to camouflage value-based political conflicts as scientific-technical ones" (Nie, 2008, p. 172). That is, decisions are to be made on the basis of science and without explicit recognition of the political trade-offs they entail. In reality, while science can inform public lands management, often the most difficult questions are not scientific but rather revolve around how to distribute resources and risks among actor groups with competing values and interests. Yet these can rarely be addressed head-on in planning processes, which instead revolve around predictive (and competing) science, a focus that tends to obscure the political tensions without resolving them. Nie views the pathologies of this planning model, alongside other factors like increasing scarcity and complexity, as a key driver of high levels of conflict in national forest management today.

Intractable conflict, in turn, is a key driver of increasing efforts to govern public lands and resources collaboratively. Indeed, many people view collaborative governance as a way to move beyond these modern pathologies of fragmented public lands management and intractable conflict. Yet politics are inherent in systems that allocate resource control and access. Thus the value of collaboration must lie not in any capacity to escape politics, which is unrealistic, but rather in its capacity to address shared problems and resolve political conflicts more effectively.

WHAT SHAPES AGENCY COLLABORATION: POLITICS AND ORGANIZATION

Plumas National Forest collaboration in headwaters restoration has taken place primarily through the Feather River CRM and secondarily through the Upper Feather River Integrated Regional Water Management (IRWM) planning process. Recognizing that collaboration increases its ability to restore the watershed, the Forest Service has been an active partner in these efforts since their inception and has worked to improve its organizational partnering capacity. But political dynamics have also complicated the agency's position, particularly with respect to the CRM as this group developed the controversial pond and plug technique, launched wider policy advocacy efforts to impel downstream beneficiaries to fund watershed restoration, and attracted the ire of downstream ranchers concerned about stream flow effects. The agency has positioned itself as a neutral actor with respect to these controversies. This position may be appropriate in light of scientific uncertainties regarding the benefits and impacts of pond and plug, but it may also serve to reinforce historic and unfair distributions of power and control over valuable resources.

Benefits and incentives for collaboration

The Plumas National Forest was one of the original signatories to the 1987 Memorandum of Understanding that formalized the CRM as a partnership between multiple state and federal agencies, resource conservation districts, Pacific Gas & Electric Company, and Plumas County to reduce erosion in the East Branch North Fork Feather River watershed. About half of the CRM's watershed restoration projects include Forest Service land. Prior to the recent eruption of conflicts with downstream landowners, most observers viewed this partnership as very successful, notwithstanding some tensions in agency-CRM working relationships.

Comments by one PNF employee underscore the importance of the partnership:

> Our number one partner for watershed work is the Feather River CRM and I'm blown away with how much can get done with partners on the national forest. I'm really shocked. It's almost like having an extra interdisciplinary team or extra district staff that's focused solely on project development and implementation. Sometimes we host field trips, like we've had some people from the Washington [D.C.] Office on the Ecosystem Services group…come out and look at watershed

> restoration projects. But we take them to the CRM stuff [rather than Forest-led projects] because they do such good work. And I mean, its not like we don't have any involvement with the CRM projects. We do a lot to support those projects at all levels of the organization. But it wouldn't all get done. They are the main driving force for getting their projects done, and they've become the main driving force on projects we get done. And it's a real nice way to kind of divide and conquer the work.

Continuing a historical pattern, Forest Service funding remains insufficient to effectively protect and restore watersheds for water quality and supply purposes. An interviewee who has worked closely with the Forest Service on water quality issues says: "The Forest Service is a very large institution and they have a whole lot of ground to manage, and they don't have a lot of money to maintain their infrastructure [particularly roads], so they just have a pretty daunting task." As federal budgets and timber receipts shrink, grants and other external funding sources are increasingly important and create incentives for working with partners. One insider related that, without the CRM, funding for watershed projects would be much smaller, on a scale sufficient for techniques like rip-rapping eroding stream banks rather restoring large meadows and floodplains. But while the partnership facilitated a more hands-on watershed restoration approach, it did so over the reservations of some agency employees who preferred a more conservative approach. In at least one case, a reluctant employee was compelled by forest leaders to work with the CRM on these projects regardless of their philosophical differences. In other cases, employees have yielded to the powerful tide of pond and plug despite their personal reservations.

Partly for budgetary reasons, the Forest Service increasingly relies on partnerships to address core program needs.[5] An agency hydrologist reports: "It really helps to have other [partners] like the CRM, because although I may be able to get something done, there is so much more out there [that needs to be done]. And there is a lot of [Forest Service] bureaucracy that gets in the way of implementing projects as well as lack of funding and manpower." Indeed, the CRM has been the leading force in funding, planning, and implementing watershed restoration projects in the Plumas National Forest, particularly using the pond and plug technique. CRM staff members prepare required NEPA planning documents for projects on national forest land, and, in terms of the partnership, the primary role of agency personnel – typically district-level specialists in each resource area, including hydrology, botany, fisheries, wildlife, and archaeology – is reviewing and approving these documents.

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[5] One senior employee relates:

> For much of my career I saw most of our outside partnerships were primarily either wildlife or recreation. The warm fuzzies that people like. And it's only been in more recent years I've seen more of that kind of partnering about things that aren't quite so warm and fuzzy, whether it's noxious weed treatment [etc.]. I think everyone recognizes times are tough. Nobody has the budget they want, and so we need to combine resources to get the work done. And so I'm seeing a lot more [programs] finding their partners now. So I think that's a very, very good thing….It makes the dollar go further, and things are better coordinated.

Both the CRM and the IRWM efforts have provided significant funding for watershed restoration on national forest lands. One employee relates: "In the Forest Service a lot of people look at the CRM, are envious of our relationship with the CRM. They've brought so much work to the forest; I think it's like $8 million worth of work. That's big money for Forest Service watershed. It's been great, we've gotten a lot of work done." The Forest has also received significant funding through the Upper Feather River IRWM program, which has won competitive state grants for regional collaboration to secure regional water supplies. In 2007, the region won a $7 million IRWM grant, of which about $2 million were allocated to the Plumas for a variety of projects including fixing or eliminating roads, stream restoration, and new restrooms for recreational sites.

Grant funding, particularly through the IRWM program, has enabled the Forest Service to hire extra staff for watershed work, including a forest-level watershed program manager who acts as liaison to the CRM, the IRWM, and other partnerships. During the period when fieldwork was conducted for this study, the Plumas also employed a full-time Partnership Coordinator who assisted with these and other partnerships.[6] This staffing arrangement has allowed the agency to improve communication and coordination with the CRM staff and ease the burden of partnership coordination on district-level staff members that have struggled with heavy workloads. These heavy workloads derived in large part from the Forest's efforts to implement the Herger-Feinstein Quincy Library Group Act (HFQLG), which largely shaped management priorities for the period during which I conducted fieldwork for this research.

The financial and other resources that collaborative efforts bring to the Forest Service are significant and are important incentives for the agency to collaborate. But it must be noted that these resources also serve as a source of power to the CRM and its preferred pond and plug technique, and this power shapes how the agency addresses internal disagreements about pond and plug and whether or not it is consistent with the agency's mission. On the other hand, the CRM's power also derives from the agreement by multiple stakeholders of the appropriateness of pond and plug, a result of long-term collaboration that enjoys a kind of bottom-up democratic legitimacy.

Collaborative watershed restoration competes with other priorities, goals, and ideas
HFQLG implementation was one of several competing forest priorities that often undermined employees' ability to attend to the CRM partnership. These competing priorities largely reflect the agency's multiple use mandate and its need to be responsive to shifting politics at local, state, and national levels. The requirement that the agency manage resource in accordance with multiple uses and considerations, e.g., for fish and wildlife habitat as well as for watershed hydrology, also engenders reservations among some employees regarding pond and plug, the CRM's main restoration technique.

[6] As of January 2014 the Plumas National Forest was seeking to re-fill this position, which has been vacant for several years.

The 1998 HFQLG Act directed the Plumas and two other California forests to implement a Community Stability Proposal developed collaboratively by the Quincy Library Group, which represented a diversity of local interests with a history of conflict.[7] Becker et al. (2013) outline the goals of the HFQLG Act:

> The Community Stability Proposal recommended a suite of forest restoration treatments be undertaken across 1.53 million acres of land within the national forests to simultaneously improve economic stability of the local communities, reduce the size and severity of wildfires, protect the California spotted owl population, and improve the condition of water resources.

In the 2000s, Congressional appropriations for implementing HFQLG constituted the largest funding source for watershed projects in the Plumas National Forest and enabled the forest to increase staffing for this work. One employee estimated that the Plumas more than doubled its permanent hydrology staff and hired more temporary staff. In 2010, the forest had seven permanent hydrologists on staff, compared to perhaps two or three hydrologists in a typical national forest.

But while HFQLG included language about riparian protection and watershed monitoring and increased the Plumas's appropriation for both forest management and watershed restoration, in practice the focus of implementation was on forest thinning projects supported by the timber sector of Plumas County. Watersheds were a secondary focus. One employee comments: "QLG legislation has this timber side and the water management side, and they should be on equal footing, but people aren't kicking and screaming as much for watershed restoration as much as they are *for* timber work, or for *no* timber work. So it gets the focus."[8] Furthermore, a recent independent evaluation of the HFQLG program concluded that a watershed protection program indicated by the Act was never implemented (Becker et al., 2013). Interviewees I spoke to indicated that watershed actions specified in vegetation management projects focused on best management practices to protect streams during logging operations as well as on fixing and/or eliminating problematic roads. Projects like stream bank stabilization were typically incorporated as part of these larger thinning projects.

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[7] Although HFQLG helped resolve bitter conflicts within the community, it also generated fierce opposition by some non-local environmentalists, and rankled some watershed residents, who saw this "collaborative" effort as in reality dominated by timber interests.

[8] During my fieldwork, in public meetings and presentations regarding HFQLG implementation, I increasingly saw QLG members frame forest management in terms of its value for water supply. Some coalition members view a water-related framing as a way to reduce the leverage of environmentalist opposition that has often blocked implementation of HFQLG projects. But some coalition members also think it's too little, too late:

> I think [making watersheds the focus of QLG] was too far outside the box, for too many. The QLG was an outside the box thing and I'm not saying that they're boneheads. They're not. But it was another layer outside that box, they just couldn't get there yet. And they haven't, yet. Even though they're trying, more and more, to tie the water to the program. They're trying to tie water to the tail and make it smell good, and they haven't put the water up front, really. They're just trying to make the program look better to Feinstein and others by at least getting water in the discussion. But in terms of really being proactive in advancing the program, or the program of work that [the CRM] program has started, it hasn't gone there.

Another agency informant, employed in a leadership capacity, commented on how the political landscape of HFQLG implementation overshadowed watershed restoration:

> The veg[etation] management component to the forest is still big and that's the QLG side. We're required to implement that legislation. We get money to do it and Senator Feinstein asks about it and we have to do it. So in a way we don't have much of a choice. That's what we get funded to do. Part of that is the watershed restoration side but it seems to almost take a backseat to be honest. So we gotta push it out in front, saying remember this is part of the legislation too. But the QLG group doesn't ask about those projects. It asks about the projects that create wood. That's their interest. That's that sector of Plumas County. So we have to push for it, and [remind people that] this is part of the QLG legislation too and we need to do it. So it doesn't get as much emphasis, I would say. Not that we are not doing it, but it's not quite as talked about.

The huge workload of vegetation management projects under HFQLG meant that hydrology staff spent the vast majority of their time on environmental analyses for these projects. Informants report that these environmental reviews, required under NEPA, became more detailed and work-intensive in response to the high rate of appeals and litigation associated with HFQLG projects. One informant described how this situation influenced project work: "The litigation in this region, and probably others though maybe to a lesser degree, has made the agency really reactive. You are writing reports for a judge. The mentality is that it's a battle. It's a really different mentality than 'we need to do something good out there.' Instead it's: 'until it's mandated, it's not our priority.'" In addition, the heavy workload of HFQLG implementation left employees stretched thin and limited their capacity to engage in CRM projects. One manager commented: "It's an opportunity for us…to work with people experienced in the restoration work. We learn from them, which is great. But it takes a lot of time away from our other duties because we're dealing with their project work, in some cases on private land."

HFQLG and other competing regional and national priorities sometimes caused staff members to overlook CRM projects. These priorities shift frequently in response to new laws, such as the American Reinvestment and Recovery Act of 2009, implementation of rehabilitation efforts following intense fires, and other factors, such as shifts in presidential administrations. In comparison, as one agency employee said of the CRM: "They don't have the whole rest of the forest to manage…. They only have the one thing to do so they work a lot faster." When the agency must respond to other priorities, watershed partnerships can get neglected:

> Our people have been bogged down in the timber stuff. So lot of times, [the CRM] practically get the whole project ready, then there are [agency] specialists that need to sign off on it, and they haven't heard much about it, they've been so distracted with other stuff…. I think we could get [the partnership] humming a little better if we could just get the gears to mesh. It's hard because…they're able to move so much faster than us. Part of it is we're bogged down with

bureaucracy. I think a big part of it is, like I said, being distracted by the QLG timber stuff.[9]

Delays create problems for the CRM because it is accountable to its funders for meeting timelines.[10] While the Forest Service is also accountable to external funders, its reliance on appropriated funds makes accountability for meeting project timelines less intense.

Agency barriers to collaboration also emerge from the culture of autonomy, divergent ideas about appropriate land management actions, and the agency's legal mandate to manage for multiple uses. One informant commented that the Forest Service still works in its own "bubble", where interactions with outside are confined or almost irrelevant. The mentality is: "Anything external is something we have to deal with." The CRM's main technique, pond and plug, has also met with resistance by some agency personnel who are uncomfortable with the scale and pace of these large projects and with potential short- and long-term impacts that include large sediment releases during project construction, creation of habitat for invasive species including bullfrogs, and major project failures. Some feel that the CRM, in focusing on restoring floodplain connectivity and meadow hydrology using pond and plug, tends to ignore other considerations. Some employees have favored more conservative, gradual, and small-scale approaches such as grade control structures deployed within the incised channel, which CRM staff members contend are less effective. In response to these critiques, one CRM member suggested that agency resource specialists are sometimes narrowly focused on their resource of concern and fail to see the bigger picture of the system-wide benefits of the pond and plug approach.

These concerns are not universal within the agency, and some employees are more supportive of pond and plug than others. Agency leaders had been, until recently, more consistently supportive of the technique. Differences derive in part from varying experience levels, according to one long-time Forest Service employee: "A lot of our people are still working more tentatively and slower because they're new in their profession and they haven't seen a wide range of what happens under different circumstances." But they also reflect different philosophical approaches to restoration, different tolerances of risk, and different views on what it means to comply with the agency's multiple-use mandate.

Acknowledging these issues, the agency has worked in recent years to become more responsive, foster early contact and involvement on projects, and maintain open lines of communication with the CRM. To help address employees concerns about pond and plug, the agency also developed a design brief in 2010 for its resource managers, to: "document the Forest's current understanding, across several resource areas, of effects associated with the treatment as well

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[9] Similarly, another employee commented: "What's limiting our capacity to work with partners is our ability to implement projects on the ground and follow through with them on the kind of timeline that working with other organizations requires."

[10] An agency employee explained: "The funders, they want to see stuff done soon, and [the CRM has] contract deadlines, so they have to move quicker, they have that impetus. The funders want it done quick so they need to make it happen quick so they can show them for the next application that [they got it done]."

as to point out gaps in our understanding that should be addressed by future monitoring or research" (Plumas National Forest, 2010, p. i).

A politically neutral stance on upstream-downstream policies and conflicts

While the agency pursued organizational changes to improve the partnership and to address employees' concerns, it has strived to remain neutral on more contentious issues, including larger policy changes sought by the headwaters coalition and on recent community conflicts over streamflow effects of pond and plug. The policy changes sought by the headwaters coalition would 1) allow the agency to exercise more authority under the Federal Power Act and 2) encourage the agency to claim water rights in the headwaters that it might then use to elicit payments from downstream water users. Both could generate a more proactive Forest Service stance toward impelling downstream water retailers and hydropower producers to contribute to the management and restoration of the watershed. In terms of the conflicts over downstream flow effects of pond and plug, the agency has defined its role as a neutral one by focusing on resolving key technical uncertainties.

As described in previous chapters, the headwaters coalition – which comprises a number of Plumas County actors, CRM and QLG members, and other watershed residents – has pursued reinvestment as a way to reverse an historic status quo that allowed downstream entities to receive Feather River water, and the flows of wealth it created, for free, while watershed residents faced economic insecurity. The initial collaborative effort to restore eroding headwaters meadows served as the platform that launched the coalition's policy advocacy efforts. While their efforts have remained intertwined strategically, the CRM has worked on the project side of watershed restoration while the headwaters coalition has worked to increase awareness of headwaters more broadly in California and effect policy changes that would attract funding resources for restoration.

A key policy change advocated by the coalition involves the way that the Forest Service exercises its authority under the Federal Power Act, which regulates development of hydropower projects. The coalition has advocated at local, regional, and national levels[11] for policy changes that would allow the agency, when undertaking relicensing processes for hydropower facilities on Forest Service lands, to place more requirements (i.e., "conditions") for watershed restoration on the hydropower operators. One coalition member explains:

> Because the projects all run through national forest land, they have the authority to place conditions on them to protect the national forest resources. So one of the conditions we've always thought they should impose would be some type of watershed reinvestment, management, some type of fee that would be directed back into projects and managing the forest. And that's still on our wish list, to get them to do that. Obviously there's substantial political opposition to that.

That political opposition derives from hydropower interests with influence at the state and national level. This informant goes on to explain: "They [hydropower interests] want to keep

[11] To access national-level officials in the Forest Service and the U.S. Department of Agriculture, under which the agency is housed, coalition members have taken advantage of the visibility afforded the community and the Plumas National Forest because of HFQLG.

the Forest Service, in fact all federal agencies, as limited as they can. That's been an ongoing battle under the whole history of the Power Act."

To be clear, the Forest Service can, and does, place some conditions on the operators, but they are limited to actions within the physical footprint of the facility. For example, under relicensing agreements for PG&E's facilities in the North Fork canyon, the utility has undertaken a fairly rigorous adaptive management program in its reservoirs to improve habitat for vulnerable species including the mountain yellow-legged frog. PG&E has also invested in recreation enhancements around its facilities. In contrast, coalition members have pressed the agency to push for conditions on a watershed scale. A Plumas National Forest employee explains the agency's perspective:

> The interpretation of that – and that's been interpreted by lawyers and everybody else – by the government lawyers is that we can only do it within the FERC[12] footprint, so whichever one is being relicensed, we can only deal with protection, enhancement, mitigation within that footprint. The counties would like to see that expanded to offsite mitigation…. And if they can change the law or figure out a way to do that, they can, but we've told them over and over again we have to play within the footprint we're given. They believe that the Forest Service should be the one that carries that flag to Congress, or whoever. And we remind them that we are not allowed to lobby; we work for the President, Congress. We are not allowed to lobby. And they can.

Coalition members acknowledge that this change would have to come from the highest levels of the agency and the U.S. Department of Agriculture.

A second change the coalition has advocated is for the Forest Service to directly claim a right to water produced on the national forest, so that, for example, they could market that water and use the proceeds to fund watershed restoration:

> The holy grail is figuring out how you can quantify a water benefit and actually give the Forest Service some type of a water right or claim to it so that there is some financial recognition for what they've done on the forest having an impact on water supply: being able to market that water, or having the person receiving the water make some type of financial contribution to support the activity.

Coalition members argue that, as a riparian landowner, under California law the Forest Service can claim a paramount water right in the headwaters. But they report that the agency has been reluctant to claim these rights for fear of political repercussions, which would likely be severe. A recent example indicates the agency's difficulties in asserting such rights: in 2011, a rule change giving the agency more control over water rights associated with ski areas on national forests was met with a swift backlash by the ski industry, which litigated the issue and forced the agency to turn back the new rule.

[12] FERC is the Federal Energy Relicensing Commission, which is the licensing authority under the Federal Power Act.

Line officers I interviewed for this study, like other personnel, were hesitant to adopt the coalition's stance that downstream beneficiaries should have some financial responsibility for restoring headwaters.[13] For example, one line officer, when asked about this issue, responded:

> I guess the way I look at this is, as a society, we're all in this together…. Personally I think as a society, we need to think in a collective whole, and that is – we need water. People in the rural areas need it, people in the cities as well, so I think it's on all of our shoulders to ensure it. And so if the responsibility is on all our shoulders, then I think that the financial responsibility is on all our shoulders.

On its face, this appears a reasonable position in an agency tasked with remaining politically neutral. But it is also strikingly devoid of reference to or acknowledgement of inequities or imbalances that may exist in terms of who can access, control, or derive benefits from resources that this officer is tasked with managing in the public trust. One is left with the impression that this context is entirely irrelevant. Neutrality is a strong cultural norm in the agency. A Forest Service social scientist explained: "We're supposed to walk that line – this is a cultural artifact again – as a federal entity, you're not supposed to take sides. And if no one's happy that generally means you're probably doing your job. [Laughs.] It's really sad but true. We're supposed to walk that apolitical line, which is bullshit because we're anything but apolitical, that just kills me." But the agency lacks the tools to address these political questions, concerning the allocation of resource benefits and trade-offs between different values, head on.

Sometimes a technically-defined, neutral role is likely the appropriate one. This is the kind of role that the agency appears to have adopted in light of recent community conflicts about the effects of pond and plug on downstream flows used by irrigators in the upper watershed. This conflict has reduced pond and plug projects and forced an ongoing restructuring of CRM governance. (As this conflict is ongoing, and I have not conducted active fieldwork to address it, the findings related in this and the following paragraph should be seen as preliminary.) Relative to this conflict, the agency has defined its role as primarily a technical one, particularly as arbiter of scientific uncertainties and technical disputes regarding restoration effects. To this end, the agency's regional office has coordinated several studies of meadow hydrology and restoration effects in the Feather River watershed and the Sierra Nevada more broadly, while local managers have worked to better clarify the significance of existing data and studies. In 2010, the Plumas released a briefing paper, intended mainly for resource specialists, that

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[13] The agency's tendency to avoid sticky political issues may be reinforced by how the agency continues to cultivate people for leadership positions. Line officers, or people being groomed for these positions, transition frequently from job to job and place to place. This remains true in the Plumas National Forest today. One informant explains the effect of this mobility in general for the agency:

> So there's not a lot of continuity or sustainability between these key leadership roles, and I think that gets in the way as well, because in essence, you don't have to become accountable in the long run. You're only there for a couple of years, and again that's a cultural artifact, and that goes back to the Forest Ranger book and Herbert Kaufmann talking about your allegiance to the agency, not to the communities you serve. That's why as a line officer we're going to keep moving you around, and moving you up, and your allegiance is to us, first and foremost. And that – I don't care what anybody says – I believe that that is still alive and well in our organization. Because it's been there since day one.

summarized current understandings and key uncertainties about pond and plug's ecological and hydrological effects (Plumas National Forest, 2010). In response to the ranchers' growing concerns, in 2013, agency staff conducted a more detailed analysis of meadow restoration effects on seasonal stream flows (Hoffman et al., 2013). In recent meetings about the future of the CRM, Forest Service staff have stressed the need to "listen to the science, and be open to others opinions, and look at the data" (Feather River CRM, 2014). In a conflict characterized by high scientific uncertainties, a technical, scientifically informed role appears appropriate.

But it should be noted that agencies also have incentives to use scientific uncertainty as an excuse to avoid or delay politically divisive decisions, and my data are insufficient to conclusively characterize the agency's actions and motivations on this issue. The agency continues to work with the affected parties toward finding a solution to the stream flow conflict. Officials have expressed a desire to continue the partnership in some form, but have distanced themselves from pond and plug. The Forest Supervisor declared a moratorium on large pond and plug projects on national forest land. In public meetings, agency representatives have stated a desire to "move beyond pond and plug" and have also expressed concern with the potential liability issues posed by stream flow impacts (Feather River CRM, 2014).

Reframing

Although the agency has strived to remain neutral with respect to the reinvestment and flow effects issues, it has also, in some sense, adopted coalition members' ideas about the importance of forest management for downstream water supplies. Forest Service leaders and managers at multiple levels, in discussing the goals of forest management, increasingly frame the agency's key role as managing the nation's headwaters. Within the agency, even the definition of "watershed" has evolved to reflect this shift. One long-time employee and line officer, interviewed in 2010, explained:

> Well when I started with the Forest Service there was a watershed program, a hydrology program, and it was more of a – how do you maintain what you have so we can get the timber cut out. And…I guess it was probably the mid-90s when we transitioned into Mike Dombeck as the Chief. That was really the big change that we had in describing what was meant by watershed condition, watershed health…. And it meant more than just having a timber sale and making sure your roads don't slide down the hill. And he, at that time, I think it was really expanded on that it was really health. It was providing for healthy sustainable systems.

Watershed restoration, though, has remained an amorphous concept, useful for leaders to focus attention on the issue du jour. As recently as the early 2000s, "watershed restoration meant to protect the watershed from catastrophic wildfires." The "water yield aspect of restoration has become more prevalent in the last probably 5 or 6 years, and probably no more than that." This framing is also consistent with a current national emphasis on the diversity of "ecosystem services" that national forests produce.

It is hard to tease out what is driving the agency's current focus on watersheds and water supply. Likely it is influenced by a need to find contemporary relevance and legitimacy, as well as by the very real threats to Western water supplies posed by climate change, drought, and fires. In the Plumas National Forest and Pacific Southwest Region, this framing may also help satisfy leaders' strategic desire to escape the conflict that has plagued the forest and the region for decades, while also attracting new funding sources in light of the HFQLG expiration in 2012. One coalition member comments: "I think in some ways that's the easy way out for the Forest Service because they've had so many issues in California, with the Sierra Nevada Framework and all the lawsuits that they've been through. In some ways, water, it maybe seems easier. It's something everybody wants, so if they can figure out a way to make that work, it lets them get along with everybody."

Finally, although many agency officials interviewed for this study believe that focusing on watershed values is the appropriate next step for national forest management, they stress that this kind of change will be slow. It takes a long time to shift agency priorities, which are tightly controlled by the budget process, which is in turn tightly controlled by Congress.[14] One line officer explained: "The traditional mindset is wood, especially on the Plumas. It's historically a timber forest." So, making water an emphasis is "one of those things that is going to take a lot of work to change the momentum." It remains to be seen to what degree the agency commits to this shift in practice. It is also a complex and challenging undertaking, given the uncertainties of climate change forecasting and the uncertainties and variability in hydrologic systems.

Discussion

The Forest Service has been a major actor in the political history of resource control in the United States. For most of the 20th century, the norms of scientific management and neutral expertise provided the agency with a great deal of power over national forest resources and their management. While in many senses the agency remains a powerful actor, the growth of intractable controversy has in practice checked its discretion, for example by shifting the venue of decision-making to the courts. In light of the high levels of controversy and complexity in contemporary public lands management, and the frequent failures of traditional approaches to resolving them, collaboration provides a different kind of mechanism to guide the agency in making decisions that involve political trade-offs. While collaboration clearly offers stakeholders a larger role in decision-making approach than previous approaches, nonetheless the Forest Service and other agencies remain central players. Academic understanding of this role and particularly its political dimensions has been limited.

This chapter has detailed the factors that have shaped Forest Service participation in collaborative, community-led headwaters restoration efforts in the Feather River watershed. Financial incentives and agency leader support for the CRM's favored restoration approach compelled collaboration, as did the CRM's legitimized position as a collaborative entity, which gave it a kind of power to pursue projects on national forest land. The agency's non-watershed priorities (particularly, its vegetation management priorities) and reservations about pond and

[14] Barriers are engrained in the "targets" system, linked to the budget, that the Forest Service uses to assign forest management goals. The agency has recently made changes to this system to improve the incentives for watershed management, among other goals, but it is still too soon to tell how these changes will play out.

plug by some resource specialists posed limits. While collaborating on the technical side of restoration projects, the agency has remained neutral on the larger political question of who should pay for headwaters restoration and has adopted a neutral, technical arbiter role in response to the downstream flow effects controversy. This neutrality is consistent with the agency's larger orientation toward political conflict: to find a technically supportable middle ground between competing interests, while avoiding an explicit discussion of these social conflicts and trade-offs.

On a conceptual level, this case builds on our understanding of the multiple forces, emanating from every direction, operating on agencies as they pursue collaboration. In this case, key forces included conflict between stakeholder groups (headwaters coalition vs. downstream beneficiaries; rancher vs. CRM), power (especially CRM power derived from legitimacy and financial resources; also downstream hydropower power derived from political influence at the national scale, QLG power, and – arguably – rancher power), scientific uncertainties (regarding restoration effects), internal agency disagreements (about restoration techniques), and competing internal priorities (which limited employees' capacities to collaborate). These forces are no different than the kinds of forces that operate on the Forest Service in the context of any decision-making process that involves trade-offs between different values and groups. Moreover, it appears that the agency's approach was also similar: follow power, avoid addressing conflict head on, and find a technically supportable middle ground. A major difference is that, in this case, "following power" largely means following the CRM, which earned power in the form of democratic legitimacy through long-term collaboration with a range of watershed stakeholders. On the other hand, the CRM's power also derived from the financial resources that it brought to the forest – resources that may have served internally to outweigh the reservations of more reluctant employees – and from a process that inadvertently excluded some stakeholders.

This case offers insights on both the role of federal agencies in collaborative resource management and on how we conceptualize collaboration more generally. Supporters of collaboration often assume that all of the representative interests are assembled and joined through a common interest in resolving a shared problem. In this way, it is assumed that collaboration achieves a kind of bottom-up accountability to the public. But this case shows that, for a number of reasons, such a tidy vision of collaboration may not conform to reality. The Feather River CRM first convened as a collaborative effort in 1985 to resolve the parties' shared erosion problem. But partly through its efforts, conditions in the watershed changed over time in ways that changed the group's structure and membership, provoked new political alignments, and complicated the agency's position as a partner. A key change was in the group's problem definition, which shifted from erosion to degraded hydrological conditions with a range of impacts to ecosystems and water supply and quality. This shift also catalyzed policy advocacy efforts to compel watershed reinvestment by downstream beneficiaries. As the political optics of headwaters restoration changed, so did the agency's roles in and support for the effort.

Collaboration is sometimes – perhaps often – messy, and this messiness complicates agency engagement and notions of bottom-up accountability. It may be tempting to dismiss this case as "not collaboration," a charge sometimes leveled at other controversial collaborative groups including the Quincy Library Group. After all, the mix of participants and stakeholders changed along the way, the effort served as a platform for policy advocacy efforts with explicit political goals, and in hindsight it is clear that some stakeholders were left out of the process. But the reality is that, as norms of collaboration spread, resource governance is evolving to encompass a range of approaches that fall along a spectrum, with varying levels of participation, representativeness, and cooperation. A key lesson for researchers is that studies of collaboration ought to reflect this range, as well as include more longitudinal studies to assess the evolving interactions of collaborative efforts with social and political contexts through time. For agencies, the messiness of collaboration underscores the importance of continually building an inclusive process; which interests are being excluded might not be clear in the beginning and might change over time.

The agency's effort to stay politically neutral in the face of watershed conflict has implications for how we understand government's role in ensuring the accountability of collaborative efforts to a wider public interest. In this case, the agency has worked to address the stream flow effects controversy by analyzing the existing data and conducting more studies. This neutral, technical position may very well help to shed more light on how pond and plug relates to the interests of the ranchers and perhaps other stakeholders. Technical analysis is clearly a necessary step in light of the scientific uncertainties. But focusing on the stream flow issues, to the neglect of other restoration outcomes, might also obscure the larger trade-offs at stake. And the agency's skittishness in the face of conflict – its retreat from the controversial pond and plug technique – could hasten a premature abandonment of this technique. Stream flow effects have proven more complicated than initially portrayed or hypothesized by the CRM, but it is not yet clear what the impact has been on downstream ranchers. Analysis of groundwater dynamics downstream of the projects, and of natural and climate-change induced variability, suggest that whatever stream flow effects the ranchers have observed may not, in fact, be due to pond and plug at all. While invasive species and fish habitat impacts remain a concern, pond and plug also has striking benefits for vegetation and wildlife habitat, livestock forage, erosion reduction, and flood protection. Current analyses suggest it may slightly reduce overall water yield through increased evapotranspiration, but the ways that it shifts peak runoff timing (from early spring to late spring and early summer) may yet prove significant and beneficial for downstream water supply management (keep in mind that the Feather River is the source of the California State Water Project and a vastly important water supply source for the state).

These questions are not only technically complicated; they also reveal the trade-offs that are at stake between different interests and the agency's difficulty in adjudicating them. What are the appropriate trade-offs between the benefits and risks of pond and plug? Shutting down pond and plug projects in response to a small but vocal community of downstream ranchers, based on science that remains inconclusive, may or may not be the outcome that best serves the public interest. But who is to define this public interest? As Martin Nie (2008) observed more generally, the Forest Service lacks the discretion, tools, legal authority, and perhaps the political will to adjudicate between competing interests on anything but technical grounds. The lack of these tools could limit the agency's "linchpin" role in collaborative governance, in part because the retreat to technical terrain tends to elevate the importance of scientific uncertainty and delay the making of politically difficult decisions. On the other hand, scientific uncertainty might also provide a focal, grounding point for collaboration and shared problem solving and learning (Ansell, 2011, p. 174). The CRM, the Forest Service, and the concerned stakeholders are working through this conflict together, including by looking more carefully at these uncertainties. Whatever decision comes out of this process may yet reflect a kind of collaborative consensus about how to move forward, even if it means the end of pond and plug. In this way, this conflict and its potential resolution might ultimately reflect the value of collaboration for resolving the difficult political questions that the agency cannot. At this point, it is too soon to tell.

Finally, this case offers some clues about the challenges of future efforts to restore Western headwaters, efforts that have implications for downstream water supply and climate change adaptation. With its wide jurisdiction in the headwaters, the Forest Service clearly has a central role to play in such efforts. This case suggests that challenges for the agency will emerge particularly from two sources. First, scientific uncertainties about effects of forest, meadow, and other watershed management and restoration approaches may complicate agreement on how to proceed. High variability across watersheds will pose an additional challenge. Second, the case points to the trade-offs and conflicts that will inevitably arise between different resource user groups, whether local versus state, environmental versus commodity, or other conflicts. Conflicts may be exacerbated by the mobility of water originating on national forest land but governed mostly by the state and depended upon by far away users and ecosystems. In some cases, shared solutions can be found, and collaboration will have an important role to play in identifying those solutions. But others may prove more difficult, forcing the agency into the role of deciding how to balance demands, risks, and resources. If the agency is unable to do so (and perhaps even if it is) we may increasingly see headwaters conflicts play out, like other national forest management conflicts, through other venues, and particularly the courts.

CHAPTER 7. THE POLITICS OF COLLABORATION IN THE FEATHER RIVER HEADWATERS: CONCLUSIONS AND RECOMMENDATIONS

Since European settlement, the Feather River watershed has been a site of resource development and export, including of water and hydropower, which fed California's growing economy and wealth. While environmental and social impacts accrued locally, the vast financial benefits of these transformations flowed mainly to people outside of the watershed. The arc of resource development in the watershed largely reflects the larger American pattern, in which conservationist policies that valued economic efficiency, order, and technical expertise over local practices neglected the complexities of both ecosystems and social systems and wrought unintended consequences for both. Collaborative meadow restoration efforts in the watershed emerged and grew in response to both the uneven ways that this history allocated natural resources and wealth and from resulting ecological and hydrological deterioration. In doing so, collaboration provided tools through which members of the headwaters community could challenge these institutional and political inequities. Understood in this light, collaborative meadow restoration – and collaborative governance more broadly – is a new chapter in a long history of political struggle over control of the West's rich resources.

Yet institutionalist and normative assumptions in much of the existing literature on collaborative environmental governance have limited critical perspectives and attention to such politics. As a result, existing accounts have inadequately characterized the larger political significance of collaboration and its increasing prominence in federal resource management policy. In this dissertation, I used tools and insights from political ecology and science and technology studies to paint a more nuanced picture of how power and politics operate in a collaborative process. My analysis was guided, in particular, by theoretical insights arising from Derek Armitage's work on integrating political ecology with commons governance and resilience literature, and by Sheila Jasanoff's work on the co-production of natural and social orders. Armitage (2008) drew attention to the messiness and unpredictability of social processes, as well as to the importance of analyzing collaborative processes in historical, political, and ecological context. He identified contextual forces that tend to favor entrenched, top-down management systems; these include power, its operation across multiple levels of social scale, the dominance of technocratic knowledge, and social constructions of human-nature relations through policy narratives and other processes. Sheila Jasanoff's (2005) work further focused my attention on the roles of knowledge production and of competing claims about nature in renegotiating social relations of resource control.

In conversation with my fieldwork and data, these bodies of theory and literature gradually helped me to identify three key loci where power and politics were renegotiated through collaborative meadow restoration in the Feather River watershed. I analyzed these processes of renegotiation in Chapters 3, 4, and 5; I summarize these findings below. The discussion that follows integrates the key findings of this project, discusses their broader relevance for understanding environmental governance, and offers insights and recommendations for managers, policy-makers, and future research.

SUMMARY OF KEY FINDINGS

Chapter 4 showed how renegotiations of power and politics occurred through the collaborative production of new knowledge and practices for meadow restoration. Chapter 5 revealed the political significance of policy reframing efforts that highlighted relationships between the watershed and downstream water users. Chapter 6 showed how the administrative and political context of national forest management responded to and shaped the politics of collaborative headwaters restoration in ways that tended to reinforce the status quo. Taken together, these findings portray a complex relationship between collaboration, power, and politics. Collaboration in this case neither overcame power differentials nor was derailed by politics. In contrast to these straightforward scenarios sometimes depicted in the literature, collaboration yielded a back-and-forth, multidirectional dynamic of political gains and losses. Renegotiations of power and politics occurred in particular through:

1) *The production of new knowledge and practices of meadow restoration*. Collaborative efforts to address erosion in the watershed led to production of new meadow restoration knowledge and practice that provided the basis for new political challenges. The pond and plug technique, which grew from a collaborative process of experimentation and learning, was responsive to both the biophysical and social landscapes of the Feather River. Biophysically, the technique emerged to address the erosion problem by restoring hydrologic function and floodplain connectivity in degraded meadow valleys. But understood from an historical and political perspective, pond and plug was also simultaneously a way for upstream residents to make new, political claims to the water and hydropower wealth derived from the watershed. These claims challenged the long-standing power of downstream actors to control the wealth derived from watershed resources with little or no obligation to upstream ecosystems or communities. Thus collaborative learning and knowledge production take place in both social and biophysical context, and they can constitute an important site for the renegotiation of power and the politics of resource control.

I want to be very clear that I see nothing duplicitous about pond and plug or its use by headwaters actors to make new political claims against downstream water and hydropower entities. Initial hypotheses that the group put forward about the upstream-downstream connections did prove oversimplistic, but these problems were acknowledged, and the effort is currently undergoing a major course correction. The larger significance is that knowledge production (i.e., “social learning”) and the development of better management techniques are very often goals of collaboration, and these learning processes are fundamentally intertwined with, and thus responsive to, the social landscapes in which they take place. Adopting a co-production lens to study other cases would likely reveal collaborative knowledge production as profoundly shaped by social and political context in many, perhaps most, instances, but with different outcomes and implications as far as whose political needs are advanced in these processes and who benefits from collaboratively-derived knowledge.

2) *The reframing of watershed policy through the idea of reinvestment*. A policy frame is a way of representing a problem in order to influence collective views of that problem and encourage some desired policy solution or outcome. In this case, new knowledge and practices of meadow

restoration, produced collaboratively, helped headwaters actors develop new policy frames and policy solutions that challenged long-standing relationships of resource control in the watershed. Collaboration provided headwaters actors with a more systemic understanding of the watershed, its hydrological properties, and its economic and political significance; this systemic understanding, in turn, enabled these actors to reframe the upstream-downstream connection and advocate new policy approaches. Headwaters actors developed the reinvestment frame by drawing attention to the hydrological transformations brought about by pond and plug, and in doing so successfully framed upstream watershed restoration as important for downstream water supply. This reframing helped garner significant restoration funds and some favorable state-level policy shifts for watershed communities.

But while reframing helped the coalition increase the visibility of headwaters in California water policy, downstream entities thwarted an actual reinvestment fee by appealing to scientific uncertainties and denying responsibility for the headwaters. An engineering logic deeply embedded in current water supply management institutions also contributed to this outcome. These findings point to the limitations of the reinvestment (and broader payment-for-ecosystem-services) policy frame. By rendering a complex social-historical upstream-downstream relationship into a technical accounting between resource producers and consumers, it necessitates reliable quantification (which may not prove feasible or significant) and obscures historic and institutional inequities. It may also detract attention from other arguments for restoring the headwaters that do not rely on a tangible, quantifiable relationship between upstream restoration and downstream water supply benefits. Policy reframing in this case enabled headwaters actors to make inroads into improving California watershed policy, but did not provide significant leverage against the political power of the downstream beneficiaries.

3) Forest Service role and implications for watershed politics. Through collaboration, headwaters actors gained access and power to conduct restoration work on public lands managed by the U.S. Forest Service, even in the face of competing agency priorities and employee reservations about pond and plug. Since the agency manages most of the upper watershed's land area, this access represents a not-insignificant degree of power, which grew both from the financial resources that the group brought to the forest and from its democratic legitimacy as a collaborative effort. Here again, though, the power gained through collaboration had limits.

As the headwaters coalition challenged downstream entities' lack of obligation to the headwaters, the Forest Service responded in ways that tended to favor the status quo and to avoid conflict and political risk. As more recent controversies regarding the potential impacts of downstream flow effects on ranchers emerged, the agency staked out its role as a technical one, particularly by working to address key scientific uncertainties. Though certainly a necessary step, scientific uncertainties may ultimately provide the agency cover for dropping its support for pond and plug in response to the new conflict. More broadly, while the Forest Service can justify its stance on these issues by invoking its apolitical mission, taken as a whole these positions reveal a reluctance, or inability, to proceed in ways that explicitly acknowledge the politics of headwaters management and governance. Political neutrality is strong cultural norm within the agency, with powerful historical and institutional precedence, and it likely has implications for how or whether other collaborative efforts can be successful in advancing innovative resource management approaches on public lands.

Overall, then, collaboration enabled the headwaters community to make powerful new claims against an historical, institutional, and political status quo that benefited downstream water beneficiaries. The production of new knowledge and practices of meadow restoration, in combination with the development of new policy narratives linking the fate of upstream headwaters and downstream water consumers, served to inspire favorable changes in headwaters policy and management. But the power of headwaters actors to create more substantial political change was checked by the kinds of contextual forces that Armitage identified: historically entrenched power, its operation across multiple levels of social scale, and the dominance of technocratic knowledge. Conflict avoidance incentives in the administrative context also played a role.

Discussion and recommendations

My findings reveal that the implications of collaboration for power and politics are not unidirectional, but more complex and multi-directional. Politics did not simply derail collaboration (Walker & Hurley, 2004). Although limited by the durability of long-standing relations of resource control in wider institutional and political contexts, collaboration did create power to effect new management solutions and even wider policy changes. Collaboration also catalyzed new conflicts, one of which (the conflict with local ranchers over downstream flow effects) has now circled back to significantly curtail the group's activities. Thus there is a back-and-forth dynamic between collaboration and political change, just as there is a back-and-forth dynamic of wins and losses in many ongoing political contests.

Findings also highlight the political dynamism of collaboration over time. Scholars have analyzed few collaborative efforts that have been in existence as long as the Feather River CRM's 29 years. My analysis shows that shifts in restoration practice, group membership, and problem definitions and goals marked important political turning points. The loss of a key funder (PG&E) precipitated a shift in problem definition (from erosion to hydrological degradation) and goals (from channel restoration to floodplain restoration). Strategically, these shifts enabled the group to access a broader array of funding sources and make claims to the wealth derived from the water downstream. A key lesson is that collaboration can yield new conflicts and political tensions as conditions change over time and as groups develop and advance solutions that are unfavorable to dominant interests. This should not be surprising: learning about a system from many different perspectives at once should generate understandings that are more comprehensive, both socially and ecologically, and better suited to revealing injustices or imbalances in terms of resource control.

Studies of collaboration tend to focus on the group and its internal process. These boundaries of analysis may be too narrow, not only if they neglect political, institutional, and cultural context, but also if they do not look at outcomes that extend beyond the process itself.

Collaborative meadow restoration served as a platform for launching broader policy advocacy efforts that were more overtly political. Collaboration provided the basis of knowledge and organization to launch these efforts, which likely would not have emerged with the same power absent the initial collaborative effort. Our accounts of collaboration and its significance ought to include these broader outcomes, which clearly have political significance and do not appear to be captured adequately in current literature.

While these findings help reveal the politics of collaboration, collaboration should not be seen as just another form of politics. While not infallible, and while not suited to every situation, collaboration can be a powerful tool for addressing complex environmental issues in ways that recognize system complexity and that confer democratic legitimacy. In this way, collaboration can help move beyond the fragmented approaches and cycles of ongoing litigation that characterize many contemporary environmental disputes. Under the right circumstances, the democratic legitimacy of collaboration may even overcome the power of entrenched interests.

But failure to recognize the political struggles that infuse collaborative processes is problematic for several reasons. Doing so obscures a long political history of American resource control. It may also give cover to agencies for adopting collaborative approaches that imply greater public accountability and access while failing to actually make any substantive improvements to ecological or social conditions. Collaboration has turned out to be more difficult and failure prone than often acknowledged in the early literature. A key reason is that researchers and practitioners have often failed to attend to political context and to the messy and complex social processes that come to bear on collaboration. When collaboration does not work, lack of nuanced attention to politics can lead analysts and participants to misdiagnose what went wrong, for example by focusing on institutional preconditions and capacities rather than on power imbalances. Repeated failures might ultimately lead policy makers to throw up their hands on the whole idea of collaboration. In contrast, an acknowledgment that political strategies and trade-offs infuse collaboration, just like they do any other form of environmental decision-making, can give practitioners, policy-makers, and analysts a clearer understanding of the approach's potential to resolve natural resource conflicts and issues. And it might help them design better processes. For example, attention to the political dynamism of collaboration over time could help managers identify when conditions change in ways that mean new groups of actors, not previously involved or represented, need to be brought in to the process.

Future research on watershed and collaborative resource governance in the U.S. would do well to harness these insights. Politics are inherent in natural resource governance because it is the mechanism through which resources are allocated and decisions are made about how to allocate risks and make trade-offs between different values and interests. Collaborative governance, although it may offer the hope of more integrated approaches and outcomes, is no less subject to politics; it is merely a different form of political negotiation. Future research should identify and analyze more examples of long-term collaboration in social, political, and biophysical context. Doing so across a wide range of cases will provide a more comprehensive picture of the mechanisms, strategies, and significance of political renegotiation in collaborative processes. Such research would also help to contextualize collaborative governance and its significance as part of an evolving political history of American resource control. It may ultimately help practitioners and resource managers embark on collaborative processes with a greater chance of success, armed with a larger perspective on the challenges and possibilities of collaboration for achieving social and ecological goals.

Literature Cited

Alpers, Charles N., & Michael P. Hunerlach. (2000). *Mercury Contamination from Historic Gold Mining in California. USGS Fact Sheet FS-061-00*. Sacramento, CA: Retrieved from http://www.dtsc.ca.gov/SiteCleanup/upload/AML_Mercury_Gold-Mining.pdf.

Amy, Douglas J. (1987). *The politics of environmental mediation*. New York: Columbia University Press.

Ansell, Chris. (2000). The Networked Polity: Regional Development in Western Europe. *Governance, 13*(2), 279-291.

Ansell, Chris, & Alison Gash. (2008). Collaborative Governance in Theory and Practice. *Journal of Public Administration Research and Theory, 18*(4), 543-571.

Ansell, Christopher K. (2011). *Pragmatist democracy: evolutionary learning as public philosophy*. Oxford; New York: Oxford University Press.

Aquafornia. (2008). The State Water Project. Retrieved May 1, 2014, from http://aquafornia.com/where-does-californias-water-come-from/the-state-water-project.

Armitage, Derek. (2005). Adaptive Capacity and Community-Based Natural Resource Management. *Environmental Management, 35*(6), 703-715.

Armitage, Derek. (2008). Governance and the commons in a multi-level world. *International Journal of the Commons, 2*(1), 7-32.

Armitage, Derek, Melissa Marschke, & Ryan Plummer. (2008). Adaptive co-management and the paradox of learning. *Global Environmental Change, 18*(1), 86-98.

Armitage, Derek R., Fikret Berkes, & Nancy Doubleday (Eds.). (2007). *Adaptive co-management : collaboration, learning, and multi-level governance*. Vancouver: UBC Press.

Aspen Environmental Group, M. Cubed. (2005). Potential changes in hydropower production from global climate change in California and the Western United States. In Suzanne Phinney, Richard McCann, Guido Franco & Matt Fagundes (Eds.), *Prepared in support of the 2005 Integrated Energy Policy Report Proceeding (Docket # 04-IEPR-01G)*.

Association of California Water Agencies. (2013). ACWA Policy Principles on Improved Management of California's Headwaters. Sacramento, CA, http://www.acwa.com/sites/default/files/post/policy-principles/2013/04/ca-headwaters-policy.pdf

Baker, Mark, & Jonathan Kusel. (2003). *Community Forestry in the United States: Learning from the Past, Crafting the Future*. Washington, D.C.: Island Press.

Bales, Roger C., John J. Battles, Yihsu Chen, Martha H. Conklin, Eric Holst, Kevin L. O'Hara, Philip Saksa, & William Stewart. (2011). Forests and Water in the Sierra Nevada: Sierra Nevada Watershed Ecosystem Enhancement Project (pp. 39): Sierra Nevada Research Institute, UC Merced. Center for Forestry, UC Berkeley. Environmental Defense Fund.

Barnett, Michael, & Liv Coleman. (2005). Designing Police: Interpol and the Study of Change in International Organizations. *International Studies Quarterly, 49*(4), 593-620.

Becker, Dennis, Scott Cashen, Antony S. Cheng, David Ganz, John Gunn, R. J. Gutiérrez, Mike Liquori, Amy Merrill, Will Price, & David Saah. (2013). Independent Science Panel

Report: Herger-Feinstein Quincy Library Group Forest Recovery Act. In Pinchot Institute for Conservation (Ed.), *Prepared for USDA Forest Service*.

Bennett, Genevieve, Nathaniel Carroll, & Katherine Hamilton. (2013). Charting new waters: State of watershed payments 2012. Washington, D.C.: Forest Trends.

Benoit, Terry, & Jim Wilcox. (1997). *Applying a fluvial geomorphic classificiation system to watershed restoration*. Fort Collins, CO: USDA Forest Service Stream Systems Technology Center.

Berkes, Fikret. (2009). Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management, 90*(5), 1692-1702.

Blomquist, William, & Edela Schlager. (2005). Political Pitfalls of Integrated Watershed Management. *Society & Natural Resources, 18*(2), 101-117.

Bodin, Örjan, Beatrice Crona, & Henrik Ernstson. (2006). Social Networks in Natural Resource Management: What Is There to Learn from a Structural Perspective? *Ecology and Society, 11*(2), r2 [online].

Bogason, Peter, & Juliet A. Musso. (2006). The Democratic Prospects of Network Governance. *The American Review of Public Administration, 36*(1), 3-18.

Booher, David E, & Judith E Innes. (2010). Governance for resilience: CALFED as a complex adaptive network for resource management. *Ecology and Society, 15*(3), 35.

Booher, David E., & Judith E. Innes. (2002). Network Power in Collaborative Planning. *Journal of Planning Education and Research, 21*(3), 221-236.

Booth, Eric, & Steven Loheide. (2013). The Drying of Sierra Nevada Wet Meadows Impacted by Channel Incision and Opportunities for Restoration. Retrieved from http://serc.carleton.edu/69108

Brechin, Gray. (1996). Conserving the race: natural aristocracies, eugenics, and the U.S. conservation movement. *Antipode, 28*(3), 229-245.

Brechin, Gray A. (2006). *Imperial San Francisco: urban power, earthly ruin*. Berkeley: University of California Press.

Brondizio, Eduardo S., Elinor Ostrom, & Oran R. Young. (2009). Connectivity and the Governance of Multilevel Social-Ecological Systems: The Role of Social Capital. *Annual Review of Environment and Resources, 34*(1), 253-278.

Brower, Ann, Chanel Reedy, & Jennifer Yelin-Kefer. (2001). Consensus versus Conservation in the Upper Colorado River Basin Recovery Implementation Program. *Conservation Biology, 15*(4), 1001-1007.

Brown, Thomas C., Michael T. Hobbins, & Jorge A. Ramirez. (2008). Spatial Distribution of Water Supply in the Coterminous United States. *JAWRA Journal of the American Water Resources Association, 44*(6), 1474-1487.

Brunner, Ronald D., Christine H. Colburn, Christina M. Cromley, Roberta A. Klein, & Elizabeth A. Olson. (2002). *Finding Common Ground: Governance and Natural Resources in the American West*. New Haven: Yale University Press.

Brunner, Ronald D., Toddi A. Steelman, Lindy Coe-Juell, Christina M. Cromley, Christine M. Edwards, & Donna W. Tucker. (2005). *Adaptive Governance: Integrating Science, Policy and Decision Making*. New York: Columbia University Press.

Bryson, J. M., & B. C. Crosby. (1993). Policy planning and the design and use of forums, arenas, and courts. *Environment and Planning B: Planning and Design, 20*(2), 175-194.
California Department of Water Resources. (2011). California's State Water Project at a Glance. http://www.water.ca.gov/recreation/brochures/pdf/swp_glance.pdf.
California Department of Water Resources. (2012). *The State Water Project Final Delivery Reliability Report 2011*. Natural Resources Agency. Retrieved from http://baydeltaoffice.water.ca.gov/swpreliability/FINAL2011DRR_DWR_Review_File-clean-6-25-12.pdf.
California Department of Water Resources. (2013). California State Water Project Water Contractors, from http://www.water.ca.gov/swp/contractor_intro.cfm
California Department of Water Resources. (2014a). California State Water Project Overview Retrieved May 21, 2013, from http://www.water.ca.gov/swp/
California Department of Water Resources. (2014b). Chart of Water Contractors Service Areas & Annual Allocations Retrieved April 4, 2014, from http://www.water.ca.gov/swp/contractor_intro.cfm; http://www.water.ca.gov/swp/docs/contractors.pdf
California Department of Water Resources. (2014c). Welcome – California Water Plan Web Site, from http://www.waterplan.water.ca.gov/
California Department of Water Resources. (Year Unknown). Integrated Regional Water Management Brochure, from http://www.water.ca.gov/irwm/grants/docs/Brochures/IRWM6.Background_120306.pdf
California Energy Commission. (2013). California Hydroelectric Statistics & Data. *Energy Almanac* Retrieved May 21, 2013, from http://energyalmanac.ca.gov/renewables/hydro/index.html
California Energy Commission. (2014). California Hydroelectric Statistics & Data. *Energy Almanac* Retrieved May 28, 2014, from http://energyalmanac.ca.gov/renewables/hydro/index.html
California Water Impact Network. (2014). The Monterey Amendments to State Water Project Contracts, from http://www.c-win.org/monterey-amendments-state-water-project-contracts.html
Carpenter, Stephen R., Harold A. Mooney, John Agard, Doris Capistrano, Ruth S. DeFries, Sandra Díaz, Thomas Dietz, Anantha K. Duraiappah, Alfred Oteng-Yeboah, Henrique Miguel Pereira, Charles Perrings, Walter V. Reid, José Sarukhan, Robert J. Scholes, & Anne Whyte. (2009). Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *Proceedings of the National Academy of Sciences, 106*(5), 1305-1312.
Carson, Rachel. (1962). *Silent spring*. Boston; Cambridge, Mass.: Houghton Mifflin ; Riverside Press.
Cash, David W., W. Neil Adger, Fikret Berkes, Po Garden, Louis Lebel, Per Olsson, Lowell Pritchard, & Oran Young. (2006). Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology & Society, 11*(2), 8. [online] URL: http://www.ecologyandsociety.org/vol11/iss12/art18/.

Caves, Jeremy K., Gitanjali S. Bodner, Karen Simms, Larry A. Fisher, & Tahnee Robertson. (2013). Integrating Collaboration, Adaptive Management, and Scenario-Planning: Experiences at Las Cienegas National Conservation Area. *Ecology and Society, 18*(3).

Cawley, Ken. (2011). Statistical Analysis of Selected Feather River Coordinated Resource Management Stream Flow Data. A report to the Feather River CRM, from http://www.feather-river-crm.org/pdf/StatReport2011.pdf

Center for Economic Development. (2010). Plumas County Economic & Demographic Profile 2009-2010, from http://www.cedcal.com/assets/09-10-Profile-PDFs/Plumas-County-2009-10.pdf

Chang, Philip. (2002). *The Feather River Coordinated Resource Management Group (CRM): Regionalism and federalism in watershed management.* (Master of Science), University of California, Berkeley.

Chichilnisky, Graciela, & Geoffrey Heal. (1998). Economic returns from the biosphere. *Nature, 391*(6668), 629-630.

Christian-Smith, Juliet, & Peter H. Gleick. (2012). *A twenty-first century U.S. water policy*. Oxford; New York: Oxford University Press.

Clarke, Jeanne Nienaber, & Daniel McCool. (1996). *Staking out the terrain: power and performance among natural resource agencies*. Albany: State University of New York Press.

Clifton, Clay C. (1994). East Branch North Fork Feather River Erosion Control Strategy. Quincy, CA: Prepared for the Feather River Coordinated Resource Management Group.

Coggins, George Cameron. (1998). Of Californicators, Quislings and Crazies: Some Perils of Devolved Collaboration. *Chronicle of Community, 2*, 27-33.

Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton, & Marjan van den Belt. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*(6630), 253-260.

Daily, Gretchen C., Stephen Polasky, Joshua Goldstein, Peter M. Kareiva, Harold A. Mooney, Liba Pejchar, Taylor H. Ricketts, James Salzman, & Robert Shallenberger. (2009). Ecosystem services in decision making: time to deliver. *Frontiers in Ecology and the Environment, 7*(1), 21-28.

Davies, Bronwyn, & Rom Harre. (1990). Positioning: The Discursive Production of Selves. *Journal for the Theory of Social Behaviour, 20*(1), 43-63.

Dayton, Bruce W. (2000). Policy frames, policy making and the global climate change discourse. In Helen Addams & John Proops (Eds.), *Social discourse and environmental policy: An application of Q methodology* (pp. 71-99). Cheltenham, UK: Edward Elgar Publishing Limited.

Dietz, T., E. Ostrom, & P. C. Stern. (2003). The Struggle to Govern the Commons. *Science, 302*(5652), 1907.

Dixon, Roland Burrage. (1905a). The Huntington California Expedition: The Northern Maidu *Bulletin of the American Museum of Natural History* (Vol. Volume 17, Part 3, pp. 119-346).

Dixon, Roland Burrage. (1905b). The Northern Maidu: The Huntington California Expedition. *Bulletin of the American Museum of Natural History, 17*(119-346).

Dodge, Jennifer. (2009). Environmental justice and deliberative democracy: How social change organizations respond to power in the deliberative system. *Policy and Society, 28*(3), 225-239.

Durant, Robert F. (2007). Toxic Politics, Organizational Change, and the "Greening" of the U.S. Military: Toward a Polity-Centered Perspective. *Administration Society, 39*(3), 409-446.

Ecosystem Sciences Foundation. (2005). *Integrated Regional Water Management Plan: Upper Feather River Watershed, California*. Retrieved from http://www.featherriverwater.com/images/IRWMP_063005.pdf.

Espeland, Wendy Nelson. (1998). *The struggle for water: politics, rationality, and identity in the American Southwest*. Chicago: University of Chicago Press.

Fairfax, Sally K. (2005). When an Agency Outlasts Its Time: A Reflection. *Journal of Forestry, July/August*, 264-267.

Feather River CRM. (1996). Fact sheet #5: Wolf creek restoration project, from http://www.feather-river-crm.org/project-files/FactSheet5.pdf

Feather River CRM. (1999). Executive Summary. Last Chance Creek Watershed Restoration Project--Ferris-Meadowview Reach *Funding application to the CALFED Ecosystem Restoration Program*. http://www.calwater.ca.gov/Admin_Record/I-016766.pdf.

Feather River CRM. (2011). Annual report to signatory agencies, from http://www.feather-river-crm.org/pdf/Final_2011AnnualReport.pdf

Feather River CRM. (2012a). DRAFT Annual report to signatory agencies, from http://www.feather-river-crm.org/pdf/Draft_2012AnnualReport.pdf

Feather River CRM. (2012b). Final Steering Committee Meeting Minutes, November 7, 2012. Quincy, CA: Plumas Corporation.

Feather River CRM. (2014). Steering Committee DRAFT Meeting Minutes, January 15, 2014. Quincy, CA.

Feather River CRM. (Year Unknown). Geomorphic restoration techniques, Section 4: Headcuts, from http://www.feather-river-crm.org/project-files/georest/geo4.html

Federal Energy Regulatory Commission. (2005). Final Environmental Impact Statement for the Upper North Fork Feather River Project (Project No. 2105-089) *Executive Summary*. Washington, D.C.

Federal Energy Regulatory Commission. (2006). Order denying rehearing. *Regarding California Sportfishing Protection Alliance request for rehearing regarding PG&E license for the Rock Creek Cresta Project No. 1962.*, from http://www.ferc.gov/whats-new/comm-meet/061506/H-6.pdf

Federal Energy Regulatory Commission. (2007a). Final Environmental Assessment, Poe Hydroelectric Project (Project No. 2107-016). Washington, D.C.

Federal Energy Regulatory Commission. (2007b). Final Environmental Impact Statement for Hydropower License. Oroville Facilities -- FERC Project No. 2100-052. California. Washington, D.C.

Federal Energy Regulatory Commission. (2009). Final Environmental Impact Statement for Relicensing of the South Feather Power (Project No. 2088-068). Section 1. Washington, D.C.

Fernandez-Gimenez, Maria E., Heidi L. Ballard, & Victoria E. Sturtevant. (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 [online] URL: http://www.ecologyandsociety.org/vol13/iss12/art14/.

Ficklin, Darren L., Iris T. Stewart, & Edwin P. Maurer. (2012). Projections of 21st Century Sierra Nevada Local Hydrologic Flow Components Using an Ensemble of General Circulation Models1. *JAWRA Journal of the American Water Resources Association, 48*(6), 1104-1125.

Fischer, Frank, & John Forester (Eds.). (1993). *The argumentative turn in policy analysis and planning*. Durham, N.C.: Duke University Press.

Fradkin, Philip L. (1995). *The seven states of California: a natural and human history*. New York: H. Holt and Co.

Freeman, Gary J. (2010, April). *Tracking the impact of climate change on Central and Northern California's spring snowmelt subbasin runoff.* Paper presented at the 78th Annual Western Snow Conference, Logan, Utah.

Furniss, Michael J., Brian P. Staab, Sherry Hazelhurst, Caty F. Clifton, Ken B. Roby, Bonnie L. Ilhardt, Elizabeth B. Larry, Albert H. Todd, Leslie M. Reid, Sarah J. Hines, Karen A. Bennett, Charlie H. Luce, & Pamela J. Edwards. (2010). *Water, climate change, and forests: Watershed stewardship for a changing climate.* (General Technical Report PNW-GTR-812). Portland, OR.

George, Holly, David Lile, Cheree Childers, Cindy Noble, Andrea Oilar, Katherine Haworth, Kristen Schmidt, & Gabe Miller. (2007). *Upper Feather River Watershed (UFRW) Irrigation Discharge Management Program: Irrigated Agricultural Practices in UFRW*. Regents of the University of California. Retrieved from http://ucanr.org/sites/UCCE-Plumas-Sierra/files/13633.pdf.

Gerlak, A. K., & T. Heikkila. (2006). Comparing Collaborative Mechanisms in Large-Scale Ecosystem Governance. *Natural Resources Journal, 46*, 657.

Getches, David H. (2000). Some irreverent questions about watershed-based efforts. In Philip Brick, Donald Snow & Sarah VanDeWetering (Eds.), *Across the Great Divide: Explorations In Collaborative Conservation And The American West* (pp. 180): Island Press.

Goldstein, Bruce Evan. (2012). *Collaborative resilience: moving through crisis to opportunity*: The MIT Press.

Gómez-Baggethun, Erik, Rudolf de Groot, Pedro L. Lomas, & Carlos Montes. (2010). The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics, 69*(6), 1209-1218.

Hajer, Maarten A. (1995). *The politics of environmental discourse: ecological modernization and the policy process*. Oxford: Oxford University Press.

Hajer, Maarten. A., & Hendrik Wagenaar. (2003). *Deliberative Policy Analysis: Understanding Governance in the Network Society*. Cambridge: Cambridge University Press.

Hammersmark, Christopher Trevor, Mark Cable Rains, & Jeffrey F. Mount. (2008). Quantifying the hydrological effects of stream restoration in a montane meadow, northern California, USA. *River Research and Applications, 24*(6), 735-753.

Hanak, Ellen, Jay Lund, Ariel Dinar, Brian Gray, Richard Howitt, Jeffrey Mount, Peter Moyle, & Barton "Buzz" Thompson. (2011). *Managing California's water: from conflict to reconciliation*. San Francisco, CA: Public Policy Institute of California.

Hardin, Garrett. (1968). The Tragedy of the Commons. *Science, 162*(3859), 1243-1248.

Harrison, Larry L. . (1991). *North Fork Feather River Erosion Control Program.* Paper presented at the Waterpower '91: A New View of Hydro Resources. International Conference on Hydropower, July 24-26, 1991, Denver, CO.

Hays, Samuel P. (1959). *Conservation and the gospel of efficiency: The progressive conservation movement, 1890-1920. With a new preface by the author. Version cited is a reprint published in 1969*. New York: Atheneum.

Hendriks, Carolyn M. (2009). Deliberative governance in the context of power. *Policy and Society, 28*(3), 173-184.

Hirt, Paul W. (1994). *A conspiracy of optimism: management of the national forests since World War Two*. Lincoln, Nebraska: University of Nebraska Press.

Hoffman, J., K. Roby, & B. Bohm. (2013). *Effects of Meadow Restoration on Stream Flow in the Feather River Watershed: A Review Based on Monitoring Data and Pertinent Research. Version 5.5 (final). With input and review from Feather River CRM Steering Committee members*. Quincy, CA: Retrieved from http://feather-river-crm.org/pdf/PPlug_FlowSummary_Final_June2013.pdf.

Hofstadter, Richard. (1955). *The age of reform : from Bryan to F.D.R*. New York: Knopf.

Hughes, S., & S. Pincetl. (2014). Evaluating collaborative institutions in context: the case of regional water management in southern California. *Environment and Planning C: Government and Policy, 32*(1), 20-38.

Imperial, Mark T. (2005). Using Collaboration as a Governance Strategy: Lessons From Six Watershed Management Programs. *Administration Society, 37*(3), 281-320.

Innes, Judith, & David Booher. (2010). *Planning with complexity: an introduction to collaborative rationality for public policy*. Oxford: Routledge/Taylor and Francis.

Innes, Judith E., & David E. Booher. (1999a). Consensus Building and Complex Adaptive Systems: A Framework for Evaluating Collaborative Planning. *Journal of the American Planning Association 65*(4), 412-423.

Innes, Judith E., & David E. Booher. (1999b). Consensus Building as Role Playing and Bricolage: Toward a Theory of Collaborative Planning. *Journal of the American Planning Association, 65*(1), 9.

Jacoby, Karl. (2001). *Crimes against Nature: Squatters, Poachers, Thieves, and the Hidden History of American Conservation*. Berkeley: University of California Press.

James, Charles D, & Richard B Lanman. (2012). Novel physical evidence that beaver historically were native to the Sierra Nevada. *California Fish and Game, 98*(2), 129-132.

Jasanoff, Sheila. (2005). Ordering Knowledge, Ordering Society. In Sheila Jasanoff (Ed.), *States of Knowledge: The Co-Production of Science and Social Order* (pp. 13-45). London: Routledge.

Jones & Stokes. (2008). Consultant's Report. Plumas Watershed Forum Program Review. Quincy, CA: Prepared for: Plumas County Flood Control and Water Conservation District, County of Plumas.

Kaufman, Herbert. (1960). *The forest ranger, a study in administrative behavior*. Baltimore: Published for Resources for the Future by Johns Hopkins Press.

Kaufman, Herbert. (2006). *The Forest Ranger: A Study in Administrative Behavior*. Washington, D.C.: Resources for the Future. Special Reprint. Originally published in 1960.

Kavvas, ML, ZQ Chen, M Anderson, L Liang, N Ohara, J Wilcox, L Mink, & T. Benoit. (2005). Assessment of the Restoration Activities on Water Balance and Water Quality at Last Chance Creek Watershed Using Watershed Environmental Hydrology (WEHY) Model. PowerPoint presentation. Hydrologic Research Laboratory, Civil and Environmental Engineering, UC Davis; and Feather River CRM.

Kelley, Robert Lloyd. (1998). *Battling the inland sea : floods, public policy, and the Sacramento Valley*. Berkeley: University of California Press.

Kenney, Douglas S. (2000). *Arguing about consensus: Examining the case against Western watershed initiatives and other collaborative groups active in natural resources management*: Natural Resources Law Center, University of Colorado School of Law.

Kettl, Donald F. (2005). The Next Government of the United States: Challenges for Performance in the 21st Century. *IBM Center for The Business of Government, Washington DC*.

Klijn, Erik-Hans, & Joop F.M. Koppenjan. (2000). Public Management and Policy Networks: Foundations of a network approach to governance. *Public Management, 2*(2), 135-158.

Knadler, Alicia. (2012). Yellow Creek restoration planned despite concern about impacts on trout, *Plumas County News*. Retrieved from http://www.plumasnews.com/~plumas6/index.php?option=com_content&view=article&id=9191:yellow-creek-to-receive-the-pond-and-plug-treatment&catid=69:-headline-news&Itemid=6

Kosoy, Nicolás, & Esteve Corbera. (2010). Payments for ecosystem services as commodity fetishism. *Ecological Economics, 69*(6), 1228-1236.

Kusel, Jonathan Paul. (1991). *It's just like baseball: A study of forest community well-being.* (Ph.D. 9228729), University of California, Berkeley, United States -- California. ProQuest Dissertations & Theses database.

Lach, Denise, Helen Ingram, & Steve Rayner. (2005a). Maintaining the Status Quo: How Institutional Norms and Practices Create Conservative Water Organizations. *Texas Law Review, 83*(7), 2027-2053.

Lach, Denise, Steve Rayner, & Helen Ingram. (2005b). Taming the waters: strategies to domesticate the wicked problems of water resource management. *International Journal of Water, 3*(1), 1-17.

Lakoff, George. (2006). Simple Framing: An introduction to framing and its uses in politics: Rockridge Institute.

Langston, Nancy. (1995). *Forest Dreams, Forest Nightmares: The Paradox of Old Growth in the Inland West*. Seattle: University of Washington Press.

Lanman, Richard B, Heidi Perryman, Brock Dolman, & Charles D James. (2012). The historical range of beaver in the Sierra Nevada: a review of the evidence. *California Fish and Game, 98*(2), 65-80.

LaRubbio, Neil. (2012, February 20). Communities help pay for ecosystem services provided by forests. *High Country News*.

Layzer, Judith A. (2008). *Natural experiments: ecosystem-based management and the environment*: MIT Press.

Lebel, Louis, John M. Anderies, Bruce Campbell, Carl Folke, Steve Hatfield-Dodds, Terry P. Hughes, & James Wilson. (2006). Governance and the capacity to manage resilience in regional social-ecological systems. *Ecology and Society, 11*(1), 19.

Lebel, Louis, Rajesh Daniel, Nathan Badenoch, Po Garden, & Masao Imamura. (2008). A multi-level perspective on conserving with communities: Experiences from upper tributary watersheds in montane mainland Southeast Asia. *International Journal of the Commons, 2*(1), 127-154.

Lebel, Louis, Po Garden, & Masao Imamura. (2005). The politics of scale, position, and place in the governance of water resources in the Mekong region. *Ecology and Society, 10*(2), 18.

Lemos, Maria Carmen, & Arun Agrawal. (2006). Environmental Governance. *Annual Review of Environment and Resources, 31*(1), 297-325.

Lemos, Maria Carmen, & João Lúcio Farias de Oliveira. (2004). Can Water Reform Survive Politics? Institutional Change and River Basin Management in Ceará, Northeast Brazil. *World Development, 32*(12), 2121-2137.

Li, Tania. (2007). *The will to improve: governmentality, development, and the practice of politics*. Durham: Duke University Press.

Lindquist, Donna S., Linton Y. Bowie, & Larry L. Harrison. (1997). Red Clover Creek Erosion Control Demonstration Project, Ten-Year Research Summary, 1985-1995. San Ramon, CA: Pacific Gas and Electric Company, Research and Development.

Lindquist, Donna S., & Jim Wilcox. (2000). *New Concepts for Meadow Restoration in the Northern Sierra Nevada*. Quincy, CA: Feather River CRM. Retrieved from http://www.feather-river-crm.org/pdf/ieca.pdf.

London, Jonathan K. (2001). *Placing conflict and collaboration in community forestry.* (Ph.D.), University of California, Berkeley. ProQuest Dissertations & Theses database.

Lurie, Susan, & Michael Hibbard. (2008). Community-Based Natural Resource Management: Ideals and Realities for Oregon Watershed Councils. *Society & Natural Resources, 21*(5), 430-440.

Margerum, Richard. (2008). A Typology of Collaboration Efforts in Environmental Management. *Environmental Management, 41*(4), 487-500.

Marsh, George P. (1864). *Man and nature, or, Physical geography as modified by human action*. New York: C. Scribner.

McCauley, Douglas J. (2006). Selling out on nature. *Nature, 443*(7107), 27-28.

McCloskey, Michael. (1996). The Skeptic: Collaboration Has Its Limits. *High Country News, 28*(9).

McCullum, Christine, David Pelletier, Donald Barr, Jennifer Wilkins, & Jean-Pierre Habicht. (2004). Mechanisms of Power Within a Community-Based Food Security Planning Process. *Health Education & Behavior, 31*(2), 206-222.

McKelvey, Kevin S, & James D Johnston. (1992). Historical perspectives on forests of the Sierra Nevada and the Transverse Ranges of southern California: forest conditions at the turn of the century. In J Verner, KS McKelvey, BR Noon, RJ Gutiérrez, GI Gould Jr. & TW Beck (Eds.), *The California Spotted Owl: A Technical Assessment of its Current Status. USDA Forest Service, Pacific Southwest Research Station. General Technical Report PSW-GTR-133* (pp. 225-246).

McKinney, Matthew, & Will Harmon. (2005). Resolving Natural Resource Disputes: A Historical, Analytical, and Prescriptive Framework. *Renewable Resources Journal, 23*(2), 16.

Meacher, Robert. (1997). The view from Plumas County. [Article]. *American Forests, 103*(1), 18.

Metze, Tamara A. P. (2009). Discursive power in deliberations: A case of redevelopment for the creative economy in the Netherlands. *Policy and Society, 28*(3), 241-251.

Middleton, Elizabeth Rose. (2008). *"We were here, we are here, we will always be here": A political ecology of healing in Mountain Maidu country.* (Ph. D. Dissertation), University of California, Berkeley, Berkeley, CA.
Miles, Matthew B., & Michael Huberman. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks, CA: Sage Publications.
Miller, Norman L., Kathy E. Bashford, & Eric Strem. (2003). Potential Impacts of Climate Change on California Hydrology. *Journal of the American Water Resources Association, 39*(4), 771-784.
Mostert, Erik, Claudia Pahl-Wostl, Yvonne Rees, Brad Searle, David Tàbara, & Joanne Tippett. (2007). Social learning in European river-basin management: barriers and fostering mechanisms from 10 river basins. *Ecology and Society, 12*(1), 19.
Muhn, James. (1992). Early Administration of the Forest Reserve Act: Interior Department and General Land Office Policies, 1891-1897. In Harold K. Steen (Ed.), *Origins of the national forests a centennial symposium* (pp. 259-275). Durham, N.C.: Forest History Society.
Muro, M., & P. Jeffrey. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management, 51*(3), 325-344.
Nadasdy, Paul. (2007). Adaptive Co-Management and the Gospel of Resilience. In Derek Armitage, Fikret Berkes & Nancy Doubleday (Eds.), *Adaptive Co-Management: Collaboration, Learning, and Multi-Level Governance*. Vancouver: UBC Press.
Nader, Laura. (1996). *Naked science : anthropological inquiry into boundaries, power, and knowledge*. New York: Routledge.
National Conservation Commission. (1909). Report of the National Conservation Commission, February, 1909. Special message from the President of the United States transmitting a report of the National Conservation Commission, with accompanying papers. In Henry Gannett (Ed.), *Document 676 of 60th Congress*. Washington D.C.: U.S. Government Printing Office.
National Fish and Wildlife Foundation. (2010). Business Plan for Sierra Nevada Meadow Restoration. Washington, D.C.
National Research Council. (2008). *Hydrologic Effects of a Changing Forest Landscape*. Washington, D.C.: The National Academies Press.
Nie, Martin A. (2008). *The governance of Western public lands: mapping its present and future*. Lawrence, Kansas: University Press of Kansas.
Norgaard, Richard B. (2010). Ecosystem services: From eye-opening metaphor to complexity blinder. *Ecological Economics, 69*(6), 1219-1227.
O'Connor, Dennis. (1994). Financing the State Water Project *Califoirnia Research Bureau Issue Summary*. Sacramento, CA: California State Library.
Ostrom, Elinor. (1990). *Governing the commons: The evolution of institutions for collective action*: Cambridge university press.
Ostrom, Elinor. (2005). *Understanding institutional diversity*. Princeton: Princeton University Press.
Ostrom, Elinor, Thomas Dietz, Nives Dolsak, Paul C. Stern, Susan Stonich, & Elke U. Weber (Eds.). (2002). *The Drama of the Commons*. Washington, D.C.: National Academy Press.

Pahl-Wostl, Claudia, Marc Craps, Art Dewulf, Erik Mostert, David Tabara, & Tharsi Taillieu. (2007). Social Learning and Water Resources Management. *Ecology and Society, 12*(2).
Pascual, Unai, Roldan Muradian, Luis C. Rodríguez, & Anantha Duraiappah. (2010). Exploring the links between equity and efficiency in payments for environmental services: A conceptual approach. *Ecological Economics, 69*(6), 1237-1244.
Paulson, Susan, Lisa L Gezon, & Michael Watts. (2003). Locating the political in political ecology: An introduction. *Human Organization, 62*(3), 205-217.
Pelletier, David, Vivica Kraak, Christine McCullum, Ulla Uusitalo, & Robert Rich. (1999). The shaping of collective values through deliberative democracy: An empirical study from New York's North Country. *Policy Sciences, 32*(2), 103-131.
Pinchot, Gifford. (1910). *The fight for conservation*. New York: Doubleday, Page & Company.
Pires, Mark. (2004). Watershed protection for a world city: the case of New York. *Land Use Policy, 21*(2), 161-175.
Plumas Corporation. (2004). *Last Chance Watershed Restoration Project, CalFed Agreement #2000-E01, Final Report*. Quincy, CA: Retrieved from http://www.feather-river-crm.org/project-files/CalfedFinal.pdf.
Plumas Corporation. (2013). *Red Clover Poco restoration project final report*. Quincy, CA: Retrieved from http://www.feather-river-crm.org/pdf/Red%20Clover%20Poco_FinalRpt.pdf.
Plumas County. (2008). Meeting Minutes, Plumas Watershed Forum, May 28, 2008, in Quincy, CA.
Plumas County. (2013). *Plumas County Draft General Plan, Economics Element*. Quincy, CA: Retrieved from http://www.countyofplumas.com/DocumentCenter/View/10738.
Plumas National Forest. (2010). *The pond-and-plug treatment for stream and meadow restoration: resource effects and design considerations*. Internal document. Retrieved from http://www.wetlandsandstreamrestoration.org/Publications/Pond%20%26%20Plug%20Treatment%20for%20Stream%20%26%20Meadow%20Restoration.pdf.
Putnam, Linda L, & Majia Holmer. (1992). Framing, reframing, and issue development. In Linda Putman & Michael E. Roloff (Eds.), *Communication and negotiation* (pp. 128-155). Newbury Park, CA: Sage.
Quincy Library Group. (1998). Letter to Mr. Kent Connaughton, USDA Forest Service, Pacific Southwest Region, Regarding the Sierra Nevada Framework for Conservation and Collaboration, from http://www.qlg.org/pub/miscdoc/sncfw/snfcc100398.htm
Redford, Kent H., & William M. Adams. (2009). Payment for Ecosystem Services and the Challenge of Saving Nature. *Conservation Biology, 23*(4), 785-787.
Reed, Mark S., Anna C. Evely, Georgina Cundill, Ioan Fazey, Jayne Glass, Adele Laing, Jens Newig, Brad Parrish, Christina Prell, Chris Raymond, & Lindsay C. Stringer. (2010). What is Social Learning? *Ecology and Society, 15*(4).
Reisner, Marc. (1986). *Cadillac desert : the American West and its disappearing water*. New York: Viking.
Rhoads, Bruce L., David Wilson, Michael Urban, & Edwin E. Herricks. (1999). Interaction Between Scientists and Nonscientists in Community-Based Watershed Management:

Emergence of the Concept of Stream Naturalization. *Environmental Management, 24*(3), 297-308.
Rhodes, R. A. W. (1996). The New Governance: Governing without Government. *Political Studies, 44*(4), 652-667.
Ribot, Jesse C., & Nancy Lee Peluso. (2003). A theory of access. *Rural Sociology, 68*(2), 153.
Robertson, Morgan M. (2004). The neoliberalization of ecosystem services: wetland mitigation banking and problems in environmental governance. *Geoforum, 35*(3), 361-373.
Roggeband, Conny, & Mieke Verloo. (2007). Dutch Women are Liberated, Migrant Women are a Problem: The Evolution of Policy Frames on Gender and Migration in the Netherlands, 1995–2005. *Social Policy & Administration, 41*(3), 271-288.
Romm, Jeff. (2002). The Coincidental Order of Environmental Justice. In Kathryn M. Mutz, Gary C. Bryner & Douglas S. Kenney (Eds.), *Justice and Natural Resources: Concepts, Strategies, and Applications* (pp. 117-138). Washington, DC: Island Press.
Ryfe, David M. (2005). Does deliberative democracy work? *Annual Review of Political Science, 8*, 49-71.
Sabatier, Paul A. (2005). *Swimming upstream: collaborative approaches to watershed management*. Cambridge, Mass.: MIT Press.
Salka, William M. (2004). Mission Evolution: The United States Forest Service's Response to Crisis. *Review of Policy Research, 21*(2), 221.
Scaglione, John, & Peter Skene Ogden. (1949). Ogden's Report of His 1829-1830 Expedition. *California Historical Society Quarterly, 28*(2), 117-124.
Scarlett, Lynn. (2013). Collaborative Adaptive Management: Challenges and Opportunities. *Ecology and Society, 18*(3).
Schiff, Ashley L. (1962). *Fire and water; scientific heresy in the Forest Service*. Cambridge: Harvard University Press.
Schneider, Mark, John Scholz, Mark Lubell, Denisa Mindruta, & Matthew Edwardsen. (2003). Building Consensual Institutions: Networks and the National Estuary Program. *American Journal of Political Science, 47*(1), 143-158.
Schout, Adriaan, & Andrew Jordan. (2005). Coordinated European Governance: Self-Organizing or Centrally Steered? *Public Administration, 83*(1), 201-220.
Schusler, Tania M., Daniel J. Decker, & Max J. Pfeffer. (2003). Social Learning for Collaborative Natural Resource Management. *Society & Natural Resources, 16*(4), 309-326.
Scott, James C. (1998). *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press.
Sedell, James, Maitland Sharpe, Daina Dravnieks Apple, Max Copenhagen, & Mike Furniss. (2000). *Water & The Forest Service*. Washington, D.C.
Selverston, Mark D. (2006). Historical Maidu of the Feather River. *Proceedings of the Society for California Archaeology, 19*, 77-82.
Sierra Nevada Alliance. (2009). Investing in California's Headwaters: The Sierra Nevada (pp. 20). South Lake Tahoe, California.
Sierra Nevada Ecosystem Project Team. (1996). Sierra Nevada Ecosystem Project, Final Report to Congress, Volume 1, Assessment Summaries and Management Strategies. Davis: University of California, Centers for Water and Wildland Resources.

Sierra Water Workgroup. (2014). Sierra Water Workgroup - About, from http://www.sierrawaterworkgroup.org/

Singleton, Sara. (2000). Co-operation or Capture? The Paradox of Co-management and Community Participation in Natural Resource Management and Environmental Policy-making. *Environmental Politics, 9*(2), 1-21.

Singleton, Sara. (2002). Collaborative Environmental Planning in the American West: The Good, The Bad and the Ugly. *Environmental Politics, 11*(3), 54-75.

Spiro, Jonathan Peter. (2009). *Defending the master race: conservation, eugenics, and the legacy of Madison Grant*. Burlington, Vt.; Hanover, NH: University of Vermont Press ; Published by University Press of New England.

State of California. (2009). *California Water Plan Update 2009. Volume 2. Resource Management Strategies. Chapter 23. Forest Management*. Sacramento, CA: California Natural Resources Agency, Department of Water Resources Retrieved from http://www.waterplan.water.ca.gov/cwpu2009/index.cfm.

State of California. (2013). *California Water Plan Update 2013, Public Review Draft. Volume 3. Resource Management Strategies. Chapter 23. Forest Management*. Sacramento, CA: California Natural Resources Agency, Department of Water Resources Retrieved from http://www.waterplan.water.ca.gov/cwpu2013/prd/index.cfm.

Stewart, William C. (1996). Economic assessment of the ecosystem *Sierra Nevada Ecosystem Project: Final report to Congress, vol. III, Assessments and scientific basis for management options*. Davis: University of California, Centers for Water and Wildland Resources.

Stoker, Gerry. (2006). Public Value Management: A New Narrative for Networked Governance? *The American Review of Public Administration, 36*(1), 41-57.

Stone, Deborah A. (1989). Causal Stories and the Formation of Policy Agendas. *Political Science Quarterly, 104*(2), 281-300.

Sustainable Conservation, Environmental Defense Fund, Sierra Nevada Conservancy, & The Nature Conservancy. (2012). Mokelumne Watershed Environmental Benefits Program. *Factsheet*, from http://www.edf.org/sites/default/files/Mokelumne_factsheet_2012.pdf

Tague, Christina, Scott Valentine, & Matthew Kotchen. (2008). Effect of geomorphic channel restoration on streamflow and groundwater in a snowmelt-dominated watershed. *Water Resources Research, 44*(10), W10415.

Takacs, David. (1996). *The idea of biodiversity : philosophies of paradise*. Baltimore: Johns Hopkins University Press.

Teisch, Jessica. (1999). The Drowning of Big Meadows: Nature's Managers in Progressive-Era California. *Environmental History, 4*(1), 32-53.

Teisch, Jessica B. (2001). Great Western Power, "White Coal," and Industrial Capitalism in the West. *Pacific Historical Review, 70*(2), 221-253.

Teisch, Jessica B. (2011). *Engineering nature : water, development & the global spread of American environmental expertise*. Chapel Hill: University of North Carolina Press.

Terriff, Terry. (2006). Warriors and Innovators: Military Change and Organizational Culture in the US Marine Corps. *Defence Studies, 6*(2), 215-247.

Thomas, Craig W. (2003). *Bureaucratic landscapes: interagency cooperation and the preservation of biodiversity*. Cambridge, Mass.: MIT Press.

Torgerson, Douglas. (2003). Democracy through policy discourse *Deliberative policy analysis: Understanding governance in the network society* (pp. 113-138). Cambridge: Cambridge University Press.

Troendle, C.A., J. M. Nankervis, & A. Peavy. (2007). Final Report. The Herger-Feinstein Quincy Library Group Project— Impacts of Vegetation Management on Water Yield: Prepared for the USDA Forest Service.

U.S. Census Bureau. (2013). *Plumas County QuickFacts*. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits. Last Revised: Thursday, 27-Jun-2013 14:21:31 EDT Retrieved from http://quickfacts.census.gov/qfd/states/06/06063.html.

USDA Forest Service. (2009). Forest Focus – Episode 4: Water, from http://www.fs.usda.gov/detailfull/r5/news-events/audiovisual/?cid=stelprdb5341308&width=full

USDA Forest Service. (2011). *Region 5 Forest Service Handbook 2509.22 - Soil and Water Conservation Handbook. Chapter 10 - Water Quality Management Handbook*. Vallejo, CA: Retrieved from http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5399662.pdf.

USDA Soil Conservation Service. (1989). East Branch North Fork Feather River Erosion Inventory Report. Davis, CA.

Vatn, Arild. (2010). An institutional analysis of payments for environmental services. *Ecological Economics, 69*(6), 1245-1252.

Voß, Jan-Peter, & Basil Bornemann. (2011). The Politics of Reflexive Governance: Challenges for Designing Adaptive Management and Transition Management. *Ecology and Society, 16*.

Walker, Peter A., & Patrick T. Hurley. (2004). Collaboration Derailed: The Politics of “Community-Based” Resource Management in Nevada County. *Society & Natural Resources, 17*(8), 735-751.

Weber, E. P. (2000). A New Vanguard for the Environment: Grass-Roots Ecosystem Management as a New Environmental Movement. *Society & Natural Resources, 13*(3), 237-259.

Weber, Edward P. (1999). The Question of Accountability in Historical Perspective: From Jackson to Contemporary Grassroots Ecosystem Management. *Administration & Society, 31*(4), 451-494.

Weir, Margaret, Jane Rongerude, & Christopher K. Ansell. (2009). Collaboration Is Not Enough: Virtuous Cycles of Reform in Transportation Policy. *Urban Affairs Review, 44*(4), 455-489.

Weiss, Kristen, Mark Hamann, & Helene Marsh. (2012). Bridging Knowledges: Understanding and Applying Indigenous and Western Scientific Knowledge for Marine Wildlife Management. *Society & Natural Resources, 26*(3), 285-302.

Wilcox, Jim. (2003a). Last Chance Creek Watershed Restoration Project Cumulative Watershed Effects Assessment. Quincy, CA: Feather River CRM.

Wilcox, Jim. (2003b). Upper Last Chance Creek watershed restoration project hydrology and geomorphology. Quincy, CA: Feather River CRM.

Wills, Leah, & Gerald J. Gray. (2001). Exploring Reinvestment from a Community-Based Watershed Perspective. *Journal of Sustainable Forestry, 13*(1), 385 - 399.

Wilson, James Q. (1989). *Bureaucracy: what government agencies do and why they do it*. New York: Basic Books.

Woelfle-Erskine, Cleo. (2008, August 25, 2008; updated September 4, 2008). Riparian repair: How can we put the West's broken rivers back together again?, *High Country News*. Retrieved from http://www.hcn.org/issues/40.16/riparian-repair

Wohlforth, Charles. (2010). Conservation and eugenics. *Orion Magazine*.

Wondolleck, Julia M., & Steven L. Yaffee. (1994). Building Bridges Across Agency Boundaries: In Search of Excellence in the United States Forest Service. Ann Arbor: University of Michigan, School of Natural Resources and Environment.

Wondolleck, Julia M., & Steven L. Yaffee. (2000). *Making Collaboration Work: Lessons from Innovation in Natural Resource Management*. Washington, D.C.: Island Press.

Worster, Donald. (1985). *Rivers of Empire: Water, Aridity, and the Growth of the American West* (Reprint. Originally published: New York: Pantheon, 1985. ed.): Oxford University Press.

Yaffee, Steven L., & Julia M. Wondolleck. (2003). Collaborative ecosystem planning processes in the United States: evolution and challenges. *Environments, 31*(2), 59-72.

Yanow, Dvora. (2000). *Conducting Interpretive Policy Analysis*. Thousand Oaks, CA: Sage.

Yin, Robert K. (2003). *Case study research: design and methods* (3rd ed. Vol. 5). Thousand Oaks, CA: Sage Publications.

Young, Jim. (2003). *Plumas County: History of the Feather River Region*. Mount Pleasant, South Carolina: Arcadia Publishing.

Young, Oran. (2006). Vertical Interplay among Scale-dependent Environmental and Resource Regimes. *Ecology and Society, 11*(1), 27. [online] URL: http://www.ecologyandsociety.org/vol11/iss21/art27/.

Zaffos, Joshua. (2003, 10 November 2003). 'Restoration Cowboy' goes against the flow, *High Country News*. Retrieved from http://www.hcn.org/issues/262/14362