The Environmental Outcomes of Collaborative Natural Resource Institutions

by

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Abstract

Across the United States there are collaborative partnerships and networks co-laboring to manage environmental and natural resources including our watersheds. There are over 2,000 of these watersheds in which at least half (as of 2002) have some form of collaborative management structure. We know much about why and how these partnerships form, but we do not know nearly as much about the environmental outcomes produced by their collaborative outputs. This dissertation analyzes the associations between water quality, measured by state and federal Clean Water Act guidelines, and the institutional arrangement of stakeholder organizations within watersheds. This research tests the hypothesis that the relationship between insufficient water quality and collaborative partnerships is negative. Also tested is the relationship between this type of institutional arrangement and environmental outcomes as perceived by stakeholders. The data for this investigation comes from surveys of officials at organizations conducting various watershed-related activities in a sample of watersheds across the fifty states, as well as from the US Environmental Protection Agency, the US Decennial Census, state environmental agencies, and other sources.

Acknowledgments

This dissertation is dedicated to my wife, Meredith Adams, for her forbearance, never-ending encouragement, and constant love. I'm looking forward to so many more good times with you and all of the adventures life will bring us and our family.

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Finally, I would be remiss not to acknowledge Homer Simpson, the fictional character who once transformed a sign that read "Don't Forget: You're Here Forever!" into one that read "Do it For Her" using pictures of his youngest daughter, Maggie. This became my mantra as I pressed on through graduate school with my daughter Violet in mind—so I wouldn't be stuck here forever.

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List of Abbreviations

ACF	Advocacy Coalition Framework
AIC	Akaike Information Criteria
BIC	Bayesian Information Criteria
BMP	Best Management Practices
BRM	Binary Response Model
CWA	Clean Water Act
ENR	Environmental and Natural Resource
HUC	Hydrological Unit Code
IAD	Institutional Analysis and Development
ICC	Interclass Correlation Coefficient
IRC	Institutional Rational Choice
LCAF	Levels of Collaborative Action Framework
NEP	National Estuary Program

NOAA	National Oceanic and Atmospheric Administration
NPEDS	National Pollution Discharge Elimination System
NPS	Nonpoint Source
SES	Socioeconomic Status
TMDL	Total Maximum Daily Load
US	United States
US EPA	US Environmental Protection Agency
USGS	United States Geological Survey

Water resource administration, because of the rich interrelationships among the various values or goods which can be derived from water, will require a very rich and complex system of organization in realizing the diverse values of multipurpose development.

Vincent Ostrom (1962)

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Introduction

A form of collaborative partnership exists in many watersheds across the United States (US), providing ample space in which to test various theories of collaboration and collective action, as well as to examine watershed partnership effectiveness. When Mark Lubell and colleagues (2002) counted, they found over 900 watershed partnerships in more than 2,000 watersheds. These watershed partnerships do many things, but we do not know whether they actually produce positive environmental outcomes from their collaborative outputs (Koontz and Thomas 2006). There are numerous ways to approach this quandary, and many have done so through case studies and other investigations allowing for small sample sizes (e.g., Imperial 2005; Sabatier et al. 2005; Schlager and Blomquist 2008; Weber 2003). Yet, even in the investigations with larger sample sizes (e.g., Lubell et al. 2002), much of the conclusions rest on *perceptions* of environmental benefit, and in many instances that has been sufficient to sustain the stakeholder collaborations (Lubell 2003). The research question for this investigation, however, asks whether water quality is greater, overall, in watersheds with collaborative partnerships than in those without such an arrangement, however formal or informal. A secondary research question asks which ecological and social characteristics and what types of organizations benefit measured and perceived improvements in water quality.

The literature offers several ways to answer these questions. Edella Schlager and William Blomquist (2008) apply the idea of polycentric governance to natural resources that cross scales and boundaries (also see V. Ostrom 1999) . Elinor Ostrom (1990) applied common pool resource theory, among other frameworks, to understand various watershed collaboratives. Institutional rational choice (IRC) models examine how institutional rules and norms affect interactive actor behavior and suggest various ways to evaluate outcomes (Ostrom 1998, 1999; Sharpf 1997). Research using the Advocacy Coalition Framework (ACF) (Sabatier and Jenkins-Smith 1993) examines collaborative effects on traditional coalitions (Lubell 2000, 2003), as well as whether the political forces that brought coalitions together continue to operate when a collaborative forms (Weible 2006). Many of these collaborative efforts are attempts to overcome collective action problems (Olsen 1971) in a natural resource setting through various institutional mechanisms (Feiock and Scholz 2010; Scholz and Stiftel 2005).

The remainder of this chapter defines and highlights collaboration in various forms, discusses the Watershed Approach framework established by the US Environmental Protection Agency (US EPA) for governing and managing water resources, the nature of watershed politics and governance, and the opportunities for collective action within and across watersheds. The chapter ends with a discussion of the challenges faced today by watershed stakeholders. Chapter two focuses on the literature and theories on which this investigation is based and introduces several testable hypotheses. Chapter three discusses the methodology used to answer the questions stated above as well as the methods by which hypotheses relating to those questions will be tested. Chapters four presents the results of the study and the ways in which it can be strengthened. Finally, chapter five concludes with general theorizing about watershed governance with relevance for both scholars and practitioners, as well as ideas for future research.

Collaboration and Networks

Collaborative approaches to public policy are used to transform diverse perspectives, information, and knowledge into action. As individuals and institutions reach across boundaries in search of extant knowledge and resources, networks of various types form; they are maintained by the interaction of members and extended by the incorporation of new individuals and institutions. When problems are easily defined, when managers have clear goals, and when objectives are easily measurable, a typical twentieth century bureaucratic organization may be ideal to develop and implement solutions. On the other hand, networks and "collaborarchies" thrive on rapidly changing situations, approach difficult problems without neat solutions, as well as deal with "wicked" (Rittel and Weber 1973) and/or "nettlesome" problems (Agranoff 2007, 2012; O'Toole Jr. 1997). The key to these networks is synergy between multiple agencies and individuals (Agranoff 2007, 187), representing public, nonprofit, nongovernmental, and private actors. Of course, "[m]ultiple parties means multiple alternatives to suggest and consider, more information available for all to use, and a decision system that is less bound by the frailties of individual thinking" (Agranoff and McGuire 2001, 321). Networks are found across all policy arenas; and they exist at multiple levels in the American federal system, horizontally and vertically connecting individuals, organizations, and institutions across the landscape, often creating a polycentric array of fragmented yet robust federalism (Feiock and Scholz 2010, 285).

Traditional organizations with information asymmetries, boundedly rational people, and boundary problems have difficulty reaching beyond their own constituencies to gather and channel resources in efficient and effective ways to address problems complex problems.

Many first-generation responses from command-and-control institutions were effective at meeting early challenges but they are not as successful at overcoming second-generation problems—those that reflect the complexity and interconnectedness of policy problems and possible solutions, as well as more complete ways of thinking about problems. Alternative approaches like collaborative public management attempt to meet these challenges, as well as embrace uncertainty and complexity (Agranoff 2012; Bingham and O'Leary 2008; Rabe 2009). Pushing us towards new models of organization is a combination of devolutionary processes, rapid technological innovation and change, increasingly scarce resources, and growing organizational interdependencies (Thomson and Perry 2006, 20). Lisa Bingham and Rosemary O'Leary (2008, 5) write, "The prevalence of network management, contracting out, and greater collaboration with citizens has altered the dynamics of public administration, public management, and what it means to be a leader." Further, the evolution of information technology has led the way for collaborative approaches, as it has reduced transaction costs and created integration across boundaries, both locally and globally (Agranoff 2007; Bingham and O'Leary 2008; Schlager and Blomquist 2008). These new dynamics have produced an ever-increasing amount of disciplinary-specific as well as multidisciplinary research; and collaboration, networks, and collaborative governance have emerged with distinct focus, even if the terms are not uniformly used.

Collaboration theoretically "brings multiple stakeholders together in common forums with public agencies to engage in consensus-oriented decision making" (Ansell and Gash 2007, 543). In some instances, however, government agencies do not formally participate but rather listen to concerns and receive recommendations from interested stakeholders who have come together to form some advocacy partnership (Koehler and Koontz 2008). And in other instances the government(s)—at various and sometimes multiple levels—becomes a partner by providing necessary resources to encourage group formation. These approaches are found in environmental and natural resource (ENR) management in general and in watershed governance in particular.

The Watershed Approach

Around the nation watershed partnerships have formed to collaboratively manage and overcome numerous collective action problems. Many of these have emerged to mitigate heterogeneous nonpoint source (NPS) pollution; others have formed to overcome habitat degradation, increase biodiversity, and to structure decision making about the natural resource in ways that are acceptable to stakeholders within the watershed. The United States Geological Survey (USGS) has classified watersheds at various scales into successively smaller hydrologic units. As a unit of analysis, this study examines watersheds at the cataloging unit level, identified by an eight-digit code, which "is a geographic area representing part of all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature" (USGS 2012). Across the fifty states there are 2,256 watersheds at this level of classification. Figure 1.1 portrays one of these watersheds in Alabama.

[Figure 1.1 about here.]

Water resource managers, watershed organizations, tribes, state and national agencies, and other stakeholders have moved toward and embraced a watershed approach—designed in part by the US EPA—for managing water quality and other natural resource characteristics.

> A *Watershed Approach* is a flexible framework for managing water resource quality and quantity within specified drainage areas, or watersheds. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. The *watershed planning process* works within this framework by using a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies, and implement and adapt selected actions as necessary. (EPA 2008, 2-1, emphasis in original)

This approach requires participation from a diverse group of stakeholders, especially when environmental conditions are extremely impaired—the remediation of which is the primary purpose of the approach—as well as when the impairment comes from diffuse and heterogeneous sources, such as NPS pollution.

The watershed approach “addresses the problems in a holistic manner and the stakeholders in the watershed are actively involved in selecting the management strategies that will be implemented to solve the problem.” The goal is to design watershed plans that “make sense for conditions found in local communities” (EPA 2008, 2-1). This process is actively encouraged by the US EPA and other governmental agencies that deal with water and land management; numerous handbooks have been developed—and updated—over the past three decades, along with numerous capacity-building educational and grant programs that are often overseen by regional US EPA offices. For the approach to work, stakeholders must come together in some form of collaborative effort to identify problems, develop solutions, implement plans, and hold each other accountable. Of course they may face many challenges related to the nature of the resource itself as well as the politics that are ever present in public management.

Watershed Politics

Three issues permeate watershed politics: boundary definition, decision making rules and structures, and accountability (Schlager and Blomquist 2008). The political choices confronted therefore are structuring governing institutions and organizations, determining who participates in decision making, deciding how decisions are made (e.g., consensus or majority), and establishing how decision makers are held accountable. The “[a]rguments over boundaries and inclusion often hinge on the outcomes advocates are trying to promote; they are political arguments” (Schlager and Blomquist 2008, 26). Biophysical and organizational boundaries can change over time, as can certain values and socioeconomic landscapes.

> Neither defining communities of interest broadly nor giving pride of place to local, geographic communities guarantees that a particular set of values will be

> pursued consistently over time as the watershed setting and its context change. (Schlager and Blomquist 2008, 63)

Moreover, these often natural boundaries rarely fit into the jurisdictional boundaries drawn by humans when making other political decisions. This makes difficult many attempts to overcome collective action problems in natural resource settings. And it also makes difficult the articulation and acceptance of decision making structures that determine who is accountable to whom.

The Institutional Landscape of Watershed Governance

Edella Schlager and William Blomquist (2008) make us keenly aware of the importance of recognizing both the physical and institutional landscapes of watersheds. The physical landscape captures the geographic, topographic, hydrographic, and hydrologic features, the water resources, the various flora and fauna and their habitats, and also the structures and habitats humans have established in the watershed. The institutional landscape of a watershed is often a "complex but largely invisible terrain of rules and organizations that govern and affect human choices about the making of decisions, the use of resources, and the relationships of people to nature and to one another" (Schlager and Blomquist 2008, 1). In Elinor Ostrom's (2005, 17) terms, these "[r]ules can be thought of as the set of instructions for creating an action situation in a particular environment." Watersheds and many other natural resources are structured by a series of physical, social, and institutional rules. The action situation is where these rules impact those participating in governance and decision making.

The visible terrain of rules is complex as well, as myriad formal institutional rules from multiple levels of government limit, prescribe, proscribe, and/or enjoin actions. At the national level the US EPA, the Forest Service, the National Park Service, the Fish and Wildlife Service, the Bureau of Reclamation, and other agencies from the departments of interior, agriculture, defense, and homeland security may each have a stake in the management of numerous watersheds across the country. At the state and local levels, many of these responsibilities are mirrored, supplemented, or even duplicated, as state and local agencies produce and provide goods and services from and in watersheds. While many of these agencies still perform distributional and regulatory functions, a number of them have become "conductive agencies" working outside their traditional boundaries to promote collaboration among multiple public, private, and nonprofit entities in pursuit of common goals (Agranoff 2012).

What is more, watersheds, like ecosystems, are complex adaptive systems. To put a finer point on it, defining an ecosystem is difficult for numerous reasons, so watersheds are often used as "ecosystem proxies" (Barham 2001, 183). Elizabeth Barham (2001, 183) writes,

> Throughout history we have organized our patters of habitation and food production around water. The placement of villages, towns, and cities, traditional structures of land control and distribution, and indeed the rise of industrial production have all been influenced by the availability, suitability, and control of water.

Although there are many more demands on water resources, this is true today just as it has been for millennia. The main difference, however, is that we have come to recognize the interconnectedness among elements in an ecosystem, including humans—truly embracing all that is connoted in the term.[1]

Many refer to watersheds a socio-ecological systems (e.g., Barham 2001; Lowe et al. 2003). Quoting Bobbie Lowe and colleagues (2003, 103), Schlager and Blomquist (2008, 3) portray these socio-ecological systems as complex adaptive systems that "are composed of a large number of active elements whose rich patterns of interactions produce emergent properties which are not as easy to predict by analyzing the separate system components." Due to this complex nature there is a great deal of uncertainty characterizing these systems (Dietz et al. 2003; Imperial 2005; Schlager and Blomquist 2008; Walker et al. 2008), which

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[1] Of course it must be noted that while this understanding of ecosystem interconnectedness is relatively recent to Western cultures, many indigenous and Eastern cultures have long held this belief.

restricts our empirical tools, forcing us to analyze individual components as a larger part of the system—or, even better, to view the individual components as an interconnected part of a networked system. Numerous actors are focused on these components, some attempting to act collectively in an attempt to benefit the entire system.

Collective Action Opportunities

These attempts at collective action have acquired numerous labels. Regardless of whether they are defined as collaboratives, networks, polycentric arrangements, in many policy arenas these can be described as self-organized federalism (Feiock and Scholz 2010) due to the numerous actors involved at multiple levels. When managing watersheds, political realities often complicate these approaches, and in the end, "people are not free to design any type of institution or policy they desire: they must settle on a tolerable mix of transaction costs" (Schlager and Blomquist 2008, 98). Because watersheds exist at multiple scales, watershed management "involves the simultaneous pursuit of multiple (but not necessarily complimentary) goals" (Schlager and Blomquist 2008, 127). In many places collaborations and networks of various types overlap at different scales. What we have then is a diverse multi-organizational, non-centralized (Elazar 1987), polycentric (E. Ostrom 2005) institutional arrangement within a watershed that

> results from the combined effects of differences among the interests of individuals and organizations within the watershed, changes over time in the understanding of problems and in values for water, the need to pursue multiple resource management goals, distinctions in the efficient scale of operation of organizations performing diverse functions, and the importance of finding distributions of benefits and costs that are perceived as fair by those who bear them. (Schlager and Blomquist 2008, 148)

This is where the true political nature of watershed governance is found. But it also creates opportunities for resource users and stakeholders to come together in pursuit these diverse goals, attempting to overcome the collective action dilemmas that are inherent in such an endeavor (Olsen 1971; E. Ostrom 1990).

Watershed Governance

It has been argued the most effective way to manage a watershed is through a large scale, integrated management institution (e.g., Grigg 1999)—an institution that could theoretically be capable of managing a region as large as the entire Mississippi River drainage basin. Other do not see this as physically or political feasible (Biswas 2004; Blomquist and Schlager 2005). And due to the politics of boundary drawing, decision making, and accountability, these integrated approaches are extremely difficult and problematic for large geographies. The most effective way to manage a watershed, according to Blomquist and Schlager (2005, 113) is through a collaborative approach that involves local stakeholders which, providing a way for communities to

> assert contested claims for inclusion, articulate and protect their values and interests during decisions about the watershed, and invest those decision-making arrangements with the mechanisms for accountability and change.

This type of arrangement connects aspects of large-scale national goals with the knowledge and experiences of those who live in the watershed. These arrangements have now become commonplace across the US—and, again, encouraged by the US EPA and numerous other federal departments and agencies charged with land management (Hoornbeek et al. 2012; Sabatier et al. 2005), reflecting the US EPA's Watershed Approach (EPA 2008).

Rather than a uniform approach, then, we have the possibility for an institutionally rich environment in which the instruments for overcoming collective action problems are available to local watershed resource users through functionally specialized institutions. The polycentric nature reflects federal arrangements to which we are well accustomed, with nested layers of authority and decision-making structures, and also with democratic features and cultural traditions that encourage community participation and self-governance—many of the very ideas Vincent Ostrom (1974) spoke of in his Alabama lectures. This dissertation investigates the institutions that have grown up from watershed users and stakeholders that have grown out of the watershed approach movement to collaboratively overcome second-order collective action problems that other (command-and-control) institutions have failed to solve.

Although the institutionally rich environment as described is a possibility, what often occurs is a fragmented arrangement of institutions working either at similar goals or at cross-purposes, adding further complexity and uncertainty to the environment. This fragmentation of authority, goals, and values, among other things, can either push groups apart or bring them together to collaboratively manage and pool resources. Examining this fragmented nature of watershed governance, Mark Imperial (2005, 283) highlights aspects that often make collaboration desirable:

> The policies and programs governing watersheds are specialized by medium (e.g., air, water, soil, land use, etc.), geographic location (e.g., wetlands, coastal zone, tidal waters, agricultural land, forest land, etc.) statute, or function (e.g., permitting enforcement, educating the public, installing best management practices, issuing grants, etc.). The corresponding institutional fragmentation limits any organization's ability to accomplish its mission by acting alone.

So within each watershed, then, there is the possibility we can find a rich institutional environment that deals with these various attributes, as well as commensurate uncertainties and complexities and that are the very nature of both social and ecological systems. Traditional command-and-control institutions have done well to ensure certain parts of the system are efficiently protected from some collective action problems. Other, more difficult collective action problems, such as NPS pollution and habitat degradation require different institutions and often different institutional actors that can deal with the heterogeneous characteristics of a watershed in a particular place.

Today's Challenges

As we face increasing uncertainty due to droughts, floods, climatic patters, and global climate change, there is an urgent sense to ensure the sustainability and adaptability of our natural resources. A changing climate can no longer be forestalled; we must adapt to it, as must our resource management institutions. Increasing conflicts over water across the US and around the globe make this ever more urgent. This adaptation may enhance the probability that our rivers, lakes, estuaries, and other waterbodies are usable today and sustainable for tomorrow.

These aspects are further explored in the next chapter. In the third chapter, several hypotheses are formulated to test the measured and perceived outcomes achieved by those involved in watershed management and governance, followed by a discussion of the methods by which the hypotheses are tested. Chapter four provides the results of these tests, and the fifth chapter offers conclusions for practitioners and scholars.

This investigation examines the relationship between watershed stakeholders and of water quality in a sample of watersheds across the United States. Such an effort to develop a broad understanding of environmental outcomes produced by these collaborative partnerships has not been attempted to date, thus this dissertation adds an important contribution to the public policy and public administration literatures related to intersectoral collaboration, networks, environmental and natural resource policy, and collective action.

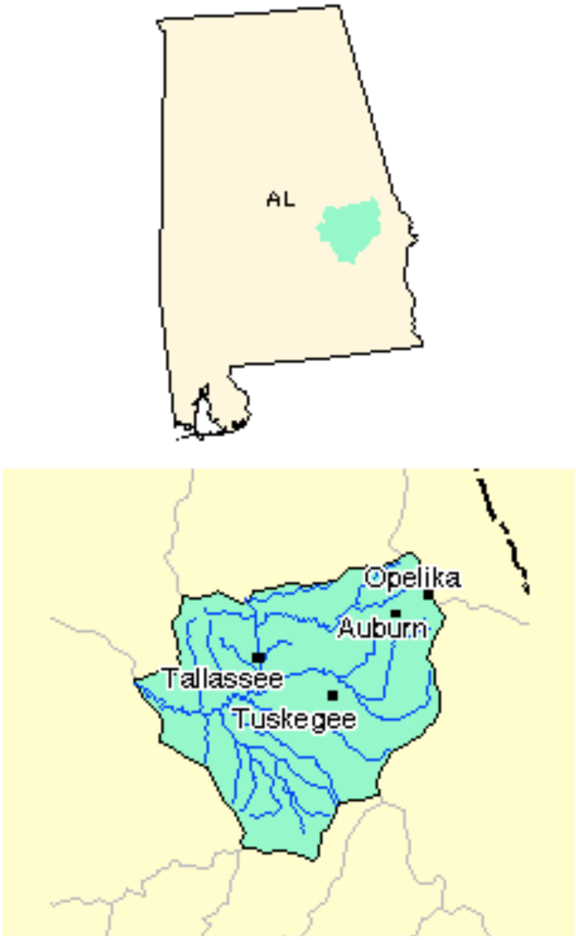

Figure 1.1: Map of a Cataloging Unit Level Watershed and Its Location

Water is the source of a complex multiplicity of 'goods' which have value to us as human beings. In a fundamental way, water is essential to the continuity of life itself. All living organisms require a regular supply of water in order to sustain their survival, growth and development. In addition to supplying water to meet the consumptive requirement of living organisms, flowing water may also be used to provide a major source of power. The same water course may provide a habitat for valuable supplies of fish and wildlife and a place for human recreation. It may be used to transport a variety of goods and commodities along its course. A stream may also be used to dilute and purify waste products, or it may be used for washing or processing purposes or as a cooling agent in industrial production.

Vincent Ostrom (1962)

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A Literature Review

Water Quality

Governments in the United States spend nearly $50 billion each year to ensure our waters are safe from pollution, either through water treatment or pollutant source reduction efforts. Poor water quality adversely impacts the health of human begins and all ecosystem flora and fauna. It has economic impacts on persons and communities that use water and its myriad resources. And it can increase the costs for water consumption (Hoornbeek 2011, 27). There are four categories for intended uses for surface waters like rivers and lakes: human water supply, human recreation, ecological support for fish and wildlife, and economic support for industry, power generation, and navigation (Hoornbeek 2011, 29–30).

Pollution of surface water occurs in many ways. Some pollutants come from point sources, where they flow out of drain pipes or other media into lakes and streams. Other pollutants come from nonpoint sources, such as run off from roadways, parking lots, and agricultural fields after a rain storm. Because nonpoint source (NPS) pollution comes from heterogeneous sources and has diffuse qualities, its mitigation and/or abatement is often understood to be a collective action problem. Moreover, it is up to the states and the US EPA (US Environmental Protection Agency)to determine if NPS pollution has had a detrimental effect on water quality. "When a state government or EPA labels a water body as 'impaired,' they mean that the quality of the water in that water body is not sufficient to support intended use(s) that are specified by state water quality standards" (Hoornbeek 2011, 30). Point source pollution is regulated by national and state governments. Nonpoint sources of pollution, however, are not, so they require a different approach if we wish to prevent or limit their impact on water quality, riparian habitats, and ecosystem processes.

This chapter places the focus on this different type of approach. In doing so it provides a review of the literature associated with public policy, the evolution of environmental policy in the United States, and policy related to regulating water quality and pollution of various types. In addition, literature related to the formation and maintenance of networks, collaborative public management, commons governance, and associated concepts is also reviewed.

Environmental Policy

Policy making in the United States can confound and complicate, as it involves numerous formal and informal institutions, endogenous and exogenous actors, various decision making points, different levels of influence and access, and often the complexities of federalism, all of which provide inputs into the political system. These various characteristics, and the politics which influence them, interact and intersect with each other, and the output is some sort of policy prescription; and as David Easton (1953) demonstrated, these outputs into the policy environment form a feedback loop which in turn informs new inputs as the system continues.

There are many theories about how the policy making process works and how policy change occurs. Charles Lindblom's (1959) model suggests policy making is a series of successive limited comparisons that result in incremental policy adjustments. In this "muddling through" approach, those making the decisions can often agree on a course of action even if they cannot agree on the problem parameters, which can often be the case in environmental and natural resource (ENR) policy domains (Lubell 2005). John Kingdon's (1984) "multiple streams" approach examines the confluence of problem, policy, and politics streams as they flow through the government waiting for a policy entrepreneur or another actor to attach a solution to that problem and wait for an open window through which they push their preferred policy alternative. Paul Sabatier (1988) places the focus on persons with similar beliefs coming together to form advocacy coalitions to affect change in a particular policy subsystem (also see Sabatier and Jenkins-Smith 1993). Elinor Ostrom (1990, 2005) examines how policy actors in interdependent situations organize to self-govern so as to get the most benefit from their interdependency by overcoming collective action dilemmas. Frank Baumgartner and Bryan Jones (2009) view policy as typically following the incremental model that Lindblom describes, but the equilibrium produced by that model is marked by punctuated disruptions that bring about significant shifts or policy change and leading to a new equilibrium. Together, these theoretical lenses portray the changing nature of environmental policy in the United States.

First-Generation Policy Responses

Earth Day 1970 is often considered the moment when a social cascade occurred that led to a punctuation of the environmental policy equilibrium, resulting in a groundswell of congressional attention to public opinion about the environment and a subsequent host of environmental policy legislation at the national level. David Webber (2008) suggests the convergence of congressional and executive policy streams in the late 1950s and 1960s, respectively, prepared the way and gave momentum to the Earth Day movement. Rachel Carson's (1962) cautionary tale *Silent Spring* had a lasting effect and made much of the American public keenly aware of myriad environmental menaces and their likely causes and outcomes.

As political forces began to mobilize around environmental issues, a spate of national legislative and administrative action occurred between 1970 and 1975, including the National Environmental Policy Act; The Clean Air Act; The Water Pollution Control Act; The Noise Control Act; The Coastal Zone Management Act; The Marine Mammal Protection Act; The Federal Insecticide, Fungicide, and Rodenticide Act; The Endangered Species Act; The Safe Water Drinking Act; The Toxic Substances Control Act; The Resource Conservation and Recovery Act; and The Energy Policy and Conservation Act, among others. These laws were in part used to deflect growing attention and perturbations of the American public over various issues, from civil rights to Vietnam in the 1970s (Repetto 2006), but they would not emerged had not a confluence of the politics, policy, and problem streams opened a policy window to allow such a punctuation in the policy equilibrium (Webber 2008).

There are still many unmet mandates and urgent challenges related to environmental governance today. But as for these early years of an environmental generation, there was nothing like it before and there has been nothing like it since in American history (Repetto 2006). The institutions which grew out of this “environmental decade” implemented policies which overcame many collective action problems, such as point source pollution and resource degradation. Rivers rarely catch fire today, and numerous endangered species have remarkably recovered. For these types of problems, traditional institutions have proved overwhelmingly effective. Other problems, however, have now come to fore; they require different, softer solutions and more modern approaches (Durant et al. 2004).

Second-Generation Policy Responses

Durant, Fiorino, and O’Leary (2004) call for a new approach to environmental governance that encourages a results-based sense of common purpose. Traditional rule-based models of rigid, adversarial, and reactive command-and-control regulatory regimes were successful at addressing many of the pressing environmental problems in the mid- to late-twentieth century, but they are now inadequate to address contemporary ENR issues that have become "wicked" or intractable problems, such as NPS pollution, species protection, biodiversity, and habitat restoration (Agranoff 2012; Durant et al. 2004, 2–4). The first-generation approaches are viewed as "problematic because they fail to recognize that many ENR risks are inherently multimedia, interactive, multiple pathway, and cumulative in nature" (Durant et al. 2004, 3). And they also fail to encourage cooperative, holistic, and cost-effective responses to today's problems (Durant et al. 2004, 4). Second-generation approaches must, according to Durant and colleagues (2004, 7), reconceptualize purpose, reconnect with stakeholders, and redefine administrative rationality, all of which are "essential for efficient, effective, equitable, and democratically accountable environmental governance in the twenty-first century."

According to this idea, ENR institutions for the twenty-first century should encourage civic environmentalism and deliberative democracy that enhances the legitimacy and quality of decision making, develops trust, and fosters social capital, or networks of reciprocity, in communities. These institutions, as described by Durant and colleagues (2004), should focus on place-based problems and solutions for ENR governance, and they should be flexible enough to adapt to changing social and natural system conditions. In water resource management institutions like these have emerged in spades over the past few decades.

Water Policy for the Twenty-First Century

"Water use in the United States is driven by many factors, including population size and distribution, the structure of economic activity, subsidies, commodity and water prices, water technologies, and laws and institutions that encourage or discourage water use" (Gleick 2012, 14). Over the past several decades through technological improvements, federal regulations, economic strategies, and a combination of these factors, the US has dramatically increased the efficiency of its water use (Gleick 2012, 14). Nevertheless, water scarcity and quality problems are going to be major challenges over the next century in the US and around the globe. “Traditional solutions in the form of new large infrastructures (dams, aqueducts, and new groundwater withdrawals) are increasingly ineffective, costly, or physically unavailable” (Gleick 2012, 19–20). The sustainability of our existing resources may require a variety of new institutional responses.

But, as in many other ENR arenas, the institutional framework for US water policy is a fragmented arrangement of complex legal and administrative structures, “based on a wide variety of federal laws, regulations, and historical court rulings, to distribute authority over water between federal, tribal, state, and local governments” (Christian-Smith and Gleick 2012, 23). Evidence of this fragmentation can be seen in the thirty agencies in ten different federal departments that have some federal responsibility over water management, in addition to the independent agencies, commissions, councils, and other offices (Christian-Smith and Gleick 2012, 28). This fragmentation is not necessarily bad; perhaps it just needs to be better understood and further embraced.

Fragmentation exists at many levels in the American federalist system. At the national level, for example, numerous agencies deal with specific attributes of watershed governance, such as the Army Corps of Engineers, the US EPA, the Bureau of Reclamation, the Federal Energy Regulatory Commission, the Fish and Wildlife Service, the Forestry Service, along with other various and sometimes competing federal statues, such as the Endangered Species Act, the Clean Water Act, and the Clean Air Act. This plethora of responsibilities is often mirrored at the state and local levels, further fragmenting responsibility within a given watershed. Even more, hydrographic boundaries, of course, do not often correspond to political ones, requiring horizontal and vertical coordination across jurisdictions and governments. Adding to these obstacles, “[o]rganizations in a watershed can indeed work at cross-purposes, failing to coordinate their actions and putting ‘turf’ interests ahead of other concerns” (Schlager and Blomquist 2008, 190). For the past two decades many organizations like these and others have embraced the fragmentation of authority and responsibility through collaboration.

Watershed Collaboration

Collaborative partnerships and collaboration activities are found in many US watersheds. This provides ample space in which to test theories of collective action and collaboration. Schlager and Blomquist (2008) apply the idea of polycentric governance to natural resources that cross scales and boundaries, following V. Ostrom, Tiebout, and Warren's (1961) theoretical line of inquiry. Elinor Ostrom (1990) has applied common pool resource theory, among others, to various watershed collaborators. Institutional rational choice (IRC) models examine how rules and norms affect actor behavior in their interactions with other institutional actors, suggesting various ways to evaluate outcomes (E. Ostrom 1998, 1999; Sharpf 1997). Research using the Advocacy Coalition Framework (ACF) (Sabatier and Jenkins-Smith 1993) examines whether the political forces that brought coalitions together continue to operate when a collaborative forms (Weible 2006). A common theme throughout these investigations is that we have "new governing institutions that encourage cooperation between local actors with conflicting interests, divergent geographic bases, and overlapping administrative jurisdictions to resolve continuing disputes over resource management" (Lubell et al. 2002, 149).

Former US EPA administrator Carol M. Browner noted the need for collaboration when she introduced the Watershed Approach in 1996 as "[p]eople working together to protect public health and the environment—community by community, watershed by watershed" (EPA 1996). Approaches like these have led to what Robert Agranoff and Mark McGuire (2003), among others, call collaborative public management. Adapting their definition from Agranoff and McGuire (2003), Bingham and O'Leary (2008, 3) define collaborative public management as

> a concept that describes the process of facilitating and operating in multiorganizational arrangement to solve problems that cannot be solved by single organizations. Collaboration means to co-labor, to achieve common goals, often working across boundaries and in multisector and multiactor relationships.

This is governance that not only involves various entities at multiple levels of government and the private sector, it is also one that necessarily involves the "public and citizens in governance" (Bingham and O'Leary 2008, 3), which is exactly the intention of the US EPA's Watershed Approach. It also encompasses the results-based sense of common purpose prescribed by Durant et al. (2004). The management of water resources is but one of many examples of a collaborative strategy to enhance public governance. Watershed management is not unique in its necessity to deal with complex, uncertain, and wicked problems, but it is an arena in which these problems are constants, as is the collective action required to overcome them (Feiock and Scholz 2010; Scholz and Stiftel 2005).

Mark Imperial (2005, 281) analyzed watershed programs "to examine how collaboration is used to enhance governance networks where problem-solving capacity is widely dispersed and few organizations accomplish their mission by acting along." He doesn't have an optimistic view that collaboration is "a magical cure for all governance problems" (Imperial 2005, 282); acknowledging this he quotes Bardach (1998, 17):

> We should not be impressed by the idea of collaboration per se. That collaboration is nicer sounding than indifference, conflict, or competition is beside the point. So, too, is the fact that collaboration often makes people feel better than conflict or competition. I do not want to oversell the benefits of interagency collaboration. The political struggle to develop collaborative capacity can be time consuming and divisive. But even if no such struggle were to ensue, the benefits of collaboration are necessarily limited.

Even still, he recognizes many beneficial qualities of collaboration. And collaborative approaches are increasingly being embraced both in and beyond ENR management, and they are increasing among watershed stakeholders, including government agencies, special government districts, citizens, interest groups, utility companies, and others (Ansell and Gash 2007; Bidwell and Ryan 2006; Koehler and Koontz 2008; Lubell et al. 2002). For those who participate in these processes perceptions can be important because they may keep the collaborative efforts going.

When formed around a natural resource these collaboratives are generally called stakeholder partnerships. Using the term partnership allows us to include multiple forms of collaboration—both formal and informal—as well as numerous types of formal and informal network arrangements. These partnerships "consist of representatives from private interest groups, local public agencies, and state or federal agencies, who convene as a group, periodically and indefinitely, to discuss or negotiate public policy within a broadly defined issue area"(Leach et al. 2002, 646), such as a watershed or drainage basin.

The Collaborative Approach

Paul Sabatier and colleagues (2005) believe collaborative approaches to watershed management overcome many of the second-generation ENR governance problems previously discussed. Collaborative management is guided by traditional management approaches but "incorporate[s] a series of adaptations and innovative choices that exploit emerging opportunities" (Sabatier et al. 2005, 6). These collaborative approaches emerged as stakeholders became increasingly dissatisfied with traditional regulatory approaches which failed to address NPS pollution and habitat protection. As well, they emerged from the need to engage in water quality planning outlined in the Total Maximum Daily Load (TMDL) provisions of the Clean Water Act (CWA), the enforcement of which began in earnest in the mid-1990s. Finding the solutions to these water quality problems requires "detailed knowledge of local conditions and the coordination of multiple agencies" (Sabatier et al. 2005, 5), creating an opportunity for collaboration.

John Hoornbeek and colleagues (2012) also acknowledge that the emphasis on collaborative approaches began when the US EPA began to enforce TMDL provisions in Section 303(d) of the CWA. (The regulations for setting TMDLs were largely ignored by the US EPA and the states for approximately twenty years after the enactment of the CWA.) Since the 1990s, TMDLs have become a valuable tool to address NPS pollution. Section 303(d) was embraced by the US EPA as part of the Watershed Approach; litigation has also furthered the active development of TMDL programs at the federal and state levels (Hoornbeek et al. 2012, 422). Unlike point source—or end of pipe—pollution, there is no mechanism to regulate NPS pollution entering waterways or riparian corridors, but TMDL provisions specify a specific "load" level of pollutants that a waterbody can safely carry and process in an average day. Determining the pollutants, the appropriate load level, and ways to reduce present loads has led to the encouragement of and the necessity for collaborative approaches among local, state, and national stakeholders—capturing a broad range of knowledge, values, and interests. Their activities range from educational campaigns to monitoring users to installing best practices, among others. Likewise, implementing TMDL plans once they are formulated and approved by state agencies or the US EPA often requires such an arrangement.

Because of the wide range of partners needed to create successful collaboratives, as many proponents argue, both environmental and economic interests are considered as "watershed partnerships address problems that are outside the scope of centralized regulation . . . and [they] allow for the adoption of flexible policy tools for addressing environmental impacts in a cost effective manner" (Lubell et al. 2002, 149). They are, in a sense, grassroots and intergovernmental network-based approaches for the local management of natural resources (Weber 2003). But, as Hoornbeek et al. (2012, 422) recognize, the view of collaborative management processes as replacements for traditional water quality regulations is "mistaken." Tracing the causal pathways indicates these mechanisms could be viewed as supplements to traditional institutions, recognizing the uniqueness of place and the best methods to deal with problems and solutions on the ground. Supplementary indeed, but they may be of primary importance to water quality as other governmental and societal priorities compete for funding and agenda space. Sabatier and colleagues (2005, 4–6) agree.

Due to the rapid emergence of watershed collaboratives in the mid-1990s as enforcement of CWA Section 303(d) began, Hoornbeek et al. (2012, 3) argue that we can view "the collaborative activities of watershed groups implementing TMDLs ... as a key element of federal policy, which can be fostered and guided by policy changes at that level." This suggests that a grassroots phenomena of emergent collaborative organizations are integral for the implementation of national ENR policy, specifically water pollution policy. But what do these collaboratives look like? How do they manage to implement policies and programs that improve environmental conditions? What qualities and characteristics make them more successful than other forms of organization?

Adaptive Systems

To answer these questions one can view watersheds as complex adaptive systems, which requires considering the kinds of institutional arrangements necessary to manage such a system. Just as watersheds are complex and adaptive, these institutional arrangements need to—and often do—exhibit complexity and adaptability. Many of the human conflicts within these systems result from collective action problems which stem from complexity, among other things, leading some to recommend adaptive governing institutions (Scholz and Stiftel 2005). Others have championed collaborative approaches as a way for self-governing resource users as they deal with complexity uncertainty (E. Ostrom (1990), (1999); E. Ostrom, Gardner, and Walker 1994).

A benefit of collaborative governance is its adaptive capacity (Sabatier et al. 2005). Vincent Ostrom noticed long ago that when it comes to understanding how best to manage water resources in the US, the challenge is "the problem of formulating institutional arrangements which recognize the diversity of interests and the potentialities for development … while recognizing the extensive interdependence of interests within particular river basins" (V. Ostrom 1962b, 65). The problem is due to the "multiplicity of uses that can be derived from a water system" (V. Ostrom 1962a, 450), as well as a multiplicity of users. No matter which mechanism resource users and stakeholders adopt, it should be able to adapt to changing natural processes of the physical resource as well as adapt to changing social circumstances and demographics, all while regarding each stakeholder as important in the process.

Adaptive governance structures must deal with limitations of human and natural systems, as well as consider likely responses and surprises from the natural system, just as some best management practices (BMP), such as adaptive management, do through the process of continuous learning. As previously discussed, many of the specialized command-and-control agencies involved in watershed management have found success dealing with first-order collective action problems. But John Scholz and Bruce Stifel (2005, 1) write, "Ironically, the very success of these specialized agencies brings about the expanding range of water conflicts we study—conflicts that emerge as decisions by one authority impacts other authorities and the users they govern." So it is second-order collective action problems that "may require fundamental changes to governing institutions, changes that enhance the adaptive capabilities of the system without destroying the capabilities of agencies to manage resources effectively within the limited scope of their authority" (Scholz and Stiftel 2005, 5). This is fostered through approaches like adaptive management.

Adaptive governance attempts to resolve conflict in a way that enhances "joint gains," reduces transaction costs, and leads to a sustainable natural resource system through various forms of conflict resolution. Scholz and Stiftel (2005, 3) continue:

> Conflicts that arise under conditions of stress on the natural system frequently arise because of unexpected responses from the natural system, and require affected agencies to deal with unfamiliar issues beyond their established expertise.

> They frequently involve new stakeholders, unfamiliar with the agencies' procedures.... Coordinating polices across fragmented arenas could produced considerable benefits for stakeholders jointly affected by the decision of specialized authorities, but this requires combinations of expertise, authority, and representation of users that are not yet an established part of the institutional structure governing water resources.

Scholz and Stiftel (2005, 3–4) use examples from water conflicts in Florida to illustrate the "challenges of political fragmentation of authority and the promise of pragmatic American problem solving." Some of the institutional innovations, like the National Pollution Discharge Elimination System's (NPEDS) success at reducing point source pollution, have resolved many collective action problems and conflicts, "while others have failed and perhaps exacerbated conflicts" (Scholz and Stiftel 2005, 4). When these second-order conflicts become intractable, that is where the role of second-generation environmental institutions self-organize and grow (Durant et al. 2004; Feiock and Scholz 2010; Lubell et al. 2002; Sabatier et al. 2005). Scholz and Stiftel (2005) argue the process of adaptive governance finds its usefulness in collaborative policy networks, such as those that have formed around watersheds.

Federalism and Intergovernmental Relations

If we consider watersheds to be complex adaptive systems then they "do not need to be simplified for one or two values, their complexity is to be recognized, protected, and respected" (Schlager and Blomquist 2008, 151). The social sciences have long viewed political complexity as a "barrier to sustainable use of natural resources and something to be corrected" (Schlager and Blomquist 2008, 151). These policies seek to simplify, integrate, and centralize so that the externalities, spillover effects, commons dilemmas, and public goods can be traded off and balanced against each other. But "[a]ll of this complexity cannot be quieted by relying on science or nature to define boundaries or by forcing diversity into the well-designed box of hierarchy" (Schlager and Blomquist 2008, 152). A recommended solution is embracing these complex and adaptive issues with a system similarly composed: federalism (e.g., Feiock and Scholz 2010). "Federalism encourages innovation and experimentation because of the dynamic tension between self-rule and shared-rule" (Schlager and Blomquist 2008, 153).[1]

Andrea Gerlak (2006) traces five historical streams of water policy in the US with an intergovernmental lens. She suggests the evolving nature of federal-state relations has resulted in improved coordination, though the challenges of policy fragmentation and ecosystem complexity remain, as does "[a] struggle between national supremacy and local autonomy" (Gerlak 2006, 231). She believes water policy has evolved into a form of pragmatic federalism, consisting of place-based collaborative experiments, with an emphasis on process rather than division of authority. The water policy arena today is contested by multiple and competing interests and stakeholders, numerous lawsuits and legal battles, demographic changes, and the lack of unifying policy. This view of pragmatic federalism "recognizes the piecemeal approach that has come to characterize the water policy arena. Due to these inherent weaknesses (and the subsequent obstacles to overarching reform), it thereby seeks to reform case by case, or watershed by watershed" (Gerlak 2006, 243).

Taking a broader view of environmental policy in general across the intergovernmental landscape, Denise Scheberle's (2004, 26) examination of trust and the politics of federalism and environmental policy "suggests that—contrary to notions of cooperative, collaborative federalism—it is easier to have federal-state working relationships that are coming apart than pulling together." By coming apart she implies intergovernmental relationships that are beset by lack of communication, hidden agendas, and hostility. On the other hand, "[p]ulling together suggests that state and federal personnel involved in the implementation of a program work cooperatively, regarding each other with mutual trust, respect, and a shared sense of program goals" (Scheberle 2004, 1). It may be for this reason that Gerlak (2006)

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[1] This idea is made explicit in Vincent Ostrom's (1974) University of Alabama lecture series, *The Intellectual Crisis in American Public Administration.*

says pragmatic work is done case by case regarding water policy. In addition, it suggests, as Scheberle (2004) does, that care must be taken to recognize an additional actor in the federal–state relationship in this arena: regional-level public agencies, namely the regional US EPA offices. “States interact with and respond to the cues of both headquarters and regional personnel, so both units are important to any systematic review of public programs” (Scheberle 2004, 198). Fundamentally, this is because regional personnel are more attuned to state politics than those at headquarters. And, as previously discussed, current and historical watershed politics and the political forces at play—at all levels of government—provides the “best understanding of implementation of any environmental law” (Scheberle 2004, 33; also see Schlager and Blomquist 2008).

Attuned to historical and current political trends, and developed in an earlier era of federalism, some larger collaborative institutions—ones with official jurisdiction over resources across several states through interstate compacts for instance—have been guided by congressional legislation and are often dependent on federal financing, and they have had mixed results regarding environmental improvement outcomes. Other cooperative approaches exist, such as the National Estuary Program (NEP) which partners federal, state, and local agencies, and often provides a model for watershed collaborations. The case by case, watershed by watershed approach is the most numerous, however, and many of these smaller collaborations have formed at the local level, creating formal and informal policy networks often designed to address a particular issue(s), such as riparian habitat restoration, dam removal, legacy pollution, and NPS pollution, among other environmental concerns.

Self-Organizing Federalism

Through federalized relationships citizens are challenged to attend to issues of power and justice, much as they are in watershed stakeholder partnerships. Federal systems are not hierarchical but polycentric or non-centralized. With federalism, mutual consent and consensus-building guides joint action among actors, not threats of coercion or command-and-control mechanisms (Schlager and Blomquist 2008). With regard to the environmental policy arena and others beset by institutional collective action dilemmas, this appears to be exactly what Feiock and Scholz (2010, 5) refer to when they describe self-organized federalism as

> the endogenous development and maintenance of institutional mechanisms that mitigate a recognized (institutional collective action) dilemma by those directly affected by the dilemma.

While there are many different institutional actors and stakeholders involved in and around watersheds, the Institutional Collective Action framework articulated by Feiock and Scholz (2010) places the primary focus on federal, state, and local governments, their field offices, and organized interests concerned with activities in a given geographic area. With framework in mind, Feiock and Scholz (2010) suggest that even at the informal level of collaboration, policy networks form as

> a more autonomous mitigating mechanism that can provide critical support for monitoring, enforcement, and compliance with the self-developed rules of institutions that impose more constraints on the autonomy of participants.(Feiock and Scholz 2010, 12–13)

And, of course, the idea is that these constraints on autonomy through self-governance can lead to a legitimate process with continued support and participant reciprocity, (Feiock and Scholz 2010, 13), all of which lead to increased support for the initiatives and programs implemented in watersheds (Sabatier et al. 2005, ch. 6).

Collective Action Institutions

Across the US networks like these have self-organized and emerged as collective action institutions (Lubell et al. 2002). As discussed at the beginning of this chapter, traditional institutions have had limited success "in regulating the remaining nonpoint sources of pollution: geographically diffuse, numerous, and heterogeneous resource users who jointly affect the environmental quality of a watershed" (Lubell et al. 2002, 149). They also face limited success when it comes to pursuing problems like riparian habitat destruction and problems that span political boundaries (Lubell et al. 2002; Schlager and Blomquist 2008). At times this occurs after "long regulatory battles that polarize watershed users into ... competing 'advocacy coalitions'. The resulting fragmentation, gridlock, and legal combat impose costs and uncertainty on all resource users" (Lubell et al. 2002, 149). This is when, it is argued, self-organized institutions can come together to overcome these collective action dilemmas (Feiock and Scholz 2010). This is the fundamental basis of the Watershed Approach and is often manifest in watershed partnerships.

Watersheds in Context

Garett Hardin's (1968) classic assessment of *The Tragedy of the Commons* provides some general context to ENR management processes. Some may view the conflict and problems inherent in water resource management as a tragedy when competing users increase consumption of a resource "in a world that is limited" Hardin (1968, 1244) wrote, "Freedom in a commons brings ruin to all." Responding to this warning several decades later, however, Dietz, E. Ostrom, and Stern (2003, 1907) wrote, "Hardin missed the point that social groups have struggled successfully against threats of resource degradation by developing and maintaining self-governing institutions." And that is exactly the point that proponents of self-organized governance (and self-organized federalism) attempt to make: it is a struggle but not necessarily a tragedy. Dietz, E. Ostrom, and Stern (2003, 1907–08) continue,

> Devising ways to sustain the earth's ability to support diverse life, including a reasonable quality of life for humans, involves making tough decisions under uncertainty, complexity, and substantial biophysical constraints as well as conflicting human values and interests. Devising effective governance systems is akin to a coevolutionary race. A set of rules crafted to fit one set of socioecological

> conditions can erode as social, economic, and technological developments increase the potential for human damage to ecosystems and even the biosphere itself.

Numerous studies have demonstrated that commons users are up to the challenge and are capable of devising institutions to solve their dilemmas (e.g., Blomquist 1992; Ostrom 1990; Ostrom et al. 1994; Schlager 2002). Of course not all watersheds are considered common pool resources (CPR), and CPR theory does not directly apply in these alternate contexts. However, as demonstrated by Feiock and Scholz (2010), many of the challenges and solutions appear to be quite similar.[2]

Of course there may always be tragic choices among competing users, but recognition of this tragedy is the first step to effective policy that can benefit both natural and human systems (Adams et al. 2003). This recognition may be an important early step to developing institutional arrangements that can successfully, effectively, and sustainably manage watersheds. The first step, however, is to recognize the community and physical attributes of the watershed.

Stakeholders and Socioeconomic and Civic Conditions

Watershed stakeholders are heterogeneous in many ways. They range from, for example, power companies which operate hydroelectric power-generating dams, to homeowners who live in a watershed, to resource users who provide water to communities, to fisheries, industries, and governments at various levels, to conservation groups, to recreational users, to agricultural users, to sporting groups, to academic researchers, and specialist practitioners. Sabatier and colleagues (2005, 20) remind us that stakeholders are also

> policymakers, agency implementers, experts both within and outside government who participate in policymaking and policy implementation, private sector businesses that are economically or otherwise affected by policies, members of the

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[2] Although the institutional landscapes were far more sparse in E. Ostrom's (1990) award-winning study of common pool resource dilemmas, many of the same conclusions were reached regarding the effect of self-organizing governance systems on autonomy, monitoring, enforcement, compliance, and legitimacy.

> general public who are economically or otherwise affected by policies, and environmental interest groups that purport to represent nonhuman values, among other groups.

In some instances traditional battle lines are drawn between stakeholders, and in others they break down as former adversaries become partners (Kash 2008). Developing trust among stakeholders involved in the watershed can lead to successful collective action (Lubell 2007) if commitment is of primary concern (Scholz, Berardo, and Kile 2008). Ryan Bidwell and Clare Ryan (2006) show that diverse stakeholder participation in watershed partnerships is necessary to achieve changes in the management of the water resource, though more homogeneous or smaller groups may be more likely to conduct watershed improvement activities.[3]

Beyond the relevant stakeholders, other community attributes affect how the resource is used and managed. Watershed partnerships are more likely to form in more densely populated areas, and more homeowners within a watershed increases the available social capital required to collaboratively manage the resource (Hoornbeek et al. 2012; E. Ostrom 1998; E. Ostrom, Gardner, and Walker 1994). As well, stakeholder participation is more likely among those with greater socioeconomic resources (Koehler and Koontz 2008). Finally, "perceptions of political efficacy" lead citizens to participate in public policy debates and collaborative decision making processes (Hoornbeek et al. 2008).

Ecological Conditions

Understanding the ecological components and conditions of the natural resource is an important step in understanding how it can be affected by social systems. In the first place, this can determine the local economy: components and conditions may determine if the primary economic engine of a watershed's community is tourism, mining, aquaculture, shale gas extraction, etc. Among these ecological conditions are differences in scale, water flow characteristics, inherent uncertainties and complexities of natural resource systems, and the

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[3] Of course Mancur Olsen (1971) described why this may be the case in his well-known monograph, *The Logic of Collective Action*.

heterogeneous geographic, geologic, topographic, hydrologic, and hydrographic features of watersheds.

Flow Regimes. As an ecological condition, stream flow is considered a "master variable" when it comes to understanding how riverine processes work. It is "strongly correlated with many critical physiochemical characteristics of rivers, such as water temperature, channel geomorphology, and habitat diversity." It also "limits the distribution and abundance of riverine species . . . and regulates the ecological integrity of flowing water systems" (Poff et al. 1997, 769). Humans have altered natural flowing waters throughout the course of history with dams, channels, levees, groundwater pumping, and the effects of urbanization. All of these have had a tremendous impact on how watersheds work. Across the US, especially in heavily altered watersheds, there are calls to return rivers to a natural flow regime, one that mimics the river in is original state before alternation. Removing dams is one way to do this, but there are many more ways which require a community of actors coming together in a collaborative fashion to meet the needs of human stakeholders and the watershed's biotic integrity (Irwin and Freeman 2002; Jacobson and Galat 2008; Poff et al. 1997).

No matter how a watershed is managed the river system therein is governed by some sort of flow regime; whether it be altered, natural, or natural-mimicking, some group of individuals and/or institutions determine how the water flows. These flow processes are important to all water resource users. To fisheries stakeholders, for example, flow determines the ability for eggs to attached to riverine substrate. For agriculture stakeholders, as another example, flow can determine the richness of alluvial soils. Flow, in general, is important to all stakeholders. When a river system is not in its natural state, and when the circumstances are suitable for long-term collaborative commitment by interested stakeholders, flow can be governed by adaptive management. This approach has been recommended in many circumstances by the US EPA as well as the interior department,[4] along with other various land and water management agencies.

Many adaptive management flow regimes are structured as a series of experiments to determine the optimal flow for stakeholders. Regardless of scale, the strategies of adaptive management, applied in this way, are used to carefully monitor and learn from scientific experiments conducted in the watershed despite limited knowledge, scientific uncertainty, and watershed complexity (Gerlak 2006, 243). The goal of this strategy is to enhance scientific learning and knowledge about the particular characteristics of the watershed, as well as to incorporate all interested stakeholders in the process. In some instances it is used to replicate a natural flow regime—or one that closely resembles this. Adaptive management is one of the most widely publicized and recommended BMPs for river basin management.

Adaptive management, in some capacity, offers a way to attempt to understand and embrace complexity, diversity, and uncertainty, while encouraging small and large watershed collaboratives, government agencies, non-governmental organizations, and other stakeholders, at multiple scales, to work together in a decision making process "intended to avoid environmental harm by imposing modest environmental changes, acknowledging uncertainty in predicting the impacts of human activity on nature, and embracing social learning" (Feldman 2008, 514). An adaptive management approach is possible at the cataloging unit subwatershed level, such as a segment of the Lower Tallapoosa River basin in Alabama (Irwin and Freeman 2002), and it can be employed at a much larger scale or even basin-wide as is done in the Susquehanna River basin (Feldman 2007). Adaptive management is not a one-size-fits-all decision making approach; rather, it recognizes complexity and allows stakeholders to learn from their mistakes and adapt to changing conditions in the watershed

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[4] In fact, the Department of Interior has developed numerous resources and technical guides to assist stakeholders in the implementation of adaptive management processes. More details can be found at `http://www.doi.gov/initiatives/AdaptiveManagement/`.

(Feldman 2007). At its core, adaptive management is designed to enhance the scientific understanding about a the nature of a resource and the causal mechanisms and pathways that have led to problems within the resource.

There are many aspects of watershed governance and river basin management for which the features of adaptive management are useful. Most importantly, it brings together interested stakeholders in an environment of structured decision making (e.g., Mahler 1987) and for using decision support tools such as Bayesian networks (e.g., Shenton et al. 2011; Stewart-Koster et al. 2010) at stakeholder meetings. Adaptive management also encourages collaborative learning about the scientific processes of the watershed, which is well suited for natural resource decision making in a setting replete with conflict (Daniels and Walker 2001). Its primary goal, however, is to adaptively manage water flow to protect riverine biotic integrity (e.g., Irwin and Freeman 2002; King et al. 2010). It is not, however, at its core a conflict resolution process. Adaptive management is often used when there is inadequate knowledge and uncertainty about the resource; it is "useful when there is broad agreement on policy goals but not about the appropriate means" to achieve them (Scholz and Stiftel 2005, 5).

Understanding Complexity and Uncertainty. Confounding sources of complexity and uncertainty are the principle issues with which watershed institutions and stakeholders must deal. These contextual characteristics come from not only the biophysical nature of the system, but also from complex and uncertain social aspects among those involved in its management (V. Ostrom 1962b; Walker et al. 2008). Uncertainty is related to the differing rates of change of various physical watershed aspects, scale differences, near decomposability, and numerous disturbance processes (Blomquist 2009). Complexity is compounded by these uncertainties which can lead to inaccurate predictions about the system, as well as disagreement about which system elements best indicate systems conditions (Blomquist 2009). To further explain the difference between complexity and uncertainty, Blomquist (2009, 112) quotes Roe (2001, 111): “Issues are uncertain when causal processes are unclear or not easily understood. Issues are complex when they are numerous, varied, and interrelated than before.” These issues of complexity and uncertainty are often dealt with through scientific learning, which is a guiding principle of adaptive management. A greater scientific understanding of the nature of the natural resources and about its causal processes enhances the ability for stakeholders to acknowledge and understand sources of complexity and uncertainty (Blomquist 2009; Roe 2001; Walker et al. 2008).

Watershed Size and Geographic Features. Of course watersheds vary in their geographic size and location. While they are often defined by a particular geographic or hydrographic feature (EPA 2008), they can over lay predominantly urban or rural settings—or both. The waterbodies contained within watersheds may have a primary purpose of providing water to agricultural interests, or they may store water for small and large communities of people. And of course there are numerous other consumptive uses. The EPA has directed the states to define designated uses for all waterbodies within their jurisdictions. Numerous waterbodies have multiple uses, including recreation, fish and aquatic species propagation, fish harvesting, æsthetic purposes, and navigation, among other uses (EPA 2008).

Scale Differences. Watersheds are nested within larger watersheds which are nested in still larger watersheds. Agencies and institutions manage watersheds at a variety of scales, some local, some regional, some super-regional (Blomquist 2009). Moreover, the watershed itself is affected at these various scales, as biotic processes or the discharge of an effluent or pollutant can have a local or a system-wide impact. For example, localized nutrient runoff combined with warm water temperatures may cause an algae bloom in small segment of a watershed, having only a localized impact; on the other hand, a chemical spill from a mining operation can flow downstream in serial fashion through several sub-watersheds, potentially flowing all the way to the end of the river system. The agencies which manage, regulate, and develop policies and BMPs for watersheds similarly exist at a variety of scales.

For example, US EPA is headquartered in Washington, D.C. but it has several regional offices distributed on a geographic basis; the national parks and forest services are similarly structured. Furthermore, nearly every state has one or more departments or agencies charged with ENR protection, working with the US EPA in some capacity. And of course there are numerous state, county, municipal, special district, and other agencies located within and across watershed boundaries at whatever scale they are examined. This is the reason for which we cannot think about watershed management without considering federalism and intergovernmental relations, and it is why collaboration or collaborative efforts are considered so valuable.

Collaborating to Manage

Regardless of setting and context, or perhaps because these aspects vary across landscapes, collaboration has been defined in many ways, often with a focus on the process or participants and how they are situated within a structure of governance. Chris Ansell and Alison Gash (2007) attempt to distinguish between the "species" of collaboration—watershed councils, community policing, community health partnerships, ecosystem co-management, and others—from the "genus" of collaborative governance. Identifying some important criteria, Ansell and Gash (2007, 544) define collaboration 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.

Other definitions abound, including some that capture formal and informal collaborative activities and relationships. Donna Wood and Barbara Gray (1991) had profound influence on the development of collaboration scholarship by calling for a common, more complete definition to use when theorizing about its processes. Following their lead Thomson, Perry, and Miller (2007, 25) define collaboration as a

> process in which autonomous or semi-autonomous actors interact through formal and informal negotiation, jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together; it is a process of shared norms and mutually beneficial interactions.

This definition highlights five key dimensions of collaboration: governance, administration, organizational autonomy, mutuality, and norms (Thomson, Perry, and Miller 2007), two of which are examined here.

The governance dimension does not necessarily imply everyone in the collaboration has to agree on the best possible solution; rather, “they must support the decision once it is made” (Thomson and Perry 2006, 24). And, as E. Ostrom (1990) made perfectly transparent, Thomson and Perry (2006, 24) suggest, “The key to success of these choices rests in participants’ willingness to monitor themselves and each other and to impose credible sanctions on noncompliant partners.” As this cycle repeats, collective responsibility is fostered, moving participants from problem blaming to problem solving (Thomson and Perry 2006, 25). Sabatier et al. (2005) suggest a successful collaborative is able to adapt to changing environmental, political, and social circumstances. Partnerships and collaboratives with adaptive capacity are necessary in many instances to address the changing and interconnected nature of watersheds, as well as for implementing programs and policies that are designed to improve or sustain environmental conditions.

Along the administration dimension, Thomson and Perry (2006, 25) found that good communication, achievable concrete goals, clear roles and responsibilities, and boundary setting fostered better collaborative environments. Short-term successes hold the collaboration together; otherwise, it appears the collaboration can fall victim to institutional inertia. More importantly, members of the collaborative should be representative of those living and working within the watershed; this not only enhances partnership legitimacy—giving credence to the administrative goals—but it also develops a civic community that is at the heart of self-governing.

Collaboration Through Networks

Collaboration and networks appear on the surface to be similar, and, in effect, they can be similarly modeled and typified. Yet, as Agranoff (2012, 23) suggests, not all collaborative agreements lead to networks. The most similar—some say most important—characteristic of both arrangements, however formal or informal, is the engagement of stakeholders (Gazley 2008, 40).

Kathleen Hale (2011, 9) writes, "What we commonly discuss as an intergovernmental system of federal, state, and local institutions that suit a range of general and special purposes is actually a network of interdependent relationships that include both public and nongovernmental organizations." These are the relationships we see in watershed management. When these stakeholder relationships are well organized, Agranoff (2007, 2) describes them as public management networks, which are "collaborative structures that bring together representatives from public agencies and [nongovernmental organizations] to address problems of common concern that accrue value to the manager/specialist, their participating organizations, and their network."

Donald Kettl (2009, 7) employs an organic metaphor for networked governance, comparing it to the human mind: "The brain's learning is adaptive behavior. Government's networks likewise have learned to adapt to fix and solve the shifting patterns and growing expectations of public policy." He continues, "Networked government has emerged as a strategy to help government adapt and perform in the changing policy world" (Kettl 2009, 7). For Eric-Hans Kiljn (1999, 14) these policy network arrangements are "more or less stable patterns of social relations between independent actors, which take shape around policy problems and/or policy programmes." Similar to self-organized federalism, each of these descriptions appear to describe the institutional landscape of many watersheds, as does self-organized federalism.

Agranoff (2007) developed a typology based on a study of networks of varying sizes across several policy arenas. This typology occurs along a dimension of least advanced to most advanced network activities, but at the core of each type is information. His typology includes information, development, outreach, and action networks. In watershed management arenas these types appear to be nested. If one compares E. Ostrom's (2005) Institutional Analysis and Development (IAD) framework of nested action situations to Agranoff's typology, information and developmental networks appear to emerge at the operational level, outreach networks appear at the collective choice level, and action networks at the constitutional level. Each of these networks types are discussed in the following sections.

Information Networks. The first and most basic type of network is an information network, which comes together "to collaboratively exchange information, learn the depth of problems, and hear how individual agencies are solving problems" (Agranoff 2007, 51). Feiock and Scholz (2010) would consider this an informal policy network. Hale (2011, 23–25) developed a typology of information positions within networks. She writes there are champions, who "provide sustained motivation and energy for policy change over time, as well as a strong measure of consistency and continuity in a particular policy direction." As well, "they provide vehicles for collaboration and synthesis between nonprofit groups and government and between different levels and branches of government." There are supporters, who "foster the implementation and institutionalization of champion ideas. . . ." There are challengers, who "define a particular policy problem quite differently from other organizations." And there are bystanders, who are "experts in the field" that can "become interested in the future as events change and (they) may shift their orientation toward a different information position." If we look at the information network locally formed around a particular watershed(s), we are likely to find individuals and organizations in each of these positions.

Developmental Networks. Moving up the scale, developmental networks are next. These networks are "prone to extensively exchanging information, but they also mutually develop management/policy/program capabilities and engage heavily in capacity building" (Agranoff 2007, 51). This type of network "goes beyond the sharing of information" as it seeks to enhance operating capacity of individual members (Agranoff 2007, 60). And, of course, there is no reason to believe that those actor positions defined by Hale (2011) are not involved at this level as well, though they may have enhanced roles and capacities. The US EPA and other federal agencies and nongovernmental organizations who provide grant funding to watershed partnerships are extensively involved in this developmental capacity.

Outreach Networks. The final two networks types actually become involved in policies and programming. Outreach networks provide "programming opportunities for participating agencies and organizations as they strategically blueprint interactive activity that is implemented by the partners" (Agranoff 2007, 67) Agranoff (2007, 67) continues:

> these networks jointly decide on activity and their partners exchange information and technologies, propose sequences for programming, exchange resource access opportunities, pool client contacts, and enhance access opportunities that lead to new programming activities.

Many of the networks involved in watershed governance are often associated with these outreach networks, as stakeholders come together from various public, private, and nonprofit sectors to make joint decisions about watershed or river basin management (Sabatier et al. 2005; Schlager and Blomquist 2008). Furthermore, as O'Toole, Hanf, and Hupe (1997, 140) write, these networks are not singular structures. "In fact, in functional terms, we can distinguish a number of subnetworks through which different sets of actors, drawn from different levels of government and from different phases of the policy process, are interlinked." And, beyond this, implementation can occur through voluntary actions, which is often the case for local stakeholders in a watershed who participate in water quality monitoring or clean-up activities and educative programming. As well, implementation activities occur at multiple levels by actors with mixed motives (O'Toole, Hanf, and Hupe 1997, 145–147).

Action Networks. Action networks are the most advanced, in the sense that they actually make policy and program adjustments. "Here the partners come together to make interagency adjustments, formally adopt collaborative courses of actions, and/or deliver services, along with all of the network activities such as exchanges of information and technologies" (Agranoff 2007, 67). Metropolitan planning organizations and watershed management super-collaboratives operating under a federal–interstate compact or an interstate compact most closely resemble this type of network in water resource management.

Common Themes

There are several common design elements we can discuss when referring to collaborative or networked governance. For Barry Rabe (2009, 49) these "include such features as the ability to forge coordination and integration among multiple governing units and the development of reliable metrics for measuring and monitoring performance." Other common characteristics include their "outward looking" nature (Kettl 2009, 10), goal congruence (Rabe 2009, 51), the ability to manage knowledge and information (Agranoff 2007; Hale 2011; Rabe 2009), boundary crossing and boundary spanning organizations (Agranoff 2007; Moore 2009), stakeholder involvement (Agranoff 2008; Cooper, Bryer, and Meek 2008; Durant, Fiorino, and O'Leary 2004; Hale 2011; Jordan and Wolf 2006; Sabatier et al. 2005), and various decision making strategies and arrangements (Agranoff 2007; Imperial 2005; Schlager and Blomquist 2008).

Similar characteristics have been elsewhere identified, all of which seem to be many of the desirable characteristics identified by collaborative governance scholars (e.g., Lubell 2003). Agranoff (2012, 86) writes,

> Collaborative management begins and builds links and often more regular networked relationships through transactions that seek information and interpretation; deal with purpose-inhibiting rules, standards, and regulations; bring in other entities to form partnerships or adapt to local policy; and pool funding.

These roles and aspects of networks and collaborative governance all seem to get at the same thing: overcoming collective action problems. All of this, however, should be placed in the context of desired goals.

As so far discussed, we know much about collaborative and network formation, characteristics, types, potentialities for success, and other information, but we know very little about the actual environmental outcomes that result from these institutions in the water policy arena. Lubell (2005, 223) examined estuaries around the country that were part of the National Estuary Program (NEP) and those that were not to determine if watershed partnerships like the NEP "affect the beliefs of stakeholders in ways that increase the likelihood of cooperation, which in theory is ultimately linked to policy effectiveness." He found that changes in collective action beliefs among stakeholders in NEP estuaries were "consistent with the hypothesis that the NEP increases the benefits and decreases the transaction costs of watershed management" (Lubell 2005, 223). Numerous case studies of watershed collaboratives have come to similar conclusions, leading to an understanding that particular characteristics of the collaboration itself increases perceived effectiveness,[5] such as the number of organizations or representatives involved in the collaborative or network, the size of the collaborative's membership (i.e., number of staff and volunteers in the member organizations), and the amount of resources of various types the collaborative is able to secure (Hardy and Koontz 2009; Heikkila 2004; Sabatier et al. 2005).

A Theoretical Framework for Explaining Collaborative Partnership Success

From the collaboration and network literature discussed thus far, there is a general understanding of how watershed partnerships may form, what they do, who is involved, and how they survive. There is evidence that they produce numerous social benefits and they generate various policy outputs. Little is known, however, about the actual outcomes they produce

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[5] Perceived effectiveness, perceived outcomes, and other perceptions are all the evidence we have to say these types of partnerships lead to positive environmental outcomes. Of course these perceptions can be the result of confirmation bias (see Kahneman 2011, 80–81).

from collaborative policy implementation. Moreover, there is no consensus about whether they are more effective than the traditional command-and-control institutions they supplement or replace. Much of the extant literature on collaboration and watershed partnerships focuses on processes and collaborative outputs; there is little evidence of the environmental outcomes of these efforts. The literature does, however, "suggest ample opportunities to design research studies linking collaborative processes to environmental outcomes" (Koontz and Thomas 2006, 113).

If the success of watershed collaboratives is measured by outcomes, there are several notable challenges according to Koontz and Thomas (2006, 113–14), including:

> (1) gathering data that measures environmental outcomes, (2) allowing for long time horizons between the implementation of collaborative outputs and environmental change, and (3) designing research protocols that untangle the effects of multiple interacting variables that shape environmental change.

The question at hand, then, is how to make valid inferences about the effects of collaboration. Though numerous journal articles show evidence of collaborative environmental outcomes from a myriad of case studies, there is little ability to make generalizations. We do have a good place to start, however, by placing the focus on (1) the attributes of the resource, (2) the attributes of institutions involved in the governance of the resource, and (3) the attributes of the community surrounding the resource (Lubel et al. 2002; E. Ostrom 1990, 2005; Ostrom, Gardner, and Walker 1994). Then, with this in mind, theoretical grounding and an analytical framework must be selected that allows for an emphasis on these foci in light of the challenges faced if this form of inquiry.

Institutional Rational Choice

Institutional rational choice (IRC) theory incorporates several analytical frameworks, including E. Ostrom's (1999; 2005) IAD framework that has been used to study institutions and actors in common-pool resource settings (E. Ostrom 1994; E. Ostrom, Gardner, and Walker

1994), making it well suited to the study of watershed management (Sabatier et al. 2005, 176). When applied to watershed management, the framework starts with the assumption that "watershed resources are subject to the tragedy of the commons and feature severe collective action problems" (Sabatier et al. 2005, 179). This framework and its associated characteristics are explored below in greater detail.

Institutional Analysis and Development. The focal units of analysis in the IAD framework are called action arenas, which consist of two components: (1) a set of actors whose behavior is modeled after Simon's (1947) satisficing man and (2) a decision-action situation.

> The model of the individual specifies the assumptions being made concerning actors' preferences, information-processing capabilities, current information, personal resources, and decision rules. The decision-action situation comprises a set of resources and constraints defining which actors are allowed to participate in a policy game, the positions and moves available to them, the information available, the outcomes for various patterns of individual actions, and the associated payoffs for the actors for each outcome. (Sabatier et al. 2005, 176)

In each action arena there is an action situation, which is the "social space where participants with diverse preferences interact, exchange goods and services, dominate one another, and fight..." (E. Ostrom 2005, 14). In this situation, the ability of stakeholders in a collaborative partnership, for instance, to promote their policy goals is determined by institutional rules in use, as well as the material and biophysical world and the nature of the community involved (E. Ostrom 2005, 16).

Considering Thomson and Perry's (2006) dimensions of collaborative governance, the governance and administration dimensions capture the constitutional choice level activities identified by the IAD framework, and the mutuality and norms dimensions capture collective choice level activities. If one is to assess the achievement of desired goals, especially if that goal is a positive impact on environmental quality, such as improvement of water quality conditions, they should be found at E. Ostrom's (2005) operational level. Operational rules affect day-to-day decisions governing the natural resource, collective choice rules determine who gets to participate in the action arena and how to change the operational rules, and constitutional rules determine the collective choice rules (E. Ostrom, Gardner, and Walker 1994, 46). Together these rules structure watershed politics (Schlager and Blomquist 2008).

The Levels of Collaborative Action Framework. Citing Menzel (1987) to acknowledge that the "complex and dynamic nature of collaboration make it unlikely that a single theory will fully explain all aspects of the process," Imperial (2005, 284–285) suggests "there is no one way to organize collaborative activities." In his analysis of six watershed management programs, Imperial (2005) adapted the IAD framework to create his Levels of Collaborative Action Framework (LCAF). While the IAD framework largely analyzes rules created at the three levels discussed above, the LCAF acknowledges that collaborative activities occurring at each of these levels are interrelated (Imperial 2005, 288). With this view, there are three levels of joint action: operational, policy making, and institutional; these respectively correspond to the levels of the IAD framework: operational, collective choice, and constitutional.

Returning briefly to Sabatier and colleagues (2005, 179) assessment of watershed governance, we know that defining collective choice rules can be difficult "because a myriad of agencies, governments, and statutes govern the operational rules applying to a particular geographic area or watershed." They argue, however, that

> collaborative processes are in fact an experiment in environmental governance occurring at the collective choice level, and the management actions produced by collaborative institutions are new sets of operational rules governing the use of resources in a specific watershed. (Sabatier et al. 2005, 179)

Effectiveness therefore is judged by whether collaborators "put projects on the ground and engage in other behavior that ultimately improve watershed health" (Sabatier et al. 2005, 179). This places emphasis on operational level activities.

This may be why Imperial (2005, 289) recognizes that the "world of action occurs at the operational level." Actions at this level are designed to 1) directly improve environmental conditions, 2) educate the public and decision makers, and 3) monitor conditions and enforce regulations. Several activities related to these three types of actions are listed in table 2.1; these include BMP installation, habitat restoration projects, educational programs for public officials, school curriculum development, and data collection on environmental activities, among several others. If watershed management programs, including stakeholder partnerships, are to improve environmental conditions, it would be though these operational level activities (Imperial 2005; Sabatier et al. 2005). Table 2.1 provides the operational level activities Imperial (2005) discovered in his investigation of six watershed management programs.

[Table 2.1 about here.]

Of course the other levels of the LCAF influence those actions that are taken at the operational level. Activities at the policy-making level, such as knowledge sharing, resource sharing, and shared policies, regulations, and social norms, as identified by Imperial (2005), "improv[e] communication among actors, coordinat[e] actions, and integrat[e] policies" as well as "enhance government service delivery" (Imperial 2005, 293). Finally, at the institutional level there are activities that "influence, constrain, enhance, or promote actions at the operational and policy-making levels" (Imperial 2005, 298). These activities include the institutionalization of shared policies as well as the development of "collaborative organizations, or organizations composed of other organizations" that "acts as a single entity" (Imperial 2005, 299). Activities at all three levels are likely to be found in many watersheds across the United States. But, to keep the focus on those activities that actually improve watershed health, and the emphasis on watershed partnership effectiveness (Sabatier et al. 2005, 179), activities occurring at the operational level are most likely to improve environmental outcomes, such as water quality improvement.

Conclusion

This chapter has described the state of the literature regarding the nature of water resource management in the United States. Collaboration occurs at multiple levels and for multiple purposes. But just how do we determine if collaboratives are effective producers of environmental benefits? Koontz and Thomas (2006) are concerned with exactly this, and more importantly with how we make valid inferences about the effects of collaboration. Numerous small-n case studies and a few large-n studies have shown that collaboration increases the *perception* of effectiveness among stakeholders. But to test actual effectiveness measured as water quality that is sufficient to meet its designated uses, as well as perceptions and the operational level activities these institutions conduct, a larger study is needed in order to make generalizations about watershed partnerships. The next chapter describes an attempt to do this through a sampling and investigation of watersheds across the fifty states.

Questions and Hypotheses

Seven principle questions to guide this inquiry have emerged from this chapter, and several testable hypotheses can be formed based on each of questions. The first question asks whether the number and type of watershed stakeholders impact measured water quality. There are eleven hypotheses that relate to this question, each of which considers a different type of stakeholder:

H1a: Insufficient water quality is negatively associated with the number of local-level nongovernmental watershed stakeholder organizations.

H1b: Insufficient water quality is negatively associated with the number of state-level nongovernmental watershed stakeholder organizations.

H1c: Insufficient water quality is negatively associated with the number of regional-level nongovernmental watershed stakeholder organizations.

H1d: Insufficient water quality is negatively associated with the number of national-level nongovernmental watershed stakeholder organizations.

H1e: Insufficient water quality is negatively associated with the number of federated nongovernmental watershed stakeholder organizations.

H1f: Insufficient water quality is negatively associated with the number of local-level governmental watershed stakeholder organizations.

H1g: Insufficient water quality is negatively associated with the number of state-level governmental watershed stakeholder organizations.

H1h: Insufficient water quality is negatively associated with the number of regional-level governmental watershed stakeholder organizations.

H1i: Insufficient water quality is negatively associated with the number of national-level governmental watershed stakeholder organizations.

H1j: Insufficient water quality is negatively associated with the number of tribal governmental watershed stakeholder organizations.

H1k: Insufficient water quality is negatively associated with the number of university-affiliated watershed stakeholder organizations.

The second question asks whether the number and type of stakeholders conducting watershed-related activities has an impact on perceived water quality improvement. (This question is very similar to the previous one which asked about measured water quality rather than perceptions of water quality.) There are eleven hypotheses associated with this question:

H2a: Stakeholder perceptions about water quality improvement are positively associated with the number of local-level nongovernmental watershed stakeholder organizations.

H2b: Stakeholder perceptions about water quality improvement are positively associated with the number of state-level nongovernmental watershed stakeholder organizations.

H2c: Stakeholder perceptions about water quality improvement are positively associated with the number of regional-level nongovernmental watershed stakeholder organizations.

H2d: Stakeholder perceptions of water quality improvement are positively associated with the number of national-level nongovernmental watershed stakeholder organizations.

H2e: Stakeholder perceptions about water quality improvement are positively associated with the number of federated nongovernmental watershed stakeholder organizations.

H2f: Stakeholder perceptions about water quality improvement are positively associated with the number of local-level governmental watershed stakeholder organizations.

H2g: Stakeholder perceptions about water quality improvement are positively associated with the number of state-level governmental watershed stakeholder organizations.

H2h: Stakeholder perceptions about water quality improvement are positively associated with the number of regional-level governmental watershed stakeholder organizations.

H2i: Stakeholder perceptions about water quality improvement are positively associated with the number of national-level governmental watershed stakeholder organizations.

H2j: Stakeholder perceptions about water quality improvement are positively associated with the number of tribal governmental watershed stakeholder organizations.

H2k: Stakeholder perceptions about water quality improvement are positively associated with the number of university-affiliated watershed stakeholder organizations.

A third question for this inquiry address watershed flow and its impact on perceptions about water quality among stakeholders. There are two hypotheses associated with this question:

H3a: Stakeholder perceptions about water quality improvement are negatively associated with no natural flowing waters.

H3b: Stakeholder perceptions about water quality improvement are positively associated with a natural flow regime governing the watershed.

The fourth question asked in this question asks whether stakeholder perceptions about water quality are associated with stakeholder community characteristics. There are four hypothesis associated with this question:

H4a: Stakeholder perceptions of water quality improvement are positively associated with the presence of a collaborative watershed partnership.

H4b: Stakeholder perceptions about water quality improvement are positively associated with stakeholder perceptions of political efficacy.

H4c: Stakeholder perceptions about water quality improvement are positively associated with trust in governmental stakeholders.

H4d: Stakeholder perceptions about water quality improvement are positively associated with trust in nongovernmental stakeholders.

The fifth question guiding the this section's inquiry asks whether perceptions of water quality are impacted by collective action beliefs held among watershed stakeholders. There are three hypotheses associated with this question:

H5a: Stakeholder perceptions about water quality improvement are negatively associated with diffuse problems.

H5b: Stakeholder perceptions about water quality improvement are positively associated with increased levels of scientific understanding about natural processes in the watershed.

H5c: Stakeholder perceptions about water quality improvement are positively associated with increased levels of causal scientific understanding about problems in the watershed.

The sixth question for this section's inquiry asks whether perceptions of water quality are impacted by the legitimacy of the decision making process for watershed management as perceived by stakeholders. There are two hypotheses associated with this question:

H6a: Stakeholder perceptions about water quality improvement are positively associated with perceptions that the decision making process is fair.

H6b: Stakeholder perceptions about water quality improvement are positively associated with perceptions that the decision making process is representative of watershed stakeholders.

The seventh and final question for this second quantitative phase of inquiry asks whether perceptions of water quality are impacted by the type and number of operational level activities conducted by watershed stakeholders. These types of activities are provided in table 2.1, and there are two hypotheses associated with this question:

H7a: Stakeholder perceptions about water quality improvement are positively associated with greater numbers of operational-level environmental improvement activities.

H7b: Stakeholder perceptions about water quality improvement are positively associated with greater numbers of operational-level educative activities conducted for decision makers and other watershed stakeholders.

The next chapter describes a way these questions can be answered, as well as a way to test each of these hypotheses, through the operationalization of many watershed-related concepts and attributes described in this chapter. The attempt to answer these questions, as well as to overcome the deficiencies of small-n case studies, involves a sample of watersheds across the fifty states.

Table 2.1: Operational Level Activities

Environmental Improvement Activities	Educative Activities
Habitat Restoration Projects	Public Ed. Programs for Schools
Clean-up Activities	Public Ed. Programs for Homeowners
Land Acquisition	Public Ed. Programs for Industry
Installing Urban Best Management Practices (BMPs)	Public Ed. Programs for Other Users
Installing Agricultural BMPs	Public Social Events
Installing Forestry BMPs	Special Events for the Public
Installing Water Flow BMPs	School Curriculum Development
Installing Sewers	Training Programs
Upgrading On-site Sewage Disposal Systems	Special Events for Elected Officials
	Special Events for Public Administrators
	Outreach Programs and Events

Note: Adapted from Imperial (2005).

In the American political system, where authority is widely dispersed, the range of strategic calculations confronting any individual is very large indeed. Numerous decision structures in a national government, 50 state governments, nearly 100,000 units of local governments and countless corporations, cooperative societies, and voluntary associations indicate some of the potential variety that may be available. The aggregate complexity in rationally calculating strategic opportunities in such a context defies human imagination. Yet human beings are able to acquire a knowledge about the essential rules of the game and make provisional calculations about strategic opportunities as they pursue their respective endeavors. Decision-making under those circumstances always occurs with substantial uncertainty and risk. Such is the necessary price for sustaining ordered relationships which are subject to change.

Vincent Ostrom and Elinor Ostrom (1972)

3

Methods of Inquiry

Introduction

This chapter proposes several methodological approaches to answer seven guiding questions. The two question consider the number and types of stakeholders involved with watershed-related activities has an impact on 1) measured water quality and 2) perceptions of water quality. A third question asks whether stakeholder perceptions about water quality are impacted by riparian flow. A fourth question concerns characteristics of the stakeholder community and related impacts on perceptions of water quality. The fifth and sixth questions concern the collective action beliefs held among stakeholders and the view of a legitimate decision-making process for watershed management, respectively, and the associated impacts on perceptions of water quality. The final question examines the number of environmental improvement and educative activities conducted by stakeholders and their perceived impact on water quality.

Each of these questions are important, because from numerous case studies we have a good understanding about the formation of watershed partnerships, what they do, what brings them together, how long they last, and for what purposes they are best suited (e.g., Imperial 2005; Sabatier et al. 2005; Schlager and Blomquist 2008; Weber 2003). But we do not know the environmental outcomes that result from institutional arrangements of this sort (Koontz and Thomas 2006; Niles and Lubell 2012). What needs to be discovered then, when applied to a particular policy arena such as environmental and natural resource (ENR) management, is whether or not these collaboratives actually benefit the environment. In other words, how and to what extent do watershed partnerships implement policies and programs designed for ecological improvement or sustainability? Several important outcomes can be identified, such as improvements in water quality, resilience in the face of drought or flood, or the ability to keep the resource sustainable in the face of new economic development.

Measurable Environmental Outcomes

The United States Environmental Protection Agency (US EPA) began with their collaborative watershed approach in the mid-1990s; following their lead the Forest Service and 18 federal agencies that manage land have "adopted ecosystem management approaches that featured collaboration as a central tenet" (Koontz and Thomas 2006, 112). Through the early 2000s, the federal interior and agriculture departments adopted watershed-based approaches that encourage collaboration with federal agencies and state and local governments, as well as with interested stakeholders. The federal government and the states provide financial and educational resources to collaborative watershed partnerships. For example, in 2004 the US EPA Region 5 field office alone awarded $42 million in Clean Water Act (CWA) Section 319 grant funding to "local watershed organizations to develop management plans for their watersheds, emphasizing collaborative, community-based management approaches that use a watershed scale" (Koontz and Thomas 2006, 112).

Hoornbeek and colleagues (2012, 421) demonstrate how these partnerships should be viewed as an "important tool of federal and state water pollution policy." Therefore,

> [w]hen collaborative watershed management is viewed (in the larger context of the Clean Water Act), it becomes evident that assessing collaborative watershed management must involve accounting not only for the emergence of collaborative groups, but also its effects on efforts to reduce pollutant loads, improve water quality, and enable compliance with water quality standards. (Hoornbeek et al. 2012, 421).

This is principally the case because many of these partnerships formed in response to the enforcement of Total Maximum Daily Load (TMDL) limits of the CWA. TMDLs are used in combination with the National Pollution Discharge Elimination System (NPDES) to mitigate pollution. TMDL development and watershed management improvement actions are part of the US EPA's national strategy to ensure clean and safe water (Hoornbeek et al. 2012). Wicked collective action problems like heterogeneous and diffuse NPS pollution and other problems are believed to bring individuals and institutions together to form watershed partnerships (Berardo and Scholz 2010; Scholz et al. 2008; Weible 2010).

Section 303(d) of the CWA outlines the TMDL process. It requires states to identify "waters within their borders for which technology-based regulatory controls are not sufficient to ensure in-stream compliance with water quality standards" (Hoornbeek et al. 2012, 422). Water quality standards are generally determined by the uses for a specific waterbody. These uses are designated by the states, and waterbodies are either *sufficient* to meet designated use(s) or otherwise *insufficient*. The technology-based controls are first-generation responses to pollution—command-and-control approaches—in place to ensure that point source pollutants are mitigated. This type of control is structured by the NPDES in which the TMDL program is nested. Section 303(d) requires that the states establish a total maximum daily amount of a pollutant that “a water body or stream segment can receive and still comply with water quality standards” (Hoornbeek et al. 2012, 422), i.e., to meet designated use(s). Because the federal and state governments regulate water quality but not NPS pollution, this is an important tool by which to identify and mitigate these pollutants and their impacts on water quality and riparian habitats.

There were about 37,000 TMDL reports approved by 2009, many of which require reductions in NPS pollution (while others address other detriments to water quality such as temperature and siltation). But despite this large number we still know little about the actions taken to implement the pollution reduction recommendations they contain. In their study of TMDL implementation in watersheds in Ohio and West Virginia, however, Hoornbeek and colleagues (2012, 422) found “that the presence of watershed groups significantly increases the probability of TMDL implementation progress.” After examining 63 TMDL reports and talking with knowledgeable state officials about implementation progress and perceived pollutant loading reductions they “find that TMDL implementation efforts are common” (Hoornbeek et al. 2012, 425-26). Nonetheless, there were a number of TMDL-listed watersheds in which they could find no implementation progress.

Hoornbeek and colleagues (2012, 428) conclude their investigation by demonstrating that active watershed partnerships may “enable the implementation of TMDL requirements and recommendations.” Comparing TMDL reports for waterbodies with an active watershed partnership and those with no partnership, they find “a positive association between the presence of a watershed group and the perceived pollutant loading reductions” as well as “perceived water body improvement” (Hoornbeek et al. 2012, 429). Their analytic techniques were not very sophisticated, and they acknowledge that different approaches are needed to make “strong conclusions regarding the dynamics of watershed group influence on TMDL implementation progress...”(Hoornbeek et al. 2012, 431). They did, however, provide a path to investigate two basic research questions about collaborative efforts asked by Koontz and Thomas (2006, 113): (1) Do collaborative processes produce different outputs than non-collaborative processes? and (2) Do collaborative outputs produce better environmental and social outcomes? These relate to a more specific question with which this present investigation is concerned: Is water quality better in watersheds with a large number of stakeholders engaged in watershed-related activities and collaborative partnerships? An appropriate answer to this questions requires consideration of the contextual characteristics and institutional features discussed in the chapter 2 and how they affect clean water and other environmental outcomes.

Sampling Approach

"The United States is divided and subdivided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units" (USGS 2012). This study examines watersheds at the cataloging unit level, which is "a geographic area representing all or part of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature" (USGS 2012). This is also the level at which federal and state agencies, as well as water quality managers, often conceptualize problems and craft solutions (Hoornbeek et al. 2012). Figure 1.1 displays one of these cataloging units and the state in which is located. There are 2,256 cataloging units across the country classified by 8-digit hydrologic unit codes (HUCs); we typically call them watersheds (USGS 2012). This effort to examine the institutions that form in these geographic locations to overcome collective action dilemmas considers the cataloging unit watershed as an action arena (E. Ostrom 2005), using each as a unit of analysis. Within each of these watersheds, it is important to remember there is the possibility for several types of waterbodies, such as lakes, rivers, stream segments, and/or estuaries, depending on cataloging unit boundaries.

Systematic Sample

The USGS provides a list of these watersheds on their water resources website.[1] All of the watersheds across the fifty states are considered as the study population for this investigation, forming a sample population from which units of analysis will be selected. Because this information is available for all 2,256 watersheds, they also form the sampling frame. A systematic sampling technique with a random start provides a nearly random sample (Singleton and Straits 2010). With this technique there is often the problem of periodicity when the population is not randomly distributed. In this instance, however, the sampling frame is organized north to south and east to west along hydrographic basins across the fifty states, so this approach should not be problematic. To account for any possibility of this, as well as to have a large enough sample to ensure reliable maximum likelihood estimation (King 1989; Long 1997), as well as considering the reality that complete information may not be available for all watersheds, a random start and sampling interval of four provides 564 observations in the overall sample used for analysis.

Any attempt to measure the institutional outcomes and water quality levels achieved by any stakeholder is fraught with numerous difficulties, most notably external and stochastic shocks, such as wildfires, mine drainage disasters, oil spills, chemical spills, flooding, and droughts. E. Ostrom (2005, 14) suggests we treat these events as exogenous and fixed—random enough to be captured by error terms in a regression equation. Other variables external to the socioecological processes are not fixed; across watersheds they have important and varied influence for which one must control in any attempt for econometric or descriptive analysis of organizational and stakeholder influence on watershed outcomes.

Data Collection and Measurement

[Figure 3.1 about here.]

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[1] United States Geological Survey, "Watershed Boundary Dataset," `http://water.usgs.gov/GIS/wbd_huc8.pdf`.

Recognizing the challenges of representation, decision making, public learning, and problem responsiveness (Scholz and Stiftel 2005, 5–6) Sabatier et al. (2005) outline six themes that can be used as a framework to analyze these collaborative approaches: process and context, participation and representation, trust building and civic communities, effectiveness, legitimacy, and survival. Each of these themes will be further explored throughout the rest of this chapter, and they provide background to the present study. Adapted from these six themes, Figure 3.1 indicates key variables of interest for this investigation, as well as their hypothesized relations. This section discusses these variables and how they are measured and collected. Data have been collected in two phases for this investigation. The analysis of data also occurred in two phases. A condensed summary of all variables, along with their level of measurement and definition is provided in table 3.3 for the first phase and in table 3.5 for the second phase.

Phase One: Data Collection and Measurement

The emphasis in the first phase is primarily placed on secondary data, although some primary data are included to better understand the information communities, or various stakeholders, in each watershed, as described below. In this phase, data are collected for variables relating to external influences, context, processes, and information communities, as well as that which is related to measured water quality in the watershed outcomes circle depicted in figure 3.1 and described in table 3.3.

Dependent Variable. To measure the level of water quality of watersheds this study considers TMDL classifications in light of waterbody designations in 2010. There are several TMDL classifications, as indicated in table 3.1; as the dependent variable for this study, TMDL classification 5 serves as a measure of the percent of total water bodies within a given watershed that were classified as insufficient to meet their designated uses *and* requiring a TMDL report and associated mitigation plan. In other words, this is the percent of all measured rivers, streams, lakes, estuaries, and other water bodies for which a known pollutant(s) was identified and considered as detrimental to the water body's designated use(s). The information for these data was collected from the US EPA's "Water Quality Assessment and Total Maximum Daily Loads Information" website, from the US EPA's "AskWATERS" website, and from state environmental department and agency websites.[2,3] Each of these classifications and related descriptions are provided in table 3.1.

[Table 3.1 about here.]

Conceptualizing and measuring a dependent variable of water quality for each watershed with this TMDL data, generates several considerations. The first of course is the view that the TMDL classifications accurately reflect actual water quality conditions in the sample of watersheds. This study proceeds as though it does, although I recognize states have disparate approaches to their TMDL development, implementation, and enforcement activities; and at the state level there often exists a rotating emphasis on watersheds within their jurisdiction, incrementally moving environmentally related focus from region to region. With this in mind, the data show that classifications 4b and 4c occur with relative infrequency and indicate that a TMDL report is not needed, either because an alternative strategy is in place (4b) or because water flow is insufficient for a TMDL approach (4c), so they are not very useful for comparisons between watersheds.[4] And because classification 3 indicates insufficient information, one cannot presume these water bodies have sufficient or insufficient water quality for their designated use(s). Additionally, since water quality is determined by each water body achieving its designated use(s), and since designated use(s) often vary across the states as a stream, river, or lake flows from one political boundary to the next, the

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[2] United States Environmental Protection Agency, "Water Quality Assessment and Total Maximum Daily Loads Information," `http://www.epa.gov/waters/ir/index.html`

[3] United States Environmental Protection Agency, "AskWATERS," `http://iaspub.epa.gov/apex/waters/f?p=131:45:17112495996962::::`

[4] Classification 4b often indicates that watershed impairments are usually point source related and are addressed by the National Pollution Discharge Elimination (NPDES) program, and classification 4c indicates that the flow of the water in a particular waterbody, often a small stream or stream segment, is too insufficient to establish a TMDL of a particular pollutant that the waterbody can assimilate on a given day

distinction between TMDL classification 1 and 2, indicating that all or some designated uses have been met, respectively, may be arbitrary, especially for those watersheds which cross state lines. This leaves TMDL classification 5—a measure of insufficient water quality—for use as a dependent variable.

In the analysis of water quality, therefore, the percentage of waterbodies within a given watershed with a TMDL classification 5—indicating a water body that has insufficient water quality to meet its designated use(s) with no remediation plan to meet that use—is standardized and transformed into the dependent variable for this study. Obtaining this variable involves considering the total number of river miles, lake acres, and estuary square miles and related TMDL classifications of each waterbody in each watershed in the sample. I gathered the total number of measured miles, acres, and square miles and calculate a percentage of each at TMDL classification 5. Because rivers (and streams), lakes, and estuaries are measured in different units, a simple summation doesn't make meaningful sense (and many upper bounds would be beyond 100%). So, in an attempt to standardize the measure, I sum the percentages and divide by one if only rivers are measured in the watershed, two if rivers and lakes are measured, and three if rivers, lakes, and estuaries are measured. The result is the dependent variable which I call *Percent Insufficient Water Bodies (2010)*.[5]

Survey Design and Relevant Questions for Phase One

The US EPA's "Surf Your Watershed" website provides a list of citizen-based groups involved in watershed-related activities at the watershed level.[6] These groups indicated their involvement with the US EPA's Adopt a Watershed program at some point over the past two decades. With this information I created a database of citizen-based groups for cataloging units included in the sample. I conducted an Internet search for each of the organizations,

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[5] An additional consideration for using TMDL 5 is related to available data for the lag variable which captures TMDL 5 in a similar manner for 2002. Information provided by state databases (and for some states in US EPA databases) for 2002 only included data related to waterbodies classified as TMDL 5; it was not until later in the decade that information on all classifications was provided in a unified report.

[6] United States Environmental Protection Agency, "Surf Your Watershed," `http://cfpub.epa.gov/surf/locate/index.cfm`.

by typing the organization's name into the Google search engine to make sure it is the same organization listed in the database and to verify that it is conducting activities in the cataloging unit. This also allowed me to either remove them from the database because they no longer exist or to get updated contact information for an official organizational representative. Each of these organizations was then categorized based on their level of activity—local, state, regional, national, or tribal—and affiliation—governmental or nongovernmental. With this information I contacted these organizations to participate in a survey regarding their watershed-related activities, as described below.

With the updated list of watershed groups and their associated contact information, I sent an initial contact email, and following the Total Design Method of multiple contacts (Dillman et al. 2014), followed up with a survey invitation to an online questionnaire hosted by the Qualtrics survey provider. This survey was conducted over several months from June to September 2014.[7] Relevant for phase one of this study, the survey asked respondents to choose a cataloging unit watershed for which they wished to provide answers. After doing this they were asked to list (1) all social, private, nonprofit, or otherwise nongovernmental organizations and associations involved in the watershed in some capacity and (2) all governmental organizations and agencies involved in the watershed. With this information a second survey was conducted. With a snowball approach taken to discover additional watershed participants, I again conducted an Internet search for relevant contact information and sent these organizational representatives survey invitations using the same approach as the first survey. Participants were contacted and responses were collected over several months, from February through May 2015. This second survey also asked respondents to name the governmental and nongovernmental organizations involved in their watershed in some capacity.

The total list generated from this investigation includes 2,795 organizations from across the country operating a multiple levels. It is worth noting that the total list organized by

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[7] Because of the time required to gather current information for these contacts, survey invitations were distributed over the period of several months to a varying number of individuals at a given time.

watershed contained 4,261 organizations. When the duplicates were removed, so as not to send the same organization more that one survey invitation, the number was reduced to 2,795. In the final sum of things, 630 survey invitations were distributed in the first round, resulting in 227 completions, a response rate of .36. For the second round, 842 distributed invitations resulted in 305 completions, a response rate of .36. This results in a total of 1,427 distributed surveys and 532 completed and usable responses.[8]

From the complete list of 4,261 governmental and nongovernmental participants organized by watershed I can get a picture of most of the actors involved in watershed-related activities at the watershed level. Using information gathered while collecting contact information, I categorized these organizations by their level of activity. The number and types of these participants are used as independent variables. The typology of these organizations is provided in table 3.2. Additional information about the survey and its questions are covered below in the section on phase two of this investigation.

[Table 3.2 about here.]

Independent Variables for Phase One. The first block at the top of figure 3.1, also as indicated in table 3.3 represents characteristics of the states in which watersheds are located; while external to the action arena they remain influential. Particular consideration should be given to the states because of their role in designating water uses, enforcing federal and state regulations, providing funding for watershed-related activities and groups, and permitting consumptive uses. And, because the case has been made that many collaborative groups have formed to overcome the collective action problem of NPS pollution, it is important to consider the states' role in various ways of mitigating NPS pollution.

[Table 3.3 about here.]

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[8] The majority of the remaining organizations that were not contacted in these two surveys are those which operate at the state, national, and international levels. Because these organizations are involved in so many watersheds, it is most likely difficult for them to respond to inquiries about a specific watershed with the survey instrument employed for this study.

At the state level, Hoornbeek (2011, 159–60) developed a 30-point state NPS policy activism measure based on (1) "[t]he number of statutory approaches used by the state to facilitate considerations of NPS water pollution concerns in state and local decision-making"; (2) "[t]he strength of the state's enforceable authorities for NPS water pollution control"; and (3) "[w]hether states provide significant funding for NPS water pollution control efforts, above and beyond matching funds required under the (CWA Section) 319(h) grant program." All three of these measures—each set to a 10-point scale—are based on data from 1997 to 2002 and are "combined to create an overall summary measure of state NPS policy activism" (Hoornbeek 2011, 160–61).

Hoornbeek (2011) indicates his NPS policy activism score does a better job at explaining state activism in this arena than traditional measures of state policy activism related to responsive theories, capacity-based approaches, and group-based theories of state policy making. For this analysis I apply Hoornbeek's (2011) measure to the state with the majority of the watershed area contained within its borders and call it *Primary State NPS Activism*.[9] Having a variable that reflects conditions at the state level when this investigation is focused on the watershed level necessitates a multilevel modeling approach for statistical analysis. This approach is discussed below.

Turning to watershed-level covariates, much of the context data (figure 3.1) that captures socioeconomic and ecological conditions is collected from the National Oceanic and Atmospheric Administration's (NOAA) "Spacial Trends in Coastal Socioeconomics" website,[10] which provides US Decennial Census data for the past five decades aggregated at the 8-digit HUC (cataloging unit) watershed level. Data from the 2000 census is used to reflect conditions in the watershed ten years prior to the dependent variable measuring water quality in 2010. (This measure captures characteristics of the watershed that may have had an

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[9] I call this variable *Primary State NPS Activism* for two reasons. The first relates to the fact that for all of the watersheds in the sample, all but four overlay a state with a geographic majority of the land size The second is because I cannot figure out how to include measures from multiple states in my econometric models. Both of these issues are further discussed in the next chapter.

[10] National Oceanic and Atmospheric Administration, "Spacial Trends in Coastal Socioeconomics," `http://coastalsocioeconomics.noaa.gov`.

impact on water quality as measured in 2010.) The following variables are gathered from this website: *socioeconomic status*, measured as the percentage of households within watershed boundaries with annual incomes of $75,000 or more;[11] *percent white population*, measured as the percent of the population that is white; *population density*, measured as the number of persons per square mile; and *watershed size*, measured as the number of square miles of the geographic area covered by the watershed.

Water rights doctrine is also important to consider as part of the watershed ecological conditions. Generally speaking, states east of the Missouri river grant water rights based on riparian rights, which finds its origins in English Common Law. Western states grant water rights based on prior appropriation doctrine. Table 3.4 indicates which law is applicable in which states. For statistical analyses, this variable will be operationalized as dichotomous, with a 0 indicating riparian rights and a 1 indicating *Prior Appropriation Doctrine*. California and Texas, states with a dual doctrine, will be coded as 1 to capture the riparian doctrine that applies to surface waters.[12]

[Table 3.4 about here.]

A measure of the percent of the water flowing through the watershed that is *intermittent*—that is, the percent that flows seasonally—is gathered to account for flow variability from Montana State University's Statistics Group Hydrological Unit Project[13]. Flow is considered a "master variable" with regards to water quality, and, while intermittent flow does not capture all the important aspects of water flow, it is still fundamental to the measure (Poff et al. 1997). This is because it captures precipitation and snow pack melt, as well as the watershed's ability to assimilate pollutants. Further, because flow is considered such

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[11] This terribly blunt measure is less than desirable and doesn't fully capture the concept of socioeconomic status. While better approaches using household income data have been demonstrated (e.g., Berry et al. 2000), these data are unavailable for the watershed level. The approach taken here reflects a similar approach used by Hoornbeek et al. (2012) in their study of TMDLs and collaborative watershed management.

[12] As dual doctrine states, California and Texas employ riparian rights for surface water—the waterbodies pertinent to the present investigation—and prior appropriation for groundwater.

[13] Montana State University "Statistics Group Hydrologic Unit Project," `http://www.esg.montana.edu/gl/huc/index.html`.

an important variable, additional measures of it are gathered in the second phase of this research design.

Two additional contextual control variables are gathered from US EPA websites. The first is a dichotomous measure of whether the watershed is part of the *National Estuary Program (NEP)*. This is gathered from the "Surf Your Watershed" website and is coded 1 if the watershed is involved in the program. Due to the nature of the program, if often spans multiple watersheds and brings stakeholders together for collaborative decision making processes related to the governance of an estuary. Secondly, from the "Water Quality Assessment and Total Maximum Daily Loads Information" website and from the EPA's "AskWATERS" website a measure of *percent insufficient water bodies (2002)* is an eight year time lag variable of the dependent variable of the percent insufficient water bodies in 2010. This measure accounts for the problem severity that watershed stakeholders faced eight years prior to the 2010 measure used in this analysis.[14]

Phase Two: Data Collection and Measurement

A survey instrument was piloted in May 2014 as I was collecting contact information from the US EPA's "Surf Your Watershed" website for the organizations described in table 3.2 in the previous section. The survey, in its initial form, was sent to several knowledgeable watershed stakeholders and specialists known to the author, including several members of a lake-based natural resource association that was in the sample and a city-level community planning official, all of whom helped to shape the final instrument. Several friends and colleagues also provided useful comments about the survey's structure and general characteristics. Beyond improving knowledge of the various stakeholders in individual watersheds—those questions that inform the first phase of the study—the survey questionnaire gathered data related to the context, stakeholder community, information community, legitimacy, policy output, and

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[14] It would be more desirable to have measured water quality in 2000, to allow for a longer time horizon and to correspond to Census data from 2000; however, 2002 is the earliest year that uniform TMDL data are available from the US EPA.

perceived watershed outcomes variable blocks indicated in figure 3.1. The questions used to gather information for these measures are provided in Appendix A.

Dependent Variable a for Phase Two. This variable relates to water quality improvement indicated in the watershed outcomes circle depicted in figure 3.1 and as indicated in table 3.5. The survey questions related to these variables asked respondents to think back over time since their organization's involvement in watershed-related activities and indicate—yes or no—if they *perceive water quality improvement*. This variable will be used for an alternative model specification discussed below. Each of these perceived outcomes are measured as dichotomous variables.[15,16]

[Table 3.5 about here.]

Independent Variables for Phase Two. For this second phase of analysis, all of the organizational stakeholders included in the first phase are included here as well, representing the information network(s) formed around watersheds. From the context block, questions about ecological conditions were asked of survey respondents. These questions provide information about whether all, most, some, or none of the river segments in the watershed are natural flowing. For purposes of analysis I use a dichotomous indicator of *no natural flowing waters*, where 0 indicates the watershed has some level of natural flowing and 1 indicates completely altered (unnatural) flow. If all segments do not flow naturally, a dichotomous indicator asks if there is a *natural flow regime* in place to mimic a natural flowing river.

Variables relating to the stakeholder community include a dichotomous indicator for the presence of a *watershed partnership*. To measure *political efficacy* the survey asks respondents to indicate how significant a role their organization has in watershed management

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[15] Using a dichotomous measure for these variables was either an accident or terrible mistake. I intended to use a scalar variable that would be comparable to the collective action beliefs discussed below, which measure similar questions related to the present state of the watershed, while these outcome measures ask respondents to indicate whether conditions have improved since their organization's involvement in watershed-related activities.

[16] While perceptions about water quality is less desirable than the variable measuring water quality in the first phase of the study, phase two is limited by survey response rates.

decisions, measured on a Likert scale ranging from very insignificant (1) to very significant (5). Respondents were asked to indicate their level of trust with other watershed stakeholders by providing a level of *trust in government stakeholders* and *trust in nongovernment stakeholders* measured on a scale of one to ten, with one indicating complete distrust and ten indicating complete trust.

Three indicators of collective action beliefs are also measured as a part of stakeholder community characteristics. First, question for a *problem diffusion* variable, measured on a scale of 1–100%, asks respondents to indicate the percent of all watershed stakeholders that would have to change behaviors to resolve watershed water-related problems.[17] Second, two measures of scientific knowledge are related to collective action beliefs. Lubell (2005, 206) writes, "Because transaction costs are a function of uncertainty, they are high when stakeholders perceive scientific knowledge as inadequate." The survey asks respondents to indicate the level of scientific understanding about the nature of the resource (*Natural Scientific Understanding*) and the level of scientific understanding about the causes of watershed problems (*Causal Scientific Understanding*), both of which are measured on a scale of one to ten, with one indicating very inadequate and ten indicating very adequate understanding.

Two survey questions attempt to measure legitimacy characteristics (figure 3.1). The first captures respondent beliefs about watershed management *decision making fairness*, asking if the process is fair to all stakeholders. The second concerns *process representativeness*, asking if the watershed management process adequately represents the respondent's organizational interests and concerns. Both of these are measured on a Likert scale ranging from strongly disagree (1) to strongly agree (5).

The policy output characteristics (figure 3.1) focus the operational level of the Institutional Analysis and Development (IAD) framework (E. Ostrom 2005) and its associated level

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[17] In theory this measure of problem diffusion is an alternative measure of the level of NPS pollution in the watershed. For example, if only a small percent of stakeholders have to change their behaviors, then NPS is not likely a diffuse problem, indicating problems may be concentrated and homogeneous "Nonpoint pollution comes from heterogeneous, geographically diffuse sources spread throughout the population, greatly raising the transaction costs of monitoring and enforcing traditional policies" (Lubell 2005, 205).

in the Levels of Collaborative Action Framework (LCAF) (Imperial 2005). Because there are so many activities identified by Imperial (2005) occurring at this level, and because I asked respondents to simply check a box on the survey if their organization produces, develops, or conducts these activities, they are separated into two categories: *environmental improvement activities* and *educative activities*. These correspond to the activities included in table 2.1. Environmental improvement activities include, among others, habitat restoration, instillation of best management practices, and clean-up events. Educative activities include, among others, programs and events for schools, programs and events for elected officials, and programs and events for public administrators. An index is used to combine these two variables into composite measures (Singleton and Straits 2010, 434–436); in the analysis they are considered count variables. These composite measures are bounded by zero and one using the formula

$$\frac{\sum \overline{\mathbf{x}}_{ni}}{n}, \tag{3.1}$$

where ($\overline{\mathbf{x}}_{ni}$) is a row vector of the average number of each activity or action conducted by survey respondents in each watershed. This number is then summed and divided by the total number of activities or actions n included in the row vector and represented in the composite index. The last set of variables for this phase of analysis are comprised of the socioeconomic, civic, and ecological context and condition variables included in phase one, as well as the measure for state-level NPS policy activism and water rights doctrine.

Data Analysis

Data analysis proceeds in two phases as previously discussed, corresponding to the two phases of data collection. In the first, data will be examined to determine the effect of external influences and context on watershed outcomes, as indicated in figure 3.1, under these headings in table 3.3, and in related hypotheses. The second phase turns to primary data to test the additional relationships indicated in figure 3.1, under these headings in table 3.5, and related hypotheses. The following sections describe the numerical procedures and econometric models for both phases.

Phase One Data Analysis

It is important to consider the nested nature of watersheds and the levels of institutions responsible for their management. Many consider watershed institutions only at the watershed level. There are many reasons why this analytic approach is insufficient; the first is empirical. Federal departments and agencies vary in their involvement in watersheds, adding a layer of stakeholders who own and operate infrastructure, from national parks to energy production units, as well as those protecting endangered flora and fauna. At another level, the EPA regional offices have important and differing relationships with state and local governments and organizations in their respective regions (Scheberle 2004). At the state level, there is variation in levels of support for watershed partnerships, policy activism related to pollution, assignment of designated uses for waterbodies, and staff dedicated to set and support the generation of TMDLs and related remediation plans. Finally, at the watershed level, there are multiple governments and other organizations involved in the management of watersheds as already discussed. Future research should address influences on actual environmental outcomes by considering variables at all of these levels.

A multilevel model. The analysis of phase one data focuses on the watershed level (level one) and the state level (level two) using a multilevel regression model.[18] The structure of the data in this analysis, approximately seven observations per state (ranging from 1 to 20), necessitates a random-effects multilevel approach. This approach partitions the variance that occurs in a regression model both between and within states, as well accounts for correlated error terms among observations within the states, ensuring the appropriate estimation of

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[18] In future investigations, additional levels—regional and national—may prove informative.

standard errors.[19]

$$\begin{aligned} \text{Level 1: } Y_{ij} &= \beta_{0j} + \beta_{1j}X_{ij} + r_{ij} \\ \text{Level 2: } \beta_{0j} &= \gamma_{00} + \gamma_{01}W_j + u_{0j} \\ \beta_{1j} &= \gamma_{10} + \gamma_{11}W_j + u_{1j} \end{aligned} \tag{3.2}$$

This systems of equations model shows the two level structure, where i references measures that vary within and between states and j represents measures that only vary between states. In this approach the level one intercept and slopes are modeled using level two predictors. Apart from this reference to j, level one resembles an ordinary least squares regression model where β_{0j} represents the intercept and $\beta_{1j}X_j$ represents the vector of independent and control variables described above. Luke (2004, 10) describes the rest of the model:

> γ_{00} is the mean value of the level-1 dependent variable, controlling for the level-2 predictor, W_j; γ_{01} is the effect (slope) of the level-2 predictor, W_j; and u_{0j} is the error, or unmodeled variability, for unit j. The interpretation of the second equation is similar, but here we are modeling the level-2 effects on the slope of X_{ij}: β_{1j} is the level-1 slope in level-2 unit j; γ_{10} is the mean value of the level-1 slope, controlling for the level-2 predictor, W_j; γ_{11} is the effect of the level-2 predictor, W_j; and u_1j is the error for unit j.

This approach allows for both fixed effects and random effects to be tied to both levels, providing variation in slopes and intercepts because it is believed that there are cross-level interactions among state characteristics and watershed stakeholder communities and their collective outcomes. Results of this analysis are presented in chapter 4.

Phase Two Data Analysis

The second phase of data analysis involves both quantitative and qualitative data. The variables associated with this phase for quantitative analysis were previously described. Qualitative data are used to reinforce and challenge the quantitative analysis, with a particular

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[19] The model is estimated using Stata 14's *mixed* command (`http://www.stata.com`), specifying a maximum likelihood estimator.

focus on operational level activities in watersheds. Of interest here is an open-ended survey question that asked respondents to indicate their organization's *most recent activity* conducted in their watershed. This section proceeds by describing the analytical method used for quantitative analysis, followed by a discussion of a typology of most recent activities and the analytical methods for qualitative analysis.

Phase two analysis of perceived environmental outcomes. The additional dependent variable described above is related to perceived water quality outcomes which have occurred since an organizations involvement in watershed-related activities in their watershed. For this variable, *perceived water quality improvement*, I use a binary response model (BRM) with a logit function because it well measures the proportional nature of the variable—a binary variable that relates to a question of whether water quality has improved since stakeholder engagement in the watershed. As I created this variable from aggregate for all those organizations responding for a given watershed, using this function allows the variable to range from $-\infty$ to ∞ when transformed into an odds ratio for ease of interpreting the effects of the explanatory variables, as shown in the following equation.

$$\frac{\Pr(y = 1|\mathbf{x})}{\Pr(y = 0|\mathbf{x})} = \frac{\Pr(y = 1|\mathbf{x})}{1 - \Pr(y = 1|\mathbf{x})} \tag{3.3}$$

This odds ratio describes how often watershed stakeholders perceive the constellation of actors involved in their watershed is having an impact on the perception of perceived water quality improvement.

Phase Two Qualitative Inquiry. A beneficial aspect of surveying organizations involved in watershed-related activities is the information gathered through the use of open-ended questions. Of particular interest for this analysis is to discover the most recent activity these organizations have conducted, and how these activities differ when a watershed partnership is present and when it is not, as well as how they differ by organizational level of focus (i.e., local level or state level, among others.). To makes sense of the responses to this question about recent activity, I employ a qualitative data analysis approach to “draw out patterns, themes, and trends” in a process of pattern matching (Brown and Hale 2014, 203). This involved categorizing responses to the question and coding them for themes, namely those activities found by Imperial (2005) in his study of watersheds that relate to collaborative activities in the LCAF. According to Brown and Hale (2014, 204), “Coding is an iterative process of review and reflection.” Following this approach involves reading through all the responses and making a list of general themes, reading through the responses again with these themes in mind and paring down the patters in finer detail, and, finally, selecting examples and quotes that are representative of the coded responses (Brown and Hale 2014, 204–205).

Conclusion

Approaching the understanding of what is occurring within and across watersheds allows us to further examine and offer suggestions about the approaches and techniques currently used to manage US water resources. The next chapter presents the results of the analytic approaches described above, with phase one—using mostly secondary data—presented in the first section and phase two—using mostly primary data—presented in the second section.

Figure 3.1: Hypothetical Framework of the Watershed Management Process

Adapted from Sabatier et al. (2005).

Table 3.1: EPA and State Water Quality TMDL Reporting Classifications

Classification	**Description**
1	All Uses Attained (Full Water Body Recovery)
2	Some Uses Attained (Partial Water Body Recovery)
3	Insufficient Data
4a	TMDL report developed and approved by the EPA
4b	TMDL report not needed due to alternative mitigation strategy
4c	TMDL report not required due to insufficient hydrology
5	TMDL report needed due to insufficient water quality

Table 3.2: Typology of Watershed Organizations

Organization Type	**Organization Type**
Local Nongovernmental	Local Governmental
ENR-Related Special District	State Nongovernmental
State Governmental	Regional Nongovernmental
Regional Governmental	National Nongovernmental
National Governmental	Tribal Governmental
University-Affiliated	Federated Organization

Table 3.3: Phase One Variables

Variable	Measurement	Definition
Dependent Variables: Watershed Outcomes		
Measured Water Quality		
Percent Insufficient Waterbodies (2010)	Continuous‡	As of 2010, the percentage measured units in the watershed for which water quality is insufficient (TMDL classification 5)
Context		
Socioeconomic Conditions		
Socioeconomic Status	Continuous‡	Percentage of Households in the watershed with annual incomes of $75,000+
Percent White Population	Continuous‡	Percentage of white population in the watershed
Population Density	Continuous	Persons per square mile
Ecological Conditions		
Watershed Size	Continuous	Logged Square Miles
Intermittent	Continuous‡	Percent of riverine water with seasonal flow and/or intermittent streams
State Water Rights Doctrine	Dichotomous	State water law (0 = Riparian Rights; 1 = Prior Appropriation)
National Estuary Program (NEP)	Dichotomous	Indicates whether watershed is part of the National Estuary Program (0 = Non NEP; 1 = NEP)

Continued on next page

Table 3.3 – continued from previous page

Variable	Measurement	Definition
Percent Insufficient Waterbodies 2002	Continuous[‡]	As of 2002, the percentage measured units in the watershed for which water quality is insufficient (TMDL classification 5). This is an eight year lag variable on this measure for 2010.
Percent Watershed in Primary State	Continuous	The percent, by majority land square miles, of the watershed that is primarily contained in one state.
Information Community		
Nongovernmental Stakeholders	Count	Number of nongovernmental stakeholders, separated by types as indicated in table 3.2
Governmental Stakeholders	Count	Number of nongovernmental stakeholders, separated by types as indicated in table 3.2
State-Level Variables Influences		
NPS Pollution Activism	Scalar	Includes measures for state statutes that facilitate state and local decision making re NPS pollution, a measure of state enforceable authority for NPS pollution, and state funding for NPS pollution control efforts beyond matching federal funds, each of which are worth up to 10 points for a maximum sum of 30. (0 = no NPS policy activism; 30 = most possible NPS policy activism)

[*] These levels of measurement will be transformed to an interval measure to reflect aggregation by watershed, as indicated in the text.

[†] These levels of measurement will be summed to reflect aggregation by watershed, as indicated in the text.

[‡] Of course percentages are not actually continuous data, but they are treated as such here.

Table 3.4: Water Rights Laws of the Fifty States*

Riparian Rights		**Prior Appropriation**	
Alabama	Arkansas	Alaska	Arizona
California[†]	Connecticut	California[†]	Colorado
Delaware	Florida	Hawaii	Idaho
Georgia	Illinois	Kansas	Montana
Indiana	Iowa	Nebraska	Nevada
Kentucky	Louisiana	New Mexico	North Dakota
Maine	Maryland	Oklahoma	Oregon
Massachusetts	Michigan	South Dakota	Texas[†]
Minnesota	Mississippi	Utah	Washington
Missouri	New Hampshire	Wyoming	
New Jersey	New York		
North Carolina	Ohio		
Pennsylvania	Rhode Island		
South Carolina	Tennessee		
Texas[†]	Vermont		
Virginia	West Virginia		
Wisconsin			

[*] Source: National Conference of State Legislatures, "State Water Withdrawal Regulations," `http://www.ncsl.org/research/environment-and-natural-resources/state-water-withdrawal-regulations.aspx`.

[†] California and Texas use a dual doctrine approach, incorporating elements of both riparian rights and prior appropriation doctrine.

Table 3.5: Phase Two Variables

Variable	Measurement	Definition
Dependent Variable: Watershed Outcomes		
Perceived Water Quality Improvement	Dichotomous*	Indicates the respondent's perception about whether there has been water quality improvement since their organization's involvement in the watershed (0 = No; 1 = Yes)
Information Community		
Nongovernmental Stakeholders	Count	Number of nongovernmental stakeholders, separated by types as indicated in table 3.2
Governmental Stakeholders	Count	Number of nongovernmental stakeholders, separated by types as indicated in table 3.2
Context		
Socioeconomic Conditions		
Socioeconomic Status	Continuous‡	Percentage of Households in the watershed with annual incomes of \$75,000+
Percent White Population	Continuous‡	Percentage of white population in the watershed
Population Density	Continuous	Persons per square mile
Ecological Conditions		
Watershed Size	Continuous	Logged Square Miles

Continued on next page

Table 3.5 – continued from previous page

Variable	Measurement	Definition
No Natural Flowing Waters	Dichotomous	Indicates whether the watershed has some or all naturally flowing waters (0) or a completely altered system with no natural flow (1)
Natural Flow Regime	Dichotomous	Indicates if a water flow regime is in place to mimcic natural flow in some or all riverine segments of the watershed(0 = No; 1 = Yes)
Intermittent	Continuous‡	Percent of riverine water with seasonal flow and/or intermittent streams
State Water Rights Doctrine	Dichotomous	State water law (0 = Riparian Rights; 1 = Prior Appropriation)
National Estuary Program (NEP)	Dichotomous	Indicates whether watershed is part of the National Estuary Program (0 = Non NEP; 1 = NEP)
Stakeholder Community		
Watershed Partnership	Dichotomous	Indicates whether a watershed partnership is present in the watershed (0 = No; 1 = Yes)
Political Efficacy*	Scalar	Indicates the level of how significant survey respondent organizations have a role in watershed management processes (1 = Very Insignificant; 5 = Very Significant)
Trust		
Trust in Governmental Stakeholders	Scalar*	Indicates the level of trust survey respondent organizations have in governmental watershed stakeholders (1 = Complete Distrust; 10 = Complete Trust)

Continued on next page

Table 3.5 – continued from previous page

Variable	Measurement	Definition
Trust in Nongovernmental Stakeholders	Scalar*	Indicates the level of trust survey respondent organizations have in nongovernmental watershed stakeholders (1 = Complete Distrust; 10 = Complete Trust)
Collective Action Beliefs		
Problem Diffusion	Scalar*	Percent of all watershed stakeholders who would have to change their behavior to resolve watershed water-related problems
Natural Scientific Understanding	Scalar*	Indicates survey respondent perceptions about the level of scientific understanding about the natural processes involved in the watershed system (1 = Very Inadequate; 10 = Very Adequate)
Causal Scientific Understanding	Scalar*	Indicates survey respondent perceptions about the level of scientific understanding about causal relationships of watershed problems, e.g., pollution, turbidity, temperature, etc. (1 = Very Inadequate; 10 = Very Adequate)
Legitimacy		
Decision Making Fairness	Ordinal*	Indicates survey respondents' perspective about whether they agree if the decision making process if fair to all stakeholders based on a Likert scale (1 = Strongly Disagree; 5 = Strongly Agree)
Process Representativeness	Ordinal*	Indicates survey respondents' perspective about the watershed management process is representative of their organization's interest and concerns based on a Likert scale (1 = Strongly Disagree; 5 = Strongly Agree)

Continued on next page

Table 3.5 – continued from previous page

Variable	Measurement	Definition
Political Efficacy	Ordinal*	Indicates survey respondents' perspective about whether they perceive their organization has a significant role in watershed management decisions based on a Likert scale (1 = Very Insignificant; 5 = Very Significant)
Policy Outputs		
Improvement/Restoration Activities	Continuous	Composite measure of the proportion of surveyed organizations that conduct activities related to habitat restoration, riparian clean-up, BMP installation, and land acquisition
Education Programs and Events	Continuous	Composite measure of the proportion of surveyed organizations that conduct education programs targeted at schools, homeowners, industry, and other resource users, as well as developing/conducting social events, public conferences, school curricula, training programs, outreach programs, and/or events and conferences for elected officials and public administrators

[*] These levels of measurement will be transformed to an interval measure to reflect aggregation by watershed, as indicated in the text.

[†] These levels of measurement will be summed to reflect aggregation by watershed, as indicated in the text.

[‡] Of course percentages are not actually continuous data, but they are treated as such here.

To understand institutions one needs to know what they are, how and why they are crafted and sustained, and what consequences they generate in diverse settings. Understanding anything is a process of learning what it does, how and why it works, how to create or modify it, and eventually how to convey that knowledge to others.

Elinor Ostrom (2005)

4

Analysis

Introduction

Considering watersheds, or a combination thereof, as complex interconnected governance and policy systems, we see diverse multi-organizational, fragmented, non-centralized, (Elazar 1987) polycentric (E. Ostrom 2005; V. Ostrom 1999) institutional arrangements that, as Schlager and Blomquist (2008, 148) write,

> result[] from the combined effects of differences among the interests of individuals and organizations within the watershed, changes over time in the understanding of problems and in values for water, the need to pursue multiple resource management goals, distinctions in the efficient scale of operation of organizations

> performing diverse functions, and the importance of finding distributions of benefits and costs that are perceived as fair by those who bear them.

The various institutional arrangements that form, either from the bottom up or top down, have been described as collaboratives, networks, collaborative networks, grassroots management, and self-organized federalism, among others (Feiock and Scholz 2010; Gerlak 2008; Hoornbeek 2011; Hoornbeek et al. 2012; Imperial 2005; Lubell et al. 2002; Margerum 2008; Sabatier et al. 2005; Weber 2003). Whatever the nomenclature, the normative goal for proponents of these institutional forms is to have resource users and interested stakeholders come together to overcome collective action dilemmas (Feiock and Scholz 2010; Olsen 1971; Scholz and Stiftel 2005; Scholz et al. 2008), as well as ideally to reduce transaction costs (Hindmoor 1998), although this is not always the case (see, for example, Agranoff 2007, chap. 8).

Institutional arrangements like these have been shown to enhance cooperation and foster belief change among stakeholders as participants hold positive perceptions of the effectiveness of their efforts (Lubell 2005). Collaboration often enhances successful implementation of policies and programs (Agranoff and McGuire 2003), with the goal of overcoming collective action dilemmas (Lubell et al. 2002). Further, collaboration can also foster learning, both among participants and across communities (Leach et al. 2013). For these reasons collaborative approaches have been widely embraced by watershed stakeholders, including government agencies, citizens, and interest groups (Ansell and Gash 2007; Bidwell and Ryan 2006; Koehler and Koontz 2008; Lubell et al. 2002). In this study I refer to these collaborations as stakeholder partnerships which "consist of representatives from private interest groups, local public agencies, and state or federal agencies, who convene as a group, periodically and indefinitely, to discuss or negotiate public policy within a broadly defined issue area" (Leach et al. 2002, 646). The number and types stakeholders may vary by watershed and include anyone or any organization that has an interest, or stake, in the watershed (Sabatier et al. 2005, 20). This chapter will proceed in two main sections. The first deals with the first phase of analysis, with an emphasis on secondary data. The second section relates to the second phase of analysis, with an emphasis on primary data.

Phase One Analysis

This section proceeds as follows. First, a brief overview of the analytic sample is provided. Then several hypotheses that relate to this phase of the analysis will be stated. Next, univariate statistics of relevant variables are introduced and discussed, after which several two-level multivariate models are presented and discussed. The penultimate subsection discusses the model that most appropriately fits the data, followed by the implications of this model and the need for understanding more about organizations involved in watershed management. This sets the stage for the following section which analyzes the primary data gathered in this study—phase two of the analysis.

This phase of data analysis begins with a starting point of 550 watersheds—approximately 24% of all US watersheds. When examining watersheds we must take into consideration (1) their nested nature and (2) regional hydrologic and geologic variations. Individually and jointly, these two characteristics enhance both a theoretical and empirical case for the use of a multilevel model when conducting econometric analyses that attempt to explain reasons for differences in water quality between watersheds.

After collecting secondary data reflecting information related to the state-level influences, the socioeconomic and ecological contexts, the information community of stakeholders, and watershed outcomes, the sample size is reduced to 344 watersheds—approximately 15%. This low number is generally due to the fact that about 200 watersheds in the sample did not have stakeholders listed with the EPA's Adopt-a-Stream Program from which an initial list of stakeholders for each watershed was initially generated, meaning organizations within these watersheds were not contacted in the survey process described in chapter 3.[1]

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[1] This deficiency can be somewhat overcome in the future by using a Google search for the watershed name and terms such as "watershed partnership," "watershed stakeholder," and "watershed coordinator" among others (Scott 2015).

One additional limit restricted the usable sample size, both of which relate to Total Maximum Daily Load (TMDL) data. Available TMDL classification data for 2002 (the time lag on the dependent variable) indicated that 38 watersheds had no waterbodies listed as TMDL classification 5, a premise that seems theoretically impossible even if it is empirically plausible. These watersheds are removed from analysis, leaving 306 watersheds for this first phase of analysis.

Despite these limitations, all 48 of the contiguous states are included in the usable sample. Many watersheds in the sample are contained within a single state, while others cross up to four state boundaries. For example, California is the primary state for 20 watersheds, meaning that the majority of the watershed's waterbodies are contained within the primary state. To summarize the sample, 214 watersheds (69.93%) overlay a single state, 74 watersheds (24.18%) overlay two states, 16 watersheds (5.23%) overlay three states, and two watersheds (0.65%) overlay four states. Although additional limitations will be discussed throughout the chapter, it is hoped that, because the units of analysis are distributed across the 48 states, this analysis creates a somewhat reliable and generalizable model of the characteristics and attributes of watersheds that are associated with lower levels of insufficient water quality. This case is made in the subsections that follow.

Guiding Question for Phase One

The question that guides this phase of inquiry asks whether the number and type of watershed stakeholders impact measured water quality. These all relate to the dependent variable measuring insufficient water quality—the percent of waterbodies within a sampled watershed that are listed as TMDL classification 5, indicating they are unable to meet designated use(s). There are eleven hypotheses that relate to this question, each of which considers a different type of stakeholder:

H1a: Insufficient water quality is negatively associated with the number of local-level nongovernmental watershed stakeholder organizations.

H1b: Insufficient water quality is negatively associated with the number of state-level nongovernmental watershed stakeholder organizations.

H1c: Insufficient water quality is negatively associated with the number of regional-level nongovernmental watershed stakeholder organizations.

H1d: Insufficient water quality is negatively associated with the number of national-level nongovernmental watershed stakeholder organizations.

H1e: Insufficient water quality is negatively associated with the number of federated nongovernmental watershed stakeholder organizations.

H1f: Insufficient water quality is negatively associated with the number of local-level governmental watershed stakeholder organizations.

H1g: Insufficient water quality is negatively associated with the number of state-level governmental watershed stakeholder organizations.

H1h: Insufficient water quality is negatively associated with the number of regional-level governmental watershed stakeholder organizations.

H1i: Insufficient water quality is negatively associated with the number of national-level governmental watershed stakeholder organizations.

H1j: Insufficient water quality is negatively associated with the number of tribal governmental watershed stakeholder organizations.

H1k: Insufficient water quality is negatively associated with the number of university-affiliated watershed stakeholder organizations.

Discussion of Univariate Distributions

Table 4.1 shows the summary statistics for all the variables associated with the above hypotheses. It is worth mentioning at the outset that an average of 41% ($\hat{\sigma} = .30$) of the watersheds in the sample have majority insufficient water quality, which is a statistically significant difference from eight years prior when 49% ($\hat{\sigma} = 32\%$) of the sample were insufficient ($\hat{\rho} = .39$; $p < .001$). (While this is impressive, further study is required to determine causal factors leading to this improvement.) Moving to organizations involved in the surveyed watersheds, table 4.1 shows than an average of 0.96 ($\hat{\sigma} = 3.07$) local-level government agencies are involved. (With such a wide range, zero to 32, this mean may be an inadequate representation of central tendency, possibly due to the amount of federally owned lands and waters in which no local-level authority is involved.) Examples of these local organizations include Clackamas County Water Environment Services, Frederick Country Forestry Board, and the Washington County Redevelopment Authority.

The average number of local-level nongovernmental organizations participating in watershed-related activities is 3.20 ($\hat{\sigma} = 5.16$), although this greatly varies from watershed to watershed, ranging from 0 to 40. Examples of these include Friends of the Savannah River Basin, Cadron Creek Alliance, and the Soque River Watershed Association. At a unique level ((Mullin 2009), an average 0.49 ($\hat{\sigma} = 1.31$) natural resource-related special districts are actively involved in watershed related activities. Examples of these include the Nez Perce Soil and Water Conservation District, Cedar Bayou Navigation District, and the Upper Salinas Las Tablas Resource Conservation District. Federated organizations, such as the Washington County chapter of the Izaak Walton League of America, the North Jersey Sierra Club, and the Alabama affiliate of the National Wildlife Federation have a unique presence in these policy subsystems, operating at the local level with influences, resources, and capacity provided from their national or international parent organizations. These organizations range from 0 to 5 participating at the watershed-level, with an average of 0.68 ($\hat{\sigma} = 1.04$) in a given watershed.

[Table 4.1 about here.]

Turning to state and regional levels, there is also wide variation in the number of organizations involved at the watershed level. An average 1.57 ($\hat{\sigma} = 2.03$) state-level nongovernmental organizations, ranging from 0 to 12, are participating in watershed-related activities. These include organizations such as the Alabama Clean Water Partnership, the Kansas Association of Wetlands and Streams, and the Texas Riparian Association. An average 1.09 ($\hat{\sigma} = 1.84$) state level government agencies and departments, ranging from 0 to 12, are participating in watershed-related activities. Examples of these include the Alaska Department of Natural Resources, the Connecticut Department of Energy and Environmental Protection, and the New Hampshire Natural Heritage Bureau. An average 0.52 ($\hat{\sigma} = 0.99$) regional-level nongovernmental organizations are active in watershed-related activities, ranging from 0 to 6. These include organizations such as the Rocky Mountain Environmental Associates, the Greater Yellowstone Coalition, and the Coalition for the Delaware River Watershed. The number of regional governmental organizations engaged at the watershed level ranges from 0 to 2, with an average of 0.07 ($\hat{\sigma} = 0.29$), with examples such as the Great Lakes Restoration Initiative, the Northeast Ohio Areawide Coordinating Agency, and the Lower Connecticut River Valley Council of Governments.

Watersheds have an average of 0.11 ($\hat{\sigma} = 0.39$) national-level nongovernmental organizations participating in watershed-related activities. This number ranges from 0 to 3 and includes organizations such as American Rivers, Save our Streams, and the Coastal Conservation Association. National-level government agencies and organizations are active in an average 0.69 ($\hat{\sigma} = 1.55$) watersheds. This number ranges from 0 to 9 and includes organizations such as the National Park Service, National Wildlife Refuges, and the US Army Corps of Engineers. University-affiliated organizations, such as the Watershed Health Clinic housed within the University of Montana and the Watershed Institute of Central Virginia, are active in an average 0.51 ($\hat{\sigma} = 1.04$) watersheds. This number ranges from 0 to 7 and often involves university extension offices. Finally, tribal government organizations are involved in an average 0.07 ($\hat{\sigma} = 0.41$) watersheds. This number ranges from 0 to 4 and includes the Confederated Tribes of Siletz Indians, the Little Traverse Bay Band of Odawa Indians, and the watershed division of The Nez Perce Tribe.

Beyond organizational involvement and the information environment, table 4.1 describes several other variables that may have an affect of water quality. Among these is a variable for the National Estuary Program (NEP), which makes incumbent on stakeholders a collaborative management approach as it necessarily brings together multiple parties at multiple levels to conduct watershed-related activities in several of US estuaries. As a dichotomous measure, it shows an average of 0.23 ($\hat{\sigma} = 0.42$) watersheds in this sample are involved in the NEP. Socioeconomic status (SES) is measured as the percentage of households within the watershed with an annual income greater than or equal to \$75,000 in 2000. Table 4.1 shows that an average of 15% ($\hat{\sigma} = 7\%$) of watershed households have incomes at this level, although this number ranges from 4% to 50%. As for population density, this table shows there were an average 154.62 persons per square mile ($\hat{\sigma} = 436.24$) living in sampled watersheds in 2000; this number ranges from 0.13 to 5334.05. This measure is related to the watershed size variable, which indicates that the average watershed is 1477.72 square miles ($\hat{\sigma} = 880.02$), ranging from 73.40 to 9574.09. Finally, table 4.1 shows that sampled watersheds had an average 85% ($\hat{\sigma} = 14\%$) white population in 2000, with a wide range of 9% to 99%. Apart from the NEP variable, these data were gathered from the 2000 US Decennial Census.

Four additional variables measure ecological and civic conditions. First, percent intermittent stream flow indicates variation in seasonal flows, as well as crudely measuring precipitation and snow pack melt. Sampled watersheds have an average of 43% ($\hat{\sigma} = 27\%$) intermittent flows; this ranges from no intermittent streams to nearly all seasonally intermittent flows (98%). An average of 93% ($\hat{\sigma} = 14\%$) of the geographic area of sampled watersheds is contained within a single state, referred to here and in the table as the primary state; this ranges from 44% to 100%. A dichotomous indicator for the prior appropriation (Western) water doctrine shows that 45% of sampled watersheds use this approach for determining water rights. The nonpoint source (NPS) pollution activism score measures state-level NPS pollution activism over the years 1997–2002; this score is based on three state-level characteristics using on a 30-point scale, averaged over the number of states that the watershed overlays. The average NPS pollution activism score for sampled watersheds is 12.26 ($\hat{\sigma} = 7.83$), ranging from 2 to 25.5. Also included as an eight-year lag on the dependent variable, is the percent of waterbodies that were designated as insufficient in 2002. The relationship of this time lag variable was discussed at the beginning of this subsection.

Analytic Methods: A Multilevel Model

It is important to consider the nested nature of watersheds and the levels of institutions responsible for their governance and management. While many focus on watershed institutions at only the watershed level, there are many reasons why this analytic approach is insufficient—the first of which is empirical. Federal departments and agencies vary in their involvement in watersheds, adding a layer of stakeholders who own and operate infrastructure, from national parks to energy production units, as well as those protecting endangered flora and fauna. At yet another level, the US EPA regional offices have important and differing relationships with state and local governments and organizations in their respective regions (Scheberle 2004). Then, at the state level, there is variation in resource-related support for watershed partnerships, policy activism related to pollution, assignment of designated uses for waterbodies, and staff dedicated to set and support the generation of TMDLs and related implementation and remediation plans. Finally, at the watershed level, there are multiple governments and other organizations involved in the governance and management of watersheds as already discussed, from local government departments to private resource-level groups.

Future research should address influences on actual environmental outcomes by considering variables at all of these levels. At present, however, this phase of the analysis focuses on the watershed level (level one) and the state level (level two) using a multilevel regression model. This focus on the state level recognizes many of the influences states have on waters within their borders. The structure of the data in this analysis, approximately seven observations per state (ranging from 1 to 20), necessitates a random-effects multilevel approach. This approach partitions the variance that occurs in a regression model both between and within states, as well as accounts for correlated error terms among observations within the states, ensuring the appropriate estimation of standard errors.[2] This analysis allows for both fixed effects and random effects to be tied to both levels, providing variation in slopes and intercepts because I believe that there are cross-level interactions among state characteristics and watershed stakeholder communities and their collective outcomes.

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[2] The model is estimated using Stata 14's *mixed* command (`http://www.stata.com`), specifying a maximum likelihood estimator.

Results

This analysis explores water quality as measured by the percentage of waterbodies within a watershed that were insufficient to meet their designated uses and requiring a TMDL report and mitigation plan in 2010. A multilevel model is used to account for the variation within and between states as related to state characteristics of NPS pollution policy activism. Using a modeling approach like this it is appropriate to identify an interclass correlation coefficient (ICC) with an empty model (Dahill-Brown and Lavery 2012; Miller 2013). Estimating an empty (null set) model produces an ICC of .293. As just discussed, this multilevel model partitions variance within and between states, so this ICC suggests that nearly 30% of the water quality variability is due to state level factors—between state variability—as opposed to within state variability.

The results of several multilevel regression models are provided in table 4.2. This series of models examines (1) a fixed effects regression that ignores state level characteristics, (2) a mixed effects regression examining between state variability, (3) a mixed effects regression including between state level variability and between state NPS policy activism variability, (4) a between state variability model that includes only statistically significant explanatory variables, and (5) a between state level and between state NPS policy activism variability model.

[Table 4.2 about here.]

The results from these models provide some support for the hypothesis that the number regional-level nongovernmental stakeholder organizations have an impact on insufficient water quality (hypothesis H1c). While both state and regional level nongovernmental stakeholder organizations have a negative association with insufficient water quality across the first three models, in each of the five models the coefficient for regional level nongovernmental stakeholder organizations is statistically significant ($p < 0.01$). Across all models, a unit increase in the number of regional organizations involved in a watershed reduced insufficient water quality in 2010 by about five percent.

Two additional variables have an impact on insufficient water quality across all five models. The first, associated with greater levels of insufficient water quality, is, obviously, the percent of insufficient water quality in 2002—the time lag variable—which is statistically significant ($p < 0.001$) in all models. The second variable associated with lower levels of insufficient water quality is related to the percent of the white population in 2000, which is statistically significant across all models ($p < 0.05$). Also worth noting, across all models the measure of within state variability has a statistically significant ($p < 0.001$) negative impact on watershed level intercepts, measured as the natural log of the variability's standard deviation. The discussion now turns to the models that best fit the data.

Using the Bayesian Information Criteria (BIC) statistics shown in table 4.2, when examining models 1–3—the full models which include all covariates discussed in the previous sections—model 2 has the best fit (BIC = 117.34). This model shows that an increase in the number of regional NGOs active in a given watershed, is associated with a 5.2% decrease in insufficient water quality ($p < 0.01$). Watersheds with higher levels of white populations are significantly associated with more sufficient water quality ($\hat{\beta}_{ij} = -0.215$; $p < 0.05$). And watersheds with insufficient water quality in 2002 are likely to still have been insufficient in 2010 ($\hat{\beta}_{ij} = 0.350$; $p < 0.001$). It is worth noting that model 2 does not include the state level variable of NPS activism, but both between state variability and within state variability are statistically significant. The estimated within state variance is $\hat{\sigma}^2 = 0.014$ (s.e. = .005; $p < 0.001$), and the estimated between state variance is $\hat{\sigma}^2 = 0.047$ (s.e. = .004; $p < 0.001$)[3]

In models 3 and 4, what I call the "fit" models, I have retained only the statistically significant variables from the models 1–3. There is little change in the $\hat{\beta}_{ij}$ coefficients and their statistical significance. A noticeable difference, however, is the change in the estimated intercepts and associated significance, as well as in the BIC statistics. Again, the BIC statistic

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[3] These are provided as natural log of the standard deviation of the variability in table 4.2 because that is how Stata presents them. For ease of interpretation they are presented as variances in the narrative.

shows the model without the measure of state level NPS policy activism (model 4) has the best fit (BIC = 39.98). In this model an increase in the number of regional NGOs involved in watershed-related activities decreases the level of measured insufficient water quality in 2010 by 4.4% ($p < 0.01$). Again, 2002 insufficiency is associated with 2010 insufficiency ($\hat{\beta}_{ij} = 0.349$; $p < 0.001$), while the percent of white population is negatively associated with insufficient water quality ($\hat{\beta}_{ij} = -0.295$; $p < 0.01$). The within and between state variances are similar to model 2 discussed above.

Discussion

It is interesting to see what the models presented here demonstrate as significant when it comes to insufficient water quality in this sample of watersheds; perhaps more interesting is what the data show is not significant. The emphasis of collaborative natural resource management is often placed at the local level (e.g., the watershed approach and grassroots environmental management.) But the data show the number of organizations working at this level are not associated with sufficient water quality. Perhaps it is a lack of institutional capacity at this level, or perhaps the transaction costs are too high for local organizations to effectively work with their counterparts without the assistance of actors at different levels. And there always is the consideration that 1) local actors favor economic development over environmental protection and 2) concerned local actors are more likely to form associations as well as partnerships when environmental conditions are overly stressed. To the latter point, severe problems may possibly be more likely to generate a greater number of actors conducting restoration, remediation, and educational activities, and the outputs they generate may require long time horizons to produce beneficial outcomes. On the other hand, it may also be that these local stakeholders benefit from interaction with those organizations located in at higher classifications in a loose network of actors that share information and resources across that network, from best practices to financial assistance programs. The evidence here cannot specify any causal processes with any certainty for this relationship.

And certainly perhaps water quality changes are so difficult to achieve, that even the significant predictors are misleading. Shortly after sending an initial contact email to one survey participant in rural central Oregon working for a coalition of municipal water providers, she telephoned me to talk about my research.[4] When we were discussing water quality, she said that measurement is often difficult, indicating impacts from climatic patters, changes in plumbing fixtures, and changes in household sizes. On the latter point, she noted that water quality is impacted when college students return home for the summer months as well as when they return to school. Even small factors like these make any measurement difficult. The goal for many working in watersheds—beyond litter clean up programs and education—is not necessarily water quality improvement, according to this official, but rather to not let water quality worsen—or maintenance of present quality in other words.

Another survey invitation provoked another telephone call; this time from a director of a local level coastal restoration nonprofit organization.[5] He indicated that larger organizations—those with more contacts and greater resources—are typically able to secure state funding for projects in various watersheds, often to the disadvantage of smaller, more scientifically focused organizations like his. Our discussion provided anecdotal evidence that state and regional level nongovernmental organizations are able to connect other organizations to produce positive environmental impacts. He indicated, however, that smaller organizations like his working in a single watershed on a specific task do not always benefit in terms of resources or a seat at the decision making table when these larger, more powerful organizations are involved.

Conclusions for the First Phase of Analysis

The results from this first phase of data analysis show that the number of regional level nongovernmental stakeholder organizations involved in watershed-related activities have a statistically significant negative impact on insufficient water quality. With this conclusion,

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[4] Informal interview with official representative of a sampled organization, March 9, 2015.

[5] Informal interview with official representative of a sampled organization, April 17, 2015.

and the consideration of how many individual organizations are involved in multiple adjacent watersheds, should we begin to re-conceptualize the watershed-by-watershed approach? If those working locally at the watershed level have little impact on actual water quality, even if they perceive they are having an impact, should watershed-related polices incentivize regional approaches? The evidence presented here isn't sufficient enough to support this claim. On the contrary, perhaps incentives should focus on encouraging local organizations to connect with regional organizations so that knowledge, best practices, and other information can be shared across broad networks of interested organizations, connecting local actors together across watersheds and expanding information networks.

Phase Two Analysis

In this phase of analysis, the focus turns to primary data collected through survey questionnaires of officials at organizations indicated to be participating in watershed-related activities in the sampling of watersheds. This section delves deeper into the features of the watershed management hypothetical diagram displayed in figure 3.1. This second phase of analysis has two parts. First, there is a discussion and presentation of a quantitative data analysis measuring stakeholder perceptions of water quality improvement since their organization's involvement in the watershed. Next, there is a discussion of a qualitative open-ended survey responses that relate to the most recent watershed-related activity conducted by respondent organizations. These activities are categorized using Imperial's (2005) Levels of Collective Action Framework (LCAF), and the discussion centers around operational-level activities conducted by various types of organizations engaged in watershed-related activities.

Phase Two Quantitative Analysis

From the outset, however, it is worth mentioning that the sample size used for this part of the analysis is considerably lower than that examined in the previous section; this phase includes information from respondents in 114 watersheds, rather than the 306 that were included in the first phase. This smaller sample size is due to the fact that complete responses to the survey questions used in this phase were considerably lower. Even still, the watersheds discussed in this section are located in each of the 48 contiguous states as well as Alaska; there were no responses from organizations operating in watersheds in Hawaii. Stakeholder perceptions of water quality in their watershed is the focus of this section. And, indeed, perceptions of water quality improvement form the dependent variable in the hypotheses and quantitative analysis presented and described in the following subsections. In addition to several additional variables that are indicated in the hypotheses formulated below (H3, H4, H5, H6, and H7), covariates relating to NEP-affiliated watersheds, US Decennial Census data, and ecological and civic conditions used in the first phase of quantitative analysis are also used in this second phase.

Guiding Questions for Phase Two Quantitative Analysis. Six questions guide this phase of inquiry, all of which, as indicated above, pertain to stakeholder perceptions of water quality, and each has several associated hypotheses. The first question asks whether the number and type of stakeholders conducting watershed-related activities has an impact on perceived water quality improvement. (This question is very similar to the one guiding the analysis in phase one which asked about measured water quality rather than perceptions of water quality.) There are eleven hypotheses associated with this question:

H2a: Stakeholder perceptions about water quality improvement are positively associated with the number of local-level nongovernmental watershed stakeholder organizations.

H2b: Stakeholder perceptions about water quality improvement are positively associated with the number of state-level nongovernmental watershed stakeholder organizations.

H2c: Stakeholder perceptions about water quality improvement are positively associated with the number of regional-level nongovernmental watershed stakeholder organizations.

H2d: Stakeholder perceptions of water quality improvement are positively associated with the number of national-level nongovernmental watershed stakeholder organizations.

H2e: Stakeholder perceptions about water quality improvement are positively associated with the number of federated nongovernmental watershed stakeholder organizations.

H2f: Stakeholder perceptions about water quality improvement are positively associated with the number of local-level governmental watershed stakeholder organizations.

H2g: Stakeholder perceptions about water quality improvement are positively associated with the number of state-level governmental watershed stakeholder organizations.

H2h: Stakeholder perceptions about water quality improvement are positively associated with the number of regional-level governmental watershed stakeholder organizations.

H2i: Stakeholder perceptions about water quality improvement are positively associated with the number of national-level governmental watershed stakeholder organizations.

H2j: Stakeholder perceptions about water quality improvement are positively associated with the number of tribal governmental watershed stakeholder organizations.

H2k: Stakeholder perceptions about water quality improvement are positively associated with the number of university-affiliated watershed stakeholder organizations.

A second question for this phases inquiry addresses watershed flow and its impact on perceptions about water quality among stakeholders. There are two hypotheses associated with this question:

H3a: Stakeholder perceptions about water quality improvement are negatively associated with no natural flowing waters.

H3b: Stakeholder perceptions about water quality improvement are positively associated with a natural flow regime governing the watershed.

The third question asks whether stakeholder perceptions about water quality are associated with stakeholder community characteristics. There are four hypothesis associated with this question:

H4a: Stakeholder perceptions of water quality improvement are positively associated with the presence of a collaborative watershed partnership.

H4b: Stakeholder perceptions about water quality improvement are positively associated with stakeholder perceptions of political efficacy.

H4c: Stakeholder perceptions about water quality improvement are positively associated with trust in governmental stakeholders.

H4d: Stakeholder perceptions about water quality improvement are positively associated with trust in nongovernmental stakeholders.

The fourth question guiding the this section's inquiry asks whether perceptions of water quality are impacted by collective action beliefs held among watershed stakeholders. There are three hypotheses associated with this question:

H5a: Stakeholder perceptions about water quality improvement are negatively associated with diffuse problems.

H5b: Stakeholder perceptions about water quality improvement are positively associated with increased levels of scientific understanding about natural processes in the watershed.

H5c: Stakeholder perceptions about water quality improvement are positively associated with increased levels of causal scientific understanding about problems in the watershed.

The fifth question for this section's inquiry asks whether perceptions of water quality are impacted by the legitimacy of the decision making process for watershed management as perceived by stakeholders. There are two hypotheses associated with this question:

H6a: Stakeholder perceptions about water quality improvement are positively associated with perceptions that the decision making process is fair.

H6b: Stakeholder perceptions about water quality improvement are positively associated with perceptions that the decision making process is representative of watershed stakeholders.

[Table 4.3 about here.]

The sixth and final question for this second quantitative phase of inquiry asks whether perceptions of water quality are impacted by the type and number of operational level activities conducted by watershed stakeholders. These types of activities are provided in table 4.3, and there are two hypotheses associated with this question:

H7a: Stakeholder perceptions about water quality improvement are positively associated with greater numbers of operational-level environmental improvement activities.

H7b: Stakeholder perceptions about water quality improvement are positively associated with greater numbers of operational-level educative activities conducted for decision makers and other watershed stakeholders.

Discussion of Univariate Statistics. Table 4.4 shows the summary statistics for all the variables associated with the above hypotheses (H2–H7). Looking at the dependent variable for perceived water quality improvement, stakeholders in 76% ($\hat{\sigma} = .43$) of the watersheds in this sample believe that quality is improving. Moving to organizations involved in the sample of watersheds, table 4.4 shows that an average of 6.78 ($\hat{\sigma} = 5.99$) local-level nongovernmental organizations are involved in watershed-related activities, ranging from zero to 32. The average number of local-level governmental organizations participating in watershed-related activities is 2.51 ($\hat{\sigma} = 3.80$), ranging from zero to 17. The average number of special districts involved in a given watershed is 1.23 ($\hat{\sigma} = 1.89$), ranging from zero to nine.

Turning to the state and regional levels, the average number of state-level nongovernmental organizations is 2.25 ($\hat{\sigma} = 2.39$), ranging from zero to 12, and the average number of state governmental organizations is 2.69 ($\hat{\sigma} = 2.24$), ranging from zero to ten. The average number of regional nongovernmental organizations involved in watershed-related activities is .74 ($\hat{\sigma} = 1.31$), ranging from zero to six. The average number of regional governmental organizations is .17 ($\hat{\sigma} = .42$), ranging from zero to two.

At the national level, an average of .31 ($\hat{\sigma} = .56$) nongovernmental organizations are involved in this sample of watersheds, ranging from zero to three, and 1.97 ($\hat{\sigma} = 2.07$) governmental organizations are involved, ranging from zero to nine. Nearly one ($\bar{x} = .97$; $\hat{\sigma} = 1.55$) university-affiliated organization is involved in watershed-related activities in the sample, ranging from zero to seven. An average of .28 ($\hat{\sigma} = .75$) tribal government agencies are involved in sampled watersheds, ranging from zero to four. And, finally, an average of 1.16 ($\hat{\sigma} = 1.20$) federated organizations are involved, ranging from zero to five.

[Table 4.4 about here.]

As for the remaining variables in table 4.4, 14% ($\hat{\sigma} = .34$) of the watersheds in the sample have no natural flowing waters, and a natural flow regime is in place in 69% ($\hat{\sigma} = .46$) of the watersheds. Stakeholders indicated that a watershed partnership is present in 89% ($\hat{\sigma} = 3.19$) of the sample. On a scale of one to five, stakeholders in the average watershed aggregately scored their political efficacy at 3.75 ($\hat{\sigma} = .89$) On a scale of one to ten, stakeholders in the average watershed aggregately scored their trust in governmental stakeholders at 6.25 ($\hat{\sigma} = 1.61$), while their trust in nongovernmental stakeholders was scored as 6.69 ($\hat{\sigma} = 1.52$).

Assessing problem diffusion, the aggregate score of stakeholders in the average watershed indicated that it would take 55% ($\hat{\sigma} = 21.71$) of stakeholders to change their behavior and/or activities before the watershed could resolve its water quality problems. On a scale of one to ten, stakeholders in the average watershed placed themselves roughly in the middle when it comes to the level of scientific understanding about natural processes in the watershed ($\bar{x} = 5.26$; $\hat{\sigma} = 1.77$), as well as their level of scientific understanding about causal processes related to watershed problems ($\bar{x} = 5.37$; $\hat{\sigma} = 1.89$). When it comes to views about a legitimate decision-making process for watershed management, in the average watershed stakeholders placed themselves at 3.26 ($\hat{\sigma} = .85$) on a scale of one to five when assessing the fairness of the process. When assessing representativeness, also on a scale of one to five, stakeholders in the average watershed placed themselves at 3.64 ($\hat{\sigma} = .79$).

Turning to policy outputs that relate to operational-level activities (table 4.3), an average 3.19 ($\hat{\sigma} = 1.42$) environmental improvement activities took place in the year prior to respondents answering the survey, ranging from zero to nine. And an average 5.27 ($\hat{\sigma} = 2.16$) educative activities occurred in sampled watersheds, ranging from zero to eleven.

Beyond these variables, table 4.4 describes several watershed context and condition variables. Among these is a variable for the NEP, which, as a dichotomous indicator, shows an average of .30 ($\hat{\sigma} = .46$) watersheds in this sample are involved in the NEP. Socioeconomic status (SES) is measured as the percentage of households within the watershed with an annual income equal to or greater than \$75,000 in 2000. This table shows that an average of 17% ($\hat{\sigma}$ = .08) of watershed households have incomes at this level, although this number ranges from 5% to 39%. As for population density, the table shows there were an average of 252.10 persons per square mile ($\hat{\sigma}$ = 572.37) living in sampled watersheds in 2000; this number ranges from .58 to 4221.19. Watersheds in the sample have an average white population of 85% ($\hat{\sigma}$ = .14), with a range of 27% to 99%. The average watershed is 1439.38 square miles ($\hat{\sigma}$ = 740.83), with a minimum of 209.9 square miles and a maximum of 3633.2 square miles. Apart from the NEP variable, these variables were gathered from the 2000 US Decennial Census.

Three additional variables measure ecological and civic conditions. Sampled watersheds have an average 32% ($\hat{\sigma}$ = .27) intermittent flows; this ranges from no intermittent flow to nearly all intermittent flows (97%). A dichotomous indicator for the prior appropriation (Western) water doctrine shows that 34% ($\hat{\sigma}$ = .48) of sampled watersheds use this approach for determining water rights. Finally, the average NPS pollution activism score for sampled watersheds is 14.79 ($\hat{\sigma}$ = 7.92), ranging from two to 25.5 on a zero to 30 point scale.[6] The discussion now turns to how these independent variables are correlated with the dependent variable of perceived water quality.

Discussion of Bivariate Relationships. Table 4.5 shows there are several variables discussed in the previous section that have a statistically significant correlation with the perception that water quality has improved in the sampled watersheds. A greater number of local non-governmental ($\hat{\rho}$ = .222; p = .017) and greater number of local governmental organizations ($\hat{\rho}$ = .226; p = .016) both have a significant impact on perceptions of water quality. Three stakeholder community characteristics also have a statistically significant correlation with water quality perceptions: the presence of a watershed partnership ($\hat{\rho}$ = .255; p = .006), political efficacy ($\hat{\rho}$ = .234; p = .012), and trust in stakeholders from governmental organizations ($\hat{\rho}$ = .100; p = .006).

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[6] This variable was used as a state-level (level II) covariate in the phase one multilevel model. Due to the limited sample size in this phase, this variable is analyzed at the watershed level.

[Table 4.5 about here.]

An understanding of the natural scientific process of the watershed is also significantly correlated with perceptions about water quality ($\hat{\rho} = .165$; $p = .079$). Decision-making process legitimacy is also important to stakeholders, as fairness ($\hat{\rho} = .215$; $p = .022$) and representativeness ($\hat{\rho} = .234$; $p = .012$) have statistically significant correlations. Regarding operational level activities, greater numbers of educative programs are significantly correlated with perceptions of water quality ($\hat{\rho} = .214$; $p = .022$).

Finally, many of the contextual and conditional aspects of watersheds are significantly correlated with perceptions of water quality. This includes the NEP ($\hat{\rho} = .363$; $p = .000$), the SES of watershed stakeholders ($\hat{\rho} = .195$; $p = .038$), the population density ($\hat{\rho} = .191$; $p = .041$), the percent of the white population ($\hat{\rho} = .224$; $p = .016$), lower levels of intermittent flows ($\hat{\rho} = -.273$; $p = .003$); and NPS policy activism ($\hat{\rho} = .194$; $p = .039$). In the next section a multivariate model is developed and assessed to determine the independent impact of each of these variables on perceptions of water quality improvement.

Analytic Methods: A Binary Response Model. To analyze the independent effect of the significant variables just described on *perceived water quality improvement*, a binary response model (BRM) with a logit function is used because it well measures the proportional nature of the variable—a binary variable that relates to a question of whether water quality has improved since stakeholder engagement in the watershed. Since this variable was created from aggregate responses for all those organizations responding for a given watershed, using this function allows the variable to range from $-\infty$ to ∞ when transformed into an odds ratio for ease of interpreting the effects of the explanatory variables, as shown in the following equation.

$$\frac{\Pr(y = 1|\mathbf{x})}{\Pr(y = 0|\mathbf{x})} = \frac{\Pr(y = 1|\mathbf{x})}{1 - \Pr(y = 1|\mathbf{x})} \tag{4.1}$$

This odds ratio describes how often watershed stakeholders perceive the constellation of actors involved in their watershed is having an impact on the perception of perceived water quality improvement.

Results. When initially creating a logit model with each of the variables having a significant impact in table 4.5, only two appear to be significant: population density and the percent of the white population. A possible explanation is that several of the variables were having an equal effect on the dependent variable. Following Long (1997), several Wald tests were conducted to rule out this potential impact. First, it was hypothesized that the effects of decision-making fairness and decision-making representativeness have an equal effect. This hypothesis was unable to be rejected at the .05 level ($\chi^2 = .30$, $df = 1$, $p = .584$). Second, it was hypothesized that, due to the nature of the question, political efficacy may have an equal impact as decision-making representativeness.[7] This hypothesis was unable to be rejected at the .05 level ($\chi^2 = .12$, $df = 1$, $p = .728$). Third, also due to the way the respondents answered the questions, political efficacy and decision-making fairness may also have an equal effect. This hypotheses is also unable to be rejected at the .05 level ($\chi^2 = 1.67$, $df = 1$, $p = .196$). Fourth, there is the possibility that population density and percent white population may have an equal effect. This hypothesis can be rejected at the .05 level ($\chi^2 = 6.18$, $df = 1$, $p = .013$). Finally, there is the possibility that political efficacy and watershed partnership may also have an equal effect on one's perceptions of water quality outcomes. And, again, this hypothesis cannot be rejected at the .05 level ($\chi^2 = .40$, $df = 1$, $p = .525$). This may indicate the need to examine various combinations of variables across several logit models.

These logit models are presented in table 4.6, each with a different combination of variables. Based on the Bayesian Information Criteria (BIC) statistics in these models, model 4 is preferred because it has the lowest BIC. When determining the strength of evidence, the calculated magnitude of difference between the two models with the lowest BIC is $m2 - m4$

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[7] The survey question relating to the political efficacy variable asked respondents to indicate their strength of their decision-making *role* in the watershed management process.

or $141.942 - 116.860 = 25.082$. This magnitude indicates the strength of evidence is very strong for model 4 (Long 1997). Additionally, although not displayed in the model, the Akaike Information Criteria (AIC) statistic is also lowest for model 4 (AIC=105.915), corresponding to the lowest BIC. Model 2 has the next lowest AIC (AIC=109.089). The AIC differences are smaller than the differences between BIC statistics for these models, arguably because model complexity is more severely penalized for the BIC statistic than the AIC statistic due to identification assumptions (Long and Freese 2006).

[Table 4.6 about here.]

Model 4 shows that a watershed stakeholder partnership increases the odds that stakeholders believe water quality improvement is occurring in their watershed ($p < .05$). Water quality is also likely to be viewed as improving when there is a higher percentage of white populations ($p < .05$) and in areas with higher population densities ($p < .05$). Looking more closely at the watershed partnership variable, however, the information presented here show that the odds of perceiving water quality improvement equals .93 (CI: .85, 1.00) when a watershed partnership is present.

Discussion of Phase Two Quantitative Analysis. The analyses presented here provide tentative support for some of the hypotheses articulated at the beginning of this section. The bivariate relationship analysis provides support for H2a and H2f, indicating a relationship between local nongovernmental and governmental organizations, respectively, and perceptions about water quality improvement. There is also support for the hypotheses relating to a watershed stakeholder partnership (H4a), political efficacy (H4b), and trust in governmental organizations (H4c). Regarding collective action beliefs, there is support for natural process scientific understanding (H5b). With regards to decision making process legitimacy, there is support for the hypotheses related to fairness (H6a) and representativeness (H6b). And, finally there is support for the hypothesis related to operational-level educative activities (H7b). Of course, it must be mentioned that among these, only the hypothesis related to watershed stakeholder partnership (H4a) found support in the multivariate binary response model (table 4.6).

Several features of this phase of the study may limit its validity. The first, and most obvious, is survey response bias. It is very likely, due to the nature of the contact information gathered for this study, that organizations participating in watershed partnerships were more likely to participate in the study. Second, the logit model used here relies on a maximum likelihood estimator; the sample size of 114 is likely too low for appropriate model estimation, as many recommend a sample size between 300 to 500 at minimum (see, for example, King 1989; Long 1997; Long and Freese 2006). Future investigations will benefit from both larger sample sizes and by including additional watersheds without stakeholder partnerships in place to see if these tentative relationships have any validity. Another aspect worth highlighting is the similar result of the percent white population variable in both phases of quantitative analysis. Further investigation would benefit from a greater specification of ethnicity than this singular indicator.

Finally, even though the operational level activities did not prove to be a statistically significant variable in the logit models, they are still worth further exploration to see just exactly what activities the stakeholders in this study are putting on the ground to improve the environment and educate resource users. And it may just be possible that the watershed stakeholder partnership variable captures a measure of these activities, as they often require multiple parties and organizations to implement them. The next section further explores these restorative and educative activities.

Qualitative Analysis

To get a greater understanding of the actual activities that watershed stakeholders in the sample are conducting at the operational level, survey respondents were asked to describe their organization's most recent activities related the improvement of environmental conditions in their watershed. Tables 4.7 and 4.8 provide a count of the activities conducted at the operational level by organizations involved in watershed partnerships and those that aren't, respectively. The purpose of asking this question was simply to get a better understanding of which types of organizations are more likely to conduct which types of activities when a partnership is present and when it is not, as well as gleaning just exactly what activities are being conducted. Using Imperial's (2005) LACF with a focus on operational level activities (table 4.3), A pattern matching approach was used to identify activities that are either related to environmental improvement or education. The responses were then sorted by whether or not the respondent indicated their organization was involved in a watershed partnership.

[Table 4.7 about here.]

Looking at the operational level of activities that are conducted by organizations involved in watershed stakeholder partnerships (table 4.7), it's immediately clear that local nongovernmental organizations are highly involved in both environmental improvement (indicated in the table as restorative for simplicity) activities, with 103 of these organizations most recently engaged in this type. Natural resource-related special districts are a distant second with 21 of them recently involved in restorative actions. Survey responses highlight a few of these activities conducted by local nongovernmental organizations:

Lake Martin Resource Association: Worked with Alabama Power Company, city, county, local businesses, area schools, associations and volunteers to organize a comprehensive clean up of lake shoreline and adjacent roadsides. The cleanup yielded more than 10 tons of trash and debris.

Partnership for the Umpqua Rivers: We do salmon habitat restoration . . . throughout the Umpqua Basin. Projects include the placement of logs and boulders, replacement of failing culverts, tidal wetland restoration, riparian restoration, fencing off channel stock water. . . . We host a river cleanup every year.

Healthy Harbor Initiative: Planting 150,000 oysters in Baltimore Harbor, installing floating wetlands, installing the Water Wheel powered trash interceptor in the Jones Falls.

Hiwassee River Watershed Coalition: Completed a 1,100 linear foot habitat restoration project in the Valley River watershed. Enhanced riparian buffers along nearly two miles of stream (removing invasive plants & planting native trees and shrubs). Installed a heavy use area on a livestock operation. Installed stormwater BMPs at a resort on Lake Chatuge. Repaired 6 leaking/failing septic systems.

These are just a few of the 103 environmental improvement activities indicated by local nongovernmental organizations involved in watershed partnerships. Survey responses also highlight a few of the improvement activities conducted by special districts:

Underwood Conservation District: We recently constructed instream salmon habitat (large wood, riffles, pools, glides). We recently replaced a fish passage barrier culvert on a salmon-bearing stream. We have also helped plan and conduct forest thinning, brush clearing, habitat improvement, and defensible space work.

Nez Perece Soil and Water Conservation District: Steelhead habitat restoration in tributaries to Clearwater. Specific actions include riparian plantings, passage barrier design and removal, road erosion reductions.

Resource Conservation District of Monterey County: Noxious riparian weed management, on-farm erosion control projects, fish habitat improvement, farm runoff water quality management.

Turning to the educational activities conducted by watershed partnership organizations, again the local nongovernmental organizations conduct more than other types of organizations, with seven organizations conducting these types of activities. A close second, five state nongovernmental organizations described educational events as their most recently conducted activities. Survey responses highlight these activities for local nongovernmental organizations:

Citizen's Environmental Coalition - Houston/Galveston Area: We publish a weekly newsletter that is emailed to almost 5,000 subscribers, with information about many of the watershed-based opportunities in the 13-county, Houston metro area. We host learning and networking events, such as the Greater Houston Environmental Summit, which will often feature speakers related to surface water quality.

Friends of the Los Angeles River: We conduct school programs throughout the year.

Anchorage Waterways Council: Creating and providing information aimed at various groups, such as pet owners, property owners, property managers, gardeners, etc.

As for the educational activities conducted by state nongovernmental organizations involved in watershed stakeholder partnerships, survey responses also highlight these activities:

Connecticut Federation of Lakes: Organized and hosted a 2 day conference of the New England Chapter of the North American Lake Management Society.

Alabama Waterwatch: AWW regularly conducts water quality monitoring workshops, community based watershed stewardship presentations and water quality data interpretation presentations throughout the state.

These are just a sample of the 162 restorative and educative activities recently conducted by organizations responding to the survey for this project that participate in a watershed stakeholder partnership.

[Table 4.8 about here.]

As indicated above, there is a slightly different arrangement of the actors who are most involved in these operational level activities when a watershed stakeholder partnership is not in place, as well as lower total number of activities (table 4.8). Local nongovernmental organizations, however, conduct the plurality (21) of restorative activities, including:

Wood-Pawcatuck Watershed Association: Completed a fish passage project involving 3 dams on the Upper Pawcatuck River.

Tri-State Steelheaders: Habitat projects aimed at improved fish passage, fish habitat, floodplain function, riparian development and function.

Regional nongovernmental organizations are the second-most involved (15) among non-partnership organizations:

The Pleateau Action Network: Acid mine drainage remediation, stream restoration projects, implementation of stormwater BMPs.

Oregon Stewardship: For the past 6 months we have improved the riparian habitat along a 1/2 mile of Bear Creek, an urban tributary of the Rogue River, by removing noxious weeds and trash and replanting native vegetation. We have also created bioswales to filter storm drain runoff. We have attempted to leave large amounts of woody debris for fish habitat. On coastal streams we have planted willows and black cottonwood and installed brush bundles in river estuaries to provide protection for salmon smolts.

State nongovernmental organizations are the leaders among those conducting educational activities outside of watershed partnerships, with nine of these indicating this as their most recent beneficial activity:

> **Leo Drey / LAD Foundation:** For a large watershed, now for more than 60 years we have been managing a more than 140,000-acre working forest to demonstrate for other private landowners how conservative single-tree selection forest management can restore forested landscapes and provide income.
>
> **Kansas Conservation and Environmetnal Education:** We run the Kansas Green Schools program, working with 485 schools across the state and encourage schools to complete a water investigation, which has students understanding more about their watershed, water resources, water consumption, and water quality.

Discussion of Phase Two Qualitative Analysis. The differences in the number of both educative and improvement activities conducted by those stakeholders involved in a partnership and those that are not are perhaps the most striking takeaway from this analysis. If this evidence is representative, partnership organizations conduct more than twice as many operational-level activities than non-partnership organizations. The most important finding here, however, is the role of the regional nongovernmental organization when a partnership is not in place. This analysis shows they are more likely to be the organization conducting watershed improvement activities in the absence of a stakeholder partnership. This could very well be why this type of organization appears so important to measured water quality improvement in the first phase's multilevel model analysis and in the second phase's bivariate analysis.

Limitations

The results of the analyses described in this chapter do not perfectly capture all the features necessary to understand stakeholder impacts on water quality. An easy critique of the quantitative analyses is the lack of incorporation of variables related to watershed-level political variables, such as congressional district voting patterns and political culture. Additionally, economic variables would enhance this inquiry, such as primary industry and strength of the overall economy within a given watershed; stakeholders within a watershed that is economically dominated by extraction industries faced challenges quite different than those in a watershed dominated by tourism. Accounting for disasters during the time period examined here within a given watershed would also be of benefit; data for these are available at the county level but not at the level of analysis considered here. Additionally, measures capturing the bureaucratic culture of state environmental agencies and the mission of state water agencies would strengthen this analysis, although some of this is captured with the variable measuring NPS policy activism. Finally, examining environmental outcomes over a period of eight years (phase 1) or cross-sectionally (phase 2) is insufficient to understand collaborative efforts. Environmental change—especially sustained changes in water quality—may take several decades to accomplish. Even with these acknowledged limitations, however, the approach taken here is a start, and it may still shed light on important institutional actors associated with lower levels of insufficient water quality.

Conclusions

This chapter has presented two phases of an investigation into the institutional and environmental landscapes of watersheds across the fifty states. The multilevel model in the first phase provides some evidence that regional-level nongovernmental organizations have an impact on measured water quality, ceteris paribus; and greater numbers of these organizations have a statistically significant correlation with stakeholder perceptions about water quality improvement, as demonstrated in the phase two bivariate results. This type of organization is obviously having an impact on local level watershed stakeholders. Perhaps these regional organization act as outreach networks (Agranoff 2007), creating programming opportunities and enhancing the capacity of those at the local level to achieve their environmental goals. Understanding just exactly what these organizations do and how they are linked to other organizations is a worthwhile endeavor if research is to benefit those engaged in watershed management.

Although the results from the second quantitative analysis presented here are tentative at best, they do provide some support for the general theme of this investigation: collaborative partnerships benefit environmental outcomes, albeit perceived outcomes, that is. A larger sample size would be helpful to tease out this relationship more precisely. In addition to a larger and more representative sample, it would be useful to have a longer time horizon to examine the effects of watersheds with stakeholder partnerships and those without. So, too, would be a better measure of environmental outcomes. If water quality maintenance is the goal of watershed stakeholders, this outcome may be just as important as water quality improvement is to other in a different watershed. Additionally, quality is not always the driving goal. For particularly arid watersheds, water quantity may be a higher priority and a more desirable outcome.

It is also worth noting the large and significant relationship between watersheds with higher levels of white populations and water quality in both quantitative analyses discussed in this chapter. When examining the environmental justice goals of federal programs, Konisky (2009) found evidence that the states were not following through on CWA enforcement in majority African American areas. While not the topic of this study, the evidence here seems to provide disappointing results for those persons and institutions concerned with promoting environmental justice, as well as for those who live in these watersheds. Moving forward, a future step is to further explain this finding may involve the inclusion of a measure of citizen and state governmental ideology (e.g., Berry et al. 1998) to more closely examine this variable. This may change the impact of white populations on water quality, as Northeastern states are richer, wetter, often more progressive, and more demographically homogeneous.

This chapter has provided the results from several analyses of stakeholder institutional arrangements, social, economic, ecological, and civic conditions, and environmental characteristics of watersheds across the United States. Although the evidence presented here does not support a majority of the hypotheses articulated in this chapter, support has been found for a few of them. Local and regional nongovernmental institutional actors have a profound impact on water quality and perceptions of water quality, while others don't. It may be more important, however, to focus on the institutional and decision-making arrangements these institutional actors form and sustain to better understand the effects of collaboration and collaborative processes on environmental outcomes in general and water quality in particular.

Table 4.1: Descriptive Statistics for Secondary Data Analysis

Variable	mean	std dev	minimum	maximum
Dependent Variable				
Percent Insufficient Waterbodies 2010 (DV)	0.41	0.30	0	1
Independent Variables				
Watershed Level (n = *306*)				
Local-level NGOs	3.20	5.16	0	40
Local-level Government Agencies	0.96	3.07	0	26
Natural Resource-related Special Districts	0.49	1.31	0	9
State-level NGOs	1.57	2.03	0	12
State-level Government Agencies	1.09	1.84	0	11
Regional-level NGOs	0.52	0.99	0	6
Regional-level Government Organizations	0.07	0.29	0	2
National-level NGOs	0.11	0.39	0	3
National-level Government Organizations	0.69	1.55	0	9
University-affiliated Organizations	0.51	1.01	0	7
Federated Organizations	0.68	1.04	0	5
Tribal Government Organizations	0.07	0.41	0	4
Control Variables				
National Estuary Program (NEP) Watershed	0.23	0.42	0	1
Socioeconomic Status (2000)	0.15	0.07	0.04	0.50
Population Density (2000)	154.62	436.24	0.13	5334.05
Percent White Population (2000)	0.85	0.14	0.09	0.99
Watershed Size (Square Miles)	1477.72	880.02	73.40	8574.09
Percent Intermittent Stream Flow	43.48	27.06	0	98.48
Percent Watershed in Primary State	0.93	0.14	0.44	1.00
Prior Appropriation Water Doctrine (Primary State)	0.45	0.49	0	1
Percent Insufficient Waterbodies 2002 (DV lag)	0.49	0.32	0	1
NPS Pollution Activism (Primary State [1997–2002])	12.39	7.73	2	25.5

Note: n *= 306*

Table 4.2: Multilevel Regression Models for Effects on Insufficient Water Quality (2010)

	Full Model 1		**Full Model 2**		**Full Model 3**		**Fit Model 4**		**Fit Model 5**	
	State Fixed Effects		State Mixed Effects		State Factors Mixed Effects		State Mixed Effects		State Factors Mixed Effects	
Watershed-Level Effects	$\hat{\beta}$	$(\hat{\epsilon})$	$(\hat{\beta})$	$(\hat{\epsilon})$	$(\hat{\beta})$	$(\hat{\epsilon})$	$(\hat{\beta})$	$(\hat{\epsilon})$	$\hat{\beta}$	$(\hat{\epsilon})$
Local NGOs	.004	(.005)	.004	(.007)	.004	(.007)				
Local Gov't Org's	.005	(.007)	.005	(.007)	.005	(.007)				
Special Districts	.007	(.016)	−.004	(.015)	−.003	(.015)				
State NGOs	−.010	(.010)	−.001	(.010)	.006	(.010)				
State Gov't Org's	.003	(.015)	.010	(.015)	.010	(.015)				
Regional NGOs	$-.045^{**}$	(.017)	$-.052^{**}$	(.017)	$-.054^{**}$	(.017)	$-.044^{**}$	(.015)	$-.045^{**}$	(.015)
Regional Gov't Org's	.011	(.052)	.005	(.048)	.010	(.049)				
National NGOs	.082	(.048)	.080	(.080)	.073	(.045)				
National Gov't Org's	−.012	(.017)	−.004	(.016)	−.003	(.016)				
University Affiliates	−.029	(.017)	−.022	(.017)	−.020	(.017)				
Tribal Gov't Org's	−.014	(.045)	−.002	(.041)	.001	(.041)				
Federated Org's	.002	(.020)	−.020	(.022)	−.030	(.022)				
% Insufficient Waters 2002	$.361^{***}$	(.048)	$.350^{***}$	(.052)	$.370^{***}$	(.050)	$.349^{***}$	(.052)	$.357^{***}$	(.051)
NEP Watershed	−.066	(.038)	−.024	(.040)	−.021	(.038)				
SES (2000)	.298	(.252)	.210	(.248)	.137	(.242)				
% Watershed in Primary State	.101	(.106)	.172	(.099)	.157	(.099)				
Population Density	.000	(.000)	.000	(.000)	.000	(.000)				
% White Population (2000)	$-.299^{**}$	(.102)	$-.215^{*}$	(.099)	$-.205^{**}$	(.103)	$-.295^{**}$	(.104)	$-.267^{**}$	(.101)
Watershed Size (mi^2)	−.000	(.000)	.000	(.000)	−.000	(.000)				
% Intermittent Flow	.001	(.001)	.001	(.001)	.001	(.001)				
Prior Appropriation Doctrine	.043	(.038)	.026	(.054)	.047	(.049)				
Intercept	$.320^{*}$	(.150)	.184	(.151)	.177	(.147)	$.541^{***}$	(.095)	$.495^{***}$	(.091)
State-Level Effects	$\ln(\hat{\sigma})$	$(\hat{\epsilon})$	$\ln(\hat{\sigma})$	$(\hat{\epsilon})$	$\ln(\hat{\sigma})$	$(\hat{\epsilon})$	$\ln(\hat{\sigma})$	$(\hat{\epsilon})$	$\ln(\hat{\sigma})$	$(\hat{\epsilon})$
Within State Variability	-1.395^{***}	(.040)	-1.527^{***}	(.043)	-1.427^{***}	(.044)	-1.488^{***}	(.043)	-1.491^{***}	(.043)
Between State Variability			-2.114^{***}	(.167)	-4.885^{***}	(.282)	-2.046^{***}	(.161)	-4.843^{***}	(.330)
Between State NPS Activism Variability					-2.906^{***}	(.745)			-2.604^{***}	(.480)
Model Fit	BIC	χ^2	BIC	χ^2	BIC	χ^2	BIC	χ^2	BIC	χ^2
	146.34	127.42^{***}	117.34	92.44^{***}	119.25	98.07^{***}	39.98	60.40^{***}	42.29	62.97^{***}

Note: level 1 observations = 306; level 2 groups = 45

Legend: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Table 4.3: Operational Level Activities

Environmental Improvement Activities	Educative Activities
Habitat Restoration Projects	Public Ed. Programs for Schools
Clean-up Activities	Public Ed. Programs for Homeowners
Land Acquisition	Public Ed. Programs for Industry
Installing Urban Best Management Practices (BMPs)	Public Ed. Programs for Other Users
Installing Agricultural BMPs	Public Social Events
Installing Forestry BMPs	Special Events for the Public
Installing Water Flow BMPs	School Curriculum Development
Installing Sewers	Training Programs
Upgrading On-site Sewage Disposal Systems	Special Events for Elected Officials
	Special Events for Public Administrators
	Outreach Programs and Events

Note: Adapted from Imperial (2005).

Table 4.4: Descriptive Statistics for Phase Two Data Analysis

Variable	**mean**	**std dev**	**minimum**	**maximum**
Dependent Variable				
Perceived Water Quality Improvement	.763	.427	0	1
Stakeholder Organizations				
Local Nongovernmental	6.781	5.989	0	32
Local Governmental	2.505	3.797	0	17
Special Natural Resource-Related Districts	1.228	1.886	0	9
State Nongovernmental	2.246	2.393	0	12
State Governmental	2.693	2.239	0	10
Regional Nongovernmental	.763	1.306	0	6
Regional Governmental	.167	.419	0	2
National Nongovernmental	.307	.653	0	3
National Governmental	1.974	2.067	0	9
University Affiliate	.965	1.545	0	7
Tribal Governmental	.281	.747	0	4
Federated Nongovernmental	1.158	1.202	0	5
Flow				
No Natural Flowing Waters	.140	.340	0	1
Natural Flow Regime	.693	.463	0	1
Stakeholder Community Characteristics				
Watershed Partnership	.886	.319	0	1
Political Efficacy	3.750	.894	1	5
Trust in Governmental Stakeholders	6.246	1.608	2	9.5
Trust in Nongovernmental Stakeholders	6.685	1.522	2	10
Collective Action Beliefs				
Problem Diffusion	54.987	21.706	9	100
Natural Process Scientific Understanding	5.261	1.765	1	10
Causal Understanding of Problems	5.373	1.883	1	10
Decision-making Process Legitimacy				

Continued on next page

Variable	**mean**	**std dev**	**minimum**	**maximum**
Decision-making Fairness	3.263	.845	1	5
Decision-making Representativeness	3.641	.786	1	5
Policy Output Characteristics				
Environmental Improvement Activities	3.185	1.418	0	9
Educative Activities	5.272	2.163	0	11
Watershed Context and Conditions				
National Estuary Program (NEP) Watershed	.298	.460	0	1
SES	.171	.084	.051	.392
Population Density	252.103	572.366	.583	4221.189
% White Population	.845	.142	.266	.992
Watershed Size (Square Miles)	1439.384	740.832	209.900	3633.200
% Interment Flow	.324	.270	0	.970
Prior Appropriation Doctrine	.342	.477	0	1
NPS Pollution Activism	14.794	7.916	2	25.500

Note: $n = 114$.

Table 4.5: Pairwise Correlations for Phase Two Data Analysis

	Perceived Water Quality Improvement	
Variable	$\hat{\rho}$	p-value
Stakeholder Organizations		
Local Nongovernmental	.222	.018**
Local Governmental	.226	.016**
Special Districts	.112	.237
State Nongovernmental	.066	.485
State Governmental	.173	.065
Regional Nongovernmental	.121	.201
Regional Governmental	.074	.433
National Nongovernmental	.073	.443
National Governmental	.163	.083
University-Affiliated	.069	.474
Tribal Governmental	.044	.643
Federated Nongovernmental	−.013	.893
Flow		
No Natural Flowing Waters	−.013	.895
Natural Flow Regime	.121	.199
Stakeholder Community Characteristics		
Watershed Partnership	.255	.006**
Political Efficacy	.234	.012**
Trust in Governmental Organizations	.100	.006**
Trust in Nongovernmental Organizations	.100	.289
Collective Action Beliefs		
Problem Diffusion	.069	.463
Causal Understanding of Problems	.100	.290
Natural Process Scientific Understanding	.165	.079*

Continued on next page

Table 4.5 – continued from previous page

	Perceived Water Quality Improvement	
Variable	$\hat{\rho}$	p-value
Decision-making Process Legitimacy		
Decision-making Fairness	.215	$.022^{**}$
Decison-making Representativeness	.234	$.012^{**}$
Policy Output Characteristics		
Environmental Improvement Activities	.147	.118
Educative Activities	.214	$.022^{**}$
Watershed Context and Conditions		
National Estuary Program (NEP) Watershed	.363	$.000^{***}$
SES	.195	$.038^{**}$
Population Density	.191	$.041^{**}$
% White Population	.224	$.016^{**}$
Watershed Size (Square Miles)	−.144	.125
% Intermittent Flow	−.273	$.003^{***}$
Prior Appropriation Doctrine	.973	.303
NPS Policy Activism	.194	$.039^{**}$

Note: $n = 114$.

Legend: $^{*}p > 0.10$; $^{**}p > 0.05$; $^{***}p > 0.01$

Table 4.6: Binary Response Models Models for Stakeholder Perceptions of Water Quality Improvement

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	$\hat{\beta}$	$(\hat{\epsilon})$	$(\hat{\beta})$	$(\hat{\epsilon})$	$(\hat{\beta})$	$(\hat{\epsilon})$	$(\hat{\beta})$	$(\hat{\epsilon})$
Local Governmental Orgs.	−.063	(.073)	−.045	(.071)	−.056	(.073)		
Local Nongovernmental Orgs.	.157	(.134)	.159	(.127)	.170	(.135)		
Watershed Partnership	1.199	(.934)			1.674*	(.874)	1.873**	(.750)
Political Efficacy	.576	(.358)	.719*	(.335)				
Trust in Governmental Organizations	.177	(.177)	.221	(.174)	.186	(.171)		
Natural Process Scientific Understanding	.167	(.157)	.175	(.157)	.150	(.150)		
Educative Activities	.135	(.135)	.106	(.132)	.225	(.124)		
SES	−5.956	(5.106)	−4.650	(4.904)	−6.350	(5.039)		
Population Density	.011*	(.005)	.009*	(.005)	.011*	(.005)	.007*	(.003)
% White Population	4.759*	(1.894)	4.816*	(1.899)	4.580*	(1.874)	4.286**	(1.663)
% Intermittent Flow	−.013	(.012)	−.011	(.012)	−.011	(.012)		
NPS Policy Activism	.013	(.037)	.013	(.037)	.013	(.036)		
Intercept	−8.171**	(2.500)	−8.158***	(2.448)	−6.778**	(2.258)	−4.789**	(1.641)
Model Fit	BIC	LR χ^2	BIC	LR χ^2	BIC	LR χ^2	BIC	LR χ^2
	144.973	41.41***	141.942	39.27***	142.942	38.70***	116.860	26.90***

Legend: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Note: *n=114*.

Table 4.7: Operational Level Activities for Partnership Organizations

Organizational Type	Restorative	Educative	Total
Local Nongovernmental	103	7	**110**
Local Governmental	7	3	**10**
Special District	21	2	**23**
State Nongovernmental	3	5	**8**
State Governmental	3	1	**4**
Regional Nongovernmental	2	0	**2**
Regional Governmental	0	0	**0**
National Nongovernmental	0	0	**0**
National Governmental	0	0	**0**
College or University	0	2	**2**
Tribal Governmental	0	0	**0**
Federated Organization	2	0	**2**
Totals	**141**	**20**	**162**

Note: Numerous organizations conduct both types of activities. These numbers are based on the first activity mentioned by the organization when responding to the survey question.

Table 4.8: Operational Level Activities for Non-partnership Organizations

Organizational Type	Restorative	Educative	Total
Local Nongovernmental	21	2	**23**
Local Governmental	3	0	**3**
Special District	1	0	**1**
State Nongovernmental	7	9	**16**
State Governmental	6	0	**6**
Regional Nongovernmental	15	2	**17**
Regional Governmental	1	2	**3**
National Nongovernmental	0	0	**0**
National Governmental	1	0	**1**
College or University	1	1	**2**
Tribal Governmental	1	0	**1**
Federated Organization	0	1	**1**
Totals	**57**	**17**	**74**

Note: Numerous organizations conduct both types of activities. These numbers are based on the first activity mentioned by the organization when responding to the survey question.

In America the power that conducts the administration is far less regular, less enlightened, and less skillful, but a hundredfold greater than in Europe. In no country in the world do the citizens make such exertions for the common weal. I know of no people who have established schools so numerous and efficacious, places of worship better suited to the wants of the inhabitants, or roads kept in better repair. Uniformity or permanence of design, the minute arrangement of details, and the perfection of administrative system must not be sought for in the United States; what we find is the presence of a power which, if it is somewhat wild, is at least robust, and an existence checkered with accidents, indeed, but full of animation and effort.

Alexis de Tocqueville (c. 1835)

5

Conclusion

Introduction

The quote which begins this chapter provides evidence that collaboration has long been a way of life in the United States. Although theories of collaboration are relatively recent, the practice of it isn't. Tocqueville (1945) recognized this is how Americans achieve collective action. Indeed, if nothing else, that is the goal of collaboration. Tocqueville's examples are of local enterprises—schools, churches, and roads—the building and maintenance of which would be impossible without a network of individual and actors co-laboring. The similarities of these actors to those who work for the maintenance and improvement of their natural resources today is remarkable. Certainly though today, with advancements in technology and communication, and with the proliferation of nongovernmental and nonprofit organizations, the network of actors surrounding a single watershed drainage basin is much larger than it was in the early 19th century. So, too, are the diverse groups of stakeholder who are engaged in or affected by environmental and natural resource (ENR) management decisions and governance.

This dissertation attempts to describe the physical and institutional landscape of watershed governance. Humans organize themselves around water—our habitats, our food production, our cities, our land distributions, and much of our energy production (Barham 2001). We are as much connected to our water resources as we are to the road, schools, and places of worship Tocqueville described. Maintaining and sustaining our water resources is as much an act of self-governance as it is an act of self-determination. Numerous collective action problems arise in any attempt of such grand acts. Collaboration fosters this collective action, and it creates institutional arrangements that allow for the pursuit of numerous goals, create economies of scale, and fairly distribute the benefits and costs of collective action (Schlager and Blomquist 2008). Moreover, these institutional arrangements can be perceived as "wild," "checkered with accidents," but replete with "animation and effort," as Tocqueville (1945) acknowledges. The US Environmental Protection Agency's (US EPA) Watershed Approach, with its emphasis on improving watersheds "community by community, watershed by watershed" (EPA 1996) can foster institutionally rich environments with robust citizen engagement. The overarching question of this dissertation seeks to discover if these collaborative efforts of watershed engagement lead to beneficial environmental outcomes.

To further pursue this overarching question, seven guiding questions were explored in chapters two, three, and four, each of which had several related hypotheses. The first and second questions examine the institutional actors engaged in watershed-level activities, asking whether the number and type of watershed stakeholders have an impact on measured and perceived water quality, respectively. The third question delves into the physical properties of the water resource, asking whether watershed flow regimes impact perceptions of water quality. The fourth and fifth questions seeks to discover whether characteristics of the stakeholder community have an impact on perceptions of water quality. The sixth question ponders how perceptions of a legitimate decision-making process impacts perceptions of water quality. The final question seeks to better understand how environmental improvement and educative activities conducted by watershed stakeholders impacts their perceptions of water quality.

The answers to these questions may certainly be interesting to scholars and those engaged in watershed management, but they are certainly not enough to capture the whole picture of the challenges of ENR management related to watersheds, let alone self-governance. Before discussing the answers to these questions that are at least tentatively gleaned in this dissertation, this chapter turns to these challenges, as well as the potential opportunities, of collaborative watershed stakeholder partnerships in particular. The discussion then turns to and collaborative public management in general before offering some concluding thoughts.

Revisiting Watershed Collaboration

Due to the incremental nature of policy making, as well as the lack of a comprehensive national approach to water governance, the policies and programs governing watersheds are highly fragmented at the federal, state, and often local levels. This institutional fragmentation "limits any organization's ability to accomplish its mission by acting alone" (Imperial 2005, 283). Much of the collaborative activity taking place in watersheds today involves the education of resource users and programs to mitigate the spread of nonpoint source (NPS) pollution into streams, rivers, lakes, and estuaries. Because of the heterogeneous nature of NPS pollution its diffuse sources, collaborative efforts are often required. Moreover, due to the nature of the federal system in the US, as well as to the diversity of land ownership and property rights, these efforts often require actors from multiple levels of government and the private sector.

Because of the wide range of partners needed to create successful collaboratives, both environmental and economic interests are considered as "watershed partnerships address problems that are outside the scope of centralized regulation . . . and [they] allow for the adoption of flexible policy tools for addressing environmental impacts in a cost effective manner" (Lubell et al. 2002, 149). This flexibility allow for the stakeholders and the natural resource system to adapt to changing social and ecological circumstances. With a scientific understanding of these varying social and ecological conditions, stakeholders can engage in experimental governance. Sure, it may lead to Tocqueville describes as accidents, but accidents can lead to scientific learning. And this learning overtime can benefit water quality and quantity in a watershed, as well as associated riparian habitats. Conflicts may arise, but, with collaboration, there is the possibility that they don't have to lead to tragedies (Dietz, E. Ostrom, and Stern 2003).

Analyzing The Guiding Questions

As described in chapter three, a sampling approach was designed capture one-quarter of the watersheds across the United States. A survey was sent to organizations engaged in watershed-related activities in the sampled watersheds. Two econometric models in chapter four attempt to answer the guiding questions articulate above. The first model, a multilevel approach that incorporated watershed-level and state-level variables, was primarily aimed at answering the first question. Looking at 2010 water quality data from Total Maximum Daily Load (TMDL) reports from federal and state agencies, the attempt was to determine which institutional actors—or stakeholders—had the greatest impact on water quality. The analysis showed nongovernmental organizations at regional level were the only type of actor with any statistically significant influence on water quality. These organizations, such as the

Coalition for the Delaware River and the Rocky Mountain Environmental Associates, span political boundaries and are often engaged with actors in multiple watersheds.

The second model attempts to answer the six remaining questions, all of which deal with stakeholder perceptions of water quality. Perceptions were used for this analysis because the TMDL data did not allow for a large enough sample size to analyze measured water quality because of limited responses to survey questions of interest. This is also the reason for which a binary response model (BRM) with a logit function was used. While bivariate correlations provided some answers to the six questions, the BRM gives tentative support to the idea that watershed partnerships matter; when a partnership is present, stakeholders are more likely to perceive water quality improvement. But, of course, this is already well known (see, for example, Imperial 2005; Lubell et al. 2002).

Collaborative Public Management

What the analyses just described were not able to ascertain, however, are the broader and bigger institutional aspects of collaborative public management, nor the types of networked arrangements that form and the institutions that are created around watersheds. To further understand these relationships, additional research is needed to examine the theoretical and causal pathways between the stakeholder community, the information they receive, the legitimacy of their collaborative processes, the outputs they produce, and the outcomes they achieve, all while accounting for socioeconomic factors and external influences (figure 3.1). What is more, there needs to be a broader understanding of the various type of networks operating as actual stakeholders or otherwise enhancing their capacity from afar. In Agranoff's (2007) terms, the focus of this dissertation has been on the information network—his most basic type. There are others, such as developmental, outreach, and action networks that are certainly engaged in ENR governance and management. The reason that the regional nongovernmental organizations may be so important to local stakeholders is that they provide the capacity-building outreach function that smaller organizations are unable to accomplish alone. If there is to be a broader understanding of the environmental outcomes that can be achieve by collaboration, then there needs to be an attempt to analyze these various network types and how they are involved throughout the ENR management process (figure 3.1).

Just as it is important to differentiate these network types, differentiating the different types of actors within a network or collaborative effort would benefit this line of inquiry. These actors may foster, hinder, challenge, or doom the collaborative effort. Hale (2011) uses typology of champions, supporters, challengers, and bystanders that could enhance our understanding of ENR management actors. In future research it would certainly be advantageous for scholars and practitioners to know which types of individuals and organizations fit in to these types, as well as how those engaged in a collaborative effort were able to overcome their challengers to achieve their objectives. This may also benefit the understanding of power dynamics in collaborative efforts. With the potential collaborative goals of consensus and collective decision making, using Hale's typology can assist in the institutional design and creation of institutional rules for newly organized and reorganized collaborative efforts.

Concluding Thoughts

This dissertation seeks to better understand the dynamics of collaboration for environmental and natural resource management. Is this to of approach worth it? Do collaborative outputs actually produce beneficial outcomes? These are questions worth of investigation, and they provide a genuine contribution to the public administration and public policy literatures. Of course further exploration is needed to determine if we are to know that these institutional arrangements fulfill their lofty goals. This is of more practical concern than theoretical. Anyone with a passing interest in the environment or in the daily news knows we face tremendous water-related challenges in the 21st century. From water scarcity in the Western US and around the globe, to water quality concerns due to increased consumption of energy, food, and industrial goods, to aging infrastructure delivering water to homes, businesses, school, and hospitals, our water resources are strained. Collaborative approaches offer the promise to expand these constraints and improve these conditions. The questions asked here, and in future research, place the emphasis on whether they fulfill that promise. If they do, their capacity for action should be further enhanced by government at all levels.

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