

Collaborative Governance of Interstate River Basins in the Western U.S. 1

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Abstract

This paper examines the institutional processes and mechanisms used by U.S. western states to engage in shared governance of interstate rivers, and the performance of these mechanisms for watershed governance. The most common mechanism used by states to govern shared rivers is a compact, which is a treaty among semi-autonomous governments. Compacts are generally viewed as inflexible, rigid governance structures incapable of responding to changing environmental and institutional settings. Using data from an NSF funded study of 14 western interstate river compacts we examine this claim. In particular, we explore the response of compacts to water conflicts. Water conflicts often emerge in response to changing circumstances - such as the development and use of new sources of water or the emergence of new values - conditions that can challenge the compatibility of compacts as cross-scale governance mechanisms. Yet, we find that members of compacts, closely related water agencies, and compact governments are capable of responding to these conflicts and changing circumstances, contrary to some of the critics of this form of governance. To better understand how these compacts perform, we identify the conditions under which compacts are likely to address conflicts, as well as consider the types of responses to these conflicts that compact parties make.

Introduction

Rapidly growing western populations, long term drought, and the emergence of environmental values have led to increasing water conflicts in the West. Yet such conflicts are not new. In the early 1900s, conflict among water users spilled across state borders, prompting water users and state water officials to search for regional solutions. In addition, the federal government conditioned the construction of large scale surface water projects on states settling their cross boundary water conflicts to allow for the orderly development of river basins. In response, state water officials turned to compacts. Interstate compacts are constitutionally authorized agreements used by states to reduce conflict and promote cooperation over a wide range of issues, including taxation, pollution and the allocation of resources (Zimmerman, 2002; Bowman, 2005). Compacts operate as self-governing institutional arrangements, akin to treaties. As the U.S. Supreme Court noted in 1938 "The compact—the legislative means— adapts to our Union of sovereign States the age-old treaty making power of independent sovereign nations." (Hinderlider vs. La Plata River and Cherry Creek Ditch Company [304 U.S. 92 (1938)]). Interstate river compacts, which are most frequently used in the western United States, specify water allocation rules and in many cases establish a governing structure through which state representatives administer compact requirements.

Early twentieth century advocates of interstate river compacts, such as Delph Carpenter, a principle designer of several early compacts, such as the 1922 Colorado River Compact, viewed these arrangements as a superior method of resolving water conflicts among states, superior, that is, to the commonly used conflict resolution mechanism at the time - federal courts. Rather than engaging in lengthy court proceedings that often excluded relevant water users, Mr. Carpenter argued that states, on behalf of their citizens, should negotiate equitable water allocations to

provide greater certainty and security for all water rights holders in a basin. In addition, a governing structure would provide states regular opportunities to meet and discuss mutual water problems, develop regulations to administer compact terms and conditions, monitor water use, and settle conflicts. And, indeed, many interstate rivers and streams in the western U.S. are governed by a compact. ¹ Most compacts contain a statement similar to this one from the Snake

River Compact:

The major purposes of this compact are to provide for the most efficient use of the waters of the Snake River for multiple purposes; to provide for equitable division of such waters; to remove causes of present and future controversies; to promote interstate comity...

Despite the prominence of compacts as institutional arrangements to allocate shared resources and promote interstate cooperation, little empirical research has examined how interstate compacts actually perform, particularly in their capacity to address conflicts. In this paper we use the lens of conflicts to better understand the governing capacity of interstate river compacts. Conflicts provide a window by which to explore the ability of compacts to respond to changing circumstances that often spark conflicts among compact members. The first component of our analysis asks: Are compact governments capable of addressing conflicts? If so, what types of conflicts are they likely to address? In addressing conflicts, compact members and water users have access to a variety of venues, from compact commissions to state legislatures, and from courts to mediation and arbitration. Do parties to compact related conflicts attempt to match particular types of conflicts with particular types of venues?

² The interstate compact is the most common legal mechanism to govern interstate rivers. The U.S. Constitution provides two other avenues by which states may allocate the waters of a shared river. First, Congress and the President, through the legislative process, may allocate waters. A legislative process emphasizes shared rule over self-rule and is the least used mechanism for allocating water among states. Second, the states using a shared river may petition the U.S. Supreme Court to decree an allocation. In a judicial process the states seeking a decree are the primary actors. A judicial process strikes a different balance between state and federal power.

The second component of our analysis then investigates compact performance from a different angle by looking at conflict outcomes. In settling conflicts, compact members may pursue a variety of institutional "fixes", from changing water management strategies to revising the constitutional rules of compacts. What types of institutional outcomes then result from addressing compact conflicts and what do these outcomes imply for the performance of compacts?

Literature Review: The Performance of Interstate River Compacts

The literature on interstate compacts provides relatively weak theoretical or empirical evidence to understand whether and how these agreements address interstate river conflicts. Although a few historic studies from the early 20th century discuss some of the advantages and disadvantages of interstate compacts, most of the scholarship assumes that compacts are an effective mechanism for resolving interstate disputes (Florestano, 1994). The relatively sparse literature on interstate compacts therefore tends to focus on describing how interstate compacts operate or the conditions under which they are likely to be used (Thursby, 1953; Leach and Sugg, 1959; Zimmerman and Wendell, 1961; Weissert and Hill, 1994; Zimmerman, 2002; Bowman, 2004). A small body of literature - coming from legal scholars and economists - has, however, begun to look more critically at the capacity of compacts to manage interstate river basins. These scholars argue that interstate river compacts have become inflexible and rigid, unable to respond to new challenges (Giardot, 1989; Hasday, 1997; Grant, 2003; Muys, 2004; Sherk, 2005). Most western river compacts were devised 30 to 80 years ago, with incorrect or outdated hydro logic data, no sunset provisions for periodic revision (Hasday, 1997) and with strict allocation rules that create incentives for non-compliance (Bennett and Howe, 1998).

While critics of compacts point to a couple lengthy Supreme Court cases as evidence of likely compact failures, no one has examined whether compacts address conflicts or new demands they face. Given the limited empirical evidence and theory building to support the critics' claims, we look to institutional and collective choice theories to provide more guidance on whether and how compacts are likely to perform. We first discuss the underlying institutional features that are likely to impede the performance of compacts in addressing disputes and what those features imply for the types of conflicts compacts may or may not address. Second, we examine the alternative institutional venues identified in the literature that compact states may use to address conflicts and the range of conflict resolution outcomes expected from those venues.

The Limitations of Compact for Resolving Conflicts

Most compacts not only allocate water among states but also create governments to administer, monitor, and enforce the water allocation agreement. In that sense compacts are also constitutions - a contract that is voluntarily entered into among parties, which supersedes prior law, and from which parties cannot unilaterally withdraw (Florestano, 1994). The constitutions define a collective choice body, the number of state representatives to the body, its powers and authorities, and its decision rules. Compacts create institutional ties among semi-autonomous governments, allowing them to engage in coordinated action around a common resource. For states to engage in coordinated action in the context of a compact, however, they must first agree upon a particular course of action. Institutional theorists suggest that unanimity voting, which is used by most compact governments or commissions, constrains their ability to adapt to new problems. A unanimity rule provides each participant in a collective choice process with a veto over decisions, allowing each actor to protect its interests and avoid exploitation by a majority

(Buchanan and Tullock, 1962). Although a unanimity rule affords considerable protection to participants, it does so at the price of very high decision making costs.

Game theorists, therefore, treat compacts as "joint decision traps" because of the use of unanimity decision rules that allow a single member to veto any action (Scharpf, 1997). As more decision-makers in an institutional setting have veto power, the more difficult it is to change the status quo (Tsebelis, 2002). In other words, members of an interstate compact are unlikely to resolve a crisis if a mutually agreed upon solution cannot be devised. As Scharpf (1997:145) explains in relation to unanimity rules,

In multilateral negotiations, rational self-interested actors would begin by proposing solutions favoring their own interests, and any communication among them would also be suspected of being self-serving and disingenuous. To work out a mutually acceptable solution under these conditions would be extremely difficult indeed.

The challenge that unanimity imposes on compact governments also has been acknowledged by the critics of river compacts. As Muys (2004:10-11), a long time observer of and participant in attempting to resolve interstate water conflicts, argues:

"Many western compacts require unanimity for official action interpreting or implementing compact provisions, thus conferring a veto power in a single state which can preclude its compact partners from administrative enforcement of asserted compact rights and obligations. This situation gives leverage to an upstream state alleged to be in violation of a compact to "stonewall" discussions and negotiations in the commission forum, since by virtue of its geographical advantage (i. e., "highority is better than priority") it may have already stored or used the volumes in dispute.

In suggesting that upstream states can stonewall discussions among compact governments,

Muy's implies that compact forums will have difficulty addressing particular types of issues.

Namely, distributional issues are likely to hinder consensus because states will not relinquish existing rights or resources. Distributional issues, indeed, are commonly seen as a hindrance to

distributional dilemmas include asymmetric power claims - for instance where upstream states have control over the flows or storage of resources needed from a downstream state— those powerful states have little incentive to work toward resolving their differences (Weissert and Hill, 1994).

A second factor that inhibits the ability of compact governments to resolve their differences stems from the federalist structure in which these agreements are embedded. In a federal system, cooperation is founded on the assumption that autonomous governments will cede some of their authority to a federal government or, in the case of compacts, to a regional government. In reality, conflicts in a federal system persist because "states do not cede all their sovereignty" (Skalaban, 1993, p. 416). With interstate river compacts, not only must states agree to work together, they must also ensure that their citizens who use the water allocated under the interstate compact do not hinder the state's capacity to comply with the compact. While compacts are the "most binding legal agreement possible between two or more consenting states" (Weissert and Hill, 1994, p.28), interstate river compacts do not devise rules and regulations that directly and immediately govern the citizens of member states. Yet in a federal system, addressing problems whose scope overlaps with multiple semi-autonomous governments requires the participation of those overlapping governments *and* the citizens they represent (Elazar 1987).

Arguably states have the legal and institutional capacity to pass laws and regulations in order to ensure that their citizens do not use water in a way that conflicts with compact rules. However, they may not always have the incentives to do so. As Derthick (1974) points out in a study of regional governments, compacts are superimposed on existing, autonomous governments. They are formed in order to restrict, even if to a limited degree, the autonomy of

those governments so that collective benefits may be realized. Thus, Derthick suggests that compacts may not be warmly embraced by state agencies whose functions they challenge; compacts can force state elected officials into difficult positions, such as shutting down their own citizens' well-established water uses in order to serve the citizens of a nearby state. As a result, Derthick (1974:192) argues, "Regional action proceeds within a narrow sphere or at a slow pace".

What is that narrow sphere within which compacts will perform? As suggested earlier, because states have veto powers, compacts may fail to address deeply divisive conflicts such as distributional conflicts involving clear winners and losers, or conflicts that pit downstream users against upstream users. Furthermore, given the reluctance of states to yield autonomy to compact governments, conflicts that entail differences between compact requirements and state laws would not likely be addressed by compact governments. Similarly, compact governments may be challenged by the extent to which the parties extend beyond the compact jurisdiction. Conflicts surrounding interstate water issues may not simply be confined to state-level issues. Municipal, agricultural and industrial water users and environmental groups, for instance, may play a key role in a given water dispute. Conflicts that implicate the citizens of member governments may

In addition to the problems compacts face around distributional issues or the incompatibility between compacts and states (or their citizens), the literature also indicates that the narrow sphere of compact capacity is likely to prevent them from addressing complex disputes. Those disputes that involve multiple underlying problems or challenges increase the chances that the interests of the member states will diverge, "making individual action preferable to cooperation" (Weissert and Hill, 1994, p. 30). To some degree, this limitation can be traced to

the permanency of compacts, which prevent compacts from handling problems broad in scope (Hasday, 1997).

Alternatives for Addressing Compact Conflicts

The limitations of compacts discussed above suggest that compact commissions will be adept at resolving simple non-distributional disputes. What is not clear is how these issues will get resolved with the high decision making costs associated with unanimity rules. When compact commissions do resolve disputes we might expect them either to maintain the status quo or devise strategy changes that fit within the overarching administrative structure already established under the compact. Alternatively, some mechanisms for addressing conflicts may, in fact, allow compacts to fundamentally change how they operate without constitutional level rule change. As Besso (2005, p. 84) has noted "informal political constructions of our constitutions is a feature of both our federal and state constitutionalisms." That is, constitutional agreements, e.g., compacts, can evolve through administrative and legislative rules and modifications. Ostrom (2005) uses the concept of levels of action to clarify this point. Operational level rules structure day to day interactions, such as authorizing an irrigator to divert a specific amount of water. Collective choice rules structure the collective choice processes used to devise, monitor, and enforce operational level rules. A compact commission may adopt collective choice rules that create the position of monitor and authorizes that person to administer the water allocation rules of the compact. Ostrom (2005) suggests that all things being equal, it is less costly to change operational level rules than collective choice rules. Thus, in the case of compacts, operational level rule changes, and, perhaps collective choice rule changes, may be viable options to reshape how compacts are governed without going through the process of formally changing the compact.

If compact parties cannot come to mutually agreeable solutions on their own, however, other alternatives are also available. Scharpf (1997:145) suggests one means of reducing the high decision making costs of a unanimity rule is through the use of "an agenda setter that defines the propositions that will be voted upon". An agenda setter, who has no stake in the conflict, may be able to help the participants discover a jointly acceptable solution. The value of a third-party intermediary is also widely recognized in the international conflict resolution literature (Frazier and Dixon, 2006), with recent research pointing to the importance of third parties that have binding authority over the outcome (Mitchell and Hensel, 2007). In the context of compacts, the third party or agenda setter may take a variety of forms, from a federally appointed chair of a compact commission, who has no voting power, to an arbitrator, to a court, to a special water master appointed by the Supreme Court (Giardot, 1989). These venues may provide another means of not only settling disputes but changing the rules of the game for compacts, again, without going through the process of amendment. Arguably, in the U.S. federal context, the third party most likely to have binding authority over compact governments will be the Supreme Court.

As much of the legal scholarship on compacts indicates, binding third-party conflict resolution through the Supreme Court has, in fact, been an important venue for compacts to resolve conflicts (Dirk, 1978; Haller, 1981; Robbins and Montgomery, 2001; Gold, 2002; Grant, 2003). However, little empirical evidence is available to show the extent to which parties involved in compact related disputes use courts compared to other third party forums or conflict resolution mechanisms provided by compacts. Nor has the literature discussed whether the outcomes of different conflict resolution forums are markedly different from one another. Over a decade ago, Zimmerman (1994) argued that there is "a considerable body of literature dealing

with the decisions of the U.S. Supreme Court settling interstate disputes, but few in-depth studies of the politics of settling such disputes so as to obviate the need for a state to bring an original jurisdiction action in the U.S. Supreme Court" (p. 10). As of yet, no quantitative or comparative analysis of compact conflicts exists to better understand when and how interstate conflicts are resolved. We attempt to fill this gap by analyzing how interstate river compacts in the western U.S. have addressed water conflicts since their inception.

Data and Methods

The data for our analysis comes from a study of 14 interstate compacts in the western United States and water conflicts that have arisen in the basins governed by these compacts (see Table 1). We focus on western compacts to help control the variability in the legal and physical setting that can drive conflicts.² In addition, as we are interested in compacts that serve as self-governing constitutional arrangements, we only include the 14 compacts where states are the primary actors in the compact - as opposed to the federal government. In this study we have collected and coded data on the rules governing each of the compacts, the organization and structure of the collective choice arrangements that administer the compacts (typically commissions), and the operational decisions and actions of the compact administration. We have also identified and coded data on the conflicts in each compact basin (since the inception of each compact) between states or other parties over compact interpretation, compliance or enforcement - 28 in total.³ Table 1 below provides an overview of the compacts and number of conflicts.

² As the western United States is relatively arid, the legal institutions that have emerged to allocate water in the West are markedly different from the East. Western states allocate water using the doctrine of prior appropriation -- meaning those citizens who put water to beneficial use first have the priority to use flows during times of scarcity.

³ We have defined a conflict as any dispute or disagreement by two or more parties over the allocation, distribution or scarcity of water resources; water quality; protection of endangered species and habitat within the river basin's boundaries that are governed under an interstate compact. We identified a total of 198 conflicts in this study, the majority of which are not related to the interstate compact. Data sources for identifying conflicts come from news

(See Appendix A for a more detailed discussion of the different governing capacities and administrative mechanisms these compacts include.)

Table 1. Overview of Interstate River Compacts and Conflicts Studied

Compact	Year Signed	Member States	Number of compact-related conflicts
Arkansas	1949	Colorado, Kansas	5
Bear	1955, 1980	Idaho, Utah, Wyoming	7
<i>Belle Fourche*</i>	1943	<i>South Dakota, Wyoming</i>	0
Big Blue	1971	Kansas, Nebraska	0
Costilla Creek	1944, 1963	Colorado, New Mexico	1
Klamath (Upper)	1956	California, Oregon	5
La-Plata*	1922	Colorado, New Mexico	1
Pecos	1949	New Mexico, Texas	1
Republican	1943	Colorado, Kansas, Nebraska	1
Rio Grande	1938	Colorado, New Mexico, Texas	3
Snake (Upper)	1949	Idaho, Utah, Wyoming	1
<i>South Platte*</i>	1923	<i>Colorado, Nebraska</i>	0
<i>Upper Niobrara*</i>	1962	<i>Nebraska, Wyoming</i>	0
Yellowstone	1950	Montana, Wyoming (North Dakota, non-voting)	3

* Denotes where member states do not actively meet or administer the compact.

To assess our research questions and the propositions gleaned from the literature, we focus on the 28 compact related conflicts we identified in our dataset. The first component of our analysis looks at the types of conflict configurations that are associated with compact commissions resolving a conflict. The key explanatory conditions for this portion of the analysis are drawn from our coding of the actors involved in each conflict and the issues underlying the conflict. We include a dichotomous variable that identifies whether the parties to

these sources are retrieved from various databases - such Lexis Nexis, ProQuest, and WorldCat. Historic news stories that are not available in online database searches were retrieved using newspaper indexes from local newspapers in each basin (where available) and from online newspaper archives such as Smalltownpaper.com, etc. Because conflicts can evolve and change substantially over time, we coded conflict "events", separating out related conflicts from one another based on a three questions: 1) did actors change? Or 2) did the issue change? Or 3) did a

each conflict are interstate (1) or involve intra-state actors only (0). We also have coded dichotomously whether conflicts involve a) distributional issues, b) upstream-downstream issues, and c) compatibility issues between state laws and compacts. To code the complexity of the dilemmas underlying the conflict, we created an index of "complexity" based on the underlying types of appropriation and provision dilemmas shaping the conflict. (Please refer to Appendix B for a detailed description of the coding for this index.)⁴

To analyze this data we rely on a methodological approach known as Fuzzy Set Qualitative Comparative Analysis (fs-QCA) developed by Charles Ragin (1987, 2000). Fs-QCA relies on Boolean algebra to assess the combinations of necessary and sufficient conditions that are related to the outcome of interest - thus drawing upon fundamental components of case-study research (Ragin 1987, 2000). Yet, unlike case-study research, this approach is particularly useful for handling medium-N data sets ($n \approx 10-65$), and those with a large number of potentially relevant, and often highly correlated, causal conditions. It should be emphasized that fs/QCA does not mimic variable based statistics, which examine the effect of each explanatory variable on the dependent variable, holding the values of independent variables constant. In contrast, fs/QCA emphasizes the "set relations" among social phenomena, which as Ragin (forthcoming) notes are the building blocks of most social science theories.⁵ In other words, it allows us to empirically evaluate the theoretical assertions that highly complex conflicts or distributional conflicts are not part of the set of conflicts addressed by commissions. Additionally, with the fs/QCA approach, the analysis typically moves between the Boolean approach and an in-depth

⁴ All of the coding decisions for these variables were interpreted by coders after detailed analyses of the supporting documents for each case and where questions of interpretation arose, cases were reviewed independently by two coders to ensure inter-coder reliability.

⁵ (For more in-depth information on the fs-QCA method and software see

examination of key cases in order to ground the findings. Consequently, we will incorporate discussions of specific cases to illustrate how the fs/QCA results play out in practice.

Using the fs/QCA technique, variables are coded on a scale of 0 to 1, as being "fully out" (0) of the variable set of interest or "fully in" (1). The fs-QCA method then constructs a "truth table" that contains all of the theoretically possible combinations of conditions that relate to the model's outcome. Each row of the truth table shows the number of actual cases in the data that match each possible combination of conditions. After minimization, the fs-QCA analysis derives a solution for the minimal conditions that are sufficient to lead to the outcome of interest. The model solution uses Boolean algebra notation (where "*" equals "AND", "+" equals "OR") to depict the combination of conditions that are sufficient for the given outcome. The presence of conditions is shown in all upper case letters, whereas the absence of conditions is shown in lower cases.

Findings

What Types of Conflicts Do Compacts Address?

The fs-QCA allows us first to examine the frequency of different configurations of conflict conditions that compact commissions have resolved (see Table 4). The explanatory variables for this portion of the analysis includes those previously described: 1) whether the parties involved are interstate ("interst"), 2) whether the conflict involves distributional issues ("distribut", 3) whether the conflict pits downstream users against upstream users (updown), 4) whether the conflict involves issues of cross-scale compatibility ("compat") between compact rules and state laws, and 5) the complexity of the underlying conflict issues ("complex").

As Table 4 reveals, compact commissions have addressed four types of conflict configurations. All four types include interstate parties, lending support to the proponents of

compacts who argue that compact commissions will typically address conflicts among interstate parties. Furthermore, six of the eight conflicts consist of configurations of conditions that involve not only interstate parties, but also distributional issues (row 1), or distributional issues and upstream/downstream issues (row 2), or compatibility issues (row three). These findings contradict the critics of compacts who suggest that compacts are incapable of addressing these conflict types. Compact commissions address conflicts many of which consist of a combination of conditions believed to make them particularly difficult to resolve.

Table 4. Conflict Configurations Addressed by Compact Commissions (n=8)

INTERST	DISTRIBUTUT	COMPAT	UPDOWN	COMPLEXITY	frequency
1	1	0	0	0	3
1	1	0	1	0	2
1	0	1	0	0	1
1	0	0	0	0	2

1=condition is present in case, 0=condition is absent in the case

Are there particular conflict configurations that only commissions and no other type of venue resolve? To answer this question, we run the Boolean minimization process through the fs/QCA analysis to derive a solution that represents the sufficient (and possibly necessary) conditions resulting in compacts addressing conflicts. The model for this is:

Model 1:

$$\text{COMPACTAD} = \text{INTERST} + \text{DISTRIBUTUT} + \text{UPDOWN} + \text{COMPAT} + \text{COMPLEX}$$

For this model, there are 2^k (2^5) or 32 logical (or potential) combinations of conditions. In this data set 13 of the 32 logical combinations are present. Analyzing the 13 combinations for sufficiency produces the following solution:

solution coverage	solution consistency
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This solution may be interpreted as conflict configurations consisting of interstate parties and no distributional issues and no compatibility issues and no upstream/downstream issues are sufficient for compact commissions to address them. That is, every instance of a conflict characterized by this particular combination of factors is addressed by a compact commission. No other type of venue addressed this combination of factors. Notice that this combination contains two cases (or 25 percent of all of the cases addressed by compact commissions).

The two cases that present this combination of conditions appear in the solution's "coverage" score. The fsQCA method relies on two measures to assess the robustness of the solution - consistency and coverage. Coverage establishes the empirical relevance of the solution by measuring how much of the outcome is explained by the causal conditions. ⁶ Consistency is a measure of how frequently the solution's causal conditions are a subset of the outcome - or how often the combination of conditions in the solution agrees on the outcome (in this case, they agree 100%).

Each of these cases involved conflict spurred by organizations who were not parties to the compacts but whose actions were perceived as threatening the compacts' water allocation rules. The proposed actions promoted disagreement and intense, sometimes heated, discussions among compact representatives who eventually agreed upon a common response to the perceived threat. For instance, one case involved an Army Corps of Engineers proposal to build a reservoir on the Purgatoire River above Trinidad, Colorado, for flood control purposes. The Purgatoire is a major tributary of the Arkansas River. Representatives on the Arkansas River Compact commission from both Colorado and Kansas expressed grave concern that the project would

⁶ The fs-QCA method can derive three different types of solutions: 1) the most parsimonious, 2) the most complex, and 3) the intermediate solution. The solution coverage score provides a way to compare which of the three different solutions explains the largest proportion of the causal outcome. For this model, we used the more complex

reduce river flows. The Kansas representatives opposed the project, the Colorado representatives split, and the federal representative, who was the nonvoting chair of the commission, supported the project. In a straw vote, the Colorado representatives decided to accede to the concerns of those who opposed the project and the commission unanimously voted against the project over the strenuous objections of the chair. The commission agreed to reconsider its original vote, at the urging of the chair, and after several meetings over the course of a year developed a compromise solution that allowed the commission to vote in favor of the project.

Even though the solution for Model 1 (where interstate parties, no distributional issues, no compatibility issues, and no upstream/downstream issues exist) is sufficient for the outcome, the coverage is relatively small. That is, there is a single configuration of conflict conditions that contains two cases. As Table 4 exhibits, compact commissions have addressed a variety of types of conflicts, but what Model 1 tells us is that so too have other venues. Only the conflict configuration of the last row is addressed by compact commissions and no other type of venue.

The conflict configurations in the other rows are addressed by compact commissions and other types of venues. For instance, the most common type of conflict configuration addressed by compact commissions is a conflict characterized by interstate parties and distributional issues, but no compatibility, upstream/downstream or complexity issues. Compact commissions have addressed three such conflicts (see the first row of Table 4). Two of the three emerged in the Bear River Basin. In negotiating the Bear Compact, states disagreed over an additional allocation of water to Wyoming irrigators along a tributary of the Bear River. Eventually, the commission negotiated the compact and then later, after a renegotiation of the same compact, the commission allocated water among downstream users. In the third case, the Arkansas River Compact commission struggled with devising a process for storing and allocating flood waters captured in

the John Martin Reservoir among Colorado and Kansas irrigators, the primary reservoir controlled by the compact commission. The commission representatives argued over a variety of methods for storing and allocating flood water over a period of years before finally adopting a particular operational approach that settled the conflict.

Thus far the evidence concerning the ability of compact commissions to address conflicts is mixed. In support of the claims of compact advocates, compacts address conflicts and those conflicts are characterized by interstate parties (see Table 4); however, in support of the critics of compacts, the type of conflict that only commissions and no other venues address are conflicts that do not entail distributional issues, compatibility issues, and upstream/downstream issues.

Conflicts Addressed by Other Venues

Additional evidence to be considered is the conflicts addressed by venues other than compact commissions. Are there conflict configurations that only non-compact venues address - or that compacts *do not* address? Similar to our analysis above, we begin with a table of the frequencies of conflict configurations addressed by venues other than compacts (see Table 5).

Table 5. Non-compact venue addressed conflict configurations

INTERST	DISTRB	COMPAT	UPDOWN	COMPLEX	frequency
0	1	1	0	0	1
0	1	0	0	0	4
0	1	0	0	1	1
0	1	0	1	0	1
0	0	1	0	0	2
1	1	0	0	0	2
1	1	0	0	1	1
1	1	0	1	0	2
1	0	1	0	0	1
1	0	0	1	0	2
1	0	0	1	1	1
1	0	1	1	0	1
1	0	1	1	1	1

1=condition is present in case, 0=condition is absent in the case

Non-compact venues address 20 conflicts consisting of 14 different conflict configurations. Non-compact venues address more and diverse configurations of conflicts than do compact commissions. One configuration appears in four cases, the remaining configurations appear in one or two cases. No single configuration dominates. In such circumstances, running Model 1 will likely produce many sufficient configurations of conflicts. It is possible to reduce the many configurations by identifying the minimal configurations that are sufficient for an outcome. Thus, running Model 1 again, but looking for the minimized solution of conditions that are associated with conflicts that are not addressed by compacts (-COMPAD) produces the following results:

Model 1a:

$$-COMPAD = INTEREST + DISTRB + COMPAT + UPDOWN + COMPLEX$$

	raw coverage -----	unique coverage -----	consistency -----
interest+	0.45	0.45	1.00
distrb*UPDOWN	0.25	0.25	1.00
solution coverage: 0.70			
solution consistency: 1.00			

There are two sufficient causal pathways to non-compact venues addressing conflicts. A sufficient condition for non-compact venues to address conflicts is for the conflicts to involve intra-state parties (or no interstate parties). The nine conflicts without interstate parties were addressed by non-compact venues, accounting for 45% of the 20 conflicts.⁷ This provides some parallel support to Model 1 - compact commissions address conflicts among interstate parties but not necessarily among intra-state parties. A second sufficient conflict configuration is conflicts that do not involve distributional issues but do involve upstream/downstream issues.

⁷ A careful consideration of Table 5 reveals that of the 9 conflicts involving intra-state parties, there are five distinct conflict configurations (the top five rows). All five distinct conflict configurations are sufficient for non-compact

These conflicts appear in the last 3 rows of Table 5. All involve interstate parties, and four of the five cases entail downstream states claiming violations of the compacts by upstream states. The fifth case involves a downstream environmental group claiming water quality violations by upstream water users. The configuration of interstate parties engaged in conflicts involving upstream/downstream issues and no distributional issues provides some evidence to support the conclusions drawn from some of the critics - that is compact commissions, because of unanimity rules, cannot readily address upstream/downstream conflicts. Yet venues other than compact commissions only address upstream-downstream conflicts in the absence of distributional concerns.

Examining the configurations of conflicts addressed by compact commissions compared to those addressed by other venues offers mixed results,. Compact commissions address interstate conflicts and those conflicts are characterized by combinations of distributional, upstream/downstream, and compatibility issues, just as supporters of compacts would expect. However, the only conflict configuration that is addressed by commissions and no other type of venue is a configuration devoid of difficult issues, just as critics of compacts would expect. Furthermore, there appears to be a particular configuration of conflicts that venues other than compact commissions resolve - those involving downstream states claiming compact violations by upstream states, just as critics of compacts would expect.

Conflict Solutions Across Venues

The second component of our analysis of compact performance considers conflict outcomes -- or the ways in which the compact related conflicts were addressed. We examine this data in order to shed light on the findings from the previous section. To assess these conflict outcomes, we compare the outcomes of all 28 conflicts, looking at the role of different venues ~

compacts, legislatures, agencies, and courts in producing different conflict resolution outcomes.

In addition, we return to key cases to examine specific instances of venues and outcomes.

As noted earlier, the literature on compacts and decision making is somewhat thin, centering on unanimity rules and high decision making costs. In general, theory suggests that compact commissions will adopt conflict solutions that require lower decision making costs. Following the work of Ostrom (2005) we expect solutions adopted by compact commissions to cluster among strategies and operational rule changes. For instance, a compact commission may experiment with different strategies for storing flood waters in a reservoir without changing the reservoir's operating rules. In light of such experimentation, the commission may choose to revise operational level rules for the reservoir. We expect fewer collective choice or constitutional choice rule changes as solutions for conflicts. For instance, a commission may adopt collective choice rules that create a position of water master with the authority to implement the water allocation rules instituted by the compact.

Table 7 arrays venues by conflict solutions. Final decisions are largely made by compact commissions and courts. Of the 28 resolved conflicts, commissions adopted final decisions among 8 of them and courts among 15 of them. The remaining 5 conflicts were resolved by federal/state agencies and legislatures. ⁸ As expected, the overwhelming majority of solutions involve operational rule changes, strategy changes, or the maintenance of the status quo. Only 8, or 29% of the solutions entailed changes in collective choice or constitutional choice rules.

⁸ The status quo case involved the Bureau of Reclamation withdrawing a plan to develop the Bear River basin after a storm of protest from a wide variety of water users, thereby maintaining the status quo within the Bear River Basin. The two conflicts involving agencies and strategy changes entailed an agency choosing not to move forward with plans to build a reservoir and another agency agreeing to consider species needs in issuing permits. The operational rule change by an agency involved the agency in issuing a permit to create a canal to deliver water during times of shortage. The operational rule change by a state legislature involved the legislature in adopting a

Table 7. Conflict Solutions by Venue

Conflict Outcomes (resolved conflicts, n=28)	Venues of Final Decision (mutually exclusive)			
	Commission	Courts	Federal or State Agency	Legislature
Status Quo	0	7	1	0
Strategy Change	0	1	2	0
Operational Rule Change	6	0	1	1
Collective Choice Rule Change	1	3	0	0
Constitutional Choice Rule Change	1	4	0	0
Total conflicts	8	15	4	1
Percent of Conflict Solutions	29%	53%	14%	4%

Solutions Adopted by Commissions. Compact commissions resolve conflicts by revising the operational rules used to administer the compacts. All six operational rule changes involved revising water allocations or water accounting procedures or both. For instance, the Rio Grande Compact Commission developed a uniform accounting procedure for tracking states' water debits and credits. To that point, each state, Colorado, New Mexico, and Texas, used a different accounting method for tracking debits and credits with states arguing over which method was appropriate. The Bear Compact Commission was particularly active in addressing conflicts through operational rule changes. In two instances the Commission revised allocation rules, granting an apportionment of water to Idaho irrigators and devising special allocation rules for end of the river water users during times of emergency. In a third conflict, the Commission revised methods for tracking water diversions.

A much less likely conflict resolution scenario is for compact commissions to revise collective choice or constitutional choice rules. The single instance of a collective choice rule change occurred with the Arkansas River Compact Commission. The Army Corps of Engineers in cooperation with the Bureau of Reclamation proposed to construct a flood control and storage reservoir above Trinidad, Colorado on the Purgatoire River, the major tributary of the Arkansas River. Kansas and Colorado water users opposed its construction, fearing that once built, it

would be used to store not only flood waters, but river water governed by the Arkansas Compact. Their opposition was overcome when the Compact Commission revised its collective choice rules, granting itself the authority to approve the operating plan for the reservoir. While in practice the Bureau of Reclamation, who would operate the reservoir, did not need the Commission's approval, the Bureau moves forward only with the consent of the states involved. The Arkansas Compact Commission and the states of Colorado and Kansas supported the reservoir's construction, it was built, and the Commission is now an active participant in ensuring the Bureau operates the reservoir according to an agreed upon operations plan.

The single instance of a Commission engaging in constitutional choice rule making involved the Bear Compact Commission. The Bear Compact was adopted and implemented in 1955. Over the course of the next decade and a half, the member states expressed increasing dissatisfaction with the Compact, the water allocations it made, and its failure to address a number of pressing issues, such as the development of large water storage projects. To address the conflicts that flared up over these issues, the commission began negotiating major revisions to the existing compact. After a decade of negotiations, the commission unanimously adopted the revisions, which were then approved by the states' legislatures.

Commissions respond to conflicts by revising the operational rules of compacts. Only on rare occasions do commissions revise their collective choice rules or attempt substantial revisions of a compact. Commissions, charged with administering compact requirements, largely focus their conflict resolution efforts on revising administrative rules.

Solutions Adopted by Courts. The pattern of conflict solutions adopted by courts differs notably from those adopted by commissions, revealing a very different role for courts in resolving

conflicts. Solutions adopted by courts tend to cluster into two groups - status quo outcomes and collective choice/constitutional choice rule changes.

In six of the seven conflicts resulting in status quo outcomes, private parties challenged decisions made by compact commissions or the actions of state or federal water agencies related to compacts. In each case, the deciding court found in favor of the commissions and agencies. In the remaining conflict the lawsuit was dismissed because of the failure to include an indispensable party. The conflicts resulting in status quo outcomes may be thought of as raising "accountability" issues. Private citizens requested independent third party reviews of the actions of public entities, a quintessential role for courts.⁹

Among the seven conflicts that were addressed through collective choice or constitutional choice rule changes five were brought before the U.S. Supreme Court. ¹⁰ The first of these cases to be filed raised the question of the relationship between state water law and the water allocation rules of compacts. A Colorado ditch company sued the Colorado State Water Engineer after he shut down their water diversions in order to meet the La Plata Compact requirements. The Colorado state courts found in favor of the ditch company, arguing state law took precedence over compact requirements. On appeal, the U.S. Supreme Court decided that compacts supercede state law, thus the Colorado State Water Engineer was correct in curtailing water diversions that were otherwise legal under Colorado law in order to meet La Plata River Compact requirements (Hinderlider vs. La Plata River and Cherry Creek Ditch Company [304 U.S. 92 (1938)]).

⁹ In the only court case involving a strategy change, how a federal water agency exercised its discretion in signing water contracts was challenged. The court limited the discretion of the agency, requiring it to conduct an environmental impact statement for its water marketing program.

¹⁰ In the other two conflicts, U.S. District Court decisions settled conflicts surrounding federal reserved rights that are addressed under the Klamath River Compact, establishing guidelines for Oregon courts to use in adjudicating water rights involving Indian tribes.

The other four Supreme Court cases involved downstream states bringing suit against upstream states for failure to meet their compact obligations. In each of the cases, the downstream states repeatedly raised noncompliance issues before the compact commissions for a decade or more, but the upstream states, through their veto power, prevented commissions from taking action. At the root of the noncompliance issues was rapidly expanding and lightly regulated groundwater pumping in each of the upstream states, groundwater pumping that affected surface water flows. In each case the Supreme Court found in favor of the downstream states. In three of the four cases, compacts were revised, and in all four cases, state water laws were revised. These cases illustrate the limitations of the compact form of government and the importance of having access to a court of equity to adapt compacts to changing circumstances.

The three revised compacts were the Pecos, the Republican, and the Arkansas. Revisions centered on creating monitoring and enforcement systems that would allow compact commissions to readily determine compliance and to access mechanisms for correcting noncompliance. In each case this involved the development of a hydrologic model and a means by which upstream states could be brought back into compliance. For instance, the Supreme Court approved the adoption of a hydrologic model developed by Texas, the downstream state, that accurately reflected flows of the Pecos River. In addition, the Court approved the appointment of a river master, an independent third party, to administer the model. If the river master determines that New Mexico, the upstream state, under delivers water to Texas, the master works with New Mexico to ensure the under delivery of water is corrected the following year. If, after the third year, New Mexico continues to under deliver; the river master has the authority to take over the administration of water in the New Mexico portion of the Pecos River Basin. Prior to the creation of monitoring and enforcement mechanisms, the downstream states

in these three compacts did not have the ability to ensure compliance on the part of upstream states.

In all four of these U.S. Supreme Court cases, upstream states adopted new water laws and revised existing water laws that more tightly regulated water use to ensure the states' stayed within their compact water allotments. For instance, Nebraska, one of the upstream states in the Republican River Compact, adopted legislation authorizing the Department of Natural Resources to impose well moratoria and to work with local natural resources districts to develop pumping regulations, subject to the Department's approval. All of the upstream states adopted stricter groundwater regulations in response to the Supreme Court's decisions.

As others have pointed out, Supreme Court cases are often costly drawn out affairs to be avoided if possible (Muys 2004, Model Compact 2006, Grant 2003). As these cases indicate, however, the Supreme Court has an important role to play in relation to interstate river compacts. In each case, the states took advantage of the equity powers of the court to develop agreements, and negotiate critical institutional changes in compact governing structures. Furthermore, Colorado, Nebraska, and New Mexico, have used the cover of the Supreme Court to engage in necessary but politically difficult changes in state groundwater laws.

Several conclusions may be drawn from this evidence concerning the capacity of compact commissions to address conflict. First, just as their creators intended, commissions address a variety of *interstate* conflicts, some quite complex, others relatively simple, but all involve interstate parties. Intrastate conflicts are left for others to resolve. Second, commissions solve conflicts by changing operational level rules for administering compacts. Most of these operational level rule changes involve how water is allocated and accounted for. Third, courts are important partners with commissions in solving conflicts. Courts provide an independent venue

that private citizens may call upon to review the decisions and actions of commissions. Furthermore, they provide a forum for states to resolve deep seated conflicts and to revise collective choice and constitutional choice rules to strengthen the governing capacity of compacts. In particular, the U.S. Supreme Court provides states with the mechanism to hold one another accountable for realizing their compact commitments and for revising and adapting compacts to better fit changing circumstances.

Conclusion

Most interstate river compact commissions use unanimity rules to make collective decisions. Unanimity rules are largely viewed as necessary, states insist on protecting their interests and authority over water, but unwieldy, limiting commissions to addressing only the simplest types of conflicts. In our study of interstate river compacts, unanimity rules do appear to shape the types of conflicts commissions address and the types of solutions they adopt, however, not in ways that critics of compacts expect. First, commissions address a variety of types of conflicts among interstate parties, but they do not address serious compact violations that require states to engage in significant water law revisions. Second, commissions solve conflicts by revising rules; usually operational level rules that change water allocations among water users or that allow more precise accounting of water diversions. These are not minor solutions. The foundation of institutional arrangements for governing water is determining and tracking water allocations.

The limitations of unanimity rules may be addressed through independent third parties, particularly courts that provide venues for states to bargain and negotiate solutions to difficult issues. If those negotiations fail, courts may develop equitable outcomes for the parties, outcomes to which the parties are bound and may enforce against one another.

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Appendix A, Description of Compact Governance

Of the 14 interstate river compacts included in this study, 11 have a formal governing body that meets at least once a year and are thus "actively administered". (Those three that are not actively administered have no conflicts associated with them.) As shown in Table 2, four of these 11 governing bodies consist of each state's top water official, another four consist of each state's top water official plus a non-voting federal representative who presides as chair, with the remaining three consisting of several representatives per state and a federal chairman. Of the eleven compacts that have governing bodies, ten of the eleven meet at least annually, with special meetings called as needed. Six of the eleven have standing technical committees and a seventh appoints such committees as needed.

The authority granted to compact governing structures varies by compact and by type of authority. As also shown in Table 2, all compact decision bodies have the authority to devise rules and regulations to administer the compact. In addition, all compact governing bodies, but for one, have the authority to establish and maintain stream gauging stations to monitor stream flows. The authority to hire employees or acquire real property differs among the compacts. Seven of the eleven governing bodies have the authority to hire employees if they desire and six of the eleven have the authority to acquire and dispose of real property. The authority to adopt regulations that establish enforcement mechanisms or that permits the investigation of members' compliance with compact requirements differs among the compacts as well. Seven of the 11 decision bodies have the authority to adopt enforcement regulations and six of the 11 have the authority to investigate members' compliance with compact rules and requirements (Costilla Creek and Big Blue).

Table 2. Structure of Compact Governments

Compacts	<i>Reps / State</i>	<i>Fed Chair</i>	<i>Votes/ State</i>	<i>Decision Rule</i>	<i>Adm Regs</i>	<i>Enforce Regs</i>	<i>Gaging Stations</i>	<i>Employees</i>	<i>Conflict Res.</i>
Arkansas	3	Y	1	unanimity	Y	Y	Y	Y	Y
Bear	3	Y	3	supermajority	Y	Y	Y	Y	N
Big Blue	2	Y	1	unanimity	Y	Y	Y	Y	N
Costilla	1	N	1	unanimity	Y	Y	Y	Y	N
Klamath	1	Y	1	unanimity	Y	Y	silent	Y	Y
La Plata	1	N	1	unanimity	Y	silent	Y	silent	N
Pecos	1	Y	1	unanimity	Y	silent	Y	Y	N
Republican	1	N	1	unanimity	Y	silent	Y	silent	N
Rio Grande	1	Y	1	unanimity	Y	silent	Y	Y	N
Snake	1	N	1	unanimity	Y	Y	Y	silent	Y
Yellowstone	1	Y	1	unanimity	Y	Y	Y	silent	Y

These 11 compacts also possess a range of resources and engage in diverse administrative activities. Most compact governments possess budgets (seven of the eleven), although typically compact governments devise budgets and then submit requests to member states' legislatures for funding. (See Table 3.) Thus far, state legislatures have met the budget requests of their compacts. Given the purpose of the compacts, to allocate water among states, the compact governments all have some form of water monitoring program in place. All measure water flows using a series of stream gages. In fact, the largest portion of each compact's budget is devoted to operating and maintaining stream gages. Most compacts (seven of eleven) have also invested in more extensive datasets and models to track stream flows, reservoir releases, and water use. While compacts allocate water, it is up to each of the states to allocate their compact share within their state boundaries. Thus, there is little need for more detailed within state water use and allocation data.

Table 3. Resources and Activities of Compact Governments

Compacts	<i>Annual Meetings</i>	<i>Technical Committees</i>	<i>Staff</i>	<i>Budget</i>	<i>Investigate Issues</i>	<i>Hydro Databases</i>	<i>Measure Flows</i>	<i>Measure SW or SW or</i>
Arkansas	1+ special	Y	Operations secretary	Y	Y	Y	Y	Y.
Bear	2+	Y	Engineer	Y	Y	Y	Y	Y

Big Blue	1+ special	Y	Secretary-	Y	y	Y	Y	Y
Costilla	1	N	Water Master	Y	Y	Y	Y	Y
Klamath	1+ special	N	Exec Dir	Y	Y	Y	silent	Y
La Plata	As needed	N	N	N	Y	silent	Y	silent
Pecos	1 +special	Y	Secretary Treasurer	Y	Y	silent	Y	Y
Republican	1	Y	N	N	Y	silent	y	silent
Rio Grande	1+ special	Y	Secretary	Y	Y	silent	Y	Y
Snake	2	N	N	N	Y	Y	Y	silent
Yellowstone	1	As needed	Secretary		Y	y	Y	silent

Appendix B: Fuzzy-Set Variable Descriptions

1. "Complexity" Coding Scheme

To code the complexity variable, we developed a scale based on the categories of common-pool resource dilemmas that underlie each conflict. As discussed in Ostrom, Gardner, and Walker, (1994), common pool resource users are likely to confront two broad categories of dilemmas - 1) appropriation and 2) provision. Appropriation dilemmas result when demand for resource flows exceeds the supply of those flows (question A7a on our conflicts coding form). These dilemmas can be confounded by problems of technological or assignment externalities. In coding the issues underlying our river basin conflicts, we categorized conflicts that involve competition among different types of resource users as implicating these assignment or technological externalities (Question A7b). We would expect that those conflicts that include both standard appropriation issues and externalities from competing users to be more complex than either of these issues alone.

Common pool resource can also face "provision dilemmas", which are those challenges

users have for sustaining that stock. Provision dilemmas can be broken down into supply-side and demand-side issues. Supply side issues result when maintenance of a common pool resource is required and common pool resource users face incentives to free-ride off investments made in that maintenance (Ostrom, Gardner, and Walker, 1994). This creates a public goods problem for shared resource users. For our river basin conflicts, we categorize those conflicts where the issues are about either a) enhancing or restoring the basin (question A7e), or b) storing the resource to meet needs at different points in time (A7c) as supply-side provision dilemmas. Demand-side provision dilemmas are tied to the impairment or loss of productive capacity that can result from resource use. For water resource conflicts, our coding characterizes conflicts involving impaired water quality as demand-side provision dilemmas (question A7d).

To develop the scale of complexity, we recognize that these categories of common-pool resource dilemmas often occur together (but not always). Those conflicts involving both appropriation and provision dilemmas will be more complex than those involving either appropriation or provision alone. In addition, we recognize that some conflicts involve questions over the information about the resource or uncertainty over whether a an appropriation or provision dilemma even exists, so we included an "uncertainty" variable (A7g), where we assume the complexity will be lower than appropriation or provision issues. However, where this uncertainty is combined with other appropriation or provision issues, complexity will be higher. The various combinations of CPR dilemmas used for calculating the complexity scale are presented in the table below. Obviously, these are not the only relevant problems that may drive a conflict. For example, we have information on whether conflicting rules or distributional issues underlie a conflict, which we have coded separately due to their theoretical importance for our study of interstate compacts. We choose to derive the complexity measure based on these

appropriation and provision dilemmas alone because these concepts are fundamental to any common-pool resource issue and their relevance and relationships have been analyzed in other studies. We therefore expect that this scale might also be applicable for other common-pool resource settings.

Complexity Scale	QCA code	Categories
Most Complex	1	Appropriation with Assignment/Tech externalities and at least one type of Provision; OR appropriation without assignment and at least two types of provision; OR Assignment/Tech externalities with at least two types of provision
High complexity	0.83	Appropriation without Assignment/Tech and one type of Provision + information; OR Appropriation with Assignment (no Provision) + information; OR Assignment and one type of provision + information; OR at least two types of provision + information
More complex than less	0.67	Appropriation without Assignment and one type of Provision (no info); OR Appropriation with Assignment (no Provision, no info); OR Assignment with one type of provision (no info); OR at least two types of provision (no info)
Moderate complexity	0.5	Demand side or Supply side provision + info (no Appropriation or Assignment); OR Only Appropriation + info; OR Assignment + info (no Provision)
Less complex than more	0.33	Demand side or Supply side provision without Appropriation or Assignment; OR Only Appropriation; OR only Assignment/Tech
Not so complex	0.17	No Appropriation, or Provision; Info issues that may become app/prov
Low complexity	0	No appropriation or provision issues; no info issues