

## Seeing Polycentrically

### *Examining Governance Situations Using a Polycentricity Lens*

William A. Blomquist and Nadine Jenny Shirin Schröder

#### 2.1 Introduction

Stephan, Marshall, and McGinnis observed: ‘Polanyi focused on polycentricity as a form of emergent order, in the sense that a complex system of component parts may exhibit regularized patterns which are only apparent if one looks at the system as a whole.’ This chapter deals with identifying regularized patterns in complex governance situations and, more specifically, with what it means to examine those situations by thinking about them as potentially polycentric. We call this approach ‘seeing polycentrically’.

A multitude of governance types qualify as polycentric. In this chapter we consider polycentricity as a particular lens through which to view governance arrangements. Given the ubiquity of governance arrangements involving multiple semi-autonomous but functionally interdependent actors, we believe it to be important to consider how thinking polycentrically might help in understanding and evaluating how they interact and perform.

The chapter proceeds as an inquiry. There is no classic or ideal type of polycentric governance, and polycentric order generally emerges rather than being planned using an a priori design. The analysis of how and in what ways a particular governance situation is polycentric, therefore should not be conducted deductively by starting with a model of a polycentric governance system and then determining how closely the situation under scrutiny fits the model. To some extent, developing an understanding of emergent situations needs to be emergent also.

An inquiry-based approach can be conducted as a kind of diagnostic assessment, guided by questions that draw out information that can be

used to develop an overall depiction of the situation.<sup>1</sup> The results from such an inquiry may also be useful in analysing the governance arrangements and contemplating modifications to them, as discussed in Chapter 11. The definitions and dimensions of polycentric governance presented in Chapter 1 can aid in identifying and organizing the inquiry one would undertake.<sup>2</sup>

In what follows, we imagine that one has come across a complex situation involving multiple centres of decision making, and then works through an inquiry process by which one might determine the extent to which that situation resembles polycentric governance. More directly, we would say that upon encountering any multi-organizational governance structure, an analyst needs to consider whether it is a polycentric governance arrangement or a fragmented and uncoordinated, polycentric mess.<sup>3</sup> We present and discuss a sequence of questions that an observer can ask before reaching conclusions about the nature, operation, and effects of complex governing arrangements. The order of the topics and the sequence of questions have been considered carefully and adjusted from time to time during the drafting of this chapter, and we recognize that the questions are so interrelated that the answer to one question will entail or pre-empt others. This will not always or necessarily be the case, however, so the questions still need to be identified separately so they can be addressed as needed or relevant. In each of the six following sections of the chapter, the reader will find a set of questions grouped by topic; the questions are listed together at the beginning of each section and then discussed.

## 2.2 Questions about the Centres Themselves

- What centres influence the governed good/service/resource?
- What are their functions?
  - Do larger centres perform functions or provide services that are beneficial for smaller centres, or vice versa?
  - Are some centres primarily provision units and others primarily production units?

<sup>1</sup> For recent examples of inquiry-based approaches to analysing complex governance situations, see Buytaert et al. (2016), Kerber (2017), and Kiparsky et al. (2017).

<sup>2</sup> We are setting aside the topic of research methods, i.e., the means by which an analyst might collect and analyse data on these inquiries.

<sup>3</sup> Of course, these are not the only options and may instead be seen as poles of a spectrum along which actual governance arrangements lie.

- Are functions concentrated in a few centres or widely spread among centres?
- What rationales underlie functional separation and functional integration among centres?
- Do the centres operate at different scales or levels?
- Is there actual duplication among the centres, and to what extent?
  - Are they identical, i.e. doing the same things in the same way?
  - Do centres that do the same things serve differing areas or clienteles?
- Is there overlap?
  - Do centres do some of the same things but not all of the same things?
  - Do centres overlap in affecting the good/service/resource but do very different things?
  - To the extent there is overlap, does there appear to be any rationale for it?
- Is there redundancy in the sense of a default actor in case another centre fails or ceases to act?
  - Where there is actual duplication, does it appear to be entirely needless or does it serve as potentially useful redundancy?
  - Do centres have overlapping authority or responsibilities formally but not necessarily in practice?

One's first impression of polycentricity may be of multiple identical centres. A polycentric structure composed of matching organizations is imaginable, but seems inconsistent with (a) processes of design, spontaneity, and emergence involving (b) intendedly albeit boundedly rational individuals, capable of engaging in (c) multiple levels of action. It is unclear why or how people would create and maintain copies of the same centres, despite being able to adapt them over time or eliminate them, or how and why any spontaneous or emergent processes of organizational creation and adaptation would produce and keep producing identical organizations.

Organizational diversity is a foundational concept for understanding polycentric governance. Instead of presuming or anticipating a set of replicas performing the same functions and operating identically, polycentric governance presumes and anticipates that the centres are differentiated. Empirical studies of polycentric structures, as well as theoretical explorations of why and how such structures would come into existence and persist over time, converge to a common view, namely, that most (and perhaps all) actual polycentric arrangements are comprised of distinct

units operating at different levels and/or performing different functions. Visualizing the polycentric governance of a region, for instance, Elinor Ostrom (2009, 753) wrote:

In a polycentric system, some units are general-purpose governments, whereas others may be highly specialized. Self-organized resource governance systems, in such a system, may be special districts, private associations, or parts of a local government. These can be nested in several levels of general-purpose governments that also provide civil equity, as well as criminal courts.

Governance functions may be distributed among centres, and if so, it can be important to inquire whether there have been reasons for arranging governance responsibilities in this fashion. For instance, one or more centres may be charged with regulating the activities of others, so that centres which provide goods and services are not policing themselves. The literature on local public economies (which are examples of polycentric arrangements) has emphasized the distinction between provision and production functions – provision decisions involving what goods or services to acquire, in what amounts and with what quality, how to pay for them, etc., and production functions being the actual transformation of inputs into the outputs that are those goods or services (Oakerson 1999; United States Advisory Commission on Intergovernmental Relations 1987). This distinction may help an analyst to begin to sort through the centres that are present in a complex situation to see whether some of them are provision units and others are production units.

Centres performing production functions may have different requirements and constraints. Roe and Schulman (2008) introduced the concept of ‘high reliability organizations’, meaning those that produce goods or services for which even slight deviations or errors may have disastrous consequences. This idea may help an analyst to make sense of the differentiation of functions across centres even when, at first glance, they are production units involved in ‘the same’ good or service or resource. On a given stream or lake, for instance, production of drinking water for public consumption may be an example of a ‘high reliability’ task, where treatment and distribution processes have to be executed the same way every time with minimal to no error, because any slippage could result in a public health epidemic, and any process changes have to be introduced carefully after extensive testing. Alternatively, the operation of facilities that manage stream flows or lake levels may be conducted within acceptable ranges, and might even be experimented with under limited conditions as part of an adaptive management approach. A complex governance

situation within which high-reliability tasks are distributed to one centre and more flexible and adaptive tasks to other centres may make sense if personnel needs, operating procedures, and performance standards differ in important ways from task to task.

It may be, and often is, the case that centres exist and operate at different levels (often referred to as ‘scales’ in the literature, although we follow the distinction of levels and scales used in Chapter 1). This observation does not assume and should not be confused with a claim that polycentric arrangements naturally or inevitably take advantage of scale efficiencies or result in appropriate matching of levels. Mismatches and inefficiencies are possible as well.

There are several ways in which levels and scales may come into play. One way is through the idea of scale of production. Conceptually at least, any good or service can be produced at levels ranging from individual to global. We can readily anticipate and observe that diverse levels of production will come into existence, whether through deliberate choice, trial-and-error adaptation, or sheer happenstance. To the extent that diversity of levels of production translates into the creation of multiple producer organizations, it is one source of polycentricity as organizations take others into account.

Scale of effects is conceptually distinct from scale of production, although as a practical matter they are often connected. Scale of effects involves the question of who benefits from or is otherwise affected by some good or service (compare with the concept of externalities, e.g. Bromley 1989). Scale of production and scale of effects do not have to match. The set of human or other beings who are affected – positively, negatively, or some combination of both – by any good or service may also range from very small to global levels. Impacts may be substantial or attenuated, and indeed, what it means to be ‘affected’ at all by any phenomenon is constructed and contestable. The inclusion of positive or negative externalities adds further complexity to an arrangement in ways that often give rise to felt needs for regulation and/or conflict resolution. As people organize processes and structures for demand articulation, demand aggregation, cost allocation, regulation, and conflict resolution, we can readily anticipate and often observe that those entities will exist at various levels corresponding not only with characteristics of the goods and services in question, but also characteristics of the communities that are perceived to be affected.

Organizationally diverse arrangements may exhibit duplication, overlap and redundancy. This is important to the understanding and analysis of

polycentric arrangements, in ways that go beyond normative judgements. Analysts sometimes use these terms interchangeably, or use one term when one of the others would be more accurate. There are important differences among the three, but our purpose is not to parse the terms. Instead, we are interested in how all three are connected with understanding polycentric governance.

All three terms have had negative connotations and have been used in critiques of multi-organizational settings. Viewed from the perspective of a Weberian ideal type of organization, all three characteristics are problematic and should be targeted for elimination. Rhetorically, just to apply the words duplication, overlap, or redundancy to a situation is to indict it as deficient and inefficient without any need for further inquiry.

Other scholars, however, have discovered some virtues in duplication, overlap and redundancy. Martin Landau's defence of redundancy (1969, 1973) is especially notable in this literature. He emphasized the value of back-up systems in complex structures to reduce their fragility and vulnerability, and his arguments became a building block of later work on robustness and resilience. Also during the 1960s and 1970s, in their studies of water resource management and of public service delivery in metropolitan areas and federal systems, both Vincent and Elinor Ostrom presented theoretical arguments and empirical support for arrangements that others had assailed for duplication and overlap. (Both often cited Landau, also.) They repeatedly connected duplication and overlap with the importance of contestation through the existence of overlapping forums for conflict resolution and the enforcement of rules guarding dissent and diversity (e.g. E. Ostrom 2009, 753). Another important thread of supporting argumentation is seen in the work of public administration scholars such as Peters (2015, 129) who have emphasized the importance of multiple channels of information and communication in complex and multi-organizational structures (see also Buytaert et al. 2016, 3).

One need not take sides among these contesting views in order to incorporate and apply the concepts of duplication, overlap, and redundancy in the effort to understand polycentric governance. Rather, one can recognize that (a) these characteristics are typically present in polycentric arrangements, (b) their presence is a matter of degree, such that there may be greater or lesser amounts of duplication, overlap, and/or redundancy in a particular setting, and (c) whether the duplication, overlap, and redundancy that are present have net positive or negative effects is an empirical question, the answer to which will depend on both the situation and the evaluative criteria the analyst applies.

### 2.3 Questions about the Social Problem Characteristics

- What biophysical characteristics of the problem/good/service/resource affect how the governance arrangement functions?
- Are there multiple possibilities to fulfil the function of the problem/good/service/resource that people are trying to address, and, if so, how does the multiplicity of decision-making centres align with those possibilities?
- How are characteristics of the problem/good/service/resource that people are trying to address multi-functional?
  - Is the problem/ good/ service/ resource used or valued in more than one way?
  - Do the multiple decision centres correspond with these multiple functions/uses/values?
- Are multiple scales of the problem/good/service/resource conceivable, such that it can be governed at smaller or larger scales and by lower or higher levels?
  - Do scale differences of centres appear to correspond in some manner with relevant differences in social problem characteristics?
  - Do scale differences of centres capture scales of production or scales of effects and, if so, in what ways?

The structure and functioning of governance arrangements strongly relates to the characteristics of social problems/goods/services/resources addressed, people's knowledge about those characteristics, and differing perceptions of them. This is an important focus of Chapter 3. The problem characteristics may change over time, and the knowledge and perceptions about them may change even more or faster. It is likely that governance arrangements reflect these processes and exhibit a multiplicity of settings with centres corresponding with different scales, levels, functional alternatives, as well as with the multifunctionality of a problem/good/service/resource. The plurality of possibilities to fulfil a function is a source for the variety of polycentric governance arrangements. For example, the function of producing drinking water may be fulfilled by using local groundwater resources, treating surface waters, transporting bottled water from a distance, etc. Governance arrangements might involve one or several of these possibilities in varying combinations, and one or more centres may come into being to pursue these possibilities separately or in a coordinated manner.

When dealing with complex and differently defined social problems, we should not expect a set of diverse and formally independent yet functionally interdependent centres to be harmonious. As Cash et al. (2006) observed, 'Knowledge is often held, stored, and perceived differently at different levels, resulting from differences across levels about what is perceived as salient, credible, and legitimate knowledge, or what is perceived as the important scale or level of the problem.' They referred to this as 'the plurality challenge'.

Differences in information and interpretations of information can and should generate some exchange, and this exchange is what we call contestation. The term is broader than the simpler 'conflict', and therefore preferable for our purposes here. (Chapter 6 focuses more directly on conflict between centres.) Contestation over differences in information or interpretations can be illuminating and can generate ideas and insights. It can also deteriorate into mere rebuttal, refutation, and rejection. What transpires in actual settings with respect to information and contestation is an empirical question. The variety of information at work in polycentric arrangements, and contestation among centres over its meaning and significance, may lead to positive or negative outcomes or a combination of both. The presence and patterns of information and contestation about the social problem, but also about governing processes are essential characteristics to be examined and assessed in any polycentric arrangement. Recent emphasis on adaptive management and collaborative governance should sharpen scholars' focus on the vital roles of information generation, exchange, and interpretation for understanding polycentric governance.

The goods and services that people produce and enjoy, the natural resources they value and with which they interact, and many other aspects of their environments are multi-functional. Very few if any phenomena of significant interest to us (including human beings) are just one thing or have just one aspect. As Norberg and Cumming (2008, 9) observed:

Each individual component of a complex system may have many properties and many functions; for example, an antelope is simultaneously a grazer, a food source, a disperser of nutrients, and a producer of methane. Any component of a complex system may have properties that are redundant (i.e. that are duplicated by other system components) and others that add diversity to the system.

A watercourse may be regarded and valued as an aesthetic treasure, a conduit for navigation, a source of drinking water, of hydropower, of waste disposal, of spiritual renewal, of recreation, of irrigation, and so on, as well as a habitat for a variety of plants and animals. Furthermore, each of these



uses and their effects may be experienced and governed by different but overlapping groups over different areas.

From a prescriptive perspective, multifunctionality may be the basis of arguments for a single integrated centre to govern and manage the water-course in its entirety and for all uses and all users. Empirical observation has tended to reveal the opposite, however. More commonly, people have established multiple overlapping centres, organized around particular groups or areas and focused on certain functions or values of the resource (Boelens, Zwarteveen, and Roth 2005; Kerr 2007; Lankford and Hepworth 2010). Such arrangements are a principal source of the overlap that occurs in polycentric governance arrangements. Whether they function well or poorly is an open question to be addressed.

The concept of scale, already discussed, has further relevance here to the existence of polycentric arrangements for the governance and management of natural resources. Natural resources tend to be interconnected, nested, and overlapping. At a broad and relatively abstract dimension, ecosystems and habitats illustrate this point. Ecosystems may contain habitats, but a habitat is not necessarily confined within a single ecosystem. Within a habitat we might identify critical zones (e.g. nesting grounds, spawning areas). The contours of those zones may change over time, as do the extent of habitats and ecosystems. We could go on, but the theoretical and analytical significance of this point for understanding polycentric arrangements can be stated directly. Natural resources exist at multiple scales and are impacted by dynamics occurring at and across multiple scales. Whether human beings are trying to exploit, preserve, or recover natural resources – and especially when human beings are trying to perform some combination of these, as is often the case – it is likely that they will organize decision making and action in multiple, overlapping centres along different scales. Inquiring about the connections between the centres in a complex governance situation and the scales and functions of a good or service is an important step in attempting to understand it from the viewpoint of polycentricity.

## **2.4 Questions about Independence and Interdependence among Centres**

- How independent are the centres in their decision making?
  - To what extent and in what ways do they control their own resources (funding, personnel, etc.)?

- What kind of questions may centres autonomously decide on, i.e. what range of discretion do they have?
- To what extent and in what ways are they able to reach their goals on their own?
- What forms do relationships among the centres take?
  - Are there formalized relationships such as contracts between centres, membership of one or more centres in another centre, etc.?
  - Are there informal forms such as interpersonal relationships, overlapping members or constituents, etc.?
  - Are some centres nested within others and, if so, in what ways, and for what apparent reasons?
  - Are some centres in competitive relationships to each other and, if so, in what ways? Does competition generate any useful information or choices and, if so, for whom and in what ways?

A diverse set of units would not necessarily constitute a polycentric structure. If a single authority can create and eliminate each unit, establish every unit's structure and define the scope and processes of its operation, which the units themselves possessed no discretion to change, such an arrangement would be more nearly monocentric than polycentric. In polycentric arrangements, the centres exhibit at least some independence or autonomy. The centres can to a greater or lesser degree adopt and alter their functions and processes. The use of qualifying expressions such as 'at least some' and 'to a greater or lesser degree' is deliberate – independence does not have to be total and usually will not be.

The other side of the coin is the interdependence of decision-making centres – various relationships among centres that constrain their independence. Biophysical characteristics of a problem/good/service/resource may relate centres to each other, but centres are also socially embedded and sometimes institutionally interconnected, generating additional interdependencies. This idea is picked up, for instance, by the literature on cross-scale and cross-level linkages (see Adger, Brown, and Tompkins 2005; Berkes 2006). The conceptions of those linkages range from broad characterizations of 'institutional interplay' among centres to more intentional 'co-management' and concrete 'bridging organizations' that are created to forge and maintain relationships among centres.

As stated in Chapter 1 and elaborated further in Chapter 3, as well as in Chapters 9 and 10, the idea of an 'overarching set of rules' appears in several important definitions of polycentricity. In actual settings, such rules

may be expected to place some limits on what centres can do and in what ways. This may encompass formal and informal rules giving some sort of order between centres (E. Ostrom 1983). However, contesting rules might also create conflicts e.g. through institutional interplay (Young 2002). Some rules may apply to the whole arrangement, others only to parts of it, e.g. rules within a hierarchy. A hierarchical structure may have elements that can be considered as separate decision-making centres if they exhibit at least some independence in decision making from the higher level.

Relationships between centres may also be shaped informally through activities and memberships of individuals. Those information relationships might change faster than an overarching rule system and can be hard to control endogenously and exogenously. They offer the chance to find governance solutions based on personal trust and to exchange information, but may also be sources of additional conflicts (E. Ostrom 1986).

Competition may be inherent to all kinds of relationships mentioned. It is a common feature of polycentric arrangements, and is the focus of Chapter 7. Relationships between centres in polycentric governance arrangements will feature various combinations of competition and coordination at a given time, over time, and from one polycentric governance arrangement to another. The question for scholars then becomes how to incorporate the concept of competition into their analyses of polycentric governance. Part of the answer lies in considering what the centres may be competing for or about, and there is a broad range of possibilities.

Centres may compete with one another for power and influence, for more material matters such as revenue or territory or personnel, or even for constituents. In polycentric governance, some centres may function as producers of public goods or services and thus may compete in ways similar to rival producers in market-like settings (e.g. Bendor 1985; Tiebout 1956). They may be imagined also as nations or states competing on the international stage, or as agencies competing for control over policy making. Any number of analogies is possible and, for a given governance situation, some will be more apt and useful than others.

The effects that competition produces in any governance situation are both contingent and a matter for empirical inquiry. It may yield benefits – competition is often said to generate information and innovation, for example (Low, E. Ostrom, and Wilson 2003, 101; Vanberg and Kerber 1994, 216). It may be detrimental, as in the often-remarked ‘race to the bottom’ phenomenon (e.g. Konisky 2007). In complex actual settings, both benefits and drawbacks are likely to be observed, and discerning the overall effect becomes a challenging evaluation task.

We need not, however, consider competition and its effects solely from the perspective of the outside analyst observing and evaluating a polycentric governance arrangement. Competition among centres will be experienced and evaluated by the participants themselves. Accordingly, competition can also be incorporated into our analyses and understanding of polycentric arrangements as an endogenous driver of change. People may respond to competition by creating or modifying or eliminating centres, changing their operations, or shifting levels of action and altering the rules governing centres and their interaction. Competition and the setting of other relationships are therefore also essential for understanding polycentric arrangements and how they change over time.

## 2.5 Questions about Coordination

- Are there identifiable ways in which centres coordinate?
  - Do they share information and, if so, about what and in what ways?
  - Do they collaborate on projects/programs/activities and, if so, in what ways?
  - Do they share or exchange resources such as funding, personnel, facilities, etc., and, if so, in what ways?
  - Do they appear to coordinate their respective functions, i.e. to identify and to some extent agree upon which centres may/must/must not do what and under which circumstances?
  - Do centres at different levels coordinate with each other?
- Are there decision centres working at more than one level of the problem/ good/ service/ resource and, what is the rationale for that and how does it affect coordination and conflicts?
- How have conflicts among centres arisen and been addressed?
  - Have conflicts had only negative impacts, or have they reflected potentially useful contestation about alternative perspectives or values?
  - Are there centres that perform conflict-resolution functions and, if so, in what ways or under what conditions?
  - Can individuals or centres challenge a decision or action that was taken at another level?

How centres take each other into account may derive to some degree from their use and pursuit of information in relation to problems, goals, strategies, and outcomes (see Chapters 5–8 in Part II). Interactions

among centres may become cooperative, competitive and, to greater or lesser extents coordinated, depending on complementarities or incompatibilities in the information they generate, exchange, withhold, and use and in how they interpret and understand it. In addition to competition, as discussed, coordination is a way that centres ‘take each other into account’. Each centre does not have to coordinate with all the others in order to constitute a polycentric arrangement, but a collection of centres that was devoid of coordination would not be a polycentric governance arrangement.

Searching for, characterizing, and assessing the coordination occurring in a polycentric governance situation is important but not simple. Coordination can appear in many forms. There are formal types of coordination, such as approval processes, and informal ones, such as consultation among peers. Coordination may be mandated (even legislatively; see Schafer 2016) or voluntary. It may be institutionalized in associations, task forces, working groups, and the like. The variety is immense, and the specific manifestations so diverse that Peters (2015, 128) has observed, ‘although we certainly know coordination when we see it, measuring that coordination in other than a qualitative sense is at present difficult if not impossible’. An added complication for the analyst is that in some situations one or more mechanisms of coordination may have been established formally, but no one is participating in them and no actual coordination is occurring in practice, so one must look beyond surface appearances.

Although coordination, cooperation, and collaboration are all used frequently and sometimes treated as synonyms, they are not the same. All cooperation/collaboration may be coordinative, but not all coordination is cooperative/collaborative, especially to the degree that cooperation connotes voluntariness – one may imagine, for instance, individuals or organizations coordinating their activities so that they can avoid each other. Coordination is therefore a characteristic property to be found at least to some extent in any polycentric governance situation, while cooperation and collaboration, although important, will be frequently but not necessarily present. Cooperation among centres is the focus of Chapter 5.

Coordination has a favourable connotation in many usages, but for our purposes we are not suggesting that it is inherently or necessarily good or efficient, fair, inclusive, etc. A cartel, for example, or a criminal syndicate involves very high levels of coordination among the centres involved. The effects of coordination are contingent and a matter for empirical investigation. The key is for analysts to look for and identify the forms and extent of coordination that are present in a polycentric governance situation as

part of the attempt to understand and explain it and assess its functioning and effects (Berardo and Scholz 2010). Berardo and Lubell (2016), and others, emphasize the bridging and bonding capital inherent to coordination processes in polycentric governance systems and the role of risk perception for organizing these processes. As noted briefly, these processes may also manifest in the establishment of specific 'boundary or bridging organizations' (i.e. additional centres). Cash et al. (2006) identified and characterized such organizations as one answer to the pervasive scale and plurality challenges playing intermediary roles in the exchange of information among centres. It should be considered that these organizations may have substantial independence and need to be counted as additional centres in a governance situation with their own goals, means, and power.

Furthermore, we make a distinction between coordination processes and whether the polycentric arrangement, as such, can be called coordinated overall. Conflicts may in some circumstances indicate a lack of overall coordination. As we have stated, conflicts are inherent to any governance situation and a dynamic component, with a strong temporal dimension, so it is relevant how conflicts arise and how they are resolved. Regularly occurring conflicts may render institutionalized conflict-resolution processes necessary. Conflicts resulting from dynamic processes, such as changing needs, changing perceptions and changing contexts, may be addressed through changes of the governance arrangements. Like competition, conflict and coordination may be endogenous drivers of change within polycentric arrangements. Individuals experiencing the presence, absence, extent, or effects of coordination and conflict may become motivated to create new centres or modify or eliminate existing ones, or shift levels of action and engage in rule adaptation for purposes of trying to alter the existence, nature, or operation of coordination in that polycentric situation. Section 2.6 elaborates these dynamisms further, and Chapters 5–8 in Part II use empirical cases to discuss, illustrate, and compare cooperation, conflict, and competition among centres.

## 2.6 Questions about Emergence, Transition, and Decline

- How do centres come into existence or dissolve?
- Are they able to change their organizational structures and/or their decision-making processes and, if so, how?
- Are they able to change their functions (activities performed, services provided, areas or constituencies served, etc.) and, if so, how?

- How have relationships and interactions between centres changed over time, and for what reasons?
- Do changes of centres or relationships reflect changed understandings of scales of problems, scales of production, or scales of effects?
- Have conflicts among centres resulted in changes to the number, composition, functions, and/or interactions of centres? If so, how did those changes occur and with what apparent consequences?

Fundamental to understanding polycentric arrangements is the recognition that both the units (centres) and their relationships can and do change. This is a focus of Chapter 4. These changes are not always or necessarily exogenously driven. Individuals within polycentric governance structures may and do generate changes. Processes of emergence, change and decline can be captured by the concepts of design and spontaneity. Because the centres in a polycentric structure are human creations, it is essential to view them as deliberately created, and therefore designed, at least, to some extent.

This does not, however, necessarily imply that a polycentric arrangement composed of those centres was designed. The structure is not merely the additive sum of the centres, but also the composite of their interactions with one another. It is possible, and even likely, that centres have been designed but the interactive system they comprise has not. Furthermore, the internal dynamics of any polycentric arrangement can be expected to change over time through the appearance or disappearance of centres and alterations in their individual operations and in their interactions with one another, and it is possible and even likely that these changes are also not designed.

Scholars have used terms such as ‘spontaneity’, ‘spontaneous order’, ‘emergence’, ‘emergent structure’, etc., to try to capture and convey the idea that even though there may be identifiable patterns in a dynamic structure, they do not necessarily reflect or result from an act or a process of design. It may also be the case that some aspects of polycentric arrangements have been designed and others have emerged so the structure has designed and undesigned elements. The multitude of polycentric arrangements that exist in the world is better approached with a conceptual toolkit that includes design as well as spontaneity or emergence, and where many polycentric arrangements belong somewhere on a spectrum between being fully designed and completely spontaneous.

Some contributors to the literature on polycentricity have argued that it is a practical impossibility for any one person to design a structure as

complex and dynamic as a polycentric governance system (e.g. Boettke and Coyne 2005, 154; McGinnis 2005, 168). Polycentric arrangements are complex, having been composed by multiple ‘designers’ who have established centres and developed and altered their relationships over time. The levels of action concept<sup>4</sup> aids in understanding and explaining scope, extent and mechanisms of endogenous change in polycentric arrangements. It was presented in 1982 by Kiser and E. Ostrom (1982) and since then has been used in many theoretical and empirical examinations of institutions and their functioning. It is also one of the core elements of the Institutional Analysis and Development (IAD) framework, although it can be used and applied outside of an IAD approach as well.

What centres exist, how they came into being, and how they are altered, are functions of actions taken at a *collective-choice level*. Similarly, what centres must, or may or may not, interact with other centres, and in what ways, depend upon rules adopted at a collective-choice level. Changes that are made at a collective-choice level feed into and shape the *operational level of action* of a polycentric structure by affecting the number, types, and functions of the centres and the manner in which they take each other into account. The *constitutional-choice level of action* is also important to understanding polycentric arrangements because decisions made at that level determine whether and how easily people may make changes at the collective-choice level. In communities (of whatever size) where the constitutional-choice level of action allows wide latitude for individuals and organizations<sup>5</sup> to establish and alter centres and their relationships, the dynamics of stability and change of polycentric structures can and should be expected to differ from those that are observed and experienced in communities with stronger constraints on institutional modification.

One seeks to understand a polycentric structure through an examination of the centres, their functions and operations, their interactions, effects, and adjustments over time as individual actors and organizations pursue their aims, try to solve problems, and adapt. Any unit may fail, or may succeed at others’ expense, or may find ways to succeed through cooperative ventures that advance others’ well-being too. More likely, a polycentric structure at any given time will include all of those experiences plus others,

<sup>4</sup> Remember that the concept of levels of action is not the same as levels of government.

<sup>5</sup> Remember that each level of action does not entail a different set of actors. Individuals working at the operational level may decide to shift to collective-choice actions to modify centres and relationships, and to constitutional-choice actions if they wish to address the processes by which such changes may take place.



which is another reason why polycentric arrangements change over time even though no single designer is adjusting the structure as a whole.

## 2.7 Questions about Effects

- How has the governance arrangement helped or hindered efforts to improve conditions and solve problems?
- In what ways and to what extent has this governance arrangement facilitated information generation, learning, error correction, and adaptation?

To this point, the inquiry has been directed toward understanding elements, context, and dynamics of the governance situation – allowing the analyst to see it in terms of polycentricity. At this stage, the analyst may pose questions about the governance arrangement as a whole and how to think about the effects it generates.

Evaluating a governance arrangement differs from evaluating a particular good or service, a programme or a policy. Citing McGinnis (2011), Koontz et al. in Chapter 8 observe, ‘Scholars of polycentricity, and governance more generally, have identified a wide range of performance criteria.’ Those authors apply multiple criteria – some emphasizing processes and others focused on outcomes – to the cases they present in Part II. These performance criteria are accountability, social learning, adaptability, representation, consideration of appropriate knowledge in decision making, network building, and coherence (both among decision centres and across levels), in addition to the familiar evaluation criteria of efficiency and efficacy. This combination of criteria is compatible with prior work by Blomquist (1992), Pahl-Wostl and Knieper (2014), Pahl-Wostl (2014, 2015) and with the recommendation of Low, E. Ostrom, and Wilson (2003, 86) that performance of management arrangements for complex resource systems can, and should, be assessed in terms of their ability to cope with risk, uncertainty, and exogenous shocks, reduce errors through learning, address local as well as subsystem and system level problems, and avoid system collapse or failure. Accordingly, the questions listed address a myriad of effects that a governance arrangement may have.

In regard to complex systems, adaptive capacity is a vital criterion. It connotes purposeful adjustment in light of updated information. In the governance context, we may link it to the concept of levels of action mentioned in Section 2.6. In a governance structure that exhibits adaptive capacity, people would be able not only to make behavioural adjustments

at the operational level in response to changed understandings, but also to shift to the collective-choice level to alter rules governing behaviour and to the constitutional-choice level when necessary to alter decision-making processes. Pahl-Wostl has linked the concept to the importance of single-loop, double-loop, and triple-loop learning as characteristics of adaptable complex governance structures.

Adaptation by governance arrangements in response to updated information and revised understandings depends necessarily upon both information generation and the interpretation of information from multiple viewpoints. Assuming that fuller information is beneficial for effective governance, arrangements that more effectively promote the generation of information from different levels, about various dimensions of problems, performance and about alternative practices would be preferable. Similarly, since information admits of multiple meanings, governance arrangements featuring diverse channels through which people can express, exchange, and even contest about the interpretation and significance of that information would be preferable to governance arrangements that limit such flows.

These criteria are readily linked to another, i.e. error reduction. Human-created structures are unavoidably error-prone to greater or lesser degree, both in bringing about undesirable results and in failing to achieve desirable ones (Bendor 1985). Error elimination may be impossible, but error reduction is nonetheless desirable and a legitimate criterion on which to evaluate the demonstrated performance of governance systems. Whether a governance arrangement enables or inhibits learning and contestation is therefore an important area for inquiry.

The examination of effects of polycentric governance arrangements in specific settings will often – perhaps always – generate mixed findings. Naturally, some trade-offs may be identified between the openness of a governance system to change and its robustness to maintain functions and withstand disruption. It is worthwhile to take both into account when evaluating governance arrangements, to consider how they are situated between rigidity and flux. Furthermore, Milman and Scott's (2010) cogent assessment of trade-offs in the water-management context is valuable. They noted that the overlap and redundancies of polycentric arrangements may enhance resilience, but also raise transaction costs and the prospects of conflict and confusion over authority and responsibility. Overlap among centres may be incomplete: 'gaps in jurisdiction' may occur where 'some aspects of water management do not fall under the purview of any water management agency' (2010, 532). The dynamic nature of polycentric

arrangements is surely an advantage in some respects, but it can also be the case that '[r]apid evolution leads to ambiguity (ill-defined roles) [that] in turn leads to legitimacy claims that can result in overlapping mandates and program implementation working at cross purposes' (2010, 532). Noting both the pitfalls and the promises of polycentricity, Milman and Scott reach a conclusion similar to that of Elinor Ostrom when she wrote 'there is no guarantee that such systems will find the combination of rules at diverse levels that are optimal for any particular environment' (E. Ostrom 1999, 39).

## 2.8 Conclusion

Since polycentric governance is widespread, it is essential to have some way of identifying and characterizing it. This is challenging, however, because of the countless forms and variations that actual polycentric arrangements may take and their continuous change over time. The diagnostic inquiry-based approach laid out above therefore has many parts and steps.

However, making this effort to 'see polycentrically' should generate insight into the ways in which the various aspects and dimensions of polycentric governance manifest themselves in a complex governance situation. What should emerge in the composite result of these inquiries is an understanding of governance in a particular setting that helps to indicate whether, to what extent, and in what ways it resembles a polycentric governance system, an uncoordinated and fragmented jumble, or something in-between. We encourage the use and refinement of this inquiry-based approach in future research on polycentric governance across a variety of settings, which will enhance the accumulation of knowledge.

Developing that kind of overall portrait of a complex governance situation, by assembling this information, is also vital to any prospect for an accurate and empirically grounded evaluation of how the governance arrangements perform and of the prospects for positive change. If we make such pronouncements without undertaking the inquiry, we run the risks not merely of failing to understand the governance arrangements, but also of substituting ideological judgements for actual analyses – i.e. (a) dismissing as undesirable all polycentric governance situations, regardless of how well or poorly they may actually operate, or (b) embracing as desirable all polycentric governance situations, regardless of how well or poorly they actually operate. Neither is the appropriate stance for committed researchers or practitioners.

Other chapters in this book use empirical cases of water and other governance situations to discuss, further illustrate and compare the elements laid out in this inquiry. How polycentric governance functions in any actual setting depends on more than the characteristics of the governance arrangements themselves. It also depends on the overarching rules of the polity, the nature of the problems being addressed, and the communities in which governance arrangements are embedded. These are the focus of Chapter 3.

## References

- Abbott, Kenneth W. 2012. The transnational regime complex for climate change. *Environment and Planning C-Government and Policy* 30 (4): 571–90. <https://doi.org/10.1068/c111127>.
- Abe, Jacques, Bradford Brown, Emmanuel A. Ajao, and Stephen Donkor. 2016. Local to regional polycentric levels of governance of the Guinea Current Large Marine Ecosystem. *Environmental Development* 17: 287–95. <https://doi.org/10.1016/j.envdev.2015.06.006>.
- Acar, Muhittin, Chao Guo, and Kaifeng Yang. 2012. Accountability in voluntary partnerships: To whom and for what? *Public Organization Review* 12 (2): 157–74.
- Acheson, J. M. 2003. *Capturing the Commons: Devising Institutions to Manage the Maine Lobster Industry*. Hanover, NH: University Press of New England.
- Adger, W. Neil, Katrina Brown, and Emma L. Tompkins. 2005. The political economy of cross-scale networks in resource co-management. *Ecology and Society* 10 (2). <https://doi.org/10.5751/ES-01465-100209>.
- Advisory Commission on Intergovernmental Relations. 1987. *The Organization of Local Public Economies*. Washington, DC: Advisory Commission on Intergovernmental Relations.
- Aligica, Paul D. 2003. Rethinking Governance Systems and Challenging Disciplinary Boundaries: Interview with Elinor Ostrom, from Rethinking Institutional Analysis: Interviews with Vincent and Elinor Ostrom, Commemorating a Lifetime of Achievement, George Mason University, Mercatus Center, November 7, 2003, 7–14. Reprinted in Aligica and Boettke 2009. *Challenging Institutional Analysis and Development: The Bloomington School*. New York: Routledge; and in Cole, Daniel H., and Michael D. McGinnis, eds. 2015. *Elinor Ostrom and the Bloomington School of Political Economy*. Lanham, MD: Lexington Books, 51–64.
2014. *Institutional Diversity and Political Economy: The Ostroms and Beyond*. Oxford University Press.
- Aligica, Paul D., and Peter Boettke. 2009. *Challenging Institutional Analysis and Development: The Bloomington School*. New York: Routledge.
- Aligica, Paul D., and F. Sabetti, eds. 2014a. *Choice, Rules and Collective Action: The Ostroms on the Study of Institutions and Governance*. Colchester, UK: ECPR Press.

- 2014b. Introduction: The Ostroms' research program for the study of institutions and governance: Theoretical and epistemic foundations. In Paul D. Aligica and F. Sabetti, eds., *Choice, Rules and Collective Action: The Ostroms on the Study of Institutions and Governance*. Colchester, UK: ECPR Press, 1–19.
- Aligica, Paul D., and Vlad Tarko. 2012. Polycentricity: From Polanyi to Ostrom, and beyond. *Governance – An International Journal of Policy Administration and Institutions* 25 (2): 237–62. <https://doi.org/10.1111/j.1468-0491.2011.01550.x>.
2013. Co-production, polycentricity, and value heterogeneity: The Ostroms' public choice institutionalism revisited. *American Political Science Review* 107 (4): 726–41. <https://doi.org/10.1017/S0003055413000427>.
- Allen, Barbara. 2014. *Vincent Ostrom and the Alaska Constitution in Ostroms the Movie*. <https://vimeo.com/channels/ostromsthemovie/84354523>.
- Allen, Barbara, and Donald Lutz. 2009. Experience guides theory: Discovering the political theory of a compound republic. In Filippo Sabetti, Barbara Allen, and Mark Sproule-Jones, eds., *The Practice of Constitutional Development: Vincent Ostrom's Quest to Understand Human Affairs*. Lanham, MD: Lexington Books, 73–104.
- Anderies, John M., and Marco A. Janssen. 2013. Robustness of social-ecological systems: Implications for public policy. *Policy Studies Journal* 41 (3): 513–36.
- Anderies, John M., Marco A. Janssen, and Elinor Ostrom. 2004. A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society* 9 (1).
- Andersson, Krister P., and Elinor Ostrom. 2008. Analyzing decentralized resource regimes from a polycentric perspective. *Policy Sciences* 41 (1): 71–93. <https://doi.org/10.1007/s11077-007-9055-6>.
- Andrews, Matt. 2013. *The Limits of Institutional Reform in Development: Changing Rules for Realistic Solutions*. Cambridge: Cambridge University Press.
- Aoki, Masahiko. 2001. *Toward a Comparative Institutional Analysis*. Cambridge, MA: MIT Press.
- Aranda-Martín, José Francisco. 2009. Irrigation and water policies in Aragon. In A., K. Biswas, C. Tortajada, and R. Izquierdo, eds., *Water Management in 2020 and Beyond*, 213–35. Springer.
- Arnold, Gwen, and Holahan Robert. 2014. The federalism of fracking: How the locus of policy-making authority affects civic engagement. *The Journal of Federalism* 44 (2): 344–68.
- Arnold, Gwen, Nguyen Long Le Anh, and Madeline Gottlieb. 2017. Social networks and policy entrepreneurship: How relationships shape municipal decision making about high-volume hydraulic fracturing. *Policy Studies Journal* 45 (3): 414–41.
- Arthur, W. Brian. 1994. *Increasing Returns and Path Dependence in the Economy*. Ann Arbor: University of Michigan Press. [www.jstor.org/stable/10.3998/mpub.10029](http://www.jstor.org/stable/10.3998/mpub.10029).
- Axelrod, Robert, and Michael D. Cohen. 2000. *Harnessing Complexity: Organizational Implications of a Scientific Frontier*. Riverside, New York: Free Press.
- Baldwin, Elizabeth, Camille Washington-Ottombre, Jampel Dell'Angelo, Daniel Cole, and Tom Evans. 2016. Polycentric governance and irrigation reform in Kenya. *Governance* 29 (2): 207–25. <https://doi.org/10.1111/gove.12160>.
- Ban, Natalie C., Vanessa M. Adams, Glenn R. Almany, Stephen Ban, Josh E. Cinner, Laurence J. McCook, Morena Mills, Robert L. Pressey, and Alan White. 2011. Designing, implementing and managing marine protected areas: Emerging trends

- and opportunities for coral reef nations. *Journal of Experimental Marine Biology and Ecology* 408 (1–2, SI): 21–31. <https://doi.org/10.1016/j.jembe.2011.07.023>.
- Bardhan, Pranab, and Dayton-Johnson, Jeff. 2002. Unequal irrigators heterogeneity and commons management in large-scale multivariate research. In Elinor Ostrom, ed., *The Drama of the Commons*. Washington, DC: National Academy Press, 87–112.
- Basurto, Xavier. 2013. Linking multi-level governance to local common-pool resource theory using fuzzy-set qualitative comparative analysis: Insights from twenty years of biodiversity conservation in Costa Rica. *Global Environmental Change* 23 (3): 573–87. <https://doi.org/10.1016/j.gloenvcha.2013.02.011>.
- Basurto, Xavier, and Elinor Ostrom. 2009. Beyond the tragedy of the Commons. *Economia delle fonti di energia e dell'ambiente* (1): 35–60.
- Beach, D. (2016). It's all about mechanisms – What process-tracing case studies should be tracing. *New Political Economy*, 21(5): 463–72.
- Beach, D., and R. B. Pedersen, (2016). Selecting appropriate cases when tracing causal mechanisms. *Sociological Methods & Research* 47(4): 837–71. <https://doi.org/10.1177/0049124115622510>
- Becker, Gert, Dave Huitema, and Jeroen C. J. H. Aerts. 2015. Prescriptions for adaptive comanagement: The case of flood management in the German Rhine basin. *Ecology and Society* 20 (3). <https://doi.org/10.5751/ES-07562-200301>.
- Bednar, Jenna. 2009. *The Robust Federation: Principles of Design: Political Economy of Institutions and Decisions*. Cambridge. New York: Cambridge University Press.
- Bednar, Jena. 2011. The political science of federalism. *Annual Review of Law and Social Science* 7: 269–88.
- Bendor, Jonathan B. 1985. *Parallel Systems: Redundancy in Government*. Berkeley, CA: University of California Press.
- Bennett, A., and C. Elman. (2006). Complex causal relations and case study methods: The example of path dependence. *Political Analysis* 14(3): 250–67.
- Benson, David, Animesh K. Gain, and Josselin J. Rouillard. 2015. Water governance in a comparative perspective: From IWRM to a 'Nexus' approach? *Water Alternatives* 8 (1): 756–73.
- Berardo, Ramiro, and Mark Lubell. 2016. Understanding what shapes a polycentric governance system. *Public Administration Review* 76 (5): 738–51. <https://doi.org/10.1111/puar.12532>.
- Berardo, Ramiro, and J. T. Scholz. 2010. Self-organizing policy networks: Risk, partner selection, and cooperation in estuaries. *American Journal of Political Science* 54 (3): 632–49. [www.scopus.com/inward/record.url?eid=2-s2.0-77954255825&partnerID=40&md5=04a8bf211ac39eee3961d75675609dc4](http://www.scopus.com/inward/record.url?eid=2-s2.0-77954255825&partnerID=40&md5=04a8bf211ac39eee3961d75675609dc4).
- Berbel, Julio, Carlos Gutiérrez-Martín, Juan A. Rodríguez-Díaz, Emilio Camacho, and Pilar Montesinos. 2015. Literature review on rebound effect of water saving measures and analysis of a Spanish case study. *Water Resources Management* 29 (3): 663–78.
- Berger, P. L., and R. J. Neuhaus. 1977. *To Empower People: The Role of Mediating Structures in Public Policy*. Washington, D.C.: American Enterprise Institute.
- Berkes, Fikret. 2005. Why keep a community-based focus in times of global interactions? *Topics in Arctic Social Sciences* 5: 33–43.

- Berkes, Fikret. 2006. From community-based resource management to complex systems: The scale issue and marine commons. *Ecology and Society* 11 (1). <https://doi.org/10.5751/ES-01431-110145>.
2007. Community-based conservation in a globalized world. 104 (39): 15188–93.
2017. Environmental governance for the Anthropocene? Social-ecological systems, resilience and collaborative learning. *Sustainability* 9:1232. <https://doi.org/10.3390/su9071232>.
- Beyer, Jürgen. 2011. Pfadabweichung: Die Internationalisierung des deutschen Unternehmenskontroll- und Rechnungslegungssystems. In Thomas M. J. Möllers, ed., *Internationalisierung von Standards*, 145–74.
- Bidwell, R. D., and C. M. Ryan. 2006. Collaborative partnership design: The implications of organizational affiliation for watershed partnerships. *Society and Natural Resources* 19 (9): 827–43.
- Biggs, Reinette, Maja Schlüter, and Michael L. Schoon, eds., 2015. *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems*. Cambridge: Cambridge University Press.
- Bish, Robert. 1999. Federalist Theory and Polycentricity: Learning from Local Governments. In Donald P. Racheter, and Richard E. Wagner, eds., *Limiting Leviathan*. Cheltenham, UK; Northampton, MA, USA: Edward Elgar.
2014. Vincent Ostrom's contribution to political economy. *Publius: The Journal of Federalism* 44 (2): 227–48.
- Biswas, A. K. 2004. Integrated water resources management: A reassessment. *Water International* 29 (2): 248–56. <https://doi.org/10.1080/02508060408691775>.
- Blomquist, William. 1992. *Dividing the Waters: Governing Groundwater in Southern California*. San Francisco, CA: ICS Press.
2009. Crafting Water Constitutions in California. In *The Practice of Constitutional Development: Vincent Ostrom's Quest to Understand Human Affairs*. Lanham, MD: Lexington Books, 105.
- BOE. 2005. Real Decreto-ley 15/2005, de 16 de diciembre, de medidas urgentes para la regulación de las transacciones de derechos al aprovechamiento de agua.
- Boelens, Rutgerd, Axel Dourojeanni, Alfredo Duran, and Paul Hoogendam. 1998. Water rights and watersheds: Managing multiple water uses and strengthening stakeholder platforms. In Rutgerd Boelens and Gloria Davila, eds., *Searching for Equity: Conceptions of Justice and Equity in Peasant Irrigation*. Assen, the Netherlands: Van Gorcum.
- Boelens, Rutgerd, and Gloria Davila, eds. 1998. *Searching for Equity: Conceptions of Justice and Equity in Peasant Irrigation*. Assen, the Netherlands: Van Gorcum.
- Boelens, Rutgerd, Jaime Hoogesteger, and Michiel Baud. 2015. Water reform governmentality in Ecuador: Neoliberalism, centralization, and the restraining of polycentric authority and community rule-making. *Geoforum* 64: 281–91. <https://doi.org/10.1016/j.geoforum.2013.07.005>.
- Boelens, Rutgerd, Margreet Zwarteveen, and Dik Roth. 2005. *Legal Complexity in the Analysis of Water Rights and Water Resources Management*. New Brunswick, NJ: Rutgers University Press.
- Boettke, Peter J., and Christopher J. Coyne. 2005. Methodological individualism, spontaneous order and the research program of the Workshop in Political Theory



- and Policy Analysis. *Journal of Economic Behavior & Organization* 57 (2): 145–58. <https://doi.org/10.1016/j.jebo.2004.06.012>.
- Boettke, Peter J., Christopher J. Coyne, and Peter T. Leeson. 2011. Quaimarket Failure. *Public Choice* 149 (1/2): 209–24.
- Boettke, Peter J., and Paul D. Aligica. 2009. *Challenging Institutional Analysis and Development*. Abingdon, UK; New York: Routledge.
- Borgatti, Stephen P., Martin G. Everett, and Jeffrey C. Johnson. 2013. *Analyzing Social Networks*. London: SAGE Publications Limited.
- Boyte, Harry, Stephen Elkin, Peter Levine, Jane Mansbridge, Elinor Ostrom, Karol Soltan, and Rogers Smith. 2014. The new civic politics: Civic theory and practice for the future. *The Good Society* 23 (2): 206–11.
- Bromley, Daniel W. 1989. *Economic Interests and Institutions: The Conceptual Foundations of Public Policy*. New York, NY: Basil Blackwell.
1991. *Environment and Economy: Property Rights and Public Policy*. Oxford: Blackwell.
2006. *Sufficient Reason: Volitional Pragmatism and the Meaning of Economic Institutions*. Princeton, NJ: Princeton University Press. [www.loc.gov/catdir/enhancements/fy0734/2005017807-b.html](http://www.loc.gov/catdir/enhancements/fy0734/2005017807-b.html).
2008. Volitional pragmatism. *Ecological Economics* 68: 1–13.
2012. Environmental governance as stochastic belief updating: Crafting rules to live by. *Ecology and Society* 17 (3). <https://doi.org/10.5751/ES-04774-170314>.
- Brougha, Ruairi, and Zsuzsa Varvasovszky. 2000. Stakeholder analysis: A review. *Health Policy and Planning* 15 (3): 239–46.
- Brunner, Ronald D. 2002. Problems of governance. In Ronald D. Brunner, Christine H. Colburn, Christsina M. Cromley, and Roberta A. Klein, eds., *Finding Common Ground: Governance and Natural Resources in the American West*. New Haven, CT: Yale University Press, 1–47.
- Bryson, John, Alessandro Sancino, John Benington, and Eva Sorensen (2017) Towards a multi-actor theory of public value co-creation. *Public Management Review* 19 (5): 640–54.
- Buchanan, James M., and Geoffrey Brennan. 1985. *The Reason of Rules*. Cambridge, UK, New York: Cambridge University Press.
- Buchanan, James M., and Gordon Tullock. 1962. *The Calculus of Consent. Collected Works of James M. Buchanan*. 3 vols. Ann Arbor, MI : University of Michigan Press.
- Buchanan, James M., and Roger D. Congleton. 1998. *Politics by Principle, Not Interest: Towards Nondiscriminatory Democracy*. Cambridge, New York: Cambridge University Press.
- Buthe, T. (2012). Taking temporality seriously: Modeling history and the use of narratives as evidence. *American Political Science Review*, 96(3): 481–93.
- Buytaert, Wouter, Art Dewulf, Bert de Bievre, Julian Clark, and David M. Hannah. 2016. Citizen science for water resources management: Toward polycentric modeling and governance? *Journal of Water Resources Planning and Management* 142 (4): 1–4.
- Byron, N. 2011. What can the Murray-Darling Basin Plan achieve? Will it be enough? In D. Connell, and R. Q. Grafton, eds., *Basin Futures: Water Reform in the Murray-Darling Basin*. Canberra: ANU E Press, 385–98.

- Campbell, A. 2016. Two steps forward, one step back: The ongoing failure to capture synergies in natural resource management (Australia). In M. D. Young, and C. Esau, eds., *Transformational Change in Environmental and Natural Resource Management: Guidelines for Policy Excellence*. New York: Routledge, 80–94.
- Capano, Gilberto. 2009. Understanding policy change as an epistemological and theoretical problem. *Journal of Comparative Policy Analysis: Research and Practice* 11 (1): 7–31. <https://doi.org/10.1080/13876980802648284>.
- Cardenas, J. C., J. K. Stranlund, and C. Willis. 2000. Local environmental control and institutional crowding out. *World Development* 28(10): 1719–33.
- Carlisle, Keith, and Rebecca L. Gruby. 2017. Polycentric systems of governance: A theoretical model for the commons. *Policy Studies Journal* 10 (2): 629. <https://doi.org/10.1111/psj.12212>.
- Carlsson, L., and A. Sandström. 2008. Network governance of the commons. *International Journal of the Commons* 2 (1): 33–54.
- Cash, D. W. 2000. Distributed assessment systems: An emerging paradigm of research, assessment and decision-making for environmental change. *Global Environmental Change-Human and Policy Dimensions* 10 (4): 241–44.
- Cash, David, W., Adger, W. Neil, Fikret Birkes, Po Garden, Louis Lebel, Per Olsson, Lowell Pritchard, and Oran Young. 2006. Scale and cross-scale dynamics: Governance and information in a multi-level world. *Ecology & Society* 11 (2).
- CESA. 2012. *Informe socioeconómico de la década 2001-2010 en Aragón*. Zaragoza: Consejo Económico y Social de Aragón.
- Chaffin, B. C., A. S. Garmestani, H. Gosnell, and R. K. Craig. 2016. Institutional networks and adaptive water governance in the Klamath River Basin, USA. *Environmental Science & Policy* 57: 112–21. <https://doi.org/10.1016/j.envsci.2015.11.008>.
- Challen, Ray. 2000. *Institutions Transaction Cost and Environmental Policy: Institutional Reform for Water Resources*. Aldershot, UK: Edward Elgar.
- Chambers, R. 1994. Participatory rural appraisal (PRA): Analysis of experience. *World Development* 22 (9): 1253–68.
- Chen, X., F. Lupi, G. He, and J. Liu. 2009. Linking social norms to efficient conservation investment in payments for ecosystem services. *Proceedings of the National Academy of Sciences* 106 (28): 11812–17.
- Chirkov, V. I, R. M Ryan, and K. M Sheldon, eds. 2011. *Human Autonomy in Cross-Cultural Contexts: Perspectives on the Psychology of Agency, Freedom and Well-Being*. Dordrecht: Springer.
- Christin, Thomas, and Simon Hug. 2012. Federalism, the geographic location of groups, and conflict. *Conflict Management and Peace Science* 29 (1): 93–122.
- Cleaver, Frances. 2002. Reinventing institutions: Bricolage and the social embeddedness of natural resource management. *The European Journal of Development Research* 14 (2): 11–30. <https://doi.org/10.1080/714000425>.
2012. *Development through Bricolage: Rethinking Institutions for Natural Resource Management*. 1st edn. New York: Routledge.
- Coase, R. H. 1990. *The Firm, the Market and the Law*. Chicago IL: University of Chicago Press.
- Cochrane, Cathy, ed., 2017. *State of the Sound*. Washington DC: Puget Sound Partnership.
- Cole, Daniel H. 2011. From global to polycentric climate governance. *Climate Law* 2(3): 395–413.

2013. The varieties of comparative institutional analysis. *Wisconsin Law Review* 2013: 383–409.
2015. Advantages of a polycentric approach to climate change policy. *Nature Climate Change* 5 (2): 114–18. <https://doi.org/10.1038/NCLIMATE2490>.
- Cole, Daniel H., and Michael D. McGinnis, eds. 2014. *Elinor Ostrom and the Bloomington School of Political Economy, Volume 1: Polycentricity in Public Administration and Political Science*. Lanham, MD: Lexington Books.
- eds. 2015. *Elinor Ostrom and the Bloomington School of Political Economy*. Lanham, MD: Lexington Books.
- Colorado Supreme Court. 2016. No. 15SC667. City of Longmont v. Colo. Oil and Gas Ass'n Preemption—Inalienable Rights Provision.
- Columbia Basin Water Transactions Programme (CBWTP). 2017. 2016 Annual Report. Portland, OR: CBWTP.
- Congleton, Roger D. 2014. The contractarian constitutional political economy of James Buchanan. *Constitutional Political Economy* 25 (1): 39–67.
- Conrad, E., T. Moran, M. DuPraw, D. Ceppos, J. Martinez, and W. Blomquist. 2018. Diverse stakeholders create collaborative, multilevel basin governance for ground-water sustainability. *California Agriculture* 72 (1): 44–53.
- Cooperrider, David L. 2005. *Appreciative Inquiry: A Positive Revolution in Change*. 1st edn. San Francisco, CA: Berrett-Koehler.
- Copes, P. 1986. A critical review of the individual quota as a device in fisheries management. *Land Economics* 62(3): 278–91.
- Cosens, Barbara, Matthew McKinney, Richard Paisley, and Aaron T. Wolf. 2018. Reconciliation of development and ecosystems: the ecology of governance in the International Columbia River Basin. *Regional Environmental Change* 18(6): 1679–92. doi: 10.1007/s10113-018-1355-1.
- Council of Australian Governments. 2000. Our vital resource: A National Action Plan for Salinity and Water Quality.
- Coward, Walter Jr. E. 1979. Principles of social organisation in an indigenous irrigation system. *Human Organisation* 38 (1): 29–36.
- Cox, Michael, Gwen Arnold, and Sergio Villamayor Tomás. 2010. A review of design principles for community-based natural resource management. *Ecology & Society* 15 (4).
- Crawford, Sue, and Elinor Ostrom. 1995. A grammar of institutions. *American Political Science Review* 89 (3): 582–600.
- Cumming, Graeme S. 2016. Heterarchies: Reconciling networks and hierarchies. *Trends in Ecology & Evolution* 31 (8): 622–32.
- Cunningham, Gord, and Alison Mathie. 2002. Asset-based community development: An overview. *Coady International Institute*. <http://www.synergos.org/knowledge/02/abcdoverview.htm> (1 of 5)9/10/2009 2:25:00 PM Retrieved February 4, 2009.
- Curtis, A., H. Ross, G. R. Marshall, C. Baldwin, J. Cavaye, C. Freeman, A. Carr, and G. J. Syme. 2014. The great experiment with devolved NRM governance: Lessons from community engagement in Australia and New Zealand since the 1980s. *Australasian Journal of Environmental Management* 21 (2): 175–99.
- Davenport, Coral. (2016). Obama Fracking Rule Is Struck Down by Court. *The New York Times*, 22 June 2016. Retrieved from [www.nytimes.com/2016/06/23/us/politics/hydraulic-fracturing-interior-department-regulations.html](http://www.nytimes.com/2016/06/23/us/politics/hydraulic-fracturing-interior-department-regulations.html)

- Davis, Charles. 2012. The politics of 'fracking': Regulating natural gas drilling practices in Colorado and Texas. *Review of Policy Research* 29 (2): 177–91.
- DeCaro, Daniel, Brian Chaffin, Edella Schlager, Ahjond Garmestani, and J. B. Ruhl. 2017. Legal and institutional foundations of adaptive environmental governance. *Ecology and Society* 22 (1).
- DeCaro, Daniel A., and Michael K. Stokes. 2013. Public participation and institutional fit: A social–psychological perspective. *Ecology and Society* 18 (4). <https://doi.org/10.5751/ES-05837-180440>.
- Deci, E. L. 1971. Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology* 18 (1): 105–15.
1975. *Intrinsic Motivation*. New York: Plenum Press.
- Dietz, T., Elinor Ostrom, and P. C. Stern. 2003. The struggle to govern the commons. *Science* 302 (5652): 1907–12.
- Dobson, A. 2007. Environmental citizenship: Towards sustainable development. *Sustainable Development* 15 (4): 276–85.
- Dobson, A., and D. Bell. 2005. *Environmental Citizenship*. Cambridge MA: MIT Press.
- Dorsch, Marcel J., and Christian Flachsland. 2017. A polycentric approach to global climate governance. *Global Environmental Politics* 17 (2): 45–64. [https://doi.org/10.1162/GLEP\\_a\\_00400](https://doi.org/10.1162/GLEP_a_00400).
- Edmunds, David, and Eva Wollenberg. 2001. A strategic approach to multi-stakeholder negotiations. *Development and Change* 32: 231–53.
- Ekstrom, Julia A., and Oran R. Young. 2009. Evaluating functional fit between a set of institutions and an ecosystem. *Ecology and Society* 14 (2).
- Elazar, Daniel. 1987. *Exploring Federalism*. Tuscaloosa, AL: University Press of Alabama.
1998. *Covenant and Civil Society: The Constitutional Matrix of Modern Democracy*. New Brunswick, NJ: Transaction Publishers.
- Elkin, Stephen L. 1988. Political institutions and political practice. In Edward B. Portis and Michael B. Levy, eds., *Handbook of Political Theory and Policy Science*. New York: Greenwood Press, 111–25.
- Ellerman, D. 2006. *Helping People Help Themselves: From the World Bank to an Alternative Philosophy of Development Assistance*. Ann Arbor, MI: University of Michigan Press.
- Embid, Antonio. 2013. La crisis del sistema concesional y la aparición de fórmulas complementarias para la asignación de recursos hídricos. Algunas reflexiones sobre los mercados de derechos de uso del Agua. In *XVIII Jornadas de Derechos de Aguas: Usos de aguas, Concesiones, Autorizaciones y Mercados de Aguas*. Zaragoza.
- Emerson, K., P. J. Orr, D. L. Keyes, and K. M. McKnight. 2009. Environmental conflict resolution: Evaluating performance outcomes and contributing factors. *Conflict Resolution Quarterly* 27 (1): 27–64.
- Engle, N. L., Lemos, M.C., 2010. Unpacking governance: Building adaptive capacity to climate change of river basins in Brazil. *Global Environmental Change* 20(1): 4–13.
- Falconer, Katherine. 2002. Developing cooperative approaches to agri-environmental policy: A transaction cost perspective on farmer participation in voluntary schemes. In Konrad Hagedorn, ed., *Environmental Co-Operation and Institutional*

- Change: Theories and Policies for European Agriculture*. Cheltenham, UK: Edward Elgar.
- Falk, Armin, and Urs Fischbacher. 2001. *A Theory of Reciprocity*. Discussion paper series. Industrial organization / CEPR 3014. London: CEPR.
- Falletti, T. G., and Lynch, J. (2008). From process to mechanism: Varieties of disaggregation. *Qualitative Sociology* 31(4): 333–39.
- Feiock, R. C. 2013. The Institutional Collective Action Framework. *Policy Studies Journal* 41 (3): 397–425.
- FES. 2010. *Social and Institutional Aspects: FES Source Book*: FES.
2014. Evolving Concepts for Assisting Villages in Governing Landscapes. FES.
- Focht, Will, and Zev Trachtenberg. 2005. A trust-based guide to stakeholder participation. In Paul A. Sabatier, Will Focht, Mark Lubell, Zev Trachtenberg, Arnold Vedlitz, and Marty Matlock, eds., *Swimming Upstream: Collaborative Approaches to Watershed Management*: Cambridge, MA: MIT Press, 85–135.
- Folke, Carl. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change* 16: 253–67.
- Folke, Carl, Jr Lowell Pritchard, Fikret Berkes, Johan Colding, and Uno Svedin. 2007. The problem of fit between ecosystems and institutions: Ten years later. *Ecology and Society* 12 (1).
- Folke, Carl, Thomas Hahn, Per Olsson, and Jon Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30 (1): 441–73. <https://doi.org/10.1146/annurev.energy.30.050504.144511>.
- Follett, Mary Parker [1924] 1951 *Creative Experience*. New York: Peter Smith.
- Foucault, M. 1984. *The Foucault Reader*. New York: Pantheon Books.
- Frack Tracker. 2018. Fracking Bans and Moratoria in New York State. [www.fracktracker.org/map/us/new-york/moratoria/](http://www.fracktracker.org/map/us/new-york/moratoria/).
- French, Stanely G. 1967. Kant's constitutive-regulative distinction. *The Monist* 51 (4): 623–39.
- Fresco, Louise O. 2009. Challenges for food system adaptation today and tomorrow. *Environmental Science and Policy* 12 (4): 378–85. <https://doi.org/10.1016/j.envsci.2008.11.001>.
- Frey, B. S. 1997. *Not Just for the Money: An Economic Theory of Personal Motivation*. Brookfield, USA: Edward Elgar.
2012. Crowding out and crowding in of intrinsic preferences. In E. Brousseau, T. Dedeurwaerdere, and B. Siebenhüner, eds., *Reflexive Governance for Global Public Goods*. Cambridge, MA: MIT Press 75–83.
- Frey, B. S., and R. Jegen. 2001. Motivation crowding theory: A survey of empirical evidence. *Journal of Economic Surveys* 15: 589–611.
- Fritsch, Michael. 2014. *Marktversagen und Wirtschaftspolitik: Mikroökonomische Grundlagen staatlichen Handelns*. 9., vollst. überarb. Aufl. Vahlens Handbücher der Wirtschafts- und Sozialwissenschaften. München: Vahlen.
- Galaz, Victor, Beatrice Crona, Henrik Österblom, Per Olsson, and Carl Folke. 2012. Polycentric systems and interacting planetary boundaries — Emerging governance of climate change—ocean acidification—marine biodiversity. *Ecological Economics* 81:21–32. <https://doi.org/10.1016/j.ecolecon.2011.11.012>.
- Galusha, Diane. 1999. *Liquid Assests: A History of New York City's Water System*. Fleishmanns, New York: Purple Mountain Press.

- Garmestani, Ahjond S., and Melinda Harm Benson. 2013. A framework for resilience-based governance of social-ecological systems. *Ecology & Society* 18 (1). <https://doi.org/10.5751/ES-05180-180109>.
- Garrick, Dustin. 2015. *Water Allocation in Rivers under Pressure: Water Trading, Transaction Costs and Transboundary Governance in the Western US and Australia*. Cheltenham, UK: Edward Elgar.
- Garrick, Dustin, and Bruce Aylward. 2012. Transaction costs and institutional performance in market-based environmental water allocation. *Land Economics* 88 (3): 536–60.
- Garrick, Dustin, Edella Schlager, and Sergio Villamayor-Tomás. 2016. Governing an international transboundary river: Opportunism, safeguards, and drought adaptation in the Rio Grande. *Publius: The Journal of Federalism* 46 (2): 170–98.
- Garrick, Dustin, and Erin O'Donnell. 2016. Exploring private roles in environmental watering in Australia and the US. In *Protecting the environment, privately*, 203–231. Singapore: World Scientific.
- Garrick, D., Siebentritt, M. A., Aylward, B., Bauer, C. J., and Purkey, A. (2009). Water markets and freshwater ecosystem services: Policy reform and implementation in the Columbia and Murray-Darling Basins. *Ecological Economics*, 69(2): 366–79.
- Garrick, Dustin, Stuart M. Whitten, and Anthea Coggan. 2013. Understanding the evolution and performance of water markets and allocation policy: A transaction costs analysis framework. *Ecological Economics* 88: 195–205. <https://doi.org/10.1016/j.ecolecon.2012.12.010>.
- Garrido, Alberto. 2007. Water markets design and evidence from experimental economics. *Environmental and Resource Economics* 38 (3): 311–30.
- Garrido, Alberto, and M Ramón Llamas. 2009. Water management in Spain: An example of changing paradigms. In A. Dinar and J. Albiac, eds., *Policy and Strategic Behaviour in Water Resource Management*. London: Earthscan. 125–46.
- Gibson, Clark, Elinor Ostrom, and Ahn T. K. 2000. The concept of scale and the human dimensions of global change. *Ecological Economics* 32: 217–39.
- Gibson-Graham, Julie Katherine. 2006. *A Postcapitalist Politics*. Minneapolis, MN: University of Minnesota Press.
- Giffinger, Rudolf, and Johannes Suitner. 2014. Polycentric metropolitan development: From structural assessment to processual dimensions. *European Planning Studies* 1–18. <https://doi.org/10.1080/09654313.2014.905007>.
- Giordano, Mark, and Tushaar Shah. 2014. From IWRM back to integrated water resources management. *International Journal of Water Resources Development* 30 (3): 364–76. <https://doi.org/10.1080/07900627.2013.851521>.
- Glick, D., K. Ray, and T. Wood. 2016. Fractured, Part V: Trouble in Triple Creek. *The Colorado Independent*, 2 November 2016. [www.coloradoindependent.com/162050/fractured-triple-creek-extraction-oil-and-gas](http://www.coloradoindependent.com/162050/fractured-triple-creek-extraction-oil-and-gas).
- Global Water Partnership. 2008. *Integrated Water Resources Management*. [www.gwptoolbox.org/index.php?option=com\\_content&view=article&id=8&Itemid=3](http://www.gwptoolbox.org/index.php?option=com_content&view=article&id=8&Itemid=3).
- Golten, Ryan, Tabor Ward, and Kathryn Mutz. 2016. Stakeholder Assessment: Colorado Oil and Gas Development. Insights from the Field. Toward an Understanding of Industry-Community MOUs. [www.oilandgasbmps.org/docs/CO189\\_MOU\\_Stakeholder\\_Assessment\\_2016.pdf](http://www.oilandgasbmps.org/docs/CO189_MOU_Stakeholder_Assessment_2016.pdf)

- Goodin, Robert E. 1996. *The Theory of Institutional Design*. Cambridge UK; New York, NY, USA: Cambridge University Press.
- Grimble, Robin, and Kate Wellard. 1997. Stakeholder methodologies in natural resource management: A review of principles, contexts, experiences and opportunities. *Agricultural Systems* 55 (2): 173–93.
- Gruby, Rebecca L., and Xavier Basurto. 2014. Multi-level governance for large marine commons: Politics and polycentricity in Palau's protected area network. *Environmental Science & Policy* 36: 48–60. <https://doi.org/10.1016/j.envsci.2013.08.001>.
- Grzymala-Busse, Anna. 2011. Time will tell? Temporality and the analysis of causal mechanisms and processes. *Comparative Political Studies* 44 (9): 1267–97. <https://doi.org/10.1177/0010414010390653>.
- Gupta, Joyeeta, Catrien Termeer, Judith Klostermann, Sander Meijerink, Margo van den Brink, Pieter Jong, Sibout Nooteboom, and Emmy Bergsma. 2010. The adaptive capacity wheel: A method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science & Policy* 13 (6): 459–71. <https://doi.org/10.1016/j.envsci.2010.05.006>.
- Haas, Peter M. 1993. Epistemic communities and the dynamics of international environmental co-operations. In Volker Rittberger, and Peter Mayer, eds., *Regime Theory and International Relations*. Oxford: Clarendon Press, 168–201.
- Hagedorn, Konrad, ed. 2002. *Environmental Co-Operation and Institutional Change: Theories and Policies for European Agriculture*. *New Horizons in Environmental Economics*. Cheltenham UK: Edward Elgar.
2008. Particular requirements for institutional analysis in nature-related sectors. *European Review of Agricultural Economics* 35 (4): 357–84.
2015. Can the concept of integrative and segregative institutions contribute to the framing of institutions of sustainability? *Sustainability* 7 (1): 584–611. <https://doi.org/10.3390/su7010584>.
- Hakim, D. 2012. Shift by Cuomo on Gas Drilling Prompts Both Anger and Praise. *New York Times*, 30 September 2012.
- Hamilton, Alexander, John Jay, and James Madison. 2009. *The Federalist Papers*. [www.gutenberg.org/files/1404/1404-h/1404-h.htm](http://www.gutenberg.org/files/1404/1404-h/1404-h.htm).
- Hanlon, Jeffery Wyatt. 2015. Maintaining Robust Resource Governance: Mechanisms of Formal Institutional Change in a Federal Bargain. Electronic Dissertation, University of Arizona. <http://hdl.handle.net/10150/577203>.
- Hardin, G. 1968. The tragedy of the commons. *Science* 162 (December 13): 1243–48.
- Hardy, Scott D., and Tomas M. Koontz. 2008. Reducing nonpoint source pollution through collaboration: Policies and programs across the US states. *Environmental Management* 41 (3): 301–10.
- Hauck, Jennifer, Christian Stein, Eva Schiffer, and Marie Vandewalle. 2015. Seeing the forest and the trees: Facilitating participatory network planning in environmental governance. *Global Environmental Change* 35: 400–10.
- Hayek, Friedrich A. 1960. *The Constitutional of Liberty*. Chicago IL: University of Chicago Press.
- Heater, D. B. (2004). *Citizenship: The Civic Ideal in World History, Politics and Education*. Manchester UK: Manchester University Press.

- Heikkila, Tanya, and Christopher M. Weible. 2015. A Summary Report of a 2015 Survey of the Politics of Oil and Gas Development Using Hydraulic Fracturing in Colorado. [www.ucdenver.edu/academics/colleges/SPA/researchandoutreach/SPA%20Institute/Centres/WOPPR/WOPPRresearch/natgasdev/Documents/CO%20Stakeholder%20Report%202015%207-24-15.pdf](http://www.ucdenver.edu/academics/colleges/SPA/researchandoutreach/SPA%20Institute/Centres/WOPPR/WOPPRresearch/natgasdev/Documents/CO%20Stakeholder%20Report%202015%207-24-15.pdf).
2016. Contours of coalition politics on hydraulic fracturing within the United States of America. In Christopher M. Weible, Tanya Heikkila, K. Ingold, and Fischer M., eds., *Policy Debates on Hydraulic Fracturing*. New York: Palgrave Macmillan. 29–52.
2017. Unpacking the intensity of policy conflict: A study of Colorado's oil and gas subsystem. *Policy Sciences* 50 (2): 179–93.
2018. A semiautomated approach to analyzing polycentric governance. *Environmental Policy and Governance* 28(4): 308–18.
- Heikkila, Tanya, Christopher M. Weible, and Jonathan J. Pierce. 2014. Exploring the policy narratives and politics of hydraulic fracturing in New York. In M. D. Jones, E. A. Shanahan, and M. K. McBeth, eds., *The Science of Stories*. New York: Palgrave Macmillan, 185–205.
- Heikkila, Tanya, and Edella Schlager. 2012. Addressing the issues: The choice of environmental conflict-resolution venues in the United States. *American Journal of Political Science* 56 (4): 774–86.
- Heikkila, Tanya, Edella Schlager, and Mark W. Davis. 2011. The role of cross-scale institutional linkages in common pool resource management: Assessing interstate river compacts. *Policy Studies Journal* 39 (1): 121–45.
- Heikkila, Tanya, Jonathan J. Pierce, Samuel Gallahar, Jennifer Kagan Deserai, A. Crow, and Christopher M. Weible. 2014. Understanding a period of policy change: The case of hydraulic fracturing disclosure policy in Colorado. *Review of Policy Research* 31 (2): 65–87.
- Heikkila, Tanya, Sergio Villamayor-Tomás, and Dustin Garrick. 2018. Bringing polycentric systems into focus for environmental governance. *Environmental Policy and Governance* 28 (4): 207–318.
- Henry, A. D., Mark Lubell, and Michael McCoy. 2011. Belief systems and social capital as drivers of policy network structure: The case of California regional planning. *Journal of Public Administration Research and Theory* 21 (3): 419–44.
- Hernandez Garcia, Alberto. 2014. Modernización de regadíos, situación actual y retos de futuro. *iagua*.
- Hernández-Mora, Nuria, and Leandro Del Moral. 2015. Developing markets for water reallocation: Revisiting the experience of Spanish water mercantilización. *Geoforum* 62: 143–55.
- Hernández-Mora, Nuria, and Lucia De Stefano. 2013. Los mercados informales de aguas en España: una primera aproximación. *ponencia presentada en las XVIII Jornadas de Derecho de Aguas Concesiones, autorizaciones y mercados de aguas, Zaragoza*.
- Hirschleifer, Jack. 2001. *The Dark Side of the Force: Economic Foundations of Conflict Theory*. Cambridge, UK; New York: Cambridge University Press.
- Hirschman, Albert O. 1970. *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States*. Cambridge, MA: Harvard University Press.



1971. Introduction: Political economics and possibilism. *A Bias for Hope: Essays on Development and Latin America*. New Haven, CT: Yale University Press.
1986. In defense of possibilism. In *Albert O. Hirschman, ed., Rival Views of Market Society and Other Recent Essays*. Cambridge, MA: Harvard University Press. 171–75.
- Hodgson, Geoffrey M. 2004. *The Evolution of Institutional Economics*. New York: Routledge.
2010. Darwinian coevolution of organizations and the environment. *Ecological Economics* 69 (4): 700–06. <https://doi.org/10.1016/j.ecolecon.2008.06.016>.
- Hooghe, Liesbet, and Gary Marks. 2003. Unraveling the central state, but how? Types of multi-level governance. *American Political Science Review* 97 (02): 233–43.
- Horne, A., and E. O'Donnell. 2014. Decision making roles and responsibility for environmental water in the Murray-Darling Basin. *Australian Journal of Water Resources* 18 (2): 118–32.
- Howell-Moroney, Michael. 2008. The Tiebout hypothesis 50 years later: Lessons and lingering challenges for metropolitan governance in the 21st century. *Public Administration Review* 68 (1): 97–109.
- Huitema, Dave, Erik Mostert, Wouter Egas, Sabine Moellenkamp, Claudia Pahl-Wostl, and Resul Yalcin. 2009. Adaptive water governance: Assessing the institutional prescriptions of adaptive (co-)management from a governance perspective and defining a research agenda. *Ecology and Society* 14 (1).
- Huntjens, Patrick, Claudia Pahl-Wostl, Benoit Rihoux, Maja Schlüter, Zsuzsanna Flachner, Susana Neto, Romana Koskova, Chris Dickens, and Isah Nabide Kiti. 2011. Adaptive water management and policy learning in a changing climate: a formal comparative analysis of eight water management regimes in Europe, Africa and Asia. *Environmental Policy and Governance* 21 (3): 145–63. <https://doi.org/10.1002/eet.571>.
- Innes, Judith E., and David E. Booher. 2010. *Planning with Complexity: An Introduction to Collaborative Rationality for Public Policy*. New York: Routledge.
- Ison, R., C. Blackmore, and B. L. Iaquinto. 2013. Towards systemic and adaptive governance: exploring the revealing and concealing aspects of contemporary social-learning metaphors. *Ecological Economics*, 87, 34–42.
- Jensen, Olivia, and Xun Wu. 2016. Embracing uncertainty in policy-making: The case of the water sector. *Policy and Society* 35 (2): 115–23. <https://doi.org/10.1016/j.polsoc.2016.07.002>.
- Jones, Candace, William S. Hesterly, and Stephen P. Borgatti. 1997. A general theory of network governance: Exchange conditions and social mechanisms. *Academy of Management Review* 22 (4): 911–45.
- Jordan, Andrew, and Dave Huitema. 2014. Policy innovation in a changing climate: Sources, patterns and effects. *Global Environmental Change-Human and Policy Dimensions* 29: 387–94. <https://doi.org/10.1016/j.gloenvcha.2014.09.005>.
- Jordan, Andrew J., Dave Huitema, Harro van Asselt, and Johanna Forster. 2018. *Governing Climate Change*. Cambridge University Press.
- Jordan, Andrew J., Dave Huitema, Mikael Hildén, Harro van Asselt, Tim J. Rayner, Jonas J. Schoenefeld, Jale Tosun, Johanna Forster, and Elin L. Boasson. 2015.

- Emergence of polycentric climate governance and its future prospects. *Nature Climate Change* 5 (11): 977–82. <https://doi.org/10.1038/NCLIMATE2725>.
- Jupille, J., J. T. Checkel, and J. A. Caporaso. 2003. Integrating institutions: Rationalism, constructivism and the study of the European Union. *Comparative Political Studies* 36 (1/2): 7–40.
- Kaplan, Thomas. 2014. Citing health risks, Cuomo bans fracking in New York state. *New York Times*, 17 December 2014.
- Kauffman, Stuart. 1995. *At Home in the Universe: The Search for Laws of Self-Organization and Complexity*. Oxford University Press.
- Kauffman, Stuart, and Simon Levin. 1987. Towards a general theory of adaptive walks on rugged landscapes. *Journal of theoretical Biology* 128 (1): 11–45.
- Keast, Robyn, Myrna, P., Kerry Brown Mandell, and Geoffrey Woolcock. 2004. Network structures: Working differently and changing expectations. *Public Administration Review* 64 (3): 363–71.
- Kendy, Eloise, Bruce Aylward, Laura S. Ziemer, Brian D. Richter, Bonnie G. Colby, Theodore E. Grantham, Leslie Sanchez, Will B. Dicharry, Emily M. Powell, and Season Martin. 2018. Water transactions for streamflow restoration, water supply reliability, and rural economic vitality in the western United States. *JAWRA Journal of the American Water Resources Association* 54 (2): 487–504.
- Kerber, Heide. 2017. Marine Litter and the Commons: How Can Effective Governance Be Established? Biennial conference of the International Association for the Study of the Commons, July 10. Utrecht, the Netherlands.
- Kerr, John. 2007. Watershed management: Lessons from common property theory. *International Journal of the Commons* 1 (1): 89–109.
- Kiser, Larry L., and E. Ostrom. 1982. The three worlds of action: A metatheoretical synthesis of institutional approaches. In E. Ostrom, ed., *Strategies of Political Inquiry*. Beverly Hills, CA: SAGE Publications Limited, 179–222.
- Kiparsky, Michael, Anita Milman, Dave Owen, and Andrew T. Fisher. 2017. The importance of institutional design for distributed local-level governance of groundwater: The case of California's Sustainable Groundwater Management Act. *Water* 9 (10): 755.
- Kneese, Allen V. 1968. The problem shed as a unit for environmental control. *Archives of Environmental Health: An International Journal* 16 (1): 124–27.
- Knieper, Christian, and Claudia Pahl-Wostl. 2016. A comparative analysis of water governance, water management, and environmental performance in river basins. *Water Resources Management* 30 (7): 2161–77. <https://doi.org/10.1007/s11269-016-1276-z>.
- Knight, Jack. 1992. *Institutions and Social Conflict*. Cambridge: Cambridge University Press.
- Koehler, Brandi, and Tomas M. Koontz. 2008. Citizen participation in collaborative watershed partnerships. *Environmental Management* 41 (2): 143–54. <https://doi.org/10.1007/s00267-007-9040-z>.
- Konisky, David M. 2007. Regulatory competition and environmental enforcement: Is there a race to the bottom? *American Journal of Political Science* 51 (4): 853–72. <https://doi.org/10.1111/j.1540-5907.2007.00285.x>.
- Koontz, Tomas M. 2004. *Collaborative Environmental Management: What Roles for Government?* Washington, DC: Resources for the Future.

2014. Social learning in collaborative watershed planning: The importance of process control and efficacy. *Journal of Environmental Planning and Management* 57 (10): 1572–93.
- Koontz, Tomas M., and Craig Thomas. 2006. What do we know and need to know about the environmental outcomes of collaborative management? *Public Administration Review* 66 (6): 111–21.
2016. The Role of Science in Collaborative Environmental Management: Top Down and Bottom Up Efforts. Paper presented at Midwest Political Science Association annual meeting, April 8–10, Chicago.
- Use of science in collaborative environmental management: Evidence from local watershed partnerships in the Puget Sound. *Environmental Science and Policy* 88: 17–23.
- Koontz, Tomas M., Divya Gupta, Pranietha Mudliar, and Pranay Ranjan. 2015. Adaptive institutions in social-ecological systems governance: A synthesis framework. *Environmental Science & Policy* 53. <https://doi.org/10.1016/j.envsci.2015.01.003>.
- Koontz, Tomas M., and Jens Newig. 2014. From planning to implementation: Top down and bottom up approaches for collaborative watershed management. *Policy Studies Journal* 42 (3): 416–42.
- Koontz, Tomas M., JoAnn Carmin, Toddi A. Steelman, Craig Thomas, Katrina Smith Korfmacher, and Moseley Cassandra. 2004. *Collaborative Environmental Management: What Roles for Government?* Washington, D.C. Resources for the Future Press.
- Koontz, Tomas M., and Sucharita Sen. 2013. Community responses to government defunding of watershed projects: A comparative study in India and the USA. *Environmental Management* 51 (3): 571–85.
- Korfmacher, Katrina Smith. 1998. Invisible successes, visible failures: Paradoxes of ecosystem management in the Albemarle-Pamlico estuarine study. *Coastal Management* 26: 191–211.
- Korhonen, J., and T. P. Seager. 2008. Beyond eco-efficiency: A resilience perspective. *Business Strategy and Management* 17 (7): 411–19.
- Landau, Martin. 1969. Redundancy, rationality, and the problem of duplication and overlap. *Public Administration Review* 29 (4): 346. <https://doi.org/10.2307/973247>.
1973. Federalism, redundancy, and system reliability. *The Journal of Federalism* 3 (2): 173–96.
- Lankford, Bruce, and Nick Hepworth. 2010. The cathedral and the bazaar: Monocentric and polycentric river basin management. *Water Alternatives* 3 (1): 82–101.
- Lankford, Bruce A., Douglas J. Merrey, Julien Cour, and Nick Hepworth. 2007. *From Integrated to Expedient: An Adaptive Framework for River Basin Management in Developing Countries*. Colombo, Sri Lanka: International Water Management Institute.
- Lawson, Tony. 2012. Ontology and the study of social reality: Emergence, organisation, community, power, social relations, corporations, artefacts and money. *Cambridge Journal of Economics* 36 (2): 345–85.
- Leach, William D., and Neil W. Pelkey. 2001. Making watershed partnerships work: A review of the empirical literature. *Journal of Water Resources Planning and Management* 127 (6): 378–85. [https://doi.org/10.1061/\(ASCE\)0733-9496\(2001\)127:6\(378\)](https://doi.org/10.1061/(ASCE)0733-9496(2001)127:6(378)).

- Lecina, S., D. Isidoro, E. Playán, and R. Aragüés. 2010. Irrigation modernization and water conservation in Spain: The case of Riegos del Alto Aragón. *Agricultural Water Management* 97 (10): 1663–75.
- Lepenies, Philipp H. 2008. Possibilism: An approach to problem-solving derived from the life and work of Albert O. Hirschman. *Development and Change* 39 (3): 437–59.
- Lesson, Peter T., and Peter J. Boettke. 2009. Two-tiered entrepreneurship and economic development. *International Review of Law and Economics* 29 (3): 252–59.
- Levi, Margaret (2009) Reconsiderations of rational choice in comparative and historical analysis. In Lichbach, M. I., and Zuckerman, A. S., eds., (2007). *Comparative Politics: Rationality, Culture and Structure*. Cambridge, UK: Cambridge University Press.
- Levi, Simon, ed. 2009. *The Princeton Guide to Ecology*. Princeton, NJ: Princeton University Press.
- Levin, S. A. 1998. Ecosystems and the biosphere as complex adaptive systems. *Ecosystems* 1 (5): 431–36. [www.scopus.com/inward/record.url?eid=2-s2.0-0000519269&partnerID=40&md5=3204204de11c8d57f167763bbcf73105](http://www.scopus.com/inward/record.url?eid=2-s2.0-0000519269&partnerID=40&md5=3204204de11c8d57f167763bbcf73105).
- Lieberman, Evan S. 2011. The perils of polycentric governance of infectious disease in South Africa. *Social Science & Medicine* (1982) 73 (5): 676–84. <https://doi.org/10.1016/j.socscimed.2011.06.012>.
- Lin, J. Y. 1989. An economic theory of institutional change: Induced and imposed change. *Cato Journal* 9 (1): 1–33.
- LIO 1. 2016. *Memo: A Proposal to Restructure*.
- Loehman, Edna T, and Sasha Charney. 2011. Further down the road to sustainable environmental flows: Funding, management activities and governance for six western US states. *Water International* 36 (7): 873–93.
- Low, Bobbi, E. Ostrom, and James Wilson. 2003. Redundancy and diversity: Do they influence optimal management? In Fikret Berkes, Johan Colding, and Carl Folke, eds., *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. New York: Cambridge University Press, 83–114.
- Lubell, Mark. 2004. Collaborative environmental institutions: All talk and no action? *Journal of Policy Analysis and Management* 23 (3): 549–73. <https://doi.org/10.1002/pam.20026>.
2013. Governing institutional complexity: The ecology of games framework. *Policy Studies Journal* 41 (3): 537–59. <https://doi.org/10.1111/psj.12028>.
- Lubell, Mark, A. D. Henry, and Mike McCoy. 2010. Collaborative Institutions in an ecology of games. *American Journal of Political Science* 54 (2): 287–300.
- Lubell, Mark, Garry Robins, and Peng Wang. 2014. Network structure and institutional complexity in an ecology of water management games. *Ecology and Society* 19 (4).
- Lurie, S., and M. Hibbard. 2008. Community-based natural resource management: Ideals and realities in Oregon watershed councils. *Society and Natural Resources: An International Journal* 21 (5): 430–40.
- Mac Odell. *Appreciative Planning and Action: Mission Statement*. [www.macodell.com/page-Appreciative-Planning](http://www.macodell.com/page-Appreciative-Planning).
- Malik, A. 2013. Reconciliation between Muslims and Christians: Collective action, norm entrepreneurship, and ‘A Common Word between Us’. *Journal of Religious Ethics* 41 (3): 457–73.

2017. Polycentricity and cultural diversity. In F. Sabetti, and D. Castiglione, eds., *Political Theory, Policy Analysis and Institutional Creativity: Extending the Work of the Bloomington School*. Lanham, MD: Lexington Books, 107–28
2018. *Polycentricity, Islam, and Development: Potentials and Challenges in Pakistan*. Lanham, MD: Lexington Books.
- Margerum, Richard D. 2011. *Beyond Consensus: Improving Collaboration to Solve Complex Public Problems*. Cambridge, MA: MIT Press.
- Marsh, David. 1992. *Policy Networks in British Government*. Oxford: Clarendon Press. [www.gbv.de/dms/bowker/toc/9780198278528.pdf](http://www.gbv.de/dms/bowker/toc/9780198278528.pdf).
- Marshall, G. R. 2002. Institutionalising cost sharing for catchment management: Lessons from land and water management planning in Australia. *Water, Science and Technology* 45 (11): 101–11.
2005. *Economics for Collaborative Environmental Management: Renegotiating the Commons*. London: Earthscan.
2008. Nesting, subsidiarity, and community-based environmental governance beyond the local level. *International Journal of the Commons* 2 (1): 75–97.
2009. Polycentricity, reciprocity, and farmer adoption of conservation practices under community-based governance. *Ecological Economics* 68 (5): 1507–20.
2010. Governance for a surprising world. In S. Cork, ed., *Resilience and Transformation: Preparing Australia for Uncertain Futures*. Melbourne: CSIRO Publishing, 49–57.
2011. What ‘community’ means for farmer adoption of conservation practices. In D. J. Pannell, and F. M. Vanclay, eds., *Changing Land Management: Adoption of New Practices by Rural Landholders*. Melbourne: CSIRO Publishing, 107–27.
2015. Polycentricity, subsidiarity and adaptive efficiency. A paper presented to the international workshop on polycentricity, Ostrom Workshop in Political Theory and Policy Analysis, Indiana University, Bloomington, Indiana USA, 14–17 December.
2017. Cost-effective environmental water for NSW wetlands and rivers. Final report to the NSW Environmental Trust. Armidale: University of New England.
- Marshall, G. R., and D. M. Stafford Smith. 2010. Natural resources governance for the drylands of the Murray-Darling Basin. *The Rangeland Journal* 32 (3): 267–82.
- Marshall, Graham R., D. W. Hine, and M. J. East. 2017. Can community-based governance strengthen citizenship in support of climate change adaptation? Testing insights from self-determination theory. *Environmental Science and Policy* 72: 1–9. <https://doi.org/10.1016/j.enviros.2017.02.010>.
- Marshall, Graham R., Michael J. Coleman, Brian M. Sindel, Ian J. Reeve, and Peter J. Berney. 2016. Collective action in invasive species control, and prospects for community-based governance: The case of serrated tussock (*Nassella trichotoma*) in New South Wales, Australia. *Land Use Policy* 56: 100–11. <https://doi.org/10.1016/j.landusepol.2016.04.028>.
- McCord, Paul, Jampel Dell’Angelo, Elizabeth Baldwin, and Tom Evans. 2016. Polycentric transformation in Kenyan water governance: A dynamic analysis of institutional and social-ecological change. *Policy Studies Journal*. <https://doi.org/10.1111/psj.12168>.
- McCoy, Amy L., S. Rankin Holmes, and Brett A. Boisjolie. 2018. Flow restoration in the Columbia River Basin: An evaluation of a flow restoration accounting framework. *Environmental management* 61 (3) : 506–19.

- McGinnis, Michael. 1999a. *Polycentric Governance and Development*. Ann Arbor, MI: University of Michigan Press.
- 1999b. *Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis*. Ann Arbor, MI: University of Michigan Press.
2000. *Polycentric Games and Institutions*. Ann Arbor, MI: University of Michigan Press.
- 2005a. Beyond individualism and spontaneity: Comments on Peter Boettke and Christopher Coyne. *Journal of Economic Behavior & Organization* 57 (2): 167–72. <https://doi.org/10.1016/j.jebo.2004.06.014>.
- McGinnis, Michael D. 2005b. Costs and Challenges of Polycentric Governance. Workshop on Analyzing Problems of Polycentric Governance in the Growing EU, Berlin, June 16.
- 2011a. An introduction to IAD and the language of the Ostrom workshop: A simple guide to a complex framework. *Policy Studies Journal* 39 (1): 169–83. <https://doi.org/10.1111/j.1541-0072.2010.00401.x>.
- 2011b. Networks of adjacent action situations in polycentric governance. *Policy Studies Journal* 39 (1): 51–78.
2015. Elinor Ostrom: Politics as problem-solving in polycentric settings. In Cole, Daniel H., and Michael D. McGinnis, eds. 2015. *Elinor Ostrom and the Bloomington School of Political Economy*. Lanham, MD: Lexington Books, 281–306.
2016. Polycentric Governance in Theory and Practice: Dimensions of Aspiration and Practical Limitations. Paper presented at Ostrom Workshop, Indiana University, Bloomington.
- McGinnis, Michael D., and Elinor Ostrom. 2012. Reflections on Vincent Ostrom, public administration, and polycentricity. *Public Administration Review* 72 (1): 15–25. <https://doi.org/10.1111/j.1540-6210.2011.02488.x>.
- McPhail, Edward, and Vlad Tarko. 2017. The evolution of governance structures in a polycentric system. In Morris Altman, ed., *Handbook of Behavioral Economics and Smart Decision-Making: Rational Decision-Making within the Bounds of Reason*. Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 290–313.
- Milman, Anita, and Christopher A. Scott. 2010. Beneath the surface: Intrnational institutions and management of the United States–Mexico transboundary Santa Cruz aquifer. *Environment and Planning C: Government and Policy* 28 (3) 528–51.
- Milward, H. B., K. G. Provan, and B. A. Else. 1993. What does the hollow state look like? In B. Bozeman ed., *Public Management: The State of the Art*. San Francisco, CA: Jossey-Bass, 309–32.
- MIMA. 2001. Real Decreto Legislativo 1/2001, de 20 de julio, por el que se aprueba el texto refundido de la Ley de Aguas. Ed, Boletín Oficial del Estado. Madrid: BOE.
- MOA. 21 January 1997. *New York City Watershed Memorandum of Agreement*.
- Mohamud, Abdirahman Mohamed, and Amina Abdulkadir M Nur. 2007. The Puntland Experience: A Bottom up Approach to Peace and State Building. Garowe, Puntland: Interpeace and the Puntland Development Research Center (chapter in forthcoming publication).

- Moriarty, Patrick, Charles Batchelor, Peter Laban, and Hazem Fahmy. 2010. Developing a practical approach to light IWRM in the Middle East. *Water Alternatives* 3 (1): 122–36.
- Morrison, Tiffany H., W. Neil Adger, Katrina Brown, Maria Carmen Lemos, Dave Huitema, and Terry P. Hughes. 2017. Mitigation and adaptation in polycentric systems: sources of power in the pursuit of collective goals. *Wiley Interdisciplinary Reviews: Climate Change* 8 (5).
- Moschitz, Heidrun. 2009. Moving on-European organic farming movements between political action and self-reflection. *International Journal of Agricultural Resources, Governance and Ecology* 8 (5–6): 371–87.
- Moss, Timothy. 2012. Spatial fit, from panacea to practice: Implementing the EU water framework directive. *Ecology and Society* 17 (3): 2.
- Mueller, Dennis C. 2003. *Public Choice III*. Cambridge: Cambridge University Press. [www.gbv.de/dms/bowker/toc/9780521815468.pdf](http://www.gbv.de/dms/bowker/toc/9780521815468.pdf).
- Muro, Melanie, and P. Jeffrey. 2012. Time to talk? How the structure of dialog processes shape stakeholder learning in participatory water resources management. *Ecology and Society* 17 (1).
- Myint, Tun. 2012. *Governing International Rivers: Polycentric Politics in the Mekong and the Rhine*. Cheltenham: Edward Elgar Publications.
- Nagendra, Harini, and Elinor Ostrom. 2012. Polycentric governance of multifunctional forested landscapes. *International Journal of the Commons* 6 (2): 104–33.
- NCDD. 2017. NCDD Resource Center. National Conference on Dialogue and Deliberation. <http://ncdd.org/rc/>
- New York City Independent Budget Office. The Impact of Catskill/Delaware Filtration on Residential Water and Sewer Charges in New York City. [www.ibo.nyc.ny.us/iboreports/waterreport.pdf](http://www.ibo.nyc.ny.us/iboreports/waterreport.pdf).
- Newig, Jens, Daniel Schulz, and Nicolas W. Jager. 2016. Disentangling puzzles of spatial scales and participation in environmental governance – the case of governance re-scaling through the European Water Framework Directive. *Environmental Management* 58 (6): 998–1014. <https://doi.org/10.1007/s00267-016-0753-8>.
- Niskanen, William A. 1994. *Bureaucracy and Public Economics*. Aldershot, Hants, UK: Brookfield, VT, USA: Edward Elgar.
- Norberg, Jon, and Graeme S. Cumming. 2008. *Complexity Theory for a Sustainable Future*. New York: Columbia University Press.
- North, Douglass Cecil. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
1993. Institutions and credible commitment. *Journal of Institutional and Theoretical Economics* 149 (1): 11–23.
1994. *Institutional Change: A Framework of Analysis Economic History*. Accessed: 10 October 10 2007. <http://ideas.repec.org/p/wpa/wuwpeh/9412001.html#provider>.
2005. *Understanding the Process of Institutional Change*. Princeton, New Jersey: Princeton University Press.
- O'Donnell, E., and D. Garrick. 2017. Defining success: A multi-criteria approach to guide evaluation and investment. In A. Horne, M. Stewardson, A. Webb, B. Richter, and M. Acreman., eds., *Water for the Environment*. Amsterdam: Elsevier, 625–45.

- Oakerson, Ronald J. 1999. *Governing Local Public Economies: Creating the Civic Metropolis*. Oakland, CA: ICS Press.
- Oakerson, Ronald, and Roger B. Parks. 1988. Citizen voice and public entrepreneurship: The organisational dynamic of a complex metropolitan county. *Publius: The Journal of Federalism* 18 (4): 91–112.
2011. The study of local public economies: Multi-organizational, multi-level institutional analysis and development. *Policy Studies Journal* 39 (1): 147–67. <https://doi.org/10.1111/j.1541-0072.2010.00400.x>.
- Obinger, Herbert. 2015. Funktionalismus. In Georg Wenzelburger, and Reimut Zohnhöfer, eds., *Handbuch Policy-Forschung*. Springer VS Handbuch. Wiesbaden: Springer VS, 35–54.
- Olson, Mancur. 1965. *The Logic of Collective Action*. Cambridge, MA: Harvard University Press.
1994. *The Logic of Collective Action: Public Goods and the Theory of Groups*. Harvard University Press 1971, Reprinted.
- Ostrom, Elinor. 1983. A public service industry approach to the study of local government structure and performance. *Policy and Politics* 11 (3): 313–41. <https://doi.org/10.1332/030557383782628599>.
1986. Multiorganizational arrangements and coordination: an application of institutional analysis. In F. X Kaufmann, Giandomenico Majone, and V. Ostrom, eds., *Guidance, Control, and Evaluation in the Public Sector*. Berlin: De Gruyter, 495–510.
1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.
1998. A behavioral approach to the rational choice theory of collective action. *American Political Science Review* 92 (1): 1–22.
1999. Polycentricity, complexity, and the commons. *The Good Society* 9 (2): 37–41.
2000. Crowding out citizenship. *Scandinavian Political Studies* 23 (1): 3–15.
2001. Vulnerability and Polycentric Governance Systems. *Newsletter of the International Human Dimensions Program on Global Environmental Change* 3: 2.
2002. *The Drama of the Commons*. Washington, DC: National Academies Press.
- 2005a. *Understanding Institutional Diversity*. Princeton: Princeton University Press.
- 2005b. Policies that crowd out reciprocity and collective action. In H. Gintis, S. Bowles, R. Boyd, and E. Fehr, eds., *Moral Sentiments and Material Interests: The Foundations of Cooperation in Economic Life*. Cambridge, MA: MIT Press, 253–75.
2007. Collective action theory. In Carles Boix, and Susan C. Stokes, eds., *The Oxford Handbook of Comparative Politics*. Oxford; New York: Oxford University Press.
2009. A general framework for analyzing sustainability of social-ecological systems. *Science* 325 (5939): 419–22. <https://doi.org/10.1126/science.1172133>.
2010. Beyond markets and states: Polycentric governance of complex economic systems. *American Economic Review* 100 (3): 641–72.
2011. Background on the institutional analysis and development framework. *Policy Stud Journal* 39 (1): 7–27. <https://doi.org/10.1111/j.1541-0072.2010.00394.x>.



2012. Nested externalities and polycentric institutions: Must we wait for global solutions to climate change before taking actions at other scales? *Economic theory* 49 (2): 353–69.
- 2014a. A frequently overlooked precondition of democracy: citizens knowledgeable about and engaged in collective action. In Cole, Daniel H., and Michael D. McGinnis, eds. 2014. *Elinor Ostrom and the Bloomington School of Political Economy, Volume 1: Polycentricity in Public Administration and Political Science*: Lanham, MD: Lexington Books, 337–52.
- 2014b. Developing a method for analyzing institutional change. In Cole, Daniel H., and Michael D. McGinnis, eds. 2014. *Elinor Ostrom and the Bloomington School of Political Economy, Volume 1: Polycentricity in Public Administration and Political Science*: Lanham, MD: Lexington Books. 281–316.
- Ostrom, Elinor, Larry Schroeder, and Susan Wynne. 1993. Polycentric institutional arrangements. In E. Ostrom, L. Schroeder, and S. Wynne, eds., *Institutional Incentives and Sustainable Development* Boulder, CO: Westview Press, 107–123.
- Ostrom, Elinor, Marco A. Janssen, and John M. Anderies. 2007. Introduction: Going beyond panaceas. *Proceedings of the National Academy of Sciences* 104 (39): 15176–8.
- Ostrom, Elinor, Roy Gardner, and Jimmy Walker. 1994. *Rules, Games and Common-Pool Resources*. Ann Arbor: The University of Michigan Press.
- Ostrom, Elinor, and Xavier Basurto. 2011. Crafting analytical tools to study institutional change. *Journal of Institutional Economics* 7 (03): 317–43. <https://doi.org/10.1017/S1744137410000305>.
- Ostrom, Vincent. 1962. The water economy and its organization. *Natural Resources Journal* 2 (4): 55–73.
1972. *Polycentricity*. Paper presented at Annual Meeting of the American Political Science Association.
1980. Artisans and Artifact. *Public Administration Review* 40 (4): 309–17.
1987. *The Political Theory of Compound Republic: Designing the American Experiment*, 3rd ed. Lanham, MD: Lexington Books.
- 1991a. *The Meaning of American Federalism: Constituting a Self-Governing Society*. San Francisco, CA: Institute for Contemporary Studies Press.
- 1991b. Polycentricity: The structural basis of self-governing systems. In *The Meaning of American Federalism: Constituting a Self-Governing Society*. San Francisco, CA: Institute for Contemporary Studies Press. 223–48.
1997. *The Meaning of Democracy and the Vulnerability of Democracies. A Response to Tocqueville's Challenge*. Ann Arbor: The University of Michigan Press.
- 1999a. Polycentricity (Part 1). In McGinnis, Michael. 1999. *Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis*. Ann Arbor, MI: University of Michigan Press, 52–74.
- 1999b. Polycentricity (Part 2). In McGinnis, Michael. 1999. *Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis*. Ann Arbor, MI: University of Michigan Press, 119–38.
- 2008a. *The Intellectual Crisis in American Public Administration*. 3rd edn. Tuscaloosa, USA: University of Alabama Press.
- 2008b. *The Political Theory of a Compound Republic: Designing the American Experiment*. Lanham, MD: Lexington Books.

2015. Executive leadership, authority relationships, and public entrepreneurship. In Cole, Daniel H., and Michael D. McGinnis, eds. 2015. *Elinor Ostrom and the Bloomington School of Political Economy*. Lanham, MD: Lexington Books, 217–32.
- Ostrom, Vincent, Charles M. Tiebout, and Robert Warren. 1961. The organization of government in metropolitan areas: A theoretical inquiry. *American Political Science Review* 55 (4): 831–42.
- Ostrom, Vincent, and Elinor Ostrom. 1999. Public goods and public choices. In McGinnis, Michael. 1999. *Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis*. Ann Arbor, MI: University of Michigan Press, 75–106.
- Paavola, Jouni. 2007. Institutions and Environmental Governance: A Reconceptualization. *Ecological Economics* 63 (1): 93–103.
- Pacheco-Vega, Raúl. 2012. *Governing Wastewater: A Cross-Regional Analysis within the Lerma-Chapala River Basin in Mexico*. Canadian Association of Latin American and Caribbean Studies (CALACS) 2012 (May 18th–20th, 2012. Kelowna, BC, Canada)
2013. *Polycentric Water Governance in Mexico: Beyond the Governing-by-River-Basin-Council Model*: 1–30. Paper presented in the 2013 Meeting of the Latin American Studies Association Meeting. Washington, D.C. 29 May–June 1 2013.
- Pahl-Wostl, Claudia. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change-Human and Policy Dimensions* 19 (3): 354–65.
2015. *Water Governance in the Face of Global Change: From Understanding to Transformation*: Springer.
- Pahl-Wostl, Claudia, Angela Arthington, Janos Bogardi, Stuart E. Bunn, Holger Hoff, Louis Lebel, Elena Nikitina, M. Palmer, L. N. Poff, K. Richards, and M. Schlüter M. 2013. Environmental flows and water governance: Managing sustainable water uses. *Current Opinion in Environmental Sustainability* 5 (3–4): 341–51.
- Pahl-Wostl, Claudia, and Christian Knieper. 2014. The capacity of water governance to deal with the climate change adaptation challenge: Using fuzzy set qualitative comparative analysis to distinguish between polycentric, fragmented and centralized regimes. *Global Environmental Change* 29: 139–54. <https://doi.org/10.1016/j.gloenvcha.2014.09.003>.
- Pahl-Wostl, Claudia, and Hare, M., 2004. Processes of social learning in integrated resources management. *Journal of Community and Applied Social Psychology* 14, 193–206.
- Pahl-Wostl, Claudia, Louis Lebel, Christian Knieper, and Elena Nikitina. 2012. From applying panaceas to mastering complexity: Toward adaptive water governance in river basins. *Environmental Science & Policy* 23: 24–34.
- Palomo-Hierro, Sara, José A Gómez-Limón, and Laura Riesgo. 2015. Water markets in Spain: performance and challenges. *Water* 7 (2): 652–78.
- Parks, Roger B., and Ronald J. Oakerson. 2000. Regionalism, localism, and metropolitan governance: Suggestions from the research program on local public economies. *State & Local Government Review* 32 (3): 169–79.

- Pascale, Richard, Jerry Sternin, and Monique Sternin. 2010. *The Power of Positive Deviance: How Unlikely Innovators Solve the World's Toughest Problems*. Brighton, MA: Harvard Press Business Review.
- Pelletier, L. G., D. Baxter, and V. Huta. 2011. Personal autonomy and environmental sustainability. In Chirkov, V. I., R. M. Ryan, and K. M. Sheldon, eds. 2011. *Human Autonomy in Cross-Cultural Contexts: Perspectives on the Psychology of Agency, Freedom and Well-Being*. Dordrecht: Springer, 257–77.
- Perez Picazo, Maria Teresa, and Guy Lemeunier. 2000. Formation et mise en cause du modèle de gestion hydraulique espagnol de 1780 a 2000. *Economies et Sociétés* no. Hors-Série:85.
- Peters, B. Guy. 2015. *Pursuing Horizontal Management: The Politics of Public Sector Coordination*. Lawrence, KS: University Press of Kansas.
- Peters, B. Guy, and Jon Pierre. 2004. Multi-level governance and democracy: A Faustian bargain? In Ian Bache, and Matthew V. Flinders, eds., *Multi-Level Governance*. Oxford; New York: Oxford University Press, 75–89.
- Pierce, Jonathan J., Jennifer Kagan, Tanya Heikkila, Christopher M. Weible, and Samuel Gallahar. 2013. *A Summary Report of Perceptions of the Politics and Regulation of Hydraulic Fracturing in Colorado*. Denver, CO: University of Colorado.
- Pierson, Paul. 2000. The limits of design: Explaining institutional origins and change. *Governance* 13 (4): 475–99. <https://doi.org/10.1111/0952-1895.00142>.
- Platt, R. H., P. K. Barten, and M. J. Pfeffer. 2010. A full, clean glass? Managing New York City's watershed. *Environment: Science and Policy for Sustainable Development* 42 (5): 8–20.
- Polanyi, Karl. 1953. *Semantics of General Economic History (Revised)*. New York: Colombia University Press.
- Polanyi, Michael. 1951. *The Logic of Liberty*. Chicago, IL: University of Chicago Press. 1964. *Science, Faith, and Society*. Chicago, IL: University of Chicago Press.
- Postel, Sandra, and Stephen Carpenter. 1997. Freshwater ecosystem services. In Daily, Gretchen C., ed., *Nature's Services: Societal Dependence on Natural Ecosystems*. Washington DC: Island Press, 195–214.
- Poteete, A. R., M. A. Janssen, and E. Ostrom. 2010. *Working Together: Collective Action, the Commons, and Multiple Methods in Practice*. Princeton: Princeton University Press.
- Poussard, H. (ed.) 1992. Community Landcare to test government policies and programs. In *Proceedings of the seventh International Soil Conservation conference: People protecting their land*. Sydney, Australia, April 10, 1992.
- Prell, Christina, Klaus Hubacek, and Mark Reed. 2009. Stakeholder analysis and social network analysis in natural resource management. *Society and Natural Resources* 22 (6): 501–18.
- Pressman, Jeffrey L., and Aaron B. Wildavsky. 1984. *Implementation: How Great Expectations in Washington are Dashed in Oakland: Or Why It's Amazing that Federal Programs Work at All, This Being a Saga of the Economic Development Administration as Told by Two Sympathetic Observers Who Seek to Build Morals on a Foundation of Ruined Hopes*. California: University of California Press.

- Prokopy, Linda Stalker, Nathan Mullendore, Kathryn Brasier, and Kristin Floress. 2014. A typology of catalyst events for collaborative watershed management in the United States. *Society & Natural Resources* 27 (11): 1177–91. <https://doi.org/10.1080/08941920.2014.918230>.
- Puget Sound Partnership. 2014. Briefing Memo: LIO Organization History. Puget Sound Partnership, Tacoma, Washington DC.
2016. *Puget Sound Partnership Understanding of the Value of Local Integrating Organizations Regarding LIO Ecosystem Recovery Plans*.
2017. State of the Sound 2017. Olympia, Washington. November 2017. [www.psp.wa.gov/so](http://www.psp.wa.gov/so)
- Purdy, J. M. 2012. A framework for assessing power in collaborative governance processes. *Public Administration Review* 72 (3): 409–17.
- Quiggin, J. 2011. Why the guide to the proposed basin plan failed, and what can be done to fix it. In J. Quiggin, T. Mallawaarachchi, and S. Chambers, eds., *Water Policy Reform: Lessons in Sustainability from the Murray-Darling Basin*. Cheltenham, UK: Edward Elgar.
- Rada, J. 2007. Managing Garfield County's Air Quality: 2008 Air Monitoring Proposal. *Garfield County*.
- Rajagopalan, Shruti. 2013. Economic Analysis of Amendments to the Indian Constitution. Economics Department, George Mason University. <http://hdl.handle.net/1920/8223>.
- Rajagopalan, Shruti, and Richard E Wagner. 2013. Constitutional craftsmanship and the rule of law. *Constitutional Political Economy* 24 (4): 295–309.
- Rast, J. (2012). Why history (still) matters: Time and temporality in urban political analysis. *Urban Affairs Review* 48 (1): 3–36. <https://doi.org/10.1177/1078087411418178>
- Ratner, Blake D., and William E. Smith. 2014. Collaborating for Resilience: A Practitioner's Guide. Manual. *Collaborating for Resilience*.
- Rayner, Tim, and Andrew Jordan. 2013. The European Union: The polycentric climate policy leader? *WIREs Climate Change* 4 (2): 75–90. <https://doi.org/10.1002/wcc.205>.
- Reed, Mark S., Anil Graves, Norman Dandy, Helena Posthumus, Klaus Hubacek, Joe Morris, Christina Prell, Claire H. Quinn, and Lindsay C. Stringer. 2009. Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management* 90 (5): 1933–49.
- Reeve, I., G. R. Marshall, and W. Musgrave. 2002. Resource Governance and Integrated Catchment Management. Issues Paper no. 2 for Murray-Darling Basin Commission project MP2004.
- Regional Implementation Working Group of the NRM Ministerial Council. 2005. Regional delivery of natural resource management - Moving forward. NRM Ministerial Council, Canberra.
- Richter, Brian D., and Gregory A. Thomas. 2007. Restoring environmental flows by modifying dam operations. *Ecology and Society* 12 (1): 12.
- Rinfret, Sara, Jeffrey Cook, and Michelle Pautz. 2014. Understanding state rulemaking processes: Developing fracking rules in Colorado, New York, and Ohio. *Review of Policy Research* 31 (2): 88–104.

- Rixen, T., & Viola, L. A. (2015). Putting path dependence in its place: Toward a taxonomy of institutional change. *Journal of Theoretical Politics* 27(2): 301–23.
- Rodriguez, C. 2014. Negotiating conflict through federalism: Institutional and popular perspectives. *Yale Law Journal* 124: 2094.
- Roe, Emery, and Paul R. Schulman. 2008. *High Reliability Management: Operating on the Edge*. (High Reliability and Crisis Management). Stanford, CA: Stanford Business Books, an imprint of Stanford University Press.
- Rust, Joshua. 2006. *John Searle and the Construction of Social Reality*. London: Continuum.
- Ryan, C. M., and J. S. Klug. 2005. Collaborative watershed planning in Washington State: Implementing the Watershed Planning Act. *Journal of Environmental Planning and Management* 48 (4): 491–506.
- Ryan, R. M., and E. L. Deci. 2011. A self-determination theory perspective on social, institutional, cultural, and economic supports for autonomy and their importance for well-being. In Chirkov, V. I., R. M. Ryan, and K. M. Sheldon, eds. 2011. *Human Autonomy in Cross-Cultural Contexts: Perspectives on the Psychology of Agency, Freedom and Well-Being*. Dordrecht: Springer, 45–64.
- Ryan, S., K. Broderick, Y. Sneddon, and K. Andrews. 2010. Australia's NRM governance system: Foundations and principles for meeting future challenges. Australian Regional NRM Chairs, Canberra
- Sabatier, Paul A., and Christopher M. Weible. 2016. The advocacy coalition framework: Innovations and clarifications. In P. A. Sabatier, ed., *Theories of the Policy Process*, 2nd edn., New York: Routledge, 189–217.
- Sabatier, Paul A., Will Focht, Mark Lubell, Zev Trachtenberg, Arnold Vedlitz, and Marty Matlock. 2005. *Swimming Upstream: Collaborative Approaches to Watershed Management*. Cambridge, MA: MIT Press.
- Sabetti, Filippo, Barbara Allen, and Mark Sproule-Jones. 2009. *The Practice of Constitutional Development: Vincent Ostrom's Quest to Understand Human Affairs*. Lanham, MD: Lexington Books.
- Sabetti, Filippo, and Dario Castiglione, eds. 2017. *Institutional Diversity in Self-Governing Societies: The Bloomington School and Beyond*. Lanham, MD: Lexington Books.
- Salter, Alexander William, and Vlad Tarko. 2017. Polycentric banking and macroeconomic stability. *Business and Politics* 19 (02): 365–95. <https://doi.org/10.1017/bap.2016.10>.
- Sarker, Ashutosh. 2013. The role of state-reinforced self-governance in averting the tragedy of the irrigation commons in Japan. *Public Administration* 91(3): 727–43.
- Sayles, Jesse S., and Jacopo A. Baggio. 2017. Social-ecological network analysis of scale mismatches in estuary watershed restoration. *Proceedings of the National Academy of Sciences of the United States of America* 114 (10): E1776–E1785. <https://doi.org/10.1073/pnas.1604405114>.
- Schafer, Josephine Gatti. 2016. Mandates to coordinate: The case of the Southern Nevada Public Lands Management Act. *Public Performance & Management Review* 40 (1): 23–47. <https://doi.org/10.1080/15309576.2016.1177555>.
- Schiffer, Eva, and Jennifer Hauck. 2010. Net-Map: Collecting social network data and facilitating network learning through participatory influence network mapping. *Field Methods* 22 (3): 231–49.

- Schlager, Edella. 2005. Getting the relationships right in water property rights. In Bryan Bruns, Claudia Ringler, and Ruth Meinzen-Dick, eds., *Water Rights Reform: Lessons for Institutional Design*. Washington DC: IFPRI, 27–54.
- Schlager, Edella, Tanya Heikkila, and Carl Case. 2012. The costs of compliance with interstate agreements: lessons from water compacts in the Western United States. *Publius: The Journal of Federalism* 42 (3): 494–515.
- Schlager, Edella, and William Blomquist. 2008. *Embracing Watershed Politics*. Boulder, CO: University Press Colorado.
- Schlager, Edella, William Blomquist, and Shui Yan Tang. 1994. Mobile flows storage and self-organized institutions for governing common-pool resources. *Land Economics* 70 (3): 294–317.
- Schlüter, Achim. 2001. *Institutioneller Wandel und Transformation: Restitution, Transformation und Privatisierung in der tschechischen Landwirtschaft*. Aachen: Shaker.
- Schmid, Alfred Allan. 2004. *Conflict and Cooperation: Institutional and Behavioral Economics*. Malden, MA: Blackwell. [www.loc.gov/catdir/toc/ecip048/2003018398.html](http://www.loc.gov/catdir/toc/ecip048/2003018398.html).
- Schneider, Mark. 1989. Intercity competition and the size of the local public work force. *Public Choice* 63 (3): 253–65.
- Scott, Tyler A. 2016. Analyzing policy networks using valued exponential random graph models: do government-sponsored collaborative groups enhance organizational networks? *Policy Studies Journal* 44 (2): 215–44.
- Scott, Tyler A., and Craig Thomas. 2015. Do Collaborative Groups Enhance Interorganizational Networks? *Policy Studies Journal* 38 (4): 654–83.
- Searle, John. 1995. *The Construction of Social Reality*. New York: Free Press.
2003. Social ontology and political power. In F. F. Schmitt, ed., *Socializing Metaphysics: The Nature of Social Reality*. Oxford: Rowman & Littlefield, 195–210.
2005. What is an Institution? *Journal of Institutional Economics* 1 (1): 1–22.
2006. Social ontology: Some principles. *Anthropological Theory* 6 (1): 12–29.
2010. *Making the Social World: The Structure of Human Civilization*. New York: Oxford University Press.
- Sen, Amartya. 2000. *Development as Freedom*. New York: Anchor Books.
- Shaffer, Austin, Skylar Zilliox, and Jessica Smith. 2014. Memoranda of understanding and the social license to operate in Colorado's unconventional energy industry: A study of citizen complaints. *Journal of Energy and Natural Resources Law*, 1–42.
- Shackelford, Scott. 2014. *Managing Cyber Attacks in International Law, Business, and Relations: In Search of Cyber Peace*. New York: Cambridge University Press.
- Shivakumar, S. 2005. *The Constitution of Development: Crafting Capabilities for Self-Governance*. New York: Palgrave Macmillan.
- da Silveira, André R., and Keith S. Richards. 2013. The link between polycentrism and adaptive capacity in river basin governance systems: Insights from the River Rhine and the Zhujiang (Pearl River) Basin. *Annals of the Association of American Geographers* 103 (2): 319–29. <https://doi.org/10.1080/00045608.2013.754687>
- Simonelli, Jeanne. 2014. Home rule and natural gas development in New York: Civil fracking rights. *Journal of Political Ecology* 21 (1): 258–78.
- Smaldino, P. E., and M. Lubell. 2011. An institutional mechanism for assortment in an ecology of games. *PLoS ONE* 6 (8). [www.scopus.com/inward/record.url?eid=2-s2.0-79961158100&partnerID=40&md5=37d2a30be789640853ea7a500b3c4422](http://www.scopus.com/inward/record.url?eid=2-s2.0-79961158100&partnerID=40&md5=37d2a30be789640853ea7a500b3c4422).

- Snohomish Camano. 2015. *ECO Net Quarterly Meeting Notes*.
- Soll, David. 2013. *Empire of Water: An Environmental and Political History of the New York City Water Supply*. Ithaca, New York: Cornell University Press.
- Sovacool, Benjamin K. 2011. An international comparison of four polycentric approaches to climate and energy governance. *Energy Policy* 39 (6): 3832–44. <https://doi.org/10.1016/j.enpol.2011.04.014>.
- Spreng, Connor P., Benjamin K. Sovacool, and Daniel Spreng. 2016. All hands on deck: Polycentric governance for climate change insurance. *Climatic Change* 139 (2): 129–40. <https://doi.org/10.1007/s10584-016-1777-z>.
- Sproule-Jones, Mark, Barbara Allen, Filippo Sabetti, Stephan Kuhnert, Brian Loveman, Anas Malik, Michael D. McGinnis, Tun Myint, Vincent Ostrom, and Jamie Thomson. 2008. *The Struggle to Constitute and Sustain Productive Orders: Vincent Ostrom's Quest to Understand Human Affairs*. Lanham, MD: Lexington Books. <http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10774665>.
- Steins, Nathalie A., and Victoria M. Edwards. 1998. Platforms for Collective Action in Multiple-Use CPRs. Paper presented at Crossing Boundaries, the seventh annual conference of the International Association for the Study of Common Property.
- Susskind, Larry, and J. L. Cruikshank. 1987. *Breaking the Impasse: Consensual Approaches to Resolving Public Disputes*. New York: Basic Books.
- Sydow, Jörg, Georg Schreyögg, and Jochen Koch. 2009. Organizational path dependence: Opening the black box. *Academy of Management Review* 34 (4): 689–709.
- Tam-Kim, Yong, Pakping Uravian, and Bruns Chalad, eds. 2003. *The Emergence of Polycentric Water Governance in Northern Thailand (Revised)* 1. Oxford University Press.
- Tang, Shui Yan. 1992. *Institutions and Collective Action: Self-Governance in Irrigation*. San Francisco, CA: ICS Press.
- Tarko, Vlad. 2017. *Elinor Ostrom: An Intellectual Biography*. London, New York: Rowman & Littlefield International.
- Tarlock, A. Dan. 2001. The future of prior appropriation in the new west. *Natural Resources Journal* 41 (4):769–93.
- Theesfeld, Insa. 2005. *A Common Pool Resource in Transition: Determinants of Institutional Change for Bulgaria's Postsocialist Irrigation Sector*. Aachen: Shaker Verlag. [www.gbv.de/dms/bsz/toc/bsz120714744inh.pdf](http://www.gbv.de/dms/bsz/toc/bsz120714744inh.pdf).
- Thelen, Kathleen. 2000. Timing and temporality in the analysis of institutional evolution and change. *Studies in American Political Development* 14(1), 101–108. <https://doi.org/10.1017/S0898588X00213035>.
2003. How institutions evolve – insights from comparative historical analysis. In J. Mahoney, and D. Rueschemeyer, eds., *Comparative Historical Analysis in the Social Sciences*. Cambridge, MA: Cambridge University Press, 208–40.
- Thiel, Andreas. 2010a. Institutions shaping coastal ecosystems: The Algarve case. *Coastal Management* 38: 2, 144–64. <https://doi.org/10.1080/08920751003605027>.
- 2010b. Constructing a strategic, national resource: European policies and the up-scaling of water services in the Algarve, Portugal. *Environmental Management* 46 (1): 44–59. <https://doi.org/10.1007/s00267-010-9498-y>.
2012. *Developing Institutional Economics for the Analysis of Social-Ecological Systems*. Berlin: Humboldt-Universität zu Berlin.

2014. Rescaling of resource governance as institutional change: Explaining the transformation of water governance in Southern Spain. *Environmental Policy and Governance* 24(4). <https://doi.org/10.1002/eet.1644>.
2015. Constitutional state structure and scalar re-organization of natural resource governance: The transformation of polycentric water governance in Spain, Portugal and Germany. *Land Use Policy* 45: 176–88. <https://doi.org/10.1016/j.landusepol.2015.01.012>.
2016. *The Polycentricity Approach and the Research Challenges Confronting Environmental Governance: THESys Discussion Paper No. 2016-1*. Berlin.
2017. The scope of polycentric governance analysis and resulting challenges. *Journal of Self-Governance and Management Economics* 5 (3): 52–82.
- Thiel, Andreas, and Christine Moser. 2018. Toward comparative institutional analysis of polycentric social-ecological systems governance. *Environmental Policy and Governance* 28 (4): 269–83. <https://doi.org/10.1002/eet.1814>.
- Thiel, Andreas, Christian Schleyer, Jochen Hinkel, Maja Schlüter, Konrad Hagedorn, Sandy Bisaro, Ihtiyor Bobojonov, and Ahmad Hamidov. 2016. Transferring Williamson's discriminating alignment to the analysis of environmental governance of social-ecological interdependence. *Ecological Economics* 128: 159–68. <https://doi.org/10.1016/j.ecolecon.2016.04.018>.
- Thiel, Andreas, Farhad Mukhtarov, and Dimitrios Zikos. 2015. Crafting or designing? Science and politics for purposeful institutional change in Social–Ecological Systems. *Environmental Science & Policy* 53: 81–86. <https://doi.org/10.1016/j.envsci.2015.07.018>.
- Thiel, Andreas, and Mukhtarov, Farhad. 2018. Institutional design for adaptive governance of natural resource governance: How do we cater for context and agency? In Terry Marsden, ed., *The SAGE Handbook of Nature*, 1st edn. London: Sage Publications, 143–60.
- Thomas, Craig W. 2002. *Bureaucratic Landscapes: Interagency Cooperation and the Preservation of Biodiversity*. Cambridge, Mass: MIT Press.
- Tiebout, Charles M. 1956. A pure theory of local expenditures. *Journal of Political Economy* 64 (5): 416–24.
- Tocqueville, A. de. 2003. *Democracy in America*. Washington, DC: Regnery Publishing.
- Tomasello, Michael. 2009. *Why We Cooperate*. Cambridge, MA: MIT Press.
- Toonen, Theo A. J. 1983. Administrative plurality in a unitary state: The analysis of public organizational pluralism. *Policy & Politics* 11: (3) 247–71.
- Trampusch, Christine, and Bruno Palier. 2016. Between X and Y: How process tracing contributes to opening the black box of causality. *New Political Economy* 21 (5): 437–54. <https://doi.org/10.1080/13563467.2015.1134465>.
- Tsebelis, George. 2002. *Veto Players: How Political Institutions Work*. New York, Princeton: Russell Sage Foundation; Princeton University Press. [www.jstor.org/stable/10.2307/j.ctt7rvv7](http://www.jstor.org/stable/10.2307/j.ctt7rvv7).
- Tullock, Gordon. 2005. *The Social Dilemma: Of Autocracy, Revolution, Coup d'Etat, and War*. Indianapolis: Liberty Fund.
- Tullock, Gordon, Arthur Seldon, and Gordon L. Brady. 2002. *Government Failure: A Primer in Public Choice*. Washington, DC: Cato Institute.
- U.S. Energy Information Administration. 2018. Colorado State Profile and Energy Estimates: Profile Analysis. *US Energy Information Administration*.



- Ulibarri, Nicola. 2015. Collaboration in federal hydropower licensing: Impacts on process, outputs, and outcomes. *Public Performance and Management Review* 38 (4): 578–606.
- United States Advisory Commission on Intergovernmental Relations. 1987. The Organization of Local Public Economies. Report A-109.
- Van Riper, C. J., A. Thiel, M. Penker, M. Braitto, A. C. Landon, and J. M. Thomsen 2018 Incorporating multi-level values into the social-ecological systems framework. *Ecology and Society* 23 (3): 25.
- van Zeben, Josephine A. W. 2013. Research Agenda for a Polycentric European Union. Working Paper Series W13–13.
- Vanberg, Viktor, and Wolfgang Kerber. 1994. Institutional competition among jurisdictions: An evolutionary approach. *Constitutional Political Economy* 5 (2): 193–219. <https://doi.org/10.1007/BF02393147>.
- Varvasovszky, Zsuzsa, and Ruair Brugha. 2000. How to do (or not to do) ... A stakeholder analysis. *Health Policy and Planning* 15 (3): 338–45.
- Vatn, A. 2002. Multifunctional agriculture: Some consequences for international trade regimes. *European Review of Agricultural Economics* 29 (3): 309–27.
2005. *Institutions and the Environment*. Cheltenham: Edward Elgar.
- Villamayor-Tomás, Sergio. 2014a. Adaptive irrigation management in drought contexts: Institutional robustness and cooperation in the Riegos del Alto Aragon project (Spain). In Anik Bhaduri, Janos Boardi, Jan Leentvar, and Sina Marx, eds., *The Global Water System in the Anthropocene*. New York: Springer, 197–215.
- 2014b. Cooperation in common property regimes under extreme drought conditions: Empirical evidence from the use of pooled transferable quotas in Spanish irrigation systems. *Ecological Economics* 107: 482–93. doi: <http://dx.doi.org/10.1016/j.ecolecon.2014.09.005>
2018. Polycentricity in the water-energy nexus: A comparison of polycentric governance traits and implications for adaptive capacity of water user associations in Spain. *Environmental Policy and Governance* 28: 252–68.
- Vousden, David. 2016. Local to regional polycentric governance approaches within the Agulhas and Somali current large marine ecosystems. *Environmental Development* 17:277–86. <https://doi.org/10.1016/j.envdev.2015.07.008>.
- Wagner, Richard E. 2005. Self-governance, polycentrism, and federalism: Recurring themes in Vincent Ostrom's Scholarly Oeuvre. *Journal of Economic Behaviour & Organization* 57 (2): 173–88.
- Walker, B. H. 1992. Biodiversity and ecological redundancy. *Conservation Biology* 6 (1): 18–23.
- Walt, G., Shiffman, J., Schneider, H., Murray, S. F., Brugha, R., & Gilson, L. (2008). 'Doing' health policy analysis: Methodological and conceptual reflections and challenges. *Health Policy and Planning* 23(5): 308–17.
- War Torn Societies Project. 2005. *Rebuilding Somaliland: Issues and Possibilities*. Lawrenceville, N J: Red Sea Press.
- Washington State Dept of Ecology. (n.d.) Watershed plan archive. <https://ecology.wa.gov/Water-Shorelines/Water-supply/Streamflow-restoration/Watershed-plan-archive> (accessed 4/8/2018)
- Wegerich, K. 2007. Against the conventional wisdom: Why sector reallocation of water and multi-stakeholder platforms do not take place in Uzbekistan. Multi-

- stakeholder platforms for integrated water management. In J. Warner, ed., *Multi-Stakeholder Platforms for Integrated Water Management*. Bodmin, UK: Ashgate, 235–44.
- Weible, Christopher M., and Tanya Heikkila. 2016. Comparing the politics of hydraulic fracturing in New York, Colorado, and Texas. *Review of Policy Research* 33 (3): 232–50.
2017. Policy conflict framework. *Policy Sciences* 50 (1): 23–40.
- Weisbord, M. R., and S. Janoff. 2007. *Don't Just Do Something Stand There! Ten Principles for Leading Meetings that Matter*. Oakland, CA: Berrett-Koehler Publishers.
- Weller, M., and S. Wolff. 2005. *Autonomy, Self-Governance and Conflict Resolution: Innovative Approaches to Institutional Design in Divided Societies*. New York: Routledge.
- Wheeler, S. A., D. H. MacDonald, and P. Boxall. 2017. Water policy debate in Australia: Understanding the tenets of stakeholders' social trust. *Land Use Policy* (63): 246–54.
- Wibbels, Erik. 2005. *Federalism and the Market: Intergovernmental Conflict and Economic Reform in the Developing World*. New York: Cambridge University Press.
- Williamson, Oliver E. 1985. *The Economic Institutions of Capitalism*. New York, NY: Free Press.
1991. Comparative economic organization: The analysis of discrete structural alternatives. *Administrative Science Quarterly* 36: 269–96.
- Wolf, J., K. Brown, and K. Conway. 2009. Ecological citizenship and climate change: Perceptions and practice. *Environmental Politics* 18 (4): 503–21.
- Woodhouse, P., and M. Muller. 2017. Water governance – an historical perspective on current debates. *World Development* 92: 225–41. <https://doi.org/10.1016/j.worlddev.2016.11.014>.
- World Bank. 2003. *World Bank Water Resources Sector Strategy: Strategic Directions for World Bank Engagement*. Washington, DC: World Bank.
- Yaffee, S. L., and J. M. Wondolleck. 2003. Collaborative ecosystem planning processes in the United States: Evolution and challenges. *Environments* 31 (2): 59–72.
- Young, Oran Reed. 2002. *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*. Cambridge, MA; London: MIT Press.
- Zulkafli, Zed, Katya Perez, Claudia Vitolo, Wouter Buytaert, Timothy Karpouzoglou, Art Dewulf, Bert de Bievre, Julian Clark, David M. Hannah, and Simrita Shaheed. 2017. User-driven design of decision support systems for polycentric environmental resources management. *Environmental Modelling & Software* 88: 58–73.