

Polycentric Systems of Governance: A Theoretical Model for the Commons

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Polycentricity is a fundamental concept in commons scholarship that connotes a complex form of governance with multiple centers of semiautonomous decision making. If the decision-making centers take each other into account in competitive and cooperative relationships and have recourse to conflict resolution mechanisms, they may be regarded as a polycentric governance system. In the context of natural resource governance, commons scholars have ascribed a number of advantages to polycentric governance systems, most notably enhanced adaptive capacity, provision of good institutional fit for natural resource systems, and mitigation of risk on account of redundant governance actors and institutions. Despite the popularity of the concept, systematic development of polycentricity, including its posited advantages, is lacking in the commons literature. To build greater clarity and specificity around the concept, we develop a theoretical model of a polycentric governance system with a focus on the features necessary or conducive for achieving the functioning predicted by commons scholars. The model is comprised of attributes, which constitute the definitional elements, and enabling conditions, which specify additional institutional features for achieving functionality in the commons. The model we propose takes the concept a step further toward specificity without sacrificing the generality necessary for contextual application and further development.

KEY WORDS: polycentricity, natural resources governance, commons

多中心是公共资源学说的一个基本概念。它指的是一个有着多个半自主决策中心的复杂治理模式。如果这些决策中心将彼此考虑成竞争与合作的关系，并且有资源去争取不同的解决方案，他们可被认作是一个多中心的治理体系。在自然资源管理这一具体环境中，公共资源学者们总结了一系列有关多中心治理体系的优点。其中，最主要的是，提高适应能力、提供与自然资源体系相符的制度，以及通过多样化的行为者和治理制度来降低风险。尽管这一概念十分流行，在公共资源的文献中，包括其所声称的优势在内的有关多中心治理的系统发展却是个缺失。为了使该概念更加明晰且具体，我们提出了一个有关多中心治理体系的理论模型。这一模型重点关注那些必要的或有助于实现公共资源学者们所预测的多中心治理功能的特征。这一模型包含了特征，即那些明确的元素，和实现条件，即多中心在公共资源中实现其功能性的其它制度特征。我们提出的这一模型，在不牺牲该概念使用和发展的普遍性的基础上，将其进一步的具体化。

1. Introduction

Polycentricity is a fundamental concept in the work of Vincent and Elinor Ostrom. The term connotes a complex form of governance with multiple centers of decision making, each of which operates with some degree of autonomy (E. Ostrom, 2005; V. Ostrom, Tiebout, & Warren, 1961). The decision-making units in a polycentric governance arrangement are often described as overlapping because they are nested at multiple jurisdictional levels (e.g., local, state, and national) and also include special-purpose governance units that cut across jurisdictions (McGinnis & Ostrom, 2011; E. Ostrom, 2005). This multilevel configuration means that governance arrangements exhibiting polycentric characteristics may be capable of striking a balance between centralized and fully decentralized or community-based governance (Imperial, 1999). While the existence of multiple, semiautonomous decision-making centers may be sufficient to characterize a governance arrangement as polycentric, it does not guarantee that there will be sufficient coordination among the decision centers such that the arrangement functions as a polycentric governance *system* (Marshall, 2015; Pahl-Wostl & Knieper, 2014). A polycentric governance system, the focus of this article, may exist if the decision-making centers take each other into account in competitive and cooperative relationships and are capable of resolving conflicts (Marshall, 2015; V. Ostrom et al., 1961).

Polycentric governance systems have been explored in a number of interdisciplinary contexts, most notably in studies of public administration and in commons scholarship concerning the governance of natural resources.¹ Despite the popularity of the concept, there has been limited systematic development of polycentricity in the commons literature (Brie, 2014). While some progress has been made in recent years (e.g., Newig & Fritsch, 2009; Pahl-Wostl & Knieper, 2014), these empirical studies have employed definitions of polycentricity that are not entirely consistent with one another and/or do not capture the full import of the concept as conceived by V. Ostrom et al. (1961), thereby impeding systematic theoretical development. Commons scholars have also attributed a number of theoretical advantages to polycentric governance systems, ranging from the promotion of learning, trust, and adaptation to the mitigation of risk of resource collapse or failure (Marshall, 2009). However, there has been comparatively little study of the contexts and institutional features likely to yield such advantages.

Developing greater clarity around the concept of polycentric governance and the conditions under which it may lead to desired outcomes is an overdue endeavor that may help to advance our understanding of more complex natural resource governance. Much of the early commons scholarship focused on small-scale, community-based resource systems, in part, because governance processes are easier to observe in less complex systems (Berkes, 2006; E. Ostrom, 1990). Relatively simple, isolated systems are the exception rather than the rule, however. Most cases of natural resource governance are complex and cross-level in character (Berkes, 2006), and most human–environment interactions concerning natural resources take place at multiple scales (Blomquist, 2009). Moreover, human activities are increasingly interconnected at the national and global level on account of technological advancements,

changes in governance systems, and the growth of capital markets (Folke, Hahn, Olsson, & Norberg, 2005). Given that polycentricity is a pervasive condition in much of the world, scholarly work that advances general understanding of the concept and helps practitioners enable and leverage the potential benefits of a polycentric governance system should be a priority.

This article builds greater clarity around the concept of polycentricity by proposing a theoretical model of a *functional* polycentric governance system for the commons.² By “functional,” we refer to the capacity of the governance system to comport with the following three claims, explored in section 4, commonly made by scholars of natural resource governance: (i) polycentric governance systems are better able to adapt when faced with social and environmental change; (ii) they provide good institutional fit for complex natural resource systems; and (iii) they mitigate the risk of institutional failure and resource losses on account of their redundant teams of decision makers employing diverse or redundant institutions. The model builds upon a definition of a polycentric governance system that is not specific to natural resource systems, but rather is drawn directly from the public administration literature in which the concept was conceived. In the language of the model, the universal definitional elements are “attributes.” Importantly, polycentric governance systems do not necessarily perform well or better than other forms of governance (Marshall, 2015; V. Ostrom et al., 1961). There are a number of potential pitfalls associated with their complexity. For example, the transaction costs associated with coordination can be quite high, particularly in larger or geographically dispersed systems (Huitema et al., 2009; Wyborn, 2015). Additionally, the dispersion of responsibilities in a polycentric governance system can make it challenging to hold decision makers accountable for their performance (Huitema et al., 2009; Lieberman, 2011). We therefore specify additional institutional features in the model that may not be integral to the core concept but are associated with achieving the functionality predicted by commons scholars. These additional features are termed “enabling conditions.”³ We distilled the attributes and enabling conditions through a review and synthesis of the commons literature and the public administration literature on metropolitan-area governance, as well as related literatures that address the form and function of polycentric governance systems. In formulating enabling conditions, we also drew from findings in related bodies of literature, such as work on social-ecological systems, where relevant.

Before we embark on this task, we clarify our position and the scope of this undertaking. First, it is not our position that all polycentric governance systems are capable of achieving the advantages examined in this article or of otherwise performing as well as or better than other forms of governance. Among other things, the effectiveness of a governance system depends upon its objectives (e.g., efficiency or equity) and the historical and cultural context in which the governance system is embedded. This raises a second point: the governance model we propose does not address the myriad contextual factors that may impact the functioning of a governance system. Our focus here is on the institutional features that theoretically enhance the functionality of polycentric governance systems in the commons. To be clear, we use the term “institution” to refer to the formal and informal rules, norms, and strategies that structure human interactions (E. Ostrom, 2005).

In section 2, we briefly trace the history of the concept of polycentricity. In section 3, we introduce the attributes that form the definitional core of the theoretical model, and in so doing, we clarify ambiguities and highlight open questions in the definition we adopt. In section 4, we describe the aforementioned theoretical advantages of polycentric governance systems, and we introduce enabling conditions that specify features that may be necessary or conducive for realizing the advantages. We present the model at the conclusion of section 4, bringing together the attributes and enabling conditions discussed in sections 3 and 4 and correlating them with the advantages they support. Finally, we conclude with a discussion of the implications of the model and the challenges that lie ahead for further development and operationalization of polycentricity.

2. History and Development of the Concept

The term polycentricity was first used in essays Michael Polanyi published as *The Logic of Liberty* (1951) to describe a method of social organization in which individuals are free to pursue their objectives within a general system of rules (Polanyi, 1951; see also V. Ostrom, 1999a). A decade after the publication of *The Logic of Liberty*, V. Ostrom et al. (1961) adopted the term polycentricity to describe a form of organization in metropolitan-area governance characterized by a multiplicity of overlapping political units. V. Ostrom et al. (1961) argued that this seemingly inefficient configuration of political units could achieve greater efficiency in the production and provision of public goods and services than a centralized government if certain market-like characteristics were present. They theorized that political units could operate in a coherent manner with predictable patterns—that is, as a system—to the extent they “take each other into account in competitive relationships, enter into various contractual and cooperative undertakings or have recourse to central mechanisms to resolve conflicts” (V. Ostrom et al., 1961, p. 831). The theoretical claims concerning polycentricity in metropolitan areas benefited from strong empirical support in the 1970s showing that the provision of police services in polycentric metropolitan areas regularly outperformed more centralized systems in terms of efficiency and certain measures of effectiveness, such as responsiveness (E. Ostrom & Parks, 1987).

In the 1980s, Elinor Ostrom turned her focus to the study of the commons where she sought to understand how humans achieve and maintain self-governance in the context of complex and dynamic social and physical environments. One of Ostrom’s most influential contributions to commons theory was her formulation of eight institutional design principles that she found to be associated with robust institutions for maintaining common-pool resources (E. Ostrom, 1990). The eighth design principle, which relates to larger-scale, more complex systems of common-pool resources, provides that the various governance activities associated with robust institutions “are organized in multiple layers of nested enterprises” (E. Ostrom, 1990, p. 101). In subsequent work, Ostrom and others have sometimes used the term “polycentric” interchangeably with, or in reference to, the “nested” requirement of the eighth design principle (e.g., Huntjens et al., 2012; E. Ostrom, 2005), though polycentricity implies more than nestedness (Gruby & Basurto, 2013).

Since Ostrom's publication of the design principles in 1990, a growing interest in polycentricity on the part of commons scholars is evident in the number of papers and books that consider the advantages of polycentric governance for sustaining natural resources (e.g., Andersson & Ostrom, 2008; Bixler, 2014; Blomquist & Schlager, 2005; da Silveira & Richards, 2013; Galaz, Olsson, Hahn, Folke, & Svedin, 2008; Marshall, 2005, 2009, 2015; Nagendra & Ostrom, 2014; Newig & Fritsch, 2009; Pahl-Wostl & Knieper, 2014; Pahl-Wostl, Lebel, Knieper, & Nikitina, 2012). In this literature, the arguments for polycentric governance have evolved beyond improved efficiency, a major objective in public administration. Blomquist (2009) observes that the rationale of commons scholars who advocate polycentric governance includes themes such as: "1) the recognition of scale diversity; 2) the desire to reduce error-proneness and promote learning; 3) the recognition of limitations on human information processing capabilities; 4) the presence of multiple goals for resource management; and 5) the recognition of the diversity of human interests and values associated with most complex natural resource systems" (p. 115). Indeed, these themes feature explicitly in the theoretical advantages of polycentric governance that emerge from recent commons scholarship. Marshall (2009) notes that polycentricity has been associated with advantages such as better access to local knowledge, closer matching of policy to context, reduction of the risk that a resource will fail for an entire region on account of multiple avenues for policy experimentation, improved information transmission due to overlap, and enhanced capacity for adaptive management. The advantages enumerated by Marshall (2009) generally figure into three broad claims concerning polycentric governance that emerge from the commons literature: (i) polycentric governance systems have a greater capacity to adapt to social and environmental change, (ii) polycentric governance systems provide good "institutional fit" for complex natural resource systems, and (iii) redundancy inherent in polycentric governance systems mitigates risk. These claims are examined in section 4. First, we introduce the attributes of a polycentric governance system, which comprise the foundation of the theoretical model.

3. Attributes

The attributes in the theoretical model represent the essential defining characteristics of a polycentric governance system based on V. Ostrom et al. (1961). Reflecting on the seminal 1961 paper, Vincent Ostrom later wrote:

As formulated by [V. Ostrom et al. (1961)], a polycentric political system would be composed of: (1) many autonomous units formally independent of one another, (2) choosing to act in ways that take account of others, (3) through processes of cooperation, competition, conflict, and conflict resolution. (V. Ostrom, 1991, p. 225)

We adopt and adapt this three-pronged distillation of the concept in formulating the attributes in the model. Our rationale for doing so is that we believe it important

that the attributes be loyal to the original 1961 conceptualization to ensure we do not imagine a substantively different concept. While there have been multiple formulations of the concept by Vincent Ostrom and others over the years, this particular formulation is a clear and concise articulation of the concept as it was originally conceived. Additionally, we note that even as polycentric governance has been explored in diverse literatures, many scholars continue to use definitions of the concept based on the original 1961 conceptualization. In devising the attributes, we make minor modifications to the first prong (discussed in subsection 3.1), and we consolidate the second and third prongs. Thus, we propose the following two attributes of a polycentric governance system: (i) multiple, overlapping decision-making centers with some degree of autonomy; (ii) choosing to act in ways that take account of others through processes of cooperation, competition, conflict, and conflict resolution. In the following subsections, we describe and expand upon the attributes.

3.1. Multiple, Overlapping Decision-Making Centers with Some Degree of Autonomy

The first attribute is comprised of a number of distinct but related elements and conditions, the meanings of which are not entirely self-evident. We substitute the term “decision-making center” for the word “unit” in V. Ostrom’s (1991) formulation because it better captures the active role that governance units assume in making and enforcing institutions in a particular domain. In fact, V. Ostrom et al. (1961) use the term “centers of decision making” to describe the units, although they do not clearly define it. McGinnis and Ostrom (2011) are instructive in this regard:

Polycentric governance requires a complex combination of multiple levels and diverse types of organizations drawn from the public, private, and voluntary sectors that have overlapping realms of responsibility and functional capacities. . . . In addition, private corporations, voluntary associations, and community-based organizations play critical supporting roles in a polycentric system of governance, even if they have not been assigned public roles in an official manner. (p. 15)

Thus, the decision-making centers in a polycentric governance system are not restricted to formal governmental bodies.

Not every organization or individual with an interest in a particular governance domain constitutes a decision-making center, however. Only those that exercise “considerable independence to make norms and rules within a specific domain” are decision-making centers (E. Ostrom, 1999, p. 552). Legislatures, administrative agencies, and other public bodies are clearly candidates for decision-making center status, as are communities of resource users like the self-organized “harbor gangs” of the Maine lobster fishery who make and enforce unwritten norms and rules (see Low, Ostrom, Simon, & Wilson, 2003). But what about organizations or individuals—state or nonstate—that lack authority to make rules in a particular governance domain but strongly influence policies or provide critical technical or financial support? We

suggest that they fall in the category of “critical supporting role” (see McGinnis & Ostrom, 2011). That is, the effective functioning of a polycentric governance system often depends upon actors who can lend technical expertise or produce a good or service more efficiently or effectively (see V. Ostrom et al., 1961). They may at times collaborate with or join a decision-making center, although they are not, in their individual capacities, decision-making centers. We therefore propose that the best way to envision a polycentric governance system is not as a tidy and static network of discrete, connected decision-making centers. Rather, it is a dense and evolving web of decision-making centers—some transitory and others relatively fixed—and supporting actors from diverse sectors and domains.

We also inserted the word “overlapping” in this attribute to describe the jurisdiction or domain of decision-making centers, which is integral to any polycentric governance system. Overlap may result from the layering of decision-making centers operating at multiple levels or jurisdictions when they share certain functional capacities or areas of responsibility (see McGinnis & Ostrom, 2011). A critical function of overlap is to facilitate the flow of information among decision-making centers, enabling them to learn which institutions employed by others have been successful (Marshall, 2008; E. Ostrom, 1999).

A reasonable question concerning polycentric governance systems is: how many decision-making centers are required? Typically, open-ended qualifiers like “many” (e.g., V. Ostrom et al., 1961), or “a multiplicity” (e.g., Aligica & Tarko, 2012) are used to describe the population of decision-making centers because the answer is context specific. As McGinnis (1999) observes: “[t]he key point is not the number of jurisdictions but rather the concurrence of multiple opportunities by which participants can forge or dissolve links among different collective entities” (p. 6). We would add that achieving balance and representation in decision making is also likely more important than the number of decision-making centers.

Finally, autonomy or independence in decision making is also a fundamental characteristic of polycentric governance systems. Autonomy implies that the decision-making centers act on their own behalf, without centralized coordination (see V. Ostrom et al., 1961). But how much autonomy is necessary (Gruby & Basurto, 2013)? Scholars commonly write that decision-making centers in polycentric governance systems exercise “considerable” autonomy or independence (e.g., Marshall, 2009, 2015; E. Ostrom, 1999, 2010) or that they are “semiautonomous” (e.g., Koma-kech & van der Zaag, 2013). Andersson and Ostrom (2008) use the phrase “some degree of autonomy,” a phrase we adopt because it highlights the uncertain and context-specific nature of the necessary or appropriate degree of autonomy.

As Marshall (2015) argues, it is *de facto* rather than formal autonomy that matters most given the focus in institutional analysis on rules-in-use rather than rules-in-form. A grant of formal independence to decision-making centers does not guarantee them considerable *de facto* autonomy; while central governments may devolve certain responsibilities to local governance organizations, they may nevertheless exert substantial control over outcomes through, for example, financial incentives and the imposition of burdensome reporting and compliance requirements (Gruby & Basurto, 2013; Marshall, 2015). The degree of autonomy required to reap the

theoretical benefits of polycentric governance systems is an open and fundamental question for which there is little practical guidance in the literature.

3.2. *Choosing to Act in Ways that Take Account of Others through Processes of Cooperation, Competition, Conflict, and Conflict Resolution*

In formulating the second attribute, we consolidated the second and third prongs of Vincent Ostrom's (1991) formulation because together, they describe how an assemblage of decision-making centers operating with some degree of autonomy may be capable of functioning as a coherent system: choosing to act in ways that take account of others through processes of cooperation, competition, conflict, and conflict resolution. Broadly, this means that decision-making centers, even if formally independent of one another, base their decisions partly on the actions, inactions, or experiences of other members of the system. In taking one another into account, decision-making centers and other supporting actors in the governance system interact in processes of cooperation, competition, conflict, and conflict resolution (V. Ostrom et al., 1961). These processes can lead to self-organizing tendencies to the extent decision-making centers have "incentives to create or institute appropriate patterns of ordered relationships" (V. Ostrom, 1999a, p. 59). Governance systems that are self-organizing are able to persist and adapt without requiring central or outside planning or direction (see Lebel et al., 2006).

Turning to the four integral processes identified by V. Ostrom et al. (1961), we understand cooperation as a broad category involving voluntary joint action that is inclusive of processes such as collaboration and contractual undertakings. Cooperation is critical to a governance system's functionality, as individual decision-making centers may be incapable of effectively or efficiently producing certain goods and services or addressing particular problems independently. Through cooperative processes, however, they may be able to enhance their collective capacity or to outsource functions to more capable decision-making centers or supporting actors. This point was fundamental to the claim in V. Ostrom et al. (1961) that polycentric governance systems may be capable of performing as well or better than monocentric systems. Their argument was premised on the notion that the entity that *provides* a public good or service to consumers need not be the same entity that *produces* it—particularly if it would be more efficient to outsource production to another entity. This important distinction between production and provision seldom figures into later commons scholarship concerning polycentricity although it remains relevant. For example, a decision-making center that lacks the resources or capability to produce knowledge needed to make effective decisions concerning a natural resource can outsource its production to more capable or efficient producers, such as a higher level of government, research scientists, or local resource users. As characterized by McGinnis (1999), "polycentricity allows considerable mixing and matching of consumption, provision, and production units operating at different scales of aggregation" (p. 4).

With respect to competition, V. Ostrom et al. (1961) assert that it can generate self-organizing tendencies in metropolitan areas as municipalities are forced to compete for residents through their mix of public goods and services on offer, and as producers of public goods and services compete for the business of municipalities. In the context of natural resource governance, similar forms of competition may support self-organization. For example, municipalities may compete for residents through the provision of cleaner water or more green spaces. Additionally, NGOs may have to compete against one another for the right to lead or influence an environmental initiative undertaken by a political jurisdiction. A competition of ideas and methods employed by decision-making centers may also drive the self-organizing tendencies of polycentric governance systems, enabling them to better address emerging challenges and goals without central direction (see Imperial, 1999; Olsson, Folke, Galaz, Hahn, & Schultz, 2007). V. Ostrom et al. (1961) note that conditions fostering competition emerge when decision-making centers are located near one another and when they have access to information about one another's performance.

While competitive processes can lead to beneficial self-organizing tendencies, intense competition over distributional issues can undermine cooperation and impede a governance system's capacity for self-organization (Poteete & Ostrom, 2004). In this regard, da Silveira and Richards (2013) evaluate the functioning of a polycentric governance system for the Pearl River basin in China. They found that it lacked incentives for cooperation and was characterized by intense competition for resources among its members that undermined its effectiveness and ability to adapt. This highlights the importance of designing institutions to manage or minimize competition over resources, and it suggests the need for effective conflict-resolution mechanisms.

Differences in power and values among parties with an interest in a shared resource make conflict nearly inevitable when decisions concerning allocation and use are made (Dietz, Ostrom, & Stern, 2003). So long as conflicts do not escalate to a point where the governance system becomes dysfunctional, they can bring about learning and change as different interests, philosophies, and perspectives are aired in the process of deliberation and conflict resolution (Dietz et al., 2003). V. Ostrom and Ostrom (1977) point out that conflict is an important indicator of potential losses and that the resolution of conflict can result in a net improvement of economic welfare. However, widely divergent or incompatible views of the preferred state or use of a natural resource could lead to potentially intractable conflict that could stymie self-organization. Maintaining the capability to resolve conflict is critical, however, and as Dietz et al. (2003) note, conflict resolution may be as important a reason for designing resource governance institutions as concern over a resource.

4. Theoretical Advantages of Polycentric Governance Systems

Having laid out the core attributes of a polycentric governance system, we turn to the three broad claims concerning the advantages of polycentricity in the governance of natural resource systems. In describing the logic of these claims, we

introduce the enabling conditions in the model, which specify institutional and design features of each attribute that may be necessary or conducive to achieving these advantages. We note that whether an enabling condition is necessary or merely helpful likely depends upon context, and the literature is not sufficiently developed for us to make those distinctions. We also acknowledge that the three advantages are closely related and mutually reinforcing in the sense that realization of one advantage likely contributes to realization of the others. For example, if a governance system produces institutions that are a good fit for natural resource systems and mitigates risk through incorporation of redundancy, its capacity to adapt to change is likely thereby enhanced. As this suggests, there is substantial overlap among attributes and enabling conditions that support each of the three posited advantages, and one could reasonably argue that all the attributes and enabling conditions are at least helpful, if not necessary, in achieving each of the advantages. However, we link the enabling conditions to the advantages they most directly support based on the development of the claims in the literature. Finally, while it is important to maintain some degree of flexibility within enabling conditions to account for context-specific application, we expect the enabling conditions to be further refined as the research agenda on polycentricity develops.

4.1. Adaptive Capacity

Perhaps the most commonly cited theoretical advantage of polycentric governance systems in the commons literature is that they may be capable of adapting to actual or anticipated social and ecological change better than more centralized forms of governance (e.g., Bixler, 2014; da Silveira & Richards, 2013; Folke et al., 2005; Marshall, 2015; Pahl-Wostl, 2009). This ability to adapt is often termed “adaptive capacity,” which Pahl-Wostl (2009) defines as “the ability of a resource governance system to first alter processes and if required convert structural elements as response to experienced or expected changes in the societal or natural environment” (p. 355). This includes adaptation through the design of new institutions (see E. Ostrom, 1999). With accumulating evidence signaling an increasing likelihood of nonlinear and abrupt changes in ecosystems (Millennium Ecosystem Assessment, 2005), there is considerable interest in designing institutions that allow for adaptation (e.g., Bixler, 2014; da Silveira & Richards, 2013; Dietz et al., 2003; Galaz et al., 2008; Pahl-Wostl, 2009; Pahl-Wostl & Knieper, 2014; Sovacool, 2011; Wyborn, 2015). Theoretical support for the proposition that polycentric governance systems exhibit greater adaptive capacity can be found in complex-adaptive systems theory, which provides that self-organizing complex-adaptive systems have the ability to adapt by changing their rules and behavior as they gain experience (Pahl-Wostl et al., 2012). Polycentric governance systems have been characterized as complex-adaptive systems (Andersson & Ostrom, 2008), and their capacity for adaption has been linked to the notion that they facilitate parallel efforts to experiment with different ideas and rule combinations which, when combined with information transmission and learning, can lead to institutional innovation to cope with change (Imperial, 1999; E. Ostrom, 1999). In

recent years, commons scholars have also begun to develop empirical support for the proposition that polycentric governance systems exhibit enhanced adaptive capacity (e.g., da Silveira & Richards, 2013; Pahl-Wostl & Knieper, 2014; Sovacool, 2011).

This potential advantage of polycentric governance systems stems first from their most basic attribute: multiple, overlapping decision-making centers operating with some degree of autonomy. If decision-making centers are actively engaged in semiautonomous efforts to govern a resource, they may produce a diversity of institutions. While the probability that a particular institution will fail is likely high (E. Ostrom, 1999), some institutions may well achieve a degree of success. If decision-making centers take into account the successes and failures of others, and learn from them, they may be capable of devising and continually adapting ever more effective institutions (see Olsson, Folke, & Berkes, 2004; E. Ostrom, 1999). As the foregoing suggests, this claim also implicates the second attribute in the model, as it requires that decision-making centers take one another into account, including through processes of cooperation and competition (e.g., of ideas or methods), and that they resolve conflicts that could undermine cooperation and stymie adaptation. Many other factors bear directly on the realization of adaptive capacity, and in the following subsections we describe the institutional features we identify as being most integral to the claim. These features constitute “enabling conditions” in the theoretical model of a functional polycentric governance system for the commons.

4.1.1. Decision-Making Centers Employ Diverse Institutions. This enabling condition makes explicit a common presumption concerning polycentric governance systems: namely, that a diversity of rules, norms, and strategies necessarily flow from a multiplicity of decision-making centers. We note that while institutional diversity is a logical outcome given a diversity of semiautonomous governance actors, there is nothing inherent in polycentricity that prevents decision-making centers from coalescing around a common policy or approach. Were this to happen, some of the advantages ascribed to polycentric governance systems in the commons may not be achieved. One of these is their enhanced adaptive capacity, for it rests upon the notion that decision-making centers will continually experiment with different resource institutions and adopt (and adapt) the more successful ones. Given the improbability that any governance system will ever stumble onto the optimal combination of rules (E. Ostrom, 1999), and given that natural resource systems are dynamic and changing, we should never expect the actors in a functional polycentric governance system to settle upon a single policy or approach. Instead, we should expect ongoing experimentation in an effort to continually improve and adapt institutions.

4.1.2. Generally Applicable Rules and Norms Structure Actions and Behaviors within the System. The capacity of governance systems to adapt to change depends in part on the existence of incentives for productive activity, including public or civic entrepreneurship, and agreed or accepted limits on the range of possible responses by governance actors. As Vincent Ostrom observes, “social organization occurs when the *potential variety* of human behavior is *constrained* so as to exclude some possibilities and permit other possibilities” (V. Ostrom, 1999a, p. 55, emphasis in original). In

a polycentric governance system, this condition is made possible by the existence of rules and norms generally applicable to actors in the system (see Aligica & Tarko, 2012; V. Ostrom, 1999a; Pahl-Wostl & Knieper, 2014). Generally applicable rules and norms bound the universe of possible policies and management strategies, and they ideally provide sufficient incentives for experimentation and creative problem solving. To facilitate adaptation, it is also critical that the rules and norms allow the entry of new actors and enable new institutional pathways when existing governance actors cannot meet the needs and objectives of the governance system (see E. Ostrom, 1999). The possibility of entry allows for the influx of fresh ideas and methods, the creation of new partnerships and synergies, and the introduction of additional capacity. This may be essential when the system is faced with abrupt or unanticipated environmental change.

4.1.3. Decision-Making Centers Participate in Cross-Scale Linkages or Other Mechanisms for Deliberation and Learning. In the commons literature, deliberation and learning have been posited as processes that support a governance system's adaptive capacity (see Berkes, 2010; Blomquist, 2009; Folke et al., 2005; Gelcich, 2014). Learning, defined here as gaining knowledge from social interactions to inform natural resource management (see Crona & Parker, 2012), is a process that depends upon ample opportunities for communication and interfacing. It is promoted by deliberation, including "[w]ell-structured dialogue involving scientists, resource users, and interested publics, and informed by analysis of key information and environmental and human environment systems" (Dietz et al., 2003, p. 1910). If there were no exchange of information among decision-making centers, each would have to learn on its own through trial-and-error processes without the benefit of knowing what policies instituted by others may have succeeded or failed (see E. Ostrom, 1999). Such an approach could undermine the governance system's ability to adapt at the pace of change.

Given that decision making in polycentric governance systems is dispersed among governmental and nongovernmental actors, achieving predicted functionality may require forums designed to bring decision makers together for deliberation and learning (see Galaz, Crona, Österblom, & Folke, 2011). We therefore specify in this enabling condition that decision-making centers participate in cross-scale linkages or other formal or informal mechanisms for deliberation and learning. The term "cross-scale linkage" generally refers to a point of interaction or cooperation (often in formalized organizations) among actors that exist at different scales or at different levels of political or social organization (Heikkila, Schlager, & Davis, 2011). The term is also used to refer to linkages among actors that exist at the same level of political or social organization but across space (i.e., "horizontal" linkages) (Berkes, 2002). With some polycentric governance systems, particularly those in smaller settings or with a significant degree of overlap among decision-making centers, informal social and professional networks may provide sufficient opportunities for interaction, deliberation, and learning. There is a risk, however, that reliance on informal networks may result in *ad hoc* decision making (Wyborn, 2015) and foster group homophily that diminishes adaptive capacity (Galaz et al., 2008).

Cross-scale linkages or multi-stakeholder forums may be especially vulnerable to domination or capture by powerful interests (see Adger, Brown, & Tompkins, 2005; Bixler et al., 2016). When networks or cross-scale linkages are captured by one or more powerful actors, the governance system may become dominated by a hegemony of ideas and interests that stifle dialogue, creative problem solving, and eliminate the diversity of institutions that underlie adaptive capacity. Adger et al. (2005) find that when cross-scale linkages are characterized by power asymmetries, more powerful actors seeking to further their interests can dominate the linkages in a way that further skews knowledge and information in their favor. No social organization is ever without power asymmetries, but at some threshold, they may inhibit the intended functioning of a cross-scale linkage. As McCay (2002) characterizes it, “[t]he question becomes to what extent are the decisions due to open and honest exchange and deliberation or instead the result of the ‘governing mechanisms’ of money and political power and authority, on the one hand, or of prestige and social influence, on the other” (p. 384).

While cross-scale linkages have been advocated for their potential to foster deliberation, learning, and adaptation, more empirical research is needed to understand how better to leverage their benefits. Important areas for research include the levels at which collaboration is most effective and the circumstances under which coordination is necessary (Wyborn, 2015). Similarly, more empirical research is needed to better understand pathologies in cross-scale linkages associated with power asymmetries and to identify strategies for preventing or mitigating them. Given the relative paucity of research in this area and the importance of context, it would be inappropriate to propose a blueprint for the design of cross-scale linkages that are effective at preventing or managing such pathologies. Ensuring that actors in a cross-scale linkage have adequate resources to enable their participation, however, is an important consideration (see Adger et al., 2005).

4.1.4. Mechanisms for Accountability Exist within the Governance System. The functionality of a governance system, including its capacity to adapt to change, depends upon the possibility of holding decision makers accountable for poor performance, corruption, or failing to meet the needs and expectations of those whom they represent. As Skelcher (2005) observes, “[a]n intrinsic element of jurisdictional integrity in a democratic system is that citizens are enabled to give consent to and pass judgment on the exercise of authority by that governmental entity” (p. 89). Lebel et al. (2006) note that downward accountability to local constituents is often weak in natural resource governance, and they contend that this can compromise not just a governance system’s adaptive capacity, but an entire social-ecological system’s adaptive capacity. As their argument goes, mechanisms for accountability allow socially vulnerable groups that bear disproportionate risks and receive insufficient benefits from natural resource policies to challenge decision-making authorities. Any resulting efforts to improve the distribution of risks and benefits may enhance the adaptive capacity of vulnerable groups, which in turn may benefit the social-ecological system as a whole by reducing conflict and strengthening weak links (Lebel et al., 2006).

In the case of a polycentric governance system, conventional mechanisms for accountability (e.g., the electoral process, deliberative processes, public hearings, demonstrations [Skelcher, 2005]) may prove inadequate on account of the dispersal of decision-making authority among governmental and nongovernmental actors. Lieberman (2011) examined polycentric governance of infectious disease control in the Eastern Cape of South Africa and found that it was difficult for citizens to hold governance actors accountable because multiple actors were responsible for performing the same or similar tasks, resulting in confusion over whom to blame or punish. Governance actors had strong incentives to shirk responsibilities because they could rely upon other actors who were assigned the same responsibilities, and they were not likely to be blamed or held accountable for inaction. Similar concerns were raised by Blomquist and Schlager (2005), who note that accountability in some polycentric governance systems may be challenged because of the high number of governance actors, each with his or her own line of accountability, and the fluidity or lack of clarity that often characterizes relationships between the actors.

To the contrary, Sovacool (2011) suggests that polycentric governance systems may actually enhance accountability because it may be more difficult for parochial interests to capture multiple levels of governance than to capture a single level. Similarly, E. Ostrom (2000) observes that polycentric governance systems, with their multiple centers of power at different levels, provide more opportunity for citizens and officials to correct maldistributions of authority and takeover by opportunistic individuals. This generally comports with V. Ostrom (1999b) who, in writing about "rule-ruler-ruled" relationships, states that "complex configuration[s] of institutional arrangements" where "everyone exercises some basic prerogative of governance and no one exercises unlimited prerogatives of governance" may help to stem abuses of power (p. 181). The topic of accountability, while clearly important, has not been explored in sufficient depth in the literature on polycentric governance for us to outline general strategies for closing accountability gaps. However, Agrawal and Ribot (1999) list a number of possibilities for decentralized governance arrangements, including monitoring by independent third parties (e.g., media or NGOs), auditing and evaluation, public reporting requirements for governmental decision makers, education, performance awards, and oversight by higher levels of government.

4.1.5. A Variety of Formal and Informal Mechanisms for Conflict Resolution Exist within the System. This enabling condition addresses the means by which decision-making centers in a functional polycentric governance system resolve conflicts that could otherwise erode coherence and undermine cooperative processes that maintain adaptive capacity (see da Silveira & Richards, 2013). V. Ostrom et al. (1961) state that having "recourse to central mechanisms to resolve conflicts," is necessary for the coherent functioning of polycentric governance systems (p. 831). The authors' use of the term "central mechanisms" does not mean that recourse to courts or higher-level government bodies is required or necessarily desirable for resolution of all conflicts. The submission of some disputes to judicial or higher-level governmental bodies may be unavoidable, particularly for decision-making centers that lack political or material clout (Agrawal & Gibson, 1999). But there is value in resolving conflicts

through informal means, as V. Ostrom et al. (1961) recognize, because when higher levels of government are invoked to resolve conflict, it tends to centralize decision-making and control. This, in turn, may impede adaptive capacity, as local decision makers sacrifice autonomy to innovate contextually adapted solutions to resolve conflict at the local level (see V. Ostrom et al., 1961). Moreover, formal conflict resolution can be costly and protracted. In this regard, one of the design principles that Elinor Ostrom (1990) found to be associated with robust institutions for sustaining common-pool resources is rapid access to low-cost conflict resolution mechanisms.

Rather than creating strict hierarchical systems, E. Ostrom (2008) proposes “[d]esigning multiple tiers of arenas that can engage in rapid discovery of conflicts and effective conflict resolution” (p. 18). It is unclear how one might operationalize such a multi-tiered system, but the important point may be that conflict resolution systems should possess a diversity of forums and offer a variety of approaches (e.g., conciliation, mediation, and arbitration) so that disputants have a choice in selecting a forum and mechanism most appropriate to the nature of the dispute and to their material circumstances. As Dietz et al. (2003) note, conflict resolution mechanisms “range from ballots and polls, where engagement is passive and participants interact minimally, to adversarial processes that allow parties to redress grievances through formal legal procedures, to various experiments with intense interaction and deliberation aimed at negotiating decisions or allowing parties in potential conflict to provide structured input to them through participatory processes” (p. 1909). The existence of a variety of formal and informal conflict resolution mechanisms may be particularly important in polycentric governance systems on account of their diversity of governance actors with varying degrees of political standing and material resources.

4.2. Institutional Fit

A second advantage of polycentric governance systems commonly cited by commons scholars is that they are capable of producing institutions that are a good fit for natural resource systems (e.g., Lebel et al., 2006). Often referred to as “institutional fit,” the term very generally refers to the match or congruence between an institution and the problem or need it is meant to address. Institutions that exhibit good institutional fit may be more robust and effective in accomplishing desired outcomes because they better account for the characteristics of natural resource systems that they seek to address (Folke, Pritchard, Berkes, Colding, & Svedin, 2007). Epstein et al. (2015) identify three types of institutional fit in the literature on social-ecological systems, two of which are relevant to the claim about polycentricity: (i) *ecological fit*, which typically considers whether institutions are aligned with the spatial, temporal, and functional characteristics of the ecosystem problem being addressed; and (ii) *social fit*, which is concerned with institutions that “reflect the interests, values, beliefs, and psychological needs of groups” (p. 36). Scholars also sometimes credit polycentric governance systems more generally with producing

“context-specific” institutions, a claim that essentially concerns institutional fit without labeling it as such (e.g., Gelcich, 2014).

The claim that polycentric governance systems provide good institutional fit for natural resource systems is partly based on the concept of “near decomposability” (Blomquist, 2009). Nearly decomposable systems are comprised of a multilevel hierarchy of subsystems within larger systems. The subsystems operate largely independently but also impact or depend upon the other subsystems to varying degrees (see Simon, 1962). The concept of near decomposability has been extended to the analysis of natural resource systems, which are typically conceived as having multiple levels of subsystems that function independently in many respects but are also functionally linked with higher-level and lower-level subsystems within the larger natural resource system (see E. Ostrom, 2007). The partial independence of each subsystem implies that a governance configuration capable of producing good institutional fit would include decision makers at the level of each subsystem to make context-specific institutions as well as decision makers with authority over the entire natural resource system in order to address cross-level interactions (see Blomquist, 2009). Thus, Folke et al. (2005) observe that polycentric governance systems may be capable of producing institutions at levels that are most appropriate to ecological scale or level. The various human behaviors, values, preferences, and norms pertaining to, and interacting with, an ecological system are also heterogeneous and multiscale or multilevel. This further complicates the challenge of institutional design, and a governance system that is similarly heterogeneous and complex may be better suited to the task (Blomquist, 2009). The diverse mix of state and nonstate governance actors in a polycentric system may be an advantage in this regard because governance actors may be able to leverage complementary knowledge (e.g., local or traditional knowledge and scientific knowledge) about social and ecological systems to inform more contextually adapted institutions, thereby enhancing fit (see Cash et al., 2006).

In terms of the model, both attributes and two previously introduced enabling conditions contribute to the realization of good institutional fit. Given their full explanation above, we address their pertinence to institutional fit in brief here. First, the existence of multiple, overlapping decision-making centers operating with some degree of autonomy (attribute one) helps make possible the production of place-specific institutions that are better tailored to a particular context or problem (see Folke et al., 2005; Pahl-Wostl et al., 2012). For example, Pahl-Wostl et al. (2012) state that “the distribution of authority among centers in a polycentric regime further enables place-specific responses to heterogeneity and uncertainties that a centralized system would make difficult” (p. 32). As Galaz et al. (2008) observe, these “place-specific responses” take the form of diverse institutional arrangements, implicating enabling condition 4.1.1, which stipulates that decision-making centers employ diverse institutions. A one-size-fits-all approach to natural resource governance is antithetical to the concept of institutional fit, as we would expect decision-making centers to employ a diversity of institutions to effectively address the governance challenges of heterogeneous and dynamic commons (see E. Ostrom, 2012). Moreover, given the complexity of natural resource systems, it is unlikely that any single decision-making center possesses the range of knowledge necessary for the

production of good institutional fit (Galaz et al., 2008). This speaks to the importance of decision-making centers taking one another into account, including through cooperative processes (attribute two), to enhance their capacity to produce institutions that are well-matched to social and ecological context. As governance actors may be widely dispersed in a polycentric governance system, participation in cross-scale linkages or other mechanisms for deliberation and learning (enabling condition 4.1.3) may be necessary for this purpose (Galaz et al., 2008; Imperial, 1999). Such participation can build trust among disparate governance actors to encourage cooperation and stimulate institutional innovation to deal with challenging natural resource concerns (see Dietz et al., 2003).

We have identified two additional enabling conditions, discussed below, that may be necessary or conducive to achieving the advantage of good institutional fit.

4.2.1. Decision-Making Centers Exist at Different Levels and across Political Jurisdictions. The claim that polycentric governance systems provide good institutional fit for natural resource systems is based largely on the characteristic that they exhibit decision-making capability at different levels (e.g., local, state, and federal) that generally correspond to the multiple spatial levels or dimensions of natural resource systems (see Folke et al., 2005). While the existence of decision-making centers at different levels is partly implied in our first attribute by the criteria that decision-making centers be multiple and overlapping, we make this explicit and expand upon it by specifying that decision-making centers also exist or operate *across* political jurisdictions. Local-level decision makers may be able to respond to environmental feedbacks more quickly than centralized decision makers (Folke et al., 2007) and to craft institutions that are better adapted to local interests and norms of behavior (E. Ostrom, 2005), but they often lack the capacity or authority to deal with transboundary issues. In this case, higher-level and/or cross-jurisdiction decision makers in a polycentric governance system are necessary to deal with concerns that cascade across levels or jurisdictions (Galaz et al., 2008; Lebel et al., 2006). Cross-jurisdiction decision making may be especially critical to fit, as Folke et al. (2007) argue that the ecosystem properties that are most challenging for governance actors are those that are linked across jurisdictions or scales. McGinnis and Ostrom (2011) observe that the existence of cross-jurisdictional decision makers is an important component of polycentricity that distinguishes it from federalism:

polycentricity conveys more than just federalism as it typically is understood. A federal system may consist only of a sequence of neatly nested jurisdictions at the local, state or provincial, and national levels, but a polycentric system also includes cross-cutting jurisdictions specializing in particular policy matters, such as an agency managing a river basin that cuts across state lines. (p. 15)

The foregoing suggests that cross-jurisdiction decision-making centers may be an integral feature in any polycentric governance system. However, this may not be

sufficient to ensure the production of institutions that are aligned with the spatial extent of a natural resource system or associated problem. As described in the following subsection, there should also be congruence between the jurisdiction of decision-making centers and the boundaries or spatial extent of the natural resource problem of concern.

4.2.2. The Jurisdiction or Scope of Authority of Decision-Making Centers Is Coterminous with the Boundaries of the Problem Being Addressed. A core concern of institutional fit in the commons is that decision-making centers have jurisdiction or authority over the full spatial extent of a natural resource system or associated problem (Folke et al., 2007). In this regard, Cash et al. (2006) note that spatial scale mismatches occur when the extent of a decision maker's authority does not map coherently onto the spatial scale of the social or ecological problem at issue. They cite transboundary pollution, migratory fish stocks, and aquifer management as examples of concerns that often extend beyond the reach of a single decision maker or governance system (Cash et al., 2006). V. Ostrom et al. (1961) make a similar point, observing that the boundaries of a political jurisdiction should "include the relevant set of events to be controlled" (p. 835). They note, for example, that the city of Pasadena suffers from smog attacks, but its political boundaries do not encompass an area sufficient to control the social and meteorological variables that contribute to the problem (V. Ostrom et al., 1961). We therefore specify as an enabling condition in the model that the jurisdiction or scope of authority of decision-making centers be coterminous with the boundaries of the problem being addressed. To the extent decision-making centers cumulatively do not have coterminous authority to make decisions pertaining to a particular concern, this enabling condition also contemplates that a new decision-making center with appropriate jurisdiction could enter the governance system, including through a collaboration with existing decision-making centers.

4.3. Mitigation of Risk through Redundancy

The final theoretical advantage we address is the claim that polycentric governance systems mitigate the risk of institutional failure and resource losses on account of their redundancy (e.g., Gelcich, 2014; Nelson, Howden, & Smith, 2008; E. Ostrom, 1999). This claim encompasses two related forms of redundancy: (i) the duplication of functions by decision-making centers within a given domain or issue area, and (ii) the existence of a diversity of institutions for managing a natural resource system across spatial and/or issue areas (see Low et al., 2003). This advantage is commonly proposed without a great deal of exposition. However, E. Ostrom (2012) provides the following hypothetical that illustrates the intuitive appeal of the claim:

Let us imagine a series of inshore fisheries located along the coast of a region and posit that every policy innovation has a probability of failure of 1/10. If the region were regulated by a single governing agency, one out of ten policy changes would be failures for the entire region. If designing rules

were delegated to three genuinely independent authorities, each of these authorities would still face a failure rate of one out of ten. The probability that a failure would simultaneously occur along the entire coast, however, would be reduced from 1/10 to 1/10³ or 1/1000. On a coast with many relatively separable inshore fisheries that are governed by local authorities, the likelihood of a *coastal-wide* failure is reduced still more. (p. 129)

As this example illustrates, the existence of redundant or back-up teams of decision makers experimenting with different rule combinations may significantly reduce the risk of policy failure for an entire region, thereby increasing the stability or resilience of a natural resource system (Galaz et al., 2008). Dietz et al. (2003) note in this regard that catastrophic resource collapses have resulted when central governments exerted sole authority over resources.

Redundancy for purposes of this advantage may exist when there are multiple local-level decision-making centers across a larger resource system, as in the previous example, or when there are redundant decision-making centers at higher and lower governance levels in the same governance domain (Andersson & Ostrom, 2008). With respect to the latter, Low et al. (2003) note that the Maine lobster fishery represents a successful example of a redundant resource regime where decision making occurs at state and local levels. Local lobster fishers control access and make some of the day-to-day informal rules for the fishery, while state government has enacted laws that protect breeding stock (Low et al., 2003). While the two centers of decision making serve largely complementary roles, state regulators have intervened when local-level failures threatened the viability of the resource (Low et al., 2003). While the creation of redundant decision-making centers in a polycentric governance system may entail additional costs and appear inefficient, it may in fact be an efficient governance strategy if it avoids the loss of a resource (Galaz et al., 2008).

In terms of the model, we introduce no new enabling conditions on account of this posited advantage, as the most essential conditions for its realization have been previously described. Fundamental to the claim that polycentric governance systems mitigate risk through redundancy are a single attribute and two enabling conditions. First, the existence of multiple, overlapping decision-making centers with some degree of autonomy (attribute one) helps ensure that redundant teams of decision makers are engaged in a governance domain. In certain contexts, such as the Maine lobster fishery, a successful configuration of redundant decision making will consist of lower- and higher-level decision-making centers. Thus, enabling condition 4.2.1, which specifies that decision-making centers exist at different levels and across jurisdictions, may be essential to realizing this advantage. The claim also presumes that decision-making centers produce diverse or different institutions in a governance domain (enabling condition 4.1.2) (see Andersson & Ostrom, 2008). Otherwise, if an institution or policy experiment fails, there would be no alternative institutional approaches that could mitigate any resulting resource losses.

4.4. Theoretical Model

In Table 1, we present a model of a functional polycentric governance system for the commons. The two defining attributes are represented in the far-left column, while the enabling conditions are in the adjacent column grouped below the attribute with which they are most closely associated. In the three columns to the right, we indicate which of the theoretical advantages are most directly supported by a particular attribute or enabling condition, recognizing that all of the elements in the model may contribute at least indirectly to realization of each advantage.

Presence of the elements we specify in the theoretical model is no guarantee that a polycentric governance system will perform effectively or achieve the advantages

Table 1. Theoretical Model of a Functional Polycentric Governance System for the Commons

Attribute	Enabling Condition	Advantage: Enhanced Adaptive Capacity	Advantage: Good Institutional Fit	Advantage: Risk Mitigation/ Redundancy
Multiple, overlapping decision-making centers with some degree of autonomy		X	X	X
	Decision-making centers employ diverse institutions	X	X	X
	Decision-making centers exist at different levels and across political jurisdictions		X	X
	The jurisdiction or scope of authority of decision- making centers is coterminous with the boundaries of the problem being addressed		X	
Choosing to act in ways that take account of others through processes of cooperation, competition, conflict, and conflict resolution		X	X	
	Generally applicable rules and norms structure actions and behaviors within the system	X		
	Decision-making centers participate in cross-scale linkages or other mechanisms for deliberation and learning	X	X	
	Mechanisms for accountability exist within the governance system	X		
	A variety of formal and informal mechanisms for conflict resolution exist within the system	X		

claimed by commons scholars. We emphasize that there are innumerable contextual factors that contribute to the emergence and maintenance of any governance system. Based on development of the concept in the literature to date, we assert that their presence makes robust and functional governance of natural resources more likely. Of course, there are no perfect governance systems, and it is unlikely that a polycentric governance system exists that fully manifests all the attributes and enabling conditions we prescribe and fully delivers on all the theoretical advantages proposed by commons scholars. Polycentricity presents in degrees, and polycentric governance systems may be more or less polycentric and more or less “system-like” in character (see Andersson & Ostrom, 2008; Galaz et al., 2011; Gruby & Basurto, 2013). It is therefore not our intention to develop a binary “litmus test” for polycentric governance systems. The model instead represents a stylized ideal type of a functional and fully polycentric governance system based on the current state of knowledge and research. In our final section below, we summarize some of the implications of the model and propose an agenda for future research.

5. The Path Forward

In developing the theoretical model, we encountered a tension between, on the one hand, more specifically defining and bounding the concept of a functional polycentric governance system, and on the other, leaving open enough space for context-specific application and further development. We believe a more systematic approach to conceptualizing polycentric governance can better facilitate critical examination of the claims associated with it and the development of more nuanced theories concerning the features and circumstances associated with functionality. We viewed our task here as taking polycentric governance a step further toward specificity, including identifying the underlying assumptions of commons scholars in attributing particular advantages to it, without sacrificing the generality necessary for contextual application. As previously noted, the theoretical model can never fully explain the emergence and success of a polycentric governance system (or lack thereof). The success of a particular polycentric governance system depends upon a myriad of factors, including the success and endurance of individual decision-making centers, which in turn may depend upon the extent to which they exhibit some combination of the eight design principles formulated by Elinor Ostrom (1990).

Moving forward, work that investigates where, and under what circumstances, polycentricity in governance can lead to expected or desired outcomes is a critical avenue for further research. Additionally, comparative studies that integrate the findings and theoretical developments concerning polycentric governance and other similar concepts, such as multilevel governance (Hooghe & Marks, 2001) and network governance (Koppenjan & Klijn, 2004; Provan & Kenis, 2007), could prove very useful in advancing our understanding of polycentricity in complex governance systems (see Galaz et al., 2011; McGinnis & Ostrom, 2011). Other issues ripe for research include: (i) investigating how various degrees or manifestations of polycentricity are related to environmental and social outcomes, (ii) exploring the quality and degree of autonomy necessary for achieving well-performing polycentric governance

systems in different settings, (iii) examining the benefits of cross-scale linkages and other coordination mechanisms and exploring how power asymmetries may be reproduced and amplified through such mechanisms and how they may be managed, and (iv) investigating mechanisms for increasing the accountability of decision makers in polycentric governance systems.

Finally, this article should not be read to suggest that polycentric governance systems are the definitive “answer” for the governance of natural resource systems. There are no panaceas, as Elinor Ostrom was well known for saying, and this is certainly as true for polycentricity as it is for other governance approaches. What succeeds in one setting may very well fail in another. Recent empirical studies suggest, however, that polycentric governance systems may be more likely than monocentric or centralized governance to exhibit enhanced adaptive capacity and therewith lead to better environmental and social outcomes (see Pahl-Wostl & Knieper, 2014; Pahl-Wostl et al., 2012). Much more empirical research is clearly needed to better predict when, where, and under what circumstances, polycentric governance systems are likely to perform well or poorly.

It is our hope that this article will continue a conversation that seeks to build clarity around the concept of polycentric governance systems and the advantages they may yield. As noted earlier in this article, polycentricity in governance is likely already a pervasive condition in much of the world, yet degradation of natural resources continues at an alarming rate (Millennium Ecosystem Assessment, 2005). This suggests that many polycentric governance systems may not be performing effectively. It is therefore critical that commons scholars move beyond making broad pronouncements concerning the theoretical benefits of polycentric governance for natural resources and begin to develop more nuanced and contextualized theories. There is ample reason to believe that polycentric governance systems, with their multiple avenues for collective action and creative problem solving, have the *potential* to lead to better social and ecological outcomes in many contexts. Given this potential and the challenges that natural resource governance presents, work that advances understanding of the concept, including factors associated with better performance, should be a priority for commons scholars.

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Notes

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1. Our usage of the terms “commons” and “natural resource systems” as the context or domain of a polycentric governance system includes social systems dependent upon or associated with the resource of concern. Some scholars prefer the term “social-ecological system” to emphasize the integration of humans in nature and the artificial nature of delineating social systems from ecological systems (Folke et al., 2005).
2. For clarity, we are developing theory only insofar as we are synthesizing the various bodies of literature already existing on the concept to propose a model of a polycentric governance system that exhibits features scholars have posited as necessary or conducive to achieving certain advantages in the commons. We are not proposing any novel features that have not previously been linked to the functionality with which we are concerned. We also note that although we developed the model with natural resource governance in mind, we make no claims about the suitability of the model for other contexts or settings.
3. It is not our intention in formulating attributes and enabling conditions to provide measurable indicators of a functional polycentric governance system. Our focus here is qualitative description of the elements of a functional polycentric governance system for the commons that necessarily leaves enough generality for contextual application and further development. Our contribution is to clarify a very complex concept and to focus critical attention on institutional features associated with expected functionality. As such, this article should aid future efforts to operationalize the concept and to develop measurable indicators.

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