

The black box of power in polycentric environmental governance

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Power as a driver in polycentric sustainability governance

Failure to address unsustainable global change is often attributed to failures in conventional environmental governance. Polycentric environmental governance—the popular alternative—involves many centres of authority interacting coherently for a common governance goal. Yet, longitudinal analysis reveals many polycentric systems are struggling to cope with the growing impacts, pace, and scope of social and environmental change. Analytic shortcomings are also beginning to appear, particularly in the treatment of power. Here we draw together diverse social science perspectives and research into a variety of cases to show how different types of power shape rule setting, issue construction, and policy implementation in polycentric governance. We delineate an important and emerging research agenda for polycentric environmental governance, integrating diverse types of power into analytical and practical models.

polycentric governance | environmental governance | power

Global environmental change is a wicked challenge: non-reducible, variable, and complex. It is also an urgent problem—failure to progress the United Nations Sustainable Development Goals (SDGs), for instance, could permanently compromise finite natural resources and inter and intra-generational well-being. While there is general agreement that averting unsustainable change is desirable, social and policy responses are often constrained by limited capacity and the fact that single actors or singular approaches—whether top down or bottom up—cannot effectively tackle such problems. Social and policy solutions need to be experimental, adaptive, distributed, and multi-scale (Loorbach et al., 2017; Ostrom, 2010a; Pattberg and Widerberg, 2016).

Environmental governance structures have broadened in response to such complexity and interdependency, from top-down centralised approaches to decentralised, community-based, or polycentric arrangements, incorporating not just principles of efficiency but also those of equity, legitimacy, and accountability (Lemos and Agrawal, 2006). Polycentric governance structures in particular have become popular with analysts since Elinor Ostrom’s reflections in 2010 on the failure of top down solutions (Ostrom, 2010a).

The concept of *polycentric governance* is best understood when juxtaposed with monocentric governance (Ostrom et al., 1961). An ideal-type *monocentric* system is one controlled by a central predominant authority (e.g. a comprehensive governmental authority or private monopoly responsible for all goods and services). By contrast, a *polycentric* system comprises multiple governing authorities at different scales which do not stand in hierarchical relationship to each other but are engaged in self-organisation and mutual adjustment (Ostrom, 2010a).

Polycentric systems are attractive to a wide variety of interests in that they allow for more policy innovation and diffusion across multiple organisational units, whether through “hard” regulation or “soft” instruments such as economic incentives, voluntary agreements, self-regulation, and sustainability certification (Jordan et al., 2013; Jordan et al., 2015). Advocates suggest that this form of governance creates new opportunities for multiple actors at multiple levels to take responsibility for initiating and implementing sustainability and resilience solutions (Carlisle and Gruby, 2017; Pattberg and Widerberg, 2016; Steffen et al., 2018). Polycentric governance is also understood to provide more opportunities for representation of different social actors than monocentric governance. As such, its inclusivity can be viewed as a more legitimate form of governance. In providing opportunities for innovation and experimentation across multiple organisational units, polycentric governance can also enable the development of tailor-made solutions that are fit for purpose (Lebel et al., 2006). It additionally provides a level of flexibility and nimbleness that may not be possible in traditional hierarchies. Furthermore, polycentric governance is regarded as more robust: when one part of the system fails there are multiple other parts able to step in (Ostrom, 2010b).

While not a panacea, polycentricism holds much promise for solving the multiple governance challenges of environmental change (Aligica and Tarko, 2012; Andersson and Ostrom, 2008). However, new research on polycentric governance is also challenging normative prescriptions, somewhat controversially (Gallemore, 2017; Sovacool et al., 2017; Sunderlin et al., 2015). In many cases, polycentric governance systems are struggling to cope with the growing risks of rapid social and environmental change (Jordan et al., 2018). Documented problems include high transaction costs, inconsistencies, freeloading, unanticipated effects, gridlock, and ultimate implementation failure (Morrison et al., 2017). A new strand of environmental policy science is also beginning to highlight how the concept of polycentricity is plagued by inherent contradictions and assumptions, and that some big gaps in knowledge remain. Power dynamics have been highlighted as one of these gaps (Morrison et al., 2017), alongside assumptions about policy experimentation (Huitema et al., 2018), lack of understanding of feedbacks (Berardo and Lubell, 2019), and limited evaluation of effectiveness (Schoenefeld and Jordan, 2017). The central focus of this paper is the pronounced lack of analysis of the role of power.

In this paper, we define power as the uneven capacity of different actors to influence the goals, process, and outcomes of polycentric governance. We argue that while it is axiomatic that all governance (whether monocentric, integrated, decentralised, or polycentric) involves uneven power dynamics, many studies of polycentric governance provide only partial analyses of the initial design or the emergent structure of polycentric systems, ignoring uneven power dynamics or relegating them to being exogenous to the system. In the rare cases where power is highlighted, we show that analyses tend to focus on the potential negative *effects* of (higher-level) power; they rarely highlight the process nor the positive outcomes of powerful steering or “orchestration” (Abbott, 2017). We argue that scientists and policymakers can improve their ability to explain and enhance the environmental outcomes of polycentric systems by re-conceiving polycentric governance not just as a structural solution or a diagnostic but also as a set of diverse institutions, agencies, and other social actors influenced by power-laden social relationships. Distilling the power dynamics inherent in polycentric governance will thus be a critical step in moving from polycentric governance as a concept to polycentric governance as a theory and practice for addressing global environmental change. We conclude by highlighting future research needs which are dependent on a power-centred analysis.

The Power Gap in Polycentric Governance and Why it Matters

All governance involves power: more powerful actors receive more favourable outcomes than less powerful ones; equality and fairness are rare. However, while many analysts of polycentric governance

have often acknowledged power dynamics, they have not directly addressed how power dynamics can challenge or reinforce polycentric governance systems (Agrawal and Ostrom, 2006; Mansbridge, 2014). As a result, studies of polycentric environmental governance often remain snapshot analyses of only the initial design or the emergent structure of polycentric systems, with post-hoc analysis of power dynamics often relegated to an explanatory postscript about “a black box of politics” or “the lack of political will”. Figure 1, for example, shows that while there has been a dramatic rise of scientific interest in polycentric environmental governance since Elinor Ostrom’s influential 2010 *Global Environmental Change* article, scientific interest in the power dynamics of polycentric governance is only now emerging as an important field in its own right.

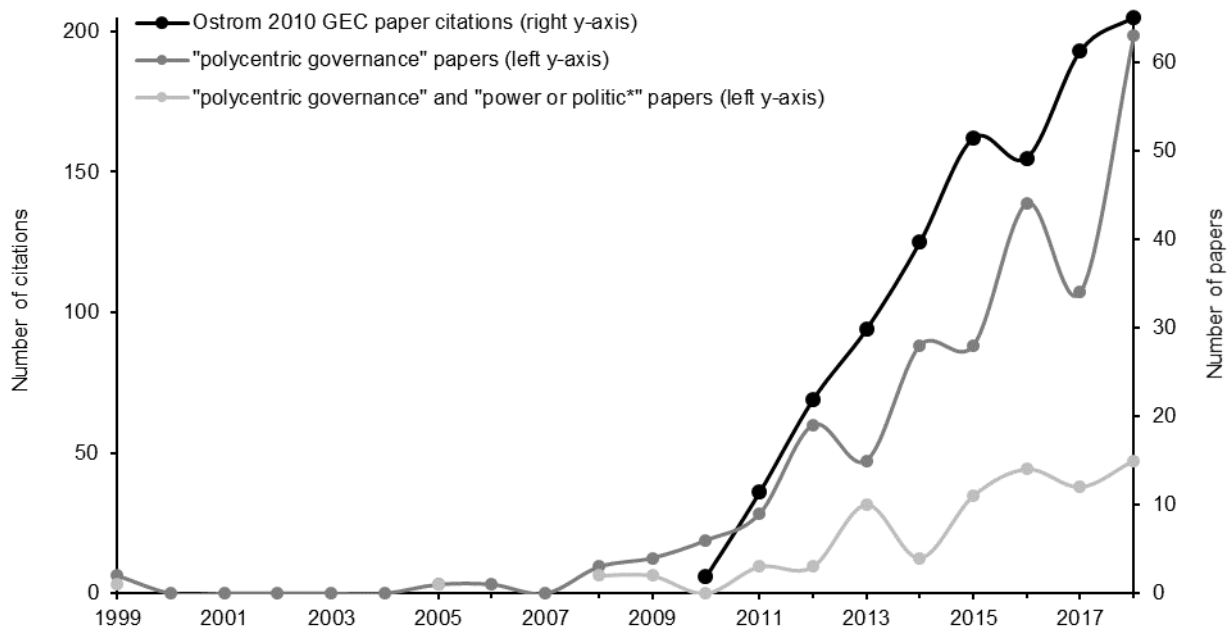


Figure 1 | Dramatic rise of scientific interest in polycentric governance since Elinor Ostrom’s influential *Global Environmental Change* article on polycentric governance (2010) (black, dark gray) and increasing interest in “polycentric governance” and “power or politic*” (light gray).

There are a variety of reasons why the power gap persists in polycentric environmental governance. The complexity and messiness of polycentric systems means that power dynamics are hidden more effectively than in other governance types; they are difficult to observe, tough to define, slippery to measure, tricky to generalise about, and challenging to manage (Sova et al., 2016). Scientists, policymakers, and practitioners working at the interface between the application of science and policy can also find power dynamics sensitive and uncomfortable, and therefore may often deliberately or inadvertently overlook them.

Oversight of power dynamics also has its roots in disciplinary divisions and trends. For example, while important strands of political science have focused on the strategies of powerful actors in driving and addressing global change (such as the World Trade Organisation, the United Nations, the United States, and multinational corporations) (Nye, 2008), these insights have often remained separate from the polycentric environmental governance literature, which tends to focus on the diffusion of power across groups of actors (with the notable exception of Abbott (Abbott, 2017; Abbott and Bernstein, 2015)). The bias towards diffuse power also reflects the broader governance literature, where researchers in the key fields of American federalism and European Union (EU) studies (Feiock, 2013; Hooghe and Marks, 2003; Scharpf, 2006), political science (Crook and Manor, 1998), public policy

and administration (Bevir and Rhodes, 2006), and institutional economics (Ostrom, 2010b), have spent many years exploring the diffusion of power away from powerful sole actors such as a centralised governmental authority. And as ably illuminated by Partzsch (2017), the small number of critical social scientists that do focus on power in environmental governance regimes tend to concentrate on the potential negative effects of visible higher-level power; they rarely deal with power that emerges from the bottom-up or is enabling rather than inhibiting.

Addressing the power gap is important because it can open up a range of new ideas, resources, and opportunities for scientists and practitioners concerned with understanding, crafting, and working within polycentric environmental governance (Kashwan et al., 2018). An improved understanding of power in polycentric systems, for example, can unmask and diagnose power asymmetries and abuses - not just corruption but also conflicts of interest, “street-level deals”, inconsistent law enforcement, illegal finance, and hidden resistance to the agreed environmental goal. It can also shed light on how mobilisation of different types of power can allow actors to redistribute risks to vulnerable populations, perpetuate the politics of avoidance, deny or distort science to delay action, and undermine a government’s capacity to act. For example, new research shows that polycentric systems can be protected and strengthened by the fact that they are made up of multiple institutions and actors, but that this multiplicity can in fact permit manipulation and exploitation of actors and goals and, in addition, screen or mask this very behaviour. Such masking can aid polycentric system drift (whereby a regime fails to adapt to a major contextual shift) or polycentric system conversion (whereby the original goals of a regime are converted to new goals) (Morrison, 2017; Okereke, 2018).

Addressing the power gap can also reveal power dynamics that are less negative and more enabling, through examination of how mobilisation of countervailing forms of power - such as new interest groups and coalitions and new monitoring mechanisms and associations - can enhance the transparency and accountability of polycentric systems and lead to positive changes to government rules, industry policies, and societal norms. In the case of the global polycentric climate system, for example, analysts are now beginning to study how powerful actors such as cities, provinces, religious leaders, and NGOs are beginning to steer polycentric climate governance, by shaping and mobilising norms and beliefs through virtual, online spaces such as social media (Dorsch and Flaschland, 2017; Gillard et al., 2017; Homsy and Warner, 2015). Finally, addressing the power gap can improve scientific understanding of polycentric systems as both individual systems and in a comparative sense. For example, a power-centred analysis can show that while two polycentric systems may appear to have similarly diverse and interconnected centres of decision-making on paper, in practice - because of where or how power is used - one system may have more concentrated centres of decision-making, with important implications for environmental performance (Gallemore and Munroe 2013).

Getting a Grip on Power

Power matters in all governance: because it critically determines and explains regime effectiveness. However, while the many theories of power converge upon this point, they often diverge on how to understand power. Some theories emphasise modes of exercise (e.g. coercive force, financial reward, institutional authority, ideological influence) (Bachrach and Baratz, 1963; Dahl, 1961; Foucault, 1980; Weber, 1922), whereas others emphasise types of capacity (e.g. “power over”, “power within”, “power to”, and “power with”) (Dewulf and Elbers, 2018; Gaventa, 2006; Partzsch, 2017) or types of power-laden actor relations (e.g. dependence, competition, antagonism) (Avelino and Wittmayer, 2016). Here, we seek to elaborate upon and extend a pre-existing typology of power (Morrison et al., 2017; Fig.1) identified to be specific to polycentric systems. We do so to provide an umbrella framework for connecting new research on polycentric environmental governance with rich strands of theory on

power dynamics across the social sciences, including the key disciplines of environmental politics, environmental policy, and environmental sociology (Fig. 2).

First, we introduce the polycentric power typology, which focuses on power as the uneven capacity to influence the goals, process, and outcomes of polycentric governance through (i) power by design, (ii) pragmatic power, and (iii) framing power (Fig. 2). We then briefly apply the typology to three robust examples (longstanding, representative, and intensively studied) to illustrate the need for and potential of more fully fledged and comparative analyses of power in polycentric environmental governance (Table 1). Our goal is not to render each example or each type of power analytically clean, rather to show how power is relational and emerges through iterative interactions over time.

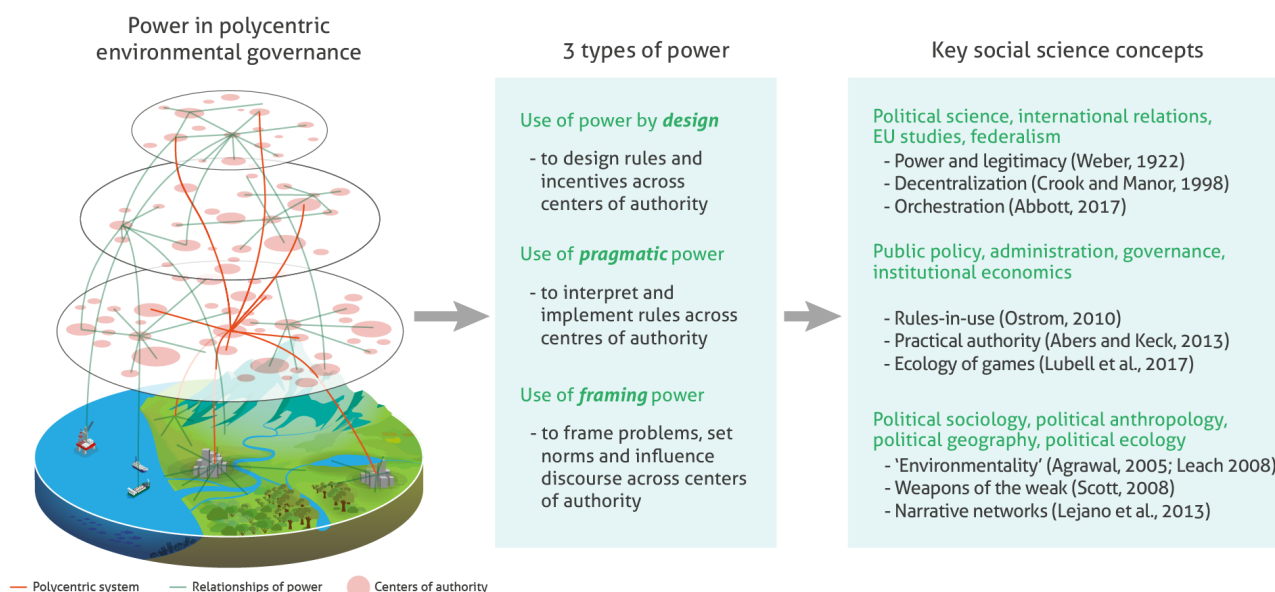


Fig. 2. Key concepts and dominant interpretations of power relevant to polycentric environmental governance. The different social science disciplines identified tend to illuminate different types of power, although there is increasing crossover.

Power by Design. A key underpinning of political science is that there is a difference between power and authority whereby power needs to be combined with legitimacy in order to be authoritative (Weber, 1922). In extending the original concept of polycentricity developed by Polanyi (Polanyi, 1951), Vincent Ostrom focused on the authoritative power of metropolitan governments to provide public goods and services in a polycentric system (Ostrom et al., 1961). This type of power is written, legislated, and visible within the deliberate design of governance, and is based on the legitimate authority of states and other powerful actors to independently legislate, create formal rules, tax, distribute resources, and design policy and markets (Jordan et al., 2013). Authoritative power to set rules and design incentives can also be distributed among actors at different levels, such as in a federated or decentralised unitary system (Crook and Manor, 1998). In polycentric systems, authoritative power can also be traced through other modes that are also formal but less direct, such as formal delegation and orchestration (Abbott and Bernstein, 2015). Social scientists typically undertake documentary review of the relevant institutional arrangements (e.g. transnational, federal, decentralised arrangements) to understand how authoritative power is officially designed and formally distributed within such systems.

Pragmatic Power. Discretion—or exertion of “rules-in-use”—is also an application of power and can manifest not just as cooperation but also as false compliance, feigned ignorance, tokenistic behaviour, and non-decision-making (Lipsky, 1971; Ostrom, 2010b; Sabatier, 1988). Analysis of pragmatic power in polycentric governance is challenging as it involves the lower-level and less visible power to interpret, certify, and monitor policy priorities, governance frameworks, and compliance agreed by state and non-state actors. Such actors are vested with “practical authority”, that is local recognition of their capabilities “on-the-ground” (Abers and Keck, 2013). This kind of power is exerted through the day-to-day practice and implementation of formal and informal rules and norms. Pragmatic power often represents the critical link between institutions and action, and can explain lack of compliance and the inability of formal government to implement unpopular policies. Stakeholders and policy practitioners are capable of withholding or granting legitimacy to a decision in accordance with their overall values, thereby affecting the implementation and effectiveness of the decision. Pragmatic power can also explain how innovation, experimentation, and creativity emerge as actors seek to navigate what they perceive to be overly rigid rules (Anderies and Janssen 2013). When discretion is exerted in polycentric governance, the values and perceptions of the actors involved are often more critical than the design properties of the governance mechanism itself. In seeking to understand pragmatic power, an entire ecosystem of institutional conditions and plurality of interests, aspirations, and strategies amongst various actors and agencies can appear to manifest as an “ecology of games” (Lubell et al., 2017). Governance analysts typically understand pragmatic power dynamics through interview, survey, ethnography, and participant observation. These methods can be immersive and long-term, comprising, for example, multiple key informant interviews with decision-makers, legal experts, key bureaucrats, and other participants in governance processes, and lengthy periods of participant observation.

Framing Power. In polycentric systems, power is not only the property of authoritative government hierarchies, street-level bureaucrats, and policy stakeholders - it is also in the hands of lobbyists, nonprofits and the media. These actors bargain for influence through rational and manipulative persuasion, inducement, sanction, and coercion (Dahl, 1961). They also use softer techniques of ideological framing that make it difficult for other actors to recognize their influence (Bachrach and Baratz, 1963). Where certain actors contest top-down decisions or perceive them as illegitimate, they may also find ways to subvert, disrupt, and avoid formal rules and regulations. Such power is less visible than power by design or pragmatic power and is created by and emerges from the way issues are constructed (e.g. organisation and communication of selected aspects of reality) and agendas are built (e.g. lobbying, rent seeking, patronage) (Fuchs and Feldhoff, 2016; Scoones, 2016). When individuals or collective actors possess the highly developed social skill to understand people and environments, frame lines of action, and mobilise people in pursuit of these frames, they are possessing and exercising framing power – in ways that can be both deliberate and accidental (Fligstein and McAdam 2011; Snow and Moss 2014). In exercising framing power, powerful players can create an “environmentality” which frames the objectives of environmental governance, the process of governing, the resources available, and the structural design (Agrawal, 2005; Bene et al., 2009; Leach, 2008). This framing endorses what is legitimised and prioritised by those actors, and it rejects what is illegitimate or deprioritised (Wilson et al 2018). Powerful players then establish and maintain complex social networks around their frames. These so-called narrative networks (Lejano et al., 2013) and their countervailing “weapons of the weak” (Scott, 2008; Scott 1990) are incremental, subtle, and hidden, and only now beginning to appear in analyses of polycentric governance (Boelens et al., 2015). When use of framing power is highlighted, analysts tend to focus on how it is used to marginalise communities, rather than how it might be used to empower communities. Discourse analyses (Foucault, 1980; 2013), through institutional examination (Schmidt 2008) and process tracing (Collier 2011), are typically used to interpret the data.

By recognising these different types of power, it becomes clear that power is not only endowed but also contested, negotiated, reinforced, and undermined through different relationships between actors in a polycentric system (Lukes, 2004). And by extending analysis of power in polycentric systems beyond the negative and coercive effects (“power over”), it is also possible to understand the process of orchestration and the positive and enabling effects of power (“power within”, “power to”, and “power with”) (Gaventa, 2006; Lukes, 2004; Partzsch, 2017). This allows us to see how multiple players, each mobilising and deploying different types of power, interact collaboratively and competitively to produce diverse social and environmental outcomes. It also reveals how they do so at multiple scales and in closed, invited, and claimed or created venues (e.g. internal government meetings, public consultation processes, community protests). In Table 1, we apply the three types of power to illustrate how addressing power dynamics can improve our ability to explain and enhance the environmental outcomes of different polycentric governance regimes. Table 1 illustrates that while some scientists are beginning to recognise and study these topics and issues within polycentricity studies (especially watershed studies: Berardo and Lubell, 2016; Pahl-Wostl and Knieper, 2014), this is still an emerging field, with many practical and conceptual challenges. In particular, future development of this typology requires shifting focus from the emergent structure of polycentric governance to asking under what conditions do different types of actors, with different types of power, achieve their preferred outcomes?

	European Water Framework Directive (WFD)	Reducing Emissions from Deforestation and Degradation Scheme (REDD+)	Great Barrier Reef Regime (GBR)
Power by Design	The European Parliament and Council commits member states of the European Union to a Directive on achieving good qualitative and quantitative status through 6 yearly cooperative River Basin Management Plans for designated River Basin Districts (Jager et al., 2016).	The United Nations Framework Convention on Climate Change (UNFCCC) exerts top-down multilateral power over forests in developing countries through a comprehensive system of national policy guidance, technical assistance, positive incentives, and stakeholder partnerships (Kashwan, 2015; Nagendra and Ostrom, 2012; Sunderlin et al., 2015).	The Australian national government, through legislation, statutory delegated authority , and participatory marine planning stipulates conservation and sustainable use of the Great Barrier Reef, in agreement with the State of Queensland, and reinforced by UNESCO World Heritage listing, and other national and state laws (Evans et al., 2014).
Pragmatic Power	Local bureaucrats aligned with agricultural interests use discretion to weaken the standards developed and to avoid full application of key principles of the Directive at the individual Basin level (Behagel and Arts, 2014).	National governments, local elites, and foreign ‘carbon entrepreneurs’ bypass indigenous community safeguards and exploit insecure tenure systems to capture carbon rights and benefits (den Besten et al., 2014; Lund et al., 2017). Local NGOs pragmatically exploit program design to achieve wider security of tenure for	Bureaucrats aligned with industry interests use discretion to avoid implementation of relevant rules to manage new and ongoing threats (Morrison, 2017).

indigenous groups (Astuti and McGregor 2017).

Framing Power	Agricultural industry interests frame the Water Framework Directive as a remote intervention by bureaucrats in Brussels, in order to ensure that water quality issues dominate the implementation process at the basin level and issues of water access and supply are minimised (Brouwer et al., 2013; Voulvoulis et al., 2017).	The World Bank, the UN-REDD Programme, and other non-governmental organisations in Washington DC, Geneva, and London undertake additional agenda-setting through their own REDD+ objective-setting, geographic targeting, and financial allocation (Gallemore and Jespersen, 2016; Di Gregorio, 2017).	Industry groups, politicians, and sections of the media shape a discourse that GBR regulation, scientists, and NGOs are stalling economic development, creating a public appetite for repeals of complementary state and national legislation on coastal development, land-clearing, and renewable energy (Björnberg et al., 2017).
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Table 1. Power Dynamics in Different Polycentric Governance Systems

Extending Analysis of Power in Polycentric Environmental Governance

Studies of polycentric environmental governance are beginning to emphasise the significance of power dynamics. This is true in recent analyses of polycentric governance under the Least Developed Countries Fund and in the United Kingdom (Gillard et al., 2017; Sovacool et al., 2017), across cities (Homsy and Warner, 2015), and systems for water sustainability in the EU and the United States (Brouwer et al., 2013; Garrick et al., 2013), and marine sustainability in the Coral Triangle (Gruby and Basurto, 2014) and Chile (Gelcich, 2014; Table 1). However there is still scant assessment of the power dynamics of polycentric governance over time, and even less analysis of how power can be mobilised in pursuit of (or resistance to) environmental goals. Most analyses of polycentric governance continue to focus on the structural dimensions of polycentric governance, ignoring power dynamics that are more enabling and less visible, and mobilised by a variety of actors and functioning across multiple scales and venues.

We conclude by proposing a number of research challenges going forward which are dependent on distilling power dynamics. They relate to ongoing assumptions and unanswered questions about *experimentation, functions and beneficiaries, problem variation* and *emergent potential* in polycentric governance. While we identify four research areas as important, there are others that are equally valid and we encourage researchers to explore all of them.

Polycentric governance as an experiment in power. Power dynamics influence not only the emergence and design of polycentric governance structures but also decisions about policy choices and the way policy outcomes are assessed within those structures. Elinor and Vincent Ostrom proposed that all policies are experiments therefore an important analytical task is to clarify variables and causality. While network analysts have produced interesting visual depictions of governance, which can essentially be viewed as “structural fingerprints” of the more visible distributions of power within a polycentric system, there is little comprehension of how different types of power explain patterns of conflict, competition, convergence, and divergence in policy choices and outcomes across polycentric systems (Lubell et al., 2017; Scott and Thomas, 2017; Weible and Heikkila, 2017). Better understanding of interdependence and feedbacks is essential. Re-emphasising polycentric governance as an experiment in power thus allows us to move beyond claiming that “power matters” to understanding which variables explain *how* power matters, how explanatory variables depend on other variables (e.g. number and type of actors, scalar and temporal dimensions, state of knowledge, range

of drivers, range of possible solutions, range of venues), and how polycentric governance might be effective relative to other arrangements and non-structural influences (Poteete et al., 2010; Turnbull et al., 2018). This effort may necessitate the introduction of new quantitative precision, for example, through comparative analysis of how various attributes of polycentric structure influence and are influenced by the different types of power (Bodin, 2017; Smith et al., 2014). Substantial inroads (drawing on institutional collective action frameworks, and social network analysis, semiautomated text analysis and fuzzy cognitive mapping techniques) are already being made to overcome traditional shortcomings in collecting and analysing in-depth and sensitive data across space and time (Eakin et al., 2017; Heikkila and Weible, 2018). Less frequent, but just as insightful in analysing self-organising power dynamics, is analysis of the existence of concrete groups (e.g. non-profit organisations and industry lobby groups) and their involvement in setting the agenda for public-good plans and initiatives, the size and hierarchical arrangement of those systems, and the receipt and distribution of organisational resources at different scales in the system. Social scientists can elicit this kind of information through surveys, interviews, and documentary or archival reviews (e.g. of organisational annual reports and other records which provide participation data, data on the receipt and distribution of fiscal resources, employee and budget numbers, personnel data, media reports on conflict) (Clarke and McCool, 1996; Morrison 2017; Varone et al., 2017). Analysis of such data has the potential to provide deep insights into how power dynamics change over time in polycentric systems, and how those power dynamics channel and resolve conflict. However, most analyses of polycentric governance are yet to vigorously combine these methods to explore power dynamics in-depth and systematically.

Explaining the functions and beneficiaries of polycentric governance. Many studies have shown that the current trend in the design and development of governance arrangements is undoubtedly towards greater polycentric governance, suggesting that top-down hierarchies remain deeply unpopular, and that the benefits of polycentric governance are more socially acceptable and are perceived to outweigh any associated pitfalls (Abbott and Bernstein, 2015; Cox et al., 2016; Jordan et al., 2015). However, if our goal is to improve understanding and response to environmental change, a deeper debate on how power dynamics affect the function and beneficiaries of polycentric governance will bring a great deal to our cause. Policy scholars have usefully begun to explore polycentric systems as complex adaptive systems of interlinked games, which are not just structural but also functional (Berardo and Lubell, 2019). Functions are the processes operating within the system that affect its evolution and outcomes. The overarching function of polycentric governance, for example, is to provide a self-organising process for environmental governance in the absence of centralised environmental leadership. Within this overarching function are other functional processes such as cooperation, learning, and equitable resource distribution. While ‘ecology of games’ scholars have provided important quantitative illumination of the cooperative structures and functions of polycentric governance, less attention has been paid to learning and resource distribution functions, and the question of how different types of power are equalised or exacerbated in polycentric systems (Berardo and Lubell, 2019). Comprehensively assessing the functions and beneficiaries of polycentric governance requires more attention than has hitherto been paid to understanding the different types of power, and how the different types of power work to maintain or undermine key principles of equity, legitimacy, transparency, and accountability (Schoenefeld and Jordan, 2017). How we extend current work to think about power-laden functions and beneficiaries will also be critical in moving polycentric governance from concept to theory and practice.

Understanding how power dynamics vary the problem in polycentric governance. While polycentric governance has proven ideal for portraying complexity in governance, early descriptive analyses often tended toward simplistic dichotomies - positioning polycentric and monocentric governance at two ends of a spectrum. More recent research has shown that polycentric and monocentric systems almost

always coexist, and they are often intertwined in complicated ways (Galaz et al., 2012; Cumming et al 2016; Lubell et al., 2017). In fact, a range of governance systems (e.g. monocentric systems, federal systems, decentralised unitary systems) are characterised by multiple centres of authority interacting coherently across multiple scales (Dorsch and Flaschland, 2017). Using polycentric governance as a diagnostic confirms that despite perceptions of the non-hierarchical nature of polycentric governance, the shadow of hierarchy is ever-present, as is the case with the REDD+ scheme, the WFD, the GBR system, and many federal systems. However we know little about how polycentric systems cope when problems exceed system boundaries or when powerful actors emerge far away from the problem's geographic centre. Does performance weaken if different types of power are concentrated at progressively further/higher levels? Some important work is already showing how polycentric arrangements embedded within established hierarchies can draw on centralised state control to good effect (Pahl-Wostl and Knieper, 2014). By applying our conceptual framework, future research can begin to explore whether and how different types of power are appropriate for different desired outcomes at different scales and at different points in time (Ingalls, 2017). For instance, highly decentralised polycentric governance may be best suited to addressing established environmental problems where there is general agreement on the solution and relative symmetry of power (e.g. point-source water pollution). Whereas, highly centralised polycentric governance may be best suited to new environmental challenges (e.g. global climate change), where there is less agreement on the solution and power is highly asymmetric (Dewulf and Elbers, 2018; Mathias et al., 2017). Connecting the polycentric power typology with recent literature on problem-driven network motifs (Bodin and Tengo, 2012) and governance modes (Ingold et al., 2018) could enable development of a dynamic set of power-laden polycentric motifs whereby the performance of different governance systems can be related to the changing power dynamics of a problem.

Navigating the emergent potential of polycentric governance. All of these research questions are complicated by the fact that polycentricity both affects and is affected by power dynamics, in a dual relationship much like the Giddensian style relationship between structure and agency (Giddens 1984). In other words, as systems become more polycentric, they affect what kinds of power become most important and how. This dual relationship and its emergent possibilities is clearly another Pandora's box for analysts and practitioners. Of interest here is the potential for some types of polycentric arrangements to be more empowering of environmentalist agents than others, and indeed to facilitate further empowerment. The emergent benefit of certain types of polycentricity has been alluded to in the literature but is yet to be systematically explored and exploited by analysts and practitioners. Understanding it requires a broadened conception of power as not just top-down and repressive; but also bottom-up and enabling. Indeed, while the idea that power need not always be top-down and repressive is not new (Foucault 1980, 2013), many contemporary analyses of power continue to gloss over that observation by focusing in on the negative aspects of top-down power. In seeking to understand the emergent potential of particular types of polycentric governance, there is exciting potential for synthetic insights to be drawn from political anthropology (on how countervailing power is developed e.g. Scott 1990; Scott 2008), complex adaptive systems (on how bottom-up innovation, experimentation, and creativity emerges and transforms e.g. Anderies and Janssen 2013; Bell and Morrison 2015), and political geography (on how power dynamics in polycentric systems evolve and interrelate across scale and space (e.g. Morrison 2017; Hettiarachchi et al 2017)). Using the power typology to draw these insights together could yield important new insights on specific forms of polycentricity that are ideal for enabling positive yet unrealised power.

Conclusion

There has been a dramatic rise of scientific interest in polycentric governance over the last decade, and increasing attention paid to the power dynamics that underpin such systems. The polycentric power

typology can accelerate understanding of polycentric governance by encouraging analysts to shift focus from the emergent potential and structural dimensions of polycentric governance to examining the power-laden conditions that enable different types of actors, with different types of power, to achieve their preferred outcomes.

Previous studies have shown that polycentric governance has proven more useful as a diagnostic and a description than a panacea for solving the multiple challenges of global environmental change (Andersson and Ostrom, 2008). Yet as global society faces multiple social and environmental pressures and messiness of governance, it is critical that we undertake the ambitious task of revealing and managing power in our polycentric quest for sustainability. Distilling the power dynamics in polycentric governance is not an easy task, but we believe that efforts to analyse and manage the functions, structures, outcomes, and potential of polycentric environmental governance will strengthen and be strengthened by incorporating power dynamics and addressing the analytic and practical challenges outlined herein.

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