



The black box of power in polycentric environmental governance

T.H. Morrison^{a,*}, W.N. Adger^b, K. Brown^b, M.C. Lemos^c, D. Huitema^{d,e}, J. Phelps^f, L. Evans^b, P. Cohen^g, A.M. Song^a, R. Turner^h, T. Quinn^b, T.P. Hughes^a

^a ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, 4811, Australia

^b Geography, College of Life and Environmental Sciences, University of Exeter, Amory Building, Rennes Drive, Exeter, EX4 4RJ, United Kingdom

^c School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI, 48109, USA

^d Institute for Environmental Studies (IVM), VU University Amsterdam, De Boelelaan 1087, 1081 HV, Amsterdam, the Netherlands

^e Faculty of Management, Science and Technology, Department of Science, Netherlands Open University, Valkenburgerweg 177, 6419 AT, Heerlen, the Netherlands

^f Lancaster Environment Centre, Lancaster University, Lancaster, Lancashire, LA1 4YQ, United Kingdom

^g WorldFish, 11960 Bayan Lepas, Penang, Malaysia

^h Environment and Sustainability Institute, University of Exeter, Cornwall Campus, Penryn, TR10 9EZ, United Kingdom

ARTICLE INFO

Keywords:

Polycentric governance
Environmental governance
Power

ABSTRACT

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.

1. Introduction

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, 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

* Corresponding author.

E-mail address: tiffany.morrison@jcu.edu.au (T.H. Morrison).

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 Perspective is the pronounced lack of analysis of the role of power.

In this Perspective, 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.

2. 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”. Fig. 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.

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

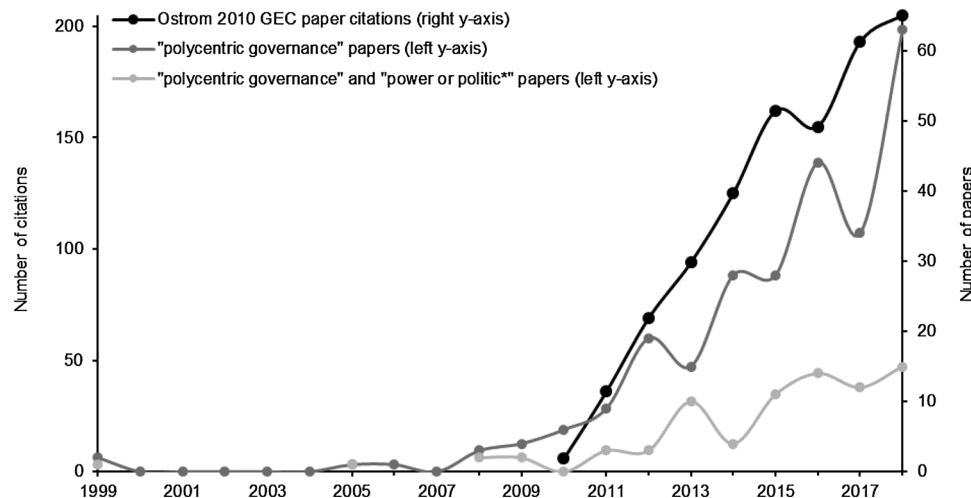


Fig. 1. Dramatic rise of scientific interest in polycentric governance since Elinor Ostrom's influential *Global Environmental Change* article on polycentric governance (2010) (black, dark gray) and increasing interest in "polycentric governance" and "power or politic*" (light gray).

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).

3. 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.

3.1. 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 amongst 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.

3.2. 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

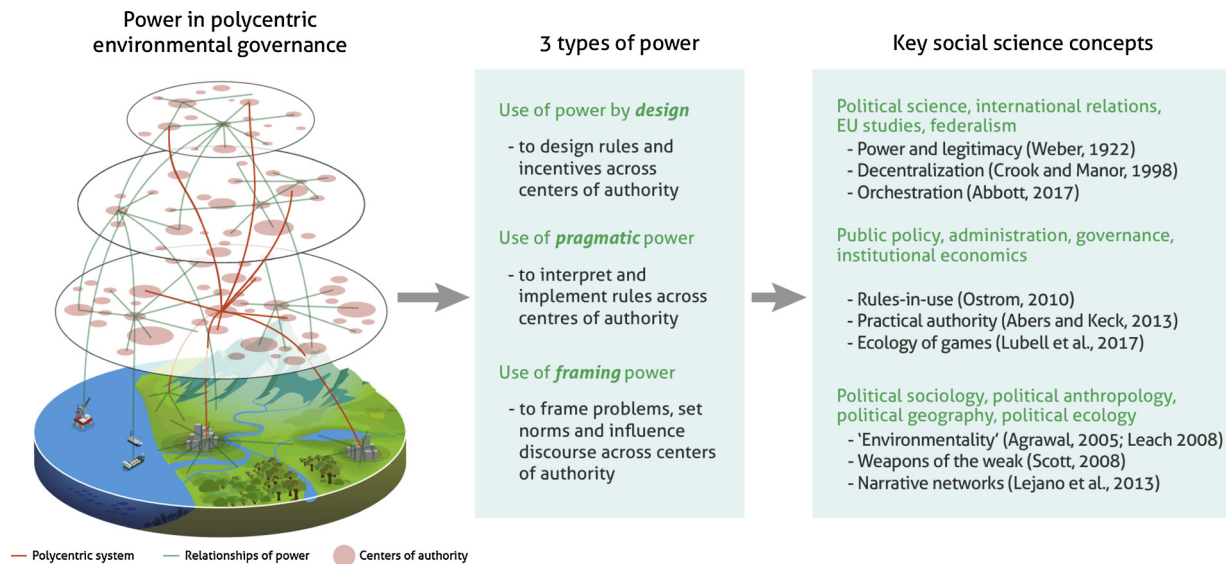


Fig. 2. Key concepts and dominant interpretations of power relevant to polycentric environmental governance. The different social science disciplines identified tend to illuminate different types of power, although there is increasing crossover.

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.

3.3. 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 recognise 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,

Table 1
Power Dynamics in Different Polycentric Governance Systems.

	European Water Framework Directive (WFD)	Reducing Emissions from Deforestation and Degradation Scheme (REDD+)	Great Barrier Reef Regime (GBR)
<i>Power by Design</i>	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).
<i>Pragmatic Power</i>	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 indigenous groups (Astuti and McGregor, 2017).	Bureaucrats aligned with industry interests use discretion to avoid implementation of relevant rules to manage new and ongoing threats (Morrison, 2017).
<i>Framing Power</i>	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 et al., 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).

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, 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?

4. 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.

4.1. 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.

4.2. 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.

4.3. 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., 2017; 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.

4.4. 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, 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.

5. 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 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.

Acknowledgments

Funding was provided by the Australian Research Council's Centre of Excellence Program (CE140100020) and an Australian Laureate Fellowship to T.H. This work also contributes to the CGIAR Research Program on Fish Agrifood Systems (FISH) supported by contributors to the CGIAR Trust Fund.

References

- Abbott, K.W., 2017. Orchestrating experimentation in non-state environmental commitments. *Env. Polit.* 26, 738–763.
- Abbott, K.W., Bernstein, S., 2015. The high-level political forum on sustainable development: orchestration by default and design. *Glob. Policy* 6, 222–233.
- Abers, R.N., Keck, M.E., 2013. *Practical Authority: Agency and Institutional Change in Brazilian Water Politics*. Oxford University Press.
- Agrawal, A., 2005. Environmentalism - community, intimate government, and the making of environmental subjects in Kumaon, India. *Curr. Anthropol.* 46, 161–190.
- Agrawal, A., Ostrom, E., 2006. Political science and conservation biology: a dialog of the deaf. *Conserv. Biol.* 20.
- Aligica, P.D., Tarko, V., 2012. Polycentricity: from Polanyi to Ostrom, and beyond. *Governance* 25, 237–262.
- Anderies, J.M., Janssen, M.A., 2013. Robustness of social-ecological systems: implications for public policy. *Policy Stud. J.* 41 (3), 513–536.
- Andersson, K.P., Ostrom, E., 2008. Analyzing decentralized resource regimes from a polycentric perspective. *Policy Sci.* 41, 71–93.
- Astuti, R., McGregor, A., 2017. Indigenous land claims or green grabs? Inclusions and exclusions within forest carbon politics in Indonesia. *J. Peasant Stud.* 44 (2), 445–466.
- Avelino, F., Wittmayer, J.M., 2016. Shifting power relations in sustainability transitions: a multi-actor perspective. *J. Environ. Policy Plan.* 18, 628–649.
- Bachrach, P., Baratz, M.S., 1963. Decisions and nondecisions: an analytical framework. *Am. Polit. Sci. Rev.* 57, 632–642.
- Behagel, J.H., Arts, B., 2014. Democratic governance and political rationalities in the implementation of the water framework directive in the Netherlands. *Public Adm.* 92, 291–306.
- Bell, J., Morrison, T., 2015. A comparative analysis of the transformation of governance systems: land-use planning for flood risk. *J. Environ. Policy Plan.* 17 (4), 516–534.
- Bene, C., Belal, E., Baba, M.O., Ovie, S., Raji, A., Malasha, I., Njaya, F., Andi, M.N., Russell, A., Neiland, A., 2009. Power struggle, dispute and alliance over local resources: analyzing 'democratic' decentralization of natural resources through the lenses of Africa inland fisheries. *World Dev.* 37, 1935–1950.
- Berardo, R., Lubell, M., 2016. Understanding what shapes a polycentric governance system. *Public Adm. Rev.* 76 (5), 738–751.
- Berardo, R., Lubell, M., 2019. The ecology of games as a theory of polycentricity: recent advances and future challenges. *Policy Stud. J.* 47, 6–26.
- Bevir, M., Rhodes, R.A.W., 2006. *Governance Stories*. Routledge, London.
- Björnberg, K.E., Karlsson, M., Gilek, M., Hansson, S.O., 2017. Climate and environmental science denial: a review of the scientific literature published in 1990–2015. *J. Clean. Prod.* 167, 229–241.
- Bodin, O., 2017. Collaborative environmental governance: achieving collective action in social-ecological systems. *Science* 357 659+.
- Bodin, O., Tengo, M., 2012. Disentangling intangible social-ecological systems. *Glob. Environ. Chang. Part A* 22, 430–439.
- Boelens, R., Hoogesteger, J., Baud, M., 2015. Water reform governmentality in Ecuador: neoliberalism, centralization, and the restraining of polycentric authority and community rule-making. *Geoforum* 64, 281–291.
- Brouwer, S., Rayner, T., Huitema, D., 2013. Mainstreaming climate policy: the case of climate adaptation and the implementation of EU water policy. *Environ. Plann. C* 31, 134–153.
- Carlisle, K., Gruby, R.L., 2017. Polycentric systems of governance: a theoretical model for the commons. *Policy Stud. J.* <https://doi.org/10.1111/psj.12212>.
- Clarke, J.N., McCool, D., 1996. *Staking Out the Terrain: Power and Performance Among Natural Resource Agencies*. SUNY Press.
- Collier, D., 2011. Understanding process tracing. *PS Polit. Sci. Polit.* 44 (4), 823–830.
- Cox, M., Villamayor-Tomas, S., Epstein, G., Evans, L., Ban, N.C., Fleischman, F., Nenadovic, M., Garcia-Lopez, G., 2016. Synthesizing theories of natural resource management and governance. *Glob. Environ. Chang. Part A* 39, 45–56.
- Crook, R.C., Manor, J., 1998. *Democracy and Decentralisation in South Asia and West Africa: Participation, Accountability and Performance*. Cambridge University Press.
- Cumming, G.S., Morrison, T.H., Hughes, T.P., 2017. New directions for understanding the spatial resilience of social-ecological systems. *Ecosystems* 20 (4), 649–664.
- Dahl, R.A., 1961. *Who governs?* Yale University Press, New Haven.
- den Besten, J.W., Arts, B., Verkoijen, P., 2014. The evolution of REDD+: an analysis of discursive-institutional dynamics. *Environ. Sci. Policy* 35, 40–48.
- Dewulf, A., Elbers, W., 2018. Power in and over cross-sector partnerships: actor strategies for shaping collective decisions. *Adm. Sci.* 8, 43.
- Di Gregorio, M., Gallemore, C.T., Brockhaus, M., Fatorelli, L., Muharrom, E., 2017. How institutions and beliefs affect environmental discourse: evidence from an eight-country survey on REDD+. *Glob. Environ. Chang. Part A* 45, 133–150.
- Dorsch, M.J., Flaschland, C., 2017. A polycentric approach to global climate governance. *Glob. Environ. Polit.* 17, 45–64.
- Eakin, H., Bojorquez-Tapia, L.A., Janssen, M.A., Georgescu, M., Manuel-Navarrete, D., Vivoni, E.R., Escalante, A.E., Baeza-Castro, A., Mazari-Hiriart, M., Lerner, A.M., 2017. Opinion: urban resilience efforts must consider social and political forces. *Proc. Natl. Acad. Sci. U. S. A.* 114 E2063-E2063.
- Evans, L.S., Ban, N.C., Schoon, M., Nenadovic, M., 2014. Keeping the 'Great' in the great barrier reef: large-scale governance of the great barrier reef marine park. *Int. J. Commons* 8, 396–427.
- Feiock, R.C., 2013. The institutional collective action framework. *Policy Stud. J.* 41, 397–425.
- Fligstein, N., McAdam, D., 2011. Toward a general theory of strategic action fields. *Sociol. Theory* 29 (1), 1–26.
- Foucault, M., 2013. *Archaeology of Knowledge*. Routledge.
- Foucault, M., 1980. *Power/Knowledge: Selected Interviews and Other Writings 1972–1977*. Pantheon, New York.
- Fuchs, D., Feldhoff, B., 2016. Passing the scepter, not the buck long arms in EU climate politics. *J. Sustain. Dev.* 9, 58–74.
- Galaz, V., Crona, B., Osterblom, H., Olsson, P., Folke, C., 2012. Polycentric systems and interacting planetary boundaries - emerging governance of climate change-ocean acidification-marine biodiversity. *Ecol. Econ.* 81, 21–32.
- Gallemore, C., 2017. Transaction costs in the evolution of transnational polycentric governance. *Int. Environ. Agreem.* 17, 639–654.
- Gallemore, C., Jespersen, K., 2016. Transnational markets for sustainable development governance: the case of REDD+. *World Dev.* 86, 79–94.
- Gallemore, C., Munroe, D.K., 2013. Centralization in the global avoided deforestation collaboration network. *Glob. Environ. Chang. Part A* 23, 1199–1210.
- Garrick, D., De Stefano, L., Fung, F., Pittcock, J., Schlager, E., New, M., Connell, D., 2013. Managing hydroclimatic risks in federal rivers: a diagnostic assessment. *Philos. Trans. R. Soc. a-Math. Phys. Eng. Sci.* 371.
- Gaventa, J., 2006. Finding the spaces for change: a power analysis. *Inst. Dev. Stud. Bull.* 37, 23–33.
- Gelcich, S., 2014. Towards polycentric governance of small-scale fisheries: insights from the new 'Management Plans' policy in Chile. *Aquat. Conserv.* 24, 575–581.
- Giddens, A., 1984. *The Constitution of Society*. Polity Press, Cambridge, England.
- Gillard, R., Gouldson, A., Paavola, J., Van Alstine, J., 2017. Can national policy blockages accelerate the development of polycentric governance? *Glob. Environ. Chang. Part A* 45, 174–182.
- Gruby, R.L., Basurto, X., 2014. Multi-level governance for large marine commons: politics and polycentricity in Palau's protected area network. *Environ. Sci. Policy* 36, 48–60.
- Heikkilä, T., Weible, C.M., 2018. A semiautomated approach to analyzing polycentricity. *Environ. Policy Gov.* 28, 308–318.
- Hettiarachchi, M., Morrison, T.H., McAlpine, C., 2017. Power, politics and policy in the appropriation of urban wetlands: the critical case of Sri Lanka. *J. Peasant Stud.* 1–18.
- Homsy, G.C., Warner, M.E., 2015. Cities and sustainability: polycentric action and multilevel governance. *Urban Aff. Rev.* 51, 46–73.
- Hooghe, L., Marks, G., 2003. Unraveling the central state, but how? Types of multi-level governance. *Am. Polit. Sci. Rev.* 97, 233–243.
- Huitema, D., Jordan, A., Munaretto, S., Hildén, M., 2018. Policy experimentation: core concepts, political dynamics, governance and impacts. *Policy Sci.* 51, 143–159.
- Ingalls, M.L., 2017. Not just another variable: untangling the spatialities of power in social-ecological systems. *Ecol. Soc.* 22, 20.
- Ingold, K., Driessen, P.P.J., Runhaar, H.A.C., Widmer, A., 2018. On the necessity of connectivity: linking key characteristics of environmental problems with governance modes. *J. Environ. Plan. Manag.* 1–24.
- Jager, N., Challies, E., Kochskämper, E., Newig, J., Benson, D., Blackstock, K., Collins, K., Ernst, A., Evers, M., Feichtinger, J., Fritsch, O., Gooch, G., Grund, W., Hedelin, B., Hernández-Mora, N., Hüesker, F., Huitema, D., Irvine, K., Klinke, A., Lange, L., Loupsans, D., Lubell, M., Maganda, C., Matczak, P., Parés, M., Saarikoski, H., Slavičková, L., van der Arend, S., von Korff, Y., 2016. Transforming European water governance? Participation and river basin management under the EU water framework directive in 13 member states. *Water* 8, 156.
- Jordan, A., Huitema, D., van Asselt, H., Forster, J., 2018. *Polycentricity in Action*. Cambridge University Press.
- Jordan, A., Wurzel, R.K., Zito, A.R., 2013. Still the century of 'new' environmental policy instruments? Exploring patterns of innovation and continuity. *Env. Polit.* 22, 155–173.
- Jordan, A.J., Huitema, D., Hilden, M., van Asselt, H., Rayner, T.J., Schoenefeld, J.J., Tosun, J., Forster, J., Boasson, E.L., 2015. Emergence of polycentric climate governance and its future prospects. *Nat. Clim. Chang.* 5, 977–982.
- Kashwan, P., 2015. Forest policy, institutions, and REDD plus in India, Tanzania, and Mexico. *Glob. Environ. Polit.* 15, 95–117.
- Kashwan, P., MacLean, L.M., García-López, G.A., 2018. Rethinking power and institutions in the shadows of neoliberalism. *World Dev.* <https://doi.org/10.1016/j.worlddev.2018.05.026>.
- Leach, M., 2008. Pathways to sustainability in the forest? Misunderstood dynamics and the negotiation of knowledge, power, and policy. *Environ. Plan. A* 40, 1783–1795.
- Lebel, L., Anderies, J.M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T.P., Wilson, J., 2006. Governance and the capacity to manage resilience in regional social-ecological systems. *Ecol. Soc.* 11, 19.
- Lejano, R., Ingram, M., Ingram, H., 2013. *The Power of Narrative in Environmental Networks*. MIT Press.
- Lemos, M.C., Agrawal, A., 2006. Environmental governance. *Annu. Rev. Environ. Resour.* 31, 297–325.
- Lipsky, M., 1971. Street-level bureaucracy and the analysis of urban reform. *Urban Aff. Q.* 6, 391–409.
- Loorbach, D., Frantzeskaki, N., Avelino, F., 2017. Sustainability transitions research: transforming science and practice for societal change. *Annu. Rev. Environ. Resour.* 42, 599–626.
- Lubell, M., Mewhirer, J.M., Berardo, R., Scholz, J.T., 2017. Transaction costs and the perceived effectiveness of complex institutional systems. *Public Adm. Rev.* 77, 668–680.
- Lukes, S., 2004. *Power: a Radical View*. Palgrave Macmillan.
- Lund, J.F., Sungusia, E., Mabele, M.B., Scheba, A., 2017. Promising change, delivering continuity: REDD+ as conservation fad. *World Dev.* 89, 124–139.
- Mansbridge, J., 2014. The role of the state in governing the commons. *Environ. Sci. Policy* 36, 8–10.
- Mathias, J.D., Lade, S.J., Galaz, V., 2017. Multi-level policies and adaptive social networks - a conceptual modeling study for maintaining a polycentric governance

- system. *Int. J. Commons* 11, 220–247.
- Morrison, T.H., 2017. Evolving polycentric governance of the great barrier reef. *Proc. Natl. Acad. Sci. U. S. A.* 114, E3013–E3021.
- Morrison, T.H., Adger, W.N., Brown, K., Lemos, M.C., Huitema, D., Hughes, T.P., 2017. Mitigation and adaptation in polycentric systems: sources of power in the pursuit of collective goals. *Wiley Interdiscip. Rev. Clim. Change* 8, e479.
- Nagendra, H., Ostrom, E., 2012. Polycentric governance of multifunctional forested landscapes. *Int. J. Commons* 6, 104–133.
- Nye, J.S., 2008. Public diplomacy and soft power. *Ann. Am. Acad. Pol. Soc. Sci.* 616, 94–109.
- Okereke, C., 2018. Equity and justice in polycentric climate governance. In: Jordan, A., Huitema, D., van Asselt, H., Forster, J. (Eds.), *Polycentricity in Action*. Cambridge University Press.
- Ostrom, E., 2010a. Polycentric systems for coping with collective action and global environmental change. *Global Environ. Change-Hum. Policy Dimens.* 20, 550–557.
- Ostrom, E., 2010b. Beyond markets and states: polycentric governance of complex economic systems. *Am. Econ. Rev.* 100, 641–672.
- Ostrom, V., Tiebout, C.M., Warren, R., 1961. The organization of government in metropolitan areas: a theoretical inquiry. *Am. Polit. Sci. Rev.* 55, 831–842.
- Pahl-Wostl, C., Knieper, C., 2014. The capacity of water governance to deal with the climate change adaptation challenge: Using fuzzy set Qualitative Comparative Analysis to distinguish between polycentric, fragmented and centralized regimes. *Glob. Environ. Chang. Part A* 29, 139–154.
- Partzsch, L., 2017. 'Power with' and 'power to' in environmental politics and the transition to sustainability. *Env. Polit.* 26, 193–211.
- Pattberg, P., Widerberg, O., 2016. Transnational multistakeholder partnerships for sustainable development: conditions for success. *Ambio* 45, 42–51.
- Polanyi, M., 1951. *The Logic of Liberty: Reflections and Rejoinders*. University of Chicago Press, Chicago.
- Poteete, A.R., Janssen, M.A., Ostrom, E., 2010. *Working Together: Collective Action, the Commons, and Multiple Methods in Practice*. Princeton University Press.
- Sabatier, P.A., 1988. An advocacy coalition framework of policy change and the role of policy-oriented learning therein. *Policy Sci.* 21, 129–168.
- Scharpf, F.W., 2006. The joint-decision trap revisited. *J. Common Mark. Stud.* 44, 845–864.
- Schmidt, V.A., 2008. Discursive institutionalism: the explanatory power of ideas and discourse. *Annu. Rev. Polit. Sci.* 11, 303–326.
- Schoenefeld, J., Jordan, A., 2017. Governing policy evaluation? Towards a new typology. *Evaluation* 23, 274–293.
- Scoones, I., 2016. The politics of sustainability and development. *Annu. Rev. Environ. Resour.* 41, 293–319.
- Scott, J.C., 1990. *Domination and the Arts of Resistance: Hidden Transcripts*. Yale University Press.
- Scott, J.C., 2008. *Weapons of the Weak: Everyday Forms of Peasant Resistance*. Yale University Press.
- Scott, T.A., Thomas, C.W., 2017. Winners and losers in the ecology of games: network position, connectivity, and the benefits of collaborative governance regimes. *J. Public Adm. Res. Theory* 27, 647–660.
- Smith, J.M., Halgin, D.S., Kidwell-Lopez, V., Labianca, G., Brass, D.J., Borgatti, S.P., 2014. Power in politically charged networks. *Soc. Networks* 36, 162–176.
- Snow, D.A., Moss, D.M., 2014. Protest on the fly: toward a theory of spontaneity in the dynamics of protest and social movements. *Am. Sociol. Rev.* 79 (6), 1122–1143.
- Sova, C.A., Thornton, T.F., Zougmore, R., Helfgott, A., Chaudhury, A.S., 2016. Power and influence mapping in Ghana's agricultural adaptation policy regime. *Clim. Dev.* 9, 399–414.
- Sovacool, B.K., Tan-Mullins, M., Ockwell, D., Newell, P., 2017. Political economy, poverty, and polycentrism in the global environment facility's least developed countries fund (LDCF) for climate change adaptation. *Third World Q.* 38, 1249–1271.
- Steffen, W., Rockstrom, J., Richardson, K., Lenton, T.M., Folke, C., Liverman, D., Summerhayes, C.P., Barnosky, A.D., Cornell, S.E., Crucifix, M., Donges, J.F., Fetzer, I., Lade, S.J., Scheffer, M., Winkelmann, R., Schellnhuber, H.J., 2018. Trajectories of the Earth System in the Anthropocene. *Proc. Natl. Acad. Sci. U. S. A.* 115, 8252–8259.
- Sunderlin, W.D., Sills, E.O., Duchelle, A.E., Ekaputri, A.D., Kweka, D., Toniolo, A., Ball, S., Daggart, N., Pratama, C.D., Padilla, J.T., Enright, A., Otsyina, R.M., 2015. REDD+ at a critical juncture: assessing the limits of polycentric governance for achieving climate change mitigation. *Int. For. Rev.* 17, 400–413.
- Turnbull, L., Hütt, M.-T., Ioannides, A.A., Kininmonth, S., Poepl, R., Tockner, K., Bracken, L.J., Keesstra, S., Liu, L., Masselink, R., Parsons, A.J., 2018. Connectivity and complex systems: learning from a multi-disciplinary perspective. *Appl. Netw. Sci.* 3, 11.
- Varone, F., Ingold, K., Jourdain, C., 2017. Studying policy advocacy through social network analysis. *Eur. Political Sci.* 16, 322–334.
- Voulvoulis, N., Arpon, K.D., Giakoumis, T., 2017. The EU water framework directive: from great expectations to problems with implementation. *Sci. Total Environ.* 575, 358–366.
- Weber, M., 1922. *Economy and Society: an Outline of Interpretive Sociology*. University of California Press, Berkeley.
- Weible, C.M., Heikkilä, T., 2017. Policy conflict framework. *Policy Sci.* 50, 23–40.
- Wilson, C.E., Morrison, T.H., Everingham, J.A., McCarthy, J., 2018. Capture and crush: gas companies in the fracking dispute and deliberative depoliticization. *Geoforum* 92, 106–116.