Environmental Governance

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Introduction:

Questions of governance and the role of the state in society have long been the focus of sociological inquiry (see Domhoff, 1990; Habermas, 1975; Weber, Roth, & Wittich, 1978). As the field of environmental sociology emerged in 1970s, one of the main questions driving the growth of this sub-discipline was the degree to which the state can successfully address environmental degradation (Buttel, 2003; Freudenburg & Gramling, 1994). One of the major themes of this research is understanding environmental governance and the degree to which it successfully reduces the creation of environmental bads and environmental destruction, both of which are products of production processes.

This chapter provides an overview of the ways that environmental sociology has addressed environmental governance. Environmental governance has been the focus of inquiry for research across all of the social sciences and beyond. This chapter, however, draws specifically on the theory and research that engages directly with environmental sociology. Although we include examples from non-Western cases, the main focus is on the more recent work on Western democracies that have been published in the English language.

The chapter is organized into three sections. First, we provide a general overview of the dominant perspectives on how environmental sociology has approached environmental governance theoretically. In this section, we emphasize the ways that the broader theoretical

literature addresses environmental governance and highlight the approaches that present viable ways to address environmental challenges. Second, we discuss the various empirical approaches for studying environmental governance today. Although this section briefly introduces the diversity of approaches employed within environmental sociology, this chapter focuses the majority of its attention on the growing work that comes from a social networks perspective. Third and finally, we present examples of recent empirical investigations into environmental governance that employ social network analysis to understand environmental governance. In particular, this section presents two examples: the first comes from a policy network approach that looks at climate politics and the second is drawn from an organizational network approach that analyzes urban environmental stewardship. The chapter concludes with a discussion of the likely future directions of research on environmental governance.

Environmental Sociological Perspectives on Environmental Governance

For decades, much of the scholarship in environmental sociology has focused specifically on a debate among scholars who come to differing conclusions about the feasibility of environmental protection. In general, these authors assess the relationship between economic development and environmental degradation (see particularly Buttel, 2000; Clark & York, 2005; Fisher & Freudenburg, 2004; Frank, Hironaka, & Schofer, 2000b; Frank et al., 2000b; Frank, Hironaka, & Schofer, 2000a; Jorgenson & Clark, 2012; York, Rosa, & Dietz, 2003). On the one hand, a number of relatively critical perspectives find that economic development is antithetical to environmental protection, given the growth imperative of modern economic systems and their need for continual resource inputs and increased environmental harm as economies continue to grow. On the other hand, scholars focusing on modernization processes and governance tend to

be more optimistic, concluding that environmental protection measures themselves are often associated with economic growth.

Research with a more critical approach has often involved a concern about the degree to which society's growth appears to have come at the expense of the natural environment (e.g. Catton, 1982; Dunlap & Van Liere, 1978, 1984; Foster, 1992; O'Connor, 1991; Schnaiberg & Gould, 1994). Although there is variation in perspective by author and the focus of their work, there are notable commonalities among them. For example, each focuses much of their attention on explaining environmental degradation with a general expectation that environmental regulation will be ineffectual overall. Among these studies, some attention has been paid to the ways that social movements will mobilize, their efforts are anticipated to be impotent overall (Gould, Lewis, & Roberts, 2004; Rudel, Roberts, & Carmin, 2011).

Environmental Governance and the Environmental State

In contrast to the research that comes from a more critical perspective, most of the scholars who take a more optimistic approach assume the feasibility of a so-called environmental state. As such, this literature tends to focus on the ways that environmental protection functions as an economically beneficial process and basic responsibility of industrialized nation-states (Frank et al., 2000b; Giddens, 1991, 2013). Many scholars have noted how the environmental state expanded its responses to environmental problems in an effort to improve environmental quality (see particularly Buttel, 2003). During the 1980s, state intervention in environmental issues decreased as economic and political trends moved toward deregulation and privatization. In the context of 1990s debates over state failures in effectively coping with the challenges of modernity and industrialization, the bulk of the responsibility for environmental protection

shifted toward private economic and civil society actors (Mol, 2003). Debates over the efficacy of top-down environmental policymaking remain highly relevant today. Given the "inability of national regulators to address successfully environmental problems in the decision-making process, and effectively enforce the decisions already made," alternative approaches to environmental governance are crucial in order to move forward with meaningful action on climate change, pollution control, and other significant environmental issues (Fisher, Frisch, & Andersen, 2009, p. 146). As we will discuss in more detail in the next section, advanced industrialized states rarely act alone in implementing environmental policies. Rather, environmental governance is carried out through hybrid arrangements among the state, market, and civil society actors (Ansell & Gash, 2007; Michelle Betsill & Bulkeley, 2006; Koontz et al., 2004; Sirianni, 2009; Spaargaren, Mol, Buttel, & Buttel, 2006; van Tatenhove & Leroy, 2003).

Ecological Modernization Theory (EMT) provides an environmental sociological perspective that examines the transformations of social practices and institutions, or patterns of "ecological restructuring," that emerge from environmental concerns in industrialized countries when "the state can no longer be expected to design and prescribe the way society and economic interactions should be organized" (see also Mol, 2001; Mol & Buttel, 2002, p. 4). In other words, EMT explores how economic growth and industrialization can be amenable to environmental protection and how solutions to environmental crises can evolve within, rather than outside of, the modern market economy (Hajer, 2000; Mol & Jänicke, 2009). EMT emerged in a Western European context and has been most applicable in cases within industrialized countries with established processes for environmental policymaking (Spaargaren & Mol, 1992; see also Galli & Fisher, 2016).

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In particular, EMT explores environmental governance in the context of shifting boundaries between state, market, and civil society (Mol & Jänicke, 2009). In contrast to government "command and control" over policymaking and implementation, from this perspective, environmental governance refers to the complex, reciprocal array of arrangements between state, non-governmental, and individual actors that emerge through the definition and pursuit of collective political goals (Betsill & Bulkeley, 2006). EMT is only one strand of a larger literature documenting a shift from government to governance of environmental issues in industrialized countries. As Koontz and colleagues state, "*government*, as a formal institution of the state, ceases to hold sole power through command and control mechanisms, thereby shifting to *governance*, a process that takes place through the collective action of a variety of participants, all of whom retain some control over decision making or implementation" (Koontz et al., 2004, p. 6 emphasis in original; see also Boyte, 2005).

Political transformations associated with industrialization—namely increased public participation, decreased state centrality, and the rise of privatization—encourage collaborative governance, or governance in which public and private actors work together toward common goals and regulations (Sirianni, 2009). This process of political modernization is characterized by the shift from state-initiated regulation to participatory governance as boundaries between state, market, and civil society blur (Leroy & van Tatenhove, 2000; Mol & Jänicke, 2009; for an alternative perspective, see Beck, 1999).

Participatory governance practices have emerged through different stages of political modernization: following the increase in civil society action that accompanied the rise of the environmental state from the 1960s through the 1980s, participatory governance emerged as a way of compensating for state failure (Fisher et al., 2009). Van Tatenhove and Leroy contend

that what they call the "societalization" of governance goes hand-in-hand with "marketization,"

or the delegation of responsibility for regulation away from the state to privatized agencies (van

Tatenhove & Leroy, 2003, pp. 167–168). As state-market interactions shift, economic processes

and actors take on new or additional roles in environmental protection (Huber, 1982). In Mol's

words, the rise of market practices in which "economic processes of production and consumption

are increasingly analyzed and judged, as well as designed and organized from both an economic

and ecological point of view" (Mol, 2001, p. 60 emphasis author's). In this "ecologized

economy," environmental protection and governance is multidirectional, wherein the purchasing

power of "citizen-consumers" combines with more top-down policies and economic tools to

achieve environmental protection (for an overview, see Mol, Sonnenfeld, & Spaargaren, 2009).

Hybrid Arrangements

As detailed by Leroy and Van Tatenhove (Leroy & van Tatenhove, 2000), the institutionalization

of "interference zones" between state, market, and civil society creates opportunities for new

combinations of governance approaches and the emergence of unique policy arrangements. Mol,

Spaargaren, and other environmental sociologists have described these diverse forms of

collaboration between social actors as "hybrid arrangements" (see particularly Spaargaren et al.,

2006). The authors note that there has been "enmeshment and hybridization" between "formerly

distinct entities" within the environmental state, pointing out that the "roles and responsibilities

formerly reserved for the (nation-)state are fulfilled by market actors and civil society groups and

organizations, and vice versa" (Spaargaren et al., 2006, p. 15). Thus, hybrid arrangements,

which vary in terms of the actors and sectors involved, create new opportunities for innovative

approaches to environmental governance and civic engagement in policy implementation (
Fisher & Svendsen, 2013; see also Fisher, Svendsen, & Connolly, 2015).

As relationships between civil society groups, businesses, and government agencies have become the norm rather than the exception, scholars have identified new forms of "collaborative governance" practices. Ansell and Gash define collaborative governance as involving "one or more public agencies" working toward policy goals by working with "non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative" (Ansell & Gash, 2007, p. 545). Moving beyond traditional public-private partnerships that focus predominantly on providing services to consumers, collaborative governance aims to set the agenda for policymaking and implementation. For example, collaborative governance may emerge as a deliberate decision-making and management strategy in cases of "policy deadlock," or when policy makers foresee implementation as being potentially difficult (Ansell & Gash, 2007, p. 553; see also Ostrom, 2012).

The Role of the State

In many ways, the collaborative approach to governance has emerged in response to the empirical reality of environmental regulation, where the state is forced to play a more limited role in regulation as the private sector adopts voluntary regulatory measures. At the same time, even with participatory governance relatively common, it is clear that these arrangements do not necessitate the dissolution of the state. Rather than replacing more traditional approaches entirely, new forms of collaborative governance may function side-by-side with top-down environmental policy processes (Mol et al., 2014; Spaargaren et al., 2006). In other cases, the role of the state may shift without disappearing entirely: for example, the state may function as a

moderator and facilitator between different interests, rather than acting on those interests directly (Mol & Buttel, 2002).

Because the lines of accountability within hybrid arrangements can be diffuse, state authority may be necessary to anchor environmental policies and provide incentives for effective implementation. For example, state-initiated regulation policies continue to play a role in providing resources, setting imperatives for regulation, incentivizing sustainable innovation, and assisting in the regulation process (Murphy & Gouldson, 2000). State backing of environmental policies can provide much-needed accountability, or what some have called a "stick behind the door" in the event of noncompliance or policy failure (Jänicke & Jörgens, 2009). In Mol's words, the state provides a "credible threat of regulation" that "may help ensure full commitment of all participants" in the governance and decision-making processes (Mol, 2003, p. 345).

Multi-Scale and Hybrid Arrangements

Within this context, a variety of hybrid arrangements have developed at multiple levels within the environmental state (Jänicke & Jörgens, 2009), and have been documented in the empirical research. In their study of the impact of integrated pollution control in linking state and market actors in regulatory action in England and Wales, for example, Murphy and Gouldson find that these efforts were successful when there was deep collaboration between state regulators and companies (Murphy & Gouldson, 2000). In light of the delayed response by national governments to global environmental issues such as climate change, many cities have implemented their own environmental protection programs, which have been referred to as "races to the top" (Rabe & Borick, 2013, p. 321). In their 2016 study, Galli and Fisher looked at how a federally funded effort to establish a sub-national low carbon energy policy was

implemented through hybrid arrangements in communities around the United States (Galli & Fisher, 2016). Since the Trump Administration pulled out of the international Paris Agreement, the "We Are Still In Campaign" provides a more recent example of this type of effort with subnational governmental actors working with businesses and civil society organizations to address the issue of climate change.[1]

As nodes of transnational networks engaged in climate protection, cities often implement bottom-up initiatives to address greenhouse gas reduction and energy conservation (Michele Betsill & Bulkeley, 2007; Bulkeley & Betsill, 2005). Cities act as key players in the transnational response to global climate change by connecting with local stakeholders, integrating climate change into pre-existing policies, and experimenting with innovative programs aimed at cost-effective greenhouse gas reduction and energy efficiency (Corfee-Morlot, Cochran, & Teasdale, 2008). Thus, city-level environmental protection programs provide researchers with an opportunity to understand more fully how hybrid arrangements are formed and implemented.

In sum, although environmental governance has been studied quite extensively, scholars note that the hybrid arrangements that are likely to lead to successful outcomes are highly contingent on the institutional, political and cultural contexts in which they emerge (Fisher et al., 2009; Mol, 2003). In some cases, this perspective has been referred to as 'networked governance.' Carlsson and Sandstrom summarize this approach as a way "to cope with the complexity of natural resource systems, institutional arrangements and related management systems should incorporate different actors from different areas of society" (Carlsson & Sandström, 2007, p. 34) Given that much of the available environmental governance sociological

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[1] See https://www.wearestillin.com/ (accessed 12 October 2018).

empirical research stresses these hybrid/networked arrangements, later sections focus on research that employs a social networks approach to analyze such arrangements.

Studying Environmental Governance

Environmental sociologists have employed various methodologies for studying environmental governance including ethnomethodologies (e.g. MacKendrick, 2018; Norgaard, 2011), mixed methods (Fisher, 2004; Fisher, 2006, 2013; Robertson, 2018), cross national comparisons (Jorgenson & Clark, 2012; Shorette, 2012; York et al., 2003), and geospatial analysis (Collins, Munoz, & JaJa, 2016; Robertson & Collins, 2018). A comparatively smaller but fast growing literature employs social network analysis to understand environmental governance, with much of it drawing from multidisciplinary perspectives. Some authors have made the case for a new understanding of 'networked' governance where the structures in which stakeholders (Provan & Kenis, 2007; Voß, Newig, Kastens, Monstadt, & Nölting, 2007), including state, non-state, as well as individual actors, connect can promote social learning and knowledge diffusion (Pahl-Wostl, 2009; Muñoz-Erickson & Cutts, 2016), mitigate risks (Berardo & Scholz, 2010), and solve problems of collective action (van Bueren, Tania, Decker, & Pfeffer, 2003). The premise of this line of inquiry is that the shape, construction, or typography of the network fundamentally alters the quality of interaction, learning, policy, and therefore governance (Newig, Günther, & Pahl-Wostl, 2010; Schusler, Decker, & Pfeffer, 2003). In the section that follows, we briefly summarize these varied methods and then focus the remainder of the chapter on the growing efforts to employ social network analysis to understand environmental governance.

Research taking an ethnomethodological approach aims to understand environmental governance structures in their social context. The premise of these methodologies is that social

practices are what render the social world available to be researched (Suchman, 2007). Hence, ethnomethodological approaches often focus on actors, their social practices and how they organize themselves within their respective social context (see e.g., Norgaard, 2011). Recent studies have emphasized the need to map how complex socio-technical relations relate to environmental governance (Wolf & Ghosh, 2019; see also Ghosh, 2018). Arguably, ethnomethodologists often opt for representing these relations through accountability (Lippert, 2015), which is core to ethnographic research on governance. One such example can be seen in the study of environmental accounting standards for carbon governance by Wolf & Ghosh (2019). In this study, the research aimed to provide an insight on how standards were produced and enforced. This practice-centered approach has the benefit of accounting for the structural context of governance and enables the authors to engage in how conventions and standards are related to the problem-solving capabilities of actors.

Other research has taken a mixed methodological approach to compare how social spheres relate to the environment: the environmental physical setting and a social/political setting. For example, environmental data is generally physically focused on resources whilst engaging with actors might be better done through a qualitative study of the incentives and personal opinions of political actors (Fisher, 2006; see also Fisher, 2004). Mixed methods, therefore, have the benefit of joining both parts together, which is particularly useful in observing how political decisions evolve into real-world outcomes. In her study of climate policymaking in the US, Fisher compares natural resource endowment to political decision making (2006). Other mixed methodological approaches are used in an 'environmental management' specific context (Molina-Azorín & López-Gamero, 2016); qualitative research that helps direct and focus quantitative research (Simpson & Samson, 2010); quantitative research on

institutions or on natural resources that highlights specific needs, which are then investigated using qualitative methods (e.g. Fisher, 2006); and employing a method of complementarity where the results from a method help make sense of the results from the other method. This form of research frequently focuses on corroboration and mutual confirmation on the same research question from two methods.

Cross-national comparisons aim to understand variations in environmental governance across nation-states. Scholars have frequently employed comparative methods to contrast different governance approaches undertaken by various countries. Most of the data available for such studies help provide good economic and political depictions of where different countries stand environmentally. Such an approach has been used to study the EU's dependency on external governance structures (Lavenex, Lehmkuhl, & Wichmann, 2009). These sociological studies of global environmental governance can be divided into two streams: (1) a stream focused on the political economy aspect of global environmental governance (Jorgenson, 2014; Jorgenson & Clark, 2012; Jorgenson, Dick, & Shandra, 2011; see also York et al., 2003); (2) a current nested in the neo-institutionalist perspective (Shorette, 2012; see also Buttel, 2000; Frank et al., 2000b, 2000a).

An alternative perspective takes a comparative approach across subnational entities. For example, Betsill and Bulkeley document how the Cities for Climate Protection program, enacted locally in cities across the world, includes a variety of state and non-state actors in its efforts to lower greenhouse gas emissions (Michelle Betsill & Bulkeley, 2006). Similarly, Bulkeley and Schroeder focus on the examples of London and Los Angeles, finding "new forms of public and private authority" in the urban governance of climate change (Bulkeley & Schroeder, 2012, p. 762). Looking at the case of New York City, Fisher and Svendsen (2013) explore a diverse

range of hybrid arrangements in environmental stewardship organizations (Fisher & Svendsen, 2013).

In some cases, this work looks at the spatial dimension of environmental issues in order to observe how environmental governance is fitted spatially (Connolly, Svendsen, Fisher, & Campbell, 2013; Locke et al., 2014). Some recent studies that employ this approach have focused on uneven emissions and various emitters. For example, Galli Robertson and Collins have compared emissions among corporate facilities of the coal-fired electric utility industry (Robertson & Collins, 2018; see also Robertson, 2018). The geospatial dimension of such questions is core to understanding who emits more and where. Various approaches and data sources can be of use when undertaking such analysis. For example, Collins and colleagues have looked into unequal pollution production and unequal repartition of industrially based exposure (Collins et al., 2016). However, complications from this type of studies can occur from the sheer quantity of data needed to analyse varying surfaces. Due to these complications, researchers seeking to undertake geospatial studies often opt for other sources/forms of data. For example, in their study of canopy distribution depending on socio-demographic factors, Watkins and colleagues have leveraged data from non-profit tree-planting organisations which provides them with concise data for their study (Watkins, Mincey, Vogt, & Sweeney, 2017). Another approach to enacting geo-spatial analysis of canopy distribution could have been the use of high-resolution satellite imaging to study equity in tree-canopy distribution (e.g. Landry & Chakraborty, 2009; Schwarz et al., 2015).

The remainder of this section focuses specifically on the ways that scholars have employed social network analysis as a framework to capture the relational nature of environmental governance, which has received growing attention in sociology in recent years.

These cases fall into two general categories: networks of organizations (which include examples of social and socio-ecological networks), and policy network analysis. Each category is described in turn with additional examples.

Network Measurement

The use of networks in the literature can take many forms, from the metaphoric to a measurable structure. In the latter case, networks are defined as a set of nodes, usually individuals, organizations, or other stakeholders involved, and the ties among them. 'Ties' can be measured by communication, exchange of resources or information, co-attendance at different policy forums or other events, and many other relationships. For example, the policy networks literature typically examines bipartite (meaning two types of nodes) networks of actors (one type of node) at the national or international level and uses policies and implementation practices (the second type of nodes) to examine the implementation and diffusion of different environmental policies.[2] Other network studies employ networks solely of beliefs (Hoffman, Lubell, & Hillis, 2014), individual respondents (M. Barnes, Kalberg, Pan, & Leung, 2016), and countries (Prell, Feng, Sun, Geores, & Hubacek, 2014), but a large proportion of the literature focuses on relationships among organizations.

Empirical network studies begin with the critical question of who needs to be included as a node in the sample. Depending on the level of analysis, this can be approached in many different ways—however, decisions regarding whom to include in the network, be these policy

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[2] It is important to stress that this list is not meant to be exhaustive regarding the usage of social networks in environmental sociology, rather it focuses on using social networks to understand environmental governance. Scholars also focus their attention on understanding social movements (Diani, 1995; D. R. Fisher, Jasny, & Dow, 2018; Tindall, 2002), belief formation (Hoffman, Lubell, & Hillis, 2014), media coverage of environmental issues (Kukkonen et al., 2018; Häussler, 2018), and scientific communication (A. Li & Yarime, 2017), among others.

instruments, individuals, organizations, countries, or something else entirely can greatly affect the outcome (Prell, Hubacek, Quinn, & Reed, 2008). In many cases, data collection begins by sampling newspaper articles and well-known events where environmental concerns are being discussed, but work is increasingly attempting to employ more grass-roots approaches to defining the population of organizations or individuals involved. These methods typically use snowball sampling approaches where organizations mention other groups that are then also sampled (for an overview of these methods, see Goodman, 2011). In snowball sampling methods, unlike others, the boundary of the network is thus provided by the members of the network themselves and is termed the 'realist' or endogenous population (Laumann & Marsden, 1992).

When sampling methods miss important sets of stakeholders, the resulting analysis is irrevocably skewed (Mbaru & Barnes, 2017), especially as there is a natural sampling bias in favor of larger, better represented organizations if they are mentioned more in the media or have more resources to attend events. As a solution to this problem, some studies have promoted the integration of Social Network Analysis (SNA) with Stakeholder analysis (Prell, Hubacek, & Reed, 2009). The objective of the use of SNA in this scenario is to envision better the network studied. The authors affirm that the "proposed combination of stakeholder analysis and SNA can help identify stakeholder categories, ensure key groups are not marginalized, and specify representatives that are well connected with and respected by the groups they need to represent" (Prell et al., 2009, p. 514). This work is an important first in addressing how to handle questions of power and representation in a network.

After the organizations or stakeholders who form the 'nodes' in the network are identified, the ties and relationships of the actors are core to understanding the network itself.

One of the aims of analyzing bonds between actors is generally to understand how conservation information is diffused (Berardo, Alcañiz, Hadden, & Jasny, 2016; Mbaru & Barnes, 2017; see also Jasny, Waggle, & Fisher, 2015; Jasny et al., 2018). Two methods are commonly used today for this purpose: collecting interaction data from newspapers, rosters, and registers and directly surveying individuals and organizations. Both of these methods suffer from different missing data problems (Groce, Farrelly, Jorgensen, & Cook, 2018). New technologies for capturing interview data in person as well as the inclusion of online data permit advances in these arenas both in the capturing of social as well as ecological data. Innovative sampling methods for empirical studies have emerged, notably the use of citizen sensing which uses low-cost digital technologies to allow citizens to gather data; rendering vast sets of big-data (Gabrys, Pritchard, & Barratt, 2016).

Possibilities for citizen collection of environmental data via smartphones and similar technologies include data on noise pollution, meteorological conditions such as UV radiation levels, and water quality (see McGrath & Scanaill, 2013 for details on all), distribution of litter (Lynch, 2018), and animal populations (Dennis, Morgan, Brereton, Roy, & Fox, 2017; Newman et al., 2012), as well as the collection of social network data (Newman et al., 2012), and how individuals interact with policy and governance (Loader, Vromen, & Xenos, 2014). The use of personal smartphones or other handheld devices to collect environmental or social data carries with it a number of additional possibilities for researchers. The role of such technologies in how they affect the actual sociological processes that underpin these networks should not be discounted either: the technologies and citizen sensing initiatives may influence social movements with environmental justice ramifications (Dhillon, 2017). Moreover, they themselves may facilitate or affect social movements (Stacey, 2018). The amplitude and shape of

'citizen data' requires adaptation to its unusual collective data structure. An illustration of this challenge can be seen in Gabrys, Pritchard, & Barratt's (2016) use of 'citizen data' to monitor township air quality. The methodology they undertook was one of collecting and cross-referencing data in order to create an air pollution baseline from which they inferred temporal events were occurring when seeing shifts. However, the democratization of research based on this type of data has a long way to go. As Bakker & Ritts emphasize in their analysis of 'smart earth' advancements, "better data does not necessarily lead to better governance" (2018, p. 208). Rather, it us up to the researchers and practitioners to make the necessary links.

Networks and environmental governance

Social network studies of environmental governance are heterogeneous in their choice of methods and focus (Groce et al., 2018; Rockenbauch & Sakdapolrak, 2017). Studies of individual networks look at the position or role of the different actors and whether there are patterns among those who play more prominent roles or occupy more central positions (Scott & Thomas, 2017), as well as the role of homophily—or similarity—within the network (Borgatti, Obstfeld, & Davis, 2014; Fischer & Jasny, 2017). One of the largest contributions of networks to the literature on environmental governance is the clarification and measurement of what is meant by 'brokerage,' 'bridging,' or 'boundary spanning' (Bodin & Crona, 2009; Connolly et al., 2013; Jasny & Lubell, 2015; Wilson & MacDonald, 2018). These are the organizations or individuals that sit at the boundaries between two or more sets of organizations, or that allow two otherwise separate networks to connect and interact (Granovetter, 1983). Even though there are a range of terms to describe such groups, these organizations have similar functions and characteristics - connecting otherwise unconnected network members and facilitating the flow of

information or resources. A more diverse and connected network has been shown to bring access to new resources (an example in the context of policy networks might be specific local or historical knowledge), to help solve collective action problems (Beilin, Reichelt, King, Long, & Cam, 2013) , and to help overcome poor socio-ecological fit (Bodin, Crona, Thyresson, Golz, & Tengö, 2014; Ernstson, Barthel, Andersson, & Borgström, 2010).

The boundaries that these bridging ties cross can be disciplinary, scalar (Andersson et al., 2014; Hamilton & Lubell, 2018), geographic (Fischer & Jasny, 2017), or financial (Barendse, Roux, Currie, Wilson, & Fabricius, 2016), among others. Boundary organizations might be formally created to be so, as is the case of the IPCC and other international scientific assessments (Hoppe, Wesselink, & Cairns, 2013; see also Leifeld & Fisher, 2017), or may come to this position as a result of network dynamics and mechanics (Ernstson et al., 2010). While most of the literature is still overwhelmingly positive about the role of brokers in this area, a few studies have highlighted the additional amount of time, work, and resources demanded by these roles, as well as other negative results like decreased trust among those who occupy these positions (M. Barnes et al., 2016; Stovel & Shaw, 2012). A particularly vivid example of the successes and failures of brokerage in a governance network is that of CalFed, "the most important collaborative watershed management program in the Sacramento-San Joaquin Delta of Northern California from 1994-2009" (Lubell, Gerlak, & Heikkila, 2012 p63). Lubell and others argue that, while the program was frequently considered a failure (Dutterer & Margerum, 2015), the legacy of this broker and the organizations that succeeded CalFed to broker these organizations after its demise have contributed substantially to the resilience of the system itself (Booher & Innes, 2010).

Scholars have noted a lack of environmental social networks literature outside of the Western context (H. Li, Lo, & Tang, 2017); however, this is due in part to the diverse and separate outlets for this literature as well as many recent articles. In Africa, many network studies of stakeholder involvement in the policy and governance process have been published (Isaac & Matous, 2017; Matouš, Todo, & Mojo, 2013) and work across the continent represents the cutting edge of comparative research (Aßmann, Henning, Krampe, Hedtrich, & Ehrenfels, Forthcoming; Bourne, Gassner, Makui, Muller, & Muriuki, 2017). In the Russian context (Davies, Holm-Hansen, Kononenko, & Røiseland, 2016) present an analytical framework for the analysis of network governance, and Kropp & Schuhmann (2016) discuss specific examples of environmental governance networks. Latin American examples include work on local communities (Rico García-Amado et al., 2012), regional governance (Armesto et al., 2007; Gelcich et al., 2010), as well as international comparative studies such as those by Di Gregorio et al., (2019) comparing Brazil and Indonesia to build a theoretical framework independent of local cultural contexts. In this particular case, the focus is on how multilevel governance arrangements interact with the issue of climate change, which necessitates a multilevel response.

Most of this literature focuses on one network, but examples of comparative research are growing (Aßmann et al., Forthcoming; Bourne et al., 2017; Jasny, Johnson, Campbell, Svendsen, & Redmond, 2019), as well as work comparing network measures to environmental outcomes (M. L. Barnes, Lynham, Kalberg, & Leung, 2016; Bodin, Sandström, & Crona, 2017). Reviews of this literature regularly call for increasing this comparison, as well as adding longitudinal analysis to see how stable these configurations are (Bodin, 2017; Groce et al., 2018). Future work, and especially comparative work, is necessary to understand what is common to these

networks across different cultural and governance conditions as well as how these networks differ.

Socio-Ecological Networks

A major shift in the thinking on environmental governance has been the introduction of 'systems' thinking (Liu et al., 2007; Ostrom, 2007), and the focus on how a network perspective can inform our understanding of the linkages between and among the social and ecological actors involved (Guerrero et al., 2018; Janssen et al., 2006). The understanding that social and ecological processes must be simultaneously interrogated and the interactions among them modeled is referenced in a variety of literatures and under a variety of terms such as socio-environmental or socio-ecological synthesis, coupled human-natural systems, and more.

A dominant theoretical perspective in the intersection between socio-ecological synthesis and network science began with Ekstrom & Young's (2009) paper introducing "institution-ecosystem fit analysis," which focuses on identifying gaps in socio-ecological relationships to measure institutional mismatch (Guerrero, Bodin, McAllister, & Wilson, 2015). In order to adapt the empirical techniques of network research to the socio-ecological nature of natural resource management, academics frequently turn towards the integration of ecological elements into their network models (Garmestani & Benson, 2013; Groce et al., 2018). This practice is already frequent in ecosystem services research where researchers in the vein of Kolosz and colleagues emphasize the need for theories to integrate human and nature interaction to build better predictive and flexible models (Kolosz et al., 2018), and will hopefully become another tool in the environmental sociologists' repertoire.

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Recent findings in studies of environmental governance maintain that misalignment between organizational networks and ecosystems reduce environmental problem-solving efficiency (Bodin, 2017; Ekstrom & Young, 2009). Bergsten and colleagues, for example, highlight that successful conservation rests on there being a good fit between social and ecological processes (Bergsten, Galafassi, & Bodin, 2014). Similarly, Chaffin and colleagues also highlight the importance of such a fit in achieving a sustainable governance regime (Chaffin, Gosnell, & Cosens, 2014). If social processes are, in some way, modified and adapted by cultural norms, then it follows that successful conservation strategies must be adapted to their local contexts in order to achieve this critical fit, which includes how network-based interventions are designed and evaluated.

Frameworks that integrate social and ecological elements often opt for a multi-level network structure (Sayles & Baggio, 2017). Governance networks and biophysical networks are each represented as networks of their own, only to be linked by the connections they share. For a considerable time, and still today, researchers resort to mapping ecosystems spatially with an average value derived from the services the ecosystems provide (Dee et al., 2017). The issue of representing ecosystems in this manner is that it fails to consider the inner dynamics of the ecosystems themselves and fundamentally assumes that spatial zones are independent of each other (Balvanera et al., 2014). The use of network science aims to correct this issue by accounting for the dynamics that make up an ecosystem. One such example can be seen in Ernstson and colleague's proposed analysis of multiple ecological networks in concurrence with analysis of accompanying social networks (Ernstson et al., 2010, p. 10).

Policy Networks and Environmental Governance

The policy networks literature is similar to that of local environmental governance in its emphasis of polycentrism and the use of network methods and modeling as well as many of the network motifs like brokerage, centrality, cohesion, and clustering (Ingold & Varone, 2012; McAllister, McCrea, & Lubell, 2014). At the same time, this approach involves different contextual and theoretical variables like political opportunity (Leifeld & Schneider, 2012), international treaties and alliances (Yun, Ku, & Han, 2014), and regime type (Compston, 2009). Even though much policy is made at the local level, the focus of much of these studies is on the engagement with the national and international policy process (Weible & Sabatier, 2005, but see Henry, Lubell, & McCoy, 2011; Lubell & Fulton, 2008).

Also, where the previous literature looked at the management side of environmental governance and was thus more tied to the literature on management practices, the policy networks literature is linked to a longer history of policy studies outside of environmental management (Rhodes, 1997). It is worth noting that some authors claim that a fundamental difference exists in the study of environmental policy and governance (Jost & Jacob, 2004). A major theoretical framework used in this literature is the Advocacy Coalition Framework, which emphasizes the need to understand coalition formation and cooperation among policy brokers to explain policy formation and implementation (Jenkins-Smith & Sabatier, 1994; Sabatier, 1988; see also Ingold, 2011). The difficulties in collecting network data, modeling interdependencies, and then relating mechanisms to policy outcomes are consistent among studies in this literature, with few studies comparing multiple networks (for an exception, see Ingold & Leifeld, 2016) or across time (for an exception, see Jasny et al., 2018).

Understanding Environmental Governance through Social and Policy Networks

This section of the chapter presents two examples from our research to provide detailed accounts of how social network analysis has been employed recently to understand environmental governance. As one of the examples comes from a policy networks perspective to understand climate policymaking in the United States and the other focuses on organizational networks to study urban environmental stewardship, these examples represent diverse approaches to studying environmental governance through social networks. Not only are the units of analysis and the objects of inquiry different, but the scale of governance that is being analyzed also vary from the federal level versus the city level.

Studying Climate Policy Networks

As has been previously noted, one common approach to studying environmental governance is to focus on the policy networks among elites engaged in decisionmaking. To date, numerous studies have employed a policy networks approach that analyses data collected from policy actors to understand climate politics around the world (see particularly Gronow & Ylä-Anttila, 2016; Jasny et al., 2018, 2015; Wagner & Ylä-Anttila, 2018; Yun et al., 2014). Coming from this perspective, our research also looks at the networks of elite policy actors in one country—the United States—to understand how expert scientific information about climate change is diffused among policy elites.

Rather than information diffusion taking place in a consistent way among policy actors coming from a range of ideological perspectives, our research concludes that scientific information about climate change is diffused through echo chambers—clusters of policy elites who hold the same position on a climate-related issue. In some cases, echo chambers amplify divergence from the consensus position of an issue like that climate change is being caused, in

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part, by human activity (Jasny et al., 2015; for analysis of the climate countermovement, see Farrell, 2016a, 2016b). In other cases, the echo chamber amplifies consensus, as we noted in our paper on the Clean Power Plan (Jasny et al., 2018). These findings have clear effects on environmental governance: "It is important to note that echo chambers themselves are value-free and apolitical; their impacts on policy discussion and debate are an effect of the political context and the ideological positions of the actors within them" (Jasny et al., 2018, p. 15).

Figure 1 presents the individual ego networks of four key members of the climate policy network in the United States in 2010 (Jasny et al., 2015). Each network illustrates how expert scientific information passed through these policy actors' personal networks, along with their responses to an attitudinal question that asks them to identify their organization's position from `strongly agree' to `strongly disagree' on the statement: There should be an international binding commitment on all nations to reduce greenhouse gas emissions. The top row incudes Representative Ed Markey, one of the Congressmen who sponsored The American Clean Energy and Security Act, and the Columbia University scientist who was well known to support the scientific consensus position in the climate debate. On the bottom row are the then newly seated chairman of the Senate Committee on Environment and Public Works, Senator James Inhofe, and a University of Alabama scientist who had spoken extensively against the scientific consensus that climate change is anthropogenic. These ego networks provide evidence of the ways that information diffuses through a policy network and shows how minority views (in this case strongly disagreeing that there should be an international binding commitment on climate change—indicated by red ties between the nodes) are amplified.

FIGURE 1 EGO NETWORKS IN THE CLIMATE POLICY NETWORKK

Studying Urban Environmental Stewardship Networks

Like the policy network approach, which highlights the roles that different policy actors play in environmental governance, the empirical reality of collaborative/hybrid governance involves integration and interaction among diverse civil society and government actors (see particularly Bodin, 2017; Bodin et al., 2017). Because of the complex land use regime in urban areas, the diverse social systems that underpin urban life, as well as the spatial distribution of infrastructure and ecosystems, it is important to understand the networks of organizations and individuals that govern these systems both socially and spatially.

In a paper on environmental stewardship networks—defined as the networks of organizations that participate and collaborate in some kind of stewardship activity such as tree planting or cleaning up litter—in Philadelphia and New York City, measures of spatial and social distance are used to understand the factors that drive tie formation in this network (Jasny et al., 2019; For an overview of urban environmental stewardship, see Fisher, Campbell, & Svendsen, 2012). Social distance in this case is represented by different organizational goals or issue foci based on organizational responses to questions on a survey of stewardship groups. Prior discussion of fit notes that such networks are (problematically) structured around shared interests or activities (e.g., park managers work with park managers), rather than around the needs of ecosystems or nature of the landscape (see Ernstson et al., 2010). An additional complicating factor is the fact that organizations that engage in stewardship activities often do so as an ancillary activity to their main goals. One such example is when a business association plants trees to beautify the neighborhood and attract investment irrespective of the needs of the ecosystem (Mattijssen, Buijs, Elands, & Arts, 2018). Because ecological processes are, in some ways, spatially bounded, or at the very least clustered around green and blue infrastructure, we

would expect a network that is more strongly structured around spatial rather than social distance would be a better "fit."

Figure 2 presents stewardship networks in Philadelphia and New York City. The nodes (green triangles for respondent organizations and circles for named alters) in this image represent the geographic and social distribution of stewardship organizations. Ties (the lines between the nodes) represent collaboration based on survey responses. As can be seen in the figure, the networks in the two cities exhibit different behaviors in this regard. Specifically, the New York network presents a stronger spatial structuring; in New York, collaboration is strongly predicted by having either closer home offices or sharing work sites. The Philadelphia network, in contrast, is more strongly structured around social similarity/organizational commonalities. The differences in structure between the stewardship networks in these two cities points to the influence of institutions and historical context in the functioning of environmental governance networks. Moreover, this study contributes to the use of traditional social networks methods and ideas (e.g. examining homophily and clustering) by adding integrated spatial analysis.

FIGURE 2: ENVIRONMENTAL STEWARDSHIP NETWORKS IN TWO CITIES

Conclusion

These two examples provide illustrations of the diverse ways that social network analysis is being used to understand environmental governance. Although this research tends to be much more empirically focused, these studies connect with the literature on the Environmental State that was cited early in this chapter. In other words, these studies help us to understand environmental governance better, in terms of the roles that different social actors play in decisionmaking, and in relation to the actual environmental realities in which they work. In both

cases, the decision-making processes that were studied involved hybrid combinations of social actors who were working on an environmental issue: federal climate policy or environmental stewardship in specific cities. Connecting this research that employs social network methods to understand environmental governance to the broader theoretical debates will contribute more broadly to the field of environmental sociology, as well as to a more general understanding of the complexity of environmental governance more broadly.

Future research must continue to integrate these innovative approaches to studying environmental governance that expands perspectives on the society-environment relationship. By incorporating these complex, interdependent, and often interdisciplinary approaches we gain a better understanding of the complex, interdependent socio-environmental world that environmental governance aims to protect. Where many of the reviews of environmental social network studies call for more empirical comparison or longitudinal data, we hope here to have begun to lay the groundwork for more integration of environmental sociological theory around environmental governance that directly connects with empirical analysis. Most critically, in the emerging interdisciplinary fields of socio-environmental systems and networked governance, sociologists must engage with other disciplines both to learn from them as well as ensure that the understanding and knowledge developed in our own field is not excluded or re-engineered from scratch.

Beyond advancing theory and methods, within the context of a growing climate crisis, along with related environmental problems, research on environmental governance is needed to assess the success and failure of policy options. Environmental sociologists are particularly well suited to contribute to analysis that helps society to move towards environmentally sound
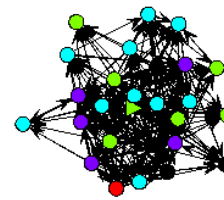
policymaking that is also environmentally just given our increasingly turbulent and unequal

world.

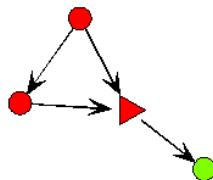Figure 1: Ego-Networks in the US Climate Policy Network

Representative Markey (D-MA)
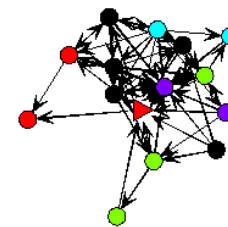16 actors, 90 ties, 82 chamber(s), 82 echo chamber(s)
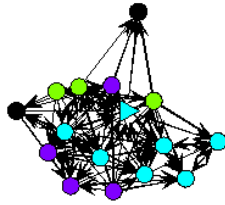
Columbia University scientist
27 actors, 234 ties, 215 chamber(s), 215 echo chamber(s)

Representative Inhofe (R-OK)
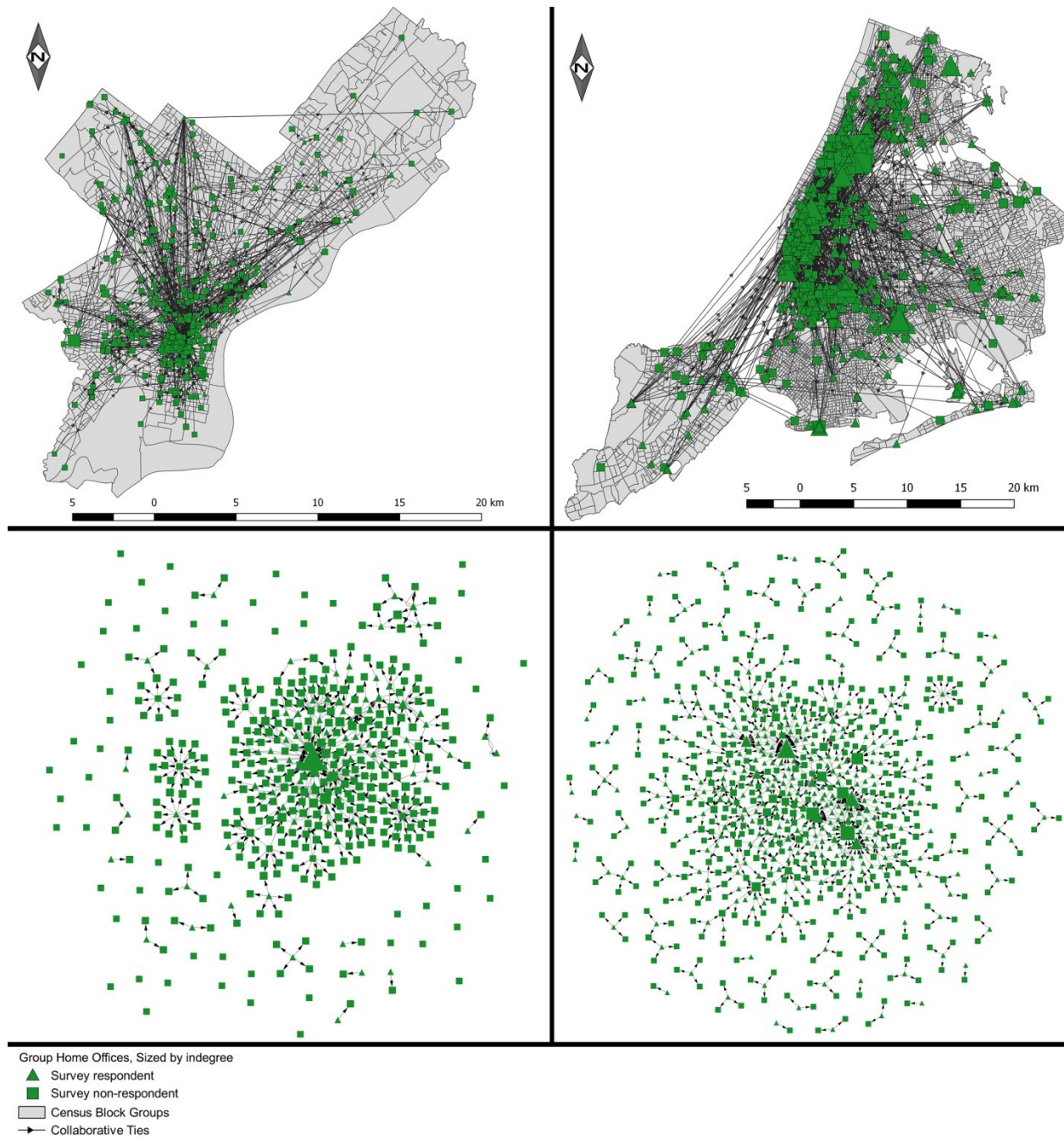4 actors, 4 ties, 1 chamber(s), 1 echo chamber(s)

University of Alabama scientist
15 actors, 56 ties, 39 chamber(s), 39 echo chamber(s)

△ Ego
◆ Strongly Agree
◆ Agree
◆ Neutral
◆ Disagree
◆ Strongly Disagree
◆ No Response

(Source: Jasny et al., 2015)

Figure 2

Group Home Offices, Sized by indegree
▲ Survey respondent
■ Survey non-respondent
▢ Census Block Groups
→ Collaborative Ties

(Source: Jasny et al., 2019)

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