ANNUAL REVIEWS

Annual Review of Environment and Resources

Reconciling Conflict and Cooperation in Environmental Governance: A Social Network Perspective

Örjan Bodin,[1] María Mancilla García,[1] and Garry Robins[2]

[1]Stockholm Resilience Centre, Stockholm University, 106 91 Stockholm, Sweden; email: orjan.bodin@su.se, maria.mgarcia@su.se

[2]Melbourne School of Psychological Sciences, The University of Melbourne, Melbourne, Victoria 3010, Australia; email: garrylr@unimelb.edu.au

Annu. Rev. Environ. Resour. 2020. 45:471–95

First published as a Review in Advance on April 22, 2020

The *Annual Review of Environment and Resources* is online at environ.annualreviews.org

https://doi.org/10.1146/annurev-environ-011020-064352

Keywords

social network analysis, conflict, cooperation, collaboration, environmental governance, social-ecological networks

Abstract

Most if not all environmental problems entail conflicts of interest. Yet, different actors and opposing coalitions often but certainly not always cooperate in solving these problems. Hence, processes of conflict and cooperation often work in tandem, albeit much of the scholarly literature tends to focus on either of these phenomena in isolation. Social network analysis (SNA) provides opportunities to study cooperation and conflict together. In this review, we demonstrate how SNA has increased our understanding of the promises and pitfalls of collaborative approaches in addressing environmental problems. The potential of SNA to investigate conflicts in environmental governance, however, remains largely underutilized. Furthermore, a network perspective is not restricted to the social domain. A multilevel social-ecological network perspective facilitates integration of social and environmental sciences in understanding how different patterns of resource access can trigger both cooperation and conflict.

Contents

1. INTRODUCTION 472
   1.1. Reconciling Cooperation and Conflict Perspectives 473
2. WHEN CONFLICT, WHEN COOPERATION, AND WHEN BOTH? 477
   2.1. Collaboration from a Network Perspective 477
   2.2. Conflictual and Troubled Relationships from a Network Perspective 481
   2.3. Interacting Cooperative and Conflictual Social Ties 482
3. RECENT ADVANCES AND WAYS FORWARD 484
   3.1. Advancing a Process-Oriented Perspective 484
   3.2. Social and Other Networks: A Multi-Network Perspective 485
4. CONCLUSION 488

Cooperation: when two or more actors work together with the intent to solve certain issues or problems for mutual benefit

Environmental governance: describes a setting where actors interact with each other to manage environmental resources and/or to address environmental problems

Collaborative environmental governance: environmental governance that is devised (or has emerged) building on principles of collaboration among participants

Conflict: when two or more actors have opposing interests, or other differences, that can lead them to confrontation

Network: a set of entities (nodes) and the relationships among them (ties)

1. INTRODUCTION

Governing the environment in ways that ensure ecological and socioeconomic sustainability is a challenging task. Current research acknowledges the inherent complexity of ecosystems, making it difficult or virtually impossible to foresee all the consequences any intervention can bring across different spatial, temporal, and administrative scales (1, 2). Being adaptive and embracing a learning-as-we-go perspective in managing the environment are commonly advocated as the best way to address the complexities and unpredictability of ecosystems (3–5). Such an approach emphasizes the importance of cooperation in achieving effective environmental governance. Indeed, because ecosystems adhere to neither human-made jurisdictional borders nor compartmentalized administrative responsibilities (6–8), no single actor can be in charge of entire ecosystems effectively (see, e.g., 9). Thus, the need to bring diverse sets of actors and stakeholders together in collaborative environmental governance is strongly emphasized in research and practice (10–12). Opposing interests and beliefs among actors and coalitions often, nonetheless, cause tensions. Thus, collaborative environmental governance typically entails both conflict and cooperation, although scholarly literature rarely studies these processes together (13). In this review, we argue that social network analysis (SNA) provides opportunities to reconcile these different perspectives.

We use the term collaborative environmental governance in a general and inclusive sense. We emphasize that studying a multitude of heterogeneous actors that collectively govern, manage, or utilize the environment is a common denominator across different literatures, e.g., collaborative or participatory governance (11, 14, 15), adaptive co-management (3, 16), or adaptive governance (4, 5, 17). Empirical evidence supporting the utility of collaborative environmental governance is building (e.g., 18–20). Collaboration as a means to build knowledge, develop trust, solve conflicts, connect across different societal and political sectors, and reach agreements is commonly emphasized in the literature (3, 4, 12, 21). Less studied, but nonetheless important, is collaboration as a means to enhance implementation of policies and agreements, i.e., to move from policy to practice (22) and as a means to ensure efficiency.

Although we use the term collaborative, this does not mean that the interactions among the actors are always cooperative—they could just as well be conflictual. Rather, the term collaborative captures the intent of a governance arrangement, i.e., that it is meant to, or has emerged to, stimulate cooperation among a multitude of actors. However, even if a governing arrangement is labeled or conceived as collaborative, not all participating actors necessarily share a cooperative intent (perhaps not even the conveners), and even with the best of intentions, fruitful cooperation

might still not emerge. Furthermore, collaborative approaches to governance are often initiated as a response to numerous potential and actual conflicts, which implies that conflicts among actors may be expected to occur (23).

Collaborative approaches to governance often rest on an overarching aim to build consensus (24). The existence of opposite and contradictory interests in how environmental resources should be managed, or who should access them, is, however, often a very difficult situation to remedy (23). We find conflictive cases in the management of virtually all kinds of environmental resources, from wetlands (25) to forests (26), including watersheds and land. Classic types of conflicts over land use include, for instance, conflicts between mining companies exploiting underground resources and peasant communities defending their interests to continue their agricultural and pastoral activities (27, 28). Other highly studied types of conflicts are those around water governance, such as conflicts over the control of watersheds (29), over modes and costs of drinking water provision (30) or upstream-downstream conflicts over water quality and quantity (31). Furthermore, what appear as conflicts over environmental resources are sometimes deeply engrained and have percolated into other areas beyond the specific resource being managed, creating a long-standing mistrust among the actors involved such as between the state and peasant communities (32, 33), and/or touching upon issues of identity and world visions (34).

In contexts characterized by hard-to-reconcile conflicts of interest, it is naturally very challenging for collaborative approaches to succeed in establishing consensus or, at a bare minimum, arriving at mutually agreeable compromises (35). The collaborative turn has consequently been criticized for not clearly articulating the existence of deep-rooted conflicts of interest among actors and stakeholders. Furthermore, it has been criticized as neglecting issues of power imbalances that create difficulties in achieving fruitful, deliberate, and constructive cooperation to facilitate effective changes from the status quo (36). Instead, collaborative arrangements have been scrutinized as perpetuating power dynamics and smoothing conflicts in a way that simply fosters oppression, legitimizing the powerful to establish their domination through imposition of their discursive position (37). Political ecologists have long investigated the different layers in conflicts around environmental resources (38). They have also called attention to two fundamental—and often linked—dynamics: the strength of economic interests in shaping natural resource governance (39) and the importance of discursive practices in consolidating specific power distributions (40, 41).

Thus, in spite of the observed and theorized benefits of cooperation in environmental governance, simply advocating collaborative environmental governance as an all-encompassing solution to all kinds of environmental problems without acknowledging the difficulties that exist in achieving fruitful cooperation is clearly not warranted (10). Moreover, even if a collaborative initiative is able to overcome some of these critical barriers so as to enhance deliberative and collective learning and understanding, this does not necessarily lead to any substantial behavioral changes or environmental improvements (42–44). Collaborative outcomes could be merely symbolic policies and/or actors agreeing on lowest common denominators (45, 46). Furthermore, engaging in collaboration is typically a time-consuming process (46, 47). Thus, there is a need to weigh such costs when comparing collaborative with, for example, more traditional bureaucratic command-and-control approaches to environmental governance.

1.1. Reconciling Cooperation and Conflict Perspectives

All this leaves us in a state of ambiguity. Is collaborative environmental governance an idealized but in practice unattainable approach to environmental management due to the existence of inherent issues of conflict and power? We argue against this interpretation. Rather, we see a need to

Tie: a relationship between two entities; in a social network context, could be friendship or be based on mistrust

accommodate perspectives of conflict and cooperation simultaneously. Processes of conflict and cooperation often work in tandem, as different types of responses to underlying conflicts of interest among actors and stakeholders. For instance, a study of land use and transportation planning in California showed that actors' choices of collaborating partners were more strongly influenced by ongoing conflicts than by their partners having similar beliefs (48). Here, the foundational element of collaboration, i.e., with whom you choose to cooperate, was closely tied to whom you perceived as your enemy, demonstrating that both conflict and cooperation occurred in parallel and could not be isolated in understanding the planning processes.

Conflict has also been studied as a positive element in an otherwise blocked relationship, challenging the view that conflict is simply a threat or an obstacle to cooperation (49, 50). Such constructive conflicts allow actors to redefine and change positions and to move forward toward different and unplanned scenarios. Drawing from a game theoretical perspective, it has also been suggested that long-standing conflicts between groups could actually promote cooperative behaviors since both groups have a lot to lose if the conflict erupts into violence (51). Scholars in conflict management have argued for a conflict transformation perspective (52–54) in which the purpose is to identify key elements that promote constructive conflict (55, 56). This also resonates with recent research that has sought to highlight the enabling aspects of power dynamics instead of solely emphasizing oppressive issues deriving from power imbalances, or simply ignoring issues of power altogether (36).

One way to reconcile perspectives of cooperation and conflict in collaborative environmental governance is to focus attention on what the actors are doing and why. An actor perspective can enhance our understanding about the realities that face actors in their struggle to meet and protect their specific needs and goals while also collectively contributing to address environmental and governance issues that they cannot address by themselves (compare with 57). Hence, an actor perspective does not preclude studying higher-level social and institutional structures.

An actor-oriented perspective is not bound to any specific theories or methods. However, here we argue for the utility of applying a social network perspective when studying how actors engage in cooperation and conflict in collaborative environmental governance (**Figures 1** and **2**; also see the sidebar titled Social Network Research). Thus, attention is directed toward who the actors are, if and in what ways they interact with other actors, and if and how this could affect their individual and collective abilities to address different kinds of environmental problems (10).

Although focusing on social networks could be seen as taking a structural perspective mapping out the actors and their relationships, we nonetheless argue it should be seen more as a process-oriented approach. Social network research implicitly carries the assumption that social processes cannot be fully understood by simply aggregating the behaviors of atomistic individuals or as solely deriving from certain macrolevel social-ecological structures. This resonates with Giddens' structuration theory, in which both structure and agency constitute social processes, or said otherwise, structure is dual: It is at the same time what sets the conditions for agency and the outcome of agents' behavior (71). A social network theorization may then be seen as a form of weak structuralism in that social networks condition actors' choices and activities, which in turn manifest in the creation and dissolution of various types of social ties (72). Hence, an empirically observed social network of actors—trying to navigate a governance context where their interests and stakes in environmental resources are contested and/or threatened by overuse or degradation—could be interpreted, understood, and subsequently analyzed as the empirical fingerprint left by different social processes (73). In this way, social network research permits inferences about social processes that jointly implicate cooperation and conflict, where these processes can be understood in terms of if and how actors choose to cooperate (or engage in conflict) with certain others.

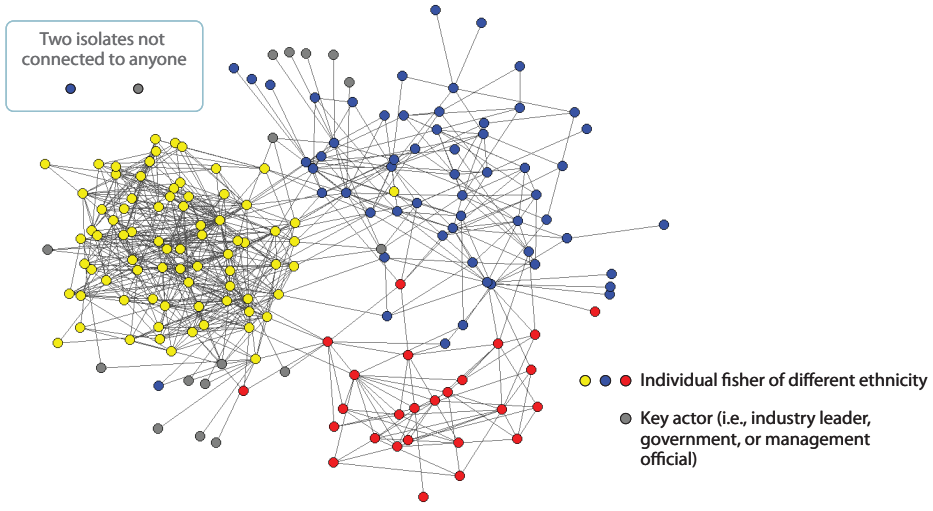

Figure 1

Information-sharing social network in Hawaii's longline fishery. Each node is an individual fisher, or an actor important for information sharing. Node colors blue, red, and yellow correspond to dominant ethnicity, and gray corresponds to being an industry leader, or a government or management official. Adapted from Reference 58.

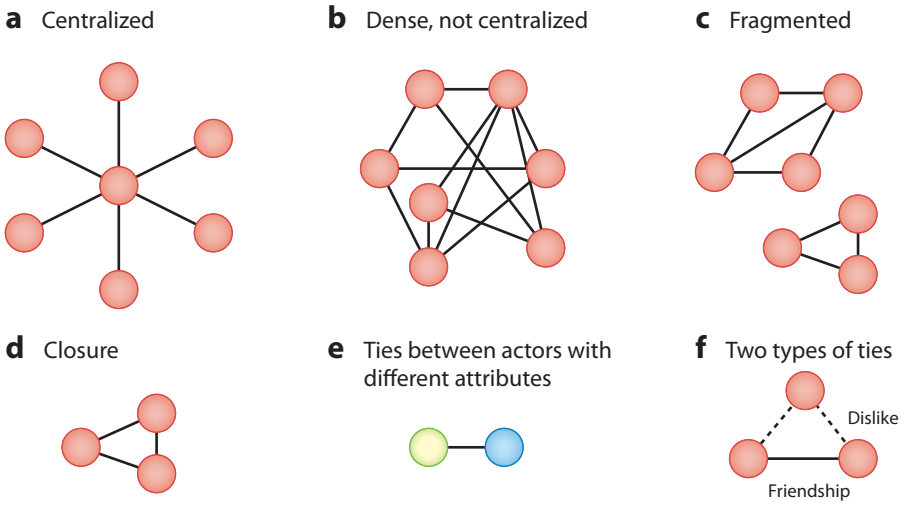

Figure 2

Network characteristics. Panel *a* represents a centralized network, panel *b* represents a network that is denser (and less centralized) than *a*, and panel *c* represents a network that is fragmented into two isolated subgroups. The building block in panel *d* captures network closure, i.e., when two actors, tied to a common third actor, tend to also form a direct tie between them. Panel *e* represents two actors with different attributes (e.g., organizational affiliation, beliefs, gender, education) who tend to form ties (this is referred to as heterophily). Panel *f* consists of two types of ties: friendship (*solid line*) and dislike (*dashed line*). In this case, two actors being friends both dislike a common third (or, similarly, two actors that dislike a common third tend to be friends).

SOCIAL NETWORK RESEARCH

A network consists of at least two types of entities: nodes and ties between pairs of nodes (often called vertices and edges). In a social network, nodes could represent actors of various kinds, such as government agencies, individual resource extractors, nongovernmental organizations, or states. They could also represent social entities other than actors, such as a venue (forum) for collaboration (45), or legally or nonlegally binding institutional arrangements (59). Ties could represent different types of relationships among these nodes, such as fishermen exchanging fishery-related information (58), trading relationships of fish buyers (60), disagreement or dislike (61), or joint participation in a venue (62). Typically, one specific type of relationship is the focus, but simultaneously studying multiple types of relationships is also common (see, e.g., 63).

The social network researcher needs to make informed decisions on what are the most relevant social entities (e.g., actors or venues) along with their most important relationships in a given empirical context, given the study objectives (64). However, empirically mapping out these entities in the form of a network visualization is merely the starting point for further analyses (**Figure 1**). No two social networks are the same. They differ in types and patterns of social ties, they differ in composition of actors and/or other social entities, and last but not least they most likely differ in terms of the social and ecological context wherein they reside. We want to emphasize the crucial importance of context in both explaining the emergence of networks and also its constraining and enabling function regarding what the existence of a specific network can imply in terms of, for example, what those actors choose to act upon (65).

The specific patterns and compositions of social networks can be indicators of social processes driving individual and collective behaviors. Different structural characteristics are often associated with different functions, so a network structure conducive to one governance aspect might not necessarily be conducive to another (66). SNA encompasses numerous techniques to analyze the pattern of relationships in the networks, seeking to assess different kinds of structural characteristics of presuming importance for, for example, sustainable development (67).

Network structural characteristics are numerous, and in subsequent sections we elaborate some of the most interesting ones in a governance context. One can broadly distinguish between two types of structural characteristics, macro- and microlevel characteristics. The former refers to characteristics of the whole network, such as centralization, density or fragmentation (**Figure 2*a–c***). The latter refers to patterns of ties involving only very few nodes and can be thought of as building blocks or motifs that might be more or less prevalent in the network, or even missing altogether (**Figure 2*d–f***). These two types of characteristics are not independent; for example, a centralized network would consist of many instances of building blocks with two nodes connected to a common third, but not to each other. The macrostructure of a social network may possibly be constrained by certain system-wide factors (e.g., geography, varied climatic conditions, cultural norms). But within these constraints, the actual macrostructure emerges from the microstructural processes of individual actors making decisions about, for example, cooperative and conflictual relationships. The microlevel characteristics indicate social processes at play in the network, so these building blocks are the direct consequence of actors' actions and intentions, constrained by rules and norms of social behaviors, as well as by pre-existing relationships.

The macrolevel characteristics can also be seen as the social infrastructure constraining and enabling individual behaviors, so there is an interplay between macro- and microprocesses embodied in the network structure. Different analyses are more or less suited for analyzing macro- versus microlevel structures. Exponential random graph models (68) and stochastic actor-oriented models (69) focus specifically on the microlevel (the latter model is also suitable for statistically analyzing longitudinal network data). Analyses for whole-network characteristics include purely descriptive metrics capturing certain statistical properties of the network such as its degree distributions (see, e.g., 70).

2. WHEN CONFLICT, WHEN COOPERATION, AND WHEN BOTH?

Studying social networks in environmental management and governance is a rather new but rapidly growing field of scientific inquiry. A recent review showed that most published papers in network studies of environmental governance were published after 2010 (74). Plenty of these have investigated the formation of different types of collaborative networks in response to environmental problems (10). To a lesser extent, some of these studies have also investigated if and how collaborative networks can lead to desirable environmental (and social) outcomes. Due to the breadth of this emerging field, and a recently published series of reviews (10, 67, 74–76), in what follows we have not attempted to exhaustively review all published studies. Rather, we focus on themes in major network studies on environmental governance where cooperative (positive) social relationships (ties) are central. We then consider work on negative social ties, where the studies examine relationships such as competition, distrust, open conflict, and the like. Finally, in our review of recent work, consistent with our overarching aim to reconcile perspectives of cooperation and conflict in environmental governance research, we discuss studies where positive and negative ties have been examined in parallel. We conclude with a section discussing how this research agenda can move forward.

2.1. Collaboration from a Network Perspective

The possible benefits deriving from collaborative environmental governance are, as stated above, plentiful and empirically well supported. Because collaboration implies the existence of social networks, the benefits of creating and maintaining networks of cooperative relationships among a multitude of actors follow naturally (see, e.g., 77). The word positive implies that the dyadic relationship is (at least potentially) beneficial for the social entities making up the network. Clearly, a positive tie can be based on many different types of relationships, such as information exchange or resource exchange, working together, being friends, etc.

At the macro level, social networks that have been found to enhance collective (social) learning (and/or innovation) can take different forms. This is an area of inquiry that is drawing a lot of attention. Some key findings about the most favorable network structure depend on the context of the required learning. On the one hand, if the learning is about complicated phenomena, i.e., predicting the social and ecological responses to interventions in complex and boundary-spanning ecosystems, networks encompassing a broad and diverse set of tightly interconnected actors with different competencies and backgrounds are favorable (78). On the other hand, if the learning is about something less complicated, or not at all about developing new knowledge but rather to diffuse existing knowledge, actor heterogeneity and dense connectivity might be less important (compare with 79).

Furthermore, domain-specific knowledge tends to develop within subgroups—often as a result of these subgroup members doing similar things (like groups of fishermen using the same gear types targeting the same fish species; see 80). To avoid the development of isolated pockets of knowledge, it is desirable to link these subgroups together. For that purpose, network brokerage—whereby intermediate actors operate as brokers to link otherwise disconnected actors—is important (81). Studying brokerage in social networks has a long history (82), including in environmental studies (83, 84). Subgroups of fishermen connected across group boundaries through brokerage have been found to produce less undesired bycatches, likely as a result of better knowledge of fishery practices (58). Similar to complicated versus simple learning, it is important to distinguish between wide and narrow brokerage. Wide brokerage implies there are many, instead of just very few, relationships that cross subgroup boundaries. For complicated learning to occur across subgroups, wide brokerage is typically required (85).

System-level outcomes also relate to the nature of the collective action problem that an environmental governance system is set to address. By different natures we differentiate at least two broad classes of environmental problems: one class that does not relate to conflicts of interest among stakeholders and another class that involves trade-offs and substantial costs and risks facing the actors. The former typically revolves around making sure different measures to deal with the given environmental problems are executed in the right order, in the right places, and in appropriate ways. The latter is typically about negotiating trade-offs, and/or taking measures to distribute costs and benefits in ways actors find acceptable, just, and legitimate. These different kinds of environmental problems are often denoted coordination and cooperation problems, respectively (86). Early empirical studies suggest that more centralized network structures (**Figure 2*a***) seem more conducive to solving coordination problems, whereas denser networks with a high level of network closure (**Figure 2*b*,*d***) seem better for cooperation problems (86, 87).

Studies emphasizing actor- and process-oriented approaches to network studies tend to focus more on microlevel social network characteristics (see the sidebar titled Social Network Research). Key defining questions are why the studied network has developed certain structural characteristics, and if and how actors can be stimulated to adjust their actions and social behaviors leading to the development of desirable network characteristics for desirable system-level outcomes (what is desirable is, however, not set in stone and depends on what to accomplish and for whom). A fundamental question is why and how actors engage in and commit to cooperate with others in the first place. Across contexts, it has been demonstrated that the pre-existence of social relationships in previous settings often instigates social relationships in new settings. Hence, social relationships that might appear as new are often better described as old ties being re-established or reactivated. Studies of a series of collaborative planning initiatives for integrated coastal zone management revealed that new initiatives were often relying on previous or other ongoing initiatives when being staffed, thereby implying that many existing relationships were reactivated (47). A recent study focused on two crisis responder networks, established to manage escalating wildfires (one in Sweden, one in Canada), found that 50–80% of all social ties in use during the crisis events were pre-existing ties (88). Specifically, for the Canadian case, establishing many social relationships among those individuals likely to be engaged in the event of a crisis was an outspoken strategy within the crisis response system, as a preparatory measure to enhance cooperation during a forthcoming crisis. The study indicates that this strategy has borne fruit since the Canadian respondents overall reported higher satisfaction in regard to how easy it was to establish and execute cooperation with others.

Another factor making actors more prone to establish cooperative ties is the perception of threats. A study of water governance found that the stronger an actor perceived a threat to water quality, the more social ties they were engaged in (89). This finding was, however, not consistent across all types of threats, and the authors suggest that actors perceiving threats that could not be dealt with effectively by traditional water protection policies (in this case, so-called cocktail effects where different pollutants interact) were more willing to engage in cooperation than others.

Another fundamental question is whom an actor chooses to engage with, given that the actor is willing to engage in cooperative relationships in the first place. The propensity of individuals to preferably connect with similar others, known as homophily, is well documented across cases and contexts and often relates to attributes such as gender, age, socioeconomic background, etc. (90). Homophily has been demonstrated to exist in many studies of environmental governance, but the specific attributes of similarity that enable homophily vary. Several studies of small-scale fisheries have shown that similarity in gear type coincides with social relationships such as information exchange (80, 91). Generally, in situations where actors have different interests and stakes in a common resource, they preferentially connect with others they perceive as having overlapping

interests and beliefs (e.g., 92, 93). A key reason behind this behavior is that actors often form coalitions of interest that they then use to pursue their goals in policy processes (94). Coalitions formed by actors having different interests then end up competing with each other, which can lead to a policy change process stalemate. Recent studies have, however, nuanced long-standing assumptions about belief similarity being the driver of social tie formation in these contexts. A study of marine aquaculture partnerships in the United States showed that trust and access to resources such as professional competence were more important than belief similarity in regard to marine aquaculture policies (95). A study of hydraulic fracturing regulation in the United Kingdom revealed that relationships exchanging technical information tend to be driven by expertise, whereas relationships exchanging political information are more driven by ideology (96). This study illustrates that different social relationships, within and across coalitions, are created for different purposes with different others. A study of Swiss nuclear energy politics before and after the Fukushima nuclear disaster demonstrated that the factors that drive social tie formation also depend on the level of uncertainty, both in terms of others' behaviors and in terms of possible consequences of certain policies (97). When uncertainty is high, actors prefer to cooperate with others they perceive as knowledgeable and trustworthy, whereas when uncertainty is low, policy preferences become more important. Finally, physical proximity often affects the likelihood of social tie formation. Studies of collaboration among volunteer organizations striving for, among other things, the conservation of green areas in urban regions have shown that two organizations being located close to each other also have a stronger than average tendency to form social ties (98, 99). Similarly, Jamaican small-scale fishermen operating from the same landing sites are more likely to have social ties (91).

Social relationships are dynamic by nature (100). Social networks change and develop over time; some ties emerge when two actors establish some form of relationship, and some dissolve when actors no longer interact. Furthermore, the nature and content of the ties can change over time. For example, in a study of climate adaptation policy networks in Switzerland, it was shown that ties that, at first, were used only to transfer information in either direction later tended to accommodate stronger mutual cooperation (101). Actors' perceptions of their network partners might also change over time. In a study of water-related policy development in Colorado, actors of opposing coalitions developed, as a result of being involved in a cross-coalition collaborative process, a more comprehensive understanding of each other's interests and goals, thereby also realizing they had overlapping interests (102). In that way, they became more motivated to further engage in cross-coalition collaboration.

This body of work suggests many different factors that stimulate any two actors to engage in and maybe strengthen cooperation over time. Yet, collaborating with other actors inevitably takes its toll on limited time and resources. Although the benefits derived from engaging in cooperation with others were associated with enhanced goal attainment in crisis management work in Swedish municipalities, beyond a certain threshold number of cooperative ties the relationship between having many cooperative ties and goal attainment essentially disappeared (103). Similar patterns of diminishing returns of additional social ties have been observed in diverse contexts ranging from artistic performance of musical writers (104) to group effectiveness in business organizations (105). In a similar vein, the cost of establishing a cooperative tie with another actor might draw from the same set of limited resources as the cost of attending yet another collaborative venue (see the sidebar titled Social Network Research). In comparing two collaborative networks, one being concerned with integrated coastal zone management planning and one being concerned with wildfire mitigation, the results indicate there is a "cost–benefit trade-off affecting the capacity of actors to participate in multiple venues and collaborate with multiple other actors" (106, p. 152).

Beyond the cost in terms of drawing from limited resources, establishing social ties is not necessarily a risk-free enterprise. First, uncertainty about others, for example, about how they tend to operate, their mandates, and the resources at their disposal, can make actors less willing to risk investing time and energy in establishing cooperative ties. In other words, even though the costs associated with networking might be generally well defined and understood, the potential benefits could be perceived as uncertain. This can make actors less prone to engage with actors located outside their professional comfort zone, although cooperating with these actors could, in theory, significantly contribute toward achieving desired outcomes (107). Second, in cases where the cost of investing time and energy in contributing to a common good is significant, actors may be cautious in establishing cooperative ties, especially if there is a high risk that others will benefit from these investments without contributing themselves (86, 108). There are even cases where the benefits derived from a social tie could be directly negative. If, for example, an actor engages in cooperation with others from an opposing coalition, there is a risk that the other actors co-opt these ties to their own benefit, potentially leaving the first actor in a less favorable situation than if it had not engaged in the so-called cooperation at all (compare with 109).

Work on desirable network structure has spurred interest in network structural interventions, seeking to determine if and how the establishment of collaborative networks with desired characteristics can be formed and shaped (network weaving; see, e.g., 110). For environmental governance, different forms of network interventions have been discussed and studied. For example, it has been suggested that by specifically targeting influential actors in communities engaged in resource extraction and management, desired behavioral changes among members of the entire communities favoring the conservation of natural resources could be achieved more effectively (76). Furthermore, in a controlled experiment where randomly selected individuals were trained in new agricultural practices in Sumatra, it was empirically demonstrated that these individuals, 18 months after the intervention, had approximately twice as many social ties as others not being targeted for training (111). This study shows that instead of trying to identify influential actors that could be targeted for certain types of interventions, a network intervener could instead stimulate the emergence of influential actors directly. Furthermore, a common approach to stimulate more cooperative behaviors among actors with different stakes in an environmental issue is to establish collaborative venues that are facilitated to a varying extent by, for example, funding and coordinating staff (45). In these venues, the objective is often to encourage cooperative behavior along with the formation of cooperative ties connecting the participants.

Intervening in networks is, however, an activity that is often encumbered with managing trade-offs putting collaborative effectiveness and democratic principles such as the inclusion of marginalized and not-so-powerful actors against each other. The research fields of network management (112, 113) and meta-governance (114) have emerged as a response to the rise of collaborative governance approaches to deal with various public policy and public administration problems, and are deeply concerned with how collaborative networks are, or can be, effectively led and at least partly controlled. Network management is more concerned with a managerial perspective investigating how leaders can manage networks and intervene in order, for example, to facilitate mutual learning and trust building through various strategies and techniques. This notion of leadership does not only include appointed leaders; any actor can, and often will, engage in activities intended to form and shape the network. Leadership in collaborative networks is therefore often an emergent property (compare with 115). Meta-governance instead adopts a macrolevel perspective investigating how to effectively regulate collaborative networks through more or less subtle and indirect interventions, seeking to influence the actors in accordance with overarching goals and objectives while not interfering with their abilities to self-organize. Both these fields, however, emphasize the inbuilt tension between the democratic need for

accountability, predictability, and transparency in public policy and administration, and the more flexible and less formal approach to management of environmental resources signifying collaborative environmental governance. In any given case, there can be inherent trade-offs between addressing environmental problems more effectively through collaboration and network interventions and preserving desirable democratic principles.

2.2. Conflictual and Troubled Relationships from a Network Perspective

Unlike research on positive (cooperative) ties, there is much less research of negative ties in environmental governance, despite the fact that the field of negative ties is somewhat of a hot topic in social network research more generally (116). A negative tie is different from a positive tie in the sense that, from the parties' perspective, the tie itself "represent[s] an enduring, recurring set of negative judgments, feelings, and behavioral intentions toward another person" (117, p. 597). As for positive ties, negative ties can derive from many different types of relationships: for example, difficult or troubled interpersonal relationships in an organizational context, dislike or distrust, conflict, or being a political adversary.

In the environmental governance literature, studies of negative ties are rare. There is an abundance of published papers studying conflict in environmental governance, but very few adopt a network approach. It is fair to say that across all of social network research, positive tie studies are more common (118), even though there is recognition that negative ties are to be expected in all or most settings and can often be very influential in affecting attitudes and behaviors (117). Several reasons seem to explain why positive tie research tends to prevail. First, negative tie data are notoriously more difficult to collect than positive tie data, as, for instance, respondents may underreport conflict (117, 119). Second, some researchers new to social networks hold the wrong perception that being in conflict equates to no tie at all. Rather, any given dyadic relationship may be built up of many different types of social ties, and conflict and competition are possible states within a relationship. It is even possible that a given relationship may comprise both positive and negative ties: When have we never dealt with (cooperated with—positive) someone we do not really like (conflicted with—negative), or been friendly with someone we do not fully trust? It is for this theoretical reason that network researchers distinguish between a relationship and a social tie, with the social relationship seen as possibly comprising several different types of ties, some of which may be positive and others negative.

For the purpose of building up negative tie research in environmental governance, it is worthwhile to visit the lessons learned from the negative tie social network research more generally. On the basis of a review of network organizational literature, Yang et al. (118) recently proposed a tripartite categorization of negative ties. A negative tie could derive from an actor's negative affect (e.g., envy or personal dislike) toward a network partner, from an actor's negative behaviors directed to a partner (e.g., open conflict or competition), or from an actor's cognitive assessment of the partner (e.g., perceiving a partner as incompetent or untrustworthy). There are counterparts in environmental governance networks: An actor may envy another who has more environmental resources, actors may behave competitively or even conflictually toward each other in accessing (shared) environmental resources, and actors may judge each other as incompetent in managing environmental resources. Of course, any individual relationship may have several of these three components simultaneously, and negative affect or cognitive assessment, even if not immediately associated with a direct and open conflict, can obviously lead to conflicts later on (117).

The reasons behind the existence of negative ties are plentiful. In contexts that are reasonably harmonious, where polarization is not strongly present and the overall level of conflictual and/or hostile sentiment is low, the existence of negative ties could be mostly related to individual

personal characteristics (such as lower tendencies for dislike among individuals of the same gender) (120). Furthermore, if someone dislikes another, that individual might just avoid the other, thereby preventing any structuring tendencies such as reciprocity to emerge at the network level (reciprocity would imply that if A dislikes B, there is a higher likelihood that B would also dislike A). In more conflictual social contexts, higher levels of structuring for negative ties are to be expected (compare with bullying among elementary school children; see 121). Hence, the possible effects of negative ties, and the underlying causes for the very existence and the structuring of negative ties, would then be systemic rather than operating only at the dyadic level.

Constraints in the context may engender more negative ties and more open conflict. Avoidance of another disliked individual is a social strategy that in effect transmutes what would be a negative tie into the absence of a relationship. It is useful to minimize the frustration and aversive consequences of negative ties—and hence we see in organizations that individuals will work around other organizational members who are seen as incompetent (120). But constraints in the social context may prevent this strategy from being adopted: For the most part, we do have to work with our bosses, whether they be competent or not. In environmental governance settings, the structure and functioning of the governed ecosystem itself may provide the context that constrains avoidance and thereby facilitates the emergence of negative ties and open conflict. The presence of environmental resources engenders competition by actors who wish to harvest the resource, and withdrawal from the competition is not the preferred or even possible option. This is why we consider negative tie research an important element in understanding environmental governance systems (this line of argumentation is developed further below).

When the sheer amount of negative ties is high, the group level effects can be significant. A study of group performance in different organizations showed that the higher the density of negative ties (defined as someone withholding valuable information, resources, and opportunities from another actor), the lower the group performance (122). Importantly, the undesired effects of negative ties on individual- and group-level outcomes depend on where they are located in the network. A study of research teams at US universities showed that the higher number of negative ties that were between groups of individuals with similar attitudes, the lower was the performance within the team level (123). Hence, even with a low density of negative ties, if the ties are at crucial points of the network structure (e.g., between groups with similar attitudes), their potential implications can be significant.

Thus, in settings that are very harmonious, the relative utility of studying negative over positive ties is perhaps relatively low. But since even a low number of negative ties can have significant implications, disregarding negative ties warrants some caution. In more troubled cases that are likely to engender polarization, competition, and conflict, studying only positive types of ties may miss the point (compare with 124). This may be particularly so in environmental governance studies where the environmental resources are likely to induce competition and conflict.

2.3. Interacting Cooperative and Conflictual Social Ties

Our fundamental argument is that for many environmental governance settings, positive and negative ties need to be studied together. Although several network-based studies measure either or both positive and negative ties, it is still relatively rare that they are analyzed simultaneously (118). Empirical studies have nonetheless demonstrated that positive and negative ties not only can cooccur in a social network, but also one type of tie can in some cases instigate the formation (or dissolution) of another type of tie. A classic example of this is Fritz Heider's (125) work on cognitive consistency and social balance. As demonstrated by Cartwright & Harary (126), theories of social balance can be specified using a network formalism where individuals have either positive

or negative ties toward each other in a signed graph (a network graph with positive or negative signs on the ties, often thought of as friends and enemies). Following Heider, the desire to limit cognitive dissonance implies that, for example, an actor will find aversive a situation where he or she has two friends who are themselves enemies. Simulations show that if such rules about social balance are followed, the network results in cliques of friends separated by negative ties. This result nicely illustrates how local social rules can play out into global network structure. Yet, balance theory in this classical raw form has limited empirical support, and more recent studies have added important nuances. Social balance theory should be accompanied by other theories in explaining the formation of a signed graph: a desire to direct positive ties toward others with higher status (and negative ties to those of lower status) and tendencies to like similar others (and thus dislike dissimilar others) (127).

Social balance theory applied on a signed graph postulates that positive and negative ties should be kept apart; i.e., a tie should be either positive or negative. As we noted above, for us negative ties are not merely the opposite or inverse of positive ties (see, e.g., 128). Cooperation and conflict are two types of social ties that may occur together (compare with 37). In other words, actors might choose to respond to an underlying conflict of interest by trying to cooperate with their opponents, or fight them, or something involving both modes of operation. This duality contrasts with a unidimensional conception of negative and positive ties as polar opposites, where one type of relationship excludes the other. Recent research has even argued that relations can dynamically move from one type to another, producing a combination of conflict and cooperation that can, depending on the timing and duration, impede or facilitate the implementation of reforms (129).

An ongoing conflict does, however, not prevent simultaneous ongoing cooperation through compromises. In the case of red drum management in North Carolina, user groups found compromises even though the conflicts were not resolved, given that "the process through which [compromises] are reached creates frustration rather than understanding" (130, p. 426). Basurto et al. (131) present another example of co-occurring conflict and cooperation in their study of small-scale fishers in Baja California, Mexico. They demonstrate how heightened rivalry among the fishers, through the implementation of marine protected areas, also gave rise to increased levels of cooperation. Hood et al. (132) show how co-occurrence of positive and negative ties can enhance performance for a team of undergraduate students engaged in a semester-long competition reflecting real-world operational contingencies in business strategy developments.

When positive and negative ties co-occur in one relationship, it is often thought of as a multiplexed or ambivalent relationship (128). A study of the social network encompassing organizations involved in governing the Swan River in Western Australia showed that positive ties (defined as crucial collaborative relationships) co-occurred with negative ties (defined as difficult collaborative relationships) more often than could be explained by chance (133). This was attributed to the governance context where different goals and objectives exist in parallel, and where disputation is common.

The implications of interacting positive and negative ties go further than co-occurrence. A study of bullying among elementary school children showed that social ties defined as liking, disliking, or being victimized interacted in several different ways (121). For example, two bullying victims of a common third had a stronger than average tendency to like each other. In politically charged environments, actors may seek allies in response to a threat that other actors could try to control them (134). In such settings, made up of allies and adversaries, any given actor's ability to exert influence over others (and to maintain control over its own whereabouts) is largely a function of how it is situated in the entire network consisting of both positive and negative ties. **Figure 3** provides an example of how a fairly complicated web of allies and adversaries puts a focal actor in a vulnerable position. This notion of positional power can be divided into two parts,

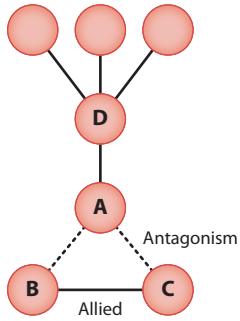

Figure 3

A is an adversary of B and C (*dotted lines*). B and C are allies and thus united against A (*solid line*). A's only ally is D, but D has three other alternative allies. Thus, A is put in a vulnerable position since its only ally D has alternatives and thus can require a lot in exchange for support. Adapted with permission from Reference 134.

power-as-access and power-as-control. The former focuses on an actor's ability to access others' resources, whereas the latter focuses on dependency, implying that if a focal actor is dependent on another actor for access to resources, that other actor can use that relationship to exert control (this is the basis for exchange network theory; see, e.g., 135).

Following a similar line of reasoning, a recent study challenges the long-standing principal finding in peace studies that democratic states rarely or never engage in violent conflict with each other (136). By analyzing networks of interstate military conflicts over nearly 200 years, the authors found that a state's decision to engage in violent conflict depends on the other states the target state is in conflict with (a conclusion that is consistent with balance theory). They did, however, not find support for any two states to avoid engaging in conflict with each other just because they both were democratic. This notable finding clearly demonstrates the utility of studying conflict and cooperation in concert from a whole-network perspective.

3. RECENT ADVANCES AND WAYS FORWARD

In summary, we see the study of cooperation and conflict in parallel as important to advance environmental governance research, and we encourage researchers to consider adopting a social network perspective in doing so. In this section, we point to some critical issues and advances in pushing this area of research forward.

3.1. Advancing a Process-Oriented Perspective

As highlighted earlier, a network can be conceived as the outcome (empirical fingerprint) of actors' involvement in various social processes that result in patterns of social relationships. Thus, studying network structure provides a means to apply reverse engineering to infer the major social processes that underpin the community of actors. Ultimately, we seek an explicit causal understanding of the factors that give rise to the observed phenomena (in this case, the empirical network). Such causal understanding enhances theory development, which is necessary to explain why we observe a particular governance setting and set of practices, and what could be done to steer environmental governance toward sustainability. An increased focus on the actors and the processes in which they engage would be particularly useful for policy change research given that it could ". . .help scholars explore alternate explanations for policy-making phenomena and provide

new insight into how collaborative processes are influenced by broader policy process dynamics" (46, p. 40).

Changes in policy and practice are often contested; thus, both changes and instances of inertia are expected to emerge from processes involving both cooperation and conflict (23). As Buhaug (137, p. 270) puts it when debating current climate-conflict research, "Indeed, further scientific progress [in this field] depends critically on our ability to specify plausible causal mechanisms, the conditions under which these are likely to play out, the actors at play, and the range of possible outcomes in terms of conflictive (or cooperative) behavior." A causal understanding enables assessment of when and how collaborative approaches to environmental governance might provide desirable solutions to environmental problems, and when other means are better suited.

Causal thinking in network studies is, however, often underdeveloped and/or unexplicated (64, 138). This does not mean that causal reasoning is incompatible with a network perspective, although it is more difficult when dealing with complex social-ecological systems that implicate many different social and environmental processes. Longitudinal network studies in particular provide a means to empirically investigate how different actor attributes (and indirectly contextual factors) influence (or are influenced by) tie formation and tie dissolution processes (100). They also provide a means to investigate how existing ties are influencing these formation and dissolution processes. Thus, these studies take on a process perspective in empirically addressing the question of why networks are formed and shaped as they are.

Gathering longitudinal network data is, however, often associated with many practical difficulties and requires substantial investments in data acquisition (138). Cross-sectional studies are thus oftentimes the only feasible option in network research. With the process-oriented view of the network we outlined above, cross-sectional data can still provide empirical support when inferring the causal social processes at play in a given case. We, however, acknowledge that such support hinges upon solid theoretical reasoning, careful study design, and thought-through data collection methods. Consequently, we call for stronger links between relevant theories across scientific disciplines. To that end, explicit and transparent expressions of relevant theories in ways that are compatible with a network perspective are needed. For example, a recent study uses a microlevel building-block approach (**Figure 2*d–f***; also see the sidebar titled Social Network Research) to translate several contemporary theories, insights, and debates about adaptive and transformative capacity in environmental governance into a series of propositions on how certain social (and ecological) network structures might be more or less conducive for instigating adaptive versus transformative responses in overcoming pressing environmental challenges (139). Furthermore, complementary (including qualitative) datasets, as well as carefully designed simulation studies, can be utilized to triangulate on plausible causal hypotheses (138, 140). Therefore, applying (where possible) mixed-method approaches could further strengthen attempts to unravel causality.

3.2. Social and Other Networks: A Multi-Network Perspective

Sustainability science is a transdisciplinary science and as such calls for looking beyond the borders of traditional scientific disciplines when asking and answering questions related to environmental problems (141). This approach is also central to social-ecological systems research (142). A foundational argument behind these calls is that the social world is not independent from the natural environment (and vice versa); thus, a more integrated perspective is needed to better understand and improve the ways in which societies govern the environment (an integrated perspective does not preclude pluralism). However, turning this compelling argument to actionable and integrated research approaches has proven challenging, and, in particular, studies using empirical and quantitative approaches often struggle to break through disciplinary boundaries (143). The network

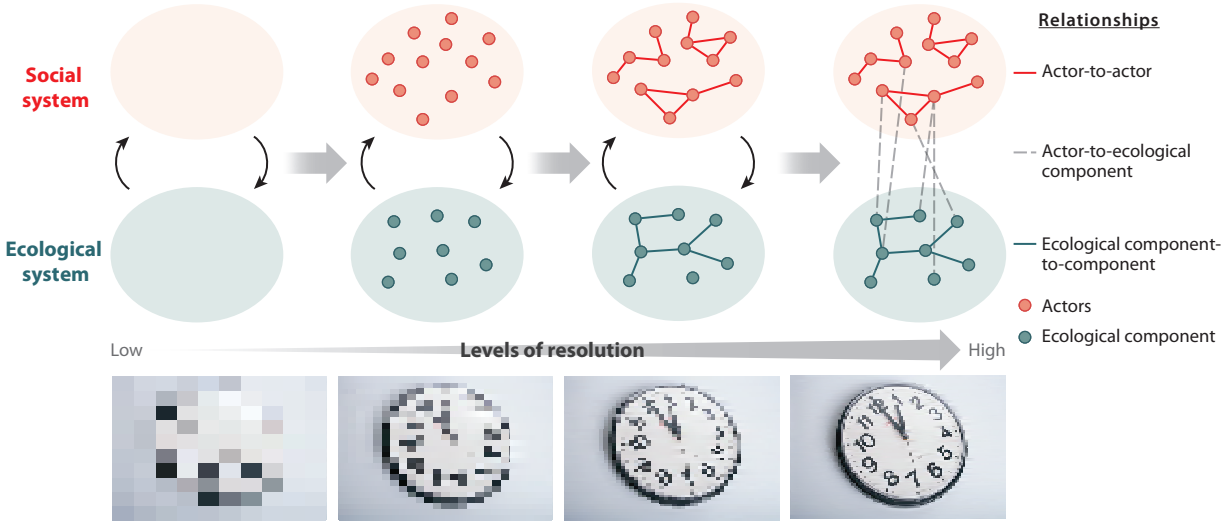

Figure 4

Increasing levels of resolution (*left to right*) in examining governance arrangements where both actors and ecological components are explicated in a series of multilevel network models. On the left, all details about the actors and ecological components are absent, whereas on the right both individual actors and specific ecological components, along with their interdependencies, are fully described as a multilevel network of nodes and ties, respectively. The ties represent actor-to-actor relationships such as cooperation or conflict (within the social system; *red nodes*), ecological component-to-component interdependencies such as nutrient flows (within the ecological system; *green nodes*), and actor-to-ecological component relations such as ownership, extraction, and other types of uses of ecological components (across the social and ecological systems; *gray dashed lines*). The curved arrows illustrate that the social and ecological systems are interdependent. To the right, these system-level interdependencies are refined by explicating how certain actors relate to certain components. Figure adapted from Reference 73, licensed under CC BY-NC.

perspective, which is widely used in many social science disciplines as well as in the environmental sciences, provides an opportunity to close this gap. Integrating the social and the ecological worlds by describing and analyzing them as integrated social-ecological networks (**Figure 4**; also see the sidebar titled Social-Ecological Systems as Social-Ecological Networks) has gained traction in recent years, and this approach has been used to conduct interdisciplinary studies of, for example, small-scale fisheries, small-scale agriculture, and interstate collaboration in the conservation of marine resources (75).

Here, we argue that the social-ecological network approach could be instrumental in explicating induced relationships among actors and stakeholders. By induced we refer to ties among actors that arise through the actors' different stakes and engagement with the environment. The

SOCIAL-ECOLOGICAL SYSTEMS AS SOCIAL-ECOLOGICAL NETWORKS

Social networks have been used to study human interactions since the 1930s (144). Similarly, network models have been used to study trophic interactions in food webs since at least the early 1970s (145). Hence, it perhaps comes as no surprise that network models and thinking where both social and ecological entities are combined and integrated in social-ecological networks have been suggested and applied in different research settings (143, 146) (**Figure 4**). Although this research is still largely in its infancy, the potential benefits with such integrated models are several (75). In short, it provides a methodological and theoretical vehicle for more integrated studies of environmental issues where both the social and the ecological worlds are treated as integral parts of the research subject.

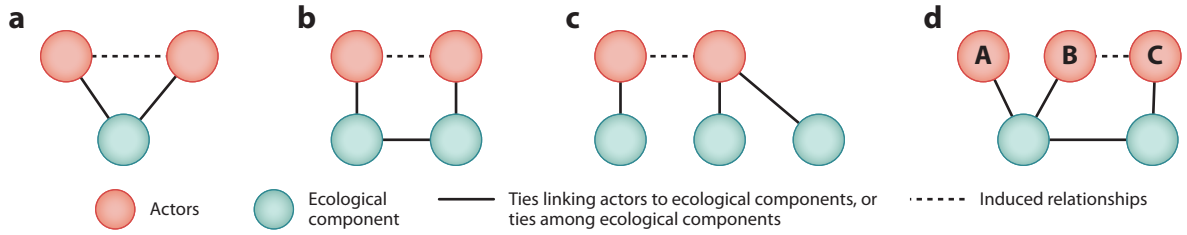

Figure 5

Social-ecological building blocks illustrating induced relationships. In panel *a*, both actors are sharing an ecological component; thus, the induced relationship could derive from a conflict of interest (or a mutual interest to address a common task). Panel *b* is similar to *a*, but here the actors have sole access to separate but interdependent ecological components. This induced relationship implies that the actors are tied to each other in the sense that if they are to succeed in, for example, landscape-level biodiversity management, they both need to account for ecological interdependencies, and thus they could benefit from cooperation (148). If the ecological tie is directed (e.g., upstream/downstream in a drainage basin context), this implies an induced relationship where one actor is put in a more favorable position than the other. In panel *c*, the unevenly distributed access to ecological components implies an induced relationship deriving from unequal opportunities. Panel *d* implies an induced asymmetric relationship in that all actors are indirectly tied through ecological interdependencies, but they have unequal opportunities to manage their interdependent ecological components (the actors A and B are more limited than actor C since they do not have sole access to their ecological component). Actors A and B are equivalent, but in order to simplify the figure, only the induced tie between actor B and C is outlined.

environment could be explicitly ecological, as when actors have stakes in certain targeted fish species in a fishery context, or it could be more policy-oriented, as when actors hold different positions in relation to different policy issues (compare with 147). These induced ties could represent more conflictual relationships arising from differences in interests (for example, competition for limited but common resources) and/or beliefs in relation to how environmental resources should be utilized (for example, conserve or exploit?). But induced ties could also represent relationships that capture mutual benefits through, for example, creating possibilities for positive synergies in environmental resource utilization (**Figure 5**).

These induced relationships constitute an important part of the context wherein the actors reside, and thus strongly influence their perceptions, behaviors, and choices of strategies to apply when interacting with others (compare with 73). Many of these induced relationships will be conflictual, as when two actors compete over a common resource (**Figure 5**). These induced ties are particularly interesting to take into account when studying social ties, both positive and negative. For example, if two actors are tied through an induced conflictual tie, a key question that follows is how the actors choose to respond to the very existence of such an induced tie (or not respond at all, which is also a response). Maybe they choose to respond by reaching out to each other, thereby instigating a cooperative relationship with the shared objective of seeking out constructive ways to remedy the induced conflictual tie. Or, they are triggered by the induced tie to engage in open conflict, trying to get ahead of the other in striving to end up on the winning side in this conflictual relationship (149). What the actors will do depends not only on many factors, such as the perceived costs of cooperation, how power and influence are distributed, the actors' time perspectives, and mandates (e.g., 150), but also on the social ties they have with other actors. No matter what they choose to do, and why, this example illustrates the existence of ambiguous relationships where different types of ties among actors interact in shaping actors' choices and behaviors. A key benefit brought forward by the social-ecological network perspective is that it provides an analytical vehicle to conceptualize, define, and make explicit a broad range of induced relationships deriving from actors' engagements with the environment by taking the specificities of the environment itself (i.e., its different components and their relationships) into account. Thus, it provides a means to analyze how structures of social and ecological interdependencies within

and across the social and the environmental worlds interact in shaping processes of conflict and cooperation in environmental governance.

4. CONCLUSION

Environmental governance is an enterprise that in many cases involves elements of cooperation and conflict. Scholarly work is, however, most often focused on either (or sometimes both) of these elements, but rarely is there an ambition to study how they interact. We propose that a social network perspective can help remedy this stalemate. Many studies that apply a social network perspective in environmental governance research, however, tend to be solely focused on cooperative ties among actors and stakeholders. Hence, even though significant progress has been made in furthering understanding of how patterns of cooperative social relationships can facilitate collaborative environmental governance, very little is known about how networks of troubled (negative) social ties, such as conflictual relationships, shape governance arrangements and influence social and environmental outcomes. Scholarly work in other research fields, such as organizational studies or international relations, has recently experienced an increased interest in studying such negative ties. Thus, insights on how negative and positive ties interact are emerging. We argue that the time is right to bring a network perspective that accommodates both cooperative and conflictual ties to the field of environmental governance research. Our belief is that such an endeavor could be instrumental in bridging the gap between cooperative and conflictual perspectives on environmental governance. It would do so by providing a means to develop empirically informed theories focusing on why actors and stakeholders sometimes engage in conflict, sometimes in cooperation, and sometimes in both, and the social and environmental consequences that these different actions bring about.

SUMMARY POINTS

1. Collaboration in governing the environment can enhance learning and understanding, increase coordinated use of intrinsically interdependent environmental resources, and facilitate negotiation when actors' interests are not aligned.
2. Collaborative approaches to environmental governance do not always succeed in overcoming conflicts and tensions. Deeply rooted conflicts of interest, mistrust, and contradictive perceptions of the key challenges at hand can prevent cooperation from emerging.
3. There is a need for (and gains to be made by) further strengthening a broadened research perspective that simultaneously looks at issues of cooperation and conflict when studying environmental governance.
4. A network perspective provides ample opportunities to study conflict and cooperation together because of its explicit focus on actors and the various different types of relationships they have with each other, but this potential has not yet been realized in environmental studies.

FUTURE ISSUES

1. We need to spend less time on just mapping out social and other types of networks. Instead we should spend more time on thinking about if and how a network perspective can contribute to theory development, and in answering theoretically challenging questions.

2. Network thinking could be applied to better understand the causes of underlying structures and processes in environmental governance, and what social and environmental outcomes such structures and processes can bring about. Longitudinal network studies are instrumental to that end, but developing stronger links to theory is just as important.
3. Environmental governance is not only a problem to be studied within the realms of social science. The governed environment and its specific characteristics often have such a strong influence on governing structures and processes that there is a chance that key insights are missed, ignored, or only rudimentally considered.
4. Social-environmental interactions can be described as social-ecological networks. Social-ecological networks can introduce and make explicit induced relationships among actors, which often derive from asymmetric or shared access to limited environmental resources. We argue that these induced relationships can be crucial in understanding if, why, and how actors interact with others, for example, if they choose to engage in conflict or in cooperation with certain others.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

We wish to thank Joe Labianca and Nick Harrigan for their insightful comments on an earlier draft of this article.

LITERATURE CITED

1. DeFries R, Nagendra H. 2017. Ecosystem management as a wicked problem. *Science* 356(6335):265–70
2. Agrawal A, Chhatre A. 2011. Against mono-consequentialism: multiple outcomes and their drivers in social-ecological systems. *Glob. Environ. Change* 21(1):1–3
3. Armitage DR, Plummer R, Berkes F, Arthur RI, Charles AT, et al. 2009. Adaptive co-management for social-ecological complexity. *Front. Ecol. Environ.* 6(2):95–102
4. Folke C, Hahn T, Olsson P, Norberg J. 2005. Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.* 30:441–73
5. Chaffin BC, Gosnell H, Cosens BA. 2014. A decade of adaptive governance scholarship: synthesis and future directions. *Ecol. Soc.* 19(3):56
6. Young OR. 2002. *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*. Cambridge, MA: MIT Press
7. Epstein G, Pittman J, Alexander SM, Berdej S, Dyck T, et al. 2015. Institutional fit and the sustainability of social-ecological systems. *Curr. Opin. Environ. Sustain.* 14:34–40
8. Folke C, Pritchard L, Berkes F, Colding J, Svedin U. 2007. The problem of fit between ecosystems and institutions: ten years later. *Ecol. Soc.* 12(1):30
9. Scarlett L, McKinney M. 2016. Connecting people and places: the emerging role of network governance in large landscape conservation. *Front. Ecol. Environ.* 14(3):116–25
10. Bodin Ö. 2017. Collaborative environmental governance: achieving collective action in social-ecological systems. *Science* 357(6352):eaan1114
11. Newig J, Challies E, Jager NW, Kochskaemper E, Adzersen A. 2018. The environmental performance of participatory and collaborative governance: a framework of causal mechanisms. *Policy Stud. J.* 46:269–97

12. Margerum RD, Robinson CJ. 2015. Collaborative partnerships and the challenges for sustainable water management. *Curr. Opin. Environ. Sustain.* 12:53–58
13. Mancilla García M, Hileman J, Bodin Ö. 2019. Collaboration and conflict in complex water governance systems across a development gradient: addressing common challenges and solutions. *Ecol. Soc.* 24(3):28
14. Ansell C, Gash A. 2007. Collaborative governance in theory and practice. *J. Public Adm. Res. Theory* 18(4):543–71
15. Emerson K, Nabatchi T, Balogh S. 2012. An integrative framework for collaborative governance. *J. Public Adm. Res. Theory* 22(1):1–29
16. Plummer R, Baird J, Dzyundzyak A, Armitage D, Bodin Ö, Schultz L. 2017. Is adaptive co-management delivering? Examining relationships between collaboration, learning and outcomes in UNESCO biosphere reserves. *Ecol. Econ.* 140:79–88
17. Karpouzoglou T, Dewulf A, Clark J. 2016. Advancing adaptive governance of social-ecological systems through theoretical multiplicity. *Environ. Sci. Policy* 57:1–9
18. Hillis V, Lubell M, Hoffman M. 2018. Sustainability partnership and viticulture management in California. *J. Environ. Manag.* 217:214–25
19. Scott TA. 2016. Is collaboration a good investment? Modeling the link between funds given to collaborative watershed councils and water quality. *J. Public Adm. Res. Theory* 26(4):769–86
20. Ulibarri N. 2015. Tracing process to performance of collaborative governance: a comparative case study of federal hydropower licensing. *Policy Stud. J.* 43(2):283–308
21. Bryson JM, Crosby BC, Stone MM. 2015. Designing and implementing cross-sector collaborations: needed *and* challenging. *Public Adm. Rev.* 75(5):647–63
22. Koontz TM, Newig J. 2014. From planning to implementation: top-down and bottom-up approaches for collaborative watershed management. *Policy Stud. J.* 42(3):416–42
23. Lewicki RJ, Gray B, Elliott M, eds. 2003. *Making Sense of Intractable Environmental Conflicts: Concepts and Cases*. Washington, DC: Island Press
24. Margerum RD. 2011. *Beyond Consensus: Improving Collaborative Planning and Management*. Cambridge, MA: MIT Press
25. Saha TK, Pal S. 2019. Emerging conflict between agriculture extension and physical existence of wetland in post-dam period in Atreyee River basin of Indo-Bangladesh. *Environ. Dev. Sustain.* 21(3):1485–505
26. Bonsu NO, Dhubháin ÁN, O'Connor D. 2019. Understanding forest resource conflicts in Ireland: a case study approach. *Land Use Policy* 80:287–97
27. Bebbington A, Humphreys Bebbington D, Bury J, Lingan J, Muñoz JP, Scurrah M. 2008. Mining and social movements: struggles over livelihood and rural territorial development in the Andes. *World Dev.* 36(12):2888–905
28. Arellano-Yanguas J. 2011. Aggravating the resource curse: decentralisation, mining and conflict in Peru. *J. Dev. Stud.* 47(4):617–38
29. Schulz C, Martin-Ortega J, Ioris AAR, Glenk K. 2017. Applying a 'value landscapes approach' to conflicts in water governance: the case of the Paraguay-Paraná Waterway. *Ecol. Econ.* 138:47–55
30. Perreault T. 2006. From the Guerra del Agua to the Guerra del Gas: resource governance, neoliberalism and popular protest in Bolivia. *Antipode* 38(1):150–72
31. Lynch BD. 2012. Vulnerabilities, competition and rights in a context of climate change toward equitable water governance in Peru's Rio Santa Valley. *Glob. Environ. Change* 22(2):364–73
32. Mancilla García M. 2017. Negotiating in the absence of trust: exploring the interactions between officials and residents in a waste management project in Copacabana, Bolivia. *Local Environ.* 22(6):667–81
33. Rivera Cusicanqui S. 1987. *"Oppressed but Not Defeated": Peasant Struggles Among the Aymaras and Qhechwa in Bolivia, 1900–1980*. Paris: UNRISD
34. Coombes B, Johnson JT, Howitt R. 2012. Indigenous geographies I: Mere resource conflicts? The complexities in Indigenous land and environmental claims. *Prog. Hum. Geogr.* 36(6):810–21
35. Mancilla García M, Bodin Ö. 2019. Participatory Water Basin Councils in Peru and Brazil: expert discourses as means and barriers to inclusion. *Glob. Environ. Change* 55:139–48
36. Morrison TH, Adger WN, Brown K, Lemos MC, Huitema D, et al. 2019. The black box of power in polycentric environmental governance. *Glob. Environ. Change* 57:101934

37. Zeitoun M. 2009. The conflict vs. cooperation paradox: fighting over or sharing of Palestinian-Israeli groundwater? *Water Int.* 32(1):105–20
38. Agrawal A. 2012. *Environmentality: Technologies of Government and the Making of Subjects*. Durham, NC: Duke Univ. Press
39. Bryant RL. 1992. Political ecology: an emerging research agenda in Third-World studies. *Polit. Geogr.* 11(1):12–36
40. Forsyth T. 2003. *Critical Political Ecology: The Politics of Environmental Science*. London: Routledge
41. Cherlet J. 2010. STS and political ecology in dialogue: future directions for a social study of environmental controversies. In *Impure Cultures: Interfacing Science, Technology, and Humanities*, ed. M Mazzotti, G Pancaldi, pp. 19–57. Bologna, Italy: Univ. Bologna, Dep. Philosophy, Int. Cent. History Univ. Sci.
42. Rudberg PM, Smits M. 2018. Learning-based intervention for river restoration: analyzing the lack of outcomes in the Ljusnan River basin, Sweden. *Ecol. Soc.* 23(4):13
43. Nykvist B. 2014. Does social learning lead to better natural resource management? A case study of the modern farming community of practice in Sweden. *Soc. Nat. Resour.* 27:436–50
44. Koontz TM, Thomas CW. 2006. What do we know and need to know about the environmental outcomes of collaborative management? *Public Adm. Rev.* 66(1):111–21
45. Lubell M, Henry AD, McCoy M. 2010. Collaborative institutions in an ecology of games. *Am. J. Pol. Sci.* 54(2):287–300
46. Koebele EA. 2019. Integrating collaborative governance theory with the Advocacy Coalition Framework. *J. Public Policy* 39(1):35–64
47. Sandström A, Crona B, Bodin Ö. 2014. Legitimacy in co-management: the impact of preexisting structures, social networks and governance strategies. *Environ. Policy Gov.* 24(1):60–76
48. Henry AD, Lubell M, McCoy M. 2011. Belief systems and social capital as drivers of policy network structure: the case of California regional planning. *J. Public Adm. Res. Theory* 21(3):419–44
49. Kim J, Jang YE, Kim S. 2018. Promoting constructive conflict from a conflict transformation perspective: the case of community-based collaboration in Korea. *J. Community Pract.* 26(4):412–28
50. Hardy C, Phillips N. 1998. Strategies of engagement: lessons from the critical examination of collaboration and conflict in an interorganizational domain. *Organ. Sci.* 9(2):217–30
51. Fearon JD, Laitin DD. 1996. Explaining interethnic cooperation. *Am. Political Sci. Rev.* 90(4):715–35
52. Chavis DM. 2001. The paradoxes and promise of community coalitions. *Am. J. Community Psychol.* 29(2):309–20
53. Miller RL, Reed SJ, Francisco VT, Ellen JM. 2012. Conflict transformation, stigma, and HIV-preventive structural change. *Am. J. Community Psychol.* 49(3–4):378–92
54. O'Brien C. 2007. Integrated community development/conflict resolution strategies as "peace building potential" in South Africa and Northern Ireland. *Community Dev. J.* 42(1):114–30
55. Deutsch M. 1969. Conflicts: productive and destructive. *J. Soc. Issues* 25(1):7–42
56. Andersen GR. 2006. Conflicts during organizational change. *Nord. Psychol.* 58(3):215–31
57. Lubell M, Robins G, Wang P. 2014. Network structure and institutional complexity in an ecology of water management games. *Ecol. Soc.* 19(4):23
58. Barnes ML, Lynham J, Kalberg K, Leung P. 2016. Social networks and environmental outcomes. *PNAS* 113(23):6466–71
59. Fidelman P, Ekstrom JA. 2012. Mapping seascapes of international environmental arrangements in the Coral Triangle. *Mar. Policy* 36(5):993–1004
60. González-Mon B, Bodin Ö, Crona B, Nenadovic M, Basurto X. 2019. Small-scale fish buyers' trade networks reveal diverse actor types and differential adaptive capacities. *Ecol. Econ.* 164:106338
61. Kriesi H, Adam S, Jochum M. 2006. Comparative analysis of policy networks in Western Europe. *J. Eur. Public Policy* 13(3):341–61
62. Berardo R, Lubell M. 2016. Understanding what shapes a polycentric governance system. *Public Adm. Rev.* 76:738–51
63. Baggio JA, BurnSilver SB, Arenas A, Magdanz JS, Kofinas GP, De Domenico M. 2016. Multiplex social ecological network analysis reveals how social changes affect community robustness more than resource depletion. *PNAS* 113(48):13708–13

64. Robins G. 2015. *Doing Social Network Research: Network-Based Research Design for Social Scientists*. London: SAGE
65. Scott TA, Ulibarri N. 2019. Taking network analysis seriously: methodological improvements for governance network scholarship. *Perspect. Public Manag. Gov.* 2(2):89–101
66. Bodin Ö, Crona BI. 2009. The role of social networks in natural resource governance: What relational patterns make a difference? *Glob. Environ. Change* 19:366–74
67. Henry AD, Vollan B. 2014. Networks and the challenge of sustainable development. *Annu. Rev. Environ. Resour.* 39(1):583–610
68. Lusher D, Koskinen JH, Robins G. 2013. *Exponential Random Graph Models for Social Networks: Theory, Methods, and Applications*. Cambridge, UK: Cambridge Univ. Press
69. Snijders TAB. 2005. Models for longitudinal network data. In *Models and Methods in Social Network Analysis*, ed. PJ Carrington, J Scott, S Wasserman, pp. 215–47. New York: Cambridge Univ. Press
70. Prell C. 2012. *Social Network Analysis: History, Theory and Methodology*. London: SAGE
71. Giddens A. 1984. *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge, UK: Polity Press
72. Leydesdorff L. 1991. The static and dynamic analysis of network data using information theory. *Soc. Netw.* 13:301–45
73. Bodin Ö, Robins G, McAllister RRJ, Guerrero AM, Crona B, et al. 2016. Theorizing benefits and constraints in collaborative environmental governance: a transdisciplinary social-ecological network approach for empirical investigations. *Ecol. Soc.* 21(1):40
74. Groce JE, Farrelly MA, Jorgensen BS, Cook CN. 2019. Using social-network research to improve outcomes in natural resource management. *Conserv. Biol.* 33(1):53–65
75. Sayles J, Mancilla Garcia M, Hamilton M, Alexander S, Baggio J, et al. 2019. Social-ecological network analysis for sustainability sciences: a systematic review and innovative research agenda for the future. *Environ. Res. Lett.* 14:093003
76. de Lange E, Milner-Gulland EJ, Keane A. 2019. Improving environmental interventions by understanding information flows. *Trends Ecol. Evol.* 34:P1034–47
77. Hahn T, Olsson P, Folke C, Johansson K. 2006. Trust-building, knowledge generation and organizational innovations: the role of a bridging organization for adaptive comanagement of a wetland landscape around Kristianstad, Sweden. *Hum. Ecol.* 34(4):573–92
78. Bodin Ö, Sandström A, Crona B. 2017. Collaborative networks for effective ecosystem-based management: a set of working hypotheses. *Policy Stud. J.* 45(2):289–314
79. Lubell M, Jasny L, Hastings A. 2017. Network governance for invasive species management. *Conserv. Lett.* 10:699–707
80. Crona BI, Bodin Ö. 2006. What you know is who you know? Communication patterns among resource extractors as a prerequisite for co-management. *Ecol. Soc.* 11(2):7
81. Burt RS. 2004. Structural holes and good ideas. *Am. J. Sociol.* 110(2):349–99
82. Gould RV, Fernandez RM. 1989. Structure of mediation: a formal approach to brokerage in transaction networks. *Sociol. Methodol.* 19:89–126
83. Hamilton M, Hileman J, Bodin Ö. 2020. Evaluating heterogeneous brokerage: new conceptual and methodological approaches and their application to multi-level environmental governance networks. *Soc. Netw.* 61:1–10
84. Barnes M, Kalberg K, Pan M, Leung P. 2016. When is brokerage negatively associated with economic benefits? Ethnic diversity, competition, and common-pool resources. *Soc. Netw.* 45:55–65
85. de Vaan M, Vedres B, Stark D. 2016. Game changer: the topology of creativity. *J. Econ. Sociol.* 17(4):53–99
86. Berardo R, Scholz JT. 2010. Self-organizing policy networks: risk, partner selection, and cooperation in estuaries. *Am. J. Pol. Sci.* 54(3):632–49
87. McAllister RRJ, Taylor BM, Harman BP. 2015. Partnership networks for urban development: how structure is shaped by risk. *Policy Stud. J.* 43(3):379–98
88. Bodin Ö, Nohrstedt D, Baird J, Summers R, Plummer R. 2019. Working at the "speed of trust": preexisting and emerging social ties in wildfire responder networks in Sweden and Canada. *Reg. Environ. Change* 19:2353–64

89. Herzog LM, Ingold K. 2019. Threats to common-pool resources and the importance of forums: on the emergence of cooperation in CPR problem settings. *Policy Stud. J.* 47:77–113
90. McPherson M, Smith-Lovin L, Cook JM. 2001. Birds of a feather: homophily. *Annu. Rev. Sociol.* 27:415–44
91. Alexander SM, Bodin Ö, Barnes ML. 2018. Untangling the drivers of community cohesion in small-scale fisheries. *Int. J. Commons* 12(1):519–47
92. Ingold K. 2011. Network structures within policy processes: coalitions, power, and brokerage in Swiss climate policy. *Policy Stud. J.* 39(3):435–59
93. Henry AD. 2011. Ideology, power, and the structure of policy networks. *Policy Stud. J.* 39:361–83
94. Sabatier PA. 1988. An advocacy coalition framework of policy change and the role of policy-oriented learning therein. *Policy Sci.* 21(2–3):129–68
95. Calanni JC, Siddiki SN, Weible CM, Leach WD. 2015. Explaining coordination in collaborative partnerships and clarifying the scope of the belief homophily hypothesis. *J. Public Adm. Res. Theory* 25(3):901–27
96. Fischer M, Ingold K, Ivanova S. 2017. Information exchange under uncertainty: the case of unconventional gas development in the United Kingdom. *Land Use Policy* 67:200–11
97. Fischer M. 2015. Collaboration patterns, external shocks and uncertainty: Swiss nuclear energy politics before and after Fukushima. *Energy Policy* 86:520–28
98. Jasny L, Johnson M, Campbell LK, Svendsen E, Redmond J. 2019. Working together: the roles of geographic proximity, homophilic organizational characteristics, and neighborhood context in civic stewardship collaboration networks in Philadelphia and New York City. *Ecol. Soc.* 24(4):8
99. Belaire JA, Dribin AK, Johnston DP, Lynch DJ, Minor ES. 2011. Mapping stewardship networks in urban ecosystems. *Conserv. Lett.* 4:464–73
100. Snijders TAB, van de Bunt GG, Steglich CEG. 2010. Introduction to stochastic actor-based models for network dynamics. *Soc. Netw.* 32(1):44–60
101. Ingold K. 2017. How to create and preserve social capital in climate adaptation policies: a network approach. *Ecol. Econ.* 131:414–24
102. Koebele EA. 2020. Cross-coalition coordination in collaborative environmental governance processes. *Policy Stud. J.* 48:727–53
103. Nohrstedt D. 2018. Networking and crisis management capacity: a nested analysis of local-level collaboration in Sweden. *Am. Rev. Public Adm.* 48:232–44
104. Uzzi B, Spiro J. 2005. Collaboration and creativity: the small world problem. *Am. J. Sociol.* 111(2):447–504
105. Oh H, Chung M-H, Labianca G. 2004. Group social capital and group effectiveness: the role of informal socializing ties. *Acad. Manag. J.* 47:860–75
106. Hileman J, Bodin Ö. 2019. Balancing costs and benefits of collaboration in an ecology of games. *Policy Stud. J.* 47(1):138–58
107. Nohrstedt D, Bodin Ö. 2020. Collective action problem characteristics and partner uncertainty as drivers of social tie formation in collaborative networks. *Policy Stud. J.* **https://doi.org/10.1111/psj.12309**
108. Angst M, Hirschi C. 2017. Network dynamics in natural resource governance: a case study of Swiss landscape management. *Policy Stud. J.* 45(2):315–36
109. Castro AP, Nielsen E. 2001. Indigenous people and co-management: implications for conflict management. *Environ. Sci. Policy* 4:229–39
110. Vance-Borland K, Holley J. 2011. Conservation stakeholder network mapping, analysis, and weaving. *Conserv. Lett.* 4(4):278–88
111. Matous P, Wang P. 2019. External exposure, boundary-spanning, and opinion leadership in remote communities: a network experiment. *Soc. Netw.* 56:10–22
112. van Meerkerk I, Edelenbos J. 2014. The effects of boundary spanners on trust and performance of urban governance networks: findings from survey research on urban development projects in the Netherlands. *Policy Sci.* 47(1):3–24
113. Klijn E-H, Steijn B, Edelenbos J. 2010. The impact of network management on outcomes in governance networks. *Public Adm.* 88(4):1063–82

114. Sorensen E, Torfing J. 2009. Making governance networks effective and democratic through metagovernance. *Public Adm.* 87(2):234–58
115. Provan KG, Kenis P. 2007. Modes of network governance: structure, management, and effectiveness. *J. Public Adm. Res. Theory* 18(2):229–52
116. Harrigan NM, Labianca G, Agneessens F. 2020. Negative ties and signed graphs research: stimulating research on dissociative forces in social networks. *Soc. Netw.* 60:1–10
117. Labianca G, Brass DJ. 2006. Exploring the social ledger: negative relationships and negative asymmetry in social networks in organizations. *Acad. Manag. Rev.* 31(3):596–614
118. Yang SW, Trincado F, Labianca G, Agneessens F. 2019. Negative ties in intra-organizational network research: a review and synthesis of the past 25 years. In *Social Networks at Work*, ed. DJ Brass, SP Borgatti, pp. 47–78. New York: Routledge
119. White H. 1961. Management conflict and sociometric structure. *Am. J. Sociol.* 67(2):185–99
120. Harrigan N, Yap J. 2017. Avoidance in negative ties: inhibiting closure, reciprocity, and homophily. *Soc. Netw.* 48:126–41
121. Huitsing G, van Duijn MAJ, Snijders TAB, Wang P, Sainio M, et al. 2012. Univariate and multivariate models of positive and negative networks: liking, disliking, and bully–victim relationships. *Soc. Netw.* 34(4):645–57
122. Sparrowe RT, Liden RC, Wayne SJ, Kraimer ML. 2001. Social networks and the performance of individuals and groups. *Acad. Manag. J.* 44(2):316–25
123. Ren H, Gray B, Harrison DA. 2015. Triggering faultline effects in teams: the importance of bridging friendship ties and breaching animosity ties. *Organ. Sci.* 26(2):390–404
124. Neal ZP. 2020. A sign of the times? Weak and strong polarization in the U.S. Congress, 1973–2016. *Soc. Netw.* 60:103–212
125. Heider F. 1946. Attitudes and cognitive organization. *J. Psychol.* 21:107–12
126. Cartwright D, Harary F. 1956. Structural balance: a generalization of Heider's theory. *Psychol. Rev.* 63:277–93
127. Yap J, Harrigan N. 2015. Why does everybody hate me? Balance, status, and homophily: the triumvirate of signed tie formation. *Soc. Netw.* 40:103–22
128. Marineau JE, Hood AC, Labianca GJ. 2018. Multiplex conflict: examining the effects of overlapping task and relationship conflict on advice seeking in organizations. *J. Bus. Psychol.* 33(5):595–610
129. Brockhaus M, Di Gregorio M. 2014. National REDD+ policy networks: from cooperation to conflict. *Ecol. Soc.* 19(4):14
130. Boucquey NC. 2016. Actors and audiences: negotiating fisheries management. *J. Environ. Policy Plan.* 18(4):426–46
131. Basurto X, Blanco E, Nenadovic M, Vollan B. 2016. Integrating simultaneous prosocial and antisocial behavior into theories of collective action. *Sci. Adv.* 2(3):e1501220
132. Hood AC, Cruz KS, Bachrach DG. 2017. Conflicts with friends: a multiplex view of friendship and conflict and its association with performance in teams. *J. Bus. Psychol.* 32(1):73–86
133. Robins G, Bates L, Pattison P. 2011. Network governance and environmental management: conflict and cooperation. *Public Adm.* 89(4):1293–313
134. Smith JM, Halgin DS, Kidwell-Lopez V, Labianca G, Brass DJ, Borgatti SP. 2014. Power in politically charged networks. *Soc. Netw.* 36(1):162–75
135. Cook KS, Emerson RM, Gillmore MR. 1983. The distribution of power in exchange networks: theory and experimental results. *Am. J. Sociol.* 89(2):275–305
136. Campbell B, Cranmer S, Desmarais B. 2018. Triangulating war: network structure and the democratic peace. arXiv:1809.04141 [stat.AP]. **https://arxiv.org/abs/1809.04141**
137. Buhaug H. 2015. Climate-conflict research: some reflections on the way forward. *Wiley Interdiscip. Rev. Clim. Change* 6(3):269–75
138. Bodin Ö, Alexander SM, Baggio J, Barnes ML, Berardo R, et al. 2019. Improving network approaches to the study of complex social–ecological interdependencies. *Nat. Sustain.* 2:551–59
139. Barnes ML, Bodin Ö, Guerrero A, McAllister R, Alexander SM, Robins G. 2017. The social structural foundations of adaptation and transformation in social–ecological systems. *Ecol. Soc.* 22(4):16

140. Schlüter M, Orach K, Lindkvist E, Martin R, Wijermans N, et al. 2019. Toward a methodology for explaining and theorizing about social-ecological phenomena. *Curr. Opin. Environ. Sustain.* 39:44–53
141. Clark WC, Dickson NM. 2003. Sustainability science: the emerging research program. *PNAS* 100(14):8059–61
142. Berkes F, Colding J, Folke C, eds. 2003. *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge, UK: Cambridge Univ. Press
143. Bodin Ö, Tengö M. 2012. Disentangling intangible social-ecological systems. *Glob. Environ. Change* 22:430–39
144. Moreno JL, Jennings HH. 1938. Statistics of social configurations. *Sociometry* 1:342–74
145. May RM. 1972. Will a large complex system be stable? *Nature* 238:413–14
146. Dee LE, Allesina S, Bonn A, Eklöf A, Gaines SD, et al. 2017. Operationalizing network theory for ecosystem service assessments. *Trends Ecol. Evol.* 32(2):118–30
147. Lubell M. 2013. Governing institutional complexity: the ecology of games framework. *Policy Stud. J.* 41(3):537–59
148. Leventon J, Schaal T, Velten S, Dänhardt J, Fischer J, et al. 2017. Collaboration or fragmentation? Biodiversity management through the common agricultural policy. *Land Use Policy* 64:1–12
149. Riek BM, Mania EW, Gaertner SL. 2006. Intergroup threat and outgroup attitudes: a meta-analytic review. *Personal. Soc. Psychol. Rev.* 10(4):336–53
150. Gray B. 1985. Conditions facilitating interorganizational collaboration. *Hum. Relat.* 38(10):911–36