Human Dimensions of Wildlife, 16:259–272, 2011

ISSN: 1087-1209 print / 1533-158X online
DOI: 10.1080/10871209.2011.542556

Routledge
Taylor & Francis Group

Social Network Dynamics in Collaborative Conservation

T. BRUCE LAUBER, RICHARD C. STEDMAN, DANIEL J. DECKER, BARBARA A. KNUTH, AND CARRIE N. SIMON

Human Dimensions Research Unit, Department of Natural Resources, Cornell University, Ithaca, New York, USA

Our research explored patterns in the development of social networks serving as the foundation for collaborative conservation. We conducted four case studies of conservation efforts associated with State Wildlife Action Plans in the United States. Data were collected on conservation objectives, key players, and their roles and interactions. Networks evolved through identifiable phases, which we labeled: organizational loyalty, reconsideration, partnership formation, and partnership utilization. During the partnership formation phase, networks had well-defined memberships, relied on structured opportunities for interaction and dialogue, and devoted attention to rules for dialogue. This phase was particularly important in contexts with multiple actors with diverse interests. In the partnership utilization phase, network memberships became more open, relied less on structured opportunities for interaction, and dialogue and decision-making became less formal. Our results can inform efforts to foster collaborative conservation.

Keywords adaptive cycle, collaboration, social networks

Introduction

Conservation problems occur in complex social–ecological systems marked by considerable uncertainty. These complexities make it difficult to predict which strategies are most effective for achieving conservation objectives and how these strategies may affect other system characteristics. Consequently, authors have argued for adaptive approaches to conservation in which strategies are modified based on learning and experience (Holling, 1978; Lee, 1993; Riley et al., 2003). Adaptive approaches to conservation are often difficult to apply in practice because conservation strategies depend on numerous individuals and organizations. Important habitats may extend across the properties of a variety of landowners, both public and private, and conservation strategies may be constrained by laws and regulations at multiple levels of government. Because conservation can be influenced by diverse stakeholders, novel collaborative governance approaches may be sought to increase adaptability (Armitage et al., 2009; Folke, Hahn, Olsson, & Norberg, 2005; Plummer & Armitage, 2007).

The success of collaborative conservation efforts depends in part on the characteristics of their underlying social networks—the patterns of relationships and interactions

Address correspondence to T. Bruce Lauber, Human Dimensions Research Unit, Department of Natural Resources, Cornell University, Ithaca, NY 14853, USA. E-mail: TBL3@cornell.edu

between individuals and organizations contributing to the conservation efforts (Bodin, Crona, & Ernstson, 2006; Crona & Bodin, 2006; Plummer, 2009). Understanding these social networks can shed light on how relationships influence activities essential to conservation: providing leadership, developing agreements, supplying resources, disseminating knowledge, and others. Collaborative conservation networks are dynamic, with both their membership and interaction patterns changing over time. Despite considerable research on collaborative conservation, these dynamics have been little studied and remain poorly understood (Plummer, 2009; Nkhata, Breen, & Freimund, 2008).

We examined collaborative efforts to implement State Wildlife Action Plans (SWAPs) in the United States. Our work focused on social networks of conservation practitioners in these conservation efforts. We explored the patterns in their evolution, assessed how network structure influenced conservation, and determined whether and how these structures varied under different conditions. Over the last decade each state and territory prepared a SWAP as a precondition for receiving State Wildlife Grant funding from the federal government. Because SWAPs are intended to be comprehensive plans for preventing species from becoming threatened or endangered, their scope puts them beyond the capacity of any state fish and wildlife agency to implement on its own. Consequently, collaboration has been important in their implementation.

Theoretical Background

Recent work has begun to inform our understanding of social network characteristics in collaborative conservation. Bodin and Crona (2009) drew on social network theory to suggest whether and how network properties influence the effectiveness of natural resource governance. They identified several network characteristics of potential importance, including density (the number of connections between actors as a percentage of all possible connections); cohesiveness (do recognizable subgroups exist); subgroup interconnectivity (if subgroups exist, are they connected to other subgroups); and centralization (do particular actors play a critical role in linking the others). They drew several conclusions. First, network structure influences the effectiveness of natural resource governance, although it is uncertain which network characteristics are most beneficial to which purposes. Second, particular network characteristics often have both advantages and disadvantages. For example, dense networks may facilitate joint actions but contribute to homogenization and subsequently decrease opportunities for innovation and learning. Finally, networks often evolve as natural resource problems are addressed, and this evolution is likely necessary for successful governance; different network structures may be more effective during different phases of governance.

Several authors (Janssen et al., 2006; Nkhata et al., 2008; Scheffer, Westley, Brock, & Holmgren, 2002) have proposed Gunderson and Holling's (2002) adaptive cycle of ecosystem function as a model for portraying the evolution of collaborative conservation networks. This model characterizes phases in the transformation of ecosystems and other complex systems. Connectivity between components is a key system characteristic. Holling (1986) originally applied the model to ecosystem transformation in which he identified four phases: (a) exploitation (recently disturbed areas dominated by organisms capable of quickly obtaining access to resources); (b) conservation (mature ecosystems dominated by organisms capable of slowly accumulating resources); (c) release (a disruptive event releases resources from biomass); and (d) reorganization (the system reorganizes so that newly released resources are available for the next phase of exploitation).

Although this model originated to characterize ecosystem processes, it has since been extended to social–ecological systems and their components (Gunderson & Holling, 2002),

including characterization of social network transformation in collaborative environmental management. Several authors whose work we discuss below have found that the model can portray the transition from a well-established governance system characterized by one set of actors and relationships to a new governance system with different actors and relationships.

Janssen and colleagues (2006) speculated that during the conservation phase, a governance network might be characterized by high centrality (with one or a few actors dominating) and low density (with many actors not directly connected). High centrality could make coordination easier because most interactions would rely on a few key players. Low density could increase efficiency because maintaining relationships involves costs but is not as important in well-established systems. The authors expected that the reorganization phase, when a new governance system is becoming established, would be characterized by high density but low centrality with actors tending to cluster in discrete groups with little interaction.

Scheffer and colleagues (2002) argued that as new natural resource problems emerge, relatively few stakeholders are connected in what they call the scattered phase (corresponding to the release phase). Connections become established as people begin to recognize or define a problem in the mobilized (reorganization) phase with stakeholders organizing into groups with similar interests. These groups begin to advocate for their interests, but do so relatively independently during the polarized (exploitation) phase. If this polarization is successfully addressed and groups with different interests are effectively linked, a new management approach may become institutionalized (conservation phase). A system may need to reorganize repeatedly as the environmental conditions change.

In Nkhata and colleagues' (2008) characterization of the evolution of collaborative networks, the opportunistic (exploitation) phase occurs when new opportunities for collaboration are seized. In the collaborative (conservation) phase, these new relationships may become institutionalized, but institutionalization may make it difficult for relationships to adapt as conditions change. Relationships may then start to break down, and actors may begin to act as adversaries (adversarial [release] phase). In the tactical (reorganization) phase, new collaborative relationships are established.

Scheffer and colleagues (2002) and Nkhata and colleagues (2008) use Gunderson and Holling's (2002) adaptive cycle to characterize the evolution of collaborative governance through stages: before collaborative relationships exist, when relationships become established and start to function, and when relationships become institutionalized. The description of this progression is not consistent from author to author, however, and the research evidence for the stage progression assertion remains scant. To contribute to the research evidence for this stage progression, we described typical stages in the evolution of collaborative conservation efforts related to the SWAPs, characterizing these stages using Gunderson and Holling's model. We also assessed relationships between network structure, activities undertaken, and management context.

Methods

We conducted our work in two phases: identification and characterization of collaborative SWAP implementation efforts; and case studies of four successful efforts to identify factors contributing to their success, including the structure and dynamics of the social networks that provided the foundation for collaborative action.

We conducted 60 telephone interviews with individuals knowledgeable about SWAP implementation. Respondents included SWAP coordinators with state fish and wildlife

agencies and representatives of other government agencies and nongovernmental organizations involved with SWAP implementation. We asked respondents to identify collaborative SWAP implementation efforts with which they were familiar (many individuals identified multiple efforts). For each effort, we collected information about objectives, perceived success, and factors influencing success. We analyzed interview transcripts or recordings and developed a system (described below) for categorizing efforts according to their objectives.

We selected four collaborative efforts that our respondents perceived to be successful out of the 144 cases identified. We use these cases to describe stages in the evolution of collaborative networks that would apply across a range of cases and to identify contextual characteristics that were related to network structure. We selected cases to be diverse with respect to conservation objectives, region of the United States, and geographic scale of conservation activity. We collected three primary types of data for each case: interview data, written documentation, and standardized social network data. We rely primarily on the interview data and written documentation in this manuscript because the standardized social network data were collected at a single point in time, thus not allowing us to observe the evolution of these groups and relationships over time.

Between November 2008 and January 2009, we visited each case study site and conducted in-depth, semi-structured interviews of individuals contributing to these efforts. The interviews addressed: (a) objectives and activities, (b) perceived success, (c) individuals involved and their roles, and (d) factors influencing success (including, but not limited to, relationships and interactions between individuals). We interviewed between 7 and 17 collaborators for each case. We selected interview participants through a "snowball sampling" process (Seidman, 1998), asking each respondent to recommend others who also played significant roles. We continued this process until additional interviews generated little new information, suggesting our respondents adequately reflected the range of perspectives and information about each case. Each site visit was followed with a standardized social network survey in which individuals were asked to report how frequently they interacted with other individuals engaged in the efforts.

We audiorecorded and transcribed most interviews. The transcripts were coded (Miles & Huberman, 1994), broken into meaningful segments (sentences or paragraphs) and assigned to descriptive categories focusing on the objectives of the efforts, the nature of activities carried out by the partnership to achieve those outcomes, and the roles played by different individuals. The creation of this category system provided us with a framework for reconstructing the history of the collaboration that occurred in each case.

Study Sites

The Grand River Grasslands Partnership (GRG) is a collaboration of state, federal, and nongovernmental organizations working to restore prairie in a 70,000-acre region in northern Missouri and southern Iowa. The region has long been a working agricultural area used primarily for cattle grazing, but retains a core of native grasslands. Conservation work began in earnest in the late 1990s when The Nature Conservancy (TNC), the Missouri Department of Conservation (MDC), and the Iowa Department of Natural Resources (Iowa DNR) acquired several parcels of land in the area with significant potential for prairie restoration. Collectively, they now own nearly 10% of the land in the area. In addition to restoration work on these government and TNC parcels, MDC and Iowa DNR have worked closely with the Natural Resources Conservation Service and the U.S. Fish and Wildlife Service to direct funding to the region from federal cost-share programs that support conservation efforts on private lands.

In the South Puget Sound region of Washington State (PS), the U.S. Fish and Wildlife Service, the Washington Department of Natural Resources, the Washington Department of Fish and Wildlife, and TNC have been interested in the preservation and restoration of prairie habitat since at least the early 1990s. This region is heavily developed, and only a limited number of suitable parcels were available for acquisition. Consequently, most of the focus today is on habitat restoration on relatively small parcels. The ownership of these parcels is varied and coordination and cooperation among parcel owners has been a major focus of the partnership. The U.S. Army's Fort Lewis has played a critical role in restoration efforts. Approximately 80% to 90% of remaining prairie habitat is on Fort Lewis' property. Although their primary mission necessarily remains troop training, Fort Lewis has actively contributed to restoration work on its properties and provides funding for restoration in adjacent areas.

The Vermont Fish and Wildlife Department and the Vermont Agency of Transportation are collaborating to improve the connectivity of fish and wildlife habitat, increase roadway safety by reducing wildlife collisions, and avoid unnecessary delays and unanticipated costs in transportation projects (VT). The agencies initially approached this work as a capacity-building effort focusing on cultivating relationships, increasing awareness of each other's needs, and improving communication and coordination. A key step in this effort was creation of an interagency steering committee, which serves as a forum for discussion on topics relevant to transportation and wildlife. The role of the committee has been formalized through a Memorandum of Understanding. Over the years, discussions on the committee have spawned a number of other collaborative efforts including a Habitats and Highways training program and cooperation on the design or maintenance of the transportation infrastructure.

The Montana Partnership (MP), comprised of approximately 25 individuals representing government agencies, nongovernmental organizations, and private landowners, is building the capacity necessary to achieve the objectives of Montana's Comprehensive Fish and Wildlife Conservation Strategy (CFWCS). The partnership was an outgrowth of a situation analysis that explored whether the CFWCS could serve as an "umbrella" for conservation work occurring in Montana. The assessment generated tremendous interest and a recommendation to establish a partnership to develop concrete proposals for building capacity for CFWCS implementation. Montana Fish, Wildlife and Parks facilitated group formation, discussion, and decision-making. Membership is broad-based including not only organizations dedicated specifically to conservation, but land owners and industry representatives. Because of the diversity of the group, much energy has been spent on building relationships between members and developing broadly acceptable guidelines for discussion and decision making.

Results

We identified four phases in the development of conservation partnerships that occurred in sequence fairly consistently in the cases we studied. Transitions between these phases were gradual, but we distinguish between them here for the sake of clarity.

Organizational Loyalty

For three of our cases, we identified an initial period in which conservation work was taking place, but not collaboratively. In this "organizational loyalty" phase, the relationships that provided the social foundation for conservation work were delimited by organizational

boundaries, and organizations worked relatively independently. As one of our respondents in the Puget Sound region described prairie restoration work during this phase: "In terms of prairie parcels . . . we just worked on this one, this one, and this one independently" (PS-01).

Because organizations were working independently, they each defined conservation objectives differently and somewhat narrowly according to their organizations' primary foci. For example:

> Washington Department of Fish and Wildlife . . . their real expertise and interest has been in butterflies. . . . From my perspective, they were way too cautious in their habitat management for many years because they didn't want to do anything that would jeopardize butterflies . . . to the point of not wanting people to walk in areas because they'd be stepping on caterpillars. (PS-03)

Similarly in Montana, a number of organizations were carrying out conservation work that contributed to the objectives of the state's Comprehensive Fish and Wildlife Conservation Strategy ("the Comp Plan"), although they were doing so independently of each other rather than collaborating: "There were . . . a lot of programs out there that . . . weren't doing work under the auspices of the Comp Plan, but they were doing work that advanced the same" (MP-08a).

In Vermont, the contrast between the objectives of the Department of Fish and Wildlife and the Agency of Transportation (VTrans) was even greater than in the other cases during the organizational loyalty phase. Not only did the two agencies generally not collaborate on conservation, but they occasionally acted as adversaries because one of the Department of Fish and Wildlife's roles was to evaluate the impacts of VTrans' transportation projects on fish and wildlife: "The Department of Fish and Wildlife . . . had a fairly prickly relationship with VTrans. . . . It was typically contentious. VTrans didn't want to have to deal with the issues that we would raise" (VT-03).

The Grand River Grasslands Partnership followed the most unique trajectory of the four cases we studied; once three key organizations (the Missouri Department of Conservation, the Iowa Department of Natural Resources, and TNC) acquired prairie parcels in the same region, their collaboration began almost immediately: "It truly was a cooperative effort from the get-go" (GRG-03); "There was pretty good cooperation it seemed like to me from the get-go on different things" (GRG-07).

The period before the partnership began, therefore, was not marked by organizations working independently on interrelated objectives in the same vicinity, but by organizations not working in the same vicinity at all.

Reconsideration

During the "reconsideration" phase, frustrations and the prospect of failure led organizations to reevaluate how they were addressing conservation problems and the most appropriate partners with whom to work. These concerns surfaced following the organizational loyalty phase in three cases and as the initial phase in the Grand River Grasslands. In the Puget Sound, invasive species were having a considerable impact on prairie parcels and several key species were faring poorly.

> The Scotch broom and tall oak grass, major invasive grasses, were just running amuck in their site. It finally got to the point where I think even they were

> realizing that they weren't focusing on the critical threat. And so in their caution to not want to spray herbicides that might impact the butterflies and not wanting to burn the butterflies, they were losing the butterflies. (PS-03)

In Montana, the frustrations that led to the partnership were two-fold. First, the Montana Department of Fish, Wildlife and Parks recognized that it would not be able to achieve the objectives of the Comprehensive Fish and Wildlife Strategy by itself:

> It started with the recognition that the comprehensive strategy wasn't going anywhere, and further, it was never going to have a chance at being implemented if only the department was implementing it. There is too much stuff that needs to happen to advance the habitat, conservation and restoration work than the department can do. (MP-08a)

Second, private landowners, who were interested in conservation but had other objectives, too, were concerned that the implementation of the strategy might jeopardize their interests:

> There was a lot of concern with the landowners . . . that had read some portion of it . . . that said, "I'm pretty scared of this so we need to be involved at least to make sure that landowners aren't penalized somehow in . . . how this plan is implemented." (MP-04)

In Vermont, the Department of Fish and Wildlife and VTrans realized that when they tried to carry out their functions independently, they faced delays and frustrations because they were necessarily interdependent.

> We . . . didn't work together in any meaningful way on the planning side of things . . . [VTrans is] planning thirty years out . . . they've done all their planning . . . they've secured their money and they're about ready to implement the job and Fish and Wildlife shows up and says, "What? You can't move forward on that . . ." And the agency would get very frustrated because . . . here it was, as far as they were concerned . . . the last minute. (VT-01)

In the Grand River Grasslands, the conservation concerns that led to the formation of the partnership arose before the key partner organizations became heavily invested in this region. These organizations individually evaluated their conservation priorities, and all ultimately concluded that grassland ecosystems were in critical need of attention. This recognition led to the decision to focus on the Grand River Grasslands:

> The process we used was to use information on species conservation needs. . . . Where do they occur in abundance? Where there are clusters of them? . . . When . . . we look at the number of species of greatest conservation need that are tied to prairies and grasslands . . . we know that prairie systems are higher priority. (GRG-0)

Partnership Formation

A period of "partnership formation," in which collaborative relationships began to form, followed the reconsideration phase in each case. During this period, the emerging

partnerships were formally organized. In three of the cases, this phase focused primarily on the activities of fostering relationships between individuals representing their organizations in the partnership and building agreement on common objectives. The social networks tended to be relatively structured; memberships were well-defined with established rules for dialogue and decision-making.

A member of the South Puget Sound Prairie Working Group explained the partnership's membership and focus during its early years in these terms:

> It was a relatively small group to begin with. I think there was The Nature Conservancy, the Washington Department of Fish and Wildlife, the Washington Department of Natural Resources, Ft. Lewis and us. (PS-01)
>
> Initially we had . . . a mission and set out some bylaws and such. (PS-01)

A second individual described how the group made use of formal venues for interaction:

> There are regular meetings . . . and we've held several targeted workshops . . . Regular meetings—three or four a year. . . . It's important to get someone to run the meeting and bring everybody together, provide a forum for presentation and discussion, so that means engaging people to present about whatever the topic of the meeting is. (PS-05)

These efforts have led to a broadening of conservation objectives:

> A success of the South Puget prairie working group has been that they're looking at all ecosystems, ecological values, and plants, animals and habitats . . . Participating in the working group shows a willingness to expand. (PS-04)

The partnership between the wildlife and transportation agencies in Vermont also had a formal structure initially. An interagency steering committee was formed early on in the process: "We formed this committee that would meet four times a year . . . which helped . . . to foster trust and identify shared goals and projects" (VT-02).

A memorandum of understanding was developed to formalize this relationship:

> We tried to formalize this process as much as possible so that it could be as durable as possible to any administrative changes. We . . . memorialized the purpose and the roles of the steering committee in a memorandum of agreement. (VT-03)

The steering committee initiated other structured opportunities for interaction. The most notable of these was a Habitats and Highways Training Program, which provided opportunities for employees of VTrans and the Fish and Wildlife Department to interact and develop relationships.

Of the cases we studied, the Montana Partnership's partnership formation stage was the most heavily structured. The Montana Department of Fish, Wildlife and Parks was deliberate in selecting who could and could not be part of the partnership, and that selection process was viewed as important by other participants:

> I would give Fish, Wildlife and Parks credit for ultimately making the decision about who was going to sit on that originally . . . folks that had enough

> diversity that one group wasn't going to be too overbearing on another group. (MP-04)

The group spent a long period of time building relationships between participants and developing ground rules to guide conversation and decision-making. Many respondents discussed these rules during the course of the interviews:

> The partnership agrees to seek win/win solutions to the extent possible. We have a three-level voting system. . . . It's not strict voting and it's not strictly a consensus . . . pretty close to consensus. The partnership agrees to fully explore and understand all the relevant issues prior to completing decisions. . . (MP-02)

Considerable attention was devoted to establishing common objectives:

> It was pretty open. . . . We had these first three meetings where you're sort of figuring out the sideboards and we did some visioning efforts. . . . What's the role of this group? Where are we working? Where are we not working? What are we tackling? (MP-03)

The Grand River Grasslands Partnership was the exception to the pattern. None of our respondents discussed an early, more structured phase of the partnership in which effort was devoted to group formation and the development of common objectives. They characterized the partnership formation period as one in which organizations that were already interested in grassland conservation decided to invest in the same region because it already had a core of native grasslands and associated species:

> We have a unique ecotype out here. . . . We're dealing with a large landscape of grass . . . the largest in the state. . . . The Nature Conservancy also noticed the vastness of grass that was down here. . . . So it lends itself very well to everyone having a vested interest in those areas. So it made it easy to work together. (GRG-05)

The formation of the partnership was further simplified by the fact that the set of interests that needed to be considered in setting the direction of the partnership was smaller; only three key players (the Iowa Department of Natural Resources, the Missouri Department of Conservation, and The Nature Conservancy) collectively own about 10% of the land in the 70,000 acre focus area:

> The Iowa DNR, the Missouri Department of Conservation and TNC . . . because they're the large landowners . . . the percentage that they own of that 70,000 acres . . . it's a fairly significant amount. So I would say that their role is very critical. (GRG-04)

This pre-existing common interest and the relatively small number of major players involved removed barriers to the emergence of the partnership and may have obviated the necessity of a more lengthy partnership formation phase.

Partnership Utilization

Eventually the shared identity and vision became strong enough that groups entered a "partnership utilization" phase, which was the last phase to date in each case. During this phase, established relationships were strong enough for activities to focus on the exchange of information, funding, assistance, and other resources to benefit conservation without the need for partnerships to devote as much attention to tending to the relationships. Respondents described such benefits frequently during our interviews as in this example from the Puget Sound: "Pat has a crew that's going out to deal with Scotch broom. We don't have to hire that crew and we don't have to organize it . . . so there's efficiency there" (PS-04).

During this period, the social networks became less structured and formal: "It's gotten much looser over the years and I think we've all kind of come to the agreement that there's no reason why we would keep somebody out" (PS-01).

In Vermont, the transition to a less structured phase, in which interactions were less formal and more directed at producing concrete outcomes, was particularly evident. After six years, the funding for the Habitats and Highways training program was eliminated, and members of the agencies began to see the steering committee as having a less prominent role:

> As far as I'm concerned there has been less emphasis on the steering committee. . . . We're seeing increasingly middle management as opposed to upper management actually attending those meetings . . . people with less and less power. (VT-01)

Nevertheless, the relationships and understanding that these more formal efforts helped to cultivate have yielded benefits:

> The success of the steering committee is not just bureaucratic. It's also . . . interpersonal. . . . Vermont runs on interpersonal relationships so knowing who to call . . . makes all the difference in the world. So yeah, the steering committee doesn't have as much power, but we know each other and it's that much easier to . . . phone. (VT-01)

Respondents cited a number of examples of specific transportation projects in which relationships and common understanding led to tangible benefits for both transportation and wildlife.

At the time our research was conducted, the Montana Partnership was at the point of transitioning from the partnership formation phase to the partnership utilization phase, during which substantive outcomes would become the focus:

> I think the next two meetings . . . are really significant in that we will have made the transition from forming this group to actually beginning to work on things of substance. . . . A critical piece of that would be getting consensus agreement on the case statement because that means that the group is actually beginning to work actively towards some kind of new initiative. (MP-06)

Because this transition was just occurring during the period of our research, we had no data on whether or how the structure of the partnership changed as a result.

Although the Grand River Grasslands Partnership formed without a more structured partnership formation phase that we could detect, it showed clear evidence of close cooperation to achieve common goals during a partnership utilization period:

> They've really defined a good focal area and so if . . . [a proposed project] meets our requirements as far as being . . . a project that's going to enhance the grasslands for birds then we'll go for it. (GRG-04)
>
> When money is tight for the Department of Natural Resources . . . [TNC] can sometimes slip in and buy up a chunk of land quickly and hold it for two or three years and then we buy it from them for the same value as what they have in it. So they don't take a loss or a gain on that. We are able to secure priority land. (GRG-05)

Discussion

We found the social networks that provided the foundation for collaborative conservation efforts to be continually changing, which is consistent with past work (Bodin & Crona, 2009; Nkhata et al., 2008; Plummer, 2009). The phases through which networks evolved corresponded reasonably well to the phases of Gunderson and Holling's (2002) adaptive cycle of ecosystem function as interpreted by several other authors, with the strongest similarities with Nkhata et al.'s (2008) interpretation. The network properties identified by Bodin and Crona (2009) as potentially important as collaborative networks evolve, such as density, cohesiveness, subgroup interconnectivity, and network centralization, changed during different phases.

The organizational loyalty phase we observed in our study cases corresponds to the conservation phase of Gunderson and Holling's (2002) model (in which connections within the system are long-standing and stable), which Nkhata et al. (2008) and Scheffer et al. (2002) described as a period of institutionalized governance relationships. During this phase, interview respondents described a high level of connectedness between individuals working on conservation or related efforts, but that connectedness did not cross established organizational boundaries, as individuals worked primarily with others within their organizations or interest groups. Consequently, our interview data suggested a low degree of inter-group cohesiveness, with relatively few connections transcending subgroups.

The reconsideration phase corresponds to Gunderson and Holling's (2002) release phase, which Nkhata et al. (2008) and Scheffer et al. (2002) have characterized as a period in which relationships begin to break down. Although organizations did not disband during this period, the relationships and ways of thinking that characterized conservation work and related efforts weakened. Individuals questioned who they should be working with and how they were defining the problems they were trying to address.

The partnership formation phase corresponds to Gunderson and Holling's (2002) reorganization phase, which Nkhata et al. (2008) and Scheffer et al. (2002) have characterized as a period in which new relationships become established. New working relationships crossing organizational boundaries began to form during this period. Because the social networks were fairly structured with an emphasis on formal venues for interaction (such as meetings and workshops) and rules for dialogue and decision-making, the density of relationships within the network increased and the network became more cohesive. Janssen and colleagues (2006) anticipated this type of pattern during the reorganization phase as a new governance system becomes established (i.e., networks characterized by a high density of

interactions but no individual or small set of individuals dominating the network). Bodin and Crona (2009) argued that high density social networks tend to become more homeogenous, and increased homogeneity was likely important during this phase as the newly formed collaborations worked to create a common set of goals.

The partnership utilization phase corresponds to Gunderson and Holling's (2002) exploitation phase (in which the new connections within the system mature and become more stable). Nkhata and colleagues (2008) portray this period as one in which opportunities for collaboration can be seized. We found that by this point the new working relationships had become sufficiently well established that the individuals within the networks could begin to take advantage of the resources (such as information, funding, and shared labor) that other network members could provide. Because the networks relied less heavily on clearly defined rules for membership and formal, structured opportunities for interaction, the density and cohesiveness of the networks decreased. This change may have been an advantage because as Janssen and colleagues (2006) point out, maintaining relationships involves costs (including both time and money). After the network has achieved a common understanding of what they were trying to accomplish during the previous phase, maintaining a high density and cohesive set of relationships likely was less important. The common understanding could serve as the basis for coordinated actions, and the relationships that were important were those that allowed the necessary resources to flow in the directions needed for that action to take place.

Although we found a similar pattern in the evolution of collaborative partnerships in the four cases we studied, the pattern was not identical. The development of the Grand River Grasslands Partnership followed the most unique trajectory. In particular, we did not detect a more structured partnership formation phase with a heavy emphasis on relationship building and development of a common agenda. Although we may not have detected this phase simply because it occurred a long time ago and the individuals we interviewed were less likely to discuss it in depth, member checks supported our belief that the partnership formation phase was indeed less pronounced in this case. We argued above that the more structured social networks during the partnership formation phase may contribute to more homogenous networks, perhaps necessary for joint action to take place. In the Grand River Grasslands, the network of collaborators was likely the most homogenous at the outset of the partnership of all our cases. The focus of this effort was a relatively small geographic area with a small number of key players; only three organizations own nearly 10% of the land in this region, and that land has served as the centerpiece of conservation efforts. Because this site was so suitable for prairie conservation, organizations chose to become involved there because of similar pre-existing interests. Consequently, it presented a more simplified environment for partnership formation with a smaller number of players with similar interests; those similarities reduced barriers to the development of relationships and a common agenda.

This interpretation is strengthened because the case with the most pronounced partnership formation phase, with the greatest attention to a deliberate and structured social network, was the Montana Partnership. This case was set in the most heterogeneous context for partnership formation. It functioned at a large, statewide scale. The partnership included 25 members with diverse interests ranging from representatives of multiple conservation organizations, to local, state, and federal government agencies, to industry interests, to private landowners. If the initial, more structured, period of partnership formation is necessary to achieve sufficient within-group homogenization to enable joint action, than it is unsurprising that a particularly lengthy partnership formation period would be found in this context. These findings lead to a tentative interpretation that the

partnership formation phase will be more important in situations in which the social context is complex—involving more people, less common ground, and operating at a larger scale.

Conclusions

The pattern we detected in the dynamics of social networks serving as the basis for collaborative conservation efforts can usefully be understood as the transition from one social structure to another. In each case, one set of relationships was replaced by a new one. The triggers stimulating these changes were consistent across our cases; each was precipitated by a threat or crisis. The potential of failure prompted organizations to rethink their approach to conservation and the most appropriate partners to engage. The characteristics of the social networks that developed were also fairly consistent. More structured networks were the norm as nascent collaborations built relationships and developed a common agenda. When that common basis for action had been established, less structured approaches were more common.

This understanding can contribute to fostering new collaborative conservation efforts. The structures of partnerships may be tailored to meet the unique needs of each stage of their development. At this point, however, our findings should be viewed as tentative hypotheses to be explored in additional work. They are based on research into four case studies with one particular focus: the implementation of the State Wildlife Action Plans in the United States. Before generalizing too much from them, it is important to explore whether these patterns hold in other conservation contexts (and, if they do not, determine why) and collect standardized social network data capable of tracking the evolutions of these networks over their multi-year lives.

References

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., . . . Wollenberg, E. K. (2009). Adaptive co-management for social-ecological complexity. *Frontiers in Ecology and the Environment*, *7*(2), 95–102.

Bodin, O., Crona, B., & Ernstson, H. (2006). Social networks in natural resource management: What is there to learn from a structural perspective? *Ecology and Society*, *11*(2), r2. Retrieved from http://www.ecologyandsociety.org/vol11/iss2/resp2/.

Bodin, O., & Crona, B. I. (2009). The role of social networks in natural resource governance: What relational patterns make a difference? *Global Environmental Change*, *19*, 366–374.

Crona, B., & Bodin, O. (2006). What you know is who you know? Communication patterns among resources users as a prerequisite for co-management. *Ecology and Society*, *11*(2). Retrieved from http://www.ecologyandsociety.org/vol11/iss2/art7/.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environmental Resources*, *30*, 441–473.

Gunderson, L. H., & Holling, C. S. (2002). *Panarchy: Understanding transformations in human and natural systems*. Washington, DC: Island Press.

Holling, C. S. (1978). *Adaptive environmental assessment and management*. New York, NY: Wiley.

Holling, C. S. (1986). The resilience of terrestrial ecosystems: Local surprise and global change. In W. C. Clark & R. E. Munn (Eds.), *Sustainable development of the biosphere* (pp. 292–317). New York, NY: Cambridge University Press.

Janssen, M. A., Bodin, O., Anderies, J. M., Elmqvist, T., Ernstson, H., McAllister, R. R. J., Olsson, P., and Ryan, P. (2006). Toward a network perspective of the study of resilience in social-ecological

systems. *Ecology and Society*, *11*(1). Retrieved from http://www.ecologyandsociety.org/vol11/iss1/art15/.

Lee, K. N. (1993). *Compass and gyroscope: Integrating science and politics for the environment*. Washington, DC: Island Press.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis* (Second ed.). Thousand Oaks, CA: Sage.

Nkhata, A. B., Breen, C. M., & Freimund, W. A. (2008). Resilient social relationships and collaboration in the management of social-ecological systems. *Ecology and Society*, *13*(1). Retrieved from http://www.ecologyandsociety.org/vol13/iss1/art2/.

Plummer, R. (2009). The adaptive co-management process: An initial synthesis of representative models and influential variables. *Ecology and Society*, *14*(2). Retrieved from http://www.ecologyandsociety.org/vol14/iss2/art24/.

Plummer, R., & Armitage, D. (2007). A resilience-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world. *Ecological Economics*, *61*(1), 62–74.

Riley, S. J., Siemer, W. F., Decker, D. J., Carpenter, L. H., Organ, J. F., & Berchielli, L. T. (2003). Adaptive impact management: An integrative approach to wildlife management. *Human Dimensions of Wildlife*, *8*(2), 81–95.

Scheffer, M., Westley, F., Brock, W. A., & Holmgren, M. (2002). Dynamic interactions of societies and ecosystems: Linking theories from ecology, economy, and sociology. In L. H. Gunderson & C. S. Holling (Eds.), *Panarchy: Understanding transformations in human and natural systems* (pp. 195–239). Washington, DC: Island Press.

Seidman, I. (1998). *Interviewing as qualitative research: A guide for researchers in education and the social sciences*. New York, NY: Teachers College Press.