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Research paper

Improving river health: insights into initiating collaboration in a transboundary river basin

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ABSTRACT

River health is a concern worldwide. Governance of river basins is particularly complicated when they are large scale and cross jurisdictional boundaries. Past approaches to making decisions in transboundary basins are limited and attention is increasingly being focused on the potential of collaboration. This research investigates the initiation phase of a collaborative conservation project (WWF-Canada Freshwater Program, St. John River project) in the St. John River Basin of Canada. A social-ecological inventory technique and social network analysis are used to identify the actors in the transboundary basin and their activities, perceptions and connections to river health, relationship with other stakeholders, and actual engagement with a milestone event in the project. Insights gained from exploring the relationships between/among these variables highlight the complicated nature of initiating collaboration. A common understanding of river health and a strong structure of connected actors were encouraging signs that collaboration may flourish, while the assertion of power and context surrounding the initiative were found to mediate its possibility. The collaborative potential of conservation projects in large-scale transboundary river basins may be enhanced through such research and by actively applying these insights.

Keywords: Collaboration; collaborative management; collaborative governance; social-ecological inventory; transboundary rivers

1 Introduction

Rivers are of critical importance for the functioning of freshwater ecosystems as well as human well-being. They, along with other surface freshwaters, are also '... among the most extensively altered ecosystems on Earth' (Carpenter *et al.* 2011, p. 75). While fluctuations are normal in freshwater systems, the novelty and size of current alterations is caused by multiple drivers (e.g. climate changes, alterations in flows by humans, changes in land-use cover, input of chemicals, invasive species, harvesting) and their interactions (Carpenter *et al.* 2011). For example, almost 60% of the large river systems in the world are impacted by dams (Nilsson *et al.* 2005) and when such systems are considered in light of climate and water withdrawal scenarios they will experience greater alterations in discharge and water stress, when compared to unimpaired rivers (Palmer *et al.* 2008). The first global-scale threat analysis to concomitantly consider water security and biodiversity reinforces the dire situation of rivers worldwide (Vörösmarty *et al.* 2010).

The management and governance of rivers is complicated by the flowing nature of these resources as well as the fact that their geographical location often does not coincide with administrative or political jurisdictions. Approximately half of the Earth's land surface, accounting for about 60% of freshwater flow globally, consists of 263 lake and river basins shared by two or more

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countries (UN Water 2008). It is anticipated that water-related conflicts between nations (water scarcity, water course alterations and dam constructions, water withdrawals, and pollution) will be exacerbated by climate change (Uitto and Duda 2002, UN Water 2008). Thousands of river basins cross borders at sub-national levels (Armitage *et al.* in review) and intrastate river basin conflicts are evident (e.g. Schlager and Heikkila 2009, Gizelis and Wooden 2010, Percy 2012). Transboundary basins also offer opportunities for sharing benefits and responsibilities – a main message put forth at Wold Water Day in 2009 (UN Water 2009). Instances of collaboration are far greater than acute conflict, with 295 international agreements regarding water being signed compared to 37 acute conflicts since 1948 (UN Water 2008).

River basins are thus emblematic of linkages between social and ecological systems as well as contemporary environmental challenges characterized by change, uncertainty, and complexity. As Armitage *et al.* (in review) observe, 'a business-as-usual approach to decision-making in transboundary basin contexts is no longer possible'. Scholars interested in the formation of institutions have particularly focused on 'local user-based arrangements' and paid less attention to '... large scale or regional institutions that may involve agencies, state governments, and local users collectively managing resources' (Heikkila and Gerlak 2005, p. 584). Calls for approaches to governance and management of river basins that stress collaboration and adaptation are pervasive and intensifying (e.g. Heikkila and Gerlak 2005, Plummer 2006, Richter *et al.* 2006, Pahl-Wostl 2007, Raadgever *et al.* 2008, Susskind 2010, Light *et al.* 2013). Within this burgeoning area of scholarship, we concentrate on how actors interact and influence the ecosystem and each other in relation to the initiation of a collaborative and adaptive governance process aimed at improving river health.

Governance processes that are collaborative and adaptive (e.g. adaptive co-management) are identified to consist of multiple phases (Olsson *et al.* 2004a, Plummer 2009, Nuñez 2013, Schröter *et al.* 2014, Baird *et al.* in review). Olsson *et al.* (2004a), for example, describe these phases as preparation, window of opportunity, and building resilience. Gaining insights about initiating such processes, especially proactively through interventions, is required (Ruitenbeek and Cartier 2001, Plummer 2009, Schultz 2009, Childs *et al.* 2013, Baird *et al.* in review). Moreover, the process by which governance arrangements move towards collaborative and adaptive forms is not well understood (Armitage *et al.* 2007, Huitema *et al.* 2009, Plummer 2009, Smedstad and Gosnell 2013).

The integrated concept of humans-in-nature draws attention to the often arbitrary and artificial distinction between social and ecological systems and emphasizes the interrelations between them as a social–ecological system (Berkes and Folke 1998, Berkes *et al.* 2003). Berkes and Folke (1998) argue that from this perspective participants must be connected to management practices from which to draw knowledge and experience required for learning and responding to system dynamics. As Schultz *et al.* (2007) point out, the techniques to make participatory conservation projects viable through the identification and engagement of a variety of stakeholders are well established and may be desirable from a democratic perspective, but alone are insufficient for successful ecosystem management. The challenge of reconnecting to the biosphere should be central to governance efforts with complex social–ecological interactions (Folke *et al.* 2011).

Social connections are a second type of relationship that provide insights into understanding collaborative and adaptive governance (e.g. Folke *et al.* 2005, Scholz and Stiftel 2005, Ansell and Gash 2008, Bodin and Prell 2011). Social network analysis has revealed relations positively related to governance outcomes, such as enhanced collective understanding (Crona and Bodin 2006, 2010) and performance (Sandström and Rova 2010). Bodin and Crona (2009), however, make clear that there is no one best governance structure as relational patterns, and their effects, are dynamic. Better understanding patterns of social relationships and their effects on environmental governance are needed (e.g. Bodin and Crona 2009, Weiss *et al.* 2012). Research from a network perspective on the initiation of collaborative and adaptive governance is limited, with Baird *et al.* (in review) being a noteworthy exception. Their study found that a network of collaborating actors is a necessary but insufficient condition for sustaining adaptive co-management for climate change adaptation. We build upon their work by undertaking an empirical investigation in this context and add the consideration of how actors connect to the ecosystem.

This research seeks to gain insights into the initiation phase of a collaborative conservation project in a large transboundary basin. More specifically, who takes the initiative in the transboundary basin; how they perceive and connect to the ecosystem (ecological) in terms of river health; how they relate and are connected to each other (social); and, who actually participated in a milestone event in the conservation initiative. In building upon information from these initial queries, attention is directed to the relationships of these variables on actual engagement as well as the influences of both enabling and constraining factors on sustained collaborative efforts. Ultimately, by better understanding the initiation phase, prospects may be enhanced that the initiation phase does not simply end but the next phase of the conservation initiative begins. The WWF-Canada Freshwater Program provides a fitting context for the study and the St. John River Basin (SJRB) offered an ideal case to ground the exploratory research.

2 Methods

2.1 *Study site*

The Wolastoqiyik or Maliseet people, indigenous to the St. John River valley, use the term Wolastoq or W'alustuk to capture the character of the 'good and bountiful river' (St. John River

Society 2008). From its headwaters in the province of Quebec and state of Maine, the St. John River flows through a variety of landscapes along its 700 km length, prior to emptying into the Bay of Fundy (see Figure 1). The St. John River is steeped in history, including the Wolastoqiyik culture and nation, the location where Champlain landed to claim the new world, an important route for exploration and transportation, and military conflict (St. John River Society 2008). In 2013 the St. John was officially designated as a Canadian Heritage River in recognition of these outstanding cultural values (Parks Canada 2013).

The SJRB is 55,000 km^2 and is situated in Quebec (13% of the basin), New Brunswick (51% of the basin), and Maine (36% of the basin) (Kidd *et al.* 2011). It forms part of the international boundary between Canada and the USA. Approximately 513,000 people reside in the basin and the population is fairly evenly divided between rural locations and urban centres, with major centres on the River including Edmundston, Fredericton, and Saint John in New Brunswick, Fort Kent and Presque Isle in Maine, and Cabano in Quebec (Kidd *et al.* 2011). A myriad of government agencies, non-governmental organizations, First Nations, and citizens are engaged in managing water in the basin. At the same time,

> currently no IJC [International Joint Commission] committees or boards guide water management over the entire watershed, and no management vehicle exists for considering water quality or environmental flows from a transboundary perspective. The Saint John appears to be an excellent candidate for the expansion of the IJC's International Watersheds Initiative (IWI). (WWF-Canada 2011, p. 27)

The St. John River and its basin has been the subject of extensive study. The International Joint Commission (IJC) voiced concerns about water quality in the international portions of the system as early as 1918 (International Joint Commission 1977). Between 1965 and 1975 substantial efforts were put forth to comprehensively study and plan for water resources. In the USA this occurred through the Northern Maine Regional Planning Commission and in Canada the St. John River Basin Board was established with the mandate to '... produce a comprehensive plan for the optimum development and utilization of the Basin's water resources' (International Joint Commission 1977, p. 10). Since the time the St. John River Basin Board ceased operation in 1975 over 100 studies have been conducted on specific aspects of the River (Kidd *et al.* 2011). In recognizing the need to synthesize the information and insights from these studies and produce a comprehensive picture, the Canadian Rivers Institute produced a state of the environment report for the St. John River in 2011. Aspects addressed include development within the basin, socioeconomic conditions, river habitats, water quality, primary production, fisheries, and traditional ecological knowledge. Kidd *et al.* (2011) and WWF-Canada (2011) provide assessments and outlooks on the system by recognizing consistent improvements in water quality, but also persistent challenges caused by human activities such as discharge and flow.

2.2 *Data collection and treatment*

Data collection occurred using the Social Ecological Inventory (SEI) technique. Schultz *et al.* (2007) conceptualized and developed the SEI from an integrative perspective to capture the connections between humans and the ecosystem at the entry point for a conservation initiative. Use of the technique in research of social–ecological systems is growing (e.g. Birge and Fred 2011, Baird *et al.* 2014). The SEI is depicted as a dynamic and interactive process consisting of six phases. These include:

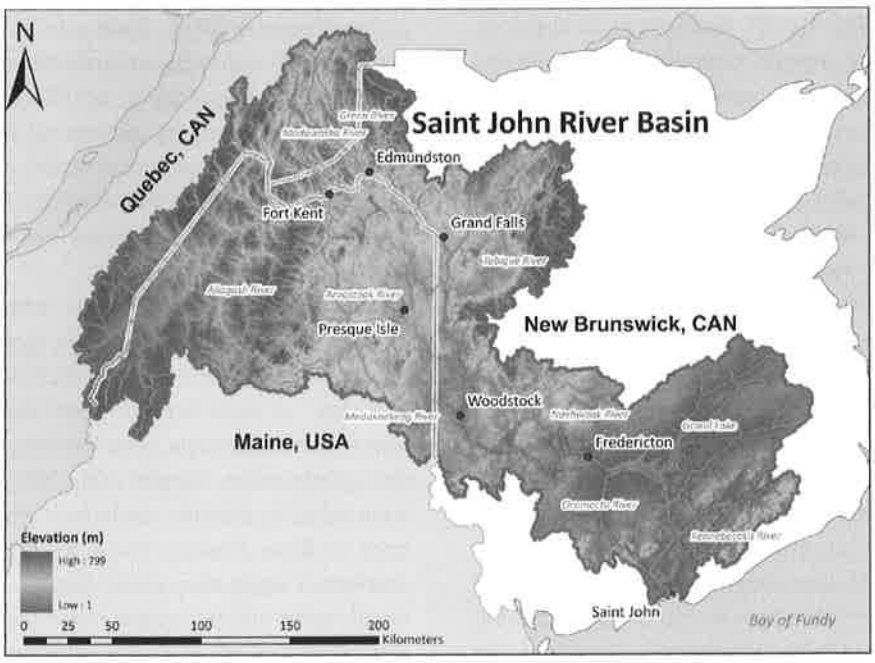

Figure 1 Map of the St. John River Basin (Kidd *et al.* 2011). Courtesy of Allen Curry.

preparation, preliminary identification, identify key informants, interview key informants, enriching the picture, and engagement (see Schultz *et al.* 2011).

In using the phases of the SEI as guides, the research team formulated the main objectives for the inquiry, worked with the local advisor from WWF-Canada to frame the research in relation to the WWF-Canada Freshwater Program, and gained clearance from the Research Ethics Board of the principal investigator's institution. With the initial phase complete, the second and third phases of the SEI were undertaken. The research team then identified categories of actors relating to river health, brainstormed entities within each category, and identified key informants for each entity. The categories included: industry, government (local, provincial, federal), conservation/environmental organizations, First Nations (elected and traditional), and other. An Internet search was conducted to expand the list, scope its relevance, and identify contact information. This search was conducted by using the terms 'Saint (or St.) John River' along with terms such as 'water quality', 'environmental flow', 'fish', 'benthic macro-invertebrates', 'water pollution', and 'river health'. All information retrieved was recorded in an Excel database and updated throughout the project. This search yielded 107 groups (organizations, agencies, and associations) and 114 key informants within these groups.

Phase four of the SEI process entails administering a questionnaire in person or by telephone or email to key informants. Spurred by the 2011 release of the Canadian River Institute's state of the environment report and WWF-Canada's Freshwater Health Assessment, the research team worked with the local advisor from WWF-Canada to develop a questionnaire complimenting the river health focus of these two initiatives. The questionnaire was specifically framed by WWF's Freshwater Health Assessment, a new tool developed to characterize and establish a baseline for understanding the health of freshwater in the Canadian context. The Freshwater Health Assessment is based on expert advice from leading aquatic biologists and questions related to actions and river health were developed using the key metrics/indicators: environmental flows, water quality, benthic macroinvertebrate population, and fish species richness. In building upon this foundation, perception questions were added with regard to river health (ecosystem and human well-being), impacts (positive and negative), and responsibility (who should be and who is). Relational questions were developed using a social network approach, including questions about with whom participants communicate, for what reasons related to river health, and how often, with a limit of 10 responses. A contact protocol and script were developed and followed. An initial attempt was made to contact each key informant in the database by telephone, a second attempt to reach by telephone with a voice message left if available, a follow-up by email was made if available, and a third and final attempt by telephone. Upon reaching a key informant, or being directed to a person deemed more appropriate to respond, the research project was described and the expectations for participation in the study were communicated. Each participant via email was provided with an informed consent form as per research ethics, the questionnaire, and a map of the SJRB. A mutually convenient time for administering the questionnaire was arranged, following the return of the informed consent document. A majority of individuals were pleased to complete the questionnaire over the telephone, but some individuals expressed a preference to complete the question by email or in person. The documents were provided in English or French, depending on the language preference of the key informant. French responses were translated to English prior to analysis. Key informants were given the opportunity to suggest potential participants they believed should be invited to participate in the study. Referrals to other key actors were recorded and checked against the database and added if appropriate. A total of 140 actors were identified through the key informant identification and referral protocols, and of those, 41 agreed to participate in the research. Participant affiliations were requested and used to identify categories of participants in terms of stakeholder type and scale.

Perceptions of river health were queried using five aspects of river health and a four-point Likert scale (1 = always insufficient; 4 = always sufficient) to rate each aspect. Median values for each aspect and for each stakeholder category were obtained by generating descriptive statistics using SPSS 20. Relationships to the ecosystem were identified in terms of the activities undertaken in the SJRB and their influence on one or more of four aspects of river health following the WWF-Canada Freshwater Health Assessment; the activities and their influence on river health aspects were provided by participants. Activities were collected in a Word document and content analysis was undertaken in two rounds to (1) group like responses and identify themes using open coding; and, (2) review and refine the themes and ensure themes captured all responses using axial coding (Neuman 2007). Each activity performed by participants was assigned a code based on the theme under which it was captured and the frequency of activity themes by stakeholder category was obtained by generating descriptive statistics using SPSS 20. The aspects of river health each participant influenced through their activities was subjected to descriptive statistics and used in the subsequent social network analysis as an actor attribute.

Relationships among actors were identified using social network analysis. This method is used to measure and visualize ties among actors in a network. Actors are represented as 'nodes' and 'ties' or lines between them indicate a relationship. Two types of relationships were investigated: information sharing and collaboration. As part of the SEI questionnaire, participants were asked to identify actors with whom they communicate for each of these reasons, using free recall with no limit on the number of actors they could identify. Furthermore, participants could name actors beyond those identified in the second and third phases of the SEI. The frequency with which actors communicate for these purposes was also collected as an indicator

of the strength of the relationship, with five options from yearly to daily. Network data were stored in Microsoft Excel, and Ucinet 6 (Analytic Technologies) and Netdraw (Analytic Technologies) were used to analyse the data. Four structural characteristics of the networks were investigated. First, participant and extended network sizes were calculated to identify the number of actors directly involved in river health (participant network) and the larger network they draw upon for information and collaboration (extended network). Second, network density was measured for the proportion of actual ties in relation to the total number possible. Network density provides insights into the speed of information diffusion and the potential for collective action present in the network (Hanneman and Riddle 2005, Bodin and Crona 2009). Third, network centralization was calculated to understand the degree to which connections in the network were evenly distributed among actors. Network centralization is an indicator of the relative advantage of actors within the network and provides insights into power distribution in the network (Hanneman and Riddle 2005). High network centralization has been associated with the ability to resolve simple problems, while a less centralized network is more suitable for managing complex problems (Bodin and Crona 2009). Centralization was further separated for the information sharing network in order to understand the direction of flow of information. Two types of centralization were investigated: 'indegree' centralization, which is the degree to which incoming ties to each actor are evenly distributed, and 'outdegree' centralization, which is the degree to which outgoing ties from actors are evenly distributed. Since the nature of collaboration is mutual engagement, indegree and outdegree were considered equivalent for this network.

In addition to the structural characteristics of the network, the centrality of individual actors and groups of actors was also investigated. Degree centrality is an indicator of the opportunities held by actors within a network to gain access to, and distribute, resources and a high centrality measure is associated with low dependency on any one actor and thus a position of power in the network (Hanneman and Riddle 2005). However, the number of ties can be constrained by capacity to maintain those relationships and too many ties can be a drawback in terms of constraining action (Bodin and Crona 2009). Similar to network centralization, both indegree and outdegree centrality were measured for the information network. The indegree centrality of each actor is a value representing the number of others that communicate with a specific actor for the purpose of information sharing and the frequency with which they communicate, and outdegree centrality describes the number of others a specific actor identified in their network and the frequency with which they communicate (the strength of the relationships). For the collaboration network, only one centrality measure was produced, as collaboration is considered mutual by nature.

The WWF-Canada Freshwater Program, St. John River Project included a range of community engagement initiatives (e.g. workshops, field trips, community presentations) including a two-day summit in 2013. The summit was used as a milestone for investigating the extent to which the whole network of actors identified through the SEI was engaged, or connected to those engaged, in the initiative. It was selected as a milestone because it marked the end of the initiation phase and brought the actors together for the first time to formally engage in the conservation project. The perspectives of the actors identified through the SEI who participated in the summit, in relation to those who did not participate in the summit, regarding river health and connections to the ecosystem via activities, were analysed in terms of median perceptions and frequency of activities. Perceptions of summit participants not identified through the SEI were not assessed. The social network was analysed for connectedness of all actors to those participating in the summit. This was undertaken by combining information sharing and collaboration networks, identifying the actors who participated in the summit, and undertaking a qualitative analysis of connectivity of the network.

3 Results

3.1 *The actors in the SJRB*

A total of 140 actors were identified through the combination of the initial key informant identification protocol and the referral protocol (section 2.2). Forty-one individuals agreed to participate in the research resulting in a response rate of 29% for the study. Each participant was asked to provide their primary affiliation and these were used to create broad categories of groups involved in river health activities. The number of participants within each category is provided in Table 1. The actors with the highest degree of representation were environmental non-governmental organizations and watershed organizations. Considering the composition of actors identified, watershed organizations were considerably overrepresented while industry and municipal/town governments were the most underrepresented actors. The remaining actor categories were fairly well represented.

Table 1 Categories of study participants

Actor categories	Number of actors identified	Number of participants
Environmental non-governmental organizations	55	18
Watershed organizations	9	9
Federal government	4	4
Municipal/town governments	25	2
Provincial government	9	3
First Nations	6	2
US agencies	5	1
Industry	26	1
Private consultant	1	1
Sum	*140*	*41*

Table 2 Perceptions of river health

Aspect of river health	Distribution of rating selection (number of respondents that chose each response)				Median rating
	Always insufficient (1)	Usually insufficient (2)	Usually sufficient (3)	Always sufficient (4)	
Water quantity	0	2	29	10	3
Timing of flow	0	5	28	7	3
Water quality	1	3	34	2	3
Fish species richness	2	13	21	4	3
Recreational opportunities	2	3	22	14	3

3.2 *Relationships to the ecosystem*

Participants provided a rating of sufficiency of five aspects of river health presented to them in the questionnaire. Participants were presented with a 4-point Likert scale to rate sufficiency and the number of responses for each and the median sufficiency rating for each is provided in Table 2. Fish species richness was rated 'usually insufficient' more often than other aspects of river health, and water quantity and recreational opportunities were rated 'always sufficient' more often than other aspects. However, there was no difference among aspects of river health in terms of the median rating for each aspect of river health. Respondents from Canadian government agencies tended to rate river health higher than other groups, while respondents from US government agencies rated this lower. First Nations rated most aspects of river health lower than other groups.

The 155 river health activities in the SJRB reported by participants in this study are shown in Figure 2. Environmental non-governmental organizations and watershed organizations tended to engage in a wide range of activities, highlighting the importance and diversity of their role within the basin, while other participant types undertook more targeted activities (e.g. industry, private consultants).

In terms of the influence the activities have on the SJRB, participants were asked to identify as many aspects of river health that were relevant for each activity. In several cases, all four aspects of river health were addressed by the activities of a single participant. Having an influence on all aspects of river health was most common for ENGOs and watershed organizations, which is not surprising given the number of participants from these organizations. Overall, water quality was the most common aspect of river health influenced by the activities of participants. In fact, influence on water quality was mentioned by all categories of actors. Fish species richness was also a focus of activities by all organizational categories but the federal and provincial governments and industry engaged in these more often than other groups. Finally, environmental flows and benthic macroinvertebrates were cited least often as being influenced by the activities of participants. The federal government was moderately involved in environmental flows activities and, along with the provincial government, engaged in several activities that supported benthic macroinvertebrates.

3.3 *Relationships among actors*

Two network types were investigated in relation to river health activities: information sharing and collaboration. Participants identified each organization and/or individual with whom they communicated for this purpose and how often. The characteristics of the two networks are presented in Table 3. Note that

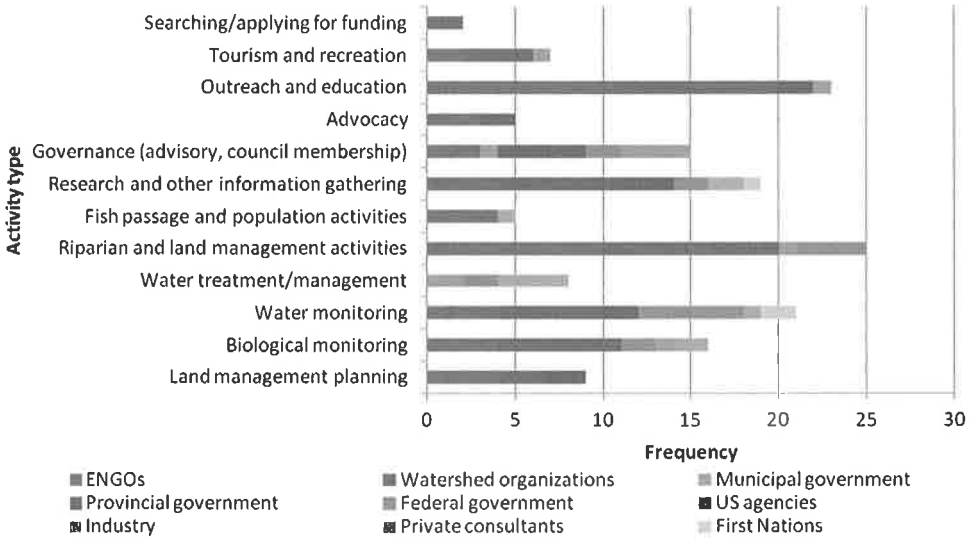

Figure 2 Activities undertaken by participants for river health.

Table 3 Information sharing and collaboration network characteristics for the SJRB

Network characteristic	Information sharing	Collaboration
Whole network size (number of nodes)	123	117
Participant network size (number of nodes)	41	37
Density (proportion of total connections possible among nodes)	0.06	0.05
Centralization (degree to which connections held by nodes are uneven)	Indegree: 5% Outdegree: 30%	22%

all network measures, except for 'whole network size' are based on the participant network (i.e. those who completed a questionnaire).

The density of the two networks is very low, less than 10% of total possible connections were reported by participants. When these networks are visualized, it is clear that there are few connections among participants for information, and particularly for collaboration, and are highly centralized through connections to a provincial agency (Figures 2 and 3).

In addition to the structural characteristics of the network, one attribute of actors and groups of actors was also investigated: centrality. The indegree centrality of each actor (i.e. a value representing the number of others that communicate with a specific actor for the purpose of information sharing and the frequency with which they communicate) is shown in Figure 3. Three government agencies (two provincial and one federal) are clearly the most often contacted by others for information related to river health. The average indegree centrality for provincial government agencies was 37 and 11 for federal government agencies, while ENGOs and watershed organizations' averages were 3 and 4, respectively. These numbers reflect the loose structure of the overall network – i.e. there are few connections in the network among non-government actors. This is particularly interesting in light of the nature and range of activities undertaken by ENGOs and watershed organizations. There is little reported sharing of information among these groups despite the commonality and, in some cases, potential

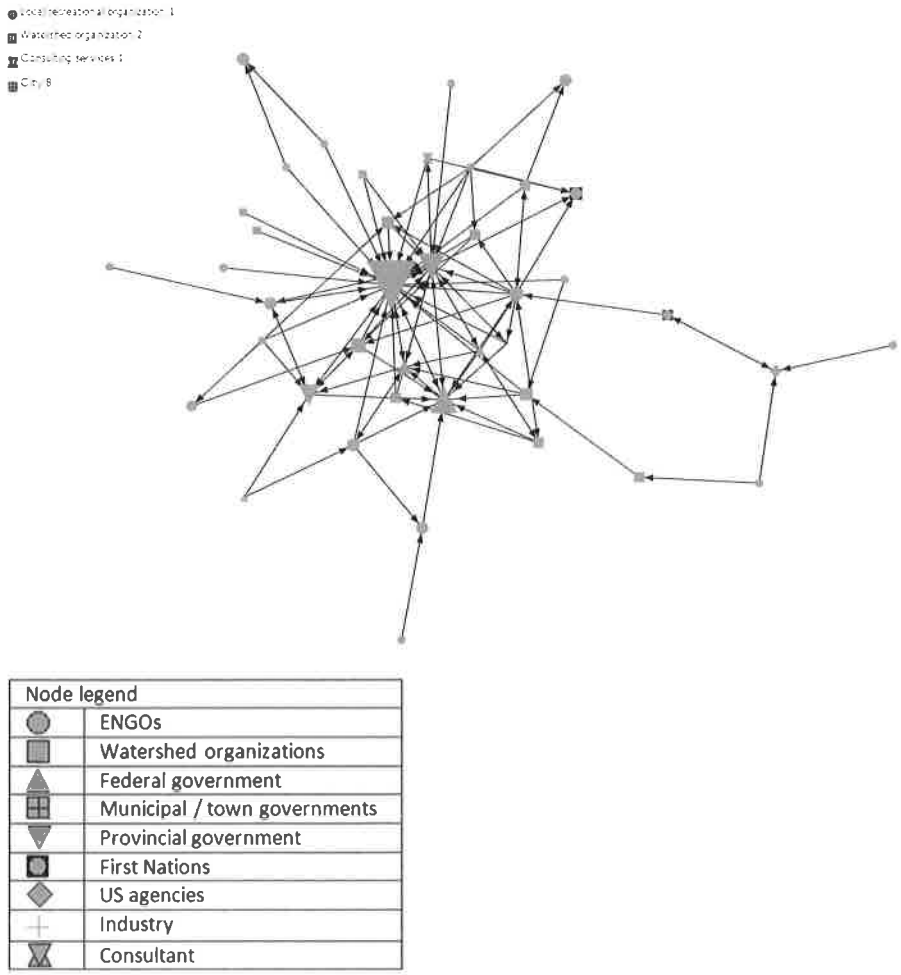

Figure 3 Information sharing related to river health by actors in the SJRB. Note: Node size indicates relative indegree centrality.

complementarity, of activities undertaken and data collected. Much of the communication within this network is directed towards the most central provincial government agency node.

The centrality of each actor for the purposes of collaboration is shown in Figure 4. Because the nature of collaboration is mutual engagement, all reported connections were considered to be reciprocal and thus indegree and outdegree centrality are equivalent. In this network, four actors, including one watershed organization, are not involved in collaboration (isolated nodes on the left side of the figure). One provincial agency is highly central in the collaboration network (centrality = 53), the same agency that is most central in the information sharing network. However, many nodes are similarly central, indicating a more evenly, albeit loosely, connected network of actors engaged in collaborative efforts in regard to river health. This is reflected in the average centrality values for stakeholder groups: the average for provincial government agencies was 33, while ENGOs and watershed organizations' centrality values were 6 and 9, respectively.

3.4 *Participation in the river summit*

Actors who participated in the St. John River summit, a milestone event for WWF-Canada's St. John River project, were identified from the list of actors engaged in river health activities through the SEI. The summit was intended to bring diverse groups together and engage in constructive dialogue about river health, and over time work towards developing an action plan that supports a healthy St. John River. A total of 66 individuals participated in the summit. The representation of different actor groups and the activities they engaged in, as a proportion of all actors and activities identified through the SEI, are given in Table 4. Participant organizations in the summit numbered 28, and 23 of those organizations either participated in the SEI or were identified by actors who participated in the SEI. Thus, 16% of actors identified through the SEI participated in the summit, and 13 participated in both the SEI and the summit (32%). Since complete information regarding activities and communication is available only for SEI participants, the results that follow focus on these actors. Several actor groups identified through the SEI were absent at the summit, including municipal/town government representatives and US government agencies at any level (Table 4).

The perceptions of river health for the St. John River were very similar between the summit participants and non-participants with a median of 3 or 'mostly sufficient' for both groups. Similarly, the frequency of actors' contributions to river health via activities was consistent across the four aspects of river

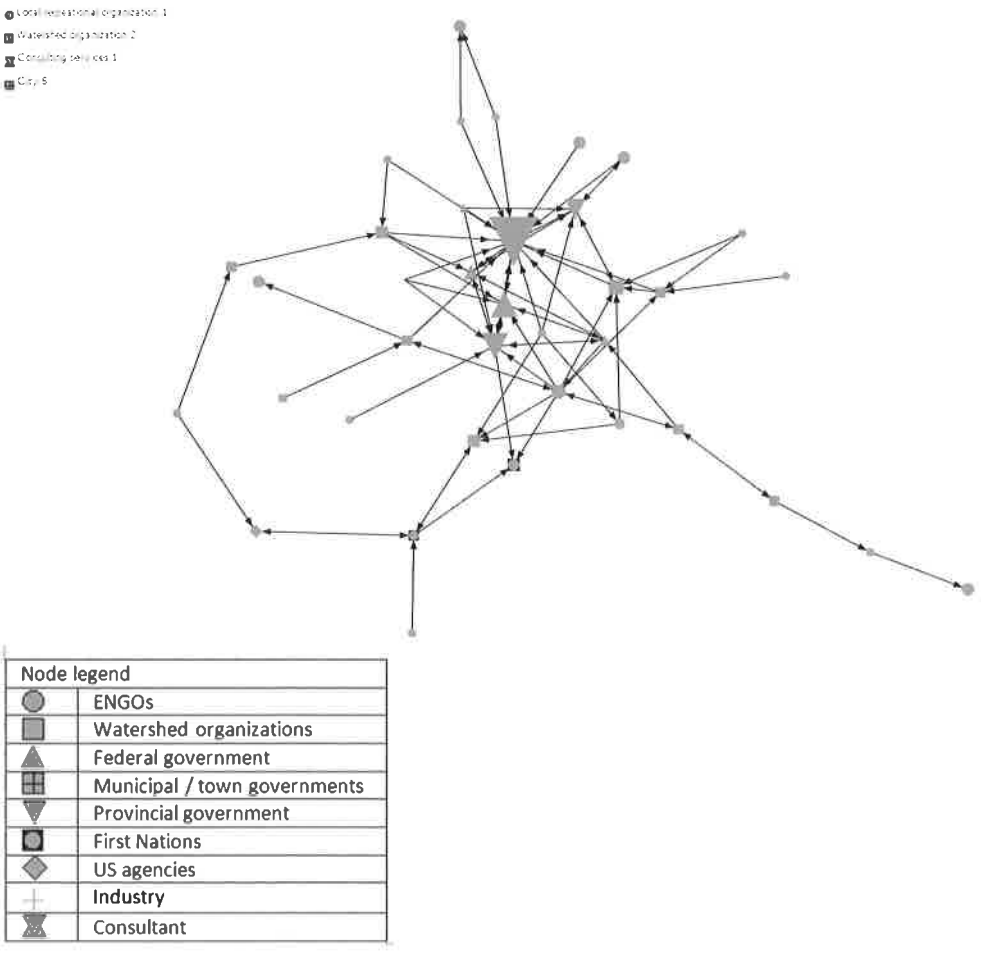

Figure 4 Collaboration related to river health by actors in the SJRB. Note: Node size indicates relative centrality.

Table 4 Actor types engaged in the summit and their activities

	Actor type									
Group	ENGOs	Watershed Organizations	Federal Government Agencies	Municipal/Town Governments	Provincial Government Agencies	First Nations	US Agencies	Industry	Private Consultants	
Frequency of summit participants	3	5	2	0	1	1	0	1	0	
Percentage of those included in the SEI	17%	55%	50%	0%	33%	50%	0%	100%	0%	
	Activities									
	Land management planning	Biological monitoring	Water monitoring	Riparian and land management activities	Fish passage and population management	Governance (advisory, council)	Advocacy	Outreach and education	Research and info gathering	Water management and treatment
Frequency by summit participants	4	8	7	3	5	2	6	8	4	6
Percentage of those included in the SEI	31%	38%	37%	14%	83%	17%	67%	31%	33%	57%

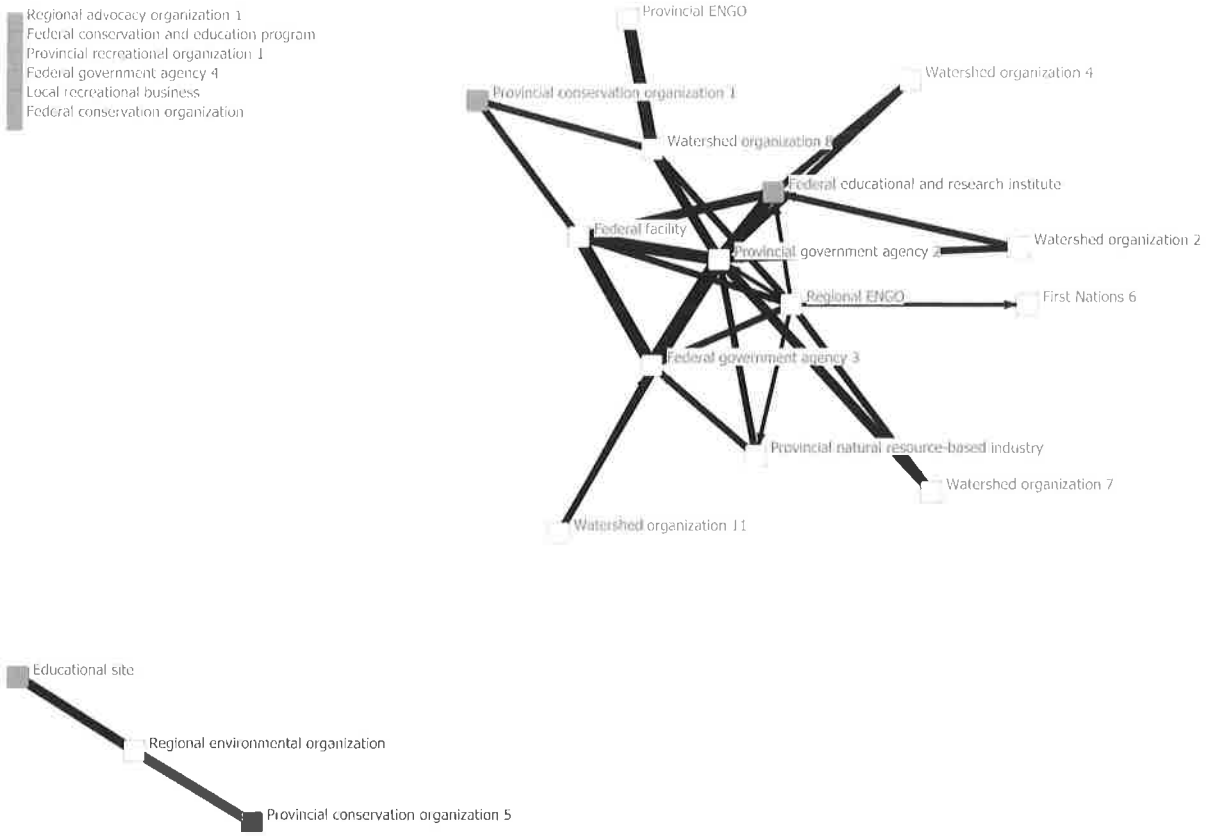

Figure 5 Network of summit participants. Note: White nodes indicate SEI respondents; grey nodes indicate non-respondents. Tie width is indicative of the frequency of communication for the purposes of sharing information. Nodes on the left side of the figure indicate those completely disconnected from any other actor in the network based on available data.

health, with summit participants engaging in approximately 32% of activities in all four aspects (range of 29%–35%). However, the specific types of activities they engaged in were not equally represented by summit participants. Notably, those who indicated that they were involved in riparian management and governance activities were underrepresented in the summit, whereas fish passage and population management and advocacy were overrepresented (Table 4).

The network of actors engaged in the summit (including both respondents and non-respondents identified by others), as a sub-network of the SEI information sharing network, is presented in Figure 5. The density of this network is low at 0.14 and the network is highly disconnected. However, where connections exist among summit participants, the tie strength is high (mean = 2.5 or 'monthly – seasonally').

4 Discussion

The SJR summit hosted by WWF-Canada was identified as an initial step in enhancing watershed governance, and was used as a milestone event to assess participation based on the responses to the SEI, particularly in relation to the representativeness of the participants of the summit, patterns of communication among them, and implications for river health.

Several stakeholder groups were represented at the summit. Participation of diverse stakeholder groups, those both with and without formal power, is considered an imperative feature of collaborative governance (e.g. Pahl-Wostl 2007, Raadgever *et al.* 2008, Susskind 2010), and one of the most important factors for the establishment of adaptive co-management (Hahn *et al.* 2006, Bodin and Crona 2009). Participation of government actors in the summit is important; the 'political space' required for stakeholder learning is created by the participation of formal organizations (Armitage *et al.* 2008). At the same time, some actor groups were absent or underrepresented at the summit (e.g. municipal governments, ENGOs, provincial agencies). The under-representation of actor groups and activity types may have implications for how the upcoming vision and action plan are positioned, as some perspectives were not represented based on this first milestone summit.

A network approach provided the social relational dimension that is needed in natural resource governance (Bodin *et al.* 2011). They highlight the incongruence between ecosystem boundaries and political ones, requiring coordination and reliance on multiple stakeholders for effective governance. Issues of power and authority factor prominently in this context (Bodin *et al.* 2011). Network centrality, as described by Benjamin *et al.* (2011), implies a position of power, authority, or control related to an actor's heightened influence over resource flows including

vital information. They suggest that the formation of formal organizational networks with the aim of addressing environmental problems can result in a shift in network power dynamics (Benjamin *et al.* 2011). As an example, Benjamin *et al.* (2011) describe the potential for altered power relationships to cause actors once considered central in a network, such as governments, to become unwilling to participate in network activities. Whether a network is mandated or voluntary may play a role in power dynamics as voluntary networks tend to favour collaboration over competition. Government agencies held central and non-reciprocal positions in both the broader SJRB network and the summit network. In fact, the provincial agency that participated in the summit holds the most central position in both networks and this may influence the process, and the 'authentic dialogue' (Susskind 2010, p. 369) emerging from the summit. The current organization of these networks resembles Provan and Kenis' (2008) lead organization form of network governance in which a highly centralized network broker makes key decisions and coordinates major network-level activities. The effectiveness of such a network form is dependent on four key structural and relational contingencies – trust, number of participants, goal consensus, and need for network-level competencies (Provan and Kenis 2008). The summit, and the results of this research, offered a point of initiation of a new mode of water governance in the St. John River Basin and how the network will function is an open question. Provan and Kenis (2008) assert that the greater the inconsistencies between contingency factors and a specific form of network, the less likely it is that the network form will be effective.

Responses from actors participating in the summit indicated that the mean perception of river health was relatively similar across actor types and between summit participants and non-participants. This indicates a common understanding of the river in terms of its ecological status that was represented in the summit. A common understanding, or shared vision, of the problem is important for the initiation of collective action in natural resource management contexts (Olsson *et al.* 2004b, Ostrom 2005). However, of equal importance is a common understanding of how the problem may be solved (Ostrom 2005), or the action plan emerging from the process initiated by the summit, and this is not clear from the data.

Most summit participants did not acknowledge that they engaged in governance activities in relation to river health activities, with the exception of a regional ENGO and a federal government agency. This reflects the surprising finding from the SEI that watershed organizations did not report being involved in governance activities, despite their role in initiating activities that influence river health, and their participation in the province-wide Water Classification Initiative put forward by the New Brunswick Department of Environment and Local Government (NBDELG) (for a full description of the initiative see Baird *et al.* 2014). This is particularly puzzling in light of ENGOs reporting governance activities. This may arise from a myriad of factors, including unequal relationships among actors (Armitage *et al.* 2008), consistent with the broader SJRB network analysis, or the current context of top-down government decision-making in the province (Baird *et al.* 2014) or a lack of understanding that the activities they are engaging in involve governance. It is important to note that activities reported by participants were coded as one of 12 activity categories, one of which was governance. The criterion for coding an activity as governance was that the activity, as reported by the organization, included some aspect of decision-making (for example, advisory committee membership or regulatory duties). Despite the lack of acknowledgement of engagement in governance activities, these actors participated in the summit. The clear dissatisfaction with the current approach and handling of water policy in the province by some actors (e.g. Baird *et al.* 2014, Office of the Ombudsman 2014) may have influenced a desire for change.

An encouraging result from the investigation of the network of participants involved in the summit is that, despite the network being fragmented, a group of strongly connected participants exist (Figure 5). While the process for moving governance arrangements towards adaptive and collaborative forms is not well understood (Armitage *et al.* 2007, Huitema *et al.* 2009, Plummer 2009, Smedstad and Gosnell 2013), centralized network structures are considered important for the initial mobilization of actors for collective action (Crona and Bodin 2006, Bodin and Crona 2009, Sandström and Rova 2010). The development of this type of a network is part of the first phase ('preparation') in the process of adaptive co-management, along with building ecological knowledge and developing a vision and goals (Olsson *et al.* 2004a). The network contributes to the ability to use a 'window of opportunity' (the second phase of adaptive co-management) (Olsson *et al.* 2004a).

5 Conclusions

Improving river health is imperative. Large-scale conservation projects in transboundary basins are immediately confronted with a myriad of challenges, such as vast geographic scale, ecological and institutional complexities, and diverse (often conflicting) interests of stakeholders. New approaches to decision-making in transboundary basins are required (Armitage *et al.* in review) and collaborative and adaptive forms of governing and managing river basins are being emphasized (e.g. Heikkila and Gerlak 2005, Susskind 2010, Light *et al.* 2013).

From an applied perspective, the research demonstrates the need for, and value of, understanding the ecological and social situation when initiating a conservation project. Utilizing an SEI and social network analysis affords an opportunity to understand who are stakeholders in the basin, how their activities relate to the ecosystem and river health, and the extent to which relationships already exist between/among them. In knowing who is influential in the river basin it is possible to reflect upon the extent to which the summit engaged 'usual' and 'unusual suspects'. The results allow those involved with conservation

projects to see where future efforts should be made in order to better 'knit' the network of actors together, and thereby, engage the full range of actors and activities in a collaborative process. In moving forward from the end of the initiation phase, understanding the flow of information in the network offers tremendous value. For example, if summit participants are receivers of information from non-participants but do not reciprocate, will summit-related information be distributed to these actors? Conversely, where summit participants are transmitters of information but not receivers from non-participants, will the views/interests of non-participants be adequately represented in the process of developing a vision and action plan?

While the SEI and social network analysis used in this research were laborious given the scale and transboundary nature of the SJRB, they offer valuable approaches to use when undertaking conservation initiatives. They afforded a systematic way to approach conservation projects and do so in a way that highlights linkages between social and ecological systems (Bodin *et al.* 2011). Experiences with undertaking them in this research confirms the importance of capturing '... human resources in the landscape or the social structures and processes underlying biological conservation values' (Schultz *et al.* 2007). Moreover, undertaking social network analysis during the initiation phase may conceptually inform the approach taken in subsequent phases. For example, Provan and Kenis (2008) relate evolution to the mode of network governance and contingency factors, while Bodin and Crona (2009) concentrate on the impact of topology (structural pattern) on governance process and outcome. While network effectiveness was beyond the scope of this research, understanding the pattern of social relations may provide a way to enhance performance.

Conservation projects are initiated because of their potential to ultimately enhance ecosystems and human well-being. This research highlights just how complicated collaboration is at inception. In the case, the possibility of collaboration appears to be mediated by the assertion of power. Power manifest in the central position of the provincial government agency in the SJRB and summit networks, the absence and under-representation of some stakeholder groups, and control of access to information from monitoring by government. This raises questions about longer term prospects for collaboration as those in positions of high in-degree centrality, such as the government agencies in this study, have been found by Crona and Bodin (2010) to hold a disproportionate influence on the potential for transforming resource management and could pose significant barriers to change. Most summit participants also did not acknowledge (or perceive) that they engaged in governance activities in relation to river health activities. Armitage *et al.* (2008) suggest that this may arise for several reasons, again including unequal relationships among actors. The larger context within which the summit was held indicates that the potential for transformation of watershed governance may not be fully present, as a central and influential government agency was not engaging in reciprocal information sharing (Moeliono *et al.* 2014).

At the same time, encouraging signs that a collaborative process may emerge from the summit and subsequent events include evidence of a strong structure of connected actors who participated in the summit, and shared information about the status of the river. Efforts to engage actors early in the process who did not participate in the first summit event to ensure broad representation (following e.g. Richter *et al.* 2006, Raadgever *et al.* 2008, Susskind 2010), a process to manage power relations (rather than eradicate power) (Moeliono *et al.* 2014) among actors while maintaining formal organization involvement (e.g. by developing trust, identifying policy entrepreneurs and leaders, and sharing information [Heikkila and Gerlak 2005]), and brokering key connections among stakeholders (Bodin and Crona 2009, Moeliono *et al.* 2014) may support the development of collaborative governance. Is there sufficient transformational potential within the group, considering the broader context, for a change in watershed governance? Continued research into the initiation of conservation projects in large-scale transboundary basins, coupled with longitudinal studies of how collaborative processes develop over time, provide fruitful and complementary avenues for future research.

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