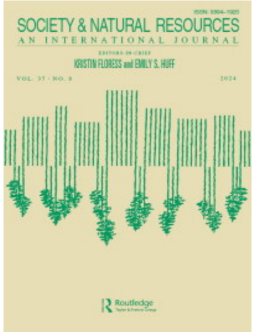

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Application of Participatory Process Mapping to Evaluate Environmental Decision-Making and Implementation

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ABSTRACT

Environmental governance outcomes hinge on the design and implementation of management decisions. Yet, available research methodologies can be limited in their ability to capture the complexity of decision-making and implementation processes and in turn predict and explain environmental governance outcomes. We present participatory process mapping as a method for examining the pathways that emerge and evolve over time that result in natural resource management decisions and on-the-ground outcomes, as perceived by participants in collaborative processes. The approach leverages a large-N comparative design, participatory diagraming within semi-structured interviews, and mental modeling toward a method that can fit into both quantitative and qualitative research designs and analysis. The method is highly flexible, offering a pathway toward capturing causal relationships while also enabling incorporation of diverse elements and relationships. Natural resource management is nonlinear and is shaped by diverse social-ecological elements, and process mapping diagrams elicited through this method reflect that reality.

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Decision-making; implementation; network analysis; participatory methods; process mapping; wildfire risk mitigation

Introduction

Environmental governance outcomes hinge on the design and implementation of management decisions. Conducting research on policy design and implementation is challenging because diverse sets of elements shape management decisions and their outcomes. These elements can also interact in timescales incongruent with conventional

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research processes (Folke 2006). Further, stakeholders who participate in these processes may have different perspectives on how a given decision was reached and subsequently implemented—based on their beliefs, preferences, perceptions (e.g., of risks), roles and engagement in these processes. These complexities limit the ability of research methodologies to predict and/or explain environmental governance outcomes.

In this research note, we present participatory process mapping as a method for examining decision pathways that emerge and evolve over time that result in natural resource management outcomes, as perceived by participants in collaborative research processes. We present process mapping to record participants' mental models (i.e., cognitive maps), or their perception of the sequence of decisions leading to an outcome (Gray, Zanre, and Gray 2014). The method focuses on the co-creation of a series of process maps that reflect participants' understanding of environmental management decision-making and implementation processes. The method combines a large-N comparative design, participatory diagraming within semi-structured interviews, and cognitive mapping. Drawing upon case study traditions (Eisenhardt 1989, Yin 2012), the method enables collection of primary data that reflect the complexity of real-world contingency and context. This is done through a participatory diagraming process—embedded within a semi-structured interview—that actively engages interviewees in the development of graphic representations of participants' ideas (Umoquit et al. 2008). Specifically, the diagraming process captures how an interviewee perceives relationships among different components along a timeline (i.e., a flowchart) (Jackson 2013). The participatory process produces a visual diagram reflecting the diversity of governance participants' understanding of a natural resource management process (Gray et al. 2012). Our methodology further advances cognitive mapping in that it captures causal relationships across time. In this way, our method borrows elements of process tracing, which is a method that focuses on causal mechanisms of social phenomena by describing steps in a causal chain (including arranging steps temporally; Beach and Pedersen 2019).

This method offers several advantages for researchers who study the design and implementation of environmental governance decisions. Its flexibility in incorporating diverse elements over time that affect environmental governance processes and the relationships between those elements lends insight into complex social-ecological systems. This method leverages desirable elements of both quantitative and qualitative research traditions. Regarding quantitative methods, the approach offers opportunities to use tools and perspectives from network science for modeling decision-making and implementation processes to find generalizable trends. With respect to qualitative methods, embedding the data collection exercise in an interview provides opportunities to create a rich understanding of unique cases and deepen understanding of themes and concepts that cut across those cases. Following our description of the method we used to study local wildfire risk mitigation, we highlight the types of research questions and objectives for which we believe this method is uniquely appropriate to address.

Methods

We applied participatory process mapping to study collaborative wildfire risk mitigation planning in Colorado. The Healthy Forest Restoration Act in 2003 introduced Community Wildfire Protection Plans (CWPP) as planning instruments to be used to identify priority areas for hazardous fuel mitigation and recommend fuel treatments to protect at-risk communities (HFRA, P.L. 108-148). Plans address risk mitigation priorities at a range of spatial scales, from neighborhood- to county-level. While the bottom-up nature of CWPPs enables planners to tailor approaches to local realities, the lack of formal accountability measures has prompted questions about the degree to which plans lead to risk mitigation projects (Steelman and Burke 2007, Jakes et al. 2011, Abrams et al. 2016, Absher, Vaske, and Peterson 2018). The number and diversity of CWPPs, along with subsequent efforts and engagement among entities to implement plans, enables an examination of the processes that shape the design and implementation of collaborative risk mitigation decisions.

Of the 263 Colorado CWPPs completed to date, we narrowed down our sample to those completed in the last 12 years (acknowledging that participants might have difficulty remembering further back in time) and purposively sampled individuals who were listed as key planning members. We then used snowball sampling (Parker, Scott, and Geddes 2019) to identify and contact other key members who participated in the CWPP planning process. Participants represented a variety of backgrounds and roles in the planning process (e.g., landowners/homeowners, foresters, independent contractors, fire chiefs, mitigation specialists, and nonprofit representatives, among others).

We conducted semi-structured interviews that included a process mapping exercise where we asked participants to reflect on one or two specific successful and unsuccessful projects that were outlined in the CWPP they developed. For each project, interviewees were prompted to identify the sequences of events that led to the decision to incorporate the project in the CWPP. Interviewees then described the events that followed the publication of the CWPP and subsequent efforts to implement the project. Interviewers utilized open-ended questions and follow-up probes to elicit new events and relationships between events until the interviewee no longer suggested new elements or links.

During elicitation, interviewers co-developed with interviewees a physical process map (i.e., a network with nodes for specific elements and arrows showing temporal/causal relationships). The aim was to have participants interact with the process map during its construction to visually guide their reflections and prompt them to suggest additional events. To accommodate different interview contexts, a variety of tools were used to create the processes maps (e.g., whiteboards, sticky notes, computer programs); interviewees were not always able to physically interact with the process map themselves but could always see it as it was being developed. The research team conducted 145 interviews with participants involved in wildfire planning, which yielded 185 process maps, as many participants worked through more than one process mapping exercise.

After the interview, the interviewer team (typically two or three researchers) created a comprehensive process map by combining the rough map from the interview with additional elements from other interview notes and comments. This final map reflected the participants' perceptions of the implementation process and relationships between elements. Links were only created between elements for which the participant indicated some form of causal relationship. Each map included an element for the specified action listed in the CWPP and the result of the action; all other elements in the process maps were placed in relation to these required events.

Final process maps were recorded in the online application Mental Modeler (mentalmodeler.org; see Gray et al. 2013), which facilitated visual assessment diagrams and enabled their export in file formats conducive to analysis. Later, elements were categorized by more general descriptors such as assets, contextual elements, or outcomes. Below we share an example analyzed from the data of how an interview excerpt (Figure 1A) translates to a decision pathway (Figure 1B) within a larger process map with categorized elements (Figure 1C).

Results and Applications

Results

Here we present a sample of results illustrating how participatory process mapping can shed light on the types of elements that disproportionately affect decision-making and implementation processes. Figure 2 presents a depiction of interactions between element classes. The systems-level perspective depicted here reveals the relative prominence of certain classes of elements (e.g., actions, outcomes, and context-based elements), and influence of relationships between elements of different classes (e.g., the reciprocal relationship between actions and outcomes; the tendency for actions to lead to other actions).

Applications

Analytical Approaches

Process mapping data are well-suited to common analytical methods in natural resource management fields like qualitative coding approaches and network analyses and amenable to novel and interdisciplinary methods. The mapping exercise can prompt more in-depth responses or novel information that can later be captured during qualitative coding of major themes. The completed maps themselves also represent a summary of a story shared by participants that can be assembled using narrative analysis. Process mapping outputs are also fundamentally network datasets. Network analysis tools can allow researchers to analyze the presence (or absence) of certain variables in a process map, such as individual elements or sub-network structures that involve several elements (Bodin and Tengö 2012). Researchers can additionally analyze “aggregate process maps” as systems diagrams (e.g., to evaluate processes operating across multiple individual process maps). The construction of aggregate process maps requires linking individual maps based on common elements, following methods employed in the construction of cognitive maps (Özesmi and Özesmi 2004, Gray et al. 2012). In conducting analysis of such aggregate process maps, it is important to bear in mind that maps document *perceptions* of causal relationships among elements that structure complex processes; accordingly, research questions should account for variation in how respondents recall events and prioritize certain types of elements. For example, as systems diagrams of perceived causal sequences, aggregate process maps can provide valuable insight into how diverse stakeholder groups act on policies, given how stakeholders’ beliefs shape their preferences and actions (Ajzen 1991, Beratan 2007).

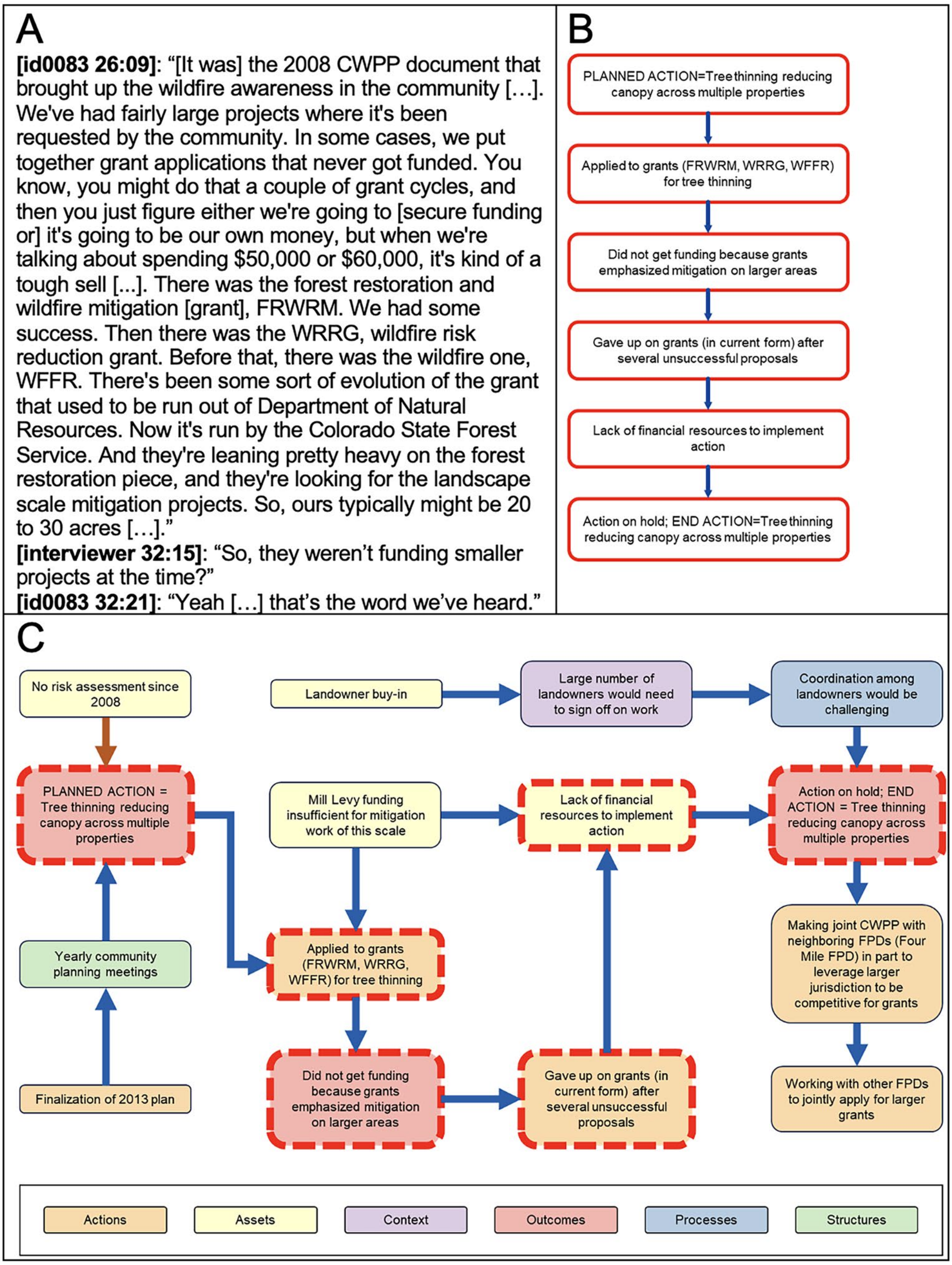

Figure 1. Illustration of the elicitation and interpretation of process maps. Panel A: Interview transcript. Panel B: Sequence of causal events, as narrated in panel A. Panel C: Process map, in which the sequence depicted in panel B (outlined in red) is embedded in a broader network of causal relationships described by the interviewee. Colors indicate classes of causal events.

Research Questions

The flexibility of process mapping can facilitate its application to diverse lines of research questions and environmental contexts (e.g., climate adaptation planning, implementation of conservation programs, watershed restoration initiatives).

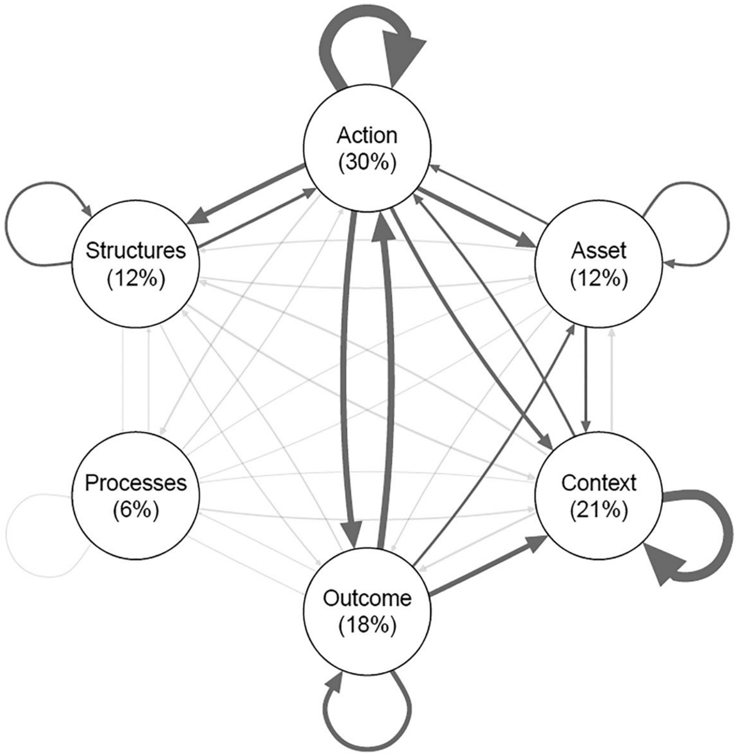

Figure 2. Relationships among classes of elements across all process maps. Each arrow indicates the frequency with which an element of one class affects an element of another class (or the same class, in the case of self-loops); line thickness is proportionate to the number of relationships summed for each directed pair of classes (ranging from 12 instances of asset → process relationships to 263 instances of action → action relationships) and lighter grey lines indicate fewer than 50 instances. The sum of each class's incoming and outgoing relationships is provided in parentheses, as a proportion of the total sum of relationships.

What types of elements occurring at what decision phases disproportionately shape environmental governance processes? Process mapping can capture causal linkages among diverse classes of elements, ranging from environmental context to cultural trends and fiscal constraints. This variety creates opportunities to test expectations about the relative influence of certain types of elements on social-ecological system dynamics.

How do sequences of causal relationships influence environmental management processes? The relational nature of process mapping data provides rich opportunities to evaluate hypotheses about how certain sequences of causal relationships influence overall environmental management processes.

What conditions favor certain types of environmental outcomes? A core strength of process mapping is its ability to capture information about how direct and indirect effects of different elements shape outcomes, such as management decisions.

Conclusion

This paper describes a method that can be applied to understand environmental management decision-making and implementation and has two main contributions. First, process tracing is an underutilized method in natural resources social sciences. This paper draws attention to its utility to incorporate many management elements that can be difficult to wrangle using other methods. Second, this paper highlights the importance of looking for causal relationships in natural resources outcomes, which is often overlooked in rich qualitative and cross-sectional quantitative methods.

We recommend this method to researchers who seek to analyze how the structure of environmental governance impacts outcomes, in natural resource management contexts and beyond. Researchers can utilize this method to study many natural resource contexts, such as climate adaptation planning or protected area management. Further, while we employed this method for individual interviews, process mapping also lends itself well to use in group interviews and focus groups and can be paired with other participatory exercises.

The key element of our approach is our focus on pathways of perceived causal relationships among elements. The approach is highly flexible, both in terms of enabling incorporation of diverse elements—including institutional arrangements, demographic characteristics, environmental processes, and landscape characteristics, among others—but also in terms of capturing how these elements influence one another. Natural resource management is nonlinear and is shaped by diverse social-ecological elements, and the process mapping diagrams elicited through this method reflect that reality.

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