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Parsing participation: models of engagement for outcomes monitoring in urban stewardship

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Parsing participation: models of engagement for outcomes monitoring in urban stewardship

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Few urban environmental stewardship, or civic ecology, practices monitor their impacts on local communities and ecosystems. This lack of monitoring prevents lay stewards from adapting their practices based on outcomes. For those that *do* collect data on their practices, we see different forms of practitioner engagement in outcomes monitoring. We categorise these different forms of engagement according to five published models of public participation in scientific research, revealing different strategies for collecting and analysing data towards adaptive co-management in urban ecosystems. We propose two broad strategies for expanding outcomes monitoring in these contexts: creating openly accessible tools and protocols for do-it-yourself inquiry and supporting more resource-intensive partnerships between practitioners and scientists for more complex forms of outcomes monitoring.

Keywords: adaptive co-management; outcomes monitoring; civic ecology practices; public participation in scientific research; stewardship

Introduction

Cities in the USA are increasingly seen as incubators for innovative and environmentally sustainable land-use policies (Beatley and Manning 1997), green infrastructure projects (Hough 2004), and land stewardship practices operating at multiple scales (Svendsen and Campbell 2008). In New York City alone, the US Forest Service's *Stewardship Mapping and Assessment Project* has identified nearly 5000 citizen groups engaged in various forms of environmental restoration, advocacy, and stewardship (United States Forest Service n.d.). These groups form horizontal networks (Svendsen and Campbell 2008) that may facilitate the development and spread of innovative solutions to complex urban environmental management challenges (Bodin and Crona 2009).

Many of the initiatives inventoried in the *Stewardship Mapping and Assessment Project* align with the concept of "civic ecology practice" developed by Krasny and Tidball (2012). Civic ecology practices are self-organised, hands-on stewardship efforts that may result in positive outcomes for individuals, communities, and urban ecosystems. They include a variety of activities, such as community gardening, street tree care, volunteer public park maintenance, and watershed restoration. Krasny and Tidball (2012) have hypothesised that civic ecology practices involved in collecting and analysing data about the outcomes

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of their work are engaging in a form of adaptive co-management (Armitage *et al.* 2008a) for natural resources in cities.

Despite this hypothesis, few civic ecology practices seem to actually monitor the impacts of their work. This lack of monitoring has three broad implications for research on, and management of, natural resources in cities. First, little can be definitively said about the individual or aggregate impact these practices have on urban biodiversity, ecosystem service provision, individual health and well-being, or community cohesion. Second, without data from outcomes monitoring, practitioners are unable to make accurate claims about the value of their work to policy-makers, philanthropic funders, or other stakeholders and supporters. Third, the lack of outcomes monitoring prevents practitioners from learning about successes and failures in their practices so as to adapt and improve them over time. Put another way, without outcomes monitoring, civic ecology practices are unable to engage in a process of adaptive co-management (Berkes 2009).

When outcomes monitoring *is* a component of civic ecology practice, it invites members of the public to participate in scientific research that tracks environmental changes towards a goal or management objective (Solbé 2005, Hellawell 1991). Public participation in outcomes monitoring is a common theme throughout the adaptive co-management literature (Allen *et al.* 2001, Ruitenbeek and Cartier 2001, Berkes 2007, 2009, Armitage *et al.*, 2008b, Charles 2008, Plummer 2009). However, participation in both scientific research and decision-making can take many different forms and involve varying degrees of stakeholder engagement (Arnstein 1969, Bonney *et al.* 2009a). We introduce five models of public participation in scientific research (PPSR) put forward by Bonney *et al*. (2009a) and further developed by Shirk *et al*. (2012) in order to begin describing, comparing, and contrasting different types of public participation in outcomes monitoring for adaptive co-management.

This paper aims to reveal how some civic ecology practices grapple with monitoring for adaptive co-management, uncovering both barriers and opportunities for different forms of public participation in outcomes monitoring research. More broadly, this paper offers a framework for parsing different degrees of stakeholder engagement in outcomes monitoring for adaptive co-management. We begin by linking civic ecology practices to the hybrid concept of adaptive co-management and then introduce five models of PPSR (Shirk *et al*. 2012) to structure our analysis. We go on to review seven examples of monitoring related to civic ecology practices underway in New York City and the nearby cities of Newark and Camden, New Jersey, assigning each one to a category of PPSR for comparison. Our analysis of these examples suggests barriers and opportunities for different models of public participation in monitoring research around civic ecology practices, with implications for both scientists and practitioners.

Participation in outcomes monitoring for adaptive co-management

The hybrid concept of adaptive co-management has been used to describe partnerships between communities and government that take an incremental approach to managing natural resources based on insights from continuous environmental monitoring (Armitage *et al.* 2008a). More recently, the concept of PPSR (Bonney *et al.* 2009a, Shirk *et al.* 2012) was developed to categorise different kinds of layperson involvement in scientific research projects. In this section, we integrate these two approaches to suggest a framework for understanding outcomes monitoring in civic ecology practices.

The notion of civic ecology practice resonates with some of the core features of collaborative resource management typically found in rural settings. Berkes (2007) identifies at least seven historical "faces" of co-management in rural communities, each one drawing on myriad definitions of co-management put forward over the past 25 years with different emphases on power sharing, trust building, and governance. These overlapping – and, at times, contradictory – definitions led Berkes (2007) to label co-management "a catch-all term" (p. 19) – an example of what Gallie (1955) called an "essentially contested concept" with a perpetually negotiated core meaning. Despite this heterogeneity, Berkes (2007) proposed that most definitions share the essential idea of *partnership between community and government* around an environmental management issue. Similarly, Krasny and Tidball (2012) proposed that civic ecology practices emerge from community-based responses to local environmental challenges and go on to build partnerships with government agencies and larger non-profit organisations. These more established entities provide civic ecology practices with funding or technical assistance and help network them with other initiatives pursuing similar goals. In return, civic ecology practitioners share in the rights and responsibilities of creating and maintaining urban green infrastructures such as gardens, parks, and swaths of urban forest. Civic ecology practices, then, can be seen as cases of co-management for patches of urban ecosystems.

Some civic ecology practices collect social or environmental data to monitor their impacts and make incremental adjustments based on their findings, thus resembling adaptive resource management typically seen in rural settings. Like co-management, adaptive management defies facile definitions and comes "in a variety of flavours" (Argent 2009, p. 12). However, at its core, most concepts of adaptive management seem to involve responses to complex or "wicked" problems (Rittel and Webber 1973) in resource management that have no obvious causes and no clear or simple solutions (Argent 2009). Adaptive management is a cautiously cyclical "learning by doing" (Walters and Holling 1990) approach to managing natural resources heavily influenced by humans (Argent 2009), and is therefore well suited to the intricate mix of social and environmental factors that comprise urban ecosystems (Gaston 2010). We therefore see civic ecology practices that partner with scientists to monitor and gradually adjust their efforts as examples of adaptive co-management in an urban context.

Those civic ecology practices that monitor the outcomes of their work are also engaged in a form of scientific inquiry that involves framing environmental research questions, collecting and analysing data, and drawing conclusions for applied practice. Recognising the role that non-scientists play in creating knowledge for adaptive co-management, Berkes (2009) lists "co-production of knowledge", "participatory research", and "collaborative monitoring" as "strategies that have been used to facilitate or improve" (p. 1700) partnerships between practitioners and scientists. However, these overlapping concepts do not shed light on the varying degrees of public participation that actually exist from case to case. Different instances of participatory research or collaborative monitoring will involve different levels of engagement for non-scientists.

We use a five-model typology of PPSR developed by Shirk *et al*. (2012) (see Table 1) to build on concepts introduced by Berkes (2009) and other related concepts, which include "citizen science" (Bonney *et al.* 2009a), "street science" (Corburn 2005), and "community-based participatory research" (Bidwell 2009). Shirk *et al*.'s (2012) "contractual" model describes projects in which laypeople frame a research agenda that is then operationalised and executed, in full, by professionally credentialed scientists. In the "contributory" model, laypeople simply collect and report data towards research projects crafted by scientists. They rarely play a role in framing the research agenda, analysing data, or drawing conclusions from research findings. Projects that fit within the "collaborative" model engage laypeople in both data collection and analysis, but little else. "Co-created" projects

Table 1. Five models of PPSR.

Five models of PPSR
• *Contractual* projects: communities ask professional researchers to conduct scientific investigations and report results
• *Contributory* projects: designed by scientists, with members of the public primarily contributing data
• *Collaborative* projects: designed by scientists; members of the public contribute data but also help to refine project design, analyse data, disseminate findings
• *Co-created* projects: designed by scientists and members of the public working together; some public participants are actively involved in most or all aspects of the research process
• *Collegial* projects: non-credentialed individuals conduct research independently with varying degrees of recognition by institutionalised science

Source: Shirk *et al.* (2012).

involve laypeople and scientists in every aspect of a research project from start to finish, while "collegial" projects are initiated and executed in their entirety by laypeople with little or no input from research scientists.

Participation in outcomes monitoring research: eight examples from civic ecology practice

Across New York City and throughout the surrounding region, thousands of small, community-based initiatives are partnering with non-profit organisations and government agencies to care for gardens, parks, street trees, and waterways (Svendsen and Campbell 2008). However, an informal census conducted in 2012 (Silva and Krasny 2013) suggests that few are engaged in monitoring the outcomes of their work. We sought to learn more about those practices that used outcomes monitoring research for adaptive co-management, asking the following three broad questions of our sample: (1) What kinds of outcomes monitoring strategies are used? (2) What role do civic ecology practitioners play in the monitoring process? (3) What are the barriers and opportunities for using outcomes monitoring to improve civic ecology practices in an adaptive co-management process?

Using a purposive sampling strategy that drew on personal knowledge of existing programmes, web searches, and information provided by interview participants, we identified seven examples of ongoing outcomes monitoring for adaptive co-management connected to civic ecology practices involving six non-profit organisations in New York City and the surrounding region. All of the following examples were active during the summer of 2012 (Silva and Krasny 2013):

- *The Bronx River Alliance* on the Bronx River Corridor, where volunteers, local land managers, and government scientists collaborated on monitoring the impact of an invasive riparian plant removal programme;
- *Compost for Brooklyn* in southern Brooklyn, where volunteers monitored the weight of kitchen scraps and yard waste transformed into compost on-site each month;
- *East New York Farms!* in eastern Brooklyn, where staff and community gardeners monitored the pounds of vegetables grown in gardens each year and the value of produce sales at local farmers markets;
- *Feedback Farms* in central Brooklyn, where volunteers monitored the pounds of vegetables produced using above-ground horticultural techniques;

- *The Gowanus Canal Conservancy* in central Brooklyn, where volunteers and staff monitored the number of pounds of compost they produced each month and a contracted scientist monitored storm-water capture in curbside bioswales maintained by Conservancy volunteers;
- *New Jersey (NJ) Tree Foundation* in the cities of Camden and Newark, where staff and volunteers inventoried recently planted street trees and monitored tree mortality from year to year.

We conducted semi-structured interviews with representatives from each of these six organisations to learn more about their monitoring efforts, supplementing the interview data with archival materials found online. The interviews lasted between 60 and 90 minutes and included a range of questions aimed at understanding the nature of the data collection efforts attached to each civic ecology practice and the extent to which organisations used the data to adapt their practices. We also collected archival material from organisational websites and, in the case of the Bronx River Alliance, a preliminary research report describing the group's invasive plant management methods. To analyse the data, the first author used codes derived from Shirk *et al.*'s (2012) rubric for delineating examples of PPSR based on public involvement in different aspects of a research initiative. Finally, we assigned each of these examples to one of five models of PPSR developed by Shirk *et al.* (2012), allowing us to assess the nature of collaboration among scientists and practitioners across the sample (Table 2).

Results and discussion

We assigned five of the seven monitoring examples to the *collegial* category of PPSR, wherein lay practitioners undertake most of the monitoring effort in the absence of any significant contributions from professional scientists. The outcomes monitoring efforts in these examples were relatively simple in scope, and included weighing compost and vegetables

Table 2. Outcomes monitoring examples according to models of PPSR.

PPSR model	Outcomes monitoring examples
Contractual	At *Gowanus Canal Conservancy*, a scientist from Drexel University was contracted to monitor storm-water capture in street tree beds and rain gardens, to assess their efficacy in preventing local combined sewage overflows
Contributory	No examples found
Collaborative	At the *Bronx River Alliance*, staff worked with ecologists from the NYC Department of Parks and Recreation to develop a protocol for tracking the success of invasive plant management
Co-creative	No examples found
Collegial	At *East New York Farms!*, staff and volunteers weigh and track vegetable harvests using the Farming Concrete protocol and track the sales of vegetables at a neighbourhood greenmarket
	At *Feedback Farms*, volunteers weigh and track vegetable harvests using Farming Concrete
	At *NJ Tree Foundation*, volunteers and staff inventory the trees they planted and monitor their mortality with the help of iTree software
	At *Gowanus Canal Conservancy*, staff and volunteers track the volume of compost produced from kitchen scraps diverted from landfills
	At *Compost for Brooklyn*, volunteers track the weight of kitchen scraps diverted from landfills through their composting programme

from gardens (East New York Farms!, Feedback Farms, Compost for Brooklyn, and Gowanus Canal Conservancy), counting dead street trees (NJ Tree Foundation), and tallying sales of locally grown produce at a neighbourhood farmers market (East New York Farms!). As Shirk *et al*. (2012) point out in their description of the collegial model of PPSR, in these examples "the degree of amateur participation in the research process is so extensive and independent that expert amateurs arguably adopt the traditional role of scientist-as-knowledge producer" (p. 5).

Though scientists were not engaged in these five examples, some practitioners nonetheless relied on protocols developed by professional researchers. iTree (Riggs 2013) and Farming Concrete (Gittelman 2010) are examples of freely accessible or "open" science protocols purposefully developed by researchers to support collegial forms of PPSR. We found both tools in use by examples in our sample. The NJ Tree Foundation, which organises communities to plant and care for street trees in Newark and Camden, used iTree, a free monitoring software developed by the US Forest Service, to help collect and organise tree mortality data. Staff and volunteers used the data to assess the viability of tree species planted in different urban contexts and adjusted their subsequent species choices accordingly. Feedback Farms and East New York Farms!, both community gardening sites in Brooklyn, made use of Farming Concrete, a protocol developed to help laypeople track the weight and market value of garden-grown vegetables. For both organisations, the resulting data on productivity informed horticultural practices such as crop selection and siting.

None of our examples involved the kind of deeply engaged partnership between scientists and practitioners that could be categorised as *co-creative* PPSR, with scientists and other stakeholders sharing responsibility for almost every dimension of a research project. Nor did we find any instances of *contributory* PPSR, where non-scientists engage in research solely through the act of data collection. Though all of the practitioners we interviewed claimed to want to work closely with scientists to improve or expand their outcomes monitoring efforts, they were also reluctant to invest limited staff and volunteer resources in such close-knit partnerships. Likewise, as Pickett *et al*. (2004) have suggested, partnerships between scientists and laypeople can be "costly in terms of money, time, and commitment" for the scientists involved. Therefore, barriers exist on both sides hampering deeply co-productive research.

The lack of *contributory* PPSR initiatives may point to a basic mismatch between data collection for adaptive co-management and data collection for formal hypothesis-driven research (Silvertown 2009). In the former, multiple stakeholders collect data to monitor the efficacy of context-specific environmental management strategies and adjust their local practices based on their findings (Armitage *et al*. 2008a). In the latter, scientists mobilise volunteers to collect data across large expanses of space and time in an effort to test hypotheses and produce generalisable knowledge about the natural world (Bonney *et al.* 2009b, Busch 2013). A *contributory* form of outcomes monitoring would, therefore, need to serendipitously align a management-driven data collection initiative with the data harvesting needs of a formal "citizen science" research project. We found no such alignment in these examples.

Two outliers in the sample suggest alternative paths for public participation in outcomes monitoring research that are relatively less inclusive for civic ecology practitioners. At the Gowanus Canal Conservancy, volunteers and staff planted and cared for street trees and curbside gardens in an effort to increase permeable surfaces for collecting and holding storm water. Some of this work was funded by a state environmental conservation grant that required the Conservancy to engage in a contractual model of PPSR with an independent scientist to monitor the efficacy of its storm-water management projects. Alternately, at the Bronx River Alliance, staff engaged in a collaborative model of PPSR with professional ecologists in the NYC Department of Parks and Recreation to develop a monitoring protocol for their riparian invasive plant removal initiatives. Though practitioners helped design the monitoring protocols, collect data, and analyse the results, ecologists seemed to play a more authoritative role in choosing the initial questions bracketing the research.

Conclusions

Using a five-model typology of PPSR developed by Shirk *et al*. (2012), we were able to disambiguate different forms of practitioner engagement in outcomes monitoring research within civic ecology practices in the New York City region. The results showed that not all participatory research initiatives are created equal. Six examples had practitioners assuming responsibility for all of the monitoring research, whereas only two examples showed practitioners and scientists working together to varying degrees. Going forward, this PPSR typology may be useful in other efforts to analyse knowledge production (Berkes 2009) and learning (Armitage *et al.* 2008c) in cases of adaptive co-management that include opportunities for practitioners to collect data on the outcomes of their efforts.

Our findings suggest that in the face of obstacles to crafting participatory research partnerships with scientists, civic ecology practitioners are often choosing to monitor the outcomes on their own, though sometimes with help from freely accessible or open research tools and protocols such as Farming Concrete and iTree. The growing availability of such protocols will likely continue to support collegial forms of public participation in outcomes monitoring research for civic ecology practices in the future. For example, during the summer of 2013, a cohort of 25 community gardens in New York City began designing and experimenting with simple and easy-to-use methods for monitoring the social and environmental impacts of their work with an eye towards improving their practices over time. The initiative, sponsored by a local public space advocacy organisation, grew out of requests from policy-makers and funders who wanted to know whether community gardens are improving communities and ecosystems in cities (Cohen *et al*. 2012). The initiative is scheduled to go into full-scale implementation in mid-2014. Other, more sophisticated do-it-yourself environmental sensing tools have been developed by organisations like the Public Laboratory for Open Technology and Science. These tools include low-cost and easy-to-assemble kits for creating satellite-grade aerial imagery, spectrometry, and near-infrared photography, all with untapped potential for outcomes monitoring geared towards adaptive co-management in civic ecology practices.

Though freely accessible and open tools and protocols for outcomes monitoring may help civic ecology practitioners improve their work through an adaptive process, they do not tap into the benefits of working closely with scientists under the co-created model of PPSR. Such partnerships might support more rigorous monitoring research that would go beyond the relatively simple data collection protocols we found in the six examples of independently driven monitoring described above. Evidence also suggests that partnerships aspiring to the co-creative PPSR model provide greater opportunities for science learning and research skill development for practitioners (Shirk *et al*. 2012). Reciprocally, for environmental scientists, working closely with practitioners on applied research for urban ecosystem management would go a long way towards fulfilling the mandates of Earth Stewardship (Chapin *et al*. 2011) and Action Ecology (Marshall *et al*. 2012), with their joint emphases on participatory inquiry for enhancing social-ecological system resilience and making scientific research more relevant to societal needs. In overcoming hurdles to forge these partnerships, both scientists and civic ecology practitioners may draw on inspirational examples of successful co-creative partnerships from other contexts, such as public health advocacy (Corburn 2005) and urban planning (Forester 1999).

Ongoing research in this area will depend upon the availability of civic ecology practitioners willing and able to engage in outcomes monitoring as a strategy for iteratively enhancing the impacts of their work based on feedback about its results. Although policy-makers, funders, and professional researchers are integral to this process, those seeking to initiate new adaptive co-management partnerships with civic ecology practitioners are wise to observe cautions advanced by Ruitenbeek and Cartier (2001) in their review of "emergent" adaptive co-management. Namely, efforts to artificially and prematurely inject adaptive co-management strategies into situations where buy-in is limited may end up doing more harm than good. Instead, policy-makers and researchers should seek out civic ecology practices showing an emergent interest in participating in adaptive co-management and focus on removing barriers to public participation in outcomes monitoring research in any form.

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