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Adaptive Management of Urban Ecosystem Restoration: Learning from Restoration Managers in Rhode Island, U.S.A

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Abstract

Urban aquatic restoration can be difficult to accomplish because of complications like pollutants, population density, infrastructure, and expense; however, restoration in urban settings has the potential to provide benefits to many people. The success of urban restoration projects—even those focused primarily on ecological targets—depends on community involvement and managers' understanding and consideration of community needs. However research on the social barriers to urban restoration and strategies managers use to overcome them is relatively rare. This work attempts to fill that gap. Building from interviews with restoration managers involved in urban aquatic restoration projects in Rhode Island, we contribute through an adaptive management approach: identifying and synthesizing the barriers for aquatic restoration projects in urban settings and strategies to overcome them. Ultimately, we suggest potential for double- and triple-loop learning by disentangling and critiquing the frames and policy/power structures that influence decision making in urban aquatic restoration.

Introduction

Ecosystem restoration is increasingly lauded as an approach not only to improve ecological conditions, but also to provide a suite of co-benefits to human communities (Bolund and Hunhammar 1999, Lundy and Wade 2011). Restoration in urban settings offers real opportunities to address environmental justice issues and deliver wide-reaching benefits to an increasingly urban populace (Pickett et al. 2001).

But urban restoration projects must navigate a wide suite of issues to succeed, including industrial pollutants, population density, infrastructure, and expense. And there is growing recognition that the success of urban aquatic restoration projects—even those focused primarily on ecological targets—depends on integrating ecological with social, behavioral, and economic factors (Groffman et al. 2003, Walsh et al. 2005, Christian-Smith and Merenlender 2008, Bernhardt and Palmer 2011). Specifically, Bernhardt et al. (2007) found in their national survey of river restoration managers that community involvement was the one marker that distinguished highly effective projects from ineffective ones. Others have

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found that even where there is broad scale support for restoration, there is often local resistance to implementation (Dutcher et al. 2004, Nassauer 2004, Connolly et al. 2013).

While researchers have begun to address some of the biophysical complexities of urban aquatic restoration (Hughes et al. 2005, Kondolf 2006, Palmer et al. 2007) less attention has been paid to the social aspects of urban restoration. Some existing research focuses on social dimensions of restoration broadly, including public engagement and decision making processes of restoration (Petts 2007, Junker et al. 2007), perceptions and values of ecosystems (Simcox and Zube 1989), and support or resistance to restoration (Gobster and Westphal 1998, Buijs 2009, Armstrong and Stedman 2012). Likewise, a limited but growing body of work focuses on the integration of scientific knowledge, management practices, and stakeholder interaction in urban aquatic restoration (Simcox and Zube 1989, Gobster and Westphal 1998, Suren 2009, Smith et al. 2016). But there is still a need for better understanding of the unique interplay of social and biophysical factors that influence the outcomes of urban aquatic restoration to foster adaptive management of urban social-ecological systems and contribute to urban aquatic restoration project success.

Adaptive management looks to build upon past successes and failures through iterative experience, learning, and adaptation (Nyberg 1999, Folke et al. 2005). Learning is a critical aspect of adaptive management, with single-loop learning evaluating the specific actions that directly influence outcomes, double-loop learning evaluating the framing of practice, and triple-loop learning looking at the context or structures influencing the frames (Pahl-Wostl 2009). However, there is not enough focus on adaptive management in practice—reviews of the literature have found only 5–14% of adaptive management articles focus on implementation (McFadden et al. 2011, Rist et al. 2013, Westgate et al. 2013, Fabricus and Cundhill 2014). McFadden et al. (2011) analyzed 96 articles published between 2000–2009 and found thirteen focused on practice and implementation and only five with a strong focus on learning and reflection. Fabricus and Cundhill (2014) found that of the articles they reviewed with a focus on practice (6% of 379 articles), the majority focused on improving existing practices or single-loop learning while only half involved double-loop learning.

Given the need for understanding social dimensions of urban aquatic restoration and for growing the literature on learning from adaptive management practice, we asked: What can we learn from restoration managers about the unique interplay of social and biophysical factors that influence the outcomes of urban aquatic restoration? Here we build from interviews with restoration managers involved in a suite of aquatic restoration projects in Rhode Island to identify and synthesize the lessons learned from managers' work in urban settings: of the social challenges they faced in completing urban restoration projects and the inventive strategies they employed to overcome barriers. Ultimately, we push towards double- and triple-loop learning by disentangling and critiquing the frames and policy/power structures that influence decision making in urban aquatic restoration.

Methods

Our findings are based on semistructured interviews with 27 local, state, federal, and non-profit restoration managers in Rhode Island, U.S.A. in summer 2013 (Druschke and Hychka

2015). Rhode Island is the smallest (1,033 sq. miles) and second densest state (1,018 persons per sq. mile), and is heavily aquatic (384 miles of tidal coastline and 1,392 stream miles) (U.S. Census 2009, U.S. Census 2012, U.S.E.P.A. and U.S.G.S. 1998). Despite its density, more than half the state is rural (U.S.D.A. Economic Research Service 2000). Its lowest household incomes are in the urban north and east, where restoration efforts often are remediation projects, urban greenways, small-scale wetland restorations for flood mitigation and water quality, and fish passage projects. While these characteristics make Rhode Island unique, in some ways Rhode Island is a microcosm of urban issues in the northeast that make our findings potentially more generalizable.

We recruited participants based on a combination of heterogeneity and nonproportional quota sampling to ensure a broad spectrum of opinions and broad representation of groups (Patton 2002, Oliver 2006, Lindlof and Taylor 2011). Through key informants, we identified potential interviewees across institutional levels and added names through snowball sampling (four municipal, six state, seven federal, and ten non-profit) (Lindlof and Taylor 2011), suspending data collection when we reached information saturation (Patton 2002). Interviews were individual and followed a standard protocol based on prior research (Gobster 1998, Druschke 2013), best practices (Lindlof and Taylor 2011), and local knowledge. Our interview script had 17 open-ended questions leading with: “Tell us a restoration success story. Why was that successful? What factors contributed to its success?” and “Tell us about a restoration project that didn’t go as well as you had hoped or planned. What went wrong? What could have gone differently?” We used the remaining questions as follow-up prompts about urban settings, public involvement, land tenure, and issues of scale. All interviews were professionally transcribed.

In our analysis, we define restoration as “an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability” (SER 2004). Our focus is on the ecological, stakeholder, and learning dimensions of urban aquatic restoration broadly (Palmer et al. 2005), including work with wetlands, rivers, and floodplains. Urban can be defined solely by population density (U.S. Census 2012), which we follow, but we call attention to the issues of involving many stakeholders, existing infrastructure, and layers of historic context as common and central to urban restoration.

To analyze the text and subtext of the transcripts we employed both content analysis—a primarily qualitative process of research design and coding, drawing inferences from, and validating analysis of discursive data (Krippendorff 1989, Hsieh and Shannon 2005)—and rhetorical analysis—which looks more deeply at both the functions and frames of language (Bazerman and Prior 2003), the interpretive maps that shape understandings of reality (Goffman 1974). These methods are not intended to derive data for statistical analysis (Hsieh and Shannon 2005), but instead to investigate and interpret discourse. Under these paired approaches, we worked deductively to develop an exhaustive code based on themes identified in the literature (Gobster 1998, Druschke 2013) and inductively to find themes grounded in and emerging from the transcripts. The code was reviewed by members of our wider research team for reliability of coding (Gibbs 2007) and validity of our analysis (Creswell 2014). Specifically, all responses coded as relating to urban aquatic restoration

were reviewed to compile a comprehensive list of barriers to and strategies for urban aquatic restoration, which we synthesized based on inductive and deductive themes.

Following the co-orientation model, which highlights that dialogue is influenced both by the attitudes of a group as well as that group's perceptions of other groups' attitudes (Connely and Knuth 2002), we identified managers' attitudes about urban aquatic restoration, as well as their perceptions about public attitudes about urban aquatic restoration. We also worked through structurational theory (Giddens 1984) to note that rhetorical arguments and structural issues are not mutually exclusive: human agency informs structure and structure informs agency, so we see structure and discourse as overlapping and interactive over time.

Barriers to Restoration

Many of the barriers identified by interviewees were not uniquely urban, but were universal issues that were exacerbated in urban settings for a number of reasons, including density of stakeholders, multiple layers of biophysical and social challenges, and pre-existing infrastructure. Employing a structurational approach, the barriers and strategies identified are of multiple, overlapping types: structural (social/institutional or biophysical) and discursive. For instance, contamination refers to issues like heavy metal contamination in urban waterways (biophysical) and also served as a narrative that people employ about urban waterways (discursive), which may or may not be related to the actual biophysical condition of the river. As we explore below, we point to these multiple dimensions to emphasize that urban barriers, opportunities, and strategies often exist on multiple levels, containing components related to policies and practices, biophysical components, and discursive narratives about urban waterways. A focus on the discursive aspects of barriers helps to understand and identify the frames that shape the context of restoration and allows for the double- and triple-loop learning that can afford real change (Pahl-Wostl 2009).

In a separate report we compiled from interviews a comprehensive list of urban aquatic restoration barriers and the strategies that some managers employed to overcome the barriers or to capitalize on the opportunities they encountered (Hychka and Druschke 2016). Here, instead, we present a selection of the barriers encountered and strategies employed that we identified as particularly relevant to urban aquatic restoration. Many of the barriers fall under three general themes: the perception of ecosystems beyond repair; the lack of political will for urban aquatic restoration; and funding constraints.

Ecosystems Beyond Repair

While the extent of human infrastructure and minimal open space in and around potential restoration sites posed a challenge in urban sites, so too did the state of ecosystems themselves (Walsh 2000, Paul & Meyer 2001, Bernhardt and Palmer 2007, Bernhardt and Palmer 2011), because, as one manager put it, they are "so far from its natural state." Many managers talked about how it was difficult to get traction to restore urban ecosystems, because they were considered too far gone ecologically. As one manager explained, there is a sense of "why bother, you know, it's not in great shape, it's not gonna be in great shape, so why should I spend my time and effort." Some managers adopted that view themselves, while others simply recognized it in others. One advocate for urban restoration reflected on a

particular colleague: “She would say, ‘Forget the urban environments. Let’s throw all our money and efforts into preserving something that’s not yet destroyed.’” Another manager described a potential funder telling her, “Don’t waste your time…that river is so degraded… You know, down at the [less urban river] system you can get way more bang for your buck. You’ll never get a decent herring run in that river.” From this standpoint, some managers have given up—or have been forced to give up—on ecological restoration in urban ecosystems.

In some cases, this argument was taken a step further to suggest that there is no nature in the city, thanks in part to the invisibility of natural features in urban areas that are underground, behind barriers, or avoided because they are deemed unsafe. One manager described taking a group to visit a canoe launch on an urban river: “They’re like, ‘Wow, where’d you get the river?’ It had been in the neighborhood, and like nobody even knew this river existed.” That same manager recalled hearing community residents insist, “We don’t have environment in this community.” Another reflected that community members, “would say things like, ‘I take two buses to show my kids grass… We don’t have environment [here].’ Environment to them meant a national park.” If people think there is not nature in the city, they do not feel any reason to support local ecological restoration.

Contamination, and the fear of contamination, also posed a significant barrier to projects and were repeatedly cited as primary reasons for abandoning proposed projects. As one manager put it, there are fewer project opportunities in urban areas because, “You know, often we suggest something and then somebody finds out it’s contaminated and then the proponent runs away, walks away, and leaves it for others to clean up.” Even when potential contamination does not derail a project entirely, it can shape the restoration strategies employed. As one manager described a potential dam restoration project on a pond surrounded by houses, “there wouldn’t have been a lotta support for movin’ the impoundment or we would have to deal with the contaminated sediments in some way.” So she decided, instead, to install a fish ladder rather than proceed with full removal. Contamination can also multiply problems. Discussing the identification of sites for a depaving effort, one manager questioned the true benefit of the project when, “we’re literally digging up another problem.”

Lack of Political Will

Several managers described encountering institutional biases against urban aquatic restoration both formally in the structure of policies and regulations, and informally in the anti-urban sentiment of some government officials. One manager reflected on politicians’ hesitance to support work in the disadvantaged community she worked in: “[Politicians] said there’s nothing you can do. Nothing works… And anything you do will be destroyed.” One neighborhood considered “transitional” and “divided politically,” a place “the state senator and the state rep didn’t even campaign in,” became the neighborhood “where you put everything that no one else wanted.” Individuals in positions of power could make or break a project based on their own perspectives, particularly in politically marginalized communities.

Both politicians and community members alike were described as fearing change. Managers expressed frustration that many proposed restoration efforts were quickly rejected by many local residents simply because they were proposing something new. One manager described frequent objections: "'Oh you wanna change something? Nope, not gonna do it.' You know, it's not so much the 'not in my backyard' philosophy as much as it is, 'No. No. You know, that dam's been there all this time. Why do you wanna take it out? And you're gonna tell me you wanna take it out for fish passage, but I don't care.'"

Funding Limitations

Urban aquatic restoration efforts are often expensive due to layers of problems including contamination, extent of existing infrastructure, and degree of degradation of the ecosystems. Managers told us, "You know, you can get maybe a quarter of an acre of restoration in, where if you go down to [a more rural part of the state] the same money will buy you, you know, 20 acres," and "if you have, you know, $2 million, you can save a huge pristine wetland area. Or you can restore a five acre contaminated site in an inner city. And that is the challenge."

Even when funds were available, we heard some federal employees complain that restoration groups "didn't want our money… Every year we would go to the city and we would say, 'You have $424,000 sitting in this account… Do you want to use it?' Nobody would ever get back to us." Managers eligible to receive these funds described institutional challenges to receiving or managing funding like the lack of the ability to write a technical contract, possess the financial reserves to cover funding matches or reimbursements, have staff available to meet with funders at inconvenient times, or write complex grant applications. Some organizations did not apply for available funding that might be useful in their communities, and, when they did, large funders were sometimes reluctant to grant funds to small groups facing these challenges.

Funding restrictions themselves proved a barrier when funds were available for certain portions of the restoration process and not others: for planning and implementation, for instance, but not monitoring, or when timing posed difficulties for implementation on projects with multiple collaborators, public engagement components, and/or matching funds. Incorporating community feedback in the design and implementation of projects was framed as important for project success in urban areas, but the time and unpredictability this entails was not always acceptable to funders.

Additionally, restoration funding is often prioritized away from cities, which are put at a disadvantage by the "acres restored" success metric of many federal funding schemes, despite the social co-benefits they provide, as well as a bias towards spending money in more pristine areas.

Strategies for Restoration

In the face of many of these significant barriers, managers were able to find creative strategies for completing aquatic restoration projects in urban areas. Many of these strategies align directly with the barriers presented above (Table 1). Some offer direct changes in

practice (single-loop) while others focus on reframing the discursive facets of the barriers (double-loop) or changing the context in which restoration is done based on this reframing (triple-loop).

Capitalizing on Urban-specific Opportunities

Urban areas, specifically, contained some surprising opportunities that managers were able to seize upon for restoration projects, including the existence of multiple beneficiaries, environmental justice concerns, environmental crises, and shifting perceptions of urban areas.

Urban ecosystems offer real opportunities to provide ecosystem service benefits to a broad community, with implications for equity, fairness, and democratic values. As one manager described of her work in urban areas, “We have more utilities and flooding potential and contaminated sediments. The projects are more expensive. But from our perspective… there’s a greater number of people receiving the direct benefit.” Some managers linked this number of beneficiaries to democratic arguments of fairness. They reasoned that it was important to spend restoration funds where many voters and taxpayers live as an issue of what one manager called “geographical equity.”

Channeling money towards urban areas offers unique possibilities because, as one manager described, “whenever you can get an overlap with cultural and natural resources, that’s a hot spot in the town, that’s something that people really care about.” Many of the projects that managers viewed as “successes” were projects that blended ecosystem improvements and community improvements. As one manager explained, “to me, wetland restoration is not distinct from community… My personal goal in everything I do is to, you know, try to improve communities by, you know, restoring the environment, whether it’s the built environment or the natural environment.”

Some urban crises also provided opportunities for intervention. While poverty and contamination are clearly barriers to restoration, they can also spark action. One manager described an abandoned lot where neighborhood children played on hazardous materials and suggested that once it was brought to the attention of policymakers, this injustice became a sounding call that led to the eventual restoration of the site and creation of nearby parks. Natural crises, too, prompted action in urban areas. Floods especially served as natural disasters that allowed the public to see the need for the potential benefits of restoration projects. One manager discussed a restoration effort where “in the middle of the whole process we had the horrible flooding in 2010, which kind of shifted people’s perception of what this could mean for them.”

This shift in perception is also true of restoration itself, with some members of the natural resource management community moving from restoration of systems to a more natural state to managing fundamentally altered or novel ecosystems (Chapin and Starfield 1997). As one manager asserted, “I see the environment as, like it or not, a managed system. I mean the entire environment; you know what I mean? So the kind of notion that there’s this, you know, pristine system that we’re working toward, I don’t even really see that.” While this perspective could lead some managers and members of the public to devalue urban

restoration, it could also prompt an opposite effect. When it becomes more and more common to see all ecosystems as human-altered and to see “pristine” conditions as unattainable, urban restoration may seem less of an outlier.

Making Systems Visible

Managers suggested several strategies to help people see and value urban ecosystems. One approach was to daylight or remove physical barriers to seeing urban systems. Others recommended general outreach efforts to make “our work attractive and palatable to urban communities and to get them to see the economic and social value of the work.” Many managers suggested getting urban residents out interacting with urban ecosystems to recognize some of their values. As one manager reflected: “We had kids canoeing on the river in their neighborhood. And suddenly this filthy river became an asset.”

Another way to achieve visibility is through the creation of urban demonstration sites, which serve to educate local stakeholders about restoration practices, while promoting restoration practice more broadly. As one manager argued, “it’s absolutely essential for us to do visible conservation in cities and to connect people, especially kids, …to let them know that nature is part of their city and that it’s there for them to use and enjoy.” Further, intentionally incorporating accessibility into restoration design such as adding a bike trail and boardwalk to an urban restoration site provides, “an opportunity to put ‘em right in the middle of it and have ‘em go, ‘Wow.’ And it’s when you do that that they start to value it, and then they start to support things like bond referendums for restoration.” These sorts of experiences improved residents’ lives, increased their appreciation of restoration sites, and also contributed to individuals supporting restoration more broadly.

Mobilizing Visionary Leaders

Strong and visionary leadership played a key role in many of the urban aquatic restoration efforts that interviewees considered success stories. Many managers said that because restoration efforts can last many years, it takes at least one persistent individual to doggedly protect a project from being stalled or derailed. These leaders can take many forms—community insiders or outsiders, public officials or local residents—and it benefited projects to cultivate champions in all these categories. Some managers argued that a trusted person within the community was particularly critical for restoration success and that managers need to spend time to determine who those key community leaders might be. Other managers suggested that outside expertise was necessary, especially in disadvantaged or highly transient communities where there might be a lack of capacity for spearheading restoration projects. These experts worked closely with community members in the design phase, served as brokers to the complicated and highly networked funding and permitting process, and helped to build capacity within communities.

The success of projects also seemed to benefit from the work of scale-brokers (Prell et al. 2009, Crona and Hubacek 2010, Ernstson et al. 2010) who could work comfortably within the community and with funders and regulators at local, regional, and national scales. The managers we spoke with shared examples of these scale-brokers who, in some cases, were

institutionally powerful and politically networked, and, in others, were charismatic, local people who had the innate ability to navigate layers of bureaucracy and power.

Long-Term Engagement with People and Sites

Many of the managers we spoke with found that performing urban aquatic restoration projects required a long-term commitment to public engagement from managers. Long-term success depended upon managers improving their communication of content about restoration projects to public audiences, as well as creating an iterative community dialogue that fostered project ownership (Druschke and Hychka 2015).

One dam removal project exemplified this type of long-term community engagement. When community concerns about contamination persisted even after an informational campaign about the project's minimal risk, project managers decided to complete "an extensive amount of sediment testing that probably wasn't necessary," in the words of one manager, "but we just felt like it needed to be done because there were these concerns, and we needed to say we have looked at this and this is what we found," or, in this case, did not find. These extra tests were ordered, in large part, because managers on the project had spent an extended amount of time in the community getting to know their concerns and interests and building mutual trust. Rather than dismiss community members' largely unfounded concerns, they were able to listen and respond to the community's particular objections and complete the project.

Working Across Spatial Scales

Many managers suggested the need to start small on urban restoration projects in order to achieve demonstrable change, help make problems seem less insurmountable, share the burden, build partnerships and relationships needed to complete long term projects, and breed success from success. They found these smaller efforts could often act as demonstration sites that, particularly in urban areas, could put residents in contact with and ultimately affect how they value these ecosystems.

Despite these real advantages of local scale projects, though, smaller victories often do little to fix ecological problems throughout the wider catchment, such as non-point source pollution or altered hydrology (Bernhardt and Palmer 2011). Further, communities act within larger socio-political frameworks, and structural issues occur across scales, from the very local, even household level, to the global geo-political situation (Braun 2005). Our interviewees suggested that urban aquatic restoration requires tiered changes, with site-level restorations that engage the citizenry and build the capacity to do more projects, coupled with broader efforts and enabling legislation to improve some of the larger, often non-point source problems (Christian-Smith and Merenlender 2008).

Synthesis and Conclusions

Following an adaptive management approach, these interviews provide an opportunity to learn from the practice of urban aquatic restoration, which is often overlooked in the literature (McFadden 2011, Fabricus and Cundhill 2014). Many of our interviewees expressed appreciation for the work presented here, because their funding environment and

workloads rarely allowed time to synthesize and learn from their collective knowledge. So we suggest that our work, and similar work by others, can provide an opportunity for the voices of managers to make it into the academic restoration literature and also provide space for learning in an adaptive management framework.

We present key barriers identified by managers as well as some of the strategies and learning approaches to dealing with these barriers (Table 1). These approaches include the practices mentioned by the managers (single-loop), changes in the framing of restoration (double-loop), and potential changes to the context that influences those frames (triple-loop) that we identified through our content and rhetorical analysis (Pahl-Wostl 2009). We suggest that our qualitative approach to analysis—specifically blending content analysis and rhetorical analysis framed in structurational and co-orientation approaches—is useful in not only documenting the suggested practices of managers, but in teasing apart the frames and contexts of those practices.

Chief among the improved practices mentioned by managers were: smaller demonstration projects that can leverage longer term support to achieve the larger systemic changes (Palmer et al. 2014, Yocum 2014, Smith et al. 2016); earmarked funds for urban projects; trainings to build local technical and procedural capacity; and flexible timeframes for spending funds. Below we expand upon the potential for reframing and transforming the practice of urban restoration (double- and triple-loop learning) identified in our research (Table 1).

Bernhardt et al. 2007 found that public participation was the one variable that differentiated successful projects in their national survey of restoration projects, but were not able to tease apart the relationship further. However, DeCaro and Stokes 2013 argue that public participation can improve the match between local conditions and their governance institutions, but caution that participation is not a panacea. Similarly, we found that the managers' frames may not allow for effective interactions with the public—for example, when managers are not using active listening they may hear legitimate concerns as "fear of change". Through active listening (Rowe and Frewer 2005) managers can listen to the concerns of the public, and derive strategies—such as flexibility, capacity building, or trust building (Stern 2008)—that deal with the true nature of their concerns instead of dismissing them or trying to fix them with an existing structural approach.

Though some of our findings are not new, they shed light on what aspects of research on urban ecosystem restoration are and are not making it into practice. For example, though there is a growing understanding of the importance of urban ecosystems in the literature (Pickett et al. 2001), there is a need for changing perspectives about the value of urban restoration in practice. Again and again, we heard managers encounter both members of the public and bureaucrats framing the discussion of urban ecosystems as too far gone to even engage in restoration. We suggest that the message that pristine conditions is not a reasonable target for and that there is great value in urban restoration should be communicated broadly to the voting public and managers.

There is a need for effective outreach that is specifically urban and employs different approaches when targeted at the general public as opposed to regulators or managers (Smith et al. 2016). Different groups have different value orientations, which influence the outcomes of restoration (Aggestrom 2014). We found that within groups there was variation in value orientation, particularly within the regulatory community, which influenced urban aquatic restoration outcomes. In turn, our work suggests that outreach for regulators and managers should include information about novel ecosystems and changing perspectives of urban ecosystems, and it should incorporate a call for allowing more time for learning from projects through funding retrospective or cross-scale analyses to promote adaptive management (Walker et al. 2002; Folke et al. 2005).

We also found that what some managers expressed as barriers, others presented as opportunities or had practical strategies they employed to overcome them. For example, environmental justice issues were both discussed as a difficulty to overcome and as a rallying call to help focus attention and resources. This points to the need for synthesis of and targeted outreach to restoration managers about effective urban restoration strategies and the great potential for peer-to-peer teaching and learning (Armitage 2009) about urban restoration that focuses on the social dimensions of practice.

There is a need for long-term public engagement or scale-brokering and for the support of institutions or individuals who can promote or facilitate urban aquatic restoration through these mechanisms. Likewise, there is a need for support of all phases of restoration efforts—including planning, implementation, and monitoring—and developing transparency in the prioritization process, particularly for publicly funded projects, is critical (Yocum 2014). The typically opaque nature of the prioritization, funding, and implementation of restoration not only thwarts meaningful public engagement, but also thwarts learning by managers and policy makers in an adaptive management framework (Moran 2007).

Finally, the use of metrics of acreage restored as indicators of restoration success is insufficient for and biases against urban projects. Instead, funding agencies might adopt an approach that recognizes the suite of co-benefits—including flood reduction, quality of life, and public health improvements—provided to a larger group of people when restoration is done in a more populated area (Smith et al. 2016).

Our findings are derived from aquatic restoration projects in Rhode Island, so are most directly applicable to other urban areas with similar historical, physiographic, and cultural settings. However, many of the larger, structural contexts and framings in which these projects were performed occur at least on a national scale. But Rhode Island is unique—it is particularly small, dense, and aquatic and there is typically strong support for environmental concerns—statewide, open space ballot initiatives pass with large margins. So similar work in other regions would be useful to see if new barriers, frames, and proposed changes in frames would be presented. Similarly, follow up work would also be useful to tease apart heterogeneity in approaches and framing between local, state, and federal managers.

Fundamentally, as restoring urban ecosystems is increasingly promoted as a strategy with both ecological and societal benefits (Bolund and Hunhammar 1999, Lundy and Wade

2011), these projects do not happen in a vacuum and social barriers to restoration are both structural and based in the public and managerial framing. We encourage other researchers to focus their powerful lenses on these social barriers to and strategies for urban aquatic restoration by looking at restoration in practice. This type of work clearly occupies an underexplored place in the adaptive management literature, but provides a great opportunity for synthesis and learning, particularly shedding light on the frames (double-) and the structures that influence these frames (triple-loop learning) about urban aquatic restoration framing and larger socio-political context in which restoration takes place.

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Table 1

Barriers to restoration projects offered by Rhode Island natural resource managers paired with single-, double-, and triple-loop strategies for overcoming and learning opportunities afforded by those barriers.

	STRATEGIES AND LEARNING APPROACHES		
BARRIERS	**Single-loop: Incremental Improvements**	**Double Loop: Reframing**	**Triple Loop: Transforming**
ECOSYSTEMS BEYOND REPAIR			
Too Far Gone	Begin with a focus on small, short term projects to build community traction.	Urban ecosystems have great potential for renewal. Abandon target of restoration as “pristine” systems. Embrace “novel ecosystem” concept.	Train managers and funders in multiple benefits of urban ecosystems. Peer to peer learning between managers.
No Nature in the City	Use ambassador or demonstration sites.	Nature is everywhere–humans are part of nature.	Broadly communicate new understanding of urban ecology. Make ecosystems visible.
RESISTANCE TO CHANGE			
Fear of Change	Use visualizations.	These “fears” may be legitimate concerns. Aquatic ecosystems are dynamic.	Mangers trained to use an active listening approach to understand the true nature of resistance to change. Trusted local describe historic conditions/change.
LACK OF POLITICAL WILL			
Within the Political System	Regulate that a given percentage of restoration funds goes to urban sites.	Need to consider the ethics of where restoration is sited.	Train managers and funders in multiple benefits of urban ecosystems. Incorporate beneficiary characteristics in the site selection process.
Within the Community	Managers attend local meetings. Teach residents how to attend a public meeting.	Low income and transient communities deserve restoration. Local concerns are valuable insights.	Have the community develop restoration plan. Work with local visionary leaders.
FUNDING			
Capacity	Train small organization staff in writing grants or technical contracts.	Local capacity for restoration is not evenly distributed, and it should be.	Take onus to obtain restoration funding off local volunteers. Invest in regional scale-brokers. Establish circulating funds for low income communities.
Timing	Allow for more flexibility in the timeframe for spending grant money.	Collaboration and local engagement is more important than short term deadlines.	Invest in long term collaboration and public engagement efforts.
Inequity in Distribution	Earmark funds for urban restoration.	Need to consider the ethics of how restoration funds are distributed.	Communicate the value of urban ecosystems to voting public and management. Have transparency in the site selection process. Move away from “acres restored” as measure of success.