The Frog Dilemma: Urban Stream Restoration and the Nature/Culture Dialectic

Lenore Newman, Ann Dale and Denver Nixon

Lenore Newman holds a Canada Research Chair in Food Security and Environment at the University of the Fraser Valley, where she is a professor in Geography. She runs a research program focused on Canadian regional cuisines, local food sovereignty, culturally preferred foods, and urban food systems. She can be reached at Lenore.Newman@ufv.ca

Ann Dale is a professor with the School of Environment and Sustainability, Faculty of Social and Applied Sciences at Royal Roads University and holds a Canada Research Chair in Sustainable Community Development. Previously, she was an Executive with the Federal Government, and was involved in creation of the National Round Table on the Environment and the Economy (NRTEE). Her current research areas include governance, social capital and sustainable community development, biodiversity policy, and deliberative electronic dialogues.

Abstract

Stream daylighting projects are highly complex and require prolonged cooperation between multiple agencies and collaboration between diverse actors. Given most of these projects are quite expensive and require extensive effort in a very small area, a "frog dilemma" emerges in which the ecological benefits might seem to not justify the resources required. However such projects can bring significant ecological, economic and social benefits to urban areas, and aid in challenging the nature/culture divide. Two stream daylighting projects in the lower mainland of British Columbia, Canada are examined, the partnerships needed to bring the projects to completion are explored, and the long term outcomes and prospects of the projects are investigated. Both projects required public/private partnerships, high levels of community agency, and the more successful of the two projects includes an ongoing monitoring and education program.

Keywords

Urban stream restoration, sustainable development, urban nature, social environmentalism, urban ecology

Introduction

As human societies become ever more urban they can seem ever more distant from the ecosystems that support them. Human interaction with ecosystems is increasingly

Denver V. Nixon is a Postdoctoral Fellow in the Department of Geography at the University of the Fraser Valley and a Sessional Lecturer at the University of British Columbia. His Ph.D. research explored the ways driving, cycling, and walking differently shape commuters' understanding of their social and physical environments.

second-hand; although photos and films of wilderness can help to build an environmental awareness in urban dwellers, we have argued elsewhere (Newman and Dale 2009, for example) that the "mundane nature" found within our cities is of great importance in ensuring that urban dwellers develop an emotional awareness of their place within the earth's biosphere. This imperative has been noted elsewhere; the battle to conserve biodiversity will be won or lost on the lands between the protected spaces (Hounsell 1999). This sentiment has been captured in what Dunn *et al*. (2006) call the "pigeon paradox"; future conservation of wild spaces is dependent on urban dwellers maintaining a connection to nature, and urban nature is an important means to this connection.

In particular the effect of nature on children has received increasing notice (Louv, 2005, for example) and there has been a marked increase in urban agriculture and urban nature in general.

In a climate of growing economic scarcity, however, it is worth noting that preservation and restoration of micro-ecologies in cities is very expensive at a time when the world's megafauna and last wild landscapes are under immediate threat. This raises a "frog dilemma" of sorts: is the small biological gain of urban restoration worth the large requirement of resources and time. As a research team we studied two regional urban stream restoration projects to see who takes part in such projects and whether such projects might draw in participants outside of the usual environmental circles, and to verify the suggested social benefits reported in other literature. We looked for benefits beyond the biological to better understand how, in these cases, the resource outlay is rewarded.

The benefit of urban nature has been examined on a number of levels; it can awaken what Hartig (2004) calls a "soft fascination"; we are drawn to certain natural elements and find them soothing. Although, at first glance, the scope of urban nature seems paltry in comparison to less human-dominated landscapes, as Cronon notes, "nature is all around us if we only have eyes to see it" (Cronon 1995, 86). In addition, new urban nature can be created within cities, a process that can have significant ecological, economic and social benefits. Stream daylighting is an extreme example of such effort given that it requires heavy equipment and careful creation of new aquatic landscapes Throughout the world, cities have historically managed streams by channelizing them, combining them with sewage systems, and often burying them in pipes. In the city of Vancouver, BC, for example, hundreds of small streams associated with the temperate rainforest have been buried during the development of the city. These streams can often be heard still running under city streets, making their way to the sea. Daylighting such streams; that is excavating them and returning them to the surface, is one of the most dramatic examples of urban ecosystem creation.

Humans have a long-standing relationship with water. Throughout history, watercourses have provided drinking water, transportation, energy, and a means to dispose of waste, and thus it is not a great surprise that nearly all major cities are built on river corridors, lakes, or oceans (Asakawa et al. 2004). The small streams within settlements have served as important sources of water and a source of aquatic plants and animals. Urban watercourses, however, quickly become highly polluted through human activity. They have been used for sewage disposal and the disposal of harmful industrial waste, and many urban streams and rivers have been covered over and diverted into sewers. The idea of reclaiming urban streams emerged in force during the 1970's and is well summarized in the landmark paper "Stream Renovation: an Alternative to Channelization" (Nunnally 1978). Nunnally saw streams as open hydraulic systems and treated them as potential assets to neighbourhoods rather than as problems to be managed or paved over.

Although follow-up studies are incomplete and site specific, once stream daylighting is completed, stream neighbours tend to agree that daylighting creates an asset. A study of Strawberry Creek and Baxter Creek in California, two early examples of daylighting, showed increased land values and general good opinion of the creeks (Purcell et al. 2002). Related research supports such a conclusion in that proximity to green areas and waterways are perceived as beneficial. A study of properties in the Lower Mainland and south Vancouver Island found that residential property values increase by 15-20% when adjacent to green areas and that people who live near greenways tend to live in their houses longer than those who do not (Quayle and Hamilton 1999). Sapporo, Japan developed an extensive greenway plan emphasizing stream protection and restoration. These improvements were very popular with neighbours in a survey (Asakawa et al. 2004), as people liked the recreation value and scenery. Further, 28% of people in the city living near a stream had participated in some sort of maintenance (Asakawa et al. 2004). This demonstrates a surprisingly large interest in active participation in the stream's upkeep; the surrounding residents saw the stream as a "neighbour".

The daylighting of streams has significant ecological effects, but only on a micro level. For example, it has long been suggested that daylighting can combat the urban heat island effect in which a city is measurably hotter than the surrounding landscape (Findlay and Taylor 2006). One of the few papers documenting this effect (Kim et al. 2008) showed that after the daylighting of 5.8 kms of Cheonggye Stream in Seoul, South Korea, which had been buried for 36 years, there were significant ecological benefits. There here was an initial 0.5 to 0.9 degree drop in temperature that will likely increase with the continued growth of major tree cover and evaporation and heat transfer contributed to the temperature decline. This could help to mitigate the urban heat island effect, which is being exacerbated by global climate change. Restoring "refugia" such as streams is also critical to organism/species survival as is restoring corridors (Lake et al. 2007). In the two case studies, restoring salmon habitat was a major consideration, a lofty goal given that it has been shown that the complex ecosystems needed to support higher level species break down at extremely low levels of human interference in a watershed (King et al, 2011).

However the benefits of urban nature are more than just biological; urban nature provides a place for the nature/culture dialectic to unfold. The social benefits of urban restoration projects such as stream daylighting are becoming more broadly known. Understanding this complex interrelation begins within the literature on happiness and wellbeing. For example, some studies have shown that local factors have a direct impact on life satisfaction (Brereton et al. 2008), and that access to surrounding environmental amenities can make us happy or contribute to a sense of well being. Chiesura (2004) examines many ways that natural areas provide social, psychological and restorative services that enhance the livability of modern cities and the well being of urban dwellers. Natural areas provide access to nature for people living in the city for recreation, aesthetics, spiritual and restorative purposes. In addition, such spaces can increase social integration and interaction among neighbours (Chiesura 2004), enhancing social capital, a necessary condition for sustainable community development (Dale and Newman 2008). Urban greenspace is appreciated and in studies is correlated to satisfaction (Bonaiuto et al. 1999). Literature also show that children prefer microhabitat to big vistas (Nablan and Trimble 1994) as they are small enough to feel unthreatening, thus streams can be particularly important to environmental education programs and educators.

The cost of stream daylighting is a direct result of two factors: the complexity of such projects and the high cost of urban land. As noted in a study that summarized ten years of salmon stream restoration in Puget Sound, barriers are high. Another barrier to daylighting is a false belief in the permanency of the built environment (Schauman and Salisbury 1998); in some cases local residents have difficulty imagining the success of the project. Stream restoration is difficult due to limited space, high land cost, and complex and expensive infrastructure requirements (Bernhardt and Palmer 2007). It is also technically difficult. As examples, urban streams have altered water and sediment flow and high velocity harms streambeds, so runoff management is needed (Niezgoda and Johnson 2005). Upstream controls are recommended as essential components (Helfield and Diamond 1997); surrounding neighbourhoods must be aware that their runoff will affect stream health, and, ideally, landscaping to reduce runoff rates is installed. Impervious areas drastically alter stream dynamics and impact stormwater management systems. These surfaces block the infiltration of stormwater and increase the amount of runoff and its rate of discharge to receiving waters (Al Bakri et al. 2008). The structure and design of a paved road creates an enormous surface that collects pollutants such as vehicle engine emissions, tires, brake linings, dripping losses, and so forth (Nolde 2006, Murakami et al. 2008). The accumulated pollutants are carried away by the stormwater runoff and are discharged into receiving waters (Gilbert and Clausen 2005, Hatt et al. 2006).

Streams are also very sensitive to urbanization. Urbanization lowers base flow, and creates downcutting due to lack of space to meander (Bernhardt and Palme, 2007). In addition, there is often a compromise to meet urban infrastructure needs, without due consideration to the ecological and social benefits of streams to a community. Naturally intermittent Baxter Creek in California, for example, is kept fed by golf course water as many people do not like intermittent flows as they find the dry streambed unappealing. Due to these and other barri-

ers, most stream restoration projects are “one offs” (Lake et al. 2007). Although concerted efforts have been proposed – such as a plan in London, England, to complete multiple daylighting efforts – most such projects are conducted by evolving teams that disband once the project is complete.

The Importance of Community Level Restoration Projects

Stream restoration is carried out by diverse actors, often volunteers, at the local community level. Community activity has been noted as a neglected but important site of innovative activity (Seyfang and Smith 2007). In previous studies of community level projects, we have noted that the volunteer nature of many community sustainable development initiatives can lead to scarce human resources being overly diluted, especially if the initiative involves protracted conflict over a long period of time (Newman *et al.* 2008). We hypothesized that similar forces would be in play in stream restoration, particularly given the long timelines involved. One of the central goals of this study was to find out what motivates volunteers to give the large amount of time and effort needed to complete a stream restoration project.

Local knowledge of the community is important to success as most successful stream restoration projects typically integrate and are highly dependent upon community stakeholders (Findlay and Taylor 2006), thus necessitating a local focus for action. Since sustainable development projects are often beyond any one sector, any one discipline, or any one level of government to solve, this integration of multiple stakeholders is key to its implementation (Dale 2001). Sustainable community development is also best facilitated when federal and provincial governments have local partnerships. A study by Hein et al suggested that stakeholder values at different scales are very different (Hein *et al*. 2006), suggesting that stream restoration will benefit from diverse participation.

The presence of healthy streams within our urban areas will require extensive local restoration of waterways lost to urban development. Literature to date, although limited, suggests that stream restoration in urban areas can offer local-level environmental benefits as well as local psychological benefits to residents; we suggest that urban stream restoration can add patches of what we have previously called mundane nature close at hand to the day to day lives of urban dwellers. The cost of such restoration in terms of money and time could pose a barrier.

Objectives

To better understand the processes and motivations involved in stream restoration projects the authors investigated two completed stream restoration projects in British Columbia, Canada. The team identified the following objectives:

1. to assess the impact of the projects and document what was done;
2. to identify key actors in the completion of the projects, and
3. to determine actor motives in project completion.

The two projects, Spanish Banks Creek in Vancouver, British Columbia and Cecelia Creek in Victoria, British Columbia, were selected through a targeted keyword search online, and through conversations with local stream advocates. Interviews and site visits were conducted in 2008 and 2009.

Methods

The research project used a case study research method in which two local case studies were examined through site visits and targeted interviewing. In addition, searches of the local gray literature were completed, which aided in establishing project histories and timelines.

Potential case-study participants were identified through web-searches (for example, names of staff or volunteers on organization web pages), and expert referrals (snowballing sampling). Daylighting projects are most often undertaken in urban areas with higher populations, several layers of government jurisdiction, and multiple stakeholders and land use claims; therefore, project leaders may arguably possess a more serious commitment and motivation than those pursuing general watershed restorations in less contentious spaces. The sample size was extremely small at five interviews, owing to the limited number of Canadian organizations doing this type of work, their tendency to dissolve upon completion of projects, their small budgets, and their associated inaccessibility.

After a search of the grey literature was completed, the sites were visited and photographed. Telephone and in-person interviews were performed with participants in each project. Two of the in-person interviews were completed in the organizations' offices and lasted over one hour. These were recorded with a digital voice recorder. One interview took place at the restoration site and took approximately forty minutes. The conditions were not supportive of audio recording, so notes were written during and after the interview. The remainder consisted of telephone conversations lasting no more than twenty minutes. The digital recordings were transcribed, and these and the field notes were analyzed line-by-line to extract relevant themes and quotes. Site visits, which were carried out in 2009, involved multiple trips to the two streams and photographic documentation.

The physical aspects of the projects are highlighted below, followed by a discussion of the interviews with key quotes highlighted. The interview quotes suggest that the motivations of the actors involved in stream restoration projects have multiple motivators that can, at least in these cases, go beyond environmental concerns.

The Two Streams

Spanish Banks Creek, Vancouver, BC

The first case stream, Spanish Banks Creek (Figures 1 and 2), is located on the West Side of Vancouver near the University of British Columbia. It drains from Pacific Spirit Regional Park into English Bay and is an unusually good candidate for daylighting as only ten percent of its watershed is impermeable so water quality is very high. A productive salmon run was destroyed in the 1950s when the final few hundred yards of the creek were replaced with an impassible culvert to allow for road and parking lot construction. An initiative to daylight the creek mouth was begun in the late 1990's by community members. Thanks to the cooperation of government agencies, the project succeeded, with annual returns of hatchery reared chum and coho steadily increasing. In 2004, more than 65 chum returnedto spawn in the creek, providing a fascinating site for thousands of people using the Spanish Bank Foreshore Trail.

Figure 1. Spanish Banks Creek

The partnership that daylighted this stream is a complex one. The Vancouver Salmon and Stream Society worked in association with the West Point Grey Residents Association as initial champions. The groups had to complete archeological and erosion studies and secured funding from the B.C. Ministry of Environment and the federal Department of Fisheries and Oceans to cover the $62,000 cost of the project. The cost was quite low compared to many daylighting projects, reflecting the ideal nature of the site. City council approved the project on Sept 1, 1999. Local schools continue to rear fish to introduce into the stream.

The physical restoration involved replacement of the fish impassible culvert in 1999. A new channel was created using rock and log placements and vegetation plantings. The creation of a beach meadow protected the mouth. The construction was carried out by John Hunter Company Ltd. and the original restoration plan was conceived by Nick Page of Raincoast Applied Ecology, a consultant specializing in the assessment, restoration, and management of ecosystems in coastal BC. An upstream pond was created in 2004 to act as juvenile habitat.

Spanish Banks creek is maintained and monitored by the Streamkeepers program. The Department of Fisheries and Oceans established the Streamkeepers program in 1993 to address a reduction in the number of salmon spawning each year in urban streams. Streamkeepers encourages community stewardship and develops involvement of local residents and industry in the management and rehabilitation of streams. Spanish Banks Creek plays an education role, and is now one of three salmon bearing streams in Vancouver, with runs

occurring each year since 2001. Thirty other streams in the city remain lost to development.

Site visits revealed a very well established stream, with good pool structure, moderate flow, clear water, and good vegetation and shading. Information signs on the pedestrian bridge remind park users that the stream is fish habitat, hopefully discouraging people from discarding trash in the stream. The site is a popular one, and is used by local schools in the fall to introduce urban students to the salmon's life cycle.

Figure 2. Spanish Banks Creek mouth, with the city in the background

Case Two: Cecelia Creek, Victoria, BC

Cecelia Creek (Figure 3) is located in the Northern portion of Victoria, BC, an area of the city that was settled early and has been the site of industrial activity as it is located along the Gorge waterway, a sheltered ocean inlet. The watershed spans two municipalities and covers 360 hectares, 90% of which is covered by impervious surfaces. Cecelia Creek and Cecelia Ravine Park are the only greenspaces in the Burnside Gorge area, and are close to two elementary schools and the Galloping Goose Trail.

Initially the Gorge and the creek were popular recreation sites, but as early as 1905 concern was raised as to the unsanitary conditions of the area. Levels of fecal coliform and chemical pollutants both reached dangerous levels in the creek. Faulty sewage lines and connected storm and sanitary sewers, along with a septic depot in the creek's ravine created coliform counts 2500 times higher than levels deemed safe for recreational use. The water also became contami-

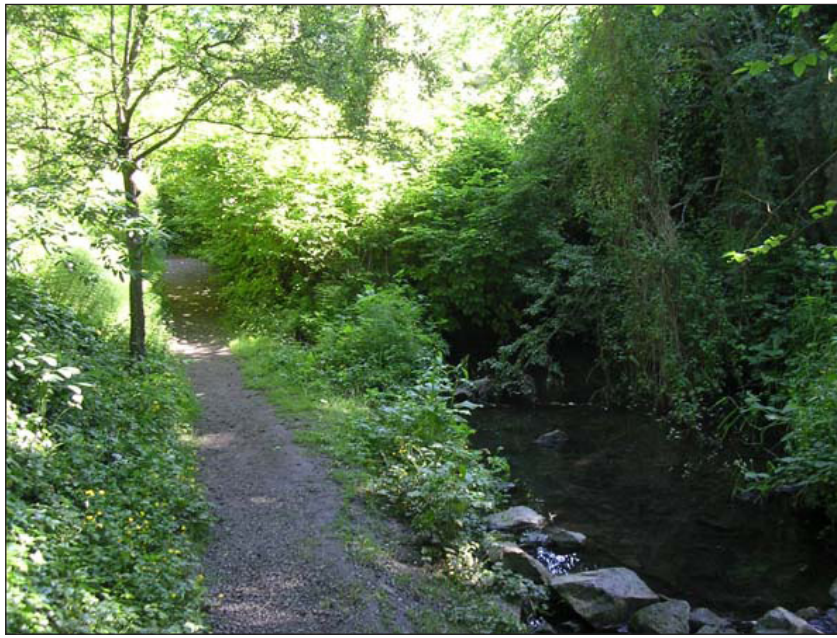
nated with petrochemicals and mercury running off of the surrounding paved surfaces in the industrial zones. Some portions of the creek had been enclosed as stormdrains, creating physical barriers to fish even in the case that the water was returned to acceptable conditions.

Cleanup of the creek began in 1990; the Cecelia Creek Clean Up Committee was formed to create a coordinated effort. The Burnside Gorge Community Association, individuals, community groups, businesses and funding partners participated in the restoration project. Partners included the Ministry of Water, Land and Air Protection; Capital Regional District (CRD); City of Victoria; Municipality of Saanich; Environment Canada; and the Veins of Life Watershed Society. A city project to improve stormdrains was used to daylight some of the buried portions of the creek. Local businesses were encouraged to adopt Best Management Practices to limit nonpoint pollution in the watershed.

The channel daylighting for the lowest 180 metre section is complete, and the Burnside Gorge Community Association and the City of Victoria are currently working on a management plan for the park that would likely include some vegetation work along the stream (i.e. removal of invasive species and replanting with native plants). There is interest in Saanich with the Quadra Cedar Hill Community Association to open up a different section of the stream as well. The CRD continues to monitor water quality through a stormwater quality monitoring program.

A site visit to the restored section of Cecelia Creek was conducted in late 2009. This creek and its ravine run north to south through a mixed-use urban area with residential apartments/condos and a variety of industrial properties on

Figure 3. Cecelia Creek



either side, as well as an SPCA centre. Running along the west side of the creek in the bottom of the ravine is a mixed-use trail that connects the downtown with the Lochside and Galloping Goose trails, and there are several "tributary" paths and staircases connecting this trail to the local streets. Just before it enters The Gorge, and underneath the Gorge Road Bridge, Cecelia Creek ducks under the trail through a culvert. If one follows the mixed-use trail north along the edge of the creek, they eventually lose sight of it when passing under the bridge for Burnside Road. It is assumed the origin of the creek disappears into a culvert in the middle of an automotive industrial area. If one follows the trail south after passing over the creek, they will first see the marsh on their right where the creek first enters The Gorge, and then as they approach the trail bridge that passes over the gorge, the marsh turns into mudflats.

The ravine itself has been largely restored and so there are a variety of grasses, bushes and trees running its length. There is also a single-track winding dirt trail that runs along part of the creek, allowing visitors to see the creek up close. Birds can be heard above the trickle of water, as the noise of the surrounding roads is largely muted by the ravine's flora and lower elevation. The creek bed itself is largely rock and sand, including both boulders and pebbles. The water is clear and smells clean.

People using the ravine include commuters and recreational cyclists and pedestrians using the trail, SPCA volunteers taking animals for walks, local employees taking their breaks, and sometimes the odd street person who sets up shelter either in the vegetation of the creek, or beside the trail under the Gorge Road Bridge. It is also heavily used by people who live in the neighborhood.

Interview Results from Both Cases

Investigation of the site histories confirmed that daylighting projects require unusually high levels of cooperation between multiple actors; both projects involved over a half dozen major partners. The interaction of community groups, private enterprise, and various levels of government is particularly interesting. Both projects also involved strong local support from individual citizens, likely a necessary component given the amount of work needed over long periods of time to successfully daylight an urban stream. To better understand the projects, we interviewed key participants. Some key points raised in the interviews are discussed below. In order to preserve anonymity, we do not identify the interviewees or associate them with a specific project.

Several of the interviewees expressed a desire to solve environmental problems for future generations, specifically for their own children and grandchildren. As one participant notes, environmental and economic debts are equally serious things;

> *I firmly believe we shouldn't be passing the cost on to your generation, at all. Debt is a big thing. Nobody talks about our national debt… This is all tied in with the environment for me.*

This participant held a view more or less the inverse of many environmental thinkers; feeling that we must have a strong economic foundation for the environment to prosper, rather than the other way around.

> *Yeah, so you know, if you don't have that in your economy – a good strong work base – then you don't have a good environment, it's as simple as that.*

In line with this conservative stance, they stated a wish for environmental restoration to become an industry, although recognizing – through personal experience – the difficulties funding such work.

> *…I have a desire for myself, for this to become an industry. But the reality is – who's going to fund it? That's what it comes down to, because a lot of it is on private lands or even precede private lands if they're restoration works, then there's an expectation from the public that that person pay for it.*

One participant emphasized the importance of quiet physical initiative and working on problems from start to finish.

> *So, what do you do? You just start at the beginning and work to the end.*
> *Well you know I'm a calm guy, just get my boat out, and go pick up some garbage. It really started out that simple…*

Several participants emphasized the importance of community, versus the actual environment, in these restorations projects and their motivation for leading them.

> *It's got nothing to do with – very little to do with – the environment, it's more with the community sort of thing.*

Another participant mentioned the need for social cohesion, not only at the community level, but also the organizational level. He notes the multi-stakeholder approach needed:

> *And so part of it was pulling all of those people in: the CRD, fisheries, housing. We got a grant from the Georgia Eco Basin, to do best management practices.*
>
> *So it was important to bring community, governments [together] and then we went out and worked with businesses as well, Because our area, so much of it was not only that residential side. We did the residential pledge and clean-ups on their side, but we also went out and worked with the industry and developed codes of practice, best management practices, and how to re-work the program...*

Another participant noted the educational component. He gave a number of examples of the hundreds upon hundreds of high school and university (education) students to which he gives tours.

Emergent themes in the interview were surprising in that environmental concerns were, in these limited cases, secondary to themes of giving back to the community, providing a legacy for children and grandchildren, and providing an educational venue.

Discussion

Although the interviews revealed similar motivations among actors for both sites,

the site visits revealed two different outcomes that reflect the physical differences between the sites. The Vancouver stream is much easier to access, and sits on the border of a nearly intact watershed. The Victoria stream is surrounded by industrial land, and the damaged watershed limits the potential for ecological restoration at this time. However both sites have certainly been improved, and both sit on popular cycling trails. The ongoing presence of a streamkeeper at the Vancouver site adds to the educational value of the project, and provides an ongoing presence of renewal that might explain the lack of vandalism and littering at the site. This was a problem in the Victoria case on our site visits. Although more cases would be needed to establish clear patterns, in these two cases the surrounding environment had an impact on the final outcomes of the projects, despite similar motivations among the project actors.

As a final synthesis we note that the two projects exhibited the complexity expected in stream restoration, complete with costly engineering challenges, ongoing watershed management, and deep involvement of local actors. Both case studies demonstrate the time, scientific analysis, multistakeholder cooperation, and ongoing maintenance that are required to re-establish a stream. However we also noted the benefits: site visits demonstrated the peaceful nature of the urban greenspaces created, and habitat was most certainly improved. The interviews revealed the dedication of those leading such efforts, and hinted that motivations include both social and environmental drivers; the desire to leave a better environment for the future was certainly present. In addition a strong educational component was noted at the Vancouver site, suggesting urban stream restoration has impacts beyond habitat. Return site visits to the Vancouver site noted the popularity of the area, particularly during the annual salmon run.

The projects also had strong local buy-in, and were championed by dedicated figures in their respective communities. What seems to emerge, however, is that the completed projects provided very strong social and environmental benefits, including cleaner water, improved habitat, pleasant environments in crowded urban areas, and strong educational benefits. The educational legacy at the Vancouver site was arguably stronger, suggesting that legacy management is an important aspect of a successful project, and that the surrounding environment does have an impact.

Conclusion

Returning to the objectives of the study it was found that in these particular cases the streams were successfully revitalized, improving the ecological condition of the sites and providing new habitat, with the proviso that in the Victoria case the surrounding environment limited the restoration of water quality sufficient for a fish population. Both sites provided nearby nature for local residents, and in the case of the Vancouver site provided an educational venue for the observation of salmon populations. Interviews with the key actors showed that in these two cases motivations beyond the environmental were factors in driving the projects.

Looking beyond the biological benefit of these projects provides some insight on the frog dilemma: the benefits of urban stream restoration fall heavily on the social end of the spectrum, both in terms of creating space for the nature/culture dialectic to unfold, and also as legacy projects for their archi-

tects, who often thought more in terms of social impact rather than ecological impact. These projects, then, do not likely represent a shift of scarce resources from nonurban preservation efforts to urban restoration efforts. Rather, the people involved were very tied to place, and were concerned about social impacts. In addition, they are from outside the usual sphere of environmentalism.

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