

# Urban Forestry Stewardship and Success

A Case Study of Four Models of Urban Forest Stewardship in King  
County, Washington



Kelly Wilkinson  
3/22/2018

Submitted in Partial Fulfillment of the Requirements for the  
Graduate Certificate in Urban Forestry Program at Oregon State University

# Table of Contents

<b>Table of Contents</b>	<b>1</b>
<b>Abstract</b>	<b>2</b>
<b>Acknowledgements</b>	<b>2</b>
<b>Introduction</b>	<b>3</b>
<b>Background</b>	<b>3</b>
What Our Urban Forests Provide	3
Threats Facing Urban Forests	3
Environmental Stewardship	4
Models of Comparison	6
<b>Methods</b>	<b>7</b>
Defining Long Term Success	7
Interviews	8
Field Study	8
<b>Data Analysis/Results</b>	<b>9</b>
<b>Discussion</b>	<b>12</b>
Contractor Work	12
Model 1: Professionally Led Volunteer Events	13
Model 2: Forterra Forest Stewards	13
Model 3: Washington Native Plant Society Master Stewards	16
Model 4: Non-profit Grassroots Organization	17
Project Examples	18
<b>Recommendations</b>	<b>22</b>
<b>Conclusion</b>	<b>27</b>
<b>Maps</b>	<b>28</b>
Map 1 - King County 2015 Forest Cover	28
Map 2 - Seattle canopy cover by Urban Forest Stewardship Plan management unit	29
Map 3 - Green Redmond Partnership Areas	30
<b>References</b>	<b>31</b>

# Abstract

Urban forests are very susceptible to degradation owing to their fragmentation from other forests and seed sources, and their proximity to human impacts. One of the most concerning of the human impacts is the introduction of invasive species due to neglect and their displacement of native plants. Forest restoration is the physical activity required to manage these forests, including the removal of invasive species and planting and maintenance of native plants.

Thousands of volunteers contribute to the care and maintenance of urban forest lands in the Puget Sound. Knowing the success of stewardship efforts is essential for extended planning and lasting conservation results. Long term volunteer stewardship of urban forests is critical for a project's success. The best volunteer stewards take ownership of these lands and prevent invasive species from taking over. As restoration and management activities in urban natural areas gain support, the need to gather data on forest restoration success has followed suit.

For this case study, four models will be compared. The first model is low volunteer training effort (only training day of), all volunteer events run by the city or contractor. The second model is moderate training effort for highly motivated volunteers (less than 20 hours of formal training, Forterra Forest Stewards). The third model is high amount of training for highly motivated volunteers, formal classes and field days (100 hours of formal training, Washington Native Plant Society Master Steward). The fourth model is a non-profit grassroot organizations focused on a specific site, a group of motivated neighbors, wide variety in experience and training and resources. In addition to these four models, this study also looks at work conducted entirely by contractors.

The objective of this study is to analyze the success of the four stewardship models and provide general recommendations to cities looking to create a sustainable urban forest restoration program. This will allow cities with smaller budgets and less flexibility for experimentation to better invest their time, money and expertise when embarking on urban forest restoration projects. The result of the work will be a summary of the information I've collected and recommendations for municipalities.

# Acknowledgements

This project would not have been possible without the support from my capstone mentor, Elizabeth Walker. Her guidance, connections and patience made this all possible. Additionally, I would like to thank all of my interview subjects who were so generous with their time and information. Lastly, I would like to thank Paul Ries, for his feedback and critical questions.

# Introduction

Thousands of volunteers contribute to the care and maintenance of King County's forested parklands. Forest restoration is a multimillion dollar investment across the greater Puget Sound area and the long term success of forest restoration in urban areas is not well understood. Adding to the complexity, urban forest restoration is conducted by local government entities as well as community groups and nonprofit organizations. The groups leading the restoration frequently work with shoestring budgets and are composed of volunteers with varying knowledge, free time and interest. Long term volunteer stewardship of urban forests is critical for a project's success. The best volunteer stewards take ownership of these lands and prevent invasive species encroachment. As restoration and management activities in urban natural areas gain support, the need to gather data on forest restoration success has increased accordingly. Knowing the success of the varying types of stewardship efforts is essential for long-term planning and lasting conservation.

## Background

### What Our Urban Forests Provide

Urban forests provide a serene and aesthetically pleasing environment to both humans and animals in the forms of public spaces and wildlife habitats. They also reduce our carbon footprint and have been linked to numerous health benefits associated with an active lifestyle made possible by more recreational locations within city limits. Exposure to nature and green spaces can reduce stress and improve mental health (Bratman et al. 2012). People who live in areas with a higher percentage tree cover consistently experience decreased occurrences of obesity, better mental health, decreased rate of type 2 diabetes, high blood pressure/stress and asthma (Ulmer et al. 2016). Trees also provide numerous ecosystem services such as stormwater management, reduction and absorption of soil pollution, air pollution, noise reduction and temperature management (Tallis et al. 2011; Bolund and Hunhammar 1999). The benefits these ecosystems provide directly translate to economic benefits, reducing costs associated with pollution removal, stormwater management, carbon sequestration and energy (Ciecko et al. 2012).

### Threats Facing Urban Forests

Urban forests are particularly susceptible to degradation due to their isolation from other natural areas and seed sources, and their close proximity to human impacts. Urban forests also face threats from development, climate change, fragmentation and invasive species.

The Puget Sound is in the midst of a population explosion. From July 1st, 2015 to July 1st, 2016, Seattle had a net gain of nearly 21,000 people (Balk 2017). The Puget Sound is one of

the most rapidly growing regions in the nation. Development within and around urban areas in forested regions can lead to decreases in forest area and fragmentation of forest stands, which can significantly affect plant and wildlife populations, forest biodiversity and health (Nowak et al. 2005). Fragmentation also decreases available seed sources and increases susceptibility to invasive species.

Urban ecosystems are more susceptible to invasive species and often require maintenance following restoration to prevent re-colonization of invasive species (Lonsdale 1999). The most common invasive species threatening urban forests in Puget Sound are *Hedera helix* (English ivy) and *Rubus armeniacus* (Himalayan blackberry). *Hedera helix* is abundant in urban and suburban forests (“Noxious weeds in King County, Washington” 2017). It outcompetes native plants and takes over the forest floor and eventually, the tree canopy. As it grows up trees it adds substantial weight which can threaten the health of the trees. *Rubus armeniacus* is also an abundant noxious weed in the Puget Sound. It thrives in environments with full sun such as along roadsides, open areas and vacant lots (“Noxious weeds in King County, Washington” 2017). It outcompetes native understory vegetation and prevents the natural establishment of native trees. Invasive species have the potential to outcompete native vegetation, decrease natural plant regeneration, and increase tree mortality.

The most unpredictable threat to urban forests ecosystems in the Puget Sound is climate change. The majority of models predict that the Puget Sound region will experience hotter summers and a loss of snowpack (Law and Waring 2015). Research about species tolerance to drought and other possible climate change outcomes is promising but the reality is that we need healthy and resilient forests now to be able to withstand future changes.

Accumulated stress from drought, invasive species and fragmentation can lead to tree mortality and changes in the density and distribution of species (Law and Waring 2015). Human activities have the potential to improve or aggravate the situation. Given the mountain of threats facing urban forests, it’s clear that to maximize the ecosystem services our forests provide, it will require active, consistent and continual management (Clark et al. 1997). One of the goals of the City of Seattle’s Urban Forest Stewardship Plan is to “increase health and longevity of the urban forest by removing invasive species and improving species and age diversity” (*Urban Forest Stewardship Plan*, 2013). Restoration is a key measure in achieving this goal. If Seattle’s forested parklands are not restored, aggressive non-native vegetation will dominate the urban forest. In one hundred years, the native trees in Seattle may be gone and with them, the services they provide (*Urban Forest Stewardship Plan*, 2013).

## Environmental Stewardship

In a paper on environmental stewardship in the Puget Sound, the authors defined environmental stewardship as such: “environmental stewardship in cities engages citizen volunteers in collective action to restore, conserve, or better understand specific environments or landscapes, and simultaneously meets personal health and well-being goals, and achieves healthier social

relationships through community building and collaboration” (Wolf et al. 2011). This definition is important because it provides three key arenas to measure success, listing social, economic and environmental benefits.

### Economic Benefits

A city wide environmental stewardship program has inherent costs but the efforts of volunteers still provide economic benefits. Municipal staff cannot feasibly provide continual monitoring and maintenance of urban forests. In many municipalities in the Puget Sound, urban forests are managed by a combination of governmental agencies, commercial firms and non-profit organizations. The non-profit organizations include Forterra, Mountains to Sound Greenway Trust, the Washington Native Plant Society and Earth Corps. Citizens are often invited to become involved in the restoration of urban forests.

The costs associated with restoration include labor, materials, outreach and administration. A study of the economic value of stewardship activities in King County Parks found that at 17 sampled events the monetary value of volunteers was approximately \$35,700 (Daniels et al. 2014). Independent Sector estimates the value of volunteers by state and found that the 2016 value of volunteer time in Washington state as \$30.04/hour (“The Value of Volunteer Time” 2016). Extrapolating that figure to the full range of restoration and stewardship events in King County, it becomes clear that these volunteer efforts are a significant contribution to the stewardship of our urban forests.

A research paper attempting to model the costs of urban forest restoration in Seattle found that “events where labor was performed by paid contractors were consistently the most costly, but the most productive in terms of acres treated per event. Cost modeling suggests that all else equal, event leader type and steep slopes contribute to greater costs, but costs decline with greater site size and phase of restoration” (Daniels et al. 2014). Volunteers provide an economic benefit to cities and knowing the types of projects they are most cost effective can help cities maximize their economic benefits.

### Social Benefits

Beyond the economic and ecological benefits, there are also health benefits to volunteers from participating in stewardship activities. Forest restoration provides an opportunity to connect with neighbors and the environment in a meaningful way. A study on urban forest volunteers found that “non-environment related motivations, particularly the desires for positive emotions, community, and to socialize are some of the most important reasons why people volunteer to restore and conserve urban landscapes” (Asah et al. 2014). This study was reinforced by research of volunteer motivations in King County parks that found social factors are a big motivator for volunteer participation (Brinkley et al. 2015). It brings together a wide range of ages, knowledge and experience. Walking through parks allows for a visual, auditory and olfactory connection with nature. The social benefits of environmental stewardship are far ranging and often the motivation behind volunteers participation.

## Environmental Benefits

The Seattle Urban Forest Stewardship Plan defines a thriving urban forest as “one that is resilient to invasive species because every ecological niche is already occupied by native species. Efforts to remove invasive species and plant diverse, healthy forests are crucial for the wellbeing of our forested parklands and other open spaces” (*Urban Forest Stewardship Plan*, 2013).

Beyond removing invasive species, urban forest restoration also takes into account forest succession. A study of the baseline ecological information about all of King County’s forested parks and natural areas found a prominence of red alder (*Alnus rubra*) and big leaf maple (*Acer macrophyllum*) (Ciecko et al. 2016). Both species are relatively short lived which, without a readily available seed source, will leave the door open for these strands to transition into non-forested parcels. This in turn provides an ideal habitat for invasive species to thrive. When an urban forest can support them, new conifer plantings will increase the forest diversity and resilience to invasive species.

A study on the link between volunteer efforts and ecological changes in Seattle found there is a positive correlation between volunteer efforts and invasive species removal but non-invasive vegetative cover and species richness have not yet demonstrated the same trend (Bazinet 2014). Restoration efforts are having a positive impact on the urban environment as a whole and continual stewardship has promising benefits. A resilient urban forest that is resistant to invasive plant species and stout in the face of climate change has the potential to provide a habitat for our native vegetation and wildlife.

## Models of Comparison

Nonprofits and municipalities have created different programs for cultivating long term urban forest stewards, varying in engagement, education and organizational structure. Four models of environmental stewardship and additionally professional contractor work were compared.

**Contractor Work:** Forest restoration work carried out at the direction of city staff but entirely by paid contractor crews. Examples from the Puget Sound include EarthCorps, DirtCorps, Garden Cycles, Washington Conservation Corps

**Model 1:** Professionally led volunteer events. This model requires very little training for volunteers and all events are run by the city or a contractor.

**Model 2:** This model involves moderate training effort for highly motivated volunteers who are interested in committing to a specific park. There is less than 20 hours of formal training. Forterra’s Forest Stewards program that they adapt to individual cities is an example of this.

**Model 3:** High amount of training for highly motivated volunteers, formal classes and field days. This model involves 100 hours of formal training. Washington Native Plant Society Master Steward is the program in the Puget Sound that uses this model.

**Model 4:** Non-profit grassroots organizations focused on a specific site or area. Groups vary in their knowledge, interests and experience.

## Methods

### Defining Long Term Success

A successful stewardship of an urban forest includes both community involvement and ecological improvements. The preliminary guidelines are for success are:

1. Decrease in invasive cover
2. Increase in tree regeneration
3. Best Management Practices appear to have been followed
4. Stewardship still actively occurring on at least an annual basis

The Green Seattle Partnership developed a four phase classification system for restoration. these phases are:

- “
- Phase 1: invasive species removal
  - Phase 2: planting of trees, shrubs, or ground cover
  - Phase 3: secondary, or follow up, invasive species removal
  - Phase 4: long-term monitoring on restored sites
  - Phase 5: trail maintenance”
- (Daniels et al. 2014)

The City of Seattle has a publically available map showing the parks and their respective restoration phase by zone. An example map showing Dr. Jose Rizal and Lewis Park is below.



## Green Seattle Partnership Reference Map



This a reference map for use by volunteers, contractors, and staff of the Green Seattle Partnership.

400ft

Pictometry International Corp. 2015

(Green Seattle Partnership Reference Map. 2018)

## Interviews

Six individuals, who have worked with at least one of the stewardship models, were interviewed. I asked about their experiences and insights on what has proven successful and what programs fell short of expectations. These interviews gave me background on program information and valuable insights on what a successful stewardship program looks like.

1. Joy Wood, Master Stewards Program Coordinator, Washington Native Plant Society Master Stewards
2. Teresa Kluver, Parks Operations Supervisor, City of Redmond
3. Lisa Ciecko, Plant Ecologist, City of Seattle
4. Greg Waggoner, Friends of North Creek Forest (Bothell)
5. Nicole Marcotte, Green Cities Program Manager, Forterra
6. Joanna Nelson de Flores, Green Cities Director, Forterra

## Field Study

One of the goals of restoration is to return sites to biologically diverse, ecologically functioning and healthy urban forests. Appropriate metrics to evaluate success in forest restoration include the number of native plant species present, density of invasive plant species and forest

structural diversity. For this project sites were selected based on recommendations from interviewees. These were a range of forested sites which have seen long term restoration, through a variety of groups. In order to determine a site's success, the Green Seattle Inventory Protocols published in 2014 were used. These protocols can be found in the addendum, which include collecting data on site characteristics such as soil moisture and textures, litter depth, canopy cover, and downed woody debris, overstory composition and health and vegetation cover, including plant species and percent cover (Green Tukwila Field Guide, 2017). In addition to the inventory data, I collected data on the amount of volunteer hours, the type of stewardship at the site and whether professional contractors were used.

## Data Analysis/Results

The following two page table provides a summary of the field findings. Detailed descriptions about four of the sites can be found in the project examples section.

**Field Study Table**

Site Name	Acres	Target Ecosystem	Year Restoration Work Began	Stewardship Type	Volunteer Hours	Professional Hours	Critical Areas?	Past Invasive Cover %	Past Regen. Density	Canopy Comp.	Canopy Cover %	Current regen. density	Current Invasive %
Cheasty Mt View NE	1.96	Conifer Deciduous Mixed Forest	2008	Forest Steward Contractor Professionally-led events	2,247 (1,190 were prof. led)	2,971	Steep slopes	high	low	low	moderate	high	low
Cheasty Mt View NW	1.18	Riparian Forest and Shrubland	2011	Forest Stewards Contractor	785	34	Steep slopes	high	low	low	moderate	high	moderate
Church Envelope	2.84	Conifer Deciduous Mixed Forest	2016	Contractor		1,884	Yes	high	low	low	moderate	high	moderate
Idylwood Beach Park B		Conifer Deciduous Mixed Forest	2009	Forest Stewards	2,587		Nearby Stream	low	moderate	high	low	moderate	low
Idylwood Beach Park C		Conifer Deciduous Mixed Forest	2009	Forest Steward	(Combined with B)		No	high	low	high	moderate	moderate	low
Idylwood Beach Park D		Conifer Deciduous Mixed Forest	2009	Forest Steward	0		No	high	low	high	high	low	moderate
Lakeridge Bangor North	1.49	Conifer Deciduous Mixed Forest	2009	Forest Steward Contractor Non-profit	2,099	210	Steep Slopes	moderate	low	low	moderate	high	low
Lakeridge Darrell's Slope	2.09	Conifer Deciduous Mixed Forest	2009	Forest Steward Non-profit	795	2	Steep Slopes	low	low	low	high	high	low
Lakeridge DHC WNPS 2007	2.07	Conifer Deciduous Mixed Forest	2007	WNPS Forest Steward Non-profit	58	2	Steep Slopes	low	low	low	moderate	moderate	low
Lewis Park - North	0.42	Conifer Deciduous Mixed Forest	2007	Forest Steward Non-profit	1,016	112	No	high	low	low	moderate	high	low
Lewis Park - North Slope	0.27	Conifer Deciduous Mixed Forest	2007	Forest Stewards Non-profit	961	182	No	high	low	low	moderate	high	low
Magnuson North Woodland	2.14	Conifer Deciduous Mixed Forest	2009	Forest Steward Contractor	3,306	1,435	No	high	low	moderate	moderate	high	low
Martha Washington Garry Oak Slope	1.25	Oak Woodland	2012	Forest Steward Contractor	1,427	259	No	high	low	moderate	high	high	low

**Field Study Table**

Site Name	Acres	Target Ecosystem	Year Restoration Work Began	Stewardship Type	Volunteer Hours	Professional Hours	Critical Areas?	Past Invasive Cover %	Past Regen. Density	Canopy Comp.	Canopy Cover %	Current regen. density	Current Invasive %
Martha Washington North End Forest	1.13	Conifer Deciduous Mixed Forest	2013	Forest Steward Contractor	1,176	135	No	high	low	moderate	moderate	high	moderate
Trenton & 42nd	1.25	Conifer Deciduous Mixed Forest	2011	WNPS Forest Steward Contractor	4,911	538	No	high	low	low	moderate	high	low
Viewpoint Open Space A	9.4	Conifer Deciduous Mixed Forest	2017	Forest Steward	449		Steep Slopes	high	low	high	moderate	low	high
West Kubota	1.45	Conifer Deciduous Mixed Forest	2011	Forest Steward WNPS Contractor	1,987	871	No	high	low	low	moderate	high	moderate
Westside Neighborhood Park A		Conifer Deciduous Mixed Forest	2009	Forest Steward	2,799		No	low	moderate	high	high	high	low
Westside Neighborhood Park B		Conifer Deciduous Mixed Forest	2009	Forest Steward	(combined with A)		Steep Slopes	high	low	moderate	moderate	high	low

**Legend**

<b>Canopy Composition Value</b> (from FLAT Manual)		<b>Canopy Cover</b>	
High	> 50% conifer/madrone OR ≤50% conifer/madrone with no capacity for restoration (includes wetlands)	(Crown closure estimate, as viewed directly above)	
Medium	1-50% conifer/madrone with capacity to support restoration to H OR <25% native cover with capacity to restore up to 50% conifer	0-39%	Low
Low	< 25% native cover with capacity for full restoration planting OR no conifer/madrone with capacity for full restoration	40-69%	Moderate
		70%+	High
<b>Invasive Cover</b>		<b>Native Tree Regeneration Density</b>	
>50%	High	0-49 trees/acre	Low
5%-50%	Moderate	50-149 trees/acre	Moderate
<5%	Low	150+ trees/acre	High

# Discussion

## Contractor Work

Contractor work tends to be the most efficient and can be beneficial in more complex cases. However it does not always provide an avenue for community engagement, which is a component of urban forest sustainability.

Contractors can be used for types of work that volunteers can not do such as herbicide applications, working on steep slopes and maintaining complex trail structures. Research within the City of Seattle parks found that the application of herbicide was one of the most successful intervention factor for restoration success (Bazinet 2015). Additionally many green spaces are steep slopes which are not safe for volunteers to work on. Contractors wear harnesses and use ropes which is not reasonable for volunteers and introduces an additional layer of liability. Beyond this, complex trail elements such as boardwalks, drainage structures and bridges are often built by contractors. Another aspect where contractors may be preferred is when access is an issue or access is restricted for volunteer groups.

The City of Redmond utilized a large amount of contractor work in their first few years as a way of showing the community significant progress quickly (Kluver, 2018, personal interview). This is an example of how contractor work can link with engaging the community.

The Duwamish Infrastructure Restoration Training (DIRT Corps) is a unique contractor service. DIRT Corps was established in 2015 to provide on-the job training for young adult workers, with a specific interest in recruiting women, military veterans and people of color. Rather than pay for school, their students earn a stipend. Their training program offers four 11-week sessions each year with focuses on green infrastructure, urban forestry and ecological restoration (Simpson 2016). The students meet one evening a week for a class and work one day a week on a project related to green infrastructure. "The program provides hands-on training with a focus on rain garden and cistern design/build, operations and maintenance (O&M), vegetation management, and ecological restoration" (Simpson 2016). This is a unique model of contractor work that connects with the community, but rather than encourage volunteer stewardship, they support worker training. DIRT Corps also runs some volunteer events to connect with the community.

In 2017 in Seattle, 159 acres were cleared of invasive species by professional crews. Over that same time frame, 14.3 acres were cleared of invasive species by volunteers (Green Seattle). The Green Seattle Partnership (GSP) has a goal of restoring 2,500 acres of forested parklands by 2025. Seattle is relying heavily on contractor work to carry out a lot of this work.

Contractor often lacks community engagement but there are exceptions to this and unique organizations such as DIRT Corps, are a great example of that.

## Model 1: Professionally Led Volunteer Events

Professionally led events require a low up-front investment from a municipality. As the name implies, these events are volunteers led by professionals. This can either be done by the municipality or a contractor. It's a great way to bring in new people and expose them to an area of their city they may never have been to through a restoration event. The downside is these events are the most costly type of volunteer event. A study done in the City of Seattle found that the professionally led volunteers costs the city approximately \$12.00 / hour (Bazinet 2015). The average cost for a Forest Steward led event (Model 2) was estimated at \$5.00. This includes the staff support, training, tools and outreach that makes up the program (Bazinet 2015).

Currently Tacoma has most of their volunteer restoration events run by Earth Corps (Nelson de Flores, 2018, personal interview). Earth Corps recruits volunteers and its paid staff members lead volunteer teams and organize efforts, with the restoration design done by the city or contractor. These types of events have the lowest barrier of entry for volunteers, requiring no prior experience and only providing minimal training.

While these events require only training day of, they tend not to offer pathways to unsupervised long term stewardship.

## Model 2: Forterra Forest Stewards

The Forest Stewards program was started in Seattle with the formation of the Green Seattle Partnership (GSP). In 2004, the GSP was formed in response to growing concerns from citizens about the health of Seattle's urban forests and a need for an organizing body (FLAT Field Manual: The Forest Landscape Assessment Tool. 2013). The GSP coordinates restoration efforts between interested citizens with the Department of Parks and Recreation, Public Utilities, and the Office of Sustainability and the Environment (Urban Forest Stewardship Plan 2013). Forterra was hired as a contractor to help with this organizing effort. After Seattle, Forterra adapted this model to team up with eight other cities; Redmond, Kirkland, Kent, Puyallup, Everett, Tacoma, Snoqualmie and Tukwila. These cities are called Green Cities, and each individual city's program is called Green [City's Name].

The Green Cities program includes a 20-year Forest Management plan and the creation of a Forest Stewards program. All of the cities follow the model of volunteers being Forest Stewards for a specific park or other urban forest. Some stewards have unique areas that aren't traditional urban forests, such as a traffic circle or trail edge. The thread that connects all of the sites is that they have trees or the potential for native trees and a native understory. The goal of these sites is a healthy urban forest of any size. Depending on the size of the site and levels of interest, there may be as many as ten stewards for a specific urban forest.

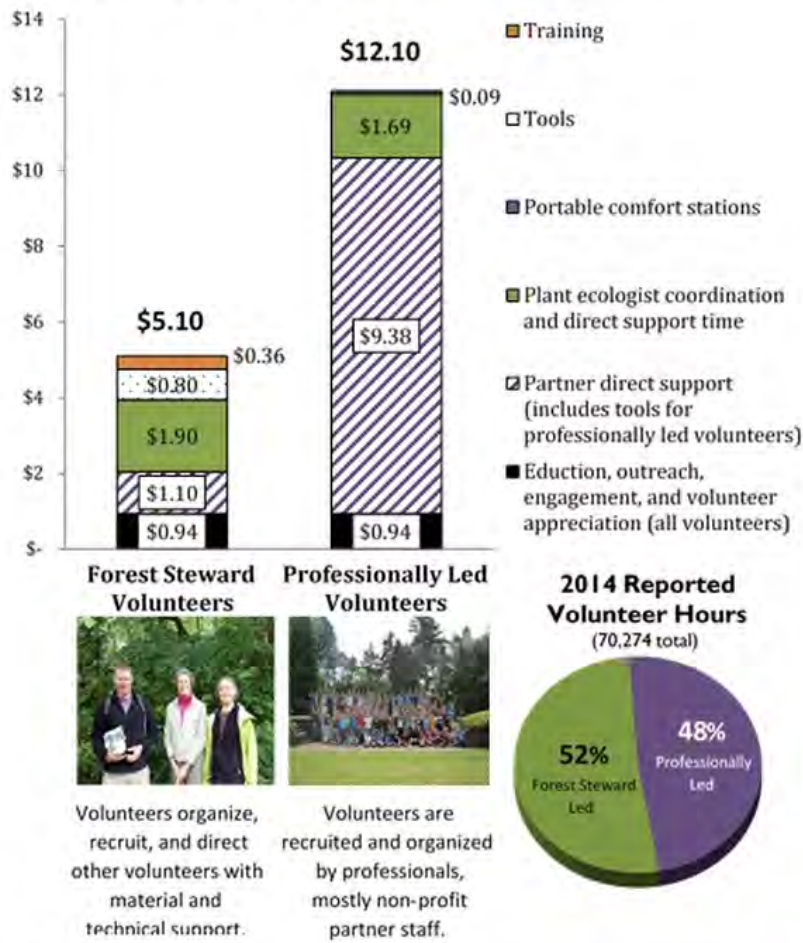
Each city has their own unique challenges and has a different strategy for training and fostering their Forest Stewards program. In Redmond, the typical training is a half day in the classroom

followed by 1:1 training at restoration events (Marcotte, 2018, personal interview). Seattle does a two day training followed by some assistance at events (Ciecko, 2018, personal interview). Both cities offer additional training programs throughout the year for their Forest Stewards. The design of the restoration site comes from the city, with input from their Forest Stewards. Forterra curated a list of Restoration Protocols to help guide the plan development and implementation. Each year the Forest Stewards and the city representative meet to create their annual plan for their forest.

Success of a Forest Stewards program varies based on the city's personnel, outreach efforts and demographics. Demographics can have a huge implication for the success of a program like this. In the City of Snoqualmie, a new and very successful Green Cities program, Forterra did a study of the demographics. They found that compared the other Green Cities, Snoqualmie has the highest % population increase since 2010, the highest % of population under 18, the lowest % of people under 65 and the highest median income (Nelson de Flores, 2018. Personal interview). This is a rapidly growing city, with a lot of young families and a wide base of potential donors to support the program. Through the use of this demographic information the city can tailor how it reaches out to the citizens and better estimate how many Forest Stewards can be expected to join.

In terms of cost, restoration events hosted by Forest Stewards are less costly than professionally led events. A study in Seattle found that “the average cost to the city for a Forest Steward volunteer is approximately \$5/hour, including all of the training, staff support, education, tools, and outreach that goes into that program. Meanwhile a professionally led volunteer costs the City about \$12/hour. Both of these types of volunteers are far less expensive on a per hour basis than professional staff, who clock in at closer to \$40 / hour ” (Bazinet 2015).

**Estimated Cost of an Average GSP Volunteer Hour**



Source: 2011 – 2014 Green Seattle Partnership work logs and Seattle Parks & Recreation expenditure database

(Bazinet 2015)

Another similar program to the Forest Stewards in this region is the Earth Corps Puget Sound Stewards. The Earth Corps Puget Sound Stewards model involves one info session, three field trainings, adoption of an EarthCorps-managed restoration site and a commitment to 25 additional volunteer hours throughout the year (EarthCorps website). EarthCorps Puget Sound Stewards differ from Forest Stewards because they focus on aquatic sites and are typically along estuaries, rivers and beaches.

This model has the advantage of being relatively low cost, having a low barrier to entry and providing volunteers with the resources and guidance for effective long term forest stewardship.



### Model 3: Washington Native Plant Society Master Stewards

The Washington Native Plant Society (WNPS) Master Steward program was created in 1996 by the Central Puget Sound Chapter of the WNPS and the Washington State University Cooperative Extension, King County. From the WNPS website, “in exchange for receiving extensive training, all stewards commit to serve for at least 100 hours over 12-18 months to restore a section of a local park and with the local WNPS chapter in education, research or other roles” (Washington Native Plant Society, 2016). The extensive training includes forest restoration techniques, recruiting volunteers, plant identification, Puget sound ecology, site planning and project management. As of December 2015, “24 training classes have been completed with 562 steward graduates who have contributed more than 145,000 volunteer hours to their local communities and statewide native plant and native plant habitat conservation, education, advocacy projects” (Washington Native Plant Society, 2016). Beyond learning restoration techniques and trainings, the program seeks to motivate volunteers to become stakeholders in the education, preservation, and restoration of native plants and their habitats.

Master Stewards are teamed up to work on a specific restoration site with an average of three other Master Stewards. Each year they work in a different city or grouping of cities. For 2018 the city will be Seattle, and for 2017 the city was was Shoreline. The Master Stewards sign a one year contract with a city, not a long term partnership. Master Stewards go through the design and implementation of restoration at a particular site. It’s a great program for volunteers who are looking to dive deep into restoration ecology and design. The trainings are on weekdays so this program does not work well for people who work traditional jobs. WNPS does not track which volunteers have remained at their site.

One of the drawbacks of the WNPS program is the lack of a consistent staff member to serve as the contact point for the Master Stewards. The program coordinator is a contractor position and has, at times, gone unfilled for months or even years. The Master Steward program also doesn’t provide tools and plants, leaving the city to pay for the course and possibly the plants and tools as well.

WNPS Master Stewards is not a model for long term stewardship. It’s high barrier of entry for potential stewards and the Stewards are not necessarily paired with hyperlocal sites. The program is great for interested people to dive deep into ecology and design and could work well in a larger ecosystem of programs but is not a stand alone replicable model for stewardship. Seattle did a great job of blending the work of Master Stewards into their larger Green Seattle program to ensure continuity and avoid backsliding.

## Model 4: Non-profit Grassroots Organization

The Puget sound has a plethora of non-profit grassroots organizations that are focused on conserving and restoring our urban forests and open spaces.

The Friends of North Creek Forest (FNCF) is an example of a very successful non-profit grassroots organization. They managed to purchase a piece of land from a developer and transferred its ownership to City of Bothell. The FNCF partnered with the University of Washington Restoration Ecology Network (UW REN) which paired students with the FNCF to conduct restoration projects on site. All restoration project designs and implementation have been conducted by UW REN students (Waggoner, 2018, personal interview). The FNCF has an board of directors, a staff member and four committees (education, stewardship, research and development). They've capitalized on their members unique skills whether it be technical expertise, storytelling, relationship building or community engagement. Now that the City of Bothell owns the property they have additional resources and staff hours available.

A successful Friends of organization is a grassroots movement, often rallied around a captivating site. This type of organization could not be created by a city but would benefit from city support. Some limitation include little oversight from the municipalities, secure funding and a clear order of succession. Without a large group of organized and engaged individuals, the Friends of organization could dwindle after pivotal leaders depart. Friends of the Duwamish Hill Preserve in Tukwila experienced this when their organizations leader moved out of state (Nelson de Flores, 2018, personal interview).

The Friends of Lewis Park (FoLP) utilized all available resources; city support, grants, neighborhood donations, and volunteer hours (Friends of Lewis Park). When the Green Seattle partnership began, this group was able to receive additional funding, guidance and resources.

A successful non-profit grassroots organization has the potential to engage the community and to enact real change. With additional resources from the city, these groups can flourish. They must be prepared for adversity though, because without succession planning and support from the city their enthusiasm and efforts could go wasted.

## Project Examples

The following are examples of successful sites that used different models of stewardship. All of the sites used a combination of techniques.

### Example Site #1: Lewis Park, City of Seattle



Lewis Park before and after restoration, photo courtesy of Forterra

Lewis Park urban forest restoration work has seen a mix of contractor, non-profit grassroots organization and the Seattle Forest Stewards program work. Lewis park is a 5.2 acre site in Seattle that was donated to the City of Seattle in the 1910's by W.H. Lewis (*Friends of Lewis Park Natural Area*). In 2007, the Friends of Lewis Park (FoLP) began weekly restoration efforts. FoLP is an all-volunteer group that works to restore and maintain Lewis Park. These efforts were included into the Green Seattle program and FoLP was granted funding and given support to begin restoration when the Green Seattle Partnership began (*Friends of Lewis Park Natural Area*).

The site is broken into eight management units, seven of which have a long term goal of a mixed hardwood conifer forest. The final unit is intended to be a mix of native and non-native trees. Prior to restoration the hardwood dominant forest was overrun with invasives, primarily *Helix hederata* (English ivy) and *Rubus armeniacus* (Himalayan blackberry). At this point most of the management units are either in phase 4 - monitoring and maintenance or phase 3 - establishment. Only one unit has invasive cover in the moderate range. Every management unit has new conifer trees and shrub plantings. The steep slopes have been purged of invasives by contractors, who also build a new elevated path in 2017 to provide a continuous trail through the steepest areas. This previously overrun, inaccessible and unhealthy urban forest now has the potential for long term recreation opportunities and a sustainable urban forest. With guidance and support from the Green Seattle Partnership and with funding from multiple sources such as the Department of Neighborhoods and the King Conservation District, Friends of Lewis Park

(FoLP) continue to host volunteer restoration events throughout the year (*Friends of Lewis Park*). Numerous community volunteers and businesses have generously contributed their time to transform this once trashed and overgrown forest into a healthy and accessible urban forest. Without the Green Seattle Partnership, ample funding and motivated community members this project would not have been available. Future plans for this park include a new outdoor education amphitheatre to broaden the array of opportunities at this park.

## Example Site #2: West Kubota, City of Seattle



West Kubota site - hardwood dominant forest with new conifer and shrub plantings

West Kubota is piece an urban forest adjacent to Kubota Gardens, a traditional Japanese garden that draws in a lot of visitors. The urban forest has the potential for a developed trail system to entice the crowds of people who visit Kubota Gardens. The forested area has some social trails but not a constructed trail system yet. The site is a deciduous forest with big leaf maple and red alder dominating the overstory. Prior to restoration occurring the entire site had high invasive cover with English ivy (*Helix hederata*) and Himalayan blackberry (*Rubus armeniacus*) dominating the understory.

Invasive species have been removed and new conifer trees and shrubs were planted with restoration work starting in 2009. The Kubota West site is 1.45 acres in size, relatively flat and surrounded by steep and riparian areas. The harder to access areas have had work conducted by contractors. There are still invasives on management units within Kubota and adjacent to the site. Within 100' of West Kubota I observed English holly (*Ilex aquifolium*) and Portugal laurel (*Prunus lusitanica*). Even further from the site, there is English ivy (*Helix hederata*) and Himalayan blackberry (*Rubus armeniacus*).



### Example Site #3: 42nd and Trenton, City of Seattle



42nd and Trenton - Invasive species were removed, new conifer and shrub plantings

42nd and Trenton is a 1.25 acre site in South Seattle. The project started in 2011 by a group of four volunteers as their WNPS Master Stewards site. A project started by WNPS which was rolled into the Forest Stewards program after it's completion. This group has been very active and some still volunteer at the site.

The site is a hardwood dominant forest. *Acer macrophyllum* (big leaf maple) is the dominant tree species followed by minor components of *Thuja plicata* (Western red cedar) and *Pseudotsuga menziesii* (Douglas fir). The groundcover was almost entirely *Hedera helix* (English ivy) which had grown up the trunks of all of the *Acer macrophyllum* trees (Hall et al. 2011). There was also *Rubus armeniacus* (Himalayan blackberry) on the site and the occasional native shrub (Hall et al. 2011). In addition to invasives species, there was also a lot of trash on the site. Many large tree failures on the site which have provided down woody debris and naturally structural diversity to the forest.

The invasive species were removed in 2011 and 2012. New coniferous trees and shrubs were planted in the fall of 2012. New soft surface trails were constructed. There is a lot of signage about the work that is occurring.

## Example Site #4: Idylwood Park, City of Redmond



Idylwood Park Unit C: Establishment Phase and Unit D: Not in restoration  
Both sites had similar understory and overstory composition prior to restoration

Idylwood Creek is a park with a mix of native forest and landscaped park areas. 6.84 acres of the park are forested. The park is adjacent to Lake Sammamish and Idylwood Creek runs into the lake. The forests are a mix of native hardwood and conifer trees. The dominant species are *Populus trichocarpa* (black cottonwood), *Pseudotsuga menziesii* (Douglas fir) and *Acer macrophyllum* (bigleaf maple).

Restoration began in 2009, with the start of the Green Redmond Partnership. Prior to restoration, 4.2 acres of the park had more than 50% invasive cover. The Forest Steward for this site previously worked as a teacher at Audubon Elementary School and has brought it many groups of students and teachers from this school to volunteer (Marcotte, 2018, personal interview). The Forest Steward also regularly brings Whale Scouts and Bellevue College Occupational Learning Services Group to volunteer (Marcotte, 2018, personal interview). This site is a great example of partnerships schools and nonprofits, combined with an enthusiastic Forest Steward can be successful. Beyond this, this site has also had professionally-led events done by Earthcorps.

Since the inception of the Green Redmond Partnership and the creation of Forest Stewards, Idylwood park has had 2,587.5 hours of volunteer work. 6.53 acres of Idylwood Park are now enrolled in restoration.

# Recommendations

Based on the research papers read, interviews conducted and field work results, the following are recommendations for long term urban forest stewardship success.

## **Start with Good Design**

Elements of restoration design and implementation strongly contribute to a sites success. A study in the Puget Sound region on ecological restoration projects by University-Community partnership found that the following factors contribute to long term restoration sites success; design elements that reduce maintenance needs, the thoroughness of the site preparation, engaging the nearby community and providing clear guidelines for the maintenance of the site (Wood et al. 2017). Good design can lower long term restoration maintenance requirements, both in terms of volunteer hours and costs.

## **Find a Champion**

Someone at the government level who is passionate about the program, hopefully more than one (Nelson de Flores, 2018, personal interview). This person can garner support and advocate for the program within the government and the community. The most effective programs have multiple people actively promoting and supporting them. This also allows for smoother succession in the event someone moves or retires. A perfect example is Phil Bennett, the City Arborist for Snoqualmie. He advocated for an urban forest stewardship plan, helped craft a volunteer strategy and recruited forest stewards. The City of Snoqualmie program is in its infancy and already has one of the highest ratio of forest stewards to residents of any Green city. An effective advocate can go a long way.

## **Foster Partnerships**

Successful partnerships can make or break an urban forest restoration project. Finding and engaging stakeholders and potential partners is a critical first step for an urban forest restoration project. It is important to research and capitalize on groups and resources that may be already available as well.

The Friends of North Creek Forest (FNCF) partnership with the University of Washington (UW) was instrumental in the project's success and long term potential. They partnered with the University of Washington Restoration Ecology Network which paired students with the FNCF to conduct restoration projects on site. The restoration project designs and implementation have been conducted by students exclusively. Multiple professors from the UW have joined the FNCF board and offer technical restoration and educational support. Without the support of UW, the FNCF would not have been able to start their restoration or education work (Waggoner, 2018. personal interview).

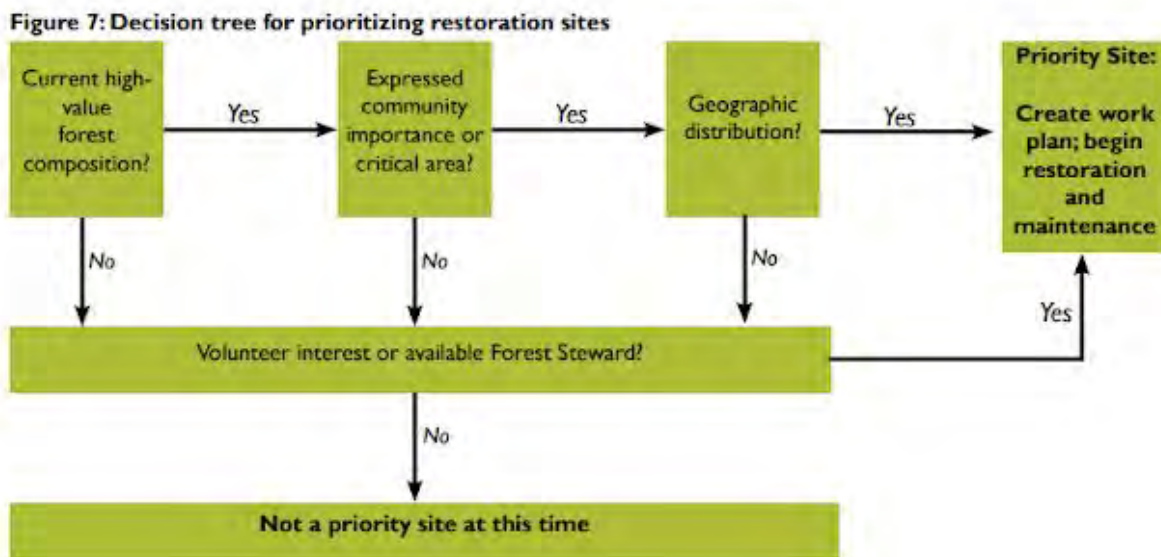


When the City of Redmond started their Forest Stewards program, the Parks Operations Supervisor, Teresa Kluver, convinced city council members to become Forest Stewards. The city council members involvement played a major role in the program's success. Funding and political support comes easily to this program now. Partnering with members of city council and other government departments can be a major advantage for fledgling and established restoration programs alike. A shared city-wide vision of urban forests and support from council members can better facilitate urban forest sustainability.

Another partnership success story comes from Redmond. The Rotary Club of Redmond will be adopting a forest and committing volunteer hours. In return, signage advertising the Rotary Club will be placed at the park (Marcotte, 2018, personal interview). Partnering with schools, other non profits or even businesses can increase available resources both in time and volunteer power and aid long term urban forest sustainability.

### Keep it Local

In the City of Redmond, staff found that restoration sites should be selected based more on volunteer interest rather than the ecological potential of the site (Kluver, 2018, personal interview). The following diagram from the City of Redmond's 20-Year Forest Management Plan illustrates this point.



(20-Year Forest Management Plan, 2009)

All of the interview subjects felt that stewards who live close to their site tend to volunteer there longer. Consider recruiting and pairing stewards with forested parks near where they reside. Ideally these stewards will plan on staying put and aiding restoration in their park long term.



Beyond selecting for local stewardship, also consider examining local demographics. The City of Snoqualmie is a good example of how demographics can influence a urban forest program. Snoqualmie, being a growing city with a lot of young families, has a wide base of potential donors and volunteers for their program. The city used this information to help engage this younger members of the city at large and get them involved in their program with a large degree of success.

Demographics can have a huge implication on how outreach should be conducted and how many stewards a city can expect. If there is less initial interest in long term stewardship, considering running more professionally led events to begin to develop interest in the city. Urban forest restoration is a relatively new field for a lot of people and events with low barriers for entry can be a great way to develop future stewards.

### **Consider Motivations**

People volunteer for a wide array of reasons, many of which may be entirely unrelated to sustainable urban forests. In order to retain and recruit volunteers we need to understand why people volunteer and why they continue to restore and conserve the urban landscape. New research on urban forest volunteer motivations is emerging, particularly in the Puget Sound. Research of volunteer motivations in King County parks found that social factors are a significant motivator for volunteer participation (Brinkley et al. 2015). “Non-environment related motivations, particularly the desires for positive emotions, community, and to socialize are some of the most important reasons why people volunteer to restore and conserve urban landscapes” (Asah et al. 2014). Considering what motivates volunteers can help guide the way you reach out and engage them in the restoration events.. Using language like “connect with your neighbors” and “community building” can really strike a chord with potential volunteers who want to become an active member of their community or just make new friends. In many cities stewards have formed communities and some even interact outside of restoration. It’s not just about stewardship of the land but also forming strong communities who own and care about the land.

Beyond social reasons, volunteers also like to visually see that they are making a impact. Most new forest stewards in Seattle want sites where they can take the site from restoration phase 1 to phase 4 (Ciecko, 2018, personal interview). This sites can be hard to come by, many sites still in phase 1 are on steep slopes or in a difficult area to access. Even if a steward doesn’t have a site that starts in phase 1, show them how their work has made a difference.

The factors driving stewards to care for the earth long term may not always be apparent. Research is showing the importance of community building for stewards to become involved long term. Something as simple as grouping stewards together for events or sites is a way to facilitate positive social experiences.

## **Hire Contractors**

Depending on a city's budget or initial steward interest, using contractors can be an effective way to conduct work stewards can't reasonably do. Beyond just doing the work, restoration contractors can be used for recruiting volunteers and running events as well.

Lewis Park is a great example of contractor work in conjunction with Forest Stewards. Contractors were employed to work on the steep slopes, erosion control and the new elevated walkway. Volunteers removed invasives and planted new seedlings in the flat and moderately sloped areas. Without the contractor's work, the invasive species would more easily move into the areas cleared by volunteers. Long term restoration success means seeing outside your site and considering other pressures on the urban forest.

Another example of a situation to use contractors is for professionally led events. Depending on the demographics of the city, it may be difficult to recruit long term stewards but easier to get single day volunteers. If this is the case having contractors lead events could be a good starting point to identify which volunteers may be interested and available in becoming long term stewards.

In 2017 the City of Seattle enrolled 173.3 new acres in restoration. 159 of these acres were completed by professional crews (Green Seattle Partnership website). Only 8% of the added acres were restored by volunteers. Of course, volunteers who completed acres on the planting, establishment or monitoring phase of this were not included in that number. To meet the City of Seattle's goal of restoring all 2,500 acres of Seattle's parklands by 2025 contractors will be necessary. Seattle has 170 forest stewards and including all volunteers, saw 78,666 volunteer hours in 2017 (Green Seattle Partnership website). While volunteers are a huge component of success but the work contractors have accomplished should not be diminished. If a city has very ambitious goals and a long way to go, hiring contractors may be a necessary part of the solution.

Research within the City of Seattle parks found that the application of herbicide was one of the most successful intervention factor for restoration success (Bazinet 2015). Herbicides are not applied by volunteers so for this restoration method, use of professional staff is required.

It is highly unlikely that a city can meet aggressive restoration goals without the use of contractors. Stewardship programs engage and empower citizens and should be a part of any urban forest restoration program. Depending on a city's goals and current state of the forests, contractor work can make for a great addition. Often contractors build trails which increase public access to an urban forest which can encourage volunteers who want more recreational space.

## **Encourage and Support Stewards**

Staff support plays a pivotal role in a successful restoration effort. Volunteers rely on staff for many things, including supplies, strategies and logistics. Redmond and Seattle use a mix of city staff and Forterra staff as points of contact for their Forest Stewards. Both Teresa Kliver of the City of Redmond and Lisa Cieko of the City of Seattle expressed their desire to provide even more staff support for their stewards. They both found it easy to provide plants and tools to stewards but much more difficult to provide personnel because of the lack of staff availability. This all goes to show that a successful volunteer restoration project can be greatly encouraged by support from the municipality.

One of the drawbacks of the WNPS program is the lack of a consistent organization staff member who also serves as the contact point for the Master Stewards. The nature of the position, being contracted, leads to long stretches of time where the position remains vacant. Having a reliable and effective point of contact is a great benefit to any sustainable urban forest stewardship program.

Supporting stewards through educational opportunities, resources, events and even awards goes a long way to keeping them around and building community. Appreciation events show stewards how valued they are and facilitate communication between other stewards. Annual on-site planning meetings between stewards and municipalities keep efforts on track and allow the city to monitor site progress and maintain relationships.

A successful long term stewardship program recognizes the valuable asset their volunteers provide and supports their stewards with resources, guidance, education and recognition.

## **Model for Successful Long Term Stewardship**

Based on the interview and field work I conducted there is not a strong correlation between the amount of formal restoration education a steward receives and the long term stewardship of a site. If the desire is to have neighbors who are empowered to care for their local parks, the best model would be to provide education opportunities throughout their experience as part of the continued engagement.

A successful stewardship program engages a diverse range of community members, supporting them with ample resources, and providing them with opportunities for learning and leadership. A successful steward doesn't need 100 hours of training if they have support from the city and their community of stewards. Stewards long term commitment to an urban forest can keep project momentum high, build community resilience and foster ownership of their public spaces.

A well organized city with resources and support will be the best able to retain long term stewards, regardless of the type of model used. The best stewardship programs pair stewards with sites very close to where they live and connects them with more knowledgeable stewards or staff members.

## Conclusion

This case study is a compilation of research, interviews and field work. The study is qualitative, has a small sample size, and focused on the Puget Sound. Cities collect data differently and the quality is unknown. Additionally, cost data was not tracked well enough to be included as a comparison for the purpose of this study. As research continues on urban forest stewardship, we will develop a better framework for what long term volunteer stewardship can achieve and which methods are more sustainable.

One of the most encouraging insights from the interviews was how responsive and adaptable all of the programs are. They all continually assess their performance with empirical data and make alterations to improve their success.

In a paper from 2015, a group of scientists advocate consideration of four core principles for restoration;

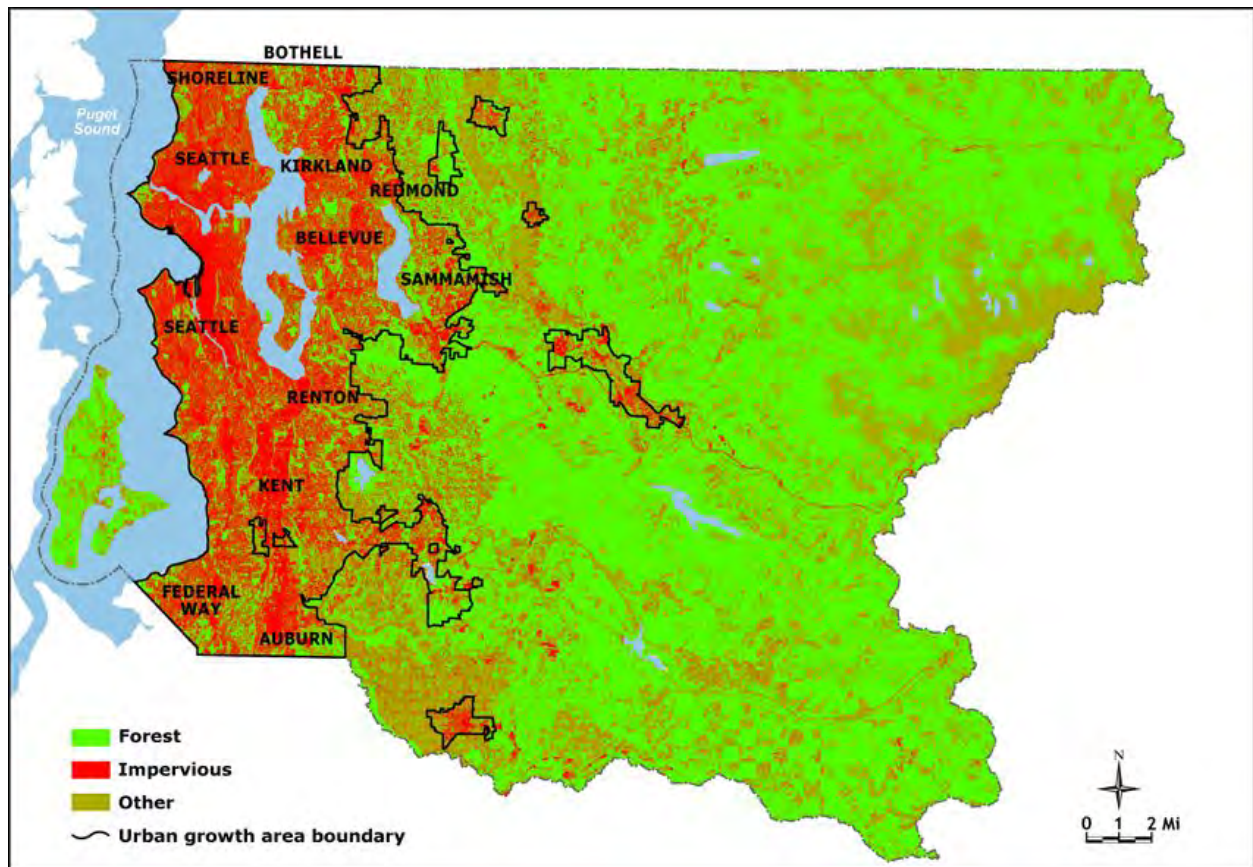
1. Restoration increases ecological integrity
2. Restoration is sustainable in the long term
3. Restoration is informed by the past and future
4. Restoration benefits and engages society

(Suding et al. 2015)

With these principles in mind, it's easy to see how long term urban forest stewardship is such a critical component for urban forest management; both for engaging society and to be sustainable in the long term.

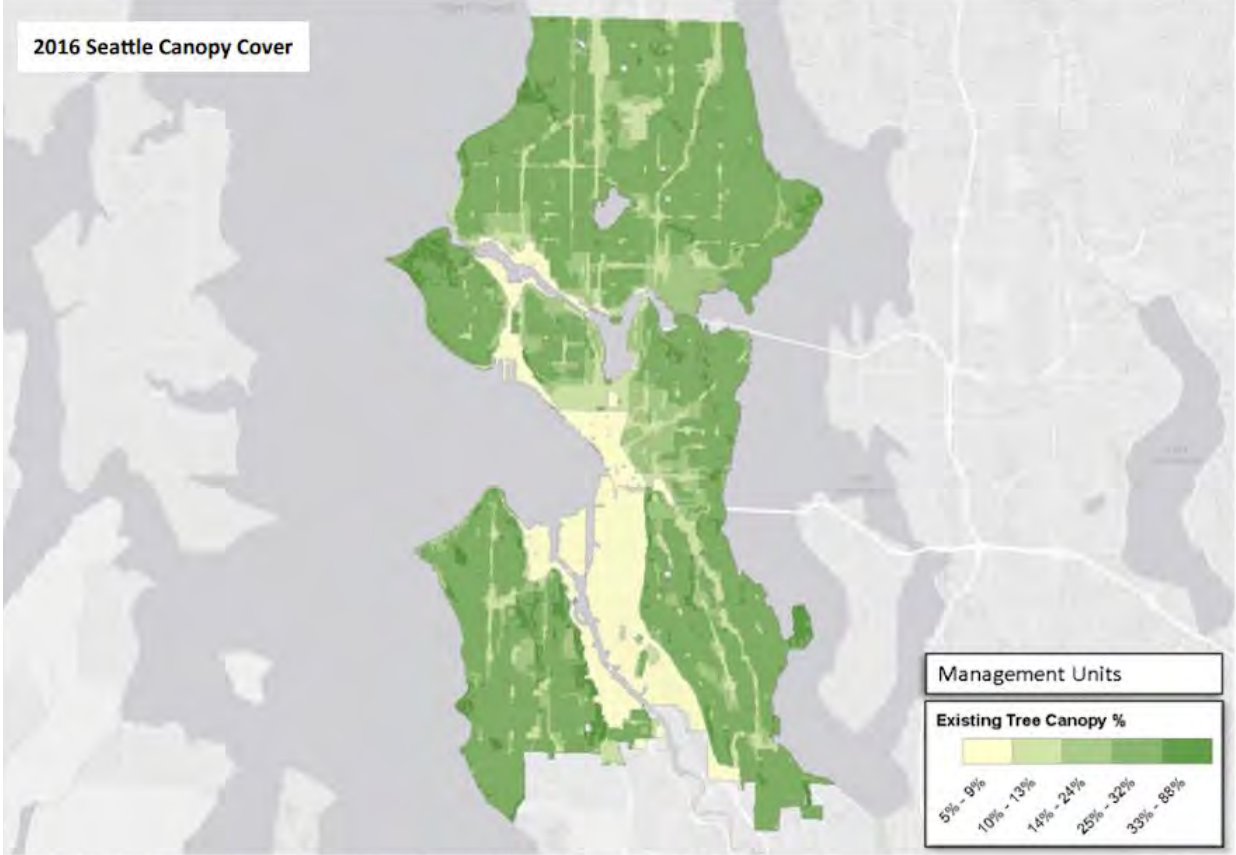
# Maps

Map 1 - King County 2015 Forest Cover



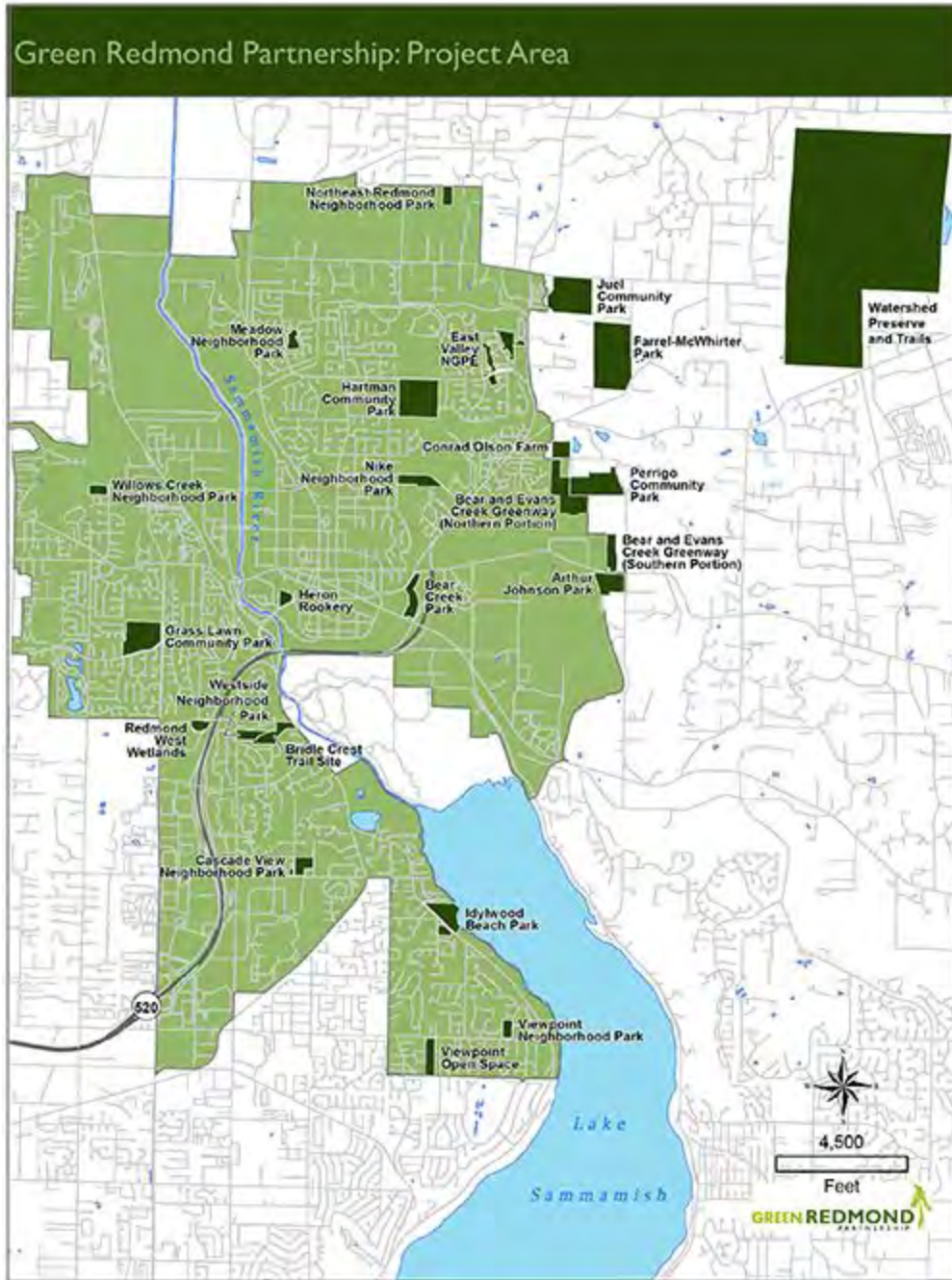
Map 2 - Seattle canopy cover by Urban Forest Stewardship Plan management unit

<http://www.seattle.gov/trees/docs/Seattle2016CCAFinalReportFINAL.pdf>





Map 3 - Green Redmond Partnership Areas



# References

All photos not cited were taken by Kelly Wilkinson

“20-Year Forest Management Plan.” 2009. Rep. *20-Year Forest Management Plan*. City of Redmond.

[https://forterra.org/wp-content/uploads/2015/05/FINAL\\_GRP\\_20\\_YP\\_InDesign\\_FORWEB.pdf](https://forterra.org/wp-content/uploads/2015/05/FINAL_GRP_20_YP_InDesign_FORWEB.pdf).

“2014 Research Accomplishment Report.” 2014. Rep. *2014 Research Accomplishment Report*. *Green Cities Research Alliance*.

“2015 Forest cover.” 2015. *KingStat*. King County.

<http://www.kingcounty.gov/services/environment/data-and-trends/indicators-and-performance/kingstat/2015/indicators/land-resources/forest-cover.aspx>.

2018. *Friends of Lewis Park Natural Area*. Accessed February 27. <http://www.lewispark.org/>.

“About the Native Plant Stewardship Program.” 2016. Washington Native Plant Society. March 8. <https://www.wnps.org/npsp/about.html>.

Asah, Stanley T., Miku M. Lenentine, and Dale J. Blahna. 2014. “Benefits of Urban Landscape Eco-Volunteerism: Mixed Methods Segmentation Analysis and Implications for Volunteer Retention.” *Landscape and Urban Planning* 123: 108–13.

doi:10.1016/j.landurbplan.2013.12.011.

Balk, Gene. 2017. “Seattle once again nation’s fastest-Growing big city; population exceeds 700,000.” *The Seattle Times*, May 25.

<https://www.seattletimes.com/seattle-news/data/seattle-once-again-nations-fastest-growing-big-city-population-exceeds-700000/>.

Barth, Benjamin James, Sean Ian Fitzgibbon, and Robbie Stuart Wilson. 2015. “New urban developments that retain more remnant trees have greater bird diversity.” *Landscape and Urban Planning* 136: 122–29. doi:10.1016/j.landurbplan.2014.11.003.

Bazinet, Oliver. 2015. “We’ve Crunched the Numbers, and the Result is... Volunteers Rock!” Green Seattle Partnership. October 29.

<http://www.greenseattle.org/weve-crunched-the-numbers-and-the-result-is-volunteers-rock/>.

Bazinet, Oliver. 2014. “Urban Environmental Stewardship in Practice: using the Green Seattle Partnership to examine relationships between ecosystem health, site conditions and restoration efforts.” Thesis. University of Washington.



- Berland, Adam. 2012. "Long-Term urbanization effects on tree canopy cover along an urban–rural gradient." *Urban Ecosystems* 15 (3): 721–38. doi:10.1007/s11252-012-0224-9.
- Bolund, Per, and Sven Hunhammar. 1999. "Ecosystem Services in Urban Areas." *Ecological Economics* 29(2):293–301.
- Bratman, Gregory N., J. Paul Hamilton, and Gretchen C. Daily. 2012. "The impacts of nature experience on human cognitive function and mental health." *Annals of the New York Academy of Sciences* 1249 (1): 118–36. doi:10.1111/j.1749-6632.2011.06400.x.
- Brinkley, Weston, David Kimmett, Kathleen Wolf, Dale Blahna, and Lisa Cieko. 2015. "King County Forested Parklands Forest Structure, Ecosystem Services, and Volunteer Stewardship." Rep. *King County Forested Parklands Forest Structure, Ecosystem Services, and Volunteer Stewardship*. Green Cities Research Alliance.
- Buchner, Derek. 2016. "Examining Restoration Success after Ten-Years of the Green Seattle Partnership: Implementation and Results of the First Phase 4 Verifications ." Thesis. University of Washington.
- Bullock, James M., James Aronson, Adrian C. Newton, Richard F. Pywell, and Jose M. Rey-Benayas. 2011. "Restoration of ecosystem services and biodiversity: conflicts and opportunities." *Trends in Ecology & Evolution* 26 (10): 541–49. doi:10.1016/j.tree.2011.06.011.
- Butler, Brett J, Jennifer J Swenson, and Ralph J Alig. 2004. "Forest fragmentation in the Pacific Northwest: quantification and correlations." *Forest Ecology and Management* 189 (1-3): 363–73. doi:10.1016/j.foreco.2003.09.013.
- Cao, Qian, Ning Sun, John Yearsley, Bart Nijssen, and Dennis P. Lettenmaier. 2016. "Climate and land cover effects on the temperature of Puget Sound streams." *Hydrological Processes* 30 (13): 2286–2304. doi:10.1002/hyp.10784.
- Cieko, Lisa, Karis Tenneson, Jana Dilley, and Kathleen Wolf. 2012. "Seattle's Forest Ecosystem Values," August.
- Cieko, Lisa. 2018. Interview - Green Seattle Model. Personal.
- Clark, James R, Nelda P Matheny, Genni Cross, and Victoria Wake. 1997. "A Model of Urban Forest Sustainability." *Journal of Arboriculture*, no. 23 (January): 17–30.
- Daniels, Jean M., Weston Brinkley, and Michael D. Paruszkiewicz. 2016. "Urban forest restoration cost modeling: a Seattle natural areas case study," January.

Del Tredici, Peter. 2006. "Brave New Ecology." *Landscape Architecture*, February, 46–52.

Dumont, Clayton W. 1996. "The Demise of Community and Ecology in the Pacific Northwest: Historical Roots of the Ancient Forest Conflict." *Sociological Perspectives* 39 (2): 277–300. doi:10.2307/1389313.

"Duwamish Infrastructure Restoration Training Corps." 2018. *Urban Systems Design*. Accessed February 13. <https://www.urbansystemsdesign.com/dirt-corps-program>.

FLAT Field Manual: The Forest Landscape Assessment Tool. 2013. Developed by: King County Parks and Natural Resources and Parks, USDA Forest Service PNW Research Station, American Forest Management, Forterra, and the University of Washington.

"Green Seattle Partnership Reference Map." 2018. City of Seattle. Accessed February 5. <http://seattlecitygis.maps.arcgis.com/>.

*Green Tukwila Forest Steward Field Guide*. 2017. <https://forterra.org/wp-content/uploads/2017/06/Green-Tukwila-Field-Guide-2017.pdf>.

"GSP Forest Steward Survey." 2015. Seattle. HBB Landscape Architecture

Hall, Evelyn, Chris Hoffer, Kory Kramer, and Johanna Striar. 2011. "East Duwamish GS: S. Chicago St: Trenton and 42nd Ave. Site Restoration Plan." [https://www.wnps.org/nps/king/documents/EastDuwamish\\_S.ChicagoSt\\_Trentonand42ndAve\\_SiteRestorationPlan.pdf](https://www.wnps.org/nps/king/documents/EastDuwamish_S.ChicagoSt_Trentonand42ndAve_SiteRestorationPlan.pdf).

Housley, Elizabeth. 2016. "Stewardship motivations, from the local to global." *Green Seattle Partnership*. October 19. <http://www.greenseattle.org/stewardship-motivations/>.

*Inventory Protocols 2014*. <http://www.greenseattle.org/wp-content/uploads/2015/08/Inventory-Protocols-2014-final.pdf>.

Kliver, Teresa. 2018. Interview - Green Redmond. Personal.

Law, B.e., and R.h. Waring. 2015. "Carbon implications of current and future effects of drought, fire and management on Pacific Northwest forests." *Forest Ecology and Management* 355: 4–14. doi:10.1016/j.foreco.2014.11.023.

MacDonagh, Peter. 2011. "The Urban Forest Is Broken: How We Can Enhance 1,000,000 Tree Initiatives to Meet Stormwater Goals." *The Urban Forest Is Broken: How We Can Enhance 1,000,000 Tree Initiatives to Meet Stormwater Goals | Low Impact Development Technology: Design Methods and Case Studies*.

Marcotte, Nicole. 2018. Interview - Forterra and Green Cities. Personal.

McPherson, E. Gregory., Scott E Maco, James R Simpson, Paula J Peper, Qingfu Xiao, Ann Marie VanDerZanden, and Neil Bell. 2002. *Western Washington and Oregon community tree guide: benefits, costs and strategic planting*. Silverton, OR: International Society of Arboriculture, Pacific Northwest Chapter.

Moskell, Christine, Shorna Broussard Allred, and Gretchen Ferenz. 2010. "Examining Motivations and Recruitment Strategies for Urban Forestry Volunteers." *Cities and the Environment* 3 (1): 1–28. doi:10.15365/cate.3192010.

Nelson de Flores, Joanna. 2018. Interview - Forterra Forest Stewards. Personal.

Nowak, David J., Eric J. Greenfield, Robert E. Hoehn, and Elizabeth Lapoint. 2013. "Carbon storage and sequestration by trees in urban and community areas of the United States." *Environmental Pollution* 178: 229–36. doi:10.1016/j.envpol.2013.03.019.

Odion, Dennis C., and Daniel A. Sarr. 2007. "Managing disturbance regimes to maintain biological diversity in forested ecosystems of the Pacific Northwest." *Forest Ecology and Management* 246 (1): 57–65. doi:10.1016/j.foreco.2007.03.050.

Nowak, David J, and Jeffrey T Walton. 2005. "Projected Urban Growth (2000–2050) and Its Estimated Impact on the US Forest Resource." *Journal of Forestry* 103 (8): 383–89.

"Noxious weeds in King County, Washington." 2017. *Noxious weeds in King County, Washington - King County*.

"Puget Sound Stewards." 2018. *EarthCorps*. Accessed February 14.  
<https://www.earthcorps.org/volunteer/puget-sound-stewards/>.

Roman, Lara. 2014. "How Many Trees Are Enough? Tree Death and the Urban Canopy." *Scenario Journal*.

Romolini, Michele, J. Morgan Grove, and Dexter H. Locke. 2013. "Assessing and comparing relationships between urban environmental stewardship networks and land cover in Baltimore and Seattle." *Landscape and Urban Planning* 120: 190–207.  
doi:10.1016/j.landurbplan.2013.08.008.

Roux, Darren S. Le, Karen Ikin, David B. Lindenmayer, Adrian D. Manning, and Philip Gibbons. 2014. "The Future of Large Old Trees in Urban Landscapes." *PLoS ONE* 9 (6).  
doi:10.1371/journal.pone.0099403.

Simpson, Cari. 2016. "Pacific Northwest Clean Water Association Newsletter."

Suding, Katharine, Eric Higgs, Margaret Palmer, J Baird Callicott, Christopher B Anderson, Matthew Baker, John J Gutrich, et al. 2015. "Committing to Ecological Restoration." *Science* 348 (6235): 638–40. doi:10.1126/science.aaa4216.

"The Value of Volunteer Time." 2016. *Independent Sector*. May 31. <https://independentsector.org/resource/the-value-of-volunteer-time/>.

Thorpe, Andrea S., and Amanda G. Stanley. 2011. "Determining appropriate goals for restoration of imperilled communities and species." *Journal of Applied Ecology* 48 (2): 275–79. doi:10.1111/j.1365-2664.2011.01972.x.

Ulmer, Jared M., Kathleen L. Wolf, Desiree R. Backman, Raymond L. Tretheway, Cynthia Ja Blain, Jarlath Pm O'Neil-Dunne, and Lawrence D. Frank. 2016. "Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription." *Health & Place* 42: 54–62. doi:10.1016/j.healthplace.2016.08.011.

*Urban Forest Stewardship Plan*. 2013. *Urban Forest Stewardship Plan*. City of Seattle.

Waggoner, Greg. 2018. Interview - Friends of North Creek Forest. Personal.

Wolf, Kathleen L., Dale J. Blahna, Weston Brinkley, and Michele Romolini. 2011. "Environmental stewardship footprint research: linking human agency and ecosystem health in the Puget Sound region." *Urban Ecosystems* 16 (1): 13–32. doi:10.1007/s11252-011-0175-6.

Wood, Joy. 2018. Interview - WNPS Master Stewards Program. Personal.

Wood, Joy K., Warren G. Gold, James L. Fridley, Kern Ewing, and Dev K. Niyogi. 2017. "An Analysis of Factors Driving Success in Ecological Restoration Projects by a University-Community Partnership." *Ecological Restoration* 35 (1): 60–69. doi:10.3368/er.35.1.60.

Yin, Robert K. *Case Study Research: Design and Methods*. 2nd ed. Applied Social Research Methods Series; v. 5. Thousand Oaks: Sage Publications, 1994.