Climate Change Vulnerability and Response in Seattle's Urban Natural Areas

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Green Seattle Partnership (GSP) was originally conceptualized as a 20-year program to drive recovery of the city's forested natural areas. Now in year fourteen of the restoration effort, Seattle Parks and Recreation, the lead agency for GSP, is undertaking an analysis of current ecological conditions using on-the-ground and remotely sensed data to better understand climate change exposures. This work helps build the program's long-range perspective while offering immediate strategies to help the natural areas adapt to existing and anticipated environmental change.

INTRODUCTION

Green Seattle Partnership (GSP) was originally conceptualized as a 20-year program to drive recovery of the city's forested natural areas. Now in year fourteen of the restoration effort, Seattle Parks and Recreation, the lead agency for GSP, is undertaking an analysis of current ecological conditions using on-the-ground and remotely sensed data to better understand climate change exposures. This work helps build the program's long-range perspective while offering immediate strategies to help the natural areas adapt to existing and anticipated environmental change.

CONTEXT

In the Pacific Northwest, climate change is influencing temperature and moisture regimes, extending drought conditions in summer and shifting precipitation to fall and winter, leading to more intense rainfall events (Snover et al. 2019). Impacts on urban natural areas are already evident in mature tree loss (Betzen 2018, Rippey 2018, Zobrist 2018), and declining tree seedling recruitment (Ettinger et al. 2017). Climate projections indicate that by the end of the century plant hardiness zones may increase half a zone while the climatic suitability for locally adapted conifer species will become more incompatible (Kim et al. 2012). The city's late 21st century climate analog may lie in Portland, OR, approximately 280 kilometers to the south (Fitzpatrick and Dunn 2019).

The City of Seattle's Climate Action Plan (2013) along with the more recent Climate Preparedness Strategy (City of Seattle 2017) provide brief direction on protecting natural areas through increasing stewardship capacity, improving species selection, and extending plant establishment periods, among other key actions. Over the past few years, staff, contractors, and volunteers have increasingly reported issues that were suspected to be related to changing climatic conditions, such as an increase in insect pest damage and increased mortality in certain species (western redcedar and bigleaf maple). GSP's partnership model offers a vehicle for collaboration between volunteer Forest Stewards, partner organizations, and professional crews to creatively adapt on-the-ground actions for improving current and future forest health.

GOALS

- GSP's goal is to restore and maintain 2,750 acres of forested natural areas while simultaneously galvanizing an informed and active community around forest restoration and stewardship (Green Seattle Partnership 2017).
- The expected outcomes for plant material installed as part of restoration efforts include: 1) rapid establishment of native planting sites in 3–5 years, 2) long-term persistence of native plants that contribute to self-renewing processes and future healthy forests, and 3) maintenance of biodiversity to help restore ecological functions and processes in the urban ecosystem.

- A climate change vulnerability analysis informs improvements to GSP best management practices and identifies how ecological processes should be considered beyond GSP's strategic plan timeline, accounting for 21st century climate projections.

APPROACH USED

In 2017, Seattle Parks and Recreation's GSP staff initiated work with Resilient Forestry LLC to assess current forest conditions and to identify strategies for increasing ecological health and resilience in future climate scenarios (Fischer et al. 2018). They utilized data from an annual inventory of restoration sites (Green Seattle Partnership 2014), along with more detailed data from a network of 150 permanent monitoring plots (Green Seattle Partnership 2013), and LiDAR data to produce current condition information for 1,529 management units.

The ecological condition data was then used to rank the following conditions for each management unit: species diversity, climate change vulnerable species, position on the landscape prone to drought and flooding, forest patch size, under-represented forest ecosystems, adjacent properties (edge effect), and forest density. The scores were combined to create an overall climate change vulnerability risk score for each management unit, offering an important opportunity to reflect on projections and consider new adaptation options.
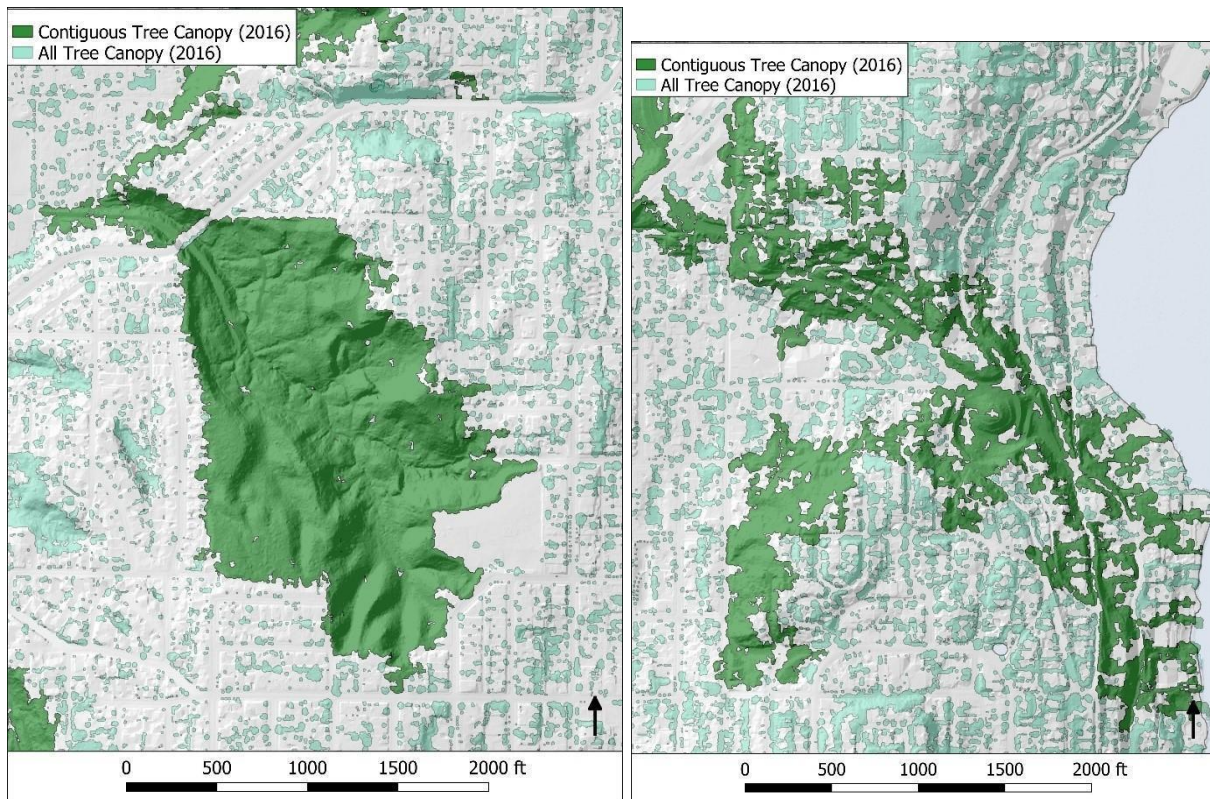

Figure 1. Examples of forested patches with low edge effect (left, Schmidt Park with 66.2 acres and about 22,000 perimeter feet with an area:edge ratio of 132) and high edge effect (right, Lakeview Park, Harrison Ridge Greenbelt, and surrounding forested area with 55.3 acres and over 110,000 perimeter feet with an area:edge ratio of 22) (Image Credit: Resilient Forestry LLC)

GSP is well positioned to help Seattle Parks and Recreation move forward a variety of climate change resistance and resilience actions. Current invasive species management efforts will continue to help build diversity, as will more recent efforts to use ecological thinning to accelerate restoration of long-lived conifer species. In addition, GSP is beginning to source native tree materials from more southern regions to support species through climate transitions.

Building institutional capacity is also crucial to plan for and mitigate climate change impacts. GSP allocates contingency funding for landslide response with crew resources, erosion control, and appropriate plant materials. In addition, prioritizing meaningful engagement with partners and stakeholders early and often to build reciprocity and capacity for climate change adaptation is foundational to GSP. Public education and outreach efforts have been regularly documented via the GSP Blog (https://www.greenseattle.org/?s=climate).

Image 1. Youth participants with GSP removing English ivy and exploring soil health (photo credit: Heidi Rose Watters)

RESOURCES

Funding to carry out analysis and planning work such as climate assessments, as well as restoration activities comes from multiple sources: Capital Improvement Program funding,

including Real Estate Excise Taxes and Seattle Park District (City of Seattle 2014), as well as private donations and in-kind contributions from volunteers and partner organizations. USDA Forest Service has funded previous research that continues to inform efforts (Kim et al. 2014). Seattle Parks and Recreation employs three full-time Plant Ecologists who direct GSP restoration and community programming, and contributed to the vulnerability assessment and ongoing climate adaptation efforts.

The current conditions analysis utilized existing ecological assessment data from an annual inventory (Green Seattle Partnership 2014) and permanent monitoring plots (Green Seattle Partnership 2013) in addition to LiDAR. GSP best management practices are captured in the GSP Forest Steward Field Guide (Green Seattle Partnership 2017), GSP Professional Crew Specifications (Green Seattle Partnership 2019), as well as a handful of other BMP documents collected at www.greenseattle.org.

KEY RESULTS

- The vulnerability analysis indicates 49% of natural area parks have multiple risk factors that impact long-term forest health and resilience. Broadleaf species dominance (69% of natural area parks), particularly bigleaf maple (32% of all tree canopy), presents a long-term challenge due to exposure and sensitivity to climate change in urban locations. Some local tree populations will become less adapted to Seattle's environment as the climate changes. About 10% of natural area acres are high risk because of their percent cover of species that are susceptible to drought, insect and disease mortality, while another 20% of acres are at moderate risk. Common high-risk species include bigleaf maple, western redcedar and western hemlock.
- GSP is moving forward a variety of adaptation actions focused on resistance and resilience to climate change. To prepare for anticipated climate impacts, prioritizing invasive weed removal and long-term stewardship in the city's riparian areas will help maintain these networks of climate and habitat refugia. GSP has completed five ecological thinning projects to help accelerate a transformation from short-lived broadleaf species to long-lived, climate-adapted species native to the Puget Sound Lowlands. In addition, crews and volunteers initiate watering earlier in spring and will extend the establishment periods in challenging sites while also amending soils with fungal/bacteria products.
- GSP is moving forward with expanding plant material sourcing to southern seed provenances —within the current West Coast range of the species. Targeting more southern seed sources may augment diversity of tree populations through the climate transitions.

Image 2. Post hardwood thinning and replanting treatment (photo credit: Lisa Ciecko)

OPEN QUESTIONS

- The impacts of continuing urbanization include fragmenting plant populations. How can genomic tools be better considered and utilized in restoration plantings and strategies?
- Much of the species vulnerability modelling that has happened to date references industrial forestry knowledge and spaces. How have others adapted species exposure and vulnerability modeling to account for current and future urban conditions?
- Acting on seed provenance recommendations requires building relationships with local and regional nurseries to provide desired plant material, seed sources, and genetic diversity. What have other cities done to build this capacity?
- There is a continued need to recognize the ongoing investment of time and financial resources to continue engaging and training staff, crews, volunteers, and stakeholders in changing practices.
- How have other cities succeeded in mainstreaming and integrating climate considerations into existing municipal decision-making processes (e.g. transportation impacts of citywide operations, elevating the natural area restoration into the City-level climate adaptation planning, climate impacts of restoration efforts, and carbon capture mitigation funding)?

- How have other cities acted on the opportunity to increase partnership with other agency experts, researchers and adjacent landowners?
- Seattle's rapid growth means an increase in heavy use of natural areas for both recreation and homeless encampments. How can we better minimize negative human impacts on sensitive restoration sites?
- GSP sites are organized into management units, called zones. Those polygons were originally drawn using existing trails, roads, or other natural features as boundaries. The current conditions analysis uses data by zone to summarize key characteristics. How can we check/improve accuracy of this analysis when the management unit is not consistently applied and, in many cases, includes multiple ecosystem types/conditions?

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