global weirding impacts on our local urban forests

May 2019

climate impact / reference / adaptation tactic

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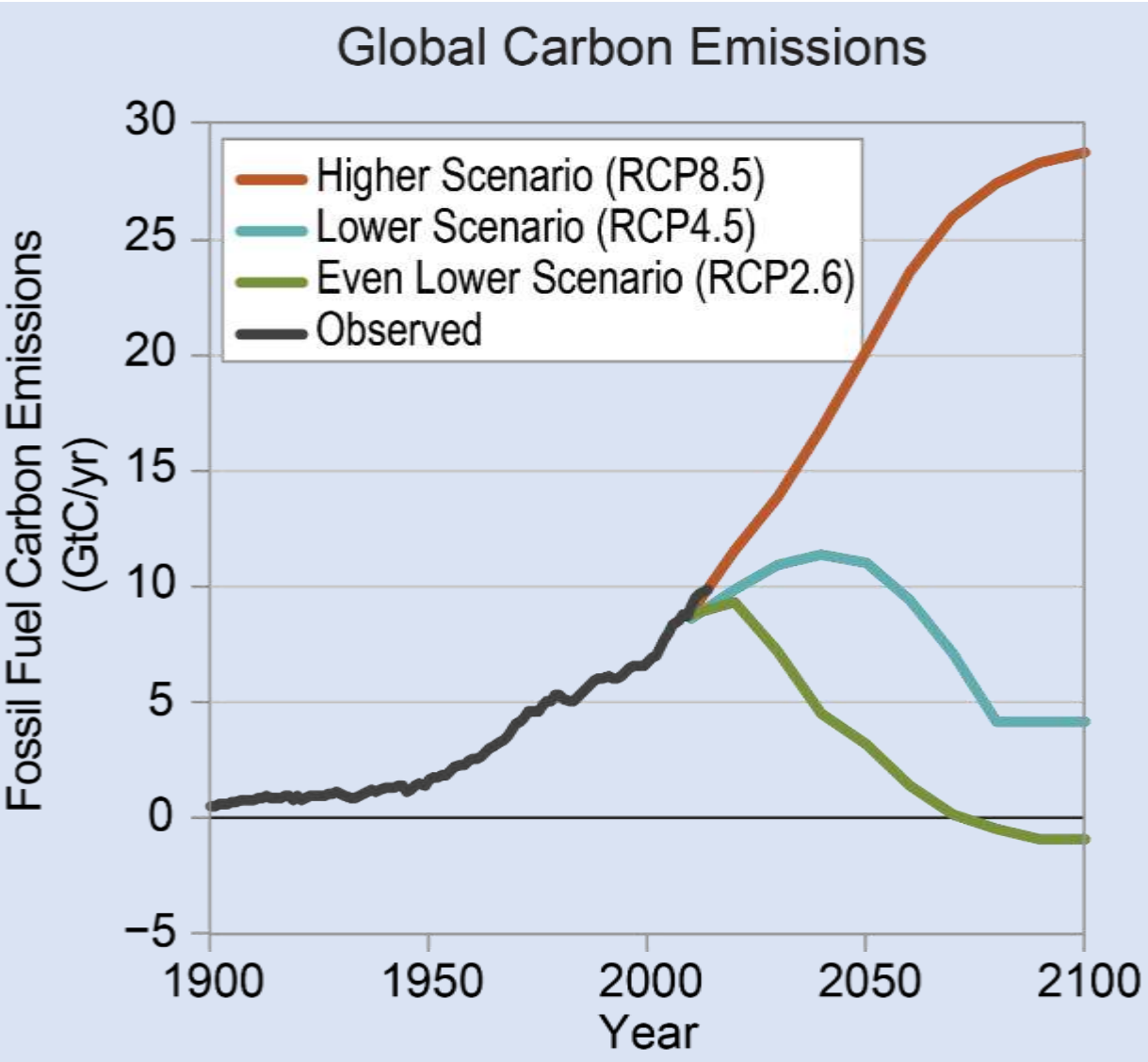
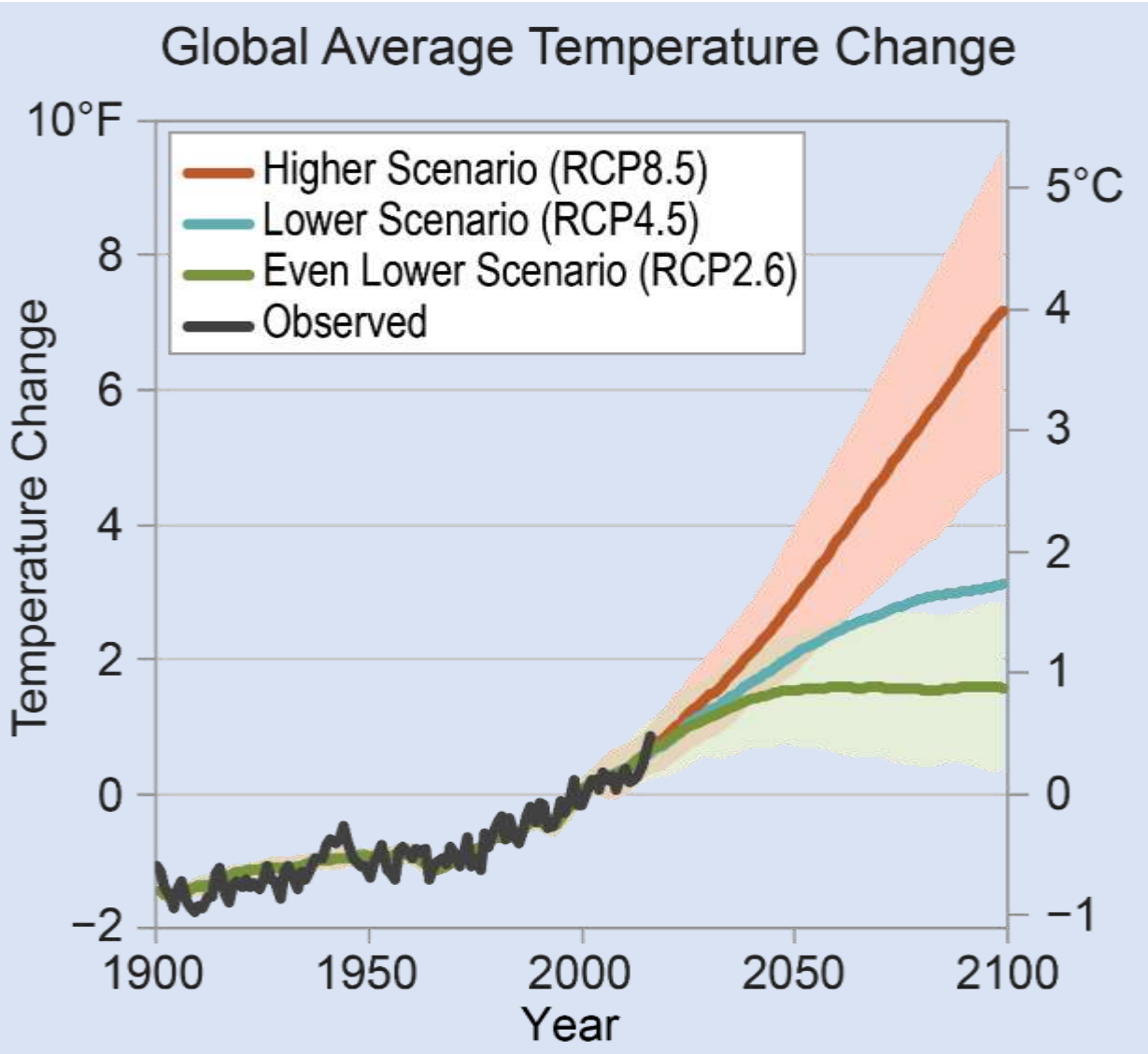
AIR TRANSPORT
THAWING PERMAFROST
COAL MINING
COAL PLANTS
OIL PRODUCTION
FERTILIZATION
INDUSTRIAL PROCESSES
LAND TRANSPORT
LANDFILLS
Illustration © Don Foley





we reached 415 ppm CO_2 on our way to a +1.5°C warming world

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Equity Impacts of Climate Change

"Climate change victimizes the victimized. It oppresses the oppressed.... It cuts along class lines, racial lines, generational lines and socioeconomic lines. So the worse off you are, the more marginalized you are, the worse you're going to suffer from what's coming."

- - Nathaniel Rich, author of Losing Earth: A Recent History

blogs.discovermagazine.com from Aug. 2, 2017

Increasing frequency and intensity of warm days/nights/events

Increasing frequency and intensity of extreme heat events

Increasing ocean temperature and acidity

Rising sea level and storm surges

Reduced snowpack

Increased precipitation

Increased frequency of heavy rainfall events

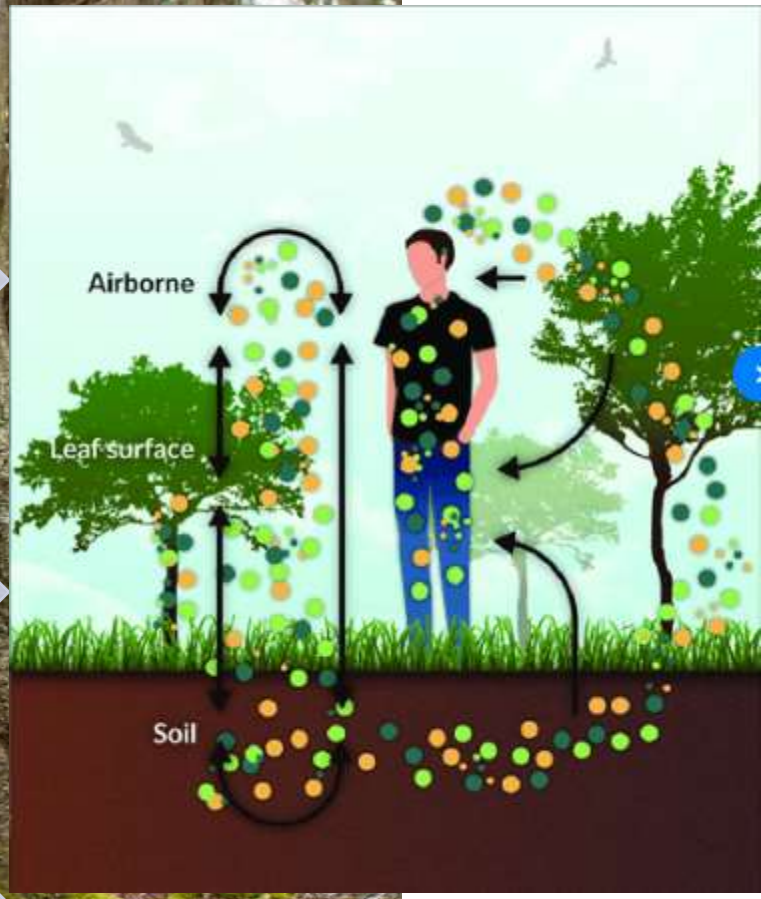
Increasing wildfires and forest area burned

phytoncides/terpenes affect human natural killer cell function to fight cancer

adrenaline and dopamine decrease to lower fatigue and anxiety

fungi & bacteria on soil, air, and leaf surfaces contribute to enrich our microbiomes

Magic and Awe



microbiome-rewilding hypothesis in *Restoration Ecology* October 2017

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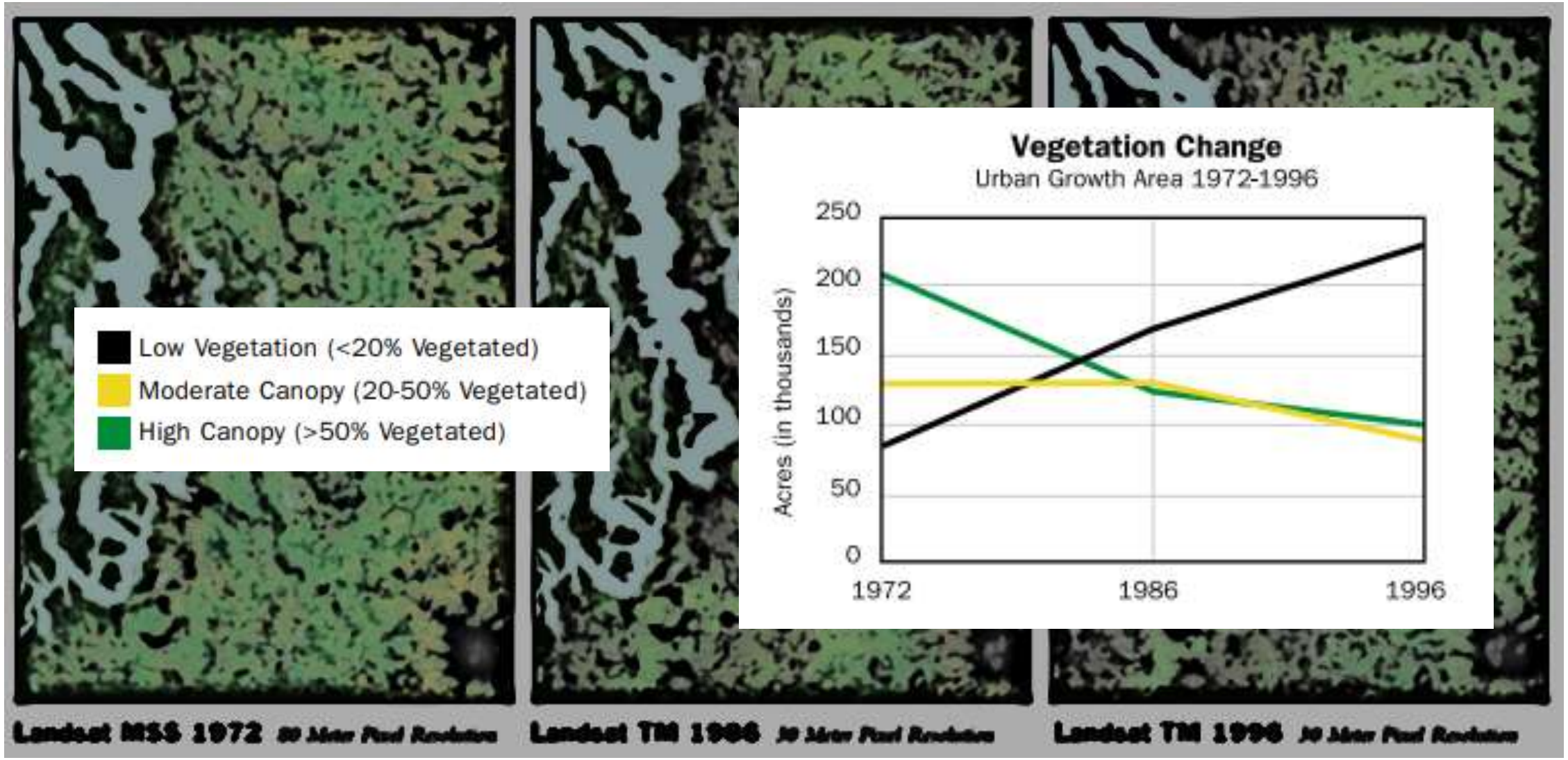

Low Vegetation (<20% Vegetated)
Moderate Canopy (20-50% Vegetated)
High Canopy (>50% Vegetated)
Vegetation Change
Urban Growth Area 1972-1996
Acres (in thousands)
250
200
150
100
50
0
1972
1986
1996
Landsat MSS 1972
Landsat TM 1986
Landsat TM 1996

Seattle No. 1 for growth this decade

Since 2010, Seattle's population has increased by 18.7 percent, the fastest growth rate among the 50 largest U.S. cities.

Seattle 1

Percent change since 2010	Population increase since 2010
18.7%	*114,412*

Denver 3
16.8%
101,403

Fort Worth 4
16.8%
125,599

Austin 2
17.9%
144,252

San Antonio 10
13.40%
178,533

Charlotte 5
16.3%
120,535

Atlanta 7
15.0%
63,441

Washington D.C. 8
14.7%
88,932

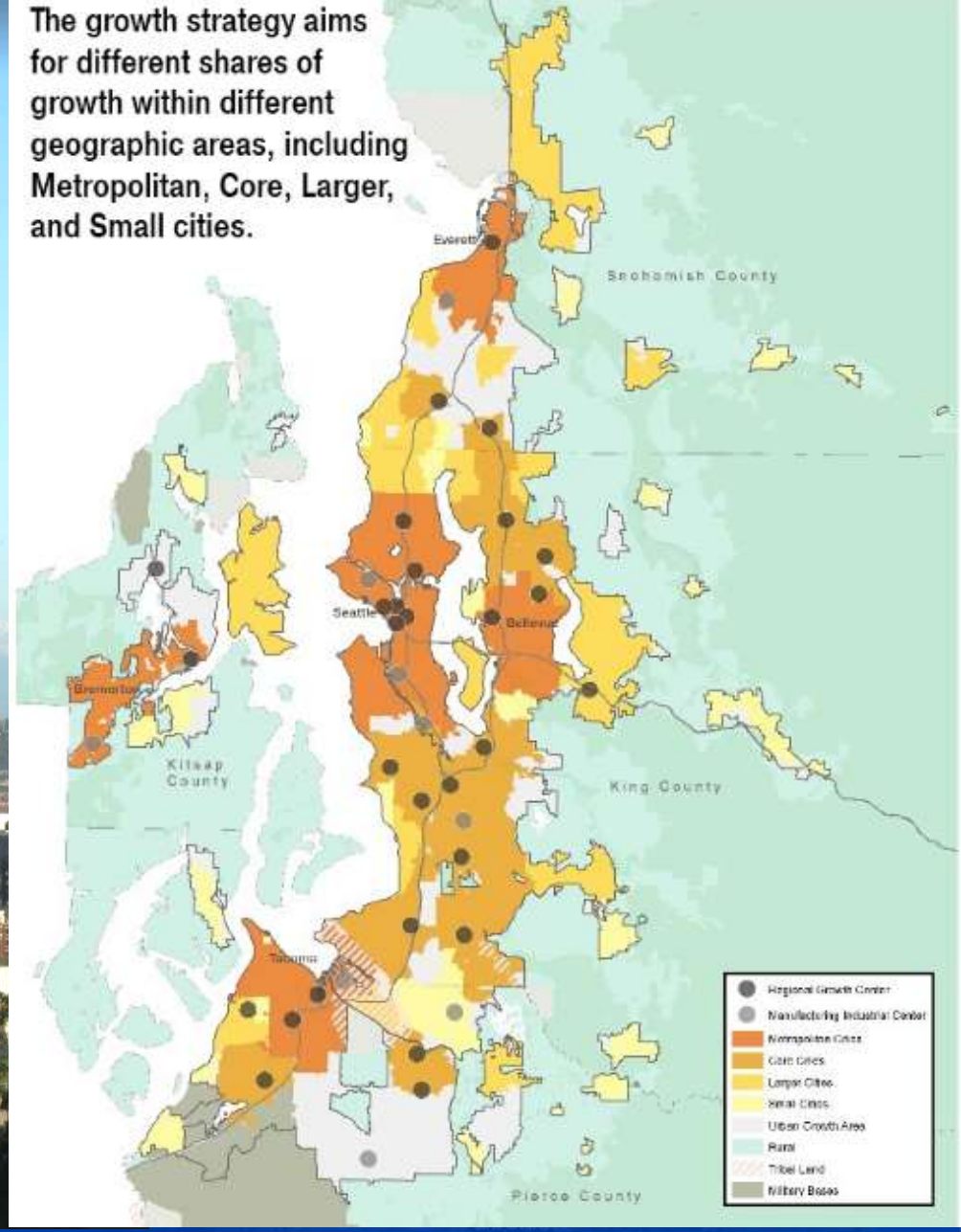
Raleigh 9
14.4%
58,421

Miami 6
15.6%
62,483

Sources: U.S. Census

MARK NOWLIN / THE SEATTLE TIMES

The growth strategy aims for different shares of growth within different geographic areas, including Metropolitan, Core, Larger, and Small cities.



seattletimes.com and Puget Sound Regional Council

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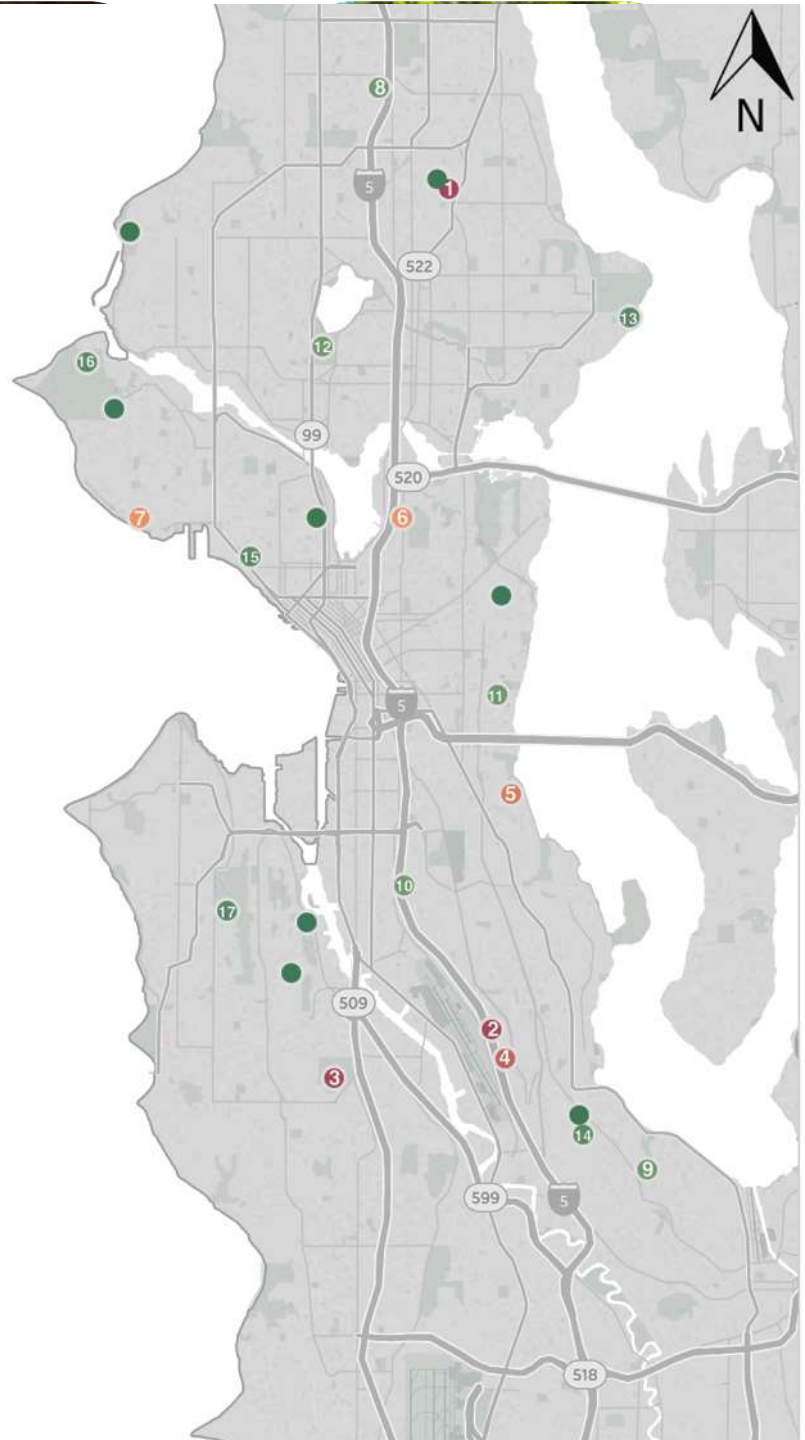
As, Al, Cd, Co, Cr, Cu, Fe, Mo, Ni, Pb

Dot map indicates sample locations with elevated moss tissue concentrations for several of the ten most toxic metals in the dataset. Numbers in filled circles link locations to the element list below.

<u>Element list (selected locations):</u>

1. Al, As, Cr, Cu, Fe, Ni, Co, Pb (Kingfisher 2)
2. Mo, Al, Fe, Co, Cr, Cu, As, Cd (East Duwamish Greenbelt 1)
3. As, Pb , Mo, Al, Co, Cr, Cu, Ni(Westcrest)
4. Cr, Al, Co, As, Ni, Mo (East Duwamish Greenbelt 2)
5. Ni, Cr, Cu, Al, Fe (Mt. Baker)
6. Pb, Mo, Ni, Cu (St. Marks Greenbelt)
7. Al, Fe, Co, Pb (Magnolia)
8. Co, Cd (Northacres)
9. As, Mo (Lakeridge)
10. Cu, Pb (Maywood Playfield)
11. Ni, Cu (Frink)
12. Cr, Cd (Woodland)
13. Cd (Magnuson South)
14. Mo (Kubota Gardens 2)
15. Pb (Kinnear)
16. Cd (Discovery Park 1)
17. As (Camp Long)

*Dark green circles indicate that none the concentrations were among the top 6 concentrations.



Results show hot-spots of heavy metal pollution in epiphytic mosses linked transportation sector such as exhaust emissions, brake and tire attrition, and lubricant degradation

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forest canopy and water cools urban heat islands

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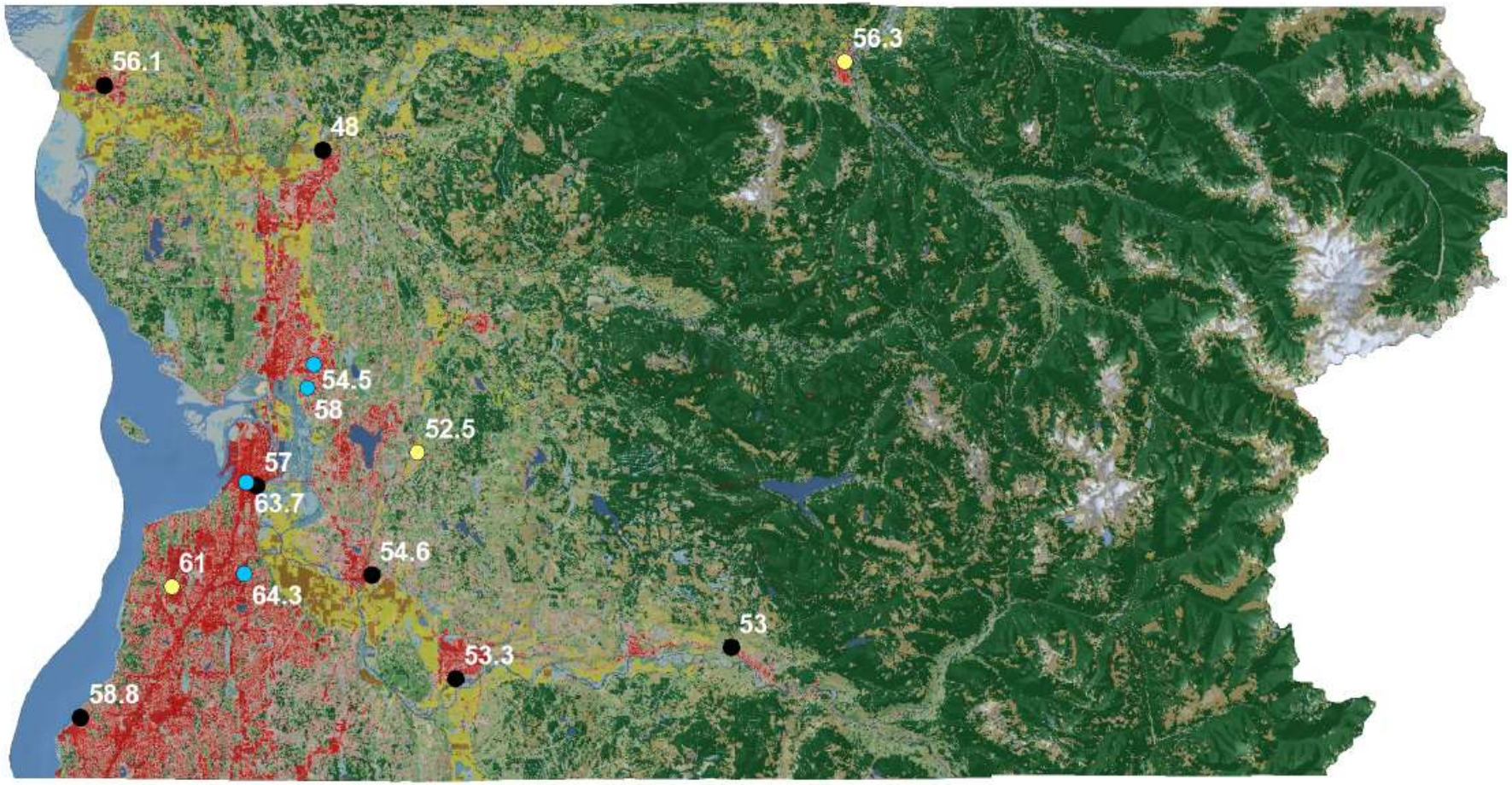

Snohomish County, Washington
Average nighttime temperatures August 18-20th, 2016

Meteorological Stations

- 150-184.7 feet elevation
- 108-144 feet elevation
- 18-51.8 feet elevation

extreme heat elevates night time temperatures

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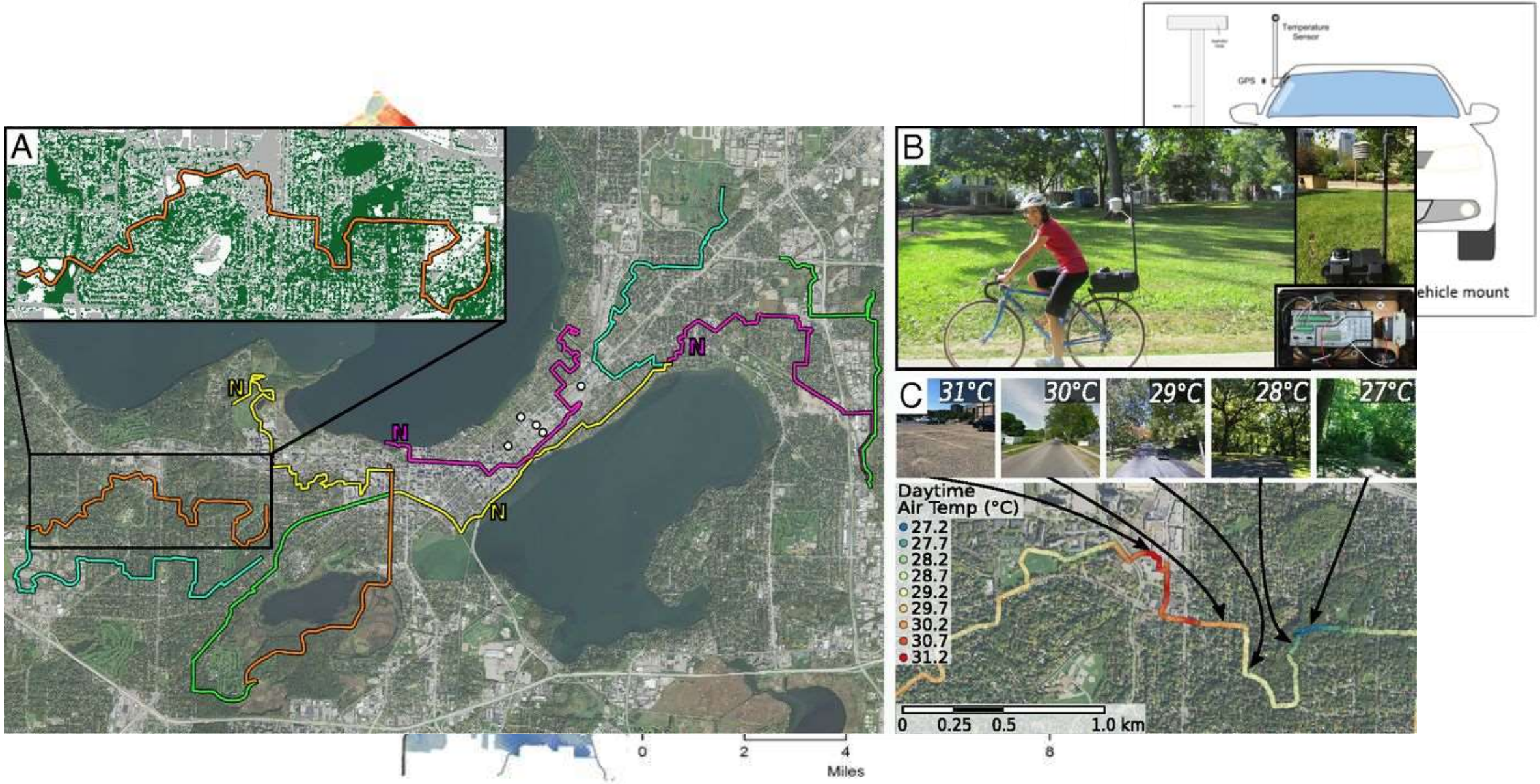
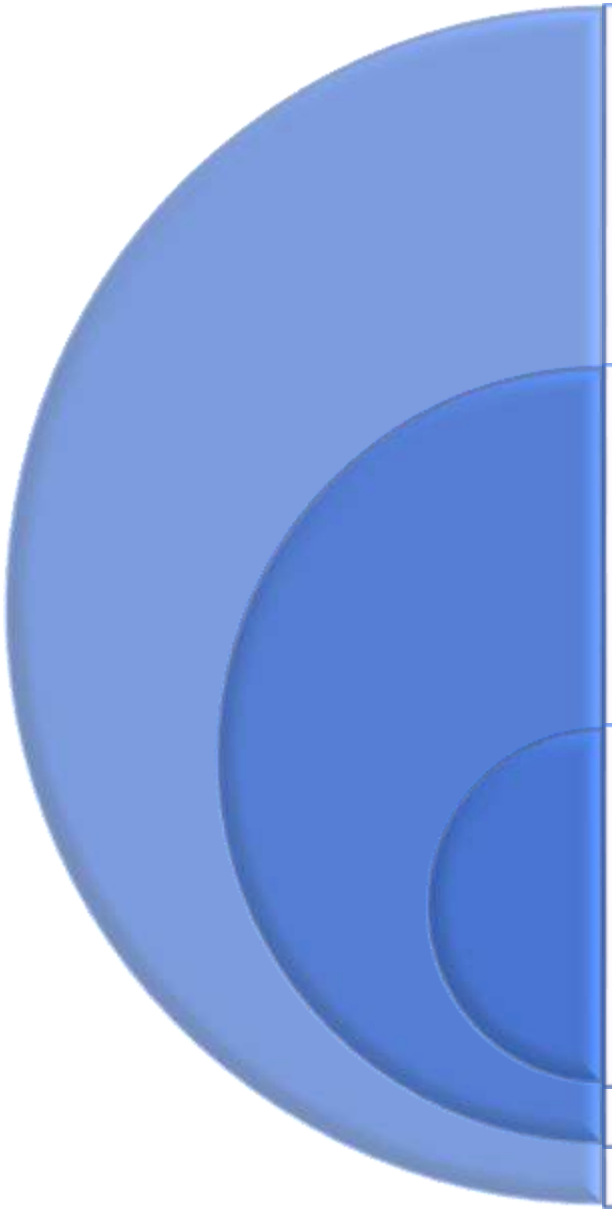

A
B
C
Temperature Sensor
GPS
ehicle mount
31°C
30°C
29°C
28°C
27°C
Daytime Air Temp (°C)
27.2
27.7
28.2
28.7
29.2
29.7
30.2
30.7
31.2
0 0.25 0.5 1.0 km
0 2 4 Miles
8



Sensitivity - ability to withstand changes in climate	• Phenology of plants/pollinators, dependence on sensitive habitat, reproductive response to changes in temperature & precipitation
Exposure – change likely to be experienced by the species or resource	• Temperature patterns, precipitation seasonality, drought extent, wind severity, soil freeze/thaw, hydrologic changes, fire frequency
Adaptive capacity – ability to cope, stay or move due to change **OR** social capacity	• Reproductive strategy, genetic variability, phenotypic plasticity, dispersal patterns, landscape permeability **OR** wealth/organizational capacity

Forest Adaptation Resources: climate change tools and approaches for land managers. 2nd ed. by Swanston et. al. 2016

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Most vulnerable

Quercus garryana, Garry oak

- Dry sites, dependent on low-intensity fire

Taxus brevifolia, Pacific yew

Pinus monticola, Western white pine

Abies grandis, grand fir

Thuja plicata, Western redcedar

ACMA, bigleaf maple

- Reproduces quickly, long-distance dispersal

Least vulnerable

Relative vulnerability to …trees in western N. America (Case & Lawler 2016)

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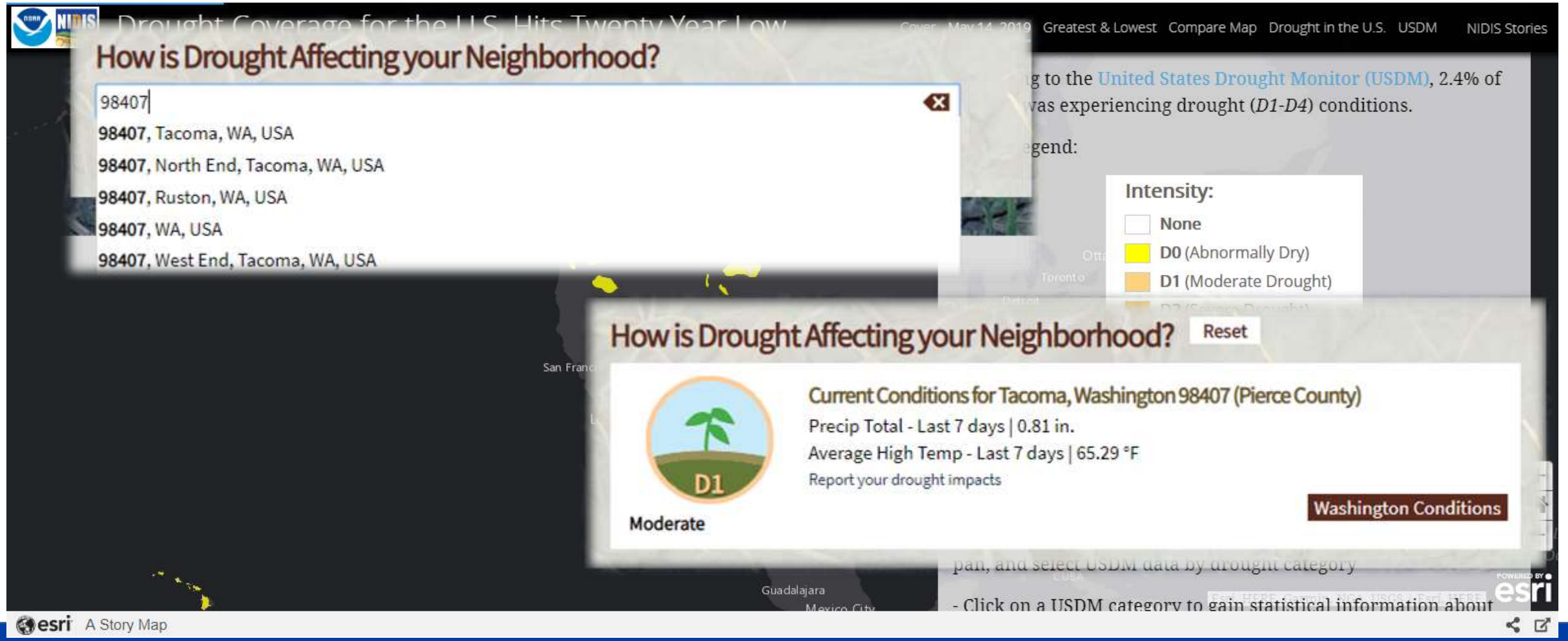
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

NIDIS Drought.gov
U.S. Drought Portal

U.S. North America Global

Drought Coverage for the U.S. Hits Twenty Year Low

May 14, 2019 marks the lowest drought coverage, by area, in the United States since 2000.



monitor conditions to better plan

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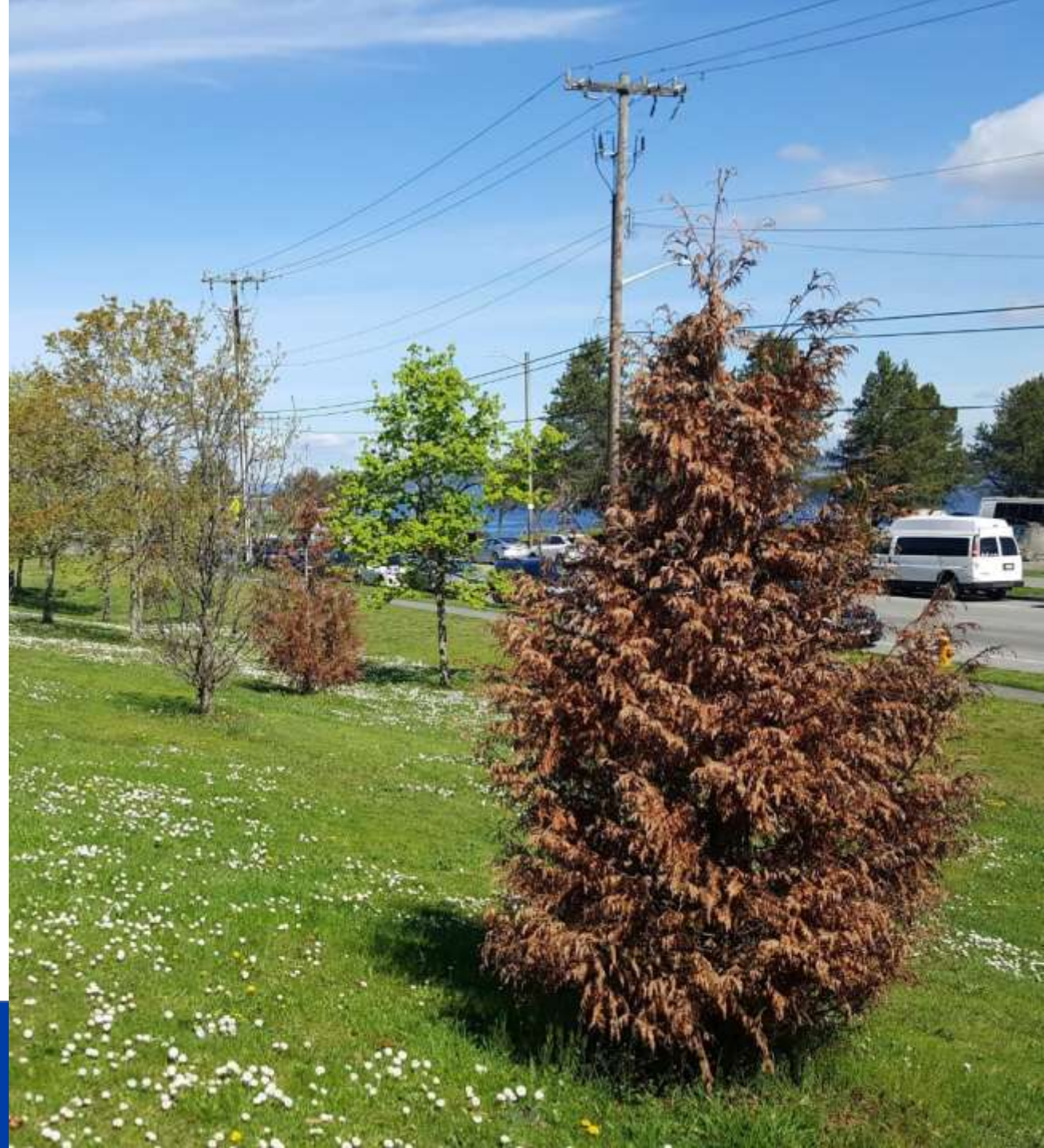
Tree Response to Drought

- Drought intolerant species decline after multiple years of drought
- Attracts insects like Western cedar borer
- Swelling and wounds around branch collar, sprouting around the branch collar area and individual branch die-off. Dies from the top down.
- Wet conditions in fall, winter, and spring encourage fungal pathogens



appropriate site for species, encourage diversity

Tree Link News

URBAN FORESTRY IN WASHINGTON STATE

FEBRUARY 6, 2019 | UNCATEGORIZED

Bigleaf Maple Decline, Results of UW Study

This article is an update to those published by the Tree Link in October 2014, "Bigleaf Maple Dieback in Western Washington?", and the follow-up articles in September of 2015, " What's Going on with Bigleaf Maple?", and in August 2016, "Bigleaf Maple Decline, Update and Next Steps".

WHAT COULD BE CAUSING THE DECLINE IN BIGLEAF MAPLES (*ACER MACROPHYLLUM*)?

As of the end of 2018, there was no sign of recovery in sick and dying bigleaf maple throughout Western Washington. Forest pathologists at Washington DNR have been investigating the increase in mortality and symptoms in bigleaf maples since

Search

SEARCH ...

Helpful Links

SUBSCRIBE TO TREE LINK

DNR Urban & Community Forestry

Arbor Day Foundation

Pacific Northwest International Society of Arboriculture

International Society of Arboriculture

Trees are Good

protect older healthy trees, thin forests, support regeneration

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monitor diseases, coordinate with pathologists, map healthy/sick trees

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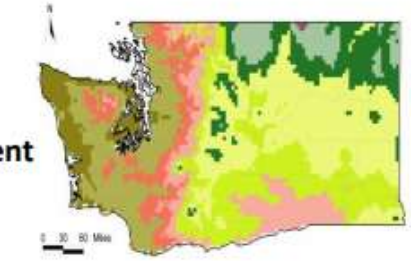
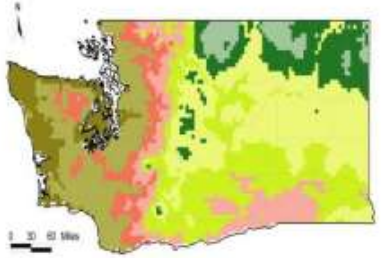
present

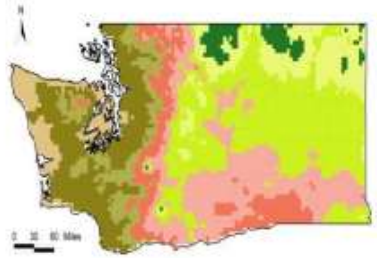


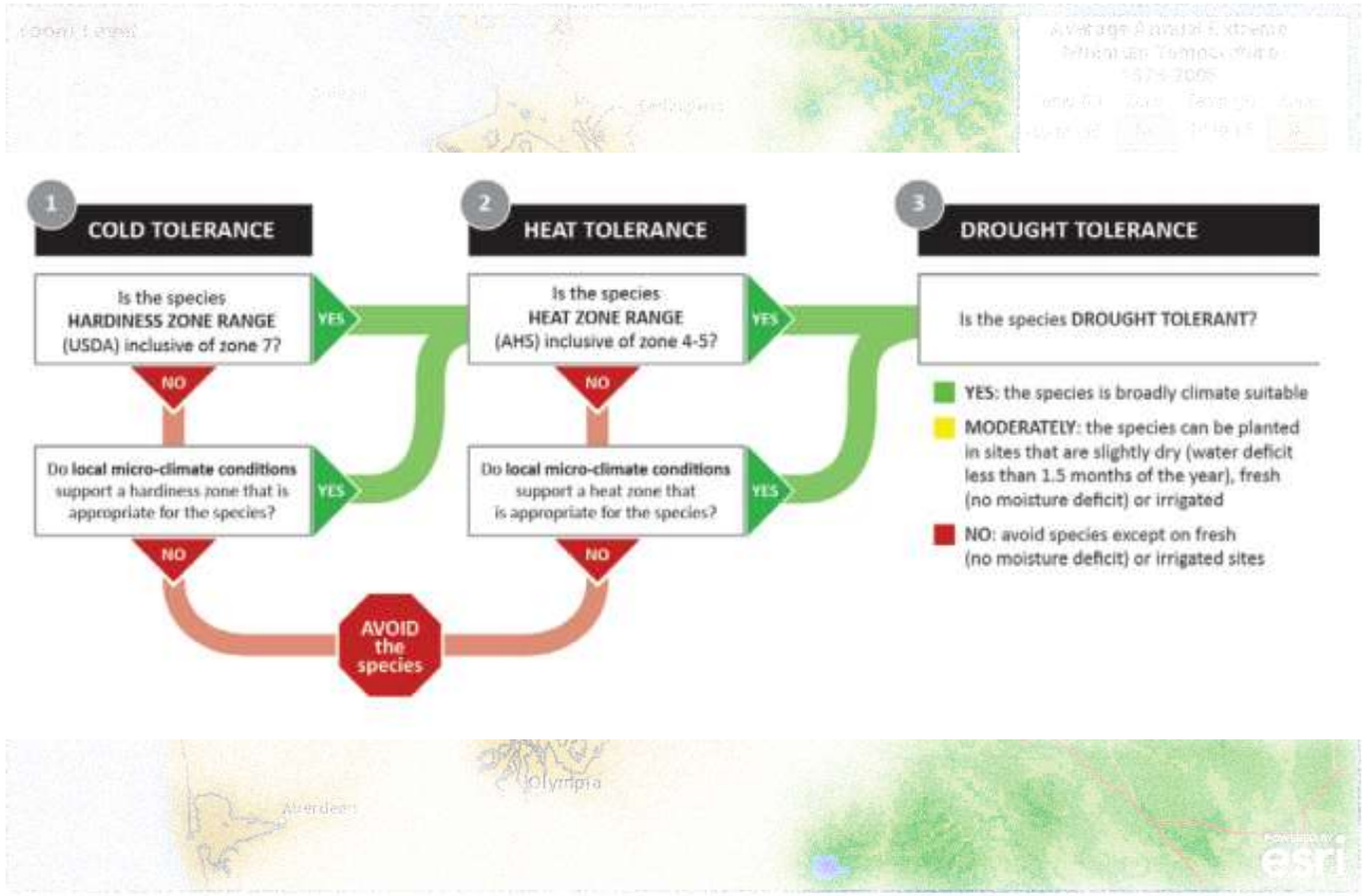
2020

2040



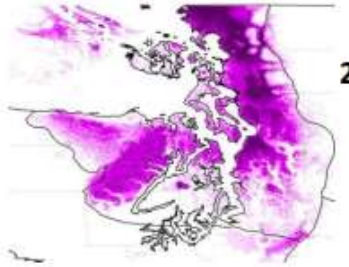
2080



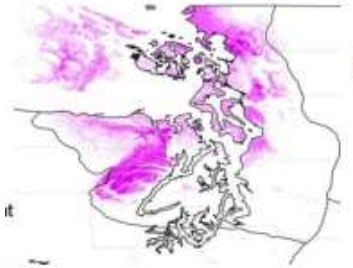


2000

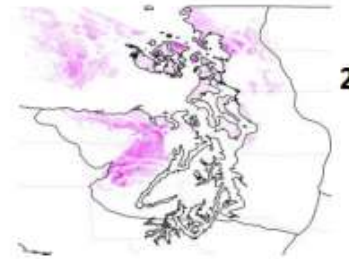
2020



2050



2080



"relax" seed zone guidelines, acclimation today vs. future adaptation

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Seedlot Selection Tool

Purpose | Instructions | More Information | People | News & Updates | Report an Issue | Account

About | Tool | Layers | Saved Runs

Planting Healthy Forests

The Seedlot Selection Tool (SST) is a GIS mapping program designed to help forest managers match seedlots with planting sites based on climatic information. The climates of the planting sites can be chosen to represent current climates, or future climates based on selected climate change scenarios.

1. Select Objective

You can find seedlots for your planting site or planting sites for your seedlot

2. Select Location

You can click on the map or enter coordinates to locate your seedlot or planting site

3. Select Region

You can select the geographic region closest to your site or choose from a list of available regions

4. Select Climate Scenarios

You can select historical, current, or future climates for your seedlots of planting sites

5. Select Transfer Limit Method

You can enter your own custom limit or use an existing zone to calculate a transfer limit

6. Select Climate Variables

You can use a variety of climate variables to match your seedlot and planting site

7. Map your Results

The map shows where to find appropriate seedlots or planting sites

use adapted/appropriate species, migration across large landscapes

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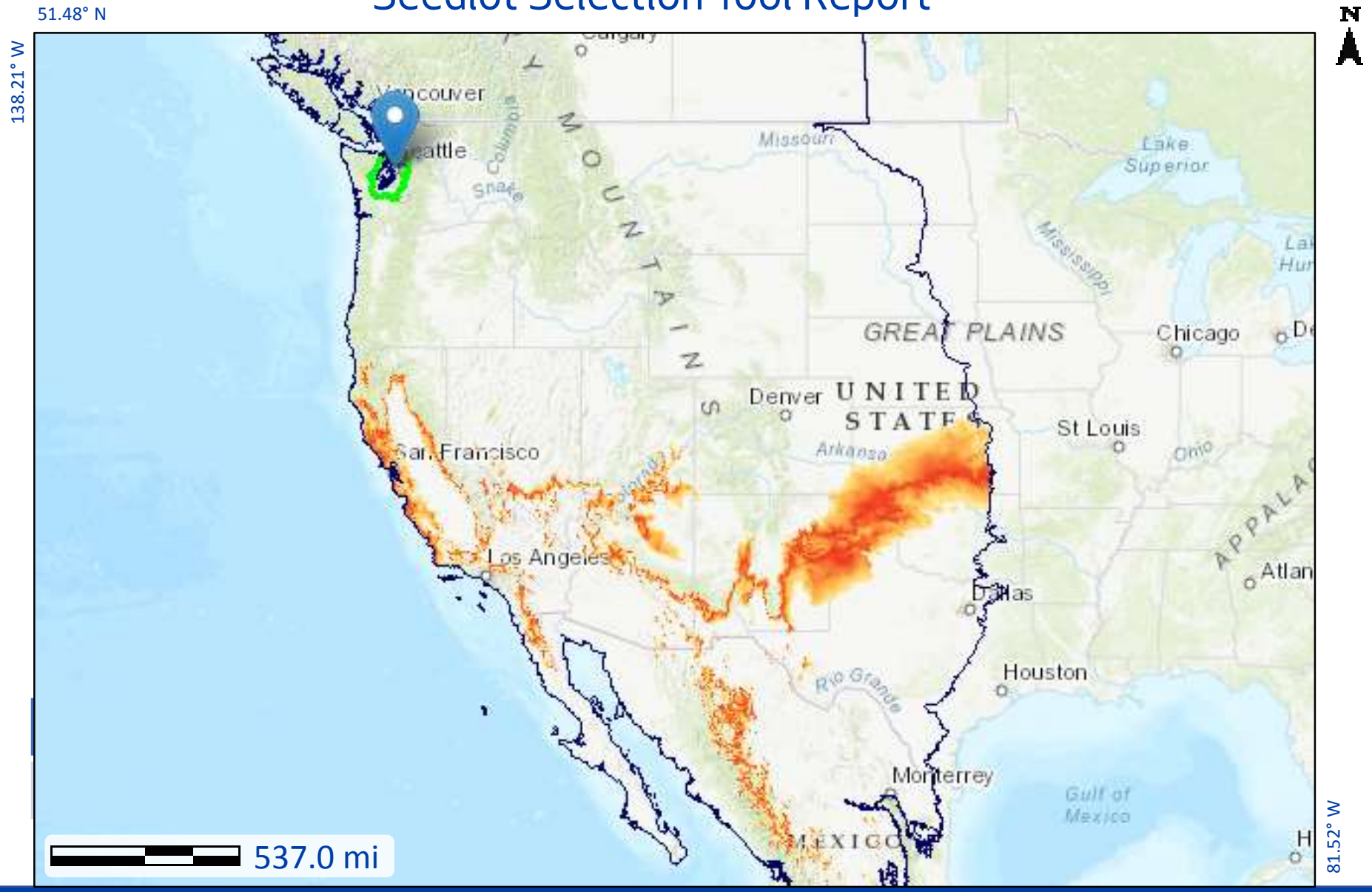
Seedlot Selection Tool Report



Low — High

Match

manage for future variability

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Discovery Park Bird Alley Hügelkultur – carbon sink

Menu of Urban Forest Adaptation Strategies

1. Sustain or restore more fundamental ecological functions
2. Reduce the impact of biological stressors
3. Reduce the risk and long-term impacts of severe disturbances
4. Maintain or create refugia
5. Maintain and enhance species diversity
6. Increase ecosystem redundancy across the landscape
7. Promote landscape connectivity
8. Maintain and enhance genetic diversity
9. Facilitate composition adjustments through species transitions
10. Realign urban ecosystems after disturbance

Forest Adaptation Resources: climate change tools and approaches for land managers. 2nd ed. by Swanston et. al. 2016

GREEN SEATTLE PARTNERSHIP

www.greenseattle.org

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Arbutus ARME

ppo.puyallup.wsu.edu/pmr

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Michael Yadrick – michael.yadrick@seattle.gov

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Resources

Adaptation Partners adaptationpartners.org/library.php

DNR TreeLink News dnrtreelink.wordpress.com

DNR Small Forest Landowner News sflonews.wordpress.com

Fourth National Climate Assessment, describes effects of climate change on US, including 10 regions and 18 national topics. Link: nca2018.globalchange.gov

- Chapter 6 highlights Forests. Link: nca2018.globalchange.gov/chapter/6
- Chapter 24 highlights the Northwest Region. Link: nca2018.globalchange.gov/chapter/24

Office of the Washington State Climatologist climate.washington.edu/index.html

Snover et. al. 2013. **Climate Change Impacts and Adaptation in Washington State**

- Link: cig.uw.edu/resources/special-reports/wa-sok

Snover et. al. 2019. **No Time to Waste**. cig.uw.edu/resources/special-reports/no-time-to-waste/

WSU Extension Forestry e-newsletter forestry.wsu.edu/nps/newsletter