

Climate Influences Range and Phenology of Northwest Shrub Species

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Shrubs are important ecosystem components (structure, cover, food) and culturally valuable but little studied

Very few have range maps

Mostly general descriptions of habitat

Most information piecemeal

Several recent projects on shrubs

1. Bibliography
2. Current occurrences (78 native species)
3. **Habitat suitability models** (4 species)
for 2000 and 2085
4. **Phenology of flowering and fruiting**
Based on recent observations & predicted
climate
5. Story Map (wrap it all together with pretty
pictures!)

Several recent projects on shrubs

1. Bibliography
2. Current occurrences (78 native species)

Various projects differ in geographic extent, species included, and spatial resolution

5. Story Map (wrap it all together with pretty pictures!)

Home > Groups > Edible shrub bibliography > Library

www.zotero.org/groups/2131424/edible_shrub_bibliography/items

Library

Trash

Tags

Alaska blueb... Amelanchier ... American mou...
 Berberis bilberry black huckle... blueberry
 buffaloberry Cascade bilb... Chemistry chokecherry
 Climate chan... Commercial Corylus corn... Disease
 Ecology elderberry evergreen hu... Fire effects
 Food/Medicin... Gaultheria s... Genetics hazelnut
 huckleberry Identificati... Indigenous u...
 Insect pests Life history Management Medicine
 oval-leaved ... Phenology Physiology prickly curr...
 Propagation Prunus virgi... Range red hucklebe...
 Ribes Ribes lacust... Rubus Rubus specta... salal
 salmonberry Sambucus can... Sambucus cer...
 Saskatoon serviceberry Sheperdia ca...
 Sorbus ameri... Vaccinium Vaccinium al...
 Vaccinium ca... Vaccinium de... Vaccinium me...
 Vaccinium my... Vaccinium ov... Vaccinium ov...
 Vaccinium pa... Vaccinium sc... Vaccinium ul...
 Vaccinium vi... Wildlife

| <input type="checkbox"/> | Title | Creator | Date Modified |
|--------------------------|---|-------------------------------------|--------------------|
| <input type="checkbox"/> | A biologist turns her sights on climate and the elusive huck... | Malchik | 5/30/2018 3:46 PM |
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| <input type="checkbox"/> | Antioxidant capacities of ten edible North American plants | Acuña et al. | 5/21/2018 3:13 PM |

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Library

Trash

Tags

- Gaultheria s...
- Alaska blueb...
- Amelanchier ...
- American mou...
- Berberis
- bilberry
- black huckle...
- blueberry
- buffaloberry
- Cascade bilb...
- Chemistry
- chokecherry
- Climate chan...
- Commercial
- Corylus corn...
- Disease
- Ecology
- elderberry
- evergreen hu...
- Fire effects
- Food/Medicin...
- Genetics
- hazelnut
- huckleberry
- Identificati...
- Indigenous u...

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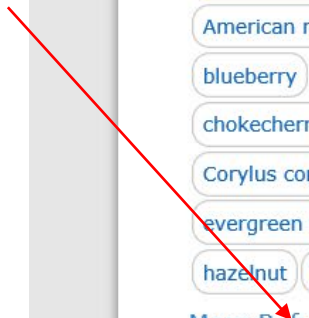
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|--------------------------|---|-------------------------------------|----------------------|
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| <input type="checkbox"/> | Diversity and abundance of ericoid mycorrhizal fungi of Gaul... | Xiao and Berch | 5/31/2018 1:39 PM |
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| <input type="checkbox"/> | Effects of thinning in a 43-year-old Douglas-fir stand on ab... | Messier and Mitchell | 5/30/2018 4:31 PM |
| <input type="checkbox"/> | Establishment of salmonberry, salal, vine maple, and bigleaf... | Tappeiner and Zasada | 5/31/2018 1:33 PM |
| <input type="checkbox"/> | Gaultheria shallon - Fire Effects Information System | Tirmenstein | 4/17/2018 4:33 PM |
| <input type="checkbox"/> | Gaultheria shallon (Salal) NPIN | Lady Bird Johnson Wildflower Center | 5/29/2018 2:34 PM |
| <input type="checkbox"/> | Is there limiting similarity in the phenology of fleshy frui... | Burns and Wilson | 5/21/2018 3:33 PM |
| <input type="checkbox"/> | Organic nitrogen use by salal ericoid mycorrhizal fungi from... | Xiao and Berch | 5/31/2018 1:39 PM |
| <input type="checkbox"/> | Photosynthetic photon flux density, red:far-red ratio, and m... | Messier et al. | 5/30/2018 4:31 PM |
| <input type="checkbox"/> | PNW-GTR-513 Special forests products: species information gu... | Vance et al. | 5/31/2018 1:57 PM |
| <input type="checkbox"/> | Potential Habitat Model for Salal (Gaultheria shallon) | Leshner et al. | 5/30/2018 |

Salal selected for example –

You can click on options or type them in the box

Note, hit **Refresh** to search a new species

All items have a URL to at least an abstract



Current Occurrences

Very few species have range maps (Little 1976; some large species)

Mostly general descriptions of habitat

Needed to start with current occurrences

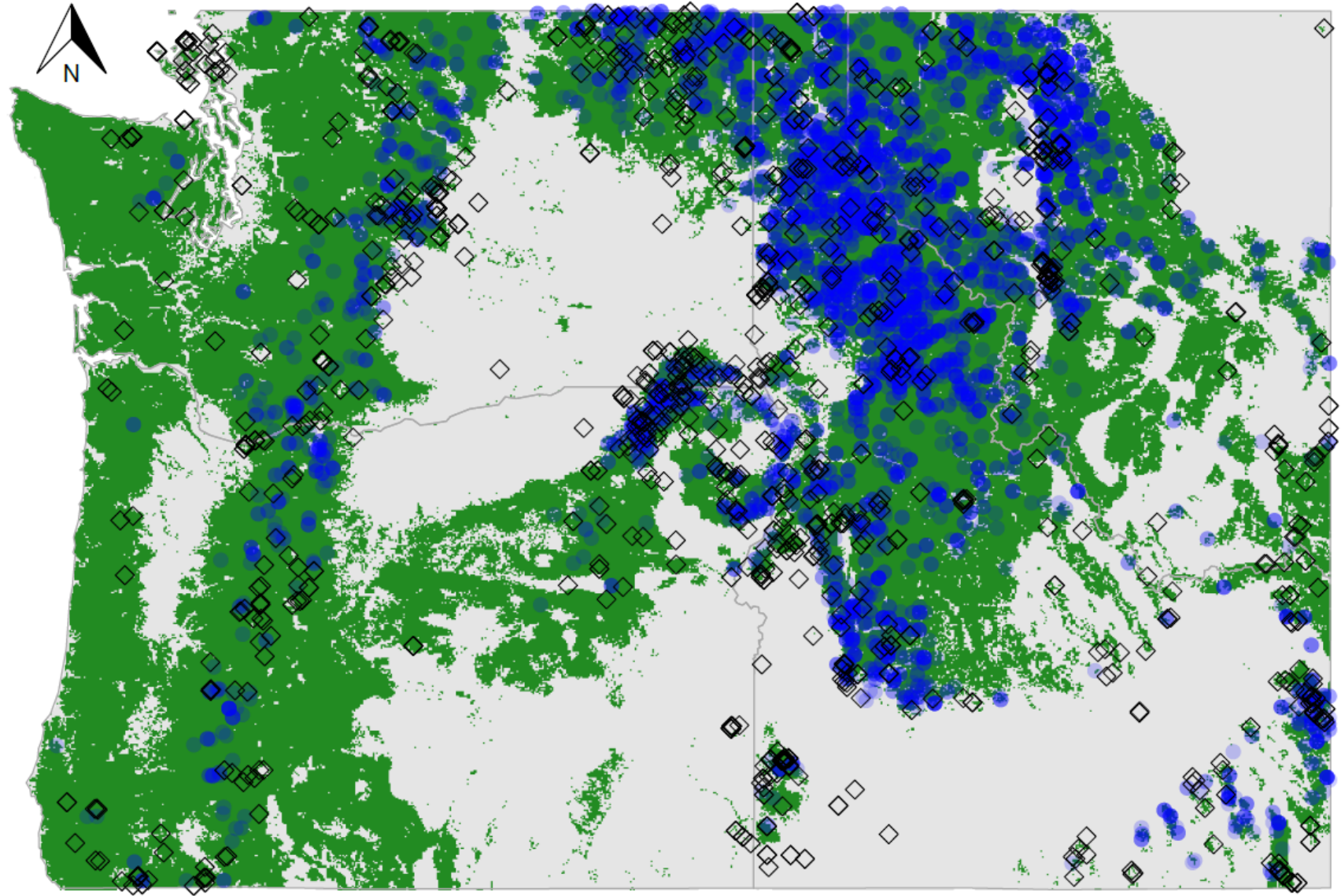
USFS FIA (Forest Inventory and Analysis)

PNW Herbaria

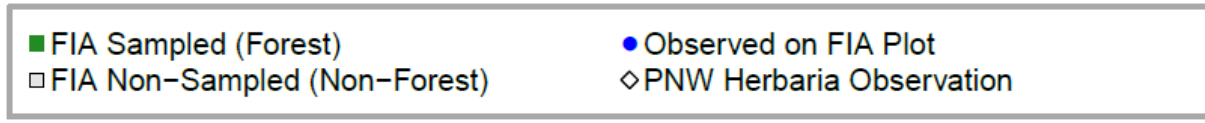
[Used other databases for some species]

Developed maps of occurrences for 78 native shrub species

Rocky Mountain maple, Douglas maple (n=2980)
Acer glabrum



Should be available by Dec 1 on PNW and TreeSearch websites



Developed current and future **habitat suitability maps for **4 culturally important species** – Patterns of occurrence /w current climate allow us to speculate how ranges might shift in the future**

Why??

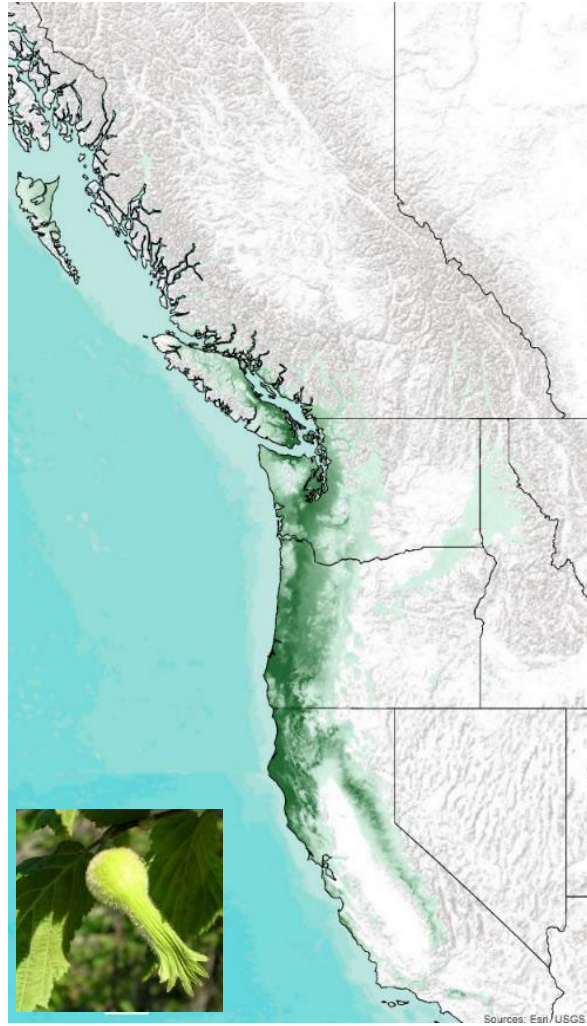
There is a strong interest in preserving and restoring culturally-important plant species across the Pacific Northwest

Warmer temperatures are changing habitat suitability

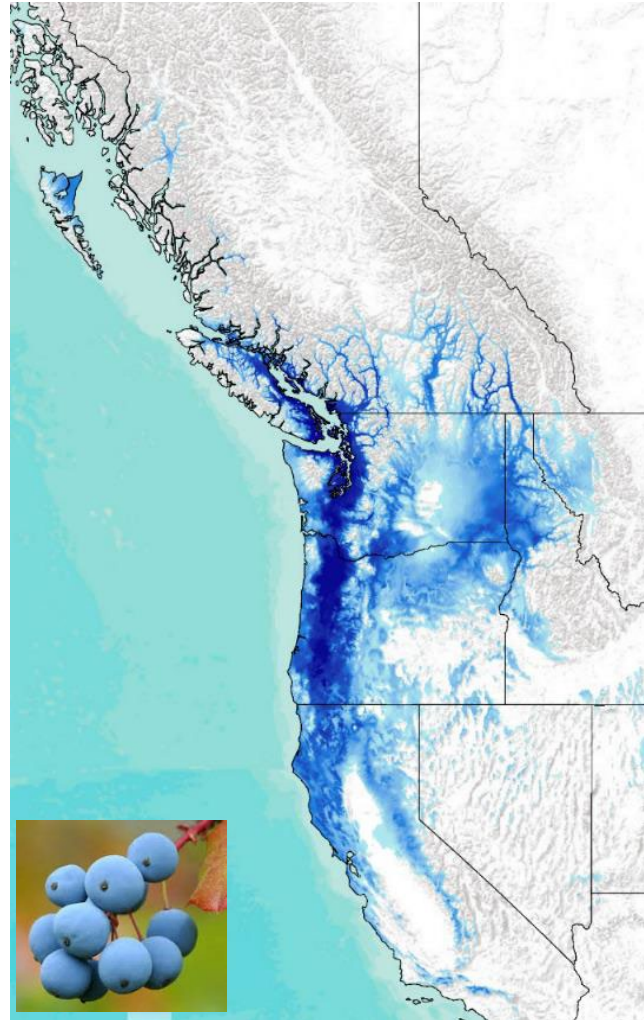
Current ranges: Habitat suitability models in MaxEnt

MaxEnt (Maximum Entropy) = species distribution model in R

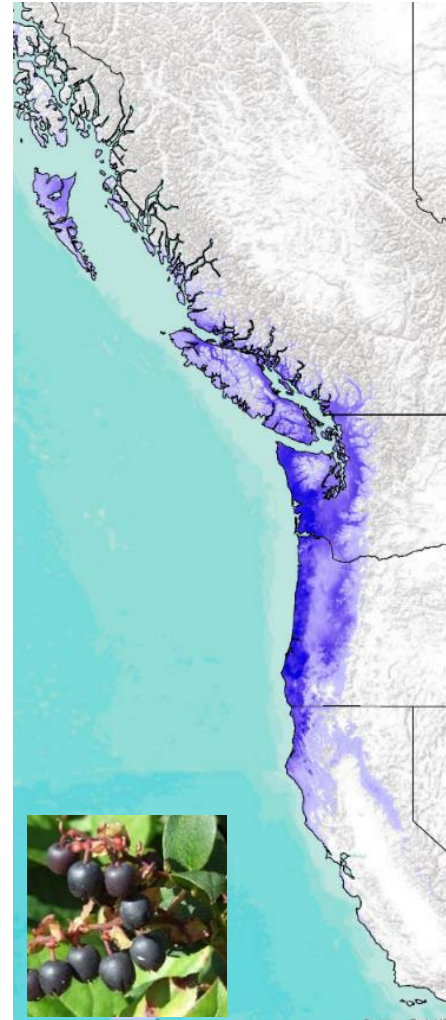
Hazelnut



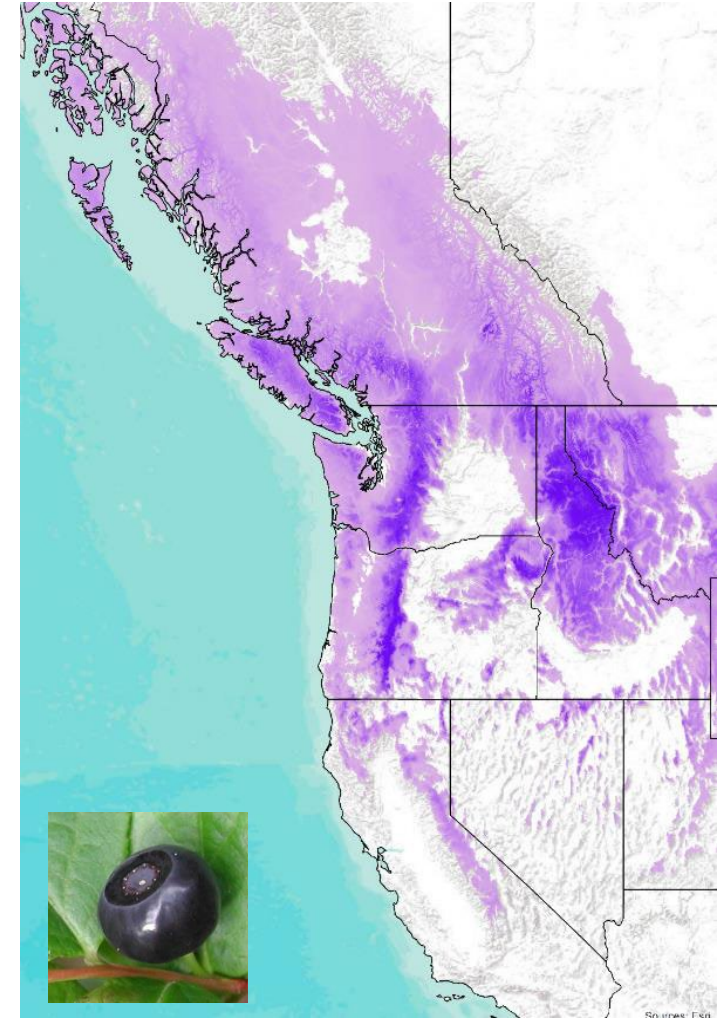
Oregon grape



Salal



Black huckleberry



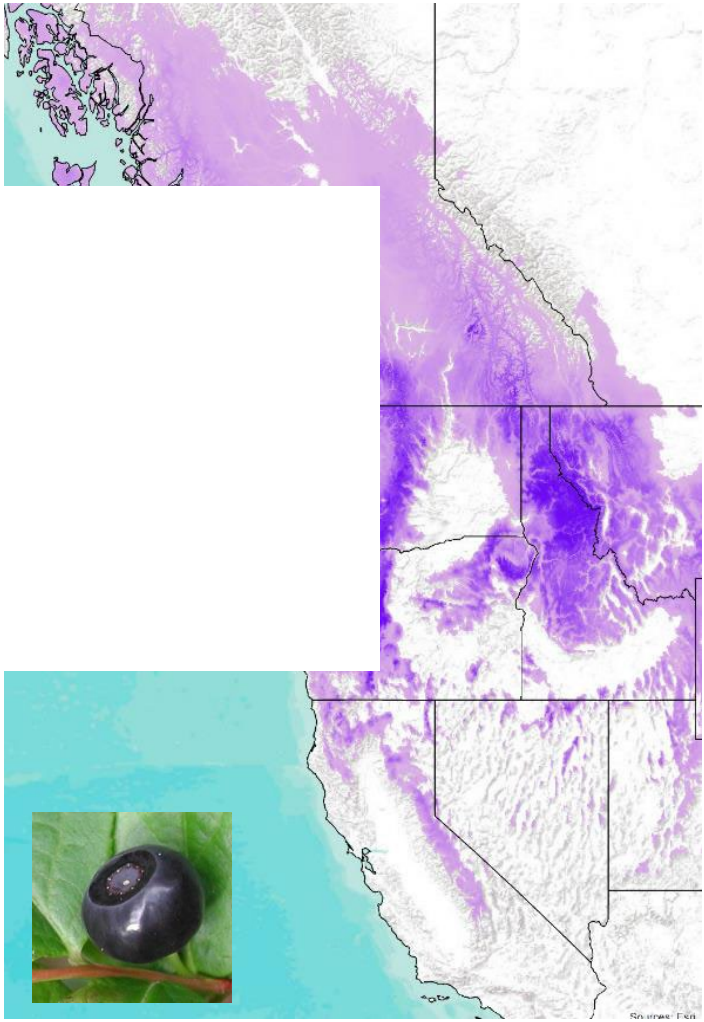
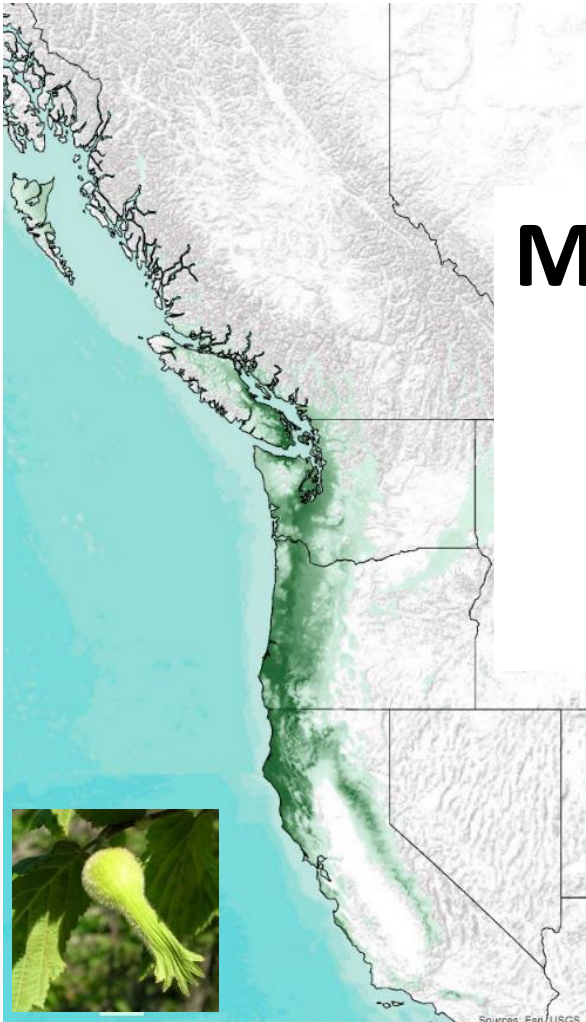
Current ranges: Habitat suitability models in MaxEnt

Hazelnut

Oregon grape

Salal

Black huckleberry



**Models for all species selected:
Mean summer precipitation
Extreme cold temperature
Climatic moisture deficit**

Bioclimatic variables (**Bold = used in VAME model**)

Annual Heat Moisture Index (AHM)

Hargreave's Climatic Moisture Deficit (CMD) *

Degree-days below 0 °C (DD0)

Degree-days below 5 °C (DD5)

30-year extreme minimum temperature, °C (EMT) *

30-year extreme maximum temperature, °C (EXT)

Frost-free period (FFP)

Mean annual precipitation, mm (MAP)

Mean annual temperature, °C (MAT)

Mean temperature of the coldest month, °C (MCMT)

Mean temperature of the warmest month, °C (MWMT)

Precipitation as snow, mm (PAS)

Summer heat moisture index (SHM)

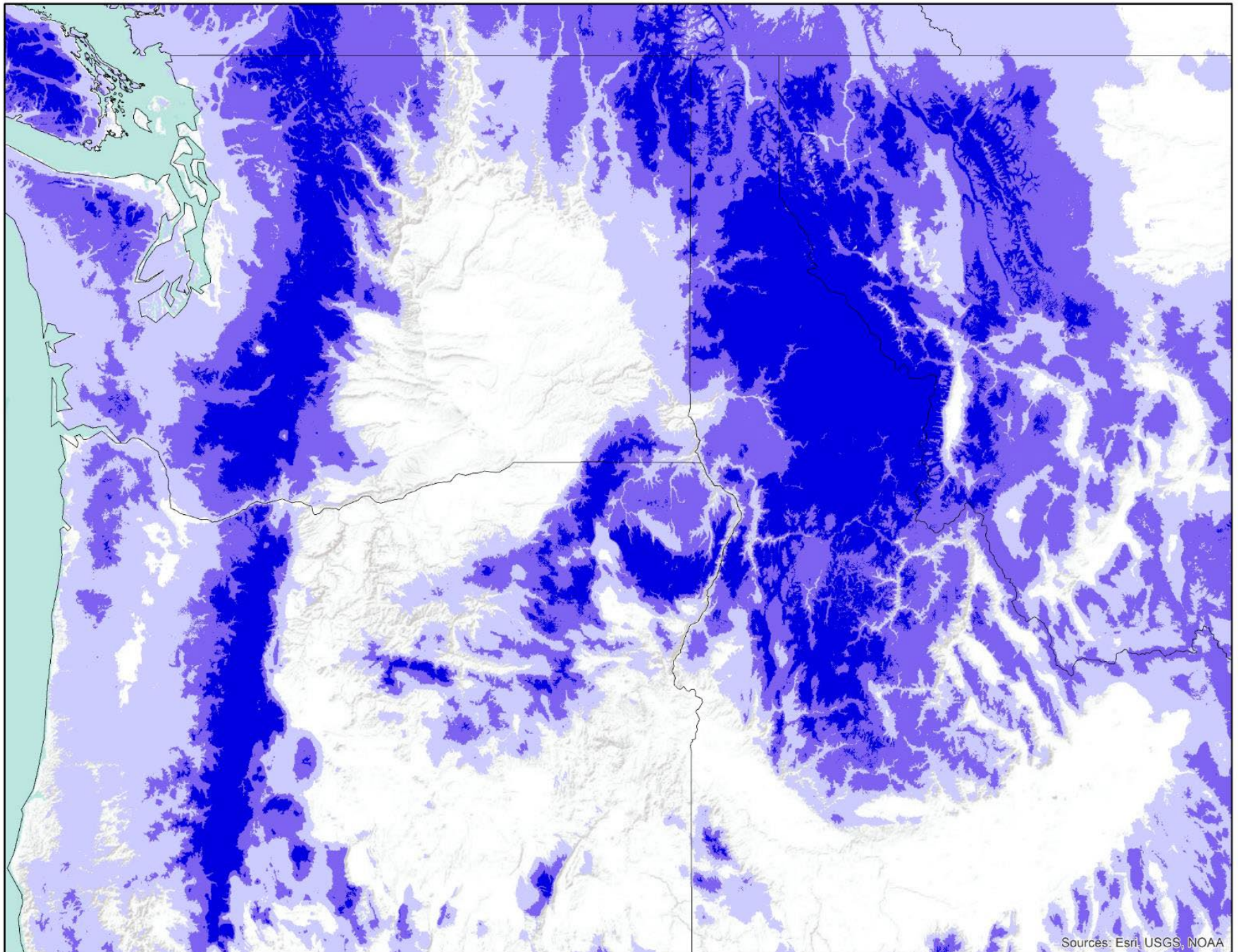
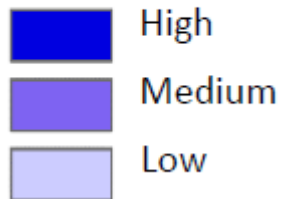
MCMT – MWMT, °C, provides a measure of continentality (TD) Hargreave's reference evapotranspiration (EREF)

Mean summer (May – September) precipitation, mm (MSP) *

*** = climate variables
selected in all 4
shrub models**

Current Habitat Suitability for huckleberry (VAME)

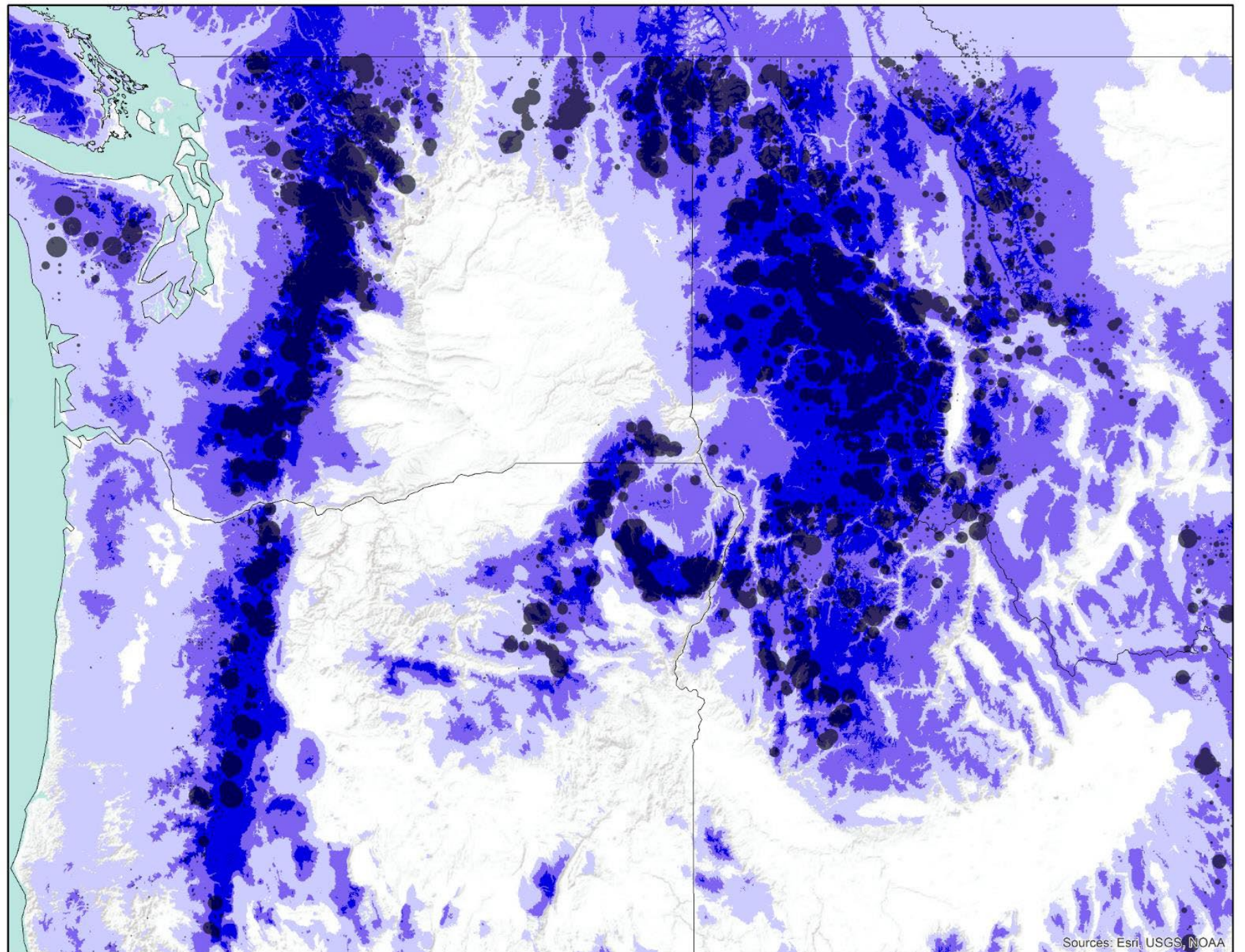
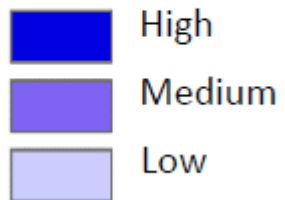
Habitat suitability



Current Habitat Suitability for huckleberry (VAME)

FIA plots with high
abundance of black
huckleberry ●

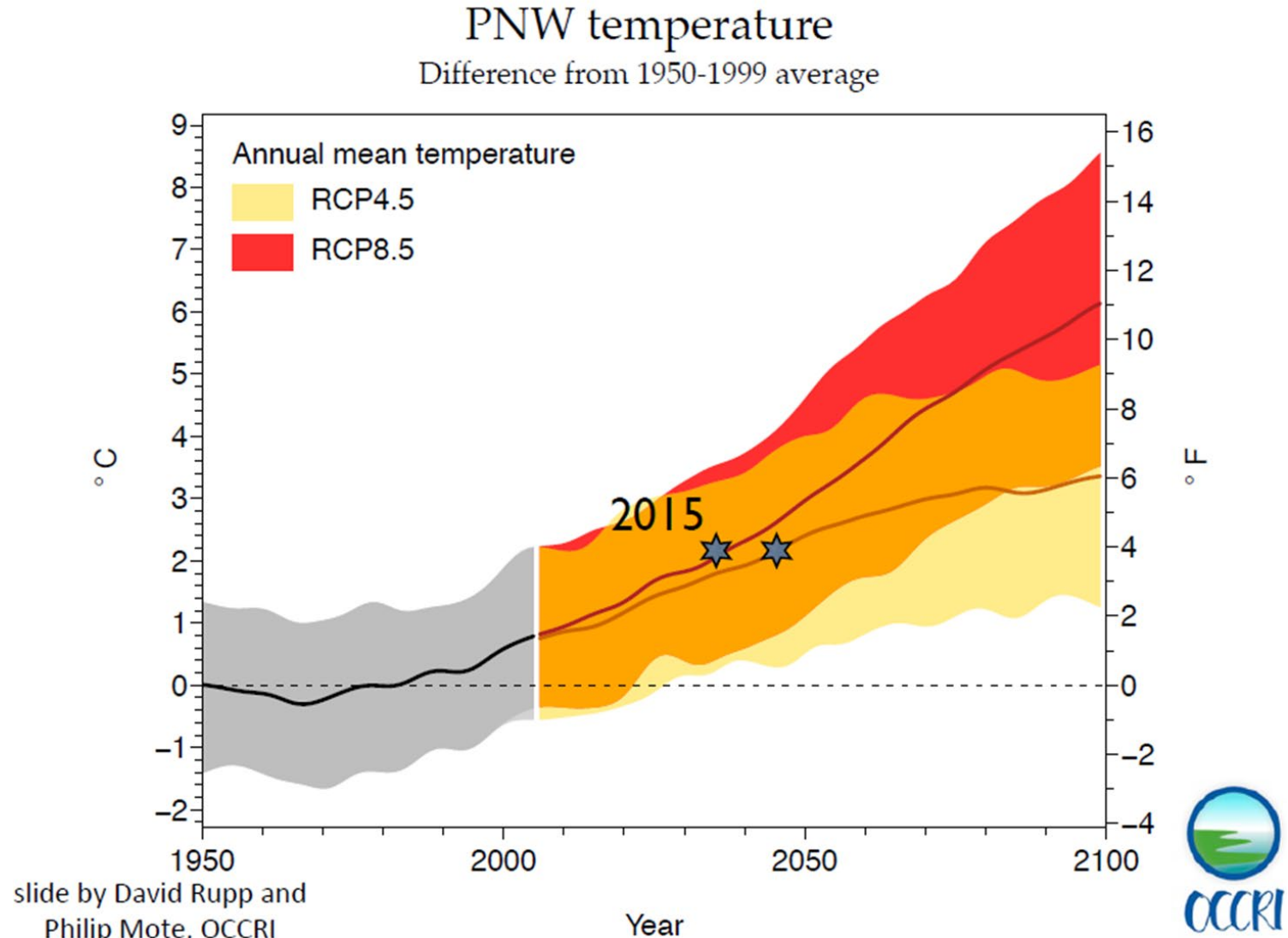
Habitat suitability



How will climate change impact species distribution?

Used 15 CMIP5 model means to predict climate in the future (2040-2069 and 2070-2099) for 2 emissions scenarios: **RCP 4.5** and **RCP 8.5**

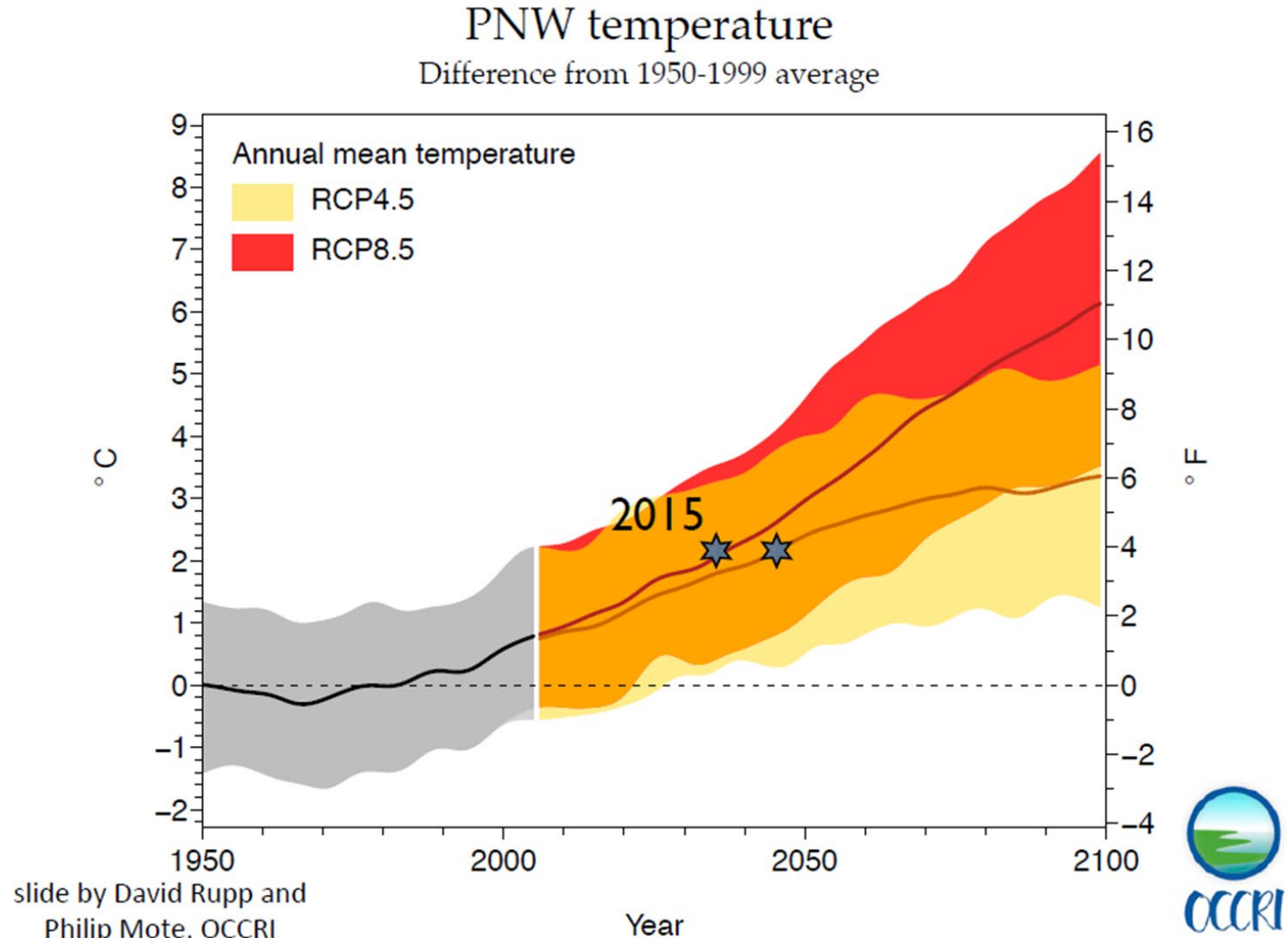
RCP = Representative concentration pathway is a greenhouse gas concentration trajectory (IPCC 2014)



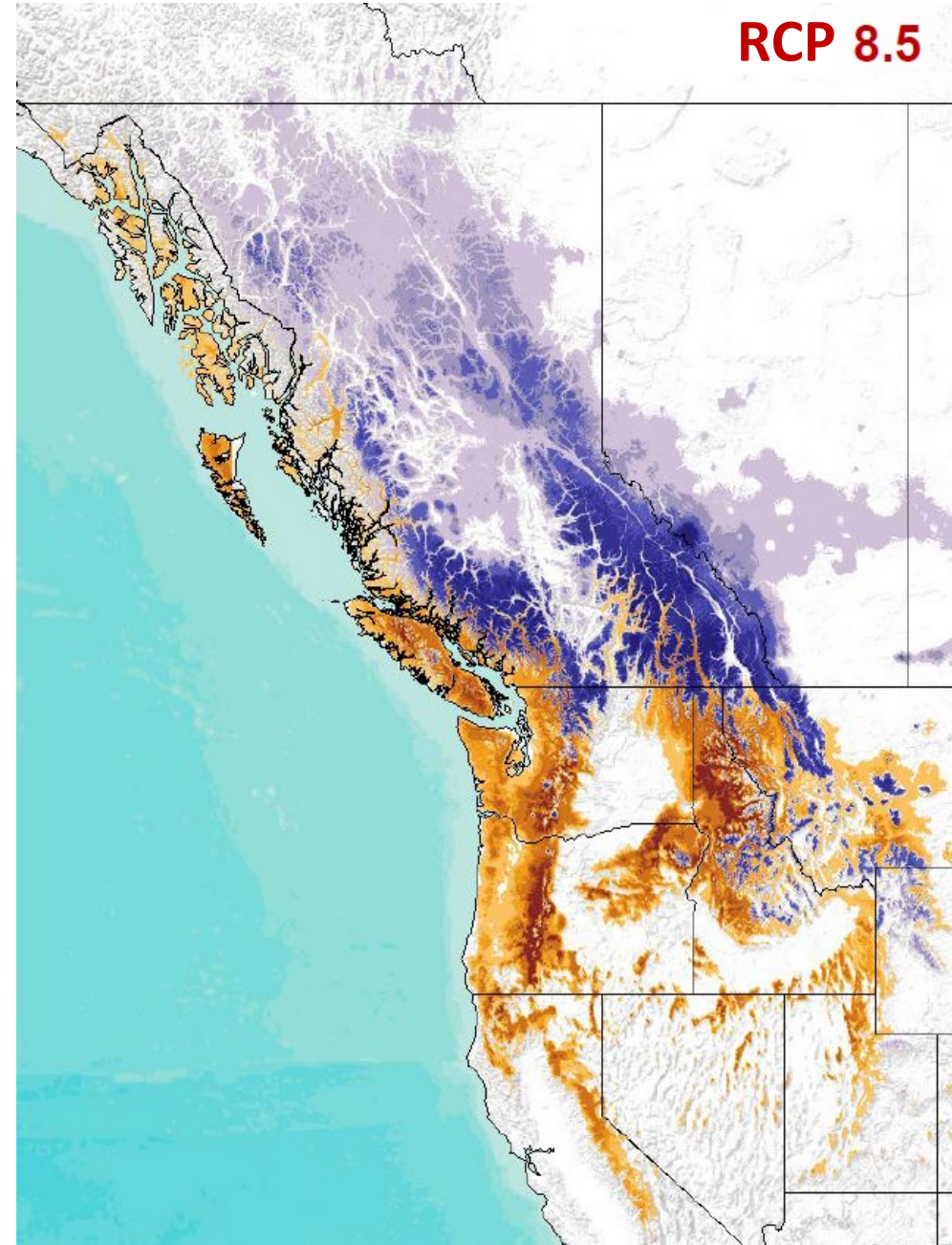
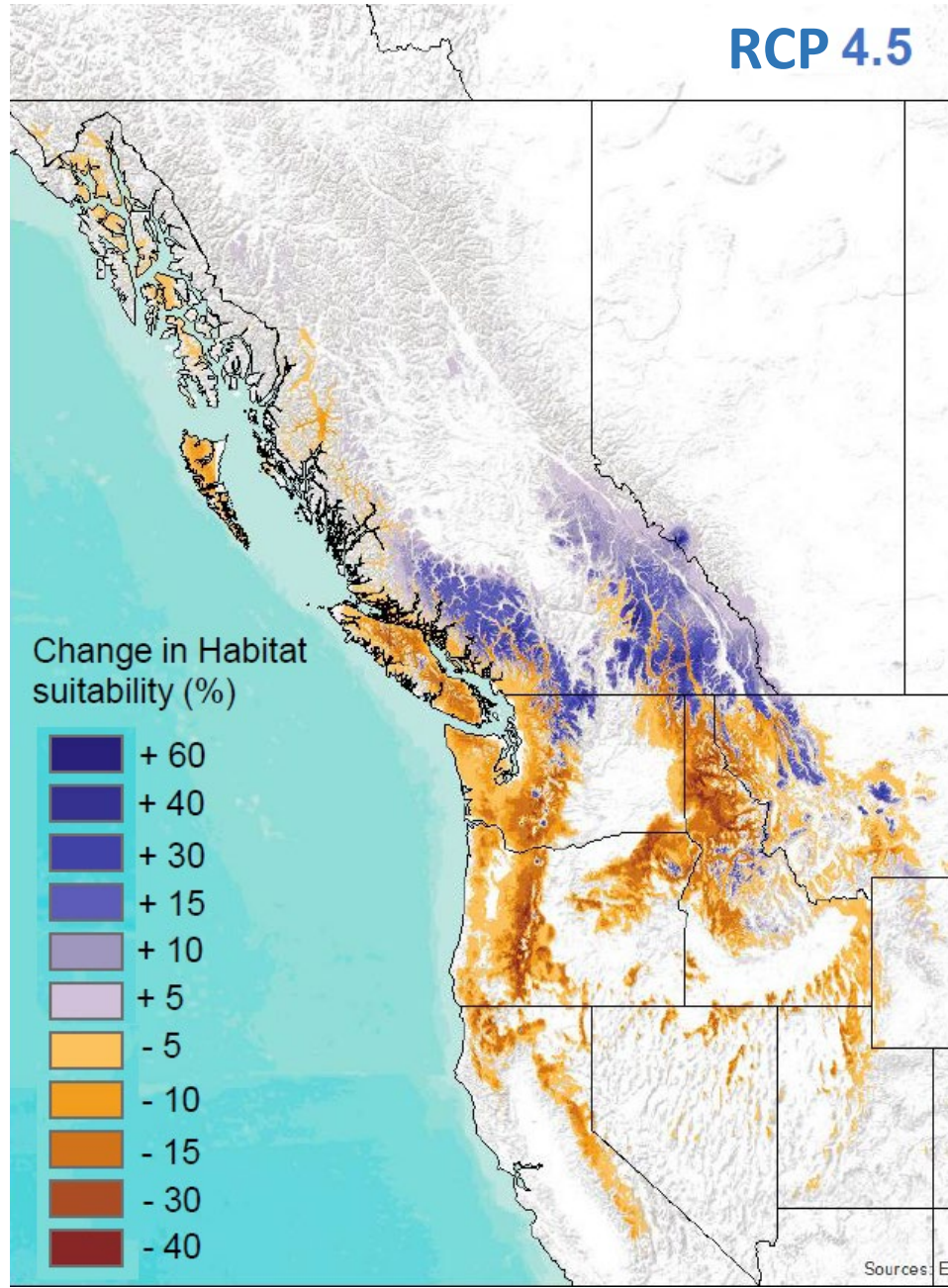
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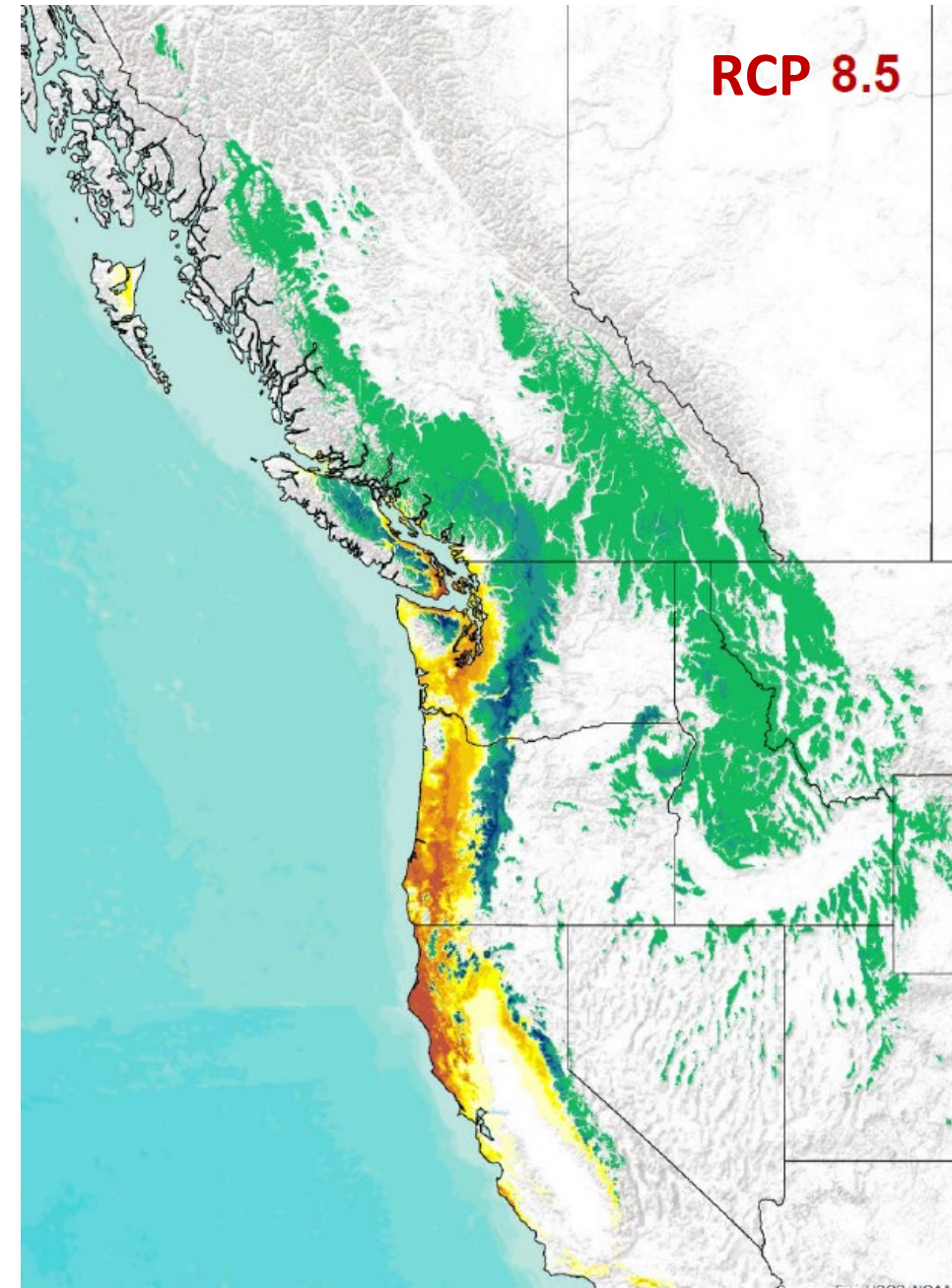
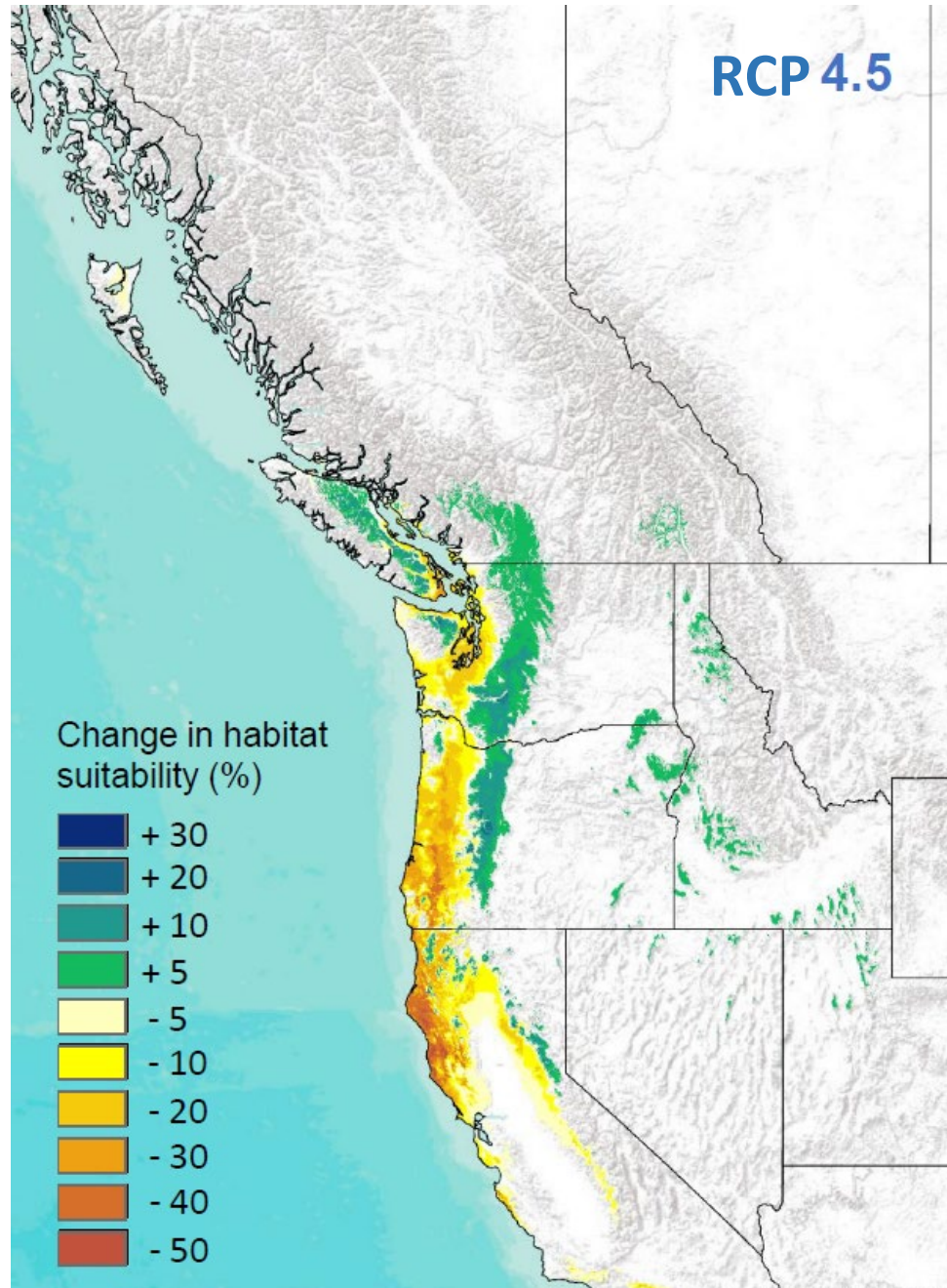
MaxEnt (Maximum Entropy) species distribution models to estimate how changes in important climate variables would impact the climatic niche of shrub species in the future



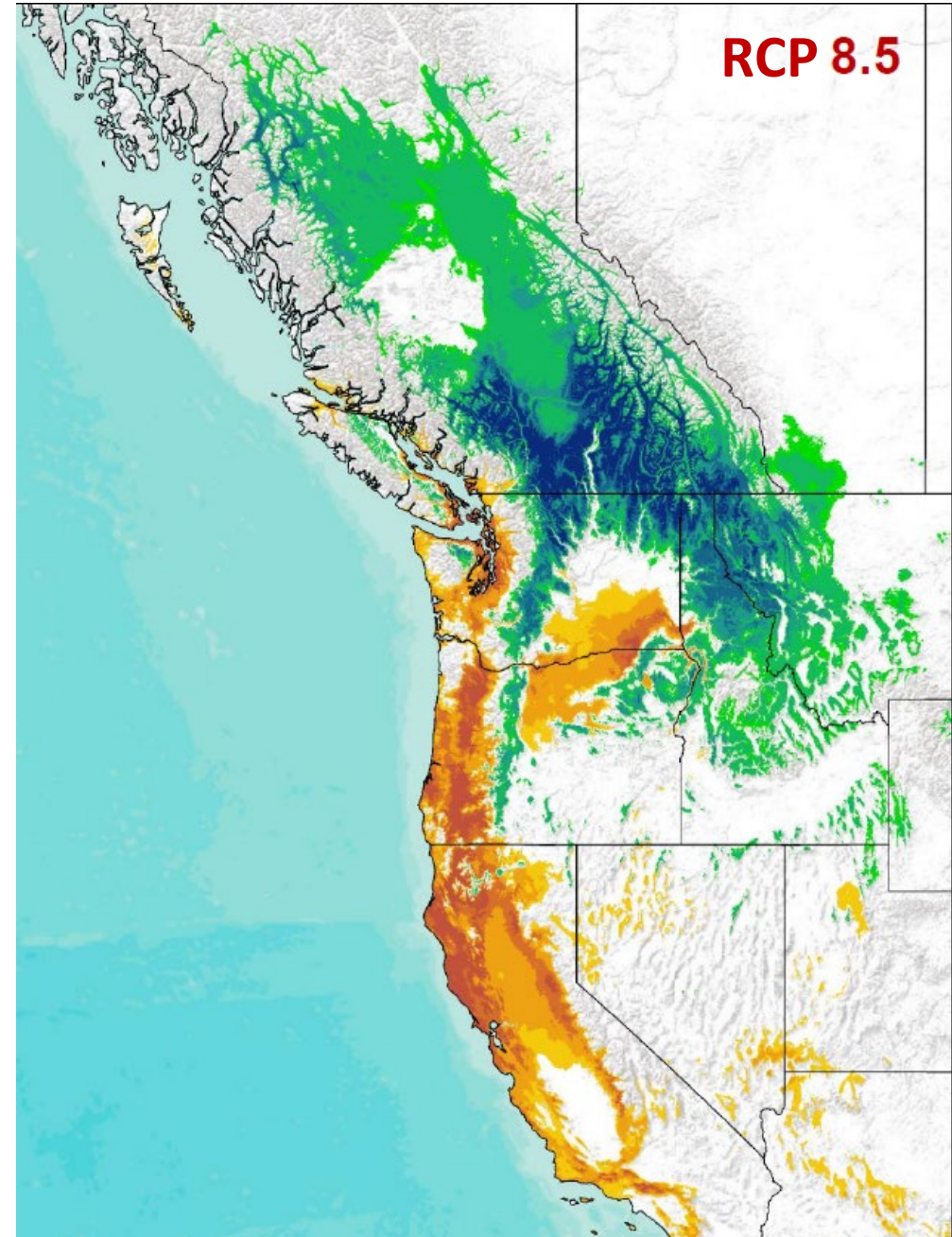
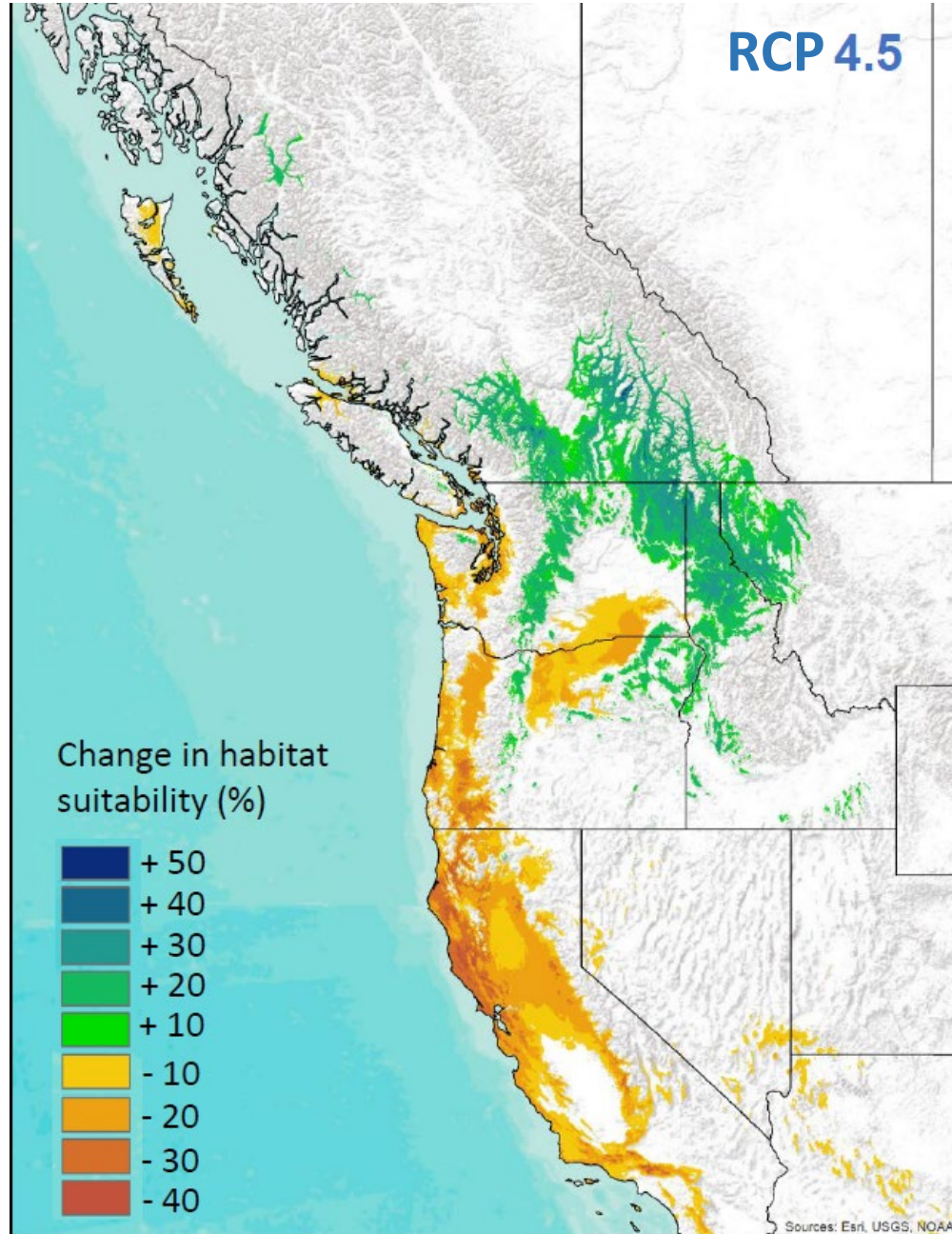
Huckleberry (VAME) in 2085



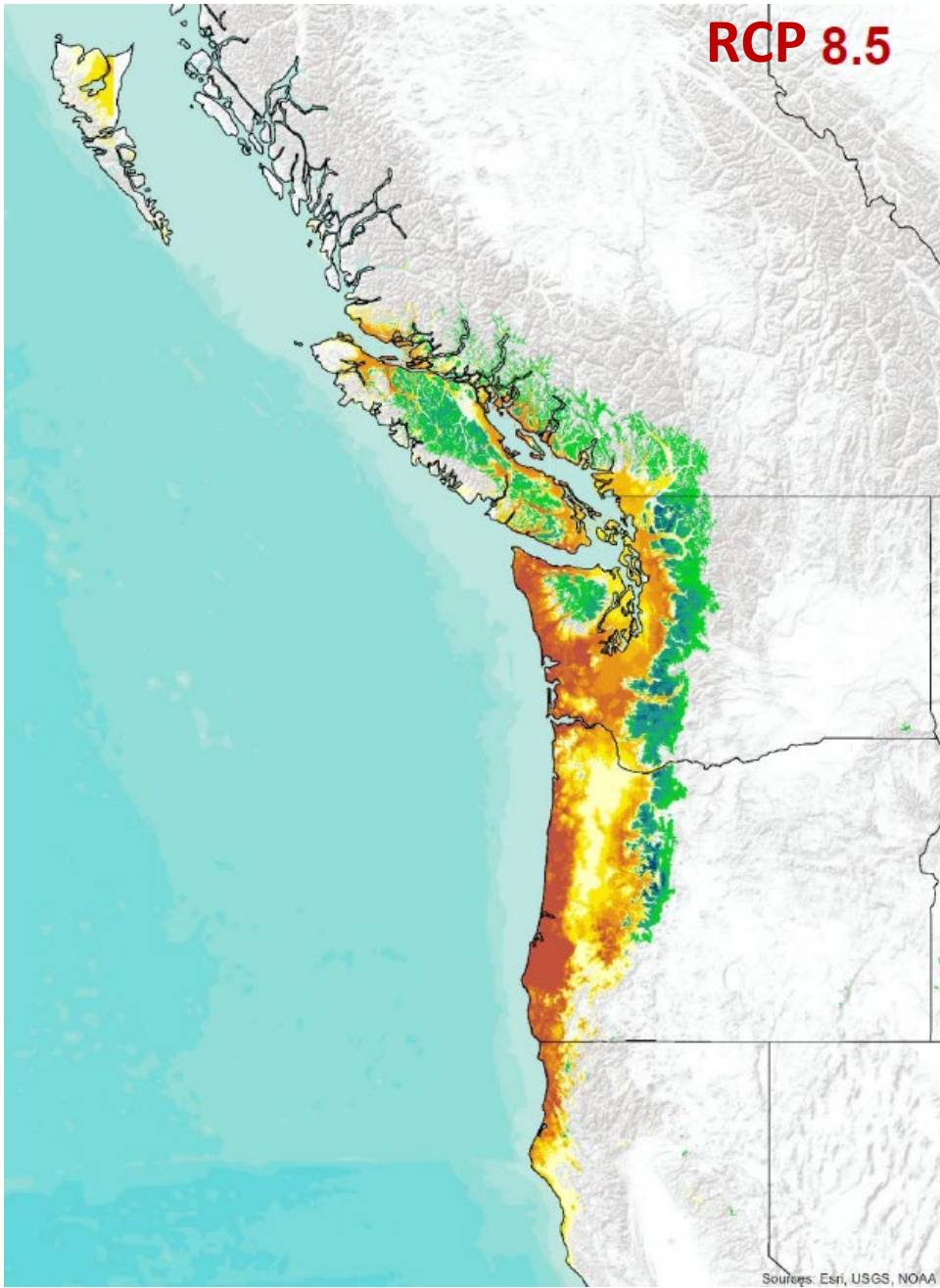
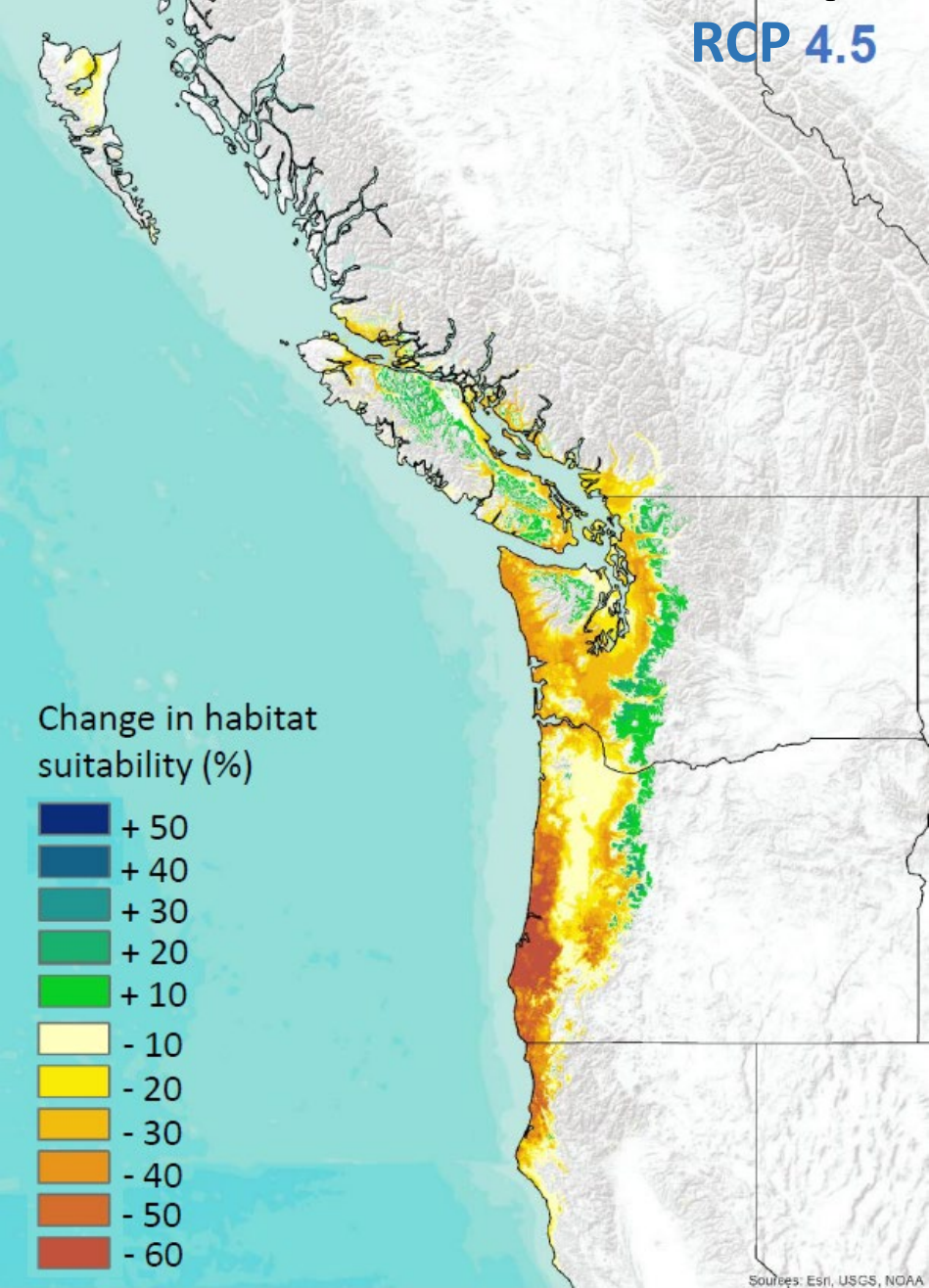
Hazelnut (COCO) in 2085



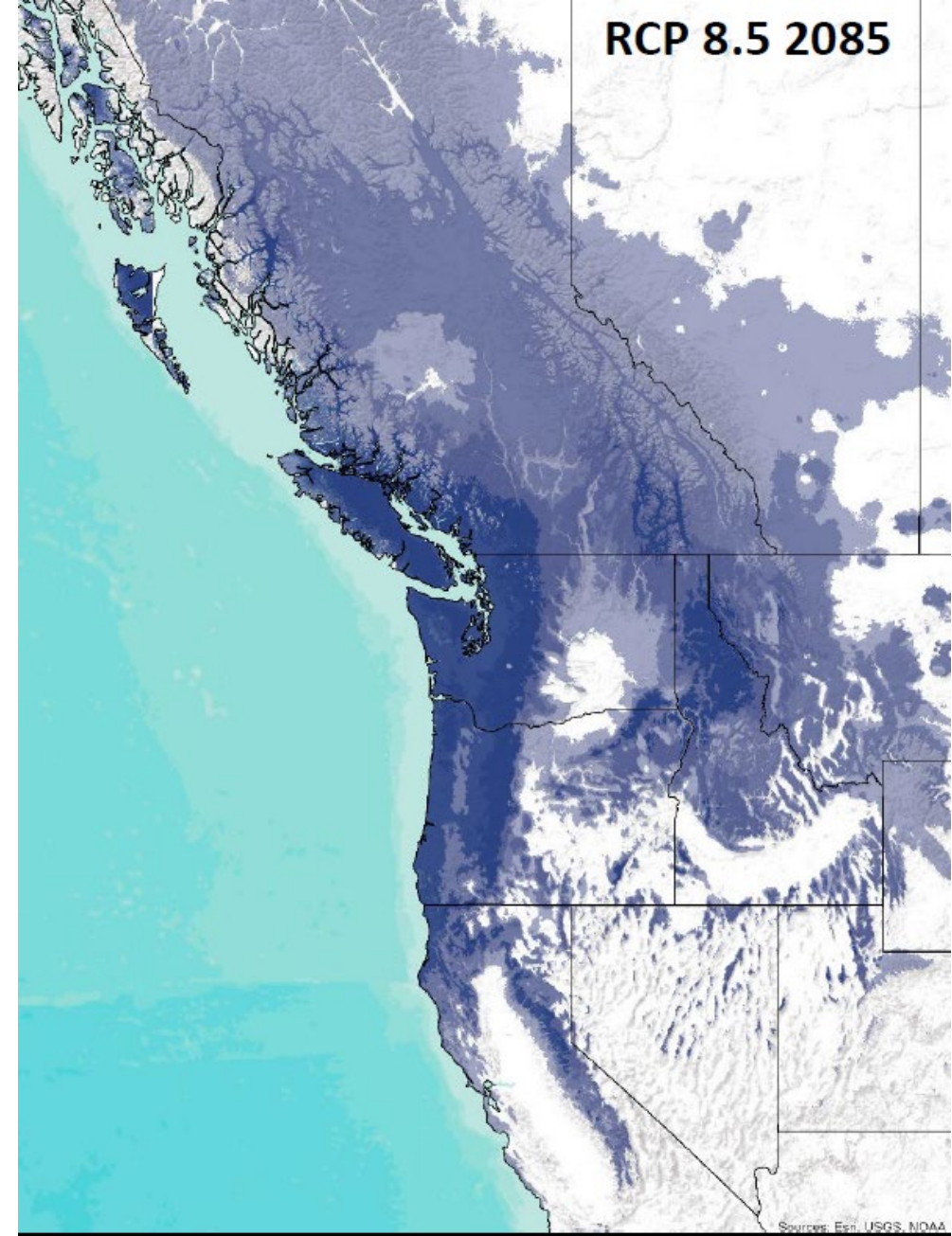
Oregon grape (MAAQ) in 2085



Salal (GASH) in 2085



Predicted range shift for all 4 shrub species by 2085



Changing phenology: Flowering and fruiting observations

- Repeated measurements of shrub phenology data are **rare**, so we estimated dates of flowering and fruiting from diverse data sources to examine how shrub phenology relates to seasonal temperatures.

We used data from many sources

Phenology data hard to come by – especially flowering data at high elevation sites



Black huckleberry in fruit, 8/3/1986
University of Idaho, collection by Fred Johnson



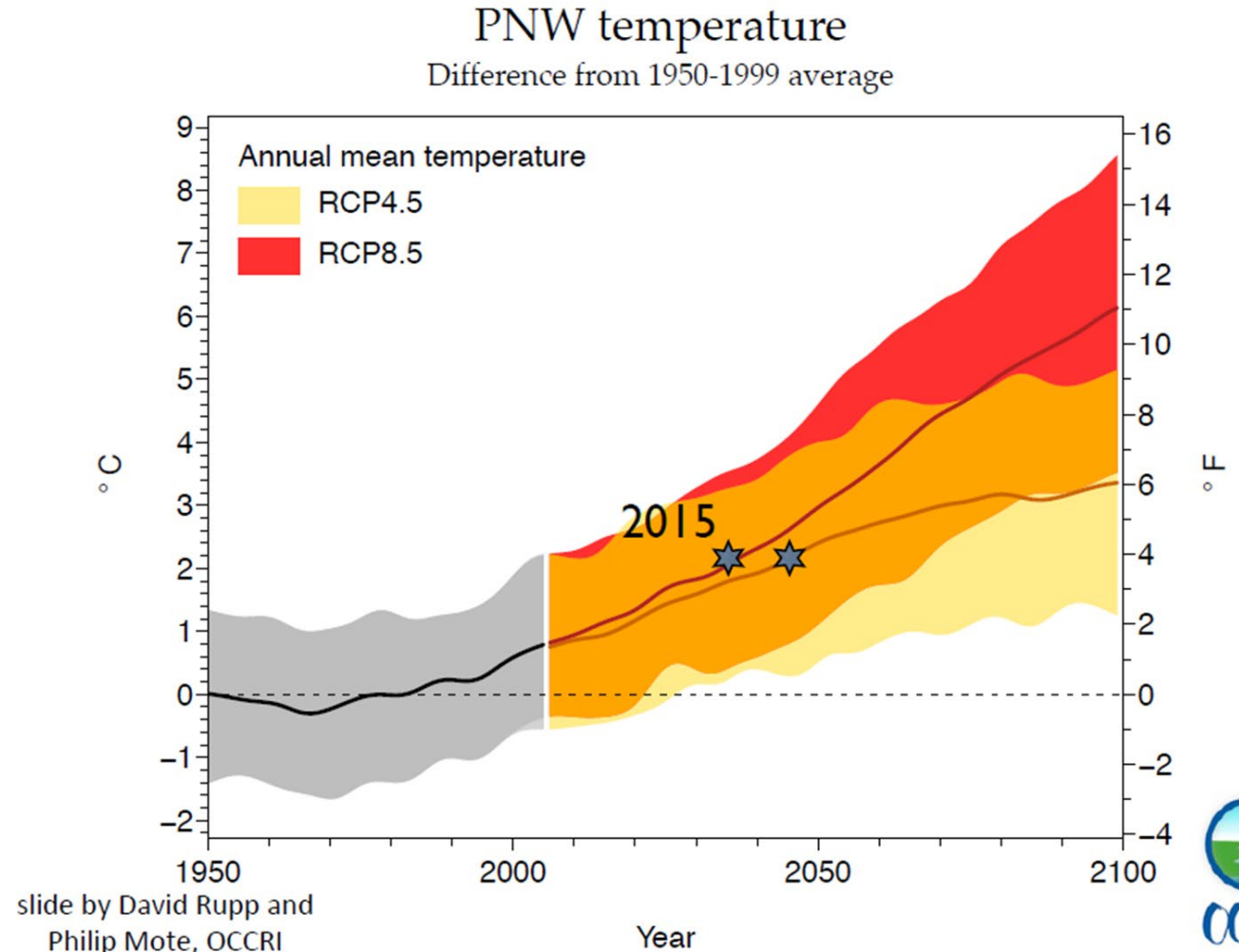
Black huckleberry in fruit, 7/29/2018
iNaturalist observation by Mitch Hurt

Changing Phenology: Climate Data

Matched locations of phenology observations to interpolated temperature data from Daymet from all observations between 1980-2017

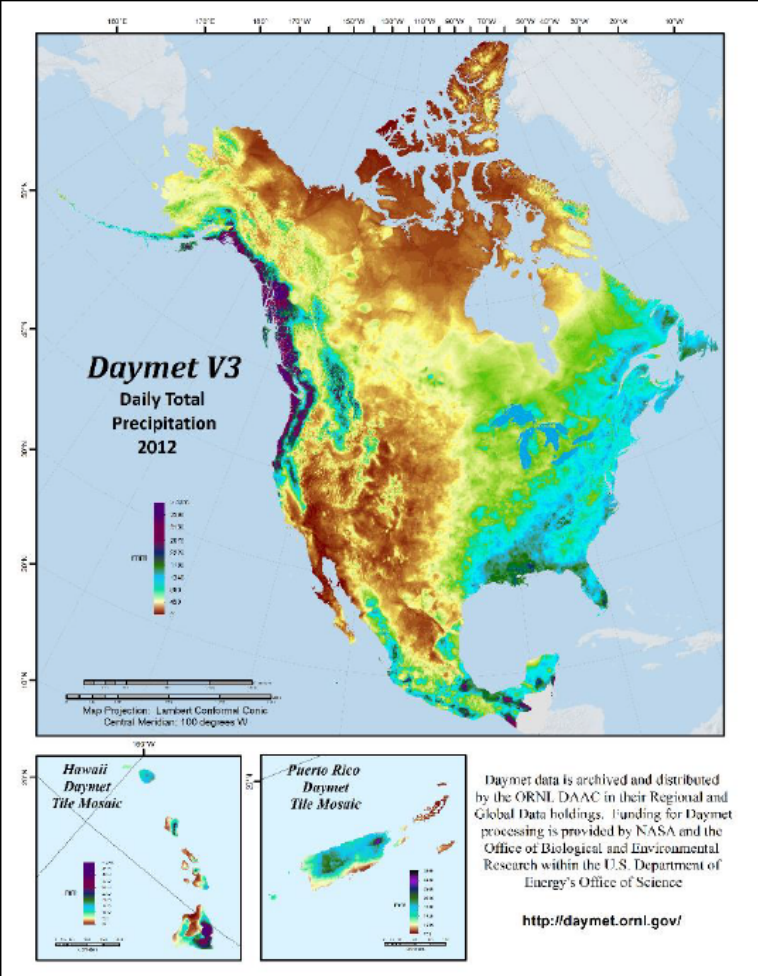
Cumulated daily temperature sums (growing degree days) for mean flowering and fruiting dates

Used GDD models and climate predictions to model future changes in phenology



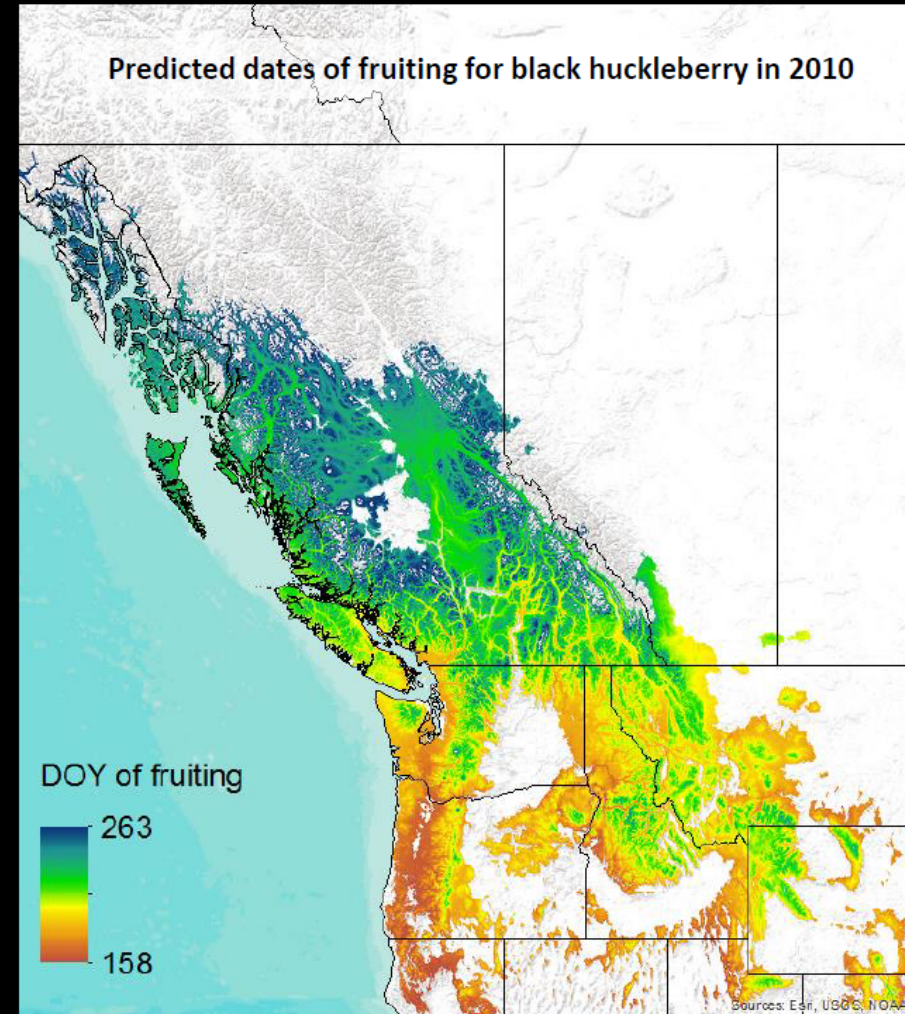
Changing phenology: Climate data

- Matched locations of phenology observations to interpolated temperature data from Daymet from all observations between 1980-2017

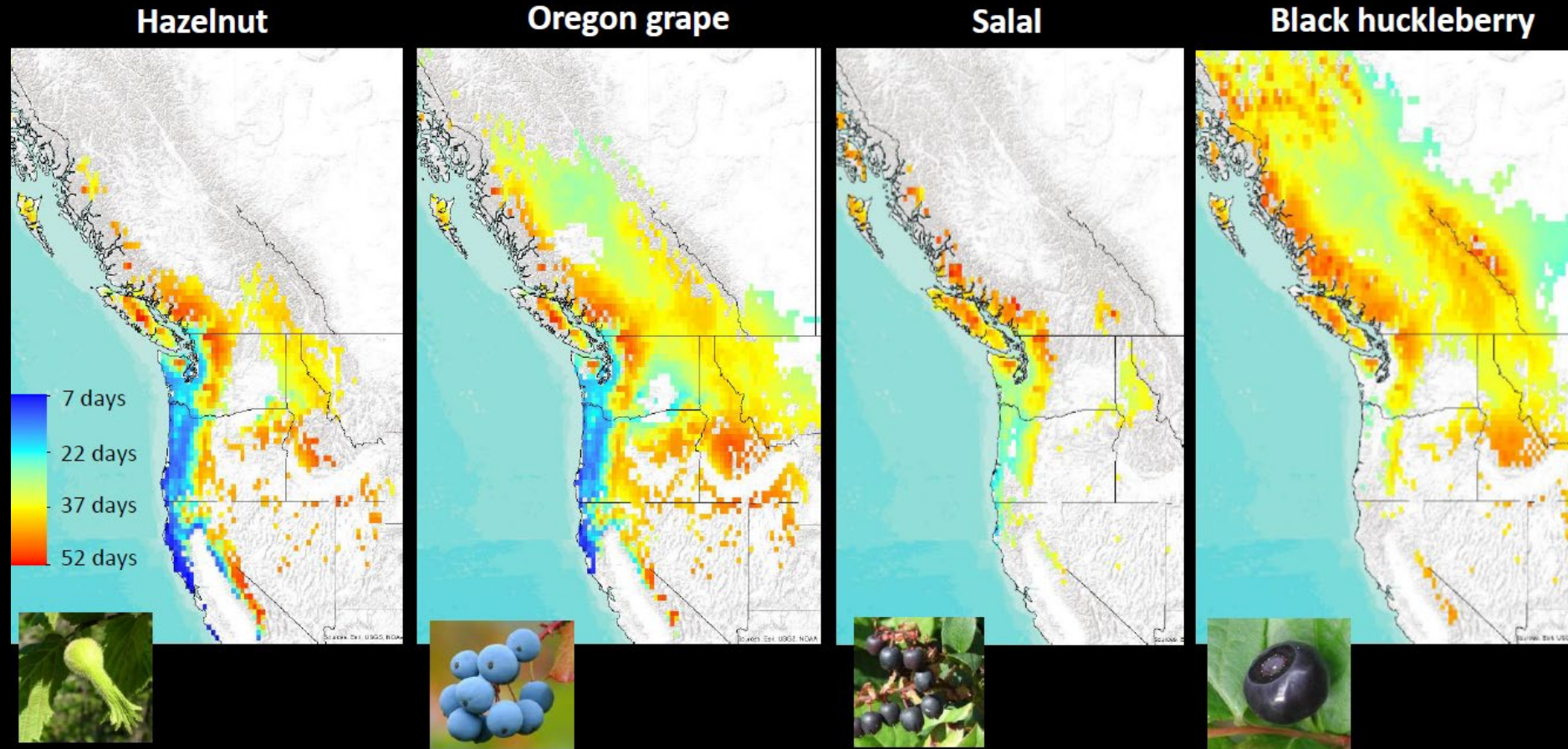


Changing phenology: Climate data

- Matched locations of phenology observations to interpolated temperature data from Daymet from all observations between 1980-2017
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Changing phenology: Shifts in flowering by 2085 - RCP 8.5



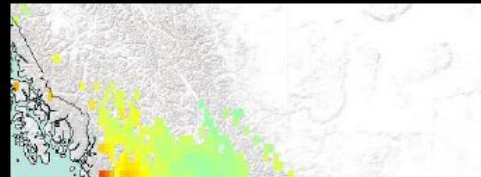
Flowering may advance 7 - 50 days by 2085

Changing phenology: Shifts in flowering by 2085 - RCP 8.5

Hazelnut



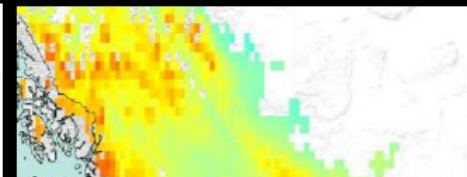
Oregon grape



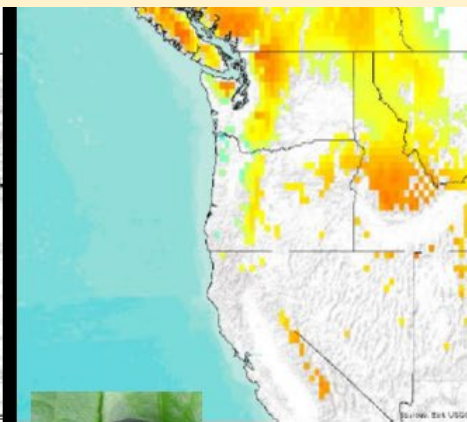
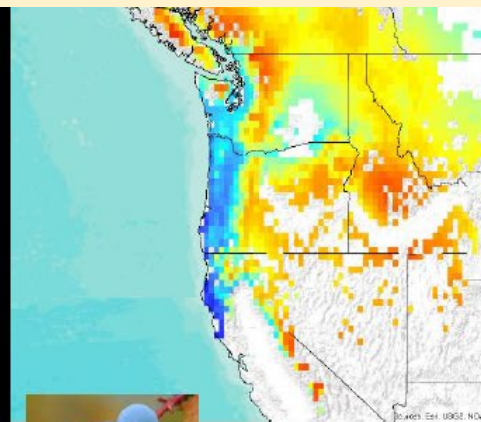
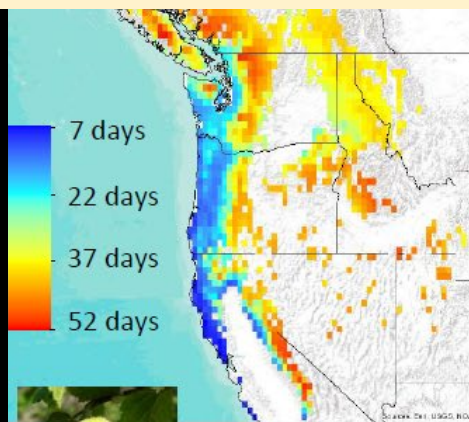
Salal



Black huckleberry

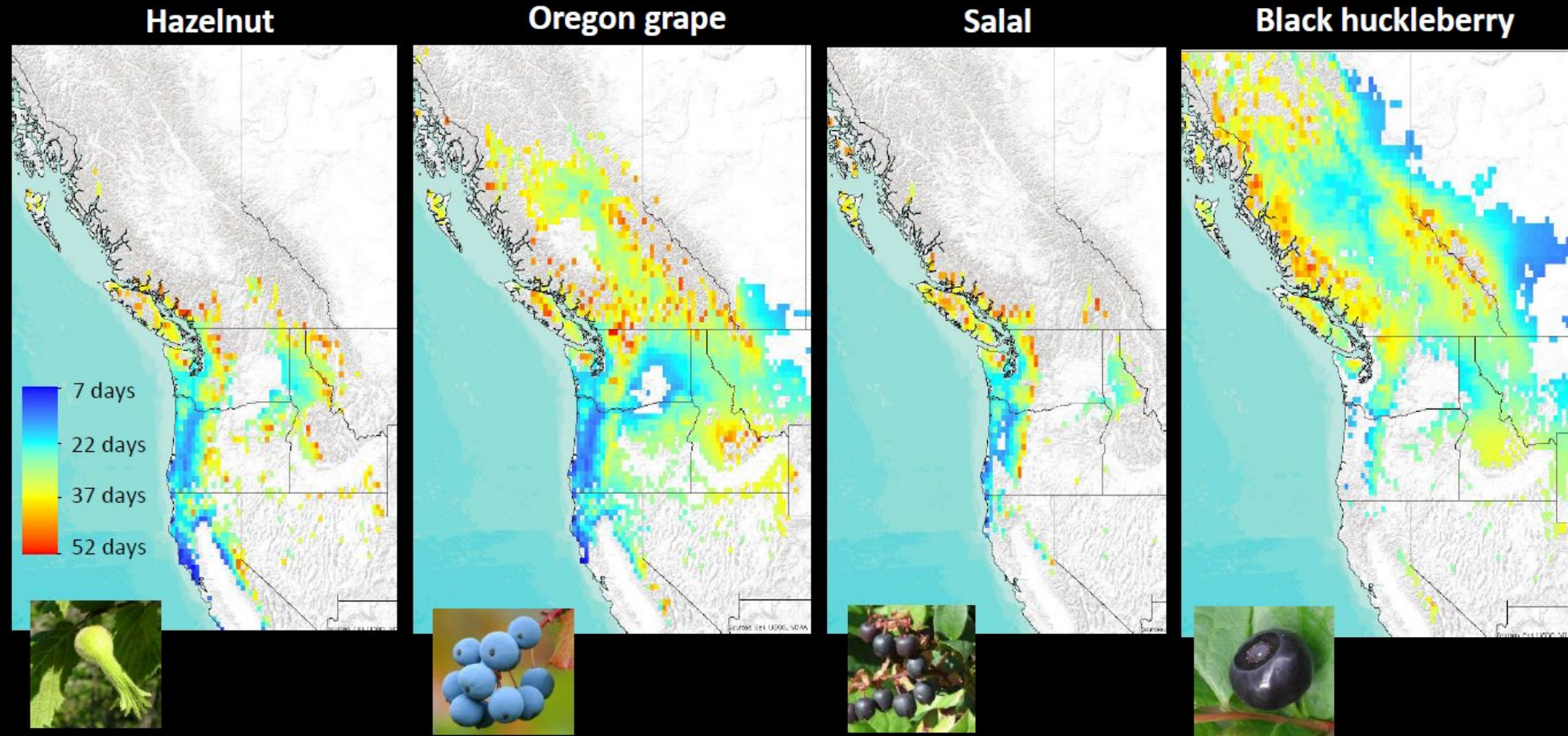


Did NOT consider factors like winter chilling due to insufficient data



Flowering may advance 7 - 50 days by the 2085....

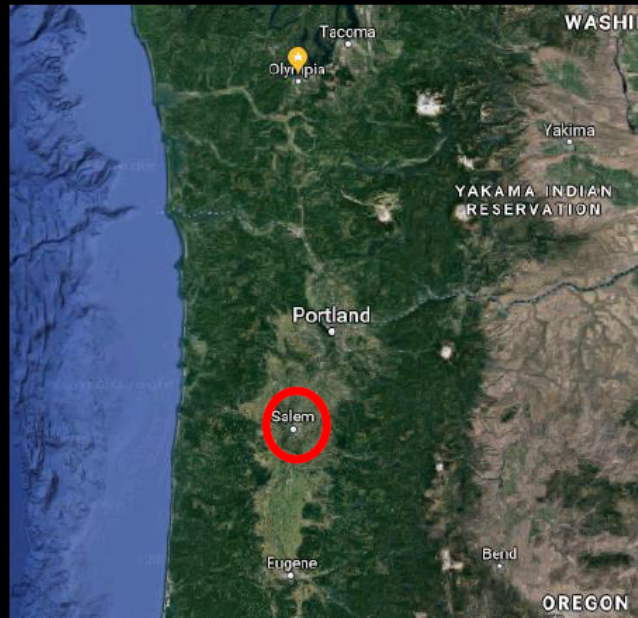
Changing phenology: Shifts in fruiting by 2085 - RCP 8.5



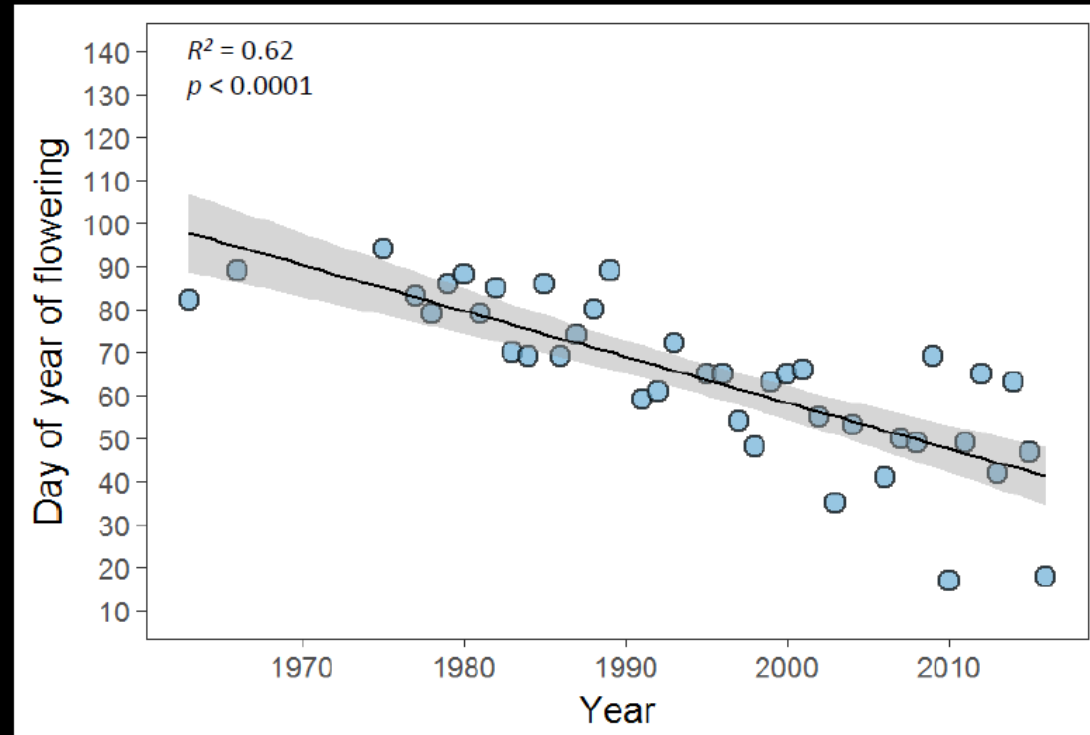
Fruiting may advance 10 - 55 days by 2085

Have there been large shifts in phenology over the recent past as temperatures have warmed?

- Wilbur Bluhm recorded phenology data around Salem, Oregon for over 50 years: <http://agsci-labs.oregonstate.edu/plantphenology/>
 - He recorded dates of Oregon grape flowering from 1960 – 2016

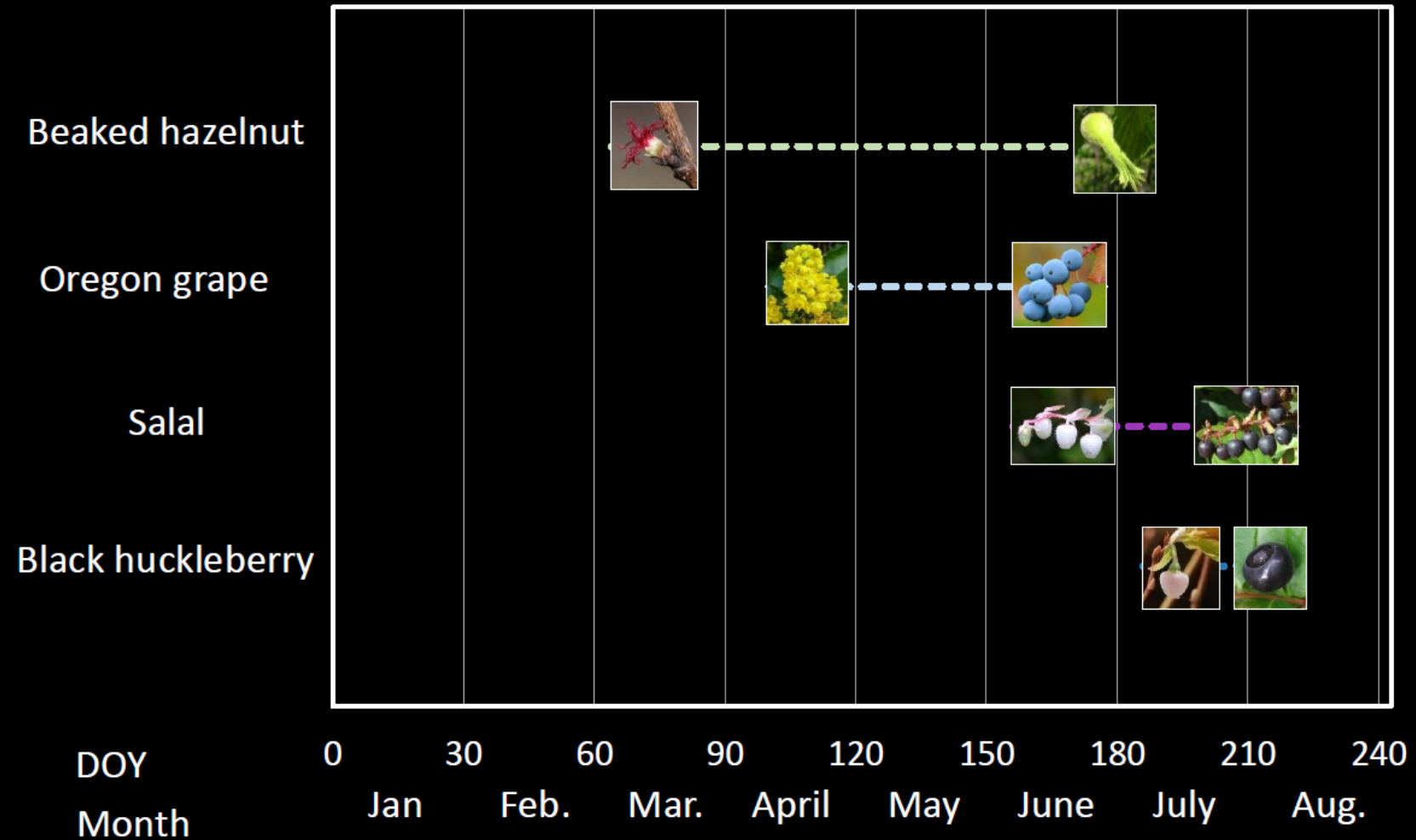


The Wilbur L. Bluhm Plant Phenology Study
Exploring the timing of important phenological events

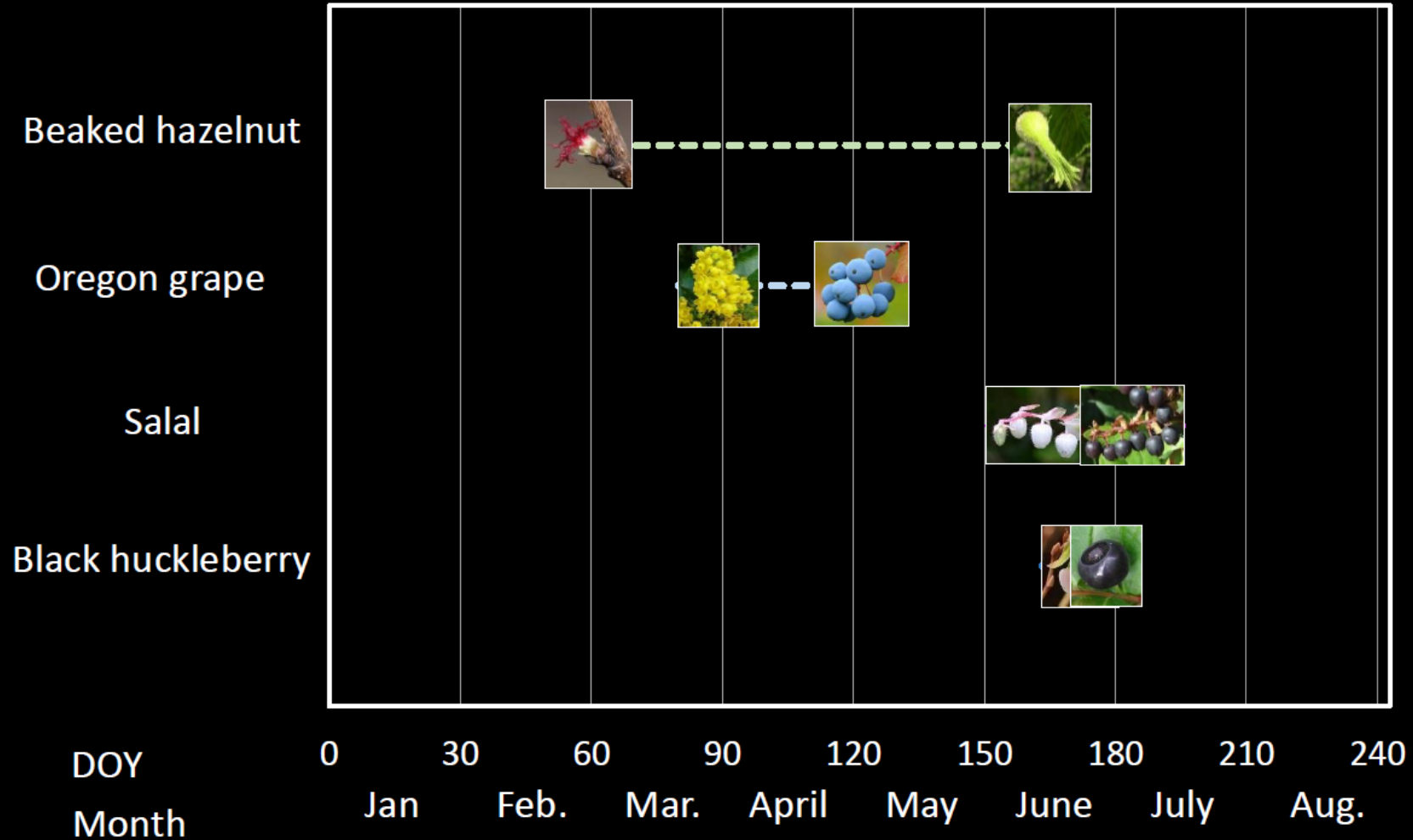


Flowering of Oregon grape has advanced an average of 50 days since 1960.....

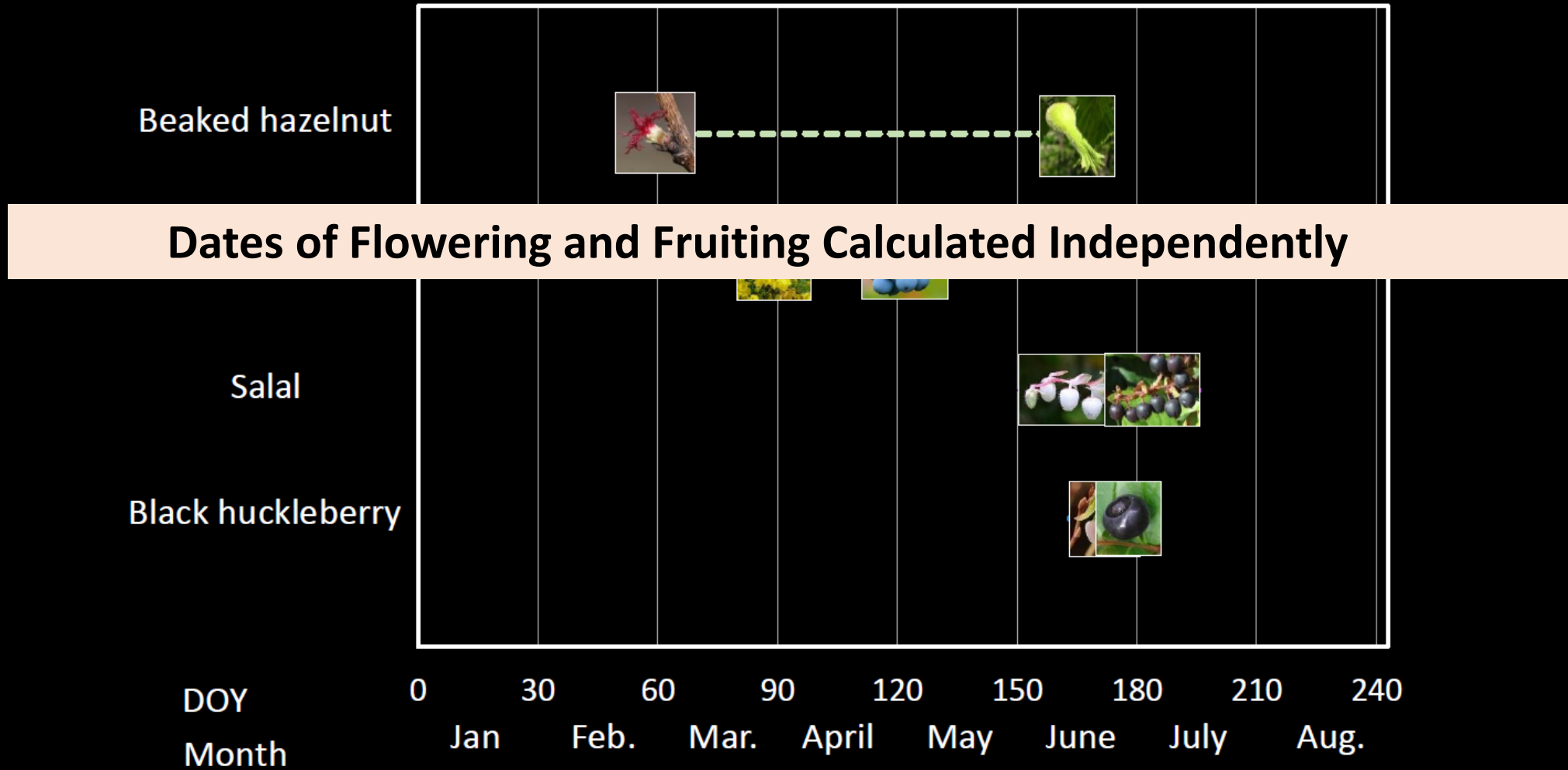
Mean flowering and fruiting dates: 1980-2016



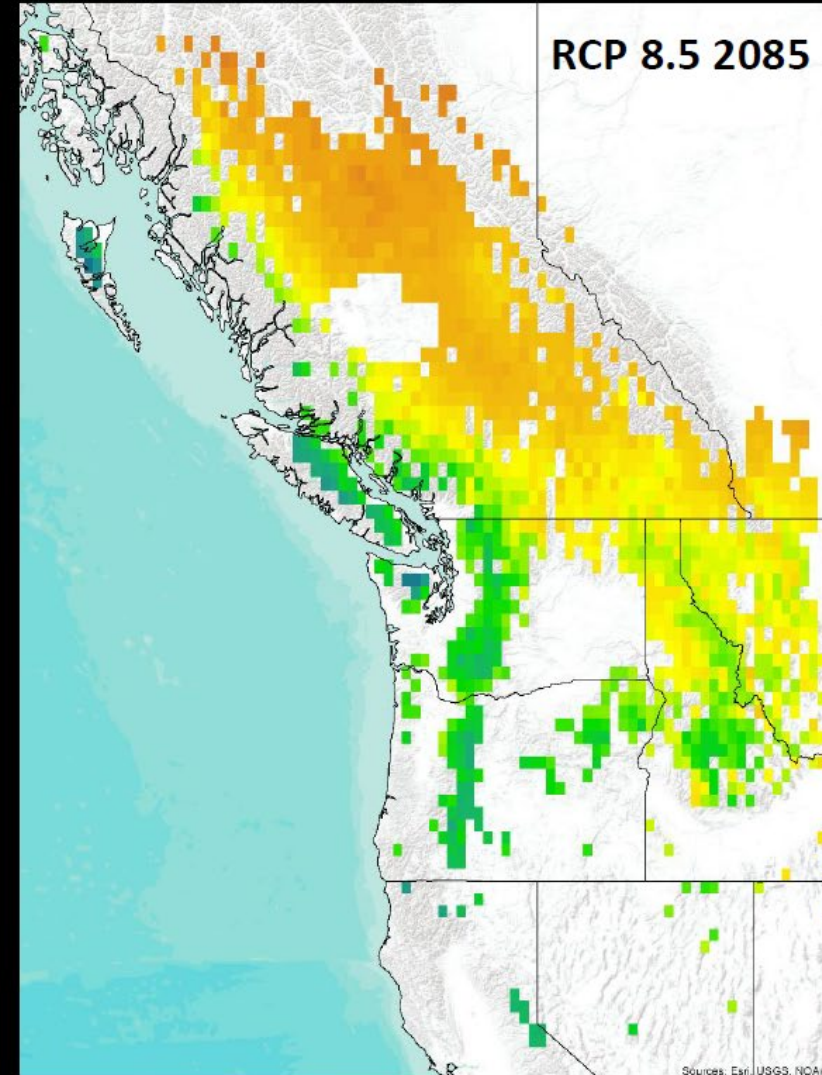
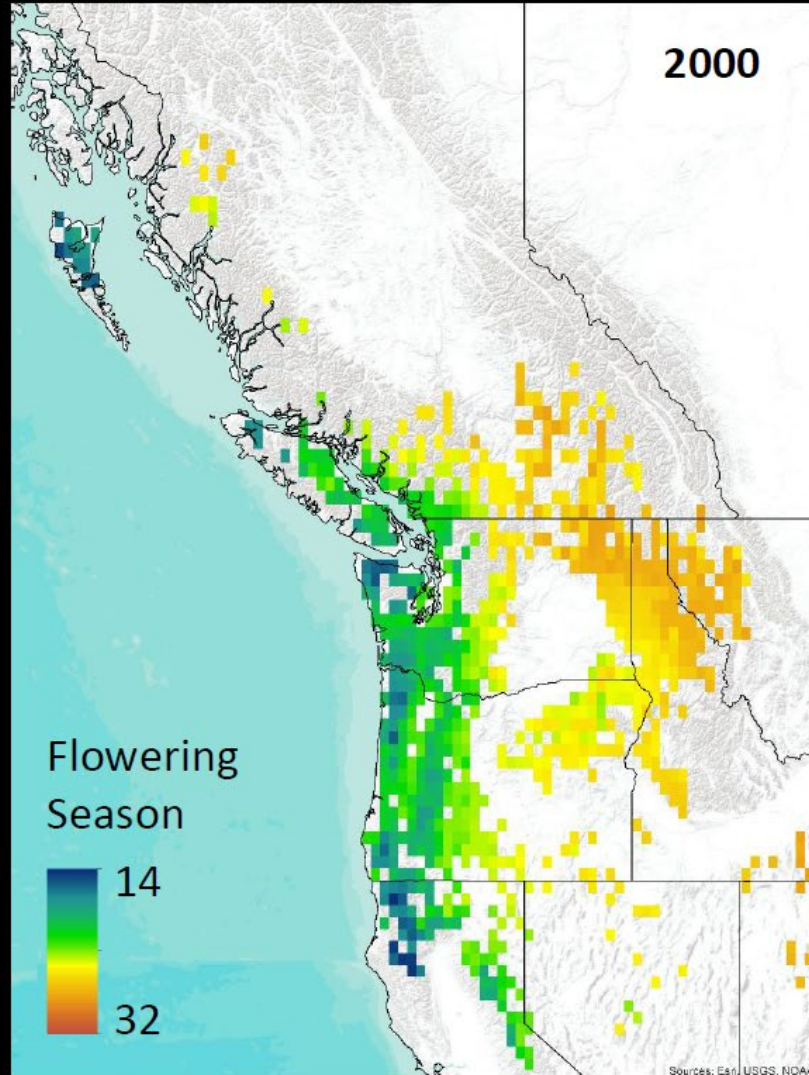
Predicted flowering and fruiting dates: 2085, RCP 8.5



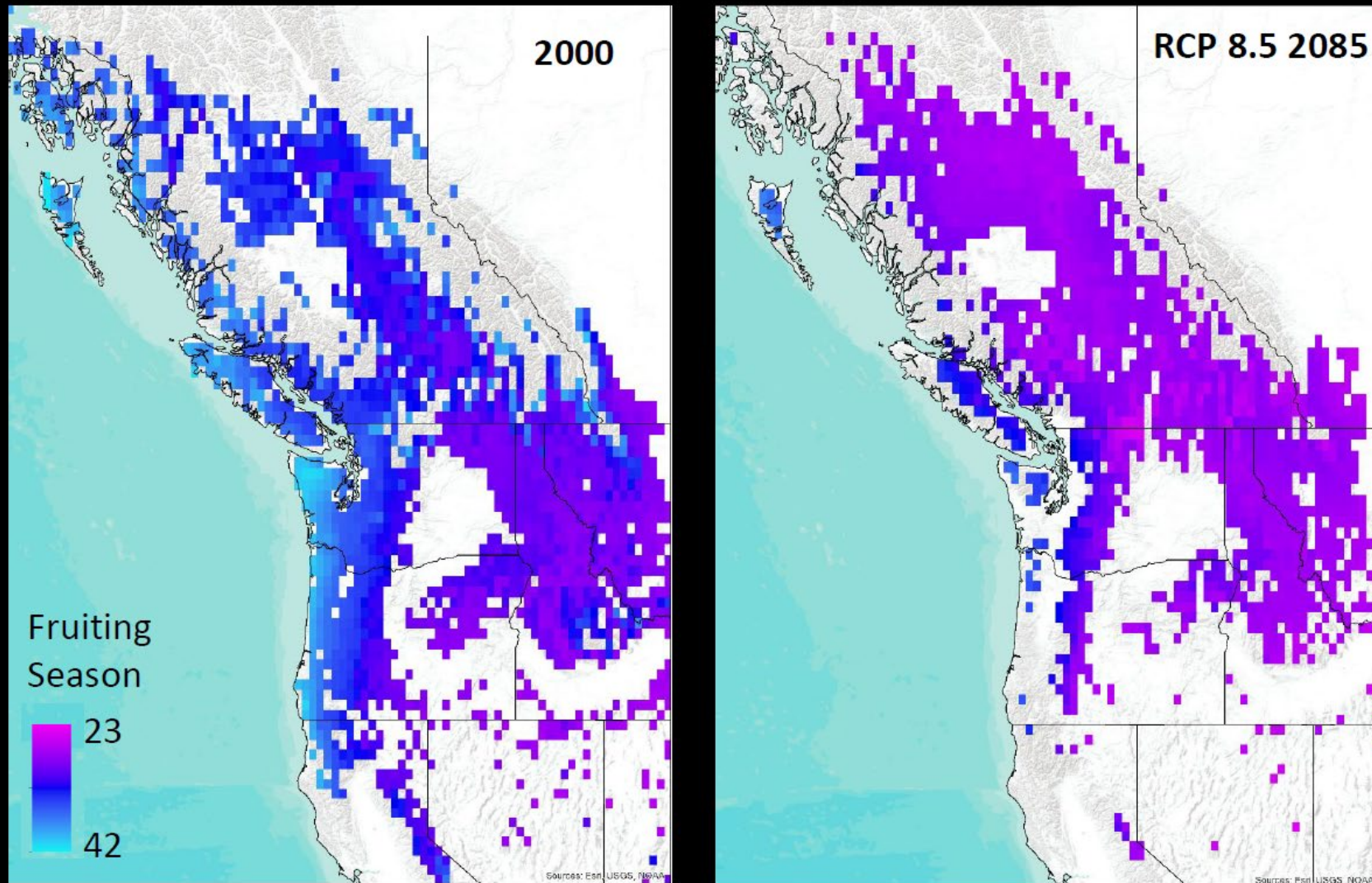
Predicted flowering and fruiting dates: 2085, RCP 8.5



Flowering season length: Black huckleberry and Oregon grape



Fruiting season length: Black huckleberry and Oregon grape



Warmer temperatures may lead to a contraction in the flowering and fruiting seasons of co-occurring species.....

Conclusions

- The ranges of culturally-important shrubs may **contract** at lower altitudes and drier sites across the Pacific Northwest
- The timing of flowering and fruiting could **advance** by 7- 55 days by 2080
- Large shifts in range and phenology of shrubs have the potential to greatly alter trophic relationships, plant-pollinator interactions, and the timing of traditional harvests in the future.



Photo: 2008 Ed Book



Photo: OSU Special Collections

Conclusions

“All models are wrong, but some are useful.” George Box

Perhaps results could:

Inform climate vulnerability assessments for target species

Serve as a basis for targeted monitoring efforts

Identify areas where climate change might impact flowering and fruiting of edible shrubs

Help managers prioritize locations for restoration projects

Encourage more observations of flowering and fruiting!



An Important Part of the Northwest Landscape and Culture

Fruit-producing shrubs such as huckleberries, salal, Oregon grape, and beaked hazelnut are an important component of social history and traditional tribal diets in the Pacific Northwest. The fruits of these shrubs are also an important food source for foraging wildlife and pollinators, and serve as the basis for both non-tribal harvesting and small-scale commercial operations. Among land managers there is a strong interest in preserving and restoring these culturally important plant species across the Pacific Northwest. Information about ecology and management of Northwest berries is scattered in many different locations and formats. We have created this website as a guide to several types of information. This webpage is a work in progress, as we become aware of additional resources we will add them to the webpage. Please send us publications or links to add additional information (huckleberry@fs.fed.us).



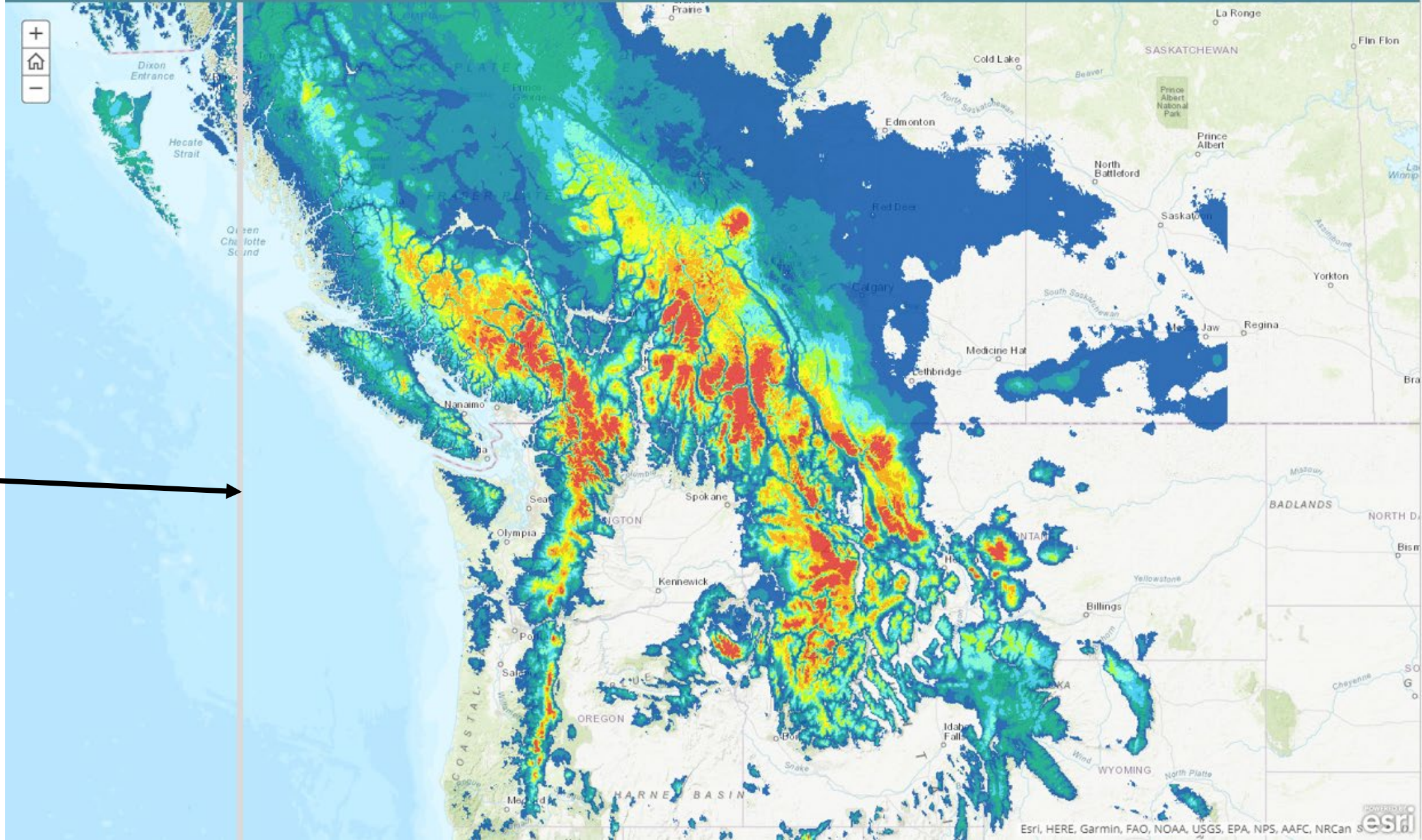
Photos: OSU Special Collections and USPWS - Pacific Region
Main photo: USPWS - Pacific Region

**“Story Map”
Interactive website – available soon!!!**

Thinleaf Huckleberry, present and 2085, RCP 8.5

LEFT: Present suitable habitat; RIGHT: Suitable habitat in year 2085, RCP 8.5

Slider bar
to see
changes in
suitable
habitat
between
now and
future



Thank you!

Funding: Northwest Climate Science Adaptation Center
Yakama Nation

People: Leslie Brodie, Yianna Bekris, Jacob Strunk, Bev Luke, Tabitha Graves
Clayton Lamb, and the many citizen scientist data collectors!

Plant Data sources:

USFS Forest Inventory and Analysis

USFS R-6 Ecology Program

National Park Service

USDI Bureau of Land Management

Project Budburst

USA NPN

PNW Herbaria

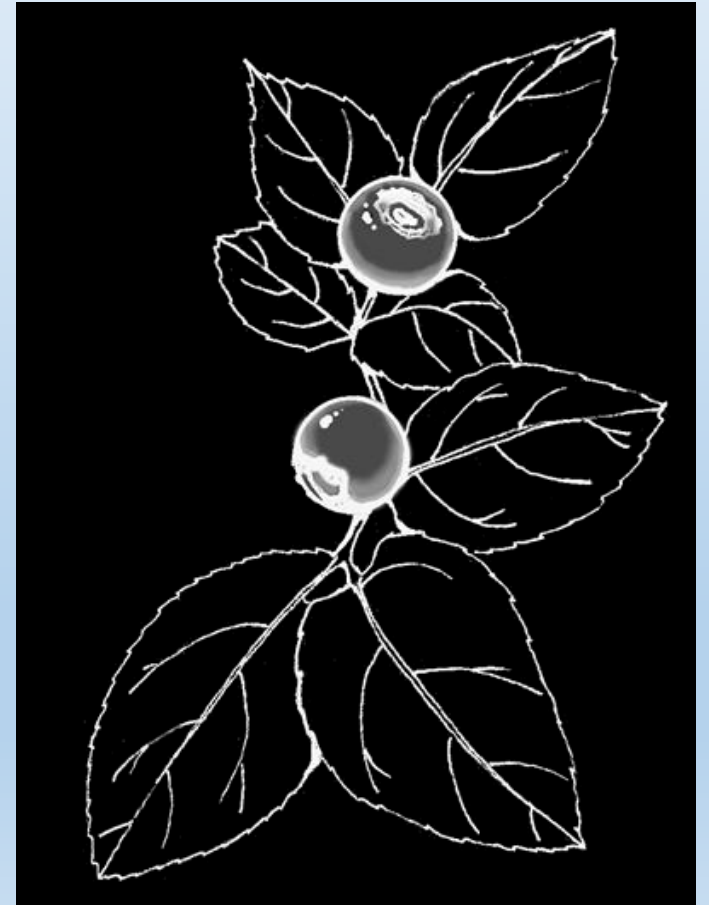
Oregon Flora

Climate data sources:

Daymet

Worldclim

ClimateNA



Climate Vulnerability Assessments for Plants

Guide to Assessing Climate Change Impacts
on Tribally Important Plants
Using Traditional and Expert-Based Knowledge
May 2019

Integrated Approach to assessing tribally important plant species using the *Three-Step Decision Support Framework* [1], *System for Assessing Vulnerability of Species to Climate Change* [2], and *Climate Adaptation Library* [3]
to rapidly develop climate-informed Species Management Proposals



Developed draft process to assess plant vulnerability (based on habitat, physiology, phenology, biotic interactions)

Example for huckleberry in this document

Included monitoring and management recommendations

Questions?

Connie.Harrington@usda.gov

GDD averages

| | GGD Flower | GGD Fruit | DOY Flower | DOY Fruit |
|-------------------|------------|-----------|------------|-----------|
| Beaked Hazelnut | 142.39 | 859 | 64 | 188 |
| | | | | |
| Oregon grape | 145.62 | 735.39 | 100 | 177 |
| | | | | |
| Salal | 459.17 | 1006.66 | 156 | 221 |
| | | | | |
| Black huckleberry | 369.98 | 622.03 | 186 | 214 |
| | | | | |
| | | | | |