Berries In a Changing Climate: Developing A Framework For Assessing Changing Species Distributions

Emily Brown, Sadie Lye, Terrell Roulston 2023 RES 509 UBC Botanical Garden

Executive Summary:

Climate change has altered global temperature and rainfall patterns, resulting in modifications to the geographical distribution of plants. These changes to the climate have impacted the productivity of plants. In order to ensure future food security, the conservation of crop wild relatives is important as these plants could have the genes and traits necessary to cope with changed climate conditions.

Berry-producing plants are threatened by climate change, as well as other anthropogenic drivers of biodiversity loss. Berries are especially important to conserve because they hold economic, cultural, and nutritional importance to Indigenous and non-Indigenous People across North America. In addition, berry-producing plants are ecologically important for many species interactions including insects, birds, and mammals. Thus, the decline and loss of berry species will have negative impacts on ecological communities.

The UBC Botanical Garden hopes to conduct a risk assessment for berry plants as part of their climate adaptation planning. To aid in this assessment we developed habitat suitability maps using species distribution modeling (SDM), focusing on four berry species of interest, *Amelanchier alnifolia* (Saskatoon berry), *Rubus lasiococcus* (Roughtfruit berry), *Rubus nivalis* (Snow raspberry), *Vaccinium parvifolium* (Red huckleberry). This study focused on the Pacific Northwest region, defined as British Columbia, Washington, and Oregon. Geolocated occurrence data of these species was sourced from the Global Biodiversity Information Facility (GBIF). Habitat suitability was modeled using 'BIOCLIM', a simplistic, easily reproducible SDM. To predict the effects of changing climate we compared variables from historical and predicted climate data from the climate model, MRI-ESM2.0, under two climate scenarios, called Shared Socioeconomic Pathways (SSP), SSP2-4.5 and SSP5-8.5.

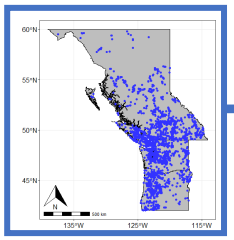
Further analysis across the entire range of *A. alnifolia* and *V. parvifolium* is needed as results for their species ranges were limited in this study, resulting in possible overestimation of changes in habitat suitability. We report drastic declines in habitat suitability occurring by 2030 and continuing to 2070 for all four berry species. By 2070, *R. lasiococcus* and *R. nivalis* are predicted to experience a greater loss of suitable habitat under SSP2-4.5 (-57% and -56% respectively) and SSP5-8.5 (-75% and -71% respectively) than *A. alnifolia* and *V. parvifolium* under SSP2-4.5 (-39% and -38% respectively) and SSP5-8.5 (-48% and -42% respectively). By 2070 the median latitudinal density of suitable habitat for all species was predicted to shift north from 0.63-1.41 degrees under SSP2-4.5, and more drastically from 1.75-2.7 degrees under SSP5-8.5.

Most urgently, we recommend the UBC Botanical Garden consider collecting samples of berries from regions in BC where these SDMs predict that species will become locally extirpated by the end of this decade to maintain this genetic diversity in gene banks and gardens. It will be important to develop predictive SDMs for more berry species to better understand the predicted effects of climate change on berry distribution in the region. Though the SDM framework we layout is easily reproducible, we encourage the UBC Botanical Garden to use this framework as a stepping-stone to create stronger SDMs to inform conservation planning.

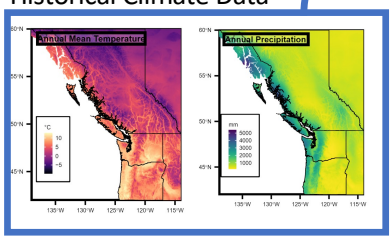
The Problem: Berries, an economically and culturally important group, are at risk due to climate change and another anthropogenic drivers. Where in the PNW will they be able to persist under future climate scenarios?

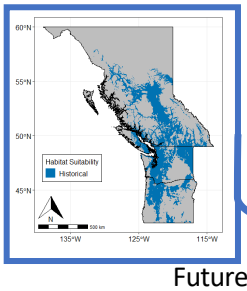
Method:

Species Observations



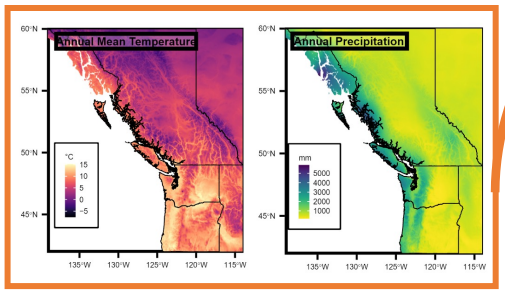
Historical Climate Data



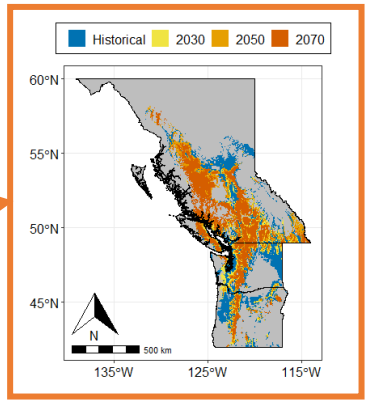


Predicted Historical Species Distribution

Future Climate Data



Predicted Future Habitat Suitability



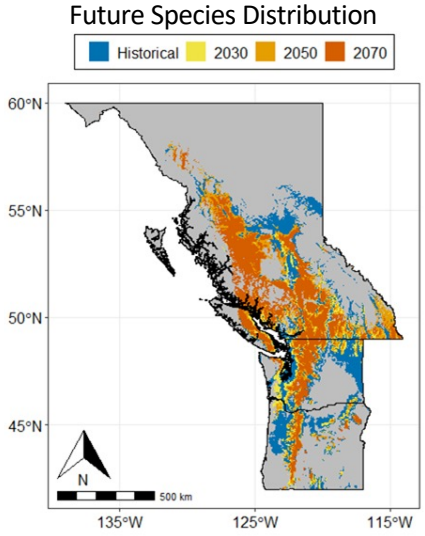
Note that species range were limited to PNW, a caveat for southern range decline.

All data & code publicly available: https://github.com/eemilybrown1/berryfun

Amelanchier alnifolia / Saskatoon berry

Culturally important species

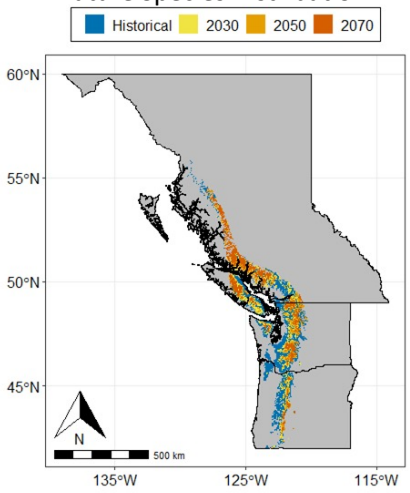
Future Species Distribution



Rubus lasiococcus / Roughfruit berry

Blue-listed species

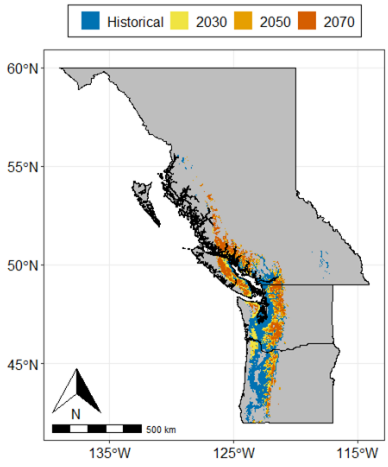
Future Species Distribution



Rubus nivalis / Snow raspberry

Blue-listed species

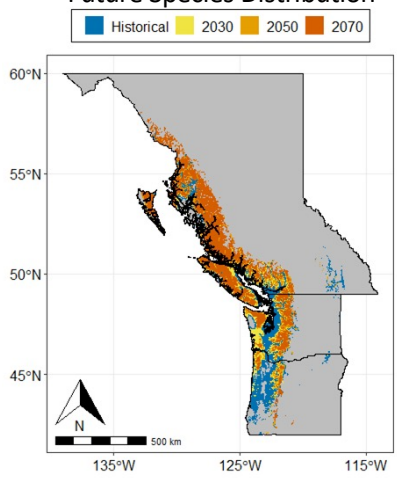
Future Species Distribution



Vaccinium parvifolium / Red huckleberry

Culturally important species

Future Species Distribution



In Summary: Under future climate scenarios, there may be less suitable habitat for berry species. Action is needed now to ensure that berries are able to persist in a future climate.

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