



Seed Trek 2.0: The Next Generation

Greg O'Neill

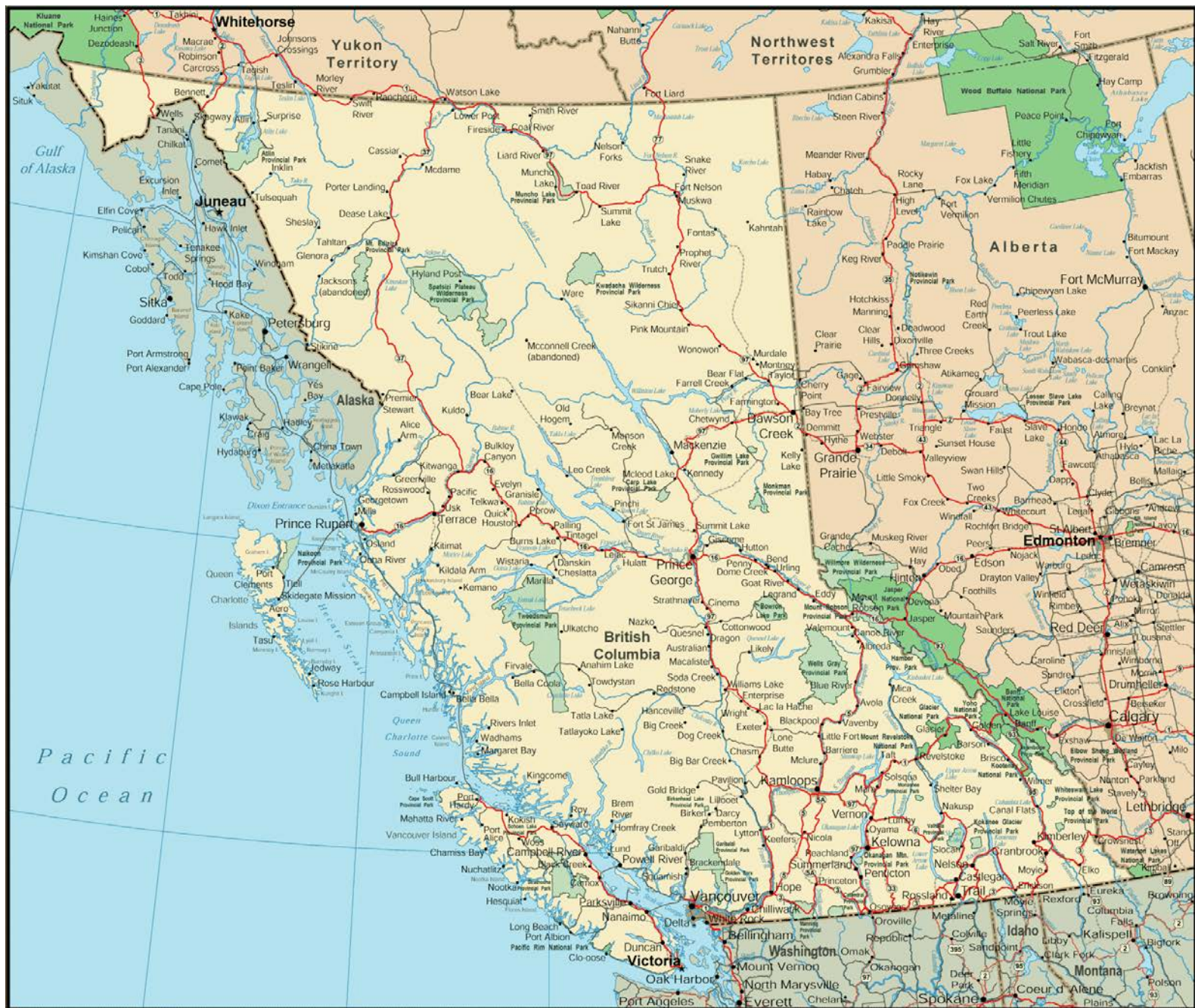
**Forest Improvement and Research Management Branch
FLNRORD**

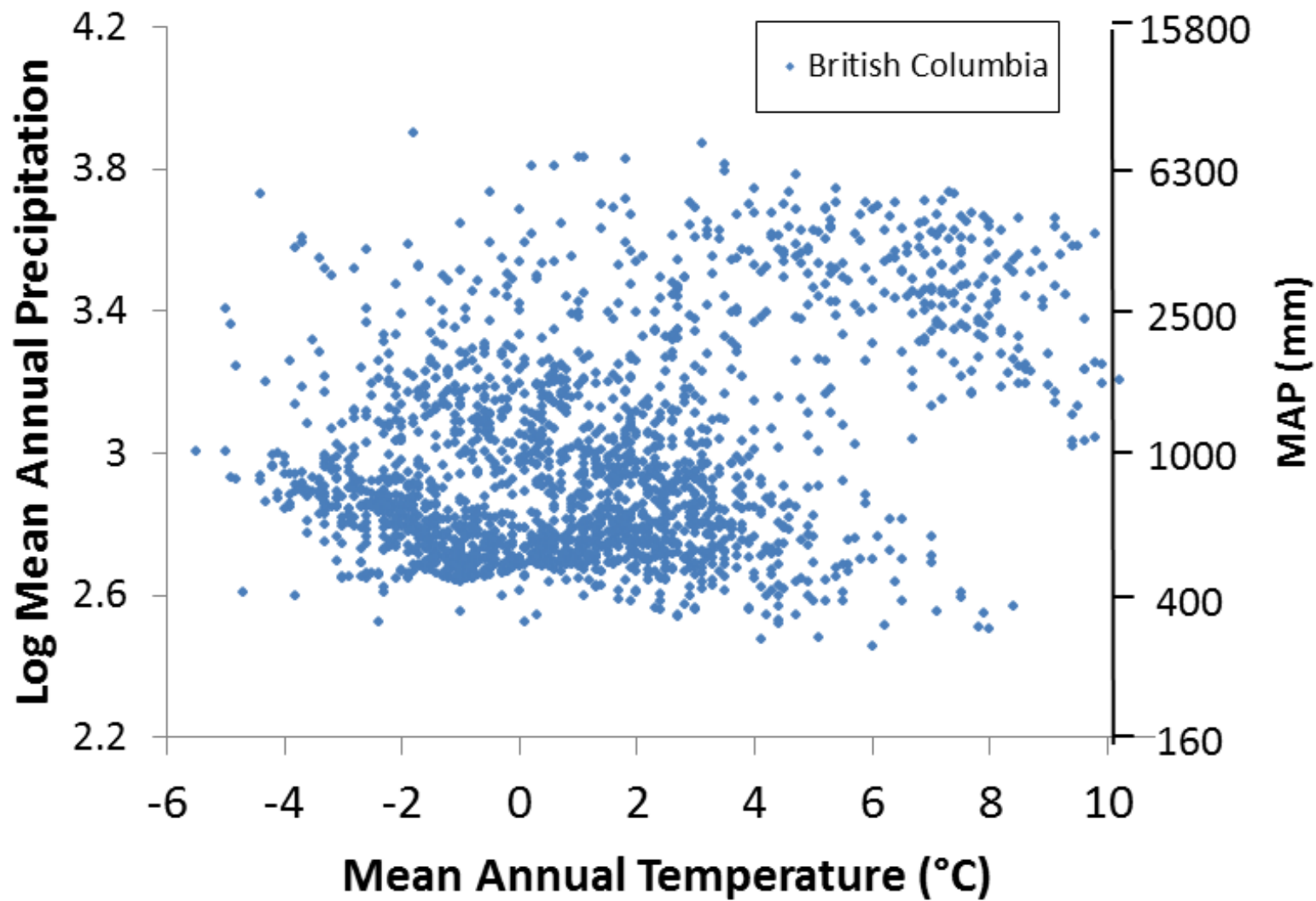
Connections Through Seed
Tree Seed Centre's 60th Anniversary

Oct 2018



Impacts of climate change
Assisted migration as an adaptation strategy
Assisted migration risks
A new seed transfer system







Impacts of climate change

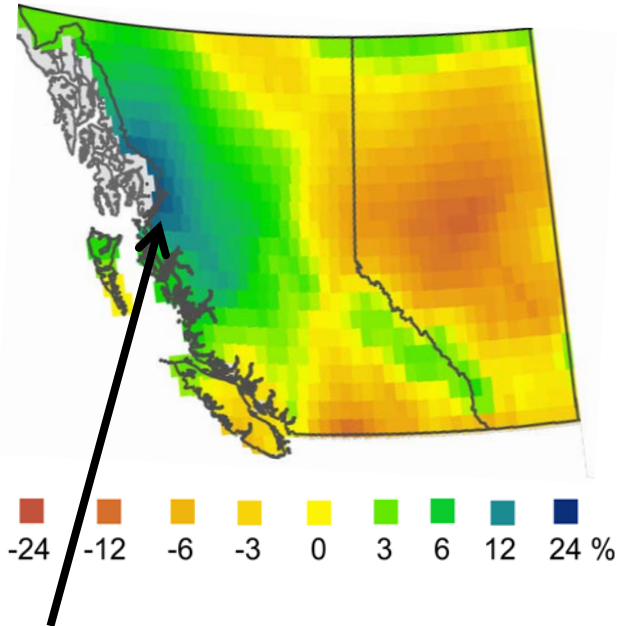
Assisted migration as an adaptation strategy

Assisted migration risks

A new seed transfer system

Observed climate trends & impacts

25-year trend in precipitation



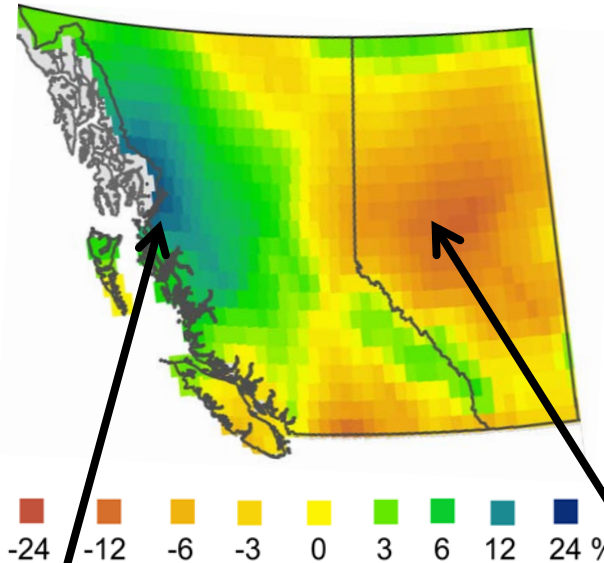
Dothistroma needle cast



Woods *et al.* 2006

Observed climate trends & impacts

25-year trend in precipitation



Dothistroma needle cast



Woods *et al.* 2006

Spruce & aspen dieback

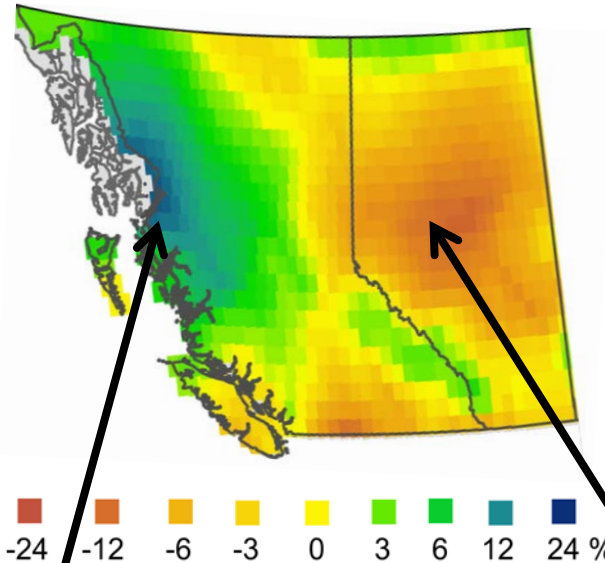


Hogg *et al.* 2008
Michaelian *et al.* 2010

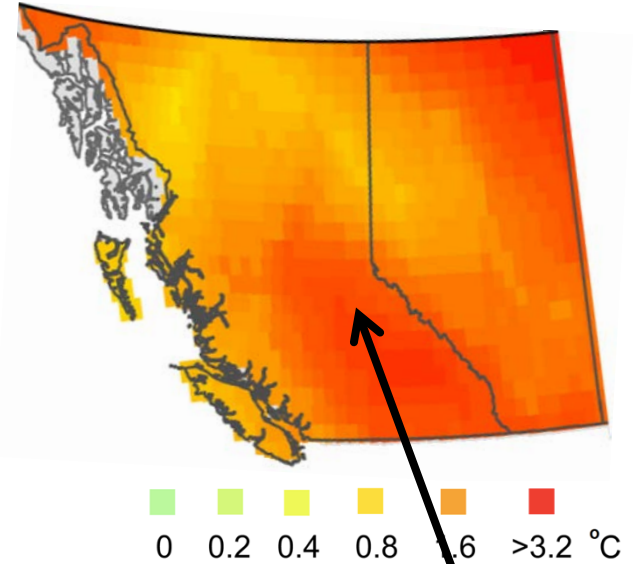
Image: Sally Aitken/Andreas Hamann

Observed climate trends & impacts

25-year trend in precipitation



25-year trend in winter temperature



Dothistroma needle cast



Woods *et al.* 2006

Spruce & aspen dieback



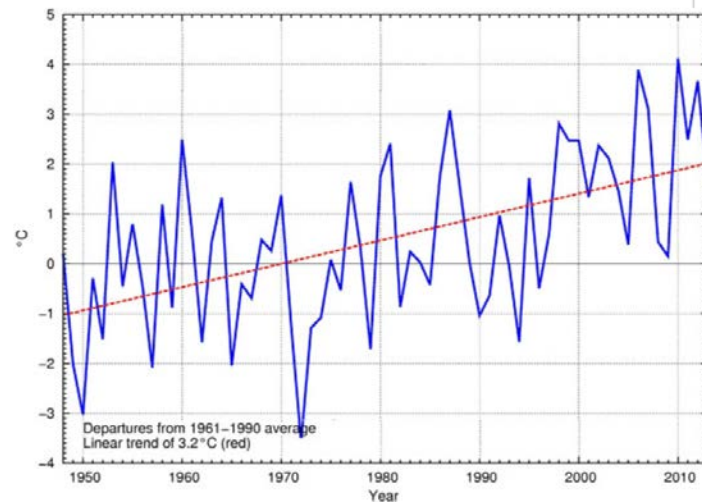
Hogg *et al.* 2008
Michaelian *et al.* 2010

Mountain pine beetle



Allen *et al.* 2010
photo: McLauchlan

Winter National Temperature Departures and Long-term Trend, 1948-2013



Yellow-cedar decline - Alaska



Beier et al. 2008

U.S. Drought Monitor West

August 4, 2015

(Released Thursday, Aug. 6, 2015)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	26.53	73.47	60.09	42.99	22.24	7.17
Last Week <i>7/28/2015</i>	26.53	73.47	60.09	42.99	22.24	7.17
3 Months Ago <i>5/5/2015</i>	23.35	76.65	63.22	39.05	17.54	7.95
Start of Calendar Year <i>1/20/2014</i>	34.76	65.24	54.48	33.50	18.68	5.40
Start of Water Year <i>9/30/2014</i>	31.48	68.52	55.57	35.65	19.95	8.90
One Year Ago <i>8/5/2014</i>	27.71	72.29	60.17	43.74	21.35	8.94

Intensity:

 D0 Abnormally Dry	 D3 Extreme Drought
 D1 Moderate Drought	 D4 Exceptional Drought
 D2 Severe Drought	

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

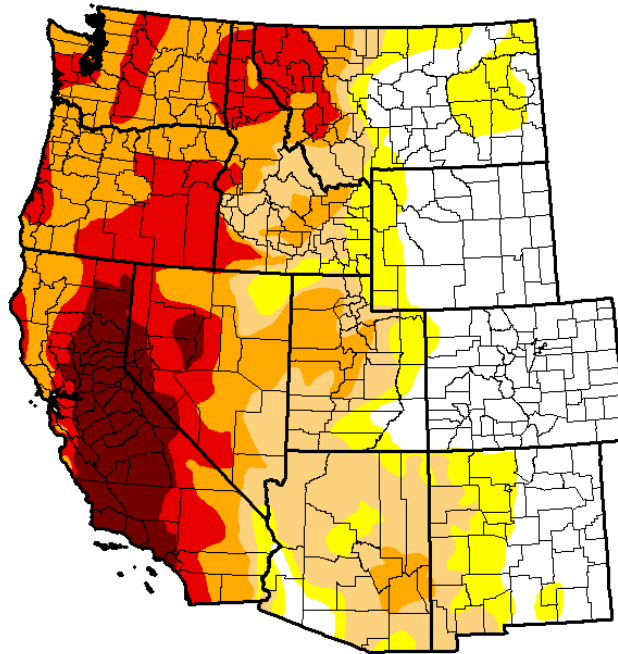
Author:

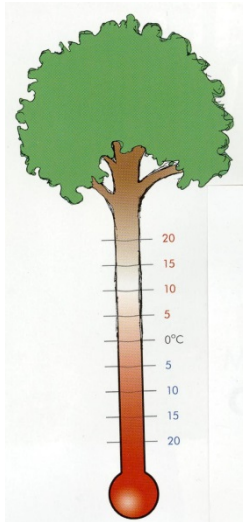
Mark Svoboda

National Drought Mitigation Center



<http://droughtmonitor.unl.edu/>





↑ Endemic pests
↑ Novel pests

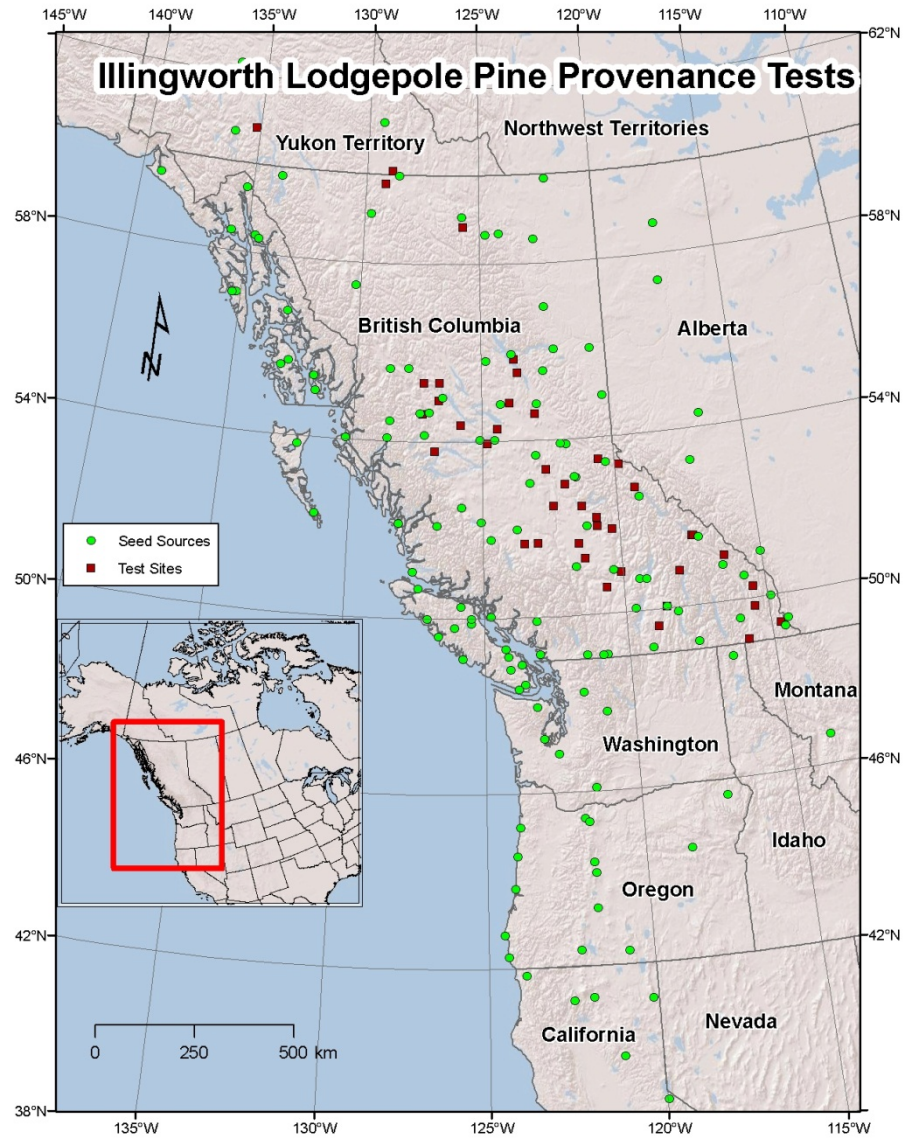
Pest damage →

Drought stress
Disrupted phenology

Maladaptation damage →



Lodgepole pine provenance trial – established 1974





Seed source -1.3 °C
Plantation -1.3 °C



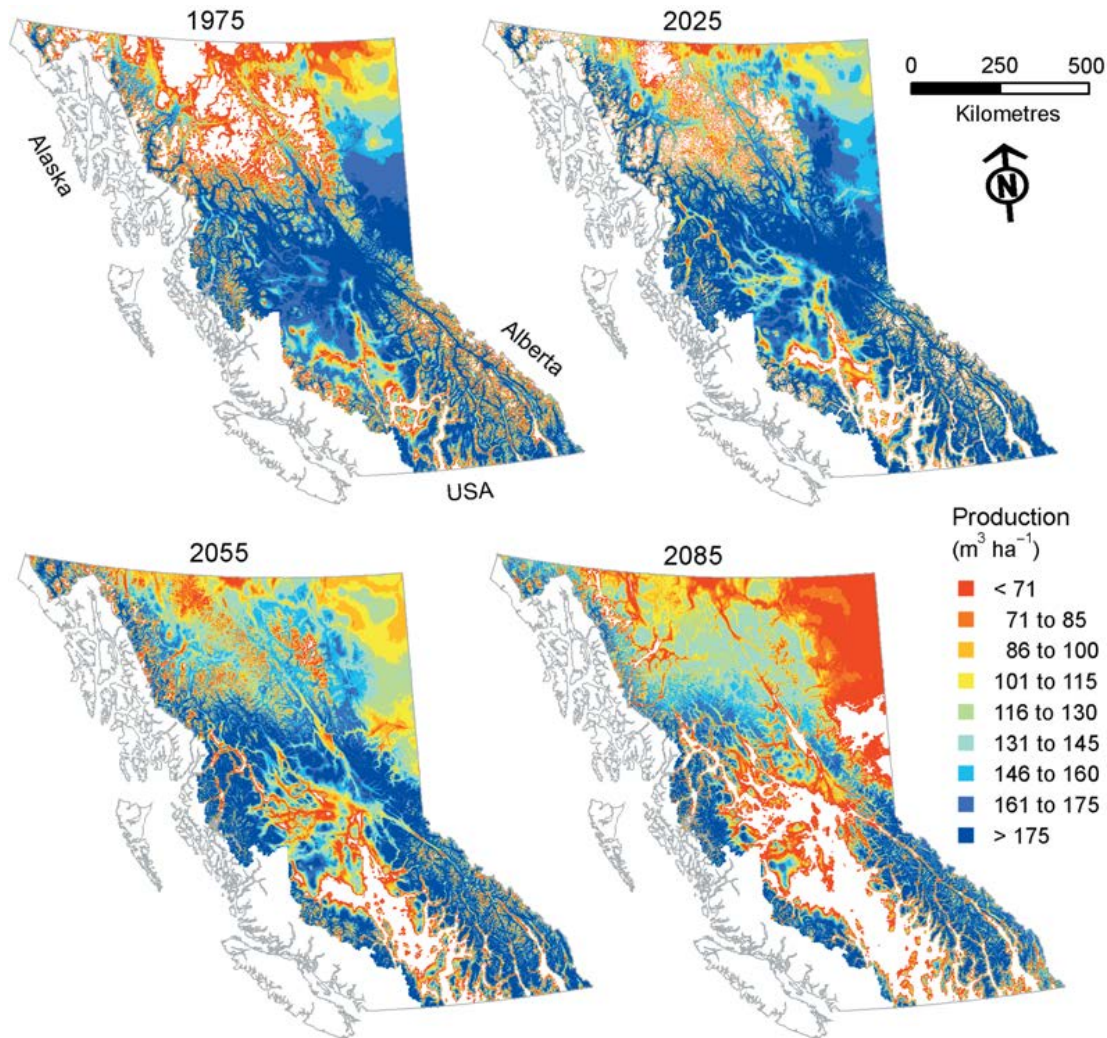
Seed source -1.3 °C
Plantation 2.9 °C

Climate change is not good for trees!

↓ growth
 ↓ wood quality
 ↑ pest damage

} ↓ value

Lodgepole pine productivity



Climate change is not good for trees!

Productivity decline: 10-30% by 2080

O'Neill, Wang, Hamann 2008

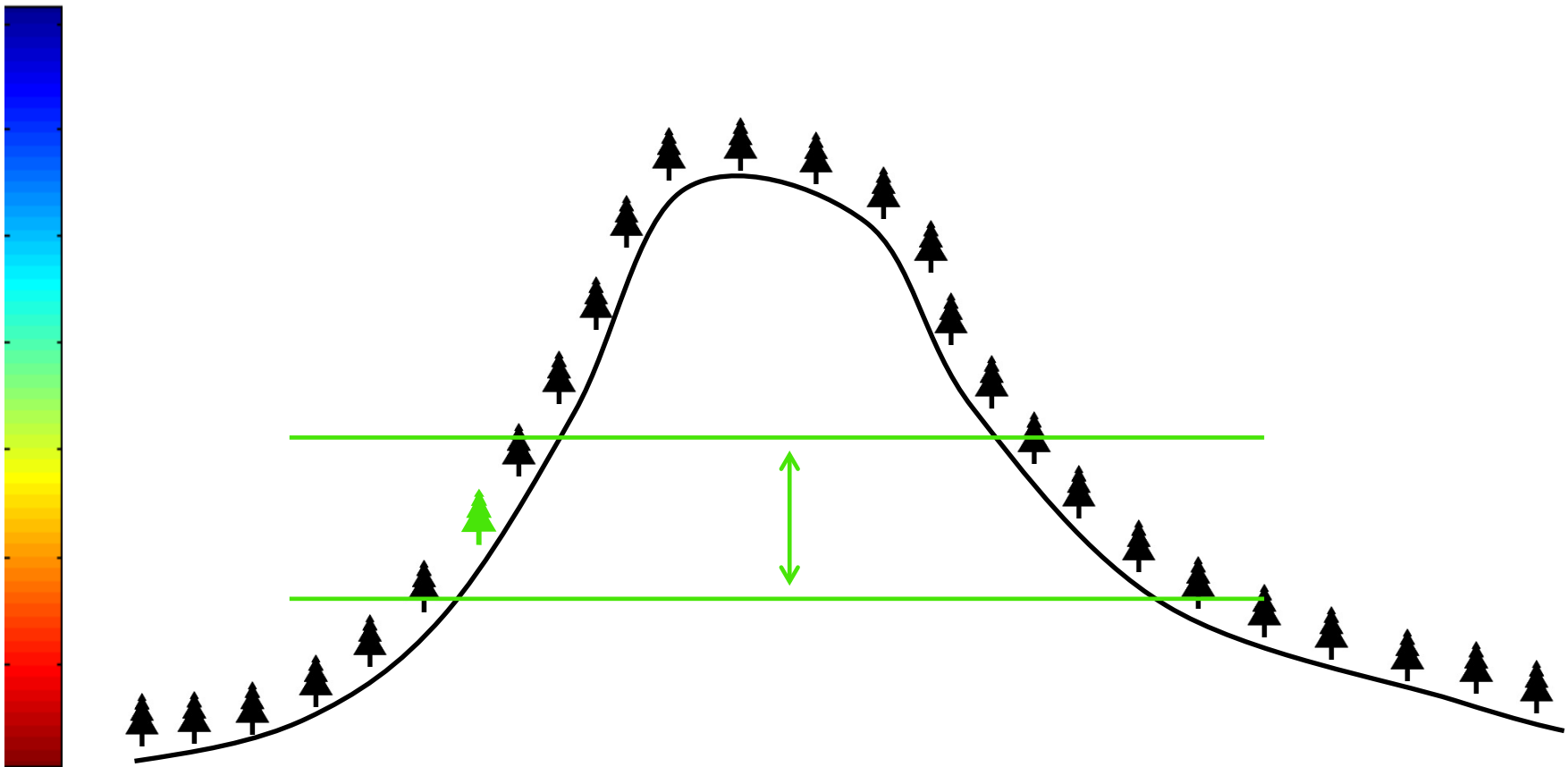


Impacts of climate change

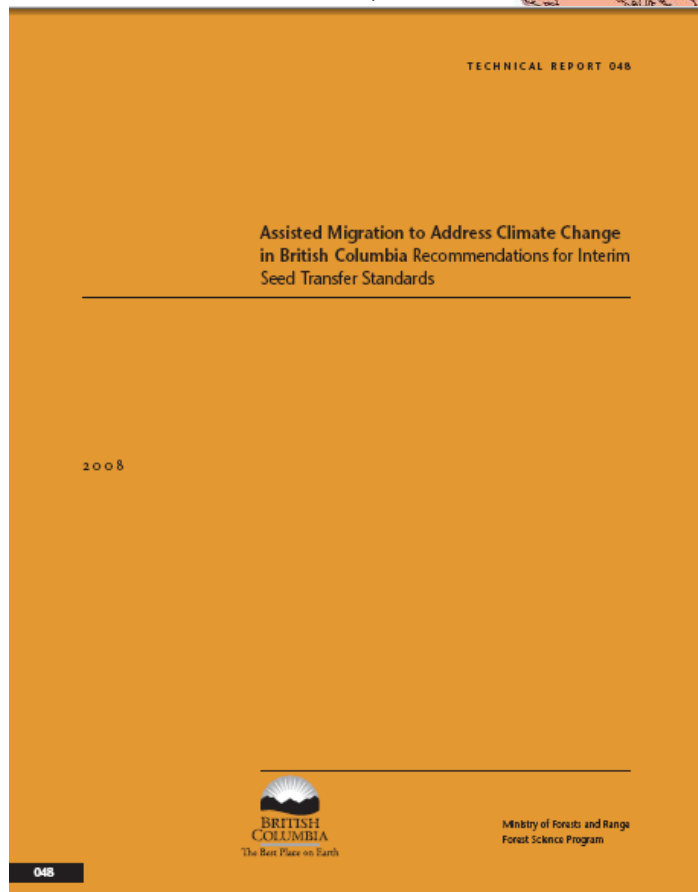
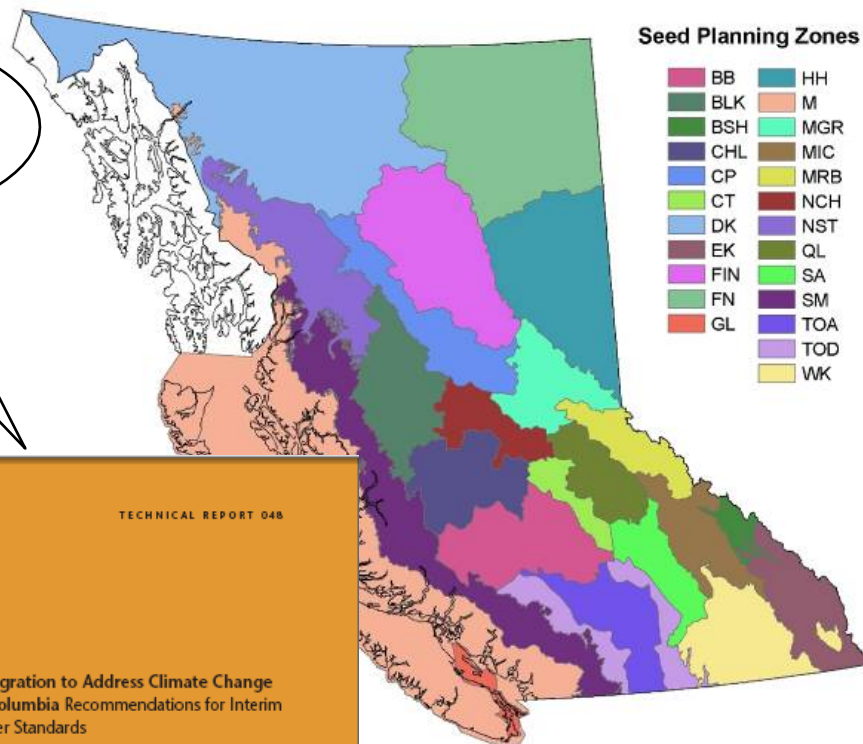
Assisted migration as an adaptation strategy

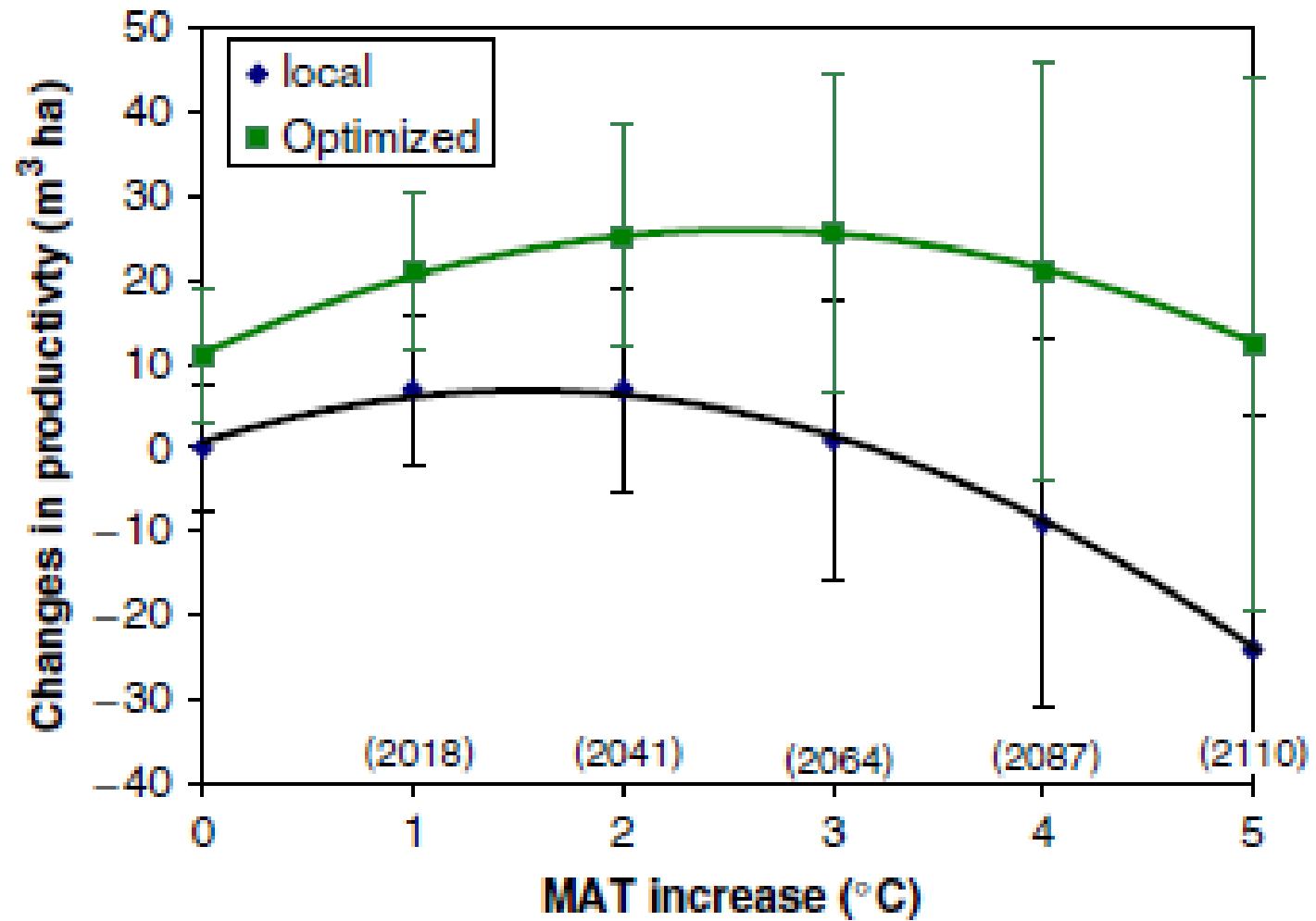
Assisted migration risks

A new seed transfer system



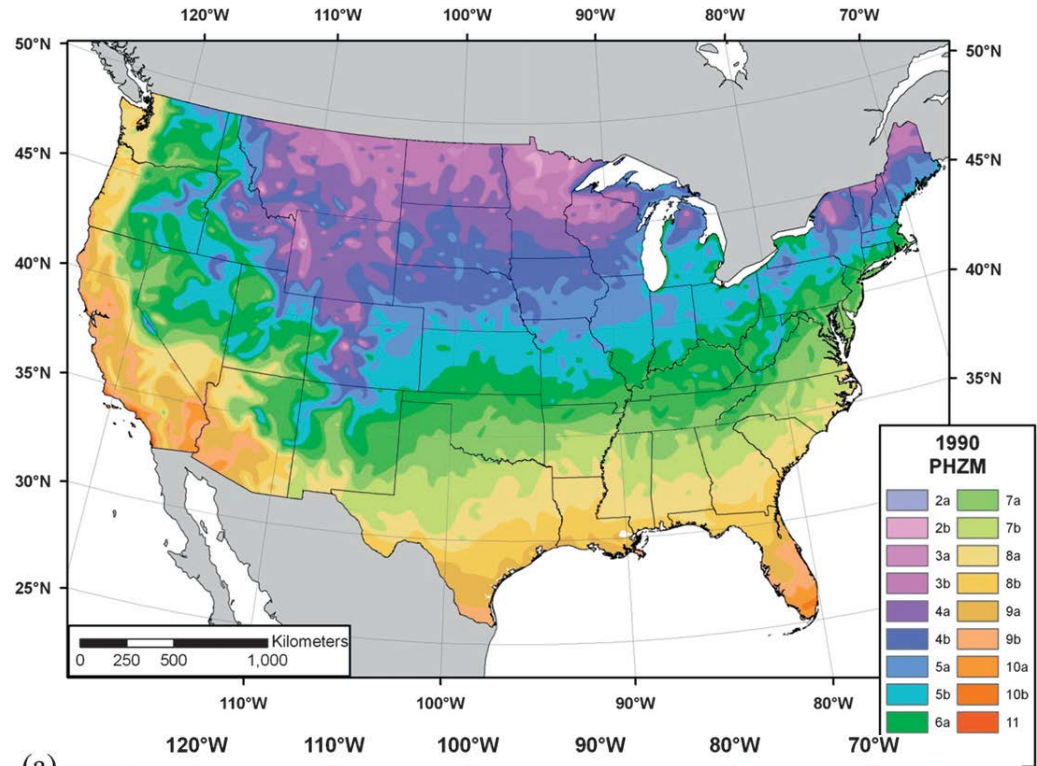
Up good. Down bad.



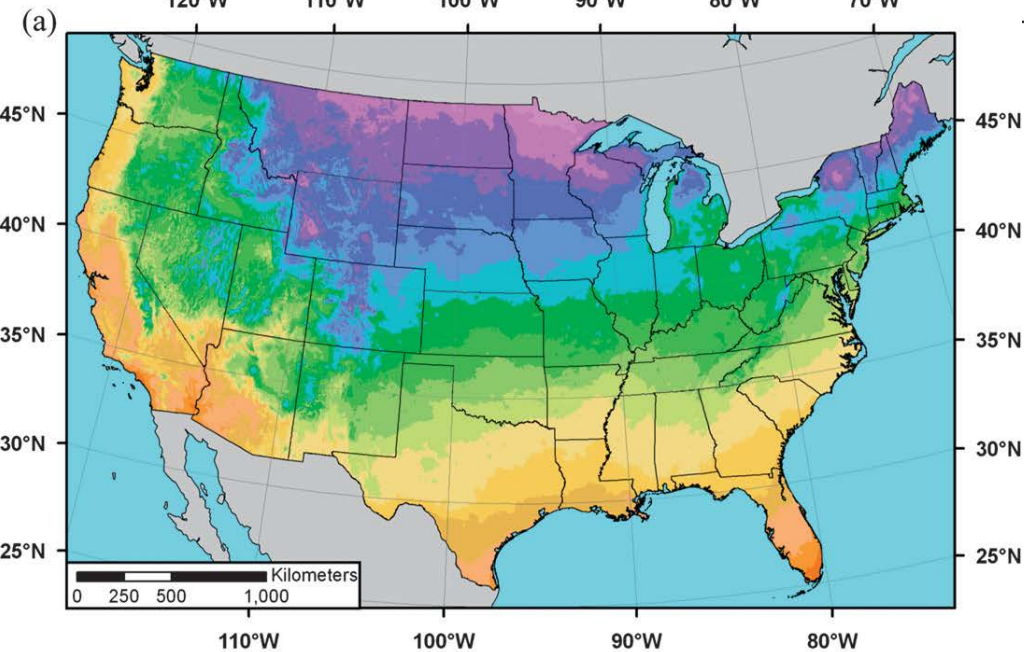


Wang et al., 2006

Assisted migration
is being used in
horticulture



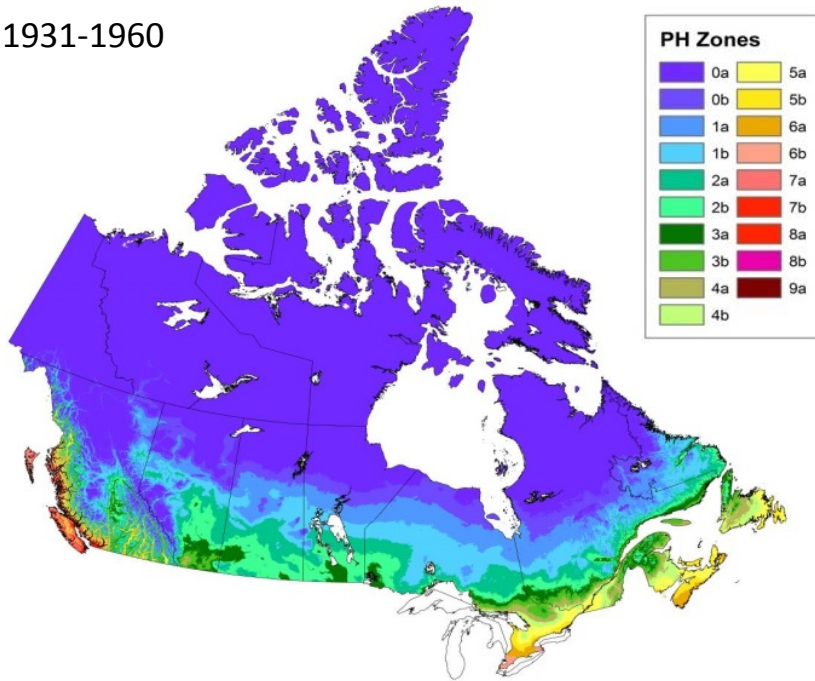
**1990 Plant Hardiness
Zone Map**



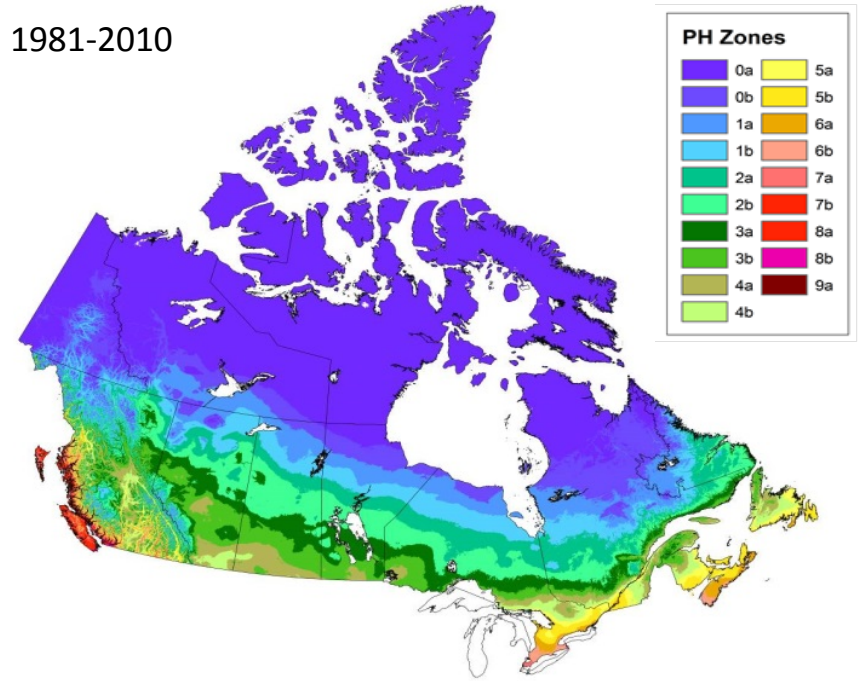
**2012 Plant Hardiness
Zone Map**

Plant Hardiness zone map

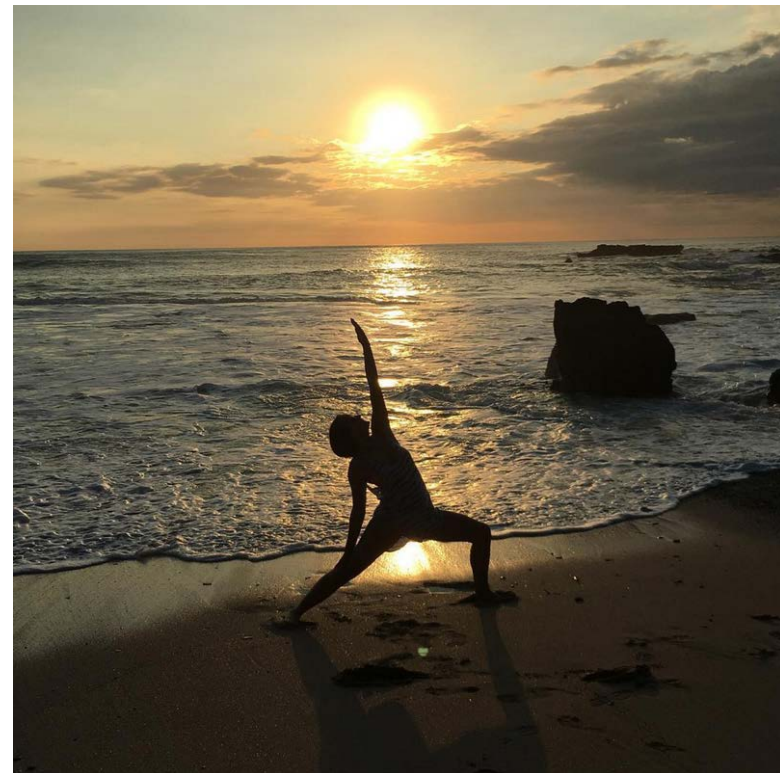
1931-1960



1981-2010



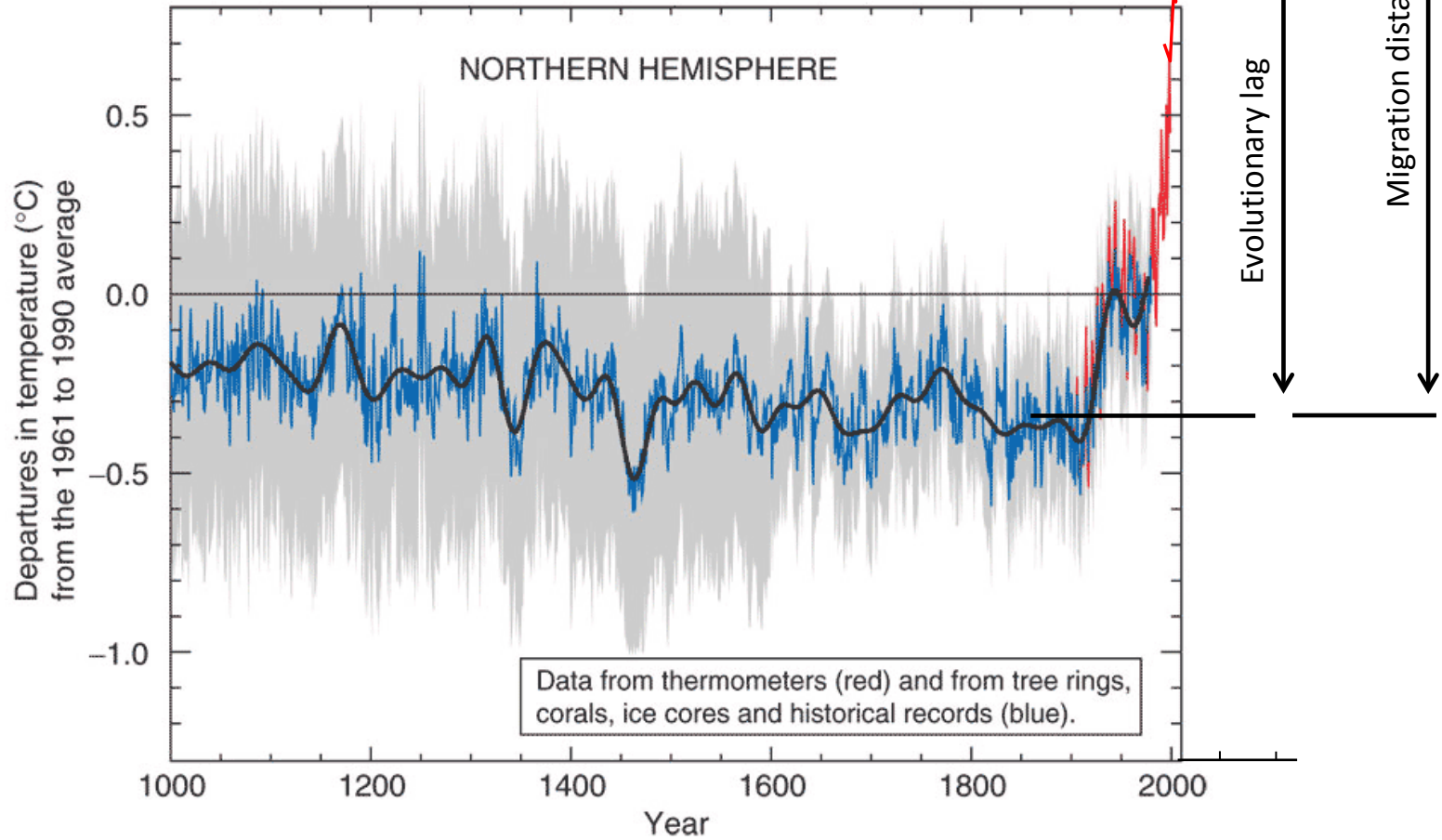
McKenney et al. 2014. BioScience





Proxy temperatures

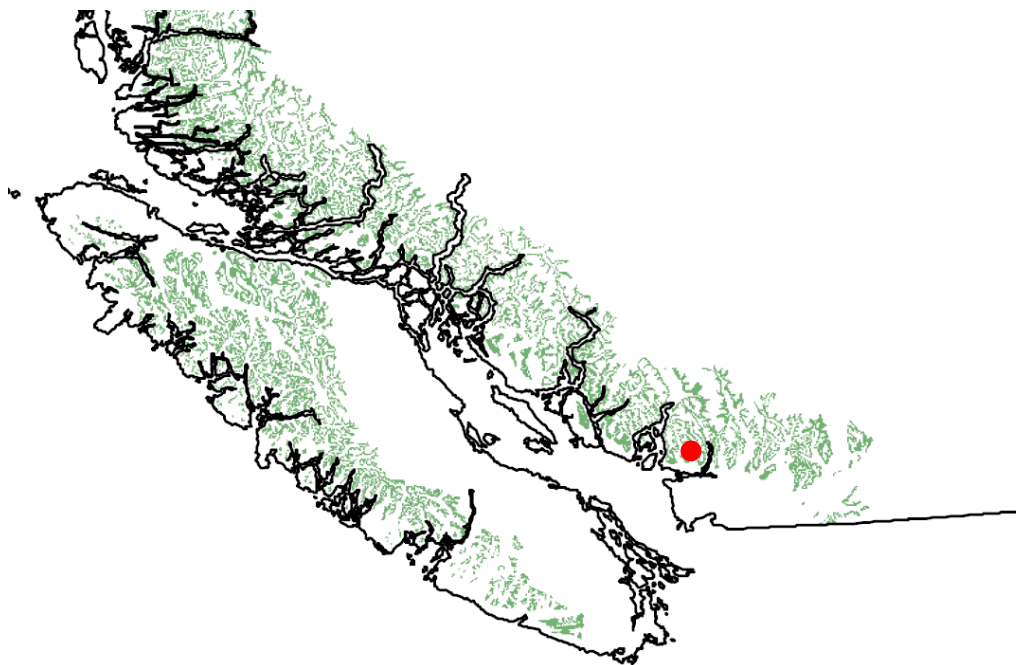
Observed temperatures



IPCC 2001

Grouse Mountain (CWHvm2)

	LAT	MAT	MCMT	TD	MAP	MSP	DD5	PAS
Current climate	51.3	5.3	-2.3	16.0	3626	787	1127	929
Migration distance	0.0	1.6	1.8	0.2	256	19	307	-207
Seed procurement target	51.3	6.9	-0.5	16.2	3882	806	1434	722 CWHvm1





Impacts of climate change

Assisted migration as an adaptation strategy

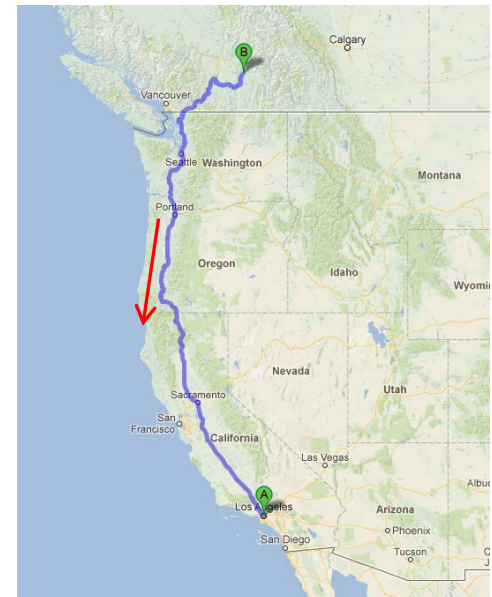
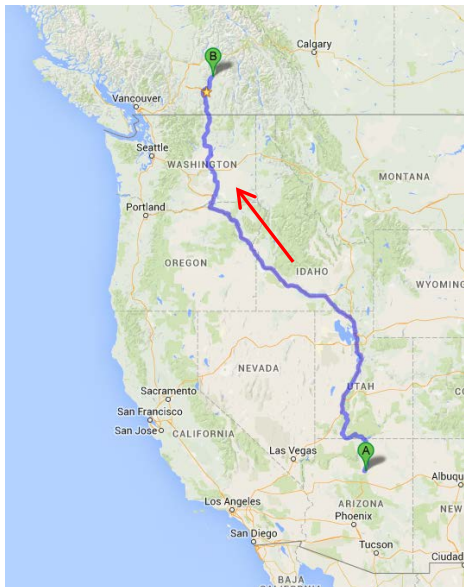
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A new seed transfer system

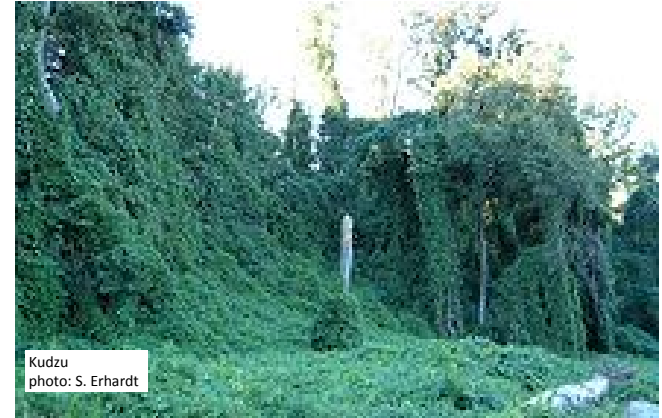
AM risks – over-transfer



Douglas-fir
20 years old



AM risks – species invasion



AM risks – hitch-hiking pathogens/insects



American chestnut blight
Photo: American Chestnut Foundation

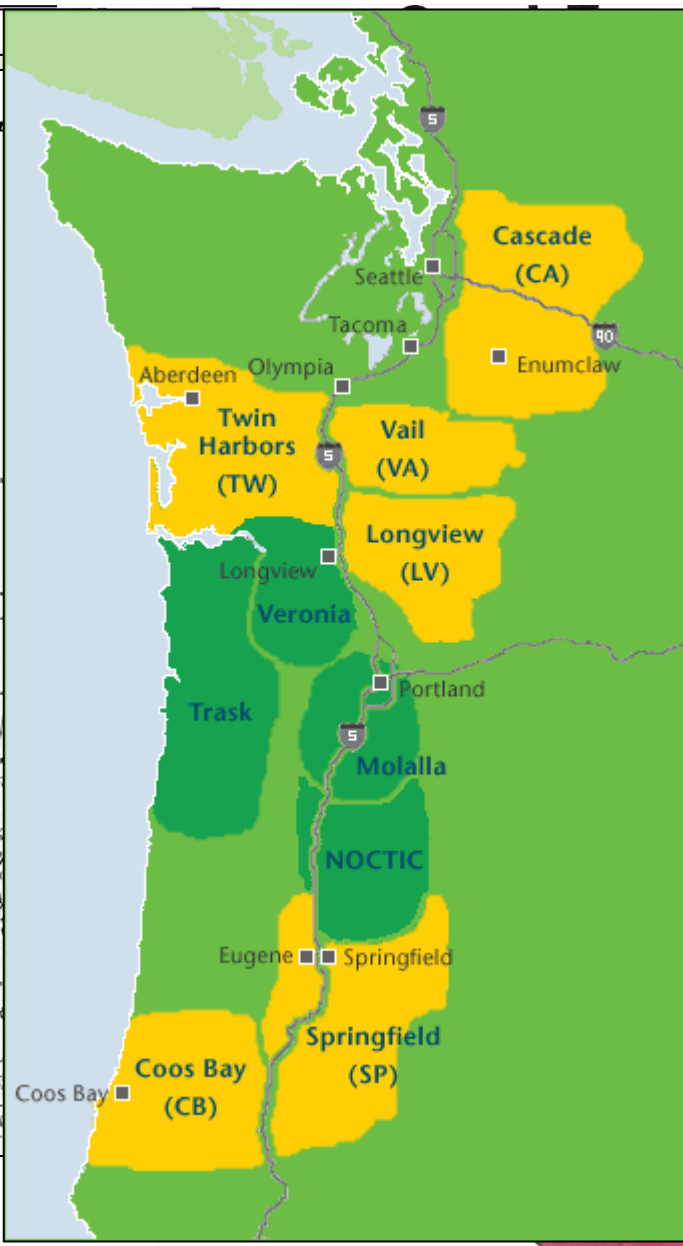
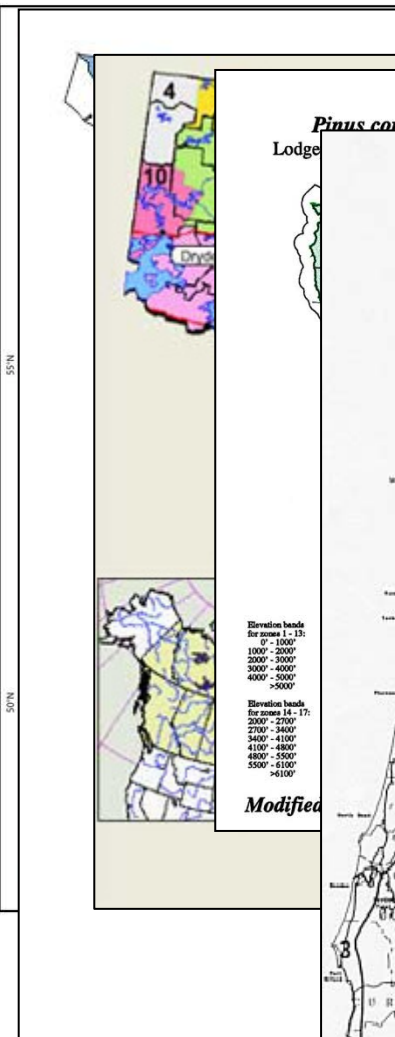


White pine blister rust
Photo: Natural Resources Canada, Canadian Forest Service

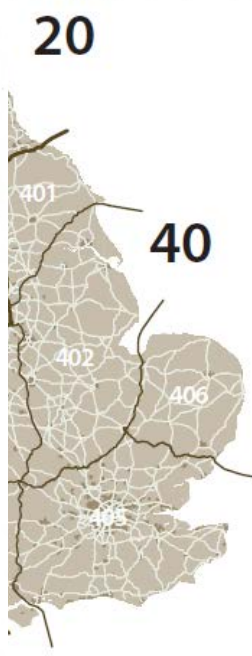
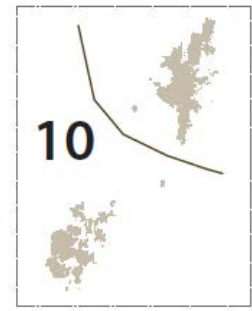


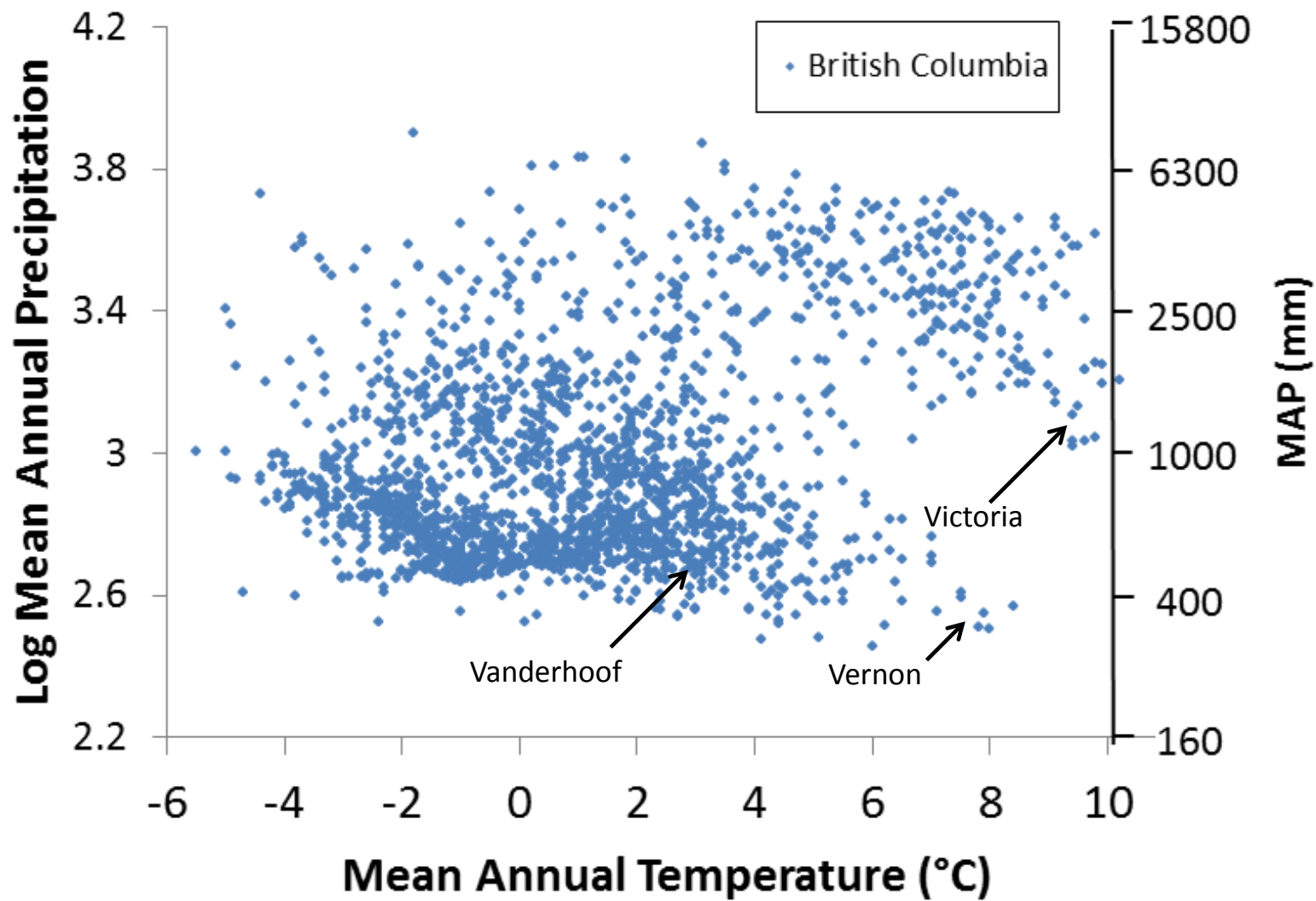
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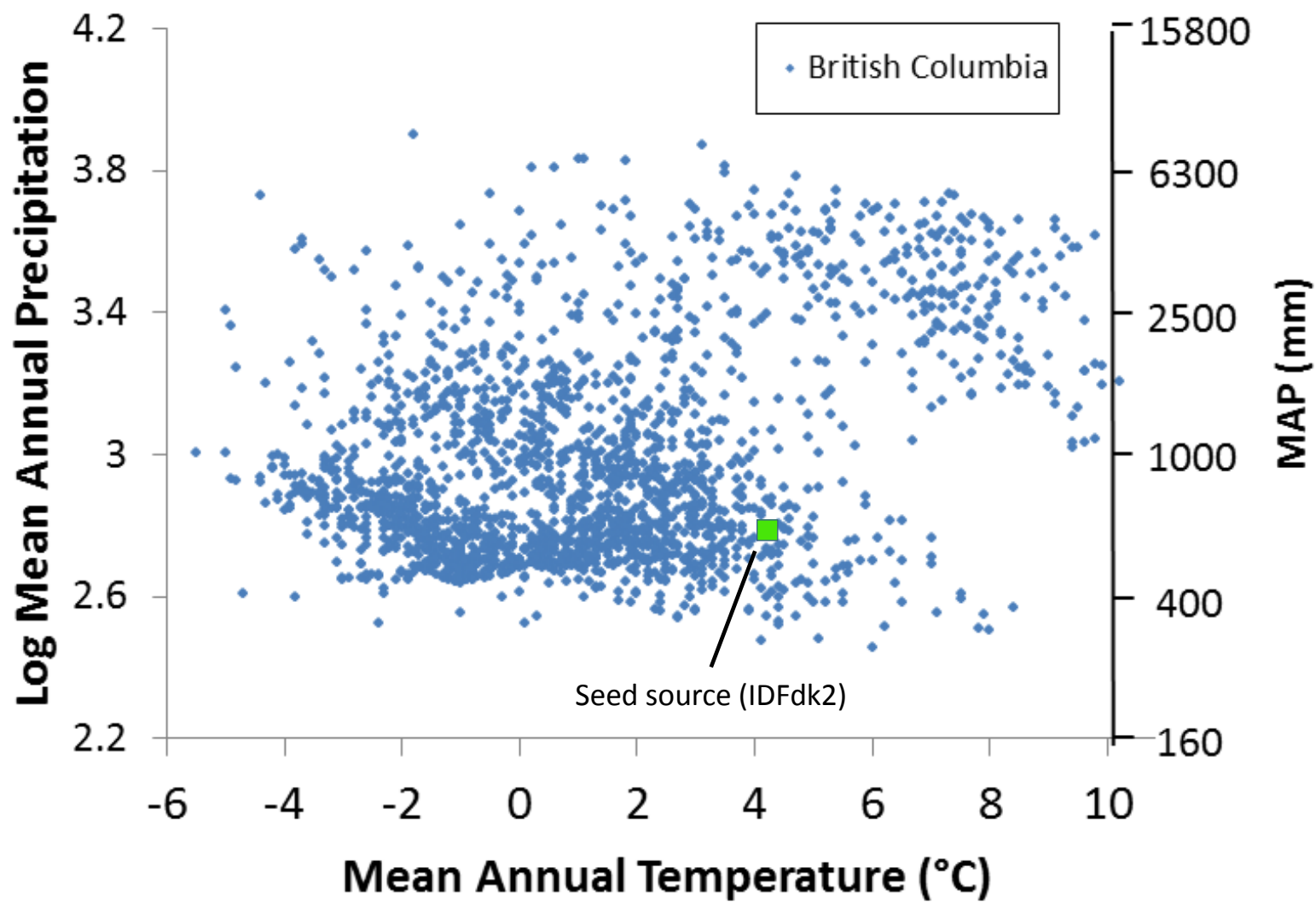
es of Kenya (Zones)

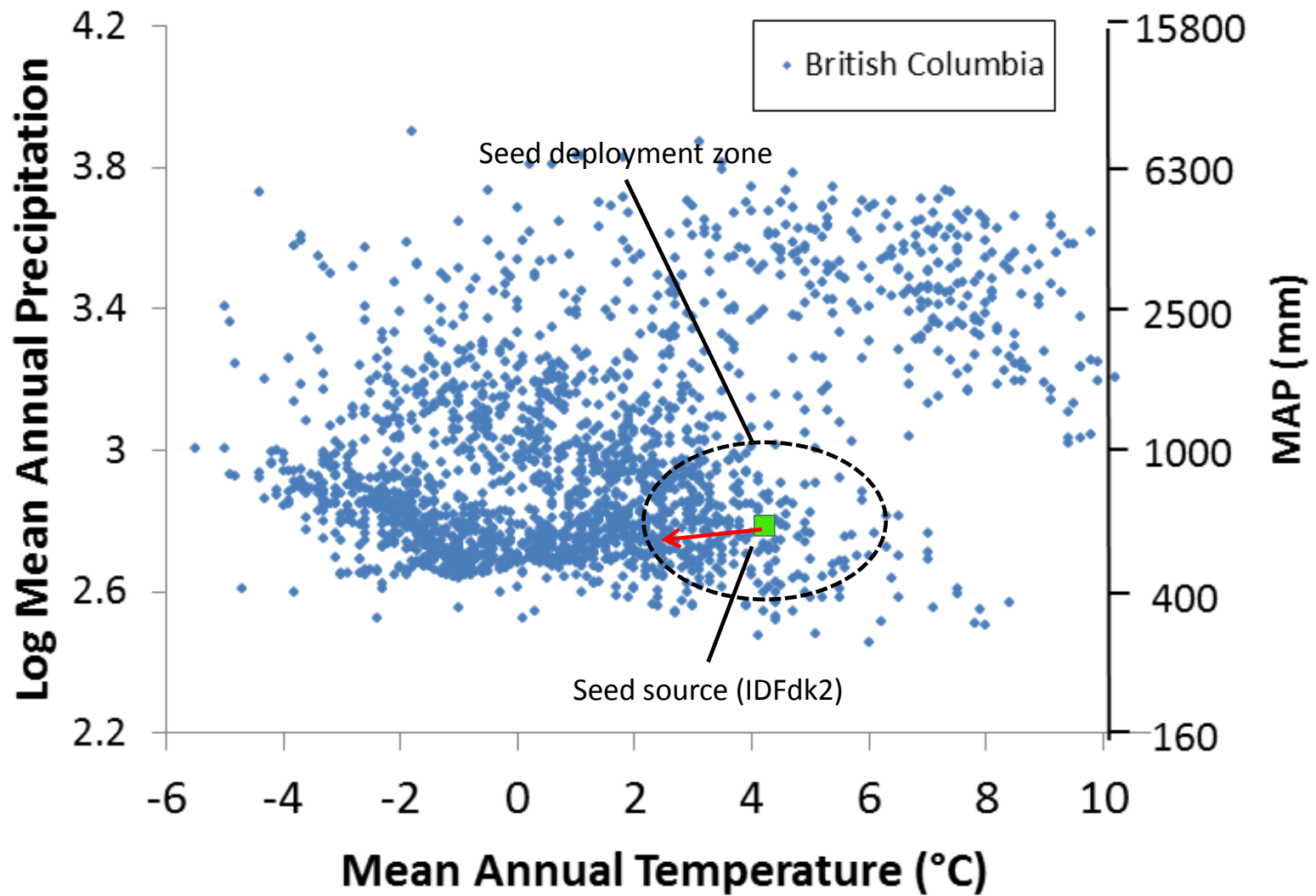


Series











Tree Improvement Branch: Seedlot Selection Tool Version 4.1

Instructions I Have A Cutblock I Have A Seedlot

Seedlot Number:

Set Species & BEC

OR

Species:

BEC Variant:

Assisted Migration Scenario:

Minimum Genetic Suitability: 98.0

Minimum Species Suitability: 40.0

GO

Plantation BEC	Seed BEC	Genetic Suitability	Species Suitability
IDFdk2	IDFdk2	100.0	65.2
ICHmk1	IDFdk2	99.7	71.5
MSdm1	IDFdk2	99.4	80.4
IDFdk1	IDFdk2	99.4	53.8
ICHmk2	IDFdk2	99.0	71.5
IDFdm1	IDFdk2	98.9	58.0
IDFdc	IDFdk2	98.9	62.4
IDFxc	IDFdk2	98.7	45.1
ICHdw3	IDFdk2	98.5	53.6
MSdm3	IDFdk2	98.5	75.5
MSdm2	IDFdk2	98.3	77.2
ICHmw2	IDFdk2	98.2	43.1
ICHdw2	IDFdk2	98.2	61.9





Tree Improvement Branch: Seedlot Selection Tool Version 4.1

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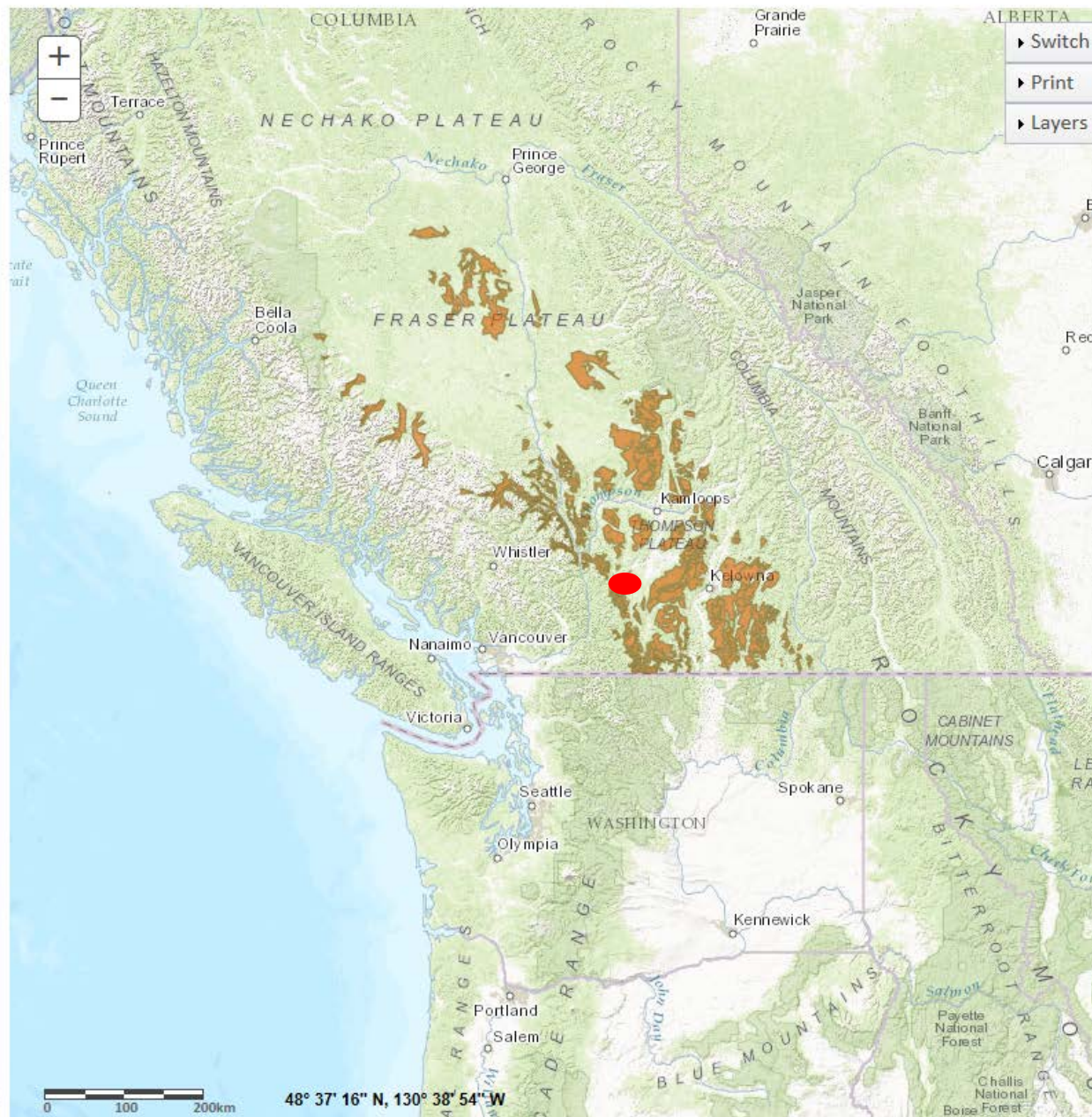
Assisted Migration Scenario:

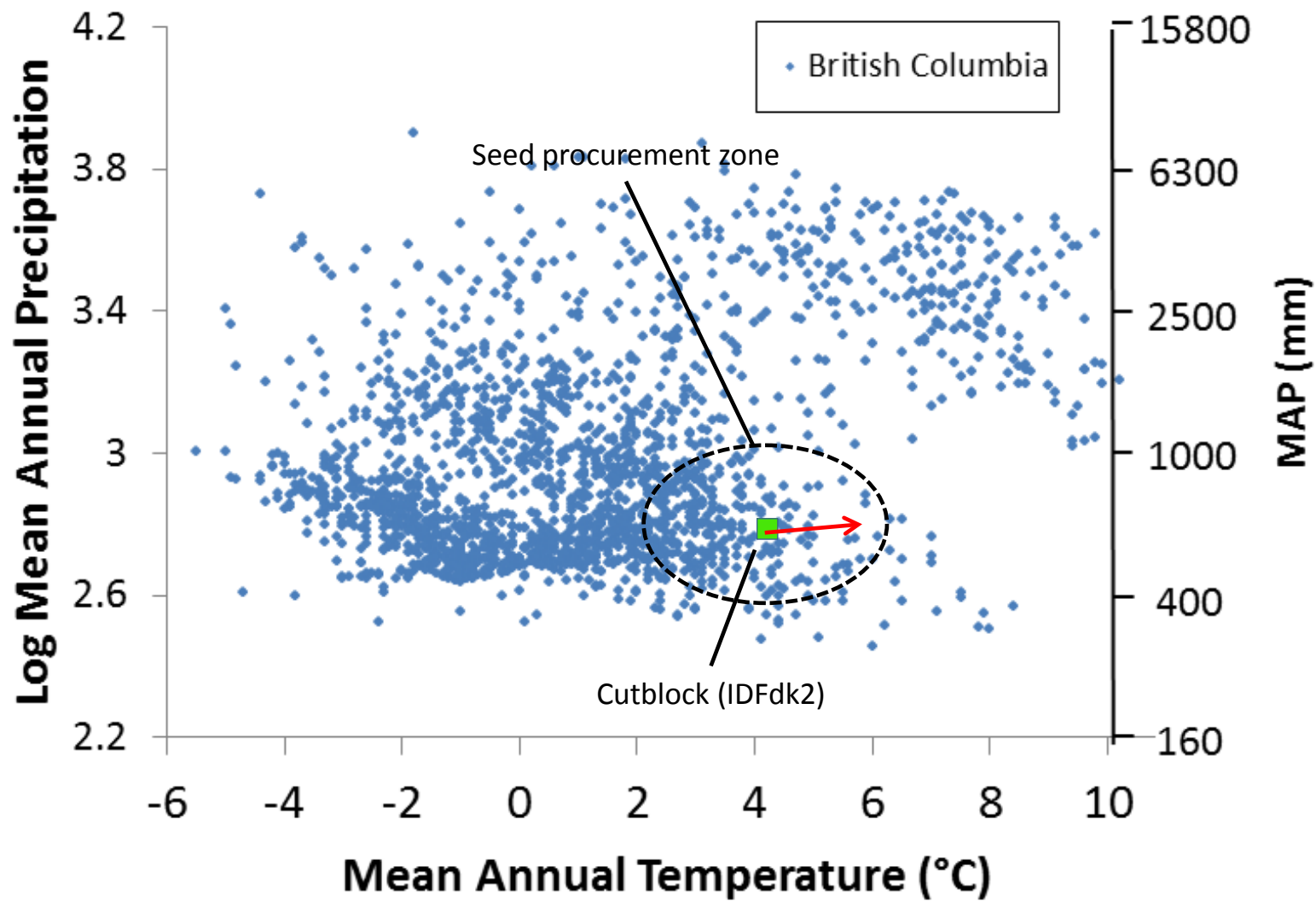
Minimum Genetic Suitability: 98.0

Minimum Species Suitability: 40.0

GO

Plantation BEC	Seed BEC	Genetic Suitability	Species Suitability
MSxk1	IDFdk2	99.7	80.3
MSxk2	IDFdk2	99.7	60.0
IDFdc	IDFdk2	99.4	42.8
MSdm2	IDFdk2	99.0	64.0
MSdc1	IDFdk2	99.0	61.4
MSxk3	IDFdk2	98.9	77.0
MSdm3	IDFdk2	98.7	77.7
MSdm1	IDFdk2	98.6	71.4
IDFdw	IDFdk2	98.6	71.6
ESSFxc2	IDFdk2	98.5	85.1
ESSFdc1	IDFdk2	98.4	76.2
SBSmm	IDFdk2	98.3	85.3
SBSmc1	IDFdk2	98.2	76.1





Instructions	I Have A Cutblock	I Have A Seedlot
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PL

IDFdk2

No Assisted Migration 

Minimum Species Suitability: 40.0

GO

The map displays the Fraser Plateau in British Columbia, Canada, with a red dot indicating a specific location. The plateau is situated between the Coast Range to the west and the Rocky Mountains to the east. Major cities shown include Vancouver, Nanaimo, Whistler, Kamloops, and Kelowna. The Fraser River flows through the plateau. To the south, the map shows the border with the United States, including Washington and Oregon, with cities like Seattle, Olympia, Portland, and Salem. The Pacific Ocean is to the west, and the United States is to the south. The map includes a scale bar (0 to 200 km) and coordinates (52° 25' 55" N, 129° 40' 54" W). A legend in the top right corner provides options to Switch, Print, and Layers.

Instructions	I Have A Cutblock	I Have A Seedlot
1. Select a cutblock or seedlot that meets the criteria for a cutblock or seedlot.		
2. Measure the area of the cutblock or seedlot.		
3. Calculate the volume of the cutblock or seedlot.		
4. Estimate the value of the cutblock or seedlot.		
5. Record the information in the table.		

Species:

PLI

BEC Variant:

IDFdk2

GO

Plantation BEC	Seed BEC	Species Suitability	Limit
IDFdk2	IDFmw1	Suitable	
IDFdk2	IDFww1	Suitable	
IDFdk2	ICHdw4	Suitable	
IDFdk2	ICHxw	Suitable	
IDFdk2	IDFdm1	Suitable	
IDFdk2	ICHdw1	Suitable	
IDFdk2	IDFww	Suitable	
IDFdk2	IDFmw2	Suitable	

Seedlot	Orchard	GW	Class	Seed BEC



Summary

1. Fixed zone → focal zone
2. Geog based → climate based
3. Assisted migration ← migrating the focus of the procurement space
4. Climate migration distance:
 - accounts for past and future CC
 - multivariate
 - transparent and accurately quantified
5. Deployability based solely on BEC climate
6. Larger average deployment area

Thank you



Acknowledgements

Technical working group

Tongli Wang

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Margot Spence

Alvin Yanchuk

Nick Ukrainetz