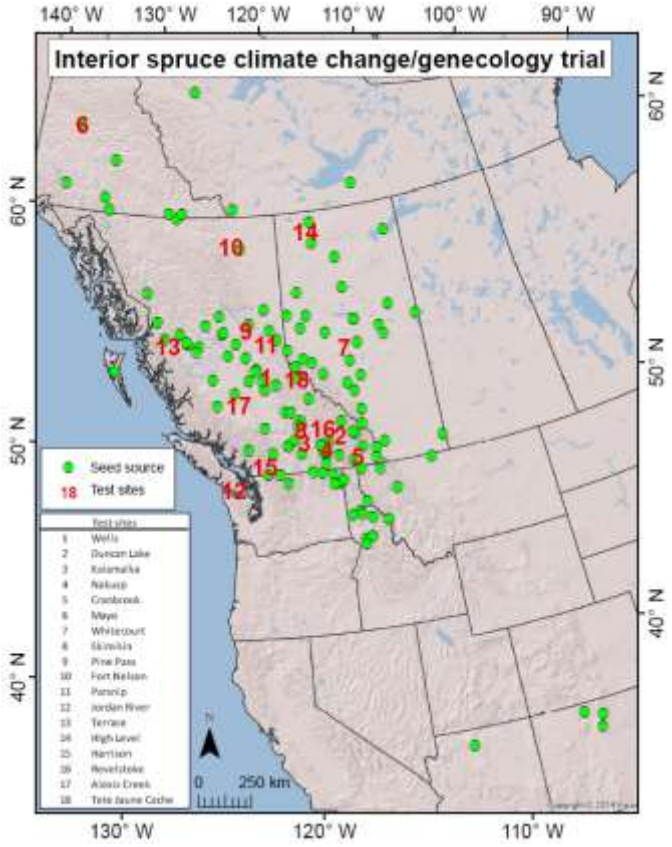
Climate Change Adaptation Research

2021 in review

2022 in view

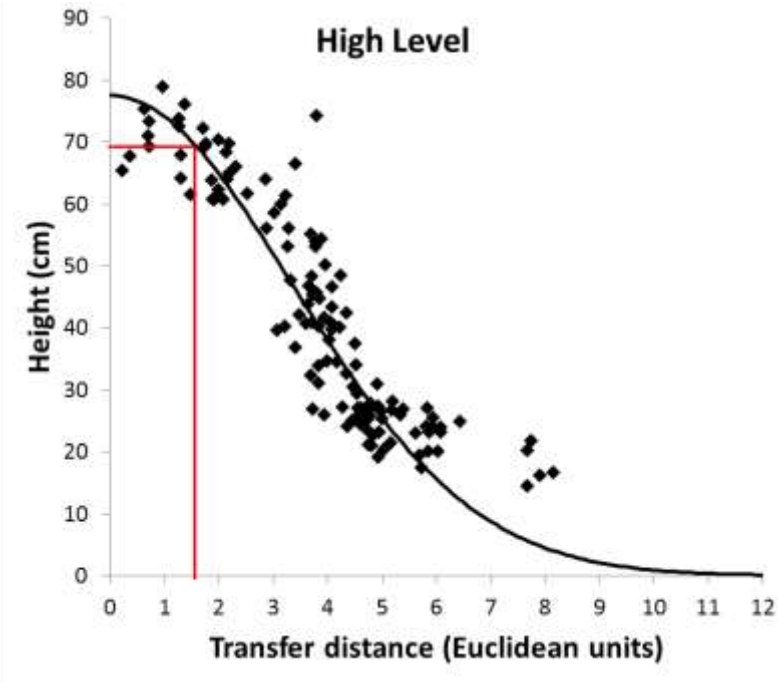
1. Sx genecology/CC field trial
2. Assisted Migration Adaptation Trial (AMAT)
3. Climate Based Seed Transfer (CBST)
4. Climate sensitive mortality function
5. CC impacts to forest productivity (new!)
6. Barriers to inter-jurisdictional seed movement (new!)
7. Species transferability
8. AM review (published!)
9. Multispectral imaging in genetic trials
10. Local adaptation to forest pests
11. Weather station assessment (new! submitted!)
12. Future forest productivity using dendro (new!)
13. Bibliographic analysis of AM research

1. Sx genecology/CC field trial



- Established 2005
- 128 pops at 17 test sites

Seedlot transferability → CBST



Climate Change Adaptation Research

2021 in review

2022 in view

1. Sx genecology/CC field trial

- Justification for merging A and B seed transfer systems

- Safe seed transfer distances for Sx
- Distances shorter in north interior

- Assisted migration can help mitigate CC impacts on productivity

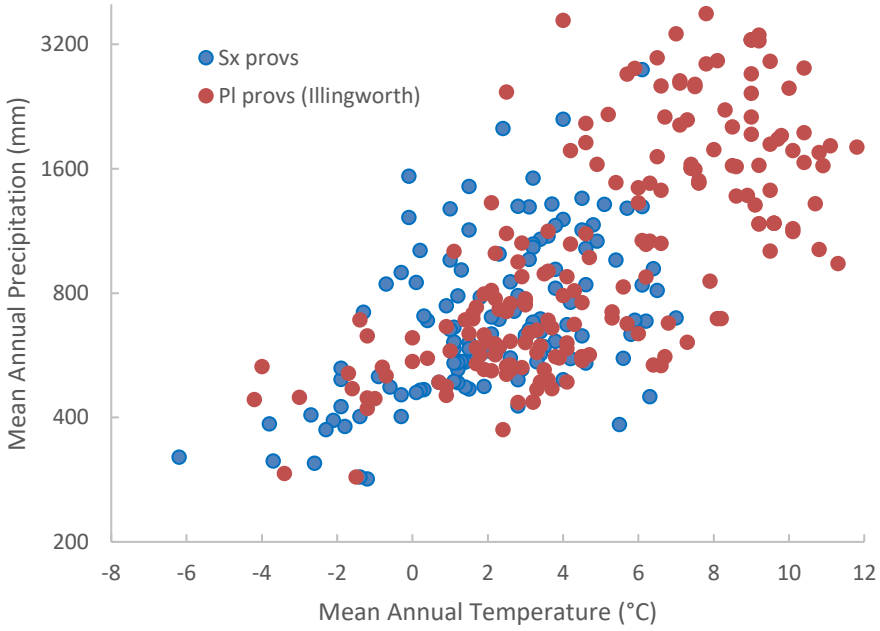
Climate Change Adaptation Research

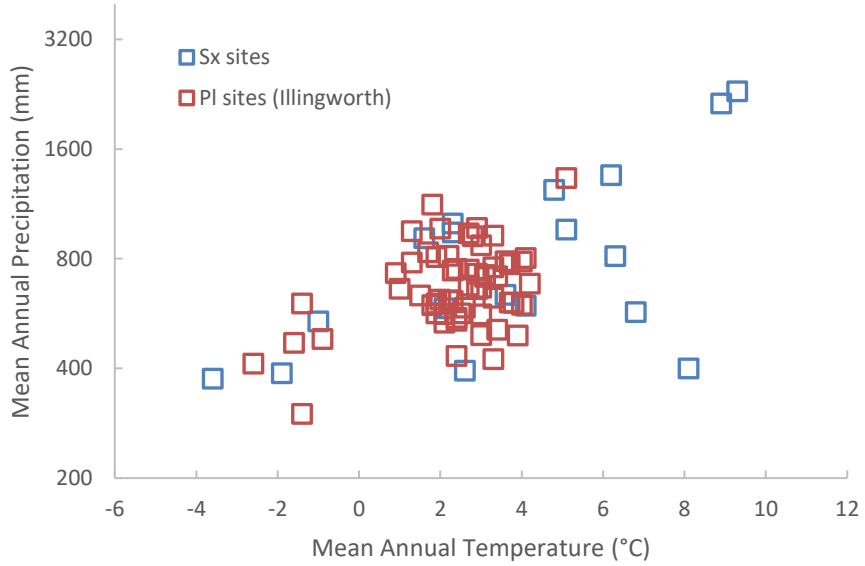
2021 in review

2022 in view

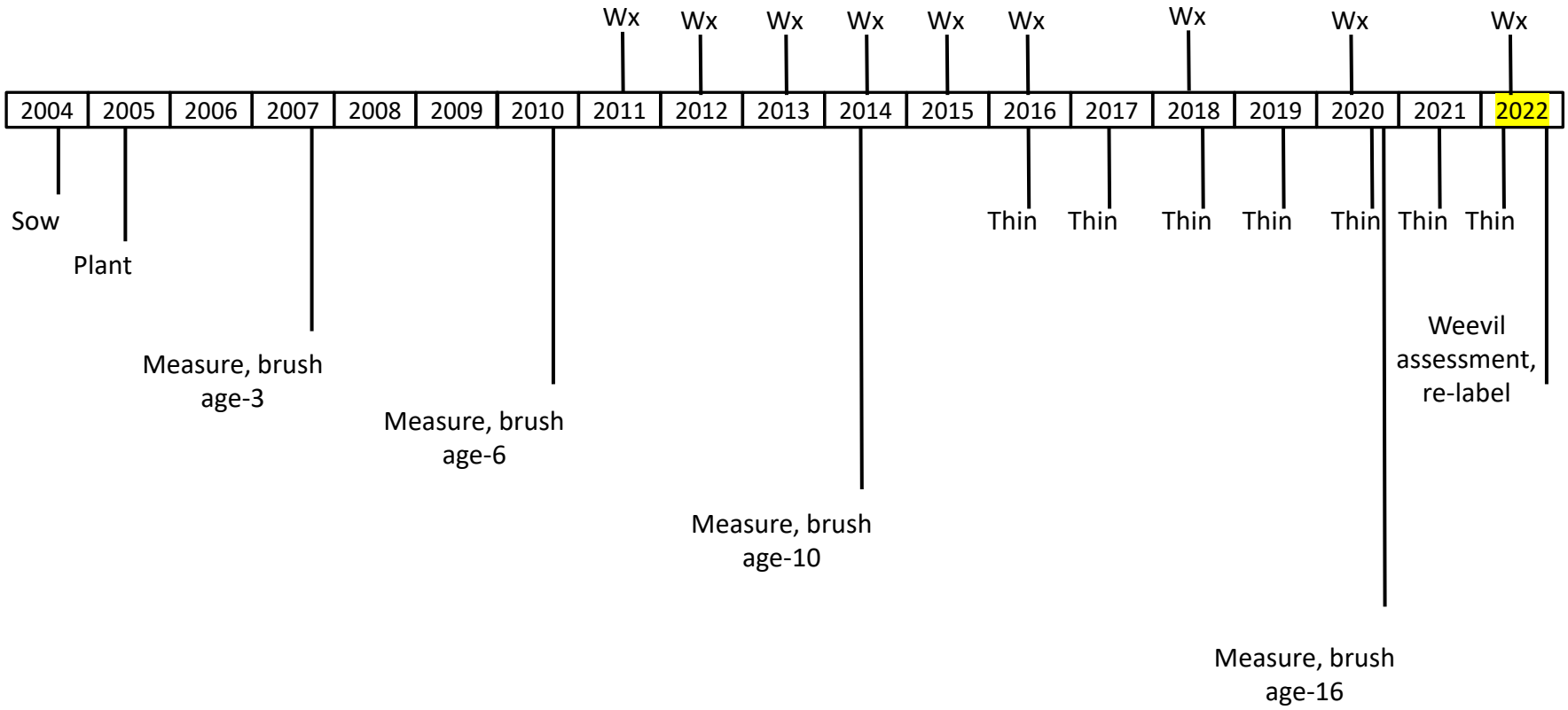
1. Sx genecology/CC field trial
2. Assisted Migration Adaptation Trial (AMAT)
3. Climate sensitive mortality function
4. CC impacts to forest productivity (new!)
5. *Pinus pseudostrobus* provenance trial (submitted!)

1. Future seed procurement areas (accepted!)
2. Barriers to inter-jurisdictional seed movement (new!)
3. Species transferability comparison
4. AM review article (published!)
5. Multispectral imaging in genetic trials (new!)
6. Transfer functions for forest health (new! accepted!)


Sx provs
Pl provs (Illingworth)
Mean Annual Precipitation (mm)
3200
1600
800
400
200
-8
-6
-4
-2
0
2
4
6
8
10
12
Mean Annual Temperature (°C)


Sx sites
Pl sites (Illingworth)
Mean Annual Precipitation (mm)
3200
1600
800
400
200
-6
-4
-2
0
2
4
6
8
10
12
Mean Annual Temperature (°C)

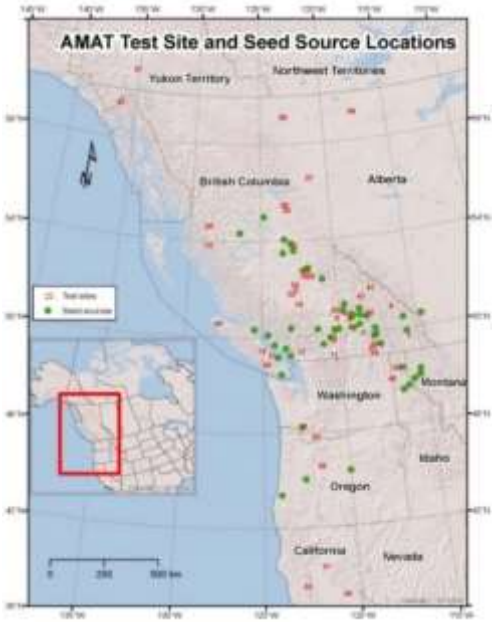
1. Sx genecology/CC field trial



2. Assisted Migration Adaptation Trial (AMAT)

- Established 2009-12
- 48 test sites
- 15 species, 48 seedlots (mostly Class A)

Photo: Ward Strong



Map: Amy Vallarino

- Seedlot transferability → CBST
- Calibrating CCISS

2. Assisted Migration Adaptation Trial (AMAT)

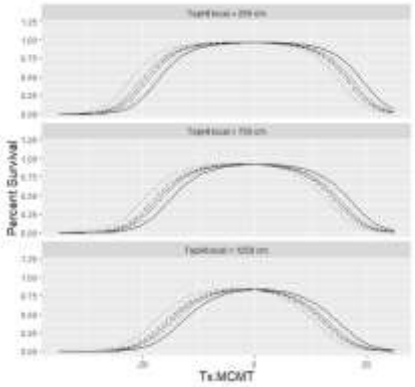
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Project design	X																			
Proposal review		X																		
Seed procurement		X																		
Locate sites/grow seedlings - series 1			X																	
Locate sites/grow seedlings - series 2				X																
Locate sites/grow seedlings - series 3					X															
Locate sites/grow seedlings - series 4						X														
Plant - series 1				X																
Plant - series 2					X															
Plant - series 3						X														
Plant - series 4							X													
Weather station\site maintenance - series 1					X	X	X	X	X	X		X		X		X		X		X
Weather station\site maintenance - series 2						X	X	X	X	X	X		X		X		X		X	
Weather station\site maintenance - series 3							X	X	X	X	X	X		X		X		X		X
Weather station\site maintenance - series 4								X	X	X	X	X	X		X		X		X	
Assess - series 1								X					X					X		
Assess - series 2									X					X					X	
Assess - series 3										X					X					X
Assess - series 4											X					X				
Extension				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

2. Assisted Migration Adaptation Trial (AMAT)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Project design	X																			
Proposal review		X																		
Seed procurement		X																		
Locate sites/grow seedlings - series 1			X																	
Locate sites/grow seedlings - series 2				X																
Locate sites/grow seedlings - series 3					X															
Locate sites/grow seedlings - series 4						X														
Plant - series 1				X																
Plant - series 2					X															
Plant - series 3						X														
Plant - series 4							X													
Weather station\site maintenance - series 1					X	X	X	X	X	X		X		X		X		X		X
Weather station\site maintenance - series 2						X	X	X	X	X	X		X		X		X		X	
Weather station\site maintenance - series 3							X	X	X	X	X	X		X		X		X		X
Weather station\site maintenance - series 4								X	X	X	X	X	X		X		X		X	
Assess - series 1								X					X					X		
Assess - series 2									X					X					X	
Assess - series 3										X					X					X
Assess - series 4											X					X				
Extension				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

	2022				
Site Name	centre stake	brush	label	download	fence removal
Placer Mountain				contractor	
Loon Lake				contractor	
Winnifred Creek					
Deep Creek					
Riske Creek				contractor	
Kalamalka	FIRM		FIRM	FIRM	
Cranbrook					
Spillimacheen					
Barnhartvale	FIRM		FIRM	FIRM	
Shrimpton				contractor	
Lynx Creek				contractor	
Likely					
Mt St Helen WA				Weyco	
Glenmerry		contractor		contractor	
Port Alberni		contractor		contractor	
McLeese Lake		contractor		contractor	
Malcolm Knapp		contractor		N/A	
Churn Creek		contractor		contractor	
Kitimat		contractor		contractor	
Strouse Lake		contractor		contractor	
Parksville					
Fletcher Lake					
Bulldog		contractor			
Ladybird		contractor			
Gavin Lake		contractor		FIRM	
PGTIS				Vanessa	
Ft St John					
Mackenzie rth				inaccessible	
Kitsumkalum					
Mackenzie South				Vanessa	
Lyman Springs (				collaborator	
Wind River WA				collaborator	
Mendoci NF CA				collaborator	
Forest Hill CA				collaborator	
Sisters OR				collaborator	
Revelstoke South					
Whitehorse ResF				YK FS	
Fort Nelson					
Priest River ID				collaborator	
Spirit Lake ID				collaborator	
Golden				contractor	
Haines				contractor	
Skimikin	FIRM		FIRM	FIRM	
Holberg				contractor	
McLure	FIRM		FIRM	FIRM	
Nitinat	FIRM		FIRM	FIRM	contractor
Revelstoke rth					
High Level AB				AB FS	

4. Climate Sensitive Mortality Function for TASS



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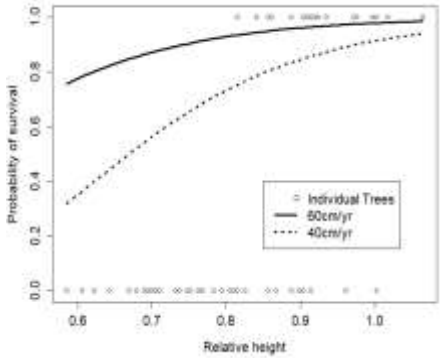

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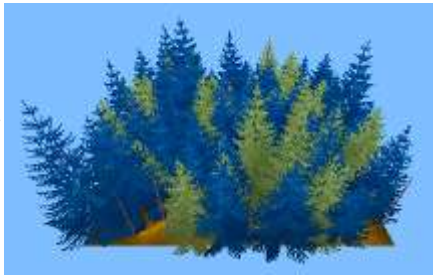


Image: Dave Simpson

4. Climate Sensitive Mortality Function for TASS

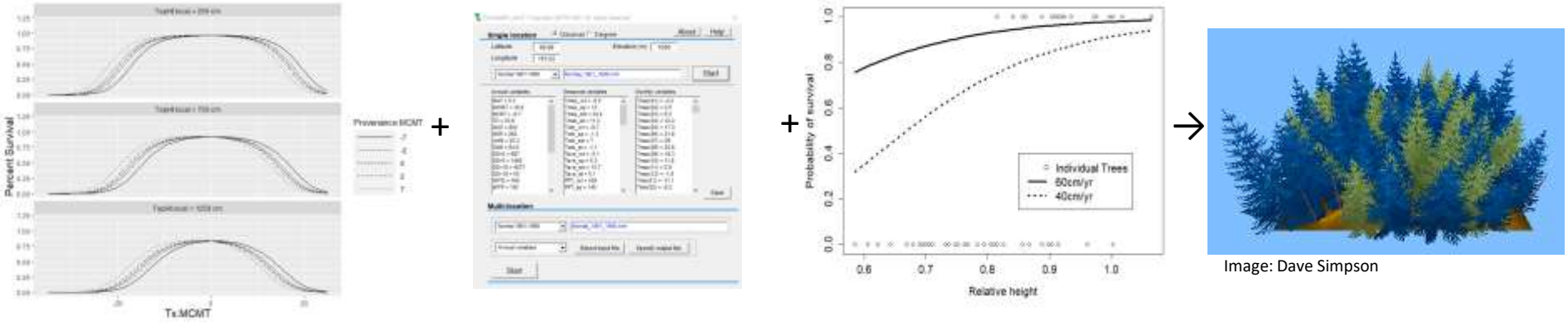


Image: Dave Simpson

Objective

- Simulate climate-induced mortality in lodgepole pine stands and apply to TASS

Funding

- 2019/20 - Forest Enhancement Society ($76,000), FAIB ($25,000)
- 2020/21 - OCF Research Program (Timber Portfolio) ($51,000)
- 2021/22 - OCF Research Program (Timber Portfolio) ($51,000)
- 2022/23 - OCF Research Program (Timber Portfolio) ($51,000) (requested)

Team

- Kate Peterson, Tongli Wang, Derek Sattler, Greg O'Neill

4. Climate Sensitive Mortality Function for TASS

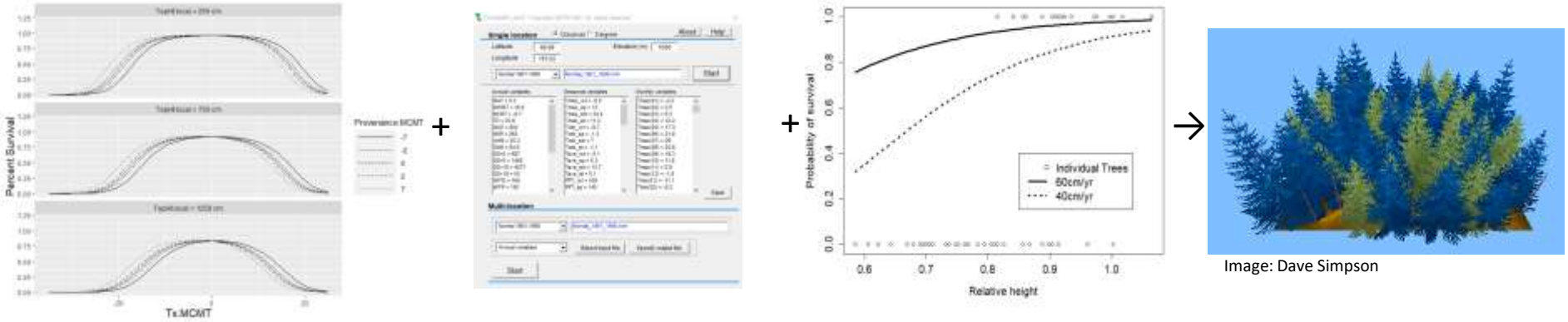


Image: Dave Simpson

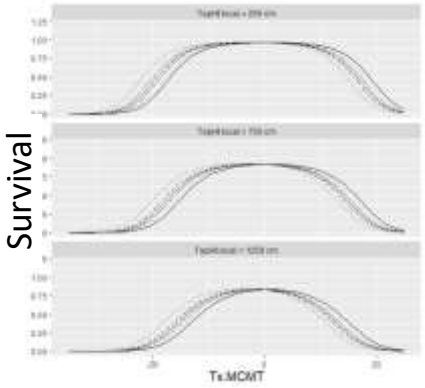
Deliverables

- Technical Report “Climate Sensitive Mortality functions for TASS” (internal review)

Extension

- Western Mensurationists Conference 2020
- International Boreal Forest Research Association conference 2021
- CFGA/WFGA Symposium 2021

5. CC Impacts to Forest Productivity



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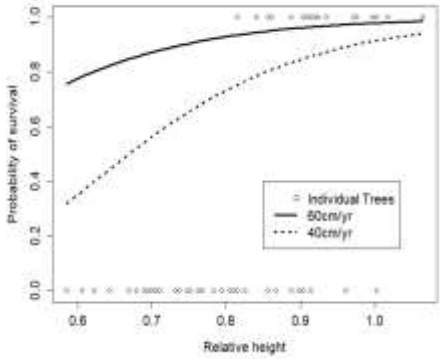


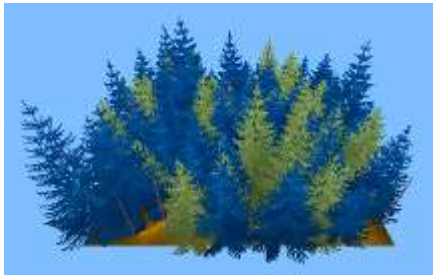
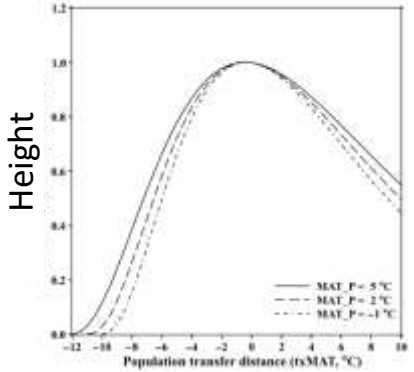


Image: Dave Simpson



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Revise

5. CC Impacts to Forest Productivity

Objective

- Revise HT transfer function and apply to TASS
- Use climate-sensitive HT and Mortality functions in TASS to predict CC impacts to Pl stands

Funding 2021/22, 2022/23 (from Project 3)

- OCF Research Program (Timber Portfolio)

Team

- Kate Peterson, Tongli Wang, Derek Sattler, Greg O'Neill

6. Barriers to inter-jurisdictional seed movement

Objective

- Identify and assess possible barriers to importation of tree seed for reforestation into BC.

Funding 2020/21, 2021-22

- none

Team

- Arial Eatherton, Harry Nelson, Greg O'Neill

6. Barriers to inter-jurisdictional seed movement

Objective

- Identify and assess possible barriers to importation of tree seed for reforestation into BC.

Funding 2020/21, 2021-22

- none

Team

- Arial Eatherton, Harry Nelson, Greg O'Neill

Survey of seed users, producers, scientists, policy-makers, managers:

- Phytosanitary
- Supply
- Legal/proprietary
- Genetic (diversity, origin)
- Technical (database)

6. Barriers to inter-jurisdictional seed movement

Objective
- Identify and assess possible barriers to importation of tree seed for reforestation into BC.

Funding 2020/21, 2021-22
- none

Team
- Arial Eatherton, Harry Nelson, Greg O'Neill

Survey of seed users, producers, scientists, policy-makers, managers:

- Phytosanitary
- Supply
- Legal/proprietary
- Genetic (diversity, origin)
- Technical (database)

Deliverable
- Manuscript "Seed without Borders: interjurisdictional seed transfer" (internal review)

7. Species transferability (on hold)

Objective

- To what extent do species differ in their safe seed transfer distance and CC sensitivity?
- At what age can safe seed transfer distance be calculated?
- Develop CBST for California

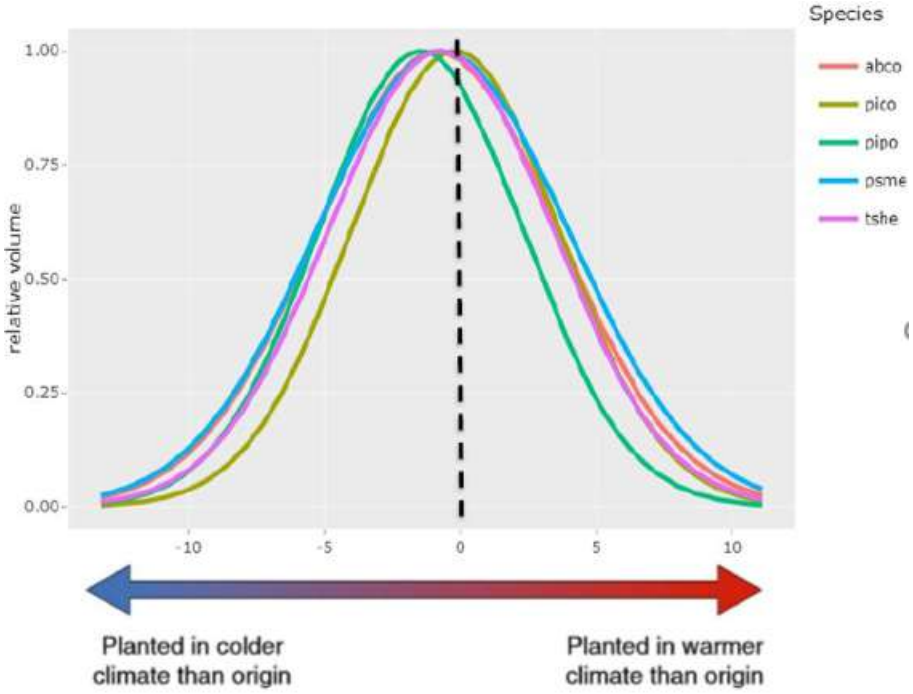
Funding

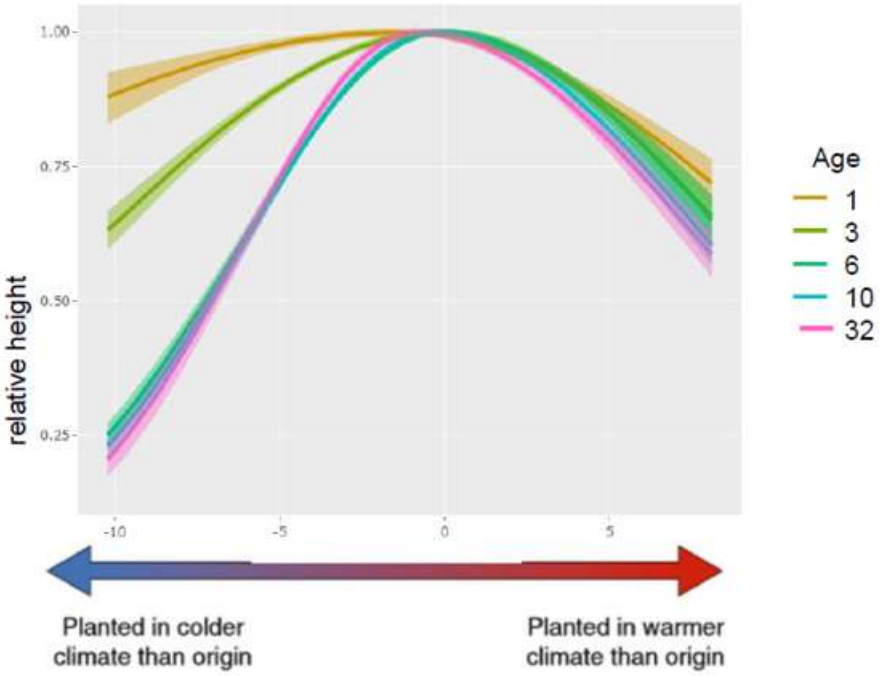
- 2020/21 - $40 000 (UC Davis)
- 2021-22 - $60 000 (CalFire)
- 2022-23 - $60 000 (CalFire) (requested)

Team

- Joseph Stewart (UCD) , Jessica Wright (USDA FS), Greg O'Neill

7. Species transferability





8. Assisted Migration Review

Objective

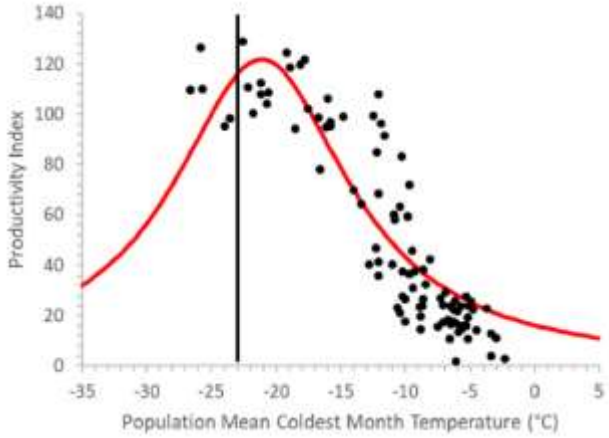
- What have we learned from assisted migration field trials?
- What is the benefit of AM?

Funding 2020/21

- none

Team

- Cuauhtémoc Saenz-Romero, Sally Aitken, Roberto Lindig-Cisneros, Greg O'Neill



8. Assisted Migration Review

Interior spruce

- Negative impacts of climate change on productivity may be mitigated by planting seed sources from locations that are 3 °C MCMT warmer than the plantation

Whitebark pine

- It is possible to establish whitebark pine outside of its current natural distribution at sites that have climates that are within the species' modelled historic climatic niche;
- Developing disease-resistant trees through selective breeding is a higher priority [than AM] in the short term

Sacred fir

- Sacred fir performs well when moved 400 m upward in elevation and local shrubs are used as nurse plants
- New assisted migration field trials in multiple disparate climates are needed

9. Multi-spectral imaging in genetics trials

Objective

- What opportunities exist for multispectral imaging to contribute to assessment of genetics field trials?

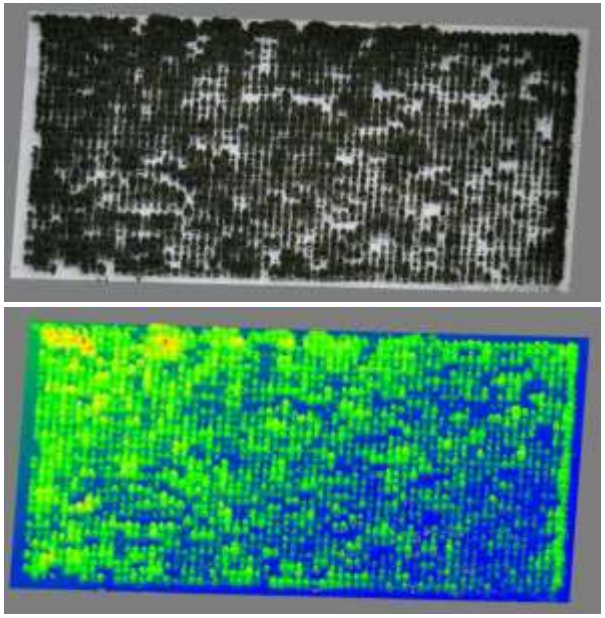
Funding 2020/21

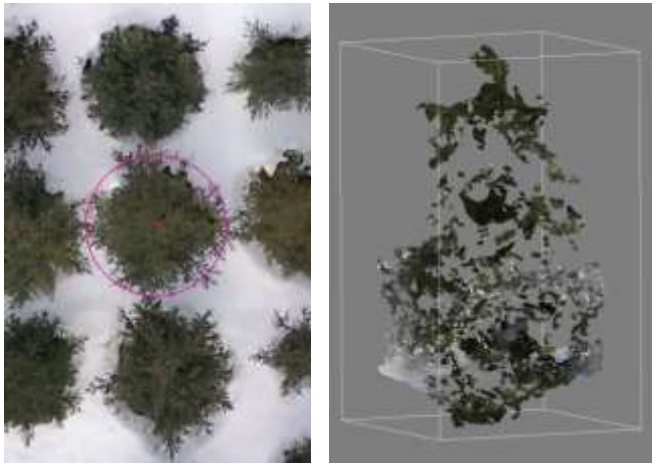
- LBIS $30,000
- NSERC $60,000

Team

- Sam Grubinger, Nicholas Coops, Greg O'Neill

9. Multi-spectral imaging in genetics trials

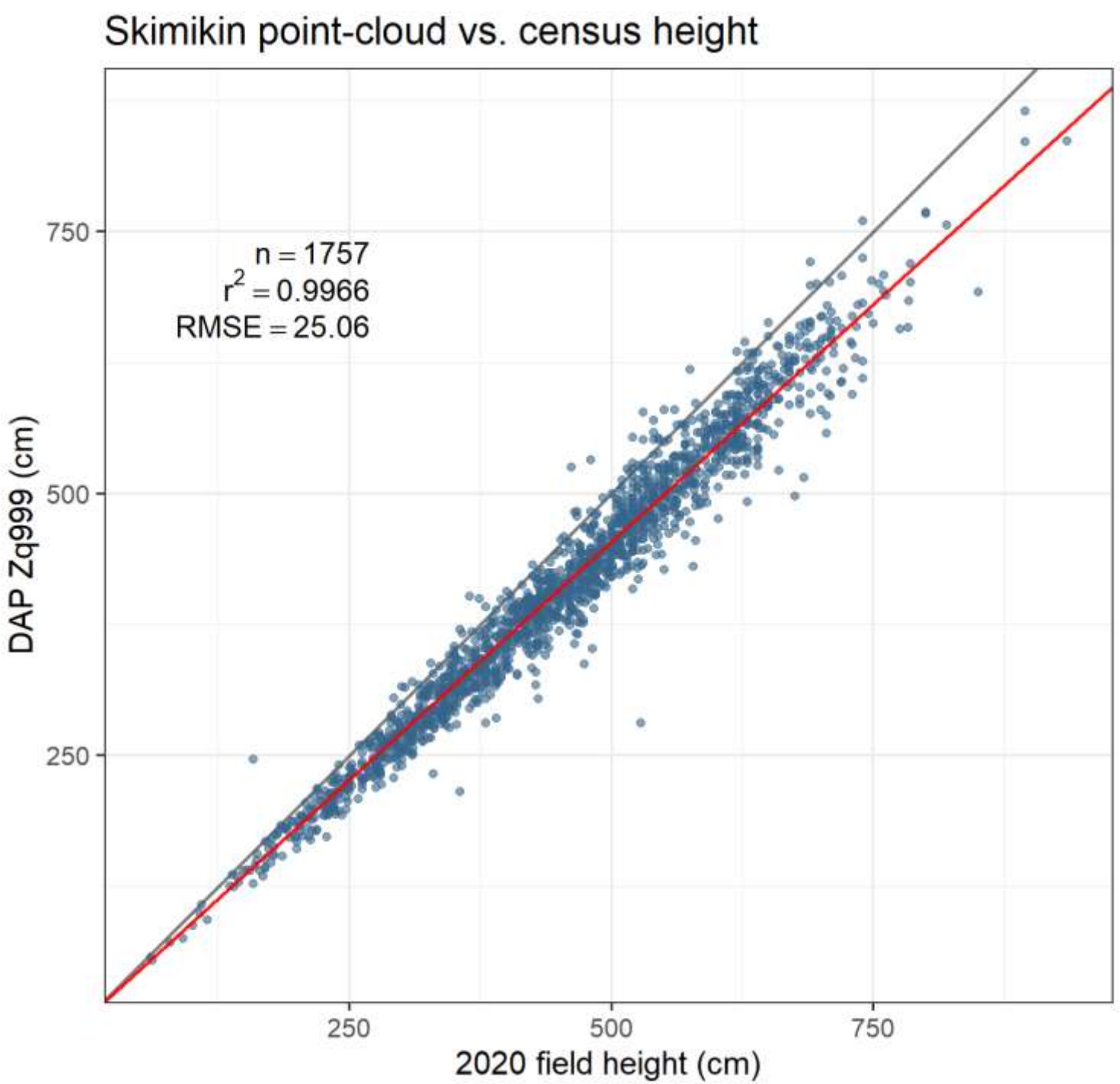




Questions

Can multispectral imaging accurately and efficiently assess:

- HT, DBH, stem volume, crown volume
- Branch length, length, diameter
- Weevil damage
- Stem straightness, ramicorn branching, forking
- Photosynthetic efficiency
- Drought stress


Skimikin point-cloud vs. census height
n = 1757
r2 = 0.9966
RMSE = 25.06
DAP Zq999 (cm)
250
500
750
250
500
750
2020 field height (cm)

10. Local adaptation to forest pests

Objective/Questions

- Does good seed transfer help limit pest damage?
- Identify specific transfers that should be avoided

Funding

2021/22 – 45,000 (FCI)
2022/23 – 65,000 (FCI) (requested)

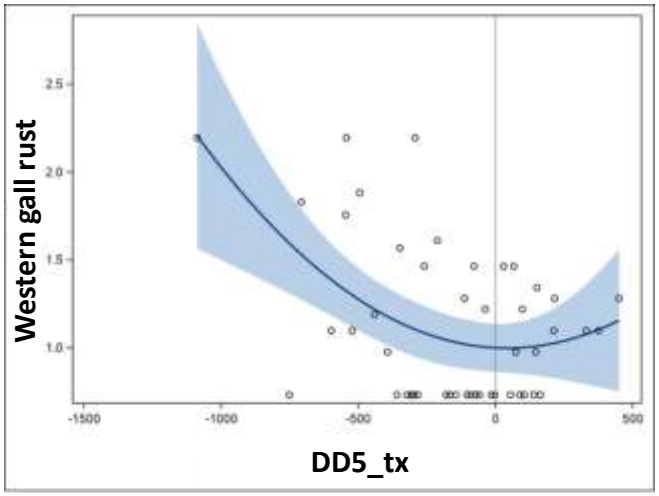
Team

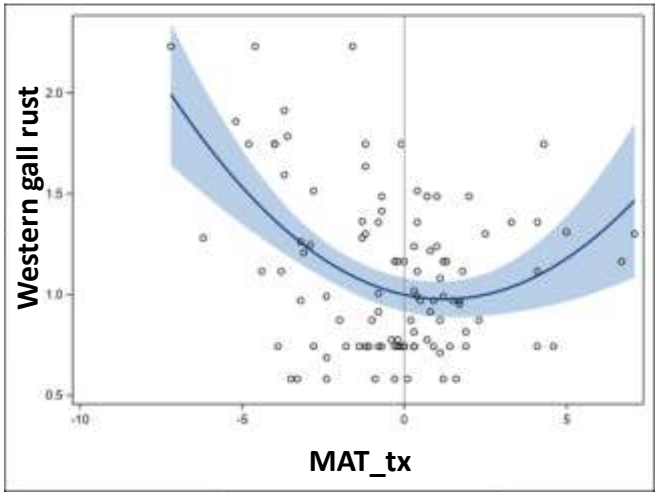
- Dawei Luo, Nick Ukrainetz, Greg O'Neill

Deliverable

- Better forest health through better seed transfer. 2021.

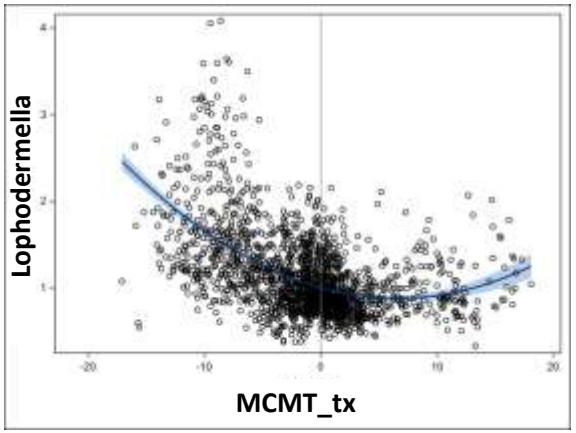
10. Local adaptation to forest pests

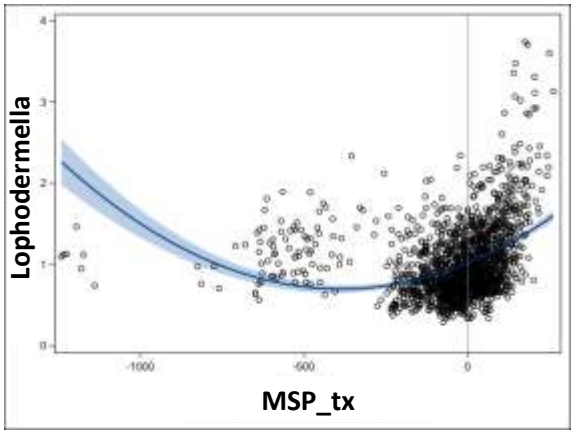




Western gall rust (stem and branches) at age-17 on lodgepole pine

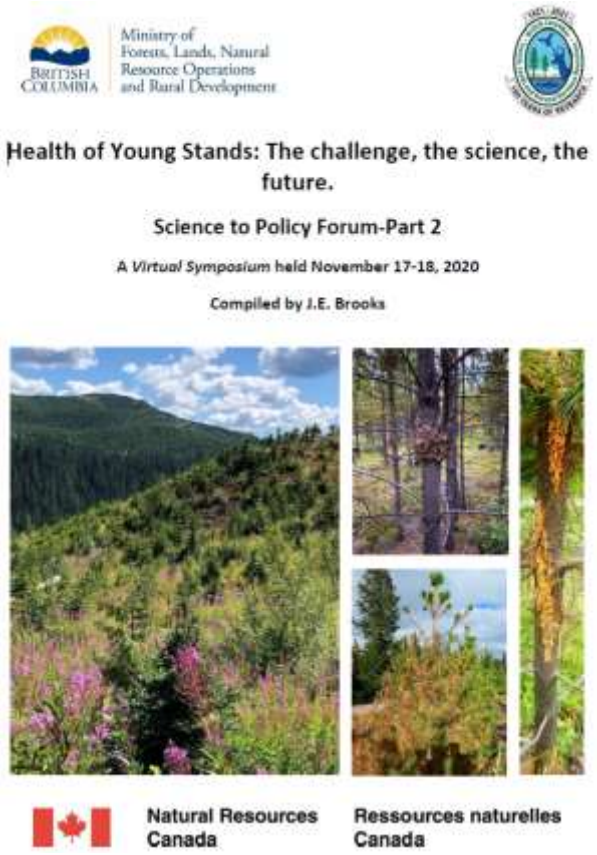
10. Local adaptation to forest pests





Lophodermella needle cast attack score on lodgepole pine

10. Local adaptation to forest pests



11. Weather station assessments

Objective/Questions

- Are field weather stations accurate?
- Evaluate tradeoffs between ClimateBC and field weather stations.

Funding 2021/22

- NSERC ($18,000)

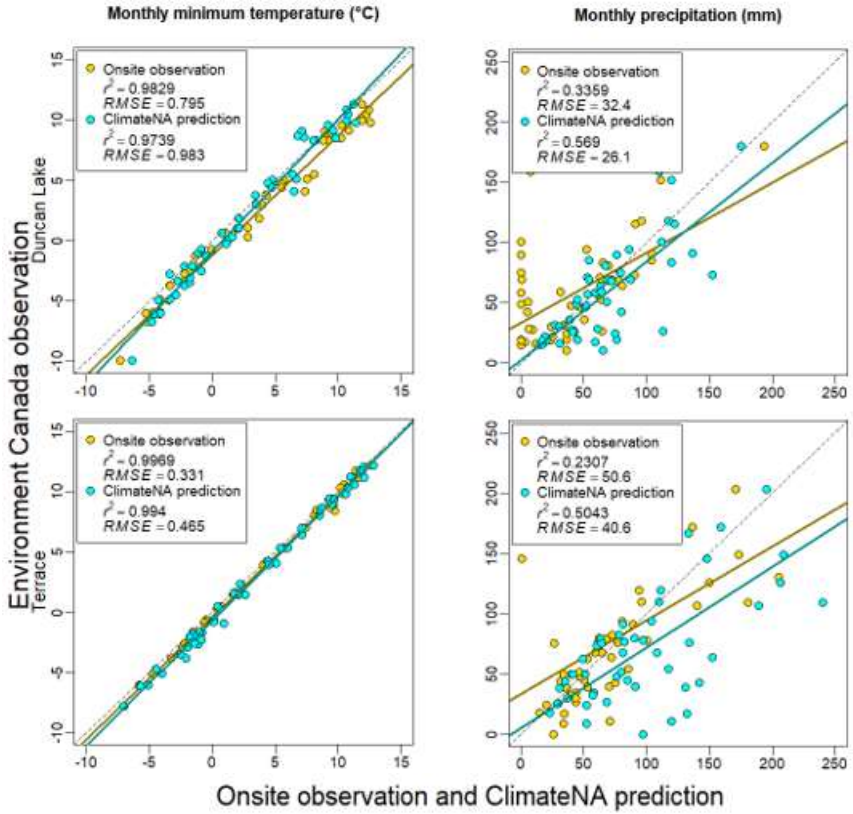
Team

- Lambert Ye, Tongli Wang, Greg O'Neill

Deliverable

- "Climate Data for Field Trials: Onsite Micro Stations *versus* ClimateNA" (submitted)

11. Weather station assessments



12. Predicting future forest productivity using dendrochronological assessment of provenance trials

Objective/Questions

- Can annual ring widths of trees in provenance trials improve forest productivity estimates?

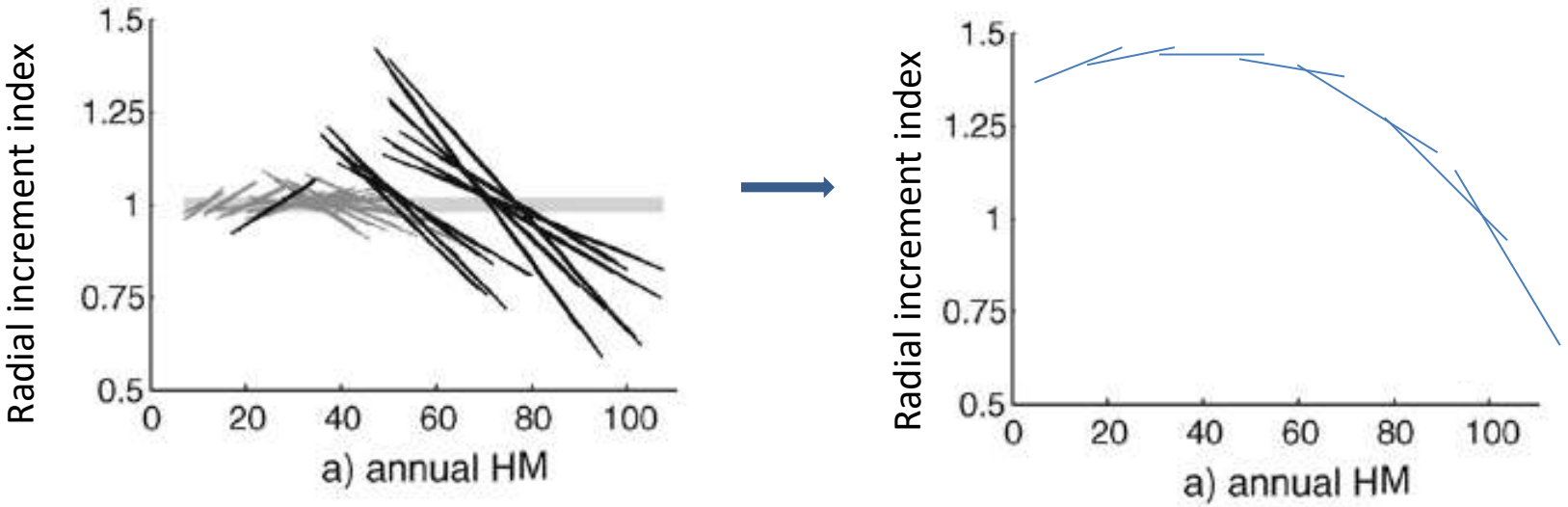
Funding

- 2021/22 - $24,000 (FLNRO Research Program)
- 2022/23 - $10,000 (FLNRO Research Program) (requested)

Team

- Jodi Axelson, Hardy Griesbauer, Greg O'Neill

12. Predicting future forest productivity using dendrochronological assessment of provenance trials



13. Bibliographic analysis of assisted migration research

Objectives

- Assess research trends in assisted migration.
- Discuss the utility of this type of analysis in identifying research trends within a field.

Funding 2021/22

- NSERC ($18,000)

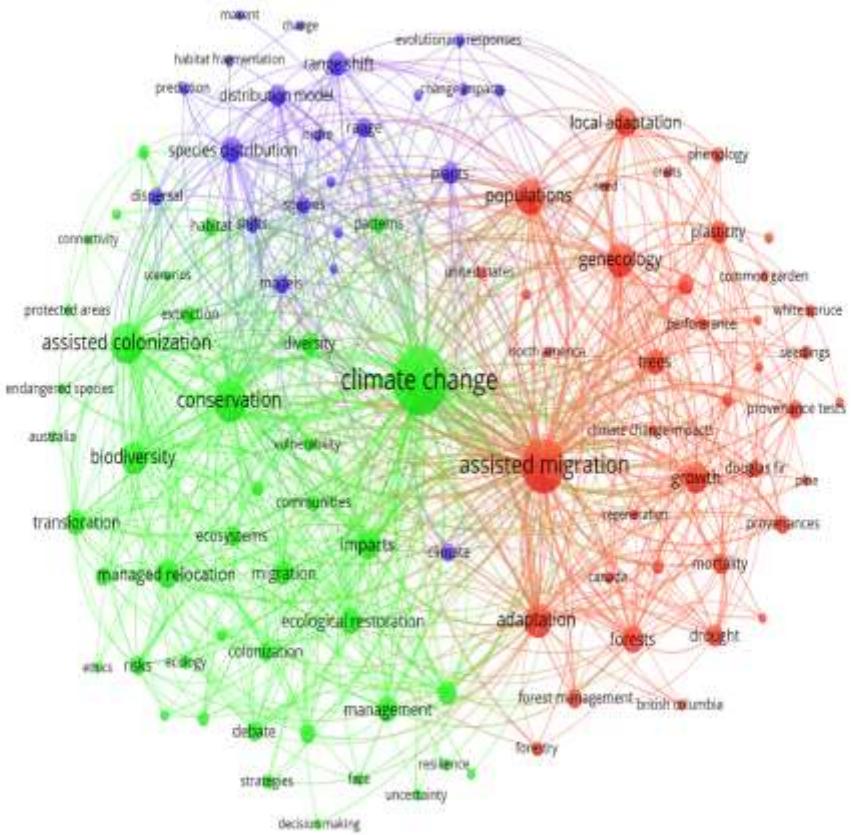
Team

- Lahcen Benomar, Raed Elferjani, Jill Hamilton, Greg O'Neill, Said Echchakoui, Yves Bergeron, Mebarek Lamara

Deliverable

- "Bibliometric analysis of the structure and evolution of research on assisted migration" (submitted)

13. Bibliographic analysis of assisted migration research



Extension

2021/22 extension			
Date	**Audience**	**Presentation**	**Format**
March	CTAC	Climate Change Adaptation Research	webinar presentation
May	WFGA/CTAC	Predicting tree mortality in a changing climate using provenance data (Peterson)	webinar presentation (coauthor)
May	WFGA/CTAC	Forest growth in a future climate: tree improvement for white spruce and lodgepole pine in Alberta (Luo)	webinar presentation (coauthor)
May	WFGA/CTAC	Bibliometric analysis of the structure and evolution of research on assisted migration (Benomar)	webinar presentation (coauthor)
June	Universidad de Michoachan de Hidalaldo	Autecology in Forest Management	webinar presentation
June	USDA Forest Service	Transitioning from Geographic Seed Zones to Climate Seed Zones to Facilitate Assisted Migration	webinar presentation
August	International Boreal Forest Research Association conference 2021	Predicting tree mortality in a changing climate using provenance data	webinar presentation (coauthor)
November	IUFRO Conifers of the Pacific North West	Local adaptation to forest pests	webinar presentation
November	UBC Forest Policy class	Implementing CBST in BC	classroom presentation
November	UBC Forest Management class	Understanding assisted migration	webinar presentation
January	Idaho Woodlot Foresters Conference	AMAT and CBST	webinar presentation
February	Tolko/Okanagan Nation Alliance	Genetic diversity and assisted migration	webinar presentation

Thanks!

Photo: Mike Carlson