# GBS Analysis of Aspen Phylogeography

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# Agenda

- Motivation for study – Missoula Flood hypothesis
- Method and basic data – Genotype by sequencing (GBS)
- Preliminary results

# Crowdfunded: Experiment.Com

experiment

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## The lost aspens of the Willamette Valley: Did catastrophic floods carry them from the Rockies?

**By Collin Peterson and Steven Strauss**

Backed by Timothy S Leatherman, David B. Wagner, Logan Norris, David Altman, Bruce P Dancik And Brenda L Laishley, Haven Baker, Bruce Chassy, Denny Luan, Terri Lomax, Jenny Kao, Ellen Watrous, David Oates, Bob Latham, Jeff Clark, Stefan Rauschen, **and 53 other backers**

**$6,100**

Raised

**152%**

# Press coverage of crowdfunding effort

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## Willamette Valley aspens could be Rocky Mountain refugees from prehistoric Missoula Floods

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## OSU researchers attempt to decode origins of Willamette aspen grove

NATHAN BRUTTELL Corvallis Gazette-Times Feb 4, 2015 0

Amanda Cowan, Corvallis Gazette-Times

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Oregon State University researcher Collin Peterson, left, and professor Steve Strauss check out the tops of aspen trees near Corvallis on Jan. 30.

At the edge of forestland southeast of Corvallis, amid the evergreens and oaks, grows a half-acre stand of white-barked aspen.

Possibly overlooked by an untrained eye, these aspen are intriguing to foresters: The next-closest

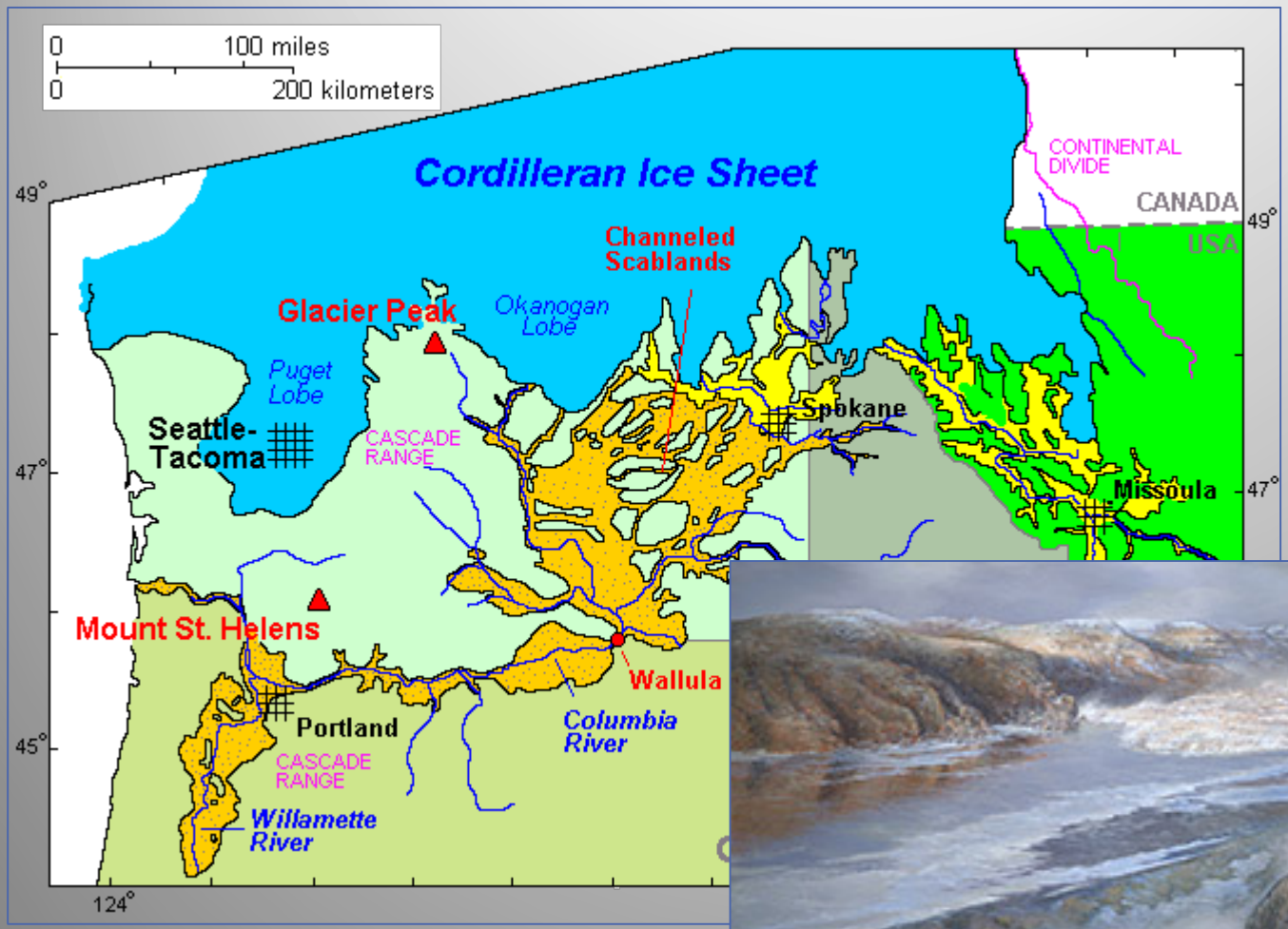
### Associated Press

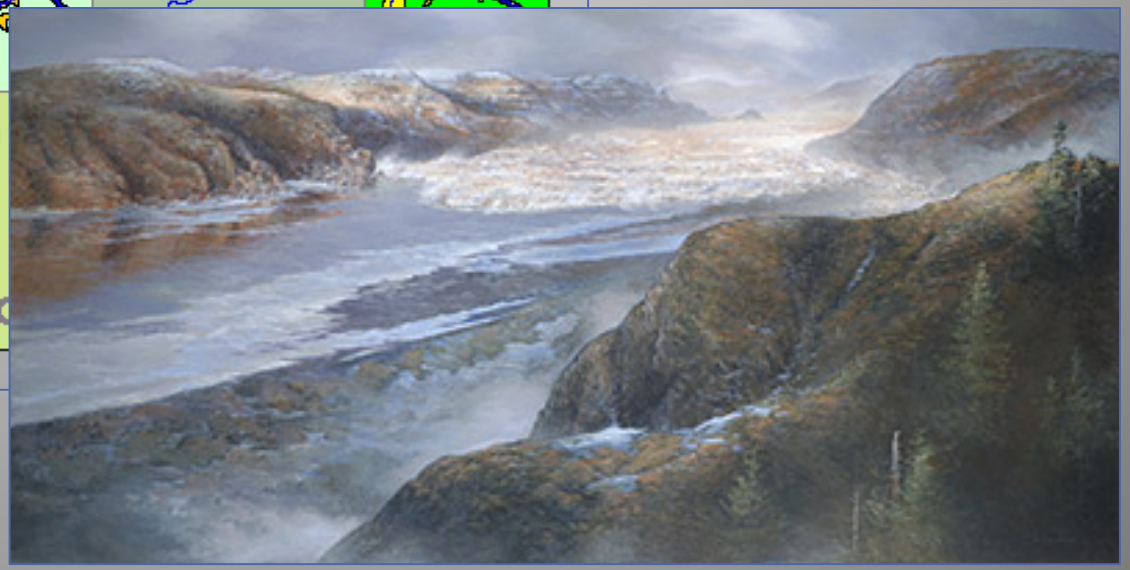
Witnesses: Warplanes bomb Yemer killing dozens

Manhunt in Brussels after raid linke attacks

Ex-Nevada shelter chief is charged

# Missoula flood hypothesis for rare Willamete Valley aspens



# Aspen source populations

Montana

Glad Creek, Oregon

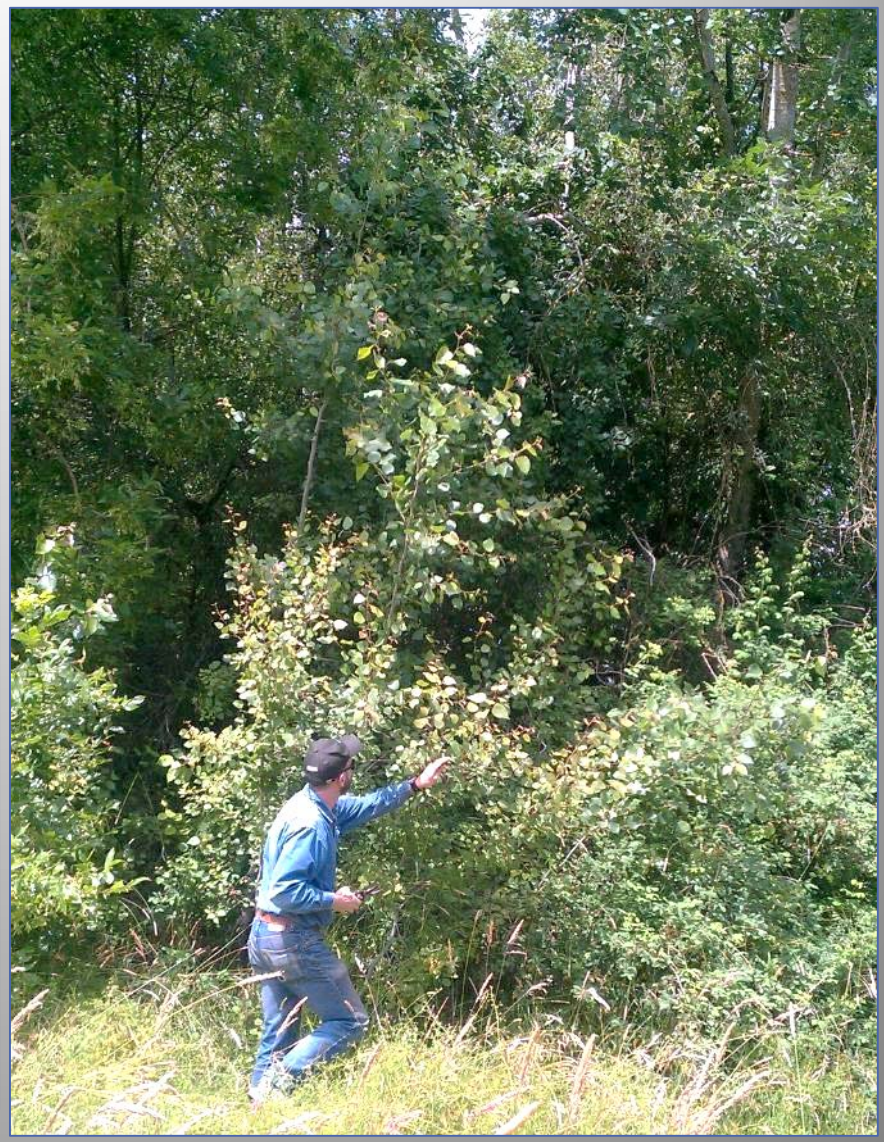
# Aspen source populations

Brooks, Oregon

Keizer Station, Oregon

# Aspen source populations

Lake Oswego, Oregon

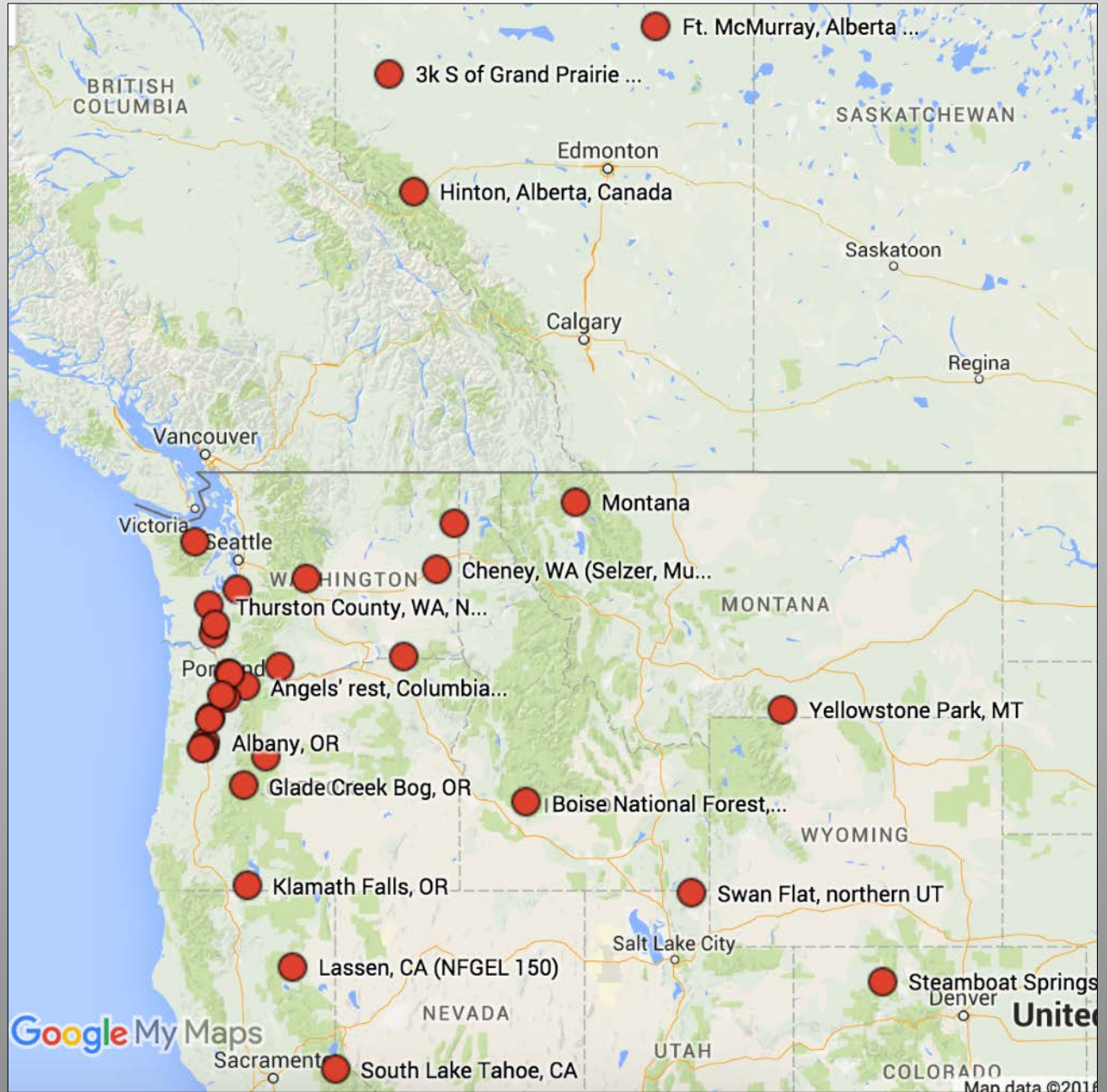


Near Calapooia River, Oregon

# Summary of aspen populations

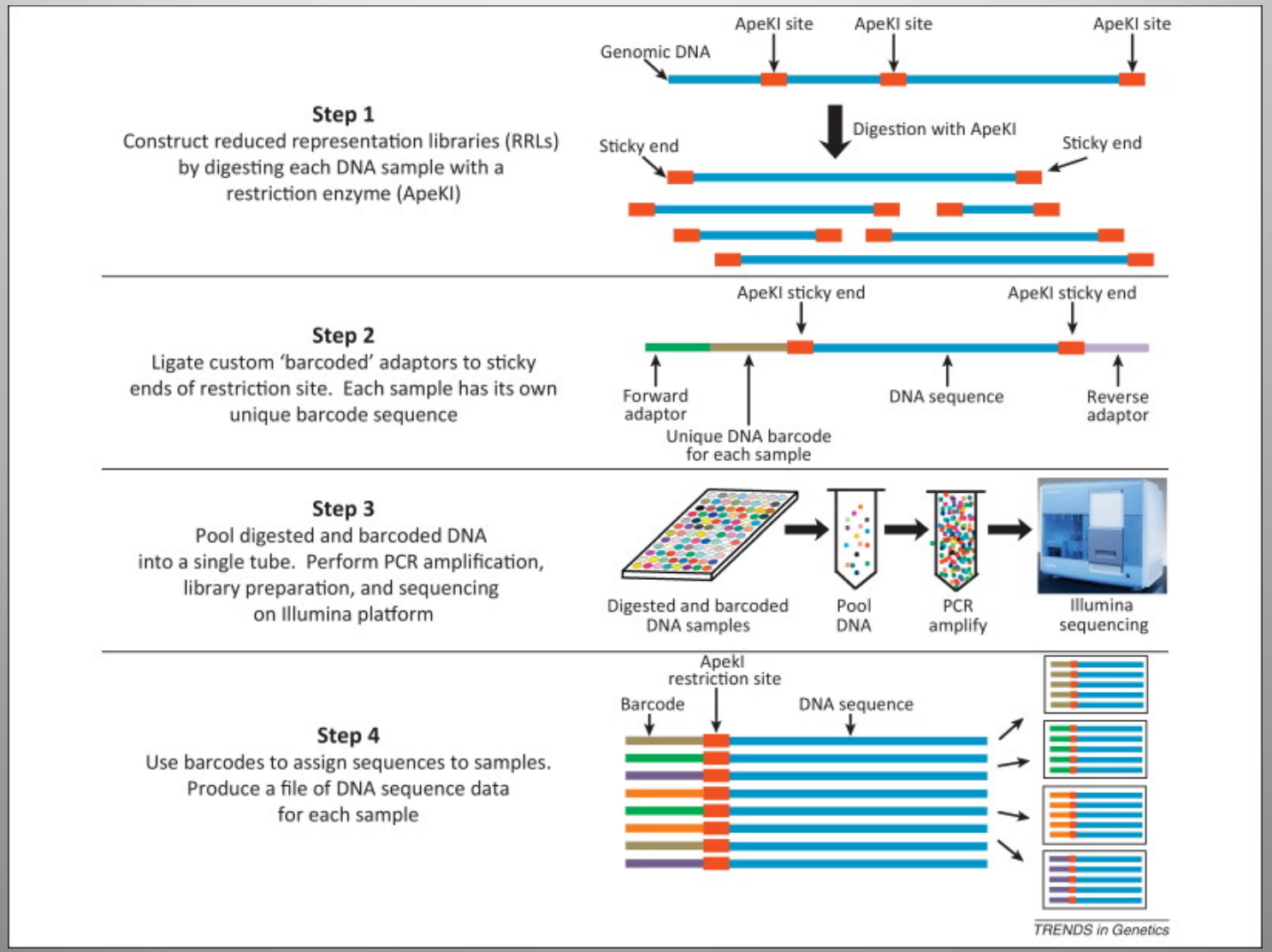
| | |
|---|---|
| Total sites | 34 |
| Ours/collaborators sites | 21 |
| New/crowd funding sites | 13 |
| No. of samples/site | 1-5 |
| Total | 96 |

# Sample locations



# Genotype by sequencing:

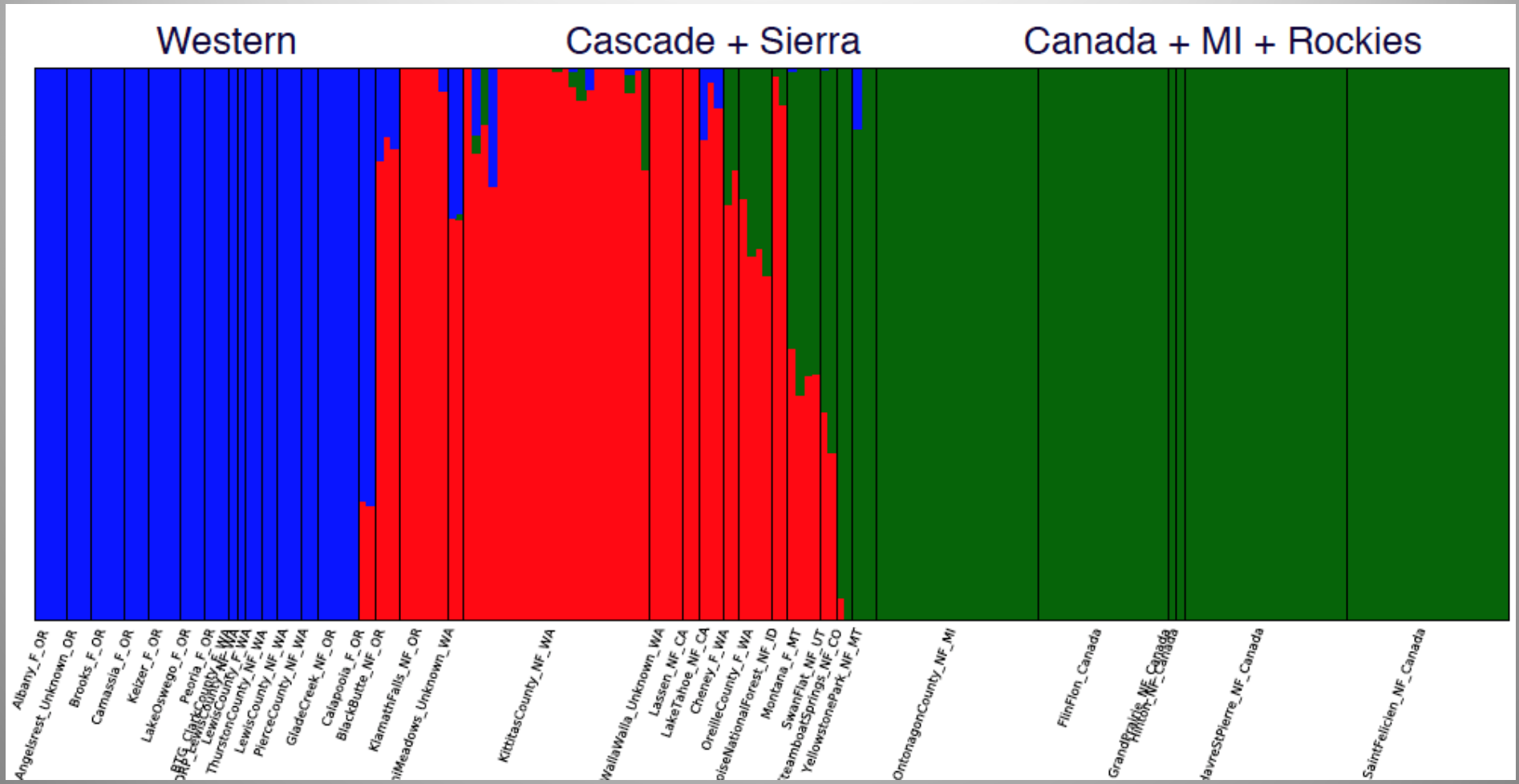
## Many random short sequences



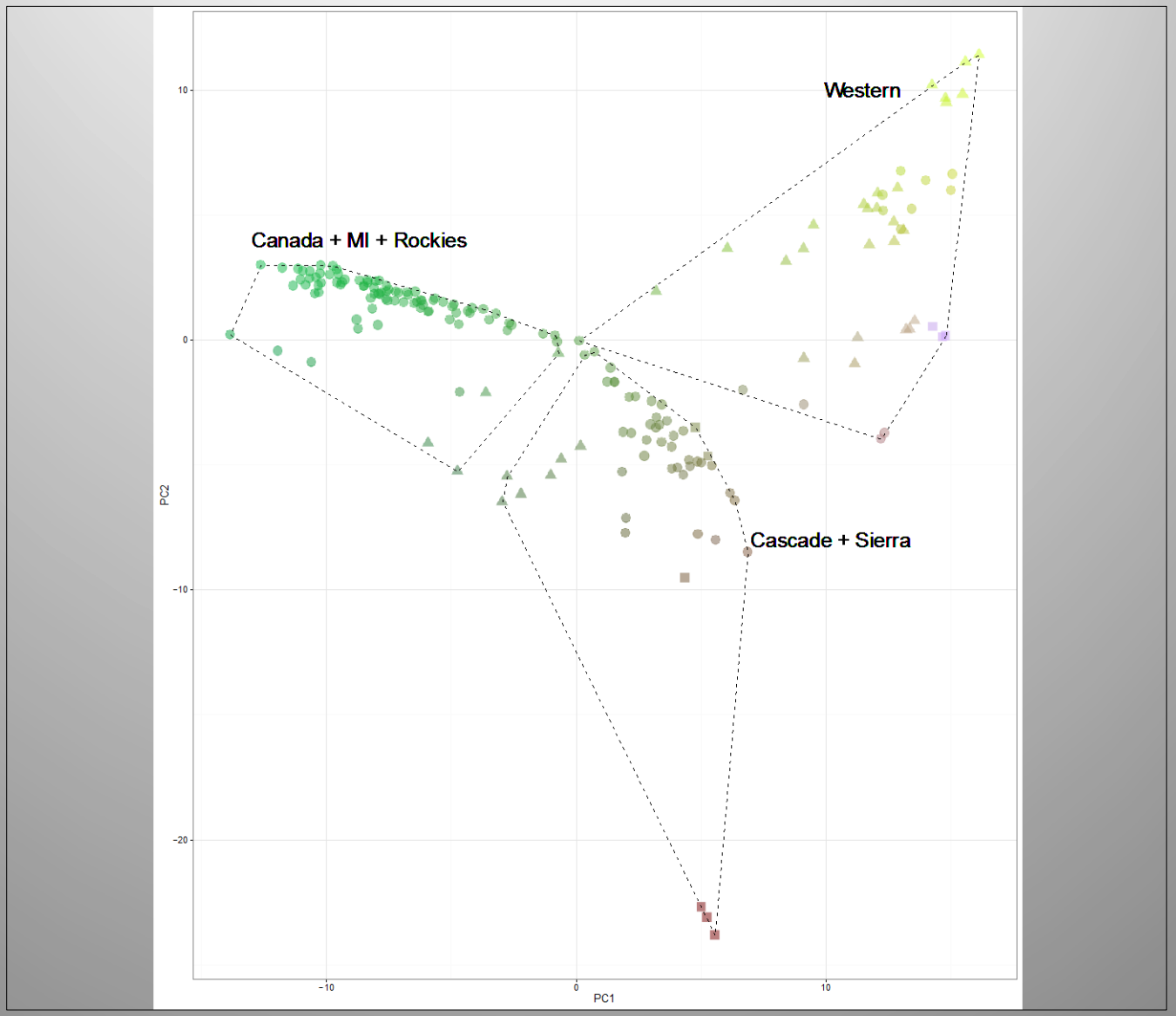
# GBS data summary

| | |
|---|---|
| Total number of raw reads | 382,821,694 |
| Total number of good barcoded reads | 322,712,109 |
| **Total number of good samples** | **79** |
| Total number of SNPs detected | 113,396 |
| Total number of SNPs detected (Strauss + Mock) | 195,421 |
| **Total number of SNPs detected (Strauss + Mock) at 90% 'N' and 8bp read depth filter** | **24,209** |

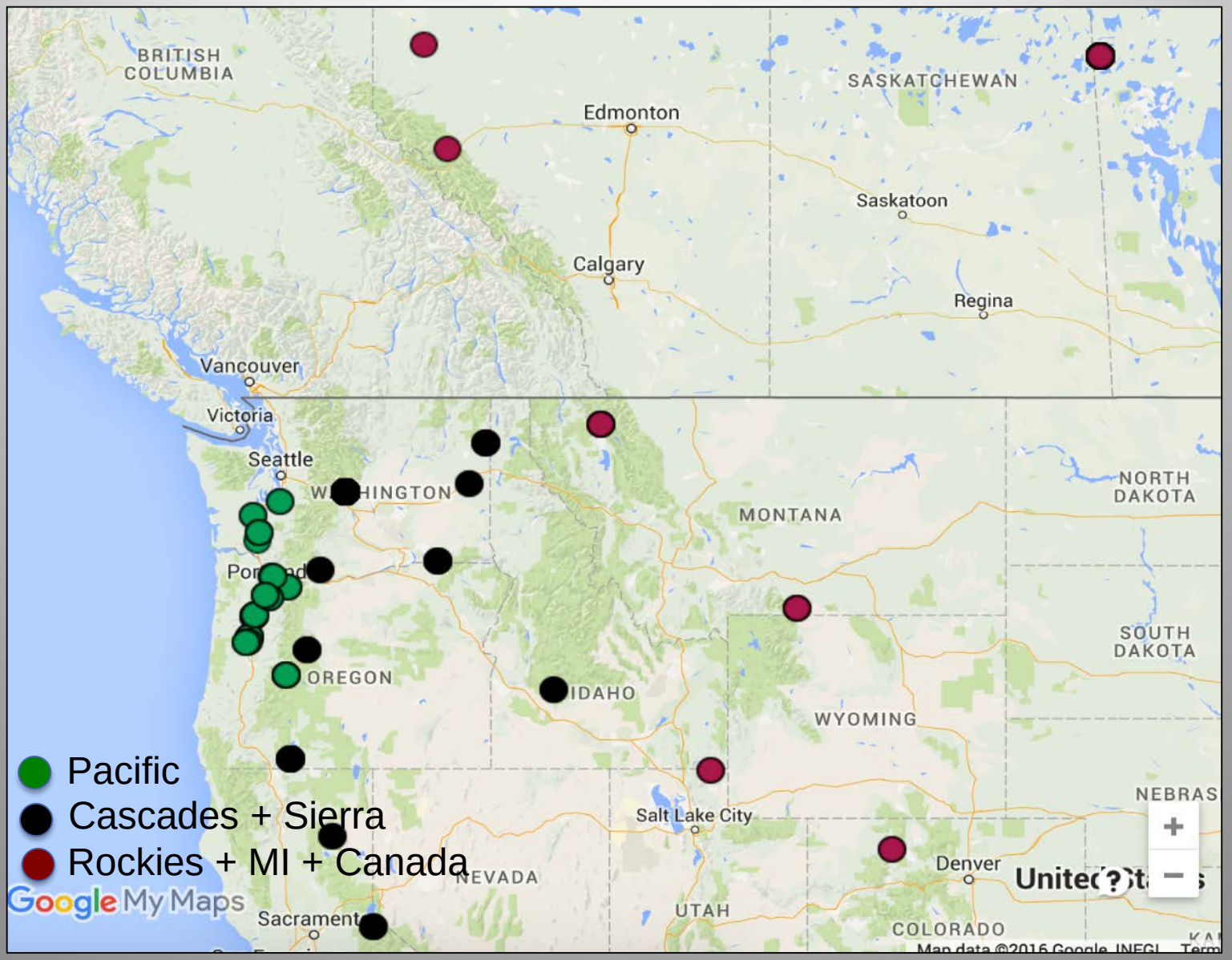
# Population analysis with “FastStructure”



# PCA (PC1 vs. PC2) overlaid with FastStructure results



# Three major groups mapped



# Discriminant analysis of three putative varieties

- 28 PC axes = 43.2% of variance in the SNP data
- Three groups
  - 1 = Cascades & Sierra
  - 2 = Canada + Michigan + Rockies
  - 3 = Western/Pacific
- **Proportion of overall correct assignment = 0.978**
- **Proportion of correct assignment per group/population**
  - **1 = 0.961**
  - **2 = 1.000**
  - **3 = 0.952**

# QUAKING ASPEN

## *Populus tremuloides* Michx.

Plant Symbol = POTR5

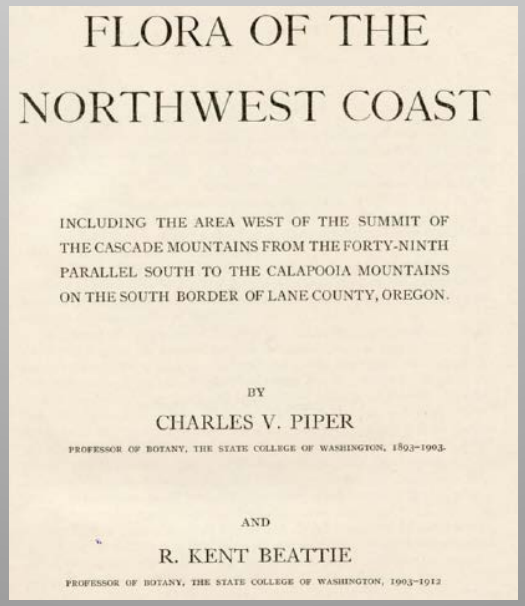
*Contributed by: USDA NRCS National Plant Data Center & the Biota of North America Program*

Brother Alfred Brousseau
© St Mary's College
@ CalPhotos

**Alternate Names**

Trembling aspen, golden aspen, mountain aspen, trembling poplar, white poplar, popple; aspen

- Willow family (Salicaceae)
- High phenotypic plasticity
- Many varieties have been described but none are formally recognized



FLORA OF THE NORTHWEST COAST

INCLUDING THE AREA WEST OF THE SUMMIT OF THE CASCADE MOUNTAINS FROM THE FORTY-NINTH PARALLEL SOUTH TO THE CALAPOOIA MOUNTAINS ON THE SOUTH BORDER OF LANE COUNTY, OREGON.

BY

CHARLES V. PIPER

PROFESSOR OF BOTANY, THE STATE COLLEGE OF WASHINGTON, 1893–1903.

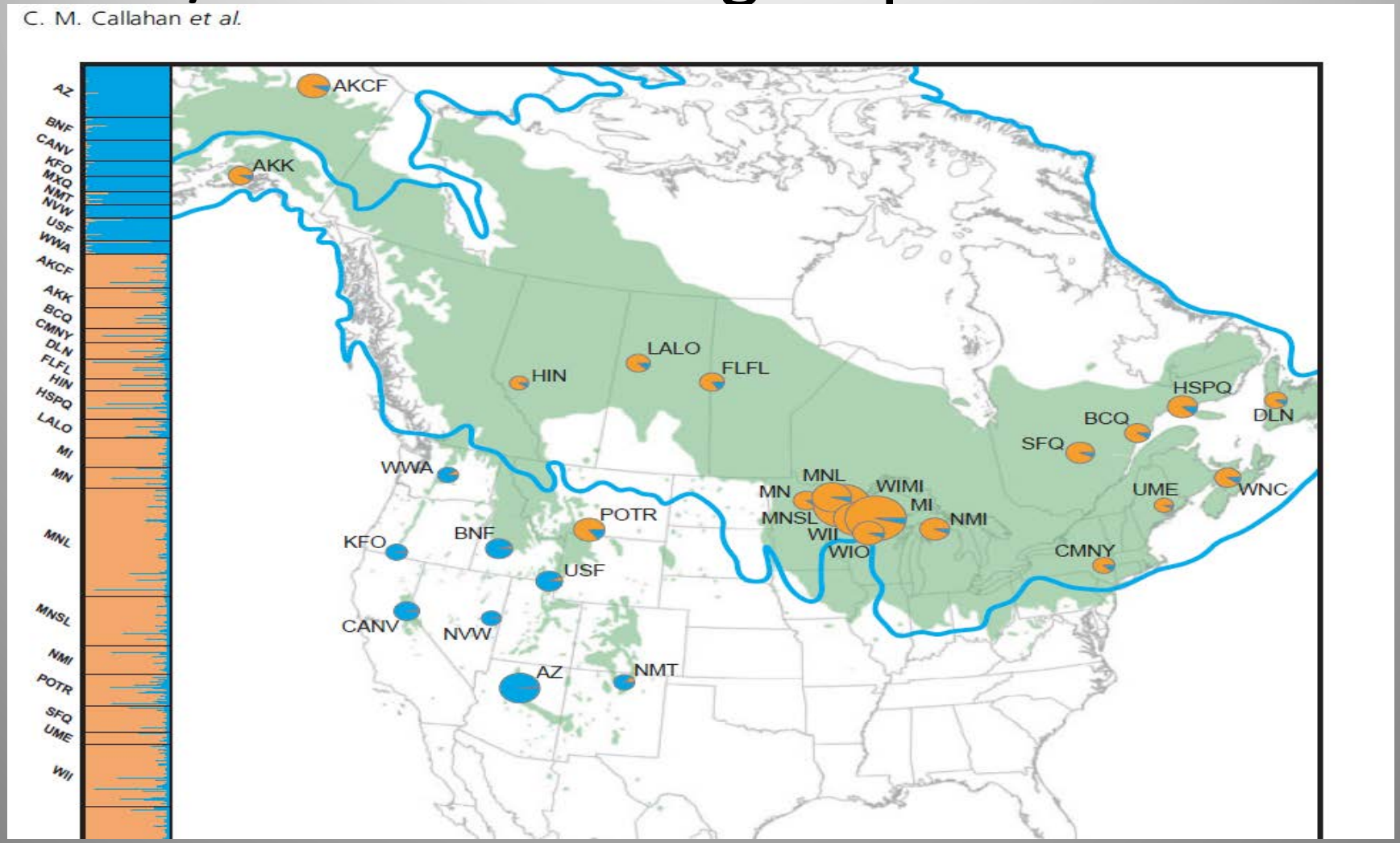
AND

R. KENT BEATTIE

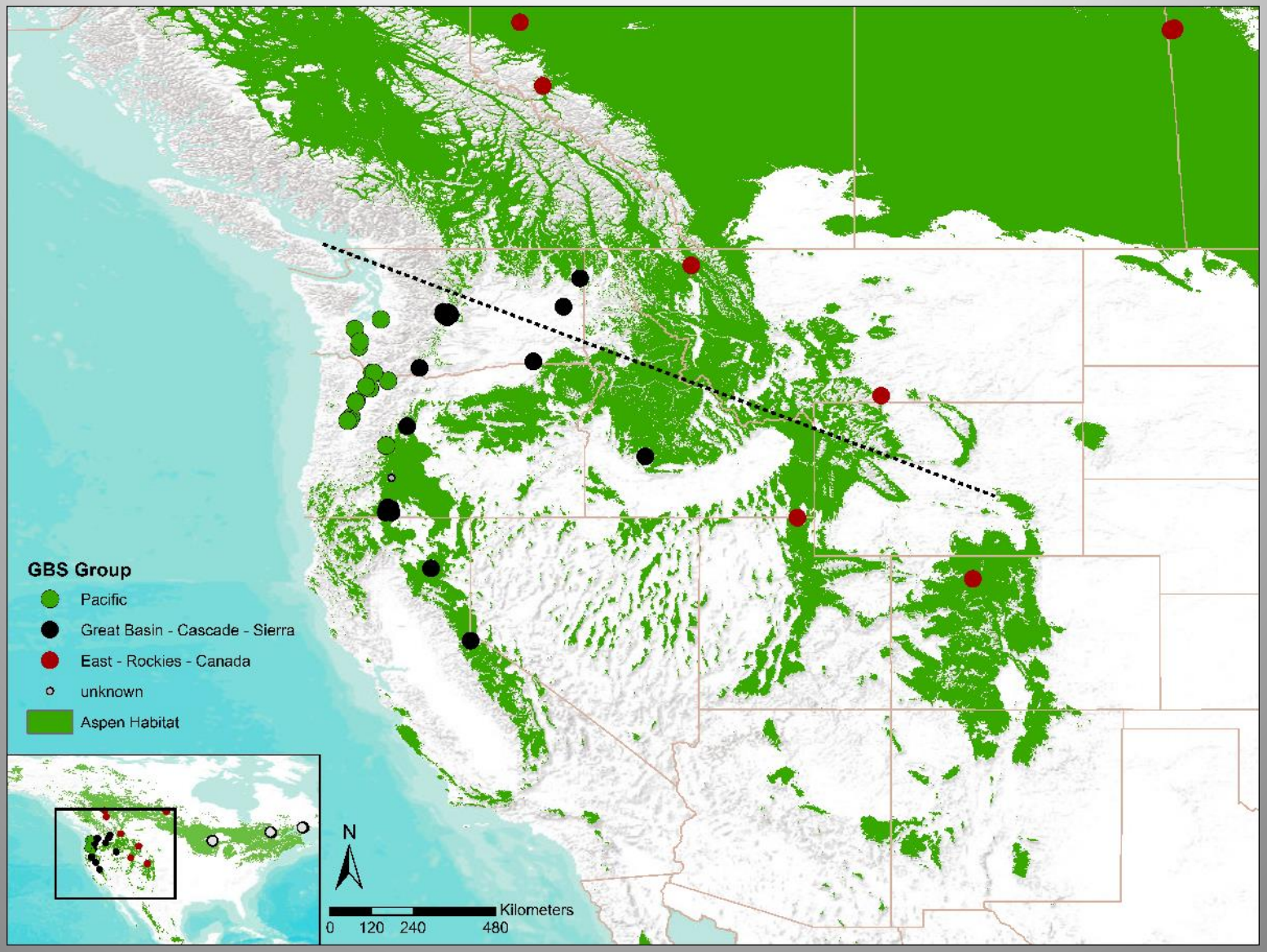
PROFESSOR OF BOTANY, THE STATE COLLEGE OF WASHINGTON, 1903–1912

| |
|---|
| Populus atheniensis Lodd. ex C.F.Ludwig |
| Populus aurea Tidestrom |
| Populus benzoifera Tausch |
| Populus cercidiphylla Britt. |
| Populus cordata Hort. ex Poir. |
| Populus glandulosa Willd. ex Steud. |
| Populus graeca Ait. |
| Populus pendula Hort. ex Tausch |
| Populus polygonifolia F. G. Bernard |
| Populus sibirica Hort. ex Tausch |
| Populus tremula subsp. tremuloides (Michx.) A.Löve & D. Löve |
| Populus tremuliformis Emerson |
| Populus tremuloides Tidestr. |
| **Populus tremuloides var. aurea (Tidestr.) Daniels** |
| Populus tremuloides var. cercidiphylla (Britton) Sudw. |
| Populus tremuloides var. intermedia Vict. |
| Populus tremuloides var. magnifica Vict. |
| Populus tremuloides var. rhomboidea Vict. |
| **Populus tremuloides var. vancouveriana (Trel.) Sarg.** |
| Populus trepida Willd. |
| Populus vancouveriana Trel. ex Zdestr. |
| Tremula trepida Raf. |

# Callahan et al. 2013 – Eight microsatellite loci in aspen show north/east and west groups



# Callahan et al. 2013 demarcation vs. current study



# Conclusions

- No evidence for Missoula flood origin
- Evidence for three major sub-specific groups in aspen – not yet recognized botanically
- Evidence for a new Pacific group in western Oregon & Washington
- Apparent differences in genetic diversity among the groups
- Data analysis still ongoing, subject to revision

# Major contributors to the study

- Upendra Devisetty, Oregon State University (OSU) and University of Arizona
- Daniel Fulop, University of California at Davis
- Collin Peterson, OSU now Idaho Fish & Game
- Richard Cronn, US Forest Service, Corvallis
- Karen Mock, Utah State University
- Bill Ripple, OSU
- Burke Greer, OSU
- Kori Ault, OSU and Lewis & Clark College
- Ed Alverson

- About 64 crowd-funders