Genecology and Seed Zones for Native Grasses and Forbs

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USDA ARS Agricultural Research Service

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

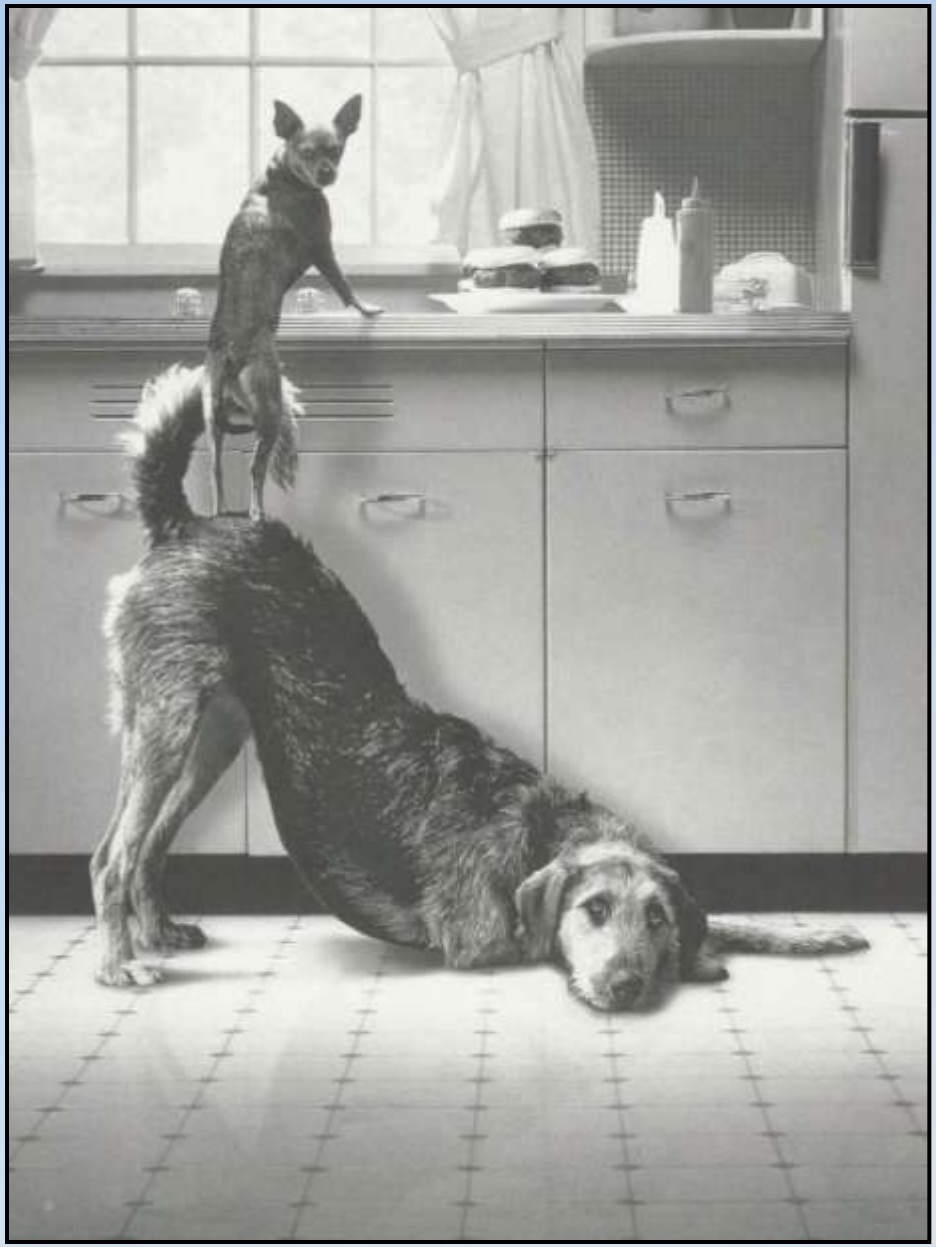
U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Cooperators

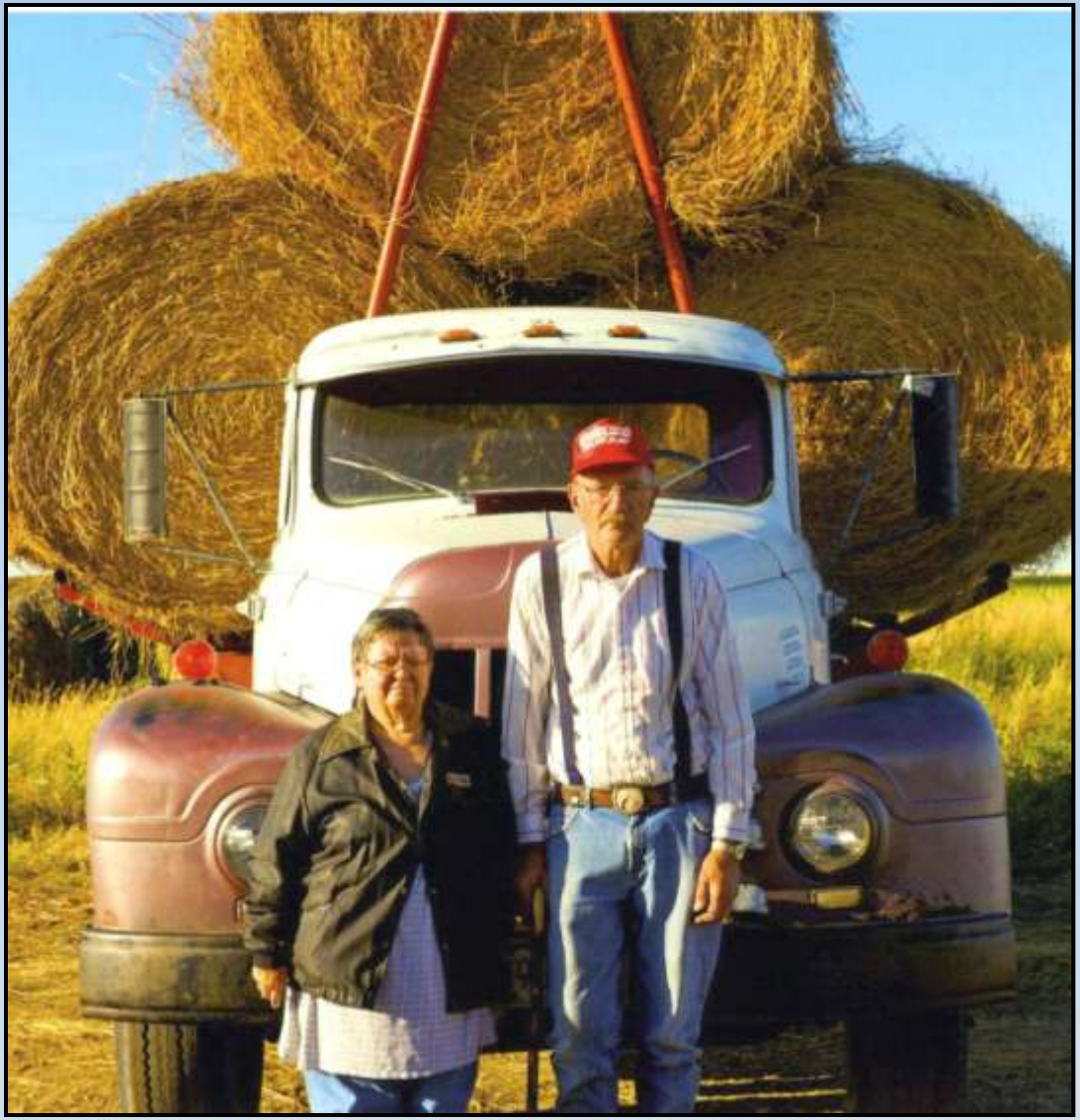
- **USDA-ARS: Tom Jones, Erin Espeland**
- **US Forest Service: Matt Horning, Andy Bower, Randy Johnson**
- **BLM: Peggy Olwell, Mary Byrne (Seeds of Success)**
- **UN-Reno: Beth Ledger**
- **Eastern Oregon Stewardship: Berta Youtie**

Current seed zone policy for native shrubs, grasses, and forbs

Summary Point 1: Work together



Summary point 2: Stay in for the long haul



Conservation of native plant species needed

Native genetic resources on the edge:

-Invasive weeds
-Frequent fires
-Overgrazing
-Revegetation
-Climate change

Gaylen Hansen

Seeds of Success

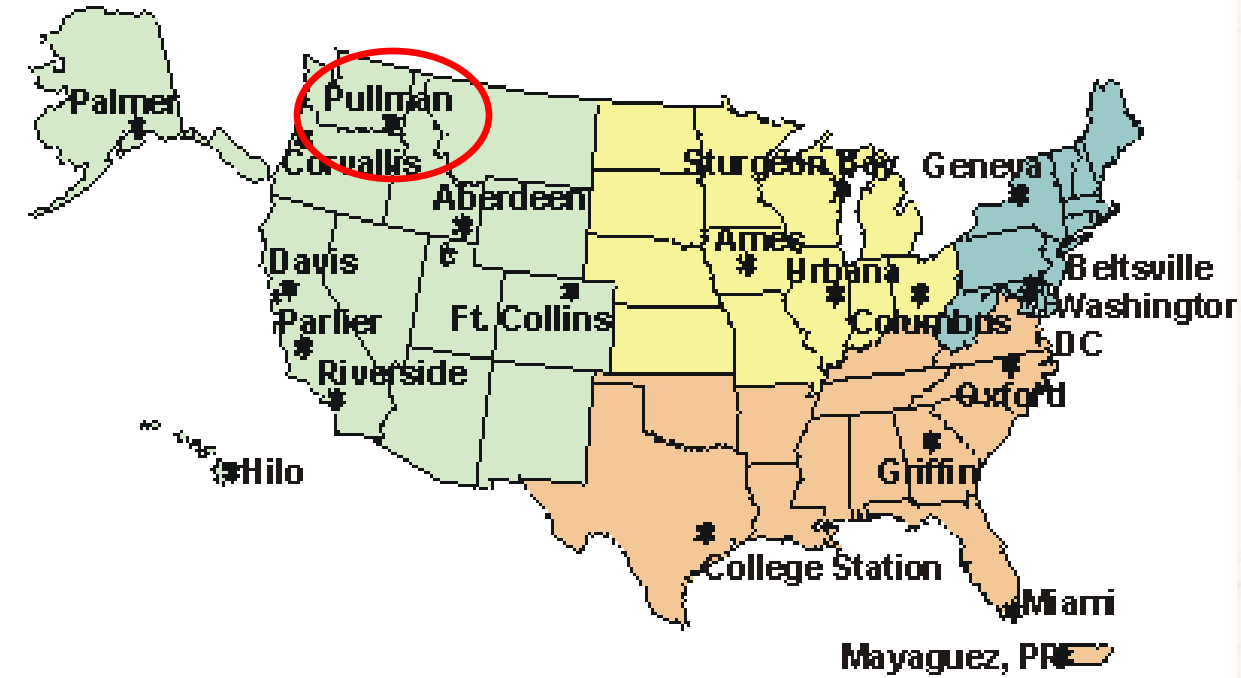
Seeds of Success (SOS) was established in 2001 by the Bureau of Land Management (BLM) in partnership with the Royal Botanic Gardens, Kew Millennium Seed Bank (MSB)

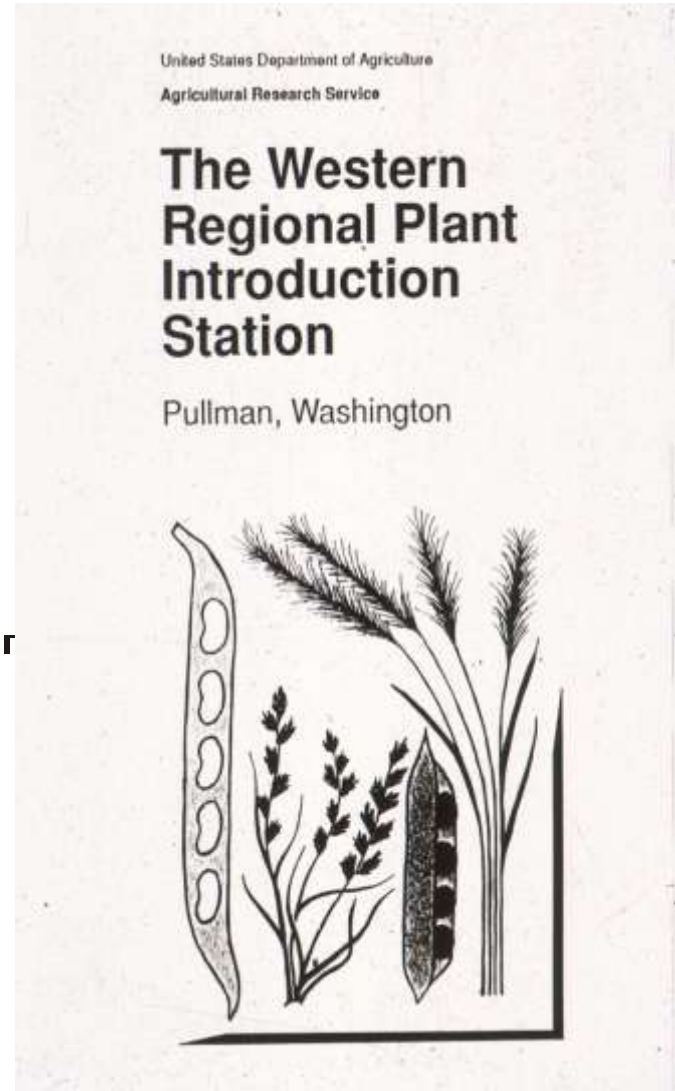
It is now an ongoing program with many partners that collect, conserve, and develop native plant materials for rehabilitating and restoring lands in the United States.

SOS and the NPGS are partnering to collect and conserve key native plant materials. Approximately 2,000 new native accessions have been acquired for the NPGS so far.

National Plant Germplasm System (NPGS)

Ex situ Conservation of Plant Genetic Resources





Cold storage (4°C) of native germplasm cooperative with the BLM, Seeds of Success Program (SOS) and the National Plant Germplasm System repository at Pullman WA. Security back-up is provided as long term storage at -18°C the Fort Collins, CO.

Seed transfer zones are needed to ensure that plant materials for revegetation are environmentally adapted and ecologically suited.

Genecology for Seed Zones

Plant genetic traits=Environmental variables

- Genetic variation in plant traits is linked with environmental variables such as temperature and precipitation at seed source locations.
- Plant traits are used with environmental variables to derive statistical models for landscape mapping and seed zone development.

Seed zone research is ongoing for:

-Indian ricegrass*
-Mt. Brome*
-Prairie junegrass*
-Sandberg bluegrass*
-Thurbers' needlegrass
-Basin wildrye*
-Bottlebrush squirreltail
-Tapertip onion*
-Sulfur-flowered buckwheat
-Douglas' dusty-maiden
-Hoary aster

Climatic data is available at seed source locations

Annual variables:

Mean annual temp (°C) and precip (mm),
Frost-free period, first frost in fall, last frost in spring
Precip as snow (mm)
Extreme min temp over 30 years

Seasonal variables:

Winter mean, max, and min temp and precip
Spring mean, max, and min temp and precip
Summer mean, max, and min temp and precip
Autumn mean, max, and min temp and precip

Monthly variables

January - December mean, max, min temps
January - December precipitation

- ❖Germplasm collection
- ❖Common garden evaluation
- ❖Analysis of genetic diversity
- ❖Link plant traits with source environment
- ❖Map seed adaptation zones
- ❖Genebank conservation

***Pseudoroegneria spicata,* Bluebunch wheatgrass**

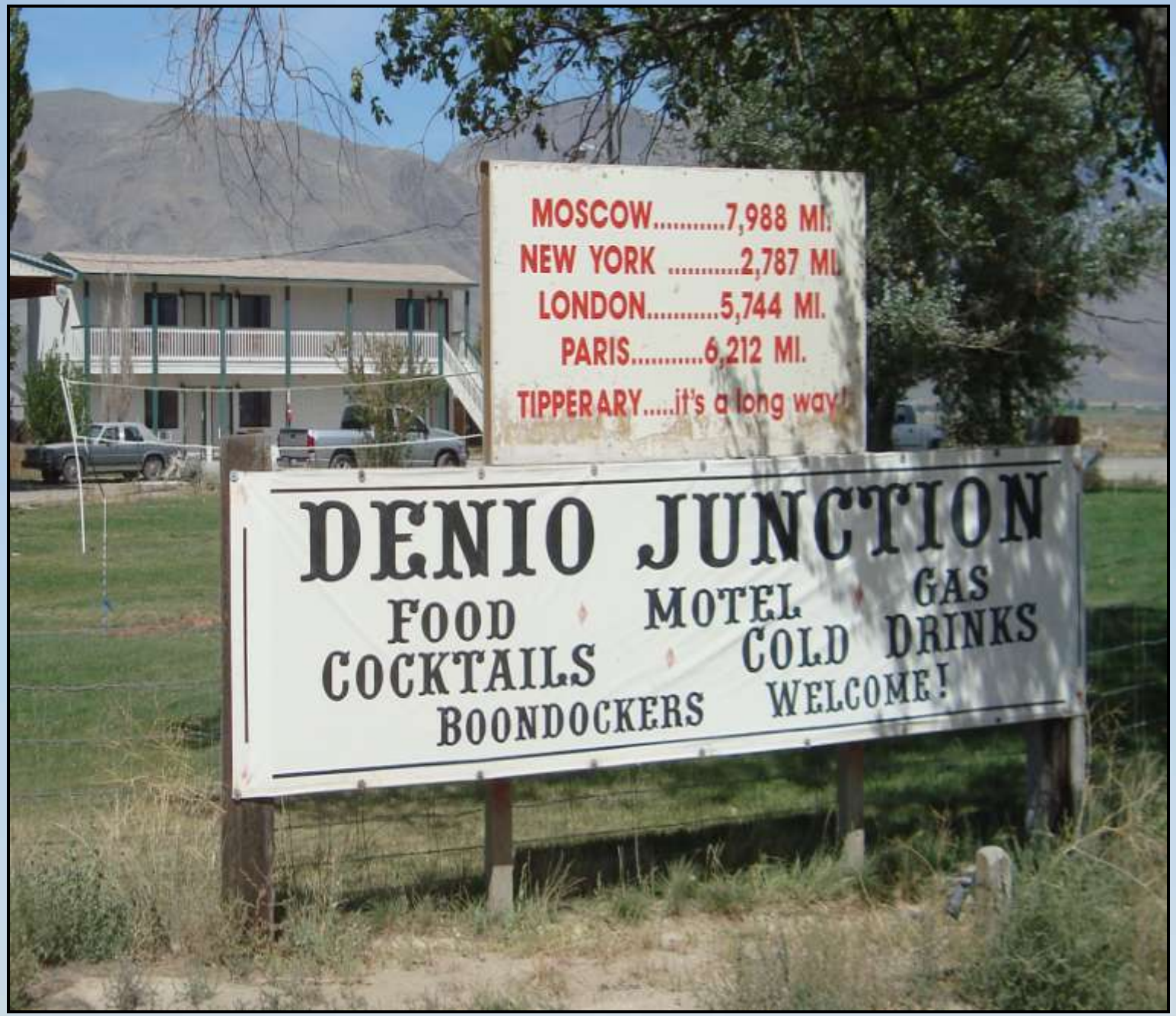
Collection essentials:

Plants, lunch, people

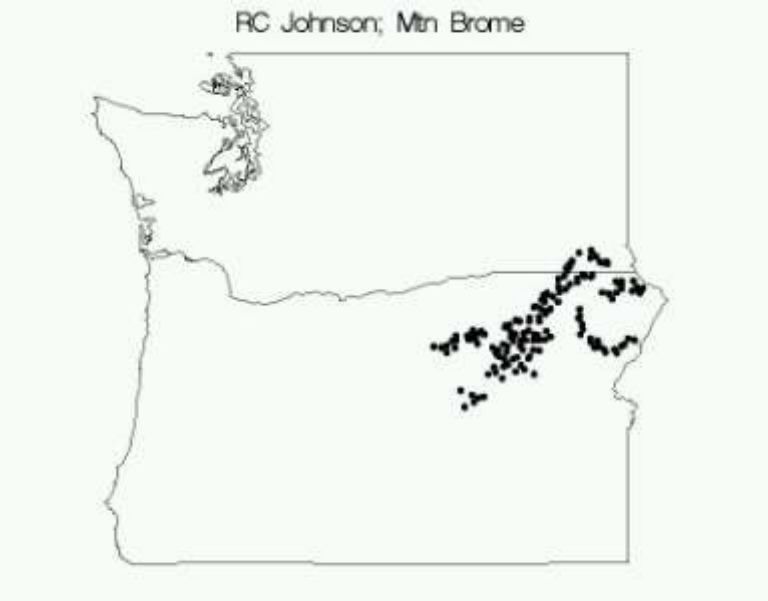
Sandberg bluegrass on old Whitebird grade

Collecting Basin wildrye at Murphy Hot Springs, Idaho

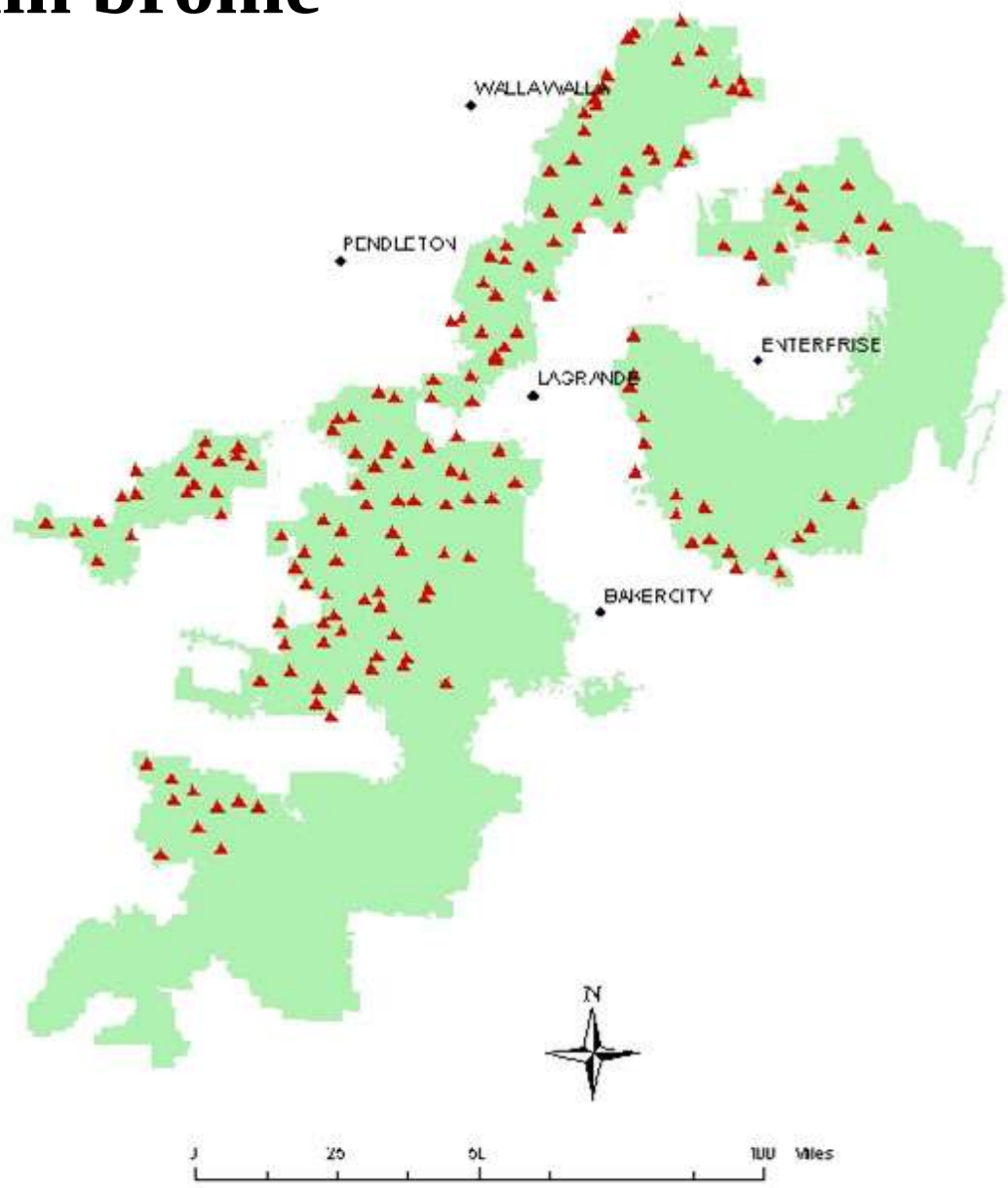
Walt Kaiser collecting *Allium acuminatum* near the Snake River


MOSCOW.....7,988 MI.
NEW YORK .....2,787 MI.
LONDON.....5,744 MI.
PARIS.....6,212 MI.
TIPPERARY.....it's a long way!
DENIO JUNCTION
FOOD
MOTEL
GAS
COCKTAILS
COLD DRINKS
BOONDOCKERS
WELCOME!

Example 1: Mountain brome



Collections of Mt. Brome in the Blue Mountains at 120 locations studied in common gardens



Example 2: Tapertip onion in the Great Basin- 55 locations

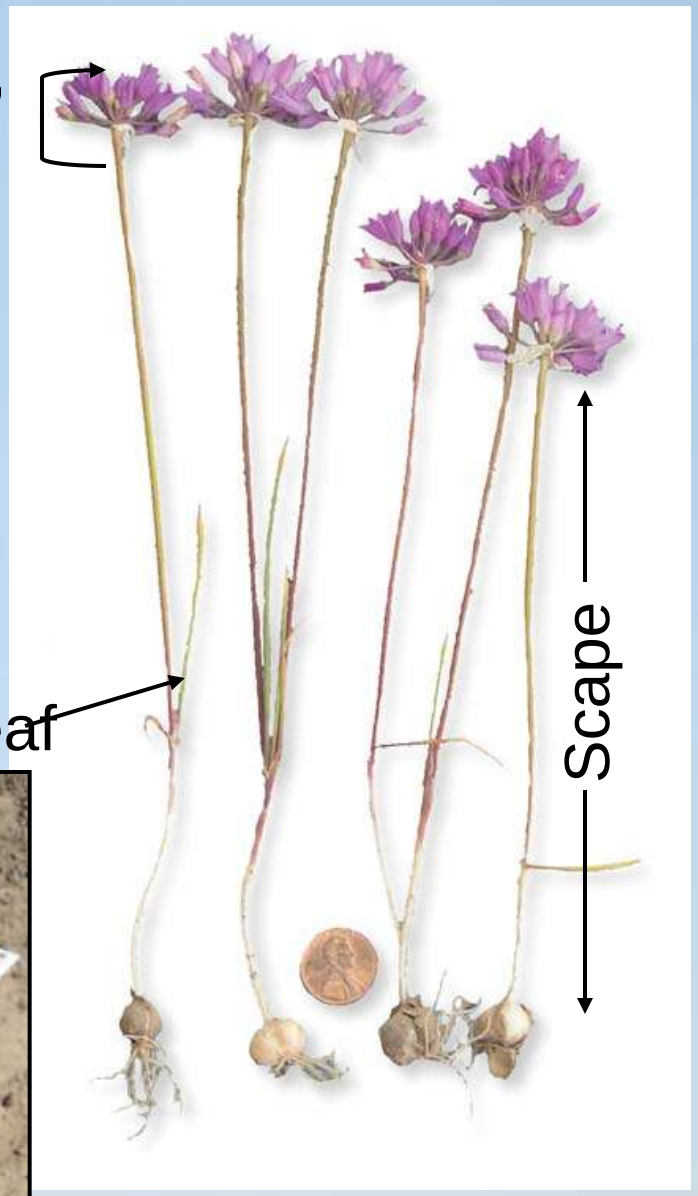
Twenty Level 4 Ecoregions	Collectionn sites
Semiarid Hills and Low Mountains	1
Southern Forested Mtns/Dry Partly Wooded Mtns	1
Mountain Home Uplands	1
Southern Forested Mountains	1
Pluvial Lake Basins	1
High Desert Wetlands	1
Continental Zone Foothills	1
Unwooded Alkaline Foothills	1
Semiarid Foothills	1
High Glacial Drift-Filled Valleys	1
Central Nevada Mid-Slope Woodland and Brushland	1
Central Nevada High Valleys	1
Carbonate Woodland Zone	2
Carbonate Sagebrush Valleys	2
Mid-Elevation Ruby Mountains	3
Semiarid Uplands	4
High Lava Plains	5
Upper Humboldt Plains	6
Owyhee Uplands and Canyons	8
Dissected High Lava Plateau	13

Common gardens

Jeanne R. Janish. 1977.

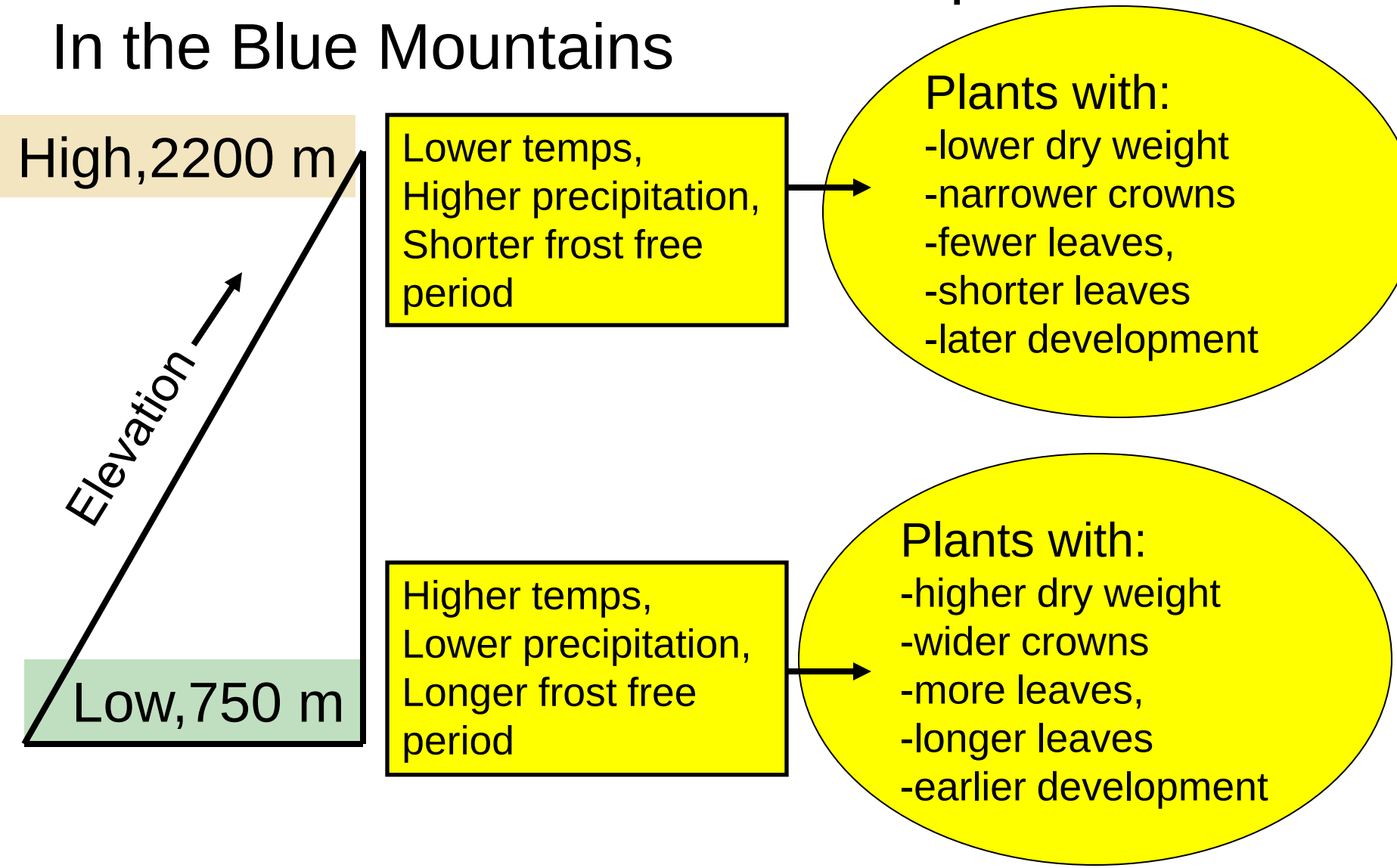
Mountain Brome: fifteen plant traits measured for two years at two common gardens (plant development, morphology, production)

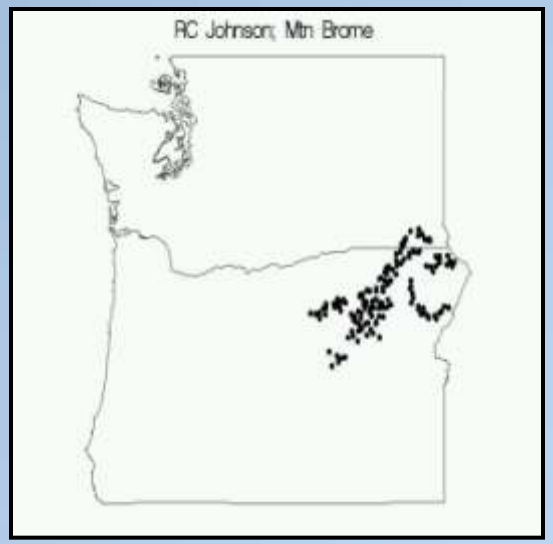
Tapertip onion common gardens
-morphology
-phenology
-production



Tapertip onion correlations	Elev.	Ann precip.	Ann Temp	Frost free days
Phenology				
Days to bolting	**0.33***	**0.31***	**-0.48****	**-0.48****
Days to flowering	-0.02	0.03	-0.23	**-0.28***
Days bolt to flower PU	**-0.46****	**-0.37****	**0.33***	**0.32***
Days bolt to flower CF	**-0.42****	**-0.41****	**0.48****	**0.48****
Days to seed maturity	0.05	-0.12	-0.10	-0.20
Production				
Survival	**0.31***	**0.33***	**-0.45****	**-0.40****
Leaf number	0.12	**0.56****	**-0.36****	-0.19
Flowers per umbel	**0.34***	0.09	**-0.22**	**-0.37****
Seeds per plant	**0.12**	**0.42****	**-0.31***	**-0.38****
Principal components				
PC 1 morphology	**0.27***	0.05	0.01	-0.04
PC 1 phenology	**0.33***	**0.28***	**-0.44****	**-0.47****
PC 1 production	**0.27***	**0.43****	**-0.41****	**-0.42****

Mt. Brome results: General Adaptation In the Blue Mountains

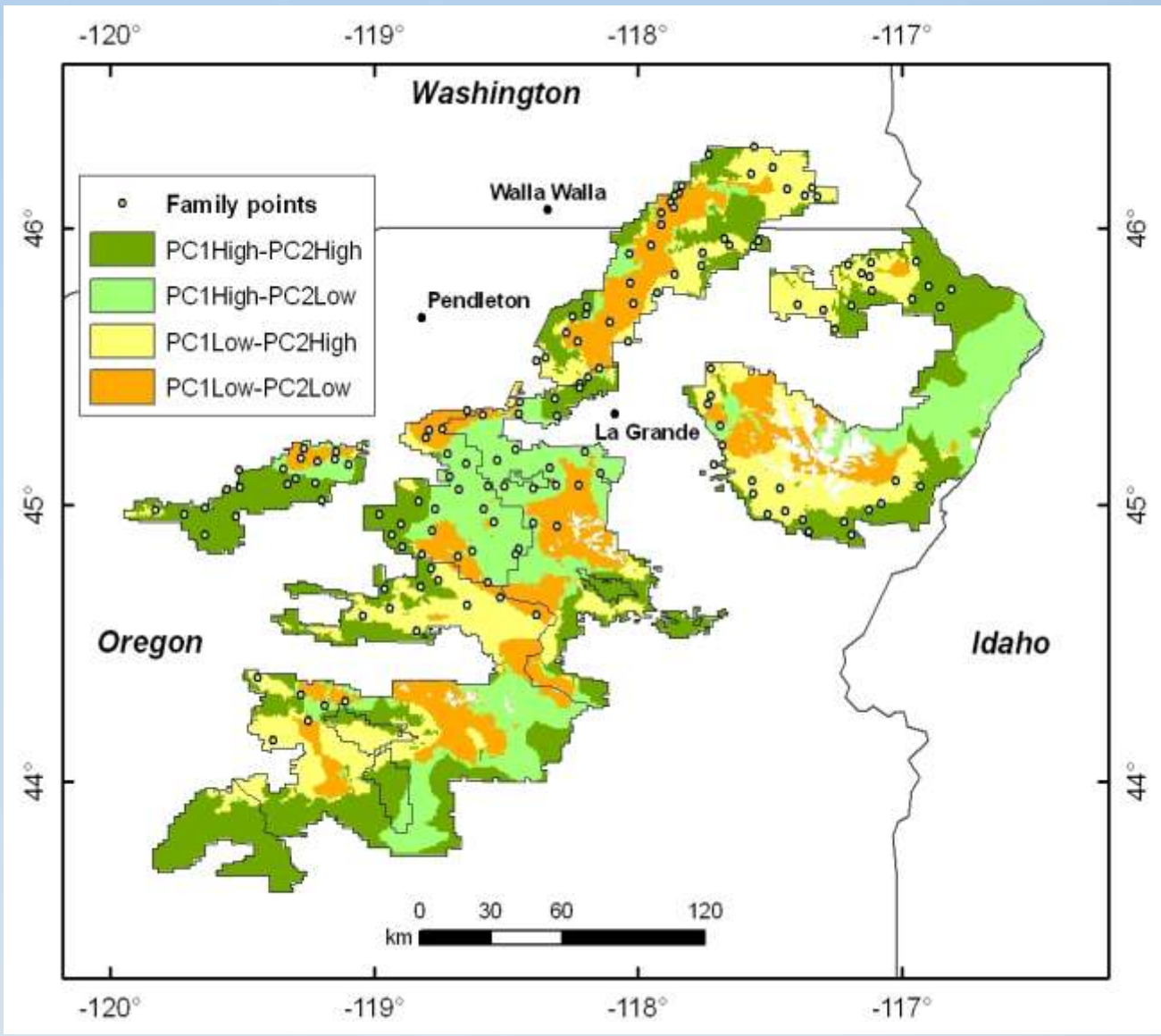




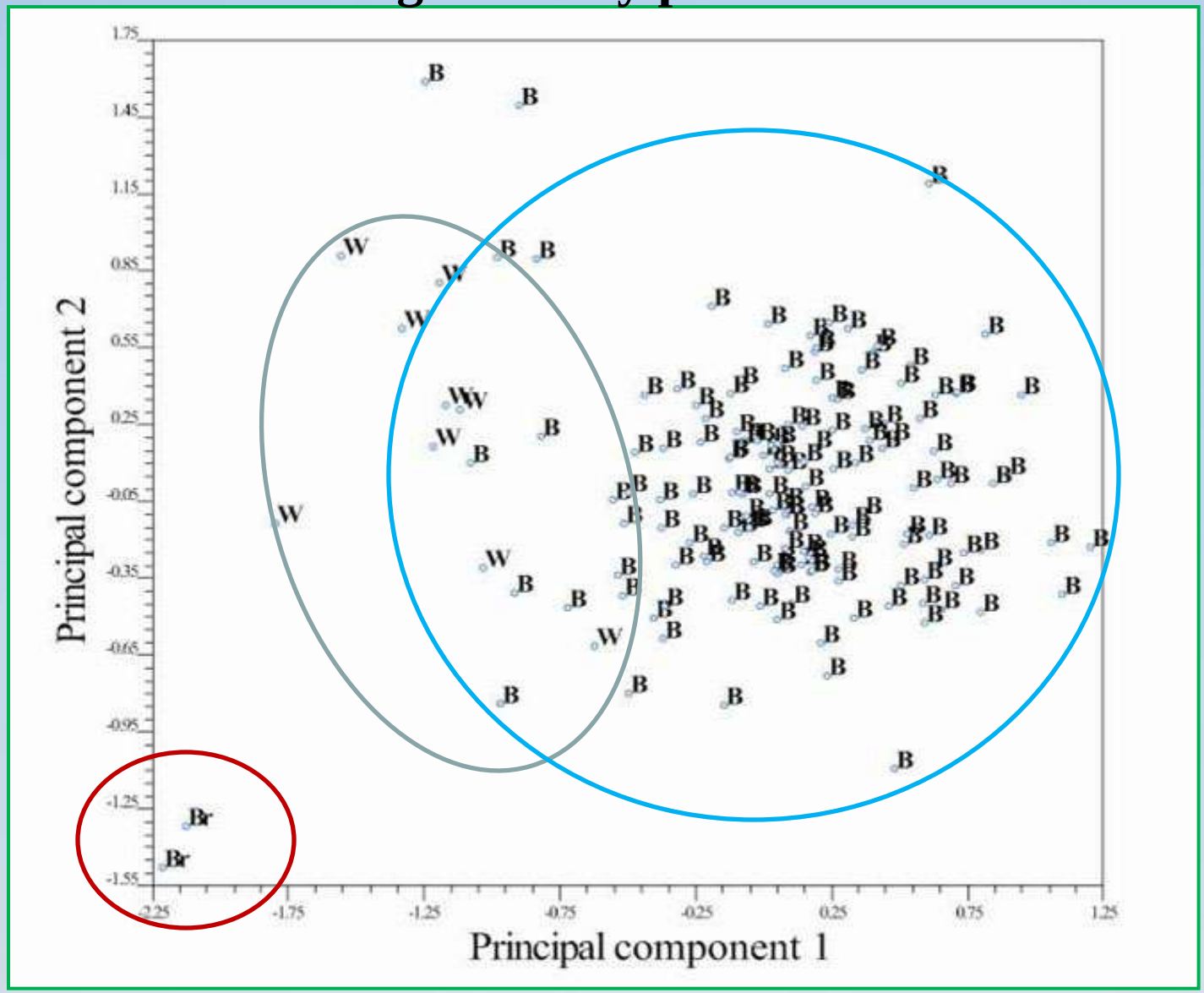
Overlay of principal components 1 and 2, composite plant traits

Mountain brome:

seed zones for in the Blue mountains.

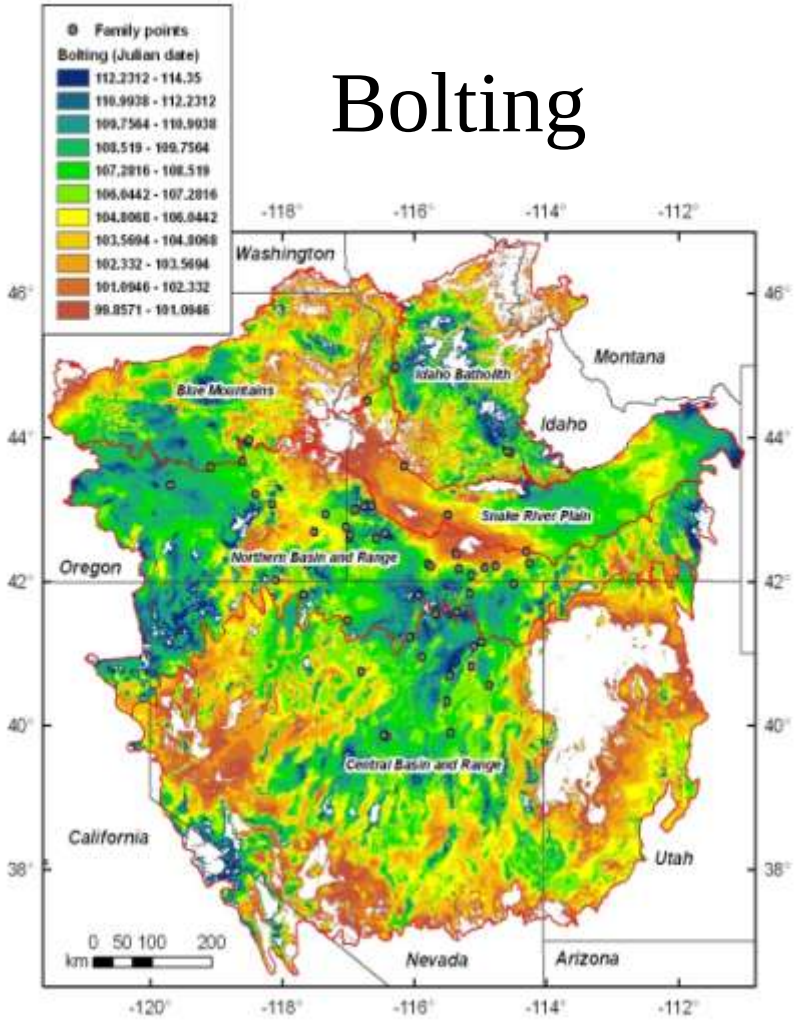


Mountain brome from the Oregon Cascades (W), the Blue mountains (B), and the cultivar Bromar (Br) distinguished by plant traits

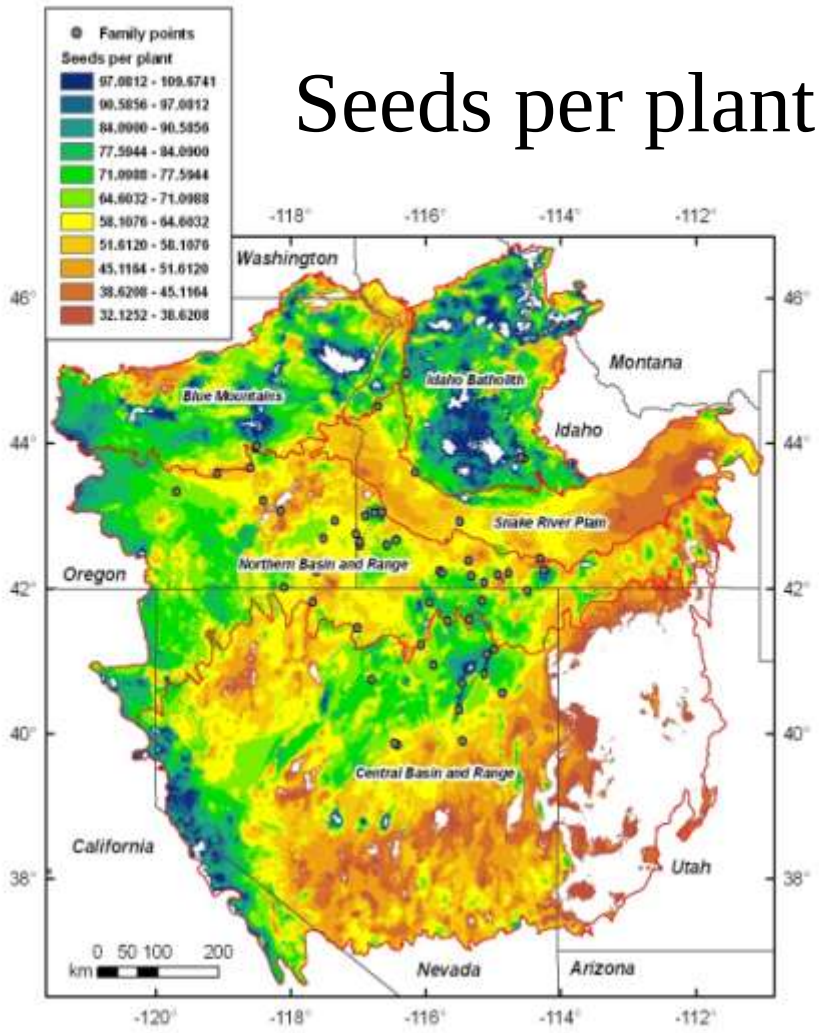


Tapertip onion in the Great Basin

Bolting



Seeds per plant



Seed zones for tapertip onion in the Great Basin region.

The map is an overlay of production and phenological traits modeled with source location environmental variables.

Tapertip onion

Summary

- These genecology studies involve collection of plant material from diverse locations, evaluation of plant traits in common gardens, linking plant traits with seed source environments, and mapping seed transfer zones.
- Using this approach we have found generally robust models for mapping seed zones of grasses and forbs.
- The seed zones help define "how local is local" and are relatively large.
- The Forest Service, Agricultural Research Service, together with BLM, are developing seed zones for numerous key range and species.