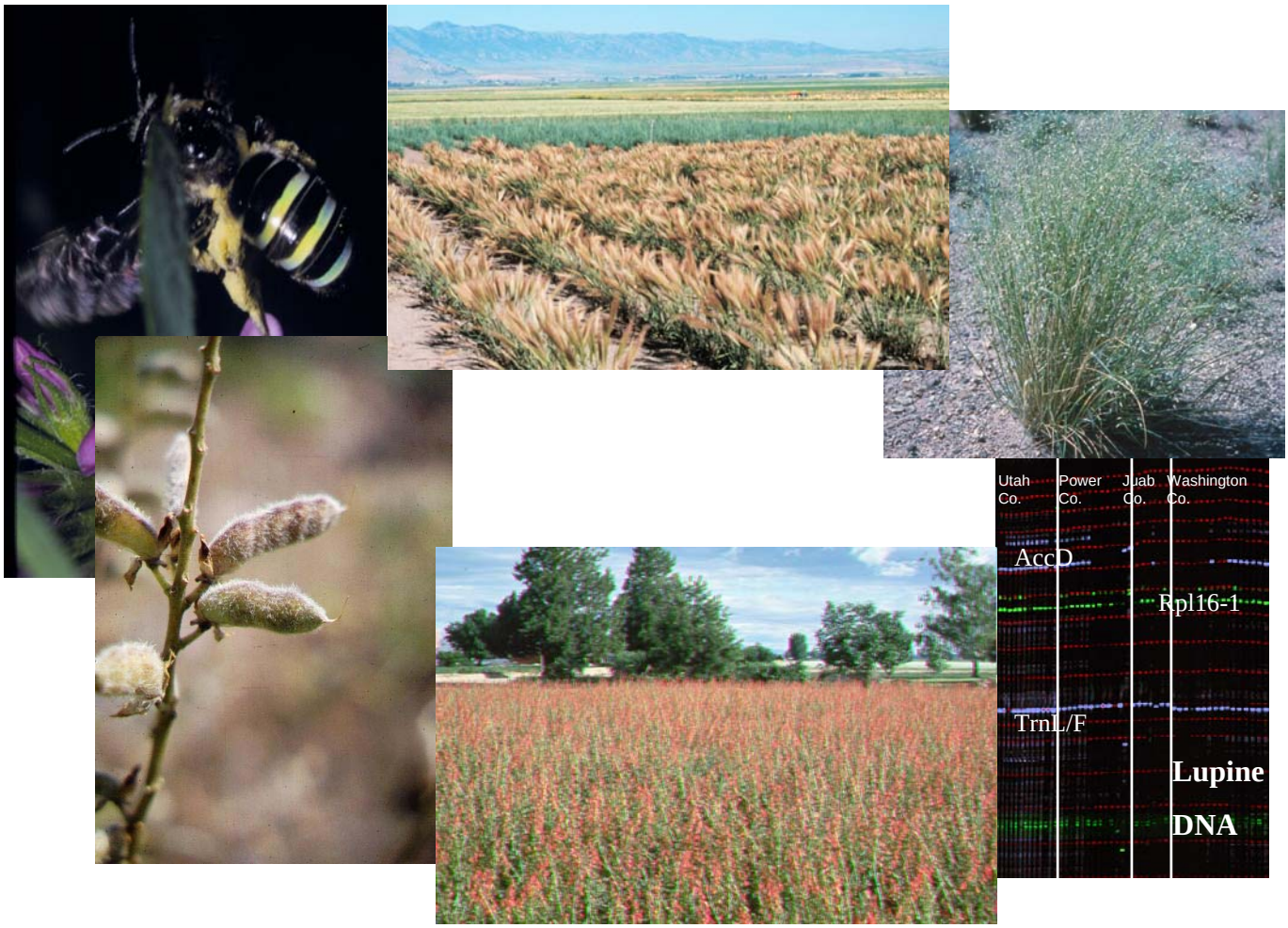
Great Basin Native Plant Selection and Increase Project

FY02 Progress Report



USDI Bureau of Land Management (Nevada, Utah, and Idaho)
USDA Forest Service, Shrub Sciences Laboratory
Provo, Utah and Boise, Idaho
Utah Division of Wildlife Resources, Ephraim, Utah
USDA Agricultural Research Service, Forage and Range Research Laboratory, Logan, Utah
USDA Agricultural Research Service, Bee Biology and Systematics Laboratory, Logan, Utah
Utah Crop Improvement Association
USDA Natural Resources Conservation Service, Idaho, Utah, and Nevada

Great Basin Native Plant Selection and Increase Project
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Cooperators:

USDI Bureau of Land Management (Nevada, Utah and Idaho) (BLM)
USDA Forest Service, Shrub Sciences Laboratory (FS-SSL)
Utah Division of Wildlife Resources (UDWR)
USDA Agricultural Research Service, Forage and Range Research Laboratory (ARS-FRRL)
USDA Agricultural Research Service, Bee Biology and Systematics Laboratory (ARS-BBSL)
Utah Crop Improvement Association (UCIA)
USDA Natural Resources Conservation Service (Idaho and Utah) (NRCS Aberdeen)

Introduction

The use of native plants for rehabilitation after wildfires and restoration of disturbed wildlands is being encouraged by various BLM programs, initiatives, and policies. This project integrates several proposals previously prepared by Idaho, Utah, and Nevada BLM to increase native plant production and use within the Great Basin, utilizing an applied science approach in a collaborative project. Although southeastern Oregon was not involved in the organizing this project, the development of native plant materials described in this proposal will also have direct application in that area. This project represents a regional approach to native plant enhancement encompassing the entirety of the Great Basin, the largest block of public rangelands (75 million acres) in BLM. This proposal was prepared in part by members of the Great Basin Restoration Initiative workgroup and meets an important objective of the GBRI strategic plan (Healing the Land 2000).

Funding period: FY01– FY05

Funding received

FY01: $1,080,000
FY02: 1,500,000
$2,580,000

Monies from both FY01 and FY02 have been transferred from BLM to the Rocky Mountain Research Station. The FY01 funding has been distributed according to the master plan by the appropriate agreement instruments to cooperators except the plan to work with commercial seed growers. The instruments for the FY02 funding and for working with commercial seed growers for both FY01 and FY02 are currently being developed so that the work can continue in a timely manner.

Project priorities: Increase native plant materials available for restoration

1. Management or re-establishment of seed sources and development of technology to improve the diversity of introduced species monocultures (*not funded in FY01 or FY02*)
2. Technology transfer
3. Genetic research

Progress to date:

Component 1. Native Plant Materials Increase

This component includes all aspects of increasing the availability of selected native plants for use in rehabilitation or restoration of disturbed Great Basin Rangelands.

Project Location: USDA-FS-RMRS Shrub Sciences Laboratory, Provo, UT and Boise, ID; Utah Division of Wildlife Resources, Ephraim, UT

Principal Investigators: Scott Jensen, Nancy Shaw, Tyler Thompson, Scott Walker

Contact Information: **Scott L Jensen**, USFS Shrub Sciences Lab, 735 N. 500 E., Provo, UT 84606-1865, 801.356.5128, cell 801.319.5105, fax 801.375.6968, sjensen@fs.fed.us

Nancy Shaw, USDA-FS, Rocky Mountain Research Station, 316 E. Myrtle, Boise, ID 83702, 208.373.4360, fax 208.373.4391, nshaw@fs.fed.us

Tyler Thompson, Utah Division of Wildlife Resources, Great Basin Research Center, 542 North Main Street, Ephraim, UT 84627, 435.283.4441, fax 435.283.5616, tylerthompson@utah.gov

Scott Walker, Utah Division of Wildlife Resources, Great Basin Research Center, 542 North Main Street, Ephraim, UT 84627, 435.283.4441, fax 435.283.5616, scottwalker@utah.gov

I. Equipment (Utah Division of Wildlife Resources [UDWR])

2. **Reel type seed harvester, 6 to 8 ft head.** Purchase of this piece of equipment is underway. It should be delivered before the 2003 field season.

4. Precision seeder, cone seeding units. Use of a precision cone seeder was donated through Brigham Young University. This funding will be used for other equipment purchases and upgrades including the possible purchase of a precision vacuum seeder. This piece of equipment is used for irregular seeds that do not flow through the cone seeder.

5. Field Tractor – 40 hp, 4-wheel drive. Additional funds for purchase of a larger tractor are currently being pursued through the Utah Division of Wildlife Resources. If awarded, these funds will allow for the purchase of a larger tractor and a transport trailer.

12. Portable Field Seed Thresher. Purchase of two seed threshers is underway with no estimate on delivery date.

3, 6-11. Other equipment, maintenance, and upgrades. These funds will be used to purchase additional listed equipment items as well as for future upgrades and

maintenance of equipment. Other possible equipment purchases may include a precision spray unit with row sprayers and a land leveler.

Note: Some of the equipment purchase may be needed to be made by Rocky Mountain Research Station rather than Utah Division of Wildlife Resources because UDWR may have matching federal funding issues. If that is the case, the appropriate agreements will specify use of the equipment by UDWR personnel and transfer of the equipment to them at the conclusion of the extended life of the cooperative agreements that authorize the conduct of this work.

II. Facilities

1. **Expand Snow Field Station, Seed Rearing Center (UDWR).**
   Securing facilities at Snow Field Station with Snow College. Snow College recently announced plans to build a new football stadium at the Snow Field Station. Funds assigned to the Snow Rearing Center will now be applied to the lease and improvement of a proposed 20-acre replacement field.

2. **Expand Fountain Green Seed Rearing Center (UDWR).** Currently UDWR Central Region and Great Basin Research Center personnel are developing a management plan for the Fountain Green Wildlife Management Area. When plans are completed these funds will be used to improve the infrastructure on the plant-rearing portion of the WMA.

3. **Greenhouse at Snow Field Station (UDWR).** These funds will be added to requested FY03 funds, if received, to purchase a larger, more substantive greenhouse located at our new seed warehouse complex.

4. **Establish field or wildland testing sites for evaluation of additional native grasses, forbs, and shrubs.**

   B. **Nevada sites (Shrub Sciences Lab [SSL]–Provo and Boise).** Funding was provided for site preparation, fencing and establishment of climatic stations at two locations, Wells and Winnemucca, Nevada.

   Winnemucca. The site is fenced and the first round of chemical weed control was completed in 2002. The climatic station has not been purchased.

   Wells. The site has been identified. Wells BLM officials are preparing an EA for fence construction and herbicide use. A fencing contract is being prepared. The climatic station has not been purchased.

   C. Idaho sites.

   Orchard Research Site (enhancement of ongoing cooperative project) (SSL-Boise and cooperators). A 5-year EA was completed for the 240 acre site by the BLM Lower Snake River District Office. Perimeter fencing is kept in repair and a plot for forb plantings is being maintained weed free by SSL-Boise. Weather stations are maintained by the USDA-ARS Northwest Watershed Research Center and the USDA-NRCS.

Idaho Native Plant Demonstration Area, Orchard Research Site (NRCS Aberdeen Plant Materials Center (Loren St. John and Dan Ogle, see Component 1-III-9 for contact information). Field visit with Mike Pellant and Nancy Shaw on October 24, 2002 to locate site. Planting site was determined to be the old demonstration nursery at the Orchard Research Site (just inside north boundary).

BLM burned the site in fall of 2002. The Aberdeen PMC will apply Roundup in spring 2003. Planting is proposed for fall 2003. Need to identify accessions and prepare planting plan.

Lucky Peak Shrub Garden (SSL-Boise). A multi-year rush skeletonweed control project was initiated. Fencelines were cleared of shrubs and debris.

III. Native Plant Increases

1. **Develop seed production, seed germination, and seeding technology for 15 native forbs of the Great Basin (UDWR, SSL-Provo and Boise and cooperators, Boise work is partially funded by Forest Service National Fire Plan money).** Nineteen forbs were selected for plant increase and research studies (Appendix 1). Literature and herbarium searches for these species are ongoing. Drought conditions since the initiation of the project have hindered collection of many species. Nonetheless we have made ample strides in achieving the project goals. We have mapped 452 forb collection sites across the Great Basin and collected seed from 234 sites (Appendix 2). Grass seed has been collected from 141 of 179 sites identified. Based on estimated minimum seed needs to conduct the suite of studies identified in our various programs, 42% of the collections are adequate. Databases have been created that include GPS, site description, and seed records for each site.

   Germination studies were conducted for three *Penstemon* species with initial results presented at the XII Wildland Shrub Symposium ("Germination of Three *Penstemons* of the Northern Great Basin") and transplant stock of about 40 penstemon accessions is being produced at the Lucky Peak Nursery.

   Tyler Thompson, Research Biologist, was hired in May 2002 to oversee the forb collection program for the Utah Division of Wildlife Resources. Scott Jensen transferred from the Utah Division of Wildlife Resources to the USDA-FS Shrub Sciences Laboratory to oversee forb research there. Common garden and evaluation sites have been identified at 8 locations in Utah, Nevada, and Idaho, and use agreements are being finalized.

   2003 Work Plan: Continue seed collection for presently identified species. Initiate germination, common garden studies, and seed production studies for selected species and accessions. Provide additional seed lots to private growers.

2. **Technology Transfer position (SSL-Boise).** It is anticipated that the Botanist/Technology Transfer position (term appointment) will be filled at the USDA-FS Rocky Mountain Research Station Laboratory, Boise, Idaho in April 2003.

3. **Seed Collection Records (UDWR, SSL-Provo).** Transfer of all native seed collection records (card files) from 1912 on for the Utah Division of Wildlife Resources and the Shrub Sciences Laboratory to electronic files is nearing completion. We will continue entering seed file data from GBRC and USDA-FS.

4. **Adaptation Zones, Genotypic Variability, and Seed Transfer Guidelines for *Atriplex canescens, Atremisia tridentata* ssp. w*yomingensis*, and *Purshia tridentate* (SSL-Durant McArthur, see Component 4-1, 2 for contact information).** Data have been collected and maps prepared for the publication for a Seed Transfer Guideline for *Atriplex canescens*. The guideline is in preparation and should be completed within a year. Genetic data (RAPD markers) have been collected and analyzed for several *Artemisia tridentata* ssp. *wyomingensis* populations and will be used with other data to prepare seed transfer data for this taxon. This guideline and the *Pushisa tridentata* one are a couple of years away.

8. **Establish commercial seed production fields with qualified seed growers in order to increase native forb availability for use in restoration of Great Basin rangelands (UDWR and SSL-Provo and Boise and cooperators)**. Location of wildland seed source sites and collection from these sites is underway and continues. Several growers in the Great Basin have been contacted and many are interested in growing forb species when adequate seed supplies are available. In addition, Brigham Young University has been contacted and has shown interest in participating in cultural care and production studies at their Spanish Fork farm. The list of species for this project was expanded to include additional species important in sage grouse diets.

   In 2002, working in conjunction with the Utah Crop Improvement Association, the Utah Division of Wildlife Resources and Shrub Sciences Laboratory filled 24 applications for stock seed. This process provided seed of 10 forb species to 7 private growers for planting seed production fields. Growers are located in Oregon, Idaho, Nevada, and Colorado. Seed was distributed using the buy-back option, a mechanism for returning part of the increased seed to the Crop Improvement Association for redistribution and further increase to additional seed growers

9. **Seed Increase at NRCS Plant Material Centers and by Private Growers:**

Project Title:	Establishment and Maintenance of Certified Foundation (G1) Seed
Project Location:	NRCS Aberdeen, ID Plant Materials Center
Principal Investigators:	Loren St. John, Center Manager Dan Ogle, NRCS Plant Materials Specialist, Boise, ID
Contact Information:	**Loren St. John**, Aberdeen Plant Materials Center, P.O. Box 296, Aberdeen, ID 83210, LorenStjohn@id.usda.gov **Dan Ogle**, Plant Materials Specialist, USDA-NRCS, 9173 West Barnes Drive, Suite C, Boise, ID 83709, Dan.Ogle@id.usda.gov

Description of Project:

To produce Certified Foundation (G1) seed of Maple Grove Lewis flax, Anatone bluebunch wheatgrass, Snake River Plains Germplasm fourwing saltbush and Northern Cold Desert Germplasm winterfat to facilitate commercial production. Evaluate procedures for production of rooted cuttings of fourwing saltbush. Establish demonstration planting near Boise, ID.

Status Report:

Seed Production

Maple Grove Flax - Seeded 1.8 acres field 3 on May 31, 2002. July 29 evaluation: Plant height 5 - 15 cm tall, good vigor. Plan to harvest summer 2003.

Anatone bluebunch wheatgrass - Seeded 1.0 acres field 11 on May 31, 2002. July 29 evaluation: good, healthy, full stand developing. Plant height 8 - 12 cm. Seedling vigor appears to be better than that of Goldar. Plan to harvest summer 2003.

Snake River Plains Germplasm fourwing saltbush - Produced approximately 70 pounds (seed analysis pending). Shipped 25 pounds Certified seed from 2001 harvest. Provided 500 Certified cuttings to Washington grower (he reported 17 percent rooting success).

Northern Cold Desert Germplasm winterfat - Produced approximately 28 pounds (seed analysis pending). Shipped 8 pounds Certified seed from 2001 harvest.

Propagation Studies

Propagation of rooted fourwing saltbush from cuttings

Four cutting dates and percent rooting:

	%
March 21, 2002	0
August 19, 2002	50
September 6, 2002	4
October 7, 2002	14

Timing of cutting harvest and morphology of cutting seem to be the most important factors.

Greenhouse seedling establishment study: Evaluate fourwing saltbush seedling emergence based upon number of propagules planted per cell (5 versus 10 per cell) and to identify number of days to emergence, growth rates and transplant dates.

Seed planted September 30, 2002. Maximum emergence within 3 weeks. Five-seed plots averaged 10.5 % emergence. Ten-seed plots averaged 8.5 % emergence.

Seedlings transplanted to 40 inch ^{3} containers on November 11, 2002. Currently average 3 to 18 cm in height. Will continue to maintain plants to evaluate growth rates and maturity.

Special note: 75 percent of seedlings had red stems and 25 percent had white stems at transplant. Could this be an indication of sex? Will monitor.

(See also Component 1-II-4-C for additional NRCS Aberdeen activity).

UDWR Seed Increase: Maintained foundation fields of ‘Anatone’ bluebunch wheatgrass, ‘Orchard’ Thurber needelgrass at the Fountain Green Wildlife Management Area.

USDA ARS FRRL (See Component 4-4, for Tom Jones contact information) Seed Increase: Seed of 17 sources of Indian ricegrass, big squirreltail, bottlebrush squirreltail, bluebunch wheatgrass, basin wildrye, Snake River wheatgrass, and green needlegrass will be made available to the Utah Crop Improvement Association for entry into the buy-back option program, a mechanism to utilize seed growers to increase seed for the 2nd generation of seed growers. Transplanted plots of Toe Jam Creek and Fish Creek bottlebrush squirreltails and Cucharas green needlegrass were established for future seed harvest.

10. Pollination and Pollinator Studies:

Project Location: USDA-ARS Bee Biology and Systematics Lab

Principal Investigator: James H. Cane

Contact Information: USDA-ARS Bee Biology and Systematics Lab,
Utah State University, Logan, UT 84322-5310 USA,
435.797.3879, fax 435.797.0461, jcane@biology.usu.edu

Description of Project:

Native bees and/or honey bees are needed to pollinate most of the wildflower species considered for Great Basin revegetation. The pollinator faunas of many of these candidate plant genera include one or more potentially manageable native cavity-nesting species. Work will begin with the pollination needs and likely pollinators of *Penstemon speciosus, Crepis acuminata*, *Hedysarum boreale* and *Balsamorhiza sagittata* (Appendix 3). Pollinator needs will be evaluated by comparing fruit and seed sets at caged flowers, openly visited flowers, and manually pollinated flowers. If plant reproduction proves to be pollinator limited, then native bee faunas will be surveyed and evaluated at managed and wild flowering populations. If bees are sufficiently abundant, then single-visit pollination efficiencies at previously caged flowers can directly evidence each bee species' contribution to seed production. Concurrently, drilled wooden nesting blocks will be placed in these habitats to acquire captive populations of one or more promising native pollinators. Currently managed bee species (alfalfa leaf-cutting bees, blue orchard bees, alkali bees, honey bees) will be evaluated for their pollination prowess with each of the target plant species as well, probably using managed stands maintained by BLM and USFS collaborators on this proposal.

Status Report:

Wild populations of balsamroot, northern sweetvetch, royal penstemon, and sulfur buckwheat were located on federal land prior to bloom in our local region. The search was assisted through our transcription of herbarium records at Utah State's Intermountain herbarium and that of the University of Nevada, Reno. A retrospective literature search has also been completed for all species except the biscuitroot.

Pollinators, particularly bees, will be needed for seed production at most of the native forbs chosen for this project from the Great Basin flora. Plants among blooming wild populations of northern sweetvetch visited freely by its pollinating bees, averaged one seed per flower; 280 unvisited flowers set no seed. Likewise, freely pollinated flowering spikes of penstemon set an average of 1000 seeds; 300 unvisited flowers set no seed. We had problems tracking seed set

with the balsamroot this spring. We have revised the method and will apply it in the coming field season when we assess pollinator needs of the other species. The hawksbeard is the one known exception for pollination need in this group; research from the 1940s demonstrated that the species is facultatively apomictic, meaning that it can set seed without fertilization.

In general, it appears that **bees are the essential pollinators** for the selected wildflower species. The one prominent exception is the penstemon, whose flowers are primarily visited by a pollen wasp (*Pseudomasaris vespoides*) in both eastern and western Nevada, along with a ground nesting species of *Osmia.* Neither species has great management potential for row crop agriculture, so alternative pollinators will be sought. Sweetvetch hosts a number of cavity nesting bee species of the genus *Osmia*. Balsamroot does too, and we obtained one of those species of *Osmia* in our nesting blocks this spring. Several dozen progeny have been processed and are currently overwintering in our cooler for release next spring.

Native insects have the potential to become pests of seed production on each of the wildflower species studied to date. We have found the following thus far: the clear wing moth *Penstemonia clarkei,* adults of which we caught at a generalized pheromone trap placed in a blooming population of royal penstemon; larvae borne in flowering shoots of penstemon; caterpillars of a gelechiid moth that web together and devour flowering racemes of sweetvetch; a tephritid fly maggot that feeds in the flower heads of balsamroot (which we failed to rear to adulthood); and a seed weevil that attacks sweetvetch. With the help and expertise of Bob Hammon at Colorado State, we hope to develop practical, safe and effective control treatments for each of these insects for future use when these wildflowers are grown in row crop agriculture.

Component 2. Manage or Restore Seed Sources and Develop Technology to Improve the Diversity of Introduced Grass Seedings

No funding was provided for any section of this component in FY01 or FY02.

Component 3. Technology Transfer

Status of Publications:

1. **Restoring Western Ranges and Wildlands (SSL-Provo and Boise, UDWR and cooperators).** This book provides background on philosophy, processes, plant materials selection, and seed and seeding technology for revegetating disturbed rangelands, emphasizing native species. The text will be completed in spring 2003. Steve Monsen (SSL-Provo, retired) and Richard Stevens (UDWR, retired) are compilers. Publication costs will be provided through this agreement and Forest Service R1/R4, National Fire Plan, Native Plant funding).

2. **Rangeland Revegetation Equipment Catalog (SSL-Provo and Boise, UDWR, BLM, and Revegetation Equipment and Technology Council).** Harold Wiedemann (retired professor, Texas A & M University) was awarded a contract to publish a revegetation equipment catalog describing types and operation of equipment designed or adapted for range and wildlife habitat improvement and disturbed land rehabilitation. Categories of equipment include: tractors, implements for controlling vegetation using fire or mechanical or chemical means, seedbed preparation, fertilizing and mulching, seeders and drills, specialized planters, seed collection, seed processing, and transport. The publication will be

produced in hard copy and also placed on a website for ease of updating. The project will be completed in spring 2005.

3. **Seed production, harvesting, cleaning, and storage of wildland grasses, forbs, and shrubs of the Intermountain area (UDWR, SSL-Provo, Utah Crop Improvement Association).** The publication is about 50 percent complete and will be finished in summer 2004.

4. **Field Guide to Intermountain Cyperaceae (excluding *Carex*) (SSL-Boise).** This is the third in a series including the Field Guide to Intermountain Rushes (GTR-INT-306) and the Field Guide to Intermountain Sedges (RMRS-GTR-10). The guides are designed to assist both specialists and nonspecialists working with these groups of plants in the Great Basin and surrounding areas. The text will be completed in spring 2003.

Component 4. Genetic Research

Project Location: Shrub Sciences Laboratory, Provo, UT

Principal Investigator: Durant McArthur

Contact Information: USDA-FS-RMRS Shrub Sciences Laboratory, 735 N. 500 E., Provo, UT 84606-1865, 801.356.5112, fax 801.375.6968, dmcarthur@fs.fed.us

1. **Genetic variability in Great Basin grasses, forbs, and shrubs.** Population genetics work is underway to determine the within and between population variation on a suite of species, especially forbs, so the implications of their use in rehabilitation and restoration plantings can be determined. This work is coordinated with the cultural care and seed studies that are also ongoing. Several populations (20 plants per population) of the following species are being studied using both allozyme and AFLP DNA markers: *Astragalus utahensis, Atriplex canescens, Bromus carinatus, Crepis acuminata, Erigeron pumilis, Eriogonium umbellatum, Lupinus argenteus, Stipa comata, Vicia americana,* and *Viguiera multiflora.* (Shrub Sciences Laboratory in cooperation with Utah Division of Wildlife Resources, Forest Service National Genetics Laboratory, PNW Forestry Sciences Laboratory- Corvallis). This work is also supported by the Forest Service National Fire Plan. See Appendixes 4 and 5 for progress to date.

   UDWR participation: More than 20 sites were visted and categorized as sites with potential or sites without potential for many of the above species. The sites were located on a map, visited, and GPS coordinates were recorded. These sites will be visited this year early and forb collections made.

2. **Genetics of source populations, seeded populations, and indigenous populations:** This work was not funded by this project but is proceeding under funding by the Forest Service National Fire Plan. Seeded, adjacent indigenous, and more distant source populations of *Atriplex canescens, Sphaeralcea* species, *Linum* species, and other species are being investigated using both allozyme and AFLP DNA markers to determine the genetic impact of species population translocation for rehabilitation and restoration. (Shrub Sciences Laboratory in cooperation with Brigham Young University, Utah Division of Wildlife

Resources, Forest Service National Genetics Laboratory, PNW Forestry Sciences Laboratory—Corvallis). See Appendix 6 for example of progress to date.
(See also Component 1-III-8)

UDWR participation: One individual was hired to work exclusively on this project. The drought conditions made it difficult to identify sites with the selected species. However, there were a number of sites identified and at three sites plant collections were made. This work will continue in FY03.

3. Patterns of genetic variation in native grasses:

Project Location: USDA-ARS Forage and Range Research Laboratory, Logan, UT

Principal Investigators: Steve Larson

Contact Information: stlarson@cc.usu.edu

Description of Project: DNA fingerprinting North American range grasses

Status Report:

I finished a significant DNA fingerprinting study of North American squirreltail grasses and submitted the manuscript to the Canadian Journal of Botany (Appendix 7) and presented results at the 2003 annual meeting of the Society of Range Management (Revegetation Technology and Equipment Council Symposium) in Casper, WY (abstracts published). Results of this study were also presented at the BLM-GRI progress and planning meeting (January 27, SLC).

Presented preliminary report from a comprehensive DNA fingerprinting study of North American bluebunch wheatgrass, which includes a substantial number of accessions from the USDA-FS Shrub Sciences Lab and Utah Division of Wildlife Resources, at the BLM-GRI progress and planning meeting (Appendix 8).

I am in the process of planning and setting up a comprehensive DNA fingerprinting study of North American *Leymus* wildryes, including basin wildrye (*L. cinereus*). I certainly would welcome any natural germplasm sources available from other BLM-GRI cooperators!

UDWR participation: Collections of Great Basin wildrye and bluebunch wheatgrass were made. Seed of bluebunch wheatgrass was given to the ARS staff in Logan where genetic characterization was completed. Great Basin wildrye seed was given to the Lab in Logan and will be analyzed this year.

4. Seed Increases, Genetic Variation and Ecophysiological Traits of Native Grasses:

Project Location: Logan, UT (USDA-ARS Forage and Range Research Lab)

Principal Investigators: Thomas A. Jones, Steven R. Larson, Thomas A. Monaco, and Douglas A. Johnson

Contact Information: Thomas A. Jones
Forage and Range Research
Utah State University
Logan, UT 84322-6300
435. 797.3082
tomjones@cc.usu.edu

Description of Project:

Genetic diversity among accessions will be characterized for 8 native grass species using Amplified Fragment Length Polymorphism (AFLP) DNA markers. Measurements of ecophysiological traits of accessions selected to represent AFLP variation will be used to provide an ecophysiological interpretation of the genetic array delineated by the DNA data.

Status Report:

Transplanted plots of Toe Jam Creek and Fish Creek bottlebrush squirreltails and Cucharas green needlegrass were established for future seed harvest. AFLP data revealed that big squirreltail (*Elymus multisetus*) is genetically distinct from bottlebrush squirreltail (*E. elymoides*), with the latter exhibiting much greater genetic variation. Four groups of *E. elymoides* ssp. *brevifolius* were detected and named A, B, C, and D. Group C was more closely related to ssp. *elymoides* than it was to ssp. *brevifolius* Groups A, B, and D despite the fact that it keys to ssp. *brevifolius*. Nine ecophysiological traits distinguished these subspecies and groups likewise, and they provide insights regarding seedling vigor, phenology, and leaf and root morphology. Work began on a similar AFLP study of bluebunch wheatgrass, but data collection is incomplete.

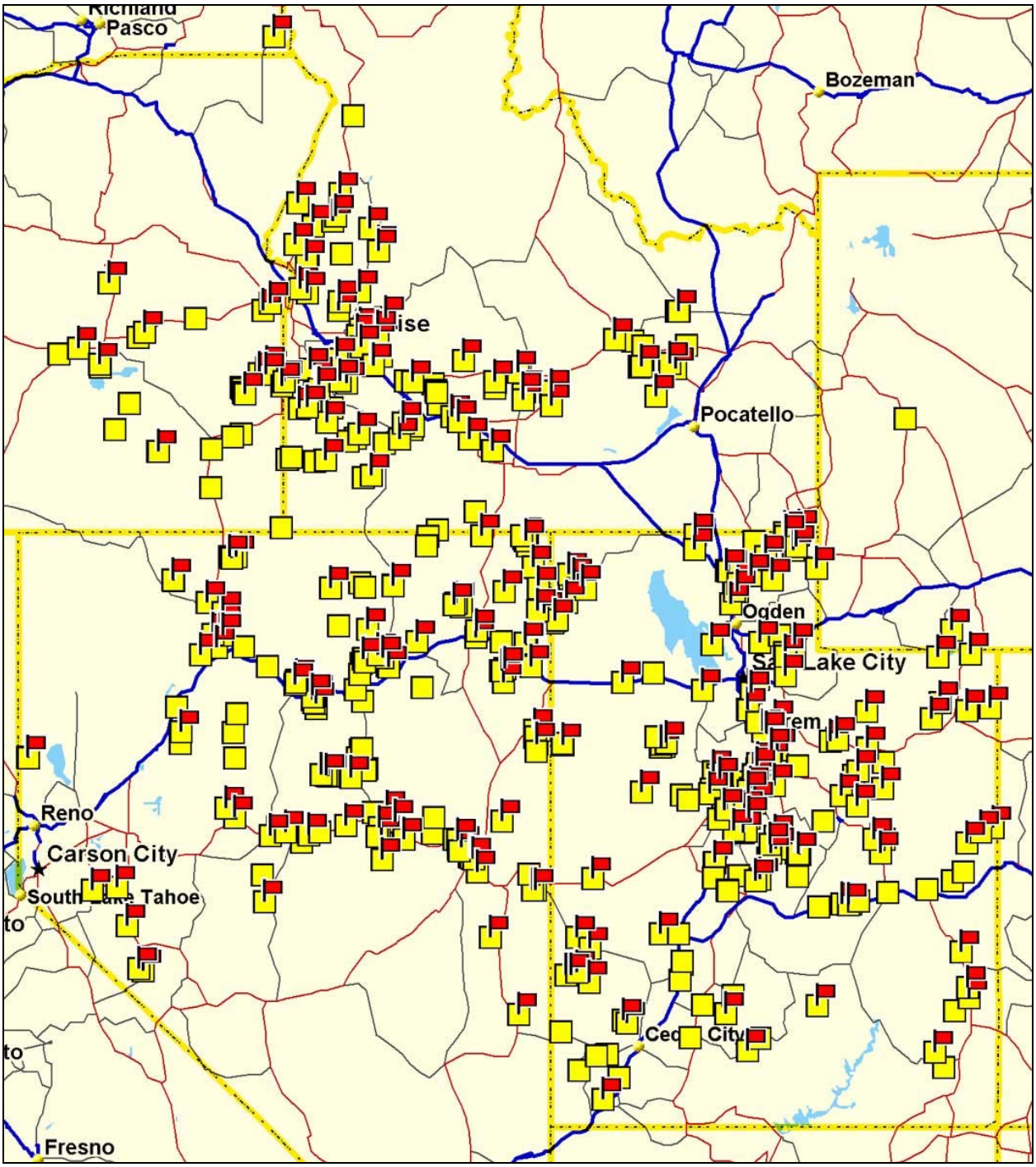
(See also: Component 1-III-9 for additional USDA-ARS-FRRL activity).

Appendix 1. Cooperative Great Basin native forb research.

Scientific Name	Common Name	Plant Selection and Increase (Jensen, Thompson, Shaw, Walker)	Pollination (Cane)	Genetic Variability (McArthur)	Genetics Seeded/Native Populations (McArthur)
Apiaceae					
Lomatium dissectum	Fernleaf biscuitroot	X	X		
L. grayii	Gray biscuitroot	X			
L. nuttallii	Nuttall biscuitroot	X			
L. triternatum	Nineleaf biscuitroot	X			
Asteraceae					
Agoseris glauca	Pale agoseris	X			
Balsamorhiza sagittata	Arrowleaf balsamroot	X	X	X	
Crepis occidentalis	Largeflower hawksbeard	X	X	X	
Erigeron pumilus	Shaggy fleabane			X	
Tragopogon dubius	Yellow salsify	X			
Viguiera multiflora	Showy goldeneye			X	
Fabaceae					
Astragalus filipes	Basalt milkvetch		X		
Astragalus lentiginosus	Freckled milkvetch		X		
Astragulus utahensis	Utah milkvetch	X		X	
Hedysarum boreale	Boreal sweetvetch	X	X		X
Lupinus argenteus	Silver lupine	X	X		
Lupinus sericeus	Silky lupine			X	
Vicia americana	American vetch	X		X	
Linaceae					
Linum perenne	Blue flax				X
Malvaceae					
Sphaeralcea coccinea	Scarlet globemallow	X			
S. grossulariifolia	Gooseberryleaf globemallow	X			X
Polygonaceae					
Erigonum ovalifolium	Cushion buckwheat	X			
E. umbellatum	Sulfur-flower buckwheat	X	X	X	

Scientific Name	Common Name	Plant Selection and Increase (Jensen, Thompson, Shaw, Walker)	Pollination (Cane)	Genetic Variability (McArthur)	Genetics Seeded/Native Populations (McArthur)
Scrophulariaceae					
Penstemon acuminatus	Sand penstemon	X			
P. deustus	Scabland penstemon	X			
P. palmeri	Palmer penstemon				X
P. speciosus	Sagebrush penstemon	X	X	X	

Appendix 2. Native grass and forb 2001 and 2002 seed collection sites (red flags) and mapped populations (yellow squares).



Appendix 3. Great Basin native forbs selected for pollination and seed predator studies.

Latin binomial	Common Name	Pollinator Need	Reproductive Pests
Astragalus filipes	basalt milkvetch	Bee?	seed weevil
Balsamorhiza sagittata	arrowleaf balsamroot	*Osmia montana*, *O. californica*	seed predator
Crepis acuminata	tapertip hawksbeard	Bee?	?
Eriogonum umbellatum	sulphur buckwheat	Bee?	?
Hedysarum boreale	northern sweetvetch	>10 *Osmia* spp.	seed weevil, bud feeding moth
Lomatium dissectum	giant biscuitroot	Bee?	?
Lupinus argenteus	silver biscuitroot	Bee	bud feeding moth
Penstemon speciosus	showy beardtongue	*Pseudomasaris vespoides, Osmia* spp.	raceme-boring moth

Appendix 4. Empirical data collection for DNA and allozyme analysis

SPECIES	COMMON NAME	N[1]	STUDY POPULATIONS
Astragalus utahensis	Utah milkvetch	4	Idaho, Nevada, Utah
Atriplex canescens	Fourwing saltbush	11	Nevada, Utah New Mexico
Bromus carinatus	Mountain brome	2	Utah
Crepis acuminata	Tapertip hawksbeard	5	Idaho, Nevada, Utah
Erigeron pumilis	Low fleabane	7	Idaho, Nevada, Utah
Eriogonum umbellatum	Sulfur-flowered buckwheat	6	Idaho, Nevada, Utah
Lupinus argenteus[2]	Silvery lupine	7	Idaho, Nevada, Utah
Stipa comata	Needle-and-thread grass	3	Nevada, Utah
Vicia americana	American vetch	3	Nevada, Utah
Viguiera multiflora	Showy goldeneye	3	Nevada, Utah

[1]Study in progress, goal is a minimum of five populations in Idaho, Nevada and Utah.
[2]Working with both *L. argenteus* and *L. sericeus* (Silky lupine).

Appendix 5. Genetic diversity in *Lupinus* (based on allozyme data at 23 loci)

An example of data collection and summarization that will be performed on all species under study for allozymes; similar data will be summarized and analyzed for molecular genetics DNA.

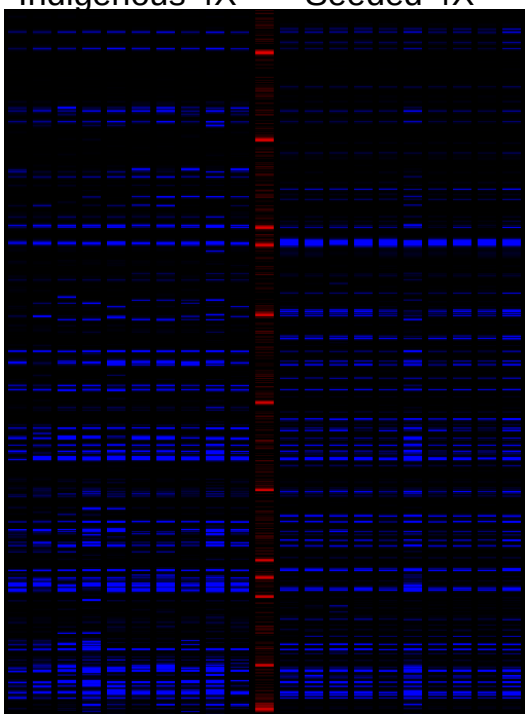
	N	P	A	Ho	He
San Juan – UT (2581)	**38**	**56.5**	**1.7 (0.7)**	**0.116 (0.24)**	**0.201 (0.23)**
Juab – UT (2586)	**40**	**65.2**	**2.0 (0.9)**	**0.098 (0.15)**	**0.220 (0.23)**
Washington – UT (2608)	**37**	**47.8**	**1.8 (1.0)**	**0.098 (0.19)**	**0.198 (0.23)**
Utah – UT (2703)	**40**	**47.8**	**1.7 (1.0)**	**0.132 (0.25)**	**0.192 (0.25)**
Power – ID (2718)	**40**	**56.5**	**2.1 (1.2)**	**0.171 (0.22)**	**0.245 (0.27)**
Lincoln – NV (2720)	**40**	**82.6**	**2.3 (0.8)**	**0.134 (0.16)**	**0.289 (0.21)**
White Pine – NV (2733)	**40**	**78.3**	**2.3 (0.9)**	**0.116 (0.14)**	**0.276 (0.20)**
Population mean	**39.3**	**62.1**	**2.0**	**0.124**	**0.232**
Species level	**272**	**95.7**	**3.0 (1.1)**	**0.161 (0.21)**	**0.195 (0.22)**

Appendix 6. Example of molecular genetic analysis using AFLP data for *Atriplex canescens.*

NUCLEAR GENETIC VARIATION

AFLP Analysis of *Atriplex*

Indigenous 4X Seeded 4X



- AFLP – Amplified Fragment Length Polymorphism analysis
- Marker bands anonymous, genetically "dominant"
- Markers abundant (100 - 1000)
- Can be adapted to screen high ploidy species
- Provide high resolution of individual identity and interpopulation-level differentiation
  - Seeded 4X *Atriplex canescens* shows higher uniformity (or genetic identity) than indigenous 4X material at Twist Hollow, Washington County, UT

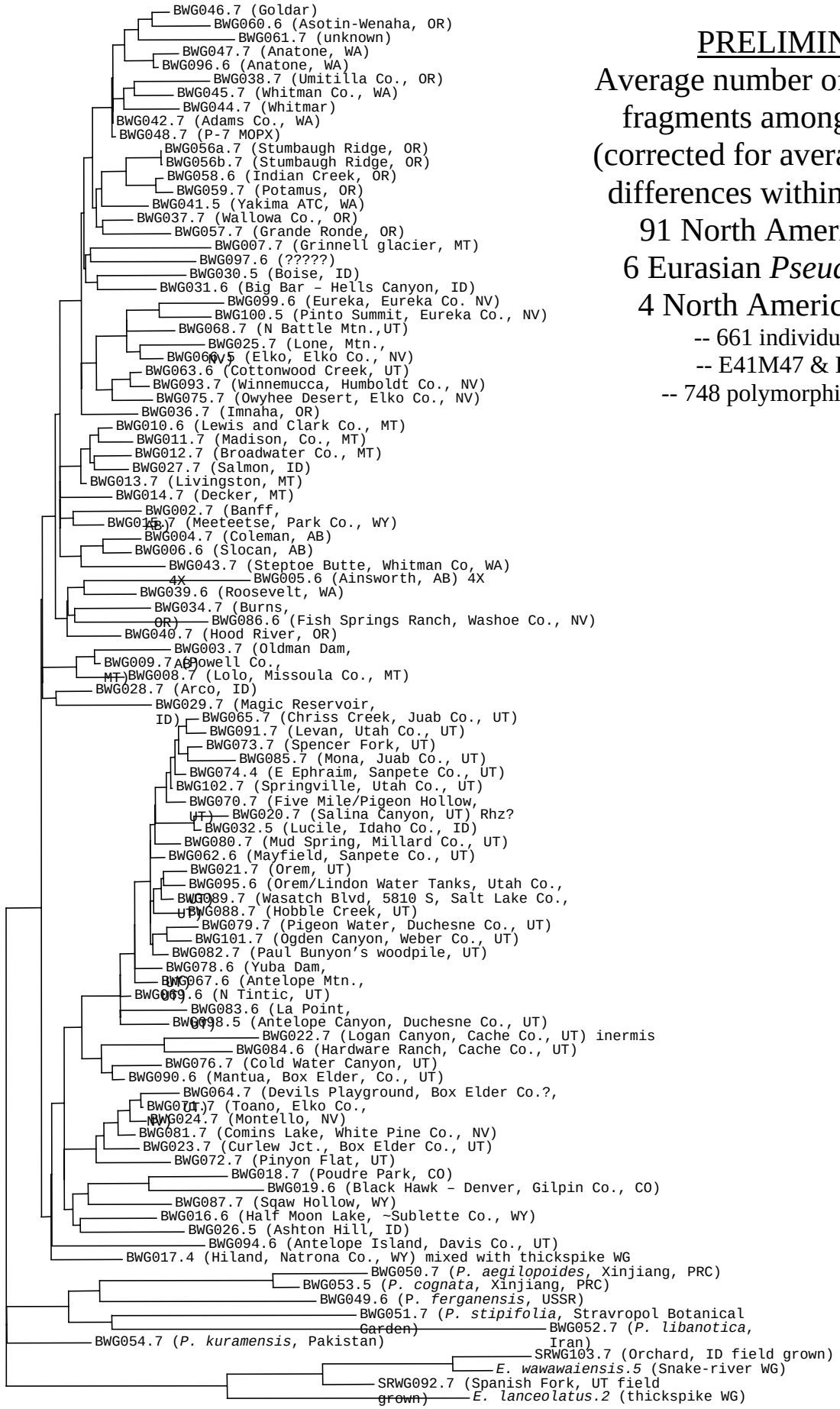
Appendix 7. Abstract of Canadian Journal of Botany submission by Steve Larson et al.

Amplified fragment length polymorphism in *E. elymoides, E. multisetus,* and other *Elymus* taxa

Steven R. Larson, Thomas A. Jones, Carrie L. McCracken, and Kevin B. Jensen

Abstract: Amplified fragment length polymorphism was used to assess DNA variation within and among 22 *E. elymoides* (Raf.) Swezey ssp. *elymoides*, 24 *Elymus elymoides* ssp. *brevifolius* (J.G. Sm.) Barkworth, and 13 *E. multisetus* (J.G. Sm.) Burtt-Davy squirreltail accessions relative to six other North American and 3 Eurasian *Elymus* taxa. The *E. elymoides* and *E. multisetus* species were both monophyletic and genetically similar relative to other *Elymus* species. The monophyly of ssp. *elymoides* was also supported, however ssp. *brevifolius* was paraphyletic and separated into four genetically distinct groups. Estimates of nucleotide divergence among these five groups range from 0.0194 to 0.0288, with approximately 0.0329 differences per site between *E. elymoides* and *E. multisetus*. Corresponding estimates of nucleotide divergence among the eight North American taxa range from 0.0243 and 0.0387. Slightly greater nucleotide divergence, 0.0346 to 0.0444, was detected between North American and Eurasian taxa. Old World species evidently formed a natural outgroup. Amplified fragment length polymorphism among *E. elymoides* accessions was correlated with geographic provenance and previously reported ecological traits. Correlation between DNA polymorphism and ecological trait variation was greater when *E. elymoides* and *E. multisetus* accessions were compared collectively. However, associations between DNA polymorphism and geographic origin were diminished when these two squirreltail species were included together. Genetically divergent *E. multisetus* and *E. elymoides* accessions were collected from the same general region, whereas genetically distinct *E. elymoides* groups generally correspond to different geographic regions. Thus, DNA fingerprinting supports the taxonomic ranks of *E. multisetus* and *E. elymoides*. Moreover, these results demonstrate that ecologically significant geographic groups within *E. elymoides* can be distinguished by DNA fingerprinting.

Appendix 8. Preliminary results of DNA fingerprinting study of North American bluebunch wheatgrass.



PRELIMINARY

Average number of polymorphic fragments among accessions (corrected for average number of differences within accessions):

91 North American BWG

6 Eurasian *Pseudoroegneria*

4 North American *Elymus*

-- 661 individual plants

-- E41M47 & E36M59

-- 748 polymorphic fragments