Seed Collection Protocol and Field Manual for Native Plant Relocation of *Festuca campestris, Festuca idahoensis,* and *Pseudoroegneria spicata.*

Submitted in partial fulfillment of the requirements for graduation with honors from the Environmental Studies Program at Carroll College, Helena, MT

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"Next in importance to the divine profusion of water, light, and air, those three physical facts which render existence possible, may be reckoned the universal beneficence of grass. Lying in the sunshine among the buttercups and dandelions of May, scarcely higher in intelligence than those minute tenants of that mimic wilderness, our earliest recollections are of grass; and when the fitful fever is ended, and the foolish wrangle of the market and the forum is closed, grass heals over the scar which our descent into the bosom of the earth has made, and the carpet of the infant becomes the blanket of the dead."

- John J. Ingalls

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Acknowledgements

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Introduction

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Society for Ecological Restoration International, 2009). Native plants have been used in the past for reforestation, watershed activities, rangeland improvement, as well as other key activities such as combating invasive species, diminishing the impact of climate change on the environment, and helping to maintain overall healthy forests (USDA Forest Service, 2008). The United States Department of Agriculture Forest Service defines a native plant as, "a plant species which occurs naturally in a particular region, state, ecosystem and habitat without direct or indirect human actions". When an ecosystem has been damaged or destroyed either by natural disaster, human hand, or an invasive species it disrupts all the organisms within the ecosystem. This disruption of the land can have devastating effects on its inhabitants.

Ecological invasions are often associated with persistent changes to underlying ecological processes (Prober et al., 2005). Restoration of invaded communities is dependent on manipulation of these processes to favor the target species composition and impart resistance to further invasion (Prober et al., 2005). Prober et al. (2005) applied these principles to extensively degraded grassy woodlands in temperate agricultural regions of Australia, where widespread invasion by Mediterranean annuals was related to altered ecological processes such as soil nutrient cycling. In their study, reestablishing a perennial sward of appropriate native tussock grasses to these ecosystems was critical for restoring pre-disturbance nitrogen cycles and improving resistance to invasion by exotic annuals; carbon supplements and spring burns facilitated the process through

complementary mechanisms. Reestablishing a desired species composition is rarely straightforward and often depends on re-instating interacting ecological processes that have become disrupted or altered during previous degradation phases (Prober, 2005).

The purpose of my study was to produce a seed collection protocol and field manual working in partnership with the USDA Forest Service Native Plant Material (NPM) Policy, to assist in the FY08 Region One Seed Transfer Zone Study as well as future endeavors with the ecological restoration of the three grass species *Festuca campestris, Festuca idahoensis, and Pseudoroegneria spicata*. This can also be used as a field guide for the identification of these grasses in the native areas of Montana and the surrounding region.

My study describes the morphology, seed collection protocol, and overall plant identification methods for *F. campestris, F. idahoensis, and P. spicata.* My study also lists the tools and equipment necessary to complete an accurate seed collection, as well as ways to determine which populations are acceptable for sampling. The Seed Transfer Zone Study will contribute to the understanding of genetic variation in core revegetation grass species within Region One (Fox, 2008). The seed collection of these three grass species was a fundamental step towards the potential restoration of these species in areas of need, and a key component of the FY08 Region One Seed Transfer Zone Study.

Grass Lifecycle and Morphology

The three grasses I collected and described, *F. campestris, F. idahoensis, and P. spicata*, are classified as perennial grasses. Perennial grasses can live through numerous cycles of growing seasons and dormant seasons, and are known to produce seeds consistently year after year (U.S. Fish & Wildlife, 2008). They do not produce the high volume of seeds that some annual and biennial plants do, however, the perennials seeds are more likely to germinate and develop into new plants than the seeds of the annual or biennials (U.S. Fish & Wildlife, 2008).

It is important to understand the morphology and diagnostic characteristics of not only the three grasses in this study, but also of grasses in general. Recognizing the morphological and diagnostic characteristics of grasses can improve the ability to identify grasses in the field. Figure 1 shows the morphology of grass species.

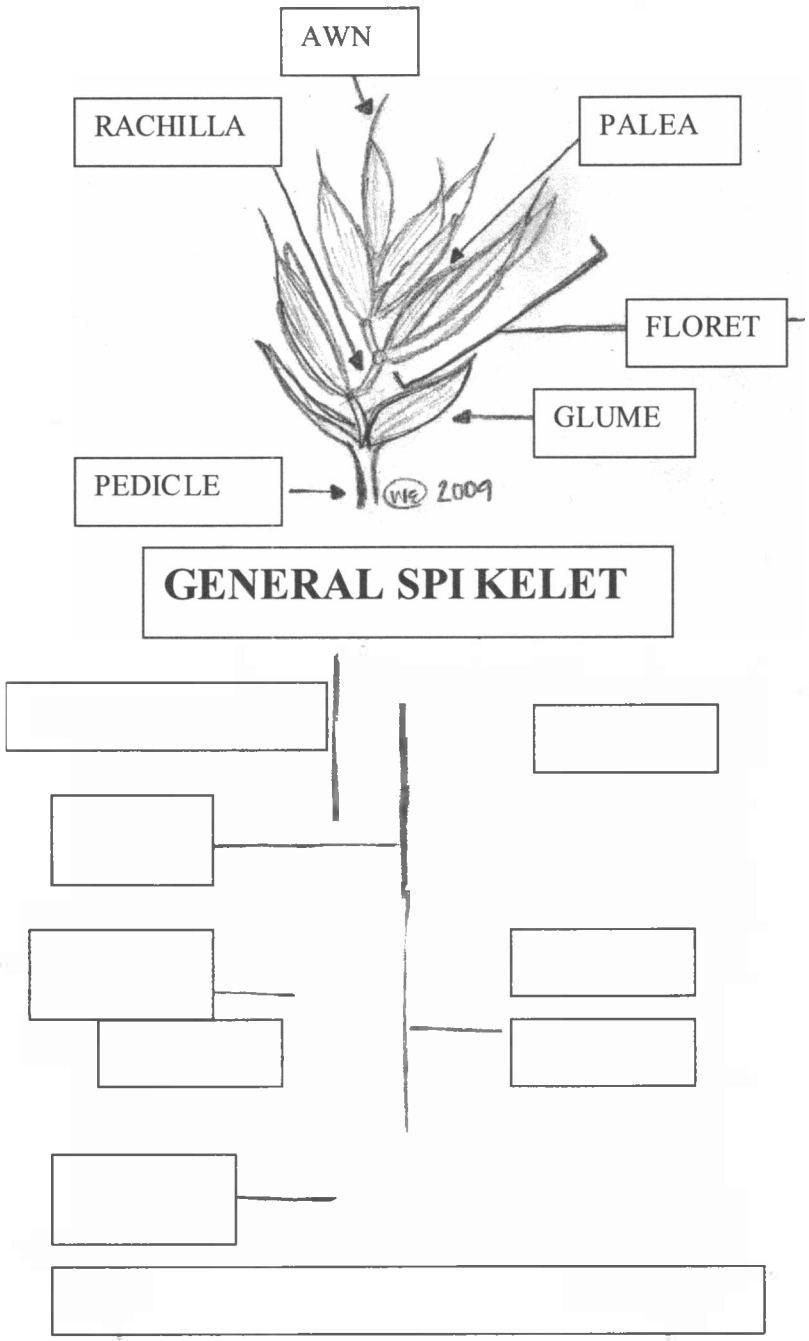


Figure 1. General example of a grass spikelet (top), and diagnostic characteristics of grass, from root to tip (bottom).

Tools, Equipment, and Recording Data

Having adequate transportation is a necessity, as most of the areas where my collections took place were remote, off main roads, and sometimes difficult to reach. A detailed map of the area is needed, and it is especially helpful to obtain a map from the local forest service office that contains locations of forest service roads, keeping in mind that they are not always accurate.

Global Positioning Systems (GPS) are necessary for accurately describing location. For my study, once a suitable location for collecting specimens was found, the GPS coordinates were recorded on the Native Plant Seed Source Location and GPS Record sheet (See Figure 2). I also recorded the area description, plant data, and area location data. This helped to describe the collection areas, while serving as a way to locate the collection sites if they need to be revisited for any reason in the future.

The genus and species should be completed correctly according to the recognized botanical name for the collection. The Administrative Unit Name is the name of the cooperating organization, for example the Region, Forest, and District. The state and county should be completed, and the T: township, R: range, and S: section should be documented as well.

Status (X Appropriate Box(es).): Moscow Assigned Accession Number _____
☐ Seed Source Selected Genus Species _____
☐ Seeds Collected NLSPL Species Code _____

NATIVE PLANT SEED SOURCE LOCATION & GPS RECORD

Administrative Unit Name: _____ Administrative Unit Number: ___ | ___ | ___ | ___ | ___

State: _____ County: _____ USGS 3rd Order HUC: _____
Legal: T ___ N R ___ S ___ Quad: _____

GPS Data: Latitude: In Degrees (DD.dddddd) ___._____ N (Geodetic Datum - WGS-84)
Longitude: In Degrees (DDD.dddddd) ___._____ W (Geodetic Datum - WGS-84)
Elevation _____ Feet above Mean Sea Level
Is GPS data corrected from an established base station? ☐ Yes ☐ No (Corrected data is preferred)
Base Station Name or why not corrected: _____
Convert Lat/Long to Universal Transverse Mercator (UTM) Coordinate System
Northing _____ meters Easting _____ meters

Located By: _____ Date: _____

AREA DESCRIPTION

Area Name: _____ Area Size: ___ acres Population Size: _____
Habitat Type #: _____ Mean Annual Precipitation: _____ in Physiographic Site: _____
Soil Type: _____ Soil Moisture: _____ Aspect: ___
Plant Association: _____ Collection Method: _____ Flowering Dates: _____
Seed Maturity: _____ Ripening Uniformity: _____ Disease/Insect Presence: _____
Site Yield Potential: _____ Additional Area Remarks: _____

PLANT DATA

Collection No: ____ Number of Plants Sampled: _____ Damage: _____
Collection Area Remarks: _____

AREA LOCATION INFORMATION

The location marker is on Road #_____ which goes from _____ to _____. The key starting point along this road is _____(bridge, junction, etc.).

From the key starting point go _____ miles ___ (up, down) the road towards _____ to the location marker which is on the _____ (up, down, left, right) side of the road on a _____ (for example, 4' post, 12" Ponderosa pine, etc.). _____

Type of Tags or Markers used: _____

Attach a sketch map (or insert a jpeg) to help relocate the collection area--REQUIRED.

Figure 2. Native Plant Seed Source Location &GPS Record (Mahalovich, 2008).

For the GPS data, the latitude and longitude should be documented (Geodetic Datum – WGS-84), as well as the elevation. The Universal Transverse Mercator (UTM) coordinate system is an acceptable coordinate system to utilize. In my study I used the UTM coordinate system.

Included in the Area Description should be the area name, the area size (documented in acres), the population size in that area, the estimated number of individual plant species, mean annual precipitation (if known), physiographic site (select from one of the following: ridge top, slope, bench, creek bottom, open range), soil type, the level of moisture in the soil (ranging from very dry to very wet), aspect (the cardinal direction in which the slope is facing), collection method (what was done to physically remove the seeds from the plant), seed maturity (when; time of the month), whether or not seed maturity was uniform among the population, whether disease or insects were present when the collection is made, the site yield potential (in poundage), and any additional remarks that need to be addressed (Mahalovich, 2008).

The Plant Data section should be completed by documenting the collection number, number of plants sampled, if there was any damage to the plant, and any remarks that need to be addressed (Mahalovich, 2008).

The Area Location Information is a crucial part of the Native Plant Seed Source Location & GPS Record documentation. This section is used if the collection sites need to be revisited for any reason. It should be entire, and exact, documenting markers on the road, key starting points, number of miles and cardinal directions, as well as any tags or markers that were placed on the route for guidance.

Seed Collection Data Sheet

Date of collection: _____

Collector's name: _____

Seed Lot Identification

Collector's ID number _____

Seed lot number _____

Scientific name: _____

State _____ County_____

Location where the seeds were collected (Choose one of three, additional lines are optional)

Township _____ Range_____ Section _____

GPS Coordinates: lat _____ long _____ elevation _____

District _____ Compartment _____ Stand _____

Collection site description:

Collection source (check one): __ wild stand, __ seed production area, __ seed orchard/field

Number of plants available for collection on this site: __ 1, ___ 2 to 20, __ 21 to 50 ___ 51 +

Number of plants collected from: ___ 1 __ 2 to 20 ___ 21 to 50 ___ 51 or more

Distance between collected plants in feet ____

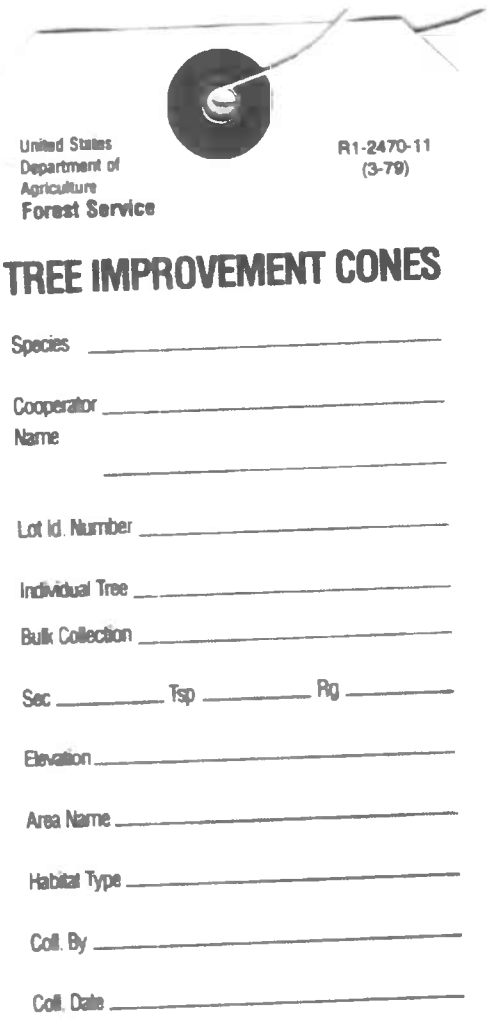
Habitat/Site Description:

Soil: ___ Rocky ___ Gravel ___ Sand ___ Loam ___ Clay
Soil series name: _____
Site type: ___ upland __ wetland __ aquatic. **Light:** ___full sun __partial shade ____full shade
Aspect: ___ N ___ S ___ E ___ W

Frequent species growing in association (list max of 5): _____,
_____, _____, _____, _____

Directions to the site: _____

Figure 3. Seed Collection Data Sheet.


United States
Department of
Agriculture
Forest Service

R1-2470-11
(3-79)

TREE IMPROVEMENT CONES

Species _____

Cooperator _____
Name
_____

Lot Id. Number _____

Individual Tree _____

Bulk Collection _____

Sec _____ Tsp _____ Rg _____

Elevation _____

Area Name _____

Habitat Type _____

Coll. By _____

Coll. Date _____

Figure 4. The recommended seed tag, form R1-2470-11.

Two other forms of documentation that I used in my study are the Seed Collection Data Sheet (see Figure 3) and seed tag R1-2470-11, which was attached to each collection in my study (see Figure 4). This document is similar to the Native Seed Source Location & GPS Record. On the Seed Collection Data Sheet the following should be provided: the date the collection was made, the name of the collector, the scientific name of the species collected, the state and county where the collection is taking place, the location where the seeds were collected (township, range, section, GPS coordinates in

latitude and longitude, elevation, district, compartment, and stand), as well as the collection site description and the habitat/site description. For the collection site description it must be noted whether the collection source is a wild stand, seed production area, or a seed orchard/field. For my study all of the collection sources were wild stands. The number of plants collected from the site also needs to be documented, as well as the distance, in feet, between the collected plants. For the habitat/site description the soil type needs to be documented (check all that apply: rocky, gravel, sand, loam, or clay). The site type also needs to be completed, as well as how much light or shade is in the collection site, the aspect, common species growing in association with the species being collected, and as always the directions to the site. Table 1 summarizes the essential tools for the collection process and their function.

Table 1. Essential tools in the collection process.

Essential Tool in the Collection Process	Function
Scissors (or Knife)	Used in the removal of the mature seeds
Hand Lens	Used in identification of grass specimens to insure that the collection is accurate
Small Brown Paper Bags	Temporary storage of collected mature seeds
Notebook & Writing Utensil	Making field notes is highly recommended
Preserved Specimens	Aid in identification of grass species

How to Determine a Suitable Population and Location to Sample

In order to first determine if the population of grass is even suitable to be collected, a preliminary visit to the site is essential. For my study, populations were defined as a collection of individuals showing a contiguous distribution, i.e., same field, drainage, or valley (Mahalovich and Rinehart, 2008).

The population must be wild, not planted or cultivated by human hand, not previously researched, or threatened by invasive plants (Fox, 2008). The population should also be big enough that at least 50 individuals can be sampled without decimating the area of the individuals. The population should not be heavily grazed by cattle or other ungulates, and should not be damaged by insects, pesticides, or other damaging agents. Locations with large weed populations should be avoided to prevent the weed seeds from coming into contact with the native species, therefore contaminating the specimens being collected (Fox, 2008).

Collections should be from several different sites with various elevations, aspects, drainage patterns, and soils, especially if the collection purpose is to investigate genetic variation. In my study I collected seeds from several different sites in the Helena National Forest as well as the Lewis and Clark National Forest in Region One, Montana at differing elevations as well as East and West of the Continental Divide (see Table 1).

Table 2. Site, approximate date of seed maturity, elevation, and location of collections.

***F.campestris* Site**	**Approximate date of seed maturity**	**Elevation**	**Divide**	**Forest**
Sweeny Creek	August 1	6,201 feet	East	Helena National
Granite Butte	August 12-13	7,126 feet	West	Helena National
Ophir Creek	August 1	6,111 feet	West	Helena National
Little Blackfoot River	July 20	5,558 feet	West	Helena National
MacDonald Pass	August 1	6,341 feet	West	Helena National
Weasel Creek	August 10	6,693 feet	East	Helena National
***F. idahoensis* Site**				
Granite Butte	August 1	6,268 feet	West	Helena National
Ophir Creek	July 20	5,866 feet	West	Helena National
Little Blackfoot River	July 17	5,397 feet	West	Helena National
Weasel Creek	August 5	6,693 feet	East	Helena National
Yankee Jim Ridge	August 13	7,386 feet	East	Lewis & Clark
Central Park	August 13-15	7,721 feet	East	Lewis & Clark
***P. spicata* Site**				
Unknown name	July 15	4,868 feet	East	Lewis & Clark
Pole Creek	July 20	5,731 feet	East	Helena National
Baid Butte	July 20	5,999 feet	West	Helena National
Weasel Creek	August 1	6,158 feet	East	Helena National

Festuca campestris

Background Information on *F. campestris*

Table 3: Scientific classification for *F. campestris*.

Kingdom	*Plantae* – Plants
Subkingdom	*Tracheobionta* – Vascular plants
Superdivision	*Spermatophyta* – Seed plants
Division	*Magnoliophyta* – Flowering plants
Class	*Liliopsida* – Monocotyledons
Subclass	*Commelinidae*
Order	*Cyperales*
Family	*Poaceae* – Grass family
Genus	*Festuca* L. – fescue
Species	*Festuca campestris* Rydb. – rough fescue

Festuca campestris is also commonly known as buffalo bunchgrass, big buffalo bunchgrass, rough fescue, mountain rough fescue, foothills rough fescue, and big rough fescue (Anderson, 2006). The large genus *Festuca*, which contains most grass species, is extensively distributed in all regions of the world including the polar, temperate, and alpine (Anderson, 2006). *Festuca campestris* is a keystone species in the Pacific Northwest, and a source of nutritious forage for many species livestock and wildlife (Cory, 2009). It is native to Colorado, Idaho, Montana, Oregon, and Washington in the United States and Alberta, British Columbia, Ontario, and Saskatchewan in Canada (see Figure 5).

Figure 5: Locations where *F. campestris* is native in North America

Identification of *F. campestris*

Festuca campestris is a bluish to gray-green colored plant, with a purple to reddish stiff base. This grass forms in large bunches, with populations in close proximity to one another. Each tussock can contain up to 25 culms and range in height from 40 to 90 centimeters. The rhizomes of *F. campestris* are short, if present at all, however the inflorescence can be fairly large, 5 to 18 centimeters long (see Figure 6 and Table 6).

Figure 6: Example of *F. campestris*.

Festuca idahoensis

Background Information on *F. idahoensis*

Table 4. Scientific classification for *F. idahoensis*.

Kingdom	*Plantae* – Plants
Subkingdom	*Tracheobionta* – Vascular plants
Superdivision	*Spermatophyta* – Seed plants
Division	*Magnoliophyta* – Flowering plants
Class	*Liliopsida* – Monocotyledons
Subclass	*Commelinidae*
Order	*Cyperales*
Family	*Poaceae* – Grass family
Genus	*Festuca* L. – fescue
Species	*Festuca idahoensis* Elmer – Idaho fescue

Festuca idahoensis is more commonly known as Idaho fescue and grows on all exposures in a wide variety of soil conditions (Henson, 2007). It serves as an essential nutrient to wildlife and livestock, particularly late in the season (Henson, 2007). Idaho fescue is drought resistant and adapts well in disturbed areas. It is a perennial, cool-season grass that is native to Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming in the United States and Alberta, British Columbia, and Saskatchewan in Canada (see Figure 7).

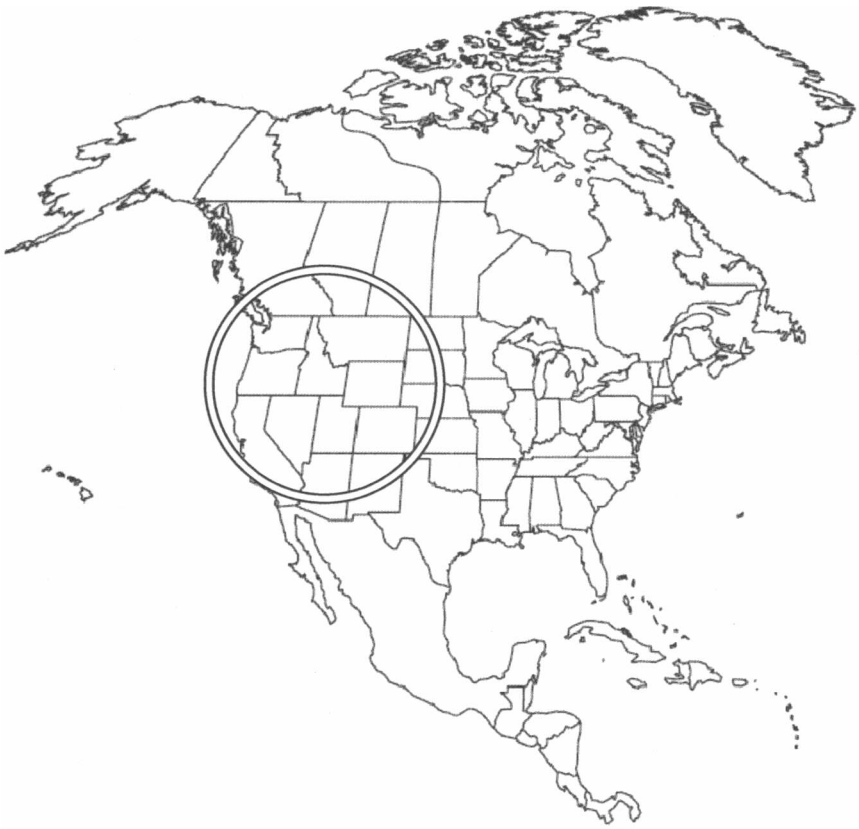


Figure 7. Locations where *F. idahoensis* is native in North America

Identification of *F. idahoensis*

Idaho fescue grows in culms that are erect and 30 to 100 centimeters in height (Henson, 2007). The fine narrow leaves that extend upward have a bluish to green coloration, and the base of the plant itself has a distinct bluish tint to it. The awns of Idaho fescue are much longer than those of Rough fescue (see Figures 7 and 8). Another grass species that has very similar diagnostic characteristics as Idaho fescue is *Poa secunda*. Correct identification is necessary so not to confuse the two species. Idaho fescue has an extensive root system, but rhizomes are absent.

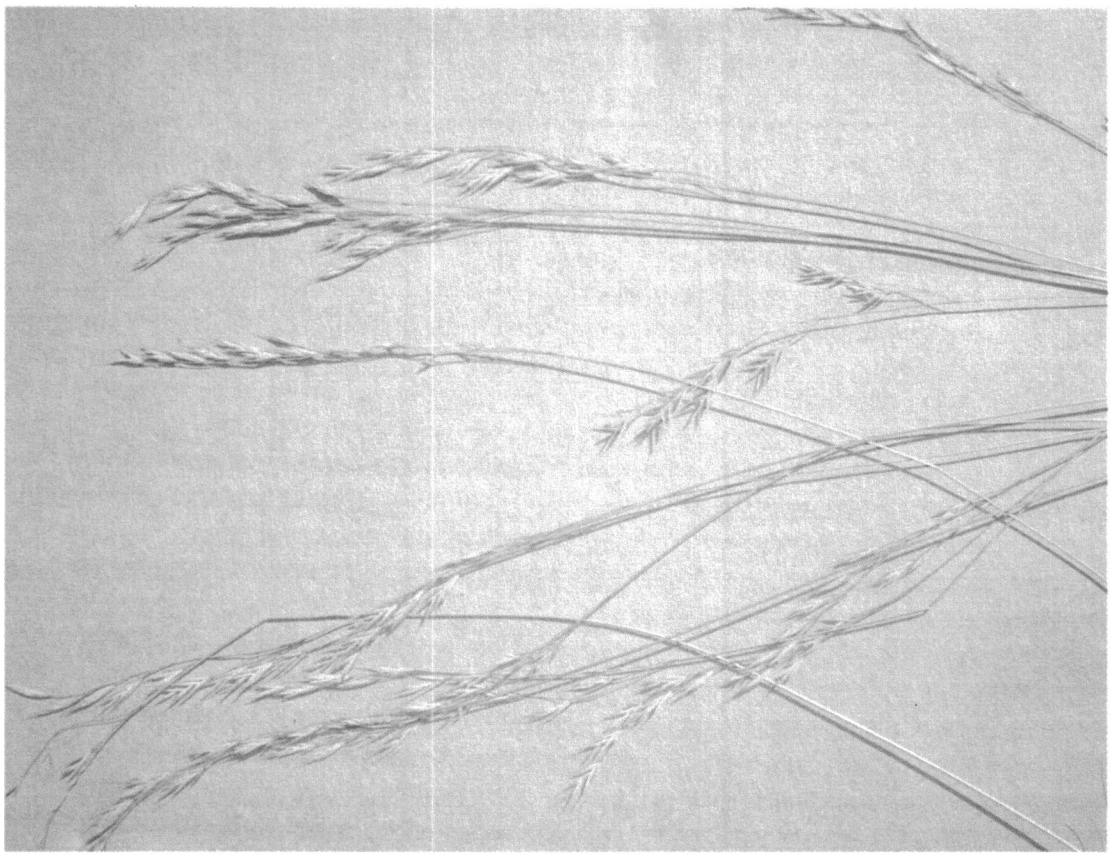


Figure 8. Photo of *F. idahoensis* inflorescence

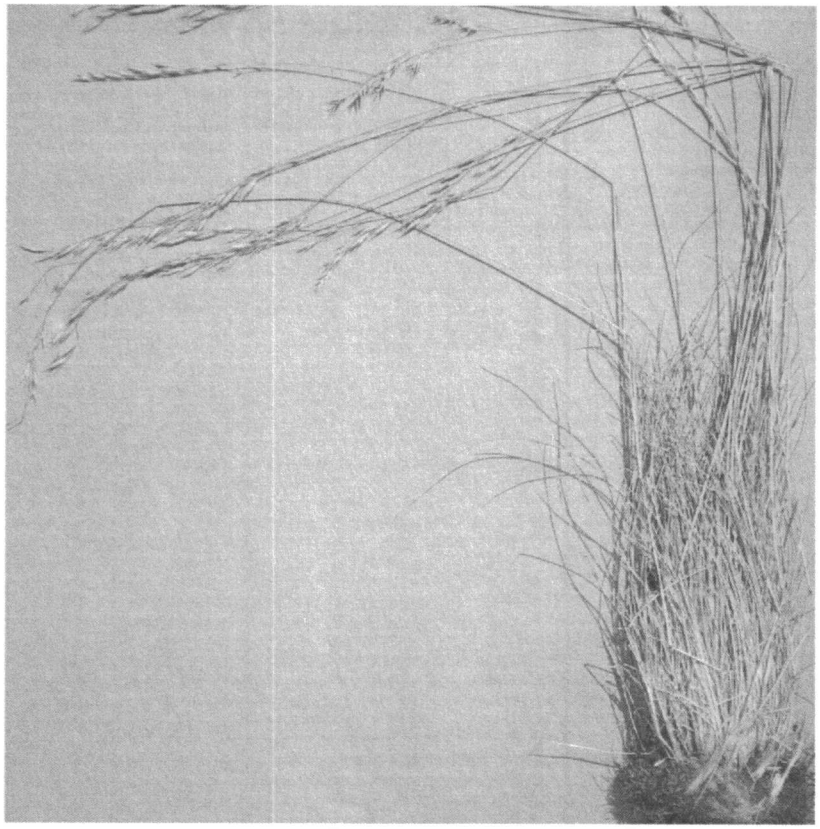


Figure 9. Photo displaying diagnostic characteristics of *F. idahoensis*

Pseudoroegneria spicata

Background Information of *P. spicata*

Table 5: Scientific classification for *P. spicata*.

Kingdom	*Plantae* – Plants
Subkingdom	*Tracheobionta* – Vascular plants
Superdivision	*Spermatophyta* – Seed plants
Division	*Magnoliophyta* – Flowering plants
Class	*Liliopsida* – Monocotyledons
Subclass	*Commelinidae*
Order	*Cyperales*
Family	*Poaceae* – Grass family
Genus	*Pseudoroegneria* (Nevski) A. Löve – wheatgrass
Species	*Pseudoroegneria spicata* (Pursh) A. Löve – bluebunch wheatgrass

Pseudoroegneria spicata, formerly known as *Agropyron spicatum*, and more commonly known as bluebunch wheatgrass has a growing season from about May until August. This perennial grass is native to Alaska, Arizona, California, Idaho, Michigan, Montana, North Dakota, New Mexico, Nevada, Oregon, Utah, Washington, Wyoming in the United States and Alberta, British Columbia, Saskatchewan, and the Yukon in Canada (see Figure 10).

Figure 10. Locations where *P. spicata* is native in North America.

Pseudoroegneria spicata commonly grows in various terrains including plains, dry slopes, canyons, rocky hills, and open wooded areas, and serves as an important foraging plant for a variety of grazing mammals because it is exceedingly leafy and produces a large amount of forage per plant (Ogle, 2002). However, the grass does not

take well to overgrazing, and if overgrazing does occur, bluebunch wheatgrass is replaced by annual plants (Herzman, 1963).

P. spicata is very drought resistant, and because of its extensive, fibrous rhizome system it makes for an excellent specimen in erosion control (Jones, 2003). Species that are often found in tandem with *P. spicata* include various species of sagebrush, Rocky Mountain juniper, Ponderosa pine, needlegrasses, and Idaho fescue among others (Ogle, 2002.)

Identification of *P. spicata*

P. spicata grows in large tussocks with numerous culms per plant (Herzman, 1963). The plant itself stands erect ranging from 15 to 30 inches in height, while the bottom of the plant, toward the soil, has a distinct bluish tint to it. The inflorescence consists of a stiff spike, usually three to six inches in length, with only one spikelet per node. The rhizomes are extensive and spread laterally up to a meter. Probably the most characteristic feature of bluebunch wheatgrass are the distinctively long awns, ranging from one-half to one inch, that turn out at a 90 degree angle at the oracle during mid to late summer when the seeds are ready to be harvested (see Figure 12).

Figure 11. *P. spicata* preserved specimen.

Figure 12. Characteristic awns of *P. spicata.*

Table 6. A comparison of diagnostic characteristics between *Festuca campestris, Festuca idahoensis*, and *Psuedoroegneria spicata* (Anderson, 2006).

	Festuca campestris	*Festuca idahoensis*	*Psuedoroegneria spicata*
Height	40 to 90 cm	30 to 100 cm	1.5 to 4.0 feet
Rhizomes	short, if present	absent	extensive, fibrous
Culms	up to 25 slanting at an angle of 45 to 50 degrees from the horizontal	no data	No data
Culm Nodes	never exposed	becoming exposed	No data
Ligule	0.1 to 0.5 mm long, ciliate	0.3 to 0.6 mm long, ciliate	0.1 to 0.4 cm long, membranous, truncate
Leaf Cross Section	5 to 7 large and 5 to 11 small veins	3 to 5 large and 2 to 5 small veins	4.0-6.0 mm wide, green to blue in color.
Relative glume length	usually conspicuously unequal, upper glume is consistently shorter than adjacent lemma	much shorter than spikelets, second glume shorter than first lemma	Mostly unequal, 0.2 to 0.5 inches long. About half as long as lowermost lemma.
Spikelet	4 to 5 florets	3 to 7 florets	Multiple florets
Lemma	very scabrous, callus not elongated, 7 to 8.5 mm long, with 5 distinct veins in the dorsal view or nerveless in dorsal view or sometimes with only the centre vein distinct, apex entire	Dorsally rounded and glabrous at base, keeled towards scaberulous apex, callus not elongated, 6 to 8 mm long, nerveless in dorsal view or sometimes with only the centre vein distinct, apex entire	contains a divergent awn
Awn	0.5 to 1.5 mm, rarely awnless	over 2mm long	very long, sometimes up to an inch in length

Seed Collection Protocol

The seed collection protocol for *F. campestris, F. idahoensis, and P. spicata* were very similar in my study. Although other sampling schemes are possible the following describes the sampling scheme utilized in my study.

Table 7. Progressive developmental stages of grass seeds and when to collect them (Holzworth et al., 2003).

Milky stage	When these seeds are extracted from the grass and squeezed between the finger and thumb, a milky white fluid is excreted. It is too early to collect from plants with seeds like this because they are not viable.
Soft-doughy stage	These seeds, when squeezed between the finger and thumb, still excrete a soft, doughy-like substance that still has little to no viability.
Hard-doughy stage	When the plant is in transition between the soft-doughy stage and the hard-doughy stage seeds are ready to be collected. However, you need to cut the inflorescence from the plant rather than extracting the seeds directly so that the seed is allowed to continue maturing as the plant dries. In this stage seeds, when squeezed between the finger and thumb, do not excrete any sort of substance and primarily keep their original shape.
Maturity	Seeds are very hard. Maturity and seed shattering occur almost simultaneously, so it is important to get to the seeds before full maturity sets in.

In accordance with the NPM policy for my study, *F. campestris* and *F. idahoensis* were obtained from three plants per population. Each collection was spaced approximately 100 feet apart from one another, while making sure to obtain the highest possible yield of seeds per plant. This ensured that there were enough seeds to be analyzed at the Coeur d' Alene Nursery for genetic variation. A total of six collections were made within each Forest/Grassland area. The collections were dispersed among differing elevations (see Table 1).

P. spicata has a few distinctive features, as noted above, that make it easier than some other grasses to identify in the field. However, having a complete understanding of the species will make it much easier to recognize. When mass collections need to be taken, the quicker the grasses can be distinguished from one another the easier the collection process will become.

P. spicata seeds come to maturity from mid-July to mid-August depending on outside factors such as elevation, temperature, and drought. It is crucial to collect from sites that have not been overgrazed by animals, as a good seed sample would be impossible from these areas. It is also important to note that reproduction is not only by way of seed, but also by tillering. In those types having rhizomes, some vegetative reproduction occurs thus not producing any seeds (Benson, 2009).

In accordance with the NPM policy, *P. spicata* seed should be obtained from 10 plants per population, with the plants being spaced at least 100 feet apart. Make sure that there are roughly an equal number of seeds per plant collected. A total of six collections should be made within each Forest/Grassland area with collections distributed across different elevations, aspects, and soil moisture. In my study, collections were executed West of the continental divide, at differing elevations (above and below 7000 feet), and East of the continental divide at differing elevations (above and below 7000 feet) (see Table 1).

For each collection the Native Plant Seed Source Location and GPS Record was completed (see Figure 1). This included documentation of GPS data, plant data, and area description. Also, a Site and Setting Form was completed, and an R1-2470-11 seed tag was completed and kept with the collections (see Figures 3 and 4).

The seeds are ripe and ready to be harvested when it is difficult to squeeze with a fingernail, and no milky white substance is produced from the squeezing motion (see Table 6). The seeds are removed by cutting the spikelets, or entire inflorescence, from the top of the plant with a pair of scissors or other sharp object. Once the seeds are removed from the plant they should be placed in a labeled brown paper bag with a seed tag and placed in a cool, dry climate until they are ready to be shipped or used. The top of the paper bag should be folded over and stapled to ensure that none of the seeds are lost. Labeling the paper bags is crucial. Keep in mind that for all three species of grass discussed, lower elevation site populations will reach seed maturation before the higher elevation site populations, so be sure to collect seed from the lower elevation sites initially (see Table 1).

In conclusion, studies such as mine are essential components of ecological restoration of ecosystems that have been damaged or destroyed either by natural disaster, human hand, invasive species, or other means. The information gathered and complied in my study will assist others in their endeavors with environmental restoration and genetic inquiry. Ecological restoration is an important facet of restoring ecosystems to a state of equilibrium, and essential in learning about the environment surrounding us every day.

Definitions

auricles: claw appendages at the base of the blade of some grasses (some grasses do not have auricles)
awn: a fibrous bristle (often called a beard) which is an extension of the midrib of the lemma. It may arise from the tip of the lemma or from the abaxial (outer) surface below the tip.
collar: a thin band of meristematic tissue at the junction of the leaf blade (lamina) and the sheath
culm: central axis of the mature grass shoot, comprised of nodes and internodes; each node bearing a leaf.
culm node: solid region on the culm which gives rise to a leaf sheath. On certain grass species, lower culm nodes may bear adventitious buds capable of producing new tillers.
floret: small flower; the reproductive unit of a grass spikelet consisting of a lemma and palea and the small flower they contain (see spikelet).
glume(s): bracts which enclose the floret(s). A spikelet can be described as a "pair" of glumes with the enclosed floret(s). The outer (lower) glume is always the largest of the pair. In some species (Paniceae family) the uppermost glume is greatly reduced and is largely replaced by the lemma of a sterile floret contained within.
inflorescence: flower head terminating the stem, consisting of a collection of flowers arranged on a common axis. There are three main grass inflorescence types: 1. panicle, 2. spike, 3. raceme.
lemma: the larger, outer, bract which, along with the palea, serves to contain the floret(s) held within. The lemma and palea provide a protective covering for the developing floret as well as for the seed after ripening.
ligule: outgrowth at the inner junction of the leaf sheath and blade, often membraneous, sometimes a fringe of hairs
palea: the shorter, upper, bract which, along with the lemma, serves to contain the floret(s) held within (see lemma).
pedicel: in grasses, a short stem segment supporting a spikelet. Such spikelets are said to be pedicellate.
sheath: lower part of the leaf that encloses the internode
spikelet: a flowering unit comprised of one or more florets enclosed by two glumes (bracts). When the spikelets are attached directly to the rachis the inflorescence is called a spike (wheat, rye, barley, ryegrass). When the spikelets are attached to the rachis with short pedicels, the inflorescence is termed as raceme. When the spikelets are attached by means of a branch the inflorescence is said to be a panicle.
tiller: a shoot that sprouts from the base of a grass

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