



Section 3

Species Selection

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Species Development

Plant Selection

Considerable attention was initially given to the identification and selection of species for development and use within the upper Colorado Plateau region. It was determined that the plant communities considered most critical candidates for restoration are the big sagebrush and pinyon-juniper communities. Different plant associations occur within these two major plant types resulting in a large number of candidate species to consider. As possible, the species selected for development included the primary species necessary to re-establish the major components of these associations. Emphasis has been given to the restoration of entire communities not just the reintroduction of a few major or dominate plants. The primary species initially identified for collection and development are listed in Table 1. The majority of species considered for development grow throughout a variety of habitats and express the capability to grow over a range of sites. This increases the possibility of multiple ecotypes or populations that are adapted to specific climatic or edaphic conditions. As possible, seeds were collected from a range of conditions that would reflect the general distribution of most species. Initial collections were scheduled to furnish sufficient germplasm to determine if multiple populations may occur in this general region. If significant differences do occur, more extensive collections will be organized and conducted by stratifying the area into ecologically defined units that represent the range of conditions in which individual species may occur.

Seeds of only a few cultivars or plants from this region are currently available from commercial companies including slender wheatgrass (*Elymus trachycaulus*) and mountain brome (*Bromus marginatus*). Compared to other areas in the Intermountain region, very little seed is collected and marketed from wildland stands from this region. Existing seed companies do not actively collect seed of any major shrub or herb species from this area. Numerous wildland stands of a number of shrubs do occur in sufficient amounts to support commercial collection and sales. Consequently, studies proposed for this program include the consideration of certain species that could be effectively produced and marketed from wildland collections.

The species initially proposed for development for the Colorado Plateau Region were compared with similar species currently being investigated by other scientists in adjacent regions. In most situations, few of the perennial broadleaf herbs are being investigated by other scientists. Some comparative evaluations were underway with many of the perennial grasses and shrubs –principally from work being funded and conducted by Utah Division of Wildlife Resources. Studies by other scientists did not, however, include collections or germplasm from the Colorado region. Consequently, efforts were designed to obtain plant materials or seed from the overall region for initial screening and evaluations.

A number of criteria were use to evaluate the ecological, biological, and propagation capabilities of the species proposed for collection. (Table 2: Forbs, Table 3: Grasses,

Table 4: Shrubs). The primary factors that influenced the selection of individual species to be included in the program centered on the importance of a species within the major plant communities it occurs and the potential to propagate and restore the species. Most grasses were recognized to be relatively easy to successfully grow and produce seed under cultivation. Since most species can be relatively easy to grow, the species that have been emphasized in our program were items that were most important in community restoration. They were the principal species that dominated individual plant communities. In contrast, many broadleaf herbs had not been grown in any cultivated situations. Planting, rearing, seed harvesting and seed processing are all potential concerns for many new species. Species that could be more easily and successfully grown were given priority. Seed collections of these species were initially emphasized. This provided seeds to establish seed increase fields and hasten the establishment of commercial production fields. Species that are more difficult to cultivate were also collected as soon as possible to begin a series of seed germination, plant biology, and life history studies. This information is necessary to successfully cultivate and establish the plant in both cultivated fields and wildland conditions.

A principal concern with the selection of broadleaf forbs has been the existence of numerous subspecies within taxa. Many forbs that occur in different communities have more than one subspecies, and each may be restricted to a specific region or soil type. As possible, individual forbs that have been included in these studies have been species with a broad range of distribution. These species are known as “generalists” and are adapted to a broad range of sites.

Shrubs that were selected for study were those that are most abundant and beneficial to wildlife habitats. Species that occur in large enough stands to produce seed necessary amounts of seed have not been included in cultivation trials. However, some species that do not produce consistent high quality are proposed for inclusion in this program. Studies are proposed to investigate means to increase seed yields from manipulation of stand density and controlling associated competition.

Table 1. - - Species proposed for development for the Uncompahgre/Colorado Region

Scientific Name	Common Name
GRASSES	
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass
<i>Bouteloua gracilis</i>	Blue grama
<i>Bromus marginatus</i>	Mountain brome
<i>Bromus anomalus</i>	Nodding brome
<i>Elymus elymoides</i>	Basin wildrye
<i>Elymus salina</i>	Salina wildrye
<i>Elymus trachycaulus</i>	Slender wheatgrass
<i>Hilaria jamesii</i>	Galleta
<i>Koeleria macrantha</i>	Prairie junegrass
<i>Leymus cinereus</i>	Basin wildrye
<i>Oryzopsis hymenoides</i>	Indian ricegrass
<i>Pascopyrum smithii</i>	Western wheatgrass
<i>Poa fendleriana</i>	Muttongrass
<i>Poa secunda</i>	Sandberg bluegrass
<i>Sporobolus cryptandrus</i>	Sand dropseed
<i>Stipa comata</i>	Needle-and-threadgrass
FORBS	
<i>Achillea millefolium lanulosa</i>	Western yarrow
<i>Aster glaucodes</i>	Blueleaf aster
<i>Astragalus mollissimus</i>	Woolly milkvetch
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot
<i>Castilleja chromosa</i>	Desert paintbrush
<i>Cryptantha flavoculata</i>	Rough seed Cryptantha
<i>Crepis acuminata</i>	Mountain Hawksbeard
<i>Erigeron pumilis</i>	Low fleabane
<i>Eriogonum flavum</i>	Yellow eriogonum
<i>Eriogonum ovalifolium</i>	Cushion buckwheat
<i>Eriogonum umbellatum</i>	Sulfur eriogonum
<i>Eriogonum racemosum</i>	Redroot eriogonum
<i>Hedysarum boreale germiale</i>	Utah sweetvetch
<i>Lesquerella rectipes</i>	Colorado bladder pod
<i>Linum lewisii</i>	Lewis flax
<i>Lupinus sericeus</i>	Silky lupine
<i>Penstemon cyanocaulis</i>	Bluestem penstemon
<i>Penstemon</i> spp.	
<i>Petrorhiza pumila</i>	Rock goldenrod
<i>Senecio multilobatus</i>	Uinta groundsel
<i>Sphaeralcea coccinea</i>	Scarlet Globemallow
<i>Stenotus armerioides</i>	Thrifty goldenweed
SHRUBS	
<i>Amelanchier alnifolia</i>	Saskatoon serviceberry
<i>Amelanchier utahensis</i>	Utah Serviceberry
<i>Artemisia nova</i>	Black sagebrush
<i>Artemisia tridentata</i> ssp. <i>tridentata</i>	Basin big sagebrush
<i>Artemisia tridentata</i> spp. <i>vaseyana</i>	Mountain big sagebrush
<i>Artemisia tridentata</i> spp. <i>Wyomingensis</i>	Wyoming big sagebrush
<i>Atriplex canescens</i>	Fourwing saltbush
<i>Cercocarpus montanus</i>	Mountain mahogany
<i>Chrysothamnus depressus</i>	Dwarf rabbitbrush
<i>Chrysothamnus nauseosus</i>	Rubber rabbitbrush
<i>Chrysothamnus viscidiflorus</i>	Low rabbitbrush
<i>Cowania stansburiana</i>	Cliffrose
<i>Ephedra viridis</i>	Green Ephedra
<i>Ceratoides lanata</i>	Winterfat
<i>Purshia tridentata</i>	Antelope bitterbrush
<i>Rhus trilobata</i>	Skunkbush sumac
<i>Rosa woodsii</i>	Woods rose

Table 2. – Criteria used to rate and determine individual forbs for plant development

	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Principal Areas of Seed Production	Seed Availability, Quantity	Potential Native Seed Production	Existence of Ecotypic Populations	Seed Quality (seed viability and ^{hardness})	Seed Processing and Cleaning	Seed Germinating Attributes	Seed Planting Methods	Seedling Establishment Capabilities	Seedling Growth Rate	Seedling Growth	Wildlife Habitat Values	Forage Value	Seasonal Forage Values
<i>Achillea millefolium lanulosa</i>	W/C	5	5	C	G	EA	G	B,I	G	G	M	M	SP,ES	
<i>Balsamorhiza sagittata</i>	W	5	5	S	G	EA	G	D	F	S	E	E	SP,ES	
<i>Eriogonum umbellatum</i>	W	2	5	S	E	EA	G	D	G	G	G	G	SP,ES, F,W	
<i>Hedysarum boreale boreale</i>	W/C	5	5	C	G	EA	G	D	G	G	E	E	SP,ES, MS	
<i>Linum lewisii</i>	W/C	5	5	C	E	EA	G	B,I,D	E	G	M	F	SP,ES	
<i>Medicago sativa</i>	C	5	-	-	E	EA	HG	B,I,D	E	G	E	E	SP,MS, F,W	
<i>Sanguisorba minor</i>	C	5	-	-	E	EA	HG	I,D	E	G	E	E	SP,MS, F,W	
<i>Tragopogon porrifolius</i>	W	4	4	S	G	P	G	D	G	G	G	G	S,MS, F	
<i>T partensis</i>	W	3	4	S	G	P	G	D	G	G	G	G	S,MS, F	
<i>T dubius</i>	W	3	4	S	G	P	G	D	G	G	G	G	S,MS, F	
<i>Agoseris glauca</i>	W	1	2	N	F	P	G	B,I	F	S	M,G	M	SP,MS	
<i>Arenaria spp</i>	W	1	2	N	F	P	G	B,I	F	S	U	M	SP,MS	
<i>Aster glaucodes</i>	W	5	4	C	G	A	G	B,I,D	G	M,G	M,G	G	SP,MS, F	
<i>Astragalus spp</i>	W	1	4	N	E	EA	HD	B,I,D	M	M,G	M,G	G	SP,MS, F	
<i>Castilleja spp</i>	W	1	1	N	E	EA	G	B,I	M	S	U	M	SP,MS	
<i>Collomia linearis</i>	W	1	1	N	G	P	G	B,I	M	M	U	M	SP,MS	
<i>Crepis acuminata</i>	W	2	4	S	G	P	G	B,I,D	G	G	G	G	SP,MS, F	
<i>Crepis occidentalis</i>	W	2	4	S	G	P	G	B,I,D	G	G	G	G	SP,MS, F	
<i>Erigeron spp</i>	W	2	4	S	G	EA	G	D	G	G	G	G	SP,MS, F,W	
<i>Lathyrus spp</i>	W	2	4	N	G	EA	MD	D	M	G	G	G	SP,MS	
<i>Lomatium simplex</i>	W	3	5	N	G	EA	G	D	G	G	G	G	SP,MS	
<i>Lupinus spp</i>	W	5	5	C	G	EA	MD	D	M	G	G	G	SP,MS	
<i>Penstemon eatoni</i>	W/C	5	5	C	G	EA	G	B,I,D	G	G	G	G	SP,MS, F	
<i>P humilis</i>	W	3	4	S	G	EA	G	B,I,D	G	G	G	G	SP,MS, F	
<i>P parviflorus</i>	W	3	4	S	G	EA	G	B,I,D	G	G	G	G	SP,MS, F	
<i>R rydbergii</i>	W/C	4	5	S	G	EA	G	B,I,D	G	G	G	G	SP,MS, F	
<i>P strictus</i>	W/C	3	4	S	G	EA	G	B,I,D	G	G	G	G	SP,MS, F	
<i>Phlox longifolia</i>	W	1	1	N	F	NA	-	B,I	F	S	M	L	SP,MS	
<i>Potentilla spp</i>	W	1	4	S	G	EA	G	B,I,D	G	G	M	G	SP,MS	
<i>Senecio spp</i>	W	1	5	S	G	P	G	B,I,D	G	G	M	M	SP,MS	
<i>Sphaeralcea coccinea</i>	W	3	4	C	E	P	HD,E	D	P,E	M	M	G	SP,MS, F	

Section 3

Table 2. – Continued

1. Principal areas of seed production:
W = Wildland harvested
C = Produced from cultivated fields
2. Seed availability, quantity:
1 = less than 200 lbs. produced annually
2 = 200 – 500 lbs. produced annually
3 = 500 – 1,000 lbs. produced annually
4 = 1,000 – 2,000 lbs. produced annually
5 = Over 2,000 lbs. produced annually
3. Potential native seed production:
1 = Poor 2 = Fair 3 = Erratic 4 = Good 5 = Excellent
4. Existence of ecotypic populations:
N = Not reported S = Suspected C = Confirmed
5. Seed quality (Seed viability and development)
P = Poor F = Fair E = Erratic
6. Seed processing and cleaning:
NA = Not easily attainable
A = Attainable but very difficult
P = Practical but cleaned to moderate purity percentages
EA = Easily cleaned to high purity percentages
7. Seed germination attributes:
HD = High percentage of seeds remain dormant
MD = Moderate fraction of seed remain dormant
E = Seeds dormancy and germination highly erratic
G = Seeds normally germinate with stratification
HG = Seeds highly germinable
8. Planting methods:
B = Broadcasting only
BC = Broadcast distribution and coverage
I = Imprint seeding
D = Drill seeding
9. Seedling establishment capabilities:
P = Poor F = Fair E = Erratic M = Moderate
G = Good E = Excellent
10. Seedling growth rate:
S = Slow M = Moderate G = Good E = Excellent
11. Wildlife habitat values:
U = Undetermined L = Low M = Moderate
G = Good E = Excellent
12. Forage value:
L = Low F = Fair M = Moderate
G = Good E = Excellent
13. Seasonal forage values:
SP = Spring ES = Early Summer MS = Mid Summer
F = Fall W = Winter

Section 3

Table 3. -- Ecological, biological, and cultural features used in the selection of grasses plant development

Species	Adapted Cultivars	Range of Occurrence	Multiple Populations	Community Importance	Seed Availability	Natural Recruitment	Plant Culture	Seed Germination	Seed Harvesting Processing	Forage Value
Muttongrass	NA	MD	LP	P	L	M	H	H	H	H
Sandburg bluegrass	A	WD	MP	P	L	E	H	H	H	M
Mountain brome	A	MD	LP	P	M	E	H	H	H	H
Nodding brome	NA	LD	RP	M	I	E	H	H	H	H
Sand dropseed	A	MD	MP	P	M	E	M	M	M	L
Galleta	NA	MD	MP	P	L	M	M	M	M	M
Prairie junegrass	NA	MD	LP	M	L	M	H	H	H	H
Indian ricegrass	A	WD	MP	P	M	L	M	P	M	H
Squirreltail	A	WD	MP	P	M	E	M	M	P	M
Slender wheatgrass	A	MD	MP	P	H	E	H	H	H	H
Western wheatgrass	A	LD	MP	P	H	P	H	M	H	M
Basin wildrye	A	LD	MP	P	M	P	H	H	H	M
Salina wildrye	NA	RD	RP	M	I	P	L	P	M	L

Table 3. -- Continued

<u>Availability of Cultivars or Ecotypes</u>	<u>Range of Occurrence</u>	<u>Number of Populations or Ecotypes</u>
A- Site adapted populations or cultivars available	WD- Widely distributed species	MP- Multiple populations occur
NA- Site adapted populations or cultivars not available	MD- Moderately distributed species	LP- Limited populations occur
	LD- Limited distribution	RP- Restricted number of populations occur
	RD- Restricted distribution	
<u>Importance of Plant Communities</u>	<u>Seed Availability</u>	<u>Natural Recruitment</u>
P- Principal species in community associations	H- Seed abundant and available	E- Excellent recruitment capabilities
M- Moderately abundant in plant communities	M- Moderate amounts of seed available	M- Moderate recruitment capabilities
L- Limited density and distribution in plant communities	L - Limited amounts of seed available	L- Limited or erratic recruitment capabilities
	I- Low and inconsistent amounts of seed available	P- Poor or no recruitment
<u>Plant Culture</u>	<u>Seed Germination</u>	<u>Seed Processing and Planting</u>
H- Plants easily grown, high seed production	H- Seed highly germinable	H- Seeds easily harvested, processed and planted
M- Plant moderately easy to culture	M- Seed moderately germinable	M- Seeds moderately easy to harvest, process, and plant
L- Plants difficult to culture	L- Irregular and erratic germination	L- Fruit structures hinder harvesting, processing and planting
	P- Poor germination, high dormancy	P- Seeds difficult to harvest, process and plant
<u>Forage Value</u>		
H- Abundant and palatable forage		
M- Moderately productive and palatable forage		
L- Low productivity and seasonal forage value		
P- Plants unpalatable		

Table 4. -- Ecological, biological, and cultural features used in the selection of shrubs for plant development

Species	Range of Occurrence	Loss of Community	Importance to Plant Association	Importance for Restoration	Wildlife Values	Number of Ecotypes	Natural Recruitment	Seed Availability	Seed Production, Cultivated Fields	Ease of harvesting and Processing
Saskatoon serviceberry	LA	L	HI	MI	HI	LP	P	H	P	M
Black sagebrush	MA	H	HI	HI	HI	MP	H	H	H	H
Basin big sagebrush	MA	L	MI	MI	MI	LP	H	H	H	H
Mountain big sagebrush	HA	M	HI	HI	HI	LP	H	M	H	H
Wyoming big sagebrush	HA	M	HI	HI	HI	MP	M	L	M	H
Fourwing saltbush	LA	H	MI	HI	HI	MP	P	H	H	H
Mountain mahogany	MA	M	MI	MI	HI	LP	P	H	P	P
Cliffrose	LA	M	MI	HI	HI	LP	P	M	P	M
Low rabbitbrush	MA	M	MI	MI	HI	LP	H	H	H	M
Rubber rabbitbrush	MA	L	MI	MI	MI	LP	H	H	H	M
Green ephedra	LA	L	MI	MI	MI	LP	P	M	H	H
Winterfat	LA	H	HI	HI	HI	LP	M	M	M	P
Chokecherry	MA	L	MI	MI	MI	LP	P	M	P	M
Antelope bitterbrush	LA	H	MI	HI	HI	MP	M	M	H	H

Table 4. -- Continued

<u>Range of Occurrence</u>	<u>Loss of Community Associations</u>
HA- Species widespread and dominant	H- Significant loss of shrub and associated species
MA- Species moderately abundant	M- Major loss of stands from different locations
LA- Plants usually exist on specific soils, precipitation zones and elevations	L- Moderate loss of principal shrub. Significant loss of understory species
<u>Importance in Restoration of Native Communities</u>	<u>Importance to Wildlife Habitats - Big Game/ Sage Grouse</u>
HI- Shrub highly important in restoring depleted sites	HI- Species highly important to restore wildlife habitats
MI- Shrub moderately important in restoring existing disturbances	MI- Species moderately important to habitat restoration
LI- Restoration of shrub communities of limited importance to most areas	LI- Limited wildlife habitats require restoration
UI- Assisted restoration not necessary for this shrub type to reestablish	
<u>Importance to Associated Species</u>	<u>Natural Recruitment Potential</u>
HI- Shrub is highly important to associated species	H- Highly successful in natural recruitment
MI- Shrub is moderately important to other plants	M- Moderately successful and limited to specific climate conditions
LI- Shrub has limited importance to other plants	L- Seeding recruitment is infrequent and there is low survivability
UI- Shrub is unimportant to understory species	P- Seedling recruitment is unsuccessful
<u>Potential Occurrence of Different Ecotypes or Site Adapted Populations</u>	<u>Seed Availability From Wildland Harvests</u>
MO- Multiple populations have been identified	H- Abundant seed crops produced annually
LP- Limited number of populations expected to occur. Only a few site specific populations exist.	M- Moderate amount of seed produced. Crops produced about 5 of every 10 years.
GP- Few populations of ecotype present. Most often a broad generalist occurs.	L- Infrequent crops develop most years. Crops harvested only in years of abundant moisture.
	P- Seed production is very infrequent
<u>Seed Production From Cultivated Fields</u>	<u>Ease of Seed Harvesting and Processing</u>
H- Consistent and high amounts of seed can be produced from cultivated fields	H- Seed collection or harvesting and cleaning can be completed with conventional equipment or practices. Costs are relatively low.
M- Only moderate amounts of seed can be grown in field plantings. Seed yields are inconsistent and require specific soils, insect pollination and culture.	M- Seed harvesting or processing requires special equipment. Seeds may require a series of conditioning procedures to be cleaned.
L- Seed production is quite low. Stands mature slowly, flowering and seed production require specific climate conditions.	L- Seed harvesting and cleaning are a major problem