

Stickney Postfire Regeneration Strategy

20090

FEIS Workshop, IFSL

Peter F. Stickney, RWU-4201

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SERAL ORIGIN of Species Comprising Secondary Plant Succession in Northern Rocky Mountain Forests

Seral origin, as defined by location relative to disturbance and time of establishment, describes the source of postdisturbance plant species constituting the vegetation of secondary plant succession (= forest succession). It provides a basis for categorizing postfire development modes.

SURVIVOR -----	Extant predisturbance (prefire) plants capable of regrowth after burning. (Susceptibility to fire relates to growing-point location relative to fuel bed/mass.)
Perennial aerial stem	Phanerophytic, without adventitious buds.
Suprasurface stem	Chamaephytic, prostrate, mat-forming or stoloniferous stems growing <u>on</u> the organic mantle.
Surface rhizome	Hemicryptophytic, stout horizontal stem rooted on or embedded in the mineral ground surface.
Rootcrown	Phanerophytic, adventitious buds.
Caudex	Subsurface to near-ground surface stems.
Rhizome	Underground stems.
Geophyte	Deeper seated regenerative plant parts (usually stems: bulb, corm, etc. or root with adventitious buds).
Colonizer -----	New plants established from post-disturbance (postfire) germinated seed.
Initial Colonizer -----	A seedling establishing in the initial community.
RESIDUAL COLONIZER:	Derived from seed on site at the time of disturbance. (= Initial <u>Onsite Colonizer</u>)
Ground-stored	Seed site in the ground.
Crown-stored	Seed site in tree crown.
INITIAL OFFSITE COLONIZER:	Derived from interaction of seed dispersal and germination substrate of the initial post-disturbance (postfire) community.
Secondary Colonizer -----	A seedling establishing in the post-initial community.
SECONDARY OFFSITE COLONIZER:	Derived from interaction of seed dispersal and germination substrate <u>and</u> established plants of the post-initial community.
Secondary onsite colonizer	Derived from seed of survivor or onsite colonizer.

R-1 Autecology Database (PLANTAU)

Field 11 - Stickney Survivor / Colonizer Modes:

Peter Stickney (1989), in meeting at the Intermountain Fire Science Laboratory, proposed modes by which plant species survive fire or colonize burned sites.

11a - Survivor Modes (postfire regrowth sources)

<u>Code</u>	<u>Mode</u>	<u>Fig. 1</u>
A	Tree without adventitious-bud root/crown (e.g. Conifer)	a.
B	Shrub without adventitious-bud root/crown	b.
C	Prostrate woody plant, stem growing <u>on</u> organic mantle	c.
D	Surface rhizome / chamaephytic root/crown in organic mantle or on soil surface	d. e.
E	Tree with adventitious-bud root/crown; soboliferous species root sucker	f.
F	Tall shrub, adventitious-bud root/crown	g.
G	Small shrub, adventitious-bud root/crown	h.
H	Rhizomatous low woody plant, rhizome in organic mantle	i.
I	Rhizomatous shrub, rhizome in soil	j.
J	Rhizomatous herb, rhizome in soil	k.
K	Tussock graminoid (e.g. bunchgrass)	l.
L	Caudex, growing points in soil	m.
M	Geophyte, growing points deep in soil	o. p.

11b - Colonizer Modes (postfire seed sources)

Fig. 2

A	Ground Residual Colonizer (onsite, initial community only)
B	Crown Residual Colonizer (onsite, initial community only)
C	Initial-offsite Colonizer (offsite , initial community only)
D	Secondary Colonizer (onsite or offsite seed sources)

11c - Successional Development Status

A	Obligate Initial Community Species (species present only/mostly present in the early seral communities)
B	Facultative Seral Species (species present in both early and late seral communities)
C	Obligate Climax Species (species present only in late seral / climax communities)

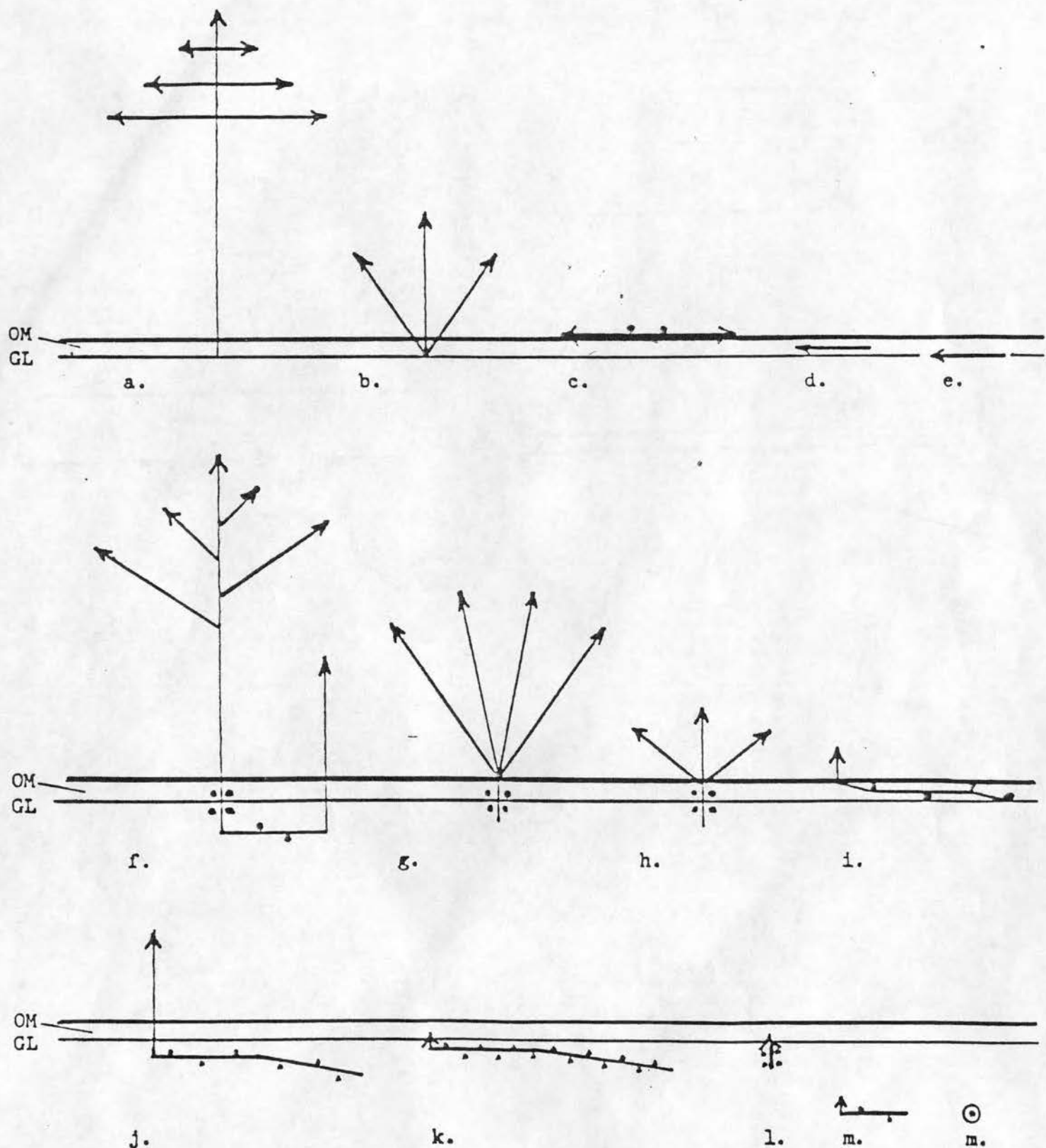


Figure 1. Seral origins for the survivor component of the initial community of forest succession in the Northern Rocky Mountains. Stylized life forms portray the perennial stem system and position of the active (arrowhead) and dormant (dots) growing points relative to the fuel bed of the forest floor (OM) and the mineral ground - organic mantle interface (GL). Life forms: a & b. perennial aerial stem without adventitious buds; c. suprasurface stem; d & e. surface rhizomes; f, g, & h. rootcrowns; i, j, & k. rhizomes; l. caudex; and m & n.

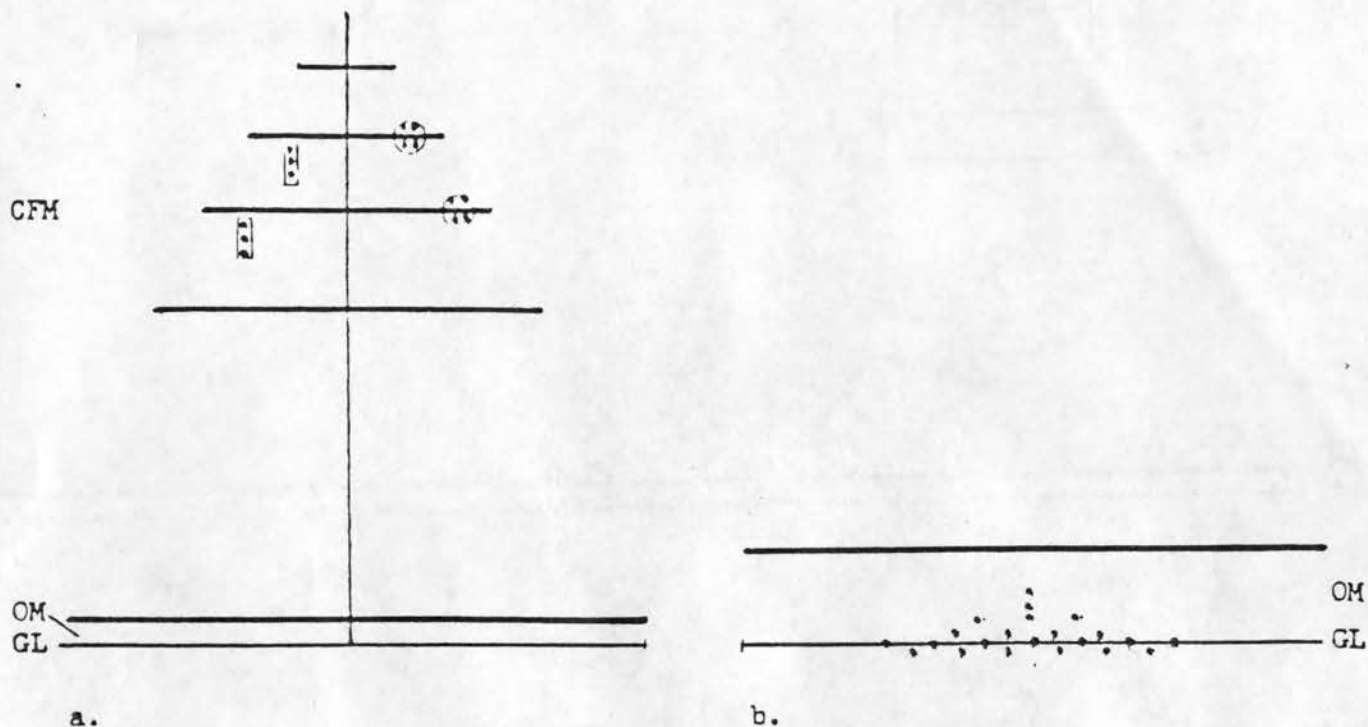


Figure 2. Seral origins for the residual colonizer component of the initial community of forest succession. Diagrammatic representation depicts locations of residual colonizer seed sources in the prefire forest relative to crown (CFM) and ground (OM) fuel masses and the mineral ground - organic mantle interface (GL). Residual colonizer seed sites: a. tree (& shrub?) crown and b. ground. Due to their restriction to the pretree stages of succession seeds of obligate initial seral species with long duration viability; e.g. Ceanothus velutinus, Dracocephalum parviflorum, Geranium bicknellii; concentrate about

APPENDIX: SERAL CHARACTERISTICS OF THE FLORISTIC COMPOSITION OF THE FIRST DECADE'S SECONDARY SUCCESSION ON SUNDANCE BURN STUDY AREAS.

Species	Physiognomic life form	Seral origin	Fire survival adaptation	First/last S.Y. record	Occurrence		
					Pres	Freq	Cover
<i>Abies grandis</i>	Tree	Introduced		2	6	4	3
<i>Acer glabrum</i>	T-Shrub	Survivor	Root crown	1	12	2	4
<i>Achillea millefolium</i>	Herb	Survivor	Rhizome	1	11	2	1
<i>Adenocaulon bicolor</i>	Herb	Survivor	Caudex	1	3	1	
<i>Agoseris grandiflora</i> ^a	Herb	2d O-S colonizer		9	4	1	
<i>Agrostis alba</i> ^a	Herb	Introduced		1	12	7	3
<i>Agrostis exarata</i>	Herb	2d O-S colonizer		5	2	1	
<i>Agrostis scabra</i>	Herb	1 O-S colonizer(?)		1	9	1	
ALNUS SINUATA	T-Shrub	Survivor	Root crown	1	10	8	6
<i>Alopecurus pratensis</i> ^b	Herb	2d O-S colonizer		9	1		
AMELANCHIER ALNIFOLIA ^c	T-Shrub	Survivor	Root crown	1	14	12	4
ANAPHALIS MARGARITACEA	Herb	1 O-S colonizer		1	18	17	13
<i>Antennaria microphylla</i>	Herb	2d O-S colonizer		3	3		
<i>Antennaria neglecta</i>	Herb	2d O-S colonizer		9	1	1	
<i>Apocynum androsaemifolium</i> ^a	Herb	Survivor	Rhizome	1	12	9	4
<i>Arabis holboellii</i>	B-Herb	R-colonizer	GSS-1	1	3	1	
<i>Aralia nudicaulis</i> ^c	Herb	Survivor	Rhizome	1	2	2	2
<i>Arnica cordifolia</i>	Herb	Survivor	Rhizome	1	2	1	
<i>Arnica latifolia</i>	Herb	Survivor	Rhizome	1	2	2	1
<i>Asarum caudatum</i>	Herb	R-colonizer	GSS-1	1	2	1	
<i>Aster conspicuus</i>	Herb	Survivor	Rhizome	1	6		
<i>Aster engelmannii</i>	Herb	Survivor	Caudex	1	4	1	
<i>Aster laevis</i>	Herb	2d O-S colonizer		3/4	1		
<i>Athyrium filix-femina</i>	Herb	Survivor(A)		2	2		
<i>Berberis repens</i> ^c	LWP	Survivor	Rhizome	1	6	3	1
BETULA Papyrifera	Tree	Survivor	Root crown	1			
		R-colonizer	GSS-1	1	8	5	2
<i>Bromus inermis</i> ^b	Herb	2d O-S colonizer		10	1		
CALAMAGROSTIS RUBESCENS	Herb	Survivor	Rhizome	1	10	7	4
<i>Calochortus apiculatus</i>	Herb	Survivor	Bulb	1	1	1	
<i>Campanula rotundifolia</i>	Herb	2d O-S colonizer		7	1		
<i>Carex deweyana</i>	Herb	R-colonizer	GSS(?)	1	1		
<i>Carex geyeri</i>	Herb	Survivor	Rhizome	1	2	2	1
<i>Carex pachystachya</i>	Herb	R-colonizer	GSS(?)	1	1	1	
<i>Carex rossii</i>	Herb	R-colonizer	GSS-2	1	17	12	10
<i>Castilleja miniata</i>	Herb	2d O-S colonizer		3	12	5	1
CEANOTHUS SANGUINEUS	T-Shrub	Survivor	Root crown	1			
		R-colonizer	GSS-2	1	14	12	10
<i>Ceanothus velutinus</i>	Shrub	Survivor	Root crown	1			
		R-colonizer	GSS-2	1	6	3	4
<i>Chenopodium album</i> ^b	A-Herb	Introduced(A)		1/1	1		
<i>Chimaphila umbellata</i>	Herb	Survivor(A)		3	2		
<i>Cirsium arvense</i> ^{a, d}	Herb	Survivor	Rhizome	1	4	1	1
<i>Cirsium vulgare</i> ^{a, d}	B-Herb	1 O-S colonizer		1	12	7	
<i>Clintonia uniflora</i> ^c	Herb	Survivor	Rhizome	1	17	8	3
<i>Collinsia parviflora</i>	A-Herb	R-colonizer	GSS-1	1	3	3	
<i>Conyza canadensis</i>	A-Herb	1 O-S colonizer		1	17	10	
<i>Cryptantha affinis</i>	A-Herb	R-colonizer	GSS-1	1	2	2	1
<i>Dactylis glomerata</i> ^b	Herb	Introduced		1	9	4	3
<i>Deschampsia elongata</i>	Herb	2d O-S colonizer		6	3		
<i>Disporum hookeri</i> ^c	Herb	Survivor	Rhizome	1	17	12	3
<i>Dracopis parviflorum</i>	B-Herb	R-colonizer	GSS-2	1/1	2		
EPILOBIUM ANGUSTIFOLIUM ^a	Herb	1 O-S colonizer		1			
		Survivor	Rhizomelike root	1	18	18	18
<i>Epilobium paniculatum</i> ^a	A-Herb	1 O-S colonizer		1	13	8	
<i>Epilobium watsonii</i> ^a	Herb	1 O-S colonizer		1/6	16	9	
<i>Equisetum arvense</i>	Herb	Survivor	Rhizome	1	1		
<i>Erigeron acris</i>	B-Herb	2d O-S colonizer		8	6	4	
<i>Erucastrum gallicum</i> ^b	A-Herb	Introduced(A)		1/1	1		

(con.)

APPENDIX. (Con.)

Species	Physiognomic life form	Seral origin	Fire survival adaptation	First/last S.Y. record	Occurrence		
					Pres	Freq	Cover
<i>Festuca arundinacea</i> ^b	Herb	Introduced		1	16	12	4
<i>Festuca occidentalis</i>	Herb	2d O-S colonizer		3	3	1	
<i>Filago arvensis</i> ^b	A-Herb	1 O-S colonizer		1	9	2	
<i>Fragaria vesca</i> ^c	Herb	Survivor	Caudex	1	4	1	1
<i>Galium triflorum</i> ^d	Herb	R-colonizer	GSS-1	1	5	2	
<i>Geranium bicknellii</i>	A-Herb	R-colonizer	GSS-2	1/9	5	4	3
<i>Gnaphalium microcephalum</i>	B-Herb	1 O-S colonizer		1	18	12	1
<i>Gnaphalium palustre</i>	A-Herb	1 O-S colonizer		1/5	7		
<i>Gnaphalium viscosum</i>	B-Herb	2d O-S colonizer		3	13	9	
<i>Gymnocarpium dryopteris</i>	Herb	Survivor(A)		3	2		
<i>Habenaria elegans</i>	Herb	Survivor	Tuber	1	15	4	
<i>Heuchera cylindrica</i>	Herb	Survivor(?)		4	1		
<i>Hieracium albidiflorum</i>	Herb	2d O-S colonizer		2	18	15	6
<i>Hieracium umbellatum</i>	Herb	2d O-S colonizer		9	1		
<i>Holodiscus discolor</i>	Shrub	Survivor	Root crown	1	6	3	3
<i>Hypericum perforatum</i> ^b	Herb	2d O-S colonizer		4/9	1		
<i>Iliamna rivularis</i>	Herb	Survivor	Caudex	1	12	8	5
		R-colonizer	GSS-2	1			
<i>Juniperus communis</i> ^c	Shrub	2d O-S colonizer		5	1	1	
<i>Lactuca serriola</i> ^{b, d}	A-Herb	1 O-S colonizer		1/1	5		
<i>Larix occidentalis</i>	Tree	R-II O-S colonizer(?)		10	4		
<i>Lilium columbianum</i>	Herb	Survivor	Bulb	1	10	8	1
<i>Lonicera utahensis</i> ^c	Shrub	Survivor	Root crown	1	11	1	3
LUPINUS ARGENTUS	Herb	Survivor	Caudex	1	3	3	3
<i>Luzula parviflora</i>	Herb	2d O-S colonizer		4	1		
<i>Luzula piperi</i>	Herb	Survivor(?)		1	1	1	
<i>Oplopanax horridum</i> ^c	Shrub	Survivor	Root crown(?)	1	1		
<i>Osmorhiza chilensis</i> ^d	Herb	2d O-S colonizer		5	1	1	
PACHISTIMA MYRSINITES	Shrub	Survivor	Root crown	1			
		R-colonizer	GSS-1	1	18	17	13
<i>Phleum pratense</i> ^b	Herb	Introduced		1	13	5	2
<i>Picea engelmannii</i>	Tree	Introduced		2	6	3	3
PINUS CONTORTA	Tree	R-colonizer	GSS-1 or 2	1	15	4	5
<i>Pinus monticola</i>	Tree	R-colonizer	GSS-1	1	13	2	1
<i>Plantago major</i> ^c	Herb	Introduced(A)		1	2		
<i>Poa compressa</i> ^b	Herb	2d O-S colonizer		9	1	1	
<i>Poa palustris</i> ^d	Herb	1 O-S colonizer		1	3	1	
<i>Polygonum douglasii</i>	A-Herb	R-colonizer	GSS-1	1	2	2	
<i>Polygonum lapathifolium</i> ^b	A-Herb	Introduced(A)		1/1	1		
<i>Populus tremuloides</i> ^d	Tree	Survivor	Root crown	1			
		1 O-S colonizer		1	13	7	3
<i>Populus trichocarpa</i> ^d	Tree	Survivor	Root crown	1			
		1 O-S colonizer		1	2	1	
<i>Prunus emarginata</i> ^c	T-Shrub	Survivor	Root crown	1	5	3	3
<i>Pseudotsuga menziesii</i>	Tree	Introduced		1	18	12	9
PTERIDIUM AQUILINUM	Herb	Survivor	Rhizome	1	15	15	14
<i>Pyrola asarifolia</i>	Herb	Survivor	Rhizome	1	6	1	
<i>Pyrola picta</i>	Herb	Survivor	Rhizome	1	5	3	1
<i>Pyrola secunda</i>	Herb	Survivor	Rhizome	2	12	7	
<i>Ribes lacustre</i>	Shrub	R-colonizer	GSS-2	1	4		
<i>Ribes viscosissimum</i> ^c	Shrub	R-colonizer	GSS-2	1	2	1	2
<i>Rosa gymnocarpa</i> ^c	Shrub	Survivor	Root crown	1	11	11	8
<i>Rubus idaeus</i> ^c	Shrub	2d O-S colonizer		4	5	1	1
<i>Rubus leucodermis</i> ^c	Shrub	Survivor	Root crown	1			
		R-colonizer	GSS-2 (?)	1	7	6	4
RUBUS PARVIFLORUS ^c	Shrub	Survivor	Rhizome	1	15	11	13
		R-colonizer	GSS-2	1			
<i>Rumex acetosella</i> ^b	Herb	Survivor	Rhizome	1/5	1		
SALIX SCOLERIANA ^a	T-Shrub	Survivor	Root crown	1	18	18	18
		1 O-S colonizer		1			
<i>Sambucus racemosa</i> ^c	Shrub	Survivor	Root crown	1	5	4	3

APPENDIX. (Con.)

Species	Physiognomic life form	Seral origin	Fire survival adaptation	First/last S.Y. record	Occurrence		
					Pres	Freq	Cover
<i>Secale cereale</i> ^b	A-Herb	Introduced		1/4	10	7	
<i>Senecio vulgaris</i> ^b	A-Herb	Introduced(A)		1/5	9	2	
<i>Silene noctiflora</i> ^b	A-Herb	Introduced(A)		1/3	2		
<i>Smilacina racemosa</i> ^c	Herb	Survivor	Rhizome	1	4	2	
<i>Smilacina stellata</i> ^c	Herb	Survivor	Rhizome	1	8	4	2
<i>Solidago canadensis</i>	Herb	Survivor	Rhizome	1	18	11	
<i>Sorbus scopulina</i> ^c	T-Shrub	Survivor	Root crown	1	4		
<i>Spergularia rubra</i> ^b	A-Herb	I O-S colonizer		1/2	6	1	
<i>Spiraea betulifolia</i>	Shrub	Survivor	Rhizome	1	8	7	5
<i>Spiranthes romanzoffiana</i>	Herb	2d O-S colonizer		3	1		
<i>Stellaria media</i> ^d	A-Herb	Introduced(A)		1/5	3	1	
<i>Stellaria obtusa</i>	Herb	R-I O-S colonizer(?)		1/1	1		
<i>Symphoricarpos albus</i> ^c	Shrub	Survivor	Rhizome	1	4	3	4
<i>Taraxacum laevigatum</i> ^{b,d}	Herb	2d O-S colonizer		5/6	2		
<i>Taraxacum officinale</i> ^{d,e}	Herb	I O-S colonizer		1	13	9	
<i>Thalictrum occidentale</i>	Herb	Survivor	Rhizome	1	7	2	2
<i>Thuja plicata</i>	Tree	2d O-S colonizer		6	2		
<i>Tiarella trifoliata</i>	Herb	Survivor	Caudex	1	2	2	
<i>Tragopogon dubius</i> ^{b,e}	B-Herb	2d O-S colonizer		8	1		
<i>Trautvetteria carolinensis</i>	Herb	Survivor	Rhizome	1	4	1	
<i>Trifolium agrarium</i> ^b	A-Herb	2d O-S colonizer(?)		2/6?	1		
<i>Trifolium hybridum</i> ^b	Herb	Introduced		1	10	4	2
<i>Trifolium repens</i> ^d	Herb	Introduced		1	12	7	2
<i>Trillium ovatum</i>	Herb	Survivor	Corm	1	2		
<i>Trisetum cernuum</i>	Herb	2d O-S colonizer		10	2		
<i>Tsuga heterophylla</i>	Tree	2d O-S colonizer		6	4		
<i>Vaccinium membranaceum</i> ^c	Shrub	Survivor	Rhizome	1	17	9	6
<i>Viola glabella</i>	Herb	Survivor	Rhiz/Caud	1	6	3	
		R-colonizer	GSS-1	1			
<i>Viola orbiculata</i>	Herb	Survivor	Rhizome	1	16	16	
		R-colonizer	GSS-1	1			
<i>Xerophyllum tenax</i>	Herb	Survivor	Rhizome	1	8	3	3

(TOTAL: 139 species)

LEGEND:

Species:

Names in capital letters denote principal cover species: (15+ percent cover)

^aseed or fruit capable of long-range wind dispersal^bexotic species^cberry or berrylike fruit, bird and/or animal dispersed^darmed fruit, animal dispersed

Physiognomic life form:

T-Shrub = tall shrub (maximum height > 2 m)

LWP = low woody plant (maximum height < 0.5 m)

A-Herb = annual herb

B-Herb = biennial or short-lived perennial herb

Seral origin:

Introduced denotes planted or seeded by man

R-colonizer denotes residual colonizer (onsite source)

I O-S colonizer denotes initial offsite colonizer (immigration in succession year 1)

2d O-S colonizer denotes secondary offsite colonizer (immigration after succession year 1)

Double entry in the species listing indicates those 14 species that exhibited more than one seral origin

(A) = accidental; denotes very infrequently surviving species or introduced as a "weed" seed in seedling mixture

Fire survival adaptation:

CSS = Tree crown source seed (onsite); 1 short-term viability, 2 long-term viability

GSS = Ground source seed (onsite); 1 short-term viability, 2 long-term viability

First/last succession year (S.Y.) record: First and last year of recorded occurrence

Occurrence: Numerals denote the number of study areas on which the species occurred as presence, frequency, and cover, respectively

APPENDIX I

Survival strategies of some Northern Rocky Mountain plant species

SURVIVING PLANT PARTS

Root Crown/Caudex:

- Trees:** *Betula papyrifera*, *Populus tremuloides*, *Populus trichocarpa*.
Shrubs: *Acer glabrum*, *Alnus sinuata*, *Amelanchier alnifolia*, *Ceanothus sanguineus*, *Ceanothus velutinus*, *Holodiscus discolor*, *Lonicera utahensis*, *Menziesia ferruginea*, *Pachistima myrsinites*, *Penstemon fruticosus*, *Prunus emarginata*, *Ribes lacustre*, *Ribes viscosissimum*, *Rosa gymnocarpa*, *Rubus leucodermis*, *Salix scouleriana*, *Sambucus racemosa*, *Shepherdia canadensis*, *Sorbus scopulina*, *Symphoricarpos oreophilus*.
Herbaceous plants: *Aster engelmannii*, *Clematis columbiana*, *Lonicera ciliosa*, *Lupinus (urgenteus and sulphureus)*, *Pedicularis contorta*, *Phacelia hastata*.

Rhizomes:

- Shrubs:** *Rubus parviflorus*, *Spiraea betulifolia*, *Symphoricarpos albus*, *Vaccinium globulare*, *Vaccinium membranaceum*, *Vaccinium scoparium*.
Herbaceous plants: *Achillea millefolium*, *Agrostis alba*, *Anaphalis margaritaceae*, *Apocynum androsaemifolium*, *Aralia nudicaulis*, *Arnica cordifolia*, *Arnica latifolia*, *Asarum caudatum*, *Aster conspicuus*, *Berberis repens*, *Calamagrostis rubescens*, *Carex concinnoides*, *Carex geyeri*, *Clintonia uniflora*, *Disporum hookeri*, *Epilobium angustifolium*, *Galium triflorum*, *Luzula hitchcockii*, *Pteridium aquilinum*, *Pyrola asarifolia*, *Pyrola secunda*, *Silene menziesii*, *Smilacina racemosa*, *Smilacina stellata*, *Solidago canadensis*, *Thalictrum occidentale*, *Tiarella trifoliata*, *Trautvetteria carolinensis*, *Viola adunca*, *Xerophyllum tenax*.

Deep, Underground Stems:

- Herbaceous plants:** *Calochortus apiculatus*, *Claytonia lanceolata*, *Erythronium grandiflorum*, *Habenaria elegans*, *Lilium columbianum*, *Trillium ovatum*.

SEED/FRUIT

Short Viability (cones in the tree):

- Trees:** *Abies lasiocarpa*, *Pinus contorta* (non-serotinous), *Pinus monticola*, *Pseudotsuga menziesii*.
Long Viability (heat treatment required, tree or ground stored):
Trees: *Pinus contorta* (serotinous).
Shrubs: *Ceanothus sanguineus*, *Ceanothus velutinus*, *Ribes lacustre*, *Ribes viscosissimum*, *Sambucus racemosa**.
Herbaceous plants: *Carex rossii**, *Dracocephalum parviflorum**, *Illecebrum rivularis**, *Geranium bicknellii**.

*Provisional

APPENDIX: VEGETATION INITIATING SECONDARY FOREST SUCCESSION ON SUNDANCE BURN STUDY AREAS—
FLORISTIC COMPOSITION OF THE FIRST POSTFIRE YEAR AND SPECIES RESPONSE TO THE FIRE

Species	Abbreviation	Sundance Burn study area																			
		01	02	03	04	05	06	07	08	09	10	14	15	16	17	18	19	20	21		
TREES																					
<i>Abies grandis</i> ¹	ABGR																				
<i>Betula papyrifera</i>	BEPA	RS ²	RS			S				S						RS			S		
<i>Larix occidentalis</i> ¹	LAOC																				
<i>Picea engelmannii</i> ¹	PIEN																				
<i>Pinus contorta</i>	PICO	S															S	S	S		
<i>Pinus monticola</i>	PIMO	S	S																		
<i>Populus tremuloides</i>	POTHE			R		RS			S	S	S						S	S			
<i>Populus trichocarpa</i>	POTRI			R																	
<i>Pseudotsuga menziesii</i>	PSME				PS	P	PS	PS	P	P ¹	P				P						
SHRUBS																					
<i>Acer glabrum</i>	ACGL	R	R	R		R						R	R	R	R				R		
<i>Alnus sinuata</i>	ALSI	R	R			R											R				
<i>Amelanchier alnifolia</i>	AMAL	R		R							R	R		R	R					R	
<i>Ceanothus sanguineus</i>	CESA	S	S	S	S	S	S				S	S	RS	RS	RS	R*S				RS	
<i>Ceanothus velutinus</i>	CEVE	S												RS	RS	RS					
<i>Holodiscus discolor</i>	HODI	H		R									R		R	RS					
<i>Lonicera utahensis</i>	LOUT				R						R		R		R	R	R				
<i>Opiopanax horridum</i>	OPHO										R										
<i>Pachystima myrsinites</i>	PAMY	RS		RS	RS	RS		S		S	RS	R	RS	RS	RS	RS	R	R	R		
<i>Prunus emarginata</i>	PHEM												R		R	R			R		
<i>Ribes lacustre</i>	RILA																				
<i>Ribes viscosissimum</i>	RIVI																S				
<i>Rosa gymnocarpa</i>	ROGY			R	R	R						R	R	R	R	R			R	R	
<i>Rubus leucodermis</i>	RULE					S		RS	RS	RS	RS										
<i>Rubus parviflorus</i>	RUPA		R	R	R	H		RS	R	R	R			R		RS	R	R	R		
<i>Salix scouleriana</i>	SASC	RS	RS	RS	S	RS	S	S	S	S	RS	RS	RS	RS	R	RS	RS	RS	RS		
<i>Sambucus racemosa</i>	SARA							RS	HS	S	S										
<i>Sorbus scopulina</i>	SOSC	R				R							R								
<i>Spiraea betulifolia</i>	SPBE	R*											R	R	R	R*			R*		
<i>Symphoricarpos albus</i>	SYAL												R	R	R	R*					
<i>Vaccinium membranaceum</i>	VAME	R		R	R	R	R	R	R	R	R				R	R				R	
HERBS (includes low woody plants)																					
<i>Achillea millefolium</i>	ACMI														R	R					
<i>Adenocaulon bicolor</i>	ADBI					R			R*	R*											
<i>Agrostis alba</i>	AGAL	S*												S*		S*					
<i>Agrostis scabra</i>	AGSC	S*														S*					
<i>Anaphalis margaritacea</i>	ANMA		X		X				X*	X	X*	X	X	X		X		X*	X*		
<i>Apocynum androsaemifolium</i>	APAN	R*	R*	R*	R	R				R			R	R		R	R				
<i>Arabis holboellii</i>	ARHO														S	S					
<i>Aralia nudicaulis</i>	ARNU		R																		
<i>Arnica cordifolia</i>	ARCO												R		R						
<i>Arnica latifolia</i>	ARLA										R								R		
<i>Asarum canadense</i>	ASCA										S										
<i>Aster conspicuus</i>	ASCO															R*					
<i>Aster engelmannii</i>	ASEN														R*	R*					
<i>Athyrium filix-femina</i>	ATFI							N		N											
<i>Barberris repens</i>	BERE												R	R	R	R				R	
<i>Calamagrostis rubescens</i>	CARU	R*		R*									R*		R*	R*			R*		
<i>Calochortus apiculatus</i>	CAAP														R*						
<i>Carex deweyana</i> ¹	CADE																				
<i>Carex geyeri</i>	CAGE																				
<i>Carex rossi</i>	CARO	S		S	S	S		S		S	S	S	S	S	R	S	S			S	
<i>Castilleja miniata</i> ¹	CAMI																				
<i>Chenopodium album</i>	CHAL					S*															
<i>Cirsium arvense</i>	CIAR								R*	R*											
<i>Cirsium vulgare</i>	CIVU								S				S	S		S					
<i>Clintonia uniflora</i>	CLUN	R		R	R	R	R	H	R	R		R			R	S*	S*		R	R	
<i>Collinsia parviflora</i>	COPA													S*		S*	S*				

(con.)

APPENDIX: (Con.)

Species	Abbreviation	Sundance Burn study area																		
		01	02	03	04	05	06	07	08	09	10	14	15	16	17	18	19	20	21	
<i>Coniza canadensis</i>	COCA	S*	S*	S*	S*	S*		S*	S*	S*	S*		S*	S*	S*	S*	S*	S*	S*	
<i>Cryptantha affinis</i>	CRAF													S*	S*					
<i>Dactylis glomerata</i>	DAGL								S				S		S					
<i>Disporum hookeri</i>	DIHO	R	R*	R	R	R*		R*	R*	R*		R		R	R	R*		R*	R*	
<i>Dracocephalum parviflorum</i>	DRPA														S	S				
<i>Epilobium angustifolium</i>	EPAN	S*	S*	S*	S*	S*	S*	R*S	S*	S*	S*	S*	S*	S*	S	S*	S*	S*	S	
<i>Epilobium paniculatum</i>	EPPA	S*		S*	S*						S*	S	S	S		S*	S*	S*		
<i>Epilobium watsonii</i>	EPWA	S*	S*	S*	S*		S	S	S*	S*	S*	S	S	S	S	S*	S*	S*		
<i>Equisetum arvense</i>	EQAR								R											
<i>Erigeron acris</i> ¹	ERAC																			
<i>Erucastrum gallicum</i>	ERGA					S*														
<i>Festuca arundinacea</i>	FEAR	S	S	S*	S	S	S	S	S	S	S	S								
<i>Filago arvensis</i>	FIAR	S*							S*					S*			S*			
<i>Fragaria vesca</i>	FRVE														X	X				
<i>Galium triflorum</i>	GATR							X		X										
<i>Geranium bicknellii</i>	GEBI												S	S			S		S	
<i>Gnaphalium microcephalum</i>	GNMI	S	S		S	S		S	S*	S	S	S	S	S	S	S	S	S	S*	
<i>Gnaphalium palustre</i>	GNPA		S*							S*			S*	S*	S*			S*		
<i>Habenaria elegans</i>	HAEL	R*											R*		R*	R*			R*	
<i>Hieracium albidiflorum</i>	HIAL										S									
<i>Iliamna rivularis</i>	ILRI			S	S	S					S	R*	S	R*	S	S	S	S	S	
<i>Lactuca scariola</i>	LASE							S*	S*	S*		S	S			S*				
<i>Lilium columbianum</i>	LIOC	R*		R*	R*	R*									R	R*		R	R*	
<i>Lolium multiflorum</i>	LOMU									S*										
<i>Lupinus argenteus</i>	LUAR												R		R	R*				
<i>Luzula piperi</i>	LUPI										X*									
<i>Phleum pratense</i>	PHPR									S*				S		S*				
<i>Plantago major</i>	PLMA										X*									
<i>Poa palustris</i>	POPA					S*														
<i>Polygonum douglasii</i>	PODO										S*		S		S*					
<i>Polygonum lapathifolium</i>	POLA										S*									
<i>Pteridium aquilinum</i>	PTAQ	R	R	R	R	R		R	R	R	R	R		R		R	R	R	R	
<i>Pyrola picta</i>	PYPI																R			
<i>Pyrola secunda</i>	PYSE									R										
<i>Rumex acetosella</i>	RUAC	R																		
<i>Secale cereale</i>	SECE					S*	S*	S*	S*	S*	S*	S*			S*	S*	S*			
<i>Senecio vulgaris</i>	SEVU				S*	S*	S*	S*	S*	S*	S*			S*						
<i>Silene noctiflora</i>	SINO					S*														
<i>Smilacina racemosa</i>	SMRA															R*				
<i>Smilacina stellata</i>	SMST					R		R					R			R*		R		
<i>Solidago canadensis</i>	SOCA														R	R*		R		
<i>Spergularia rubra</i>	SPRU						S*		S*		S*						S*	S*		
<i>Stellaria media</i>	STME					S*					S*					S*				
<i>Stellaria obtusa</i>	STOB										S									
<i>Taraxacum officinale</i>	TAOF	S							S		S									
<i>Thalictrum occidentale</i>	THOC					R									R	R				
<i>Viarella trifoliata</i> var. <i>unifoliata</i>	TITRU								R	R										
<i>Troutvetteria carolinensis</i>	TRCA								R	R										
<i>Trifolium repens</i>	TRRE		S*			S*	S*		S	S*	S*					S*			S	
<i>Trillium ovatum</i>	TROV									R	R									
<i>Viola glabella</i>	VIGL							R*S	R*	R										
<i>Viola orbiculata</i>	VIOR	R			R			R*	R*		R			S		R			R	
<i>Xerophyllum tenax</i>	XETE	R					N			N			N		R	R	R			

¹Not observed in initial flora.²Key to appendix symbols:

N Nonsurvivor.

P Reforestation transplant.

R Survivor, regrowing from burned plant.

S Colonizer, seedling first postfire year.

X Present first year; postfire origin unascertained.

* Flowering first postfire year.