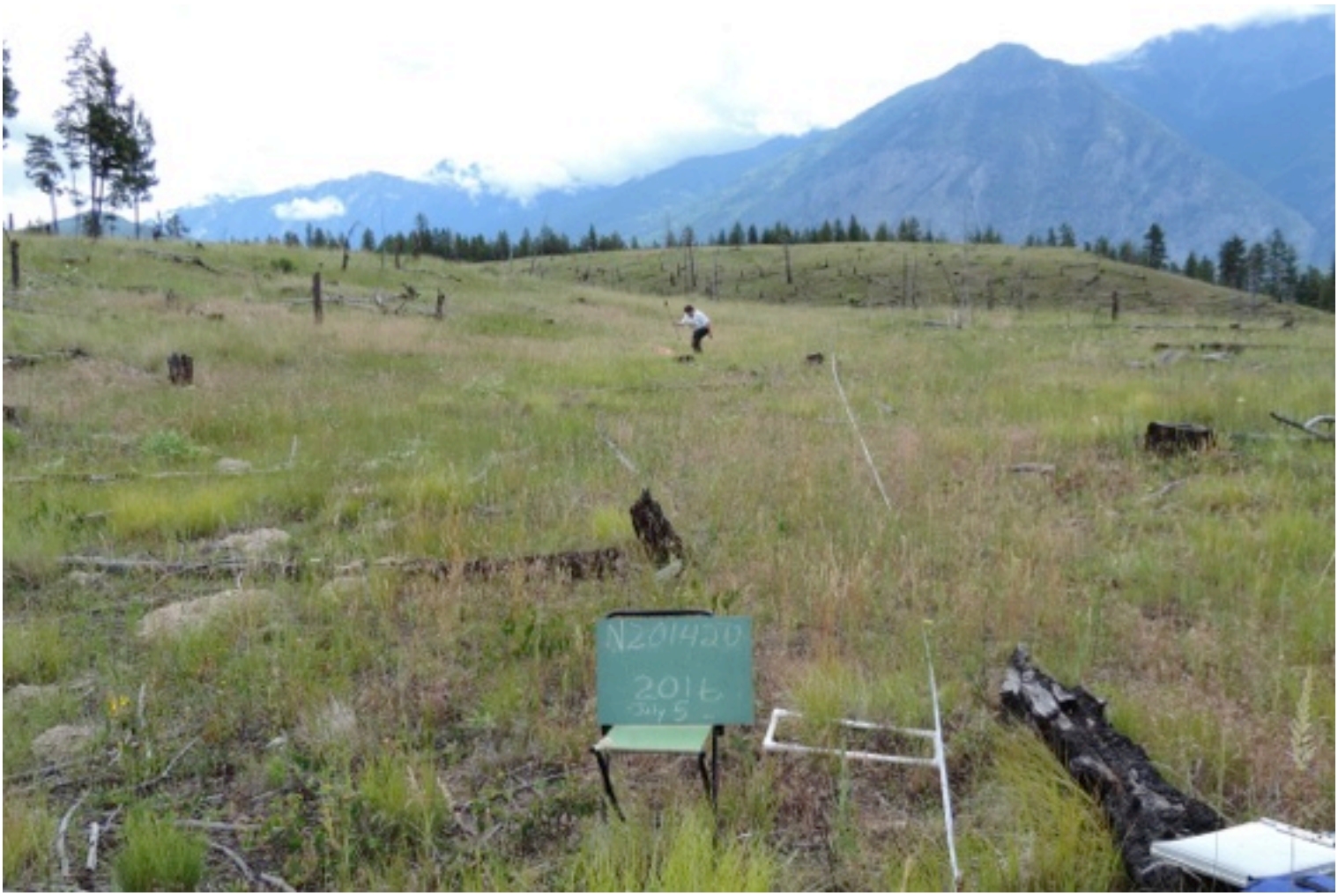
VEGETATION CHANGE FOLLOWING BURNING AND/OR THINNING IN ROCKY MOUNTAIN FOREST DISTRICT

1997-2016



N20142U transect 16 years after a stand replacement fire

REPORT COMPILED BY

Mountain Research Consulting
Gail M. Berg
November 2016
for

MINISTRY OF FORESTS, LANDS & NATURAL RESOURCES OPERATIONS,
RANGE BRANCH, ECOSYSTEM RESTORATION SECTION

TABLE OF CONTENTS

INTRODUCTION

One of the objectives of the Ecosystem Restoration Program in British Columbia is to increase the density of favored native grasses like rough fescue and blue bunch wheatgrass by thinning out the the tree canopy thereby allowing in more light and reducing competition for moisture. The ER program has helped to mitigate the dwindling supply of wild forage in the Rocky Mountain Trench by opening up thousands of hectares of closed forest in the past three decades. This thinning of closed canopy polygons complimented with prescribed fire (in some cases) encouraged site and species specific understory vegetation production. The (former) Invermere Forest District initiated their vegetation inventory program for rangeland areas in 1993 in order to type, evaluate and monitor plant communities. This initiative has complimented the restoration program and some of those transects became the baseline for monitoring the effects of thinning and burning on the landscape. It has been five years since the vegetation plots summarized in this report have been monitored.

Vegetation monitoring occurred within three different treatments: 1. Thinning and Prescribed Fire (WC44, WC55, SW15) ; 2. Stand Replacement Wildfires ((N20753, N20142L, & N20142U); 3. Prescribed Fire (SN13, SN14, SN35, SW10, SW11, SW16, WC36, WC41, WE04 & WE11). Response varied within each group and between treatments depending successional status at the time of the initial research.

Over the time frame of this report, recreational use of open forest and rangeland areas using ATV's, motorcycles and bicycles continued to increase. It also appears that the elk populations in the East Kootenays are expanding their territories as there are now groups of elk around Spillimacheen and Parson on the east side of the Columbia and on the west side north of Brisco. The number of livestock on the range units where the transects are located has also changed over the years. Partial funding for fencing of privately owned forage production land and the Wildlife Compensation Program have helped compensate ranchers for losses due to wildlife depredation on their properties.

All of the above impacts make it difficult to pinpoint causes of change in vegetation structure. The dynamics of what is really affecting plant species composition and abundance is complex and cannot be fully understood with the type of operational research done for this report. What we can see are short term trends due to weather patterns, stresses (overgrazing, drought, human activity, disturbance) on the ground management changes and normal plant succession activity.

1. METHODS

Sites were randomly selected within treatment areas to try to accommodate different plant communities. In some cases the fire was very intense on a site, in others it was a cool ground fire. Some areas were thinned first, others were not.

Four sites (SW10, SW11, SW15 and SW16) with pre-burn data were tracked in the Johnson Lake Burn (1999) area for numerous consecutive years after the fire. Three sites (SN35, SN14 and SN13) were tracked in the Springbrook Burn (1999, 2005) and two sites (WC41and WC36) were tracked in the Elk Burn (1999). Two sites (WE04, WE11) were monitored in the Rushmere Burn (2000). Two sites (WC44 and WC55) in the thinning treatment in Wolf Pasture were monitored for six and four years respectively and this area was also burned in 2004. Three sites (N20753, N20142L, and N20142U) within severe wildfires (2000) in Wolf-Sheep Creek Range unit have been monitored five times after the fires.

Transect Names and Locations

Transect No.	Northing	Easting	Transect No.	Northing	Easting
N20142L	595347	5521767	SW15	588489	5533293
N20142U	595272	5521876	SW16	588730	5532184
N20753	594628	5526274	WC36	595508	5529239
SN13	592156	5530716	WC41	595773	5528699
SN14	592725	5531671	WC44	592427	5521479
SN35	591190	5531085	WC55	592733	5522159
SW10	589360	5533200	WE04	575297	5582930
SW11	589303	5533826	WE11	575641	5582504

1.2 Data Collection and Storage

Each site was given a unique number and was permanently marked with one or in some cases two rebar rods and an aluminum name plate. The starting point of the vegetation transect was GPS'd and environmental data recorded on the original plot sheets (slope, aspect, elevation, moisture regime, nutrient regime, biogeoclimatic zone, disturbances, meso-slope position, landform element, structural stage) which are now housed in the Rocky Mountain Forest District office. Photographs were taken of the transect line and one Daubenmire frame along the tape. In some cases photos were taken in all four directions to get a sense of the magnitude of the disturbance. A 30 m. transect was run with 15 separate Daubenmire frame plots (20 x 50cm) placed at 2 m. intervals along the transect. Percent cover of all plants (including small trees, shrubs, lichens and moss) and litter and bare ground within the frame plots was noted. Zero to 15% cover was recorded in 1% increments; 16-100% was recorded at 5% intervals. ARCTUVA (Kinnikinnick) and PHLOX are treated as forbs, not shrubs even though they have woody stems and are perennials. Most forbs are flowering annuals with soft stems. In 2011 and 2016 all moss and lichen species were

lumped into MOSS or LICHEN which may be confusing, but since their role in rangelands is primarily as crusts to preserve soil moisture, a general percent cover overall is informative in that context. Information from the individual frames along the tape was averaged after all data was recorded.

Two 10 x 10m shrub plots were done as well, one at each end of the tape (1-10m. mark and 20-30m. mark). A shrub is any perennial plant with a woody stem from 0-2m. in height. If the plot is in a forested area, a 20m. sq. tree plot is done between the 5 and 25m. marks on the tape. Density distribution classes were assigned to the shrubs and trees, rather than % cover. The 2016 data was added to EXCEL sheets generated in previous years.

Forage production data was collected over several years on many of the sites and gives a rough estimate of forage production for that particular plant community in that polygon. Grasses and forbs were clipped to a 5cm. height on half of a .5m x 1m. square area (under a production cage if it had been reset recently), near the transect. The clip location varies from year to year, hence the variability of production. All new growth on any shrubs within this clip area was also pruned and collected. Shrub production is especially volatile since there may not be the same cover of shrubs in the clipped plot as in the larger transect shrub plots. The density distribution class of the shrubs is a much better measure of the abundance of those particular plants and how they reacted to treatments or stress. In 2016, samples were air dried in paper bags for 10 days in a greenhouse during hot weather then weighed. The forage production data is in the form of a spreadsheet and was converted to grams per square meter.

Name changes of plants, grasses in particular, have occurred during the last twenty years due to the use of genetics rather than characteristics of similarity for plant ID. Some of the local Stipas were renamed to the genus Achnatherum; Bluebunch wheat grass went from *Agropyron spicatum* to *Elymus spicata* to *Pseudoroegneria spicata* so the abbreviation in the data may read AGROSPI, ELYMSPI or PSEUSPI. Generally for British Columbia you take the first 4 letters of the genus and first three of the species to get the abbreviation. The EFlora of British Columbia database can be accessed using Latin or common names and will give the appropriate abbreviation. http://ibis.geog.ubc.ca/biodiversity/eflora/

2 FACTORS AFFECTING THE VEGETATION RESPONSE

2.1 Livestock Rotations and Carryover

The rotation information from Rocky Mountain Forest District (RMFD) files from 2011 to 2016 is incomplete. In discussions with Doug and Karen Barraclough they stated that Elk Pasture (where WC 36 and 41 are located) is no longer used due to lack of water in the springs. They had 85 cow/calf pairs this year (2016) on the other pastures on Premier Ridge where the transects were located but the AUM's were very conservative and would not have much impact on the vegetation in the transect areas.

The western part of the Sheep Creek North range unit has been used by Ernst Rast for the last 5 years. The transects closer to Johnson Lake (SW10,11) had many more invasive species than the other ones (SW15&16) further away.

Springbrook Pasture on the east side of the Sheep Creek North range unit, has been used by Harlan Bradford's livestock. No AUM information was available for the years 2011-2016.
(See the discussion section for more detailed information)

2.2 Elk Population in MU 4-21 Management Unit

The most recent elk survey done between Canal Flats and the US border was completed in January 2013. During the survey 409 cows, 104 calves and 61 bulls were observed in the entire unit. It appears that MU 4-21 elk populations are declining lately. The report stated that MU4-21 had a 34% population decline likely due to high harvest of homesteader elk on private land. However some land nearby Premier

Ridge has been fenced out which would change grazing patterns in nearby areas. Game cameras set up on the new fence show elk still trying to access forage growing areas 2 years in.

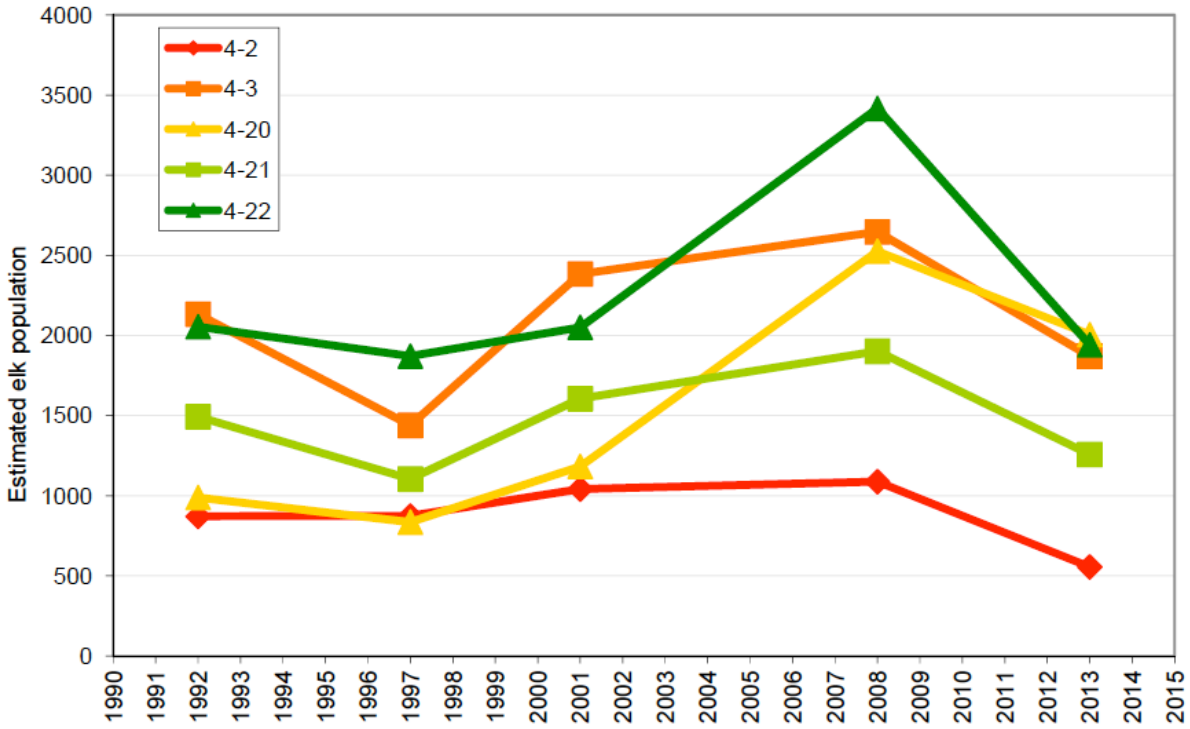


Figure 4: Population estimates by MU for 1992, 1997, 2001, 2008 and 2013 for East Kootenay Trench elk inventories.

(Graph taken from the 2014/2014 MFLNRO survey report)

2.3 Human Activity

Due to its location away from large resort areas and seasonal road closures, Wolf Sheep Creek Range unit is mainly used by locals for activities like firewood cutting, hunting, weekend camping or hiking. In recent years some out of province ATV use has occurred originating out of Wasa, but this does not seem to be a continuing problem. (Barraclough pers com). The same is not true for Sheep Creek North and West and Rushmere range units. Sheep Creek North (west side of highway) has lots of camping and recreatiion use at the Johnson Lake campsite and elsewhere in random locations near the lake. The gravel pit nearby has been busy with extraction due to road repairs between Skookumchuk and Canal Flats and new fencing has been installed along the highway. The north end of Rushmere RU has seen an increase in human activity since 2005. It is a very popular quadding/motorcycle use area for Albertans mainly, with many new trails compared to ten years ago. People also camp on Crown land long term at a couple of sites near the ATV trails within the treatment area. Large ruts are becoming the norm and the fence into the Nature Trust property has been cut, but luckily the transects used for this report are unaffected so far although one trail is within site of the WE11 end point. Garbage disposal is still an issue here as well.

2.4 Air Pollution

There is no doubt that pulp mills emit hazardous chemicals into the air and water and that some of this effluent migrates into soil. The influence zone around the source point is large and cumulative effects

complicate the issue. Fourteen of the sixteen transects are located within five kilometers of the Paper Excellence Canada owned Skookumchuk Pulp mill. The new owners have received funding for upgrades to reduce emissions. "*Pulp and Paper Green Transformation Program (PPGTP) were announced mid-November, with Nanaimo Forest Products and Paper Excellence sharing $21.3 million. In some cases, PPGTP funding allowed mills to expand their revenue streams by selling surplus energy to the grid."* (Pulp and Paper News, Nov. 2013). Although most studies concentrate on human health hazards, evidence of negative effects on lichen growth from SO_2 emissions was noted 35 years ago. (Sheridan et al, 1976) No plant studies specific to the Skookumchuk Pulp Mill were found during an internet search but it is likely that there have been effects on native plant communities in the general area. What these effects are is out of the scope of this report. An historical list of current emissions (substance reports) for this mill is available from: http://ec.gc.ca/inrp-npri/donnees-data/index.cfm?do=facility_history&lang=En&opt_npri_id=0000001185&opt_report_year=2013

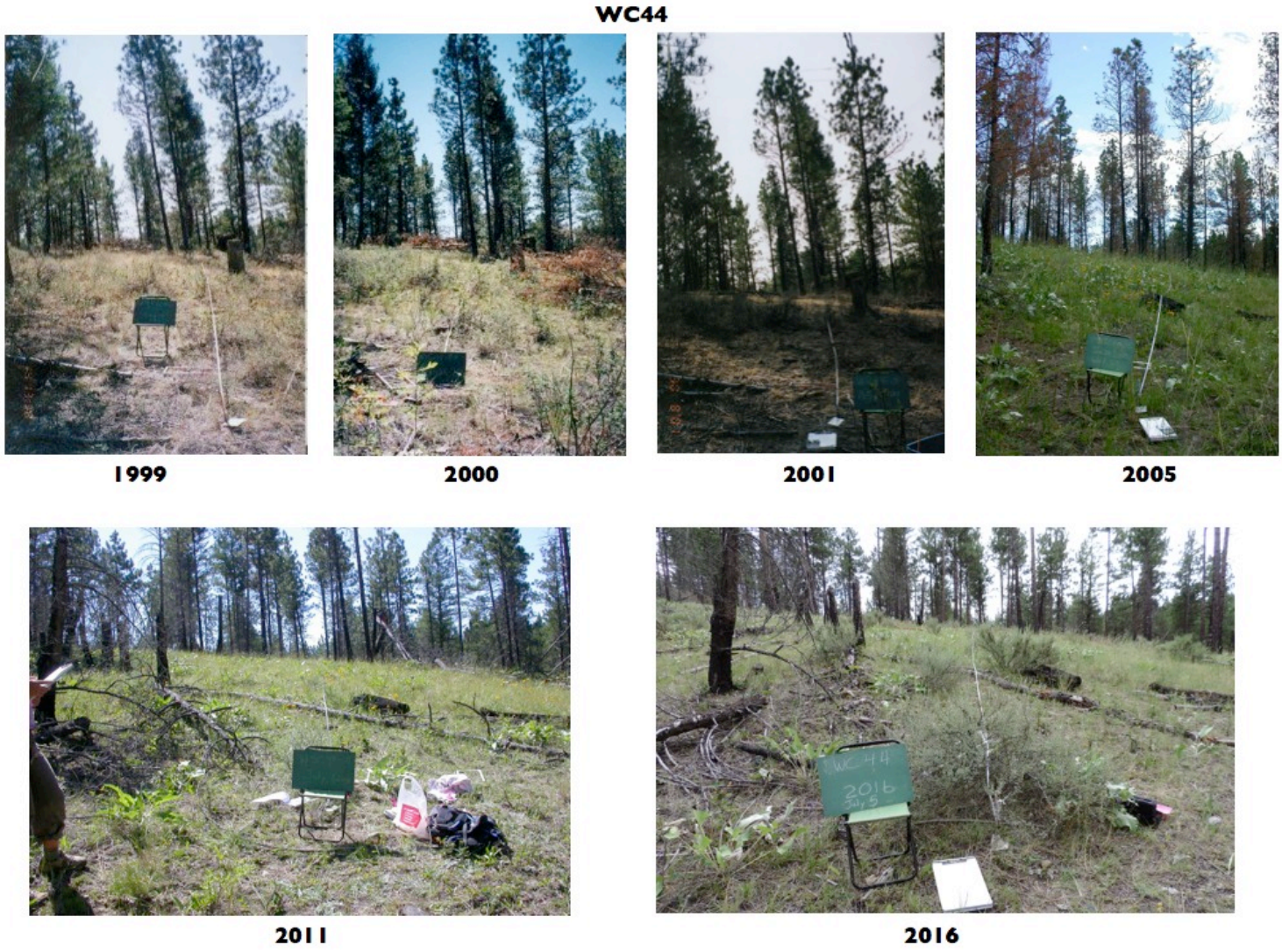
2.5 Natural Openings vs. Thinned Polygons

Natural openings appear to change in different ways than thinned polygons (where trees have been removed). The natural openings seem to have already reached a steady state and are more affected by disturbances like grazing, ATV's and other recreational use. It is just so much easier to move through or camp on those sites than a place riddled with big or small tree stumps. They therefore suffer from a wider variety of uses which can lead to weed invasions, loss of lichen crust or damage to individual plants due to soil disturbance or compaction from many sources. There was much more species movement and enrichment on thinned polygons than natural opening

3 RESULTS

3.1 Thinning and Prescribed Fire Transects

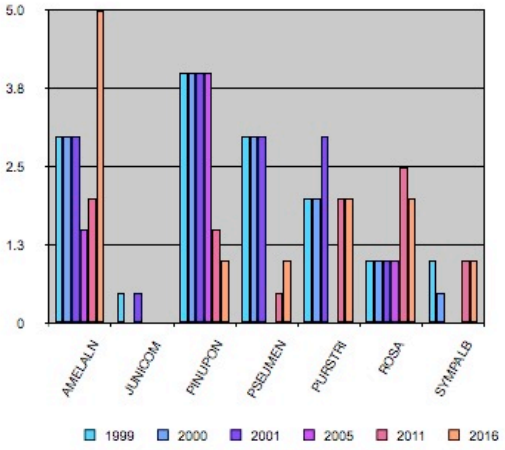
3.1.1 WC44 Transect, Wolf Pasture, Wolf Sheep Creek RU



WC44 was originally an opening in a mainly closed *Pinus ponderosa - Pseudotsuga menziesii* polygon prior to thinning treatments in the winter of 1998. This plot was put in place in July 1999 during the rangeland inventory (after the thinning) but before any prescribed fire treatment. Pile burning happened in 2002 and a prescribed burn was carried out in the pasture in 2004. There have been not other treatments since then.

WC44	1999	2000	2001	2005	2011	2016
ACHIMIL	0.1	0.1	0	0	1.07	0.53
ACHNNEL1				0.1		0.73
AGROPYR						0.13
ALLICER	0.3	0	0	0.3		
AMELALN					0.73	0.53
ANEMMUL	0.2	0.1	0.1	0.2	0.33	0.13
ANTENNA	0.2	0	0.1	0.1	0.33	0.87
ARABHOL				0.1	0.13	0.06
ARCTUVA	0.1	0.1	0	0.3		
ASTECON						0.13
ASTRMIS	0.4	0.1	0.3	8	2.73	1.8
BALSSAG	0.1	0.5	0.2	6	3.4	0.53
BURGUNDY	0	10	0	0		
CALCAR	0	0	0.7	0		
CALOAPI				0.1		
CLADONI	0.7	0	0			
CREPATR	0.2	0.5	0.2	1	1.27	0.4
ELYMSMI	0	0	1	0		
ELYMSPI	0.5	0.6	0	0.1		0.47
ERIGERO	0	0	0.1	0	0.27	
FESTCAM	0.3	0.3	0.2	0.1		1.47
GAILARI				0.3		0.13
GEUMTRI	0.1	0.1	0	0.1	0.2	
HETEVIL	0	0.1	0	0.7		0.13
KOELMAC	0.3	0.3	0.2	0.3		3.33
LIMEGRN	0.7	0.5	0			
LOMATRI					0.07	
MEDILUP						0.06
OXYTSER				0.1		
PELTIGE	0.1	0	0.1			
PENSCON	0	0.1	0	0.3	0.27	
PHLOX	5	5	5	4	17.67	15.3
PURSTRI					2.67	3.33
SOLICAN					0.33	1.3
SONCHUS				0.1		
SYMPALB					0.2	0.33
TARAOFF	0.6	0	0	2	3.47	1.47
TRAGDUB					0.4	0.27
MOSS	0	0	3	2	9.87	
LICHEN					0.07	1.53

FORBS/GRASS
ACHIMIL Yarrow has decreased since the last check, a trend which appeared in many transects this year. PHLOX had the highest cover of anything found and ANTENNA Antennaria is slowing increasing. ACHNNEL Columbia needlegrass has come into this area now as well as an Agropyron. FESTCAM rough fescue and ELYMSPI Bluebunch wheatgrass are slowly increasing while KOELMAC Junegrass is doing very well at colonizing this site.



WC44	1999	2000	2001	2005	2011	2016
AMELALN	3	3	3	1.5	2	5
JUNICOM	0.5		0.5	0		
PINUPON	4	4	4	4	1.5	1
PSEUMEN	3	3	3	0	0.5	1
PURSTRI	2	2	3	0	2	2
ROSA	1	1	1	1	2.5	2
SYMPALB	1	0.5	0	0	1	1

SHRUBS
Despite a few low years, AMELALN Saskatoon has actually increased in this area. Tree seedlings from PINUPON & PSEUMEN have gone down to the point where ingrowth would not be a threat in the immediate area. ROSA has shown a few more plants which is promising for future years.

WC44	GRASS	FORB	SHRUB	LITTER		g/m2
2001	3.31	4.23	0			
2005	9.08	31.78	9.08			
2011	20	76	0	34		
2016	14	44	0	32		

PRODUCTION
Like many other clip plots, forbs and litter have more volume than grasses.

Increases in preferred grasses is slowly taking place but production figures show forbs are amassing more volume. Desired shrubs like AMELALN Saskatoon has increased to a desired level but others are slow to make inroads into the area. Compared to the plot below (WC55) which was in a closed forest, not an opening, this site is not doing as well except for AMELALN Saskatoon production. It could be that it is a drier site on a slope rather than a flat area above a slope.

3.1.2 WC55 Transect, Wolf Pasture, Wolf Sheep Creek RU

2001

2005

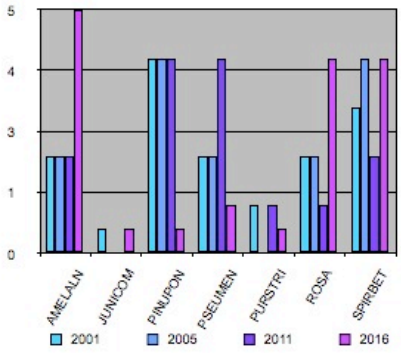
2011

2016

WC55 was a closed *Pinus ponderosa - Pseudotsuga menziesii* forest prior to thinning treatments in the late 90's. This plot was put in place in August 2001 after the thinning but before any prescribed fire treatment. Pile burning happened in 2002 and a prescribed burn was carried out in the pasture in 2004. There have been not other treatments since then. In 2016 the start pin was found and the production cage was still on site, but not used for the clip.

	2001	2005	2011	2016
ACHIMIL				0.2
AMELALN				1
ANENMUL			0.93	
ANTENNA			1.47	0.13
ARCTUVA	0.5	0.1	0.07	0.27
ASTER	0.1	0.2	0.27	
ASTRMIS			0.07	0.2
CALARUB	3	4		5.53
CALCAR	0.5			
CAMPROT	0	0.2		
CAREX				2.6
CPEPATR	0	0.1	0.13	0.27
ELYMSPI	0.1	0		0.06
EPILOBI	0	0.1		
ERIGPUM			0.07	
FESTCAM	0.3	0.1		0.13
HETEVIL				0.47
LIMEGRN	7			
OXYTROP	0.3	0.1		0.27
PELTCAN	5			
PENSCON	0.1	0.8	0.47	
PHLODIF	0.1	0.2		0.27
PINUPON			0.07	
PSEUMEN			0.47	
ROSA				0.67
SOLICAN	0	0.7	1.87	1.6
SONCARV	0	0.1		
SPIRBET				2
TARAOFF	0	0.3	0.6	0.67
VIOLA	0	0.1	0.4	
MOSS			3	
LICHEN			3	2.67

FORBS/GRASS
ASTRMIS Timber milk vetch and most other forbs are at low levels and the small tree seedlings were not found in any Daubenmire frames. CALARUB Pinegrass is increasing and CAREX, ELYMSPI Bluebunch wheatgrass and FESTCAM Rough fescue are maintaining a presence. LICHEN is also stabilizing at a low level. See the main text for information about the individual burn piles and their species composition.



WC55	2001	2005	2011	2016
AMELALN	2	2	2	5
JUNICOM	0.5	0		0.5
PINUPON	4	4	4	0.5
PSEUMEN	2	2	4	1
PURSTRI	1	0	1	0.5
ROSA	2	2	1	4
SPIRBET	3	4	2	4

SHRUBS
AMELALN Saskatoon, SPIRBET Birch leaf Spiraea and ROSA are all doing well on this site. Tree seedlings from PINUPON and PSEUMEN are decreasing. The area showed signs of elk loafing and lots of pellets.

g/m2	GRASS	FORB	SHRUB	LITTER
2005	27.24	36.32	0	
2011	74	60	6	104
2016	20	8	16	442

PRODUCTION
At this point in time there is more grass volume than forb in the clip plot. The litter figure is mainly pine needles.

The grasses are holding their own on this site with desired species moving in to compete with CALARUB Pinegrass. A few forbs are increasing their presence and lichen is stabilizing at a low level. Grass production was greater than forb production on the clip plot. Young trees are disappearing and three kinds of shrubs are increasing their densities.

In addition to the 15 Daubenmire plots, five burn piles were monitored along the transect. A metal pin was placed at the center of each pile then species names and cover/presence were noted in a 1m. diameter arc radiating from each pin. This extra monitoring was in response to concerns about heat intensity and soil damage caused by burn piles. The results are in the table below.

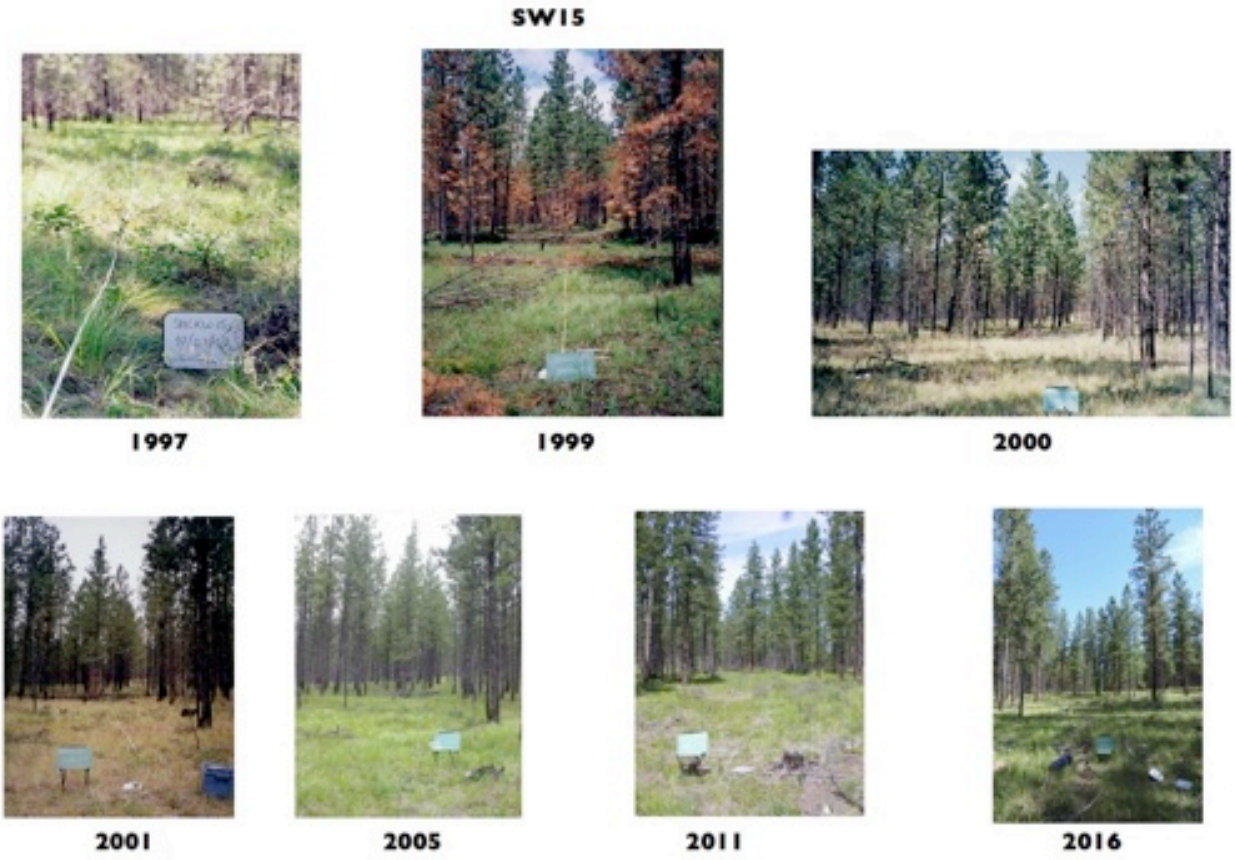
% Cover/Presence of Species by year (/) on old burn piles along WC55 transect

	1	2	3	4	5
	2001-2016	**2001-2016**	**2001-2016**	**2001-2016**	**2001-20016**
Calarub	<1/<1/25/p	<1/3/15/p	<1/12/15/p	0/4/<1/p	<1/10/0/p
Carex	0/0/0/0	0/0/0/0	0/0/0/p	0/0/0/0	0/0/0/0
Festcam	<1/<1/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/p
Elymspi	<1/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0
Achimil	0/0/0/p	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0
Agoseris	0/0/0/0	0/0/0/0	0/0/0/p	0/0/0/0	0/0/0/0
Allium	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/<1/0/0
Amelaln	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/p	0/0/0/0
Anemone	0/<1/0/0	0/<1/0/0	0/0/0/0	0/0/<1/p	0/0/0/0
Antennaria	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/p
Aster laevis	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/p
Astrmis	0/<1/2/0	0/<1/0/p	0/0/<1/0	0/0/<1/0	0/<1/0/0
Camprot	0/0/0/0	0/0/0/0	0/0/0/0	0/1/0/0	0/<1/0/0
Crepatr	0/0/0/p	0/0/0/p	0/0/0/0	0/0/0/0	0/0/0/0
Epilobi	0/0/0/0	0/0/0/0	0/0/0/0	0/1/<1/0	0/1/0/0
Lactuca	0/<1/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0
Lomatri	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0<1/0/0
Moss	0/0/0/0	0/20/0/0	0/60/0/0	0/30/5/0	0/0/0/0
Oxytropis	0/<1/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/p
Peltigera	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0	0/0/5/0
Penscon	<1/<1/<1/0	0/<1/0/0	0/0/<1/0	0/2/0/0	0/<1/0/0
Phlox	0/0/0/0	0/0/0/0	0/0/<1/0	0/0/0/0	0/0/0/p
Pinupon	0/0/0/0	0/0/0/0	0/0/<1/p	0/0/0/0	0/0/0/0
Pseumen	0/0/<1/0	0/0/0/0	0/0/<1/0	0/0/0/0	0/0/<1/0
Solidago	0/0/<1/p	0/0/0/p	0/0/<1/0	0/0/<1/p	0/1/1/p
Sonchus	0/0/0/p	0/0/0/0	0/0/0/0	0/0/0/0	0/0/0/0
Spiraea	0/0/0/0	0/0/0/0	0/0/0/p	0/1/0/0	0/0/0/0
Taraoff	0/0/0/0	0/0/<1/0	0/0/0/0	0/0/0/0	0/0/0/0
Viola	0/0/0/p	0/0/0/0	0/0/<1/0	0/0/<1/0	0/0/0/0
new species for 2016	P=present no cover data				

Eight new species have managed to move into the burn piles since 2011. Although a few of them are annuals with wind blown seed, others are perennials which should have a positive long term impact on percent cover on these impacted sites. Carex Sedge, Achimil Yarrow, Amelaln Saskatoon, Aster laevis Smooth aster and Antennaria Pussytoes are all either great ground covers or forage plants of benefit to the plant community at large. Solidago Golden rod and Calarub Pinegrass are now consistently in all the burn piles likely due to their underground rhizomes. The mosses and lichens seem not to be able to survive on this substrate for long periods quite yet.

Burn piles from WC55 taken in 2016

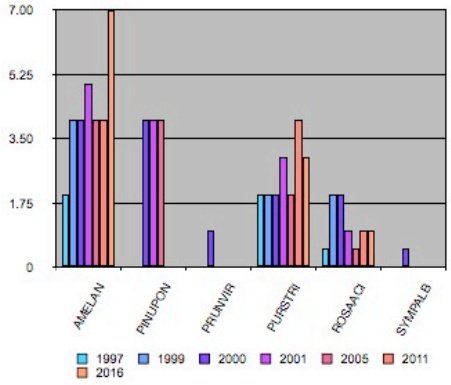
3.1.3 SW15 Transect, Skookumchuk Pasture, Sheep Creek North RU, West Rotation



SW15 is located in a *Pinus ponderosa/Pseudotsuga menziesii* forest. It was thinned and burned in the late 1990's. The start pin was not found in 2016 and no production cage was on site.

SW15	1997	1999	2000	2001	2005	2011	2016
ACHIMIL						0.07	0.33
AMELALN							4.13
ANTENNA	0	0	0.1	0	0.3		0.73
ANTENEG							2.3
ANEMONE	0	0	0	0.1	0.1	0.27	
APOCAND	1	3	0.1	0.4	2	1.73	
ARCTUVA	0	0	2	4	2	16.33	14.7
ASTECIL	0	0.5	0	0			0.47
ASTEFOL	0.03	4	0	0			5.47
ASTER	0		0	3	4	2.13	
ASTRMIS	.0.3	0.9	2	0	2	0.2	2.4
CALARUB	8.8	12	4	2	7	1.4	4.2
CAMPROT	0	0	0.1	0.1	0.1		0.13
CAREXDRY	0.3	0.1	0.7	0.5	0.3	0.47	0.67
EPILOB						0.07	
FESTCAM	0	0.7	0.9	0.6	0.3		0.33
FRAGVIR	0.4	0.8	1	0	0.9	0.8	0.53
HIERACI	0	0	0.9	0.3		0.8	
KOELMAC	0.2	0.5	0	0.4	0.3		0.4
LITHRUD							0.73
MEDILUP	0	0	0.1	0	0.4	0.93	0.27
PENSCON	0.3	1	2	0.1	2	0.27	0.47
PHLOX	0.2	0	0.1	0		0.33	0.27
POA COM		0.3	0	0			0.33
PURSTRI						0.13	1.67
SOLICAN							0.73
SMILSTE	0.1	0.9	0.4	0	0.2		
STIPRIC	3.3	2	4	2	2	2.13	3.13
STIPCOL						0.13	
TARAOFF	0	0.5	0	0	0.3	0.13	0.13
VIOLA	0.4	0.3	1	0.1	0.1	0.27	1.2
MOSS						3	
LICHEN						0.8	2.53

FORBS/GRASS
This site seems to have gained all the right attributes from the thinning and burning needed for the desired plant community. CALARUB Pinegrass is being complimented with some robust FESTCAM rough fescue (in area near transect) plants and increasing STIPRIC Richardson's needlegrass, CAREXDRY & KOELMAC Junegrass. The only weedy species MEDILUP Black medic, is decreasing here. There is still a compliment of forbs but none of them are taking over and reflect a site with more moisture. Lichens are increasing but mosses seem to be declining.



SW15	1997	1999	2000	2001	2005	2011	2016
AMELAN	2.00	4.00	4.00	5.00	4.00	4.00	7.00
PINUPON	0.00	0.00	4.00	4.00	4.00		
PRUNVIR	0.00	0.00	1.00	0.00	0.00		
PURSTRI	2.00	2.00	2.00	3.00	2.00	4.00	3.00
ROSAACI	0.50	2.00	2.00	1.00	0.50	1.00	1.00
SYMPALB	0.00	0.00	0.50	0.00	0.00		

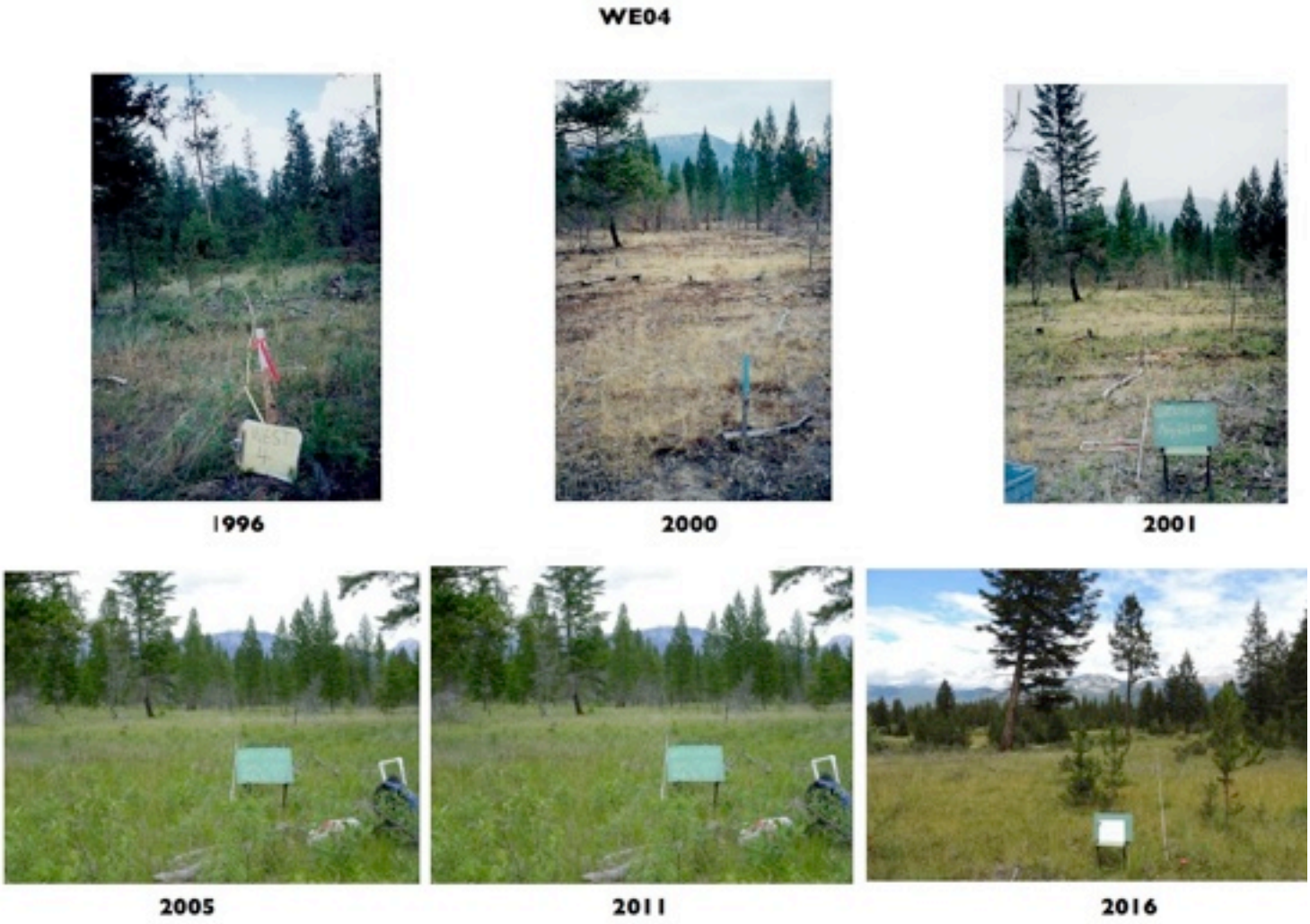
SHRUBS
AMELALN Saskatoon has increased in this area and looks robust. Tree seedlings from PINUPON, PRUNVIR Chokecherry and SYMPALB Snowberry have not been since in the last 11 years. PURSTRI Bitterbrush and ROSA are consistently at low density levels.

SW15	GRASS	FORB	SHRUB	LITTER		g/m2
1997	40.50	69.10	93.30			
1998	15.36	10.17	40.88			
1999	15.90	15.05	2.76			
2000	30.86	5.98	0.00			
2001	16.21	0.86	40.30			
2005	36.32	9.08	4.54			
2011	20.00	116.00	0.00	136.00		
2016	46.00	38.00	4.00	452.00		

PRODUCTION
A huge increase in plant litter (not needles) on this site in 2016 since 2011. The grass component also showed a nice increase since 1997 whereas the forbs have gone up and down.

This area is the epitome of success for achieving a desired plant community. The site, treatment and use of the area, have all aligned and resulted in an amazing result. Even though there is a large landing right across the truck trail full of weedy species, this area has remained almost 100% weed free with plenty of cover to choke out any invaders. Further work to the west of here may result in similar situations and disperse grazing in this pasture.

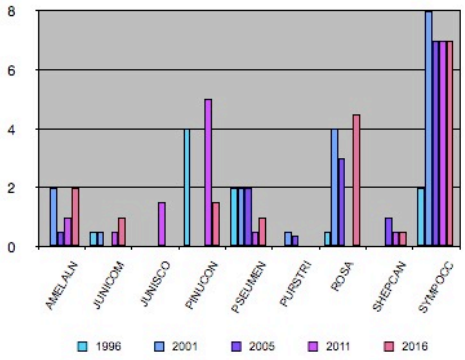
3.1.4 WE04 Transect, Rushmere Grazing Area, Westside RU



WE04 is an opening in a *Pseudotsuga menziesii* forest. The Rushmere burn occurred in 2000 on this site. A lot of thinning has happened on this particular area. Considering that it was a popular motorcycle area for locals in the 1990's and is now a destination area for tourists hauling quads and motorcycles, this site is doing amazingly well. Although the trails are expanding they have still not affected this transect, which is within 50m. of a quad trail. Scattering coarse woody debris around after thinning seems to have initially deterred motorized access but in the last five years more access trails are being made or utilized. The start pin was not found and no production cage was onsite.

WE04	1996	2001	2005	2011	2016
ACHIMIL	0.5	0.1	0.5	0.6	0.6
AMELALN				2	2.47
ANEMONE	0.4	0.1	0.8	0.33	
ANTENNA			0.1		
ARENSER					0.07
ARCTUVA	20	8	5	20.33	37.7
ASTER	0.5	0.7	0.4	0.67	1.67
ASTRMIS			0.3		
CALARUB	0.6	0.9	0.1	0.53	0.53
CAREXDRY	0	0.5			0.2
ELYMSMI			0.4	1.8	0.27
ELYMSPI			0.1		
FESTCAM	0	0.2	0.5	0.13	0.47
FRAGVIR	0.7	1	2	0.53	0.27
GALIUM				2.07	4
JUNCUS				0.2	0.27
JUNISCO				0.27	
MEDILUP				0.6	
OXYTCAM			0.7	0.13	
PEDICULARIS					0.07
PENSCON	0.3	0.4	0.2		0.27
POA	0.6	0.2		0.33	0.27
POA SEC			0.5		
PSEUMEN					0.07
SOLICAN					2.3
STIPNEL				0.07	
STIPRIC	7.7	5	7	4.13	4.3
SYMPOCC				3.27	6.3
TARAOFF			0.3	0.33	0.07
VICIA			1		
VIOLA	1.5	3	2	3.87	0.4
MOSS					0.13
LICHEN				0.27	

FORBS/GRASS
ARCTUVA Kinnickinnik amassed a large volume of cover in the area in the last 5 years regaining it's 1996 status. GALIUM Bedstraw made a modest gain along with ASTER and SOLICAN Canada goldenrod showed up for the first time. Grasses are dominated by STIPRIC Richarsons needlegrass and CALARUB pinegrass but ELYMSMI Western wheatgrass and FESTCAM Rough fescue are also around but with low cover. MOSS is staying at a low density and no LICHEN was found this year.



WE04	1996	2001	2005	2011	2016
AMELALN	0	2	0.5	1	2
JUNICOM	0.5	0.5	0	0.5	1
JUNISCO				1.5	
PINUCON	4	0	0	5	1.5
PSEUMEN	2	2	2	0.5	1
PURSTRI	0	0.5	0.4		
ROSA	0.5	4	3		4.5
SHEPCAN	0	0	1	0.5	0.5
SYMPOCC	2	8	7	7	7

SHRUBS
This is a very shrubby area with very large densities of small SYMPOCC Western snowberry and ROSA. AMELALN Saskatoon and JUNIPERs are less dense. Tree seedlings from PINUCON Lodgepole pine and PSEUMEN Douglas fir are still thriving on the site at low densities despite this being very close to a popular quad/motorcycle track and random camping area which continues to expand.

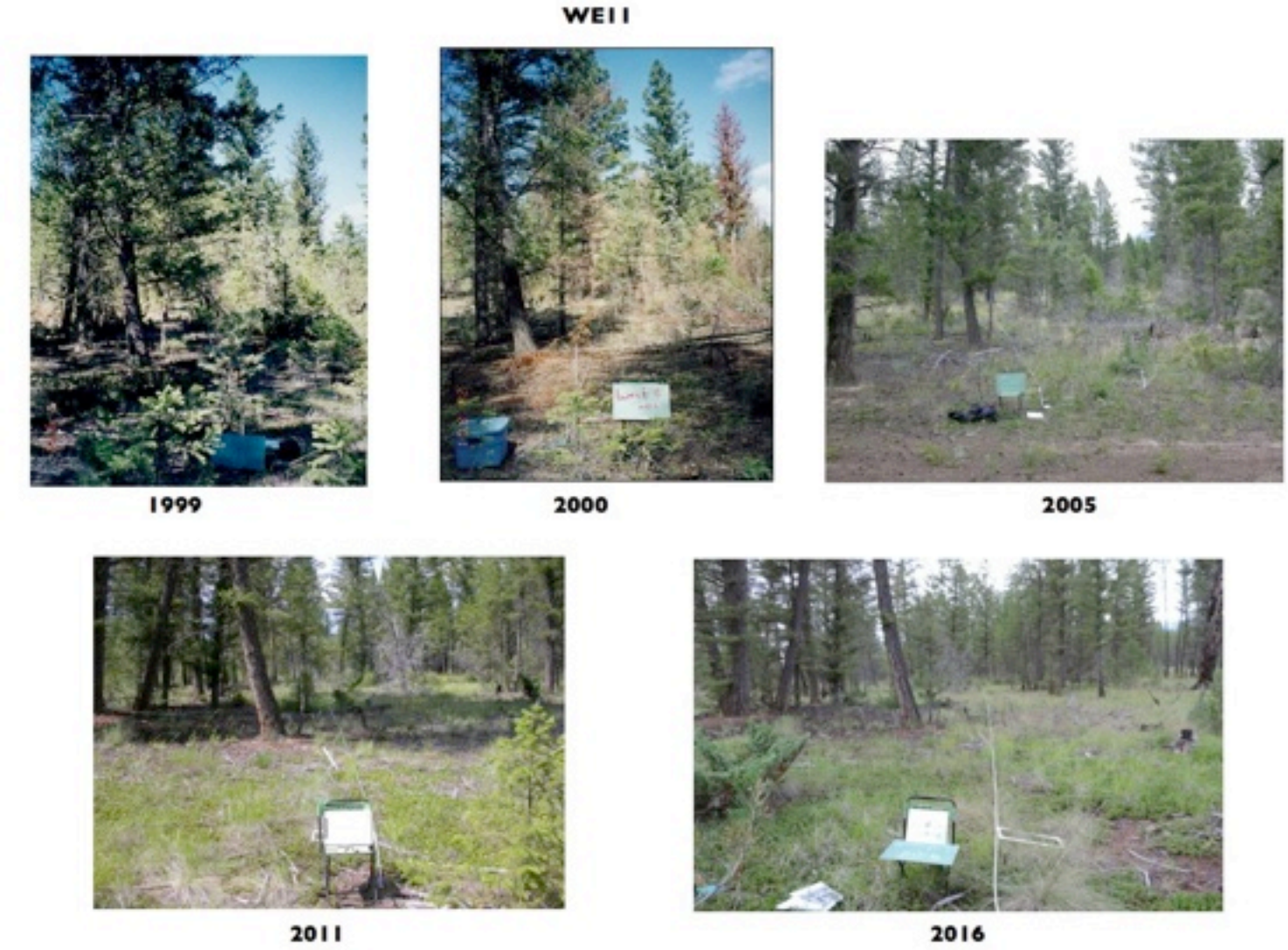
WE04	GRASS	FORB	SHRUB	LITTER g/m2	
1997	27.08	1.5	0		
1999	12.02	4.84	20.09		
2005	40.86	36.32	4.54		
2011	74	12	2	62	
2016	64	8	138	134	

PRODUCTION
There was more GRASS than FORB volume in 2016 which has been a trend the whole time in this area. There was much more SHRUB volume this year than in the past and a large amount of LITTER was collected on the clip plot as well.

Kinnikinnick has more than one system for reproduction and has illustrated this with increasing cover in the area. Richardson's needlegrass has a wide range of tolerance for both elevation and moisture so it is common in many plots in this report as it out-competes other more habitat specific grasses. The long awns easily latch onto anything passing by effectively distributing seed to new locations. Western snowberry has maintained a high density for 15 years due to it's tolerance for disturbance, ability to underground rhizomes and ability to produce large amounts of high quality seed.

.

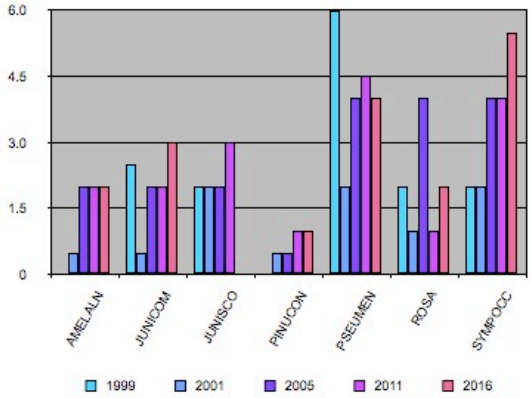
3.1.5 WE11 Transect, Rushmere Grazing Area, Westside RU



WE11 was an ingrown *Pseudotsuga menziesii* forest. It was thinned in the late 1990's and burned in 2000. This site has not been grazed by livestock for many years due to lack of water and downsizing of the tenure holder herds. It is adjacent to Nature Trust land. ATV use is increasing and an access trail is adjacent to this transect and the Nature Trust fence nearby had been taken down. The start pin was not found in 2016 and no production cage was onsite.

WE11	1999	2001	2005	2011	2016
ACHIMIL	0.4	0.1	0.1		0.13
ANTENNA	0.07	0.1	0.1	0.4	0.13
ARCTUVA	1.93	2	5	9.47	11.7
ASTEFOL			0.4	2.6	3.27
ASTRMIS			0.3	0.07	0.33
CALARUB			0.1	2.6	1.4
CAREXDRY	0	0.1			
ELYMSPI	0.73	0.3	3	0.27	0.07
FESTCAM	0.1	0	0.1	2.27	2.27
FRAGVIR			0.1	0.2	
HETEVIL	0.27	0	0	0.27	
JUNICOM					3.33
JUNISCO				2	
KOELMAC	0	0.1	0.7	0.27	0.07
LINUPER			0.1		
LOMATRI				0.13	0.67
OXYTCAM			0.1	0.73	
PELTIGE	0.67	0.1			0.93
PENSCON	0	0.1	0.2		0.53
PSEUMEN					1.33
ROSA				0.33	0.33
SOLICAN	0.27	0.2	0.5	1.8	0.4
STIPRIC				0.53	1.27
SYMPOCC					0.2
TARAOFF	0.13	0		0.13	
VIOLA			0.1	0.53	0.07
MOSS				0.27	
LICHEN				0.4	

FORBS/GRASS
ARCTUVA Kinnickinnik is increasing in cover steadily as are ASTEFOL Leafy aster, LOMATRI Nine-leaved desert parsley and PENSCON Yellow penstemon. Although there is a lot of FESTCAM Rough fescue and STIPRIC Richardson's needlegrass in the area, it did not show up along the transect line in high cover. PELTIGERA was the only lichen found.



WE11	1999	2001	2005	2011	2016
AMELALN	0	0.5	2	2	2
JUNICOM	2.5	0.5	2	2	3
JUNISCO	2	2	2	3	
PINUCON	0	0.5	0.5	1	1
PSEUMEN	6	2	4	4.5	4
ROSA	2	1	4	1	2
SYMPOCC	2	2	4	4	5.5

SHRUBS
SYMPOCC Western snowberry is dense here and PSEUMEN Douglas fir continues to persist at a medium density. JUNICOM Common juniper is gradually increasing in density while AMELALN Saskatoon stays at a low density.

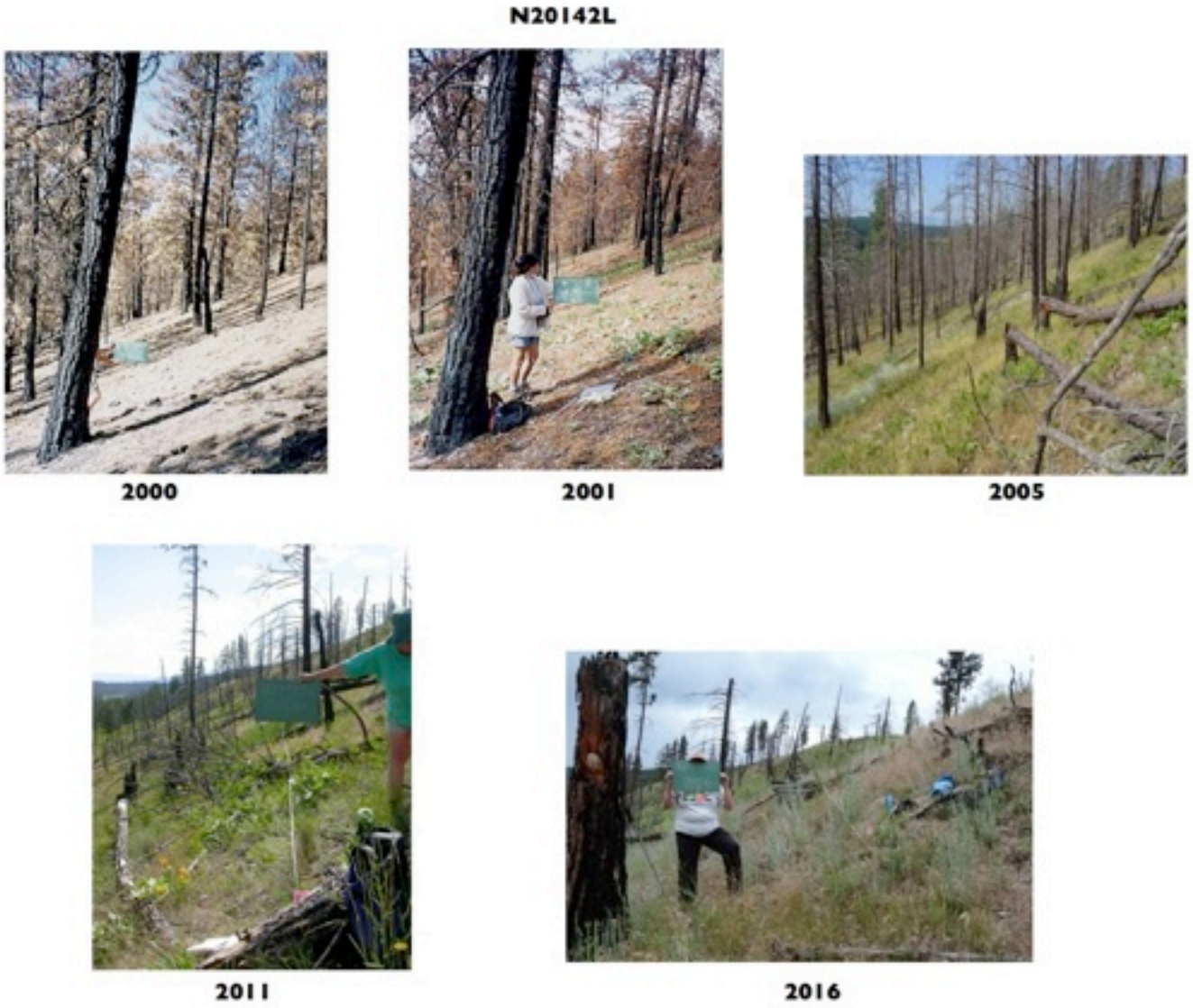
WE11	GRASS	FORB	SHRUB	LITTER	g/m2
1999	15.15	7.02	42.97		
2005	45.4	77.18	4.54		
2011	34	102	2	44	
2016	76	6	60	96	

PRODUCTION
The clip came up with a lot of GRASS, SHRUB and LITTER. Field notes make mention of lots of litter

All of the above species that are maintaining or increasing their presence have multiple survival strategies and or reproduction modes. The volume of litter in the area is also increasing which helps with the soil making process and maintenance of soil moisture to enable more plants to endure.

3.2 Stand Replacement Wildfire Transects

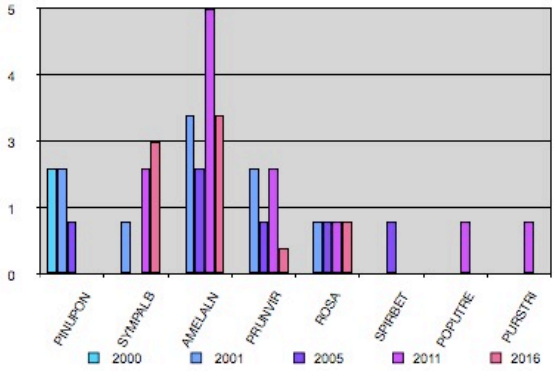
3.2.1 N20142L Transect, Gina Pasture Wolf-Sheep Creek RU



N20142L was a moderately open *Pinus ponderosa* forest prior to a wildfire in 2000. Many trees in the earlier photos have fallen over giving an almost unobstructed view of the Purcell mountains to the east. The eastern part of Gina pasture was thinned by machine in 2009 and the landings burned in 2012. This transect is actually within a Nature Trust property and their staff were onsite fixing fence while we were completing the transect in 2016. Cows no longer graze this area unless a gate is left open, then they stick to the riparian areas along the road.

N20142L	2000	2001	2005	2011	2016
ACHIMIL	0.0	0.0	0.1	0.1	
AGRO SP	0.0	0.0	0.0	0.1	
ANTE SP	0.0	0.0	0.0	0.1	
AMELALN	0.0	0.3	0.0	0.0	
APOCAND	0.0	3.0	13.0	5.4	
ARTEFRIG					3.67
ASTEFOL	0.0	0.0	1.0	0.0	
ASTELAE	0.0	0.0	0.0	2.3	3.07
ASTRMIS	0.0	0.0	0.1	0.0	
BALSSAG	0.0	2.0	0.0	9.3	2
BROMTEC	0.0	0.0	0.1	18.1	10.2
CALARUB	0.0	0.0	0.0	0.1	
CAMPROT	0.0	0.0	0.1	0.0	0.06
DESCSOH	0.0	0.0	2.0	0.1	
EPILOBI	0.0	0.0	0.2	0.0	
ERIOUMB	0.0	0.1	0.0	0.0	
FESTCAM	0.0	0.0	0.0	0.1	
FILAARV	0.0	0.0	0.3	0.0	
FUZZY	0.0	0.0	0.3	0.0	
GAILARI	0.0	0.0	0.7	0.5	
HETEVIL	0.0	0.0	1.0	0.8	1.67
KOELMAC	0.0	0.0	0.1	0.6	0.67
LACTUCA					0.06
LEPIDEN	0.0	0.0	0.3	0.0	
LITTLEGRN	0.0	0.0	4.0	0.0	
MEDILUP	0.0	0.0	0.3	2.5	2.3
MELILOT	0.0	0.1	0.1	0.3	0.2
OXYTCAM	0.0	0.0	0.0	0.2	
POA COM	0.0	0.0	0.0	0.5	
PSEUSPI	0.0	0.0	0.1	0.6	1.6
SONCHUS	0.0	0.0	3.0	0.1	0.06
STIP SP	0.0	0.0	0.0	0.4	
TARAOFF	0.0	0.0	0.3	0.3	0.06
TRAGDUB					0.4
TRIF SPP	0.0	0.0	0.0	1.7	
VERBTHA	0.0	0.0	0.0	1.3	
MOSS	0.0	0.0	1.0	0.7	
LICHEN	0.0	0.0	0.0	0.0	

FORBS/GRASS
The grass and forb information is interesting in that there are 14 less genus' in 2016 than in 2011 even though the infromation was gathered very close to the same date. There is one new native plant ARTEFRIG sage; a welcome addition to this steep slope. BROMTEC Downy brome (a weedy species) shows less cover than in 2011 which is a good sign that things are stabilizing a little in this area. PSEUSPI Bluebunch wheatgrass appears to be increasing in cover.



N20142L	2000	2001	2005	2011	2016
PINUPON	2.0	2.0	1.0	0.0	0
SYMPALB	0.0	1.0	0.0	2.0	2.5
AMELALN	0.0	3.0	2.0	5.0	3
PRUNVIR	0.0	2.0	1.0	2.0	0.5
ROSA	0.0	1.0	1.0	1.0	1
SPIRBET	0.0	0.0	1.0	0.0	0
POPUTRE	0.0	0.0	0.0	1.0	0
PURSTRI	0.0	0.0	0.0	1.0	0

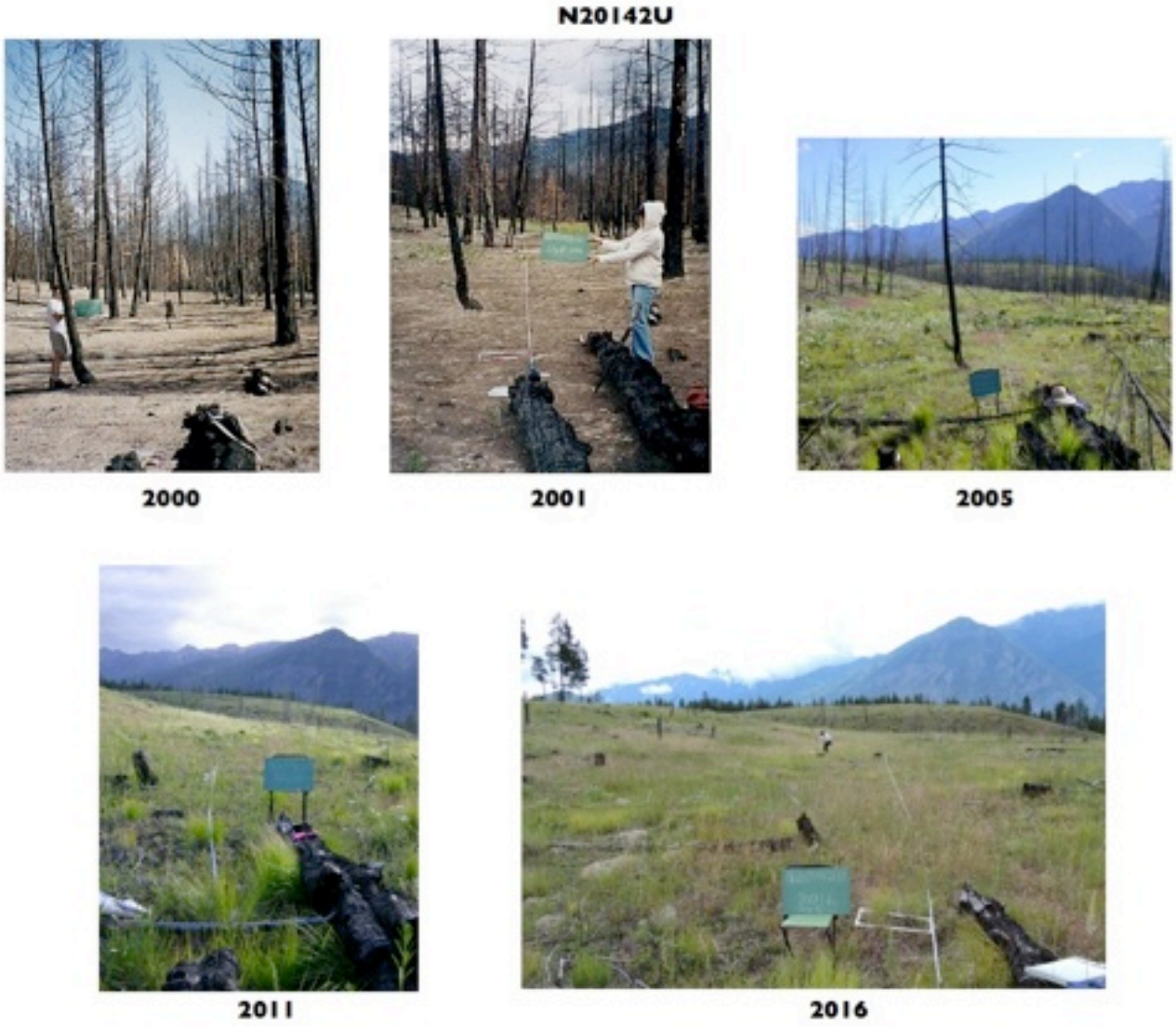
SHRUBS
SYMPALB Snowberry continues to slowly increase in density while ROSA remains at a stable low density. AMELALN Saskatoon and PRUNVIR chokecherry have gone down in density within the transect in the last five years. Four shrubs/trees PINUPON Ponderosa pine, SPIRBET Spiraea, POPUTRE Trembling aspen and PURSTRI Bitterbrush have disappeared from this immediate area.

N20142L	GRASS	FORB	SHRUB	LITTER	g/m2
2000	0	0	0		
2001					
2005	4.54	36.32	0		
2011	NO DATA				
2016	28.0	32	0	34	

PRODUCTION
There appears to be more litter this year than in 2005 which was the last time it was clipped.

Due to the extreme nature of the disturbance in 2000 and the fact that it is a steep south facing slope this site will continue to fluctuate for years to come. Forbs keep moving in and out but a few natives are taking hold and will hopefully stabilize and increase. Shrubs are still at low densities and not expected to increase any time soon. ELYMSPI Bluebunch wheatgrass is gaining headway and is well suited to this site as is the ARTEFRI Sage which now has taken hold.

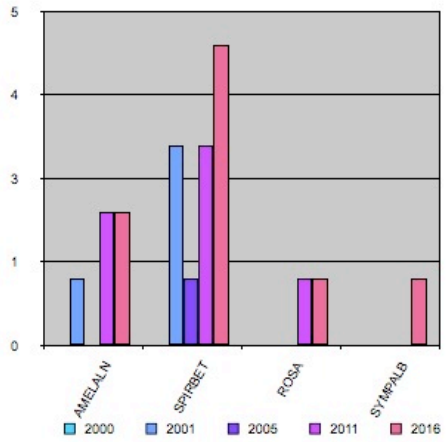
3.2.2 N20142U Transect, Gina Pasture, Wolf Sheep Creek RU



N20142U was an open Pinus ponderosa/Pseudotsuga menziesii forest prior to the 2000 wildfire. Many trees have fallen down or been removed between 2001 and 2016 providing a clear view of the gully in the back ground. The eastern half of Gina pasture was thinned by machine in 2009 and the landings burned in 2012. Vegetation is covering much more of the surface area on this site now, although many of the plants are weedy species. The start pin was found in 2016 but no production cage.

N20142U	2000	2001	2005	2011	2016
ACHIMIL			1.0	1.67	0.33
ACHNOCC			0.5		
AGRO SP				0.13	
ALLICER				0.2	
AMELALN		0.9		0.2	1.6
ANTE SP				0.07	
APOCAND			0.1		
ARABHOL					0.33
ASTELAE				2.07	
ASTERAC			5.0		
BALSSAG		1.3	4.0		
BROMTEC			0.3	2.27	1.73
CALAPUR			0.5		
CALARUB				4	5.3
CAMPROT					0.06
CAREX SP				0.27	
DODEPUL					0.06
ELYMXAL			0.5		
EPILOBI			0.2	0.4	0.27
ERIGPUM				0.07	
ERYSINC			0.5		
FILAARV			0.9		
HETEVIL			1.0	3.73	
KOELMAC				0.07	0.93
LEPIDEN					0.73
MEDILUP				7	0.33
LEPIDEN			0.4		
PHLODIF					0.2
TRAGDUB					0.8
POACOM				0.2	1.47
POA PRA				0.8	1.27
POTENTILL					0.13
SISYMBR			2.0		
SOLISPA			0.3	0.47	1.87
SONCHUS			0.9		
SPIRBET			0.4	0.67	1
STIPRIC				0.53	
STIPNEL					0.06
TARAOFF			0.9	1.33	0.06
TRAGDUB				0.13	0.8
VIOLADU					0.13
MOSS			26.0	0.33	4.87
LICHEN				2.93	2.99

FORBS/GRASS
CALARUB Pinegrass is increasing in this area as is KOELMAC Junegrass, POACOM Canada bluegrass and POAPRA Kentucky bluegrass. STIPNEL Stipa nelsonii is also now in the area. Annual forbs are fickle in their presence and many that were around in previous years have departed while some others like VIOLA and PHLOX showed up for the first time.



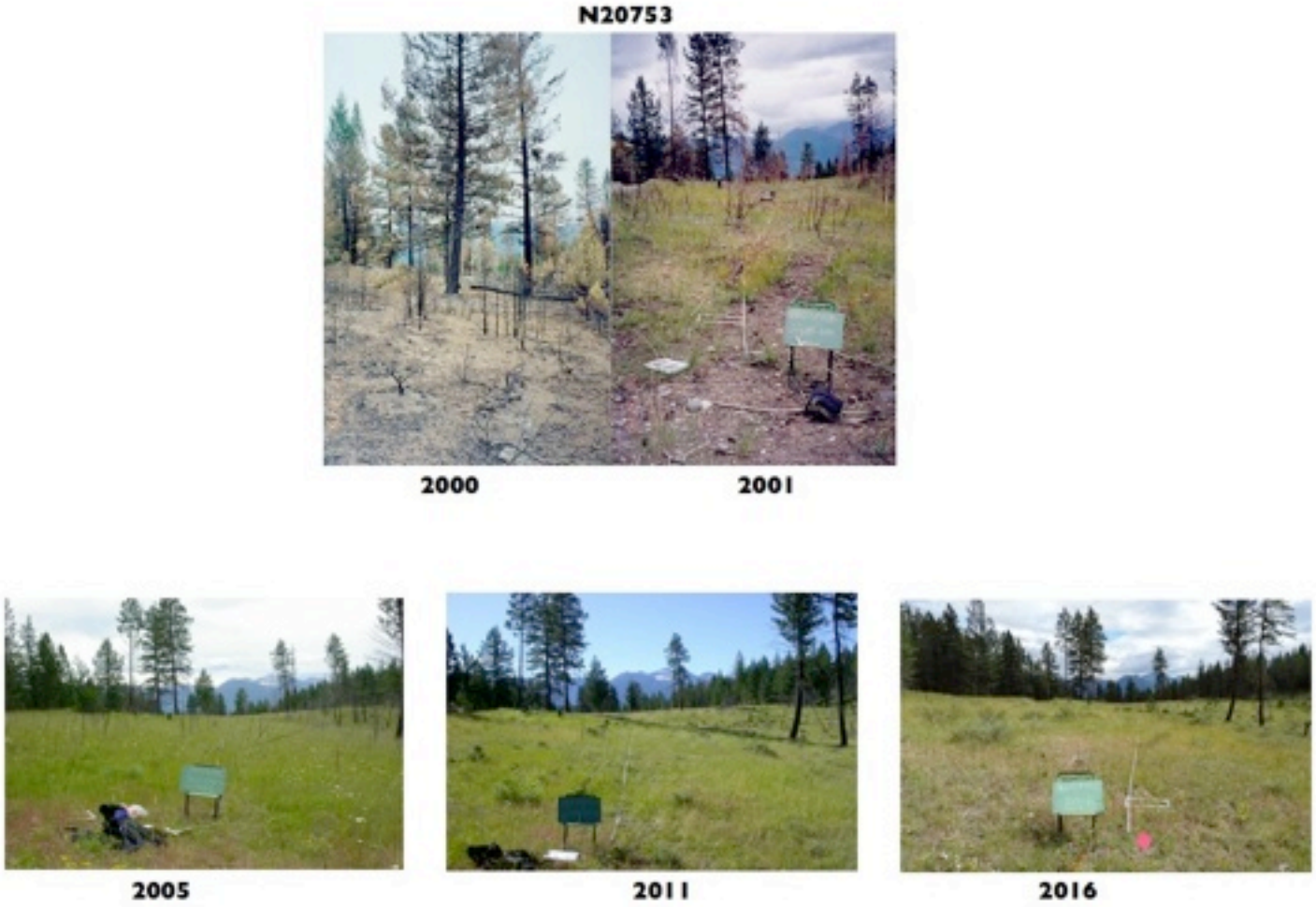
SHRUBS
AMELALN Saskatoon has remained stable in density since it showed up in 2001; the same goes for ROSA which appeared in 2011. SPIRBET Spiraea is increasing in density and SYMPALB Snowberry has arrived in the area.

N20142U	GRASS	FORB	SHRUB	LITTER	g/m2
2000	0	0	0		
2005	9.08	36.32	0		
2011	no data				
2016	98	214	0	148	

PRODUCTION
Forbs make up the bulk of the production in this area, but grasses and litter are catching up. There was noticeably more cover in this transect site than last time.

For some reason, a rodent population has taken up residence in this area and dozens of mounds were seen all over this upper area. They do not appear to be made by ground squirrels but the coarse textured soils make for easy digging. This new disturbance will no doubt attract weedy species accustomed to disturbance. Grasses are steadily increasing as are forbs and abundant litter will only increase soil moisture and fertility in the future.

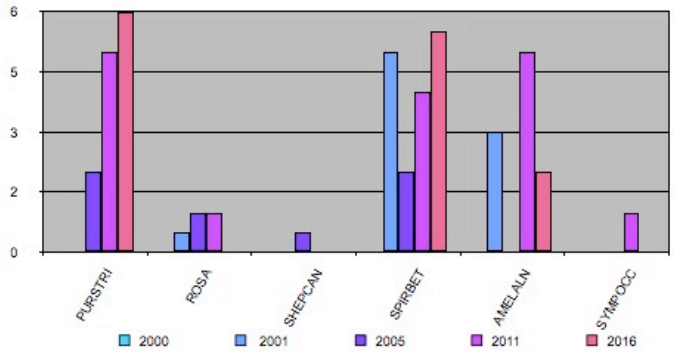
3.2.3 N20753 Transect, Gina Pasture, Wolf Sheep Creek RU



This site was an opening in a *Pseudotsuga menziesii* forest prior a wild fire which burned in 2000. Numerous small trees were invading the site at that time. Note that all the small trees are now gone and some of the larger trees were salvage logged between 2001 and 2005. The western part of this pasture was thinned in 2008 and broadcast burned in 2010. The start pin was found in 2016 but no production cage.

N20753	2000	2001	2005	2011	2016
ACHIMIL		0.2	3.0	0.8	
ACHNNEL		0.7	2.0	0.33	3.73
ACHNOCC		0.1	0.0	0	
ACHNRIC		0.0	0.3	0.87	0.26
AGROPYR		1.0	0.0	3.27	
AGROSTI		0.0	1.0	0	
ALLICER		0.0	0.1	0	
AMELALN					0.47
ANTENNA		0.1	0.0	1.4	0.33
ARCTUVA		0.4	2.0	0.53	
ASTRMIS		0.4	0.7	0.4	
BROMTEC		0.0	2.0	0.07	0.4
CALARUB		1.0	2.0	0	0.2
CALOCHORTU					0.06
CERAARV					0.13
CREPATR		0.1	0.0	0	
EPILOBI		0.0	0.1	0.2	
EPILFOL					0.13
FESTUCA		0.1	0.0	0.07	
FRAGVIR		0.3	0.6	1.27	0.13
HETEVIL		0.2	2.0	8.13	1.27
KOELMAC		0.4	0.0	2.33	6.8
LEPIDEN		0.1	0.9	0	1.13
LITHRUD		0.0	0.0	0.07	
MEDILUP		0.0	0.4	6.2	0.33
PHLODIF		0.1	0.0	1.33	0.4
POA COM		0.0	0.1	1.73	0.93
POA PRA		0.0	0.0	0.4	0.6
PSEUSPI		0.0	0.7	0.47	
SPIRBET					4.4
TARAOFF		0.3	2.0	1.67	0.33
TRAGDUB		0.0	0.3	0.13	0.6
VIOLA					0.27
ZYGAVEN		0.0	0.0	0.13	
MOSS		0.0	0.0	9.4	
LICHEN		0.0	0.0	0.47	5.27

FORBS/GRASS
As with the other severe fire transects, many forbs that were present 5 years ago, are now not within the transect area. Other plants have showed up like Calochortus Mariposa lily, CERAARV Field chickweed and EPILFOL Leafy willowherb. Some grasses are increasing KOELMAC Junegrass, ACHNNEL Achnatherum nelsonii but others ACHNRIC Achnatherum richardsonii, POACOM Canada bluegrass and FESTUCA Fescue seem to have declined. What is interesting is that the moss has fallen off but the lichen is increasing. Typically, lichen is one of the first things to populate on bare rock surfaces, but it seems to have a harder time on burned soil substrates.



N20753	2000	2001	2005	2011	2016
PURSTRI		0.0	2.0	5	6
ROSA		0.5	1.0	1	
SHEPCAN		0.0	0.5	0	
SPIRBET		5.0	2.0	4	5.5
AMELALN		3.0	0.0	5	2
SYMPOCC		0.0	0.0	1	

SHRUBS
PURSTRI Bitterbrush has steadily increased in this area as has SPIRBET Spiraea (after a decline in 2005). AMELALN Saskatoon has declined likely due to increased pressure from browsing by wildlife. SYMPOCC Snowberry, ROSA and SHEPCAN Soopolallie have all moved elsewhere than within the transect shrub plot elsewhere.

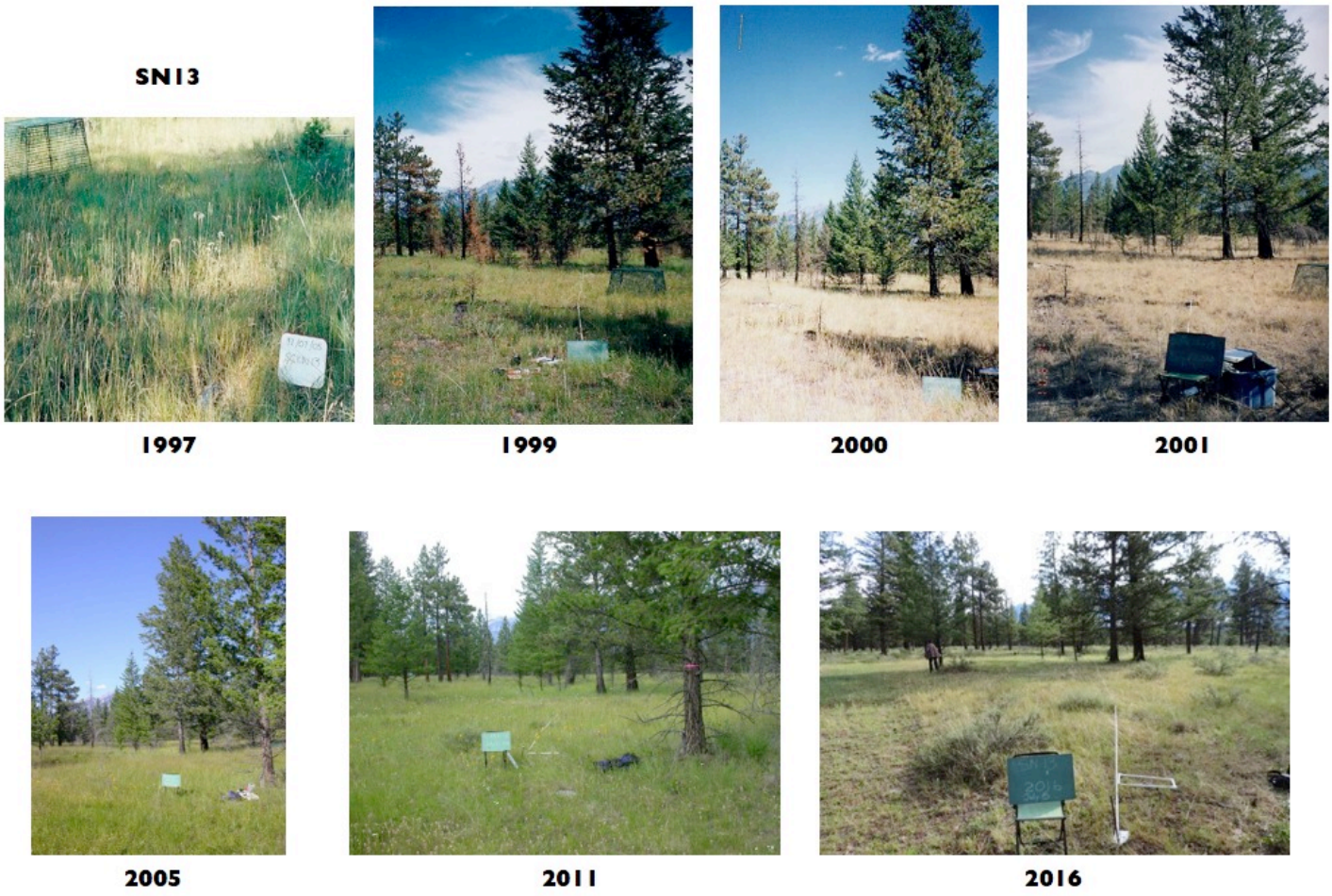
N20753	GRASS	FORB	SHRUB	LITTER	g/m2
2000	0	0	0	0	
2001	0	0	0	0	
2005	59.02	4.54	22.7	4.54	
2011	60	8	0	26	
2016	4	2	0	74	

PRODUCTION
Grass production has declined dramatically but littler is up. Could be that this area has not been grazed as hard by livestock due to lack of a close water supply.

A couple of the grasses are increasing onsite and litter is as well, mostly attributable to this phenomenon. Shrub densities are variable according to species, with some disappearing altogether. Annual forbs seem to come and go in this opening possibly due to their reproductive strategies or the fact that areas nearby were thinned and broadcast burned since the initial wildfire.

3.3 Prescribed Burning Transects

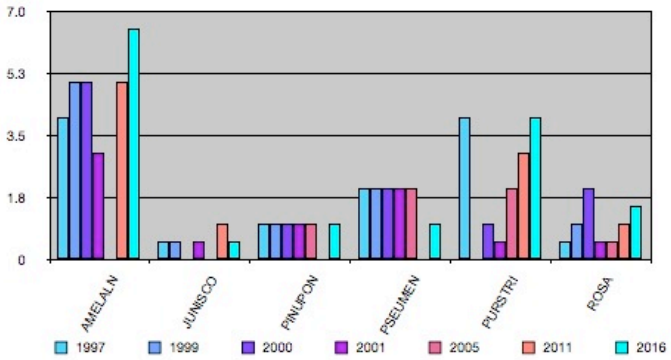
3.3.1 SN13 Transect, Springbrook Pasture, Sheep Creek North RU, North rotation



SN13 is an opening in a *Pinus ponderosa/Pseudotsuga menziesii* forest. No thinning of trees was needed to open the canopy but large numbers of young trees were establishing in the area. This resulted in the Springbrook Pasture burns in 1999 and 2005. It is an easy area to burn due to two natural fire guards (road to Premier Lake and Sheep Creek) ensuring added safety and lower costs. Logging happened nearby recently which opened up areas that had escaped damage from the two above mentioned burns. The start pin was found in 2016 but no cage was located.

SN13	1997	1999	2000	2001	2005	2011	2016
ACHIMIL	0.70	0.70	0.00	0.00	0.30	0.33	0.20
AGROSTI					0.10		
AGOSERI	0.00	0.00	0.30	0.00		1.40	0.93
AGROPYR	0.90	0.10	0.00	0.20			
ALLICER					0.1	0.07	0.06
AMELALN					0.3	0.8	1
ANEMMUL	0.70	0.00	0.80	0.50			0.13
ANTENNA	0.30	0.40	0.40	0.10	0.10	0.13	0.27
ARCTUVA	0.00	1.00	0.00	1.00	1.00	0.67	1.33
ARNICA					0.80		
ASTER	0.00	0.40	0.10	0.10			0.8
CALARUB	0.00	0.50	0.10	0.00	0.30	0.93	0.60
CALCAR	0.00	10.00	2.00	2.00			
CALOCHO	0.00	0.00	0.10	0.00		0.13	0.06
CAREXDRY	0.00	0.40	0.70	0.30			0.13
CARECOI					0.3		
CIRSIUM	0.00	0.40	0.00	0.00			
CREPATR	0.00	0.50	0.10	0.10	0.80	0.47	
DODEPUL					0.10	0.07	
ELYMSMI	0.00	0.10	0.00	0.00			
ELYMSPI	6.00	1.00	2.00	3.00	1.00	1.67	
ELYMUS	0.00	0.00	0.30	0.00			
EPILFOL							0.06
ERIGPUM	0.10	0.30	0.10	0.00		0.73	0.53
ERIOGON	0.00	0.00	0.30	0.00			
FESTCAM	0.00	0.50	0.80	1.00	0.90	0.93	
FESTIDA	10.00	0.60	0.00	0.00	2.00	2.07	
FESTSAX	0.00	0.00	0.00	0.30			
FRAGVIR	0.00	0.20	0.00	0.10			0.06
GAILARI	0.00	0.10	0.00	0.10		0.20	
GEUMTRI	0.70	0.50	0.20	0.00	0.90	1.80	5.00
KOELMAC	0.80	2.00	0.70	1.00	1.00	1.00	0.33
LOMAMAC	0.00	0.10	0.00	0.00	0.10		1.13
LOMADIS	0.00	0.00	0.10	0.00			
LOMATRI	0.10	0.50	0.00	0.00	0.20	0.13	0.13
MEDILUP	7.00	3.00	1.00	0.00	11.00	7.07	2.87
ORTHIMB	0.00	0.10	0.20	0.00	0.30	0.67	0.06
PENSCON	0.30	0.00	0.40	0.10	0.50	0.93	0.60
PHLODIF	0.00	0.00	0.40	0.20	0.40	0.80	0.80
PINUPON							0.13
PLANPAT					0.10		0.13
POA COM						0.07	0.13
POA PRA						0.07	
PURSTRI						2	0.67
SOLIDAG	0.00	0.00	0.30	0.00			0.2
STIPNEL							0.13
STIPRIC	1.10	0.00	7.00	4.00	2.00	1.40	9.70
TARAOFF	0.20	0.00	0.00	0.10	0.10	0.87	1.00
ZIGAVEN					0.30	0.13	
MOSS	0.00	0.70	0.00	0.00		0.07	8.47
LICHEN						1.4	2.2

FORBS/GRASS
ARCTUVA Kinnikinnick is spreading at this site though still low in % cover. GEUMTRI Prairie smoke more than doubled its' density this year. MOSS and LICHEN are increasing at a steady rate. As for the grasses, STIPRIC Richardson's needle grass cover is expanding, but the FESCUEs were missing this year as was ELYMUS. This site was grazed earlier in the year so they may have been grazed down beyond recognition. There was also logging nearby which may have forced animals to use different areas than normal. As with other transects, the annual forbs come and go.



SN13	1997	1999	2000	2001	2005	2011	2016
AMELALN	4.00	5.00	5.00	3.00	0.00	5.00	6.50
JUNISCO	0.50	0.50	0.00	0.50	0.00	1.00	0.50
PINUPON	1.00	1.00	1.00	1.00	1.00	0.00	1.00
PSEUMEN	2.00	2.00	2.00	2.00	2.00	0.00	1.00
PURSTRI	4.00	0.00	1.00	0.50	2.00	3.00	4.00
ROSA	0.50	1.00	2.00	0.50	0.50	1.00	1.50

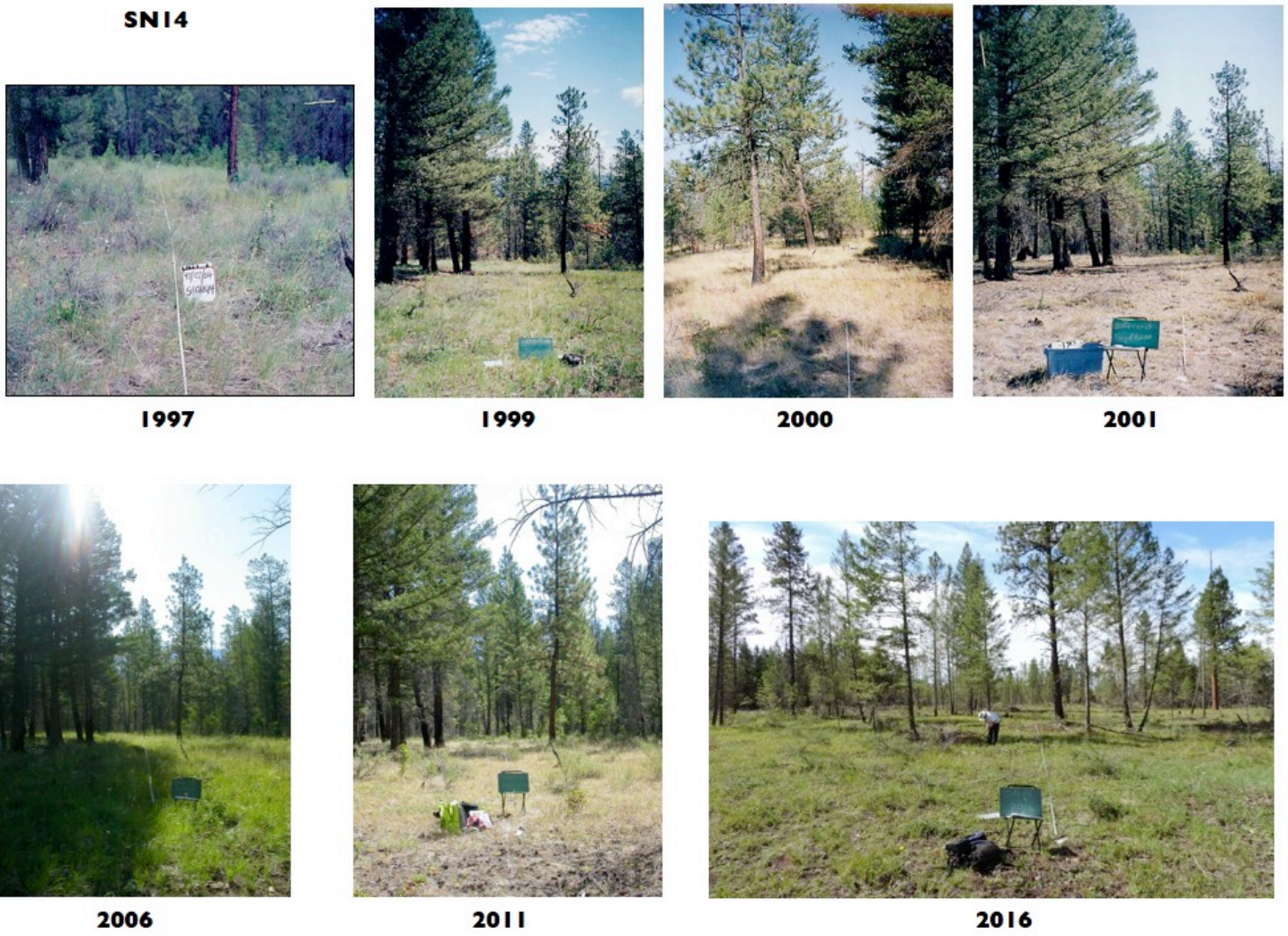
SHRUBS
AMELALN Saskatoon continues to increase after a slump ten years ago. Small amounts of PINUPON Ponderosa pine and PSEMEN Douglas fir are still showing up in the shrub category and also as small seedlings in the Daubenmire frames. JUNISCO Rocky Mtn. juniper, PURSTRI Bitterbrush and ROSA have all gone up and down in density since 1997.

SN13	GRASS	FORB	SHRUB	LITTER		g/m2	
1997	53.00	0.3	3.8				
1998	33.64	2.78	5.93				
1999	26.46	2.04	4.24				
2001	47.80	2.78	0.00				
2005	54.5	22.7	n/a				
2011	74.00	8.00		42			
2016	20.00	14.00	0	42			

PRODUCTION
The clip data tells the story of the decline in grass volume but the rise in forb volume for this year and over the last 19 years. Because the clip is done in a different location near the transect every time; it is not a totally accurate account, but averaged over the years and in other plots of the same plant community can be used to set carrying capacities.

There has been a steady decline in grass production on this site and an increase in forb production. Even CALARUB Pinegrass is not especially abundant. Recent logging activity in the area, may take the pressure off this site and reverse this trend.

3.3.2 SN14 Transect, Springbrook Pasture, Sheep Creek North Range Unit, North Rotation

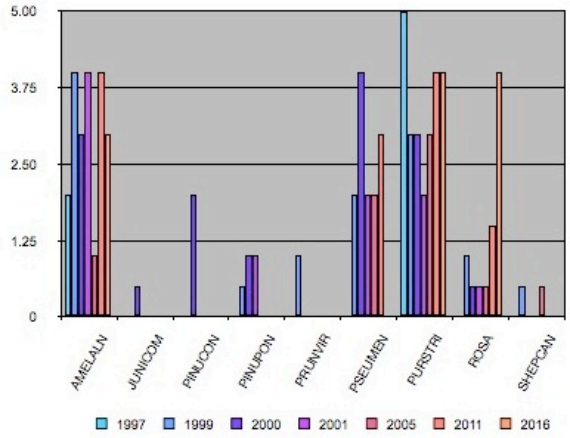


SN14 is an opening in a *Pinus ponderosa/Pseudotsuga menziesii* forest. This site received prescribed burns in 1999 and 2005. As is very evident from the 2016 image, selective logging occurred the winter of 2015/2016 opening up the immediate area that had escaped fire damage in earlier years. The start pin was found in 2016 but no production cage.

SN14	1997	1999	2000	2001	2005	2011	2016
ACHIMIL	2.30	0.90	0.60	0.30	1.00	0.87	0.73
AGOSGLA	0.50				0		0.13
ANEMMUL	0.70				0	0.27	2.2
ALLICER	0.10	0.50			0.1	0.07	
ANTENNA	1.50	2.00	2.00	1.00	2.00	1.13	0.06
ARABHOL		0.10			0		
ARCTUVA	4.00	1.00	2.00	2.00	2.00	4.67	8.67
ASTER	0.10	0.30	0.20				0.73
ASTRMIS	1.20	0.90	0.30		1.00	0.40	0.47
CALARUB	1.80	0.40	0.30	0.40	0.30	0.93	1.67
CALCAR			3.00	7.00			
CALOCHO			0.10		0.10		0.06
CAMPROT				0.10			0.13
CAREX							0.73
CASTILL			0.10				
CLADCAI		0.60					
CREPATR	1.00	0.50	0.20	0.60	0.70	0.27	
DODECAT			0.10		0.1		
ELYMSPI	0.20	0.80	1.00	0.90	1.00	0.60	
ERIGERO				0.10	0.20		0.53
FESTCAM		0.20	1.00	0.70	0.50	0.07	0.67
FESTIDA	8.80	0.50	0.10		0.70	1.07	
FRAGVIR							2.2
HIERSCO	0.20						
KOELMAC	1.20	1.00	0.10	0.10	1.00	0.20	0.06
LOMATRI		0.30		0.10	0.30		0.06
MEDILUP	1.60	0.90	1.00		9.00	3.93	1.27
ORTHOCA	0.50	0.10	0.20		0.10	0.07	
PELTIGE	0.60	6.00	0.70	0.30	7.00		0.2
PENSCON	0.70	0.10	0.10		0.10	0.60	0.6
PHLOX	2.60	0.90	1.00	0.90	1.00	0.60	2.06
STIPRIC	1.10	1.00	4.00	3.00	1.00	2.87	1.2
TARAOFF	0.10	0.30			0.40		1.2
ZIGAVEN		0.20			0.50	1.00	
MOSS						8.00	
LICHEN							

FORBS
ARCTUVA Kinnikinnick is increasing in the area as is PHLOX. Many other forbs were missing this year. Grasses are still not greatly abundant and some species ELYMSPI Bluebunch wheatgrass, FESTIDA Idaho fescue were absent this year. STIPRIC Stipa richardsonii is its usual resilient self, showing up at varying cover in most

PRODUCTION
The higher forb production once again shows up in the clip data; higher litter value may be attributed to conifer needles.



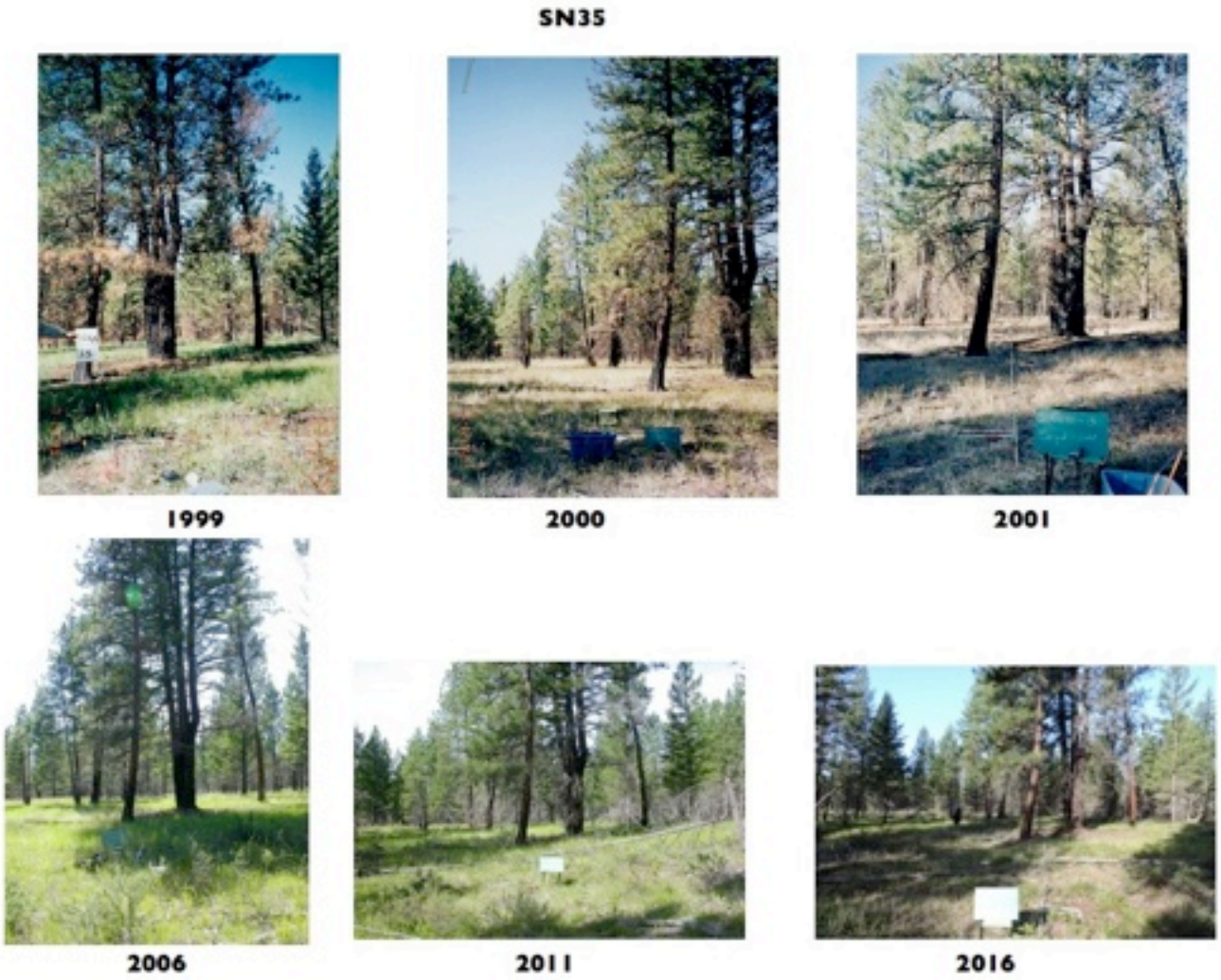
SN14	1997	1999	2000	2001	2005	2011	2016
AMELALN	2.00	4.00	3.00	4.00	1.00	4.00	3
JUNICOM	0.00	0.00	0.50	0.00	0.00		
PINUCON	0.00	0.00	2.00	0.00	0.00		
PINUPON	0.00	0.50	1.00	1.00	0.00		
PRUNVIR	0.00	1.00	0.00	0.00	0.00		
PSEUMEN	0.00	2.00	4.00	2.00	2.00	3.00	
PURSTRI	5.00	3.00	3.00	2.00	3.00	4.00	4
ROSA	0.00	1.00	0.50	0.50	0.50	1.50	4
SHEPCAN	0.00	0.50	0.00	0.00	0.50		

SHRUBS
Five species of shrubs have been missing from this area for 11 years (unless they came in then moved out again). The area was burned in 1999 and 2005 and appears to have been logged this past winter. The transect was relatively untouched except for surface disturbance from equipment (start pin had been bent over). This could account for some of the change. PURSTRI Bitterbrush and ROSA are continuing to maintain their density onsite. AMELALN Saskatoon has been much more variable.

SN14	GRASS	FORB	SHRUB	LITTER		g/m2	
1997	9.20	3.00	11.30	223.70			
1998	14.86	2.96	42.00	8.05			
1999	15.27	6.59	0.00	0.00			
2001	17.56	17.67	0.00	0.00			
2005	18.2	36.3	n/a	22.7			
2011	42.00	14.00	0.00	98.00			
2016	14.00	66.00	0.00	62.00			

A nearby landing, access road and burn pile with vast areas of bare ground will no doubt affect this area in the future unless it is promptly scarified and seeded with short lived annual grasses. Shrub density is mediocre and young trees have all but disappeared.

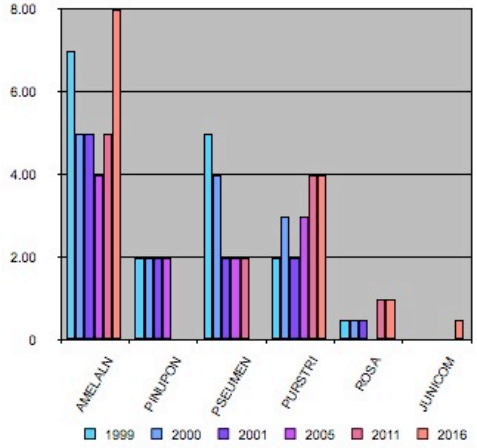
3.3.3 SN35 Transect, Springbrook Pasture, Sheep Creek North RU, North Rotation



SN35 is an opening in a *Pinus ponderosa/Pseudotsuga menziesii* forest. This site was control burned in 1999 and 2005. Logging happened over the past winter (2015/16) and the new access road is very close, but did not affect this immediate area. The start and end pins were found in 2016 but no production cage.

SN35	1999	2000	2001	2005	2011	2016
ACHIMIL	0	0	0	0.1		0.13
ACHNNEL	0	0	0	0.1		
ALLICER	0.10	0.10	0.00	0.30	0.13	0.27
AMELALN	0.00	5.00	0.00	4.00	5.00	7.13
ANEMMUL	0.10	0.30	0.90	0.90	0.47	0.40
ANTESPA					0.27	
ANTENNA	0.90	0.90	0.90	0.90	0.33	0.53
ARCTUVA	1.00	2.00	0.00	5.00	13.07	10.60
ARNICA	0.10	0.00	0.00	0.00		
ASTER	1.00	0.00	0.00	0.00	0.33	1.13
CALARUB	1.00	1.00	2.00	4.00	2.00	0.73
CALOAPI	0.00	0.00	0.00	0.10	0.13	
CALOMAC						0.06
CAREXDRY	0.70	1.00	0.90	0.50	0.67	0.73
CASTSUL	0.10	0.00	0.00	0.00	0.07	
CREPATR	0.40	0.10	0.00	0.50	0.20	0.47
ERIGPUM						0.20
ELYMSPI	0.10	1.00	2.00	0.30	0.13	0.20
FESTCAM	0.30	0.50	0.10	0.00	0.73	0.27
FESTIDA	0.10	0.30	0.00	0.60	0.13	0.33
FRAGVIR	0.30	0.00	0.50	0.50		
HIERACI	0.20	0.00	0.00	0.00		
KOELMAC	0.10	0.20	0.00	0.10	0.13	0.27
LOMATRI	0.00	0.10	0.00	0.10	0.07	
MEDILUP	0.30	0.50	0.00	0.90	0.73	0.13
PELTCAN	0.00	0.00	0.10	0.00		
PENSCON	0.60	0.30	0.10	0.20	0.60	0.87
PHLOX	0.20	0.50	0.60	0.50	0.60	0.80
PURSTRI	0.00	0.70	0.00	0.70	0.33	
ROSA					0.33	1.33
SOLISPA	0.00	0.00	0.00	0.30	0.67	
SPIRBET					0.53	
STIPRIC	0.10	0.00	0.50	0.00		0.93
TARAOFF					0.13	0.40
MOSS					0.13	
LICHEN					0.20	

FORBS
ARCTUVA Kinnikinnick has consistently had the highest % cover of all the forbs. PENSCON Yellow penstemon and PHLOX are increasing steadily. The grasses were all present and had increased since the 2011. ERIGPUM Shaggy fleabane was detected for the first time in the Daubenmire frame. No moss or lichen was found this time. New logging is very close to this transect area.



SN35	1999	2000	2001	2005	2011	2016
AMELALN	7.00	5.00	5.00	4.00	5.00	8.00
PINUPON	2.00	2.00	2.00	2.00	0.00	0.00
PSEUMEN	5.00	4.00	2.00	2.00	2.00	0.00
PURSTRI	2.00	3.00	2.00	3.00	4.00	4.00
ROSA	0.50	0.50	0.50	0.00	1.00	1.00
JUNICOM						0.5

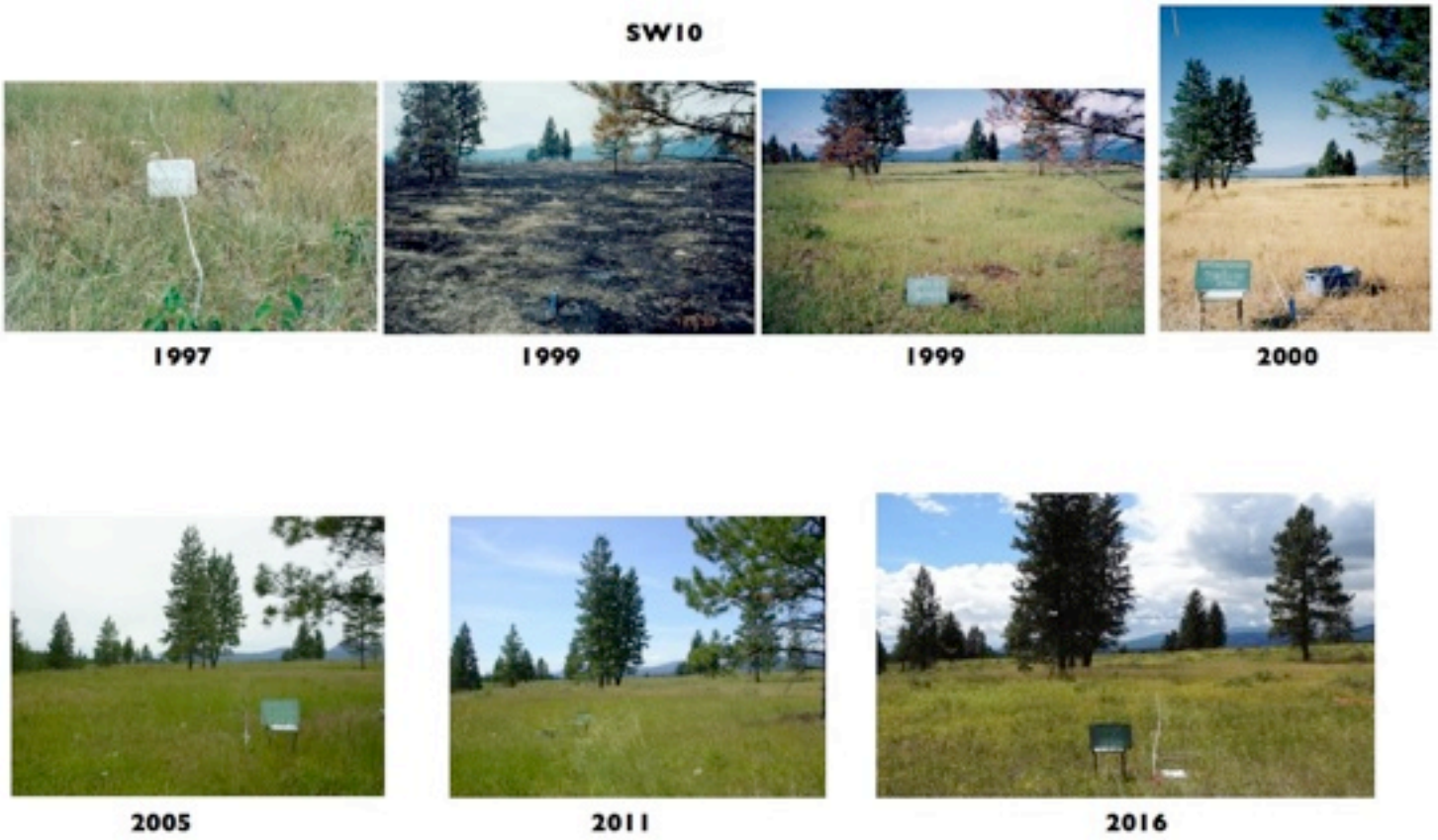
SHRUBS
Field notes say tons of small AMELALN Saskatoon are coming in therefore increasing. No small trees are coming into the transect area which is a good sign. ROSA and PURSTRI Bitterbrush are maintaining their presence and JUNICOM Common Juniper arrived on site since the last check.

SN35	GRASS	FORB	SHRUB	LITTER		g/m2
1999	18.80	1.66	4.84			
2000	11.02	11.43	2.68			
2001	14.25	6.41	4.29			
2005	22.7	22.7	4.5			
2011	38.00	60.00	26.00	68.00		
2016	20.00	90.00	4.00	88.00		

PRODUCTION
Forb production has increased as well as litter (lots of pine needles in litter). Cows have been in here already this year and have grazed a lot of different plants.

Forb production is definitely outstripping grass production with the steady increase in ARCTUVA Kinnickinnik accounting for most of it. Desired grasses are still at low cover values hinting at grazing stress which does not explain the high density of AMELALN Saskatoon; perhaps this is related to season of use or proximity to other more desirable habitat nearby.

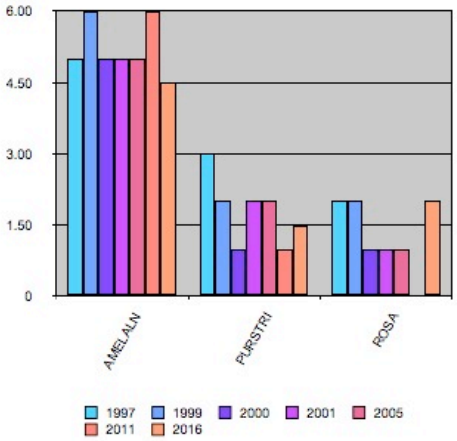
3.3.4 SW10 Transect, Skookumchuk Pasture, Sheep Creek North RU, West Rotation



SW10 is located in an open grassland polygon. It has had a history of overgrazing and was reverting to an area dominated by non-native grasses and invasive plants in the early 90's. It was burned in 1999. The start pin was not found in 2016 and the production cage was collapsed but still on site.

SW10	1997	1999	2000	2001	2005	2011	2016
ACHIMIL	1.30	0.60	0.80	0.10	1.00		
AMELALN					0.70	2	
ANTENNA	0.00	0.30	0.10	0.10	0.10		
APOCAND	0.40	0.50	0.00	0.00	0.20	0.53	0.67
ARCTUVA	1.00	0.40	2.00	1.00	1.00	0.33	
ARABHOL					0.10		
ASTRMIS	0.00	0.30	0.00	0.00	0.50	0.27	
BROMANO							0.13
BROMTEC	0.00	0.40	0.10	0.50	3.00		0.27
CALARUB						0.07	
CALOCHORTUS							0.06
CAMPROT	0.00	0.50	0.00	0.00		0.13	0.27
CERASTI							0.20
ELYMSPI	0.40	0.00	0.40	0.30	0.30		
ERIGFIL					0.20		
ERIGPUM	0.00	0.00	0.10	0.00			0.47
FESTIDA	0.90	0.00	0.10	0.00	0.80	1.13	
FESTCAM	0.50	0.40	0.00	0.00	0.20		0.47
GAILARI						0.2	
KOELMAC	0.10	0.30	0.10	0.00	0.10		
LEPIDEN							0.6
LOMATRI	0.00	0.00	0.10	0.00	0.30		
MEDILUP	0.10	19.00	2.00	0.00	18.00		1.73
PENSCON	0.30	0.00	0.10	0.00			
PLANPAT					0.1	0.27	0.06
POA COM	9.50	30.00	11.00	7.00	3.00	6.13	2.47
POA PRA	1.50	0.10	1.00	0.10		0.13	
POTENTI	0.00	0.30	1.00	0.50	8.00	6.67	11.27
POTEGRAFLA							0.60
STIPNEL	1.10	3.00	5.00	3.00	2.00	0.60	
STIPRIC	0.10	3.00	2.00	3.00	2.00	4.33	3.73
TARAOFF	0.00	0.50	0.00	0.00	5.00	1.53	
TRAGDUB	0.40	0.60	0.40	0.10	0.10	0.13	0.06
MOSS	0.00	2.00	0.00	0.00	0.40	0.00	
LICHENSP	0.00	0.90	0.00	0.00		0.13	

FORBS / GRASS
ACHIMIL yarrow, has decreased to the point where it was not detected in the last two re-runs. There is more APOCAND spreading dogbane two kinds of POTENTILLA are taking over large areas of this plot. CERASTI chickweed is also showing up this time around. STIPRIC Richardson's needlegrass remains the dominant grass in the area with POACOM Canada bluegrass maintaining a presence as well. Two weedy bromes, BROMTEC and BROMANO continue to plague the area. We did not find FESTIDA Idaho fescue in the Daubenmire frames this year, but did find a small amount of FESTCAM Rough fescue despite the amount of weedy plants on site.



SW10	1997	1999	2000	2001	2005	2011	2016
AMELALN	5.00	6.00	5.00	5.00	5.00	6.00	4.50
PURSTRI	3.00	2.00	1.00	2.00	2.00	1.00	1.50
ROSA	2.00	2.00	1.00	1.00	1.00	0.00	2.00

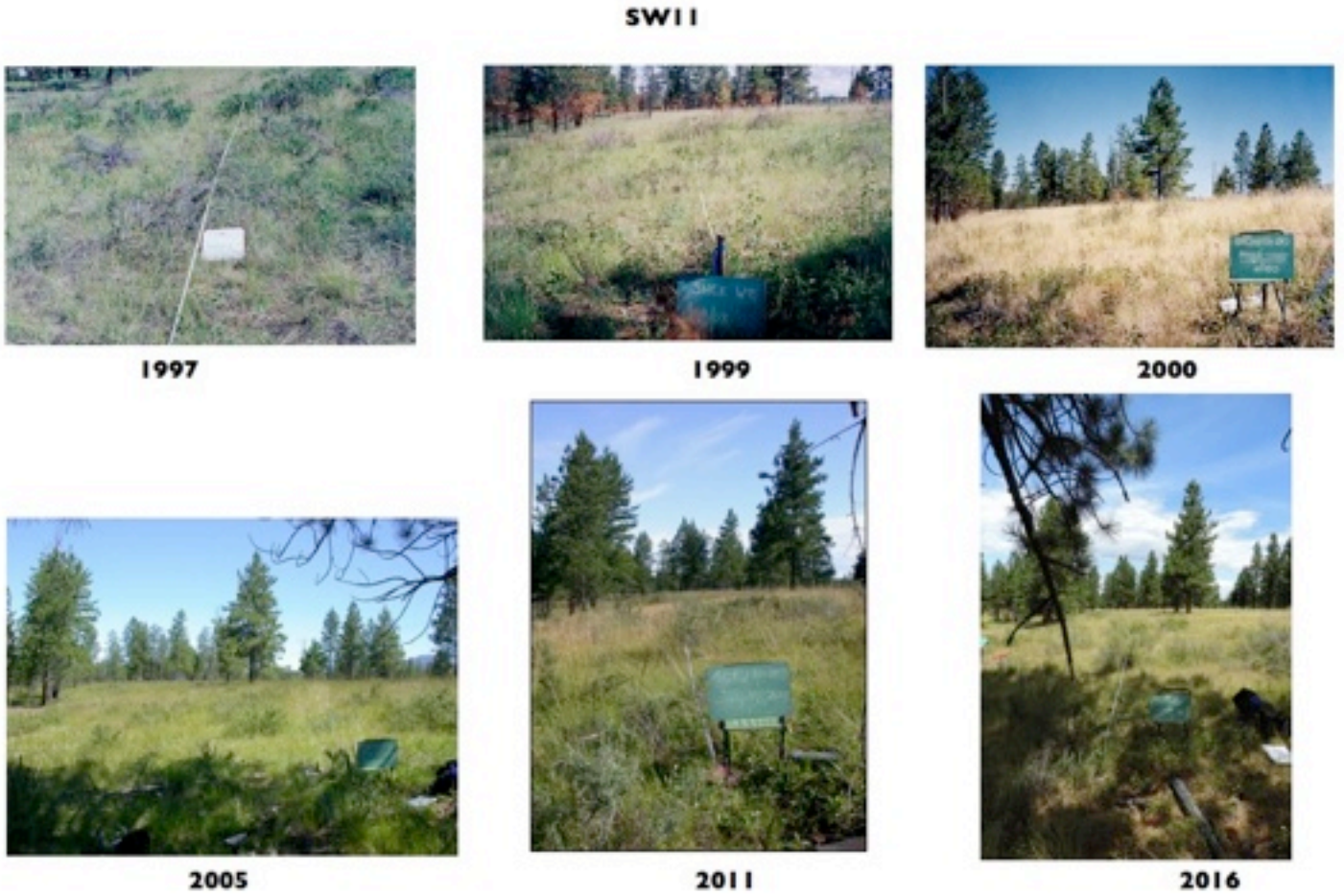
SHRUBS
AMELALN Saskatoon had a nice increase after the burn in 1999 then again in 2011. It is now at its' lowest level since monitoring began. Both PURSTRI Bitterbrush and ROSA had the same sort of ups and downs and only ROSA has fully recovered to it's 1997 level.

SW10	Grass	Forb	Shrub	Litter		g/m2
1997	162.40	1.70	5.40	48.70		
1998	121.11	0.00	36.91	0.00		
1999	52.03	0.01	2.09	0.00		
2000	58.83	0.75	9.35	0.00		
2005	59.02	18.2	9.08	22.7		
2011	154.00	8.00	16.00	2.00		
2016	48.00	52.00	0.00	106.0(		

PRODUCTION
Less grass volume was clipped this year and a lot more forb volume. Litter also increased significantly; I suspect from the large amount of Potentilla now in the area.

This site looked like a field of potentilla upon first glance. These plants have definitely taken hold of the area since 2011. This would account for a lot of the forb volume in the clip. STIPRIC Richardson's needlegrass is the only grass able to compete effectively with the forbs.

3.3.5 SW11 Transect, Johnson Lake Pasture, Sheep Creek North RU, West Rotation

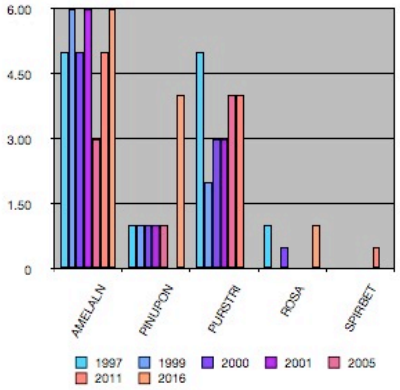


SW11 is located in a grassland opening. It was burned in 1999. The start and end pin were both located in 2016 and the cage was intact but not used for the clip as it had not been moved for 5 years.

SW11	1997	1999	2000	2001	2005	2011	2016
ACHIMIL	0.30	0.00	0.20	0.00	0.50	0.33	
ALLICER						0.13	
AMELALN					0.90	2.6	5.27
ANEMONE							0.13
ANTENNA	0.00	0.10	0.00	0.10	0.20	1.00	1.13
APOCAND	0.00	0.30	0.00	0.00	0.00		0.33
ARABHOL						0.07	
ARCTUVA	14.00	5.00	7.00	4.00	3.00	1.20	1.30
ASTRMIS	0.20	0.00	0.20	0.00	0.50	0.47	0.27
BROMSQU	0.00	0.00	0.00	0.00	0.10		
BROMTEC	0.80	2.00	0.00	1.00	6.00	0.47	0.20
CALARUB	0.70	0.20	0.00	0.10	0.00	1.60	0.40
CALCAR	0.00	0.00	10.00	0.00	0.00		
CALOMAC	0.00	0.10	0.00	0.00	0.00		0.06
CAREX						0.2	
DESCSOH	0.00	0.00	0.00	0.00	0.1		
DODEPUL						0.13	
EPILFOL							0.4
ELYMSPI	0.00	0.00	0.00	0.10	0.00		
ERIGPUM					0.1	0.27	1.27
FESTCAM	2.70	0.30	0.60	0.30	0.20	0.13	0.07
FESTIDA	4.80	3.00	0.10	0.30	0.50	2.40	0.27
FILAARV					0.20	0.27	
FRAGVIR	0.30	0.10	0.00	0.00	0.00		
HETEVIL						0.67	
KOELMAC	0.10	0.80	0.10	0.10	0.10	1.40	1.20
LEPIDEN	0.00	0.00	0.00	0.10	0.80		
MEDILUP	0.40	2.00	1.00	0.00	0.00	8.27	4.40
PENSCON	0.70	0.30	0.10	0.10	0.10		0.33
PHLODIF					0.20		
PLANPAT							0.13
POA	0.00	0.00	3.00	0.00	0.90	1.20	1.47
POA COM	0.90	3.00	0.80	0.60	0.10	1.33	0.27
POA PRA	0.20	0.00	0.00	1.00	0.00		
POTENTI					2.00		0.87
POTEREC							0.67
PURSTRI					2.00	0.2	4.1
STIPNEL	0.00	10.00	12.00	11.00	5.00	0.47	2.30
STIPRIC	0.00	0.10	0.00	0.00	0.00		
SPIRBET						0.27	
TARAOFF					0.4	0.73	0.73
TRAGDUB	0.00	0.30	0.10	0.10	0.70	0.27	0.33
ZYGAVEN						0.07	
MOSS	0.00	2.00	0.00	0.00	1.00	8.20	10.30
LICHEN	0.00	9.00	0.00	0.00	12.00	5.67	

FORBS/GRASSES

ANTENNA Antennaria has steadily increased over the years as have the Potentillas and mosses. ARCTUVA Kinnikinnick has dramatically declined since 1997 as has the LICHEN in the last 11 years. Grasses are maintaining a presence but cannot compete with the forbs for nutrients. This transect is quite close to Johnson Lake so an easy walk for livestock or wildlife to refresh themselves and come back. The weedy BROMTEC Downy brome seems to be decreasing here.



SW11	1997	1999	2000	2001	2005	2011	2016
AMELALN	5.00	6.00	5.00	6.00	3.00	5.00	6.00
PINUPON	1.00	1.00	1.00	1.00	1.00	0.00	4.00
PURSTRI	5.00	2.00	3.00	3.00	4.00	4.00	0.00
ROSA	1.00	0.00	0.50	0.00	0.00	0.00	1.00
SPIRBET	0.00	0.00	0.00	0.00	0.00	0.50	0.00

SHRUBS

AMELALN Saskatoon remains at a high density in the area, even though the plants are repeatedly browsed. Tree seedlings from PINUPON are making a comeback this year. Although PURSTRI Bitterbrush was absent from the shrub plot this year, I am sure it will make a comeback. ROSA continues to stay at a low density and SPIRBET Spiraea was absent in 2016.

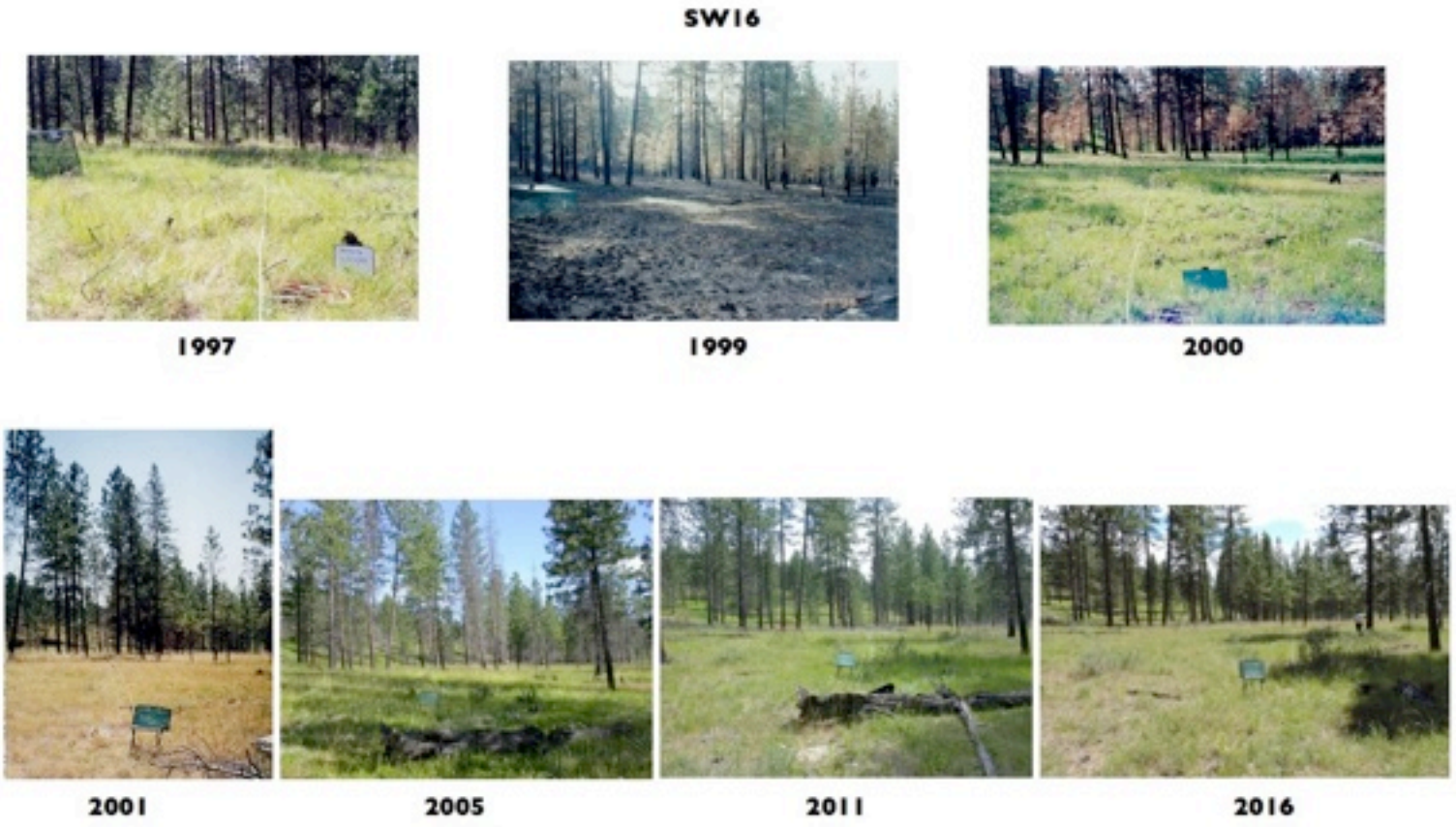
SW11	GRASS	FORB	SHRUB	LITTER		g/m2
1997	32.00	2.20	0.00			
1999	31.56	9.31	7.37			
2000	34.41	8.74	63.79			
2001	13.74	4.17	0.07			
2005	77.2	36.32	18.2			
2011	164.00	8.00	18.00	206.00		
2016	18.00	152.00	8.00	8.00		

PRODUCTION

This year the forb component greatly exceeded the grass volume. The reason for the large amount of litter in 2011 was the fact that a cage was in place for the 5 previous years which allowed a nice litter layer to develop. This was not the case in 2016 no matter where the frame landed.

This very dry site close to Highway 93/95 and Johnson Lake appears to still endure a lot of use from both ungulates and livestock. Grasses seem to be stagnant or receding and some forbs are increasing in cover and volume in litter. Decreased livestock numbers in the past five years may help in the long term, but the closeness to Johnson Lake is a drawback.

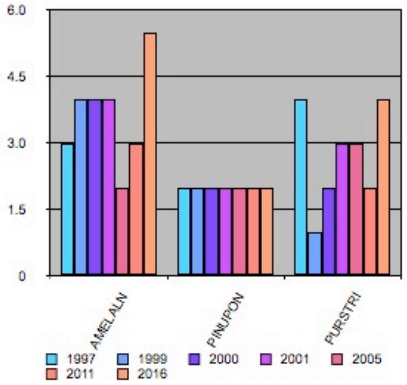
3.3.6 SW16 Transect, Johnson Lake Pasture, Sheep Creek North RU, West Rotation



SW16 is an opening in a *Pinus ponderosa* forest. It was burned in the late 1990's. The site was originally moderately grazed and seems to have maintained that status. The start pin was not found in 2016 but the production cage was intact.

SW16	1997	1999	2000	2001	2005	2011	2016
ACHIMIL	0.1	0.2	0.1	0.2	0.6	0.53	1.2
AMELALN						0.67	0.93
ANTENNA		0.1		0.1			
ARABHOL	0.1			0.1			
ARCTUVA	15	6	6	6		6.13	10.5
ARTEMISI	0.01	0.1	0.3	0.4	0.2		
ASTEFOL	0.2	0.7	0.1	0.1		0.13	0.13
ASTRMIS	0.2	1	1	0.4	8	1.53	7.4
BORAGIN				0.1			
BROMTEC					0.5		
CALARUB		0.8	0.4		0.3	0.73	0.73
CAMPROT	0.2		0.2	0.1			
CAREXDRY	0.3	0.6	0.5	0.5	0.4		0.27
CASTSUL						0.2	
EPILFOL							0.06
ERIGERON						0.27	
ELYMSPI				0.2	3		
FESTCAM		2	0.4	0.7	0.2		0.27
FESTIDA						0.07	
FRAGVIR	0.5	0.7	0.2	0.2			0.27
GAILARI						0.13	
GENTIANA							0.13
HETEVIL				0.1			0.06
KOELMAC	1.3	2	2	3	1	1.4	0.33
LEPIDEN				0.3	0.2		
MEDILUP	1.6	11	3		17	6.13	3.3
PENSCON	0.5	3	0.7	0.5	0.9	0.67	1.6
PHLOX	0.6	0.3	0.2		0.5	0.93	0.13
PINUPON							0.2
POA	0.2		0.3			0.07	
POA COM	0.7	4	0.9	0.7	0.9	0.87	1.2
SEDUM		1	0.1		0.1		
SOLICAN						1.6	
STIPNEL		3				0.13	
STIPRIC	6.3		4	4	3	2.87	5.8
TARAOFF						0.53	0.67
TRAGDUB							0.13
VIOLA		0.6		0.2		0.2	1
MOSS	0.8	6			0	2.73	
LICHEN						6	

FORBS/GRASS
ARCTUVA Kinnickinnik is gaining density in this area as is PENSCON Yellow penstemon. ASTRMIS Timber milk-vetch seems to vary with the amount of available moisture. The grasses seem to be struggling to increase except for STIPRIC Richardon's needlegrass which is back up to 1997 cover. The fescues and Poas are barely holding their own.



SW16	1997	1999	2000	2001	2005	2011	2016
AMELALN	3	4	4	4	2	3	5.5
PINUPON	2	2	2	2	2	2	2
PURSTRI	4	1	2	3	3	2	4

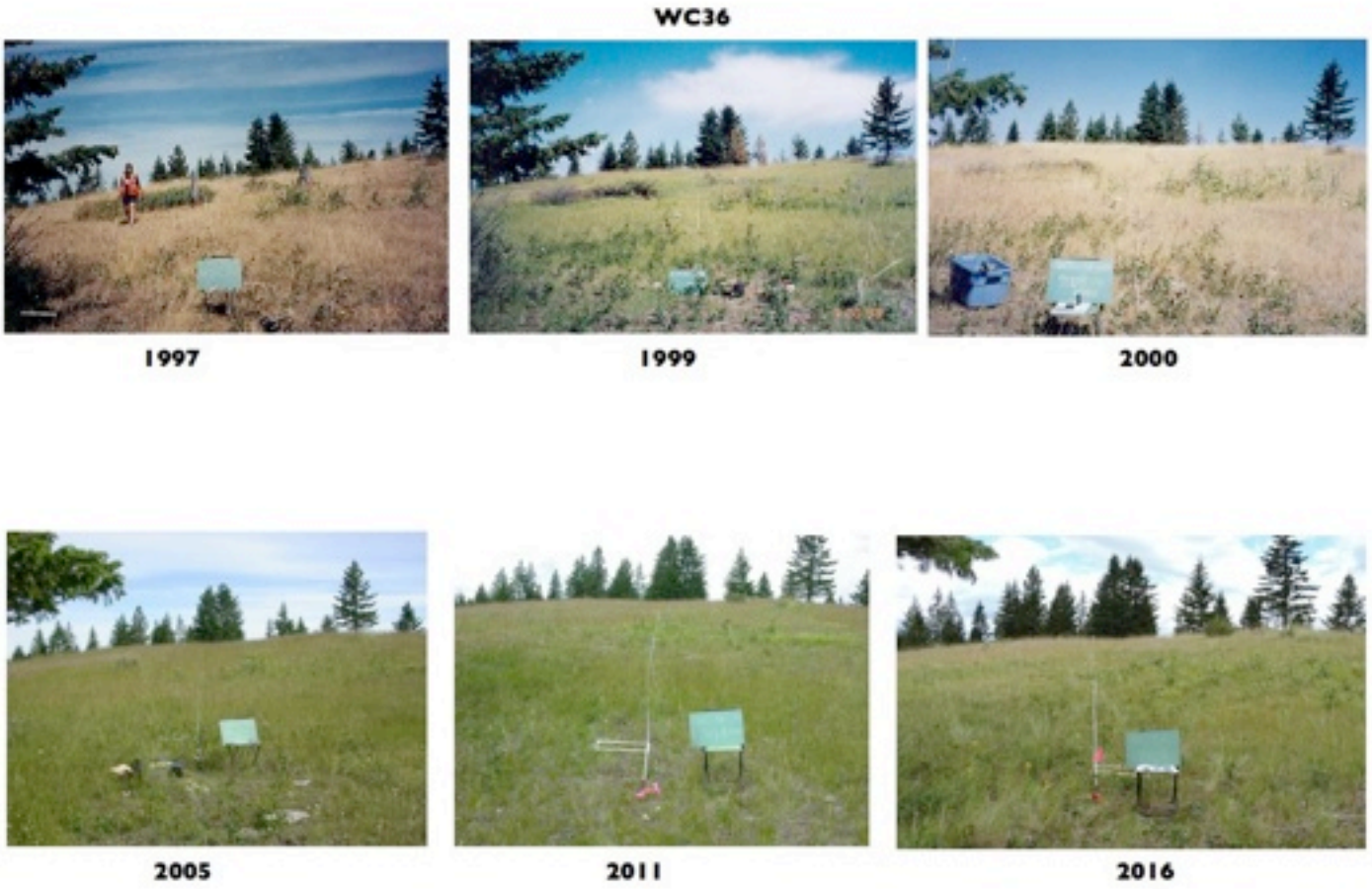
SHRUBS
AMELALN Saskatoon has maintained a sustainable density on this site except in 2005 when there were only a few individuals. PINUPON Ponderosa pine maintains a low amount of individuals trying to grow on this site. PURSTRI Bitterbrush has gone up and down and is currently at the same density as in 1997.

SW16	GRASS	FORB	SHRUB	LITTER		g/m2
1997	36.70	8.40	13.90			
1998	22.80	5.42	12.47			
1999	14.55	19.16	11.93			
2000	20.60	33.41	0.00			
2001	19.65	12.65	4.55			
2005	45.4	49.94	36.32			
2011	68.00	56.00	4.0	34		
2016	2.00	122.00	0.00	764		

PRODUCTION
The grass decline shows up in the clip data with much more forb volume and litter (likely a lot of needles).

Due to it's adaptation to variable conditions and reproductive strategies, STIPRIC Richardson's needlegrass maintains a dominant presence on this site and elsewhere. ARCTUVA Kinnickinnik has also gained ground almost back to its' 1997 levels. Mosses and lichens have declined since 2011.

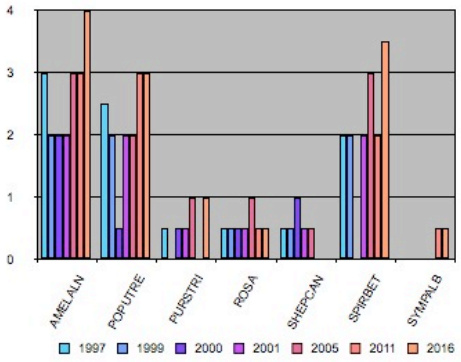
3.3.7 WC36 Transect, Elk Pasture, Wolf Sheep Creek RU (Premier Ridge)



WC36 is a meadow on upper Premier Ridge. The Elk Burn took place in 1999. Discussions with Doug Barraclough (the tenure holder) confirmed that the livestock have not been in the area for many years due to lack of water and abundant forage elsewhere. The trail to this site was still overgrown with grasses and forbs so that it was difficult to discern where it was. This is a good sign and indicates that the road closure seems to be working. The start pin was not found but the cage was intact although collapsed and overgrown with vegetation.

WC36	1997	1999	2000	2001	2005	2011	2016
ACHIMIL	0.3	2	1	0.4	1	1	2.6
AMELALN						0.13	1.67
ANEMMUL	0.2	0.1	0.1	0.3	0	0.33	0.26
ANTENNA	2.2	0.8	0.3	0.5	0.7	0.4	
ARNIFUL						0.4	
ASTER						0.2	
ASTRMIS	0.1	0.7	0.1	0	15	2.4	8.67
CALARUB	1	0.2	0	3	0	1.33	2.4
CALCAR	2.5	6	0	2	0		
CASTLUT							0.4
CALOAPI						0.2	0.2
CERASTI	0	0.3	0	0	0.1		0.06
DODEPUL						2.07	0.53
ELYMSPI	0.2	0	0	0	0	0.13	0.06
ERIGPUM	0.1	0	0.3	0.1	0		
FESTCAM							0.13
FESTIDA	1.3	2	14	0	3	10.67	3.87
FESTSAX	0.2	0	0	1	0		
FRAGVIR							0.13
GENTIANA						0.33	
HETEVIL	0.5	1	1	0.4	0.9	4.07	2.4
KOELMAC	0.60	0.3	0.1	0.3	0.4	0.67	0.53
LEGUME						0.13	
LOMATRI						0.07	0.06
MARIAPI							0.2
MEDILUP						6.2	2
ORTHIMB	0.10	0	0.3	0.1	0	1.13	1.47
OXYTCAM							1.67
PELTIGE	0.20	0.2	0	0.1			2
PENSCON						0.13	
PLANPAT	0.1	0.8	0	0	0		
POA	3	0.4	0.7	0	0		
POA COM	0	0.1	0.3	0.5	0.3	0.13	
POPUTRE						4.33	
SISYRIN						0.33	
SPIRBET						1.6	1.4
STIPNEL	2.2	10	7	0	7		1.93
STIPOCC	0	0	0	4	0		
STIPRIC	1.9	2	8	2	0.5	0.8	8.6
TARAOFF	0	0.7	0	0.1	0.3	0.73	2.3
TINYWHITE						0.93	
TRAGDUB						0.13	
VICIA	0	0	0	0.1	0		
ZYGAVEN						0.33	0.13
MOSS						1.93	0.4
LICHEN						9.53	2.47

FORBS/GRASS
ASTRMIS Timber milk-vetch had higher cover this year with the exception of 2005. OXYTCAM Locoweed showed up this year as well. A small amount of FESTCAM Rough fescue was noted this year, which is a good sign that use is changing. FESTIDA Idaho fescue is much more prevalent but seems to fluctuate a lot. STIPRIC Richarson's needlegrass is at an all time high in 2016. The POAs were absent this time. Lichens seem to be less frequent possibly due to the increase in use by elk given the large amount of pellets seen on the site.



WC36	1997	1999	2000	2001	2005	2011	2016
AMELALN	3	2	2	2	3	3	4
POPUTRE	2.5	2	0.5	2	2	3	3
PURSTRI	0.5	0	0.5	0.5	1		1
ROSA	0.5	0.5	0.5	0.5	1	0.5	0.5
SHEPCAN	0.5	0.5	1	0.5	0.5		
SPIRBET	2	2	0	2	3	2	3.5
SYMPALB						0.5	0.5

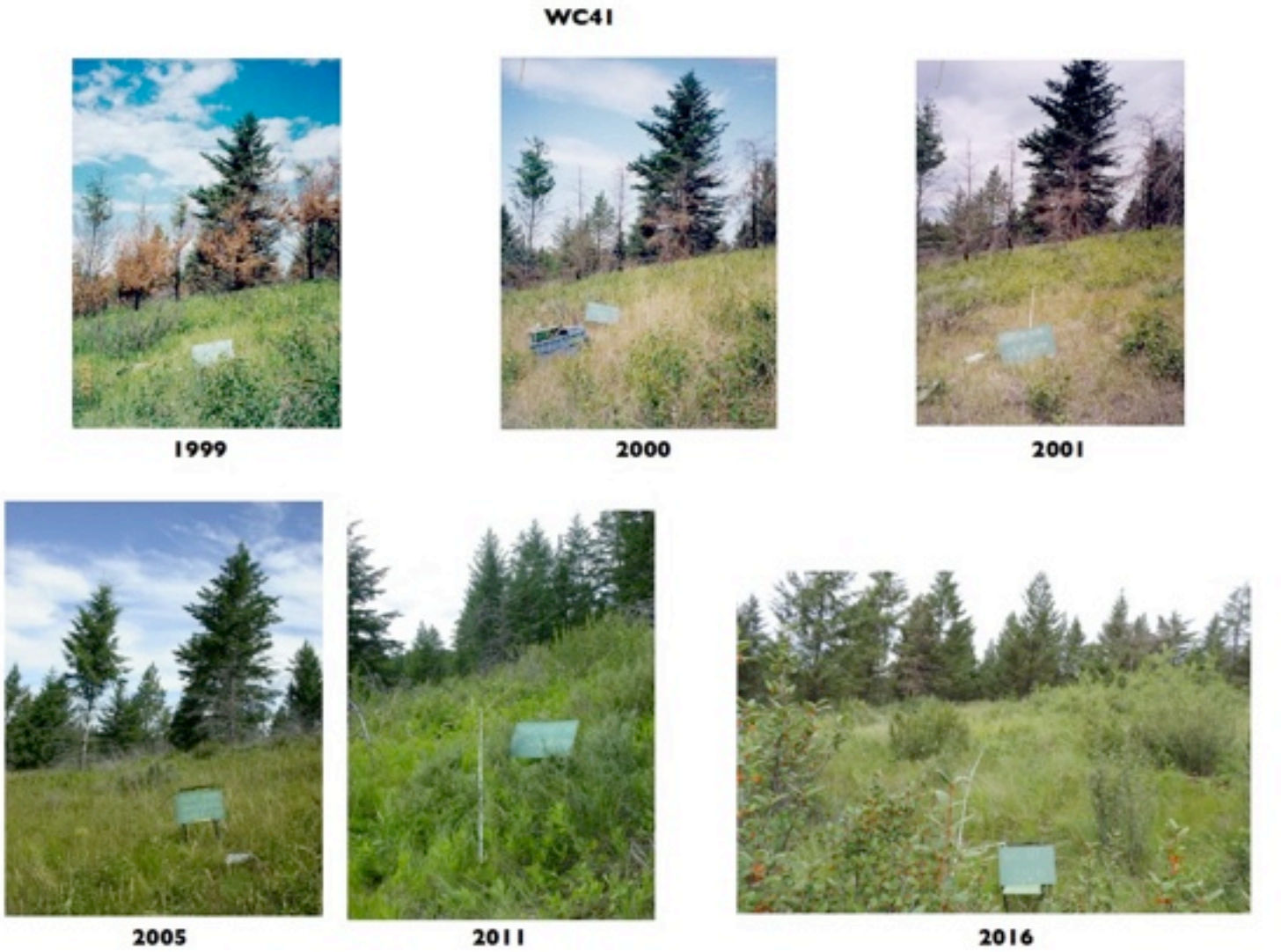
SHRUBS
AMELALN Saskatoon and ROSA are maintaining a stable presence in this area near the top of Premier ridge which is grazed by elk, deer and sheep. More POPUTRE Trembling aspen and SPIRBET Spiraea are slowly creeping into the site. SHEPCAN Soopolallie has died out in this

WC36	GRASS	FORB	SHRUB	LITTER		g/m2
1997	31.17	2.80	0.00			
1998	86.69	5.20	0.00			
1999	5.82	2.09	0.00			
2005	113.5	13.62	0			
2011	no data					
2016	18	34	0	64		

PRODUCTION
Grass volume is decreasing and forb volume increasing. Lots of

This area has been well used by elk which are possibly the cause of stagnant increases in shrub production. There was very good litter cover which translates into less use by wildlife. Grasses are still dominated by CALARUB Pinegrass, but fescues are present in small percentages. It is hard to say if this situation will change.

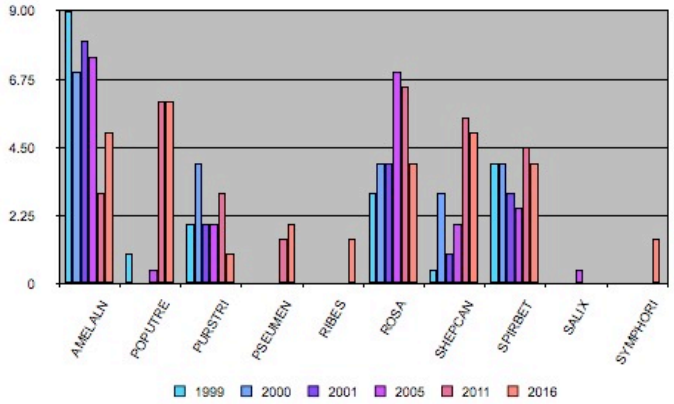
3.3.8 WC41 Transect, Elk Pasture, Wolf Sheep Creek Range Unit



WC41 is a west facing *Amelancier/Purshi/Rosa* dominated hillside. It burned well during the Elk Burn in 1999 due to plenty of fuel. The start pin was not found in 2016 (it may be under some of this new vegetation) and the identifying ribbon on a nearby tree and paint mark no longer existed. There was no production cage on site.

WC41	1999	2000	2001	2005	2011	2016
ACHIMIL	0.7	0.3	0.2	0.5	0.27	1.4
AGROPYR	1					0.06
AMELALN					0.53	
ANEMMUL	0.4	0.3	0.1	0.1		0.6
ANTENNA	0.2		0.3	0.5		0.2
ARCTUVA	2	4	4	5	9.07	4.27
ASTER	5	3	2	4.1	25.6	10.27
ASTRMIS	0.1		0.1			0.6
CALARUB		0.7		2	2.6	11.67
CALCAR	1	2	0.1			
CAREXDRY	0.1	0.3	0.2	0.3		0.2
CERASTI	0.5	0.2	0.6		0.47	0.2
DODEPUL					0.13	0.27
ELYMSPI		0.1	0.7	0.1		0.13
FESTCAM	0.7	2	2	0.8	0.93	
FESTIDA		0.7		0.1		0.13
FRAGVIR	2	2	1	3	1.33	7
GENTIANA					1.2	
HEDYSUL	0.4	0.4	0.5	0.4	0.13	
KOELMAC		0.1	1	0.3	0.87	0.4
LITHRUD			0.4	0.3		
LOMATRI		0.2				1.67
MAHOAQUI						
PENSCON					0.4	1.67
POA	0.6	2	0.9			
POA CUS				0.1		
POA PRA	0			0.7		
POPUTRE					2.33	13.3
PSEUMEN					0.2	
PURSTRI					4	6
ROSA					0.33	3.53
SPIRBET					2.33	1
STIPNEL	0		1			0.33
STIPOCC	1	0.5	1			
STIPRIC	0.2					5
SISYIDA						0.06
TARAOFF					0.07	0.13
MOSS					0.33	
LICHEN					0.8	0.6

FORBS/GRASS
Due to the fairly dense cover on this site, the plant community is leaning towards a fairly moist combination of forbs like ASTER and FRAGVIR Strawberry combined with the grasses CALARUB Pinegrass and STIPRIC Richardson's needlegrass. FESCUEs are not thriving here under the shrubs.



WC41	1999	2000	2001	2005	2011	2016
AMELALN	9	7	8	7.5	3	5
POPUTRE	1	0	0	0.5	6	6
PURSTRI	2	4	2	2	3	1
PSEUMEN					1.5	2
RIBES						1.5
ROSA	3	4	4	7	6.5	4
SHEPCAN	0.5	3	1	2	5.5	5
SPIRBET	4	4	3	2.5	4.5	4
SALIX				0.5		
SYMPHORI						1.5

SHRUBS
POPUTRE Trembling aspen, AMELALN Saskatoon and SHEPCAN Soopolallie are the main shrubs/small trees on this site which has the most dense shrub cover of any of the plots in this report. Even though it is a slope facing NW, a large variety of shrubs have taken hold and this time round a RIBES species was detected.

WC41	GRASS	FORB	SHRUB	LITTER		g/m2
2005	186.14	13.62	18.16	9.08		
2011	no data					
2016	60	30	10	40		

PRODUCTION
There is not much data from past years to compare the 2016 clip to. Grass did have the highest volume though followed by litter which

What sets this site apart from all others is the density of shrubs and increase of Poplar for a west facingslope. This has allowed different forbs to establish on site and increased litter production.

4 DISCUSSION

4.1 Livestock Rotations, Timing and AUM's

Pasture Name	Year	Dates	Animal Numbers	Comments
Wolf Sheep Creek RU				cc cow calf
Gina				y yearling
	2016	July 31-Aug 28	85cc+4b	b bull
	2011	July 4-24th	90cc+6b	
	2009	July 26-Aug 15	95cc+6b	if there is water
	2007	July 22-Aug 11	110cc+5b	
	2006	May 22-June 6	100cc	
		July 22-Aug 11	110cc+5b	
	2005	July 22-Aug 11	110cc+5b	
Elk				
	2016	non use for many years		
	2011	no water		
	2008	Oct5-15	105cc+5b	along with 3mile
	2005	Sep 16-Sep 28	110cc+5b	
Wolf				
	2016	June 25-July 30	85cc+4b	
	2009	June 28-July 26	95cc+5b	
	2007	June 25-July21	110cc+5b	
	2006	June 6-July10	100cc	
		June 24-July 21	110cc+5b	
	2005	June 24-July 21	110cc	
		July 17-Aug 20	100cc+5b	

There does not seem to be an over allocation of livestock AUM's in the areas of any transects in Wolf Sheep Creek Range Unit. The cow herd size is 23% lower than in 2007 and slightly lower than in 2011. The tenure holders have fenced some hayfields which now allows them to bring the cows home earlier to graze and take off more hay. Wolf pasture has been utilized at the same time almost every year as a breeding area and could use a time change or rest. The same goes for Gina.

Sheep Creek North RU			
Johnson Lake			
	2016	Sept 8-October 8	60cc
	2014	May10-June 25	30yearlings
	2013	July 1-Aug 31	30cc
	2012	June 25-Sept 20	35cc
	2011	July 2-Sept 15	40cc
	2010	Aug 3-Aug 15	185cc 29y
	2009	May 26-Jun 6	187cc 22y 15b
	2007	May 24-Jun 4	210cc+16y+ 18b
Skookumchuk			
	2016	no data available	
	2010	Aug 31-Sep 6	185cc 29y
	2009	Jun 7-Jun 16	187 cc 22y 15b
	2007	Jun 5-Jun 14	210cc 16y 18
Springbrook			
	2016	no data but was grazed	
	2011	May 21-May 29	90 cc
	2010	Sep 28-Oct 2	185cc 29y
	2009	July 10- July 23	187cc 22y 15b

The situation in Johnson Lake pasture on Sheep Creek North Range Unit is quite different. Herd size has dropped dramatically since a new tenure holder came on board and the timing has been changed, giving that pasture variable rest periods. However, the plant community around SW11 transect near Johnson lake looked over-utilized. If the cows are not moved around they tend to stay near the lake. It is also heavily utilized by elk as well so very hard to manage and long term damage due to overuse is very hard to reverse.

4.2 Weather

The early spring of 2016 in the East Kootenays was warm and dry until June but then the summer consisted of cool weather with above average rainfall followed by short periods of heat. This was noted as unusual by long term residents of the East Kootenays and gave the Protection segment of the local Forestry office some much needed relief. This unusual weather affected plant emergence, blooming times

(reproduction) and senesence; pushing it ahead by as much as two weeks. Transects were done at almost exactly on the same date as the last contract in 2011 and things definitely were speeded up. This would affect what was seen for annual forbs in the individual Daubenmire frames if they left little trace. You would still see all the grasses and perennials, but they may have already gone to seed or finished flowering.

4.3 Plant response by treatment type

4.3.1 Thinning and Prescribed Fire

This treatment seemed to have the most success in achieving the dual objectives of a desired plant community for grazers as well as eliminating small tree seedlings if the site was previously a closed forest, not an opening in the area that was thinned. The original openings surrounded by closed forest which was thinned do not seem to respond as well as the thinned areas themselves. This may be due to less change in site conditions (light being a big factor) and continued grazing pressure until the adjacent areas "catch up" in forage production. There would also be less disturbance on the openings during thinning which would expose mineral soil to aid in new species establishment.

Whether or not the area was thinned in winter on frozen ground or not and what was done with all the small leftover coarse woody debris can also determine how long it takes for new species to emigrate and grow on those sites. The small burn piles monitored on WC55 are taking a very long time to establish any kind of a sustainable plant community most likely due to soil sterilization.

Slope and aspect also seem to predetermine success. A slightly concave area (SW15) lends itself to increased vegetation response due to the extra available moisture compared to a steep southwest facing slope.

Shrub density seemed to vary with each transect and no trend was seen.

4.3.2 Prescribed Fire (no thinning on the actual transect location)

This treatment definitely removed small tree seedlings and improved shrub rejuvenation in the short term. It appears that grass production increases are short lived on openings and is quickly surpassed by forb production in the long term. It seems that no amount of prescribed burning on overgrazed opening polygons will positively shift the plant community. Increases in weed populations were seen on more than one of these sites. The difference between a temporary full grazing ban on these areas combined with fire and just fire would be phenomenal, but is not feasible due to the presence of large elk herds in the area. WC41 however, is a west facing opening on a slope and has had phenomenal shrub growth since the burn went through, but no livestock have used the area for years and elk seem to have skipped this site as well.

4.3.3 Stand Replacement Wildfire

These sites were of great interest due to the extreme nature of the event; a new slate of species except for those perennials whose root systems or seed survived the onslaught. A great number of different annual forbs have moved in and out of these three areas. Native grasses with deep underground root systems have managed to increase but shrubs have come and gone in small amounts. Coarse woody debris broke down much more readily due to the fire intensity, even the trees left standing fell over and rotted sooner without their protective bark layer. Forb and grass production are both increasing and very few new tree seedlings are coming into these sites.

Soil texture also affects the thermal transfer properties of soil which in turn determines a plants ability to sprout after a fire goes through. There is more damage to below ground plant structures in fine textured calcareous soils similar to some in the Trench. If the plant is able to re-grow, then those succulent new shoots and stems stand out on the landscape and become the favored and targeted food of grazers. This is a Catch-22 situation for restoration activities in the East Kootenays.

Overall, the density of small tree seedlings had decreased or recruitment had stopped completely. This was one of the goals of these projects and i would say it was met. Forbs seem to take on the task of

revegetation mainly due to their seed dispersal mechanisms. The annuals come and go over time then specific perennials take hold and stabilize the sites (or in some cases possibly exclude other plants). I did notice that this year ACHIMIL Yarrow had decreased in many transects, which was odd given its' vigorous underground rhizomes. Invasive plants were only an issue at a few sites in the Sheep Creek North (west rotation) RU and those sites were near water sources which increased their chances of being overgrazed. Moss and lichen cover was variable between sites with no trend apparent.

I think that bird and small mammal species benefitted the most from this work, with the variability of seeds, leaves, stems and flowers made available for a wide range of tastes. The increased cover would work well for small rodents scurrying to their hiding places. That extra litter would also add to greater soil fertility and protection of soil moisture which enables all those important microbes to populate and thrive below the surface.

4.4 Known plant responses to fire (from the FEIS database)

After reviewing information on many local plant species on the Fire Effects Information System (FEIS) website, and reading several recent PDF documents regarding vegetation response to restoration treatments the following issues were of the utmost importance. During the planning stages of a burn, information on the current plant community structure has to be included since the species will have different tolerances to fire depending on the season and intensity of the burn, amount of litter, their reproductive strategies, how old the plant is, their above ground growth form, rooting structure and palatability to grazers. The following species specific information has been summarized from the FEIS website and gives a general overview of members of local plant communities within the transects.

The method of reproduction plays an important role in whether or not grass plants will withstand a low or medium intensity fire. For instance the weedy species BROMTEC (cheatgrass) is highly adapted to frequent fires. It produces abundant seeds which can survive in mineral soil and then maintains dominance in cold semiarid situations through early and rapid growth which depletes soil moisture before native species have emerged. (FEIS website) CALARUB (Pinegrass) may sprout from rhizomes after a fire, establish from off site sources or be stimulated into mass flowering (as seen in some areas of the Lake Enid wildfire) all of which enable the plant to occupy space and utilize nutrients before others. The local FESTCAM (rough fescue) rarely flowers and when it does the seed crop partially develops in the fall then matures the following summer which would hamper reproduction by seeds. In this case then, tillers located in the above ground clump could either be protected or destroyed depending on the fire intensity, fuel and moisture content of the clump. Since this plant is also a favorite of ungulates, grazing would further impair their chances for reproduction. FESTIDA (Idaho fescue) and KOELMAC (Junegrass) are much smaller plants that can easily survive light fires. FESTIDA produces tillers in the fall when prescribed burning is less likely to happen in the Trench. AGROSPI (Bluebunch wheatgrass) has buds that are protected by plant material or soil. There is little leafy material so tops burn quickly and burning can stimulate flowering and seed setting. The introduced AGROSMI (western wheatgrass) also burns quickly but has rhizomes and can recover quickly from fire. The two introduced Poas, POACOM (Canada bluegrass) and POAPRA (Kentucky bluegrass) both have dense creeping rhizomes which, if they survive, will quickly recover and spread. STIPRIC (spreading needlegrass) reproduces sexually by wind or animal transport of their seeds (because of the awns). They are shallow rooted as well, but seem to be able to maintain their status or increase in specific plant communities studied. There seems to be a decrease since 2005 in the other needle grasses (STIPNEL and COL which may be the same species), a taller plant with a more upright stature.

Shrubs are important to elk, deer and wild sheep in the Trench but are also utilized by livestock. Many birds and small mammals are dependent on berry production of most of the following species. Winter food caches of seeds and berries stored underground may play a role in recolonization of burned

areas. More specifically, JUNICOM (common juniper) is not at all equipped to withstand fire unless above ground stems of the plant or seeds survive and sprout. It has flammable foliage full of resin which burns intensely when ignited. PURSTRI (antelope brush) is also susceptible to fire kill due to its above ground root crown and weak sprouting capabilities. It is common in many of the transects and seems to have maintained its presence in the low intensity prescribed burns. SHEPCAN (Soopolallie) is only moderately fire resistant with its adventitious roots and bud root crown. The seeds are easily dispersed by birds and animals and play a role in introductions of this plant to new sites. Some ROSA (Rosas) are very tolerant to fire damage and sprout readily from root crowns or the roots themselves. They may also grow from seeds brought from outside the area as many animals and birds consume rosehips then travel and deposit them elsewhere. AMELALN (Saskatoon) usually sprouts from root crowns or rhizomes if it is top-killed. It prefers light to moderate intensity fires and cover increases or is unaffected after a few years. However in the East Kootenays, these succulent young sprouts are the favored food of ungulates and can deter upward growth of the plant. SPIRBET (birch-leaved Spiraea) is highly resistant to fire kill. Like AMELALN, it sprouts from surviving root crowns and below ground rhizomes. Normally it will increase in cover and frequency and is an indicator species for thinned sites. SYMPALB (common snowberry) is highly resistant to fire due to its rhizomatous system and ability to produce viable seed. It is among the first to colonize after a fire and loves disturbance (usually seen along trails).

Native forbs, as a group, play more of a role in soil cover than in food production for ungulates. They do produce pollen for honey production, seeds and nectar for insects and birds, some palatable stems and leaves and of course serve the role of providing an amazing array of floral displays and medicinal properties important to humans. Within the forbs, ARCTUVA (Kinnikinnick) prefers short fire cycles with low fire intensities. Its three methods of reproduction (latent buds on horizontal stems, dormant buds on the stem base or root crowns and seeds protected in a fleshy coating) give it an advantage over other plants. Rooted stolons may also survive under logs or rocks due to its sprawling growth habit. This plant has increased in several of the transects and is treated as a forb even though it is a perennial with a woody stem. ACHIMIL (yarrow) regenerates rapidly from rhizomes and wind dispersed seeds from nearby plant groupings. Cover and frequency generally increase after one or two years. ANTENNA (*Antennaria*, pussytoes) has stolons located on the soil surface so may perish in a fire unless their root crowns are sufficiently insulated by soil. They may also colonize mineral soil from wind dispersed seed. APOCAND (spreading dogbane) can colonize immediately via rhizomes or off-site seed sources. It can maintain pre and post fire frequency. BALSSAG (arrow-leaved balsamroot) can reproduce from wind born seed or regrowth from a caudex. It appears to be able to withstand even the most intense fires (as in N20142U and L transects) and will increase slowly in density after fires. Established MEDISAT (alfalfa) plants have deep root systems which are not adversely affected by moderate intensity fires even though the tops are killed. In Nevada it is used to form vegetative fuel breaks (fire guards) since it is less likely to burn than many of the native species. MELIALB (sweet white clover) is a biennial. Due to its ability to contract its roots pulling the crown underground in the fall, the buds are protected not only from freezing but dormant season fires. It is also highly palatable to livestock and horses and the seeds remain viable in the manure, a transport mechanism to new sites. Another legume, OXYTSER (silky locoweed), has a hard seed coat which enable them to survive for years in soil. There is evidence though that fire can scarify this coating and enable them to sprout and produce new plants. POTEREC (sulphur cinquefoil), a non-native intruder, loves post fire conditions of disturbance and less competition. Their perennating buds can survive low to moderate intensity fires. PHLOHOO (similar to our spreading phlox) may be top killed during a fire, but is common in post fire communities due to its ability to sprout from the base and off site seed source introductions. SOLICAN (Canada goldenrod) with its prolific maze of rhizomes and reliable seed production is generally enhanced by low to medium intensity fires. As we all know, TARAOFF (dandelion) is a prolific producer of seed which enables it to maintain its presence anywhere as long as there is wind to carry the seed. TRAGDUB (salsify) is an early seral species that loves disturbance. It is common in post fire communities and makes its way there mainly via wind born seed the same as

dandelion. The deeply buried bulbs of ZIGAVEN (meadow death-camas) allow it to regenerate from almost any intensity of fire. CIRSARV (Canada thistle) is able to colonize recently burned sites due to its extensive root systems. This plant needs to be monitored post fire to ensure it does not replace natives in highly disturbed situations.

5 RECOMMENDATIONS

5.1 Planning Integration

Although long term plans have been done for each of the above mentioned areas that the transects are located in (generally a range unit or a pasture), there does not seem to be anyone reviewing this information and securing funding to carry on. Perhaps this is due to many more hectares being taken into the fold of ER, limiting the amount spent in the central and north Rocky Mountain Trench areas. There seems to be less of a problem than in the south where degradation is greater. However, the large elk herd around Windermere and Aquisknuk First Nation would seem to warrant further study and perhaps joint projects with First Nations (who have embarked on large thinning projects on both Shuswap and Aquisknuk reserves in the last 10 years). More collaboration with First Nations, the public and the owners of large pieces of private land could improve habitat/ on otherwise inaccessible areas. This may help remove some of the grazing pressure from Crown grazing areas and private forage land.

In the past, rotations and carrying capacities in the former IFD had been carefully laid out for years in advance to ensure variability of turnout pastures and movements according to a unique set of rules for that range unit based on vegetation inventory and analysis of past rotations. There was flexibility if the weather or amount of rainfall was above or below the norm. This was to try to accommodate restoration treatments, take the pressure off poor condition plant communities (in order that they might make some recovery species wise) and provide enough forage to accommodate ungulates and livestock. In some instances, grazing regimes are the only alternative to maintaining and/or improving rangeland condition. Further work with tenure holders and wildlife managers needs to be done to facilitate more proactive grazing regimes.

5.2 Prescribed Burning

Combining thinning with burning seems to achieve the optimum response. Fear of repercussions for overachievement (burns that stray outside of boundaries in planning areas) should not interfere with plans. Burning of already open areas may give a short term increase in forage production and get rid of unwanted tree seedlings, but concentrating on closed forest areas will be of more benefit in the long run.

5.3 Coarse Woody Debris

The burn piles monitored on WC55 are still very deficient of plants compared to the surrounding area. The intensity of the burn in those small piles appears to have significantly affected the soils ability to sustain plants after 7 years. Scattering of this coarse woody debris appears to have temporarily deterred ATV and motorcycle trail expansion on Rushmere Range Unit. In the future, piles of small debris should be scattered around and burned during a prescribed fire or combined into one big pile to make less of an overall impact.

5.4 Monitoring

Monitoring is essential, whether it be repeat photos with species counts or some other method that shows what is happening on ecosystem restoration sites. Different agencies can combine resources to lower costs. For example, repeat elk counts in polygons in restoration areas can give a rough guide to use by ungulates. Ranchers with unfenced forage stands and game cameras also have good insights into

what is going on in their areas since they are out there more than anyone else. Collaboration with the Agriculture Wildlife Compensation program and MFLNRO would make it easier to pinpoint problem areas adjacent to Crown land and help to incorporate additional knowledge into the planning process for habitat enhancement.

BIBLIOGRAPHY

1. Barkworth, Mary E., Laurel K. Anderton, Kathleen M. Capels, Sandy Long and Michael B. Piep Eds. 2007. **Manual of Grasses for North America**. Intermountain Herbarium and Utah State University Press, Logan, Utah 84322 628pp

2. Brown, James K.; Smith, Jane Kapler, eds. 2000. **Wildland Fire in Ecosystems: Effects of Fire on Flora**. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257p.

3. **Fire Effects Information System**, [FEIS]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/

4. Metlen, Kerry L.; Dodson, Erich K.; Fiedler, Carl E. 2006. Research Project Summary: **Vegetation response to restoration treatments in ponderosa pine-Douglas-fir forests of western Montana**. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/

5. Newman, Reg, John Parminter and Sheryl Wurtz 2005 **Understory Succession following Ecosystem Restoration of Ingrown Dry Forests** Forests Science Program, 2005/2005 Annual Technical Report FSP Project #Y051069

6. Phillips, Becky and Patrick Stent 2013 **2012-13 South Trench Trench Elk Inventory** Ministry of Forests Lands and Natural Resource Operations. Cranbrook, BC

7. Pulp and Paper Canada Nov. 26, 2013 **Final 16 PPGTP projects total $109 million**

8. Sheridan, Richard P, Carla Sanderson and Richard Kerr. **Effects of Pulp Mill Emissions on Lichens in the Missoula Valley, Montana.** In:The Bryologist, Vol. 79, No. 2 (Summer, 1976), pp. 248-252

9. Zouhar, Kristin; Smith, Jane Kapler; Sutherland, Steve; Brooks, Matthew L. 2008. **Wildland fire in ecosystems: fire and nonnative invasive plants**. Gen. Tech. Rep. RMRS-GTR-42-vol. 6. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 355 p.