Evaluation of the Effectiveness of Noxious Weed Management through Inventory and Establishment of Long-Term Monitoring Plots at Grant-Kohrs Ranch NHS

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Summary

There has been a large decline in the leafy spurge and yellow toadflax infestations in the Grant-Kohrs riparian zone since the initiation of herbicide spot spraying by the Exotic Plant Management Team in 2006. These declines in weed canopy cover from 2003 to 2009 - 2010 are significant in paired t-tests. The suppression of the target weeds was in excess of 90%. The spray program has been successful in reducing the target weed abundance in the Grant-Kohrs Ranch riparian zone. Introduced exotic grasses with rhizomatous growth habits dominate the herbaceous layer of the riparian zone. The principal exotic grasses are quackgrass, smooth brome, and redtop. These rhizomatous grasses are well adapted to moist sites that have a history of disturbance and are most likely to occupy the spots where the target weeds are being suppressed. Although exotics account for 72% of the canopy cover, native species still outnumber non-native species. Imazapic (Plateau) was the primary herbicide when starting the spray program in 2006, then in 2008 chlorsulfuron (Telar XP) was added to achieve efficacy on yellow toadflax. A broad spectrum of kill and cumulative soil residual herbicides in current treatment strategy results in about 10% non-vegetated area within the spray monitoring plots. An alternative IPM treatment strategy taking advantage of the fact that the weed infestations have been weakened by the previous spraying would now switch to sequential year spot spraying with glyphosate (Rodeo) combined with seeding historically appropriate introduced pasture grasses or native reedgrasses at the time of spraying. The glyphosate effects only green plants at the time of spraying, it has no soil residual activity.

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Introduction

The objective of this monitoring project was to determine outcome of herbicide spot spraying treatment strategies on yellow toadflax and leafy spurge at Grant-Kohrs Ranch through establishment and monitoring of fixed location plots comparable to 2003 inventory data.

During 2003, a limited invasive plant survey was completed at GRKO. The 2003 Invasive Plant Survey--Grant-Kohrs Ranch National Historic Site was a component of the Intermountain Noxious Weed Inventory and Mapping Project and was implemented through a cooperative agreement between the National Park Service and Montana State University. The Northern Rocky Mountain Exotic Plant Management Team (EPMT) initiated treatment of invasive plants in 2003 on the uplands at GRKO and began treatment within the Clark Fork River Riparian Area/Superfund site in 2006. Invasives in the riparian area were initially not managed because of grazing exclusion and limited control options.

There has been annual riparian zone weed management since 2006, but there has been no formal measurement of treatment outcomes. These rhizomatous weeds are very difficult to control and there is considerable uncertainty on the resultant post-spray community composition The EPMT has provided limited mapping/observation, but has been more focused on implementing control. This 2009-2010 monitoring project conducted a first time evaluation of treatment outcomes focusing on the invasives and noxious weeds: leafy spurge and yellow toadflax. The monitoring was conducted in the original 2003 mapping area that was within or immediately adjacent to Clark Fork River riparian areas where a majority of leafy spurge and yellow toadflax are found.

As of 2008 more than $27,000 had been invested in treatment of yellow toadflax, leafy spurge, and Canada thistle in the riparian area alone. Imazapic (Plateau at 12 oz/ac) initially was the principal herbicide used to suppress all these weeds in the riparian zone. However the imazapic treatments of yellow toadflax were relatively ineffective. In 2008 chlorsulfuron treatment (Telar XP at 1.5 oz/ac) was employed for the yellow toadflax.

The following three questions were addressed by this monitoring study:

1.) How did the 2009 and 2010 abundance of target invasives compare with the inventory completed in 2003?

2.) What impacts are the treatment strategies having upon the target invasives and desirable plants?

3.) Are management activities shifting the plant communities to a desirable end point?

Methods

The 2003 weed canopy cover data was generated within the proposed area by walking along transects spaced at 25 meters apart and estimating the canopy cover of weeds of concern. These data were used to generate a GIS weed map. The canopy cover data generated from the 2003 mapping exercise was used to define the pre-spray baseline of permanent monitoring plots established in 2009. The monitoring study was implemented through the establishment of 25 permanent circular 1/40 acre (18.6 ft radius) community composition plots in July 2009. The center of the plots were marked by rebar driven into the ground and capped with 2 inch diameter aluminum survey caps inscribed with the plot number. Canopy cover of every species present in a plot was estimated by the ocular macroplot method using these canopy cover classes and calculating abundance using the class interval mid-point:

Class	Interval	Mid-Point Value
Trace	present but less than 1%	0.5
Present	1 to 5%	3.0
1	5% to 15%	10
2	15% to 25%	20
3	25% to 35%	30
4	35% to 45%	40
5	45% to 55%	50
6	55% to 65%	60
7	65% to 75%	70
8	75% to 85%	80
9	85% to 95%	90
Full	>95%	95

The data were entered into an MS Access database for processing and summary analyses. The pre and post-spray canopy cover values for leafy spurge and yellow toadflax were compared by paired T-test. All 25 plots were contrasted for 2003 and 2009. Plot 91 was eroded into the Clark Fork River in the spring of 2010. Accordingly the T-test contrasts with 2010 used only 24 pairs.

Results and Discussion

The two herbicide treatments have been quite efficacious on these two difficult target weeds (Table 1). As of 2009 leafy spurge suppression was 93% and yellow toadflax suppression was 91%. The infestation at Plot 9003 appeared to have not been located by the EPMT and not sprayed as of 2009. The EPMT did spray this patch in fall 2009 and it was well controlled as of 2010. The overall high level of suppression was maintained in 2010 (Table 2). Measured leafy spurge canopy cover did not change from 2009 to 2010 in spite of higher rainfall in 2010. Measured yellow toadflax canopy cover was lower in 2010 than 2009 but the measured one year decline was not statistically significant

Table 1. Data for 2009 versus 2003 pre-spray baseline infestations.

Using all 25 plot data pairs:
Leafy Spurge
Average Canopy Cover 2003 = 15.4%
Average Canopy Cover 2009 = 1.1%
P= <.001
Efficacy 93%

Yellow Toadflax
Average Canopy Cover 2003 = 7.0%
Average Canopy Cover 2009 = 1.8%
P= .071
Nominal Efficacy 74%

Excluding plot 9003
Yellow Toadflax
Average Canopy Cover 2003 = 6.9%
Average Canopy Cover 2009 = 0.6%
P= .024
Efficacy 91%

Table 2. Data for 2010 versus 2009.

Using 24 plot data pairs:
Leafy Spurge
Average Canopy Cover 2009 = 1.10%
Average Canopy Cover 2010 = 1.12%
P= .960 not significant

Yellow Toadflax
Average Canopy Cover 2009 = 1.85%
Average Canopy Cover 2010 = 0.40%
P= .207 not significant

Graminoids (various grasses, Baltic rush, and some sedges) are the major life form comprising the canopy cover of the spot sprayed monitoring plots (Table 3). The non-random location and size of the monitoring plots does not capture the overall abundance of large shrubs (tall willows and water birch) in the riparian zone. Non-target forbs account for only 4% of the canopy cover. Bare ground and or litter accounted for ~10% of the area of the monitoring plots. These bare/dense litter areas were primarily the specific spots which had been spot sprayed to suppress the target weeds.

Table 3. Mean ocular estimates of absolute percent canopy cover by lifeform.

Lifeform	2009 % Canopy Cover	2010 % Canopy Cover
Graminoids	76.0	80.9
Leafy spurge	1.1	1.1
Yellow toadflax	1.8	0.4
Other Forbs	4.2	4.2
Shrubs	5.6	5.1
Horsetails	0.3	0.5
Bare Soil/Litter	11.4	9.9

The vegetation in the monitoring plots is dominated by exotics, averaging 72% of total canopy cover, even with the marked reduction in target weeds (Table 4). The principal exotic are introduced grasses: quackgrass, smooth brome, and redtop (Tables 5 & 6). These rhizomatous grasses are well adapted to moist sites that have a history of disturbance and are most likely to eventually occupy the spots where the target weeds are being suppressed.

Table 4. Percent of vegetative canopy cover from exotics versus native species.

Origin	2009 % Of Vegetative Canopy Cover	2010 % Of Vegetative Canopy Cover
Exotic	72.5	71.7
Native	27.3	28.1
Unknown	0.3	0.2

Table 5. Fifteen most abundant species in 2009.

Scientific Name	Common Name	Species % Canopy Cover
Elymus repens (exotic)	quackgrass	25.3
Bromus inermis (exotic)	smooth brome	19.3
Agrostis stolonifera (exotic)	redtop	13.0
Poa juncifolia	rush bluegrass	10.5
Juncus balticus	Baltic rush	3.3
Deschampsia caespitosa	tufted hairgrass	2.5
Salix bebbiana	Bebb willow	2.0
Linaria vulgaris (exotic)	yellow toadflax	0.6 - 1.8
Euphorbia esula (exotic)	leafy spurge	1.1
Cirsium arvense (exotic)	Canada thistle	1.1
Salix boothii	Booth's willow	1.0
Betula occidentalis	water birch	1.0
Poa compressa (exotic)	Canada bluegrass	0.8
Salix exigua	sandbar willow, coyote willow	0.6
Iris missouriensis	Rocky Mountain iris	0.6

Table 6. Fifteen most abundant species in 2010.

Scientific Name	Common Name	Species % Canopy Cover
Elymus repens (exotic)	quackgrass	30.4
Bromus inermis (exotic)	smooth brome	22.6
Poa juncifolia	rush bluegrass	11.1
Agrostis stolonifera (exotic)	redtop	9.3
Juncus balticus	Baltic rush	4.2
Deschampsia caespitosa	tufted hairgrass	2.5
Salix bebbiana	Bebb willow	2.1
Salix boothii	Booth's willow	1.3
Euphorbia esula (exotic)	leafy spurge	1.1
Iris missouriensis	Rocky Mountain iris	1.0
Betula occidentalis	water birch	0.5
Symphoricarpos occidentalis	western snowberry	0.5
Sonchus arvensis (exotic)	perennial sowthistle	0.5
Poa compressa (exotic)	Canada bluegrass	0.4
Linaria vulgaris (exotic)	yellow toadflax	0.4

Although the sprayed plots are rather strongly dominated by exotic grasses they are not monotypic. Average species richness was ~11 species in both years (Table 7). Species richness and Shannon diversity are function of plot size, so these data can be used to describe year to year trends in sprayed plot diversity; but cannot be directly compared to plots of other sizes. The total number of species determined within the combined plots in 2009 was 69 and then 61 in 2010. Although exotics account for 72% of the canopy cover, native species still outnumber non-native species (Table 7).

Table 7. Species richness, diversity and evenness in 2009 and 2010.

Parameter	2009	2010
Average Richness per Plot	11.5	11.1
Total Richness All Plots	69	61
Exotic Richness	25	21
Native Richness	41	37
Origin Unknown	3	3
Shannon's Diversity	1.276	1.252
Evenness	0.525	0.525

Richness = number of species
Shannon`s diversity index = - sum (Pi*ln(Pi))
Evenness = Shannon`s diversity index / ln (Richness)

Recommendations

Future desired condition:

The NPS could consider two alternative future desired conditions. Without implementing a program of planting native species in the weed treatment areas, the sprayed spots and bare soil/litter areas will almost certainly be occupied by the introduced rhizomatous grasses that now dominate the riparian zone. These would be primarily smooth brome, quackgrass, and redtop. An alternative future desired condition would be to attempt to reestablish the native species that comprise the herbaceous and small shrub layers of the potential natural communities as defined during the Natural Resource Damage assessment (see Rice, Peter M. March 6, 2002. Baseline vegetation types & restoration goals for Grant-Kohrs Ranch. 19p). In Rice 2002 the community classification system developed by Hansen et al. (1995) for classifying riparian vegetation in Montana was used as the basis for setting baseline/restoration goals. A four stepped process was used:

1. The plant communities currently occupying the Ranch floodplain were determined and mapped in 2000.

2. The successional pathways were considered to identify any additional communities that are presently absent from the riparian zone.

3. Grazing disclimaxes were excluded from the baseline/restoration goals list of communities.

4. Nonindigenous and infrequently occurring native species were removed from the species lists for each community type.

Tables 8 and 9 (from Rice 2002) summarize the average species composition for two currently lost native Potential Natural Community types that would prevail in the Grant-Kohrs riparian in the absence of the history of anthropogenic and livestock disturbances. In contrast with the current condition as summarized in Table 4a and b, bluejoint reedgrass (Calamagrostis canadensis) and narrow spiked reedgrass (Calamagrostis stricta) are major native grasses that are lacking in the herbaceous layer. Red osier dogwood (Cornus stolonifera)

Table 8. (Table 18 from Rice 2002). Bluejoint Reedgrass (CALCAN) habitat type native species list.

Genus	Species	Common name	%CC
Calamagrostis	canadensis	Bluejoint reedgrass	28.63
Calamagrostis	stricta	Narrow spiked reedgrass	26.18
Senecio	triangularis	Arrowleaf groundsel	3.62
Deschampsia	cespitosa	Tufted hairgrass	3.41
Juncus	balticus	Baltic rush	2.97
Eleocharis	rostellata	Beaked spikerush	2.57
Aster	occidentalis	Western aster	1.88
Pedicularis	groenlandica	Elephant's head	1.68
Senecio	integerrimus	Western groundsel	1.66
Helianthus	tuberosus	Jerusalem artichoke	1.58
Carex	aquatilis	Water sedge	1.41
Viola	sp.	Violet	1.39

Ligusticum	tenuifolium	Slender leafed licorice root	1.32
Heracleum	lanatum	Cow parsnip	1.14
Alopecurus	alpinus	Alpine foxtail	1.13
Agrostis	scabra	Tickle grass	1.08
Trisetum	wolfii	Wolf's trisetum	1.08
Angelica	arguta	Sharptooth angelica	1.07
Senecio	pseudaureus	Streambank groundsel	1.07

Table 9. (Table 15 from Rice 2002). Geyer Willow / Bluejoint Reedgrass (SALGEY/CALCAN) habitat type native species list (species with >1% average canopy cover).

Genus	Species	Common name	%CC
Salix	geyeriana	Geyer willow	21.59
Salix	boothii	Booth willow	19.81
Calamagrostis	canadensis	Bluejoint reedgrass	11.56
Calamagrostis	stricta	Narrow spiked reedgrass	7.10
Salix	drummondiana	Drummond willow	4.53
Solidago	canadensis	Canada goldenrod	3.81
Juncus	balticus	Baltic rush	2.71
Deschampsia	cespitosa	Tufted hairgrass	2.62
Fragaria	virginiana	Wild strawberry	2.31
Salix	wolfii	Wolf's willow	2.25
Salix	bebbiana	Bebb willow	2.24
Betula	occidentalis	Water birch	2.19
Geum	macrophyllum	Large leaved avens	2.13
Cornus	stolonifera	Red osier dogwood	2.07
Aster	occidentalis	Western aster	2.06
Equisetum	arvense	Field horsetail	1.85
Betula	glandulosa	Bog birch	1.78
Salix	tweedyi	Tweedy's willow	1.76
Polemonium	occidentale	Western polemonium	1.66
Alnus	incana	Mountain alder	1.56
Heracleum	lanatum	Cow parsnip	1.51
Glyceria	striata	Fowl mannagrass	1.50
Salix	exigua	Sandbar willow	1.47
Scirpus	microcarpus	Small flowered bulrush	1.47
Achillea	millefolium	Common yarrow	1.44
Epilobium	angustifolium	Fireweed	1.32
Aster	foliaceus	Leafy aster	1.28
Valeriana	edulis	Edible valerian	1.26
Ribes	sp.	Currant	1.19
Rosa	acicularis	Prickly rose	1.19
Aster	sp.	Aster	1.18
Bromus	ciliatus	Fringed brome	1.18
Rhamnus	alnifolia	Alder buckthorn	1.18
Potentilla	fruticosa	Shrubby cinquefoil	1.12
Carex	pachystachya	Thick headed sedge	1.00

The native large shrubs, water birch, Geyer willow, Booth willow, and Bebb willow are still quite abundant in the GRKO riparian zone. The 2009 weed spraying monitoring plots were not selected to encompass these large stature shrubs. Red osier dogwood (Cornus stolonifera) is a smaller statured but ecologically important native shrub that is lacking in the current riparian zone community.

Herbicide & replanting IPM option:

Tordon (picloram) and Telar (chlorsulfuron) are the most effective herbicides for control of yellow toadflax in grasslands. However sequential treatments (up to three years) are usually required because yellow toadflax resprouts from its rhizomes in the growing season after the initial spraying. Picloram is not an option in the GRKO riparian zone because of the label shallow groundwater restriction. When repeated in sequential years the 1.5 ounce rate of Telar is quite effective, but the subsequent soil residual results in a rather broad spectrum plant species kill, hence the ~10% average bare ground/litter of the spot spraying areas. Fall applied Plateau (imazapic) is a more selective treatment option for leafy spurge than Telar. Two or three sequential year fall treatments with Plateau at 12 oz/ac plus methylated seed oil at 1 qt/ac are effective on leafy spurge. The imazapic treatments still allow many composite family forbs to remain or establish anew in the sprayed spots. However sequential year accumulation of soil residual imazapic retards reestablishment of grasses and contributes to the average 10% of bare ground/litter being measured.

Treatments made through 2010 have substantially reduced the area and canopy cover occupied by yellow toadflax and leafy spurge. The resprouts are being generated from herbicide weakened rhizome systems. An adaptive strategy would be to begin spot spray the remaining yellow toadflax and leafy spurge in sequential years in late summer/fall with glyphosate (Rodeo) and a suitable surfactant. The sprayed spots could be seeded with aggressive introduced grasses, smooth brome in particular, at the time of spraying. The introduced grasses should provide competition to slow, if not prevent, reestablishment of the yellow toadflax and leafy spurge. This IPM approach could maintain the current status of the herbaceous layer. If the desired future condition is to attempt at least partial restoration of site appropriate native species, the seeding would be done with bluejoint reedgrass and (Calamagrostis canadensis) and narrow spiked reedgrass (Calamagrostis stricta). However there is less certainty of establishing these native riparian zone grasses and their persistence in competition with the surrounding introduced grasses is unknown.

Glyphosate formulations (Rodeo) at 1 qt/ac. formulated product/ac a 4-pound acid-equivalent per-gallon concentrate would control yellow toadflax. At 1.5 pints per acre the same glyphosate formulations should provide 80% to 90 % leafy spurge control when applied from mid-July to mid-September. Tank mixing 2,4-D could further enhance control. Including 2,4-D in the prescription would also allow reseeding with introduced or native grasses at the time of spraying.

Alternative herbicides:

DuPont product development scientists have preliminary data suggesting that the newly registered herbicide Perspective (39.5% aminocyclopyrachlor and 15.8% chlorsulfuron) may be efficacious on yellow toadflax at higher rates. Perspective at 4.75 to 8 oz/ac does have more clearly demonstrated high efficacy on leafy spurge. Perspective currently has a non-crop label which would suffice in the absence of grazing. A range and Pasture label is expected in 2012.

Suggested monitoring schedule:

Continue annual monitoring for four years if glyphosate treatment and reseeding is adopted as an IPM strategy. If the current program of only spot spraying with Plateau and Telar is continued reread the plots only at four or five year intervals. If there is a switch to Perspective then monitor for at least the first two years after beginning treatments.

Appendices

Plot Coordinates

Plot #	LAT	LONG
9001	46.40840650	-112.74636635
9002	46.40765548	-112.74415084
9003	46.41237617	-112.74445125
9004	46.41293406	-112.74475702
9005	46.41193092	-112.74660775
9006	46.42005265	-112.74570652
9007	46.40333712	-112.74396309
9008	46.42262220	-112.74205335
9009	46.42112553	-112.74570652
9010	46.41472042	-112.74676868
9011	46.41204357	-112.74724611
9012	46.41173780	-112.74506279
9013	46.40949547	-112.74641999
6	46.40605000	-112.74465000
7	46.40685618	-112.74528273
20	46.41301453	-112.74540075
23	46.41490817	-112.74499842
46	46.41156077	-112.74375924
47	46.40416324	-112.74524518
50	46.40687764	-112.74393090
56	46.41001582	-112.74598547
58	46.41108871	-112.74665066
64	46.41615808	-112.74537929
69	46.41834140	-112.74512717
91	46.40922725	-112.74495550

Plot Maps (some plots had both yellow toadflax and leafy spurge)

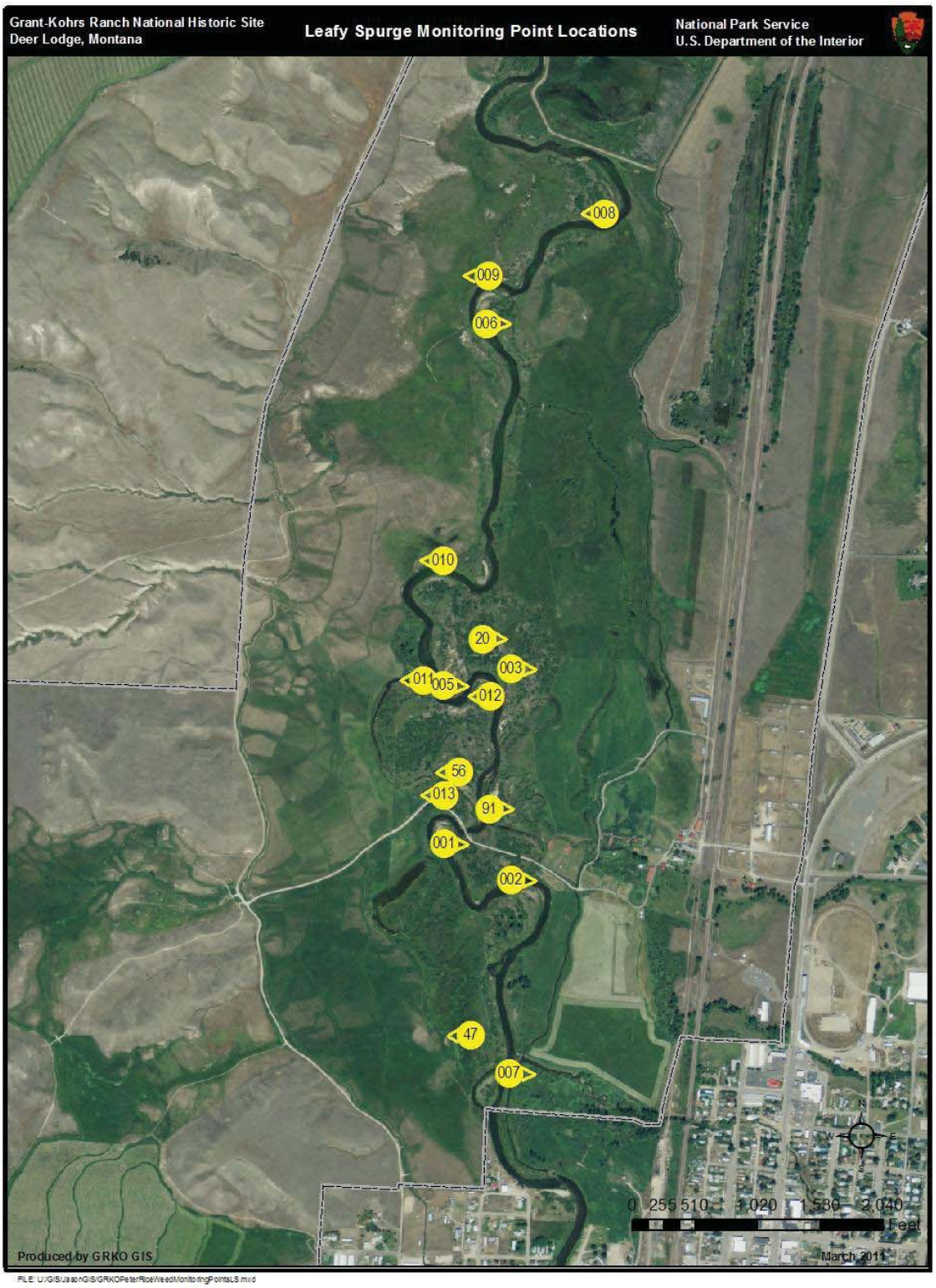

Figure 1. Location of leafy spurge plots (arrow point indicates which side of the river).

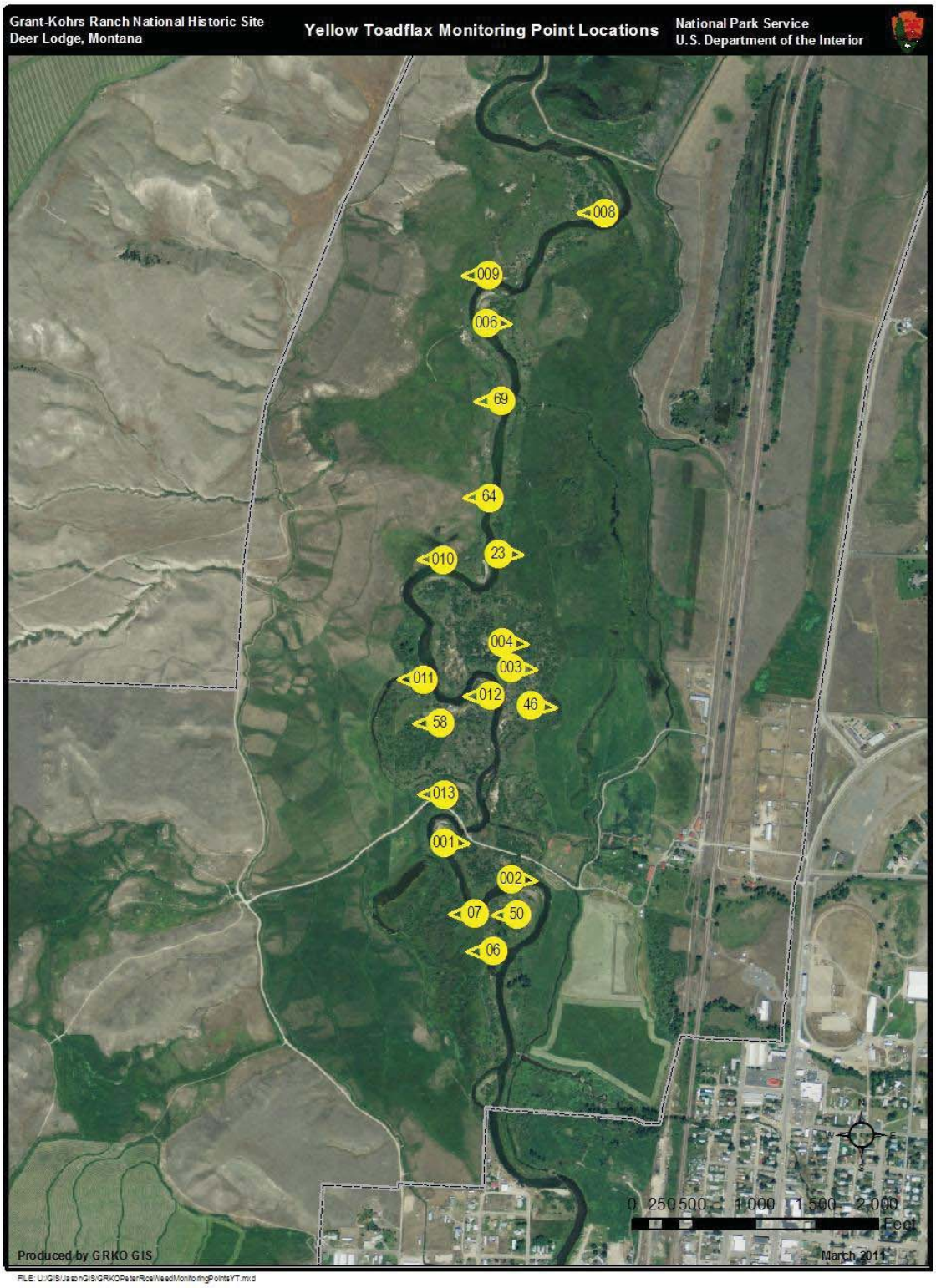

Figure 2. Location of yellow toadflax plots (arrow point indicates which side of the river).

Species List and Average Canopy Covers by Year (2009 & 2010)

2009 Species List and Average % Canopy Cover for All Plots Combined			
Scientific Name	**Common Name**	**Code**	**% Canopy Cover**
Elymus repens	quackgrass	ELYREP	25.26
Bromus inermis	smooth brome	BROINE	19.34
Agrostis stolonifera	redtop	AGRSTO	13.00
bare soil or litter	bare soil or litter	BARE	11.40
Poa juncifolia	rush bluegrass	POAJUN	10.48
Juncus balticus	Baltic rush	JUNBAL	3.34
Deschampsia caespitosa	tufted hairgrass	DESCES	2.54
Salix bebbiana	Bebb willow	SALBEB	2.02
Linaria vulgaris	yellow toadflax	LINVUL	1.82
Euphorbia esula	leafy spurge	EUPESU	1.08
Cirsium arvense	Canada thistle	CIRARV	1.06
Salix boothii	Booth's willow	SALBOO	1.04
Betula occidentalis	water birch	BETOCC	1.00
Poa compressa	Canada bluegrass	POACOM	0.80
Salix exigua	sandbar willow, coyote willow	SALEXI	0.58
Iris missouriensis	Rocky Mountain iris	IRIMIS	0.56
Symphoricarpos occidentalis	western snowberry	SYMOCC	0.54
Poa pratensis	Kentucky bluegrass	POAPRA	0.52
Phleum pratense	timothy	PHLPRA	0.46
Trifolium pratense	red clover	TRIPRA	0.40
Solidago canadensis	Canada goldenrod	SOLCAN	0.28
Equisetum laevigatum	smooth scouring-rush	EQULAE	0.24
Rosa woodsii	Wood's rose	ROSWOO	0.22
Glycyrrhiza lepidota var. glutinosa	licorice	GLYLEP	0.20
Urtica dioica	stinging nettle	URTDIO	0.16
Sonchus arvensis	perennial sowthistle	SONARV	0.16
Silene latifolia ssp. Alba	bladder campion	SILLAT	0.16
Ribes oxyacanthoides	Canadian gooseberry	RIBOXY	0.14
Magnoliopsida species	unknown forb	FORBX1	0.12
Lolium pratense	meadow fescue	FESPRA	0.12
Achillea millefolium	common yarrow	ACHMIL	0.10
Argentina anserina	silverweed cinquefoil	ARGANS	0.08
Carex sp.	sedge	CAREXX	0.08
Stachys palustris	marsh hedge nettle	STAPAL	0.06
Symphyotrichum chilense	Pacific aster	ASTCHI	0.06
Symphyotrichum campestre	western meadow aster	ASTCAM	0.06
Sisymbrium loeselii	false London rocket	SISLOE	0.06
Tragopogon dubius	western salsify	TRADUB	0.06
Cardaria draba	whitetop	CARDRA	0.06
Stellaria longipes	longstalk starwort	STELON	0.04
Equisetum arvense	field horsetail	EQUARV	0.04
Solidago missouriensis	Missouri goldenrod	SOLMIS	0.04
Magnoliopsida species	unknown forb	FORBX2	0.04
Artemisia ludoviciana	white sagewort	ARTLUD	0.04

Trifolium longipes	longstalk clover	TRILON	0.02
Brassica sp.	mustard species	BRASIC	0.02
Amelanchier alnifolia	western serviceberry	AMEALN	0.02
Alopecurus pratensis	meadow foxtail	ALOPRA	0.02
Calamagrostis canadensis	bluejoint reedgrass	CALCAN	0.02
Allium schoenoprasum	wild chives	ALLSCH	0.02
Agrostis idahoensis	Idaho bentgrass	AGRIDA	0.02
Trifolium repens	white clover	TRIREP	0.02
Maianthemum stellatum	starry false Solomon's seal	SMISTE	0.02
Prunus virginiana	chokecherry	PRUVIR	0.02
Potentilla gracilis	graceful cinquefoil	POTGRA	0.02
Rorippa sylvestris	creeping yellowcress	RORSYL	0.02
Rumex crispus	curly dock	RUMCRI	0.02
Salix geyeriana	Geyer willow	SALGEY	0.02
Osmorhiza chilensis	mountain sweetroot	OSMCHI	0.02
Descurainia incana	mountain tansymustard	DESRIC	0.02
Verbascum thapsus	common mullein	VERTHA	0.02
Centaurea biebersteinii	spotted knapweed	CENMAC	0.02
Galium boreale	northern bedstraw	GALBOR	0.02
Erigeron sp.	fleabane species	ERIGER	0.02
Epilobium minutum	chaparral willowherb	EPIMIN	0.02
Epilobium ciliatum	fringed willowherb	EPICIL	0.02
Helianthus nuttallii	Nuttall's sunflower	HELNUT	0.02
Cynoglossum officinale	houndstongue	CYNOFF	0.02
Taraxacum officinale	dandelion	TAROFF	0.02
Sisymbrium altissimum	tall tumblemustard	SISALT	0.02

2010 Species List and Average % Canopy Cover for All Plots Combined			
Scientific Name	**Common Name**	**Code**	**% Canopy Cover**
Elymus repens	quackgrass	ELYREP	30.42
Bromus inermis	smooth brome	BROINE	22.63
Poa juncifolia	rush bluegrass	POAJUN	11.08
bare soil or litter	bare soil or litter	BARE	9.92
Agrostis stolonifera	redtop	AGRSTO	9.29
Juncus balticus	Baltic rush	JUNBAL	4.19
Deschampsia caespitosa	tufted hairgrass	DESCES	2.52
Salix bebbiana	Bebb willow	SALBEB	2.13
Salix boothii	Booth's willow	SALBOO	1.25
Euphorbia esula	leafy spurge	EUPESU	1.13
Iris missouriensis	Rocky Mountain iris	IRIMIS	1.04
Betula occidentalis	water birch	BETOCC	0.52
Symphoricarpos occidentalis	western snowberry	SYMOCC	0.48
Sonchus arvensis	perennial sowthistle	SONARV	0.46
Poa compressa	Canada bluegrass	POACOM	0.42
Trifolium pratense	red clover	TRIPRA	0.42
Linaria vulgaris	yellow toadflax	LINVUL	0.42
Equisetum arvense	field horsetail	EQUARV	0.38
Ribes oxyacanthoides	Canadian gooseberry	RIBOXY	0.35
Glycyrrhiza lepidota var. glutinosa	licorice	GLYLEP	0.29

Cirsium arvense	Canada thistle	CIRARV	0.21
Argentina anserina	silverweed cinquefoil	ARGANS	0.21
Silene latifolia ssp. Alba	bladder campion	SILLAT	0.21
Salix exigua	sandbar willow, coyote willow	SALEXI	0.19
Lolium pratense	meadow fescue	FESPRA	0.15
Equisetum laevigatum	smooth scouring-rush	EQULAE	0.13
Carex sp.	sedge	CAREXX	0.13
Solidago canadensis	Canada goldenrod	SOLCAN	0.10
Rosa woodsii	Wood's rose	ROSWOO	0.10
Magnoliopsida species	unknown forb	FORBX1	0.10
Urtica dioica	stinging nettle	URTDIO	0.08
Solidago missouriensis	Missouri goldenrod	SOLMIS	0.08
Phleum pratense	timothy	PHLPRA	0.08
Cardaria draba	whitetop	CARDRA	0.08
Stachys palustris	marsh hedge nettle	STAPAL	0.08
Achillea millefolium	common yarrow	ACHMIL	0.06
Allium schoenoprasum	wild chives	ALLSCH	0.06
Brassica sp.	mustard species	BRASIC	0.04
Vicia americana	American vetch	VICAME	0.04
Symphyotrichum campestre	western meadow aster	ASTCAM	0.04
Rorippa sylvestris	creeping yellowcress	RORSYL	0.04
Alopecurus pratensis	meadow foxtail	ALOPRA	0.04
Maianthemum stellatum	starry false Solomon's seal	SMISTE	0.04
Stellaria longipes	longstalk starwort	STELON	0.04
Tragopogon dubius	western salsify	TRADUB	0.04
Trifolium longipes	longstalk clover	TRILON	0.04
Trifolium repens	white clover	TRIREP	0.04
Potentilla gracilis	graceful cinquefoil	POTGRA	0.04
Aster ap.	aster species	ASTERX	0.02
Amelanchier alnifolia	western serviceberry	AMEALN	0.02
Collomia linearis	slender-leaf collomia	COLLIN	0.02
Magnoliopsida species	unknown forb	FORBX2	0.02
Galium boreale	northern bedstraw	GALBOR	0.02
Helianthus nuttallii	Nuttall's sunflower	HELNUT	0.02
Penstemon species	penstemon species	PENSTE	0.02
Prunus virginiana	chokecherry	PRUVIR	0.02
Rubus idaeus	American red raspberry	RUBIDA	0.02
Rumex crispus	curly dock	RUMCRI	0.02
Salix geyeriana	Geyer willow	SALGEY	0.02
Sisymbrium loeselii	false London rocket	SISLOE	0.02
Taraxacum officinale	dandelion	TAROFF	0.02
Lactuca serriola	prickly lettuce	LACSER	0.02

2003 Pre-Spray Baseline % Canopy Covers of Yellow Toadflax and Leafy Spurge

Plot #	Yellow Toadflax % Canopy Cover	Leafy Spurge % Canopy Cover
6	7	0
7	10	0
20	0	10
23	20	0
46	65	0
47	0	6
50	5	0
56	0	2
58	5	0
64	12	0
69	6	0
91	0	6
9001	6	30
9002	6	30
9003	8	30
9004	0	0
9005	0	30
9006	3	30
9007	0	30
9008	3	30
9009	3	30
9010	6	30
9011	3	30
9012	3	30
9013	3	30

% Canopy Cover of Species in Each Plot for 2009 & 2010

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
6				
	Agrostis stolonifera	AGRSTO	20	20
	bare soil/litter	BARE	40	0.5
	Betula occidentalis	BETOCC	0.5	0.5
	Elymus repens	ELYREP	30	60
	Equisetum arvense	EQUARV		0.5
	Equisetum laevigatum	EQULAE	0.5	
	Euphorbia esula	EUPESU	0.5	0.5
	Juncus balticus	JUNBAL	3	10
	Linaria vulgaris	LINVUL	0.5	0.5
	Symphoricarpos occidentalis	SYMOCC	0.5	0.5
7				
	Argentina anserina	ARGANS	0.5	0.5
	Carex sp.	CAREXX	0.5	
	Cirsium arvense	CIRARV	3	0.5
	Elymus repens	ELYREP	50	70
	Equisetum arvense	EQUARV		3
	Equisetum laevigatum	EQULAE	0.5	
	Euphorbia esula	EUPESU	10	3
	Juncus balticus	JUNBAL	10	3
	Linaria vulgaris	LINVUL	0.5	0.5
	Poa juncifolia	POAJUN	30	20
	Symphoricarpos occidentalis	SYMOCC	3	0.5
20				
	Achillea millefolium	ACHMIL	0.5	
	Agrostis stolonifera	AGRSTO	20	20
	bare soil/litter	BARE	50	50
	Carex sp.	CAREXX	0.5	
	Cirsium arvense	CIRARV		0.5
	Equisetum arvense	EQUARV	0.5	0.5
	Euphorbia esula	EUPESU	0.5	3
	Juncus balticus	JUNBAL	0.5	3

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Lactuca serriola	LACSER		0.5
	Linaria vulgaris	LINVUL		0.5
	Magnoliopsida species	FORBX1	0.5	
	Phleum pratense	PHLPRA	10	0.5
	Poa juncifolia	POAJUN	3	3
	Rosa woodsii	ROSWOO	0.5	
	Salix exigua	SALEXI	0.5	0.5
	Solidago missouriensis	SOLMIS	0.5	0.5
	Sonchus arvensis	SONARV	3	10
	Stachys palustris	STAPAL	0.5	0.5
	Taraxacum officinale	TAROFF	0.5	
	Trifolium repens	TRIREP	0.5	0.5
23				
	Achillea millefolium	ACHMIL	0.5	
	Argentina anserina	ARGANS		0.5
	Bromus inermis	BROINE	40	50
	Cardaria draba	CARDRA		0.5
	Carex sp.	CAREXX	0.5	3
	Cirsium arvense	CIRARV	10	0.5
	Equisetum arvense	EQUARV		3
	Equisetum laevigatum	EQULAE	3	
	Iris missouriensis	IRIMIS	0.5	0.5
	Juncus balticus	JUNBAL		3
	Linaria vulgaris	LINVUL	0.5	
	Magnoliopsida species	FORBX1		0.5
	Magnoliopsida species	FORBX2		0.5
	Phleum pratense	PHLPRA	0.5	0.5
	Poa juncifolia	POAJUN	50	40
	Potentilla gracilis	POTGRA	0.5	
	Silene latifolia ssp. Alba	SILLAT	0.5	0.5
	Solidago missouriensis	SOLMIS	0.5	
	Tragopogon dubius	TRADUB	0.5	0.5
	Trifolium longipes	TRILON	0.5	0.5
46				
	Agrostis idahoensis	AGRIDA	0.5	

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Agrostis stolonifera	AGRSTO	3	10
	Alopecurus pratensis	ALOPRA	0.5	0.5
	Argentina anserina	ARGANS		0.5
	bare soil/litter	BARE	40	40
	Brassica sp.	BRASIC	0.5	
	Bromus inermis	BROINE	10	10
	Calamagrostis canadensis	CALCAN	0.5	
	Cynoglossum officinale	CYNOFF	0.5	
	Descurainia incana	DESRIC	0.5	
	Juncus balticus	JUNBAL	20	20
	Linaria vulgaris	LINVUL	3	3
	Magnoliopsida species	FORBX1	0.5	0.5
	Poa juncifolia	POAJUN	3	
	Rorippa sylvestris	RORSYL	0.5	0.5
	Salix boothii	SALBOO	3	10
	Silene latifolia ssp. Alba	SILLAT		0.5
	Stachys palustris	STAPAL		0.5
	Stellaria longipes	STELON	0.5	0.5
	Tragopogon dubius	TRADUB		0.5
	Trifolium pratense	TRIPRA	10	10
47				
	Elymus repens	ELYREP	80	80
	Euphorbia esula	EUPESU	0.5	0.5
	Juncus balticus	JUNBAL	3	3
	Poa juncifolia	POAJUN	10	10
	Ribes oxyacanthoides	RIBOXY	0.5	0.5
	Salix bebbiana	SALBEB	20	20
	Salix exigua	SALEXI	0.5	0.5
50				
	Agrostis stolonifera	AGRSTO	50	70
	bare soil/litter	BARE	40	10
	Bromus inermis	BROINE	3	3
	Collomia linearis	COLLIN		0.5
	Elymus repens	ELYREP	0.5	
	Equisetum arvense	EQUARV		0.5

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Equisetum laevigatum	EQULAE	0.5	
	Euphorbia esula	EUPESU	0.5	0.5
	Linaria vulgaris	LINVUL	0.5	0.5
	Magnoliopsida species	FORBX1	0.5	
	Magnoliopsida species	FORBX2	0.5	
	Salix bebbiana	SALBEB		0.5
	Taraxacum officinale	TAROFF		0.5
56				
	Agrostis stolonifera	AGRSTO	30	
	Allium schoenoprasum	ALLSCH	0.5	0.5
	bare soil/litter	BARE	10	0.5
	Carex sp.	CAREXX	0.5	
	Cirsium arvense	CIRARV	0.5	0.5
	Deschampsia caespitosa	DESCES	0.5	0.5
	Elymus repens	ELYREP	40	60
	Euphorbia esula	EUPESU	3	0.5
	Glycyrrhiza lepidota var. glutinosa	GLYLEP	3	3
	Iris missouriensis	IRIMIS		0.5
	Juncus balticus	JUNBAL		3
	Magnoliopsida species	FORBX2	0.5	
	Penstemon species	PENSTE		0.5
	Poa juncifolia	POAJUN		20
	Poa pratensis	POAPRA	10	
	Ribes oxyacanthoides	RIBOXY	0.5	3
	Rosa woodsii	ROSWOO	3	0.5
	Salix bebbiana	SALBEB	0.5	0.5
	Silene latifolia ssp. Alba	SILLAT	0.5	0.5
	Sisymbrium loeselii	SISLOE	0.5	
	Urtica dioica	URTDIO	3	0.5
58				
	Agrostis stolonifera	AGRSTO	3	20
	bare soil/litter	BARE	40	20
	Betula occidentalis	BETOCC	10	10
	Cirsium arvense	CIRARV	0.5	0.5
	Elymus repens	ELYREP	20	20

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Euphorbia esula	EUPESU	0.5	0.5
	Iris missouriensis	IRIMIS	3	3
	Linaria vulgaris	LINVUL	0.5	0.5
	Poa juncifolia	POAJUN		3
	Poa pratensis	POAPRA	3	
	Rosa woodsii	ROSWOO	0.5	0.5
	Salix bebbiana	SALBEB	20	20
	Salix boothii	SALBOO	20	20
	Stachys palustris	STAPAL	0.5	0.5
64				
	bare soil/litter	BARE	3	0.5
	Bromus inermis	BROINE	30	30
	Cardaria draba	CARDRA	0.5	0.5
	Elymus repens	ELYREP	70	70
	Equisetum arvense	EQUARV		0.5
	Euphorbia esula	EUPESU	0.5	0.5
	Juncus balticus	JUNBAL	3	0.5
	Linaria vulgaris	LINVUL	0.5	
	Magnoliopsida species	FORBX1	0.5	
	Poa juncifolia	POAJUN		0.5
	Silene latifolia ssp. Alba	SILLAT		0.5
	Solidago canadensis	SOLCAN	0.5	0.5
69				
	bare soil/litter	BARE	20	30
	Bromus inermis	BROINE	70	60
	Cardaria draba	CARDRA	0.5	
	Elymus repens	ELYREP		10
	Euphorbia esula	EUPESU	0.5	0.5
	Juncus balticus	JUNBAL		0.5
	Linaria vulgaris	LINVUL	3	
	Magnoliopsida species	FORBX1		0.5
	Maianthemum stellatum	SMISTE		0.5
	Poa juncifolia	POAJUN	3	0.5
	Silene latifolia ssp. Alba	SILLAT	0.5	0.5

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
91				
	Agrostis stolonifera	AGRSTO	60	
	Betula occidentalis	BETOCC	10	
	Deschampsia caespitosa	DESCES	3	
	Elymus repens	ELYREP	0.5	
	Equisetum arvense	EQUARV	0.5	
	Euphorbia esula	EUPESU	0.5	
	Linaria vulgaris	LINVUL	0.5	
	Poa juncifolia	POAJUN	0.5	
	Salix boothii	SALBOO	3	
	Salix exigua	SALEXI	10	
	Stellaria longipes	STELON	0.5	
9001				
	Achillea millefolium	ACHMIL	0.5	0.5
	Agrostis stolonifera	AGRSTO	3	
	Betula occidentalis	BETOCC	0.5	0.5
	Bromus inermis	BROINE	40	40
	Cirsium arvense	CIRARV	0.5	0.5
	Elymus repens	ELYREP	40	40
	Euphorbia esula	EUPESU	0.5	3
	Linaria vulgaris	LINVUL	3	
	Maianthemum stellatum	SMISTE	0.5	
	Poa juncifolia	POAJUN	10	10
	Ribes oxyacanthoides	RIBOXY	0.5	0.5
	Rubus idaeus	RUBIDA		0.5
	Salix exigua	SALEXI	3	3
	Tragopogon dubius	TRADUB	0.5	
	Urtica dioica	URTDIO	0.5	0.5
9002				
	Argentina anserina	ARGANS	0.5	
	Artemisia ludoviciana	ARTLUD	0.5	
	Betula occidentalis	BETOCC	3	0.5
	Bromus inermis	BROINE	20	30
	Cirsium arvense	CIRARV		0.5
	Elymus repens	ELYREP	70	60
	Equisetum laevigatum	EQULAE	0.5	

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Euphorbia esula	EUPESU	0.5	3
	Glycyrrhiza lepidota var. glutinosa	GLYLEP	0.5	0.5
	Juncus balticus	JUNBAL		0.5
	Lolium pratense	FESPRA	3	3
	Poa juncifolia	POAJUN	3	10
	Rumex crispus	RUMCRI	0.5	0.5
	Salix exigua	SALEXI		0.5
	Solidago canadensis	SOLCAN	0.5	0.5
	Symphyotrichum chilense	ASTCHI	0.5	
9003				
	Achillea millefolium	ACHMIL	0.5	0.5
	Allium schoenoprasum	ALLSCH		0.5
	Alopecurus pratensis	ALOPRA		0.5
	Argentina anserina	ARGANS	0.5	3
	bare soil/litter	BARE	10	30
	Bromus inermis	BROINE	10	10
	Cirsium arvense	CIRARV	10	0.5
	Elymus repens	ELYREP	0.5	
	Erigeron sp.	ERIGER	0.5	
	Euphorbia esula	EUPESU		0.5
	Galium boreale	GALBOR	0.5	0.5
	Iris missouriensis	IRIMIS	10	20
	Juncus balticus	JUNBAL	20	20
	Linaria vulgaris	LINVUL	30	3
	Magnoliopsida species	FORBX1		0.5
	Osmorhiza chilensis	OSMCHI	0.5	
	Phleum pratense	PHLPRA	0.5	
	Poa juncifolia	POAJUN	3	3
	Potentilla gracilis	POTGRA		0.5
	Rorippa sylvestris	RORSYL		0.5
	Silene latifolia ssp. Alba	SILLAT	0.5	0.5
	Sonchus arvensis	SONARV	0.5	0.5
	Stachys palustris	STAPAL	0.5	0.5
	Symphyotrichum campestre	ASTCAM	0.5	0.5
	Urtica dioica	URTDIO	0.5	0.5

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Vicia americana	VICAME		0.5
9004				
	Agrostis stolonifera	AGRSTO	20	20
	Allium schoenoprasum	ALLSCH		0.5
	Argentina anserina	ARGANS	0.5	0.5
	bare soil/litter	BARE	20	20
	Cirsium arvense	CIRARV	0.5	0.5
	Iris missouriensis	IRIMIS		0.5
	Juncus balticus	JUNBAL	3	10
	Linaria vulgaris	LINVUL	0.5	0.5
	Phleum pratense	PHLPRA	0.5	0.5
	Poa juncifolia	POAJUN	50	50
	Potentilla gracilis	POTGRA		0.5
	Solidago missouriensis	SOLMIS		0.5
	Sonchus arvensis	SONARV	0.5	0.5
	Symphyotrichum campestre	ASTCAM	0.5	
9005				
	Agrostis stolonifera	AGRSTO	3	3
	bare soil/litter	BARE	3	
	Bromus inermis	BROINE	30	50
	Elymus repens	ELYREP	50	50
	Equisetum laevigatum	EQULAE	0.5	3
	Euphorbia esula	EUPESU	0.5	3
	Glycyrrhiza lepidota var. glutinosa	GLYLEP	0.5	0.5
	Linaria vulgaris	LINVUL	0.5	0.5
	Lolium pratense	FESPRA		0.5
	Poa juncifolia	POAJUN	3	3
	Silene latifolia ssp. Alba	SILLAT	0.5	
	Solidago canadensis	SOLCAN	0.5	0.5
	Solidago missouriensis	SOLMIS		0.5
	Vicia americana	VICAME		0.5
9006				
	bare soil/litter	BARE	3	3
	Bromus inermis	BROINE	40	40
	Elymus repens	ELYREP	40	50

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Euphorbia esula	EUPESU	3	3
	Juncus balticus	JUNBAL		0.5
	Poa juncifolia	POAJUN	3	3
	Solidago canadensis	SOLCAN	3	
	Solidago missouriensis	SOLMIS		0.5
9007				
	Agrostis stolonifera	AGRSTO	3	
	Amelanchier alnifolia	AMEALN	0.5	0.5
	bare soil/litter	BARE	3	30
	Betula occidentalis	BETOCC	0.5	0.5
	Brassica sp.	BRASIC		0.5
	Bromus inermis	BROINE	10	20
	Elymus repens	ELYREP	20	30
	Poa compressa	POACOM	20	10
	Poa juncifolia	POAJUN	30	10
	Prunus virginiana	PRUVIR	0.5	0.5
	Ribes oxyacanthoides	RIBOXY	0.5	0.5
	Rosa woodsii	ROSWOO	0.5	0.5
	Salix exigua	SALEXI	0.5	
	Sisymbrium altissimum	SISALT	0.5	
	Solidago canadensis	SOLCAN	0.5	
	Symphoricarpos occidentalis	SYMOCC	10	10
9008				
	Agrostis stolonifera	AGRSTO	50	40
	Cirsium arvense	CIRARV	0.5	0.5
	Elymus repens	ELYREP	40	50
	Epilobium ciliatum	EPICIL	0.5	
	Euphorbia esula	EUPESU	0.5	3
	Glycyrrhiza lepidota var. glutinosa	GLYLEP	0.5	3
	Linaria vulgaris	LINVUL	0.5	0.5
	Poa juncifolia	POAJUN	0.5	
	Ribes oxyacanthoides	RIBOXY	0.5	3
	Silene latifolia ssp. Alba	SILLAT		0.5
	Sisymbrium loeselii	SISLOE	0.5	0.5
	Tragopogon dubius	TRADUB	0.5	

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Urtica dioica	URTDIO		0.5
	Verbascum thapsus	VERTHA	0.5	
9009				
	Agrostis stolonifera	AGRSTO	10	
	Aster ap.	ASTERX		0.5
	bare soil/litter	BARE		0.5
	Bromus inermis	BROINE	20	30
	Cardaria draba	CARDRA		0.5
	Cirsium arvense	CIRARV	0.5	
	Elymus repens	ELYREP	30	30
	Equisetum arvense	EQUARV		0.5
	Equisetum laevigatum	EQULAE	0.5	
	Euphorbia esula	EUPESU	0.5	0.5
	Helianthus nuttallii	HELNUT	0.5	0.5
	Iris missouriensis	IRIMIS	0.5	0.5
	Juncus balticus	JUNBAL	0.5	3
	Magnoliopsida species	FORBX1	0.5	0.5
	Maianthemum stellatum	SMISTE		0.5
	Phleum pratense	PHLPRA		0.5
	Poa juncifolia	POAJUN	30	30
	Rosa woodsii	ROSWOO	0.5	0.5
	Solidago canadensis	SOLCAN	0.5	
	Symphoricarpos occidentalis	SYMOCC		0.5
	Symphyotrichum campestre	ASTCAM	0.5	0.5
	Symphyotrichum chilense	ASTCHI	0.5	
9010				
	Bromus inermis	BROINE	60	50
	Cardaria draba	CARDRA	0.5	0.5
	Cirsium arvense	CIRARV	0.5	
	Elymus repens	ELYREP	20	20
	Equisetum arvense	EQUARV		0.5
	Euphorbia esula	EUPESU	3	0.5
	Juncus balticus	JUNBAL	0.5	0.5
	Linaria vulgaris	LINVUL	0.5	
	Magnoliopsida species	FORBX1	0.5	

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Poa juncifolia	POAJUN	10	30
	Silene latifolia ssp. Alba	SILLAT	0.5	0.5
9011				
	Achillea millefolium	ACHMIL	0.5	0.5
	Agrostis stolonifera	AGRSTO	10	
	bare soil/litter	BARE	3	3
	Betula occidentalis	BETOCC	0.5	0.5
	Brassica sp.	BRASIC		0.5
	Bromus inermis	BROINE	30	30
	Centaurea biebersteinii	CENMAC	0.5	
	Elymus repens	ELYREP	20	20
	Euphorbia esula	EUPESU	0.5	0.5
	Juncus balticus	JUNBAL	20	20
	Linaria vulgaris	LINVUL	0.5	
	Poa juncifolia	POAJUN	10	10
	Ribes oxyacanthoides	RIBOXY	0.5	0.5
	Rosa woodsii	ROSWOO	0.5	0.5
	Salix geyeriana	SALGEY	0.5	0.5
	Silene latifolia ssp. Alba	SILLAT	0.5	0.5
	Sisymbrium loeselii	SISLOE	0.5	
	Solidago canadensis	SOLCAN	0.5	0.5
	Symphyotrichum chilense	ASTCHI	0.5	
	Trifolium longipes	TRILON		0.5
9012				
	Agrostis stolonifera	AGRSTO	10	10
	Artemisia ludoviciana	ARTLUD	0.5	
	Bromus inermis	BROINE	70	70
	Elymus repens	ELYREP	10	10
	Euphorbia esula	EUPESU	0.5	0.5
	Glycyrrhiza lepidota var. glutinosa	GLYLEP	0.5	
	Linaria vulgaris	LINVUL	0.5	
	Poa juncifolia	POAJUN	10	10
	Solidago canadensis	SOLCAN	0.5	0.5
9013				
	Agrostis stolonifera	AGRSTO	30	10

Plot ID	Scientific Name	Code	2009 % CC	2010 % CC
	Bromus inermis	BROINE	0.5	20
	Deschampsia caespitosa	DESCES	60	60
	Epilobium minutum	EPIMIN	0.5	
	Euphorbia esula	EUPESU	0.5	
	Ribes oxyacanthoides	RIBOXY	0.5	0.5
	Salix bebbiana	SALBEB	10	10
	Silene latifolia ssp. Alba	SILLAT	0.5	0.5
	Solidago canadensis	SOLCAN	0.5	
	Stellaria longipes	STELON		0.5
	Trifolium repens	TRIREP		0.5

Sampling Protocol for Ocular Macroplot Canopy Cover Method

Plot centers are marked with 2 inch aluminum survey caps, with the plot number, on rebar stakes driven flush to the ground. A metal detector will be necessary to find most of the flush markers in the future as they will subside into the soil somewhat and be covered with litter and dense vegetation. A pin is used to hold the end of a tape at the plot center and the tape is used to circumscribe an 18.6 ft radius (1/40 acre) circular plot. Four or more perimeter circumference points can be temporarily marked with wire pin flags. The plot is inspected to develop a list of all species present. The canopy cover of each species is assigned according to one of these class intervals:

Class	**Interval**	**Mid-Point Value**
Trace	present but less than 1%	0.5
Present	1 to 5%	3.0
1	5% to 15%	10
2	15% to 25%	20
3	25% to 35%	30
4	35% to 45%	40
5	45% to 55%	50
6	55% to 65%	60
7	65% to 75%	70
8	75% to 85%	80
9	85% to 95%	90
Full	>95%	95

The proportion areas (% canopy Cover Class Intervals) for this 1/40 acre circular plot can be first estimated by standing in the center of the plot with the tape still outstretched. Trace or up to 1% is a 1.9 ft radius (3.7ft diameter) circle. Present or 1 to 5% is a 4.2 ft (8.3 ft diameter) circle. Larger class intervals are established by dividing the plot into quarters (the 4 pin flags being distributed at approximately ¼ of the circumference) and mental subtraction or addition of the smaller class intervals. Upon surveying the entire plot first from the center, then by walking throughout the plot, all the canopy cover provided by each individual species is mentally regrouped into one contiguous area and the canopy cover estimated within the appropriate class interval. The accuracy standard is one class interval. A field data form follows. These data are analyzed using the mid-point value for the class interval.

Ocular Macroplot Field Data Form

Grant-Kohrs Ranch Weed Plot Monitoring by Ocular Macroplot Method 1/40 ac, 18.6 ft radius, 37.2 ft dia

Plot #	Coordinates	Plot Radius (ft)	Date	Who
		18.6		

	Species Code	Life Form	CC	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
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24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				

Plot Notes:

radius (diameter) ft	CC codes
1.9 (3.7)	T=<1%
4.2 (8.3)	P=1-<5%
	1=5-<15%
	2=15-<25%
	etc.
	9=85-<95
37.2 (18.6)	F=95-100%