

**Center for Invasive Plant Management  
and  
Missouri River Watershed Coalition**  
*Conservation Innovation Grant*

Russian olive, salt cedar and *Phragmites* study sites:

pre-treatment data collection protocols

and data summary

Prepared by:

*Synergy Resource Solutions, Inc.*

5393 Hamm Rd.

Belgrade, MT 59714

*countgrass.com*

September 24, 2012

## *Plot Locations and Transect Layout*

Plot locations were chosen on the ground to be representative of vegetation density and structure within predetermined polygons (sites). Each site contained three treatment plots and one control plot. At each plot a 50 m or 25 m transect line was established, with the start and end points recorded as waypoints using a Montana 650T GPS. Transect ends were also marked with metal U-posts labeled with metal tags. Tag information included plot title, transect number, and whether it was a treatment or control site. The same information, along with azimuth of the transect line, was written on a white dry-erase board as part of photo documentation. Photo documentation was done at both ends of every transect, and included photos of the transect line and photos in the four cardinal directions, or two landscape photos taken at slight angles from the transect. Table 1 below summarizes the plot layouts.

**Table 1:** Site names and plot layouts (Note: FtKeogh1 is also known as Cottonwood Flat, and FtKeogh 2 is also known as East Yellowstone)

<b>Site</b>	<b>Number of Plots</b>	<b>Transect Length</b>	<b>Photos</b>	<b>Date Sampled</b>
AllenTreat	3	50 m	Transect + 4 directions	8/8/2012
AllenCont	1	50 m	Transect + 4 directions	8/9/2012
ArapooishTreat	3	50 m	Transect + 4 directions	8/8/2012
ArapooishCont	1	50 m	Transect + 4 directions	8/8/2012
FtKeogh1Treat	3	25 m	Transect + 4 directions	8/10/2012
FtKeogh1Cont	1	25 m	Transect + 4 directions	8/10/2012
FtKeogh2Treat	3	50 m	Transect + 4 directions	8/9/2012
FtKeogh2Cont	1	50 m	Transect + 4 directions	8/9/2012
LovellTreat	3	50 m	Transect + 4 directions	8/6/2012
LovellMulch	2	50 m	Transect + 2 landscape	8/30/2012
LovellCont	1	50 m	Transect + 4 directions	8/6/2012
SturgisSite1Treat	2	50 m	Transect + 2 landscape	8/27/2012
SturgisSite1Cont	1	50 m	Transect + 2 landscape	8/28/2012
SturgisSite2Treat	1	50 m	Transect + 2 landscape	8/28/2012
SturgisSite2Cont	1	50 m	Transect + 2 landscape	8/28/2012
PhragTreat	2	50 m	Transect + 2 landscape	8/29/2012
PhragCont	1	50 m	Transect + 2 landscape	8/29/2012

## ***Data Collection Protocols***

### ***Data Collection***

Data collection was conducted by well-trained range, soil, and botany specialists and technicians to assure quality data. Most data were entered directly into the Database for Inventory Management and Analysis (DIMA)<sup>1</sup> on field tablet computers. Data was collected using six protocols: dry weight rank with comparative yield plots, line-point intercept, belt transects for woody plant density, soil stability, canopy gap intercept, and basal gap intercept. A site description was also entered using slope, aspect, azimuth, slope shape, landscape unit, and hillslope profile. Soil samples were also collected for laboratory analysis.

### ***Line-Point Intercept***

Line-point intercept was used to determine canopy cover, basal cover, litter cover, soil surface cover, and woody debris cover. Methods established by Herrick, et al.<sup>2</sup> were used with a laser point-intercept device substituting for a pin. Data were collected at 1-m increments, starting at the zero end of each transect line. In some cases, vegetation made a 50 m transect impossible, so the line was shortened to 25 m and point-intercept data were collected every 0.5 m. To collect data at each point on the line the laser point-intercept device was leveled and aimed through the canopy. Each layer of canopy intercepted by the laser was identified all the way to the basal component. For this particular study, woody debris was classified by two width categories: fine woody litter was < 7.5 cm in diameter, while coarse woody litter was  $\geq 7.5$  cm.

### ***Dry Weight Rank with Comparative Yield Plots***

Dry weight rank with comparative yield plots was the protocol used to collect data on species composition and production for herbaceous and shrubby plants. To conduct the dry weight rank method, comparative yield plots were first determined. Comparative yield plots were determined by walking around the plot and choosing three locations that represented low (rank one), medium (rank two) and high (rank three) production, as estimated by dry weight of current-year herbage. Circular 0.25 m<sup>2</sup> hoops were placed at each location and all current-year herbage within the hoop was clipped, weighed, and saved for weighing again when dry. After identifying comparative yield plots, dry weight rank was conducted at predetermined points along the 50 m transect line starting at the 5 m point, and every 10 m thereafter. At each predetermined point the observer walked in a straight line perpendicular to the transect line and placed a 20x20 cm quadrat frame every two steps, centered on his/her toe to prevent bias. Upon placing the frame on the ground, three species within the frame were identified and ranked by dry weight (one, two, or three from the comparative yield plots). Ten frames were placed along each perpendicular line, with perpendicular lines alternating on either side of the transect, for a total of 50 frames that covered the plot. A slightly different method was used for determining production at the Phragmites

sites, due to the monoculture nature of the sites. Instead of assigning rank one, two, or three to each hoop, comparative yield plots were established at predetermined locations along the transect line: 12.5 m, 25 m, and 37.5 m. All three locations were clipped using a 0.5 m<sup>2</sup> hoop, and ranked as a two.

### ***Belt Transect for Woody Plant Density***

Belt transects were used to determine the density of live and dead trees within each plot. Observers walked along each side of the transect and counted number of woody species according to size classes. For multi-stemmed species such as salt cedar and willow, the size classes were all based on height: <20 cm; 20-100 cm; 1-2 m; 2-4 m; >4 m; or dead. For single-stemmed species such as Russian olive, size classes were based on height up to 180 cm and then on diameter breast height (DBH): <30 cm; 30-180 cm; DBH 2.5-15 cm; DBH 15-25 cm; DBH >25 cm; or dead. Belt width varied depending on plot-specific densities, and in some cases seedling densities were so high that 20x20 cm quadrats were used to estimate density. In all cases, densities were calculated as plants per hectare.

### ***Canopy and Basal Gap Intercept***

Canopy and basal gap provide information about changes in spatial distribution of vegetation particularly as it relates to erosion resistance. Canopy and basal gap protocol followed Herrick et al.<sup>3</sup> The minimum gap size for both canopy and basal gap was 20 cm, so that a gap required a continuous space between canopies or plant bases that was at least 20 cm. Any plant canopy (annual or perennial) that intersected the transect line for more than 1.7 cm broke the canopy gap. Any plant base, regardless of size, broke the basal gap.

### ***Soil Stability***

Soil stability provides information about the degree of soil structural development and erosion resistance. Soil stability protocol followed Herrick, et al.<sup>4</sup> Samples were collected every 10 m along the transect line beginning at the 10 m mark, for a total of nine samples at each plot. For heavily wooded areas where a 25 m transect line was used samples were taken beginning at the 5m mark and then every 5 m thereafter. Each sample was collected from the surface 3 mm of soil after removal of litter. Observers recorded whether there was a plant canopy or no canopy over the point where each sample was taken. Each sample was placed onto a small sieve within a compartmentalized plastic box. When all samples were collected, the free half of the box was filled with water to create even water pressure across the surface of the compartments. Each sample was placed into the water at 15 second intervals until all samples were submerged in water. After 5 minutes, each sample was dipped 5 times. Observers rated the samples on a scale of one to six, based on the degree to which the soil sample maintained physical integrity. The ratings were as follows: 1—50% of structural integrity lost within 5 seconds or soil too unstable to sample; 2—50% of structural integrity lost 5-30 seconds after immersion; 3—50% of structural integrity lost 30-300 seconds after immersion, or <10% of soil remaining on sieve after

five dipping cycles; 4—10-25% of soil remains on sieve after dipping cycles; 5—25-75% of soil remains on sieve after dipping cycles; 6—75-100% of soil remains on sieve after dipping cycles.

### ***Soil Sampling for Texture and Nutrient Analysis***

A soil coring device was used to collect 10 sub-samples at each plot, with sampling locations distributed in a roughly systematic fashion within 5 m of the transect line. Sub-samples were combined by site, air-dried, crushed, and sieved with a 2 mm mesh sieve prior to shipment to Midwest Laboratories<sup>5</sup>. Midwest Laboratories will conduct testing for organic matter; available phosphorous; exchangeable potassium, magnesium, calcium and hydrogen; soil pH; buffer index; cation exchange capacity; percent base saturation of cation elements; and soil texture.

### ***A note about data summarized in this report***

Data presented in this report are based on site averages—that is, for sites with more than one transect (most treatment sites), data is averaged across all transects within the site. While this is convenient for reporting, the reader should be aware that sites were often extremely heterogeneous and each plot may be worth considering on its own. This summary report is not an exhaustive display of all data collected. Original plot data can be obtained from the organizers of this project. All plant codes that appear in the data tables or graphs are standard codes that can be found on the USDA Plants Database<sup>6</sup>.

---

<sup>1</sup> <http://jornada.nmsu.edu/monit-assess/dima>

<sup>2</sup> Herrick, J.E., J.W. Van Zee, K.M Havstad, L.M. Burkett and W.G. Whitford. 2009. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Volume I: Quick Start. USDA-ARS Jornada Experimental Range, Las Cruces, NM.

<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

<sup>5</sup> <https://www.midwestlabs.com/>

<sup>6</sup> [http://plants.usda.gov/about\\_plants.html](http://plants.usda.gov/about_plants.html)

*Data Tables for Foliar and Basal Cover by Site*

<b>Allen Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	80.7	0.7
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	54.7	2.0
CHENO	<i>Chenopodium</i>	goosefoot	46.0	0.0
CYOF	<i>Cynoglossum officinale</i>	houndstongue	1.3	0.0
GALIU	<i>Galium</i>	bedstraw	1.3	0.0
CIAR4	<i>Cirsium arvense</i>	Canada thistle	0.7	0.0
PHPR3	<i>Phleum pratense</i>	timothy	0.7	0.0
POLYG4	<i>Polygonum</i>	knotweed	0.7	0.0
POPR	<i>Poa pratensis</i>	Kentucky bluegrass	0.7	0.0

<b>Allen Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	94.0	0.0
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	82.0	10.0
CHENO	<i>Chenopodium</i>	goosefoot	30.0	0.0
POPR	<i>Poa pratensis</i>	Kentucky bluegrass	6.0	0.0
GALIU	<i>Galium</i>	bedstraw	2.0	0.0
NECA2	<i>Nepeta cataria</i>	catnip	2.0	0.0

*Data Tables for Foliar and Basal Cover by Site*

<b>Arapoish Treatment Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
THIN6	Thinopyrum intermedium	intermediate wheatgrass	76.7	10.7
PODE3	Populus deltoides	eastern cottonwood	32.0	0.0
ELAN	Elaeagnus angustifolia	Russian olive	30.0	0.0
CIAR4	Cirsium arvense	Canada thistle	10.7	0.0
POPR	Poa pratensis	Kentucky bluegrass	10.7	0.0
CHENO	Chenopodium	goosefoot	10.0	0.0
TAMAR2	Tamarix	tamarisk	7.3	0.0
SYOC	Symphoricarpos occidentalis	western snowberry	4.7	0.0
BRIN2	Bromus inermis	smooth brome	3.3	0.0
TORY	Toxicodendron rydbergii	western poison ivy	2.0	0.0
ASSP	Asclepias speciosa	showy milkweed	1.3	0.0
CLEMA	Clematis	leather flower	1.3	0.0
CYOF	Cynoglossum officinale	houndstongue	1.3	0.0
GLLE3	Glycyrrhiza lepidota	American licorice	1.3	0.0
AMBRO	Ambrosia	ragweed	0.7	0.0
BRJA	Bromus japonicus	Japanese brome	0.7	0.0
ELTR7	Elymus trachycaulus	slender wheatgrass	0.7	0.0
POCO	Poa compressa	Canada bluegrass	0.7	0.0
RIBES	Ribes	currant	0.7	0.0
ROSA5	Rosa	rose	0.7	0.0
SPPE	Spartina pectinata	prairie cordgrass	0.7	0.0

<b>Arapoish Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
THIN6	Thinopyrum intermedium	intermediate wheatgrass	80.0	12.0
ELAN	Elaeagnus angustifolia	Russian olive	54.0	0.0
TAMAR2	Tamarix	tamarisk	28.0	0.0
PODE3	Populus deltoides	eastern cottonwood	20.0	0.0
BRJA	Bromus japonicus	Japanese brome	6.0	0.0
CHENO	Chenopodium	goosefoot	4.0	0.0
POPR	Poa pratensis	Kentucky bluegrass	2.0	0.0

**Data Tables for Foliar and Basal Cover by Site**

<b>Fort Keogh 1C(ottonwood Flat) Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	Elaeagnus angustifolia	Russian olive	98.7	0.0
BRJA	Bromus japonicus	Japanese brome	12.0	0.0
ELTR7	Elymus trachycaulus	slender wheatgrass	6.0	0.0
CIVU	Cirsium vulgare	bull thistle	1.3	0.0
FRPE	Fraxinus pennsylvanica	green ash	1.3	0.0
POPR	Poa pratensis	Kentucky bluegrass	1.3	0.0
BRIN2	Bromus inermis	smooth brome	0.7	0.0
CHENO	Chenopodium	goosefoot	0.7	0.0
DESCU	Descurainia	tansymustard	0.7	0.0
MELIL	Melilotus	sweetclover	0.7	0.0
MUHLE	Muhlenbergia	muhly	0.7	0.0
NECA2	Nepeta cataria	catnip	0.7	0.0
PASM	Pascopyrum smithii	western wheatgrass	0.7	0.0
POBI7	Potentilla biennis	biennial cinquefoil	0.7	0.0
POLYG4	Polygonum	knotweed	0.7	0.0

<b>Fort Keogh 1 (Cottonwood Flat) Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	Elaeagnus angustifolia	Russian olive	96.0	0.0
AGCR	Agropyron cristatum	crested wheatgrass	36.0	0.0
BRIN2	Bromus inermis	smooth brome	16.0	0.0
POPR	Poa pratensis	Kentucky bluegrass	8.0	0.0
PASM	Pascopyrum smithii	western wheatgrass	2.0	0.0



*Data Tables for Foliar and Basal Cover by Site*

<b>Fort Keogh 2 (East Yellowstone) Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	81.3	1.3
PODE3	<i>Populus deltoides</i>	eastern cottonwood	13.3	0.0
TAMAR2	<i>Tamarix</i>	tamarisk	9.3	0.0
PASM	<i>Pascopyrum smithii</i>	western wheatgrass	7.3	0.0
CHENO	<i>Chenopodium</i>	goosefoot	4.0	0.0
SALIX	<i>Salix</i>	willow	4.0	0.0
PHAR3	<i>Phalaris arundinacea</i>	reed canarygrass	2.7	0.7
DESCU	<i>Descurainia</i>	Tansy mustard	2.0	0.0
POBI7	<i>Potentilla biennis</i>	biennial cinquefoil	2.0	0.0
VEBR	<i>Verbena bracteata</i>	bigbract verbena	2.0	0.0
VALER	<i>Valeriana</i>	valerian	0.7	0.0

<b>Fort Keogh 2 (East Yellowstone Control) Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	86.0	0.0
DISTI	<i>Distichlis</i>	saltgrass	16.0	0.0
BRIN2	<i>Bromus inermis</i>	smooth brome	8.0	0.0
TAMAR2	<i>Tamarix</i>	tamarisk	8.0	0.0
PASM	<i>Pascopyrum smithii</i>	western wheatgrass	6.0	0.0
EQUIS	<i>Equisetum</i>	horsetail	4.0	0.0
POPR	<i>Poa pratensis</i>	Kentucky bluegrass	4.0	0.0
DESCU	<i>Descurainia</i>	Tansy mustard	2.0	0.0
SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	2.0	0.0
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	2.0	0.0

*Data Tables for Foliar and Basal Cover by Site*

<b>Lovell Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	38.7	0.0
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	30.0	0.0
PODE3	<i>Populus deltoides</i>	eastern cottonwood	25.3	0.0
SYMPH	<i>Symphoricarpos</i>	snowberry	20.7	0.0
POPR	<i>Poa pratensis</i>	Kentucky bluegrass	18.0	2.0
BRIN2	<i>Bromus inermis</i>	smooth brome	6.0	0.0
ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	6.0	0.0
SALIX	<i>Salix</i>	willow	6.0	0.0
GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	5.3	0.0
CADR	<i>Cardaria draba</i>	whitetop	3.3	0.0
ELCA4	<i>Elymus canadensis</i>	Canada wildrye	2.0	0.0
MAIAN	<i>Maianthemum</i>	mayflower	2.0	0.0
SPSA3	<i>Sphaerophysa salsula.</i>	alkali swainsonpea	1.3	0.0
AMBRO	<i>Ambrosia</i>	ragweed	0.7	0.0
CIAR4	<i>Cirsium arvense</i>	Canada thistle	0.7	0.0
MELIL	<i>Melilotus</i>	sweetclover	0.7	0.0
RHTR	<i>Rhus trilobata</i>	skunkbush sumac	0.7	0.0

*Data Tables for Foliar and Basal Cover by Site*

<b>Lovell Mulch Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	67.0	0.0
BRIN2	<i>Bromus inermis</i>	smooth brome	37.0	0.0
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	19.0	0.0
TAMAR2	<i>Tamarix</i>	tamarisk	17.0	0.0
CIAR4	<i>Cirsium arvense</i>	Canada thistle	14.0	0.0
CHENO	<i>Chenopodium</i>	goosefoot	10.0	0.0
GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	10.0	0.0
SPAI	<i>Sporobolus airoides</i>	alkali sacaton	7.0	0.0
ALPR3	<i>Alopecurus pratensis</i>	meadow foxtail	4.0	0.0
ASSP	<i>Asclepias speciosa</i>	showy milkweed	4.0	0.0
CADR	<i>Cardaria draba</i>	whitetop	3.0	0.0
SYMPH	<i>Symphoricarpos</i>	snowberry	3.0	0.0
CAREX	<i>Carex</i>	sedge	2.0	0.0
COUM	<i>Comandra umbellata</i>	bastard toadflax	2.0	0.0
JUBA	<i>Juncus balticus</i>	Baltic rush	2.0	0.0
PACA6	<i>Panicum capillare</i>	witchgrass	2.0	0.0
RIBES	<i>Ribes</i>	currant	2.0	0.0
SPSA3	<i>Sphaerophysa salsula</i>	alkali swainsonpea	2.0	0.0
APOCY	<i>Apocynum</i>	dogbane	1.0	0.0
GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	1.0	0.0
MAIAN	<i>Maianthemum</i>	mayflower	1.0	0.0

<b>Lovell Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	54.0	0.0
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	38.0	0.0
PODE3	<i>Populus deltoides</i>	eastern cottonwood	36.0	0.0
ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	24.0	0.0
POPR	<i>Poa pratensis</i>	Kentucky bluegrass	12.0	0.0
GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	4.0	0.0
SPAI	<i>Sporobolus airoides</i>	alkali sacaton	4.0	0.0
SYMPH	<i>Symphoricarpos</i>	snowberry	4.0	0.0
RHTR	<i>Rhus trilobata</i>	skunkbush sumac	2.0	0.0

*Data Tables for Foliar and Basal Cover by Site*

<b>Sturgis Site 1 Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
THIN6	Thinopyrum intermedium	intermediate wheatgrass	45.0	3.0
ELAN	Elaeagnus angustifolia	Russian olive	20.0	0.0
POPR	Poa pratensis	Kentucky bluegrass	20.0	1.0
BRIN2	Bromus inermis	smooth brome	18.0	2.0
COAR4	Convolvulus arvensis	field bindweed	6.0	0.0
CIAR4	Cirsium arvense	Canada thistle	1.0	0.0

<b>Sturgis Site 1 Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
ELAN	Elaeagnus angustifolia	Russian olive	58.0	0.0
BRIN2	Bromus inermis	smooth brome	56.0	2.0
POPR	Poa pratensis	Kentucky bluegrass	14.0	0.0
JUBA	Juncus balticus	Baltic rush	10.0	0.0
TRIFO	Trifolium	clover	6.0	0.0
CAREX	Carex	sedge	4.0	0.0
AMBRO	Ambrosia	ragweed	2.0	0.0

***Data Tables for Foliar and Basal Cover by Site***

<b>Sturgis Site 2 Treatment Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
BRIN2	Bromus inermis	smooth brome	52.0	4.0
ELAN	Elaeagnus angustifolia	Russian olive	32.0	0.0
POPR	Poa pratensis	Kentucky bluegrass	24.0	0.0
CAREX	Carex	sedge	18.0	0.0
JUBA	Juncus balticus	Baltic rush	6.0	0.0
CIVU	Cirsium vulgare	bull thistle	2.0	0.0
CYOF	Cynoglossum officinale	houndstongue	2.0	0.0
PAVI2	Panicum virgatum	switchgrass	2.0	0.0
PHPR3	Phleum pratense	timothy	2.0	0.0
SCIRP	Scirpus	bulrush	2.0	0.0

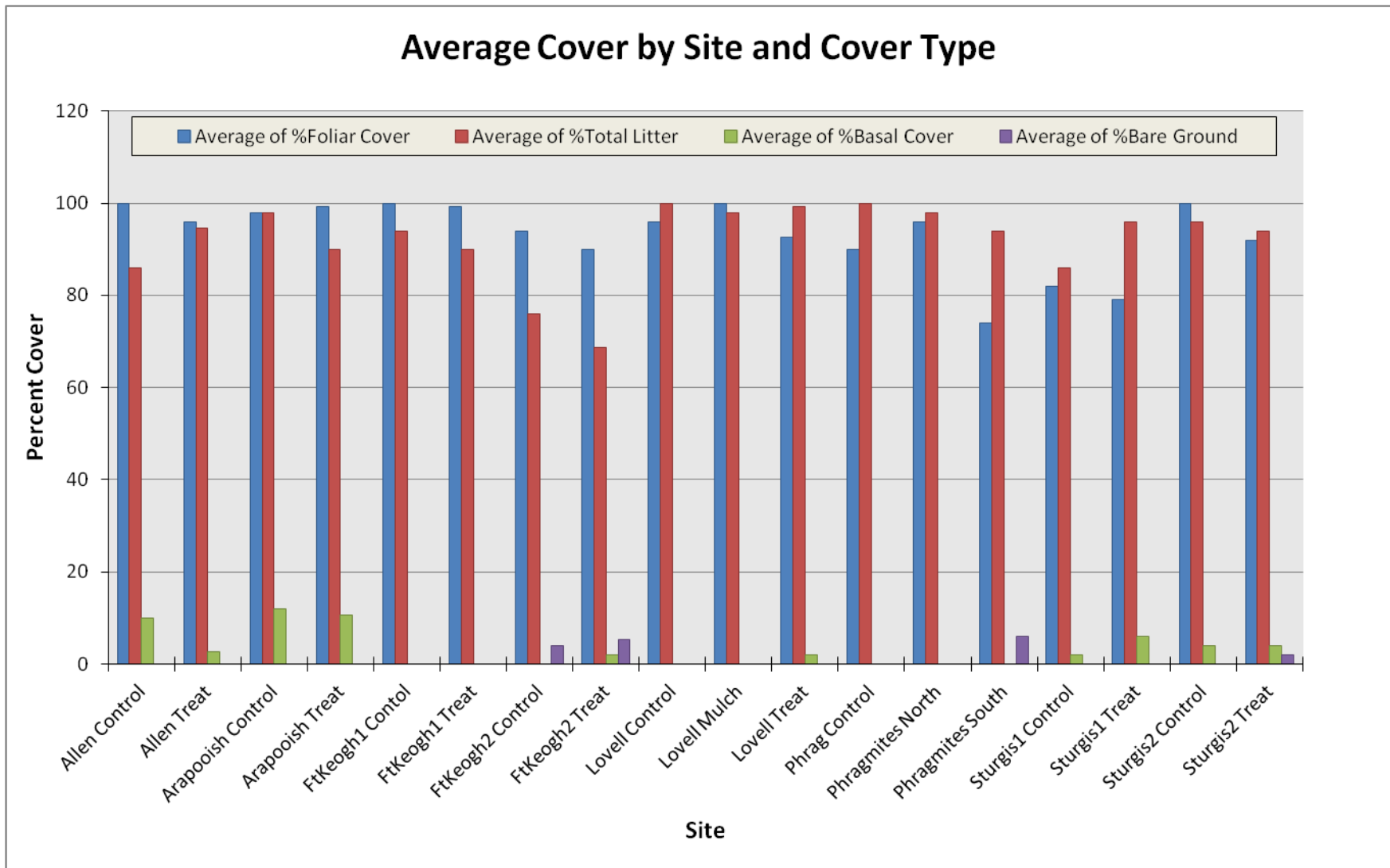
<b>Sturgis Site 2 Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
BRIN2	Bromus inermis	smooth brome	62.0	2.0
ELAN	Elaeagnus angustifolia	Russian olive	44.0	0.0
ANGE	Andropogon gerardii	big bluestem	24.0	2.0
SPPE	Spartina pectinata	prairie cordgrass	14.0	0.0
POPR	Poa pratensis	Kentucky bluegrass	8.0	0.0
CYOF	Cynoglossum officinale	houndstongue	4.0	0.0
AGST2	Agrostis stolonifera	creeping bentgrass	2.0	0.0
JUBA	Juncus balticus	Baltic rush	2.0	0.0
PAVI2	Panicum virgatum	switchgrass	2.0	0.0

*Data Tables for Foliar and Basal Cover by Site*

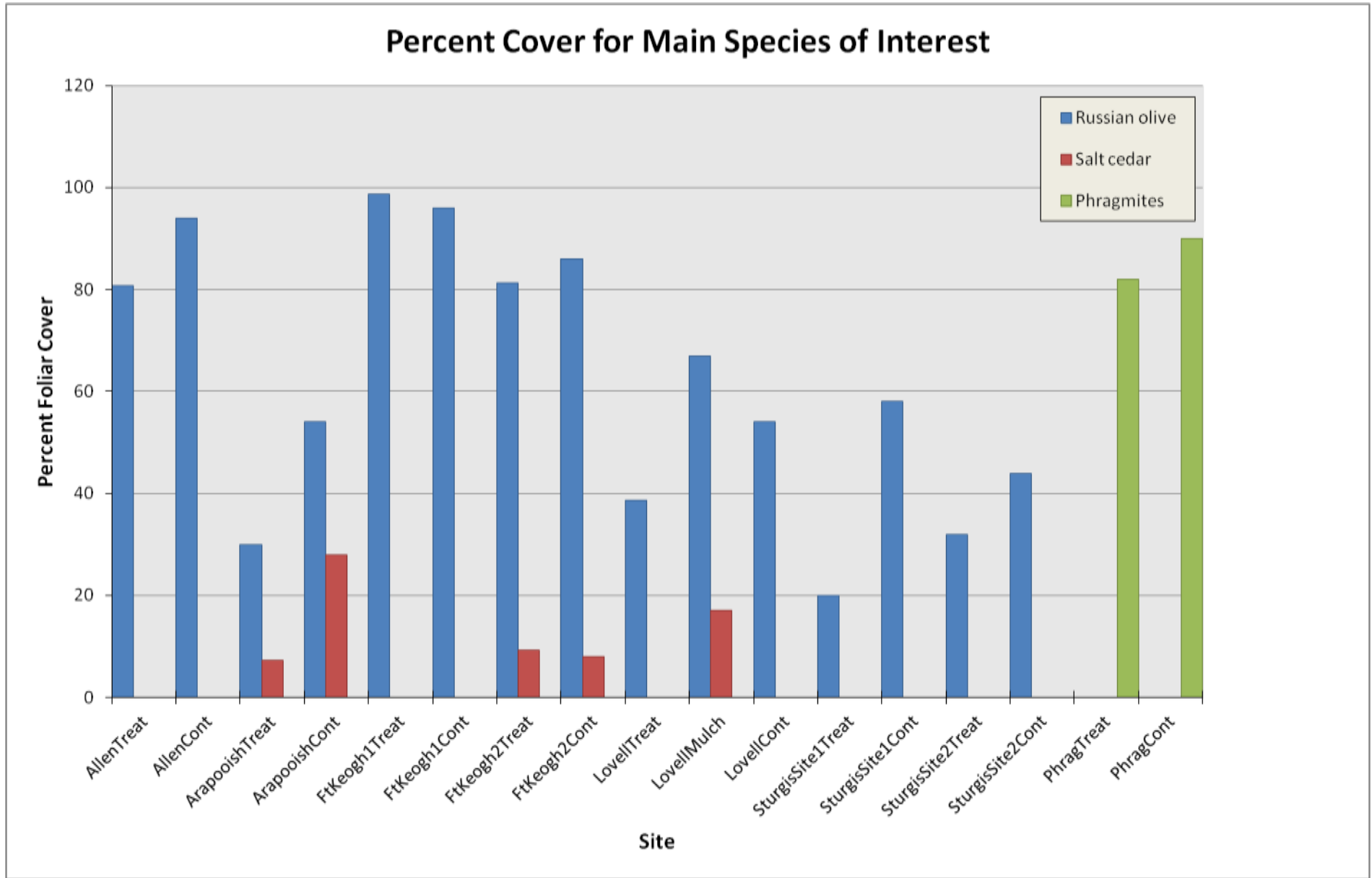
<b>Phragmites North and South Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
PHAU7	Phragmites australis	common reed	82.0	0.0
SPPE	Spartina pectinata	prairie cordgrass	8.0	0.0
CAREX	Carex	sedge	2.0	0.0
AMBRO	Ambrosia	ragweed	1.0	0.0

<b>Phragmites Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Foliar Cover (%)</b>	<b>Basal Cover (%)</b>
PHAU7	Phragmites australis	common reed	90.0	0.0
SYMPH	Symphoricarpos	snowberry	2.0	0.0

*Graph of Average Cover by Site and Cover Type*

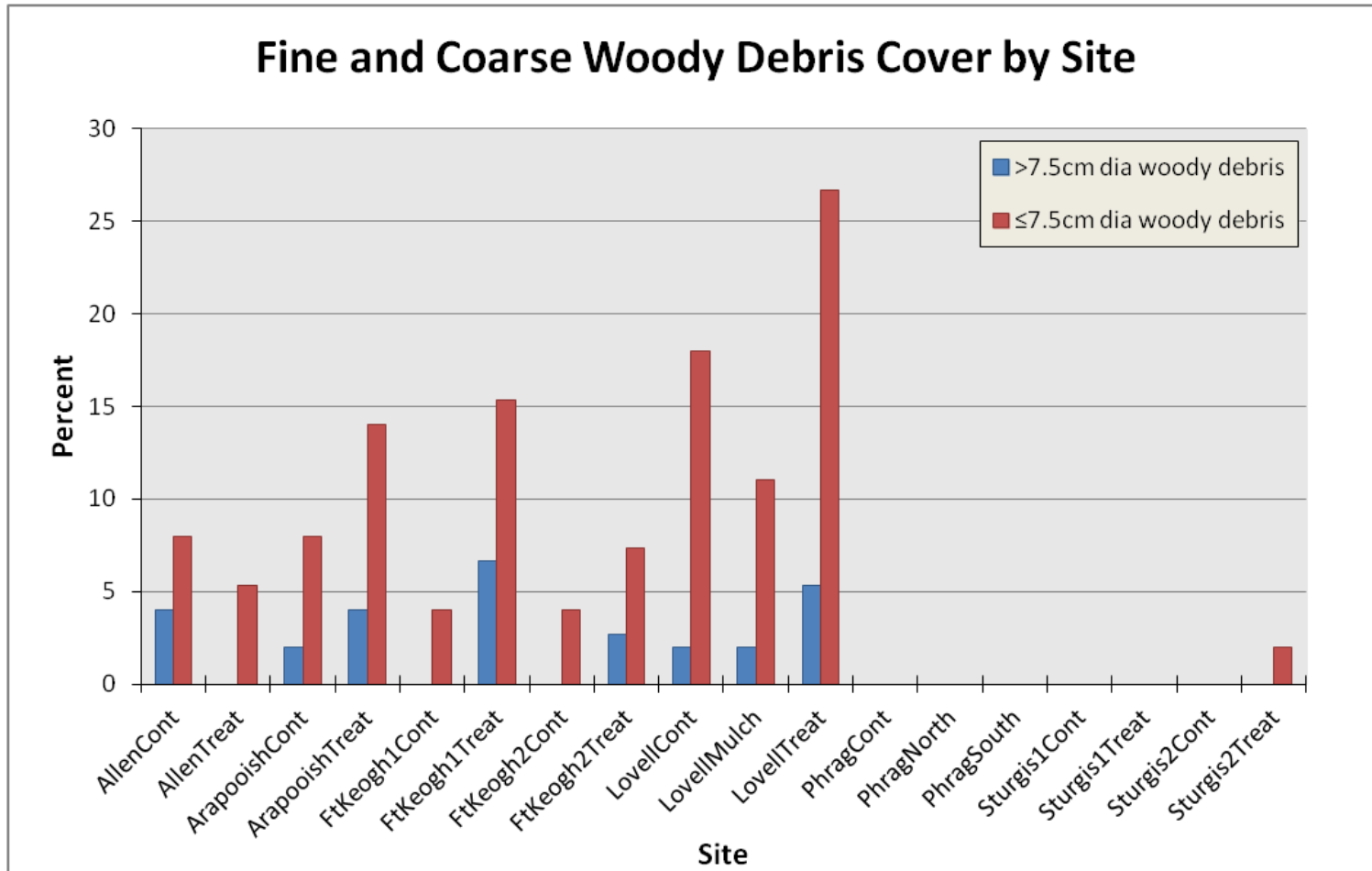


*Graph of Percent Cover for Main Species of Interest*





*Percent Cover for Woody Debris*



*Data Tables for Herbaceous Composition and Production by Site*

<b>Allen Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
CHENO	Chenopodium	goosefoot	51.47	16.07
THIN6	Thinopyrum intermedium	intermediate wheatgrass	38.80	16.66
CYOF	Cynoglossum officinale	houndstongue	14.60	4.60
POPR	Poa pratensis	Kentucky bluegrass	3.67	1.98
CIAR4	Cirsium arvense	Canada thistle	1.80	1.01
PHLEU	Phleum	timothy	1.20	0.22
JUAC	Juncus acuminatus	tapertip rush	0.40	0.11
DESCU	Descurainia	tansymustard	0.20	0.11

<b>Allen Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
THIN6	Thinopyrum intermedium	intermediate wheatgrass	70.20	20.85
CHENO	Chenopodium	goosefoot	29.60	8.74
CIAR4	Cirsium arvense	Canada thistle	0.20	0.11

**Data Tables for Herbaceous Composition and Production by Site**

<b>Arapooish Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
THIN6	Thinopyrum intermedium	intermediate wheatgrass	54.07	18.76
BRIN2	Bromus inermis	smooth brome	17.30	5.60
CIAR4	Cirsium arvense	Canada thistle	12.87	4.52
CHENO	Chenopodium	goosefoot	7.53	2.76
POPR	Poa pratensis	Kentucky bluegrass	7.07	2.50
SYOC	Symphoricarpos occidentalis	western snowberry	3.53	1.27
PHLEU	Phleum	timothy	2.00	0.56
ASCLE	Asclepias	milkweed	1.60	0.56
MAIAN	Maianthemum	mayflower	1.00	0.34
DESCU	Descurainia	tansymustard	0.60	0.22
CYOF	Cynoglossum officinale	houndstongue	0.50	0.17
ROSA5	Rosa	rose	0.50	0.17
AMBRO	Ambrosia	ragweed	0.40	0.11
RHTR	Rhus trilobata	skunkbush sumac	0.20	0.11
COUM	Comandra umbellata	bastard toadflax	0.20	0.11

<b>Arapooish Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
THIN6	Thinopyrum intermedium	intermediate wheatgrass	70.40	20.18
BRIN2	Bromus inermis	smooth brome	10.60	3.03
CHENO	Chenopodium	goosefoot	6.20	1.79
POPR	Poa pratensis	Kentucky bluegrass	5.20	1.46
DESCU	Descurainia	Tansy mustard	3.60	1.01
SYOC	Symphoricarpos occidentalis	western snowberry	2.20	0.67
AMBRO	Ambrosia	ragweed	1.20	0.34
MAIAN	Maianthemum	mayflower	0.40	0.11
CYOF	Cynoglossum officinale	houndstongue	0.20	0.11

**Data Tables for Herbaceous Composition and Production by Site**

<b>Fort Keogh 1 (Cottonwood Flat) Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	27.20	1.79
BRIN2	<i>Bromus inermis</i>	smooth brome	25.40	0.90
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	23.00	0.84
BRJA	<i>Bromus japonicus</i>	Japanese brome	16.73	0.93
NECA2	<i>Nepeta cataria</i>	catnip	13.47	0.90
CIVU	<i>Cirsium vulgare</i>	bull thistle	9.40	0.56
SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	5.80	0.22
CHENO	<i>Chenopodium</i>	goosefoot	5.70	0.34
POLYG4	<i>Polygonum</i>	knotweed	4.60	0.22
LEPID	<i>Lepidium</i>	pepperweed	4.00	0.22
POPR	<i>Poa pratensis</i>	Kentucky bluegrass	4.00	0.28
EPILO	<i>Epilobium</i>	willowherb	3.87	0.19
POBI7	<i>Potentilla biennis</i>	biennial cinquefoil	3.20	0.17
THAR5	<i>Thlaspi arvense</i>	field pennycress	2.00	0.11
DESCU	<i>Descurainia</i>	tansymustard	1.60	0.11
GAURA	<i>Gaura</i>	beeblossom	1.40	0.11
LACTU	<i>Lactuca</i>	lettuce	1.30	0.06
CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	1.20	0.11
AMBRO	<i>Ambrosia</i>	ragweed	0.20	0.00

<b>Fort Keogh 1 (Cottonwood Flat) Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
POPR	<i>Poa pratensis</i>	Kentucky bluegrass	42.80	2.47
THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	32.40	1.91
AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	16.20	0.90
EPILO	<i>Elymus canadensis</i>	Canada wildrye	2.80	0.11
SYMPH	<i>Epilobium</i>	willowherb	2.00	0.11
AMBRO	<i>Symphoricarpos</i>	snowberry	1.40	0.11
ELCA4	<i>Ambrosia</i>	ragweed	1.40	0.11
BRJA	<i>Bromus inermis</i>	smooth brome	0.40	0.00
POBI7	<i>Potentilla biennis</i>	biennial cinquefoil	0.20	0.00
BRIN2	<i>Bromus japonicus</i>	Japanese brome	0.20	0.00
CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	0.20	0.00

**Data Tables for Herbaceous Composition and Production by Site**

<b>Fort Keogh 2 (East Yellowstone) Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
PASM	Pascopyrum smithii	western wheatgrass	62.80	4.37
THIN6	Thinopyrum intermedium	intermediate wheatgrass	35.60	2.86
CHENO	Chenopodium	goosefoot	23.00	1.85
JUNCU	Juncus	rush	9.20	0.67
PHAR3	Phalaris arundinacea	reed canarygrass	9.10	0.67
BRIN2	Bromus inermis	smooth brome	8.13	0.64
AGCR	Agropyron cristatum	crested wheatgrass	6.20	0.45
COCA5	Conyza canadensis	Canadian horseweed	5.20	0.34
VEBR	Verbena bracteata	bigbract verbena	4.30	0.28
DESCU	Descurainia	tansymustard	4.00	0.30
GAURA	Gaura	beeblossom	4.00	0.34
EPILO	Epilobium	willowherb	3.40	0.22
NECA2	Nepeta cataria	catnip	3.30	0.28
LEPID	Lepidium	pepperweed	2.20	0.22
AMBRO	Ambrosia	ragweed	2.10	0.11
SALSO	Salsola	Russian thistle	2.00	0.11
CAREX	Carex	sedge	1.80	0.11
CENTA	Centaurea	knapweed	1.40	0.11
DISTI	Distichlis	saltgrass	0.60	0.00
MAVE2	Marsilea vestita	hairy waterclover	0.60	0.00
VALER	Valeriana	rough cocklebur	0.40	0.00
XAST	Xanthium strumarium	valerian	0.40	0.00
POPR	Poa pratensis	Kentucky bluegrass	0.20	0.00
BRJA	Bromus japonicus	Japanese brome	0.20	0.00
EQUIS	Equisetum	horsetail	0.20	0.00
SYOC	Symphoricarpos occidentalis	western snowberry	0.20	0.00

<b>Fort Keogh 2 (East Yellowstone) Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
BRIN2	Bromus inermis	smooth brome	27.20	1.91
CHENO	Chenopodium	goosefoot	17.00	1.23
POPR	Poa pratensis	Kentucky bluegrass	14.80	1.01
DISTI	Distichlis	saltgrass	12.60	0.90
PASM	Pascopyrum smithii	western wheatgrass	10.00	0.67
AGCR	Agropyron cristatum	crested wheatgrass	8.60	0.67
DESCU	Descurainia	tansymustard	4.20	0.34
JUNCU	Juncus	rush	2.20	0.11
BRJA	Bromus japonicus	Japanese brome	2.00	0.11
EQUIS	Equisetum	horsetail	1.00	0.11
AMBRO	Ambrosia	ragweed	0.40	0.00

*Data Tables for Herbaceous Composition and Production by Site*

<b>Lovell Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
SYMPH	Symphoricarpos	snowberry	26.20	5.38
POPR	Poa pratensis	Kentucky bluegrass	22.80	3.33
THIN6	Thinopyrum intermedium	intermediate wheatgrass	17.27	2.50
SPSA3	Sphaerophysa salsula	alkali swainsonpea	9.00	1.18
ELTR7	Elymus trachycaulus	slender wheatgrass	6.70	1.46
CIAR4	Cirsium arvense	Canada thistle	5.10	0.45
GLLE3	Glycyrrhiza lepidota	American licorice	4.60	0.97
PHLEU	Phleum	timothy	4.60	0.93
BRIN2	Bromus inermis	smooth brome	3.90	0.78
CARDA2	Cardaria	whitetop	3.47	0.34
MAIAN	Maianthemum	mayflower	2.80	0.52
ELCA4	Elymus canadensis	Canada wildrye	1.07	0.19
SPAI	Sporobolus airoides	alkali sacaton	0.50	0.06
MELIL	Melilotus	sweetclover	0.40	0.00
ASCLE	Asclepias	milkweed	0.40	0.11
TAMAR2	Tamarix	tamarisk	0.20	0.00
ELAN	Elaeagnus angustifolia	Russian olive	0.20	0.00

<b>Lovell Mulch Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
BRIN2	Bromus inermis	smooth brome	40.40	16.03
SPAI	Sporobolus airoides	alkali sacaton	23.80	8.18
THIN6	Thinopyrum intermedium	intermediate wheatgrass	17.80	6.16
ALPR3	Alopecurus pratensis	meadow foxtail	14.30	5.60
CHENO	Chenopodium	goosefoot	12.60	4.93
GLLE3	Glycyrrhiza lepidota	American licorice	10.90	3.92
CIAR4	Cirsium arvense	Canada thistle	6.10	2.19
SYMPH	Symphoricarpos	snowberry	5.20	1.79
ASSP	Asclepias speciosa	showy milkweed	1.60	0.56
SPSA3	Sphaerophysa salsula	alkali swainsonpea	1.20	0.45
CADR	Cardaria draba	whitetop	1.20	0.45
COUM	Comandra umbellata	bastard toadflax	1.00	0.34
GRSQ	Grindelia squarrosa	curlycup gumweed	0.60	0.22

*Data Tables for Herbaceous Composition and Production by Site*

<b>Lovell Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
ELTR7	Elymus trachycaulus	slender wheatgrass	46.20	6.95
BRIN2	Bromus inermis	smooth brome	11.80	1.79
POPR	Poa pratensis	Kentucky bluegrass	11.20	1.68
THIN6	Thinopyrum intermedium	intermediate wheatgrass	11.20	1.68
GLLE3	Glycyrrhiza lepidota	American licorice	10.60	1.57
SYMPH	Symphoricarpos	snowberry	4.60	0.67
ASCLE	Asclepias	milkweed	1.80	0.22
EQUIS	Equisetum	horsetail	1.00	0.11
MAIAN	Maianthemum	mayflower	1.00	0.11
SPAI	Sporobolus airoides	alkali sacaton	0.60	0.11

**Data Tables for Herbaceous Composition and Production by Site**

<b>Sturgis Site 1 Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
THIN6	Thinopyrum intermedium	intermediate wheatgrass	74.10	21.97
BRIN2	Bromus inermis	smooth brome	34.20	9.30
COAR4	Convolvulus arvensis	field bindweed	4.70	1.40
CIAR4	Cirsium arvense	Canada thistle	2.80	0.78
POPR	Poa pratensis	Kentucky bluegrass	2.00	0.56
GLLE3	Glycyrrhiza lepidota	American licorice	0.60	0.11
TAOF	Taraxacum officinale	common dandelion	0.30	0.11
CIVU	Cirsium vulgare	bull thistle	0.20	0.11

<b>Sturgis Site 1 Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
BRIN2	Bromus inermis	smooth brome	55.00	11.77
SONU2	Sorghastrum nutans	Indiangrass	31.60	6.73
JUBA	Juncus balticus	Baltic rush	6.00	1.23
POPR	Poa pratensis	Kentucky bluegrass	2.20	0.45
TRIFO	Trifolium	clover	1.60	0.34
AGST2	Agrostis stolonifera	creeping bentgrass	1.40	0.34
CIVU	Cirsium vulgare	bull thistle	0.80	0.22
CIAR4	Cirsium arvense	bulrush	0.40	0.11
SCIRP	Scirpus	Canada thistle	0.40	0.11
AMBRO	Ambrosia	ragweed	0.20	0.00
CAREX	Carex	sedge	0.20	0.00
TAOF	Taraxacum officinale	common dandelion	0.20	0.00



**Data Tables for Herbaceous Composition and Production by Site**

<b>Sturgis Site 2 Treatment Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
BRIN2	Bromus inermis	smooth brome	72.40	22.19
CAREX	Carex	sedge	16.60	5.04
POPR	Poa pratensis	Kentucky bluegrass	4.20	1.35
JUBA	Juncus balticus	Baltic rush	2.00	0.56
EQLA	Equisetum laevigatum	smooth horsetail	1.80	0.56
AGST2	Agrostis stolonifera	creeping bentgrass	0.80	0.22
CRYPT	Cryptantha	cryptantha	0.40	0.11
GLLE3	Glycyrrhiza lepidota	American licorice	0.40	0.11
PHPR3	Phleum pratense	timothy	0.40	0.11
SYMPH	Symphoricarpos	snowberry	0.20	0.11
CIVU	Cirsium vulgare	bull thistle	0.20	0.11
CIAR4	Cirsium arvense	Canada thistle	0.20	0.11
SCIRP	Scirpus	bulrush	0.20	0.11
CYOF	Cynoglossum officinale	houndstounge	0.20	0.11

<b>Sturgis Site 2 Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
BRIN2	Bromus inermis	smooth brome	42.60	11.32
SPPE	Spartina pectinata	prairie cordgrass	28.20	7.51
ANGE	Andropogon gerardii	big bluestem	20.40	5.49
PAVI2	Panicum virgatum	switchgrass	2.80	0.78
CIAR4	Cirsium arvense	Canada thistle	1.60	0.45
AGST2	Agrostis stolonifera	creeping bentgrass	1.20	0.34
JUBA	Juncus balticus	Baltic rush	0.60	0.11
LITHO3	Lithospermum	stoneseed	0.60	0.11
GLLE3	Glycyrrhiza lepidota	American licorice	0.40	0.11
CYOF	Cynoglossum officinale	houndstounge	0.40	0.11
POPR	Poa pratensis	Kentucky bluegrass	0.40	0.11
TAOF	Taraxacum officinale	common dandelion	0.20	0.00
EQLA	Equisetum laevigatum	smooth horsetail	0.20	0.00
MOFI	Monarda fistulosa	wild bergamot	0.20	0.00
SYMPH	Symphoricarpos	snowberry	0.20	0.00

***Data Tables for Herbaceous Composition and Production by Site***

<b>Phragmites North and South Transects</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
PHAU7	Phragmites australis	common reed	98.80	51.78
SPPE	Spartina pectinata	prairie cordgrass	1.10	0.56
AMBRO	Ambrosia	ragweed	0.20	0.11

<b>Phragmites Control Transect</b>				
<b>Species</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Comp (%)</b>	<b>kg/ha</b>
PHAU7	Phragmites australis	common reed	99.60	56.38
SPPE	Spartina pectinata	prairie cordgrass	0.40	0.22

### *Data Tables for Woody Species Density*

<b>Salt Cedar Density by Size Class (plants/ha)</b>							
	TAMAR2						TAMAR2 Total
<b>Site</b>	< 20 cm	20-100 cm	1-2 m	2-4 m	>4 m	Dead	
AllenCont	0	0	0	0	0	0	0
AllenTreat	0	0	0	0	0	0	0
ArapooshCont	0	0	0	200	400	0	600
ArapooshTreat	0	0	50	450	325	0	825
FtKeogh1Cont	0	0	0	0	0	0	0
FtKeogh1Treat	100	0	0	0	0	0	100
FtKeogh2Cont	0	50	300	150	250	0	750
FtKeogh2Treat	10000	102000	0	4200	150	0	116350
LovellCont	0	0	0	0	0	0	0
LovellMulch	0	0	0	50	400	238	688
LovellTreat	0	50	0	0	0	350	400
Sturgis1Cont	0	0	0	0	0	0	0
Sturgis1Treat	0	0	0	0	0	0	0
Sturgis2Cont	0	0	0	0	0	0	0
Sturgis2Treat	0	0	0	0	0	0	0

<b>Other Multi-Stemmed Species by Size Class (Plants/ha)</b>					
	RHTR		SALIX		
<b>Site</b>	1-2 m	Dead	2-4 m	>4 m	Dead
FtKeogh2Treat	0	0	0	50	0
LovellCont	0	0	0	50	0
LovellTreat	100	50	100	0	100

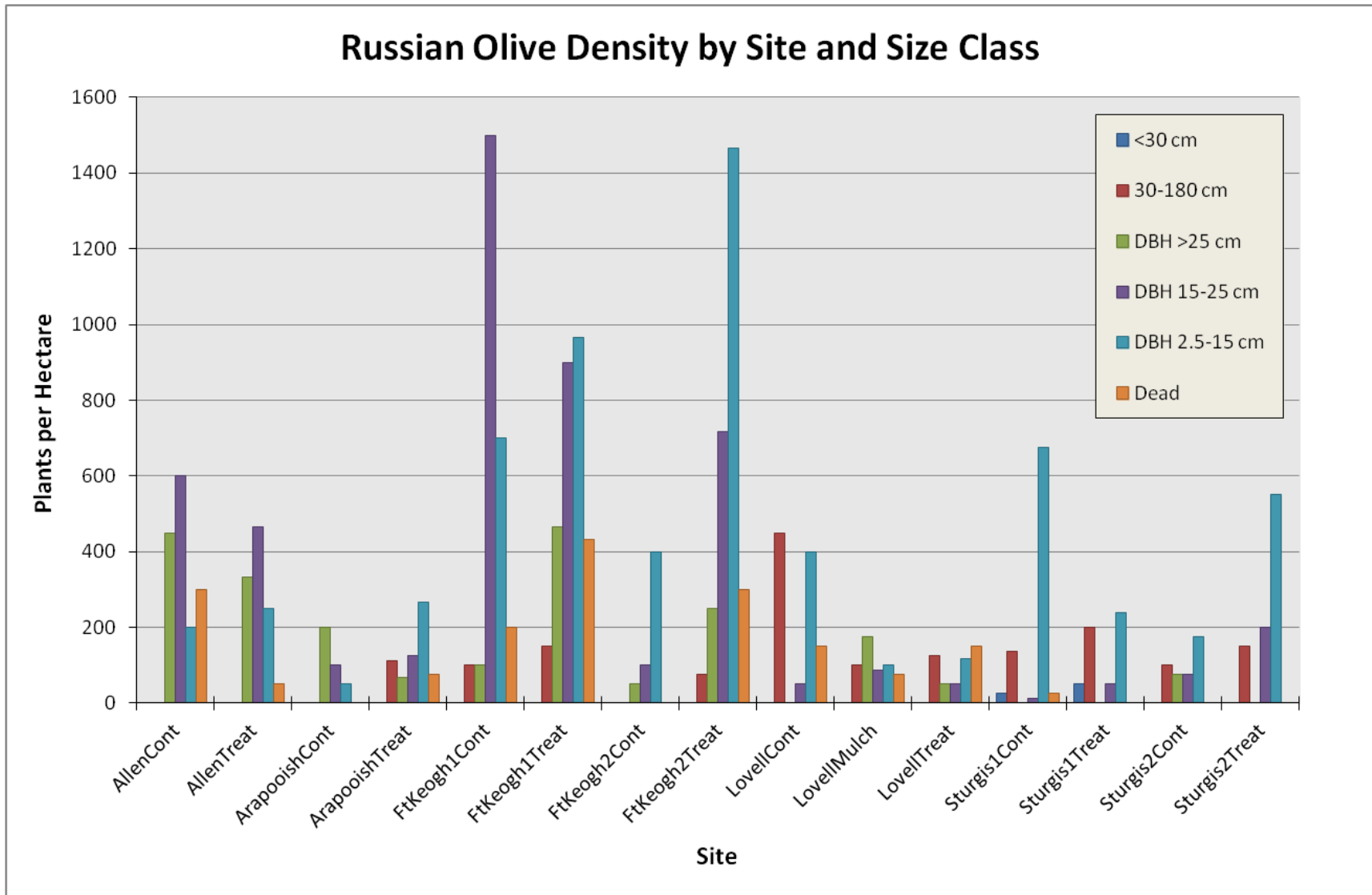
### *Data Tables for Woody Species Density*

<b>Russian olive density by size class (plants/ha)</b>							
	ELAN						ELAN Total
<b>Site</b>	<30 cm	30-180 cm	DBH 2.5-15 cm	DBH 15-25 cm	DBH >25 cm	Dead	
AllenCont	0	0	200	600	450	300	1550
AllenTreat	0	0	250	467	333	50	1100
ArapooishCont	0	0	50	100	200	0	350
ArapooishTreat	0	113	267	125	67	75	646
FtKeogh1Cont	0	100	700	1500	100	200	2600
FtKeogh1Treat	0	150	967	900	467	433	2917
FtKeogh2Cont	0	0	400	100	50	0	550
FtKeogh2Treat	0	75	1467	717	250	300	2808
LovellCont	0	450	400	50	0	150	1050
LovellMulch	0	100	100	88	175	75	538
LovellTreat	0	125	117	50	50	150	492
Sturgis1Cont	25	138	675	13	0	25	875
Sturgis1Treat	50	200	238	50	0	0	538
Sturgis2Cont	0	100	175	75	75	0	425
Sturgis2Treat	0	150	550	200	0	0	900

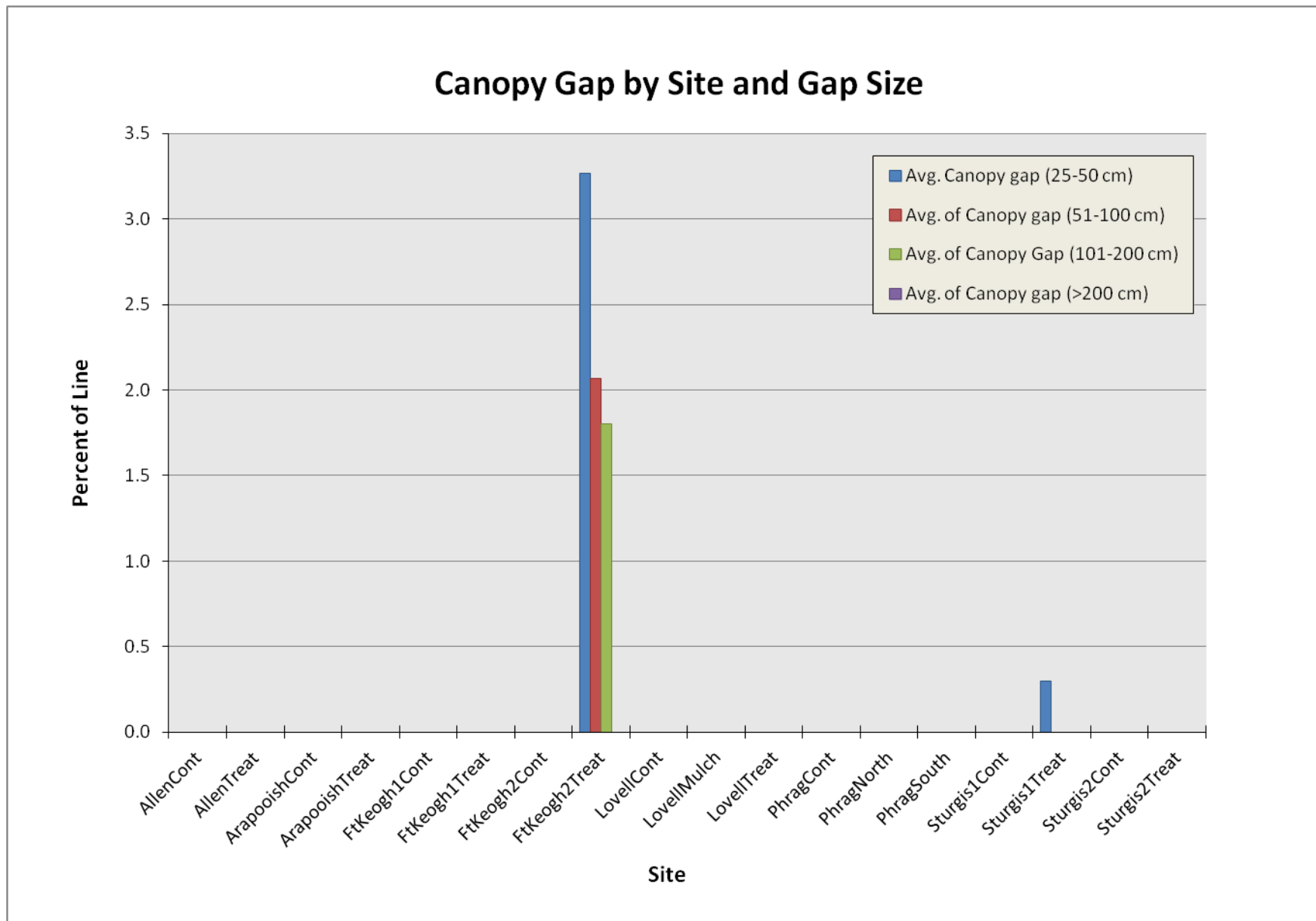
### *Data Tables for Woody Species Density*

<b>Other Single-Stemmed Species by Size Class (Plants/ha)</b>									
	PODE				SHAR		JUOC		FRPE
<b>Site</b>	<30 cm	DBH 15-25 cm	DBH >25 cm	Dead	DBH 15-25 cm	DBH 2.5-15 cm	30-180 cm	DBH 2.5-15 cm	<30 cm
ArapooishCont	0	0	200	0	0	0	0	0	0
ArapooishTreat	0	150	125	0	50	150	0	0	0
FtKeogh1Treat	0	0	100	0	0	0	100	100	67200
FtKeogh2Treat	4000	0	100	0	0	0	0	0	0
LovellCont	0	0	150	50	0	0	0	0	0
LovellTreat	0	0	50	50	0	0	0	0	0

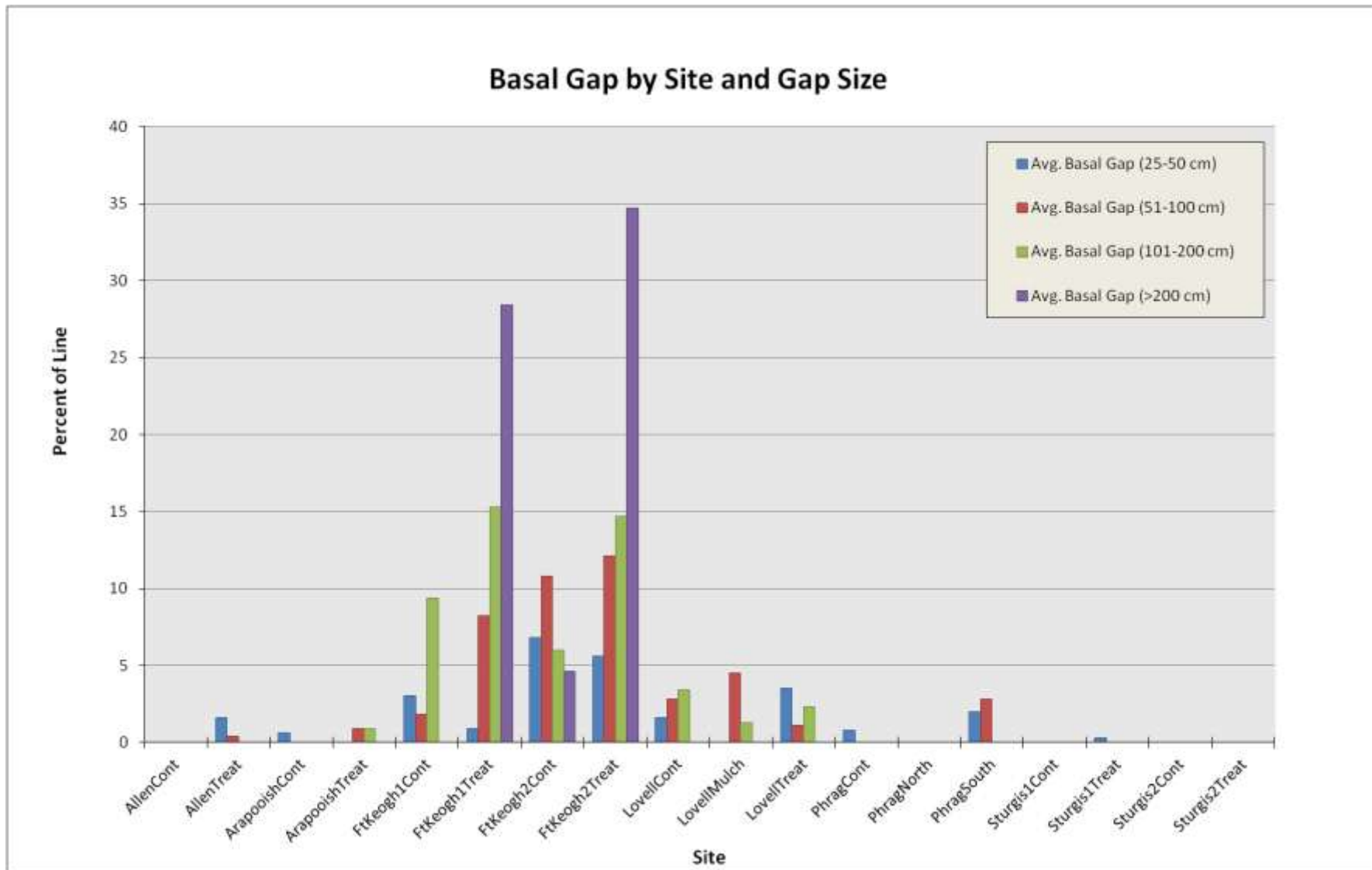
*Graph for Russian Olive Density*



*Graphs for Canopy and Basal Gap by Site*



*Graphs for Canopy and Basal Gap by Site*





*Soil Stability by Site*

