PROVINCE OF BRITISH COLUMBIA

2016 Ecosystem Restoration Monitoring: Lizard East

Rocky Mountain Trench Ecosystem Restoration Program

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The Fish & Wildlife Compensation Program is a partnership between BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams.

Introduction

The dry climatic zones of British Columbia were historically characterized by low intensity frequent fires, resulting in fire-tolerant species with minimal surface fuels (Klenner et al. 2008, Gayton 2001, Dawson 1998). A mosaic of multi-aged stands, mixed grassland and shrublands, and open forests are the result of a combination of low intensity frequent fires (every 7-50 years) as well as infrequent stand replacing fires (Kaye et al. 1999, Cooper 1960).

Open forest and grassland areas are highly susceptible to increases in conifer regeneration and encroachment resulting in loss of habitat due to canopy closure. Closed canopies reduce the amount of light that penetrates to the forest floor and encourages growth of plants that require mesic conditions in stands that historically supported sun-loving plants (Cooper 1960, Lunan and Habek 1973, and Lieffers and Stadt 1993). Increased effectiveness of wildfire management is thought to be a major contributor to the changes in forest and litter cover and conifer encroachment on low-elevation grasslands; this variation has a negative impact on wildlife habitat and the biomass production of the understory vegetation (Stam et al, 2008).

The Rocky Mountain Trench Ecosystem Restoration Program is collaborative partnerships working to restore grasslands and open Douglas fir and Ponderosa pine forests of the East Kootenay and Upper Columbia Valley Region. The program partners include an array of resource users, land managers, government agencies, First Nations, land conservation trusts, naturalist and environmental societies and other citizen stakeholder groups. These stakeholders have adopted ecosystem restoration or habitat enhancement programs intended to restore the ecological processes of fire-maintained ecosystems (Rocky Mountain Trench Ecosystem Restoration). The focus of the restoration and enhancement activities is to restore key wildlife winter range, red- and blue-listed species habitat and increase forage for livestock, thus diminishing the wildlife/livestock conflict (Rocky Mountain Trench Ecosystem Restoration Steering Committee 2006).

This report summarizes the ecosystem monitoring data collected at Lizard East; located near Elko, B.C. in the summer of 2016.

Study Area

The Lizard Range is the western edge of the Rocky Mountains southeast of Fernie, B.C. The southern terminus of the Lizard range is located at the Elk River and the village of Elko, B.C. The Lizard East plots are located approximately five kilometres northeast of Elko. The elevation varies between 1150 and 1250 metres with southern facing steep slopes with occasional gullies and demobilized transmission line/logging roadways (no road access to site). Lizard East is located within the IDFdm2 biogeoclimatic zone (Interior Douglas fir dry mild).

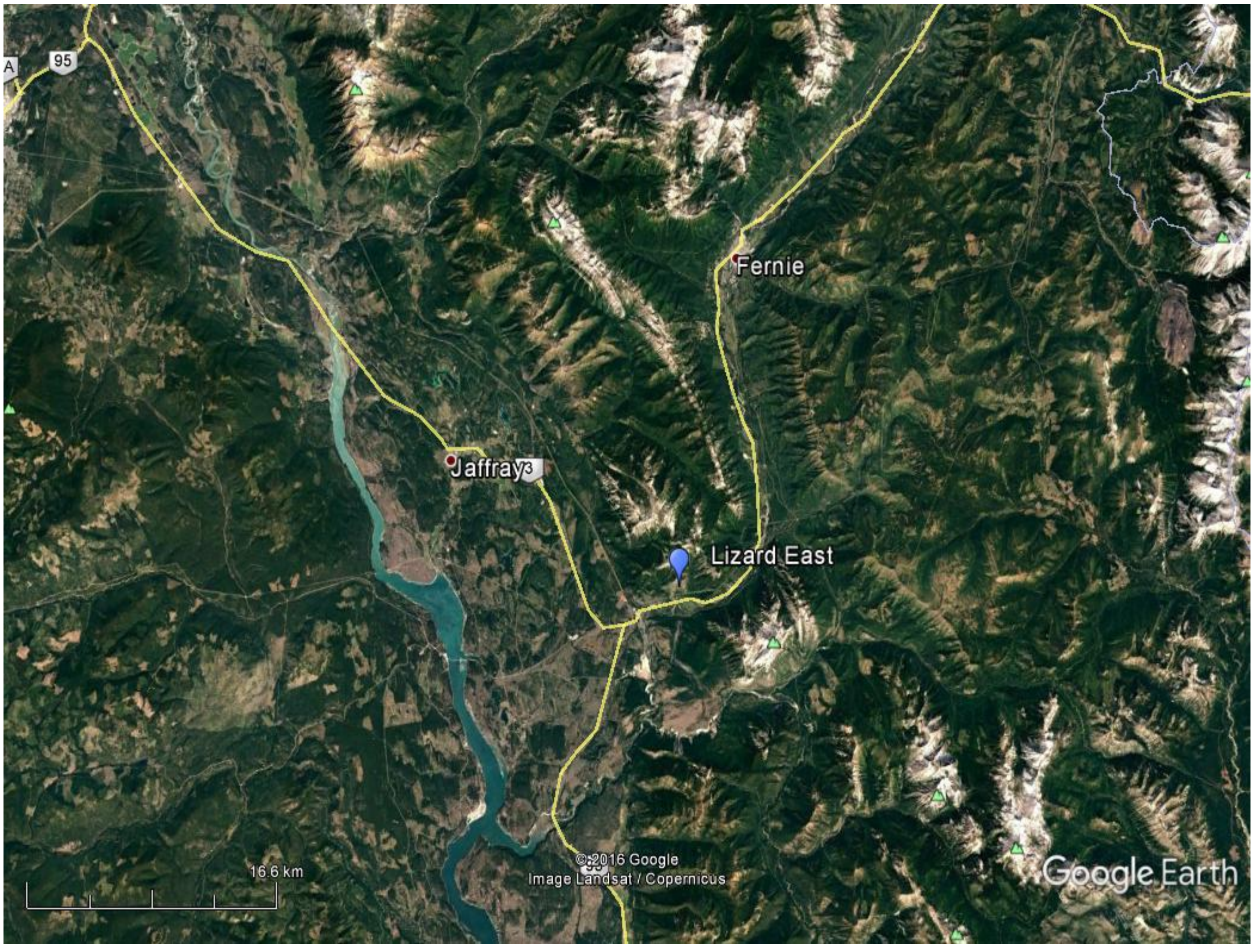

Figure 1: Location of Lizard East study area

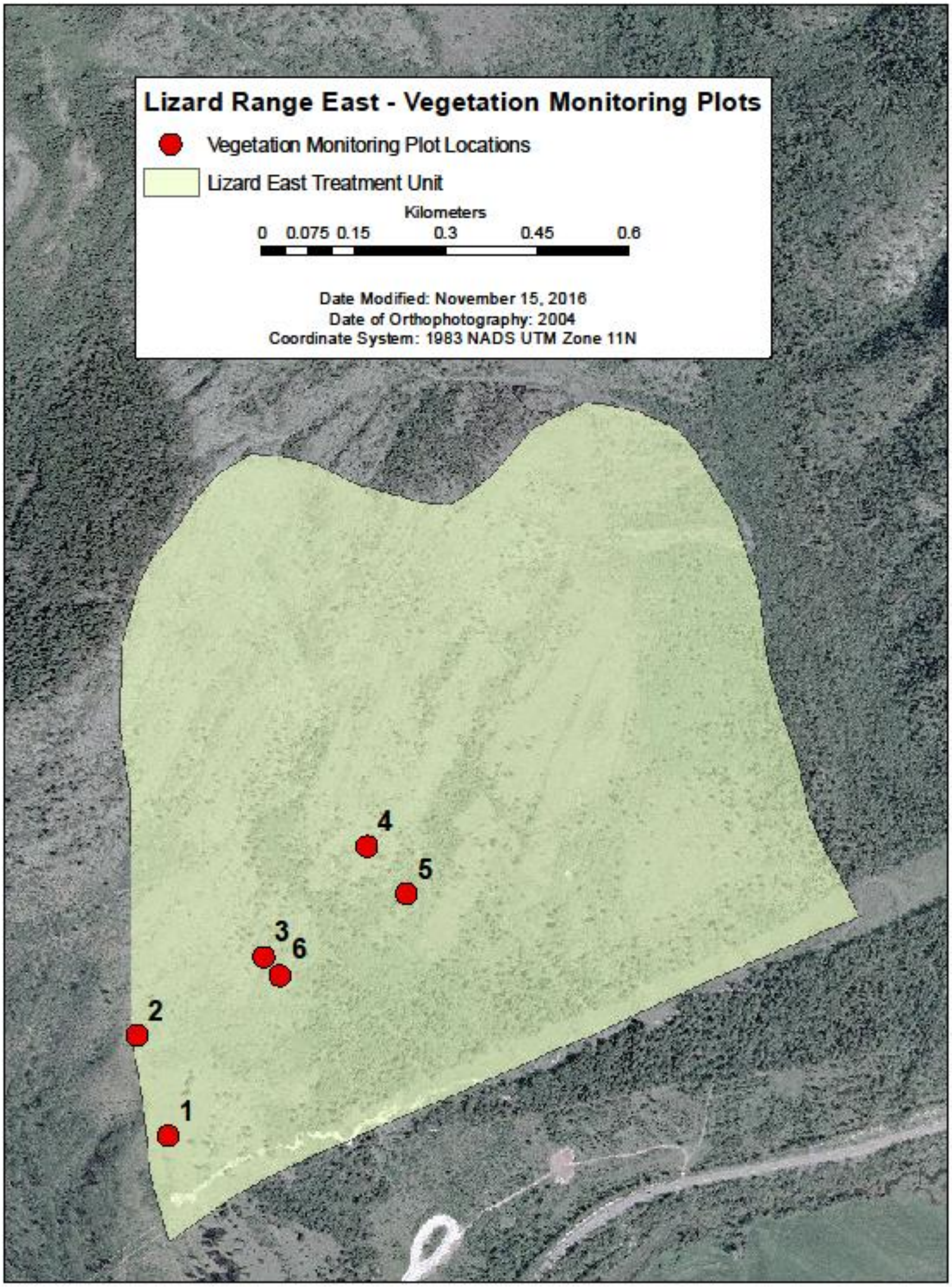

Figure 2: Lizard East plot locations

Methods

Methodology was guided by the East Kootenay Trench Restoration Effectiveness Monitoring Plan (Machmer et al. 2002), for the purpose of ecosystem monitoring at Lizard East. This is the pre-monitoring plot establishment required to evaluate effectiveness of the subsequent treatment using the three objectives outlined:

Restoration Objective 1: To reduce tree density, increase tree size, and achieve a tree species composition that falls within the historical range of variability for treated areas (based on aspect, slope, topography, moisture).

Restoration Objective 2: To maintain or increase fire-adapted native understory vegetation in treated areas.

Restoration Objective 3: To minimize the establishment and spread of non-native plant species, particularly noxious species, in treated areas.

Plot Establishment

Six plots were established within the proposed treatment area using a Garmin 62S GPS; plots were chosen as representative sites and to avoid old roads, cliff and other local topographic anomalies. Plots centres were marked with flagging tape and a 10" steel spike. UTM's of plot centres were recorded. Each plot consisted of four, 25 metre-long transects originating at plot centre; the first transect was assigned a random bearing and the subsequent transects determined by adding 90 degrees and rotating in a clockwise direction. The locations of the Daubenmire frames were also marked using 10" spike and flagging tape on each transect.

Understory monitoring

Understory plot layouts were conformed to methods in Machamer et al. (2002), however; modifications to the plot layout were made to increase the intensity of the data collection per plot. These modifications included: increasing the number of spokes radiating from plot centre from three to four and increasing the length of each spoke from 11.64 to 25 meters as recommended by Harris (2014). Five Daubenmire frame locations were permanently marked on each transect (5 frames per transect = 20 total per plot) with a 10" steel spike. The five frames were located at the 5m, 10m, 15m, 20m and 25m intervals along each transect. In addition, duff depths (cm) were taken at 5.3m, 10.3m, 15.3m, 20.3m and 25.3m intervals. At each Daubenmire location, the frame was placed on the right side of transect and the percent cover for all shrubs, grasses, bunchgrasses, forbs and weeds present are documented. In addition to vegetation cover, the percent cover of rock, bare soil, bryophytes, dead and live wood, litter, cryptogrammic crust and scat was recorded. Species and ground cover with less than 1% cover was recorded as 1%. When bunchgrasses or weedy species were observed with a percent cover of five or lower, the number of culms were individually counted and recorded.

To estimate the shrub cover, the line-intercept method was conducted along each of transect to the full 25 meter length (Figure 3). All shrub species with intercepting cover were recorded to the nearest centimetre. A percent cover was determined per species by calculating the total length of interception along the transect and then dividing by the total length of the transect (25m) to determine a mean cover per species.

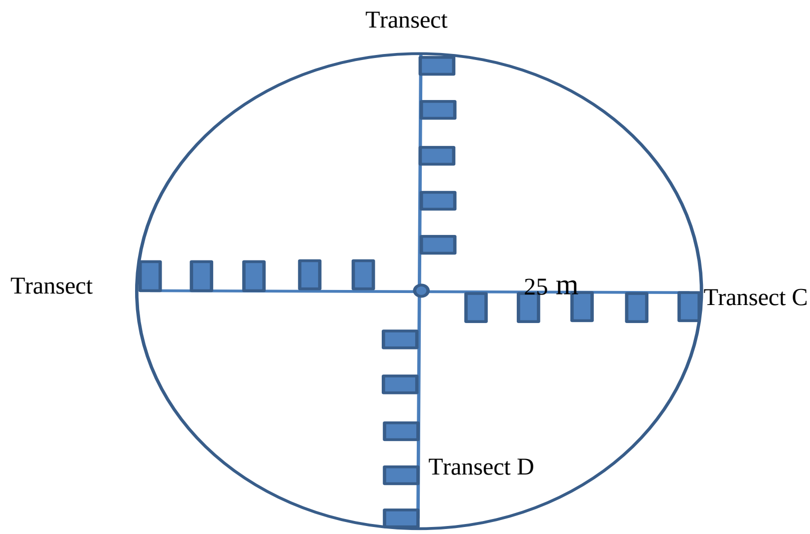

Figure 3: Schematic for understory Daubenmire plot layout

Four photos were taken at five separate representative plots; one photo per cardinal direction taken from plot centre was focused on a one metre tall photo stake positioned approximately five metres from plot centre.

Coarse Woody Debris

Coarse wood debris (CWD) estimates were conducted along transect transects B and D according to BC Ministry of Environment Field Manual for Describing Terrestrial Ecosystems (BCMOF 2010). Any woody debris intercepting the 25 m transects (with a diameter greater than 7.5 cm) was classified as CWD and recorded. For every individual piece the tree species, diameter (cm), length (m), and decay class were recorded. Volume per plot (m^3/ha) was calculated and a mean volume (m^3/ha) for the site was provided. Volume per plot was calculated using the following formula adapted from Wagner (1982):

$$V= \sum d^2 \left[\frac{(\pi^2)}{(8*l)}\right]$$

Where:

V=Volume per unit area

d= piece diameter (cm) at intersection

l= length of transect (m)

Overstory monitoring

Overstory plot layout conformed to the BC Ministry of Forests and Range and the BC Ministry of Environment Field Manual for Describing Terrestrial Ecosystems (BCMOF 2010; and Machamer et. al. 2002). Nested fixed radius plots (Figure 4) were established at the plot centres to sample each layer. Species, diameter (at breast height (dbh)), decay class, crown condition, evidence of pathogens and insects and wildlife use was recorded for each tree in the dominant, mature, pole and sapling layers. A tally was taken by species of live and dead regeneration trees between 10 cm and 1.3 metres in height. Stand density (stems per hectare (stems/ha)) was calculated using the conversion factor for each layer and is outlined in Table 1. Tree heights and increment bores were randomly taken on two trees per plot in order to determine co-dominant stand height and approximate age of stand. In order to estimate canopy cover, a spherical densitometer was used for each of the cardinal directions at plot centre.

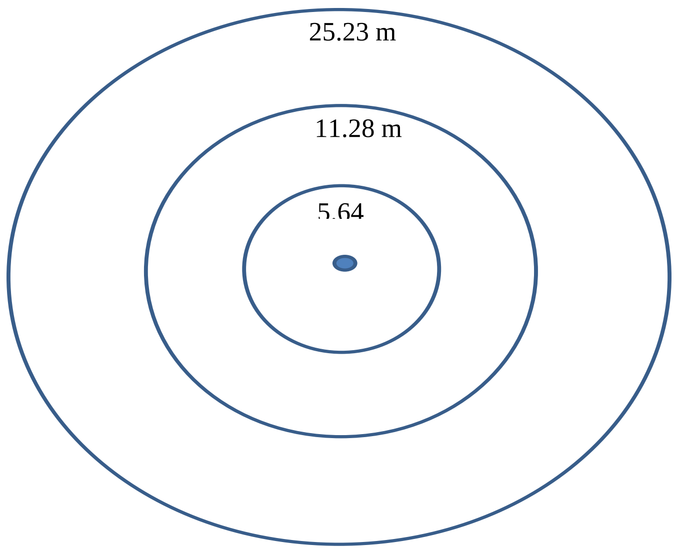

Figure 4: Schematic overstory nested fixed radius plots.

Table 1: Summary of overstory measurements and descriptions for nested fixed radius plots and size/age classes

Radius	Area (m2)	Conversion factor to ha	Size/age class	Height and/or dbh range
5.64	100	1000	Regeneration	10 cm -130 cm height
5.64	100	1000	Sapling	>1.3 m height, <7.5 cm dbh
5.64	100	1000	Pole	7.5 - 12.49 cm dbh
11.28	400	25	Mature	>12.5 - 30 cm dbh
25.23	1999	5	Dominant	>30 cm dbh

Soils

One soil plot was selected to represent the site for soil classification. The soil examination looked at the surficial material, texture of the mineral horizons, root size and abundance, soil rooting depth. The depths of the L, F, and H layers and the abundance and size of roots were all measured and recorded. The depth of each mineral horizon was documented as well as the horizon texture and percent course fragment content. The Humus form was also noted as a mull, moder, or mor.

Results and Discussion

Ecological Site Description

The Lizard East unit is mosaic of natural openings and timbered patches. The timber patches are predominately veteran Douglas fir with mature trembling aspen thickets localized in gullies and topographic depressions. The understory plant community is composed of fescue species *(festuca spp.),* fernleaf desert parsley *(Lomatium dissectum)*, spreading dogbane *(Apocynum androsaemifolium)* and leafy aster *(Aster foliaceus).* In addition, a shrub layer of snowbrush *(Ceanothus velutinus)*, Saskatoon *(Amelanchier alnifolia)* and kinnikinnick *(Arctostaphylos uva-ursii)* was also common throughout the plots.

The Lizard East unit is situated in the IDFdm2 biogeoclimatic zone (Kootenay, dry mild interior Douglas fir variant). Zonal IDFdm2 sites have climates with hot, very dry summers and cool winters with very light snowfall, allowing for soil to dry out during the late summer and to freeze to shallow depths in the winter. The climax stands include Interior Douglas fir *(Pseudotsuga menziesii)* or mixed seral stands of Douglas fir, western larch *(Larix occidentalis)* and lodgepole pine *(Pinus contorta)*. Understory is dominated by pinegrass *(Calamagrostis rubescens)* and shrub species such as birch-leaved spirea *(Spiraea betulifolia),* common juniper *(Juniperus communis),* soopilallie *(Shepherdia Canadensis),* Saskatoon, and common snowberry *(Symphoricarpos albus)* (Braunmandl 1992).

Rocky Mountain bighorn sheep *(Ovis canadensis)* is a blue listed species provincially and is known to inhabit the area of Lizard East. The red-listed American badger *(Taxidea taxus)* is widespread in the area (Lizard Range Ecosystem Restoration Plan, 2016) but no evidence of badger activity was found at or near the monitoring plots. Sign of elk, deer and bear was observed on site during plot establishment in July 2016.

Understory

The species richness per plot ranged from 14 (plot 5 and 6) to 32 species (plot 1) with an average of 22.2 species per plot (St Dev=7.0) (Figure 3). The number of species across all plots totalled 46 different species.

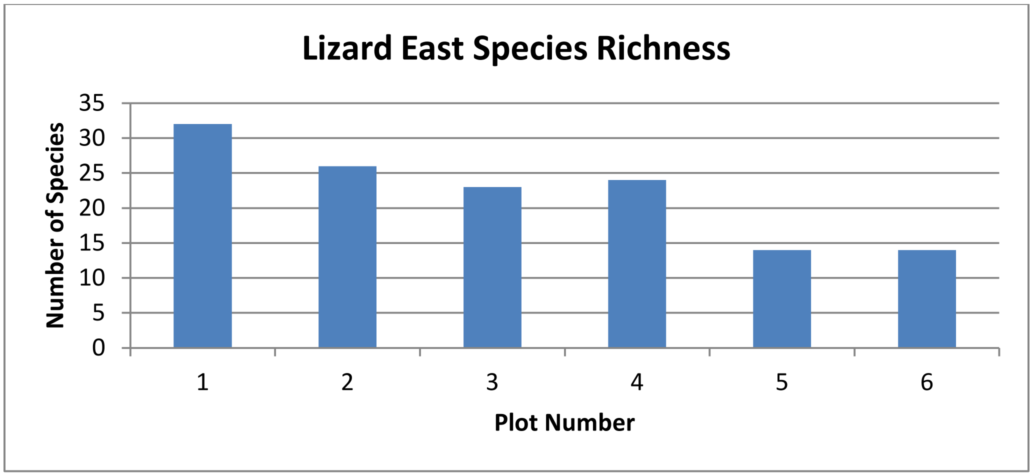

Figure 5: Hoodoo East species richness (does not include tree species)

Daubenmire frames were used at 20 locations within each plot; within the frames the abiotic ground cover was composed predominately of litter (57.6%, St Dev=32.8), followed by rock (43.7%, St Dev=33.3) and bryophytes (17.0%, St Dev=14.2) (Table 2). The Cryptogrammic crust layer plays a smaller role (10.0%, St Dev=0) in the abiotic ground cover than the other components; this is due to the abundance of loose rock and steep slopes throughout the site. Cryptogrammic crust is a thin layer composed of mosses, lichens, algae, and bacteria; these crusts form an important function in soil erosion protection as well as moisture absorption and providing nitrogen and other nutrients for plant growth (Ponzetti and McCune 2001). Soils are particularly susceptible to disturbance when the crust is prominent in the ground cover.

Table 2: Mean percent cover of abiotic ground cover

	2016	
	Mean	St Dev
Litter	57.6	32.8
Rock	43.7	33.3
Soil	18.3	17.9
Bryophytes	17.0	14.2
Cryptogrammic Crust	17.0	0.0
Dead Wood	13.3	8.2
Scat	5.3	3.2
Live Wood	0.0	0.0

Snowbrush, a sprawling shrub species was common on site with the highest percent cover of any understory species with an average 54.0% cover (St Dev=40.4). The most extensive understory species after Snowbrush was kinnickinnick (35.0%, St Dev=7.1) and a brome species *(Bromus sp) (29.7%, St Dev=28.3),* an extensive sod forming grass. The species with the highest percent cover in the forb functional group included fernleaf desert parsley (11.3%, St Dev=6.4), early blue violet *(Viola adunca)* (10.7%, St Dev=9.0) and leafy aster (9.9%, St Dev=10.0). The remaining forb species present showed no other dominant species.

The bunchgrass group was largely formed of fescue *(Festuca spp)* (9.0%, St Dev=3.5) and bluebunch wheatgrass *(Pseudoroegneria spicata)* (9.0%, St Dev=8.6). More minor occurrences of junegrass *(Koeleria macrantha)* (6.6%, St Dev=4.3) and poa *(Poa sp)* (4.9%, St Dev=3.7) were also present. The largest components of the shrub layer within the Daubenmire frames was snowbrush (54.0%, St Dev=40.4), kinninkinnink (35.0%, St Dev=7.1) and Saskatoon (27.7%, St Dev=24.3). Also common throughout the site was pinegrass, quackgrass *(Agropyron repens),* common and rocky mountain juniper *(Juniperus communis, J. scopulorum)*, and wild bergamot *(Monarda fistulosa).*

Infestations of invasive weed species, including St. John's wort *(Hypericum perforatum)*, sulphur cinquefoil *(Potentilla recta)* and hawkweed *(Hieracium spp.)* are scattered throughout Lizard East. Spotted knapweed *(Centaurea maculsa)* also occurs but at a lesser extent. St. John's wort and sulphur cinquefoil were both located within the Daubenmire frames at 7.8 (St Dev=5.0) and 10.5 (St Dev=8.4) percent cover (average), respectively.

Table 3: Mean percent cover of understory functional groups

	2016	
	Mean	St Dev
Shrub	22.5	15.9
Grass	19.1	10.6
Weed	9.1	1.9
Bunchgrass	8.7	3.6
Forb	5.7	3.3
Sedge	0.0	0.0

The average percent cover of all present shrub species in the 100 metre (four 25 metre transects) line intercept was 1.3% (St Dev=1.5) (Table 4). The species within the shrub layer with the highest percent cover was mock orange (2.6%, St Dev=1.3), willow species (1.8%, St Dev=0.0) and rocky mountain juniper (2.0%, St Dev=1.9). Also common at Lizard East but with a lesser percent cover was snowberry, snowbrush and Saskatoon. All shrub cover was less than two metres in height. Kinnickinnick was not included in the shrub plots due to its expansive cover and low significance as a browse species.

Table 4: Mean percent cover of shrub species in 5.64 m radius plot

	Mean	St Dev
Mock orange *(Philadelphus lewisii)*	2.6	1.3
Rocky Mountain juniper *(Juniperus scopulorum)*	2.0	1.9
Willow *(Salix spp.)*	1.8	0.0
Snowbrush *(Ceanothus velutinus)*	1.8	0.4
Common snowberry *(Symphoricarpos albus)*	1.8	2.4
Saskatoon *(Amelanchier alnifolia)*	1.7	1.9
Douglas maple *(Acer glabrum)*	1.1	0.6
Baldhip rose *(Rosa gymnocarpa)*	0.8	0.6
Soopolallie *(Shepherida canadensis)*	0.6	0.0
Common juniper *(Juniperus communis)*	0.6	0.9
Pin cherry *(Prunus pensylvanica)*	0.4	0.3

No coarse woody debris with diameters of 7.5cm or greater intersected any of the transects within the six plots.

Overstory

The overstory of Lizard East treatment unit is characterized entirely by Douglas fir. Trembling aspen *(Populus tremuloides)* thickets that were generally localized to depressions and gullies. Within the plots, 62% of trees measured were Douglas fir and 38% of trees were trembling aspen; no other tree species were located within the 25 metre radius plots. Variation between plots was low as only two plots contained aspen. The mean percent crown closure was 8.4% (St Dev=10.8). The trees ranged in height from 7.9 metres to 21.6 meters, averaging 14.9 metres (St Dev=3.9). The average age for the stand was 59.9 years (St Dev=15.7). The stem diameter distribution indicates that the majority of trees within the plots are classified as either dominant (57%) or mature (32%) with minor instances of pole (5%), sapling (3%) and regen (3%) (Figure 6).

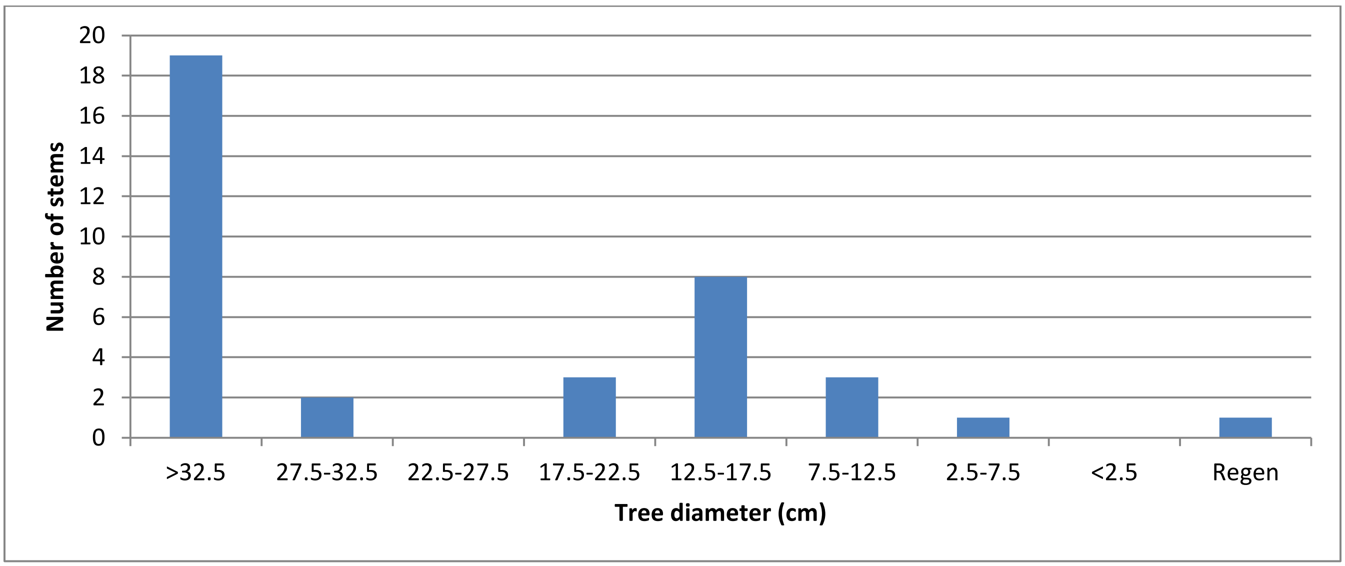

Figure 6: Stem diameter distribution (does not includes regeneration layer)

The regeneration layer had the highest density of stems per hectare with an average of 166.7 stems per hectare (stems/ha) (St Dev=122) followed by the mature, pole, sapling and dominant layers (Table 6.). The entire overstory, including the regeneration layer, had an average of 334.2 stems/ha (167.5 stems/ha without the regen layer). These numbers are within the targeted stems per hectare for an open forest system (76-400 stems/ha) set out by Machmer (2002) but does not take into account the localized areas of increased stem density.

Table 6: Stems per hectare by tree species and layer

	2016		
Layer	Species	Count	Mean Stems/ha
Dominant	Fd	21	18
Mature	At	12	50
Pole	At	2	66.7
Sapling	Fd	1	33
Regen	Fd	1	166.7

Soils

One soil plot was selected to represent the site for soil classification; the soils textures were determined to be a loam with effervescence at depth in the C layer only. While the soil nutrient was determined to be poor, the soil moisture at the time was subxeric and the humus form was moder. There was a high percentage of coarse fragment material throughout the depth of the soil pit (40% cobbles and 60% gravels), ultimately the depth was limited by coarse fragments occurring 35 cm below the surface.

Recommendations

Currently, the stand density within the vegetation monitoring plots at Lizard East falls within the targeted density for grasslands/open forest ecosystems; however, these calculations do not reflect the areas of dense Douglas fir and trembling aspen thickets that occur throughout the landscape and were not captured in the overstory plot data. Rejuvenating these areas to a density of an open forest system would increase the value of the site as an ungulate winter range.

The infestations of invasive species such as St John's wort, sulphur cinquefoil and hawkweed are currently reducing the native plant community; there is the potential for the infestation to spread if not controlled before the site is treated. Intensive vegetation monitoring should occur on site after treatment so the density and distribution of these species can be observed.

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