Antelope Creek Habitat Development Area
Summer Range Technician Report 2018
Compiled by Kyla Rushton

Field work was completed at Antelope Creek Habitat Development Area (ACHDA), 20km west of Brooks, Alberta from April 30th to July 27th, 2018. ACHDA was established in 1986 and operates under a partnership between Alberta Fish and Game, Ducks Unlimited Canada, Alberta Environment and Parks (AEP) and Wildlife Habitat Canada. This partnership has allowed ACHDA to be managed in a way which enhances livestock and wildlife productivity while coexisting with other land use interests such as various areas of research and energy resource development. ACHDA showcases how competing land uses can be managed while protecting wildlife habitat, riparian areas and native grassland. ACHDA serves as a model ranch for how rangeland in the Dry Mixedgrass natural subregion can be managed.

Since the ranch was acquired, research has continually been done on rangeland management as well as wildlife habitat management. Most recently, a rangeland inventory has been undertaken. The rangeland inventory currently in progress uses more recently available technology including GPS mapping and Grassland Vegetation Inventory (GVI) data. A rangeland inventory was conducted in Field 2 and the Cassils Field in 2015 followed by Field 3 and Field 4 in 2016 and 2017 respectfully. In the summer of 2018 the final native grassland field in ACHDA (Field 1) was inventoried. These vegetation inventories have been done to assess the vegetation composition and range health of the ranch and to inform grazing practices and habitat development on the ranch.

Climatic Conditions

As shown in Table 1 the Brooks area had less precipitation than average in the 2018 summer, although it was not extraordinarily dry. The ranch does appear to be in something of a microclimate as many times storms would affect Brooks and other surrounding areas but not the entire ranch.

Table 1: Precipitation recorded in Brooks summer 2018 and deviation from average precipitation in the area

Month	*2018 precipitation (mm)*	*Average precipitation(mm)*	*% deviation from Average*
May	23.7	35	-32
June	47.5	58	-18
July	30.8	32	-3.7
August	4.3 (as of Aug 24)	34	-87

Description of Duties

The month of May on ACHDA was made up of assisting the ranch manager with ranch upkeep and improvements prior to cattle arriving. These duties included tightening, fixing and replacing fences as well as maintenance around the corrals. The Ducks Unlimited water control structures were also assessed for required maintenance, cleared of debris and adjusted for anticipated water levels and water requirements. Grazing cages in each of the fields were moved prior to the cattle arriving in late May. The invasive Downy Brome (*Bromus tectorum*) which has been introduced around the ranch on and adjacent to industrial sites, had been effectively hand-picked by the ranch manager and previous summer range technicians. In the summer of 2018 the only Downy Brome plants found on the ranch were on two lease sites. One site was adjacent to the north road of Field 2 and the other side was adjacent to the ditch and north/south road in the south west side of Field 2. The southern Field 2 site required two days of hand picking, and the northern site required an hour of hand picking. After revisiting sites on the ranch throughout the summer which had previously been infested, no other Downy Brome plants were encountered on the ranch.

In late May and June I checked cattle on quad or horseback daily, which often including bringing sick calves and cows in from the fields. In June I continued to assist the ranch manager with maintenance around the ranch including pulling fence posts in the Crested Wheatgrass Fields. On June 11th I attended range health training provided by Alberta Environment and Parks (AEP) at the Stavely Research Ranch, and on June 21st I began the range inventory of Field 1 with the guidance of Range Resource Stewardship Section (RRSS) staff. The range inventory was carried out through July and concluded July 20th. I also conducted transects on Crested Wheatgrass in Field 2 and Field 3. The last week of July was spent clipping forage production cages in the Fields 1, 2, 3 and 4 as well as the Cassils Field. The majority of August was spent on data entry into the Ecosys database, analysis using ArcGIS, and labelling transect photos. Several days were spent doing analysis of the mowing treatment and GPS collar data on Crested Wheatgrass in Fields 2 and 3 with the help of RRSS staff.

Range Inventory

The range inventory of Field 1 was completed between June 21 and July 20 2018. The purpose of the inventory was to ground truth the Grassland Vegetation Inventory (GVI) of the ACHDA land base and determine the plant communities and their boundaries. The other fields on the ranch were completed over the previous three summers beginning in 2015 and Field 1 was the final native field to be inventoried. Prior to the 2018 season I received training in range inventory by AEP rangeland specialists including Amanda J. Miller, Craig DeMaere, Hilary Baker, and Tanner Broadbent when assisting with annual monitoring of the Range Reference Area program, as well as range inventory project work over the summer of 2017. In the 2018 season I received training in range health assessments from AEP staff as well as guidance from RRSS staff when beginning the inventory.

The inventory was completed in accordance with the range survey methods as per the Alberta Environment and Parks' Range Inventory Manual (2018). Using GVI as a reference, ground truthed distinctions between plant communities were made by visual assessment. The linework of GVI was found to be fairly accurate in upland areas and for the majority of field 1 the lines of GVI were used to distinguish between loamy, blowout and saline lowland range sites. Deviation from GVI classification was mostly in areas of anthropogenic disturbances such as irrigation ditches, pipeline right of ways and powerlines as well as roads and truck trails.

The final map of range inventory polygons is shown in Fig. 1. In most GVI polygons 2-3 plant communities were contained within the GVI boundaries. In these instances, the GVI polygons were split into smaller polygons along the boundaries of the plant communities. Each of the plant communities distinguished were assessed individually for plant community composition and range health. For nearly all polygons a 50m transect was laid out at a site representative of range health and vegetation composition in the polygon. 10 microplots were sampled at 5m intervals along the 50m transect. At each microplot grass, forbs, moss & lichen and bare soil cover was estimated within a $1/10m^2$ frame. Shrub and tree cover was estimated at a $1m^2$ quadrant. Litter estimates were done by hand raking all litter in a 1/4m^2 frame at two or three representative locations within each polygon. Also within each polygon a Rangeland Health Assessment was completed. Weedy species were noted on range health forms and vegetation inventory (MF5) forms, and reflected in the range or riparian health score. All weedy species encountered (such as Canada Thistle (*Cirsium arvense*) and Sow Thistle (*Sonchus arvense*) were scattered throughout the polygon they were in.

Vegetation and site data was entered into the AEP Ecosys database under the study code 74AC18. GVI polygons were modified using ArcGIS, and health score and litter estimates were incorporated into polygon attributes. Range health and riparian assessments were compiled in excel spreadsheets. Photos of all riparian and upland plant community polygons were labeled by polygon number. In Field 1, 423.7 ha of total area was surveyed which was composed of 62 upland communities, eight riparian areas and one gravel dugout (a component of irrigation infrastructure). Each of these polygons was classified as a plant community and mapped. Of the 62 plant communities surveyed 60 of these had full 50m transects and detailed assessments completed within the plant community. Two saline lowland polygons had very similar vegetation and structure to other saline lowlands so the vegetation inventory referenced a nearby plant community which had a completed MF5. Many of the deviations from GVI polygons and GVI line work was due to recent anthropogenic disturbances, such as canal ditches and industrial activity.

In Fig.1 the plant communities identified in the range inventory were grouped into eight common classifications. Each classification was made based on which communities had vegetation most similar to one another. The communities that were encountered in fewer than three polygons were grouped as per their predominant landform type: saline lowland, blowout, or loamy. Community types in the rangeland community guide (2013) including Western Wheat Grass - Sedge - Needle and Thread (A*gropyron smithii- Carex - Stipa comata*) (DMGA16) and Salt Grass - Western Wheat Grass (*Distichlis stricta - Agropyron smithii*) (DMGA44) were observed most frequently. DMGA16 was the community that covered the most area in Field 1 and is a late seral community for blowout sites. Saline lowland communities were very similar to one another but composition varied between polygons, likely due to water level fluctuations and the possibility that vegetation may be determined by previous water levels and salinity of the current year. “Agro smi – Dist str” referred to a conditional vegetation community in Field 1 that was encountered frequently but was not well described by the range plant community guide.

Table 2: classification of plant communities and areas in Field 1

Community	Area (ha)
DMGA16	115.62
Saline lowland communities	81.444
Blowout communities	65.26
Crested Wheatgrass	33.32
Loamy communities	31.68
DMGA44	17.39
Agro smi – Dist str	15.77
Sub irrigated communities	8.94

Of the communities covering the greatest areas, many communities were highly similar to one another. The differences between plant communities often appeared to be due to differences in salinity, differences in seasonal water levels and development of soils. Blowout communities were most often distinguished from loamy communities due to the greater frequency of deep rooted grasses such as Needle and Thread Grass (*Stipa comata*) which requires more developed soil, and cannot grow in the weakly developed soil of blowout communities. The vegetation in saline lowlands seemed to be influenced by cattle activity. Areas highly utilized by cattle (as indicated by severe pugging) had an increase in Foxtail Barley (*Hordeum jubatum)* and a corresponding difference in vegetation community classification. Pugging and the presence of Foxtail Barley also contributed to the reduced range health of some areas as Foxtail Barley is a species which indicates higher grazing pressure.

Range health of polygons was assessed as outlined in the Range Health Assessment Field Workbook (Adams et al. 2016). Each polygon was assigned a health classification of "healthy", "healthy with problems", or "unhealthy" based on how closely the plant community resembled that of the reference plant community, the structure of vegetation layers compared to the expected structure, presence of vegetation litter as well as site stability/degree of erosion and noxious weeds. Of the 64 upland polygons inventoried, 7 polygons were classified as "unhealthy", 29 polygons were classified as "healthy with problems", and 26 polygons were classified as "healthy". Most often the reasons the health score of an area was reduced was because of pugging by cattle or the presence of invasive agronomic species or noxious weeds. Erosion was infrequently encountered, but bare soil was somewhat frequent in blowout sites. Blowout sites are expected to have bare soil due to limiting factors in the Dry Mixedgrass subregion such as low amounts of moisture and impermeability of soil by vegetation, due to the lack of soil development (Solonetzic soils). However, some blowout sites appeared to have bare soil caused by to higher levels of utilization by cattle. Overall Field 1 didn't have any major management concerns due to cattle use, and although the year had less than average precipitation, vegetation appeared to be vigorous and healthy.

Product of the Rangeland Inventory the following data files and folder have been supplied to RRSS staff:

- 2 excel files of Crested Wheatgrass statistics and summaries
- Arc folders of data files: GIS_offline
- Range health excel sheet
- Riparian health excel sheet
- Plot photos folder: Transect Photos

Clipping

AEP has monitored forage production records of Range Reference Areas on ACHDA since 1988 which provides a strong history of grazing effects on productivity in the Dry Mixedgrass. The exclosure and range cages on ACHDA were clipped July 27-August 3. Fields 1-4 had both exclosures and range cages, while the Cassils Field only had range cages and no exclosure. 10 1/4m^2 plots were clipped inside each exclosure, and 10 range cages were clipped in each field except for where 2 cages were knocked over in Field 4. At each clipping site all litter and green vegetation was collected with the separation of litter, grass, and forbs. No shrubs were recorded in clipping plots. Clipping samples were dried and weighed by AEP in Lethbridge.

Crested Wheatgrass Project

Background information

Crested Wheatgrass in an invasive species of grass which was frequently used in reclamation between 1903 and 1993. On ACHDA there are many industrial disturbances such as well sites and pipelines that are vegetated by Crested Wheatgrass. Crested Wheatgrass has a high protein content early in the spring but forage quality decreases quickly, and has been found to be inadequate for lactating cattle by mid-June in southeastern Alberta. Crested Wheatgrass has been associated with reductions in biodiversity and has been found to spread quickly and easily invade native grassland. For ecological concerns the spread of Crested Wheatgrass should be reduced in native grassland. Over time Crested Wheatgrass tufts, known as tussocks, build up and hold great amounts of litter (Ogle 2006). An abundance of litter reduces the vigor of Crested Wheatgrass plants by suppressing new growth (Henderson 2005). Suppressing growth reduces Crested Wheatgrass plant productivity and also prevents other species from establishing (Henderson 2005).

By mowing Crested Wheatgrass areas, the unpalatable tussocks were anticipated to be disturbed and more grass was expected to grow after being mowed. It was expected that mowed areas of Crested Wheatgrass would be preferred by cattle rather than areas of unmowed Crested Wheatgrass because of an anticipated increase in young and palatable Crested Wheatgrass following mowing due to the disturbance of unpalatable tussocks and abundant litter. A preference for mowed Crested Wheatgrass was expected to increase the intensity of grazing in mowed areas as measured by the GPS collars worn by cattle. An increase in intensity of grazing was expected to mimic clipping and reduce seed availability of Crested Wheatgrass. This clipping effect was expected to be measured by a decrease in Crested Wheatgrass cover and an increase in other forb and grass species cover over time. The hypothesis that mowing would affect cattle preference was tested by comparing the time cattle spent in mowed and unmowed areas of Crested Wheatgrass.

Methods

After areas of Crested Wheatgrass were mowed in 2015 in Fields 2 & 3, transects were revisited and re-inventoried in July 2018. The species composition of 2015 and 2018 transects were compared statistically using t-Tests. The GPS collar data from cattle in 2016 was mapped and analyzed using GIS. The analysis of collar data used the vegetation inventories of Fields 2 & 3 to determine the boundaries between areas (polygons) of Crested Wheatgrass and native vegetation. The amount of time cattle spent in the Crested Wheatgrass polygons was determined by finding kernel density of data points within each of the plant community polygons.

Results

The electivity values (forage ratios) of Crested Wheatgrass communities were found to be significantly higher than in native vegetation in Field 2 & 3 which is represented by Fig.4 as determined by a t-Test (two-sample assuming unequal variances $p<0.05$ in both Field 2 & 3. In Field 2 $t_{30}=2.05$ $p<0.05$, Field 3 $t_{24}=1.66$). In Fig.5 the percentage of invasive species (Crested Wheatgrass and *Poa pratensis* (Kentucky Bluegrass)) was found to be significantly higher in 2015 than in 2018 as determined by a t-Test (two-sample assuming unequal variances in Field 3 $t_6=5.803$, $p < 0.005$). As represented by Fig.6 species richness was found to be higher in 2018 than in 2015 as determined to be significantly different by a t-Test (two-sample assuming unequal variances $t_6=1.983$, $p<0.05$). Species richness shown in Fig.7 as measured by Simpson's index was found to be significantly higher in 2018 than in 2015 as determined by a t-Test (two-sample assuming unequal variances $t_6=1.983$, $p<0.05$). Fig.9 is the result of Ward's cluster analysis showing the transects of 2015 were most similar in composition to the other transects in 2015 and the transects of 2018 most similar to other transects of 2018. The electivity values of mowed and unmowed Crested Wheatgrass is represented by Fig.8 was determined to be insignificant by a t-test (two-sample assuming unequal variances $p=0.377$ $t_{30}=0.317$).

Table 3: number of days cattle spent in Field 2 and Field 3 during each month of the summer in 2016

	Field 3 days	Field 2 days
May	14	3
June	30	4
July	26	23
August	8	18

Discussion

The amount of time cattle spent in the Crested Wheatgrass polygons was compared to the amount of time cattle spent in native vegetation polygons and was found to be significantly different (Fig. 4). The amount of time cattle spent in mowed versus unmowed Crested Wheatgrass was not found to be significantly different which was not as predicted.

Electivity for Crested Wheatgrass and Native Plant Communities

Field 2 & 3 GPS collar data was analyzed independently because of the differences in field features as well as the differences in grazing times for each of the fields. The differences in grazing times was anticipated to have an effect on electivity values due to the decrease in the palatability of Crested Wheatgrass over the summer. In the study, Field 2 & 3 were grazed at slightly different times of the year; Field 2 was primarily grazed in July and August, while Field 3 was primarily grazed in June and July (Table 3). It was expected that the field grazed earlier would have more drastic differences in electivity values because protein content would be comparatively higher in Crested Wheatgrass and thus more appealing to cattle, but the results did not support this idea (Fig. 4). Some of the differences in cattle electivity may have been in response to native plant health and vigor through the year as well as potential effects of precipitation on vegetation influencing palatability and accessibility of species (Ganskopp et al. 1997). There are many other possible explanations for these results and further study should be conducted in more controlled environments and with more sample plots.

Community Comparisons

The Crested Wheatgrass mowing trial transects of 2015 and 2018 were compared and the percent of vegetation composed of non-native grasses (Crested Wheatgrass and Kentucky Bluegrass (*Poa pratensis)*) was found to decrease significantly between 2015 and 2018. This significant reduction of agronomic species suggests that the preference of cattle to graze Crested Wheatgrass over native vegetation may have resulted in more intense grazing which contributed to the reduced dominance of Crested Wheatgrass. Along with a reduction in non-native grasses, species of native grasses (*Agropyron dasystachyum*, *Agropyron smithii, Koeleria macrantha,* and *Stipa comata)* not previously recorded in 2015 were observed in 2018.

The cluster Dendrogram shown in Fig. 8 was compiled by the dissimilarity in species composition for each of the four transects in 2015 and 2018 being compared to one another. Fig. 8 transects from 2015 are most similar to one another, and transects from 2018 are also most similar to one another (McCune 2003). The grouping provided by Ward's method of clustering indicates that there has been a directional change in community composition between 2015 and 2018 in the communities surveyed. As determined to be statistically significant by a t-Test, the decrease in percent introduced grass (Crested Wheatgrass and a negligible amount of Kentucky Bluegrass) and the corresponding increase in percent native species indicates that there was a directional change in community composition.

Wetlands, roads, irrigation ditches and industrial sites as well as salt and mineral access influence cattle behavior and may explain some of the preference cattle showed for Crested Wheatgrass communities. Additionally, the analysis of cattle time, as derived from the GPS collar data, assumes that the time cattle spent in each of the polygons was representative of the amount of time they spent foraging in that polygon. This is likely not a fair assumption as cattle may spend time ruminating, sleeping and drinking in certain areas rather than foraging.

The ability of Crested Wheatgrass to utilize moisture and low levels of nutrients commonly allows it to outcompete native species (Henderson 2005). In this study the Crested Wheatgrass communities had existed for over 30 years, so it was expected that soil moisture and nutrients would have been somewhat depleted. If moisture and nutrients were limiting factors preventing native species from establishing in Crested Wheatgrass communities then Crested Wheatgrass would have to be minimized for a long period of time to allow nutrients and soil moisture to recover before native species could establish in the communities. However, the results of the community composition comparison indicate that within three years native species began to establish, therefore suggesting that the abundance of litter, and early green-up associated with Crested Wheatgrass likely prevents native species from establishing and outcompetes them for space in the early part of the growing season.

Concluding Remarks

For the majority of the area in Field 1 the linework of GVI was true to plant communities, specifically around the wetlands and saline lowlands. Most of the polygons added or changed were areas of distinct features such as isolated saline lowlands and industrial disturbances such as well sites, old roads and pipeline right of ways. Areas subirrigated due to the irrigation ditch that runs through Field 1 required substantial modification of GVI polygons. The most time consuming task in the rangeland inventory was distinguishing the linework between subirrigated areas and upland areas as well as choosing representative sites for the vegetation inventory transects and representative range health scores for each of the polygons. Areas of interest included linear disturbances vegetated with Crested Wheatgrass, such as the powerline and road, because the Crested Wheatgrass appeared to be spreading to the east, possibly due to the predominant wind direction in the area. The information presented in this report is meant to visually represent Field 1 during the summer of 2018.

Throughout the second half of June and the month of July I frequently encountered 8-12 pronghorn including 4-6 adolescents. The herd was extremely shy but was found in the South West corner of Field 1 almost daily. The frequent sightings of the herd suggests that wildlife-friendly fencing efforts which have been made on ACHDA should be continued and maintained.

As suggested in this report and in years previous, ACHDA seems to be in a microclimate and storms frequently affect areas surrounding the ranch but not the entirety of the ranch. It may be beneficial to have rain gauges and record precipitation around the ranch in future years to compare to the recorded precipitation in Brooks and other areas as well as within the ranch.

The study on Crested Wheatgrass and cattle electivity produced interesting results, and the results suggest that early grazing of Crested Wheatgrass may help to reduce the dominance and spread of Crested Wheatgrass and support the establishment of native species over time. Further monitoring and analysis of cattle electivity in the heterogenous native fields (Field 1, 2, 3, 4 & Cassils) may allow further management decisions to be made regarding early season grazing of Crested Wheatgrass within fields of native vegetation. Although early season grazing may not be feasible in Field 1 due to the small and linear areas of Crested Wheatgrass early season grazing, or a skim grazing approach may be useful in other areas of ACHDA.

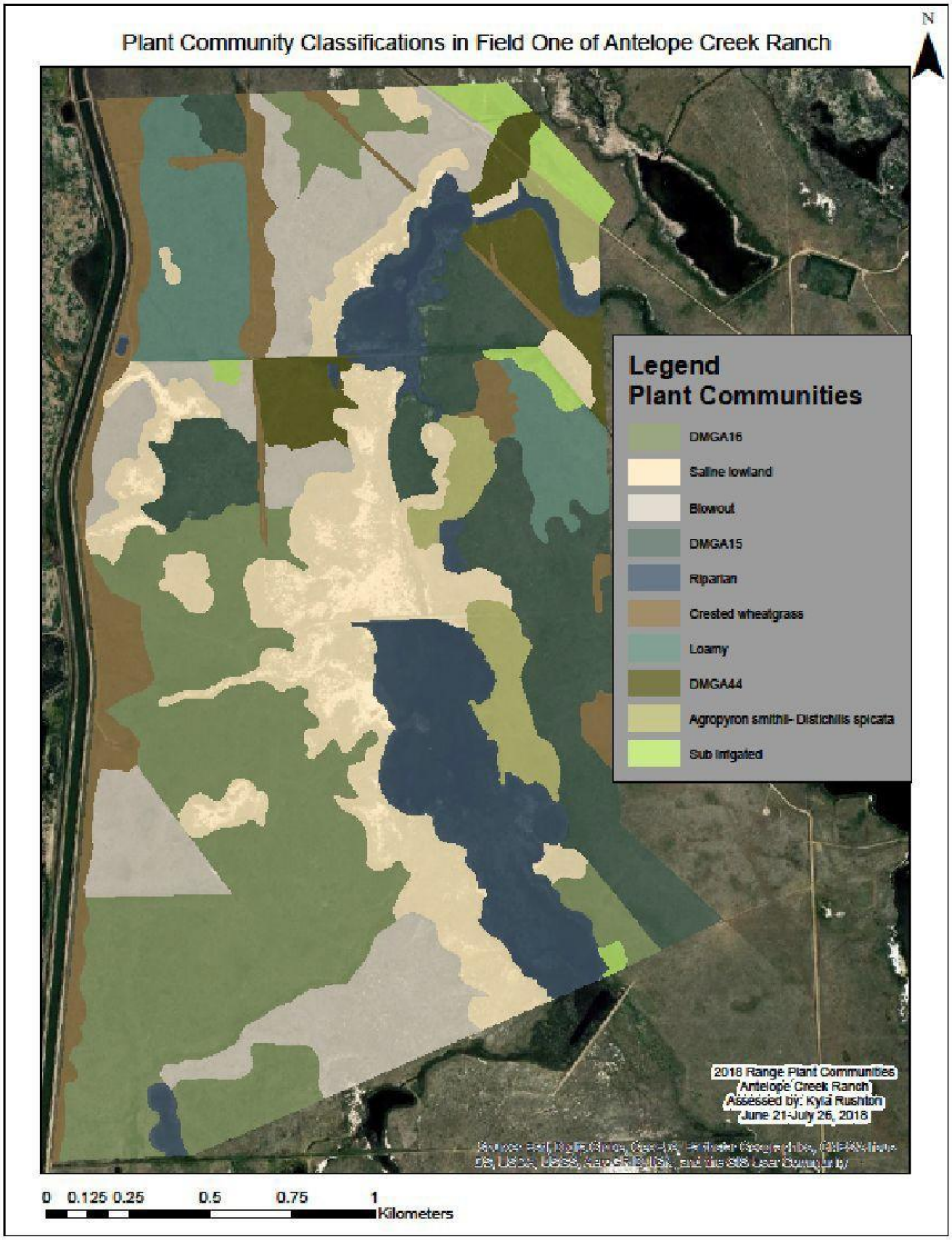

Figure 1: Community classifications of as inventoried in 2018

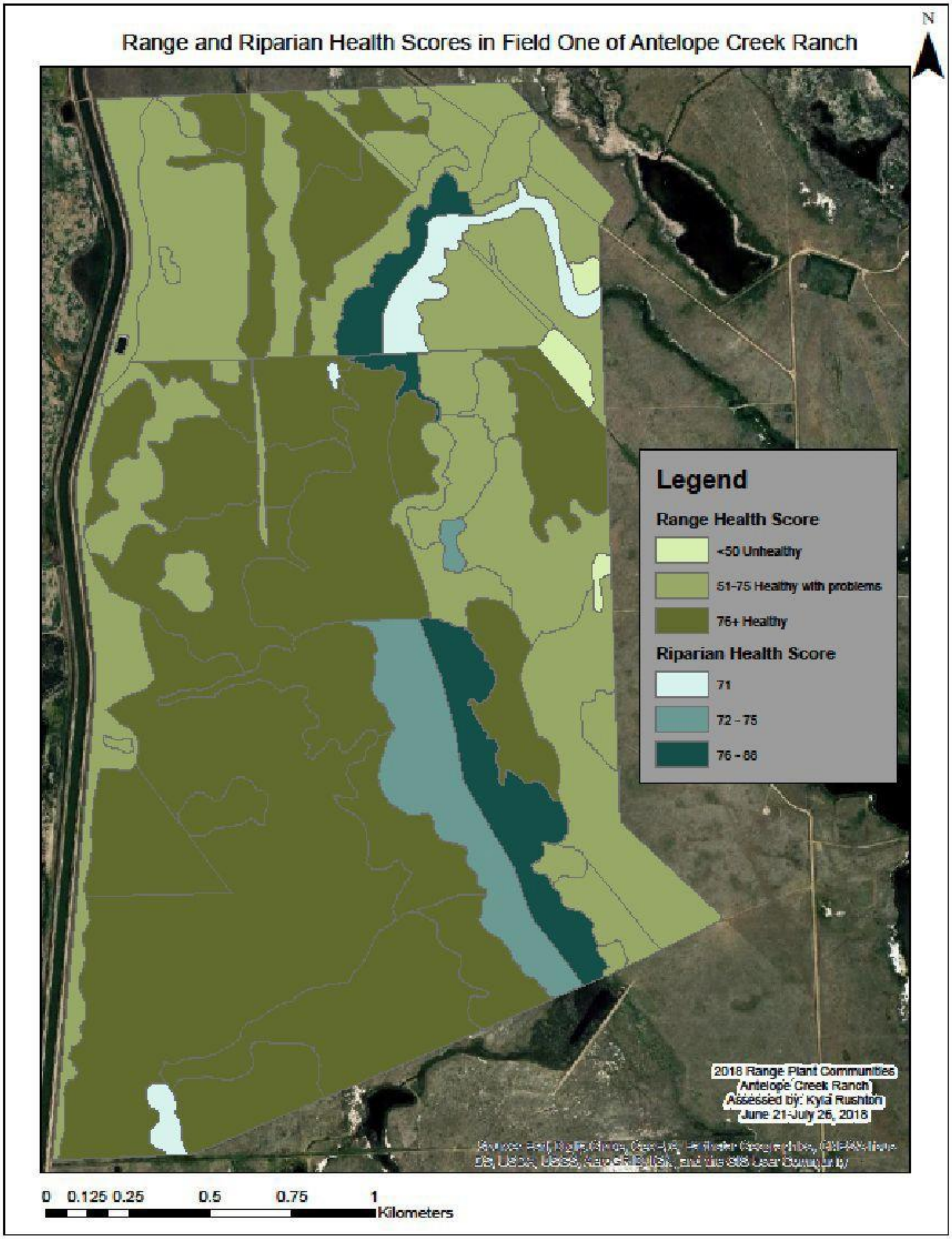

Figure 2: Range health and riparian health scores as assessed in 2018

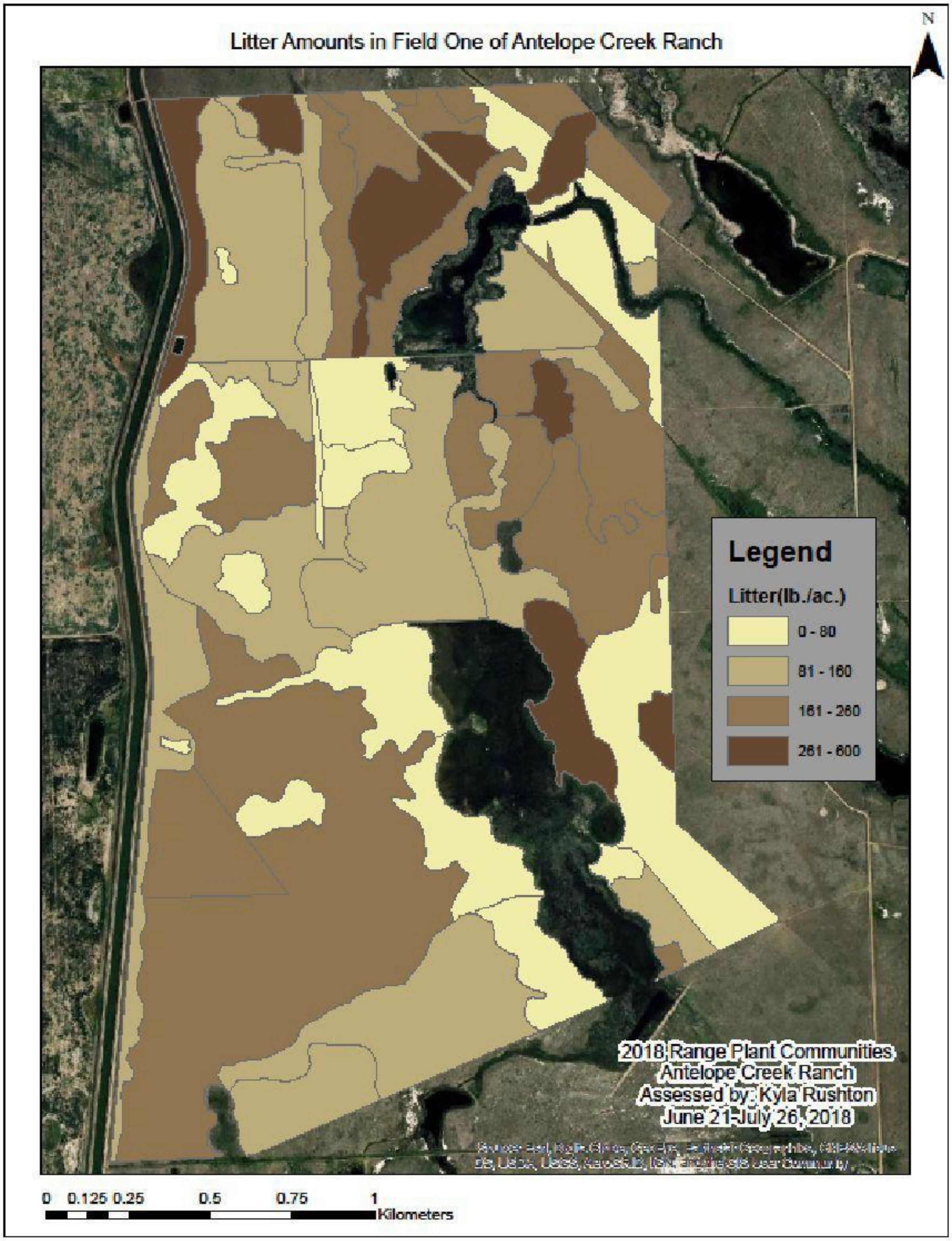

Figure 3: Amounts of litter as assessed and estimated in 2018

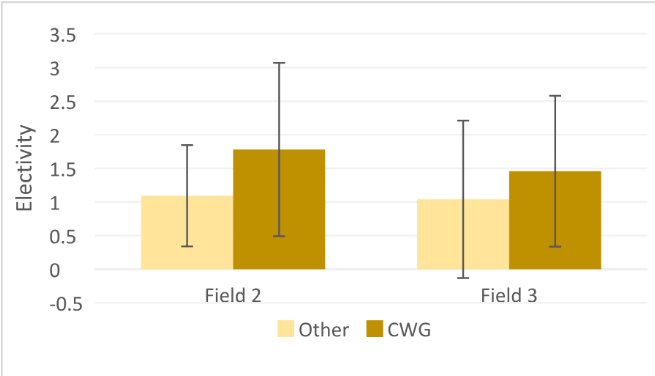

Figure 4: Forage ratios of Crested Wheatgrass in comparison to other vegetation in field 2 and field 3, corresponding to Table 4

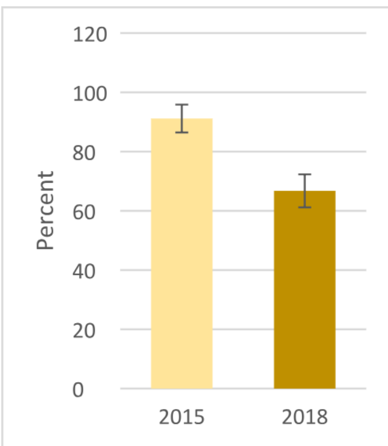

Figure 5: Percentage of introduced species (Crested Wheatgrass and Kentucky Bluegrass) in fields 2 and 3 in areas which received mowing, corresponding to Table 5

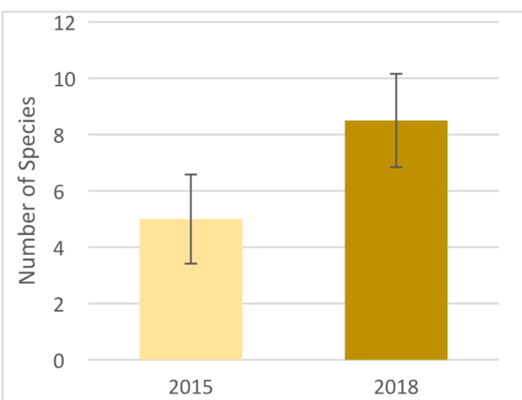

Figure 6: Species richness of transects in 2015 and 2018, corresponding to Table 6

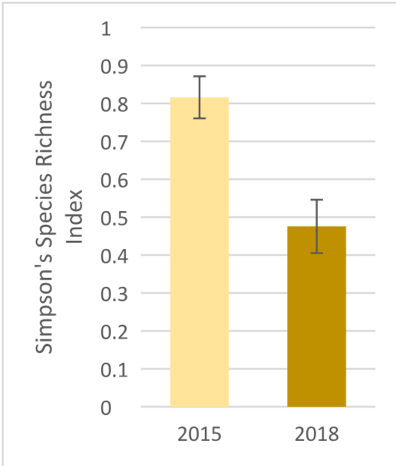

Figure 7: Simpson's species richness index t-Test P<0.005

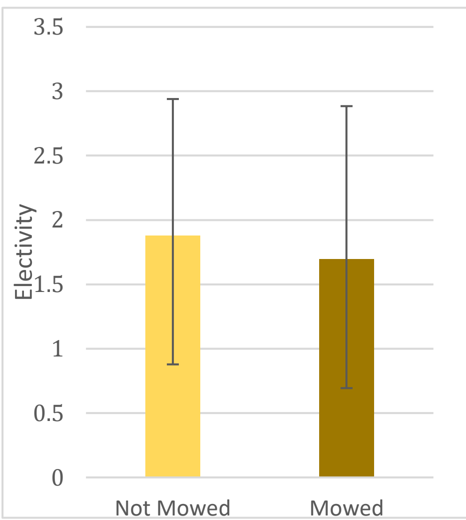

Figure 8: Forage ratios of mowed and unmowed CWG, df=15 mowed n=9, unmowed n=8. T-test assuming unequal variances p=0.377

Table 4: t-Test: Two-Sample Assuming Unequal Variances sample size and degrees of freedom for electivity values as shown in Fig. 4

	df	Crested Wheatgrass sample size (n)	Other veg. Sample size (n)	P-value
Field 2	30	17	71	<0.05
Field 3	24	16	102	<0.05

Table 5: t-Test: Two-Sample Assuming Unequal Variances sample size and degrees of freedom for Percentage of introduced species as shown in Fig. 5

	df	Sample size (n)	Other veg. Sample size (n)	P-value
Field 2 & 3	6	4	71	<0.005

Table 6: t-Test: Two-Sample Assuming Unequal Variances sample size and degrees of freedom Simpson's species richness in 2015 and 2018 as shown in Fig. 6

	df	Sample size (n)	Other veg. Sample size (n)	P-value
Simpson's Species Richness	4	6	71	<0.05

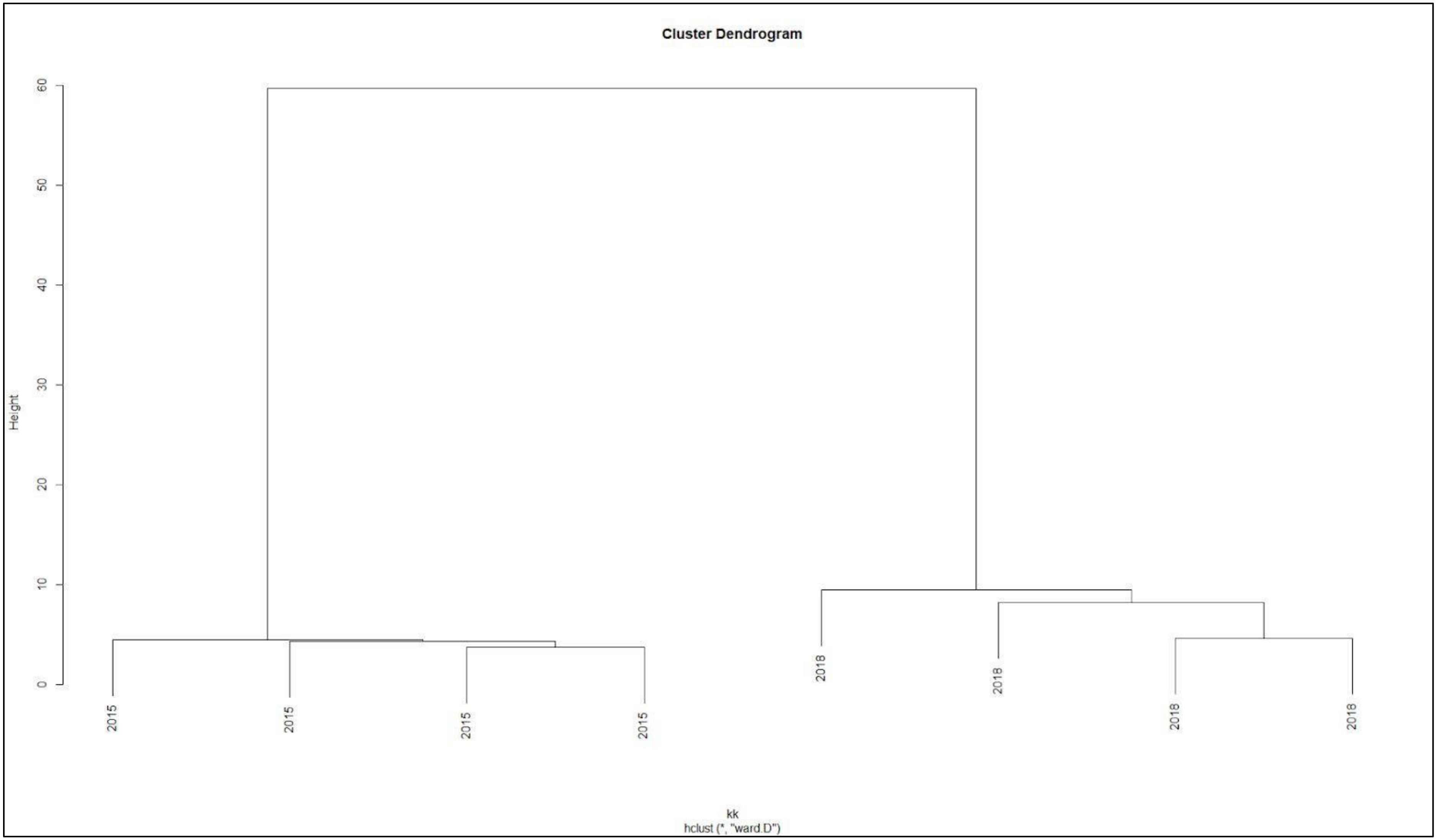

Figure 9: Ward's cluster denrogram representing dissimilarity between vegetation transects in 2015 and 2018

References

Adams, B.W., J Richman, L. Poulin-Klein, K. France, D. Moisey & R.L. McNeil. 2013. Rangeland Plant Communities for the Dry Mixedgrass Natural Subregion of Alberta. Second Approximation. Rangeland Management Branch, Policy Division, Alberta Environment and Sustainable Resource Development, Lethbridge, Alberta. Pub. No. T/040

Environment and Parks, Government of Alberta (2018), Rangeland Resource Stewardship Section Alberta Environment and Parks Range Inventory Manual, Range Inventory Manual for Forest Reserve Allotments and Grazing Leases within Rocky Mountain, Foothills, Parkland and Grassland Natural Regions. Edmonton, Alberta. Retrieved from Government of Alberta: https://open.alberta.ca/publications/9781460139486#summary

Ganskopp, D., Myers, B., Lambert, S., & Cruz, R. (1997). Preferences and behavior of cattle grazing 8 varieties of grasses. *Journal of Range Management*, *50*(6), 578. doi:10.2307/4003451

Henderson, D. C. (2005). Ecology and management of Crested Wheatgrass invasion. Ph.D. Thesis, Department of Renewable Resources, University of Alberta. Edmonton, Alberta.

Henderson, D. C. & Naeth, M. A. (2005). Multi-scale impacts of Crested Wheatgrass invasion in mixed-grass prairie. Biological Invasions, 7(4), 639-650. doi:10.1007/s10530-004-6669-x

McCune, B., & Grace, J. B. (2002). Hierarchial clustering. In Analysis of ecological communities (3rd ed., pp. 86-96). Gleneden Beach, Oregon: MJM Software Design.

Ogle, D. G. (2006, May 24). Plant guide: crested wheatgrass Agropyron cristatum (L.) Gaertn. Retrieved from https://plants.usda.gov/plantguide/pdf/pg_agcr.pdf