Autecology of Fragile Pricklypear on the Northern Mixed Grass Prairie

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The autecology of Fragile Pricklypear, *Opuntia fragilis*, is one of the prairie plant species included in a long ecological study conducted at the NDSU Dickinson Research Extension Center during 67 growing seasons from 1946 to 2012 that quantitatively describes the changes in growth and development during the annual growing season life history and the changes in abundance through time as affected by management treatments for the intended purpose of the development and establishment of scientific standards for proper management of native rangelands of the Northern Plains. The introduction to this study can be found in report DREC 16-1093 (Manske 2016).

Fragile Pricklypear, *Opuntia fragilis* (Nutt.) Haw., is a member of the cactus family, Cactaceae, and is a native, perennial, low growing, inconspicuous, succulent, cactus with easily detached stem segments that is extremely drought tolerant. Aerial growth has numerous jointed stems forming clumps that are sometimes 3.5 inches (9 cm) tall. Stems are somewhat bilaterally flattened, less than 2 inches (5 cm) long with one to several joined together. Barbed spines (1-10) about 1 inch (3 cm) long form at areole equally distributed over the stem with the longer spines towards the top. The root system has extensive shallow fibrous lateral roots. Regeneration is by vegetative and sexual reproduction. Vegetative growth is by rooting of detached stem segments. The barbed spines readily cling to fur, clothing, and leather boots; the stem segments easily detach at the joint and are transported until the spine breaks. Sexual reproduction is from perfect bisexual showy yellow to greenish yellow solitary flowers that are seldom observed with both male and female organs that emerge during June to July. The fruit is an ovoid spiney green berry. The seeds are whitish to gray. Fire top kills most of the aerial stems but seldom kills the entire plant. This summary information on growth development and regeneration of fragile pricklypear was based on the works of Stevens 1963, Great Plains Flora Association 1986, Johnson and Larson 2007, and Stubbendieck et al. 2011.

Cacti do not conduct photosynthesis by the same processes as cool season (C_3) and warm season (C_4) plants. Cacti photosynthesize by a third method; Crassulacean Acid Metabolism (CAM) that is an evolved photosynthetic process providing a solution with reduced water loss. Cacti open their stomatas only at night, when evaporation of water is naturally less. Atmospheric carbon dioxide is taken into the stem where it combines with an organic acid and is stored until daylight. During the daytime, the stomata are closed, stopping all exchanges with the outside atmosphere, the presence of sunlight activates the photosynthetic processes in cells with chlorophyll, and the previously night time captured carbon dioxide becomes available to produce carbohydrates. This description of CAM was summarized from Mozingo 1987.

Closed stomata during the daytime prevents foliage-active herbicides from entering cacti plants when applied during daylight hours and are thus totally ineffective. However, foliage-active herbicides applied during nighttime hours, when the stomata are open, is an effective modification to otherwise standard practices. There is usually one negative side effect from performance of this successful scientifically modified treatment; your neighbors will be convinced that you are totally daft.

Procedures

The 1955-1962 Study

Fragile pricklypear plant growth in height was determined by measuring ungrazed stems from ground level to top of leaf or to the tip of the inflorescence of an average of 10 plants of each species at approximately 7 to 10 day intervals during the growing seasons of 1955 to 1962 from early May until early September. Dates of first flower (anthesis) were recorded as observed. These growth in height and flower data were reported in Goetz 1963.

The 1983-2012 Study

A long-term study on change in abundance of Fragile pricklypear was conducted during active plant growth of July and August each growing season of 1983 to 2012 (30 years) on native rangeland pastures at the Dickinson Research Extension Center ranch located near Manning, North Dakota. Effects from three management treatments were evaluated: 1) long-term nongrazing, 2) traditional seasonlong grazing, and 3) twice-over rotation grazing. Each treatment had two replications, each with data collection sites on sandy, shallow, and silty

ecological sites. Each ecological site of the two grazed treatments had matching paired plots, one grazed and the other with an ungrazed exclosure. The sandy, shallow, and silty ecological sites were each replicated two times on the nongrazed treatment, three times on the seasonlong treatment, and six times on the twice-over treatment.

During the initial phase of this study, 1983 to 1986, the long-term nongrazed and seasonlong treatments were at different locations and moved to the permanent study locations in 1987. The data collected on those two treatments during 1983 to 1986 were not included in this report.

Abundance of Fragile pricklypear was determined with plant species stem density by 0.1 m^2 frame density method and with plant species basal cover by the ten-pin point frame method (Cook and Stubbendieck 1986).

The stem density method was used to count individual stems of each plant species rooted inside twenty five 0.1 m^2 quadrats placed along permanent transect lines at each sample site both inside (ungrazed) and outside (grazed) each exclosure. Stem density per 0.1 m^2 quadrat, relative stem density, percent frequency, relative percent frequency, and importance value were determined from the stem density data. Plant species stem density data collection was 1984, 1986 to 2012 on the twice-over treatment and was 1987 to 2012 on the long-term nongrazed and seasonlong treatments. However, stem density data was not collected during 1991, 1993 to 1997 on the sandy, shallow, and silty ecological sites of all three management treatments, stem density data was not collected during 1992 on the sandy ecological site of all three management treatments, and stem density data was not collected during 1999 on the sandy and silty ecological sites of the long-term nongrazed treatment.

The point frame method was used to collect data at 2000 points along permanent transect lines at each sample site both inside (ungrazed) and outside (grazed) each exclosure. Basal cover, relative basal cover, percent frequency, relative percent frequency, and importance value were determined from the ten-pin point frame data. Point frame data collection period was 1983 to 2012 on the twice-over treatment and was 1987 to 2012 on the long-term nongrazed and seasonlong treatments. However, point frame data was not collected during 1992 on the sandy ecological sites of all three treatments.

During some growing seasons, the point frame method or the stem density method did not document the presence of a particular plant species which will be reflected in the data summary tables as an 0.00 or as a blank spot.

The 1983-2012 study attempted to quantify the increasing or decreasing changes in individual plant species abundance during 30 growing seasons by comparing differences in the importance values of individual species during multiple year periods. Importance value is an old technique that combines relative density or relative basal cover with relative frequency producing a scale of 0 to 200 that ranks individual species abundance within a plant community relative to the individual abundance of the other species in that community during a growing season. Density importance value ranks the forbs and shrubs and basal cover importance value ranks the grasses, upland sedges, forbs, and shrubs in a community. The quantity of change in the importance values of an individual species across time indicates the magnitude of the increases or decreases in abundance of that species relative to the changes in abundance of the other species.

Results

Fragile pricklypear is classified with the shrubs because the aboveground stems remain alive through the winter and commence growth the following spring. Most fragile pricklypear plants are not seen until someone puts their knee or hand on the ground. The aerial jointed stems rarely grow to 9 cm (3.5 in) tall and are hidden under layers of grass. The earliest first flowers appeared on 21 June and the mean first flowers occurred on 4 July during the 1955-1962 study (table 1) (Goetz 1963). Flowers were not observed during the 1969-1971 study (Zaczkowski 1972). Flowers of fragile pricklypear are rarely observed (Stevens 1963, Great Plains Flora Association 1986, Johnson and Larson 2007). A mean mature height of 7.3 cm (2.9 in) with an annual variance in height from 3.0 cm (1.2 in) to 9.0 cm (3.5 in) was reached during July on the fall grazed pastures of the 1955-1962 study (table 2) (Goetz 1963).

At the start of the study (1983-1987), the densities and basal cover of fragile pricklypear were low. During the low precipitation period of 1988 to 1992, the densities and basal cover increased. During the later period of 1998 to 2012, most of the densities increased and most of the basal cover decreased from the respective mean values determined during the early period of 1983 to 1992.

On the sandy site of the nongrazed treatment, Fragile pricklypear was present during 22.2% and 28.0% of the years that density and basal cover data were collected, with a mean 0.09 stems/m^2 density and a mean 0.03% basal cover during the

total period, respectively. During the early period (1983-1992), fragile pricklypear was present during 0.0% and 16.7% of the years, with a mean 0.0 stems/m^2 density and a mean 0.05% basal cover. During the later period (1998-2012), fragile pricklypear was present during 28.6% and 40.0% of the years, with a mean 0.10 stems/m^2 density and a mean 0.02% basal cover, respectively. The stem density increased and the basal cover decreased over time.

On the sandy sites of the seasonlong treatment, Fragile pricklypear was present on the ungrazed sandy site during 57.9% and 46.2% of the years, with a mean 0.88 stems/m^2 density and a mean 0.13% basal cover, and was present on the grazed sandy site during 68.4% and 72.0% of the years that density and basal cover data were collected, with a mean 1.61 stems/m^2 density and a mean 0.19% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present on the ungrazed sandy site during 0.0% and 66.7% of the years, with a mean 0.0 stems/m^2 density and a mean 0.44% basal cover. During the later period (1998-2012), fragile pricklypear was present on the ungrazed sandy site during 73.3% and 46.7% of the years, with a mean 1.10 stems/m^2 density and a mean 0.04% basal cover, respectively. The stem density increased with the basal cover decreased over time. During the early period (1983-1992), fragile pricklypear was present on the grazed sandy site during 0.0% and 66.7% of the years, with a mean 0.0 stems/m^2 density and a mean 0.44% basal cover. During the later period (1998-2012), fragile pricklypear was present on the grazed sandy site during 86.7% and 86.7% of the years, with a mean 2.00 stems/m^2 density and a mean 0.12% basal cover, respectively. The stem density increased and the basal cover decreased over time.

On the sandy sites of the twice-over treatment, Fragile pricklypear was present on the ungrazed sandy site during 42.9% and 41.4% of the years, with a mean 0.23 stems/m^2 density and a mean 0.06% basal cover, and was present on the grazed sandy site during 90.5% and 86.2% of the years that density and basal cover data were collected, with a mean 0.74 stems/m^2 density and a mean 0.18% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present on the ungrazed sandy site during 83.3% and 66.7% of the years, with a mean 0.53 stems/m^2 density and a mean 0.14% basal cover. During the later period (1998-2012), fragile pricklypear was present on the ungrazed sandy site during 26.7% and 33.3% of the years, with a mean 0.10 stems/m^2 density and a mean 0.03% basal cover, respectively. Both the stem density and basal cover decreased over time. During the early period (1983-1992), fragile pricklypear was present on the grazed sandy site during 83.3% and 80.0% of the years, with a mean 0.33 stems/m^2 density and a mean 0.29% basal cover. During the later period (1998-2012), fragile pricklypear was present on the grazed sandy site during 100.0% and 93.3% of the years, with a mean 0.90 stems/m^2 density and a mean 0.11% basal cover, respectively. The stem density increased and the basal cover decreased over time.

On the shallow site of the nongrazed treatment, Fragile pricklypear was present during 31.6% and 34.6% of the years that density and basal cover data were collected, with a mean 2.0 stems/m^2 density and a mean 0.08% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present during 20.0% and 57.1% of the years, with a mean 0.24 stems/m^2 density and a mean 0.23% basal cover. During the later period (1998-2012), fragile pricklypear was present during 35.7% and 33.3% of the years, with a mean 2.70 stems/m^2 density and a mean 0.03% basal cover, respectively. The stem density increased and the basal cover decreased over time.

On the shallow sites of the seasonlong treatment, Fragile pricklypear was present on the ungrazed shallow site during 60.0% and 69.2% of the years, with a mean 0.70 stems/m^2 density and a mean 0.16% basal cover, and was present on the grazed shallow site during 75.0% and 73.0% of the years that density and basal cover data were collected, with a mean 0.86 stems/m^2 density and a mean 0.16% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present on the ungrazed shallow site during 20.0% and 28.6% of the years, with a mean 0.24 stems/m^2 density and a mean 0.11% basal cover. During the later period (1998-2012), fragile pricklypear was present on the ungrazed shallow site during 73.3% and 93.3% of the years, with a mean 0.90 stems/m^2 density and a mean 0.19% basal cover, respectively. Both the stem density and basal cover increased over time. During the early period (1983-1992), fragile pricklypear was present on the grazed shallow site during 20.0% and 28.6% of the years, with a mean 0.24 stems/m^2 density and a mean 0.11% basal cover. During the later period (1998-2012), fragile pricklypear was present on the grazed shallow site during 93.3% and 100.0% of the years, with a mean 1.10 stems/m^2 density and a mean 0.18% basal cover, respectively. Both the stem density and basal cover increased over time.

On the shallow sites of the twice-over treatment, Fragile pricklypear was present on the ungrazed shallow site during 72.7% and 83.3% of the years, with a mean 0.72 stems/m^2 density and a mean

0.15% basal cover, and was present on the grazed shallow site during 31.8% and 76.7% of the years that density and basal cover data were collected, with a mean 0.16 stems/m^2 density and a mean 0.11% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present on the ungrazed shallow site during 57.1% and 70.0% of the years, with a mean 0.46 stems/m^2 density and a mean 0.14% basal cover. During the later period (1998-2012), fragile pricklypear was present on the ungrazed shallow site during 80.0% and 93.3% of the years, with a mean 0.80 stems/m^2 density and a mean 0.16% basal cover, respectively. Both the stem density and basal cover increased over time. During the early period (1983-1992), fragile pricklypear was present on the grazed shallow site during 14.3% and 90.0% of the years, with a mean 0.06 stems/m^2 density and a mean 0.14% basal cover. During the later period (1998-2012), fragile pricklypear was present on the grazed shallow site during 40.0% and 80.0% of the years, with a mean 0.20 stems/m^2 density and a mean 0.08% basal cover, respectively. The stem density increased and the basal cover decreased over time.

On the silty site of the nongrazed treatment, Fragile pricklypear was present during 42.1% and 53.8% of the years that density and basal cover data were collected, with a mean 0.23 stems/m^2 density and a mean 0.11% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present during 20.0% and 42.9% of the years, with a mean 0.08 stems/m^2 density and a mean 0.30% basal cover. During the later period (1998-2012), fragile pricklypear was present during 50.0% and 60.0% of the years, with a mean 0.30 stems/m^2 density and a mean 0.04% basal cover, respectively. The stem density increased and the basal cover decreased over time.

On the silty sites of the seasonlong treatment, Fragile pricklypear was present on the ungrazed silty site during 70.0% and 61.5% of the years, with a mean 0.45 stems/m^2 density and a mean 0.12% basal cover, and was present on the grazed silty site during 60.0% and 50.0% of the years that density and basal cover data were collected, with a mean 0.34 stems/m^2 density and a mean 0.13% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present on the ungrazed silty site during 40.0% and 71.4% of the years, with a mean 0.32 stems/m^2 density and a mean 0.30% basal cover. During the later period (1998-2012), fragile pricklypear was present on the ungrazed silty site during 80.0% and 60.0% of the years, with a mean 0.50 stems/m^2 density and a mean 0.06% basal cover, respectively. The stem density increased and the basal cover decreased over time. During the early period (1983-1992), fragile pricklypear was present on the grazed silty site during 40.0% and 71.4% of the years, with a mean 0.16 stems/m^2 density and a mean 0.34% basal cover. During the later period (1998-2012), fragile pricklypear was present on the grazed silty site during 66.7% and 46.7% of the years, with a mean 0.40 stems/m^2 density and a mean 0.05% basal cover, respectively. The stem density increased and the basal cover decreased over time.

On the silty sites of the twice-over treatment, Fragile pricklypear was present on the ungrazed silty site during 72.7% and 63.3% of the years, with a mean 0.61 stems/m^2 density and a mean 0.15% basal cover, and was present on the grazed silty site during 86.4% and 90.0% of the years that density and basal cover data were collected, with a mean 0.99 stems/m^2 density and a mean 0.18% basal cover during the total period, respectively. During the early period (1983-1992), fragile pricklypear was present on the ungrazed silty site during 85.7% and 100.0% of the years, with a mean 0.73 stems/m^2 density and a mean 0.39% basal cover. During the later period (1998-2012), fragile pricklypear was present on the ungrazed silty site during 66.7% and 40.0% of the years, with a mean 0.50 stems/m^2 density and a mean 0.02% basal cover, respectively. Both the stem density and basal cover decreased over time. During the early period (1983-1992), fragile pricklypear was present on the grazed silty site during 71.4% and 100.0% of the years, with a mean 0.77 stems/m^2 density and a mean 0.31% basal cover. During the later period (1998-2012), fragile pricklypear was present on the grazed silty site during 93.3% and 93.3% of the years, with a mean 1.10 stems/m^2 density and a mean 0.11% basal cover, respectively. The stem density increased and the basal cover decreased over time.

Fragile pricklypear stem densities were not differentially effected by the nongrazed treatment and the ungrazed and grazed areas of the seasonlong and twice-over treatments. The annual absolute stem densities were generally low and fragile pricklypear was not documented to be present during numerous years that density data were collected.

Discussion

Fragile pricklypear, *Opuntia fragilis*, is an inconspicuous succulent until a detached stem segment becomes attached to your clothing or skin. It grows well at low to moderate abundance on sandy, shallow, and silty ecological sites. Fragile pricklypear jointed aerial stems remain close to the ground and rarely grow to 9 cm (3.5 in) tall. Mean mature height of stems growing in fall grazed pastures reached 7.3 cm (2.9 in) in height during July. Mean first flowers occur on 4 July but are

rarely observed. The abundance of fragile pricklypear increases when problems like periods of low precipitation decrease the population of the prairie plant community.

Density of fragile pricklypear increased from the early period (1983-1992) to the later period (1998-2012) on all treatments on sandy ecological sites except on the ungrazed sandy site of the twice-over treatment, increased from the early period to the later period on all treatments on shallow ecological sites, and increased from the early period to the later period on all treatments on silty ecological sites except on the ungrazed silty site of the twice-over treatment. Fragile pricklypear stem densities were not significantly different on the nongrazed treatment and on the ungrazed and grazed areas of the seasonlong and twice-over treatments on the sandy, shallow, and silty ecological sites.

Basal cover of fragile pricklypear decreased from early period (1983-1992) to the later period (1998-2012) on all treatments on sandy ecological sites, decreased from the early period to the later period on all treatments on shallow ecological sites except on the ungrazed and grazed shallow sites of the seasonlong treatment and on the ungrazed shallow site of the twice-over treatment, and decreased from the early period to the later period on all treatments on silty ecological sites. Fragile pricklypear basal cover were not significantly different on the nongrazed treatment and on the ungrazed and grazed areas of the seasonlong and twice-over treatments on the sandy, shallow, and silty ecological sites.

The increasing fragile pricklypear stem density over time would indicate that the number of stems per unit area were increasing from 1988 to 2012 with a mean change from 0.28 stems/m^2 to 0.85 stems/m^2. The decreasing basal cover over time would indicate that the size of each cluster of stems and the quantity of ground covered by fragile pricklypear were decreasing with a mean change from 0.25% basal cover to 0.08% basal cover.

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Table 1. First flower of Opuntia fragilis, Fragile Pricklypear.

	Apr	May	Jun	Jul	Aug	Sep
First Flower 1955-1962						
Earliest			21			
Mean				4		

First Flower data from Goetz 1963.

Table 2. Autecology of Opuntia fragilis, Fragile Pricklypear, with growing season changes in mature height.

				Percent of Mature Height Attained					
Data Period	Minimum Annual Mature Height cm	Maximum Annual Mature Height cm	Mean Mature Height cm	Apr %	May %	Jun %	Jul %	Aug %	Sep %
1955-1962	3.0	9.0	7.3			93.7	100.0		

Data from Goetz 1963.

Table 3. Autecology of Opuntia fragilis, Fragile pricklypear, with growing season changes in density importance value, 1983-2012.					
Ecological Site Year Period	Nongrazed	Seasonlong		Twice-over	
		Ungrazed	Grazed	Ungrazed	Grazed
Sandy					
1983-1987	0.00	0.00	0.00	3.55	3.48
1988-1992	0.00	0.00	0.00	7.34	2.38
1993-1998	0.00	0.00	7.17	2.37	8.77
1999-2003	0.00	0.93	5.04	0.73	4.79
2004-2009	1.05	2.07	6.85	0.97	6.68
2010-2012	0.84	2.50	8.65	0.00	6.19
Shallow					
1983-1987	3.41	0.00	0.00	1.80	0.55
1988-1992	0.00	0.00	2.73	12.04	0.00
1993-1998	0.00	0.00	7.63	15.24	0.00
1999-2003	28.30	0.74	6.17	2.88	0.00
2004-2009	2.16	7.61	7.15	4.75	3.81
2010-2012	0.00	2.36	6.99	3.62	3.75
Silty					
1983-1987	0.00	0.00	1.67	3.96	2.36
1988-1992	0.63	3.88	0.72	9.14	14.55
1993-1998	0.00	3.41	2.55	5.13	6.99
1999-2003	1.97	1.97	2.11	4.32	5.75
2004-2009	2.34	2.83	1.45	5.14	7.49
2010-2012	0.84	3.07	2.63	0.00	9.55

Table 4. Autecology of Opuntia fragilis, Fragile pricklypear, with growing season changes in basal cover importance value, 1983-2012.					
Ecological Site Year Period	Nongrazed	Seasonlong		Twice-over	
		Ungrazed	Grazed	Ungrazed	Grazed
Sandy					
1983-1987	0.00	0.00	1.52	1.41	2.22
1988-1992	0.00	0.00	1.14	0.65	1.29
1993-1998	0.23	0.00	1.99	0.76	1.56
1999-2003	0.00	0.00	0.54	0.12	0.97
2004-2009	0.51	0.35	1.33	0.48	1.21
2010-2012	0.30	0.15	0.98	0.00	0.75
Shallow					
1983-1987	0.00	0.00	0.00	0.80	0.82
1988-1992	1.02	0.00	0.43	1.57	1.89
1993-1998	0.70	0.00	1.53	1.21	0.83
1999-2003	0.08	0.31	1.02	1.25	0.90
2004-2009	0.50	2.50	1.76	1.65	0.72
2010-2012	0.00	0.65	1.01	0.95	0.12
Silty					
1983-1987	0.00	0.00	0.00	1.51	1.82
1988-1992	1.66	2.88	2.41	3.12	2.58
1993-1998	1.34	0.94	1.19	1.59	0.96
1999-2003	0.37	0.71	0.43	0.41	0.89
2004-2009	0.45	0.57	0.60	0.07	1.00
2010-2012	0.17	0.00	0.00	0.00	0.43

Literature Cited

Cook, C.W., and J. Stubbendieck. 1986. Range research: basic problems and techniques. Society for Range Management, Denver, CO. 317p.

Goetz, H. 1963. Growth and development of native range plants in the mixed prairie of western North Dakota. M. S. Thesis, North Dakota State University, Fargo, ND. 165p.

Great Plains Flora Association. 1986. Flora of the Great Plains. University of Kansas, Lawrence, KS.

Johnson, J.R., and G.E. Larson. 2007. Grassland plants of South Dakota and the Northern Great Plains. South Dakota State University. B 566 (rev.). Brookings, SD**.**

Manske, L.L. 2016. Autecology of prairie plants on the Northern Mixed Grass Prairie. NDSU Dickinson Research Extension Center. Range Research Report DREC 16-1093. Dickinson, ND.

Mozingo, H.N. 1987. Shrubs of the Great Basin. University of Nevada Press. Reno, NV.

Stevens, O.A. 1963. Handbook of North Dakota plants. North Dakota Institute for Regional Studies. Fargo, ND.

Stubbendieck, J., S.L. Hatch, and N.M. Bryan. 2011. North American wildland plants. 2nd Ed. University of Nebraska Press. Lincoln, NE.

Zaczkowski, N.K. 1972. Vascular flora of Billings, Bowman, Golden Valley, and Slope Counties, North Dakota. PhD. Thesis. North Dakota State University, Fargo, ND. 219 p.

Appendix
Autecology Data
of Fragile Pricklypear

Table 1.	Density analysis for native range on the nongrazed grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NG-W & E				Relative	
Site:	Sandy, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990						
1991		No Densities Collected				
1992		No Densities Collected				
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998						
1999		No Densities Collected				
2000						
2001						
2002						
2003						
2004						
2005						
2006		0.04	0.52	4.00	1.15	1.67
2007		0.04	0.66	4.00	1.30	1.96
2008						
2009		0.04	0.93	4.00	1.72	2.66
2010		0.04	1.01	4.00	1.52	2.53
2011						
2012						

Table 2.	Density analysis for native range on the 4.5 month seasonlong grazing syst					
	at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12				Relative	
Site:	Sandy, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990						
1991		No Densities Collected				
1992		No Densities Collected				
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998						
1999						
2000						
2001						
2002						
2003		0.08	1.20	8.00	3.45	4.65
2004		0.04	0.50	4.00	1.76	2.27
2005						
2006		0.08	0.88	4.00	1.25	2.13
2007						
2008		0.20	2.44	12.00	5.56	7.99
2009						
2010		0.08	2.17	4.00	2.56	4.74
2011						
2012		0.08	1.26	4.00	1.52	2.77

Table 3.	Density analysis for native range on the 4.5 month seasonlong grazing syst					
	at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12				Relative	
Site:	Sandy, grazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990						
1991		No Densities Collected				
1992		No Densities Collected				
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.18	4.58	4.00	2.59	7.17
1999		0.20	3.09	0.62	1.79	4.87
2000		0.37	4.34	8.00	3.63	7.97
2001		0.32	3.76	8.00	2.22	5.98
2002		0.04	0.64	4.00	2.15	2.79
2003		0.08	0.92	8.00	2.67	3.58
2004		0.06	0.87	4.00	2.12	2.99
2005		0.20	2.13	16.00	4.49	6.62
2006		0.12	2.27	6.00	2.49	4.77
2007						
2008		0.64	8.56	32.00	12.50	21.06
2009		0.32	2.27	12.00	3.41	5.68
2010		0.24	4.96	16.00	8.16	13.12
2011						
2012		0.28	5.93	16.00	6.90	12.83

Table 4.	Density analysis for native range on the twice-over rotation grazing syste					
	at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6				Relative	
Site:	Sandy, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.04	2.16	4.00	3.19	5.33
1985		No Densities Collected				
1986		0.04	0.85	4.00	1.79	2.63
1987		0.04	0.62	4.00	2.08	2.70
1988		0.16	9.30	12.00	8.33	17.64
1989						
1990		0.04	1.05	4.00	3.33	4.39
1991		No Densities Collected				
1992		No Densities Collected				
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.04	0.49	4.00	1.89	2.37
1999						
2000						
2001		0.04	1.02	4.00	2.63	3.65
2002						
2003						
2004						
2005						
2006		0.04	0.62	4.00	2.70	3.32
2007						
2008						
2009		0.04	0.65	4.00	1.85	2.51
2010						
2011						
2012						

Table 5.	Density analysis for native range on the twice-over rotation grazing syste					
	at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6				Relative	
Site:	Sandy, grazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.06	2.10	5.60	3.15	5.24
1985		No Densities Collected				
1986		0.04	0.90	4.00	1.89	2.79
1987		0.04	0.50	4.00	1.92	2.42
1988		0.06	3.12	6	4.03	7.15
1989						
1990						
1991		No Densities Collected				
1992		No Densities Collected				
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.15	4.19	9.33	4.58	8.77
1999		0.08	2.35	4.00	1.89	4.24
2000		0.14	3.15	7.00	4.17	7.32
2001		0.08	1.34	5.00	2.15	3.49
2002		0.07	1.82	5.00	2.87	4.68
2003		0.06	1.33	5.00	2.88	4.21
2004		0.09	2.71	6.00	3.89	6.60
2005		0.13	2.80	7.20	3.22	6.01
2006		0.15	4.17	12.00	7.47	11.63
2007		0.04	1.56	4.00	2.27	3.84
2008		0.07	3.47	5.33	5.17	8.64
2009		0.05	0.99	5.33	2.35	3.34
2010		0.07	1.73	5.33	3.49	5.22
2011		0.06	1.29	4.00	1.79	3.08
2012		0.12	5.00	8.00	5.26	10.26

Table 6.	Points analysis for native range on the nongrazed grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NG-W & E		Relative		Relative	
Site:	Sandy, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990						
1991						
1992		No Points Collected				
1993		0.30	0.91	1.00	0.45	1.37
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006		0.08	0.29	0.75	0.39	0.68
2007		0.10	0.53	1.00	0.60	1.13
2008		0.05	0.32	0.50	0.40	0.71
2009		0.05	0.23	0.50	0.33	0.56
2010		0.05	0.18	0.50	0.26	0.44
2011						
2012		0.05	0.20	0.50	0.27	0.46

Table 7.	Points analysis for native range on the 4.5 month seasonlong grazing syst					
	at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12		Relative		Relative	
Site:	Sandy, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990						
1991						
1992		No Points Collected				
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004		0.05	0.17	0.50	0.22	0.38
2005		0.05	0.18	0.50	0.23	0.42
2006						
2007						
2008		0.10	0.60	1.00	0.71	1.31
2009						
2010						
2011						
2012		0.05	0.18	0.50	0.25	0.44

Table 8.	Points analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.						
System:	West/East/North						
Pasture:	NR-9-12		Relative		Relative		
Site:	Sandy, grazed	Basal	Basal	Percent	Percent	Importance	
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value	
1983		No Data					
1984		No Data					
1985		No Data					
1986		No Data					
1987		0.20	0.67	2.00	0.85	1.52	
1988							
1989		0.10	0.43	1.00	0.52	0.95	
1990							
1991		0.30	1.64	3.00	1.96	3.60	
1992		No Points Collected					
1993		2.05	3.19	12.00	4.79	7.97	
1994							
1995							
1996							
1997		0.30	1.04	3.00	1.44	2.48	
1998		0.13	0.65	1.33	0.85	1.51	
1999		0.10	0.32	0.83	0.37	0.68	
2000		0.05	0.20	0.50	0.30	0.50	
2001							
2002							
2003		0.20	0.65	2.00	0.87	1.52	
2004		0.30	1.06	3.00	1.35	2.41	
2005		0.20	0.63	2.00	0.84	1.46	
2006		0.20	0.68	2.00	0.93	1.61	
2007		0.05	0.16	0.50	0.23	0.39	
2008		0.10	0.49	1.00	0.62	1.11	
2009		0.10	0.41	1.00	0.58	1.00	
2010		0.15	0.53	1.50	0.76	1.28	
2011		0.05	0.23	0.50	0.30	0.53	
2012		0.15	0.42	1.50	0.70	1.12	

Table 9.	Points analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6		Relative		Relative	
Site:	Sandy, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983						
1984		0.48	1.32	3.06	1.28	2.60
1985		0.16	0.6	1.58	0.9	1.5
1986						
1987		0.16	0.68	1.54	0.86	1.53
1988						
1989		0.10	0.51	1.00	0.63	1.14
1990						
1991		0.13	0.62	1.25	0.82	1.45
1992		No Points Collected				
1993		0.27	0.57	2.67	1.11	1.68
1994						
1995						
1996		0.2	0.69	1.5	0.74	1.43
1997						
1998		0.08	0.66	0.75	0.8	1.45
1999		0.05	0.27	0.50	0.34	0.62
2000						
2001						
2002						
2003						
2004		0.10	0.40	1.00	0.52	0.92
2005		0.10	0.56	1.00	0.65	1.20
2006						
2007						
2008		0.05	0.33	0.50	0.41	0.74
2009						
2010						
2011						
2012						

Table 10.	Points analysis for native range on the twice-over rotation grazing syste					
	at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6		Relative		Relative	
Site:	Sandy, grazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		0.23	0.42	1.67	0.54	0.96
1984		1.00	3.25	6.00	2.47	5.72
1985		0.20	0.80	2.02	1.01	1.80
1986		0.16	0.80	1.54	0.92	1.71
1987		0.10	0.39	1.00	0.51	0.91
1988		0.17	0.84	1.72	1.02	1.86
1989						
1990						
1991		0.37	1.59	3.33	1.72	3.31
1992		No Points Collected				
1993		0.68	1.24	3.00	1.38	2.62
1994		0.20	0.81	2.00	1.02	1.83
1995						
1996		0.20	0.72	2.00	1.00	1.72
1997		0.23	0.71	2.25	1.01	1.71
1998		0.10	0.66	1.00	0.79	1.45
1999		0.17	0.69	1.50	0.79	1.48
2000		0.12	0.49	1.00	0.59	1.09
2001		0.10	0.40	1.00	0.50	0.90
2002		0.07	0.25	0.70	0.33	0.58
2003		0.09	0.36	0.83	0.45	0.81
2004		0.09	0.29	0.90	0.41	0.70
2005		0.40	1.47	3.83	1.78	3.24
2006		0.10	0.38	1.00	0.51	0.89
2007		0.05	0.20	0.50	0.27	0.47
2008		0.05	0.29	0.50	0.35	0.64
2009		0.13	0.58	1.25	0.72	1.30
2010		0.13	0.55	1.25	0.69	1.24
2011		0.10	0.43	1.00	0.58	1.01
2012						

Table 11.	Density analysis for native range on the nongrazed grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NG-W & E				Relative	
Site:	Shallow, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987		0.12	2.13	0.71	1.28	3.41
1988						
1989						
1990						
1991		No Densities Collected				
1992						
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998						
1999		No Densities Collected				
2000		3.48	75.65	44.00	31.43	107.08
2001						
2002		0.04	0.37	4.00	1.41	1.77
2003		0.08	1.18	8.00	3.17	4.35
2004						
2005						
2006		0.04	1.43	4.00	2.22	3.65
2007						
2008		0.08	5.88	4.00	3.45	9.33
2009						
2010						
2011						
2012						

Table 12.	Density analysis for native range on the 4.5 month seasonlong grazing syste					
	at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12				Relative	
Site:	Shallow, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990						
1991		No Densities Collected				
1992						
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998						
1999						
2000						
2001						
2002						
2003		0.04	1.10	4.00	2.60	3.70
2004		0.12	3.45	12.00	8.11	11.56
2005		0.08	1.45	8.00	2.99	4.43
2006		0.20	7.69	12.00	8.11	15.80
2007						
2008		0.04	1.43	4.00	2.86	4.29
2009		0.20	5.21	8.00	4.35	9.56
2010		0.12	3.00	8.00	4.08	7.08
2011						
2012						

Table 13.	Density analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12				Relative	
Site:	Shallow, grazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988		0.12	5.26	12.00	5.66	10.92
1989						
1990						
1991		No Densities Collected				
1992						
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.08	3.28	4.00	4.35	7.63
1999						
2000		0.12	3.26	12.00	8.11	11.37
2001		0.16	3.09	6.00	3.13	6.22
2002		0.12	3.58	8.00	4.88	8.45
2003		0.18	2.71	4.00	2.12	4.82
2004		0.08	2.65	6.00	5.14	7.79
2005		0.06	1.26	4.00	1.60	2.85
2006		0.20	4.72	12.00	6.52	11.24
2007		0.04	1.19	4.00	1.89	3.08
2008		0.12	3.45	10.00	5.74	9.19
2009		0.16	3.03	16.00	5.71	8.74
2010		0.14	5.03	8.00	4.55	9.58
2011		0.04	0.81	4.00	1.20	2.02
2012		0.10	3.64	10.00	5.75	9.38

Table 14.	Density analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6				Relative	
Site:	Shallow, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984						
1985		No Densities Collected				
1986		0.08	1.18	4.00	1.28	2.47
1987		0.04	0.76	4.00	2.17	2.94
1988		0.06	2.68	6.00	3.82	6.49
1989						
1990						
1991		No Densities Collected				
1992		0.14	24.17	8.00	17.50	41.67
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.52	7.74	12.00	7.50	15.24
1999						
2000						
2001		0.08	0.92	8.00	3.77	4.69
2002		0.04	0.52	4.00	1.49	2.01
2003		0.08	1.23	8.00	6.45	7.68
2004		0.10	3.10	6.00	3.61	6.71
2005		0.08	0.55	4.00	0.77	1.32
2006		0.04	2.38	4.00	2.78	5.16
2007		0.04	0.47	4.00	1.28	1.75
2008		0.04	3.33	4.00	4.17	7.50
2009		0.12	2.79	10.00	3.24	6.03
2010		0.04	2.38	4.00	3.23	5.61
2011						
2012		0.08	1.76	8.00	3.50	5.25

Table 15.	Density analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.						
System:	West/East						
Pasture:	NR-1-6				Relative		
Site:	Shallow, grazed		Relative	Percent	Percent	Importance	
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value	
1983		No Densities Collected					
1984							
1985		No Densities Collected					
1986		0.04	0.60	4.00	1.05	1.66	
1987							
1988							
1989							
1990							
1991		No Densities Collected					
1992							
1993		No Densities Collected					
1994		No Densities Collected					
1995		No Densities Collected					
1996		No Densities Collected					
1997		No Densities Collected					
1998							
1999							
2000							
2001							
2002							
2003							
2004							
2005							
2006		0.04	0.58	4.00	1.54	2.12	
2007		0.04	1.64	4.00	1.89	3.53	
2008		0.08	6.67	8.00	9.09	15.76	
2009		0.04	0.40	4.00	1.04	1.44	
2010		0.08	3.34	6.00	4.76	8.10	
2011							
2012		0.04	1.22	4.00	1.94	3.16	

Table 16.	Points analysis for native range on the nongrazed grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NG-W & E		Relative		Relative	
Site:	Shallow, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990		0.20	1.06	1.00	0.67	1.73
1991		0.30	1.04	2.00	1.29	2.33
1992		0.10	0.41	1.00	0.63	1.05
1993		1.00	1.85	5.00	2.33	4.17
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001		0.05	0.17	0.50	0.25	0.42
2002						
2003						
2004		0.15	0.65	1.00	0.64	1.29
2005		0.05	0.19	0.50	0.26	0.45
2006		0.05	0.18	0.50	0.28	0.46
2007						
2008						
2009		0.08	0.33	0.75	0.48	0.80
2010						
2011						
2012						

Table 17.	Points analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12		Relative		Relative	
Site:	Shallow, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983	No Data					
1984	No Data					
1985	No Data					
1986	No Data					
1987						
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003		0.20	0.57	2.00	0.96	1.53
2004		0.33	0.91	3.25	1.44	2.34
2005		0.75	2.04	7.00	3.00	5.03
2006		0.25	0.98	2.50	1.51	2.49
2007		0.30	1.15	2.00	1.12	2.28
2008		0.05	0.29	0.50	0.42	0.72
2009		0.15	0.91	1.50	1.20	2.11
2010		0.10	0.45	1.00	0.63	1.09
2011						
2012		0.10	0.32	1.00	0.54	0.86

Table 18.	Points analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.						
System:	West/East/North						
Pasture:	NR-9-12		Relative		Relative		
Site:	Shallow, grazed	Basal	Basal	Percent	Percent	Importance	
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value	
1983		No Data					
1984		No Data					
1985		No Data					
1986		No Data					
1987							
1988							
1989							
1990		0.20	0.84	2.00	1.32	2.15	
1991							
1992							
1993		0.55	1.26	4.00	2.16	3.42	
1994							
1995							
1996		0.50	1.27	5.00	2.38	3.65	
1997		0.20	0.66	1.00	0.49	1.15	
1998		0.10	0.45	0.75	0.50	0.95	
1999		0.08	0.19	0.75	0.36	0.55	
2000		0.10	0.29	0.50	0.28	0.57	
2001		0.10	0.27	1.00	0.46	0.72	
2002		0.22	0.70	2.17	1.18	1.88	
2003		0.17	0.54	1.67	0.85	1.39	
2004		0.20	0.64	2.00	0.93	1.57	
2005		0.45	1.13	4.00	1.67	2.80	
2006		0.20	0.72	2.00	1.05	1.76	
2007		0.30	0.77	3.00	1.33	2.10	
2008		0.15	0.48	1.50	0.81	1.29	
2009		0.15	0.50	1.00	0.53	1.03	
2010		0.15	0.43	1.50	0.73	1.16	
2011		0.10	0.30	1.00	0.53	0.83	
2012		0.15	0.36	1.50	0.67	1.03	

Table 19.	Points analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6		Relative		Relative	
Site:	Shallow, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		0.11	0.32	1.11	0.50	0.82
1984		0.11	0.35	1.08	0.50	0.85
1985						
1986						
1987		0.32	1.25	2.13	1.10	2.35
1988		0.21	0.73	2.05	1.16	1.89
1989		0.31	1.27	2.09	1.19	2.46
1990						
1991		0.10	0.40	1.00	0.60	1.01
1992		0.20	1.19	1.67	1.29	2.49
1993		0.27	0.83	2.67	1.43	2.25
1994		0.08	0.32	0.75	0.53	0.85
1995						
1996		0.20	0.57	2.00	0.90	1.47
1997		0.30	0.97	2.00	0.93	1.90
1998		0.05	0.34	0.50	0.43	0.77
1999		0.12	0.37	0.83	0.37	0.74
2000		0.35	0.98	2.50	1.28	2.26
2001		0.20	0.53	2.00	0.97	1.50
2002		0.15	0.47	1.00	0.49	0.96
2003		0.07	0.33	0.67	0.47	0.81
2004		0.35	1.04	2.50	1.16	2.21
2005		0.15	0.54	1.33	0.67	1.21
2006		0.20	0.94	1.50	0.97	1.91
2007		0.20	0.89	2.00	1.17	2.05
2008		0.05	0.31	0.50	0.39	0.70
2009		0.18	0.83	1.50	1.02	1.84
2010		0.25	0.88	2.00	1.08	1.96
2011						
2012		0.10	0.35	1.00	0.54	0.89

Table 20.	Points analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6		Relative		Relative	
Site:	Shallow, grazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		0.10	0.21	1.00	0.41	0.62
1984		0.10	0.22	1.00	0.44	0.67
1985		0.11	0.38	1.03	0.57	0.95
1986		0.10	0.40	1.01	0.56	0.95
1987		0.10	0.36	1.02	0.58	0.93
1988		0.10	0.36	1.04	0.55	0.91
1989		0.42	1.61	4.20	2.48	4.09
1990						
1991		0.20	0.86	2.00	1.21	2.07
1992		0.15	1.01	1.50	1.39	2.40
1993		0.60	1.29	4.00	2.08	3.36
1994						
1995						
1996		0.10	0.24	1.00	0.47	0.71
1997						
1998		0.07	0.37	0.67	0.51	0.88
1999		0.06	0.17	0.63	0.30	0.47
2000		0.08	0.23	0.83	0.47	0.70
2001		0.10	0.27	1.00	0.47	0.74
2002		0.08	0.18	0.75	0.32	0.50
2003		0.22	0.74	2.00	1.37	2.11
2004		0.15	0.40	1.33	0.59	0.99
2005		0.11	0.33	1.13	0.52	0.84
2006		0.15	0.57	1.25	0.78	1.34
2007		0.05	0.21	0.50	0.29	0.49
2008						
2009		0.08	0.26	0.75	0.41	0.67
2010						
2011						
2012		0.05	0.13	0.50	0.24	0.36

Table 21.	Density analysis for native range on the nongrazed grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NG-W & E				Relative	
Site:	Silty, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989		0.04	0.52	0.52	2.00	2.52
1990						
1991		No Densities Collected				
1992						
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998						
1999		No Densities Collected				
2000		0.08	1.03	4.00	2.13	3.15
2001		0.08	0.50	4.00	1.09	1.58
2002						
2003		0.04	1.16	4.00	2.00	3.16
2004		0.08	4.17	6.00	5.03	9.20
2005		0.04	0.35	4.00	1.22	1.57
2006						
2007		0.04	1.12	4.00	2.13	3.25
2008						
2009						
2010		0.04	1.01	4.00	1.52	2.53
2011						
2012						

Table 22.	Density analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12				Relative	
Site:	Silty, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990		0.08	1.36	8.00	4.55	5.91
1991		No Densities Collected				
1992		0.08	5.26	4.00	4.35	9.61
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.08	0.97	6.00	2.44	3.41
1999		0.10	1.38	0.61	2.50	3.89
2000						
2001		0.08	0.38	4.00	1.08	1.46
2002		0.04	0.36	4.00	1.75	2.11
2003		0.04	0.58	4.00	1.82	2.40
2004		0.04	0.85	4.00	2.13	2.98
2005						
2006		0.08	1.56	4.00	1.81	3.37
2007		0.04	0.34	4.00	1.28	1.62
2008		0.08	1.71	8.00	5.41	7.12
2009		0.06	0.78	4.00	1.13	1.91
2010		0.04	2.22	4.00	3.13	5.35
2011						
2012		0.06	1.53	4.00	2.33	3.86

Table 23.	Density analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12				Relative	
Site:	Silty, grazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987		0.04	0.30	4.00	1.37	1.67
1988						
1989						
1990		0.04	0.56	4.00	2.33	2.89
1991		No Densities Collected				
1992						
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.04	0.47	4.00	2.09	2.55
1999		0.04	0.51	0.51	2.13	2.64
2000		0.12	0.96	6.00	2.84	3.80
2001						
2002		0.04	0.28	4.00	1.64	1.92
2003		0.04	0.37	4.00	1.82	2.19
2004		0.04	0.40	4.00	1.82	2.21
2005		0.16	1.63	12.00	3.61	5.24
2006						
2007						
2008						
2009		0.04	0.20	4.00	1.04	1.24
2010		0.04	1.59	4.00	2.44	4.03
2011						
2012		0.04	1.01	4.00	2.86	3.87

Table 24.	Density analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6				Relative	
Site:	Silty, ungrazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.10	2.03	8.00	2.51	4.53
1985		No Densities Collected				
1986		0.08	1.41	6.00	2.23	3.64
1987		0.08	1.66	6.00	2.05	3.71
1988		0.04	1.95	4.00	2.78	4.73
1989						
1990		0.08	3.51	4.00	3.29	6.80
1991		No Densities Collected				
1992		0.13	16.32	5.00	8.68	25.01
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.12	2.60	4.00	2.54	5.13
1999		0.12	2.97	12.00	2.78	5.75
2000		0.16	7.84	4.00	3.13	10.97
2001		0.04	0.50	4.00	1.49	2.00
2002		0.04	0.81	4.00	2.08	2.89
2003						
2004						
2005		0.06	1.20	6.00	2.80	3.99
2006		0.08	1.15	5.33	2.20	3.35
2007		0.04	1.79	4.00	3.03	4.82
2008		0.04	4.55	4.00	7.69	12.24
2009		0.12	1.69	12.00	4.76	6.46
2010						
2011						
2012						

Table 25.	Density analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6				Relative	
Site:	Silty, grazed		Relative	Percent	Percent	Importance
Species:	Opuntia fragilis	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.09	2.17	9.33	3.49	5.66
1985		No Densities Collected				
1986		0.08	0.53	4.00	0.90	1.43
1987						
1988		0.04	3.45	4.00	3.85	7.29
1989						
1990		0.09	4.09	4.00	3.34	7.43
1991		No Densities Collected				
1992		0.24	23.50	9.33	20.00	43.49
1993		No Densities Collected				
1994		No Densities Collected				
1995		No Densities Collected				
1996		No Densities Collected				
1997		No Densities Collected				
1998		0.05	2.31	5.33	4.69	6.99
1999		0.13	3.14	1.45	3.02	6.16
2000		0.31	5.82	5.00	2.79	8.60
2001		0.12	1.52	4.00	1.17	2.70
2002		0.12	2.47	5.00	2.85	5.33
2003		0.05	2.02	5.00	3.92	5.94
2004		0.12	4.78	9.33	6.40	11.18
2005		0.23	2.55	10.00	3.00	5.55
2006		0.11	1.28	6.00	2.05	3.32
2007						
2008		0.07	14.00	4.00	9.12	23.12
2009		0.07	0.41	5.33	1.34	1.76
2010		0.07	5.12	6.00	5.87	10.99
2011		0.10	2.14	6.00	2.54	4.68
2012		0.09	7.10	5.33	5.90	12.99

Table 26.	Points analysis for native range on the nongrazed grazing system at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NG-W & E		Relative		Relative	
Site:	Silty, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988						
1989						
1990						
1991		0.90	2.14	8.00	2.88	5.02
1992		0.40	1.62	3.00	1.64	3.26
1993		0.80	2.10	3.50	1.75	3.85
1994						
1995						
1996		0.20	0.59	2.00	0.96	1.55
1997		0.10	0.34	1.00	0.47	0.81
1998		0.08	0.87	0.75	0.96	1.82
1999		0.05	0.28	0.50	0.34	0.62
2000						
2001						
2002						
2003		0.15	0.56	1.00	0.65	1.21
2004		0.05	0.23	0.50	0.29	0.52
2005		0.05	0.18	0.50	0.23	0.41
2006		0.05	0.24	0.50	0.30	0.55
2007						
2008		0.05	0.26	0.50	0.33	0.59
2009		0.05	0.27	0.50	0.37	0.64
2010		0.05	0.22	0.50	0.28	0.50
2011						
2012						

Table 27.	Points analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.						
System:	West/East/North						
Pasture:	NR-9-12		Relative		Relative		
Site:	Silty, ungrazed	Basal	Basal	Percent	Percent	Importance	
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value	
1983		No Data					
1984		No Data					
1985		No Data					
1986		No Data					
1987							
1988		0.60	1.70	4.00	1.74	3.44	
1989		0.10	0.40	1.00	0.49	0.89	
1990							
1991		0.10	0.58	1.00	0.69	1.27	
1992		0.60	4.51	5.00	4.27	8.78	
1993		0.70	1.18	7.00	2.71	3.89	
1994							
1995							
1996		0.10	0.41	1.00	0.55	0.95	
1997		0.10	0.31	1.00	0.50	0.81	
1998							
1999		0.15	0.39	1.50	0.63	1.01	
2000		0.10	0.31	1.00	0.47	0.77	
2001		0.05	0.14	0.50	0.31	0.45	
2002		0.15	0.36	1.50	0.57	0.93	
2003		0.05	0.17	0.50	0.23	0.40	
2004		0.13	0.38	1.25	0.55	0.93	
2005		0.13	0.41	0.75	0.34	0.75	
2006		0.15	0.51	1.50	0.69	1.20	
2007							
2008		0.05	0.23	0.50	0.31	0.55	
2009							
2010							
2011							
2012							

Table 28.	Points analysis for native range on the 4.5 month seasonlong grazing system at the Dickinson Research Extension Center.					
System:	West/East/North					
Pasture:	NR-9-12		Relative		Relative	
Site:	Silty, grazed	Basal	Basal	Percent	Percent	Importance
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987						
1988		0.60	1.84	5.00	2.48	4.32
1989						
1990		0.20	0.69	2.00	1.05	1.74
1991		0.15	0.67	1.50	0.98	1.65
1992		0.40	1.83	4.00	2.52	4.35
1993		1.00	1.80	5.00	2.15	3.94
1994						
1995						
1996		0.40	1.04	3.00	1.29	2.33
1997						
1998		0.05	0.37	0.50	0.50	0.87
1999		0.15	0.40	1.50	0.60	1.00
2000		0.10	0.46	0.50	0.28	0.74
2001						
2002						
2003		0.05	0.19	0.50	0.25	0.43
2004		0.20	0.71	2.00	0.93	1.64
2005		0.10	0.39	1.00	0.48	0.87
2006						
2007						
2008		0.10	0.49	1.00	0.58	1.07
2009						
2010						
2011						
2012						

Table 29.	Points analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.						
System:	West/East						
Pasture:	NR-1-6		Relative		Relative		
Site:	Silty, ungrazed	Basal	Basal	Percent	Percent	Importance	
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value	
1983							
1984		0.44	1.17	2.58	1.12	2.29	
1985		0.15	0.62	1.54	0.93	1.55	
1986		0.16	0.43	1.60	0.60	1.04	
1987		0.14	0.49	1.44	0.68	1.17	
1988		0.63	2.04	5.80	2.69	4.72	
1989		0.34	1.33	3.39	1.94	3.26	
1990		0.10	0.36	1.00	0.46	0.81	
1991		0.30	1.17	2.75	1.46	2.63	
1992		0.55	2.04	4.00	2.12	4.17	
1993		1.13	2.33	7.00	3.07	5.41	
1994		0.05	0.23	0.50	0.30	0.53	
1995							
1996		0.20	0.65	2.00	1.00	1.64	
1997		0.08	0.28	0.75	0.42	0.70	
1998		0.10	0.51	1.00	0.76	1.27	
1999		0.05	0.21	0.50	0.29	0.50	
2000		0.05	0.28	0.50	0.37	0.65	
2001		0.05	0.16	0.50	0.27	0.42	
2002		0.05	0.20	0.50	0.28	0.48	
2003							
2004							
2005		0.05	0.18	0.50	0.25	0.43	
2006							
2007							
2008							
2009							
2010							
2011							
2012							

Table 30.	Points analysis for native range on the twice-over rotation grazing system at the Dickinson Research Extension Center.						
System:	West/East						
Pasture:	NR-1-6		Relative		Relative		
Site:	Silty, grazed	Basal	Basal	Percent	Percent	Importance	
Species:	Opuntia fragilis	Cover	Cover	Frequency	Frequency	Value	
1983		0.20	0.28	1.50	0.41	0.69	
1984		0.73	1.94	4.12	1.66	3.59	
1985		0.17	0.62	1.71	0.97	1.59	
1986		0.19	0.69	1.93	0.96	1.65	
1987		0.18	0.66	1.83	0.91	1.58	
1988		0.68	2.33	5.61	2.76	5.09	
1989		0.60	2.88	2.00	1.29	4.17	
1990		0.10	0.52	1.00	0.72	1.25	
1991		0.10	0.34	0.82	0.50	0.82	
1992		0.18	0.63	1.50	0.95	1.58	
1993		0.17	0.41	1.67	0.87	1.28	
1994							
1995							
1996		0.20	0.42	1.33	0.71	1.14	
1997		0.18	0.41	1.50	0.68	1.09	
1998		0.15	0.94	1.50	1.30	2.25	
1999		0.07	0.15	0.67	0.31	0.47	
2000		0.06	0.22	0.63	0.41	0.62	
2001		0.13	0.36	1.33	0.62	0.99	
2002		0.11	0.30	1.10	0.55	0.85	
2003		0.16	0.64	1.40	0.87	1.51	
2004		0.19	0.52	1.50	0.64	1.16	
2005		0.21	0.60	1.80	0.78	1.37	
2006		0.05	0.17	0.50	0.26	0.43	
2007		0.10	0.32	0.83	0.45	0.77	
2008		0.10	0.56	1.00	0.82	1.38	
2009		0.10	0.32	1.00	0.55	0.86	
2010		0.10	0.28	0.83	0.41	0.70	
2011		0.07	0.22	0.67	0.36	0.59	
2012							