Autecology of Broom Snakeweed on the Northern Mixed Grass Prairie

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The autecology of Broom Snakeweed, *Gutierrezia sarothrae*, 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).

Broom snakeweed, *Gutierrezia sarothrae* (Pursh) Britt. & Rusby, is a member of the aster (sunflower) family, Asteraceae, and is a native, short lived perennial (20 years), deciduous with partial die back of annual aerial flower stalks, warm season shrub or subshrub that is drought tolerant and has a high water use efficiency. Aerial growth has a single to several woody decumbent spreading stems at ground level arising from a stem base; the woody stems produce numerous erect fine annual branched stalks that rebranch forming a dense crown 8-28 inches (20-70 cm) tall. The root system has a stout deep woody taproot and has numerous extensive long lateral roots. The lateral roots that grow close to the soil surface can capture moisture from light rainfall events. Regeneration is by vegetative and sexual reproduction. Vegetative growth is sprouts from adventitious buds on the root crown and from perennating buds on the woody decumbent stems. Sexual reproduction is from small flowers clustered in heads that are borne in compact terminal corymbs that emerge during August-October. Pollination is by insects. Seed is an achene dispersed by wind. Aerial parts are highly combustible and are top killed by fire. Sprouts develop from adventitious buds on the root crown and from perennating buds on the woody decumbent stems. This summary information on growth development and regeneration of broom snakeweed was based on the works of Stevens 1963, Great Plains Flora Association 1986, Mozingo 1987, Tirmenstein 1999d, Stubbendieck et al. 2003, Hurteau 2006b, Johnson and Larson 2007, and Stubbendieck et al. 2011.

Procedures

The 1955-1962 Study

Broom snakeweed 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 1969-1971 Study

The range of flowering time of Broom snakeweed was determined by recording daily observations of plants at anthesis on several prairie habitat type collection locations distributed throughout 4,569 square miles of southwestern North Dakota. The daily observed flowering plant data collected during the growing seasons of 1969 to 1971 from April to August were reported as flower sample periods with 7 to 8 day duration in Zaczkowski 1972.

The 1983-2012 Study

A long-term study on change in abundance of Broom snakeweed 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 Broom snakeweed 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

Broom snakeweed resumed growth during early spring and developed numerous erect fine annual herbaceous aerial stems arising from woody decumbent spreading stems growing up to ground level that develop from a stem base with a deep taproot. The aerial stems rebranch forming a dense crown 8-24 inches (20-70 cm) tall. Flowers form at the top of each branch. The earliest first flowers appeared on 20 July, the mean first flowers occurred on 30 July during the 1955-1962 study, and the flower period extended from late July through early September during the 1969-1971 study (table 1) (Goetz 1963, Zaczkowski 1972). A mean mature height of 14.0 cm (5.5 in) with an annual variance in height from 11.0 cm to 21.0 cm (4.3 in to 8.3 in) was reached during August on the fall grazed pastures of the 1955-1962 study (table 2) (Goetz 1963).

Plant species composition in rangeland ecosystems is variable during a growing season and dynamic among growing seasons. Relative stem abundance of broom snakeweed, as measured by density and basal cover importance values (tables 3 and 4), was scarce to absent during the 30 year study of 1983 to 2012. Broom snakeweed was present at the start of the study, before, and during the low precipitation period of 1988 to 1992 at low abundance on the sandy and shallow sites of the nongrazed treatment (table 4), at low abundance on the silty sites of the seasonlong treatment (table 4), and at low abundance on the sandy, shallow, and silty sites of the twice-over treatment (tables 3 and 4). Broom snakeweed was very scarce following the low precipitation period when growing season precipitation was at normal quantities. During 1998 to 2012, Broom snakeweed was present at extremely low abundance on the shallow site of the nongrazed treatment (tables 3 and 4) and at extremely low abundance on the shallow and silty sites of the twice-over treatment (tables 3 and 4).

On the sandy site of the nongrazed treatment, Broom snakeweed was present 0.0% and 4.0% of the years that density and basal cover data were collected, with a mean 0.0008% basal cover, respectively. Broom snakeweed was documented to be present on the sandy site of the nongrazed treatment during one growing season, 1987 (table 4), and was not present following the low precipitation period of 1988 to 1992 (tables 3 and 4). Broom snakeweed is drought tolerant and should have survived the low precipitation period, however, broom snakeweed requires full sunlight and is shade

intolerant.

On the sandy site of the seasonlong treatment, Broom snakeweed was present on the ungrazed sandy site during 0.0% and 0.0% of the years, and on the grazed sandy site during 0.0% and 0.0% of the years that density and basal cover data were collected, respectively. Broom snakeweed was not documented to be present on the ungrazed and grazed sandy sites of the seasonlong treatment (tables 3 and 4).

On the sandy sites of the twice-over treatment, Broom snakeweed was present on the ungrazed sandy site during 4.8% and 0.0% of the years, with a mean 0.04 stems/m^2 density, and on the grazed sandy site during 4.8% and 3.4% of the years that density and basal cover data were collected, with a mean 0.02 stems/m^2 density and a mean 0.0007% basal cover, respectively. Broom snakeweed was documented to be present on the ungrazed sandy site during one growing season, 1986 (table 3), and present on the grazed sandy site during two growing seasons, 1983 and 1986 (tables 3 and 4), and broom snakeweed was not present on the sandy sites of the twice-over treatment following the low precipitation period of 1988 to 1992 (tables 3 and 4). Broom snakeweed is drought tolerant, however it requires full sunlight and is shade intolerant.

On the shallow site of the nongrazed treatment, Broom snakeweed was present 10.5% and 7.7% of the years that density and basal cover data were collected, with a mean 0.05 stems/m^2 density and a mean 0.005% basal cover, respectively. Broom snakeweed was documented to be present before the low precipitation period of 1988 to 1992 during 1987 (table 4) and present following the low precipitation period during 2007 and 2011 (tables 3 and 4). During 1998 to 2012, the shallow site had a mean 0.07 stems/m^2 density and a mean 0.002% basal cover for broom snakeweed on the nongrazed treatment. Broom snakeweed appears to have preference for shallow ecological sites. Broom snakeweed has been slowly developing a presence following the low precipitation period on the shallow site as the nongrazed treatment degrades from lack of defoliation by grazing.

On the shallow sites of the seasonlong treatment, Broom snakeweed was present on the ungrazed shallow site during 0.0% and 0.0% of the years, and on the grazed shallow site during 0.0% and 0.0% of the years that density and basal cover data were collected, respectively. Broom snakeweed was not documented to be present on the ungrazed and grazed shallow sites of the seasonlong treatment (tables 3 and 4).

On the shallow sites of the twice-over treatment, Broom snakeweed was present on the ungrazed shallow site during 13.7% and 6.7% of the years, with a mean 0.02 stems/m^2 density and a mean 0.001% basal cover, and on the grazed shallow site during 18.2% and 6.7% of the years that density and basal cover data were collected, with a mean 0.02 stems/m^2 density and a mean 0.005% basal cover, respectively. Broom snakeweed was documented to be present before and during the low precipitation period of 1988 to 1992 on the ungrazed shallow site during 1984, 1985, 1986, and 1990 (tables 3 and 4), and on the grazed shallow site during 1984, 1985, 1986, and 1987 (tables 3 and 4) and present following the low precipitation period on the ungrazed shallow site during 2002 (table 4) and on the grazed shallow site during 1998 and 2012 (table 3). During 1998 to 2012, the ungrazed shallow site had a mean 0.001% basal cover and the grazed shallow site had a mean 0.01 stems/m^2 density for broom snakeweed on the twice-over treatment.

On the silty site of the nongrazed treatment, Broom snakeweed was present during 0.0% and 0.0% of the years that density and basal cover data were collected, respectively. Broom snakeweed was not documented to be present on the silty site of the nongrazed treatment (tables 3 and 4).

On the silty site of the seasonlong treatment, Broom snakeweed was present on the ungrazed silty site during 0.0% and 0.0% of the years, and on the grazed silty site during 0.0% and 3.8% of the years that density and basal cover data were collected, with a mean 0.004% basal cover, respectively. Broom snakeweed was not documented to be present on the ungrazed silty site (tables 3 and 4). Broom snakeweed was documented to be present before the low precipitation period of 1988 to 1992 on the grazed silty site during 1987 (table 4) and not present following the low precipitation period on the grazed silty site of the seasonlong treatment (tables 3 and 4).

On the silty sites of the twice-over treatment, Broom snakeweed was present on the ungrazed silty site during 13.6% and 3.3% of the years, with a mean 0.03 stems/m^2 density and a mean 0.002% basal cover, and on the grazed silty site during 18.2% and 13.3% of the years that density and basal cover data were collected, with a mean 0.05 stems/m^2 density and a mean 0.003% basal cover, respectively. Broom snakeweed was documented to be present before and during the low precipitation period of 1988 to 1992 on the ungrazed silty site during 1984, 1986, and 1987 (tables 3 and 4), and on the grazed silty site during 1983, 1984, 1985, 1986, 1987, 1988, and 1989 (tables 3 and 4) and present following the low precipitation period on the grazed silty site during 2000 (table 3). During 1998 to 2012,

the grazed silty site had a mean 0.007 stems/m^2 density for broom snakeweed on the twice-over treatment.

Stem density of broom snakeweed was extremely low on all ecological sites of all treatments. More times of broom snakeweed presence were documented during the early years of 1983 to 1992 than that during the later years of 1998 to 2012. On the nongrazed treatment, broom snakeweed was present on the sandy site one time during the early years and zero times during the later years, was present on the shallow site one time during the early years and two times during the later years, and was not present on the silty site. On the seasonlong treatment, broom snakeweed was not present on the sandy and shallow sites, and was present on the silty site one time during the early years and zero times during the later years. On the twice-over treatment, broom snakeweed was present on the sandy site three times during the early years and zero times during the later years, was present on the shallow site five times during the early years and three times during the later years, and was present on the silty site seven times during the early years and one time during the later years.

Broom snakeweed presence appears to be increasing during the later years on the shallow site of the nongrazed treatment and appears to be decreasing during the later years on the sandy, shallow, and silty sites of the twice-over treatment.

Discussion

Broom snakeweed, *Gutierrezia sarothrae*, is a subshrub that is scarce on healthy vegetated mixed grass prairie plant communities. Broom snakeweed is drought tolerant, however, it has a high requirement for full sunlight and is shade intolerant. The presence of broom snakeweed indicates the lack of shading. The perennial portions of broom snakeweed are all belowground. It has a stout deep woody taproot, a large woody stem base or crown, which develops several woody decumbent spreading stems that grow up to ground level from which the annually produced numerous herbaceous aerial stems develop from buds. The aerial stems produce many branches with flowers at the top during late July through early September. Erect aerial stems reach maximum mature height during August. Normal height is reported to be 70 cm (28 in), however, in the Northern Plains it rarely grows over 46 cm (18 in). Stems growing in fall grazed pastures reached mean mature height at 14.0 cm (5.5 in) (30.5% of the normal height). The stem heights collected during the 1955-1962 study were shorter than the normal height of 46 cm (18 in) because the soils had quantities of mineral nitrogen available at much less than the threshold quantity of 100 lbs/ac which resulted from the detrimental effects caused by the traditional management practices on the biogeochamical processes of the prairie plant communities. The herbaceous aerial stems of broom snakeweed die back completely to ground level during winter.

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Table 1. First flower and flower period of Gutierrezia sarothrae, Broom Snakeweed.

	Apr	May	Jun	Jul	Aug	Sep
First Flower						
1955-1962						
Earliest				20		
Mean				30		
Flower Period						
1969-1971				X XX	XX X	

First Flower data from Goetz 1963.
Flower Period Data from Zaczkowski 1972.

Table 2. Autecology of Gutierrezia sarothrae, Broom Snakeweed, 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	11.0	21.0	14.0		35.0	67.6	90.9	100.0	

Data from Goetz 1963.

Table 3. Autecology of Gutierrezia sarothrae, Broom snakeweed, 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	1.81	1.38
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.00	0.00
1999-2003	0.00	0.00	0.00	0.00	0.00
2004-2009	0.00	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.00	0.00
Shallow					
1983-1987	0.00	0.00	0.00	0.35	0.24
1988-1992	0.00	0.00	0.00	0.35	0.00
1993-1998	0.00	0.00	0.00	0.00	0.37
1999-2003	0.00	0.00	0.00	0.00	0.00
2004-2009	1.20	0.00	0.00	0.00	0.00
2010-2012	0.39	0.00	0.00	0.00	0.13
Silty					
1983-1987	0.00	0.00	0.00	1.00	1.24
1988-1992	0.00	0.00	0.00	0.00	1.58
1993-1998	0.00	0.00	0.00	0.00	0.00
1999-2003	0.00	0.00	0.00	0.00	0.14
2004-2009	0.00	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.00	0.00

Table 4. Autecology of Gutierrezia sarothrae, Broom snakeweed, 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	0.17	0.00	0.00	0.00	0.02
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.00	0.00
1999-2003	0.00	0.00	0.00	0.00	0.00
2004-2009	0.00	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.00	0.00
Shallow					
1983-1987	0.93	0.00	0.00	0.05	0.22
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.00	0.00
1999-2003	0.00	0.00	0.00	0.30	0.00
2004-2009	0.05	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.00	0.00
Silty					
1983-1987	0.00	0.00	0.15	0.11	0.15
1988-1992	0.00	0.00	0.00	0.00	0.03
1993-1998	0.00	0.00	0.00	0.00	0.00
1999-2003	0.00	0.00	0.00	0.00	0.00
2004-2009	0.00	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.00	0.00

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Appendix
Autecology Data
of Broom Snakeweed

Table 1.	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:	Sandy, ungrazed		Relative	Percent	Percent	Importance
Species:	Gutierrezia sarothrae	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984						
1985		No Densities Collected				
1986		0.08	2.38	5.33	3.06	5.44
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						
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2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 2.	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:	Sandy, grazed		Relative	Percent	Percent	Importance
Species:	Gutierrezia sarothrae	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984						
1985		No Densities Collected				
1986		0.04	1.49	4.00	2.64	4.13
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						
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2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 3.	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:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987		0.02	0.08	0.17	0.09	0.17
1988						
1989						
1990						
1991						
1992		No Points Collected				
1993						
1994						
1995						
1996						
1997						
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2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 4.	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, grazed	Basal	Basal	Percent	Percent	Importance
Species:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983		0.02	0.03	0.17	0.05	0.08
1984						
1985						
1986						
1987						
1988						
1989						
1990						
1991						
1992		No Points Collected				
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 5.	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:	Gutierrezia sarothrae	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						
2004						
2005						
2006						
2007		0.08	3.64	6.00	3.57	7.21
2008						
2009						
2010						
2011		0.02	0.48	2.00	0.69	1.17
2012						

Table 6.	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:	Gutierrezia sarothrae	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.01	0.11	0.67	0.20	0.31
1985		No Densities Collected				
1986		0.02	0.26	2.00	0.47	0.73
1987						
1988						
1989						
1990		0.02	0.67	1.33	0.71	1.38
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						
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2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 7.	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:	Gutierrezia sarothrae	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.01	0.12	0.67	0.18	0.30
1985		No Densities Collected				
1986		0.01	0.14	0.67	0.28	0.42
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		0.01	0.08	0.67	0.29	0.37
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012		0.01	0.12	0.67	0.26	0.38

Table 8.	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:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987		0.10	0.38	1.00	0.55	0.93
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007		0.03	0.11	0.25	0.16	0.27
2008						
2009						
2010						
2011						
2012						

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:	Shallow, ungrazed	Basal	Basal	Percent	Percent	Importance
Species:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983						
1984						
1985		0.02	0.09	0.17	0.12	0.21
1986						
1987						
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002		0.02	0.08	0.08	0.05	0.13
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 10.	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:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983						
1984						
1985		0.03	0.12	0.35	0.16	0.28
1986						
1987		0.12	0.42	0.88	0.42	0.84
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 11.	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:	Gutierrezia sarothrae	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.03	0.65	2.67	0.80	1.45
1985		No Densities Collected				
1986		0.02	0.38	1.33	0.42	0.79
1987		0.01	0.30	1.33	0.46	0.76
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						
2007						
2008						
2009						
2010						
2011						
2012						

Table 12.	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:	Gutierrezia sarothrae	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984		0.01	0.18	0.67	0.38	0.56
1985		No Densities Collected				
1986		0.05	1.54	4.00	1.64	3.17
1987						
1988						
1989		0.05	2.96	4.67	3.33	6.30
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		0.01	0.31	0.67	0.38	0.68
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 13.	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:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983		No Data				
1984		No Data				
1985		No Data				
1986		No Data				
1987		0.10	0.33	1.00	0.41	0.74
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 14.	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:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983						
1984						
1985						
1986						
1987		0.05	0.19	0.52	0.25	0.44
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 15.	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:	Gutierrezia sarothrae	Cover	Cover	Frequency	Frequency	Value
1983		0.03	0.06	0.33	0.11	0.16
1984						
1985		0.03	0.20	0.35	0.27	0.47
1986						
1987		0.02	0.06	0.18	0.08	0.14
1988		0.02	0.05	0.17	0.09	0.14
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						