Autecology of Sand Cherry on the Northern Mixed Grass Prairie

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The autecology of Sand Cherry, *Prunus pumila*, 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).

Sand cherry, *Prunus pumila* L., is a member of the rose family, Rosaceae, and is a native, perennial, deciduous, cool season shrub that is drought tolerant. Aerial growth has several creeping stems that radiate outward from a stem base 10-15 feet (3-4.5 m) long; spreading vertical branches ascend from the horizontal stems and seldom grow to 12-15 inches (30-38 cm) tall. The root system is fibrous with extensive spreading lateral roots. Most of the root biomass remains within the top 10 inches (25 cm) of soil, with some vertical roots descending to 8-12 feet (2.4-3.7 m) deep. An abundant rhizome system exists with equal distribution at shallow and deep soil layers; the rhizome network interconnects the stem bases. Regeneration is by vegetative and sexual reproduction. Vegetative growth is by sprouts from the root crowns and rhizomes and by suckers from the shallow lateral roots. Sexual reproduction is from perfect bisexual small showy flowers with both male and female organs that emerge during May-early June. Self pollination is possible; cross pollination is by insects. The fruit is a drupe that ripens during late July-September. The seed is inside a hard woody stone. Seed distribution is by birds and small mammals. Low and moderate severity fire top kill aerial parts and activate shoot growth from the root crowns, rhizomes, and lateral roots. Some shallow roots and rhizomes can be killed by fire on dry soil, however, the deep roots and rhizomes are well insulated from the heat. This summary information on growth development and regeneration of sand cherry was based on the works of Stevens 1963, Great Plains Flora Association 1986, NRCS Staff 2002c, Taylor 2006, and Larson and Johnson 2007.

Procedures

The 1955-1962 Study

Sand Cherry 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 Sand Cherry 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 Sand Cherry 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 Sand Cherry 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

Sand cherry resumed growth during early spring. Aerial branching woody stems develop from several horizontal creeping stems that radiate outward 3-4.5 m (10-15 feet) from a woody stem base. An extensive deep and shallow rhizome network interconnects the stem bases. The small perfect showy flowers occur in umbel-like clusters of 2 to 4. The earliest first flowers appeared on 7 May, the mean first flowers occurred on 15 May during the 1955-1962 study, and the flower period extended from late May through early June during the 1969-1971 study (table 1) (Goetz 1963, Zaczkowski 1972). A mean mature height of 10.8 cm (4.3 in) with an annual variance in height from 7.0 cm to 14.0 cm (2.8 in to 5.5 in) was reached during July 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 amoung growing seasons. Relative stem abundance of sand cherry, as measured by density and basal cover importance values, was documented only on the shallow site of the nongrazed treatment and on the ungrazed sandy and shallow sites of the twice-over treatment. Sand cherry was documented to be present during one growing season during the early years of 1983 to 1992 and was documented to be present several times during the later years of 1998 to 2012.

On the sandy site of the nongrazed treatment, Sand cherry was not present during the years that density and basal cover data were collected (tables 3 and 4).

On the sandy sites of the seasonlong treatment, Sand cherry was not present on the ungrazed and grazed sandy sites during the years that density and basal cover data were collected (tables 3 and 4).

On the sandy sites of the twice-over treatment, Sand cherry was present on the ungrazed sandy site during 47.6% and 6.9% of the years, with a mean 0.9 stems/m^2 density and a mean 0.005% basal cover, and was not present on the grazed sandy site during the years that density and basal cover data were collected, respectively. Sand cherry was present on the ungrazed sandy site during one growing season, 16.7% and 0.0% of the early years, with a mean 0.1 stems/m^2 density and a mean 0.0% basal cover and was present during 60.0% and 13.3% of the later years, with a mean 1.3 stems/m^2 density and a mean 0.01% basal cover, respectively (tables 3 and 4).

On the shallow site of the nongrazed treatment, Sand cherry was present 31.6% and 30.8% of the years that density and basal cover data were collected, with a mean 8.3 stems/m^2 density and a mean 0.28% basal cover, respectively. Sand cherry was not present on the shallow site of the nongrazed treatment during the early years and was present during 40.0% and 53.3% of the later years, with a mean 10.6 stems/m^2 density and a mean 0.49% basal cover, respectively (tables 3 and 4).

On the shallow sites of the seasonlong treatment, Sand cherry was not present on the ungrazed and grazed shallow sites during the years that density and basal cover data were collected (tables 3 and 4).

On the shallow sites of the twice-over treatment, Sand cherry was present on the ungrazed shallow site during 22.7% and 3.3% of the years, with a mean 0.3 stems/m^2 density and a mean 0.002% basal cover, and was not present on the grazed sandy site during the years that density and basal cover data were collected, respectively. Sand cherry was not present on the ungrazed shallow site during the early years and was present during 33.3% and 6.7% of the later years, with a mean 0.4 stems/m^2 density and a mean 0.003% basal cover, respectively (tables 3 and 4).

On the silty sites of the nongrazed, seasonlong, and twice-over treatments, Sand cherry was not present during the years that density and basal cover data were collected (tables 3 and 4).

Stem density of sand cherry was rare during the early years of 1983 to 1992, except for one growing season (1987) on the ungrazed sandy site of the twice-over treatment. Consequently, after the drought year of 1988, sand cherry was not documented to be present on the ungrazed sandy site for 13 years. During the later years of 1998 to 2012, sand cherry was documented to be present during 60% of the growing seasons at a density range from 0.4 stems/m^2 to 9.2 stems/m^2. On the ungrazed shallow site of the twice-over treatment, sand cherry was not present during the early years and was present during 33.3% of the growing seasons of the later years at a density range from 0.8 stems/m^2 to 2.0 stems/m^2.

On the shallow site of the nongrazed treatment, sand cherry was not present during the early years and was present during 40% of the growing seasons of the later years at a density range from 8.8 stems/m^2 to 45.2 stems/m^2.

Shrubs cannot encroach into a healthy prairie plant community until after the resource uptake competitiveness of the grasses has been reduced. Withholding partial defoliation by grazing causes reduction of grass plant resource uptake competitiveness. Sand cherry was documented to be on the ungrazed sandy site of the twice-over treatment 18 years after the exclosure was constructed. Sand cherry was documented to be on the ungrazed shallow site of the twice-over treatment 17 years after the exclosure was constructed. On the shallow site of the nongrazed treatment, sand cherry was present at a density of 13.6 stems/m^2 12 years after the exclosure was constructed.

Discussion

Sand cherry, *Prunus pumila*, is a short shrub that can encroach mixed grass prairie plant communities where poor grazing management or the exclusion of grazing has caused reduction of grass resource uptake competitiveness. Sand cherry has several creeping horizontal stems that radiate outward from a stem base that is connected to several other stem bases by an extensive shallow and deep rhizome system. Aerial woody stems develop on the creeping horizontal stems to a height of 30 to 38 cm (12 to 15 in) and has the potential to form dense colonel colonies on numerous soil types. Sand cherry is drought tolerant and shade intolerant.

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Table 1. First flower and flower period of Prunus pumila, Sand Cherry.

	Apr	May	Jun	Jul	Aug	Sep
First Flower 1955-1962						
Earliest		7				
Mean		15				
Flower Period 1969-1971			X X			

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

Table 2. Autecology of Prunus pumila, Sand Cherry, 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	7.0	14.0	10.8	78.6	81.8		100.0		

Data from Goetz 1963.

Table 3. Autecology of Prunus pumila var. besseyi, Sand cherry, 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	1.30	0.00
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	5.75	0.00
2004-2009	0.00	0.00	0.00	2.09	0.00
2010-2012	0.00	0.00	0.00	4.41	0.00
Shallow					
1983-1987	0.00	0.00	0.00	0.00	0.00
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	25.96	0.00	0.00	0.00	0.00
1999-2003	42.59	0.00	0.00	1.02	0.00
2004-2009	17.88	0.00	0.00	0.29	0.00
2010-2012	0.00	0.00	0.00	0.68	0.00
Silty					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					

Table 4. Autecology of Prunus pumila var. besseyi, Sand cherry, 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	0.00	0.00	0.00
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	0.73	0.00
Shallow					
1983-1987	0.00	0.00	0.00	0.00	0.00
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	1.00	0.00	0.00	0.00	0.00
1999-2003	8.01	0.00	0.00	0.09	0.00
2004-2009	3.35	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.00	0.00
Silty					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					

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Appendix
Autecology Data of Sand Cherry

Table 1.	Density analysis for native range on the twice-over rotation grazing syster					
	at the Dickinson Research Extension Center.					
System:	West/East					
Pasture:	NR-1-6				Relative	
Site:	Sandy, ungrazed		Relative	Percent	Percent	Importance
Species:	Prunus pumila	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984						
1985		No Densities Collected				
1986						
1987		0.08	1.85	4.00	2.04	3.89
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		0.24	4.44	8.00	3.92	8.37
2001						
2002		0.92	16.67	8.00	3.70	20.37
2003						
2004		0.04	0.97	4.00	1.72	2.70
2005						
2006		0.08	1.48	4.00	2.04	3.52
2007		0.04	0.61	4.00	1.85	2.46
2008		0.12	2.13	4.00	1.72	3.85
2009						
2010		0.12	1.53	4.00	1.64	3.17
2011		0.24	2.86	8.00	3.13	5.98
2012		0.08	0.90	8.00	3.17	4.08

Table 2.	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:	Prunus pumila	Cover	Cover	Frequency	Frequency	Value
1983						
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		0.05	0.29	0.50	0.38	0.67
2011		0.10	0.67	1.00	0.84	1.51
2012						

Table 3.	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:	Prunus pumila	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		1.36	14.53	3.42	11.43	25.96
1999		No Densities Collected				
2000						
2001		4.40	30.14	56.00	16.09	46.23
2002		4.52	41.54	56.00	18.42	59.97
2003		2.96	43.53	52.00	20.63	64.16
2004		1.72	58.11	32.00	29.63	87.74
2005		0.88	7.69	28.00	11.86	19.56
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 4.	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:	Prunus pumila	Density	Density	Frequency	Frequency	Value
1983		No Densities Collected				
1984						
1985		No Densities Collected				
1986						
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		0.12	0.87	0.29	1.27	2.13
2000		0.08	0.45	4.00	0.93	1.39
2001		0.12	0.69	4.00	0.91	1.60
2002						
2003						
2004						
2005						
2006		0.20	0.98	4.00	0.75	1.72
2007						
2008						
2009						
2010		0.08	0.94	4.00	1.11	2.05
2011						
2012						

Table 5.	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:	Prunus pumila	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		0.30	2.76	3.00	3.23	5.99
1999		1.80	7.68	16.00	9.28	16.95
2000		1.15	4.27	10.50	5.69	9.96
2001		0.45	1.57	4.00	2.00	3.57
2002		0.55	1.91	5.00	2.24	4.16
2003		0.70	2.17	5.00	3.25	5.41
2004		0.75	2.86	6.00	3.35	6.21
2005		1.65	6.57	14.00	7.29	13.87
2006						
2007						
2008						
2009						
2010						
2011						
2012						

Table 6.	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:	Prunus pumila	Cover	Cover	Frequency	Frequency	Value
1983						
1984						
1985						
1986						
1987						
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002		0.05	0.17	0.50	0.29	0.45
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						