

Autecology of Sand Bluestem on the Northern Mixed Grass Prairie

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The autecology of Sand bluestem, *Andropogon hallii*, 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 bluestem, *Andropogon hallii* Hack. is a member of the grass family, Poaceae, tribe, Andropogoneae, syn.: *Andropogon gerardii ssp hallii* (Hack.) Wipff., and is a native, long lived perennial, monocot, warm-season, tall grass, that is drought tolerant. The Sand bluestem and Big bluestem are taxonomically classified to the same genus and species, however, they are morphologically distinct and ecologically they occupy dissimilar habitats. The first North Dakota record is Potter and Green 1958. Leaf blades are bluish green 20-30 cm (8-12 in) long, 3-10 mm wide, tapering to a point with prominent midrib and strongly ridged on upper surface. The split sheath is bluish green with purple tinge and soft hairs, and has a slight keeled ridge. The collar is indistinct and medium broad with long straight hairs. The ligule is a fringed membrane, 3-4.5 mm long with long soft hairs. The auricles are absent. The well developed prominent rhizomes are coarse, scaly, 10-20 cm (4-8 in) long. The extensive root system has numerous main roots arising from stem crowns and rhizome nodes growing downward, branching with numerous lateral roots producing a great mass in the top 76 cm (2.5 ft) of soil, with a few long main roots descending to 1.8-3.1 m (6-10 ft) in depth. Regeneration is primarily asexual propagation by rhizome tillers. Seed production is poor and seedlings are extremely rare. Flower stalks are coarse, solid center of pith, 60-150 cm (24-59 in) tall, and grooved on one side. Inflorescence are several spicate racemes with 2 to 7 (usually 3) branches, 4-7 cm (1.6-2.8 in) long on a short axis at the end of a main stem branch. Spikelets are in pairs, with one

sessile and fertile, and the other on short pedicel and sterile. The seed heads are covered with dense yellow hairs. Flower period is from late July to mid August. Aerial parts are palatable to livestock. Fire consumes aerial parts halting the processes of the four major defoliation resistance mechanisms and causing great reductions in biomass production and tiller density. This summary information on growth development and regeneration of Sand bluestem was based on works of Stevens 1963, Zaczkowski 1972, Dodds 1979, Great Plains Flora Association 1986, Uchytel 1988, Broyles 2006, and Johnson and Larson 2007.

Procedures

The 1983-2012 Study

A long-term change in grass and upland sedges species abundance study 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 enclosure. 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 each grass and upland sedge species was determined with plant species basal cover by the ten-pin point frame method (Cook and Stubbendieck 1986). 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 enclosure. 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 on the 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 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 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 the community during the growing season. Basal cover importance value ranks the grasses, upland sedges, forbs, and shrubs in a community. The quantity of change in the importance value 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 bluestem resumes basal leaf growth from axillary buds of crown tillers and fall produced tiller buds on rhizomes 10-20 cm (4-8 in) long. Early leaf growth is slow. Rapid leaf growth occurs during June with 3.5 new leaves produced by mid June. Lead tillers at the 3.5 new leaf stage are physiologically capable of positive response to partial defoliation of 25% to 33% of leaf weight by graminivores. Early stalk growth becomes active reaching the flower period during late July to mid August. Viable seeds are produced infrequently. Seedlings have relatively weak vigor and rarely develop into established plants. Colonization usually occurs through the well developed rhizome system. Unless the grazing management practice has properly manipulated the stimulation of an adequate quantity of Sand bluestem vegetative tillers, lactating cows

will be grazing forage below their requirements after late July.

Grass species composition in rangeland ecosystems is variable during a growing season and dynamic among growing seasons. Patterns in the changes of individual grass species abundance was followed for 30 growing seasons during the 1983-2012 study on the sandy and shallow ecological sites of the long-term nongrazed, traditional seasonlong, and twice-over rotation management treatments (tables 1 and 2).

On the sandy site of the nongrazed treatment, Sand bluestem was present during 4.0% of the years that basal cover data were collected with a mean 0.59% basal cover during the total 30 year period (tables 1 and 2).

On the sandy site of the ungrazed and grazed seasonlong treatment, Sand bluestem was not present during 1983 to 2012.

On the sandy site of the ungrazed twice-over treatment, Sand bluestem was present during 53.6% of the years that basal cover data were collected with a mean 1.10% basal cover during the total 30 year period. During the early period (1983-1992), Sand bluestem was present during 25.0% of the years with a mean 0.14% basal cover. During the later period (1998-2012), Sand bluestem was present during 80.0% of the years with a mean 1.81% basal cover. The percent present and basal cover increased on the sandy site of the ungrazed twice-over treatment over time (tables 1 and 2).

On the sandy site of the grazed twice-over treatment, Sand bluestem was present during 10.3% of the years that basal cover data were collected with a mean 0.011% basal cover during the total 30 year period. During the early period (1983-1992), Sand bluestem was present during 11.1% of the years with a mean 0.008% basal cover. During the later period (1998-2012), Sand bluestem was present during 6.7% of the years with a mean 0.003% basal cover. The percent present and basal cover decreased on the sandy site of the grazed twice-over treatment over time (tables 1 and 2). The percent present and basal cover were much greater on the sandy site of the ungrazed twice-over treatment than those on the sandy site of the grazed twice-over treatment.

On the shallow site of the nongrazed treatment, Sand bluestem was not present during 1983-1992.

On the shallow site of the ungrazed and grazed seasonlong treatment, Sand bluestem was not present during 1983 to 2012.

On the shallow site of the ungrazed twice-over treatment, Sand bluestem was present during 3.5% of the years that basal cover data were collected with a mean 0.024% basal cover during the total 30 year period.

On the shallow site of the grazed twice-over treatment, Sand bluestem was not present during 1983-1992.

Discussion

Sand bluestem, *Andropogon hallii*, is a native, long-lived perennial, warm season, tall grass, monocot, of the grass family that is usually present on healthy sandy mixed grass prairie plant communities. Sand bluestem can grow on sandy and shallow ecological sites. Sand bluestem had good abundance on the sandy site of the ungrazed twice-over treatment, had low abundance on the sandy site of the grazed twice-over treatment, and was present on the sandy site of the nongrazed treatment. Sand bluestem was present on the shallow site of the ungrazed twice-over treatment. Sand bluestem grows better in areas with deep sands.

Sand bluestem and Big bluestem can produce hybrids of intermediate morphological characteristics. Because they can produce hybrids, some taxonomists keep placing Sand and Big bluestem within the same genus and species, however, they have distinctly different morphological characteristics and live in very different habitat types and retain separate species in this report. Sand bluestem is a valuable asset on the Northern Mixed Grass Prairie.

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Table 1. Autecology of <i>Andropogon hallii</i> , Sand bluestem, with growing season changes in basal cover, 1983-2012.					
Ecological Site Year Period	Nongrazed	Seasonlong		Twice-over	
		Ungrazed	Grazed	Ungrazed	Grazed
Sandy					
1983-1987	0.00	0.00	0.00	0.28	0.14
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	2.47	0.00	0.00	0.84	0.03
1999-2003	0.00	0.00	0.00	1.33	0.01
2004-2009	0.00	0.00	0.00	1.95	0.00
2010-2012	0.00	0.00	0.00	2.12	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	0.00	0.00	0.00	0.12	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
Silty					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					

Table 2. Autecology of <i>Andropogon hallii</i> , Sand bluestem, 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	2.14	1.95
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	14.09	0.00	0.00	7.75	0.19
1999-2003	0.00	0.00	0.00	8.08	0.07
2004-2009	0.00	0.00	0.00	24.07	0.00
2010-2012	0.00	0.00	0.00	24.26	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	0.00	0.00	0.00	1.14	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
Silty					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					

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