

# Autecology of Needleleaf Sedge on the Northern Mixed Grass Prairie

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The autecology of Needleleaf sedge, *Carex duriuscula*, 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).

Needleleaf sedge, *Carex duriuscula* C.A. Mey., is a member of the sedge family, Cyperaceae, syn.: *Carex eleocharis* Bailey, *Carex stenophylla* Wahl., and is a native, long lived perennial, monocot, cool-season, short graminoid, that is drought tolerant. The first North Dakota record is Stevens 1963. Early aerial growth consists of basal leaves arising from rhizome tiller buds. Basal leaf blades are very fine, needle like, stiff, 5-7.6 cm (2-3 in) long, 1-1.5 mm wide, tapering to a point, usually with edges rolled inward. The sheaths are tight and thinning upward. The ligule is wider than long. The dark brown rhizomes are long and slender producing single tillers at 2.5-7.6 cm (1-3 in) progressive intervals. The fibrous root system fans out obliquely downward with numerous main roots that have frequent lateral roots branching to the 2<sup>nd</sup> and 3<sup>rd</sup> order forming a dense mat. Regeneration is primarily asexual propagation by rhizome tiller buds. Flower stalks are erect, triangular in cross section, 7.6-20.3 cm (3-8 in) tall. Inflorescence is a solitary, terminal small, spike, 1-2 cm (0.4-0.8 in) long 5-10 mm wide, with male flowers above and few female flowers below (monoecious). Flower period is from May to mid June. Aerial parts are highly palatable to livestock. Fire top kills aerial parts and consumes entire crown when soil is dry. This summary information on growth development and regeneration of Needleleaf sedge was based on works of Stevens 1963, Zaczowski 1972, Dodds 1979, Great Plains Flora Association 1986, and Johnson and Larson 2007.

## Procedures

### The 1955-1962 Study

Grass and upland sedge tiller growth in height of leaves and stalks were collected from ungrazed plants during the growing seasons of 1955-1962. Basal leaves were measured from ground level to the tip of the extended leaves. Culm leaves were measured from ground level to the apex of the uppermost leaf. Stalk measurements were from ground levels to the tip of the stalk or to the tip of the inflorescence after it had developed. An average of 10 plants of each species were measured at approximate 7 to 10 day intervals from early May until early September. In addition, phenological growth stages were recorded to include stalk initiation, head emergence, flowering (anthesis), seed development, seed maturity, earliest seed shedding, and an estimation of percent of leaf dry in relation to total leaf area. The grass growth in height and phenological data were reported in Goetz 1963.

### The 1964-1969 Study

Phenological data of grass and upland sedge at anthesis stage was determined by recording observation dates. Leaf senescence by date was determined as an estimation of percentage of dry leaf in relation to total leaf area. Grass and upland sedge tiller growth in height of leaves were collected from ungrazed plants during the growing seasons of 1964-1966. Basal leaves were measured from ground level to the tip of the extended leaf. Culm leaves were measured from ground level to the apex of the uppermost leaf. An average of 20 plants at approximately 7 to 10 day intervals during the growing season from mid April to late August from control treatment on sandy, silty, overflow, and thin claypan ecological sites. Phenological data of anthesis stage, leaf senescence, and growth in leaf height were reported in Goetz 1970.

### The 1969-1971 Study

The range of flowering time of grasses and upland sedges were 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.

## Results

Needleleaf sedge resumes active leaf growth when liquid water becomes available in the soil for at least during the daylight hours. Basal leaves arise from rootstock buds and rhizome buds. Growth of new leaves is visible by 8 April (table 1). Growth of the flower stalk is visible by 29 April (tables 2). Leaf growth is very rapid during April and May, by late April, the tallest leaf has reached 53.0% of maximum height and by late May, the leaves have reached 90.0% of maximum height (table 1). Flower stalk growth is also very rapid. The flower stalk develops through the boot stage reaching head emergence by 2 May, with mean first flowers on 12 May and a 3 week flower period from mid May to mid June (tables 3 and 4). Flower stalks are at 40.8% of maximum height in early May, 70.7% of maximum height in mid May, and at 82.1% of maximum height in late May (table 2). Seeds are developing from mid May, are mature by 28 June, and the seed stalk reaches maximum height in early July (tables 2 and 4). Leaves reach maximum height in early July and leaf dryness starts soon after on 8 July and continues through July and August on silty ecological sites during 1955-1962 study (tables 1 and 4). During the 1964-1969 study, leaf dryness on thin claypan and silty sites starts during early June and on sandy sites starts mid June; these leaves are quite dry by late July (table 5). Leaf height on the thin claypan site are shorter (table 6) than those on silty sites during the 1955-1962 study (table 1). After mid June, leaf heights of tillers on the sandy and silty sites during the 1964-1969 study (table 6) are taller than those on the silty site during the 1955-1962 study (table 1). Needleleaf sedge herbage biomass was clipped every two weeks from areas that it was abundant during 5 growing seasons producing peak biomass during the first week of June at 182.50 lbs/ac (table 7). Even though upland sedges are short, on some ecological sites they contribute 23% of the herbage biomass, which is substantial. The upland sedges produce a lot of pounds of beef in the Northern Mixed Grass Prairie.

## Discussion

Needleleaf sedge, *Carex duriuscula*, is a native, long-lived perennial, cool season, short graminoid, monocot, of the upland sedge family that is common on healthy mixed grass prairie plant communities. Needleleaf sedge can grow on sandy, shallow, silty, and thin claypan ecological sites. Needleleaf sedge resumes leaf and stalk growth early from rhizome tiller buds. The long dark brown rhizomes produce single tillers at progressive intervals. New leaves of Needleleaf sedge are visible by 8 April and new stalks are visible by 29 April. Leaf growth is at 26% height on mid April, 71% height on mid May, 97% height on mid June, and 100% of maximum height on 1 July. Stalk growth is at 71% height on mid May, 92% height on mid June, and 100.0% of maximum height on 1 July. The stalk develops through the boot stage, reaches head emergence by 2 May, mean first flower occurs on 12 May, with a flower period from May to mid June. Seeds are developing from mid May, reach mature stage by 28 June, and start being shed within a few days. Leaf dryness starts early July and continues through July and August. Tillers drop below the phosphorus requirements of lactating cows early in the growing season. Crude protein content is adequate during June into early July, and remains below the requirements of lactating cows after mid July. Needleleaf sedge has an extensive fibrous root system that fans downward from each rhizome node spaced at 2.5 to 7.6 cm (1-3 in) intervals. Needleleaf sedge is a valuable asset on the Northern Mixed Grass Prairie.

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Table 1. Mean leaf height in cm and percent of maximum leaf height attained by Needleleaf sedge, *Carex duriuscula*, 1955-1962.

		April				
		1	8	15	22	29
cm			1.5	2.5	3.0	5.2
%			15.0	26.0	31.0	53.0
		May				
		1	8	15	22	29
cm		6.0	6.8	7.0	8.7	8.8
%		61.0	69.0	71.0	89.0	90.0
		June				
		1	8	15	22	29
cm		9.1	9.4	9.5	9.7	9.7
%		93.0	96.0	97.0	99.0	99.0
		July				
		1	8	15	22	29
cm		9.8				
%		100.0				
		August				
		1	8	15	22	29
cm						
%						

Data from Goetz 1963.

Table 2. Mean stalk height in cm and percent of maximum stalk height attained by Needleleaf sedge, *Carex duriuscula*, 1955-1962.

		April				
		1	8	15	22	29
cm						3.0
%						24.4
		May				
		1	8	15	22	29
cm		5.0	6.9	8.7	9.3	10.1
%		40.8	55.8	70.7	75.6	82.1
		June				
		1	8	15	22	29
cm		10.6	11.3	11.3	11.7	12.0
%		86.3	91.9	91.9	95.1	97.3
		July				
		1	8	15	22	29
cm		12.3				
%		100.0				
		August				
		1	8	15	22	29
cm						
%						

Data from Goetz 1963.

Table 3. First flower and flower period of Needleleaf sedge, *Carex duriuscula*.

	Apr	May	Jun	Jul	Aug	Sep
First Flower 1955-1962 Earliest						
Mean		12				
Flower Period 1969-1971			X XX			

First Flower Data from Goetz 1963 and Whitman et al. 1951.

Flower Period Data from Zaczkowski 1972.

Table 4. Flower stalk seed development and percent leaf dryness of Needleleaf sedge, *Carex duriuscula*.

Data Period	Flower Stalk Development			Seed Development	
	Boot	Emerge	Flower	Mature	Shed
1955-1962		2 May	12 May	28 Jun	

  

Data Period	Leaf Tip Dry	Percent Leaf Dryness			
		0-25 %	25-50 %	50-75 %	75-100 %
1955-1962	13 Jun	8 Jul	22 Jul	10 Aug	23 Aug

Data from Goetz 1963.

Table 5. Mean date of first flower and date of percentage categories of leaf senescence for Needleleaf sedge, 1964-1966.

Ecological Site	Anthesis	Leaf Tip Dry	Leaf 0-25% Dry	Leaf 25%-50% Dry	Leaf 50%-75% Dry
Sandy	4 May	1 Jun	15 Jun	3 Jul	25 Jul
Silty	5 May	31 May	7 Jun	30 Jun	31 Jul
Overflow	No Data				
Thin claypan	5 May	22 May	6 Jun	28 Jun	27 Jul

Data from Goetz 1970.

Table 6. Mean leaf height in cm for Needleleaf sedge, 1964-1966.

Ecological Site	15 Apr	30 Apr	15 May	31 May	15 Jun	30 Jun	15 Jul	31 Jul	15 Aug	31 Aug	Maximum Height
Sandy	2.01	3.61	5.00	8.00	9.50	12.40	12.90	12.90	12.80	12.80	13.00
Silty	2.01	4.29	7.01	9.70	10.80	11.61	12.19	12.09	11.91	11.91	12.19
Overflow	No Data										
Thin claypan	2.01	3.61	5.31	6.40	8.10	8.31	8.61	8.61	8.61	8.61	8.61

Data from Goetz 1970.

Table 7. Herbage biomass (lbs/ac) and percent of total weight of Needleleaf sedge from an ungrazed area it was abundant, 1958-1962.

		1 May	15 May	1 Jun	15 Jun	1 Jul	15 Jul	1 Aug	15 Aug	1 Sep	Mean
Needleleaf Sedge	lbs/ac	115.26	76.84	182.50	134.47	118.14	89.33	98.93	104.69	83.56	115.95
	%	23.5	12.3	23.2	13.1	11.2	7.2	8.1	7.5	7.0	11.0

Data from Goetz 1963.

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