

Autecology of Canada Bluegrass on the Northern Mixed Grass Prairie

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The autecology of Canada bluegrass, *Poa compressa*, 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).

Canada bluegrass, (Flatstem bluegrass) *Poa compressa* L., is a member of the grass family, Poaceae, tribe, Poeae, and is a naturalized (introduced from Europe into Canada during the late 1700's), long lived perennial, monocot, cool-season, mid grass, that is moderately tolerant of drought and saline soils, and shade intolerant. The first North Dakota record is Zaczkowski 1970. Early aerial growth consists of basal leaves arising from rhizome tiller buds. Basal leaf blades are short 2-10 cm (0.8-4 in) long, 1.2-3.2 mm wide, bluegreen, with tip boat prow shaped. The split sheath is compressed and strongly flattened and has thin, translucent margins that overlap near base. The collar is yellow, narrow and divided. The membrane ligule is continuous with sheath margins and has 1 mm long ends rising to an acute center at 3 mm long. The auricles are absent. The rhizome system has frequent branching with solitary or usually several tillers produced at each node at progressive intervals. The fibrous root system has fine branching main roots arising from stem crowns and rhizome nodes that extend deep into the soil. Regeneration is primarily asexual propagation by crown and rhizome tiller buds. Seedlings are only successful where competition from established plants is nonexistent. Flower stalks are erect, wiry, hollow, 20-40 cm (8-16 in) tall, and strongly flattened to be 2-edged. Inflorescence is a narrow, compact, oblong panicle, 3-8.5 cm (1.2-3.3 in) long, that opens during flowering and becomes contracted after flowering. Two or a few short branches arise at each node with a few small spikelets, 3-5.5 mm long, that have 2-6 florets each.

Flower period is from early to late June, starting about two weeks after Kentucky bluegrass. Aerial parts are highly palatable to livestock. Fire top kills aerial parts and can consume entire crown when soil is dry. Fire halts the processes of the four major defoliation resistance mechanisms and causes great reductions in biomass production and tiller density. This summary information on growth development and regeneration of Canada bluegrass was based on works of Stevens 1963, Zaczkowski 1972, Dodds 1979, Great Plains Flora Association 1986, Uchtyl 1993, Larson and Johnson 2007, and St. John et al. 2012.

Procedures

The 1969-1971 Study

The range of flowering time of grasses and upland sedges 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 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 was reflected in the data summary tables as a 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

Canada bluegrass, *Poa compressa*, has a similar appearance to Kentucky bluegrass except the hollow stem of the flower stalk is strongly flattened at the bottom and has a reddish purple color and the phenological growth stages occur about two weeks later. Canada bluegrass has early greenup towards

late April or early May. Early boot stage occurs in early to mid May and stalk emergence occurs in late May. Early stalks with flowers appear during early June. Zaczkowski (1973) determined that escaped Canada bluegrass plants had a four week flower period during June (table 1). Seed development occurs after the flower stage and seeds mature during late June into early July.

The nutritional quality of ungrazed lead tillers change with the tillers' phenological development. The crude protein content starts to decrease shortly after the flower stage with little forage quality by mid to late June. Basal leaves of vegetative tillers developed during early July and fall tiller growth began in mid August.

The 1983-2012 study follows the patterns in the changes of individual grass species abundance for 30 growing seasons on the sandy, shallow, and silty ecological sites of the long-term nongrazed, traditional seasonlong, and twice-over rotation management treatments (tables 2 and 3). Grass species composition in rangeland ecosystems is variable during a growing season and dynamic among growing seasons.

On the sandy site of the nongrazed treatment, Canada bluegrass was present during 28.0% of the years that basal cover data were collected with a mean 0.44% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 46.7% of the years with a mean 0.74% basal cover. Canada bluegrass had low abundance on the sandy site of the nongrazed treatment (tables 2 and 3).

On the sandy site of the ungrazed seasonlong treatment, Canada bluegrass was present during 40.0% of the years that basal cover data were collected with a mean 0.83% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 66.7% of the years with a mean 1.39% basal cover. Canada bluegrass had moderate abundance on the sandy site of the ungrazed seasonlong treatment (tables 2 and 3).

On the sandy site of the grazed seasonlong treatment, Canada bluegrass was present during 36.0% of the years that basal cover data were collected with a mean 0.33% basal cover during the total 30 year period. During the early period (1983-

1992). Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 60.0% of the years with a mean 0.56% basal cover. Canada bluegrass had low abundance on the sandy site of the grazed seasonlong treatment (tables 2 and 3).

On the sandy site of the ungrazed twice-over treatment, Canada bluegrass was present during 53.6% of the years that basal cover data were collected with a mean 0.48% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 93.3% of the years with a mean 0.82% basal cover. Canada bluegrass had low abundance on the sandy site of the ungrazed twice-over treatment (tables 2 and 3).

On the sandy site of the grazed twice-over treatment, Canada bluegrass was present during 37.9% of the years that basal cover data were collected with a mean 0.13% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 66.7% of the years with a mean 0.26% basal cover. Canada bluegrass had low abundance on the sandy site of the grazed twice-over treatment (tables 2 and 3).

On the shallow site of the nongrazed treatment, Canada bluegrass was present during 7.7% of the years that basal cover data were collected with a mean 0.02% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 13.3% of the years with a mean 0.04% basal cover. Canada bluegrass had very low abundance on the shallow site of the nongrazed treatment (tables 2 and 3).

On the shallow site of the ungrazed seasonlong treatment, Canada bluegrass was present during 3.9% of the years that basal cover data were collected with a mean 0.002% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 6.7% of the years with a mean 0.003% basal cover. Canada bluegrass had very low abundance on the shallow site of the ungrazed seasonlong treatment (tables 2 and 3).

On the shallow site of the grazed seasonlong treatment, Canada bluegrass was not present during the total 30 year period (tables 2 and 3).

On the shallow site of the ungrazed twice-over treatment, Canada bluegrass was present during 31.0% of the years that basal cover data were collected with a mean 0.1% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 60.0% of the years with a mean 0.19% basal cover. Canada bluegrass had very low abundance on the shallow site of the ungrazed twice-over treatment (tables 2 and 3).

On the shallow site of the grazed twice-over treatment, Canada bluegrass was present during 16.7% of the years that basal cover data were collected with a mean 0.03% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was present during 10.0% of the years with a mean 0.02% basal cover. During the later period (1998-2012), Canada bluegrass was present during 26.7% of the years with a mean 0.05% basal cover. Canada bluegrass had very low abundance on the shallow site of the grazed twice-over treatment (tables 2 and 3).

On the silty site of the nongrazed treatment, Canada bluegrass was present during 50.0% of the years that basal cover data were collected with a mean 2.84% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 86.7% of the years with a mean 4.92% basal cover. Canada bluegrass had moderate abundance on the silty site of the nongrazed treatment (tables 2 and 3).

On the silty site of the ungrazed seasonlong treatment, Canada bluegrass was present during 46.2% of the years that basal cover data were collected with a mean 2.41% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 73.3% of the years with a mean 4.12% basal cover. Canada bluegrass had moderate abundance on the silty site of the ungrazed seasonlong treatment (tables 2 and 3).

On the silty site of the grazed seasonlong treatment, Canada bluegrass was present during

42.3% of the years that basal cover data were collected with a mean 0.69% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 66.7% of the years with a mean 1.08% basal cover. Canada bluegrass had moderate abundance on the silty site of the grazed seasonlong treatment (tables 2 and 3).

On the silty site of the ungrazed twice-over treatment, Canada bluegrass was present during 55.2% of the years that basal cover data were collected with a mean 2.28% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was present during 11.1% of the years with a mean 0.02% basal cover. During the later period (1998-2012), Canada bluegrass was present during 93.3% of the years with a mean 4.36% basal cover. Canada bluegrass had moderate abundance on the silty site of the ungrazed twice-over treatment (tables 2 and 3).

On the silty site of the grazed twice-over treatment, Canada bluegrass was present during 50.0% of the years that basal cover data were collected with a mean 0.33% basal cover during the total 30 year period. During the early period (1983-1992), Canada bluegrass was not present. During the later period (1998-2012), Canada bluegrass was present during 93.3% of the years with a mean 0.48% basal cover. Canada bluegrass had low abundance on the silty site of the grazed twice-over treatment (tables 2 and 3).

On the shallow site, Canada bluegrass was present during 11.9% of the years with a mean 0.03% basal cover. On the sandy site, Canada bluegrass was present during 39.1% of the years with a mean 0.44% basal cover. On the silty site, Canada bluegrass was present during 48.7% of the years with a mean 1.71% basal cover.

On the shallow site of the seasonlong treatment, Canada bluegrass was present during 1.9% of the years with a mean 0.001% basal cover. On the shallow site of the nongrazed treatment, Canada bluegrass was present during 7.7% of the years with a mean 0.02% basal cover. On the shallow site of the twice-over treatment, Canada bluegrass was present during 23.9% of the years with a mean 0.07% basal cover.

On the sandy site of the nongrazed treatment, Canada bluegrass was present during 28.0% of the years with a mean 0.44% basal cover.

On the sandy site of the seasonlong treatment, Canada bluegrass was present during 38.0% of the years with a mean 0.58% basal cover. On the sandy site of the twice-over treatment, Canada bluegrass was present during 45.8% of the years with a mean 0.31% basal cover.

On the silty site of the seasonlong treatment, Canada bluegrass was present during 44.2% of the years with a mean 1.55% basal cover. On the silty site of the nongrazed treatment, Canada bluegrass was present during 50.0% of the years with a mean 2.84% basal cover. On the silty site of the twice-over treatment, Canada bluegrass was present during 52.6% of the years with a mean 1.30% basal cover.

On the shallow site of the not grazed treatments, Canada bluegrass was present during 14.2% of the years with a mean 0.04% basal cover. On the shallow site of the grazed treatments, Canada bluegrass was present during 8.3% of the years with a mean 0.02% basal cover.

On the sandy site of the not grazed treatments, Canada bluegrass was present during 40.5% of the years with a mean 0.59% basal cover. On the sandy site of the grazed treatments, Canada bluegrass was present during 37.0% of the years with a mean 0.23% basal cover.

On the silty site of the not grazed treatments, Canada bluegrass was present during 50.4% of the years with a mean 2.51% basal cover. On the silty site of the grazed treatments, Canada bluegrass was present during 46.2% of the years with a mean 0.51% basal cover.

Discussion

Canada bluegrass, *Poa compressa*, is a naturalized, introduced, long-lived perennial, cool season, mid grass, monocot, of the grass family. Canada bluegrass was introduced from Europe into Canada sometime around or after 1700. It now extends across the prairie Provinces of Canada and extends southward in Northern and Eastern United States.

Zaczkowski (1972) was the first botanist to find Canada bluegrass present in western North Dakota in 1970. It was present at the DREC ranch just west of Manning, ND, during 1983 to 1985 at low abundance. A long low precipitation period occurred during 1988 to 1992. Canada bluegrass was not present on any sites during that period and did not reappear until 1995, the third growing season with

near 100% of the long-term mean precipitation. Canada bluegrass has a strong preference for ungrazed silty and sandy ecological sites and a much lower affinity to shallow ecological sites and grazed mixed grass prairie. Canada bluegrass is not a desirable grass to have in a grassland pasture.

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Table 1. Flower period of *Poa compressa*, Canada bluegrass.

	Apr	May	Jun	Jul	Aug	Sep
Flower Period 1969-1971			XX	XX		

Flower Period Data from Zaczkowski 1972.

Table 2. Autecology of <i>Poa compressa</i> , Canada bluegrass, 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	0.00	0.00
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.20	0.01
1999-2003	1.46	0.08	0.08	0.50	0.19
2004-2009	0.62	1.70	0.81	0.72	0.20
2010-2012	0.00	3.40	1.03	1.82	0.55
Shallow					
1983-1987	0.00	0.00	0.00	0.00	0.04
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	0.01	0.01	0.00	0.27	0.08
2004-2009	0.08	0.00	0.00	0.17	0.04
2010-2012	0.00	0.00	0.00	0.19	0.03
Silty					
1983-1987	0.00	0.00	0.00	0.06	0.00
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.14	0.26	0.09	0.42
1999-2003	7.65	11.79	2.99	3.08	0.40
2004-2009	4.94	0.28	0.22	5.53	0.62
2010-2012	1.98	0.38	0.00	5.59	0.51

Table 3. Autecology of <i>Poa compressa</i> , Canada bluegrass, 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	1.86	0.08
1999-2003	11.52	0.69	0.70	5.82	1.47
2004-2009	4.83	15.81	5.51	7.28	1.61
2010-2012	0.00	33.17	8.21	21.27	4.66
Shallow					
1983-1987	0.00	0.00	0.00	0.00	0.12
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	0.09	0.07	0.00	2.23	0.65
2004-2009	0.94	0.00	0.00	1.57	0.34
2010-2012	0.00	0.00	0.00	1.55	0.30
Silty					
1983-1987	0.00	0.00	0.00	0.21	0.00
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	1.37	2.39	0.90	3.36
1999-2003	55.42	81.03	19.39	29.51	2.62
2004-2009	39.99	2.27	1.58	54.83	5.19
2010-2012	18.68	2.58	0.00	54.43	4.03

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