Autecology of Daisy Fleabane on the Northern Mixed Grass Prairie

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The autecology of Daisy fleabane, *Erigeron strigosus*, 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).

Daisy fleabane, *Erigeron strigosus* Muhl. ex Willd., is a member of the aster (sunflower) family, Asteraceae, and is a native, short lived biennial or annual, dicot, herb. The first North Dakota record is Stevens 1953. First year aerial growth forms a basal rosette of leaves along with the early development of the crown and taproot. Second year early growth develops basal leaves oblanceolate to elliptic to 15 cm (5.9 in) long, 2.5 cm (1.0 in) wide, with relatively long petioles that are early decidous, followed by a single or 2 to 5 erect, simple, stems 30-80 cm (11.8-31.5 in) tall arising from the crown. Stems leaves are alternate, sparse, linear to oblanceolate 2-8 cm (0.8-3.1 in) long, 16 mm wide, sessile, decreasing upward. Stem and leaves are covered with short flattened hairs, thicker below than above. The root system consists of a shallow branching taproot with extensive spreading secondary fibrous roots. Regeneration is by limited vegetative and sexual reproduction. Vegetative growth is regrowth shoots from the existing crown. Inflorescence are several to numerous solitary heads 1 cm (0.4 in) wide terminal on peduncles arising from leaf axils forming cymes on branches from the upper portions of the stems. Flowers have white ray florets appearing during mid June to early August. Pollination is by numerous small bees, flies, and other insects. Fruit is a small achene with pappus of small tufts of bristles. Aerial parts are not usually eaten by livestock and are totally killed by fire. Damage to aerial parts activates limited regrowth shoots from the existing crown. This summary information on growth development and regeneration of Daisy fleabane was based on works of Weaver 1954, Stevens 1963, Zaczkowski 1972, Great Plains Flora Association 1986, Stubbendieck et al. 2003, and Johnson and Larson 2007.

Procedures

The 1969-1971 Study

The range of flowering time of Daisy fleabane 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 Daisy fleabane 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 Daisy fleabane 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 the 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 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

Daisy fleabane grows as a winter biennial or rarely an annual. The first year aerial growth forms a basal rosette of leaves, a crown, and a taproot. Second year growth resumes early spring producing a set of larger basal leaves with long petioles. One to a few erect stems arise from the crown. A shallow branching taproot continues to develop below the crown with extensive spreading secondary fibrous roots. All of the basal rosette leaves become senescent around the flower period. Numerous solitary composite heads develop on peduncles that arise from leaf axils on the upper portion of the stem. The observed 6 week flower period extends from mid June to early August (table 1) (Zaczkowski 1972). The mean mature stem height ranges from 30 cm (11.8 in) to 80 cm (31.5 in) tall (Stevens 1963).

Plant species composition in rangeland ecosystems is variable during a growing season and dynamic among growing seasons. Daisy fleabane was found to have low abundance on the sandy and shallow ecological sites. Patterns in the changes of individual plant species abundance was followed for 30 growing seasons during the 1983-2012 study on the silty ecological sites of the long-term nongrazed, traditional seasonlong, and twice-over rotation management treatments (tables 2, 3, and 4).

Daisy fleabane develops from seed as a winter biennial or annual depending on when it germinates; in the early fall or in the early spring. Precipitation amounts above average were evaluated for August, September, October, April, and May during the 30 growing seasons of 1983-2012 (Manske 2016). Daisy fleabane was present during 12 growing seasons and not present during 18 growing seasons. During 9 growing seasons that Daisy fleabane was present, one or two of the late summer or early fall months plus one or two of the early spring months received above average precipitation. During 3 growing seasons that Daisy fleabane was present, one or two of the previous late summer or early fall months received above average precipitation, and the two spring months received normal or slightly below

normal precipitation. Daisy fleabane was not present during growing seasons that the previous late summer or early fall months did not receive above average precipitation and only the early spring months received above average precipitation.

Daisy fleabane was present during 12 growing seasons (40.0%). During all 12 of these growing seasons (100.0%) the Daisy fleabane seeds had germinated during the previous late summer or early fall and the plants were winter biennials. At no time during the total 30 year period did Daisy fleabane seeds germinate during the current early spring months, thus none of the plants were annuals.

On the silty site of the nongrazed treatment, Daisy fleabane was present during 5.3% and 7.7% of the years that density and basal cover data were collected with a mean 0.021 stems/m^2 density and a mean 0.006% basal cover during the total 30 year period, respectively. During the early period (1983-1992), Daisy fleabane was not present on the silty site of the nongrazed treatment. During the later period (1998-2012), Daisy fleabane was present during 7.1% and 6.7% of the years with a mean 0.029 stems/m^2 density and a mean 0.002% basal cover, respectively. Daisy fleabane was not present during the early period and all observations were made during the later period that indicated low abundance.

On the silty site of the ungrazed seasonlong treatment, Daisy fleabane was not present during the total 30 year period.

On the silty site of the grazed seasonlong treatment, Daisy fleabane was not present during the total 30 year period.

On the silty site of the ungrazed twice-over treatment, Daisy fleabane was present during 22.7% and 10.3% of the years that density and basal cover data were collected with a mean 0.055 stems/m^2 density and a mean 0.003% basal cover during the total 30 year period, respectively. During the early period (1983-1992), Daisy fleabane was not present where basal cover data were collected and was present during 14.3% of the years with a mean 0.13 stems/m^2 density. During the later period (1998-2012), Daisy fleabane was present during 20.0% and 13.3% of the years with a mean 0.02 stems/m^2 density and a mean 0.002% basal cover, respectively. The percent present for basal cover data and stem density decreased slightly and the observations made during the later period for the basal cover data indicated low abundance.

On the silty site of the grazed twice-over treatment, Daisy fleabane was present during 18.2% and 3.3% of the years that density and basal cover data were collected with a mean 0.023 stems/m^2 density and a mean 0.001% basal cover during the total 30 year period, respectively. During the early period (1983-1992), Daisy fleabane was not present where basal cover data were collected and was present during 14.3% of the years with a mean 0.014 stems/m^2 density. During the later period (1998-2012), Daisy fleabane was present during 20.0% and 6.7% of the years with a mean 0.027 stems/m^2 density and a mean 0.001% basal cover, respectively. The percent present for density data and stem density increased slightly and the observations made during the later period for the basal cover data indicated low abundance. Daisy fleabane on the silty site of the ungrazed and grazed twice-over treatment had low abundance and the percent present, stem density, and basal cover were fairly similar.

Daisy fleabane was present on the silty site of the nongrazed treatment during 5.3% and 7.7% of the years with a mean 0.02 stems/m^2 density and a mean 0.006% basal cover. Daisy fleabane was not present on the silty site of the seasonlong treatment. Daisy fleabane was present on the silty site of the twice-over treatment during 20.5% and 6.8% of the years with a mean 0.039 stems/m^2 density and a mean 0.002% basal cover. The percent present for the density data and stem density were slightly greater on the twice-over treatment. The percent present for basal cover data and basal cover were slightly greater on the nongrazed treatment. Daisy fleabane had low abundance on all management treatments (tables 2, 3, and 4).

On the silty site, Daisy fleabane was present during 9.2% and 4.3% of the years with a mean 0.02 stems/m^2 density and a mean 0.002% basal cover indicating a very low abundance.

Discussion

Daisy fleabane *Erigeron strigosus*, is a native, late succession, winter biennial or rarely annual, dicot, forb of the aster family that is usually present at low abundance on healthy mixed grass prairie plant communities. Daisy fleabane can grow on silty ecological sites. Germination of Daisy fleabane seed during late summer or early fall depends on above average precipitation during August and/or September and/or October. A small basal rosette of leaves and the initial development of a taproot arise from the seed. Water stress caused by low precipitation during a growing season month

after germination can terminate seedling development. The leaves of the basal rosette and taproot over winter and resume development early the following spring if April and/or May receive above average precipitation. A set of larger basal leaves with long petioles develops then one or a few erect stems arise from the crown. Extensive spreading secondary fibrous roots develop from the shallow branching taproot. The basal rosette leaves become senescent just before or during the flower period. Numerous solitary composite heads with white ray florets develop on the peduncles that arise from leaf axils on the upper portion of the stem. A 6 week flower period extends from mid June to early August (1969-1971 study). The mean mature stem height ranges from 30-80 cm (11.8-31.5 in) tall (Stevens 1963).

Daisy fleabane is primarily a winter biennial and germinates during late summer or early fall during growing season months with above average precipitation. Continuation of growth development the following spring requires above average or near normal precipitation during the two early spring months. During the total 30 year period, Daisy fleabane seed did not germinate during the early spring months. Daisy fleabane was present on the 1983-2012 study during 12 growing seasons (40.0%) in low abundance on silty ecological sites.

The production of a huge quantity of tiny seeds that have pappus of bristles permitting wide distribution by wind help Daisy fleabane to persist on the Northern Mixed Grass Prairie.

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Table 1. Flower period of Erigeron strigosus, Daisy fleabone.

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

Flower Period Data from Zaczkowski 1972.

Table 2. Autecology of Erigeron strigosus, Daisy fleabane, 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	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Shallow					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Silty					
1983-1987	0.00	0.00	0.00	1.71	0.13
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	0.29	0.00	0.00	0.27	0.16
2004-2009	0.00	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.93	0.29

Table 3. Autecology of Erigeron strigosus, Daisy fleabane, 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	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Shallow					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Silty					
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	0.32	0.00	0.00	0.10	0.00
1999-2003	0.00	0.00	0.00	0.06	0.04
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 Erigeron strigosus, Daisy fleabane, with growing season changes in density, 1983-2012.					
Ecological Site Year Period	Nongrazed	Seasonlong		Twice-over	
		Ungrazed	Grazed	Ungrazed	Grazed
Sandy					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Shallow					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Silty					
1983-1987	0.00	0.00	0.00	0.03	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	0.01	0.00	0.00	0.00	0.01
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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