Autecology of Little Bluestem on the Northern Mixed Grass Prairie

Llewellyn L. Manske PhD
Research Professor of Range Science
North Dakota State University
Dickinson Research Extension Center
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The autecology of Little bluestem, *Schizachyrium scoparium*, 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).

Little bluestem, *Schizachyrium scoparium* (Michx.) Nash., is a member of the grass family, Poaceae, tribe, Andropogoneae, syn.: *Andropogon scoparius* Michx., and is a native, long lived perennial, monocot, warm-season, mid grass, that is drought tolerant. The first North Dakota record is Bolley 1891. Early aerial growth consists of basal leaves arising from axillary buds of crown tillers and from fall produced tiller buds on short rhizomes. Leaf blades are usually partially folded along mid rib, 5-15 cm (2-6 in) long, 3-6 mm wide, tapering to a point, bluish green with red tinge, constricted at base. The split sheath has nonoverlapping margins, is strongly keeled, and flattened laterally with purplish base. The collar is continuous and broad. The ligule is a fringed membrane, 0.6-2.3 mm long, with a blunt rounded shape, and covered with short hairs. The auricles are absent. The rhizomes are short and can form mats. The extensive root system has numerous tan roots 0.1-1.0 mm thick, branching profusely to the third and fourth order with many branches 76 cm (30 in) long and diverging at various angles. The lateral spread is 30.5-45.7 cm (12-18 in) outward from base of crown then most roots grow vertically downward to 1.4-1.7 m (4.5-5.5 ft) deep. Finely branched rootlets almost completely occupy the top 76 cm (2.5 ft) of soil. Regeneration is primarily asexual propagation by crown tillers and short rhizome tillers. Seedlings are rare and usually have weak vigor. Flower stalks are erect, fine, wiry, flattened towards base, with solid center of pith, 30-80 cm (12-32 in) tall, red to reddish purple, and not grooved. Inflorescence are numerous, single spicate racemes terminal on stem branches, 2.5-7.6 cm (1-3 in) long. Flower period is from early August to September. Leaves are highly palatable to livestock, however, most animals are reluctant to push their nose into the dense concentration of stiff seed heads. Fire top kills aerial parts and kills deeply into the 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 Little bluestem was based on works of Weaver 1954, Stevens 1963, Zaczkowski 1972, Dodds 1979, Great Plains Flora Association 1986, Steinberg 2002, Larson and Johnson 2007, Stubbendieck et al. 2011, and Tober and Jensen 2013.

Procedures

The 1946-1947 Study

Grass and upland sedge species samples to determine crude protein and phosphorus content were collected weekly during the growing seasons of 1946 and 1947 from two seeded domesticated grasslands and a native rangeland pasture at the Dickinson Research Extension Center located at Dickinson in western North Dakota. Current year's growth of lead tillers of each species was included in the sample; previous year's growth was separated and discarded. Ungrazed samples were collected for each species except for Kentucky bluegrass, which only grew along a watercourse where almost all of the plants had been grazed and remained in an immature vegetative stage, however, a small number of plants escaped grazing and developed normally providing the phenological development data. Crude protein (N X 6.25) content was determined by the procedure outlined in the Official and Tentative Methods of Analysis (A.O.A.C. 1945). Phosphorus content was determined by the method outlined by Bolin and Stamberg (1944). Data were reported as percent of oven-dried weight.

Plant condition by stage of plant development and growth habit was collected for each species on sample dates. These data are reported as phenological growth stage in the current report. The

grass nutritional quality and phenological growth data were published in Whitman et al. 1951.

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 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 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 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 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 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

Little bluestem resumes basal leaf growth from axillary buds of crown tillers and fall produced tiller buds on short rhizomes. Growth of new Little bluestem leaves is visible by 8 May (table 2). Leaf growth is extremely slow during May. Rapid leaf growth begins during early June and continues

through June (tables 1 and 2). Crude protein content is at 11.7% in early June, Little bluestem produces 3.5 new leaves a little after mid June when crude protein content is at 11.0% and a phosphorus content at 0.223% (table 1). 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 gramnivores. During mid June, leaf height is 72% of maximum at 11.0 cm (4.3 in) tall (table 2). Early stalk growth become active during mid to late June, develops to the boot stage between 30 June and 2 July, flower stalk growth is rapid during July, reaches head emergence around 19 July, produces the first flowers by 16 July, reaches mean first flower stage on 2 August, with a 2 week flower period from early to mid August (tables 1, 3, 4, and 5). The flower stalks are at 73.2% height in late July, at 80.5% height in early August, and at 100% maximum height in mid August (table 3). The lead tillers contain 10.9% crude protein in early July and drops below the requirements of lactating cows during the first week of July (tables 1 and 6). Leaf growth is at 96.0% height in early July and at 100% growth in height on 22 July (table 2). Seeds are developing by 24 July, maturing by 6 August, reach the mature stage during 18 August to 3 September, and start being shed around 30 August (tables 1 and 5). Leaf dryness starts during late July, continues during August into September (table 5). Phosphorus content of lead tillers drops below requirements of lactating cows during the first week of August (tables 1 and 6). Unless the grazing management practice has properly manipulated the stimulation of an adequate quantity of Little bluestem vegetative tillers, lactating cows will be grazing forage below their requirements after mid 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, shallow, and silty ecological sites of the long-term nongrazed, traditional seasonlong, and twice-over rotation management treatments (tables 7 and 8).

On the sandy site of the nongrazed treatment, Little bluestem was present during 40.0% of the years that basal cover data were collected with a mean 2.37% basal cover during the total 30 year period. During the early period (1983-1992), Little bluestem was present during 60.0% of the years with a mean 1.46% basal cover. During the later period (1998-2012), Little bluestem was present during 46.7% of the years with a mean 3.31% basal cover. The percent present decreased and basal cover increased greatly on the sandy site of the nongrazed treatment over time (tables 7 and 8).

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

On the sandy site of the ungrazed twice-over treatment, Little bluestem was present during 71.4% of the years that basal cover data were collected with a mean 0.37% basal cover during the total 30 year period. During the early period (1983-1992), Little bluestem was present during 62.5% of the years with a mean 0.17% basal cover. During the later period (1998-2012), Little bluestem was present during 100.0% of the years with a mean 0.60% basal cover. The percent present and basal cover increased on the sandy site of the ungrazed twice-over treatment over time (tables 7 and 8).

On the sandy site of the grazed twice-over treatment, Little bluestem was present during 65.5% of the years that basal cover data were collected with a mean 0.17% basal cover during the total 30 year period. During the early period (1983-1992), Little bluestem was present during 66.7% of the years with a mean 0.30% basal cover. During the later period (1998-2012), Little bluestem was present during 80.0% of the years with a mean 0.15% basal cover. The percent present increased and basal cover decreased on the sandy site of the grazed twice-over treatment over time (tables 7 and 8). The percent present and basal cover were greater during the early period on the sandy site of the grazed twice-over treatment and the percent present and basal cover were greater during the total study and the later period on the sandy site of the ungrazed twice-over treatment.

On the shallow site of the nongrazed treatment, Little bluestem was present during 34.6% of the years that basal cover data were collected with a mean 0.11% basal cover during the total 30 year period. During the early period (1983-1992), Little bluestem was present during 16.7% of the years with a mean 0.05% basal cover. During the later period (1998-2012), Little bluestem was present during 53.3% of the years with a mean 0.18% basal cover. The percent present and basal cover increased on the shallow site of the nongrazed treatment over time (tables 7 and 8).

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

On the shallow site of the ungrazed twice-over treatment, Little bluestem was present during 79.3% of the years that basal cover data were collected with a mean 1.15% basal cover during the total 30 year period. During the early period (1983-1992), Little bluestem was present during 66.7% of the years with a mean 0.47% basal cover. During the later period (1998-2012), Little bluestem was present during 100.0% of the years with a mean 1.79% basal cover. The percent present increased and basal cover increased greatly on the shallow site of the ungrazed twice-over treatment over time (tables 7 and 8).

On the shallow site of the grazed twice-over treatment, Little bluestem was present during 60.0% of the years that basal cover data were collected with a mean 0.30% basal cover during the total 30 year period. During the early period (1983-1992), Little bluestem was present during 60.0% of the years with a mean 0.21% basal cover. During the later period (1998-2012), Little bluestem was present during 73.3% of the years with a mean 0.46% basal cover. The percent present and basal cover increased on the shallow site of the grazed twice-over treatment over time (tables 7 and 8). The percent present and basal cover were greater on the shallow site of the ungrazed twice-over treatment than those on the shallow site of the grazed twice-over treatment.

On the silty site of the nongrazed treatment, Little bluestem was not present during 1983 to 2012.

On the silty site of the ungrazed seasonlong treatment, Little bluestem was not present during 1983 to 2012.

On the silty site of the grazed seasonlong treatment, Little bluestem 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), Little bluestem was not present. During the later period (1998-2012), Little bluestem was present during 6.7% of the years with a mean 0.003% basal cover. Little bluestem was not present during the early period and all basal cover observations were made during the later period indicating extremely low abundance on the silty site of the grazed seasonlong treatment over time (tables 7 and 8).

On the silty site of the ungrazed twice-over treatment, Little bluestem was present during 13.8% 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), Little bluestem was not present. During the later period (1998-2012), Little bluestem was present during 13.3% of the years with a mean 0.01% basal cover. Little bluestem was not present during the early period and all basal cover observations were made during the later period indicating low abundance on the silty site of the ungrazed twice-over treatment over time (tables 7 and 8).

On the silty site of the grazed twice-over treatment, Little bluestem was present during 10.0% of the years that basal cover data were collected with a mean 0.11% basal cover during the total 30 year period. During the early period (1983-1992), Little bluestem was present during 10.0% of the years with a mean 0.04% basal cover. During the later period (1998-2012), Little bluestem was present during 13.3% of the years with a mean 0.19% basal cover. The percent present and basal cover increased on the silty site of the grazed twice-over treatment over time (tables 7 and 8). The percent present were similar and basal cover was greater on the silty site of the grazed twice-over treatment than that on the silty site of the ungrazed twice-over treatment.

On the sandy site, Little bluestem was present during 35.4% of the years with a mean 0.97% basal cover. On the shallow site, Little bluestem was present during 34.8% of the years with a mean 0.52% basal cover. On the silty site, Little bluestem was present during 5.5% of the years with a mean 0.05% basal cover. Little bluestem was not abundant on any of the ecological sites. It had greater percent present and basal cover on the sandy site.

On the sandy site of the nongrazed treatment, Little bluestem was present during 40.0% of the years with a mean 2.37% basal cover. On the sandy site of the seasonlong treatment, Little bluestem was not present. On the sandy site of the twice-over treatment, Little bluestem was present during 68.5% of the years with a mean 0.27% basal cover. On the sandy site, Little bluestem had greater percent present on the twice-over treatment and greater basal cover on the nongrazed treatment.

On the shallow site of the nongrazed treatment, Little bluestem was present during 34.6% of the years with a mean 0.11% basal cover. On the shallow site of the seasonlong treatment, Little bluestem was not present. On the shallow site of the twice-over treatment, Little bluestem was present during 69.7% of the years with a mean 0.73% basal cover. On the shallow site, Little bluestem had the greatest percent present and basal cover on the twice-over treatment.

On the silty site of the nongrazed treatment, Little bluestem was not present. On the silty site of the seasonlong treatment, Little bluestem was present during 1.9% of the years with a mean 0.002% basal cover. On the silty site of the twice-over treatment, Little bluestem was present during 11.9% of the years with a mean 0.07% basal cover. Little bluestem had low abundance on all silty ecological sites. Of these, the greatest percent present and basal cover was on the twice-over treatment.

On the nongrazed treatment, Little bluestem was present during 24.9% of the years with a mean 0.83% basal cover. On the seasonlong treatment, Little bluestem was present during 0.6% of the years with a mean very near to zero % basal cover. On the twice-over treatment, Little bluestem was present during 50.0% of the years with a mean 0.35% basal cover. Little bluestem had low abundance on all management treatments. Of these, the greatest percent present was on the twice-over treatment and the greatest basal cover was on the nongrazed treatment.

Discussion

Little bluestem, *Schizachyrium scoparium*, is a native, long-lived perennial, warm season, mid grass, monocot, of the grass family that is common on healthy mixed grass prairie plant communities. Little bluestem can grow on sandy, shallow, and silty ecological sites. Little bluestem was not very abundant on any of the ecological sites of the three management treatments. Little bluestem had greater percent present and basal cover on the sandy site and had the greatest percent present on the twice-over treatment and greatest basal cover on the nongrazed treatment. Little bluestem resumes basal leaf growth from axillary buds of crown tillers and fall produced tiller buds on short rhizomes. New leaves of Little bluestem are visible by 8 May. Leaf growth is rapid during June. Leaf growth is at 26% height during mid May, 72% height on mid June when 3.5 new leaves are produced, 99% height on mid July, and at 100% maximum height on 22 July. Early active stalk growth begins in mid June. The stalk is at boot stage between 30 June and 2 July, stalk growth in height is rapid during July, head emergence is reached by 19 July, early first flowers appear 16 July, mean first flowers occur on 2 August, with a 2 week flower period from early to mid August. Seeds are developing from 24 July, seeds are maturing around 6 August, reach the mature stage between 18 August and 3 September, and start being shed on 30 August. Crude protein content of lead tillers is at 11.7% during early June, is at 11.0% during mid June at the 3.5 new leaf stage, is at 10.9% during early July, and drops below the requirements of lactating cows during the first week of July. Lead tillers drop below the phosphorus requirements of lactating cows during the first week of August. Little bluestem must have 25% to 33% of the lead tiller weight removed by grazing animals by mid July to stimulate vegetative tiller development and to reduce the quantity of stiff seed heads which grazing livestock are reluctant to push their nose into giving the false impression that cattle do not like to eat Little bluestem. If there is ungrazed Little bluestem in a pasture, it is the managers fault, not the plants or the cattle. Little bluestem is a valuable asset on the Northern Mixed Grass Prairie.

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Table 1. Schizachyrium scoparium, Little bluestem, weekly percent crude protein, percent phosphorus, and phenological growth stages of ungrazed lead tillers in western North Dakota, 1946-1947.

Sample Date	Crude Protein %	Phosphorus %	Phenological Growth Stages
Apr 1			
13			
19			
25			
May 4			
10			
16			
23			
28			
Jun 6	11.7	0.217	Early leaf greenup
13	11.8	0.214	
19	11.0	0.223	Active leaf growth
26	10.0	0.228	
Jul 2	10.9	0.198	Flower stalk developing
8	8.4	0.202	
16	8.7	0.203	Flowering (Anthesis)
24	8.5	0.208	Seed developing
30	5.3	0.181	
Aug 6	5.6	0.135	Seed maturing
13	6.5	0.151	Drying
20	5.7	0.148	
26	4.9	0.126	
Sep 3	4.4	0.103	Seed mature
12	-	-	
21	-	-	
29	2.2	0.031	Drying
Oct			
Nov 5	3.4	0.075	Drying

Data from Whitman et al. 1951.

Table 2. Mean leaf height in cm and percent of maximum leaf height attained by Schizachyrium scoparium, Little bluestem, 1955-1962.

	April				
	1	8	15	22	29
cm					
%					
	May				
	1	8	15	22	29
cm		4.0	4.0	4.2	5.1
%		26.0	26.0	28.0	34.0
	June				
	1	8	15	22	29
cm	6.0	10.0	11.0	12.6	12.8
%	39.0	65.0	72.0	82.0	84.0
	July				
	1	8	15	22	29
cm	14.7	14.9	15.2	15.3	
%	96.0	98.0	99.0	100.0	
	August				
	1	8	15	22	29
cm					
%					

Data from Goetz 1963.

Table 3. Mean stalk height in cm and percent of maximum stalk height attained by Schizachyrium scoparium, Little bluestem, 1955-1962.

	April				
	1	8	15	22	29
cm					
%					
	May				
	1	8	15	22	29
cm					
%					
	June				
	1	8	15	22	29
cm					17.0
%					46.5
	July				
	1	8	15	22	29
cm	18.0	18.0	21.7	25.5	26.7
%	49.3	49.3	59.5	69.9	73.2
	August				
	1	8	15	22	29
cm	29.4	32.1	36.5		
%	80.5	87.9	100.0		

Data from Goetz 1963.

Table 4. First flower and flower period of Schizachyrium scoparium, Little bluestem.

	Apr	May	Jun	Jul	Aug	Sep
First Flower						
1955-1962						
Earliest				16		
Mean					2	
Flower Period						
1969-1971					XX	

First Flower Data from Goetz 1963 and Whitman et al. 1951.
Flower Period Data from Zaczkowski 1972.

Table 5. Flower stalk seed development and percent leaf dryness of Schizachyrium scoparium, Little bluestem.

	Flower Stalk Development			Seed Development	
Data Period	Boot	Emerge	Flower	Mature	Shed
1955-1962	30 Jun	19 Jul	2 Aug	18 Aug	30 Aug

		Percent Leaf Dryness			
Data Period	Leaf Tip	0-25	25-50	50-75	75-100
	Dry	%	%	%	%
1955-1962	24 Jul		26 Aug	7 Sep	

Data from Goetz 1963.

Table 6. Intake nutrient requirements as percent of dry matter for range cows with average milk production.

	Dry Gestation	3rd Trimester	Early Lactation	Lactation (Spring, Summer, Fall)
1000 lb cows				
Dry matter (lbs)	21	21	24	24
Crude protein (%)	6.2	7.8	10.5	9.6
Phosphorus (%)	0.11	0.15	0.20	0.18
1200 lb cows				
Dry matter (lbs)	24	24	27	27
Crude protein (%)	6.2	7.8	10.1	9.3
Phosphorus (%)	0.12	0.16	0.19	0.18
1400 lb cows				
Dry matter (lbs)	27	27	30	30
Crude protein (%)	6.2	7.9	9.8	9.0
Phosphorus (%)	0.12	0.17	0.19	0.18

Data from NRC 1996.

Table 7. Autecology of Schizachyrium scoparium, Little 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	2.50	0.00	0.00	0.29	0.47
1988-1992	1.20	0.00	0.00	0.05	0.09
1993-1998	0.63	0.00	0.00	0.28	0.02
1999-2003	5.74	0.00	0.00	0.68	0.06
2004-2009	3.25	0.00	0.00	0.45	0.14
2010-2012	0.00	0.00	0.00	0.76	0.34
Shallow					
1983-1987	0.00	0.00	0.00	0.85	0.37
1988-1992	0.06	0.00	0.00	0.16	0.05
1993-1998	0.04	0.00	0.00	0.50	0.06
1999-2003	0.36	0.00	0.00	1.98	0.48
2004-2009	0.10	0.00	0.00	1.63	0.71
2010-2012	0.00	0.00	0.00	2.13	0.07
Silty					
1983-1987	0.00	0.00	0.00	0.00	0.08
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.10	0.00
1999-2003	0.00	0.00	0.00	0.00	0.00
2004-2009	0.00	0.00	0.00	0.02	0.00
2010-2012	0.00	0.00	0.02	0.00	0.93

Table 8. Autecology of Schizachyrium scoparium, Little 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	20.26	0.00	0.00	2.50	3.28
1988-1992	7.40	0.00	0.00	0.26	0.59
1993-1998	6.25	0.00	0.00	3.11	0.13
1999-2003	37.10	0.00	0.00	5.62	0.45
2004-2009	19.64	0.00	0.00	5.39	1.08
2010-2012	0.00	0.00	0.00	7.44	2.71
Shallow					
1983-1987	0.00	0.00	0.00	4.96	2.42
1988-1992	0.60	0.00	0.00	1.24	0.50
1993-1998	0.83	0.00	0.00	3.15	0.32
1999-2003	2.38	0.00	0.00	12.09	4.12
2004-2009	0.81	0.00	0.00	10.72	5.77
2010-2012	0.00	0.00	0.00	16.78	0.35
Silty					
1983-1987	0.00	0.00	0.00	0.00	0.26
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.92	0.00
1999-2003	0.00	0.00	0.00	0.00	0.00
2004-2009	0.00	0.00	0.00	0.33	0.00
2010-2012	0.00	0.00	0.14	0.00	4.90

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