Autecology of Altai Wildrye on the Northern Mixed Grass Prairie

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The autecology of Altai wildrye, *Leymus angustus*, 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).

Altai wildrye, *Leymus angustus* (Trin.) Pilg., is a member of the grass family, Poaceae, tribe, Triticeae, syn.: *Elymus angustus* Trin., and is a long lived perennial, monocot, cool-season, mid grass, that is drought tolerant, very winter hardy, highly tolerant of saline soils nearly at the level of tall wheatgrass, and fairly tolerant of alkaline soils. Altai wildrye was introduced into Canada as two seed lots. The first seed lot arrived in 1934 from Voronezh, USSR, located in the far western European Russian Steppe. The second seed lot arrived in 1939 from the Steppe of Kustanay located in the northern region of Kazakhstan. Three synthetic strains were developed from seed increase plots started in 1950 at the Swift Current Research Station followed by more sites at seven research stations in Alberta, Manitoba, and Saskatchewan, which produced the first released cultivar, Prairieland, in 1976. Seed from the increase fields at Swift Current was used to establish 60 acres of Altai wildrye monoculture at the NDSU Dickinson Research Extension Center for a replicated study of late season grazing during mid October to mid November conducted from 1983 to 2005 for 23 years. Early aerial growth consists of basal leaves from crown tiller buds. Basal leaf blades are 15-25 cm (6-10 in) long, 0.5-0.7 cm wide, erect, coarse, light green to bluegreen to blue, and can remain upright under deep wet snow. The leaf sheath is usually shorter than the internodes and grayish green. The membrane ligule is 0.5-1.0 mm long with an obtuse apex. Some early specimens of introduced strains showed vigorous rhizome charateristics and aggressive spreading which was considered to be undesirable. The available released plant material are generally weakly rhizomatous with short rhizomes. Unfortunately, fields seeded with plant material that has nonaggressive short rhizomes is limited by around a 20 to 25 year life expectancy. However, the uniquely deep extensive fibrous root system that can penetrate to depths of 3-4 m (9.8-13.1 ft) and efficiently absorb available soil water was retained. Regeneration is primarily asexual propagation by crown and short rhizome tiller buds. Seedlings have slow, weak growth and are successful only when competition from established plants is nonexistant. Flower stalks are erect, 60-100 cm (24-39 in) tall, mostly leafless and few in numbers. Inflorescence is a terminal spike 15-20 cm (6-8 in) long, 1 cm in diameter, that has closely spread overlapping spikelets of 2 or 3 florets, with 2 or 3 spikelets per node. Basal leaves are palatable to livestock and seed stalks are not. Wildryes maintain slightly higher levels of protein and digestibility with advancing maturity better than other species of perennial grasses. Wildryes are best used for late season grazing from mid October to mid November. 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 reduction in biomass production and tiller density. This summary information on growth development and regeneration of Altai wildrye was based on works of Lawrence 1976 and St. John et al. 2010.

Procedures

The 1983 to 2009 Study

Altai wildrye was evaluated as a perennial monoculture pasture for fall grazing from mid October to mid November and was compared with five traditional fall management strategies. Altai wildrye grass seed was harvested from the increase field at the Swift Current Research Station, Saskatchewan, Canada and then was planted into 60 acres of poor quality cropland at the DREC ranch, western North Dakota, during early spring 1983. A gentle rain fell for most of the next three days and within a week there were 60 acres of beautiful 3-4

inch tall cotyledons. These pastures were grazed lightly that fall and grazed at full stocking rate during the fall of 1984, and annually there after. Cow and calf weight performance and the costs and returns were evaluated during 1984 to 1998 (15 years). Herbage biomass production was evaluated during 1984 to 2002 (19 years). Plant basal cover was evaluated during 1983 to 2009 (27 years).

Results

Cow and calf weight gain performance on Altai wildrye was compared to five traditional late season management practices grazed for 30 days from mid October to mid November. The Repeated Seasonal treatment grazed a previously ungrazed native rangeland pasture at an appropriately adjusted rate of 4.60 acres per cow-calf pair with 1.21 lbs per cow of supplemented crude protein per day. Cows lost weight. Calf weight gain was 1.80 lbs per day, 11.83 lbs per acre, and accumulated weight gain was 54.00 lbs (table 1). The 6.0-m Seasonlong treatment continued to graze the same previously grazed native rangeland pasture at 4.04 acres per cow-calf pair with no supplemental crude protein. Cows lost 1.74 lbs per day, lost 12.90 lbs per acre, and accumulated weight loss was 52.20 lbs. Calf weight gain was 0.59 lbs per day, 4.38 lbs per acre, and accumulated weight gain was 17.73 lbs (table 1). The 5.5-m Seasonlong treatment continued to graze the same previously grazed native rangeland pasture at 2.53 acres per cow-calf pair with no supplemental crude protein. Cows lost 0.82 lbs per day, lost 9.77 lbs per acre, and accumulated weight loss was 24.60 lbs. Calf weight gain was 0.92 lbs per day, 10.90 lbs per acre, and accumulated weight gain was 27.60 lbs (table 1). The Deferred grazed treatment continued to graze the same previously grazed native rangeland pasture at 2.18 acres per cow-calf pair with no supplemental crude protein. Cows lost 0.74 lbs per day, lost 9.96 lbs per acre, and accumulated weight loss was 22.20 lbs. Calf weight gain was 0.77 lbs per day, 10.36 lbs per acre, and accumulated weight gain was 23.10 lbs (table 1). The Cropland Aftermath Seasonal pasture treatment grazed annual cereal stubble at 6.63 acres per cow-calf pair with no supplemental crude protein. Cows lost 1.61 lbs per day, lost 7.27 lbs per acre, and accumulated weight loss was 48.17 lbs. Calf weight gain was 0.42 lbs per day, 1.90 lbs per acre, and accumulated weight gain was 12.57 lbs (table 2).

Beef cows grazing native rangeland pastures after mid October have negative weight performance because the forage has inadequate levels of crude protein. The calves have weight gains far below their genetic potential because of the cow's reduced milk production.

This decline in cow and calf weight performance on traditionally managed native rangeland pastures begins in midsummer. The crude protein content of native grass lead tillers drop below a lactating cow's dietary requirements in mid to late July. Traditional management of native rangeland pastures does not activate sufficient quantities of secondary vegetative tillers that could meet the crude protein requirements until late September or mid October. Partial defoliation that removes 25% to 33% of the aboveground leaf weight on 60% to 80% of the native grass lead tillers at phenological growth stages between the 3.5 new leaf stage and flower stage (early June to mid July) stimulates vegetative reproduction of secondary tillers in quantities sufficient to extend by two to two and a half months the length of time that native rangeland grasses meet beef cow crude protein requirements. However, there are no manipulation treatments that can push the biological limitations of native grasses to maintain adequate crude protein levels after mid October.

The Wildryes, like Altai and Russian, are the only perennial grasses in the world that retain crude protein levels near lactating beef cow requirements until mid November. There are no perennial grasses that retain nutritional quality to meet beef cow dietary requirements later than this.

Cows and calves grazing Altai wildrye complementary pastures for 30 days from mid October to mid November had positive weight gain performance. Cows gained 0.55 lbs per day, 11.87 lbs per acre, and accumulated weight gain was 16.50 lbs. Calves gained 1.73 lbs per day, 37.96 lbs per acre, and accumulated weight gain was 52.77 lbs (table 2).

Evaluation of annual forages as pastures for lactating beef cows was started in 1993 and evaluation of a late season annual forage pasture for dry cows during mid November to mid December was started in 2003. Cow weight gain was 1.05 lbs per day, 60.14 lbs per acre, and accumulated weight gain was 33.68 lbs on 0.56 acres for 32 days. Calf fetus weight gain was about 0.78 lbs per day, and accumulated weight was about 24.92 lbs. The cow and fetus calf weight performance was adequate for the dry gestation production period, however, when the treatment costs and returns were evaluated, the net returns were negative, there was a loss of $5.97 per cow-calf pair and a loss of $10.66 per acre.

The spring seeded winter cereal of fall rye was evaluated next as a seasonal pasture grazed for 30 days from mid October to mid November for lactating beef cows with a calf on the side. Cow weight gain was 1.05 lbs per day, 67.02 lbs per acre, and accumulated weight gain was 31.50 lbs on 0.47 acres for 30 days. Calves weight gain was 2.00 lbs per day, 127.66 lbs per acre, and accumulated weight gain was 60.00 lbs (table 2). Spring seeded winter cereal is a viable seasonal pasture for lactating cows and calves during mid October to mid November.

The evaluation of costs and returns for the five traditional management practices showed that they all had low production cash costs per acre. However, all treatments had low weight of crude protein captured per acre and all treatments had high costs per lb of crude protein greater than $0.25 per lb CP. All treatments except the crop aftermath had high feed costs per day greater than $0.62/day. All treatments had high costs per lb of calf gain greater than $0.42 per lb of calf gain. As a result, the Repeated Seasonal lost $13.40 per cow-calf pair and lost $2.91 per acre, the 6.0-m Seasonlong lost $22.98 per cow-calf pair and lost $5.69 per acre, the 5.5-m Seasonlong lost $2.84 per cow-calf pair and lost $1.12 per acre, the Deferred grazed lost $3.36 per cow-calf pair and lost $1.51 per acre (table 3) and the Cropland Aftermath lost $4.46 per cow-calf pair and lost $0.67 per acre (table 4). The greater the quantity of captured weight of crude protein per acre determines the level of profitability of forage strategies, not the lower cash costs per acre.

The Altai wildrye complementary pasture had low costs for forage per ton, lb of crude protein, feed per day and per lb of calf gain, as a result, the Altai wildrye fall pasture gained $24.76 per cow-calf pair and gained $17.81 per acre (table 4). The Spring Seeded Winter Cereal seasonal pasture when grazed for 30 days from mid October to mid November had low costs for forage per ton, lb of crude protein, and per lb of calf gain. The feed cost per day was 4 cents higher than the low cost of $0.62 per day. As a result, the Spring Seeded Winter Cereal pastures gained $22.30 per cow-calf pair and gained $47.45 per acre (table 4). Both the Altai wildrye and Spring Seeded Winter Cereal pastures had better cow-calf weight performance and had lower costs and greater returns than the five traditional late season management treatments (tables 1, 2, 3, and 4).

Altai wildrye had good development and herbage production during its first growing season (1983) with a mean of 1876.18 lbs/ac on mid October (table 5). Because of what appeared to be high herbage biomass production, it was grazed lightly at 2.70 acres per AUM the first year. Cows gained 0.51 lbs per day and 5.7 lbs per acre. Calves gained 1.52 lbs per day and 17.0 lbs per acre.

During the second fall (1984), herbage biomass was at an amazing 6051.24 lbs/ac on mid October (table 5), cow and calf weight performance was very good to mid November. Cows gained 1.43 lbs per day, 20.13 lbs per acre, and accumulated weight gain was 44.42 lbs. Calves gained 1.37 lbs per day, 26.80 lbs per acre, and accumulated weight gain was 42.32 lbs over 31 days. Available herbage was still plentiful, so the calves remained with the cows until 3 December, which turned out to be a big mistake. Between mid November and early December, the cows lost 1.67 lbs per day and the calf gains decreased greatly to 0.84 lbs per day. This showed that the calves should not remain on the Altai wildrye pastures after mid November.

In 1985, grazing started on 18 October and the calves were weaned 25 days later on 12 November with a gain of 2.58 lbs per day, 51.0 lbs per acre, and accumulated weight gain of 64.34 lbs. Cows had gained 2.62 lbs per day, 52.32 lbs per acre, and accumulated weight gain was 65.40 lbs. However, available herbage was still plentiful, and the dry cows were left on pasture until 2 December. Between 12 November and 2 December, the cows lost 7.54 lbs per day.

During 1986 and 1987, grazing started 16 October and the calves were weaned around 12 November, with a gain of 0.81 lbs per day, 18.71 lbs per acre, and accumulated weight gain of only 21.53 lbs. Cows lost 0.80 lbs per day, 16.41 lbs per acre, and accumulated weight loss was 19.61 lbs. The late grazing after mid November was causing a reduction in herbage biomass production and a decrease in the nutritional quality resulting in the cows losing weight and the calves were not gaining much weight.

The low precipitation years of 1988 to 1992 caused additional reduction in herbage biomass production greater than 56%, resulting in a reduced grazing period of 28 days from 13 September to 11 October with cow weight losses of 0.74 lbs per day, 18.89 lbs per acre, and accumulated weight losses of 22.50 lbs. Calves, however, performed well with weight gains of 1.86 lbs per day, 38.71 lbs per acre, and accumulated weight gain was 50.71 lbs

Herbage production was slow to recover from the previous low precipitation period and from the effects of grazing after mid November. During

1993 to 1997, the mean herbage biomass was only 1846.92 lbs/ac on mid October (table 5), and the length of the grazing period had to be reduced again to 25 days from 13 October to 7 November. However, cow and calf weight performance was improving. Cow weight gain was 1.09 lbs per day, 23.21 lbs per acre, and accumulated weight gain was 28.91 lbs. Calf weight gain was 1.48 lbs per day, 28.33 lbs per acre, and accumulated weight gain was 35.91 lbs

During 1998 to 2002, the herbage production increased to a mean of 2627.24 lbs/ac (table 5) on mid October and the length of the grazing period was increased to 28 days from 6 October to 4 November, however, the available nutritional quality had decreased. Cow weight gain was 1.02 lbs per day, 16.65 lbs per acre, and accumulated weight gain was only 19.89 lbs. Calf weight gain was 1.47 lbs per day, 30.28 lbs per acre, and accumulated weight gain was 41.95 lbs.

During 2003 to 2007, the herbage production had decreased more than 40% with a mean 1463.03 lbs/ac on mid October (table 5) and by the growing season of 2009, the Altai wildrye community was considered lost.

The Altai wildrye pastures were seeded during the spring of 1983 and 27 growing seasons later the plants were almost totally gone. All wildrye tussocks are sensitive to soil compaction of the area from the edge of the crown out to the drip line of the leaves. A trail of dead plants developed whenever a vehicle drove in the pasture. However, the primary cause for the reduction of the plant population density resulted from the grazing period after mid November and from removing greater than 50% of the aboveground herbage weight.

All grass tillers live for two growing seasons, first as a vegetative tiller and second as a reproductive lead tiller. Cool season grasses develop the vegetative tillers during the previous late summer from mid August to hard frost. During the selection process between 1934 and 1976, plants with aggressive spreading rhizomes were selected against to prevent escape and invasion of Altai wildrye plants into other plant communities. By default, vegetative reproduction of the next generation of tillers was encumbered unto the crown tillers.

Carryover leaves within an Altai wildrye tussock greenup early and provide most of the carbohydrates and energy for growth of the current years lead tillers. The lead tillers produce 3.5 new leaves around early June and seed stalks develop and the early stalks are visible before 21 June. Most of the aboveground herbage biomass weight in June is the leaves and stalks of the lead tillers (figure 1). After the flower stage, the crude protein content of the lead tillers starts to decrease. The vegetative tillers increase in rate of growth shortly after the lead tillers reach the flower stage. The aboveground herbage biomass during July and August is primarily the declining lead tillers and the developing vegetative tillers (figure 1). From mid August to about mid October, the fall tillers develop and produce the additional herbage biomass during September and October (figure 1). By mid October, the fall tillers should have around 10 to 12% crude protein, the vegetative tillers should have around 10 to 8% crude protein, and the lead tillers should have 8 to 6% crude protein. The ratio of the three tiller types would effect the mean crude protein level of the Altai wildrye forage from mid October to mid November. When 50% or more of the aboveground herbage remains on mid November, most of the vegetative tillers and fall tillers should survive to the next spring and maintain or increase basal cover. However, when greater than 50% of the aboveground herbage is removed by mid November or during the longer grazing period after mid November, some, many, or most of the fall tillers and vegetative tillers will have lost greater biomass than they can recover from, resulting in a reduction in the following growing season basal cover. During the 19 year period from 1984 to 2002, nine of the grazing periods extended past mid November and removed greater than 50% of the aboveground herbage biomass resulting in reduction of basal cover of the Altai wildrye (table 6). During that period basal cover changed from 16.10% to 5.43% basal cover of Altai wildrye for a 66% reduction. Herbage biomass decreased 71% from 6051.24 lbs/ac in 1984 to 1742.53 lbs/ac in mid October of 2002. Between 2002 to 2009, the basal cover and herbage biomass decreased severely. As Altai wildrye decreased, crested wheatgrass, smooth bromegrass, and Canada bluegrass increased to fill the void (table 6).

The next growing seasons basal cover and herbage biomass depends on the survival of the vegetative tillers and fall tillers and the nutritional quality of the Altai wildrye forage during the grazing period from mid October to mid November depends on the high percent composition of vegetative tillers and fall tillers in each tussock. The maintenance of the Altai wildrye fall pastures requires that greater than 50% of the aboveground herbage remain at the end of the grazing period on mid November. Grazing longer than mid November is extremely negative for

the grass plants and the dry cows lose a great deal of weight that is expensive to put back on, therefore, stop grazing Altai wildrye pastures on mid November no matter how much standing herbage remains and remove the cattle as soon as possible before 50% of the herbage is removed.

Discussion

Altai wildrye, *Leymus angustus*, is an introduced cool season, mid grass, monocot, of the grass family that is drought tolerant, winter hardy, and tolerant of saline and alkaline soils. Altai wildrye prefers loam and clay loam soil but has a wide tolerance for soil types. Early season aerial growth of basal leaves arise from crown tiller buds. Carryover leaves provide carbohydrates and energy for new leaf growth. Tillers from short rhizomes are rare. Vegetative growth of crown tillers form large tussocks. Leaves of lead tillers develop from leaf buds developed on vegetative tillers the previous late summer after mid August just before the apical meristem was induced to develop flower bud primordia which will emerge the following June. Basal leaves and seed stalks of lead tillers have priority over development of other tiller types. After the lead tillers reach the flower stage, vegetative crown tillers increase in growth rate. The lead tillers produce almost all of the herbage weight during June, vegetative crown tillers produce the additional herbage weight during July and most of August. Fall tillers produce the additional herbage weight after mid August during September and October. The quantity of crude protein in the herbage during the late grazing period from mid October to mid November depends on the percent composition of vegetative crown tillers and fall tillers. When grazing removes greater than 50% of the aboveground herbage biomass during the grazing period or any grazing after mid November, a large portion of the vegetative crown tillers and fall tillers do not survive until the following spring. That loss causes the basal cover to decrease and the quantity of available crude protein is greatly reduced for that next fall grazing period resulting a great reduction in cow and calf weight performance.

Fall grazing of Altai wildrye pastures that removes less than 50% of the herbage biomass stimulates the quantity of vegetative tillers and fall tillers which increase the crude protein content of the next falls grazable forage. Test plots of wildrye grasses that are not grazed have different growth characteristics and much different nutrient quality curves than the same wildrye species that is fall grazed.

Cutting Altai wildrye for hay greatly reduces the number of vegetative tillers produced, resulting in decreased basal cover and herbage biomass production. Cattle reject Altai wildrye hay as winter feed. The best use of Altai wildrye is as fall pastures grazed from mid October to mid November.

Fertilization of mineral nitrogen on Altai wildrye synchronizes tiller growth in the early portion of the growing season and causes premature rapid senescence of those tillers resulting in low nutritional quality herbage later that growing season. If the soil needs amendments use aged composted manure.

Altai wildrye was introduced into North America in 1934 from the region around the Altai mountains located in Central Asia where the borders of Russia, China, Mongolia, and Kasakhstan come together. The wildrye grasses require management different from North American traditional grass management. Which has resulted in low acceptance and use of wildryes, like Altai, as late season pastures grazed from mid October to mid November. However, as scientists learn more about the correct management of Altai wildrye, it will increase in use and provide high quality forage for cows and calves during that late season window that has no other perennial grass forage plant available.

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Table 1. Cow and calf weight performance during the 30 day fall portion of the grazing season from mid October to mid November on four native rangeland grazing management systems.

	Repeated Seasonal	6.0-m Seasonlong	5.5-m Seasonlong	4.0-m Deferred
Fall	Native Rangeland	Native Rangeland	Native Rangeland	Native Rangeland
Days	30	30	30	30
Acres	4.60	4.04	2.53	2.18
Cow				
Accumulated Wt.		-52.20	-24.60	-22.20
Gains/Acre		-12.90	-9.77	-9.96
Gain/Day		-1.74	-0.82	-0.74
Calf				
Accumulated Wt.	54.00	17.73	27.60	23.10
Gain/Acre	11.74	4.38	10.90	10.36
Gain/Day	1.80	0.59	0.92	0.77

Table 2. Cow and calf weight performance during the 30 day fall portion of the grazing season from mid October to mid November on three domesticated forage late season pastures.

	Seasonal Pasture	Complementary Pasture	Seasonal Pasture
Fall	Cropland Aftermath	Altai Wildrye	Spring Seeded Winter Cereal
Days	30	30	30
Acres	6.63	1.39	0.47
Cow			
Accumulated Wt.	-48.17	16.50	31.50
Gains/Acre	-7.27	11.87	67.02
Gain/Day	-1.61	0.55	1.05
Calf			
Accumulated Wt.	12.57	52.77	60.00
Gain/Acre	1.90	37.96	127.66
Gain/Day	0.42	1.73	2.00

Table 3. Costs and returns for native rangeland pastures grazed during the 30-day fall lactation production period from mid October to mid November.

		Native Rangeland Repeated Seasonal	Native Rangeland 6.0-m Seasonlong	Native Rangeland 5.5-m Seasonlong	Native Rangeland Deferred Grazing
Days		30	30	30	30
Growth Stage		fall	fall	fall	fall
Herbage Weight	lb/ac	797	891	1423	1649
Forage DM Weight	lb/ac	199	223	356	412
Costs/Acre					
Land Rent	$	8.76	8.76	8.76	8.76
Custom Work	$				
Seed Cost	$				
Baling Costs	$				
Production Costs	$/ac	8.76	8.76	8.76	8.76
Forage DM Costs	$/ton	88.85	78.57	49.21	42.52
Crude Protein	%	4.8	4.8	4.8	4.8
Crude Protein Yield	lb/ac	9.55	10.70	17.20	19.90
Crude Protein Cost	$/lb	0.92	0.82	0.51	0.44
Forage Allocation	lb/d	30.0	30.0	30.0	30.0
Land Area/Period	ac	4.60	4.04	2.53	2.18
Forage Costs/Period	$/pp	40.30	35.39	22.16	19.53
Supplementation					
Roughage/Day	lb/d				
Crude Protein/Day	lb/d	1.21			
Sup. Cost/Period	$/pp	10.90			
Total Feed Cost	$/pp	51.20	35.39	22.16	19.53
Cost/Day	$/d	1.71	1.18	0.74	0.65
Accumulated Calf Wt.	lbs	54.00	17.73	27.60	23.10
Weight Value @$0.70/lb	$	37.80	12.41	19.32	16.17
Net Return/c-c pr	$	-13.40	-22.98	-2.84	-3.36
Net Return/acre	$	-2.91	-5.69	-1.12	-1.51
Cost/lb of Calf Gain	$	0.95	1.99	0.80	0.85

Table 4. Costs and returns for domesticated forage pastures grazed during the 30-day fall lactation production period from mid October to mid November.

		Cropland Aftermath Seasonal Pasture	Altai Wildrye Complementary Pasture	Spring Seeded Winter Cereal Seasonal Pasture
Days		30	30	30
Growth Stage		fall	fall	Vegetative
Herbage Weight	lb/ac	270	2590	
Forage DM Weight	lb/ac	135	648	1908
Costs/Acre				
Land Rent	$	2.00	8.76	22.07
Custom Work	$			16.08
Seed Cost	$			3.60
Baling Costs	$			
Production Costs	$/ac	2.00	8.76	41.75
Forage DM Costs	$/ton	29.63	27.04	43.77
Crude Protein	%	2.0	8.5	12.15
Crude Protein Yield	lb/ac	2.70	54.80	231.90
Crude Protein Cost	$/lb	0.74	0.16	0.18
Forage Allocation	lb/d	30.0	30.0	30.0
Land Area/Period	ac	6.63	1.39	0.47
Forage Costs/Period	$/pp	13.26	12.18	19.70
Supplementation				
Roughage/Day	lb/d			
Crude Protein/Day	lb/d			
Sup. Cost/Period	$/pp			
Total Feed Cost	$/pp	13.26	12.18	19.70
Cost/Day	$/d	0.44	0.40	0.66
Accumulated Calf Wt.	lbs	12.57	52.77	60.00
Weight Value @$0.70/lb	$	8.80	36.94	42.00
Net Return/c-c pr	$	-4.46	24.76	22.30
Net Return/acre	$	-0.67	17.81	47.45
Cost/lb of Calf Gain	$	1.05	0.23	0.33

Table 5. Altai wildrye mean monthly herbage biomass (lbs/ac) from two replicated 30 acre fall grazed pastures during mid October to mid November except 1988-1990 grazed during mid September to mid October, 1983-2007.

	15 Jun	15 Jul	15 Aug	15 Sep	15 Oct	15 Nov
1983	618.69	1028.30	985.31	610.49	1876.18	1385.58
1984-1987	3304.89	3914.55	4209.87	4914.48	4948.51	2467.76
1988-1992	1268.32	1615.92	1764.75	2763.49	698.00	
1993-1997	800.22	1226.61	923.2 7	1764.37	1846.92	881.27
1998-2002	1301.76	2085.29	2269.43	2645.30	2627.24	1140.30
2003-2007	755.36	1533.80	1275.71	1368.98	1463.03	716.93
1984-2002	1668.80	2210.59	2291.83	3021.91	3140.89	1496.44

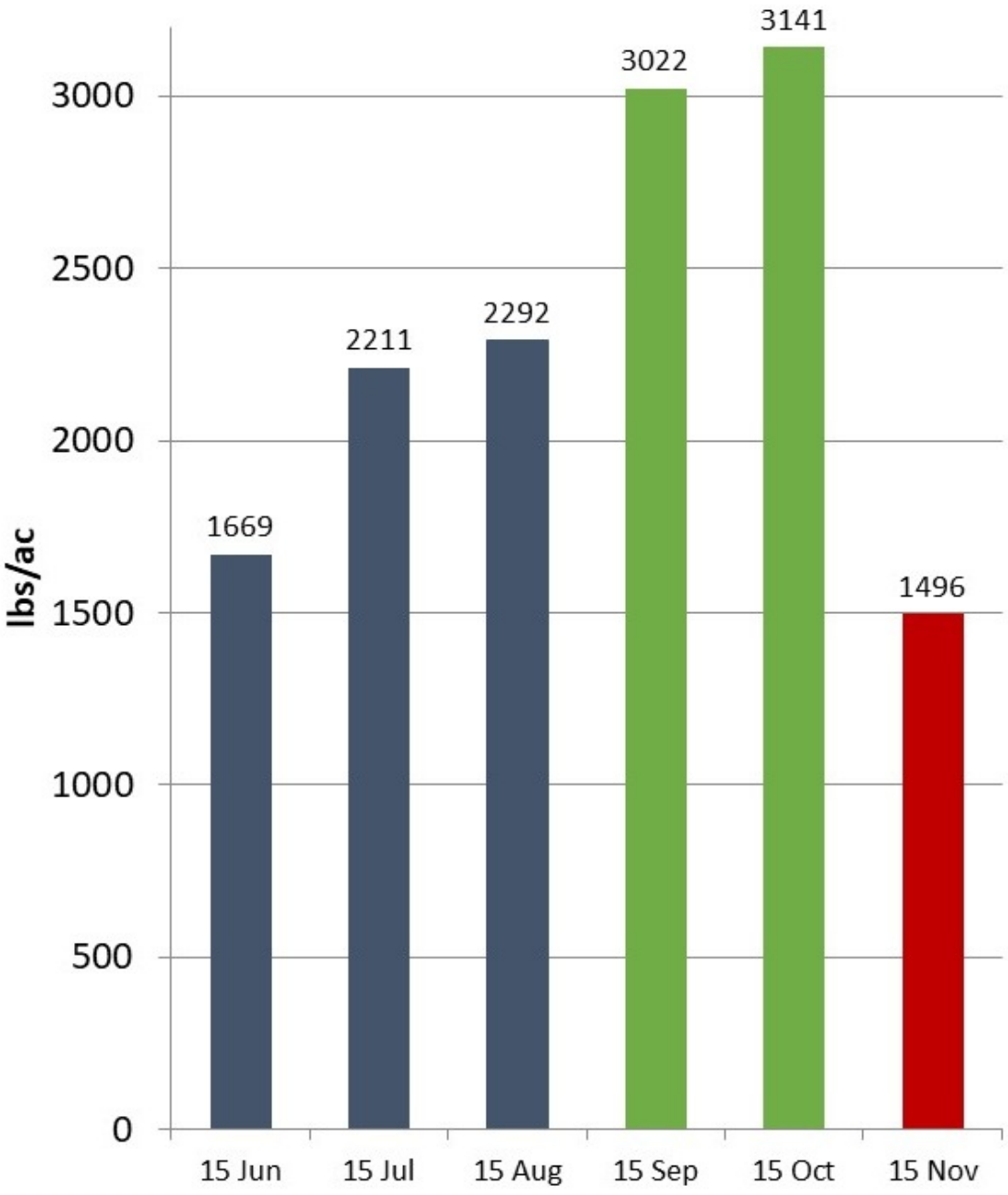

Figure 1. Altai wildrye mean monthly herbage biomass (lbs/ac) on two pastures fall grazed during mid October to mid November, 1984-2002.

Table 6. Changes in annual percent basal cover of plants growing on two replicated 30 acre Altai wildrye fall grazed pastures, 1983-2009.

	Altai wildrye	Crested wheatgrass	Smooth bromegrass	Japanese bromegrass	Kentucky bluegrass	Canada bluegrass	Native cool season grasses	Native warm season grasses	Late succession forbs	Mid succession forbs	Early succession forbs	Annual grasses
1983	3.55								0.05	0.15	4.55	25.95
1984	16.10				0.10		0.50		0.03	0.28	12.05	3.83
1985	8.98								0.03	0.05	6.30	0.33
1986	16.03	0.03			0.10		0.18	0.10	0.10		0.45	1.13
1987	14.97	0.02			0.09		0.07		0.04	0.03	1.12	0.22
1988	14.78	0.62			0.02			0.05	0.24		2.53	1.58
1989	19.44						0.02		0.96	0.05	3.49	
1990	16.36								1.37		1.17	
1991	10.66	0.09	0.09				0.12	0.03	0.38		0.17	0.39
1992												
1993	30.55	0.27	0.19				0.12	0.18	1.08	1.06	8.23	0.02
1994												
1995												
1996												
1997												
1998	4.68	0.03	0.40	0.03	0.98		2.10	0.08	1.93	0.43	0.80	
1999	9.03	1.43	1.53	0.25		1.43	2.33	0.65	0.35	0.08	0.28	
2000	7.30	1.33	2.95	1.10		2.85	1.30	0.60	0.38	0.05	0.38	
2001	6.05	2.43	1.50	0.48		4.48	3.43	0.03	0.55		1.35	
2002	5.43	3.67	2.92	0.22		4.56	1.60	0.12	0.02		0.99	
2003	3.65	7.09	3.97	0.12		6.30	0.78		0.08	0.02	1.33	
2004	2.92	9.32	3.67	0.20		2.87	1.56	0.05	0.13		0.03	
2005	2.79	12.62	4.73	0.28		6.92	0.62		0.17	1.77	0.18	
2006	2.18	12.73	5.17	0.67		6.54			0.18		2.97	
2007	1.35	14.31	4.90	1.05		4.54	0.22				0.15	
2008	0.37	12.18	4.20	0.02		0.03	0.36	0.59			0.39	
2009	0.19	16.55	4.03	0.12		0.63	0.32			0.21	0.47	

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