
PROBLEMS TO CONSIDER WHEN IMPLEMENTING GRAZING MANAGEMENT PRACTICES IN NORTHERN GREAT PLAINS

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Range management practices that have been developed and found to be successful in ecosystems outside the Northern Great Plains usually require modification and adjustments in order to successfully implement them into the Northern Great Plains grassland ecosystem. Each region of the country has a unique set of problems and circumstances that make "across the board" use of most range management principles and practices nearly impossible. Many practices need to be developed specifically for an ecosystem and may not be effective when tried in a different ecosystem. Identifying and understanding the set of problems for each region is essential for the development and implementation of optimum range management principles and practices for that region. This paper will attempt to point out three major problems that need to be considered when implementing grazing management practices in the Northern Great Plains. These three problems are: 1) plant growth is limited by several factors, 2) ungrazed grasses are low in nutritional quality during the later portion of the grazing season, and 3) some grazing starting dates cause negative effects.

The type of livestock grazing management that is successful in an ecosystem is generally regulated by the responses to grazing by the individual plant species and the productivity of those species. The plant species present are generally determined by the physical characteristics (climate, soil, and topography) of a region. Several grassland plant communities have been defined and described for the Northern Great Plains (Barker and Whitman 1988, Shiflet 1994). These grassland plant communities are basically quite similar in the species that are present. The main differences are in the relative amounts of each component graminoid species. The major graminoid plants with wide distribution throughout the Northern Great Plains are western wheatgrass, needleandthread, blue grama, upland sedges, prairie Junegrass, prairie sandreed, and plains reedgrass. Several species of forbs and shrubs also have wide distribution across the Northern Great Plains. The variations in relative abundance of the plant species present in grassland plant communities of the Northern Great Plains are primarily due to differences in soil moisture, soil type, geology, topography, and slope aspect. The precipitation and seasonal precipitation pattern are probably the most important factors in determining the type of vegetation and its productivity in a region.

The annual precipitation for the Northern Great Plains has a great deal of variability from year to year and the long term means range from less than 12 inches in the west to more than 20 inches in the east with a similar change from north to south. The average over most of the region is about 15 inches of precipitation. The seasonal precipitation pattern is characterized by a period of maximum precipitation in late spring and early summer, tapering off to a moderately light amount during fall and winter. Periods with low precipitation levels occur frequently. These periods may last in duration for several weeks, several months, and sometimes several years. The longer periods are identified as drought. The low precipitation periods place plants under water stress and limit growth.

Herbage production from grassland plant communities is also limited by temperature. The frost free period is usually short, from 120 days in the north to 160 days in the south. Plants require temperatures above the level that freezes water in plant tissue and the soil in order to continue active growth. Many perennial plants begin active growth in spring before the start of the frost free period and continue after the first frost in fall. Low air temperatures during the early and late portions of the growing season greatly limit plant growth. Plant growth is also limited after mid summer by high temperatures, high evaporation, drying winds, and low precipitation.

A technique to identify months with conditions that are unfavorable for plant growth was developed by Emberger et al. (1963). This method plots mean monthly temperature (C^o) and monthly precipitation (mm) on the same axis but with the scale of the precipitation data at twice that of the temperature data. The temperature and precipitation data are plotted against an axis of time. The resulting ombrothermic diagram shows general monthly trends and identifies months with conditions that are unfavorable for plant growth. Plants are under water stress during months when the precipitation data curve drops below the temperature data curve and plants are under temperature stress when the temperature curve drops below the freezing mark (0^oC). During the past 12 years (1983-1994) (Table 1) 43% of the growing season months from mid April through mid October had low precipitation conditions that have caused water stress in perennial plants. The ombrothermic diagram (Fig. 1) of long term data (100 years) for Dickinson, North Dakota shows that perennial plants are near water stress conditions during the months of August, September, and

October. These long term near water stress conditions limit plant growth. Favorable conditions of precipitation and temperature for plant growth occur during the months of May, June, and July.

Dr. Harold Goetz collected plant leaf and flower stalk height data from ungrazed plants in western North Dakota for 6 years and reported his work as a thesis (Goetz 1963). These data are summarized in tables 2 and 3, and figure 2. The upland sedges complete 100% of their growth in leaf and flower stalk height by 30 June. The cool season grasses complete 100% of their growth in leaf and flower stalk height by 30 July. The warm season grasses complete 100% of their growth in leaf height and 91% of their growth in flower stalk height by 30 July. A small amount of flower stalk elongation occurs after 30 July for the warm season grasses. The short period of May, June, and July is when nearly all of the growth in graminoid leaf and flower stalk height occurs.

Peak above ground herbage biomass usually occurs during the last 10 days of July. This would coincide with the time when 100% of the growth in height has been completed. Herbage biomass of ungrazed plants increases in weight during May, June, and July, and after the end of July the weight of the herbage biomass decreases because the rate of senescence of the grass leaves exceeds growth and the cell material in the above ground parts is being translocated to the below ground parts.

The translocation of cell material from the above ground parts to the below ground parts causes a decrease in the nutritional quality of the above ground parts. Dr. Warren Whitman collected biweekly nutritional quality samples from ungrazed plants of the major grass species in western North Dakota for two years. The results of this work were reported by Whitman et al. (1951) and are summarized in table 4 and figure 3. Ungrazed plants of the major upland sedges, cool season grasses, and warm season grasses drop below 9.6% crude protein levels around mid July. This drop in crude protein levels occurs at about the same time that the maximum amount of plant growth in height and weight occurs.

The levels of crude protein in the above ground herbage after mid July become very important in livestock production because 1000 pound cows requires 9.6% crude protein from their diet in order to maintain body weight and average lactation (NRC 1984). Most ruminant animals require a daily dry matter intake of about 2% (1.5-2.5%) of their body weight (Holechek et al. 1989). Cows may be able to compensate for lower quality forage for a short period of time by increasing intake and/or selecting plant parts higher in nutritional quality than average plant parts.

Cows on seasonlong grazing systems lose weight from early or mid August to the end of the grazing season (Fig. 4). This loss of weight does not hurt the animal but it does decrease the level of lactation. Doug Landblom (1989) has sampled milk production by weigh-suckle-weigh method of commercial crossbred cows of mainly British breed ancestry over a 3 year period using a seasonlong grazing system on native range pastures. He has found that the milk production decreases from 14.1 pounds per day in mid June, to 11.4 pounds per day by the end of August, and to 7.0 pounds per day by the end of October. This reduction in milk production has a negative effect on calf growth.

Animal performance is also affected by the grazing starting date. The time of year that grazing is started is important because early grazing greatly effects the percentage of the potential peak above ground herbage biomass that is reached. Two good independent studies have been conducted in the Northern Great Plains that evaluated starting dates for seasonlong grazing management. One study was conducted at Swift Current, Canada and reported by Campbell (1952) and the other was conducted at Mandan, North Dakota and reported by Rogler et al. (1962). Summaries of these two studies are shown in table 5 and figure 5. Unpublished data collected at Dickinson, North Dakota has been added to table 5 and figure 5. The data from the 3 locations closely agree and show that if seasonlong grazing is started in mid May on native range, 45-60% of the potential peak herbage biomass will be lost and never be available for grazing livestock. If the starting date of seasonlong grazing is deferred until early or mid July, nearly all of the potential peak herbage biomass will grow and be available to grazing livestock but the nutritional quality will be at or below the crude protein levels required for a lactating cow. If the starting date is deferred until after mid July, less than peak herbage biomass will be available to grazing livestock because of senescence and the translocation of cell material to below ground parts.

A grazing starting date in May on native range has unacceptable reductions in herbage biomass. Starting dates after mid July have less than acceptable animal performance because of the low nutritional quality. Data from these studies indicate that a starting date between early June and early July would provide the lowest negative effects on herbage biomass production and nutritional quality of the available forage.

The phenological growth stage of the grass plants would be the best indicator to determine when to start grazing. Grazing grass plants before the third leaf stage causes negative effects in grass growth. Starting grazing after the third leaf stage seems to stimulate tiller production. Most native cool season grasses reach the third leaf stage around early June, and most native warm season grasses reach the third leaf stage around mid June. This indicates that seasonlong grazing management systems on native range should wait until mid June to start but rotation grazing systems could start in early June.

The Northern Great Plains has three major problems that need to be considered when implementing any grazing management practice. Plant growth is limited by several climatic factors. The most important of these are low annual precipitation, limited seasonal distribution of precipitation, frequent drought conditions, cool temperatures in spring and fall, and hot temperatures in summer. Favorable precipitation and temperature conditions occur during May, June, and July. Most of the plant growth occurs during the short period of May, June, and July. The nutritional quality of the native vegetation is a limiting factor in animal performance because all the major graminoid species drop below the 9.6% crude protein requirements for 1000 pound lactating cows after mid July if the plants are ungrazed. The low nutritional quality causes a loss of weight by the cows and a reduction in milk production which reduces the daily gain of the calves. The starting dates of seasonlong grazing in May causes great reductions in herbage biomass production which would cause reductions in stocking rates and animal production per acre. Deferring grazing starting dates until after mid July allows for near peak biomass production but causes a reduction in animal performance because of the low nutritional quality of the available forage. It is possible that no range management practice can solve all the inherent problems in an ecosystem completely, but the successfully implemented practices will have solutions or compensations for large portions of each of these problems. There may be more than one optimum or nearly optimum grazing management practice for an ecosystem.

One grazing management system that has attempted to address these three inherent problems on the Northern Great Plains is the twice over rotation system on native range with complementary domesticated grass spring and fall pastures. A spring pasture of crested wheatgrass is used during the month of May. A three or four pasture native range rotation system is used from early June until mid October with each pasture being grazed for two periods. The first period is grazed for 15 or 11 days in each pasture of a 3 or 4 pasture system, respectively, during the 45 day period when grasses can be stimulated to tiller which is from the third leaf stage to the flowering stage (1 June to 15 July) and a second period is grazed for 30 or 22 days in each pasture of a 3 or 4 pasture system, respectively, after mid July and before mid October. A fall pasture of Altai wildrye is grazed with cows and calves from mid October until weaning in early or mid November and grazed by dry cows from mid November until mid or late December.

The twice over rotation system with complementary domesticated grass pastures has a grazing season of over 7.5

months with the available forage above, at, or only slightly below the requirements for a lactating cow for nearly the entire grazing season. It requires less than 12 acres per cow-calf pair for the entire 7.5 month grazing season on grassland that traditionally requires 24 acres per cow-calf pair grazed for 6.0 months seasonlong. The cow and calf weight performance is an improvement over other systems tested in the Northern Great Plains.

The range management practices that can be implemented successfully on the Northern Great Plains, whether they are practices that have been developed in this ecosystem or modified practices that have been brought in from outside ecosystems, will have major components that address the inherent problems of this ecosystem and will solve large portions of each of the major problems. Only these management practices have the potential to maximize the vegetation and animal performance on the Northern Great Plains grassland ecosystem.

Table 1. Months when temperature and precipitation conditions caused water stress for perennial plants.

Year				Months					Percentage of 6 Months 15 Apr - 15 Oct
1983		Apr					Sep		25%
1984			May		Jul		Sep		50%
1985					Jul				17%
1986						Aug		Oct	25%
1987		Apr		Jun			Sep	Oct	50%
1988		Apr		Jun	Jul	Aug	Sep	Oct	83%
1989					Jul	Aug	Sep		50%
1990					Jul	Aug	Sep		50%
1991					Jul	Aug			33%

1992			May				Sep	Oct	42%
1993						Aug	Sep	Oct	42%
1994					Jul	Aug	Sep		50%

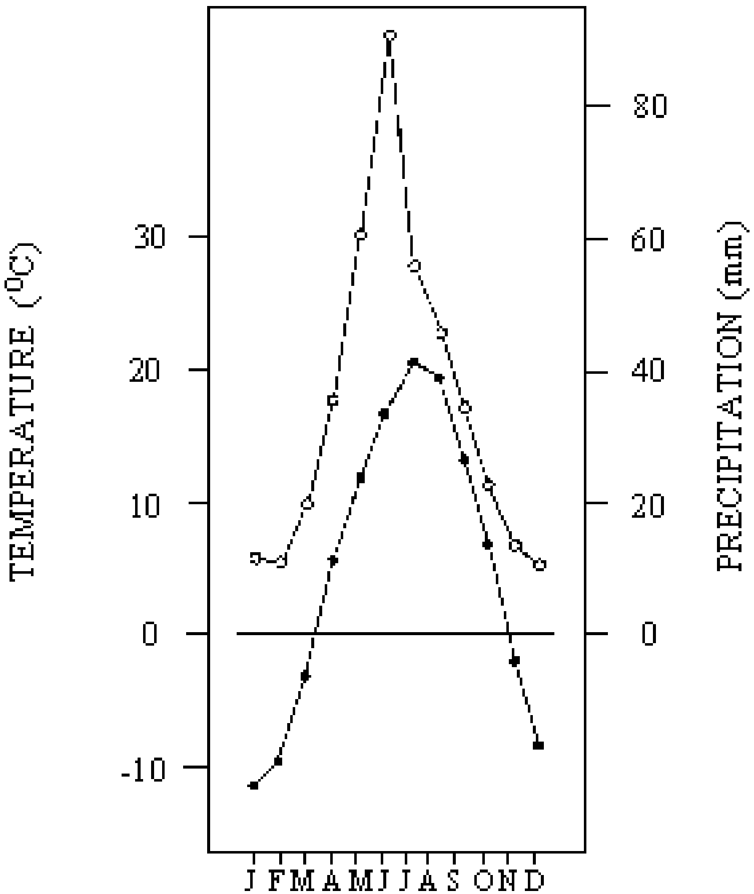
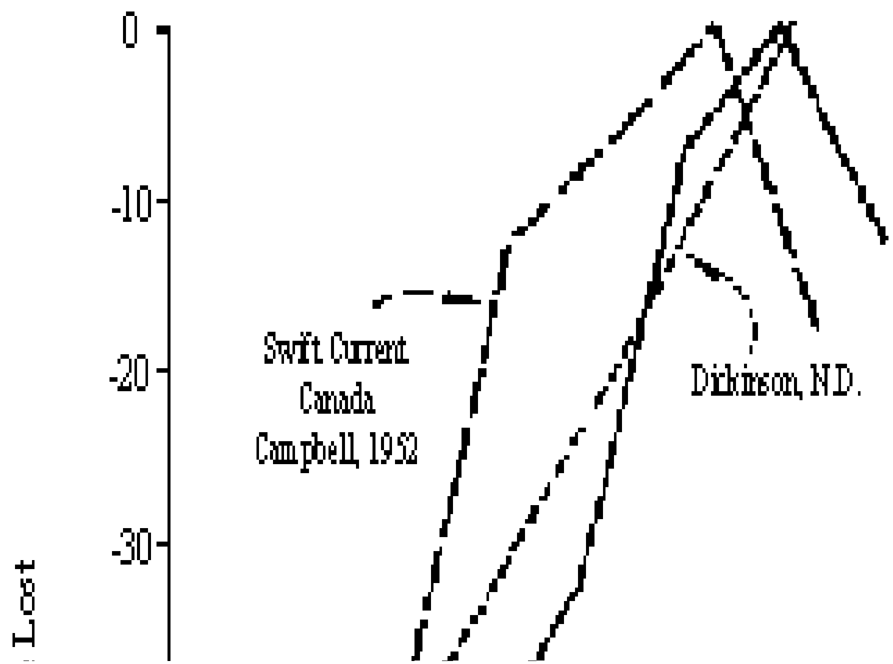


Fig. 1. Ombrothermic diagram oflong term mean monthly temperature and monthly precipitation at Dickinson, North Dakota.

Table 2. Mean percent growth in leaf height completed by sample date from ungrazed plants of major graminoid species from western North Dakota mixed grass prairie.						
	15 May	30 May	30 Jun	30 Jul	30 Aug	30 Sep
UPLAND SEDGES	75	93	100	-	**-**	**-**
Western Wheatgrass	54	69	92	100	-	-
Needleandthread	40	62	97	100	-	-
Prairie Junegrass	72	84	93	100	-	-
Plains Reedgrass	68	78	95	100	-	-
COOL SEASON GRASSES	59	73	94	100	**-**	**-**
Blue Grama	34	48	82	100	-	-
Prairie Sandreed	16	39	88	100	-	-
WARM SEASON GRASSES	25	44	85	100	**-**	**-**
Goetz. 1963. MS Thesis. NDSU						

Table 3. Mean percent growth in flower stalk height completed by sample date from ungrazed plants of major graminoid species from western North Dakota mixed grass prairie.						
	15 May	30 May	30 Jun	30 Jul	30 Aug	30 Sep
UPLAND SEDGES	66	82	100	-	-	**-**

Western Wheatgrass	0	0	91	100	-	-
Needleandthread	0	39	85	100	-	-
Prairie Junegrass	0	42	100	-	-	-
Plains Reedgrass	0	0	100	-	-	-
COOL SEASON GRASSES	0	20	94	100	-	**-**
Blue Grama	0	0	68	94	100	-
Prairie Sandreed	0	0	0	88	100	-
WARM SEASON GRASSES	0	0	34	91	100	**-**
Goetz. 1963. MS Thesis. NDSU						



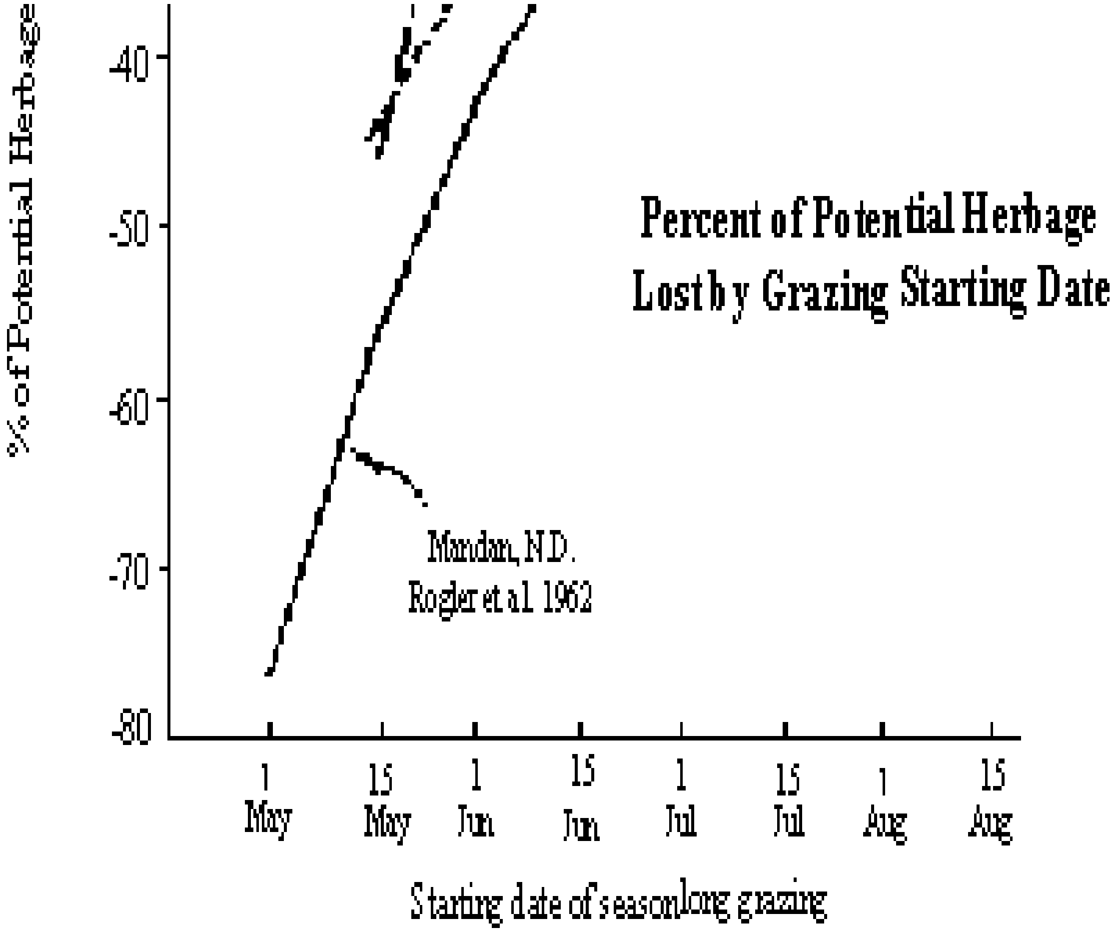


Fig. 2. Mean percent growth in leaf and flower stalk height completed by sample date from ungrazed plants of three categories of graminoids from estern North Dakota mixed grass prairie.

Table 4. Mean percent crude protein from ungrazed plants of major graminoid species from western North Dakota mixed grass prairie.

	23 Apr	8 May	23 May	8 Jun	23 Jun	8 Jul	23 Jul	8 Aug	23 Aug	8 Sep	23 Sep	5 Nov
UPLAND	17.5	15.3	14.3	13.6	12.2	10.0	8.5	7.8	7.6	7.6	6.9	6.9

SEDGES												
Western Wheatgrass	24.3	23.2	18.5	15.3	14.3	12.8	9.1	7.7	6.9	6.0	6.6	-
Needleandthread	23.9	17.6	15.7	14.6	12.4	9.8	8.3	6.8	6.2	6.1	6.2	5.4
Prairie Junegrass	19.4	19.8	14.1	14.1	12.2	8.8	7.1	6.4	6.3	4.6	-	-
Plains Reedgrass	-	-	20.4	13.4	13.1	11.5	9.5	7.6	5.8	5.9	5.5	-
COOL SEASON GRASSES	22.5	20.3	15.4	14.3	12.6	10.2	8.0	6.7	6.3	5.6	6.4	5.4
Blue Grama	-	17.0	15.4	13.8	15.1	11.7	9.8	7.6	7.7	7.1	6.9	7.3
Prairie Sandreed	-	14.3	16.0	14.4	11.6	10.3	8.7	7.0	6.5	4.9	3.5	2.9
WARM SEASON GRASSES	-	15.7	15.7	14.1	13.4	11.0	9.3	7.3	7.1	6.0	5.2	5.1
Whitman et. al. 1951. NDAC Bulletin 370												

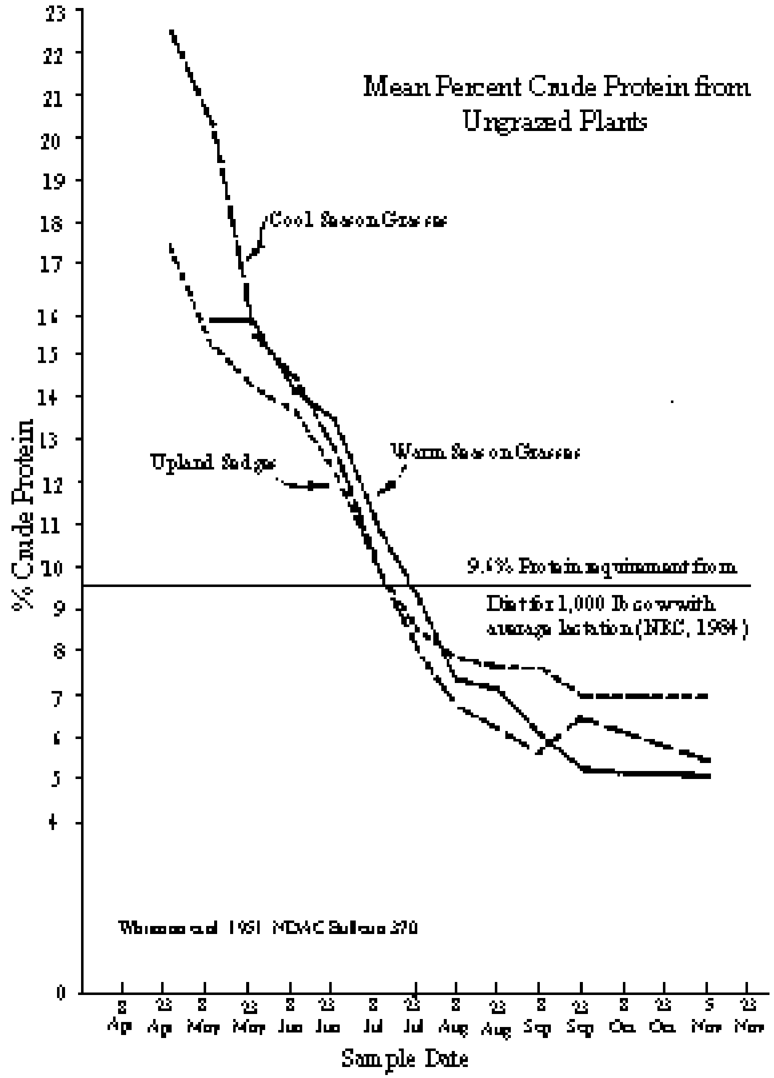
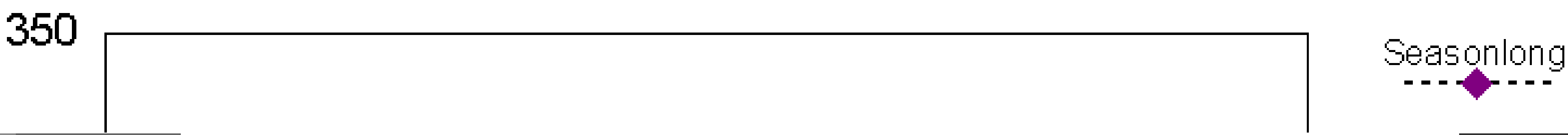


Fig. 3. Mean percent crude prtein from ungrazed plants of three categories of graminoids from eastern North Dakota mixed grass Prairie.



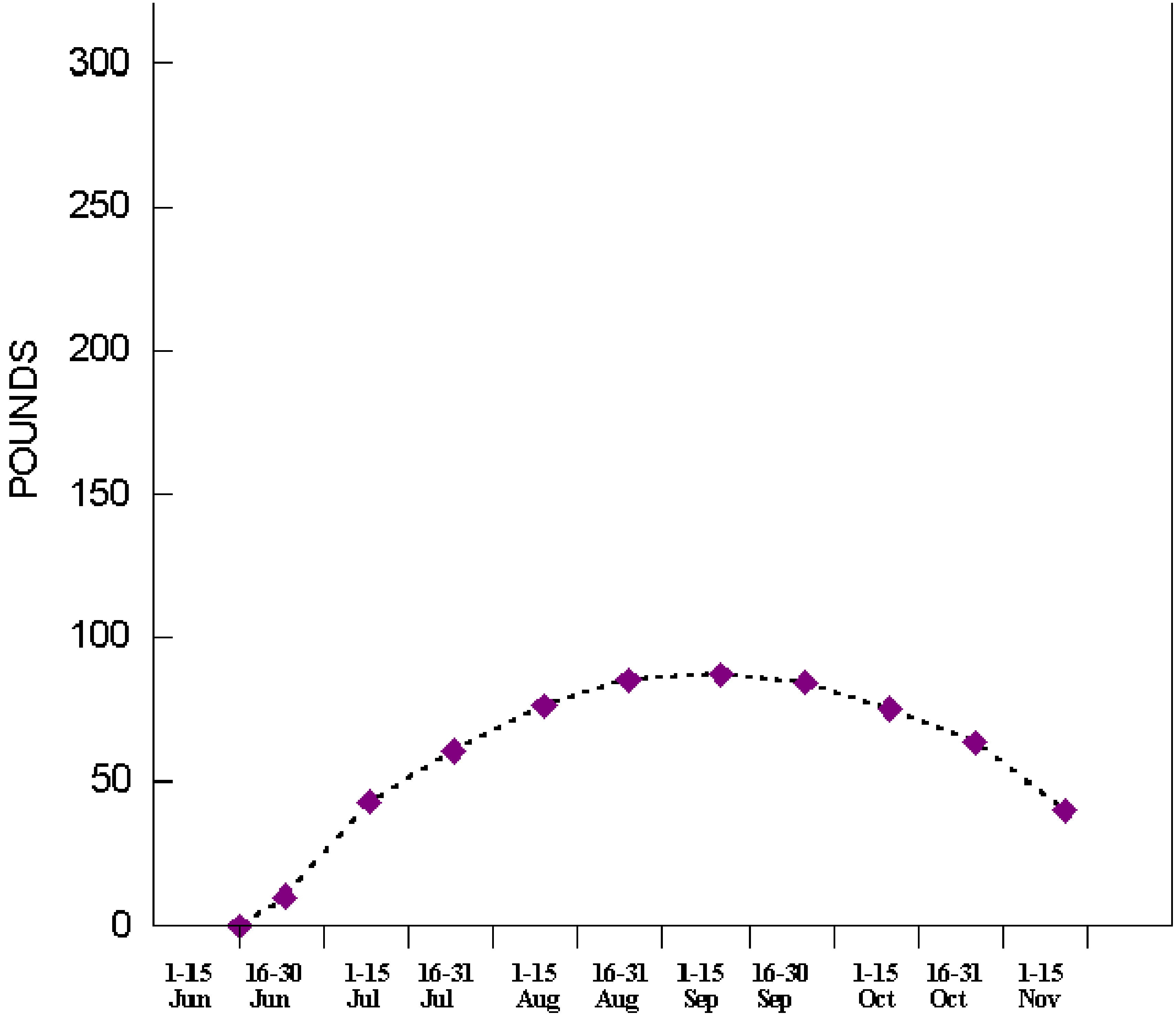


Fig 4. COW ACCUMULATED WEIGHT GAIN

Fig. 4. COW ACCUMULATED WEIGHT GAIN

Table 5. Percentage of potential peak above ground herbage not produced as a result from different starting dates of seasonlong grazing management.

Starting dates for seasonlong grazing	Swift Current[a] grazing data	Mandan[b] clipping data	Dickinson grazing data
1 May	-	-76%	-
15 May	-46%	-57%	-45%
1-5 Jun	-13%	-43%	-
15-20 Jun	-7%	-33%	-21%
1-5 Jul	0%	-8%	-
15-20 Jul	-18%	0%	0%
1 Aug	-	-13%	-

[a]Campbell 1952. [b]Rogler et al. 1962.

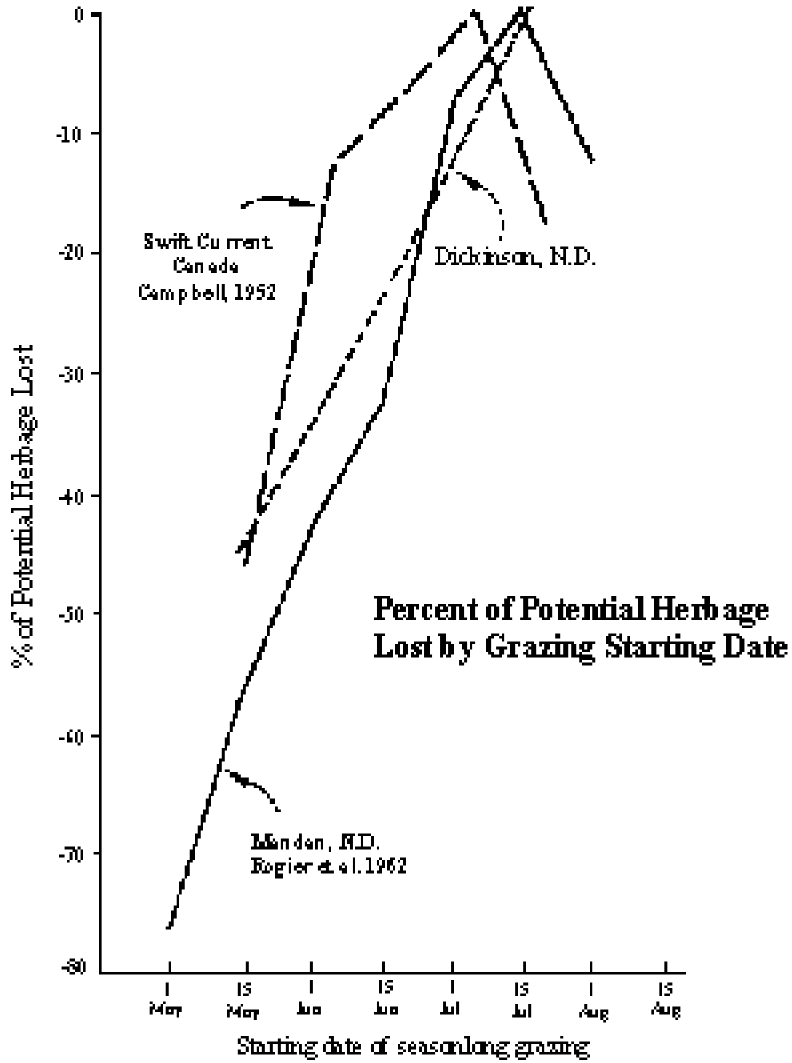


Fig. 5. Percentage of potential peak above ground herbage not produced as a result from different starting dates of seasonlong grazing management

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