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# GRAZING BEHAVIOR RESPONSES OF FREE-RANGING BEEF COWS TO FLUCTUATING THERMAL ENVIRONMENTS[1]

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## SUMMARY

The fluctuating thermal environment common to southwestern Montana rangelands may be a primary stressor of free-ranging beef cattle. Foraging behavior may vary with the duration and magnitude of exposure. The objective of this study was to examine grazing behavior of beef cows with previous fall grazing experiences, over a continuous fall season. This period was selected as characteristic of initial stages of re-exposure to declining ambient temperatures. Daily grazing time was estimated for twelve gestating Hereford x Angus cows grazing a 324 ha native range pasture. Each animal was fitted with a vibracorder to record grazing events over a continuous 53d period from October 11 to December 2, 1988. Charts were changed daily. Mean daily temperature was calculated from hourly ambient temperatures for the period 0701 to 0700h. A running average temperature represented the time course of thermal acclimation. Short-term thermal stress was defined as the deviation of the current mean temperature from the acclimated temperature for the previous 1 to 10d. Data were analyzed by SAS regression analysis. Daily grazing time averaged 482 min./day. Temperature had a negative quadratic effect ($p<.001$) on daily grazing time. Short-term thermal stress using acclimated temperatures calculated for 1 to 6d decreased grazing time ($p<.05$). The best fit model (Adj R-sq = 0.15) incorporated short term thermal stress calculated for lag of 1d. Mean daily temperature had a greater effect on daily grazing time than did short term thermal stress. These results indicate free-ranging beef cows grazing southwestern Montana rangelands in the fall are more responsive to current thermal conditions than to deviations from an acclimated temperature.

KEY WORDS: Stress, Temperature, Cattle, Grazing, Behavior

## INTRODUCTION

The fluctuating thermal environment common to southwestern Montana rangelands may be a primary stressor of free-ranging beef cows. The amount of forage consumed and subsequent nutritional status of grazing livestock is determined by time spent grazing and rate of intake (Arnold and Dudzinski, 1978). Grazing behavior may vary as a result of environmental temperature relative to a lower critical temperature and duration of exposure (Kennedy, 1985). Behavioral responses to changes in forage quality and quantity have also been reported (Leaver, 1985). Alterations in foraging behavior may be viewed as a response to a stressor and the ramifications for the animal would define the stress as physiological (harmless), overstress (damage), or distress (pathological) (Ewbank, 1985).

Senft and Rittenhouse (1985) hypothesized that foraging behaviors are minimized in response to short-term thermal stress (STTS), which is the deviation of the current day's temperature from a running average temperature. Two principal foraging behaviors of range beef cattle, daily grazing time (DGT) and forage intake, were reported to be positively correlated to declining ambient air temperatures (Adams et al., 1986). Recent examinations of foraging behaviors of range beef cows within a familiar winter environment demonstrated consistency and insensitivity to STTS despite widely fluctuating and cold (8 to -26 C) temperatures (Dunn et al., 1988; Beverlin, et al., 1989).

The objective of this study was to examine grazing behavior (specifically the amount of time per day spent grazing) of free-ranging beef cows with previous fall grazing experiences over a continuous fall season. This period was selected as characteristic of initial stages of re-exposure to declining ambient temperatures.

## METHODS

The study area was a 324 ha pasture located at the Red Bluff Research Ranch, Norris, Montana. The pasture contained sandy and silty range sites typical of southwestern Montana foothill range. Dominant vegetation included bluebunch wheatgrass (Agropyron spicatum), needleandthread (Stipa comata), Idaho fescue (Festuca idahoensis) and basin wildrye (Elymus cinereus). Daily grazing time was estimated for twelve gestating 7-year-old Hereford x Angus cows. Each animal was fitted with a vibracorder to record grazing events (Stobbs, 1970) over a continuous 53d period from October 11 through December 2, 1988. Cows wore the same vibracorder throughout the trial and charts were changed daily. Total DGT was estimated for the period 0701 to 0700h. All cows had similar previous grazing experiences at the study site.

Regression analysis (SAS 1988) was utilized to analyze effects of mean daily temperature (MDT), mean daily temperature squared (MDT2), STTS and interactions of these variables on DGT. Mean daily temperature for the period 0701 to 0700h was calculated from hourly ambient temperatures recorded at the research ranch. Components of a model developed by Senft and Rittenhouse (1985) were used to express STTS. A running average temperature represented the time course of thermal acclimation and STTS was defined as the deviation of the current mean temperature from an acclimated temperature for the previous 1 to 10 days. Prior experimentation (Beverlin et al., 1989) indicated that longer lag periods (>10d) for expression of STTS were nonsignificant for both DGT and daily forage intake; therefore lags (>10d) were not examined.

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Mean daily temperature during the study ranged from a high of 16.33 to a low of -9.27 C (Figure 1). Short-term thermal stress calculated for a lag of 1d (STTS1) ranged in magnitude from a minimum of 0.19 to a maximum of 12.09 C (Figure 1). Maximum snow ground cover was 18cm; however, the prevailing southwesterly wind and less severe microclimates facilitated accessible forage throughout the study.

## RESULTS

Daily grazing time averaged 482 min/day (Root MSE=82) over the fall grazing season, but varied as a function of STTS, MDT and MDT2. Short-term thermal stress, using acclimated temperatures calculated for lags of 1 to 6d, decreased DGT ($p<.05$). Mean daily temperature had a positive linear and a negative quadratic effect on DGT. Interactions of the variables were nonsignificant ($p>.05$). The model which provided the best fit (Adj R-sq=0.15) incorporated STTS calculated for a lag of 1d. The parameter estimates along with associated standard errors and significance levels for the independent variables are listed in Table 1. These parameter estimates define the response surface of DGT to MDT and STTS1 (Figure 2).

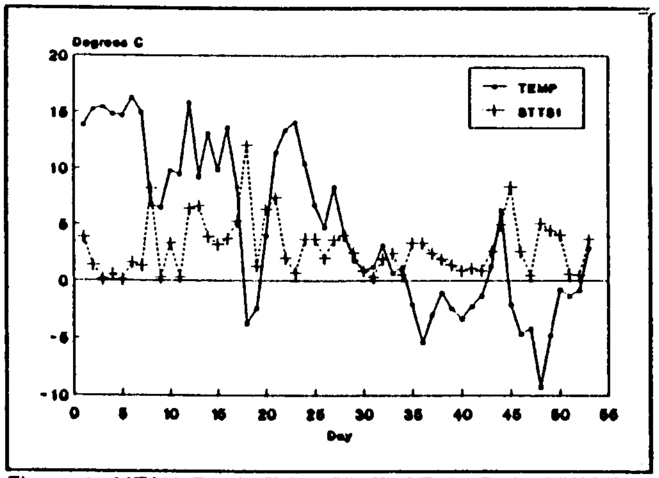

Figure 1. MEAN DAILY TEMPERATURE AND SHORT-TERM THERMAL STRESS LAG OF 1 DAY (FALL 1988)

TABLE 1. REGRESSION PARAMETER ESTIMATES FOR SHORT-TERM THERMAL STRESS LAG 1d, TEMPERATURE AND TEMPERATURE SQUARED[a]

| Variable | df | Estimate | Std Error | p-value |
|---|---|---|---|---|
| Intercept | 1 | 500.36 | 17.55 | 0.0001 |
| STTS1 | 1 | -5.38 | 1.37 | 0.0001 |
| Temp | 1 | 14.14 | 2.61 | 0.0001 |
| $Temp^2$ | 1 | -0.36 | 0.09 | 0.0001 |

[a]The model was significant at ($p<.001$).

## DISUSSION

In the present study, average DGT (482 min/day) was less than reported (Dunn et al., 1988; Beverlin et al., 1989) winter grazing times of prepartum cows at the same study site. In winter, cattle adjusted within-day grazing patterns in response to temperature fluctuations, but maintained consistent DGT which averaged 510 min/day and 528 min/day, respectively (Dunn et al., 1988; Beverlin et al., 1989). Adams et al. (1986) reported a reduction in grazing time for cows grazing winter range as temperatures declined, with an average total grazing time of 432 min/day, which was less than observed in the present study. The lower grazing times reported by Adams et al. (1986) may be due to differences in forage availability, (both quantitative and structural), and naturally occuring shelter.

The DGT response surface to STTS1 and MDT (Figure 2) illustrated that MDT had a greater effect on fall DGT than did STTS. The slight negative influence of STTS1 on DGT was similar to conclusions drawn from STTS effects upon winter DGT (Beverlin et al., 1989). However, unlike winter DGT, the current day's temperature had a pronounced nonlinear effect upon DGT in this fall study. Thus, fall DGT appeared to be more unstable over a range of higher air temperatures than grazing times observed during winter trials at the same study site. It is possible that other foraging behaviors such as forage intake and microclimate selection may also alter in response to fall thermal environments.

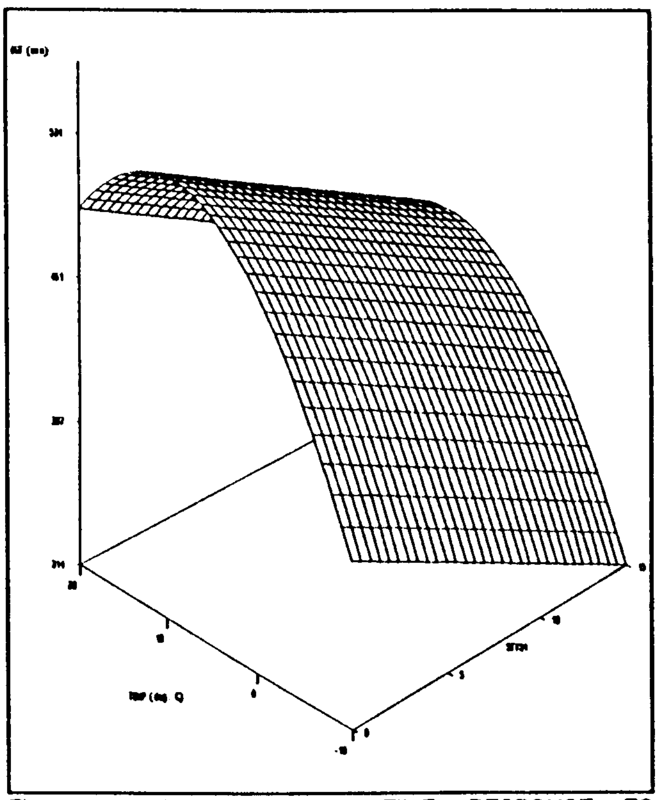
Figure 2. DAILY GRAZING TIME RESPONSE TO TEMPERATURE AND STRESS

The difference in response of DGT seen in the winter and fall may best be explained by the manner in which an animal becomes acclimated to changes in the thermal environment. When an environment presents novel or unfamiliar characteristics, stressor effects are more pronounced (Levine, 1985). Exposure to declining temperatures during the fall season may present short term environmental characteristics that are novel in comparison to the previous seasons conditions. Before the grazing animal becomes habituated to the changes in the thermal environment, the stressor may elicit a substantial behavioral response. As an animal is repeatedly exposed to a stimulus, subsequent reactions diminish (Levine, 1985). The mid-winter insensitivity to the thermal environment may be a function of physiolgical adaptation to both low and unstable ambient temperatures. This adaptation would be a function of both duration of exposure and previous grazing experiences within the thermal environment.

The alterations in foraging patterns created by the fall thermal environment were not considered severe. For mid-gestational conditions, impacts upon cows at maintenance requirements would be minimal, categorizing these fall thermal conditions as a physiological stress. It is unknown if these behavioral adjustments represent any physiological changes in response to thermal stress.

These results indicate free-ranging beef cows grazing southwestern Montana rangelands are more responsive to current thermal conditions than to deviations from an acclimated temperature. Also, free-ranging cattle appear to be more responsive to thermal conditions during the fall season than during the winter.

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