Cues cattle use to avoid stepping on crested wheatgrass tussocks

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Abstract

This paper tests 2 hypotheses regarding the cues cattle use to avoid stepping on crested wheatgrass (*Agropyron cristatum* (L.) Gaertner) tussocks. The first hypothesis is that cattle are attentive to shade and avoid tussocks by stepping on light areas (soil interstices) and avoiding dark areas (tussocks). In an experiment with 90 Angus heifers placed in a short-duration grazing paddock of 8.5 ha, the animals stepped with equal relative frequency on 28 patches of bare ground, 37 disks painted the shade and color of bare ground, and 37 disks painted to match vegetation over a 24-h period. We therefore reject the shade-cue hypothesis. The second hypothesis is that cattle are attentive to the vegetation itself in their avoidance behavior, and that as they crop the vegetation the frequency of trampling increases. In experiments similar to the first, cattle stepped on 85 intact tussocks 9 times, on 85 clipped (3 to 4 cm above litter) tussocks 28 times, on 85 vegetation-free tussock mounds 107, times and on 35 patches of bare ground 130 times. These differences are statistically significant. The data are consistent with the vegetation-cue hypothesis, except that the cattle also were attentive to the elevated substrate upon which the tussock grew. We conclude that, under the test conditions, hoof action does not have an important impact on crested wheatgrass pastures used for short-duration grazing. The impact could approach importance, however, if the pasture was grazed more heavily and if the vegetation was dry and dusty.

Key Words: short-duration grazing, hoof action, trampling vegetation

Two hypothesized benefits of short-duration grazing are the trampling and mixing of soil and litter (Savory 1978, 1983) and the destruction of standing dead vegetation which deters grazing within caespitose grasses (Willms et al. 1980). In an earlier study, however, we demonstrated that cattle avoid stepping on crested wheatgrass (*Agropyron cristatum* (L.) Gaertner) tussocks and concluded that the abovementioned potential benefits from hoof action are minimal (Balph and Malechek 1985). This conclusion nevertheless might not hold under certain circumstances. For example, as vegetation is eaten or becomes covered with dust, the cue that cattle may use to avoid stepping on tussocks, the green vegetation itself, may disappear. Discovery of the cues cattle use in avoiding tussocks should enable us to predict under what conditions of the environment or grazing animals would trample crested wheatgrass.

This study tests 2 hypotheses regarding the cues cattle use to avoid stepping on tussocks. The first is that the animals are attentive to substrate shade (achromatic variable) and/or color (see Hailman 1977:137-139 for discussion of chromatic variables). The tussocks are dark (green), whereas the spaces between the tussocks are light (beige). If cattle step on light and not dark, they would avoid trampling tussocks. This discrimination task is simple and does not require depth perception, an ability thought to be poorly developed in cattle (Arnold and Dudzinski 1978). The second hypothesis is that cattle are attentive to the tussock as a visual and perhaps tactile stimulus. As tussocks are eaten, error in trampling avoidance should increase.

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Methods

The tests were conducted in 1985 and 1986 at the Tintic pasture research facility, about 10 km southwest of Eureka, Utah. The 8.5-ha paddock was part of a short-duration grazing cell in which 90 Angus heifers were moved from paddock to paddock at 2-day intervals (see Malechek and Dwyer 1983 and Balph and Malechek 1985 for details). The predominant vegetation of the pasture was crested wheatgrass from a seeding established in the early 1960's.

The shade-cue hypothesis was tested by placing 74 disks, cut to a diameter of 20 cm from asphalt shingles, along 2 transects that bisected the paddock (see Balph and Malechek 1985). Thirty-seven of the disks were painted beige to match the soil and the other 37 green to match the vegetation. Thirty-seven patches of bare ground, each 20 cm in diameter, served as controls. The disks and controls were alternated and spaced at approximately equal distances from one another along the entire length of both transects. The cattle were then released into the paddock and the number of hoofprints on the disks and soil locations counted 24 h later by a technician who did not know the hypothesis being tested.

The vegetation-cue hypothesis was tested by locating 50 clusters of 3 tussocks, made equal in diameter, along the same 2 transects. In each cluster, 1 tussock was clipped to the litter and dusted with soil so that the remaining mound had the same color as the surrounding substrate. Another tussock was clipped 3 to 4 cm above the litter, simulating what we thought was the lowest the plants could be grazed by cattle, while the third tussock was left intact with vegetation 15 to 30 cm in height. After the cattle had been in the paddock for 24 h, one of us counted the number of hoofprints on each of the 3 types of tussocks. This test was duplicated the following year except for the inclusion of a control (flat and bare) area the size of a tussock (mean diameter 23.4 cm), randomly located by dropping a coin over the shoulder, near each cluster of tussocks and the use of 35 rather than 50 clusters. Because the soil was dry in 1986 and the hoofprints sometimes indistinct, 2 of us counted hoofprints independently as a check on interobserver reliability.

The data were subjected to chi-square analysis (test for goodness of fit and test of independence).

Results

If the shade-cue hypothesis was correct, we expected very few hoofprints on the dark disks and about as many hoofprints on the light disks as on the control areas of bare ground. There were 50 hoofprints on 37 dark (green) disks, 48 on 37 light (beige) disks, and 48 on 28 of 37 control areas (the data collector was unable to find the remaining 9 control areas). The observed distribution of hoofprints did not differ significantly from chance expectation $\chi^2 = 2.20$, df = 2, $P>0.3$), nor was there any tendency for the cattle to

step on dark disks less often than on light disks or bare ground (χ^2 = 0.26, df = 1, $P>0.5$). These results indicate that cattle do not use shade as a cue to avoid trampling crested wheatgrass tussocks.

If the vegetation-cue hypothesis was correct, we expected the cattle to trample short-clipped tussocks more often than intact tussocks due to the decrease in cue strength. In the first test of this hypothesis with 50 samples per treatment, 5 hoofprints occurred on unclipped tussocks, 13 on short-clipped tussocks, and 58 on totally-clipped tussocks. This outcome was in the predicted direction and differed significantly from what chance would dictate (χ^2 = 64.45, df = 2, $P<0.001$). Differences between successive treatments compared to chance expectation also were significant or nearly so (χ^2 = 3.56, df = 1, $P<0.06$ for unclipped versus short-clipped; χ^2 = 28.52, df = 1, $P<0.001$ for short-clipped versus totally clipped).

Our expectations for the repeat test of the vegetation-cue hypothesis were the same as those for the original test, with the addition that cattle should step on totally clipped tussocks with the same frequency that they stepped on control areas (bare ground). The results in the 35 samples of each treatment were 4 (5, second observer) on unclipped tussocks, 15 (21, second observer) on short-clipped tussocks, 49 (49, second observer) on totally clipped tussocks, and 134 (123, second observer) on control areas. The distribution again was in the predicted direction and deviated significantly from chance expectation (χ^2 = 196.79, df = 3, $P<0.001$; analysis based on data from the first observer, chosen by tossing a coin). Differences between successive treatments compared to chance expectation were significant in all cases (χ^2 = 6.37, df = 1, $P<0.02$; χ^2 = 18.06, df = 1, $P<0.001$; χ^2 = 36.65, df = 1, $P<0.001$; respectively). The interobserver reliability check showed no significant difference between observers (χ^2 = 1.54, df = 3, $P>0.5$).

We conclude from these tests that the vegetation-cue hypothesis is correct but incomplete. The cattle seldom stepped on intact tussocks, but when the tussock height was reduced, the trampling frequency increased. When no vegetation was visible, however, the animals still exhibited a strong avoidance of the elevated substrate upon which the tussocks grew, as shown by the significant difference in their response to totally clipped tussocks versus bare ground. This indicates that the mound itself can act as a secondary cue governing hoof placement. These results strengthen the hypothesis advanced earlier that cattle avoid stepping on tussocks because the tussocks present an uneven surface upon which to walk (Balph and Malechek 1985).

Discussion

Animals seek simple, stable cues to guide their behavior. The shade-cue hypothesis at the outset seemed to us to meet these criteria. In retrospect, however, the hypothesis was flawed. We observed after the tests that rain darkened the soil and made the light-dark cues unreliable. It is not surprising, therefore, that the data were inconsistent with the shade-cue hypothesis.

The findings from the vegetation-cue tests indicate that cattle eat the primary cue they rely upon to avoid stepping on tussocks. A key question is: Does the increase in trampling frequency constitute an important hoof-action effect? Our own view is that, under the test conditions, hoof action would not have a major impact on crested wheatgrass pastures used for short-duration grazing. The impact could approach importance, however, if the pasture was grazed more heavily and if the vegetation was dry and dusty. Severe trampling of bunchgrass pastures can, we believe, be expected only near salt or water resources where animal use is exceptionally high and where jostling among animals may prevent them from avoiding tussocks.

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