Preferences of Angora goats for eight selections of grasses used for reclamation of Great Basin rangelands

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Abstract

Mature Angora goats were pastured in plots supporting eight selections of grasses used for rangeland reclamation in the northern Great Basin. The objectives were to establish the relative preferences of goats for these forages at two stages of phenology (late-boot and dormant) and relate selective preferences to forage production and quality attributes. Numbers of each selection visited, total bites harvested, and percent plant weight utilized characterized diets of goats. Forage attributes included herbage production, CP, and IVOMD. Crested wheatgrass selections (cultivars 'Nordan' and 'Hycrest II') were consistently ranked as preferred forages at both stages of phenology, with the two receiving 80 + % of the grazing activity. Cultivars 'Magnar' and 'Trailhead' basin wildrye, 'Goldar' bluebunch wheatgrass, and 'Bozoisky' Russian wildrye were ranked as indifferently foraged upon, and a numbered selection (No. 9021076) of thick-spiked wheatgrass and the closely related cultivar 'Secar' Snake River wheatgrass ranked as avoided. Variation in herbage production among selections was significantly and positively correlated with visits to selections and total bites but not well enough to be an accurate predictor of selectivity. Indices of forage quality (CP and IVOMD) were not significantly correlated with selectivity. Adequate livestock performance can probably be attained on the preferred and indifferently ranked forages through mid-summer without supplementation. The two thick-spiked wheatgrasses, No. 9021076 and 'Secar' Snake River wheatgrass, are not recommended as forages for Angora goats.

Keywords: Grazing; Foraging; Selectivity; Forage preference; Angora goat; Behaviour; Forage quality predictor

1. Introduction

While domestic goats (*Capra hircus hircus*) are frequently classified as browsers (Stoddart et al., 1975; Harrington, 1982; Stuth, 1991) their feeding habits in many environments are more diverse (Malechek and Leinweber, 1972; Lindahl, 1974; Lu, 1988) even to the extent that some have called them omnivorous (French, 1970). Their selective grazing habits can be

exploited for biological control of weeds resulting in increased carrying capacity of rangelands in some instances (Davis et., 1975; Radcliffe, 1985; Norton and Deery, 1985; Lu, 1988). Recent work on native rangelands in the northern Great Basin revealed that mature Angora goats were primarily grass consumers (90 + % of diet) and that kids, although initially more diverse in their diet selection than adults, increased their dependence on grasses (66–88%) as the animals matured (Richman, 1993). Other work with Spanish goats in the same area detected grass/forb/shrub ratios

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in their diet of 33:64:3, respectively, when herbaceous plants were green and growing, and ratios of 48:50:2 when forages were dormant (B. Fajemisin, personal communication, 1993). Although some localized exceptions occur (Welch and Wagstaff, 1992), secondary chemicals in many western trees and shrubs appear to be generally effective deterrents to browsing by goats and large herbivores (Smith, 1950; Provenza and Malechek, 1986; McKell, 1989). This may cause a greater demand by large herbivores on the herbaceous components of the region than occurs in other biomes.

In many instances selective grazing by wild and/or domestic herbivores shapes the character and composition of vegetation (McNaughton and Georgiadis, 1986; Crawley, 1990; Brown and Stuth, 1993; Taylor et al., 1993). Consequently, information regarding the seasonal preferences of grazers is critical to pasture managers concerned with establishment and/or persistence of forages, livestock managers striving to meet nutritional needs of their herds (Vallentine, 1974), and other land managers seeking to encourage or discourage use of their ground cover (Fagerstone et al., 1980).

The objectives of this research were to: (1) establish the relative preferences of Angora goats for eight available selections of grasses at two stages of phenology, and (2) to relate selective rankings exhibited by goats to herbage production and quality indices of the forages. These were accomplished using 'cafeteria style' grazing trials in plots supporting equal numbers of plants of each selection.

2. Materials and methods

Selections of grasses evaluated are adapted to and used for seeding areas in the arid Great Basin. Selections (and recommended precipitation ranges for establishment) included two cultivars of basin wildrye (*Leymus cinereus* (Scribner & Merrill A. Löve)), 'Magnar' (20–63 cm) and 'Trailhead' (20–41 cm), two selections of thick-spiked wheatgrass (*Elymus lanceolatus* ((Scribner & J.G. Smith) Gould), selection No. 9021076 (15–41 cm) and cultivar 'Secar' Snake River wheatgrass (20–46 cm), one cultivar of bluebunch wheatgrass (*Pseudoroegneria spicata* (Pursh) A. Löve) 'Goldar' (20–46 cm), the 'Bozoisky' (31–36 cm) cultivar of Russian wildrye (*Psathyrostachys junceus* (Fischer) Nevsk), cultivar 'Nordan' crested

wheatgrass (*Agropyron desertorum* (Fischer ex Link) Schultes) (20–30 cm), a successful and long used introduction to the region, and a crested wheatgrass cross cultivar called 'Hycrest II' (20–20 cm; a product of *Agropyron desertorum* and *Agropyron cristatum* (L.) Gaertner). The numbered selection of thick-spiked wheatgrass was rhizomatous in nature, while remaining selections had caespitose growth forms.

Origin of seed for 'Magnar', 'Goldar', and 9021076 was the Aberdeen, ID Plant Materials Center. 'Trailhead' and 'Bozoisky' were products of the Bridger, MT Plant Materials Center, and 'Secar' was released through the Pullman, WA Plant Materials Center. 'Nordan' seed was acquired commercially, and 'Hycrest II' seed furnished by USDA–ARS Logan, UT.

The research was conducted on the Northern Great Basin Experimental Range (119°43′W, 43°29′N) 70 km west–southwest of Burns, OR. Mean annual precipitation at the 1375 m level is 28.2 cm with peak monthly accumulations in November, December, January, and May (2.8–3.6 cm), and a mean minimum accumulation (0.8 cm) in July. Herbaceous plant yield in the region is most strongly correlated with the 'crop year' or September–June moisture accumulation (Sneva, 1982) which averages 25.5 cm. Typically herbaceous plant growth begins in the spring with warming temperatures and is arrested by soil moisture depletion by mid-July. Mean annual temperature is 7°C, and extremes are −29 and 42°C. Soil where plots were established is a Holte (coarse–loamy, mixed, frigid Aridic Duric Haploxerolls) Milican (coarse–loamy, mixed, frigid Orthidic Durixerolls) complex (Lentz and Simonson, 1986).

Study plots were established in spring 1990 from transplants initiated in a greenhouse the previous winter, and grazing trials were conducted in early June and late August 1991. Plots were irrigated in 1990 to facilitate establishment, and crop year precipitations for 1990 and 1991 were 67% and 79% of average, respectively. Project design was a randomized complete block with three replications, two stages of phenology, and eight selections. Each replicate contained two macroplots (20.6 m to a side) with one grazed during the late-boot stage of phenology and the second during dormancy. A macro-plot supported 98 plants of each selection (total/macro-plot 784 plants) with each plant randomly positioned and established in a 28 × 28 matrix. Matrix rows and columns were 76 cm apart.

Three extra macro-plots of identical composition and design were available and used to familiarize goats with the forages, physical aspects of the project, and sampling procedures. All plots were mowed each fall to eliminate the influence of cured, standing litter on forage selection (Ganskopp et al., 1992a). Weeds were treated mechanically, small rodents controlled with zinc phosphide, and jack rabbit grazing prevented by permanent fencing.

Before each grazing trial two plants of each selection were harvested to ground level, oven dried at 40°C, and retained for measures of herbage production and forage quality as indexed by CP content (AOAC, 1990) and IVOMD (Tilley and Terry, 1963). Two sets of numbered cards (1–28) were also arranged on the ground, outside of an enclosing electric fence, to facilitate identification of rows and columns of the macro-plot, and a small water trough placed within the enclosure.

Seven mature Angora does (randomly selected from a group of 30) were used in the project. Ages ranged from 3 to 10 years and weights from 35 to 44 kg. At each stage of phenology, three grazing trials were conducted over 3 successive days. A trial began with an observer, equipped with a backpack mounted platform and lap-top computer, and two goats entering a macro-plot. The observer selected one of the animals for monitoring, tallied each bite when material was severed from a plant by pressing the space bar, and entered a 'W' when the goat abandoned a plant and began walking in search of another. Goats were quite tame and could be easily approached to within 1–2 m as they foraged. Because we could not identify some selections from cursory examination, two other technicians simultaneously recorded row/column coordinates of plants as the goats foraged. After a goat visited 50 plants, a third animal was released for observation, and sampling progressed until a total of six goats were released and 250 plants were visited. Visits included only plants actually foraged upon with subsequent returns and regrazing of individual plants also scored as visits. Trial runs revealed our progressive release of animals and the monitoring of 50 visits per goat avoided satiation of animals and potential depletion of one or more selections before a trial was completed.

After sampling, goats were left to forage in the macro-plot until evening when they were penned to prevent possible predation by coyote. The following morning a technician examined the previously grazed macro-plot and scored degree of utilization for each plant with indices ranging from 0 to 3. Scores reflected: (0) no grazing, (1) 1–20% weight removed, (2) 21–40% weight removed, and (3) over 40% weight removed.

Coordinate data from the grazing trials were keypunched and interfaced with plotmaps to provide a sequential listing of selections grazed. These data were then sorted by selection ($n = 8$) and observation number (1–250) and linear regressions, relating observation numbers (independent variable) to cumulative number of plants grazed (dependent variable), conducted on each selection. The individual slopes of these regressions consequently depict the relative rates at which selections were visited by goats and were used as observations in later analyses of variance.

Bite-count and coordinate data were integrated with plotmaps to provide listings of total bites harvested from each selection. Utilization data were similarly processed. Software for acquiring and interfacing bite count and utilization data, plant coordinates, and plotmaps were generated in GWBasic by the senior author. In our analysis three variables served as indices of forage selection (visitation rates, total bites, and percent plant weight utilized), one variable reflected herbage mass (forage available), and 2 variables indexed forage quality (CP and IVOMD). Because stages of phenology or growth cannot be randomized in the field, analysis of variance was a split-plot with three replications, two stages of phenology as whole-plots, and eight selections as sub-plots. Replication × phenology was the error term (2 df) for the phenology effect, and replication × phenology × selections was the error term (28 df) for selections and the phenology × selections interaction. Selection totals within macro-plots for utilization, CP content, and IVOMD served as single observations in analyses of variance and were subsequently converted to percentages for presentation.

Relationships among all possible paired combinations of the six variables at each stage of phenology were examined using Pearson's coefficient of correlation. In all analyses statistical significance was assumed at $P < 0.05$. Mean separations and preference rankings were accomplished with Fisher's Protected Least Square Difference ($P = 0.05$) procedures. For preference rankings selections scoring greater than 1 LSD above the mean or hypothesized expectation were viewed as 'preferred', those less than 1 LSD below

were scored as 'avoided', and those within ± 1 LSD of the mean or postulated value considered 'passively' foraged upon (Ganskopp et al., 1992b). Preference rankings for visits and bite count data were assigned on the basis of two separate null hypotheses. The first assumed that since equal numbers of plants of each selection were available, opportunity to visit and bite upon selections would also be equally distributed. With eight selections and 250 visits tallied per trial, one would expect roughly 31 visits to each selection. The second assumed distributions of visits and bites among selections would reflect the relative mass contributed by selections in each macro-plots. While comparison among goats was not a specific objective of this project, the similarity of diets among animals at each stage of phenology was quantified using Kulczynski's mathematical expression (Oosting, 1956) and the number of visits to selections for individual goats.

3. Results

Analyses of variance revealed significant ($P < 0.05$) phenology effects for indices of forage quality (CP and IVOMD), significant selection effects for all six variables analyzed, and significant phenology × selection interactions for total bites, percent utilization, and CP data. Given the significant phenology or interaction effects for four of six variables analyzed, two-way presentations of all data are provided for consistency in interpretation and discussion.

Linear models adequately described rates at which goats visited selections with the 48 r^2s averaging 0.92 (SE = 0.011). Visitation rates varied ($P < 0.00$) among selections with no significant phenology or interaction effects (Figs. 1A and 1B). Together, visits to the two crested wheatgrass selections ('Nordan' and 'Hycrest II') accounted for 78–80% of total observa-
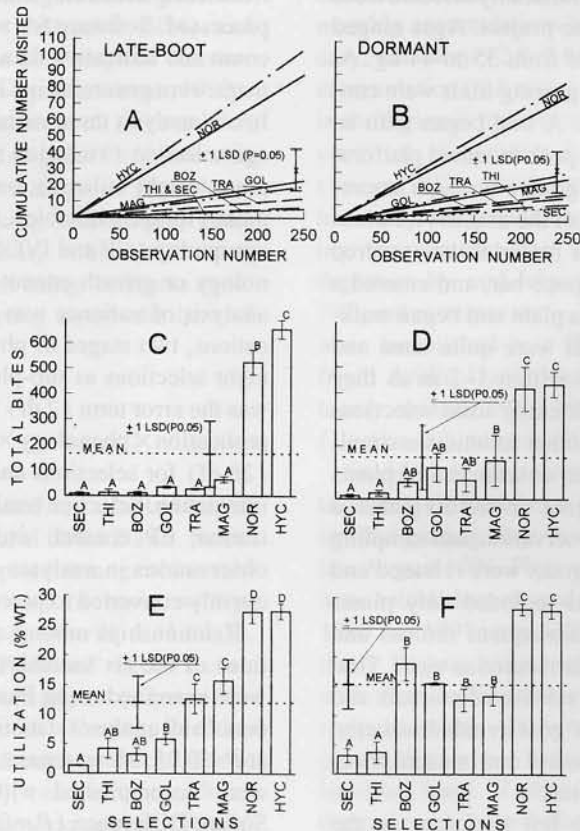

Fig. 1. Cumulative number of plants visited, total bites harvested, and percent of plant weight utilized by Angora goats foraging on eight selections of grasses during late-boot and dormant stages of phenology on the Northern Great Basin Experimental Range, Burns, Oregon. Bars within each graph sharing a common letter are not different ($P > 0.05$).

Table 1
Preference ratings assigned to eight selections of grasses grazed at two stages of phenology by Angora goats on the Northern Great Basin Experimental Range. Ratings are based on numbers of visits to plants, total bites harvested, and percent plant weight utilized and are assigned on the basis of two null hypotheses: (1) assumed foraging opportunity was equal among selections, and (2) assumed foraging opportunity mirrored relative herbage mass of selections. Ratings and interpretations are: +, preferred; 0, indifferently foraged upon; −, avoided

Selection	Null hypotheses									
	Opportunity equal among selections						Opportunity related to relative herbage mass			
	Visits		Total bites		% Utiliz.		Visits		Total bites	
	LB	DO	LB	DO	LB	DO	LB	DO	LB	DO
SEC	−	−	−	−	−	−	−	0	0	0
THI	−	−	−	−	−	−	−	−	−	−
BOZ	−	−	−	0	−	0	0	−	0	−
GOL	0	0	−	0	−	0	0	0	0	0
TRA	−	−	−	0	0	0	0	0	0	0
MAG	0	0	0	0	0	0	0	0	0	0
NOR	+	+	+	+	+	+	+	+	+	+
HYC	+	+	+	+	+	+	+	+	+	+

LB, late-boot stage of phenology; DO, dormant state of phenology; SEC, 'Secar' Snake River wheatgrass; THI, thick-spiked wheatagrass No. 9021076; BOZ, 'Bozoisky' Russian wildrye; GOL, 'Goldar' bluebunch wheatgrass; TRA, 'Trailhead' basin wildrye; MAG, 'Magnar' basin wildrye; NOR, 'Nordan' crested wheatgrass; HYC, 'Hycrest II' crested wheatgrass.

tions and both were assigned preferred ratings (Table 1). 'Goldar' and 'Magnar' received indifferent ratings, and the remaining selections were scored as avoided. Of those avoided, thick-spiked wheatgrass and 'Secar' Snake River wheatgrass ranked lowest with only three to seven plants visited per trial.

Totaled over the three replications, 4009 bites were tallied in our late-boot sampling and 3845 during dormancy. Total bites by goats exhibited significant selection and phenology × selection effects. At the late-boot stage of phenology the 'Nordan' and 'Hycrest II' crested wheatgrasses were again ranked as preferred (Table 1) and together the two accounted for 88% of total bites tallied (Fig. 1C). Only 'Magnar' received an indifferent rating, leaving the remaining five selections classified as avoided. During dormancy total bites were slightly more equitably distributed among selections (Fig. 1D). Again, however, only the crested wheatgrasses were scored as preferred. More selections ('Bozoisky', 'Goldar', 'Trailhead', and 'Magnar') received an indifferent rating during dormancy than during the late-boot stage of growth, and only the two thick-spiked wheatgrasses were classified as avoided.

Selection and phenology × selection effects were significant for percent plant weight utilized. At both

stages of phenology the crested wheatgrasses were assigned preferred preference ratings (Figs. 1E and 1F), the two basin wildryes ('Magnar' and 'Trailhead') ranked as indifferent, and the two thick-spiked wheatgrasses scored as avoided (Table 1). 'Bozoisky' Russian wildrye and 'Goldar' bluebunch wheatgrass were elevated from avoided during the late-boot stage of growth to an indifferent rating during dormancy.

Total forage available in macro-plots averaged 100 kg at the late-boot stage of growth and 113 kg during dormancy (Figs. 2A and 2B). Selection variation was significant, but phenology and interaction effects were not. In more typical years we would expect a 40–60% increase in herbage mass between the late-boot stage of phenology and entry of plants into dormancy. Since crop year precipitation was 79% of average, however, growth was arrested during late-anthesis to early seed development in the grasses and few selections expressed their full potential. Among selections 'Nordan' and 'Hycrest II' ranked highest in herbage production with 'Trailhead' and 'Secar' ranking lowest (Figs. 2A and 2B).

Under our null hypothesis that the distributions of visits and total bites by goats would mirror the relative herbage mass of selections, more indifferent ratings
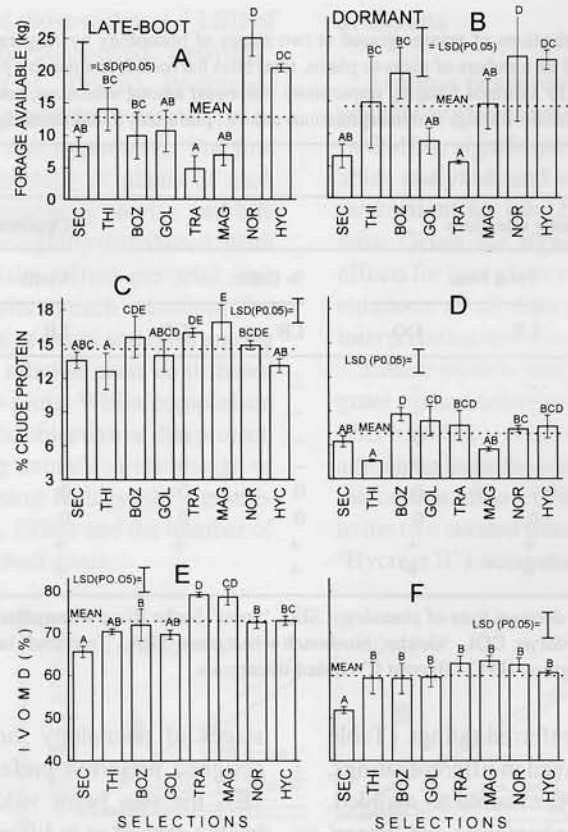
Fig. 2. Forage mass available, CP content, and IVOMD of eight selections of grasses grazed by Angora goats during late-boot and dormant stages of phenology on the Northern Great Basin Experimental Range, Burns, Oregon. Bars within each graph sharing a common letter are not different ($P > 0.05$).

Table 2

Percent of total herbage contributed by eight selections of grasses and percent of visits to selections and total bites harvested by Angora goats grazing during late-boot, and dormant stages of phenology. Means within rows under each stage of phenology sharing a common letter are not different ($P > 0.05$)

Grass selection	Phenology					
	Late-boot			Dormant		
	% Total herbage	% Total visits	% Total bites	% Total herbage	% Total visits	% Total bites
'Secar'	8a	1b	1b	6a	2a	1a
Thick-spike	14a	1b	1b	13a	3b	2b
'Bozoisky'	9a	3a	1a	17a	7b	5b
'Goldar'	11a	3a	3a	8a	10a	9a
'Trailhead'	5a	4a	2a	5a	6a	6a
'Magnar'	7a	7a	5a	13a	10a	11a
'Nordan'	26a	37b	39b	19a	30b	32b
'Hycrest II'	20a	44b	48b	19a	32b	34b

Table 3
Pearson's correlation coefficients (r) relating comparisons among three indices of forage selection by Angora goats and measured of forage availability and quality of eight selections of grasses at two stages of phenology on the Northern Great Basin Experimental Range. Bold coefficients denote $P < 0.01$, and underlined coefficients $P < 0.05$. N for each value = 24

Dormant	Late-boot					
	Visits	Total bites	Percent utilization	Herbage available	Percent CP	Percent IVOMD
Visits		**0.98**	**0.90**	**0.72**	−0.14	0.12
Total bites	**0.98**		**0.99**	**0.76**	−0.16	0.05
Percent utilization	**0.87**	**0.83**		**0.61**	0.00	0.36
Herbage available	0.42	0.47	0.44		−0.40	−0.33
Percent CP	0.24	0.21	0.41	0.04		0.40
Percent IVOMD	0.38	0.35	0.39	−0.15	0.15	

occurred than when we assumed equal foraging opportunity among selections (Tables 1 and 2). Most rating changes involved shifts from the avoided to the indifferent ranking for the 'Secar' and 'Trailhead' selections. No rating changes occurred for the two preferred selections or the avoided No. 9021076 selection of thick-spiked wheatgrass. Correlation coefficients relating mass of grasses to indices of forage selection were positive ($P < 0.05$) during both stages of phenology (Table 3).

Forage quality as indexed by CP and IVOMD varied significantly among selections and stages of phenology (Figs. 2C, 2D, 2E, and 2F). CP content averaged 14.6% at late-boot and 7.0% during dormancy. Among selections the numbered thick-spiked wheatgrass consistently ranked lowest in CP content.

Across selections, mean levels of IVOMD were 72.5% and 59.9% during late-boot and dormant stages of growth, respectively. The two basin wildrye selections, 'Magnar' and 'Trailhead', ranked highest in IVOMD at the late-boot stage of phenology, and with the exception of the low value accorded 'Secar' Snake River wheatgrass, IVOMD values were clustered closely about the mean during dormancy. Variation in CP content and IVOMD of forages were weakly associated with visitation rates, total bites, or percent plant weight utilized (Table 3).

The strongest correlations between indices describing forage selection by goats (visitation rates, total bites, or percent utilization) and forage attributes occurred during the late-boot stage of growth and involved herbage mass available (Table 3). Among indices describing forage selection, visitation rates and

total bites were highly correlated at both stages of phenology. These two variables were also highly ($P < 0.01$) correlated with percent plant weight utilized at both stages of phenology. Among goats Kulczynski's index suggested a high degree of similarity occurred in their foraging endeavors. Indices among animals averaged 79 (SE = 3.6, range 53–95) and 77% (SE = 2.5, range 62–86), respectively, during late-boot and dormant trials, which reduced to an overall value of 78% (SE = 2.3) for the combined trials.

4. Discussion

Goats were very selective in their grazing of these grasses, with well over 80% of their feeding activity focused on the two crested wheatgrasses ('Hycrest II' and 'Nordan'). Richman (1993) observed Angoras grazing nearby pastures dominated by native grasses and noted the animals first examined areas where crested wheatgrass occurred before foraging on the native vegetation. The two thick-spike wheatgrass selections (No. 9021076 and 'Secar') received very little attention and were generally classified as avoided. Although this high level of selective behavior was expressed during both active growth and dormant stages of phenology there was a slightly broader acceptance of the forages after foliage had cured. This is consistent with observations in other environments (Stuth, 1991).

Although inferences from our utilization data were similar to those above, the goats used various approaches in grazing the forages which were not quan-

tified and that could potentially impact the grasses in different ways. Among the forages the two basin wild-ryes ('Magnar' and 'Trailhead') and two crested wheatgrasses were the largest in stature being taller and having longer, wider, and tougher leaves than the other selections. The remaining grasses were relatively similar in morphology with fine leaves and stems. During the late-boot stage of growth, when grasses are most affected by defoliation (McIlvanie, 1942; Ganskopp, 1988) the goats removed individual leaves without detaching stems from the four larger selections, and removed entire stems with three to four leaves and the enclosed reproductive tissue from the other grasses. As the apical meristems were removed from the finer grasses, their continued growth would require initiation of new tillers from the base of the plant. Apical meristems were not removed from the coarser grasses and reproductive development continued, impeded only by the loss of some photosynthetic area. These variations in foraging technique, even within a single growth form, may partially confound our efforts to adequately model or predict plant responses to defoliation (Obeso, 1993).

During plant dormancy the goats systematically removed seed heads from the crested wheatgrasses and stripped individual leaves from the remaining selections. While herbivory at this stage of growth has little impact on subsequent plant health, the goats' selective behavior most certainly enhanced their diet quality. Our CP and IVOMD data (Figs. 2C and 2D) describe whole-plant samples and are most likely an underestimate of actual diet quality. This is of little consequence during our late-boot sampling when mean CP content of forages ($\bar{x} = 14.6\%$) exceeded the roughly 8% maintenance requirement of goats (NRC, 1981). Whole-plant samples averaged 7% CP during our dormant trial, indicative of a potential deficiency. Supplementary sampling of crested wheatgrass seedheads during the trial, however, revealed dietary CP most likely equaled or exceeded 9.3% (SE = 0.8). One should not infer from this that goats could continue to perform adequately on these grasses as the summer progressed, as other work in the region has demonstrated that CP content of grasses can dip as low as 3% as forages age, weather and shatter (Angell et al., 1990).

Among variables describing forage quality and availability, only herbage availability was consistently ($P < 0.05$) correlated with visits, bites, and utilization

(Table 3). Others have noted that animals prefer to graze where they can maximize intake (Black and Kenny, 1984). Our positive relationships support this hypothesis; however, our linear models account for only 37–58% of the variation among selections during the late-boot stage of phenology, and even less (17–22%) during dormancy. While herbage mass alone was a poor predictor of the selective grazing exhibited, it perhaps should be measured as a covariate in trials where forages express substantial variation in production. Indeed, referencing indices of forage preference in this trial to available herbage resulted in a more conservative classification with more selections placed in the indifferently accepted category than when forage availability was assumed equal among selections. Similar to findings elsewhere (Provenza and Balph, 1987) our conventional measures of forage quality were of little value in modeling or predicting forage selection.

Correlations among our indices of forage selection (Table 3) were exceptionally high between visits and total bites ($r = 0.98$) at both stages of phenology. This suggests that number of plants visited would provide an adequate description of diets, and the effort of documenting total bites is perhaps unnecessary duplication. Percent plant weight utilized, which indexes grazing impact on the plants, is an integration of number of plants grazed, herbage mass, and amount of material removed. Utilization was associated ($P > 0.01$) with visits and total bites, but not well enough to be extrapolated from those data.

5. Conclusions

Angora goats were very selective in their use of these grasses. The 'Hycrest II' and 'Nordan' crested wheatgrasses were clearly preferred, and producers contemplating their use or establishment would certainly find them avidly consumed. If mixtures of these selections are contemplated, however, managers should closely monitor use of the crested wheatgrass to assure its persistence in the stand. When restricted to less acceptable forages, domestic stock can typically perform satisfactorily if nutritional requirements are met. Most likely, Angoras confined to the indifferently categorized selections ('Magnar', 'Trailhead', 'Goldar', and 'Bozoisky') would receive adequate nutrition through mid-summer. Although pasture management becomes

more complex, seeding a mixture of grasses may be more appropriate in this case, as goats do not thrive if kept on single sources of feed for appreciable time (Lindahl, 1974). The consistent avoidance of the numbered selection (No. 9021076) of thick-spiked wheatgrass and the substantial but less consistent avoidance of the closely related 'Secar' Snake River wheatgrass, suggests that Angoras may have to be forced to consume these varieties. On a positive note, the seeding of these 2 selections might be used to discourage foraging by goats in critical or sensitive environments. This hypothesis has not been tested, however, and managers should proceed with some caution if such applications are contemplated.

Acknowledgement

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