

# The Botanical Composition of the Diet of Free-ranging Cattle on an Alpine Range in Australia

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## Abstract

Five oesophageal-fistulated steers were used to determine the botanical composition, on a quantitative basis, of the diet of free-ranging cattle on an alpine range in Victoria, Australia. The steers primarily selected 4 grass species, 3 sedges and 1 rush, 6 forbs and 3 shrub species. Species selection changed significantly with seasonal advance. Generally grass species were preferred early in the grazing season, shrubs in the middle of the season and forbs towards the end of the season. The main species identified in the diet which should be used as indicator species of range condition are: alpine star-bush (*Asterolasia trymalioides* F. Muell.), snow daisy (*Celmisia asteliifolia* J.D. Hook), alpine grevillea (*Grevillea australis* R. Br.), scaly buttons (*Leptorhynchos squamatus* (Labill.) Less.) and soft snow grass (*Poa hiemata* Vick.).

The Bogong High Plains are an alpine range located in south-eastern Australia. The alpine vegetation on the High Plains has provided summer grazing for livestock since the 1850's. Overgrazing by sheep, cattle and horses, especially during drought years, resulted in a depletion of vegetation cover associated with extensive soil erosion (Costin 1958). The uncontrolled grazing practices were regarded as deleterious to catchment condition and in 1945 government departments dealing with land management imposed strict regulations on the graziers. Sheep and horses were banned, the use of fire to improve the palatability of the herbaceous vegetation was stopped. Cattle numbers were controlled and the grazing season was restricted to the summer and early autumn period (mid December to early April). In the 1960's the most exposed sites (those with highest altitude) were withdrawn from grazing, and

vegetation cover on these sites has improved markedly (SCA 1978; also Wimbush and Costin 1979). In the 1970's conservation groups began to lobby the government to impose further restrictions on alpine grazing and as a consequence the High Plains were declared a National Park in 1981. The grazing lobby presented a persuasive case for the continuation of alpine grazing and it is present government policy to maintain the practice.

More information with regard to the effect of grazing on the alpine environment is needed in order for the National Parks Service to be able to make the right management decisions. The preferred utilization by cattle of particular vegetation communities was reported by van Rees and Hutson (1983). The objectives of this paper are to define quantitatively the diet of cattle in the 3 most common alpine vegetation communities, and to relate the composition of the diet to the availability of plant species in the field. Management implications of these findings are discussed.

## Study Area

The Bogong High Plains is a dissected alpine plateau with an altitude range from 1,660 m to 1,984 m A.S.L. The study area was located on the main plateau of the High Plains in the vicinity of Mt. Nelse (37° 51'S, 147° 20'E). The major vegetation communities in the study area were grassland, heathland and mossbeds. Vegetation classification followed that of McDougall (1982). Average annual precipitation on the High Plains is 2,555 mm, with much of this falling as snow during the winter and early spring. For most of the study period, December 1982 until April 1983, eastern Australia experienced dry weather conditions and the High Plains received only 33% of average summer rainfall. A drought-breaking rain of 300 mm in the third week of March 1983 brought the total summer rainfall to average. Although the High Plains experienced dry conditions, the nutritional quality of preferred dietary species did not appear to vary significantly from preceding grazing seasons (van Rees and Beard 1984).

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## Methods

### Sampling Technique

Five 'mountain-raised' oesophageal-fistulated steers were used for diet determination. The steers were yarded at night but were unrestricted in their movements during the day. Oesophageal extrusa samples were collected from the steers approximately every third morning in one of 4 areas. In each area 3 vegetation communities, grassland, heathland and mossbeds, were sampled before moving to the next area. Each vegetation community in each area was sampled at least once per month during the 3 months grazing season. During a sampling period the steers were permitted to graze an area of approximately 2 ha (termed a sample site) in only 1 vegetation community. This experimental design allowed for a determination of variation in:

- (i) diet selection between steers,
- (ii) diet selection in different vegetation communities,
- (iii) diet selection with seasonal advance, and
- (iv) diet selection within communities between areas.

Extrusa samples were collected after a 45-minute grazing period. The botanical composition of the extrusa samples was determined using the microscope-point technique (Heady and Torell 1959). Two hundred points were used for each sample. The percentage cover of each species was corrected to a dry weight basis using weight for area constants, determined for each species following the method described by Hamilton and Hall (1975). On average less than 5% of an extrusa sample consisted of unidentifiable material.

### Statistical Analyses

Only those species which comprised more than 5% of the diet of any one steer on at least one collection day were included in the statistical analyses. The analyses took the form of multi-way analysis of variance (Nie et al. 1975). Differences in diet selection between steers, collection days during the season, areas and vegetation communities were determined for each of the major species (>5%) in the diet.

### Availability

The consumption of the major species throughout the season was compared to the availability of the species at each sample site. Availability was determined using a quadrat technique. Each vascular plant species in a 5 × 4-m quadrat was recorded and assigned a quantitative estimate of cover and abundance using a scale similar to that designed by Braun-Blanquet (1932). Three quadrats were taken at each sample site; the results were averaged. There was little variation in cover and abundance of species between quadrats within the same vegetation community. The native alpine plant species are perennial, and there was no observable change during the season in the contribution each of the species made to the vegetation.

## Results

During the 1982–83 grazing season, 177 extrusa samples were collected on 41 collection days, in 4 areas in 3 vegetation communities. Six grass species, 3 sedges and 1 rush, 16 species of forbs and 8 species of shrubs were identified in the extrusa samples (Table 1). Of these 34 species only 17 species comprised more than 5% of the diet of any one steer on at least 1 collection day. Only these 17 species will be discussed.

### Grassland

In the grassland community 2 grasses, 1 sedge, 2 forbs and 2 shrubs were the main components in the diet of cattle (Table 2). Changes in dietary preferences were clearly evident with seasonal

Table 1. Species identified in extrusa samples.

Species	Species
Grasses	Forbs (cont.)
<i>Agropyron velutinum</i>	* <i>Craspedia</i> sp.
* <i>Danthonia nudiflora</i>	* <i>Leptorhynchos squamatus</i>
<i>Deyeuxia crassiuscula</i>	<i>Microseris scapigera</i>
* <i>Poa costiniana</i>	<i>Oreomyrrhis eriopoda</i>
* <i>P. hiemata</i>	<i>Poranthera microphylla</i>
* <i>P. hothamensis</i>	<i>Ranunculus victoriensis</i>
Sedges	<i>Rumex acetosella</i>
* <i>Carex gaudichaudiana</i>	* <i>Scleranthus biflorus</i>
* <i>Carex</i> spp.	<i>Senecio lautus</i>
* <i>Carpina nivicola</i>	<i>Stackhousia pulvinaris</i>
Rush	<i>Trachymene humilis</i>
* <i>Empodisma minus</i>	<i>Viola betonicifolia</i>
Lily	Shrubs
* <i>Astelia alpina</i>	* <i>Asterolasia trymaloides</i>
Forbs	<i>Epacris glacialis</i>
<i>Acaena anserinifolia</i>	<i>Exocarpos nanus</i>
* <i>Asperula gunnii</i>	* <i>Grevillea australis</i>
* <i>Celmisia asteliifolia</i>	<i>Hovea longifolia</i>
	<i>Pimelea alpina</i>
	<i>P. axiflora</i>
	* <i>Richea continentis</i>

\*these species contribute more than 5% to the diet on at least 1 collection day.

advance. The intake of soft snow grass (*Poa hiemata* Vick.)<sup>1</sup> decreased during the season while the intake of the snow daisy (*Celmisia asteliifolia* J.D. Hook) increased, and the intake of the shrubs alpine star-bush (*Asterolasia trymaloides* F. Muell.) and

Table 2. Major plant species grazed by 5 fistulated steers in grassland, expressed as percent dry matter of species identified in extrusa samples, during January, February, and March 1983, and availability, in percent cover, of the species as an average of the 4 grassland sites.

Species	January %d.m.	February %d.m.	March %d.m.	Availability % cover
<i>Asterolasia trymaloides</i>	3.2	20.8	10.4	0–5
<i>Carex</i> spp.	4.1	1.4	0.7	0–5
<i>Celmisia asteliifolia</i>	3.7	9.2	40.1	6–20
<i>Danthonia nudiflora</i>	7.7	4.0	7.4	0–5
<i>Grevillea australis</i>	10.2	18.4	2.2	0–5
<i>Leptorhynchos squamatus</i>	10.9	8.3	5.9	6–20
<i>Poa hiemata</i>	55.5	37.4	31.8	51–75
Unidentifiable material	4.7	0.5	1.5	3

alpine grevillea (*Grevillea australis* R. Br.) was highest in the middle of the grazing season (Table 2). The average percentage cover of these species in the grassland community provides information on the degree of selective grazing by the steers on some of the major species. The alpine star-bush and alpine grevillea and the snow daisy were strongly selected towards the middle and end of the grazing season (Table 2).

### Heathland

In the heathland community 2 grass species, 4 forbs and 2 shrubs were the main species grazed by the steers (Table 3). Changes in dietary preferences with seasonal advance were similar to what occurred in the grassland community, with the grasses decreasing in the diet during the season, the forbs increasing and the shrubs being most represented during the middle of the season (Table 3). Alpine star-bush, snow daisy and soft snow grass were grazed in a higher proportion than their availability (Table 3).

### Mossbed

In the mossbed community 1 grass species, 1 sedge, 1 rush, 1 lily,

<sup>1</sup>Nomenclature according to Forbes et al. (1984).

**Table 3. Major plant species grazed by 5 fistulated steers in heathland, expressed as percent dry matter of species identified in extrusa samples, during January, February and March 1983, and availability, in percent cover of the species as an average of the 4 heathland sites.**

Species	January %d.m.	February %d.m.	March %d.m.	Availability % cover
<i>Asperula gunii</i>	6.1	0.8	1.9	0-5
<i>Asterolasia trymaloides</i>	6.2	43.9	37.5	0-5
<i>Celmisia asteliifolia</i>	4.8	13.3	38.9	0-5
<i>Graspedia</i> sp.	1.4	0.8	0.3	0-5
<i>Grevillea australis</i>	13.7	10.3	7.7	21-50
<i>Poa hiemata</i>	28.9	6.8	5.2	0-5
<i>P. hothamensis</i>	32.4	11.1	4.8	21-50
<i>Scleranthus biflorus</i>	1.4	7.2	2.6	0-5
Unidentifiable material	5.1	5.8	1.1	

1 forb and a shrub species were the major components of the diet (Table 4). The leaves of the lily, silver astelia, (*Astelia alpina* R. Br.) are similar in texture to the snow daisy and the former species also increased in the diet with seasonal advance. The spreading rope-rush (*Empodisma minus* (J.D. Hook.) L. Johnson & Cutler) declined in the diet, while the prickly snow grass (*Poa costiniana* Vick.) was grazed at a relatively constant level during the season

**Table 4. Major plant species grazed by 5 fistulated steers in mossbeds, expressed as percent dry matter of species identified in extrusa samples, during January, February, and March 1983 and availability, in percent cover, of the species as an average of the cover in the 4 mossbed sites.**

Species	January %d.m.	February %d.m.	March %d.m.	Availability % cover
<i>Astelia alpina</i>	0.5	7.4	28.4	6-20
<i>Carex gaudichaudiana</i>	3.4	1.1	0.9	0-5
<i>Celmisia asteliifolia</i>	—	4.9	0.5	0-5
<i>Empodisma minus</i>	51.8	26.6	19.2	51-75
<i>Poa costiniana</i>	43.2	59.8	49.8	6-20
<i>Richea continentis</i>	1.1	0.3	1.2	21-50

(Table 4). Prickly snow grass was grazed to a greater extent than its availability (Table 4).

#### Variation between Steers

There was no qualitative difference between steers in the range of plant species selected. On a daily basis there were significant differences ( $P<0.05$ ) in the proportion of the various species grazed by the steers. When all the collection days were included in the analysis, and the data were analyzed for differences between steers in plant species selection, the individual steers varied significantly ( $P<0.05$ ) in their dietary preferences for alpine grevillea, scaly buttons (*Leptorhynchus squamatus* (Labill.) Less.), prickly snow grass and candle heath (*Richea continentis* B.L. Burtt).

#### Variation between Vegetation Communities and Areas

The diet selected in the grassland and heathland community was relatively similar in species composition, except for the main grass species grazed. Soft snow grass was grazed in grassland while ledge grass (*Poa hothamensis* Vick.) was grazed in heathland. This is because the composition of the herbaceous vegetation between the two communities has a large degree of overlap. The species composition of the mossbed and the other two communities has little overlap and species selection in this community was very different.

In the analysis of variance the two-way interactions between areas and vegetation communities were investigated to determine whether there were differences in diet selection between areas within the same vegetation community. The interactions were not significant for 2 species from the mossbed community, spreading

rope rush and candle heath. For the other species the interaction between areas and vegetation community was significant ( $P<0.05$ ). This implies that the consumption of these species was significantly different between areas within a particular community.

#### Variation during the Season

Seasonal variation in the proportions of the major species grazed was exhibited by all the major species except for the grass *Poa costiniana*.

#### Discussion

Cattle were highly selective in their dietary preferences and concentrated on a relatively small number of species. From the 61 species available in the grassland, heathland and mossbed communities cattle primarily grazed 4 grass species, 3 sedges and 1 rush, 6 forb species and 3 shrub species. Diet selection in the grassland and heathland communities was very similar except for the two grasses, soft snow grass and ledge grass. Soft snow grass is a common component in the grassland community, while ledge grass is usually found only in the heathland community. There is little overlap in species composition between the mossbed community and the other communities, and this was reflected in the difference in the diet selected in grassland and heathland from that in the mossbed community. Behaviour studies of cattle in the same study area (van Rees 1984) showed that cattle spent 45.5% of total grazing time in the grassland community, 40.7% in heathland, and only 5.5% in mossbeds. Since the rate of ingestion of vegetation is unknown and is also unlikely to be consistent between communities, these data cannot be used to estimate total consumption of each species. However, it is clear that the contribution of the species grazed in the mossbed community are a relatively small component of the total diet.

Dietary preferences changed markedly during the season. In the grassland and heathland communities the consumption of the grasses, soft snow grass and ledge grass, and the forb scaly buttons decreased during the season, the consumption of the shrubs, alpine star bush and alpine grevillea, was highest in the middle of the season, and the consumption of the forb, snow daisy, increased during the season. The seasonal changes in dietary preferences did not appear to correlate with seasonal changes in the nutritional quality of preferred plants (van Rees 1984). The nutritional quality of the plants was measured in terms of in vitro digestibility, cell wall fraction, in vitro digestibility of the cell wall fraction, nitrogen and mineral content (van Rees and Beard 1984, van Rees 1984). It appears that factors other than the parameters of nutritional quality measured, such as physical, chemical and morphological aspects of plant material may have an as yet undetermined role in diet selection.

Overgrazing of rangeland by herbivores results in a loss of cover of preferred dietary species. This enables less preferred plants to increase in cover through reduced competition by the preferred plants (Dyksterhuis 1949, Petrides 1975). The identification of the quantitative diet of cattle has shown that the most commonly grazed species are common components of the alpine vegetation. Monitoring studies of the grazed grassland have shown that these species have remained common over a number of years (van Rees et al. 1985). These results indicate that the grazed grassland vegetation is in equilibrium with the present grazing pressure. There is evidence that without grazing by cattle the vegetation changes markedly. In a small grassland plot fenced since 1946 (Carr and Turner 1959b, Carr 1979) there has been an increase in the cover of the preferred dietary species alpine star bush and snow daisy. The cover of soft snow grass has remained unchanged since 1946. The vegetation of this fenced plot is still changing and has not reached a climax (Carr 1977).

#### Conclusion

The identification of the preferred species in the diet of the cattle

on the Bogong High Plains will allow for the establishment of more effective monitoring programs of the grazed communities. The heathland community, because of a very dense shrub cover, does not appear to be as susceptible to cattle grazing as the grassland community, and monitoring programs have not been established in this community. The mossbed community is very susceptible to trampling by cattle but as this community is primarily entered by cattle seeking water and is not a preferred grazing community (van Rees and Hutson 1983) this community is not monitored for preferred dietary species. Monitoring programs are underway in this community to determine the effects of trampling (van Rees unpubl.). In the grassland community the relative abundance of preferred dietary species could be used as an indicator to determine trends in the cover of these species. Species which should be monitored regularly for changes in cover and abundance in the field are (1) alpine star-bush (*Asterolasia trymaloides*), (2) snow daisy (*Celmisia asteliifolia*), (3) alpine grevillea (*Grevillea australis*), (4) scaly buttons (*Leptorhynchus squamatus*) and (5) soft snow grass (*Poa hiemata*). A reduction in cover of these species would be an indication that the grassland community was over utilized and a reduction in stocking rate would be warranted.

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