

# Interpreting Diet Preference of California Bighorn Sheep on Native Rangeland in South-central British Columbia

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In 1954 the population of California bighorn sheep (*Ovis canadensis californiana*) totaled less than 1,700 animals. Three of the largest herds, containing approximately 400 animals each, occurred in British Columbia, while a similar sized herd ranged in the southern Sierra Nevada Mountains of California.

The Junction herd, located between the confluence of the Fraser and Chilcotin Rivers in the central interior of British Columbia, has been a primary source for reintroductions into historical sheep ranges in Washington, Oregon, North Dakota and Idaho. By 1970 approximately 42% of all California bighorn sheep in North America originated genetically from this Chilcotin River stock. The total population of California bighorn sheep at this time was estimated to be 3,200 animals, an increase of 53% in British Columbia and 153% in the United States.

Since 1970 British Columbia herd sizes have remained relatively stable, with apparent low productivity being attributed to competition with domestic livestock, alienation of winter ranges, predation, and disease. To investigate this low herd productivity, many researchers have collected information describing winter diet of California bighorn in B.C. However, few people have looked at diet throughout all seasons of the year, while even fewer studies have examined these diets in terms of forage preferences and selectivity. Specifically, preferred plant species on the summer range can be as important as those on the winter range. Growth rates, lactation, and deposition of body fats are all influenced by summer diet. Moreover, the ability of animals to survive winter stress may be influenced by the amount of body fats deposited throughout the summer foraging period. Additionally, spring and summer grazing, during periods of active plant growth, may lead to long term botanical changes with subsequent effects on animal productivity.

The combination of existing low herd productivity and a need for more information on California bighorn provided the impetus for a joint study among the B.C. Fish and Wildlife Branch, the University of British Columbia (Departments of Plant and Animal Science) and Simon Fraser University at the Okanagan Game Farm near Penticton in south central B.C. Our objectives in this study were to determine: (1) the trend in range condition produced by year-round foraging, and (2) sheep diet and forage selectivity as influenced by plant phenology throughout the grazing year. Our first summer's data provide a useful base for discussing the interpretation of forage preferences exhibited by California bighorn sheep.



California bighorn sheep ram.

In April 1977, 20 California bighorn were released into a 42-hectare (104 acres) enclosure. The plant communities, typical of some bighorn habitat in the province, are lower grassland zones dominated by big sagebrush (*Artemisia tridentata*) and bluebunch wheatgrass (*Agropyron spicatum*), with browse species such as saskatoon (*Amelanchier alnifolia*) and snowberry (*Symphoricarpos albus*) in the draws at lower elevations. At higher elevations, ponderosa pine (*Pinus ponderosa*) provides an overstory for rough fescue (*Festuca scabrella*), bluebunch wheatgrass, and mixed forbs. Aspect and drainage conditions profoundly influence vegetational patterns, with sagebrush occupying dry sites and bluebunch wheatgrass occurring primarily on more northerly aspects.

Forage utilization and trends in range condition were assessed by sampling for herbage productivity and botanical composition both within and outside enclosures of 480 square meters (5,200 sq. feet). Bighorn sheep diet and selectivity were determined by comparing relative proportions of plant species available for use throughout the grazing year. Identification of botanical material in feces was determined with epidermal cell slides prepared for 65 of the 83 plant species found on the study site.

## Results

Selectivity patterns of the sheep differed widely for the three

Table 1. Bighorn diet in relation to botanical composition of range.

Species	Common names	May		June		July		August	
		Diet	Bot. Composition	Diet	Bot. Composition	Diet	Bot. Composition	Diet	Bot. Composition
<b>Grass</b>									
<i>Agropyron spicatum</i>	bluebunch	9.0	30.6	11.5	31.0	15.5	32.1	16.0	32.4
<i>Bromus tectorum</i>	cheatgrass	1.0	13.7	1.0	21.2	1.0	23.1	0.0	20.7
<i>Stipa comata</i>	needleandthread	4.0	3.5	6.0	7.9	7.5	8.9	12.5	6.4
<i>Koeleria cristata</i>	Junegrass	5.0	5.9	7.5	5.9	10.0	6.6	14.0	7.1
<i>Festuca scabrella</i>	rough fescue	10.0	T	9.5	T	10.0	T	21.5	T
Other grasses		13.0	11.5	11.5	10.6	14.5	7.1	13.0	9.0
Total grasses		42.0	65.2	47.0	76.6	58.5	77.8	77.0	75.6
<b>Forbs</b>									
<i>Balsamorhiza sagittata</i>	balsamroot	9.0	5.2	19.0	3.9	1.5	2.2	0.0	2.9
<i>Achillea millefolium</i>	yarrow	1.5	3.0	1.0	1.3	1.0	T	0.0	T
<i>Lupinus sericeus</i>	lupine	3.0	1.2	1.0	T	1.5	T	1.5	T
Other forbs		26.5	8.3	20.5	4.0	25.0	1.8	13.0	4.5
Total forbs		40.0	17.7	41.5	9.2	29.0	4.0	14.5	7.4
<b>Browse</b>									
<i>Artemisia tridentata</i>	big sagebrush	1.5	11.4	1.4	9.7	0.0	13.3	0.0	12.3
<i>Amelanchier alnifolia</i>	saskatoon	2.5	T	4.0	T	2.5	T	1.5	T
<i>Prunus virginiana</i>	chokecherry	2.0	T	1.0	T	2.0	T	1.0	T
<i>Eriogonum heracleoides</i>	Wyeth buckwheat	3.0	1.8	0.5	1.0	0.5	1.0	0.0	1.2
<i>Eriogonum niveum</i>	snow buckwheat	2.5	2.2	0.0	1.6	1.0	2.4	0.0	2.3
Other browse		6.5	1.4	6.0	1.1	6.5	0.8	6.0	1.2
Total browse		18.0	16.8	11.5	13.4	12.5	17.5	8.5	17.0

All values in percent.

T = Trace

forage classes of browse, forbs, and grasses (Table 1). Browse in the diet during the spring month of May equaled 18%, approximately proportional to the relative availability of these woody plant species. In contrast to browse, total forbs in spring were highly selected, contributing 40% to the diet while making up only 17.7% of the botanical composition. Balsamroot (*Balsamorhiza sagittata*) was highly preferred, comprising 9% of the diet. This early maturing perennial forb was actually selected at two different time periods, as resprouting plants were immediately eaten as they reappeared following initial grazing. Grasses in early spring, other than rough fescue were typically selected against. The most abundant plant species on the study site was bluebunch wheatgrass (30.6%), which formed only 9% of the diet. This relationship points out a pitfall of investigating only diet to determine forage preferences. Bluebunch wheatgrass, one of the most frequent species in the May diet, is obviously not nearly



Study site on Okanagan Game Farm near Penticton, B.C.

as preferred as rough fescue or balsamroot. The latter plant species appeared approximately 86% more often in the diet than in the available forage, 9.9 compared to 5.2%.

Grasses constituted the largest proportion of the animals' diet during all four summer months, increasing from 42% in early spring to 77% in August. However, in May, June and July, grasses were apparently selected against, as in all three of these months the relative proportion of total grasses available on the range was more than the relative proportion of grasses appearing in the diet. Only in August did these two proportions equalize, indicating that grasses, particularly bluebunch wheatgrass and cheatgrass (*Bromus tectorum*), were less preferred as forage than either browse or forbs.

Rough fescue provides a major exception to this generalization, as in August this species composed 21.5% of the diet, even though occurring less than 1% of the botanical composition. However, data indicating high selectivity must be evaluated carefully. Rough fescue occurred on the study site exclusively as an understory of ponderosa pine, which was intensively utilized by the sheep for shade during the hot August weather. Therefore, the high proportions of rough fescue in the diet may be partially attributable to its presence in shade areas as much as its apparent palatability.

Forbs, in contrast to grasses, comprised successively smaller portions of the summer diet, declining from 40.0% in May to 14.5% in August. However, in all four months forbs remained a preferred class of forage, as percent forbs in the diet always exceeded percent forbs available on the study site. Balsamroot was the more preferred forb in June, composing 19% of the diet but only 3.9% of the botanical composition. Beginning in July, when balsamroot dried and weathered, Indian paintbrush (*Castilleja thompsonii*) (4.5%) and lemonwood (*Lithospermum*

*ruderales*) (3.5%) became the most highly selected forbs. A late-blooming summer species, brown-eyed susan (*Gaillardia aristata*), contributed 2% to the diet in August, making it the most preferred forb in late summer.

Browse declined in the diet throughout the summer from 18.0 to 8.5%, and as a forage class was selected in approximately the same proportions as in the available forage. However, this forage class contains big sagebrush, an unpalatable woody species which should not be lumped managerially with other browse species which were generally selected for, even during the dry summer months of July and August. Saskatoon, chokecherry (*Prunus virginiana*), and snowberry all produced selectivity indexes (% diet/% botanical composition) greater than one, suggesting that these browse plants are preferred forage species.

Once again, however, these data must be evaluated carefully. Judging the importance of a plant species based solely upon proportions in the diet or even selectivity indexes may represent a hasty conclusion. Saskatoon has a relatively small selectivity index, approximately 2/1. However, this plant species may be nutritionally important in the animals' diet. Utilization of this browse species equaled 65% from May to August. Forbs were also intensively utilized (80%), while bluebunch wheatgrass,



Heavy utilization of leaves and buds on Saskatoon.

which composed 32% of the forage and 16% of the diet from July to August, was utilized less than 1% in terms of total standing crop.

These utilization measures are extremely important for proper

management of bighorn sheep, or any other wildlife species. Diet and selectivity data alone do not impart any information regarding the potential impact of foraging animals on their own habitat in terms of range condition. Saskatoon and sumac (*Rhus glabra*) were heavily hedged and may not be available for spring use in subsequent years. Bluebunch wheatgrass formed a major part of the diet during all four months, yet has not been stressed by animal utilization. In other words, selectivity and utilization measurements must be related to plant species response before sound animal and habitat management programs can be developed.

The relationship between forage quality and selectivity is complex. Relating grazing preference to a single forage parameter such as crude protein provides dubious conclusions. For example, crude protein levels for all forage classes in April and May were relatively similar, and typically greater than required for adequate growth and maintenance. However, the sheep still exhibited marked forage selectivity. Other studies on bighorn sheep suggested that forage moisture content correlated with food preferences. This correlation may have been true on our study site as the sheep eagerly sought succulent new forbs in early spring, and nearly eliminated some of these plant species from the grazed areas. Again, however, forage selection is not determined solely by moisture content. Rather selection is in response to many complex factors that are dynamically related to plant nutrient cycles, animal dietary needs, and forage availability.

Even selectivity data based on individual plant species may be insufficient, as bighorn tend to be highly selective in their grazing of plant parts. The sheep consistently selected leaves rather than stems of bluebunch wheatgrass, June grass (*Koeleria cristata*), Kentucky bluegrass (*Poa pratensis*), rough fescue, and needleandthread (*Stipa comata*). In autumn, the sheep selected fall regrowth of bluebunch wheatgrass over old growth. Bluebunch wheatgrass responded to autumn rainfall in terms of total biomass more than any other grass species on the study site, and this regrowth provided a diet of 18% crude protein. Thus, while bluebunch wheatgrass was selected against in each summer month, this plant species may still be managerially important as a forage that can provide high crude protein levels at a time of the year when protein for many other forage species is generally below maintenance.

These subtle selectivity patterns and nutritional parameters are extremely important. Bighorn sheep habitat consists of a variety of plant species, all of which contribute to diet during different and specific portions of the foraging year. Proper habitat management techniques must consider and reflect this wide habitat/diet variability. ●

**Program Administrator** at the Utah State University. Responsibilities include the in-country administration of a range management sheep and goat research project in Morocco. Coordinate research activities with U.S. and foreign students, scientists, etc. Responsibilities include the in-country administration of a range management sheep and goat research project in Morocco. Coordinate research activities with U.S. and foreign students, scientists, etc. Purchase equipment, establish office, provide reports, etc. BS in range science or related field required.

Graduate degree preferred; opportunity exists for pursuit of graduate degree while employed. Permanent residence in Morocco required. Overseas experience in animal production, agriculture, or natural resource management desirable. Fluency in French or Arabic is mandatory. Submit application and credentials by November 15, 1979 to: Dr. John C. Malachek, Small Ruminants—CRSP, UMC 52, Utah State University, Logan 84322. An affirmative action/equal opportunity employer.