Diet and Performance of Sheep on Rangeland in Semiarid Argentina

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Highlight: *During 1968 a study was conducted with sheep grazing sandhill pasture in the semiarid area of Argentina. Measurements made included botanical analyses of forage available, forages selected, intake, body weight, and wool growth. Botanical analyses showed that sheep selected their diet from species comprising less than one-fourth of all forage available. Two coarse perennials,* Sporobolus rigens *and* Hyalis argentea, *representing between 64.0 and 84.8% by weight of all forages available, were not consumed by the sheep. The animals preferentially grazed certain species even when these species were available in very low amounts. Digestible organic matter intake, body weight, and wool production followed a similar pattern. An inadequate intake of energy would appear to be the most serious nutritional deficiency identified by this study.*

The cattle and sheep industry in semiarid Argentina is based primarily on natural unimproved pastures. Extensive grazing combined with low and erratic rainfall has seriously affected the naturally occurring plant species and modified the botanical composition and ecological structure of the original plant communities.

Economics preclude the use of concentrates to improve animal performance in this region. Therefore, more attention must be given to preventing further deterioration of pastures and to improvement of livestock production through better forage management. However, before improved systems of pasture management can be developed, more information is needed on the botanical composition of pastures and the botanical and nutritive composition of the diet selected by sheep grazing the pastures. Any management system developed should be one which is mutually beneficial to both the plant and the animal.

In the present investigation, the objectives were to determine the forage species available, the contribution of these forages to the diet of grazing sheep, and the nutrient intake and performance of sheep under grazing conditions in the sandhill area of semiarid Argentina.

Materials and Methods

The experiment was conducted on the experimental farm of the National University of the South at Argerich, 35 km southwest of Bahia Blanca, Argentina. The 32-ha experimental area was representative of the surrounding area and had been subjected to grazing practices similar to those in the surrounding area.

The sandhill grassland area typical of that used in the present study covers an area of approximately 4 million ha and extends both south and southwest of Bahia Blanca. The plant communities of this area have been described by Verettoni (1964, 1965).

The climate at Argerich is

Table 1. Monthly rainfall (mm) in Argerich, Argentina.

	1908-1938		1951-1968			
	Average	Range	Average	Range	1967	1968
January	48	0-168	51	3-107	29	3
February	46	0-187	49	2-113	113	28
March	70	8-191	76	2-248	17	67
April	40	0-148	49	0-147	37	2
May	31	0-115	28	0- 96	51	0
June	11	0- 45	49	6-163	9	34
July	18	0-102	34	0-135	23	20
August	19	0-110	18	0- 69	0	20
September	34	0-150	42	0-128	60	36
October	67	6-169	57	12-178	178	28
November	49	6-165	57	8-188	42	64
December	48	0-178	69	10-162	76	162
Totals	482	243-860	579	308-853	635	464

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temperate with a yearly average temperature of 14°C. The average summer temperature is 21.8°C, and the average winter temperature is 6.5°C. Temperatures below 0°C can occur on the average during 7 months each year. The average rainfall between 1951-68 was 579 mm with a monthly distribution as presented in Table 1.

The experiment was initiated January 1, 1968, and terminated December 31, 1968. Monthly observations were made of the amount of forage available within plots using the weight estimate method (Pechanec and Pickford, 1937). Samples were taken each month, within a few days before or after the collection of esophageal fistula samples, by clipping 40 random square-meter quadrats in the field, hand separating the species in the field, drying the samples for 24 hours at 75°C, and weighing the clippings.

Four esophageal fistulated (Bishop and Froseth, 1970) and five intact fecal bagged 2-year-old Corriedale wethers were used to determine in vitro organic matter digestibility (IVOMD), digestible organic matter intake (DOMI), the percent protein of consumed forage, and total protein intakes.

Esophageal fistula samples were collected four consecutive days each month from the four esophageal fistulated sheep. The sheep were not permitted to graze for about 3 hours before sampling. This period coincided with their observed normal rest period. Samples were collected in the evening for periods of 30 to 45 minutes. The extrusa was thoroughly mixed and divided into two equal sub-samples, one for botanical analysis and one for laboratory analysis. The saliva was retained as part of the sample. The sub-samples for botanical analysis were frozen and stored. The samples for laboratory analyses were dried at 75°C for 24 to 36 hours and ground through a 1-mm screen.

Forage intake was estimated from the IVOMD of samples collected from the esophageal fistulated sheep and total fecal collection data from the five intact fecal bagged sheep the second, third, and fourth day of each esophageal collection period.

Weight gains were determined with 17 2-year-old Corriedale wethers grazed on the 32-ha field using a put-and-take system (Mott and Lucas, 1952). All sheep were weighed monthly at the same time of day after being withheld from water for 12 hours. The average initial weight of the 17 tester animals was 42.6 kg. An initial grazing pressure of 1.25 sheep/ha was reduced to 0.75 sheep/ha during the winter months of May, June, and July.

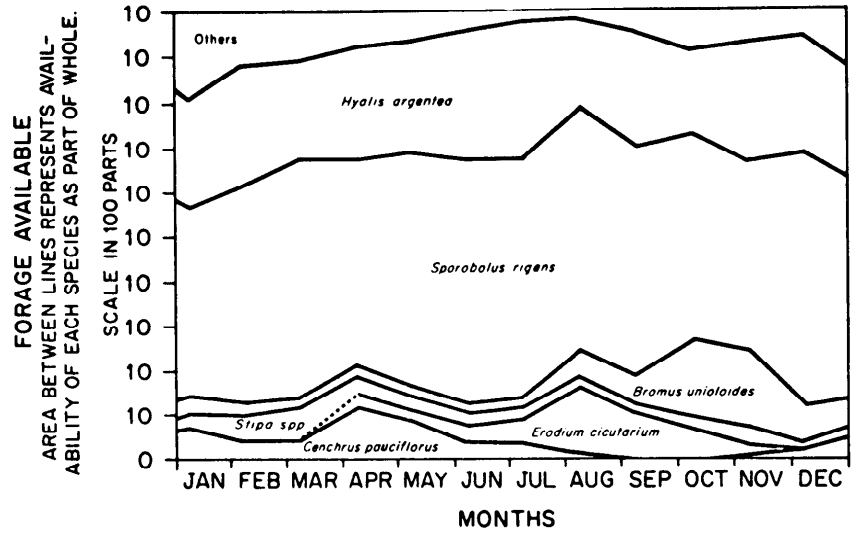

Fig. 1. *Monthly variation in forage species available to grazing sheep.*

The wool dye-banding technique of Williams and Chapman (1966) was used to measure the monthly wool growth of 8 of the Corriedale wethers. Grams of wool produced each month were determined from staple length delineated with dye-banding and total fleece weights determined by shearing at the conclusion of the experiment.

All sheep had free access to water, salt, and 1:1 mixture of salt and bonemeal. All sheep were drenched with thiabendazole every 3 months and dipped for external parasites at the beginning of the experiment. after the collection of esophageal fistula samples, by clipping 40 random square-meter quadrats in the field, hand separating the species in the daily botanical sub-samples were pooled each month by animal and divided into four equal parts, one for examination by each of four botanical assistants. Each assistant identified 200 points on one pooled sample for a total of 800 points on each botanical sample.

Total nitrogen was determined by the Kjeldahl method (AOAC, 1965), using copper sulfate as the catalyst, and in vitro digestibility by the method of Tilley and Terry (1963) as modified by Barnes (1966) utilizing a 48-hour incubation with buffer solution and rumen fluid followed by an additional 24 hours incubation with pepsin.

The data were subjected to analyses of variance. Duncan's Multiple Range Test was used to determine differences among means (Steel and Torrie, 1960).

Results and Discussion

The two dominant forage species

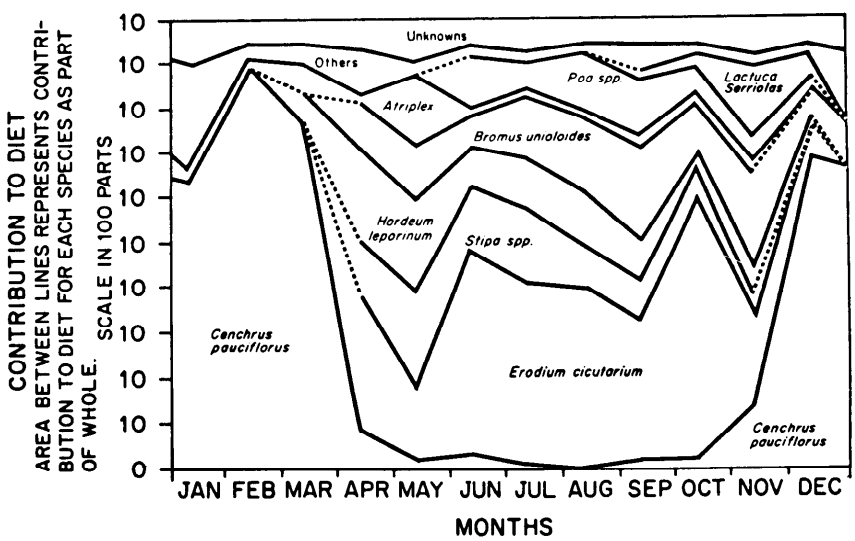

Fig. 2. *Monthly variation in contribution of various forage species to the diet.*

identified in the present study were two coarse perennials, *Sporobolus rigens* and *Hyalis argentea* (Fig. 1). These two species together represented between 64.0 and 84.8% by weight of all forage available throughout the year. Other species making a sizable contribution to the forage available were *Bromus unioloides* in October with 17.1%, *Erodium cicutarium* 15.1% in August, *Cenchrus pauciflorus* 11.8% in April, and *Stipa* spp. 7.2% in March.

Although *Sporobolus rigens* and *Hyalis argentea* were the predominating forage species available in the field, there was no evidence of their being consumed by the sheep (Fig. 2). During the summer months of December, January, and February, the main forage species appearing in the diet of the sheep was *Cenchrus pauciflorus* representing 68.1, 64.3, and 89.8%, respectively, of the total forage consumed. During these same months, the amount of this forage available for consumption was 0.8, 6.9, and 3.6% of the total, respectively. In March, April, and May the amount available was 4.1, 11.8, and 8.8% of the total, but the percentages in the diet were 77.3, 7.7, and 1.4%, respectively. As consumption decreased, the amount available in the field increased. The decreased intake of this forage may be related to the formation of a spiny spikelet during this period and the consequent rejection of this forage by the sheep.

As the consumption of *Cenchrus pauciflorus* declined, other species appearing in substantial quantities in the diet were *Erodium cicutarium, Stipa* spp., *Hordeum leporinum, Bromus unioloides, Atriplex semibaccata, Poa* spp. and *Lactuca serriolas* (Fig. 2). The data indicate that the animals preferentially grazed certain species even when these species were present in very low amounts. The data in Table 2 illustrate the relatively small amount of forage available which is acceptable to the sheep compared to the total forage available. This may reflect grazing conditions not conducive for maintenance and growth of acceptable species.

The percent protein in forage consumed by the animals ranged from 13.6 to 26.3% with an average of 18.8% for the year. Intakes of protein under the conditions of this study (Table 2) would not appear to be a limiting factor for production based on requirements (National Research Council, 1968).

An inadequate intake of energy, particularly during the winter months, would appear to be the most serious nutritional deficiency identified in this study. This resulted from a decrease in energy value of the forage consumed and a decreased intake (Table 2). The DOMI varied from 6.7±0.2g in July to 13.2±0.8g/kg W/day in March. Intake of digestible dry matter (DOM) body weights, and wool production followed similar trends during the year. Losses in weight and a reduction in wool growth were noted during June, July, and August when intakes averaged 8.0g DOM/kg W/day (Table 2 and Fig. 3). The maintenance requirement of grazing sheep has been estimated to be 10.2g DOM/kg W/day (Langland et al. 1963). The data obtained in the present investigation indicate that over a 12-month period the sheep consumed sufficient nutrients from pasture for wool production and a gain of 14.3 kg.

Botanical analyses of the diets show that sheep selected their diet from species comprisng less than one-fourth of all forage available. The sheep preferred certain forages, although those selected varied with season of the year. Any system of pasture management must therefore consider not only the species available but also their physiological growth patterns and acceptability of the species to animals.

Under the semiarid conditions in Argentina, it appears that improvement of the plant community and livestock production from pasture should consider a management system which allows the annual spring herbages, such as *Cenchrus pauciflorus, Erodium cicutarium* and *Bromus unioloides* to be grazed in the spring before they mature. The important, but less palatable, perennials, such as *Stipa* spp., *Atriplex semibaccata,* and *Poa* spp., should be

Table 2. Monthly variation in forage available (kg/ha), and organic matter and protein intake of sheep grazing natural pasture.

Month	Total forage available[1] (kg/ha)	Acceptable forage available[2] (kg/ha)	IVOMD[3] (%)	DOMI[4] (g/kgW/day)	Protein content in diet[3] (% in O.M.)	Protein intake (g/kgW/day)
January	1576	413	55.4^{cd}(1.0)[5]	9.7^{bc}(0.9)	13.6^{b} (0.2)	2.5^{a} (0.2)
February	1243	222	58.9^{ef} (0.9)	12.7^{d} (0.6)	14.2^{b} (0.3)	3.1^{bc} (0.1)
March	1013	166	60.9^{f} (0.8)	13.2^{d} (0.8)	20.1^{d} (0.5)	4.4^{e} (0.3)
April	1588	399	51.1^{b} (0.9)	8.5^{b} (0.6)	18.7^{d} (0.8)	3.1^{bc} (0.2)
May	1682	340	51.9^{b} (0.9)	10.3^{bc}(0.6)	14.1^{b} (0.3)	2.8^{ab} (0.2)
June	1276	171	47.2^{a} (1.0)	8.6^{b} (0.4)	19.5^{d} (1.2)	3.6^{cd} (0.2)
July	1300	162	48.2^{a} (0.9)	6.7^{a} (0.2)	22.5^{e} (0.6)	3.2^{bc} (0.1)
August	1208	285	52.9^{b} (0.8)	8.7^{b} (0.4)	26.3^{a} (0.6)	4.3^{e} (0.2)
September	1336	270	51.9^{b} (0.6)	9.5^{bc}(0.2)	20.4^{d} (0.2)	3.6^{cd} (0.1)
October	1098	338	53.3^{bc}(0.8)	9.0^{bc}(0.5)	23.0^{e} (0.6)	3.9^{de} (0.2)
November	839	233	53.0^{bc}(0.9)	9.8^{bc}(0.4)	16.5^{c} (0.6)	3.0^{bc} (0.1)
December	1245	174	57.3^{de}(1.2)	10.6^{c} (0.4)	16.3^{c} (0.6)	3.0^{bc} (0.1)
Year Mean	–	–	53.5	9.8	18.8	3.4
$S\bar{x}$	–	–	0.90	0.55	0.61	0.18

[1] Total forage available based on field measurements.
[2] Total forage available minus the four species apparently not consumed. These include *Distichlis scoparia* (1.1–4.7%), *Solanum eleagnifolium* (0.1–4.9%), *Sporobolus rigens* (41.6–56.9%), and *Hyalis argentea.*
[3] In vitro organic matter digestibility determined on samples collected from four esophageal fistulated sheep 4 consecutive days each month.
[4] Digestible organic matter intake estimated from IVOMD and total fecal collections of five fecal bagged sheep 3 consecutive days each month.
[5] Numbers in parentheses are standard errors. Means in the same column bearing different superscripts differ significantly ($P \leq .05$).

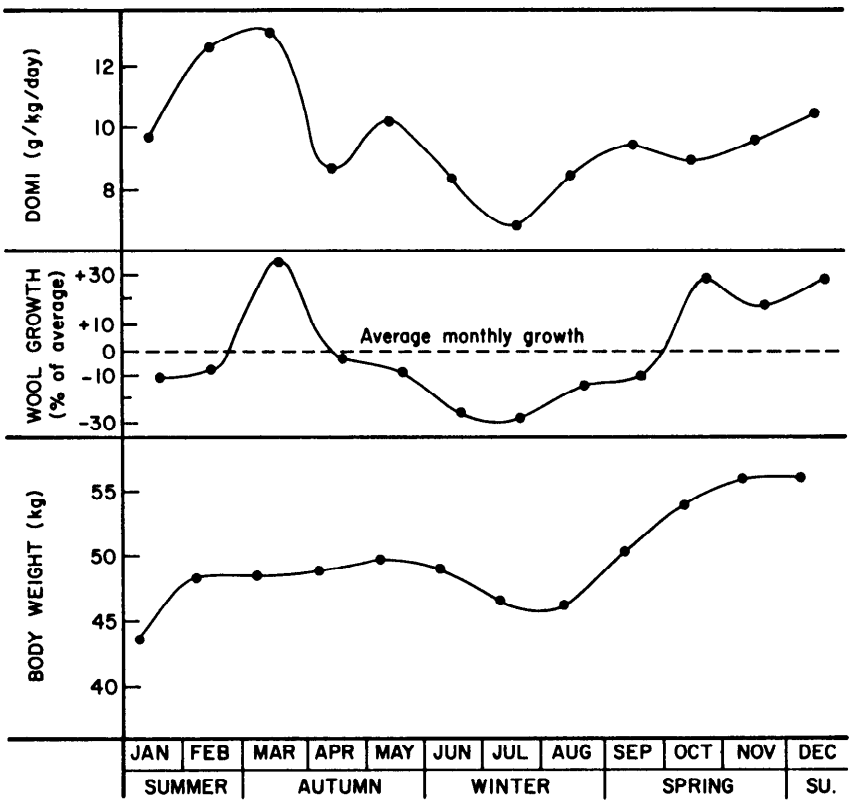

Fig. 3. *Monthly variation in digestible organic matter intake, wool production, and body weight.*

conserved for use in the fall and winter months. The interaction between animals and pastures should be studied to discover practices which more fully exploit the production potential of both plants and animals.

The possibility of reducing the amount of unacceptable forage available in the field needs investigation. A reduction in amount of unacceptable forage in the field should have favorable effects on the yield of other species by reducing competition for moisture, nutrients, and light.

Summary and Conclusions

A 12-month experiment was conducted in 1968 with grazing sheep in the sandhill area of semiarid Argentina. Field samples indicated that the two dominant species available in the field were two coarse perennials, *Sporobolus rigens* and *Hyalis argentea*, which together comprised between 64.0 and 84.8% of the forage available to the sheep. These species were not consumed by sheep.

Many of the species contributing substantially to the diet were often present in very low amounts in the field. The main species selected were: *Cenchrus pauciflorus, Stipa* spp., *Erodium cicutarium, Hordeum leporinum, Bromus unioloides,* and *Poa* spp.

Over the 12-month experimental period the sheep were able to consume sufficient nutrients from pasture for wool growth and a gain of 14.3 kg. A lack of energy, particularly during the winter months, appeared to be the most serious nutritional deficiency identified in this study. Protein intake did not appear to be a limiting factor for production in these sheep.

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