Nutritional Composition of Desert Mule Deer Forage in the Picacho Mountains, Arizona

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Abstract

Nineteen forage species used by Desert Mule Deer (*Odocoileus hemionus crooki*) in the Picacho Mountains, Arizona were collected bimonthly in 1983 and analyzed for dry matter, protein fiber, lignin, ether extract, ash, cellulose, cell solubles, and hemicellulose. Results of the analyses are presented as a reference source for wildlife biologists, range managers, and others working with desert ecosystems.

Introduction

Knowledge of the nutritional composition of forage used by wildlife is important for land managers. Rautenstrauch at al. (1988) briefly summarized how forage quality data have been used and presented the first data on the quality of Desert Mule Deer forage in xeric regions of the Sonoran Desert. Although forage quality has been measured throughout the range of Rocky Mountain Mule Deer (*Odocoileus hemionus*) by Kufeld et al. (1973) and in the more mesic regions of the range of Desert Mule Deer (*O. h. crooki*) in the Trans-Pecos region of Texas (Payton and Garner, 1980), in Arizona chaparral (Swank, 1956; Reynolds, 1967), in desert grassland (Short, 1977), and in chaparral-desert ecotone (Urness et al., 1971; Horejsi, 1982), quality values of Desert Mule Deer forage in xeric regions of the Sonoran Desert have only been reported once (Rautenstrauch et al., 1988).

The objective of our present study was to measure the nutritional quality of some important Desert Mule Deer forages in the Picacho Mountains of southcentral Arizona. We present this information in an unsummarized format as a reference for wildlife managers and researchers working with the Sonoran Desert.

B. D. Leopold, University of Arizona, helped collect forage samples. K. C. Maddock supervised the proximate analyses. This study was funded by the U.S. Bureau of Reclamation and the U.S. Fish and Wildlife Service.

Study Area

The study was conducted in the Picacho Mountains, Pinal County, Arizona. The study area covered approximately 228 km^2 and ranged in elevation from 485 to 1,374 m.

The Lower Sonoran Life Zone (Lowe, 1964) which covers the Picacho Mountain lowlands consists of two basic plant communities, one of Little-Leaf Palo Verde (*Cercidium microphyllum*) and Saguaro Cactus (*Carnegie gigantea*) on the mountain slopes and bajadas (the transition zone between the desert floor and mountain slopes), and one of Creosotebush (*Larrea tridentata*) and Triangle-Leaf Bursage (*Franseria deltoidea*) on the flats.

Within the mountainous terrain and bajadas water was available in 6 big game water catchments, 1 ephemeral spring, and an undetermined number of rain pools. In the flat country away from the mountains (≥ 1 km) (1 km) there were 21 stock ponds.

Mean daily maximum temperatures 13 km east of the study area at Eloy, Arizona ranged from 19 C in January to 41 C in July, and mean daily minimum temperatures ranged from 2 C in January to 24 C in July (Sellers and Hill, 1974). The area has an arid climate with an annual precipitation average of 21 cm, 40% of which falls during the summer months of July, August, and September (Sellers and

Table 1. Nutritional composition (%) of 19 Desert Mule Deer forage species collected bimonthly in the Picacho Mountains, Arizona 1983.

Month	Dry Matter*	Protein	Fiber ADF	Fiber NDF	Lignin	Ether Extract	Ash	Cell-ulose	Cell soluble	Hemicel-lulose
					%					
Catclaw Acacia (*Acacia greggii*)										
Jan–Feb	52.07	13.91	37.21	52.80	10.51	2.51	5.78	27.02	47.20	15.60
Mar–Apr	45.21	12.29	41.86	57.70	9.67	3.53	5.98	32.16	42.30	15.84
May–Jun	47.12	13.81	38.07	47.15	10.42	1.63	6.43	27.93	52.85	4.40
Jul–Aug	59.32	11.29	47.62	56.90	9.75	2.60	9.30	36.63	43.10	9.28
Sep–Oct	51.90	14.43	42.12	54.37	10.25	3.02	5.98	32.45	45.63	12.25
Nov–Dec	47.55	13.45	43.72	57.30	11.48	1.93	5.55	32.64	42.70	13.58
False Mesquite (*Calliandra sp.*)										
Jan–Feb	56.73	9.76	47.30	54.61	9.02	1.87	6.37	36.29	45.39	7.31
Mar–Apr	55.00	12.25	37.04	52.24	8.51	2.37	5.95	27.53	47.76	15.20
May–Jun	55.49	10.56	44.46	40.20	12.31	2.17	7.01	29.26	59.80	4.26
Jul–Aug	59.35	8.62	56.87	59.46	12.36	3.09	8.63	40.16	40.54	2.59
Sep–Oct	44.76	13.45	30.56	47.59	6.98	2.98	9.55	20.53	52.41	17.03
Nov–Dec	56.41	9.93	49.93	60.17	10.88	1.54	8.44	35.41	39.83	10.74
Saguaro (*Cereus giganteus*)										
Jan–Feb	**									
Mar–Apr	**									
May–Jun	35.42	9.66	26.15	26.76	3.90	9.35	9.28	22.39	73.24	0.61
Jul–Aug	10.68	13.75	35.91	39.47	8.40	3.92	7.68	27.41	60.53	3.56
Sep–Oct	**									
Nov–Dec	**									
Little-leaf Palo Verde (*Cercidium microphyllum*)										
Jan–Feb	62.51	6.27	47.45	63.58	6.53	4.10	5.34	41.28	36.42	16.13
Mar–Apr	60.95	7.38	40.38	64.62	8.99	2.38	7.59	31.59	35.38	24.24
May–Jun	30.99	16.31	31.79	36.39	8.22	2.99	5.50	24.09	63.61	4.66
Jul–Aug	57.48	6.24	49.37	65.66	11.66	2.41	5.86	36.81	34.34	16.29
Sep–Oct	38.28	12.22	30.97	49.02	8.30	4.14	8.41	22.94	50.98	18.05
Nov–Dec	63.56	6.67	42.26	60.12	11.66	1.89	6.24	30.86	39.88	17.86
Brittlebush (*Encelia farinosa*)										
Jan–Feb	36.86	11.04	22.31	30.36	5.48	5.12	11.74	17.21	69.64	47.33
Mar–Apr	38.23	9.28	20.67	28.86	5.87	8.93	12.29	14.86	71.14	8.19
May–Jun	49.56	8.49	28.74	38.98	8.08	3.57	14.80	20.09	61.02	10.24
Jul–Aug	72.02	3.28	48.72	63.88	13.64	3.31	8.23	33.79	36.12	15.16
Sep–Oct	38.28	8.60	28.28	34.84	7.60	7.37	16.66	20.45	65.16	6.56
Nov–Dec	31.84	12.70	26.11	31.27	8.74	6.24	13.06	17.57	68.73	5.16
Mormon Tea (*Ephedra* spp.)										
Jan–Feb	56.80	6.69	49.92	59.94	10.03	1.66	5.88	40.26	40.06	10.02
Mar–Apr	55.12	6.43	47.83	63.87	7.44	3.06	6.93	39.65	36.13	17.32
May–Jun	48.79	4.89	54.39	60.92	7.21	1.60	4.15	52.30	39.08	9.72
Jul–Aug	56.60	5.23	59.04	68.35	9.90	0.93	5.75	48.74	31.65	9.31
Sep–Oct	56.44	8.46	53.00	62.30	9.76	2.52	7.36	43.88	37.70	9.30
Nov–Dec	57.04	5.55	55.17	63.39	7.91	1.60	6.07	47.49	36.61	8.22
Wild Buckwheat (*Eriogonum fasciculatum*)										
Jan–Feb	60.13	5.67	43.39	58.11	11.72	2.44	7.94	31.02	41.89	14.72
Mar–Apr	62.76	3.70	46.58	60.73	11.93	2.38	6.34	34.14	39.27	14.15
May–Jun	68.97	5.34	31.85	52.85	12.39	1.54	6.76	24.23	47.15	15.14
Jul–Aug	87.18	3.94	52.64	66.88	13.76	1.31	6.22	38.41	33.12	14.24
Sep–Oct	67.92	4.95	56.69	67.45	13.52	2.00	6.13	43.33	32.55	10.76
Nov–Dec	58.41	5.46	47.91	60.31	15.15	1.21	5.89	32.71	39.69	12.40
Wright Buckwheat (*Eriogonium wrightii*)										
Jan–Feb	60.39	6.73	46.83	60.71	10.44	3.38	5.15	36.35	39.29	13.88
Mar–Apr	68.36	5.19	50.16	63.57	15.38	3.59	5.02	33.77	36.43	13.41
May–Jun	63.40	5.93	36.76	57.55	12.46	2.40	3.86	31.78	48.49	13.24
Jul–Aug	81.20	4.28	48.53	72.77	16.79	1.50	3.23	31.43	27.23	24.24
Sep–Oct	52.50	7.54	41.32	57.52	10.39	3.52	4.34	31.41	42.48	16.20
Nov–Dec	55.47	5.10	44.81	61.30	11.43	1.82	4.26	34.09	38.70	16.49
Spurge (*Euphorbia* spp.)										
Jan–Feb	60.67	6.40	29.11	37.32	7.59	3.97	9.43	18.30	62.68	8.21
Mar–Apr	49.86		27.75	34.92	7.40	5.52	8.30	17.28	65.08	7.17
May–Jun	51.92	5.12	26.78	31.67	6.95	3.17	5.67	19.59	68.83	4.89
Jul–Aug	65.82	5.90	31.25	37.86	8.21	4.35	6.60	21.91	62.14	6.61
Sep–Oct	39.03	6.62	37.20	44.20	5.88	4.59	20.58	15.23	55.80	7.00
Nov–Dec	49.17	5.81	40.83	48.74	8.38	4.49	14.78	21.55	51.26	7.91
Lance-leaf Ditaxis (*Ditaxis lanceolata*)										
Jan–Feb	44.73	11.08	39.47	51.84	7.81	2.09	10.12	31.81	48.16	12.37
Mar–Apr	49.03	6.25	48.85	65.19	11.33	0.94	7.56	37.16	34.81	16.34
May–Jun	61.92	7.02	47.63	58.61	10.49	2.92	8.91	36.74	41.39	10.98
Jul–Aug	80.30	6.47	50.71	67.55	10.40	1.35	8.34	39.66	32.45	16.84
Sep–Oct	44.13	10.43	37.72	52.98	8.14	2.80	11.46	30.15	47.02	15.26
Nov–Dec	47.93	8.10	49.83	58.97	13.63	2.46	10.15	36.11	41.03	9.14
Desert Lavender (*Hyptis emoryi*)										
Jan–Feb	51.05	5.85	41.82	57.11	10.74	5.76	5.55	30.89	42.89	15.29
Mar–Apr	48.24	5.25	47.08	57.33	10.66	7.37	5.98	35.97	42.67	10.25
May–Jun	56.56	7.20	38.20	46.23	11.34	12.45	8.10	24.75	53.77	8.03
Jul–Aug	55.52	6.13	53.24	60.01	16.67	7.98	7.12	35.06	39.99	6.77
Sep–Oct	31.17	11.48	38.92	50.95	11.63	7.87	8.33	27.55	49.05	12.03
Nov–Dec	36.80	8.56	42.44	50.23	15.05	9.62	7.00	27.29	49.77	7.79
Janusia (*Janusia* spp.)										
Jan–Feb	63.76	4.77	47.86	61.98	9.72	0.84	5.95	39.20	38.02	14.12
Mar–Apr	64.27	4.97	51.83	67.66	13.18	1.77	6.97	45.97	38.04	8.74
May–Jun	63.92	8.31	44.11	57.23	10.50	2.42	6.64	32.85	42.77	13.12
Jul–Aug	74.16	6.63	48.76	62.30	9.22	0.79	6.98	38.94	37.70	13.54
Sep–Oct	31.03	8.90	42.80	56.84	9.09	3.22	7.23	34.19	43.16	14.04
Nov–Dec	53.13	6.88	44.10	59.23	9.91	1.78	6.66	33.48	40.77	15.13
Range Ratany (*Krameria parvifolia*)										
Jan–Feb	66.11	5.81	41.75	62.37	10.33	1.02	5.14	31.60	37.63	20.62
Mar–Apr	58.75	5.79	39.25	60.86	9.63	1.06	5.43	29.65	39.14	21.62
May–Jun	58.42	6.58	33.27	54.36	9.36	1.07	4.49	23.69	45.64	21.09
Jul–Aug	62.35	7.87	39.75	59.32	11.74	0.69	5.29	27.84	40.68	19.57
Sep–Oct	52.37	7.30	40.68	60.54	11.16	1.32	5.00	29.67	39.46	19.86
Nov–Dec	60.63	6.28	37.38	60.66	11.16	1.49	6.36	24.52	39.34	23.28
Mammillaria (*Mammillaria* spp.)										
Jan–Feb	35.72	6.08	26.49	61.56	6.02	2.16	15.59	18.64	38.44	35.07
Mar–Apr	62.28	5.46	30.50	66.24	8.82	0.93	18.42	15.57	33.76	35.74
May–Jun	23.37	4.56	32.07	67.66	6.62	0.53	13.79	21.57	32.34	35.59
Jul–Aug	40.81	6.30	48.13	77.14	4.57	0.41	33.91	16.84	22.86	29.01
Sep–Oct	52.61	4.05	24.43	45.98	5.84	1.85	17.08	11.76	54.02	21.55
Nov–Dec	16.07	5.75	44.15	69.30	3.34	1.83	16.53	19.38	30.70	25.15
Opuntia (*Opuntia* spp.)										
Jan–Feb	86.64	6.47	14.22	23.30	3.08	3.69	16.94	11.81	76.70	9.08
Mar–Apr	75.56	6.08	17.26	28.98	3.88	2.45	15.24	11.37	71.02	11.72
May–Jun	36.40	6.64	29.63	44.67	5.60	5.02	11.68	22.65	55.33	5.04
Jul–Aug	26.99	5.07	24.47	42.47	4.93	5.64	14.36	21.91	62.14	6.61
Sep–Oct	15.40	5.82	19.09	74.00	2.42	3.06	9.06	13.12	26.00	54.91
Nov–Dec	14.03	7.77	27.99	44.72	5.85	7.87	7.10	22.14	55.28	16.73
Odoro (*Porophyllum* spp.)										
Jan–Feb	44.11	6.27	43.60	56.09	8.60	1.98	6.33	35.85	43.91	12.49
Mar–Apr	44.14	5.50	37.66	50.48	9.17	1.83	7.60	28.65	49.52	12.82
May–Jun	54.14	4.50	42.24	53.65	10.00	1.74	5.22	32.24	46.35	11.41
Jul–Aug	68.90	3.21	49.10	62.56	12.44	2.10	5.50	36.43	37.44	13.46
Sep–Oct	52.37	7.30	37.95	50.95	9.47	3.09	9.54	28.88	49.05	13.00
Nov–Dec	41.20	7.25	41.80	54.08	10.55	1.64	7.81	31.30	45.92	12.28
Mesquite (*Prosopis* spp.)										
Jan–Feb	53.40	13.39	29.84	44.19	6.83	5.11	9.35	23.17	55.81	14.35
Mar–Apr	31.62	25.12	27.43	38.40	7.07	4.62	7.67	20.24	61.60	10.97
May–Jun	38.47	20.82	31.24	39.45	7.11	2.93	6.54	24.43	60.55	8.21
Jul–Aug	62.64	13.11	30.98	42.28	6.18	4.50	6.71	25.60	57.72	11.30
Sep–Oct	42.62	19.11	27.42	42.54	5.74	4.83	8.08	22.57	57.46	14.94
Nov–Dec	50.40	16.34	32.00	44.07	8.92	4.45	8.60	23.55	55.93	12.07
Jojoba (*Simmondsia chinensis*)										
Jan–Feb	45.73	6.99	28.01	50.86	6.12	2.24	6.06	22.68	49.14	22.85
Mar–Apr	51.00	10.07	27.59	48.30	7.43	3.83	6.61	19.92	51.70	20.71
May–Jun	42.59	7.52	29.65	54.73	9.06	6.15	5.90	19.68	45.27	25.08
Jul–Aug	57.32	6.25	39.22	58.28	10.80	2.52	7.00	27.81	41.72	16.56
Sep–Oct	44.77	10.98	30.61	55.45	7.75	3.18	6.88	23.27	44.55	24.84
Nov–Dec	44.71	9.36	27.55	55.15	8.80	2.39	6.09	19.68	44.85	27.60
Globe Mallow (*Sphaeralcea* spp.)										
Jan–Feb	29.93	18.35	25.66	43.77	5.86	2.19	12.67	20.24	56.23	18.11
Mar–Apr	32.94	12.95	33.78	51.65	8.88	3.47	10.14	24.50	48.35	17.87
May–Jun	50.47	6.47	38.26	56.79	9.14	1.75	6.66	29.09	43.21	18.53
Jul–Aug	74.04	5.74	48.78	70.60	12.59	1.74	7.58	34.89	28.05	21.82
Sep–Oct	36.91	13.32	30.86	53.70	8.54	3.47	11.43	46.30	22.87	22.84
Nov–Dec	33.28	13.52	39.71	54.80	10.86	1.53	10.04	29.76	45.20	15.09

*All values except dry matter reported on a moisture free basis.
**Plant parts used by Desert Mule Deer not available for sampling.

Hill, 1974). Climate data for 1981–82 were not significantly different from the 20 year averages given above (Natl. Oceanic and Atmosph. Admin., 1981, 1982).

Methods

During 1983 samples of 19 forage species used by Desert Mule Deer were collected bimonthly. The selection of forage species collected was based on observations of forage consumed by Desert Mule Deer in the Picacho Mountains. Plant collections were made during two to three days in the middle of each bimonthly period. At least 200 g (fresh weight) of each species was collected from at least 20 different individual plants over a range of the available habitat. Plant parts collected mimicked plant parts selected (leaves, flowers, new growth) by Desert Mule Deer as much as possible. As plant parts were collected they were individually placed in pretared brown paper bags and weighed. Samples were kept for approximately 48 hours at ambient temperatures until received at the Animal Sciences Laboratory, University of Arizona, where they were frozen and stored at −20 C until analysis.

Dry matter (%) was determined by heating samples to a constant weight in a convection oven at 35 C. Dried matter was then ground to a 2 mm particle size with a Wiley

laboratory mill. The percentage of ether extract (lipid) was determined by the procedure described by the Association of Offical Agricultural Chemists (1980). Fiber, lignin, and cellulose were determined according to Goering and Van Soest (1970). Nitrogen was determined using a micro Kjeldahl digestion and an autoanalyzer.

All parameters for each sample were only measured once. Following completion of all laboratory analyses, anomalous data points were reanalyzed for verification of accuracy. In some cases, bimonthly samples on either side of a data point in question were also reanalyzed. Plant names follow Lehr (1978).

Results and Discussion

Results of chemical analyses are presented in Table 1. A knowledge of nutritional values of key forage species has practical application in ungulate management and research. Our purpose was to present the nutritional quality of key forage plants as an easily accessed reference. Forage quality can be used as a criterion for assessing the quality of habitats. Monitoring seasonal nutritional levels of key forage species can help wildlife managers determine when the habitat is most productive and may provide clues as to when and if diet supplements are called for. This is especially important on ranges shared by native ungulates and livestock.

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