The Effects of Plant Nutrition on the Diet Quality of White-tailed Deer on Aransas National Wildlife Refuge

by

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ABSTRACT

A 2,025 acre experimental area, enclosed by a deer-proof fence and a water barrier, was burned over a 2-year period. Thirteen known deer food plants were collected every two weeks and 30 deer were collected three times between June and January. Rumen content samples were taken. These and the plants were analyzed for levels of calcuim, protein, and phosphorus. Most plant species, including those in the unburned area stay above the maintenance level of 7% protein. Forbs were lower in protein on burned area possibly due to shallow root systems. Calcium levels were continuously above the .09% optimum level on all areas. Phosphorus content never stayed consistenly above the optimum level of .25% on all areas. Levels were slightly higher on the burned areas for this nutrient. Nutrient levels in the rumen were well above the levels required for optimum body condition for the burned area, while in the unburned the levels were lower but near optimum or higher. Burning seemed to show a difference in the deer but not the vegetation.

ACKNOWLEDGMENTS

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INTRODUCTION

Deer are a highly valued economic commodity. One of the most hunted of all the species of big game is the white-tailed deer, Odocoileus virginianus (Thompson et al. 1973). Ramsey (1965) noted that the economic potential of this resource is rapidly gaining importance with increasing public demand for hunting.

Texas has very little public land, less than 1,000 square miles, where hunting without cost is allowed. Almost all the approximately 300,000 deer harvested are taken on private land where an access fee is imposed by the land owner. Land owners in Texas received approximately $13 million for granting access for hunting priviledges on their lands in 1965 (Klussman 1966). In some years land owners receive more income from the sale of hunting leases for white-tailed deer than from the sale of their livestock (Teer et al. 1965). So there is evidence that it is economically advantageous to find ways to keep this resource in top quality.

From the fall of 1964, the deer herd on the Aransas Refuge has undergone a steady decline in body condition, as evidenced by a reduction in body size and antler development, and population density (Beasom, personal communication). This study was initiated as a part of an overall study by the Department of Wildlife and Fisheries Science to determine the causative factors for these declines. My objectives are: to evaluate the nutritional quality of thirteen known deer food plants and to evaluate the nutritional quality of actual deer diets on burned and unburned areas on the Aransas National Wild-

life Refuge, Texas.

REVIEW OF THE LITERATURE

Poor body condition must ultimately be associated with the condition of the habitat. If the habitat is nutritionally poor, then the deer consume this poor quality food because it is the only kind available. This results in poor quality deer. Upland habitats of the southern United States are low in soil fertility which produce forage with deficiencies in net energy, protein, and calcium. This usually results in small statures and low densities of white-tailed deer on those habitats (Short 1969). One way to improve overall deer quality is to modify the nutritional quality of their diet.

Prescribed range burning increases the nutritional quality of plants by making nutrients tied up in the mature vegetative matter more available to plants. Some other advantages obtained from burning are: increased grazing capacity, inhibition of unwanted brush, increased palatability of forage, removal of dead plants, improved access to forage, start of new growth one to three weeks earlier and initiation of new woody browse growth (Vallentine 1971). With successive burns, there is a large increase in protein and phosphorus levels and a slight increase in calcium levels over time (Lay 1957).

Calcium, protein, and phosphorus are three essential nutrients on which deer depend to maintain optimum physiological condition. Deer body maintenance and development is dependent upon adequate protein levels. Phosphorus is essential for metabolism. Calcium and phosphorus are important components of bones, antlers, and soft tis-

sues. Phosphorus plays a role in estrus and, therefore, affects productivity (Short 1969). Some effects of varied nutrient levels are shown by French et al. (1956). Deer on low phosphorus, calcium, and protein diets shed their winter and summer coats later than those fed higher levels of these nutrients. Deer fed on low protein diets produced little or no antler growth, while those on low calcium and phosphorus diets produced very short antlers. The production of these antlers also was initiated later in the low calcium, phosphorus, and protein diets. A delay in the velvet removal also resulted. Low levels of the same nutrients were found to greatly restrict growth. These diets resulted in reduced body size and width to about one-half that of the control animals. Diets containing 13-16% protein and greater than .09% calcium and .25% phosphorus were determined optimum.

STUDY AREA AND METHODS

Part of the southern peninsula of the Aransas National Wildlife Refuge was partitioned off by the use of an existing deer-proof fence put up in 1963 by the U.S. Fish and Wildlife Service for another project (See figure 1). In November 1974, 400 hectares were burned. Then 800 hectares were burned in April 1975 and the remainder in November 1975. The total experimental area encompassed 2,025 hectares.

Plants were sampled biweekly from June to December 1976 by clipping. See Table 1 for a list of deer food plants sampled. There were eight plants available during the entire sampling period which provided enough new herbage production to permit analysis. The samples were oven-dried, ground with a Wiley mill, and stored for later

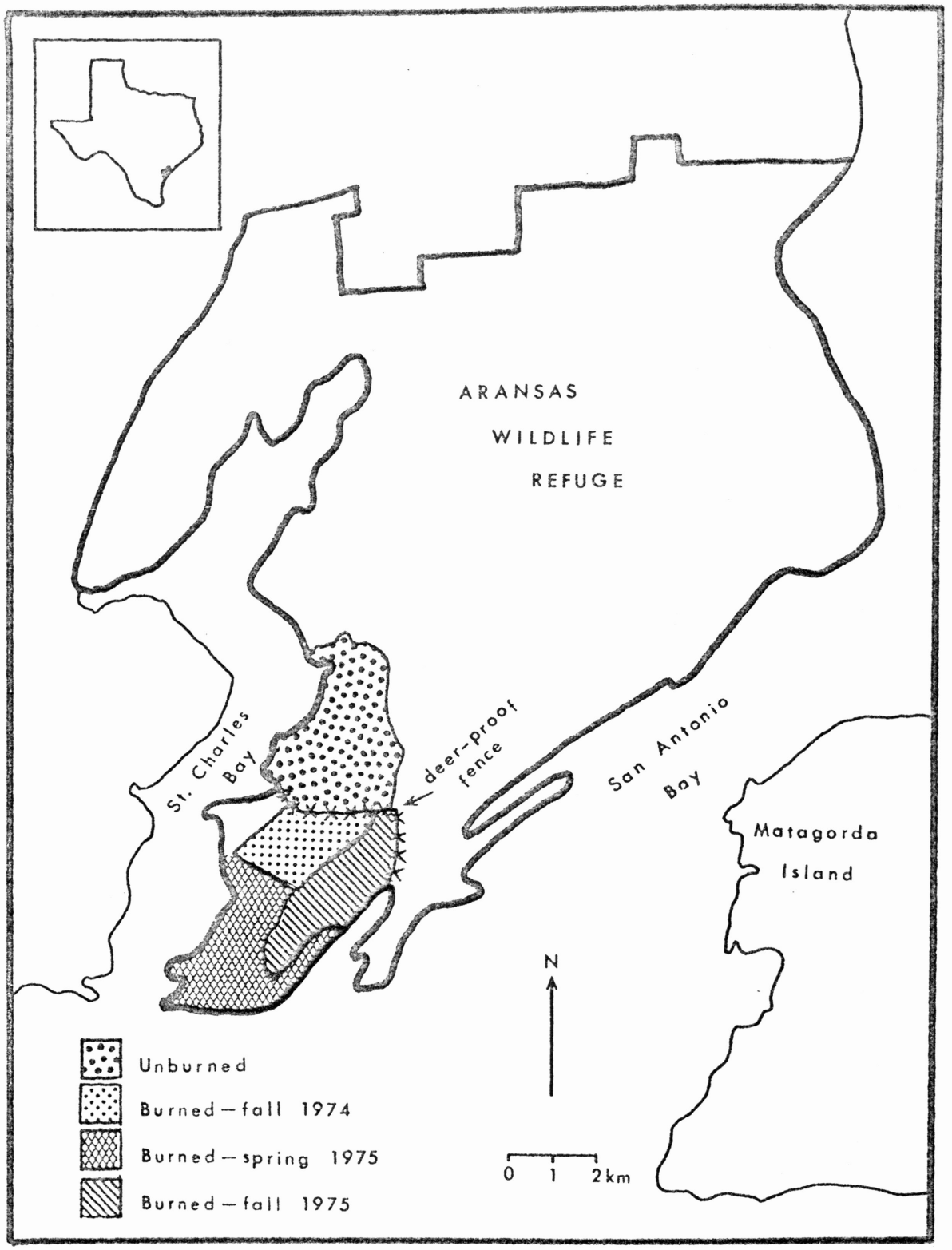

Fig. 1 Location of burned (experimental) and unburned (control) areas on The Aransas National Wildlife Refuge.

Table 1. DEER FOOD PLANTS

Common Name	Scientific Name
Live Oak	Quereus virginiana
Smilax	Smilax spp
Yaupon	Ilex vomitoria
Hercules Club	Zanthoxylum clava-herculis
Spadeleaf	Centella asiatica
Queen's Delight	Stillingia sylvatica
Southwestern Ragweed	Ambrosia psilostachya
French Mulberry	Callicarpa americana

analysis. Deer were collected in July, October, and January. Usually five deer were taken on each area (burned and unburned) once each of these months. Rumen content samples were taken at this time. These were brought back to the Caesar Kleberg Research lab at Texas A&M University, dried, ground with the Wiley mill, and stored. The day before analysis both the rumen samples and plant samples were taken out of storage and put into a plant drying oven overnight. The next day the samples were analyzed for protein by micro Kjeldahl distillation according to Horowitz (1965) or analyzed for calcium and phosphorus with a spectro photometer according to Hall and Hacskaylo (1963).

RESULTS

Vegetation

The results of nutritional analysis on plants was found to vary seasonally, with precipitation and drought periods, and by species over the study area. Browse responded better to burning compared to forbs. See Tables 2-4.

For the protein determinations all plants stayed above the maintenance level of 7% for a majority of the time on all areas. No real monthly trend could be discerned. Most of the species stayed about at the same protein content level or went down from fall to winter. The fall 1975 burn averaged higher than the fall 1974 burn. Live oak and Hercules club were higher on the fall 1974 burn compared with the unburned area. Yaupon was higher on the fall 1975 burn compared

Table 2. PERCENT PROTEIN IN PLANTS

Unburned Area

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	8.30	6.83	6.34	8.39	5.95	6.30	6.81
Smilax	18.32	15.87	19.88	11.80	9.37	8.14	9.18
Yaupon	12.33	9.01	9.38	10.30	10.41	9.24	
Hercules Club	16.43	10.26	10.54	-	-	-	-
Spadeleaf	9.83	7.20	9.76	7.23	10.75	-	-
Queen's Delight	10.79	10.11	-	-	-	-	-
SW Ragweed	14.16	13.72	12.31	11.61	9.00	10.12	-
French Mulberry	15.49	11.17	15.67	11.57	7.43	-	-

Fall 1974 Burn

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	8.95	10.59	7.82	9.62	*	*	*
Smilax	17.83	17.18	16.37	10.22	*	*	*
Yaupon	8.32	13.00	8.85	11.80	*	*	*
Hercules Club	17.87	10.61	12.10	-	*	*	*
Spadeleaf	8.57	5.98	9.17	5.15	*	*	*
Queen's Delight	7.54	8.52	-	-	*	*	*
SW Ragweed	9.69	9.97	9.11	-	*	*	*
French Mulberry	11.26	11.46	12.29	15.20	*	*	*

Fall 1975 Burn

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	9.63	10.24	7.14	8.57	7.27	7.32	7.20
Smilax	17.36	18.00	18.95	18.94	10.62	9.07	8.26
Yaupon	11.35	12.67	11.62	14.15	13.47	11.77	11.19
Hercules Club	20.99	9.18	10.83	-	-	-	-
Spadeleaf	9.45	11.76	10.95	9.09	4.45	-	-
Queen's Delight	7.90	7.56	-	-	-	-	-
SW Ragweed	8.18	10.11	9.33	-	5.83	7.75	10.26
French Mulberry	15.81	11.32	12.79	9.28	9.22	-	-

- Not available
* Area recently reburned

Table 3. PERCENT CALCIUM IN PLANTS

Unburned Area

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	.156	.751	.784	.328	.300	.427	.856
Smilax	.331	.744	.613	.170	.689	.615	1.292
Yaupon	.195	.454	.627	.266	.264	.256	.801
Hercules Club	.755	.208	1.845	-	-	-	-
Spadeleaf	2.616	2.990	2.283	2.428	1.703	1.969	-
Queen's Delight	.287	.636	-	-	-	-	-
SW Ragweed	3.382	3.079	4.382	-	1.859	1.934	3.462
French Mulberry	1.338	.824	1.548	1.309	1.793	-	-

Fall 1974 Burn

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	.249	.095	.637	.322	*	*	*
Smilax	.246	.439	.714	.625	*	*	*
Yaupon	.064	.068	.508	.093	*	*	*
Hercules Club	.586	1.644	1.934	-	*	*	*
Spadeleaf	1.928	1.319	1.968	2.430	*	*	*
Queen's Delight	1.002	.808	-	-	*	*	*
SW Ragweed	.849	3.041	3.210	-	*	*	*
French Mulberry	.341	.975	1.196	1.421	*	*	*

Fall 1975 Burn

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	.171	.154	.433	.449	.599	.570	.347
Smilax	.415	.563	.501	.293	.481	.500	.577
Yaupon	.294	.400	.461	.120	.400	.341	.351
Hercules Club	.473	1.032	2.120	-	-	-	-
Spadeleaf	1.116	1.326	1.410	.686	2.158	2.428	-
Queen's Delight	.518	1.155	-	-	-	-	-
SW Ragweed	3.079	2.459	3.470	-	3.202	3.965	3.184
French Mulberry	.754	.839	1.381	1.298	1.471	-	-

\- Not available
* Area recently reburned

Table 4. PERCENT PHOSPHORUS IN PLANTS

Unburned Area

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	.127	.059	.066	.093	.082	.101	.106
Smilax	.421	.223	.318	.181	.105	.070	.149
Yaupon	.132	.072	.098	.063	.091	.078	.136
Hercules Club	.321	.197	.119	-	-	-	-
Spadeleaf	.117	.079	.126	.068	.114	.112	-
Queen's Delight	.146	.151	-	-	-	-	-
SW Ragweed	.234	.227	.229	-	.163	.135	.133
French Mulberry	.183	.108	.155	.111	.080	-	-

Fall 1974 Burn

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	.131	.114	.110	.124	*	*	*
Smilax	.373	.236	.226	.126	*	*	*
Yaupon	.108	.140	.073	.096	*	*	*
Hercules Club	.363	.208	.150	-	*	*	*
Spadeleaf	.124	.090	.109	.054	*	*	*
Queen's Delight	.103	.132	-	-	*	*	*
SW Ragweed	.144	.194	.116	-	*	*	*
French Mulberry	.159	.136	.141	.199	*	*	*

Fall 1975 Burn

Plant	June	July	Aug	Sept	Oct	Nov	Dec
Live Oak	.143	.140	.114	.120	.067	.111	.102
Smilax	.318	.314	.268	.334	.181	.100	.095
Yaupon	.145	.109	.121	.164	.136	.179	.142
Hercules Club	.459	.114	.168	-	-	-	-
Spadeleaf	.134	.131	.121	.175	.052	.062	-
Queen's Delight	.126	.114	-	-	-	-	-
SW Ragweed	.138	.155	.127	-	.093	.226	.315
French Mulberry	.282	.129	.157	.362	.302	-	-

- Not available
* Area recently reburned

with the fall 1974 burn and the unburned area. All other plant species on both burned areas were comparable in protein content with the unburned area or lower.

The unburned area stayed consistently above the 0.09% optimum calcium level, as well as the fall 1975 burn. On the fall 1974 burn, all but yaupon stayed above this level. The unburned area contained the highest calcium levels. An increase in the levels of calcium was noticed in the fall 1975 burn when it was compared to the fall 1974 burn. Forbs had higher levels in all areas compared to woody browse.

Phosphorus levels were slightly higher on the burned areas with the fall 1975 being the highest. Nowhere did the levels stay consistently above the optimum of 0.25%. Yaupon and Hercules club seemed to concentrate this nutrient best. Forbs, again, contained lower levels on the two burned areas compared with the unburned area.

Deer

In all three nutrient determinations the levels were always higher on the burned areas compared with the unburned area. See Table 5. For all nutrients and both areas, the levels were higher than the optimum levels with one exception. In October the protein levels dropped to below the 13% optimum level in both areas. Also, the calcium and phosphorus levels dropped in both areas for that same month but not below optimum levels.

It was observed that the fawns collected on the burned areas showed higher weights than those on the unburned areas. The difference in weight among adults was not significant.

Table 5. AVERAGE NUTRIENT LEVELS IN THE RUMEN

Nutrient	Month	Burned	Unburned
Protein	July	18.46%	13.83%
	Oct	9.05	8.14
	Jan	15.42	13.38
Calcium	July	.884%	.822%
	Oct	.115	.094
	Jan	1.153	.825
Phosphorus	July	.87%	.765%
	Oct	.409	.309
	Jan	1.06	.830

CONCLUSION

The vegetation nutrient level results did not demonstrate what we had hoped to accomplish. The nutrient levels had not increased very significantly due to the prescribed burning. A possible explanation concerning the difference of nutrient levels between forbs and woody browse on burned and unburned areas was sought. Forbs have shallower root systems compared to browse. Since burning denudes the land of vegetation, this increases radiation impinging upon the soil, which, in turn, increases evaporation of soil moisture. All the litter in the unburned areas could prevent the soil moisture and nutrients from evaporation.

Calcium levels were continuously high. This is due to the fact that the area is on the coast and calcium from shells is continuously available. Calcium was observed to be in higher levels among plants in the unburned area. This could be due to the fact that calcium uptake in plants is slow. Burning increased the growth rate of plants on the burned areas and, therefore, gave them a shorter time period in which to incorporate this nutrient.

Phosphorus is a relatively unavailable nutrient in this area as well as many other areas. One property of this nutrient is to become tied up very quickly in the soil in an unavailable state to plants. Burning did increase the levels in plants, but not very significantly.

The deer on the Aransas National Wildlife Reguge seem to be acquiring the nutrients in levels needed for optimum growth. The only explanation could be their well-known, uncanny sense of the correct

plant part to eat. Somehow they seem to know which plant contains the highest nutrients. Even though we did not increase the nutrient levels of the vegetation significantly, the deer are responding.

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