

FOOD HABITS AND WEIGHTS OF BOBWHITE FROM NORTHEASTERN OKLAHOMA TALL GRASS PRAIRIE

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Food habits and dynamics of weight of bobwhite quail (*Colinus virginianus*) were determined from 302 birds collected in Rogers County, Oklahoma, from September 1975 through February 1976. Seeds of 108 plant species from 23 families were consumed by quail. Important species by volume were lespedeza (*Lespedeza* sp.), sumc (*Rhus glabra* and *R. copallina*), and maize (*Sorghum vulgare*). Seasonal variability of food consumption and implications to management are discussed. Mean weight of 296 birds was 188.8 g. Juveniles exhibited a significant linear trend of increasing weight throughout the collection period. No trend in weight was detected for adults.

INTRODUCTION

The populations of bobwhite (*Colinus virginianus*) in Oklahoma have benefited in the past from the agricultural practices. Recently, however, the bobwhite has been systematically excluded by the reduction in available habitat as the economics of farming demanded more intensive use of agricultural lands. However, approximately 50% of Oklahoma is rangeland, which provides habitat for much of the state's quail population. Several studies (1, 2, 3, 4) of food habits of bobwhite in tallgrass prairie have been accomplished, but grazing by cattle has not been the major factor influencing vegetation where these studies occurred in Kansas and Oklahoma. The food habits of 302 bobwhite quail collected on a cattle ranch in the tallgrass prairie of northeastern Oklahoma are reported in this paper.

METHODS AND MATERIALS

Bobwhite were collected on the McFarlin-Ingersoll Ranch located 5 km north of Inola, Rogers County, Oklahoma. The major portion of the 4,696-ha ranch is located at T20N, R17E, in the eastern Cherokee prairie on the Parson-Dennis-Bates soil association (5). The physiography is level to gently sloping plains broken by east-facing escarpments and low, buttelike knobs. Approximately 85% of the ranch is native grassland interspersed with wooded draws. The remainder of the ranch includes tame pasture and cropland. The mean annual temperature and precipitation are 15.8 C and 67.6 cm, respectively (6). Winters are moderate and sunny with cold periods usually lasting only a few days.

Bobwhite on the ranch are managed by W. W. Ingersoll in cooperation with several field trial clubs, which sponsor the Oklahoma Open Championship, American Field Quail Futurity, and other field trials of local and national significance. Present habitat management includes 32 food plots, each approximately 15 by 60 m planted to *Sorghum alnum*. Plots were generally placed as near woody cover as possible. Most food plots also contained a feeder. There were 60 feeders on the ranch in which maize seed was available from September through February to supplement the quails' diet of naturally occurring foods.

Bobwhite were collected from September 1975 through February 1976. Most quail were shot during the hunting season by Mr. Ingersoll and guests. The monthly goal of 20 birds was reached in all months except February. Sex, age (7), and weight were recorded for each bird within three hours of collection. Each bird's crop was removed, individually marked, encased in a plastic bag, and frozen pending analysis of the contents.

The method of analysis of crop contents was similar to the technique used by Carpenter (8). Contents were sorted to species and volume measured by recording water displacement in a graduated cylinder. Food items of less than 0.1 cc were recorded as trace.

Each species of seed was assigned a number, and a sample of each seed type was placed in a seed mount for identification. Seeds were identified using the reference collections of the Oklahoma Cooperative Wildlife Research Unit and the Oklahoma

State University Herbarium, and reference publications of Delorit (9) and Martin and Barkley (10). The nomenclature follows Waterfall (11), and common names are cited according to Darrow *et al.* (12). When a common name was not available the generic name was used.

RESULTS

Characteristics of Collected Bobwhite

Laessle and Frye (13) found that birds collected from the same covey had essentially the same diet. Bobwhite were collected from a large number of locations and from several coveys on the study area to avoid biasing the results. The average number of birds collected per covey on a single day was 2.9.

Age, weight, and sex were determined on 296 of 302 bobwhite collected. Juveniles comprised 80% and males 55% of the wild birds collected. The mean weight of all birds collected was 188.8 g (Table 1). Wild adults were significantly heavier ($P < 0.001$, $t = 3.3402$, $df = 217$) than wild juvenile birds. Mean weights vary only slightly from those reported from Kansas by Robel and Linderman (14) for the same months (adults, $\bar{x} = 195.8$, $N = 43$; juveniles, $\bar{x} = 182.7$, $N = 155$).

Pen-reared birds constituted 26% of all birds collected. All pen-reared birds collected were juveniles hatched during early June 1975 and released in August 1975. Pen-reared birds weighed significantly more than the wild juvenile birds ($P < 0.001$, $t = 4.5594$, $df = 249$). This is partially accounted for by the pen-reared birds being older than most of the wild population.

Adult females averaged 1.6 g lighter than the adult males and wild juvenile females averaged 3.9 g lighter than wild juvenile males (Table 1). Neither of these differences were significant ($P < 0.10$). The lack of a significant weight difference between the sexes has been reported by several researchers (14, 15, 16, 17). The mean weight of wild birds increased significantly during November 1975 ($P < 0.05$, $t = 2.3004$, $df = 62$) and January 1976 ($P < 0.05$, $t = 2.2672$, $df = 132$). The increase during both months was due primarily to the significant weight gains of juveniles (Table 1). Adults exhibited no significant monthly weight gains.

TABLE 1. Mean monthly weights, standard error in grams, and sample size of bobwhite collected from September 1975 through February 1976, Rogers County, Oklahoma.

	September	October	Monthly Collection Period			January	February	Total
			November	December				
Pen-reared	186.4±3.6(15)	193.4±6.3(7)	190.8±5.3(25)	208.0±4.2(10)	206.8±4.1(16)	197.6±4.3(3)	196.1±2.4(76)	
Wild	165.4±6.2(8)	174.8±5.1(19)	185.7±2.2(45) ^a	185.3±2.0(59)	191.5±1.9(75) ^a	192.6±4.2(14)	186.3±1.7(220)	
Adult	179.1±2.7(2)	189.7±5.1(5)	200.3±4.9(10)	194.2±4.8(9)	191.8±4.8(14)	194.4±7.7(4)	194.1±2.4(44)	
Juvenile	160.8±7.3(6)	169.4±6.1(14)	181.6±2.0(35) ^a	183.7±2.1(50)	191.4±2.1(60) ^b	191.9±5.2(10)	184.5±1.3(175)	
Adult female	176.4±0.0(1)	192.0±6.0(4)	199.0±8.9(5)	202.3±5.1(2)	190.0±8.9(5)	183.4±0.0(1)	193.2±4.0(18)	
Adult male	181.7±0.0(1)	180.9±0.0(1)	203.1±6.6(4)	194.9±5.2(6)	192.8±5.9(9)	198.1±9.5(3)	194.8±3.0(24)	
Juvenile female	140.2±2.0(2)	177.5±2.9(6) ^b	178.0±3.2(16)	180.2±3.8(20)	188.2±2.8(33)	189.6±7.6(5)	182.4±1.9(82)	
Juvenile male	171.1±5.5(4)	163.4±10.2(8)	184.6±2.4(19)	186.0±2.4(29)	195.2±3.0(27) ^a	194.3±7.9(5)	186.3±1.8(92)	
Total	179.1±3.8(23)	179.8±4.3(26)	187.5±2.4(70)	188.6±2.0(69)	192.1±1.8(91)	193.5±3.5(17)	188.8±1.1(296)	

^a Differs significantly ($P < 0.05$) from mean weight of previous month.

^b Differs significantly ($P < 0.01$) from mean weight of previous month.

Regression analysis was performed on the data to detect trends in weight. Both male and female pen-reared birds exhibited linear weight trends with positive slopes (b), ($Y = a + bX$), of 5.6 and 2.0 respectively, and observed significance levels (OSL) of 0.082 and 0.043 respectively. No significant trend over time was found for the weights of adult males or females. Changes in weights of adult females exhibited a bell shape with heaviest weight occurring in November-December 1975. The trend was not statistically significant, but has been reported by other researchers (14, 18). Wild juvenile females exhibited a significant linear weight increase (OSL = 0.0015) with a slope of 15.2. Weights of wild juvenile males were even more significantly linear (OSL = 0.0001) but with a much smaller slope (1.2).

The aforementioned dynamics of weight permit two conclusions about this population of quail. The similarity of mean weights to those of other populations reported indicates that it is probably a representative population for this geographic region. The positive linear trends in weight of the juvenile segment of the population implies an adequate if not abundant food supply. This is substantiated by the lack of any significant monthly decrease for any segment of the population.

Food Habits

Forty-one crops (14%) were empty. This was apparently due to collecting birds throughout the day. Eubanks and Dimmick (19), Robel (3), and Robinson (20) reported empty crop percentages of 9, 8, and 15, respectively. The mean volume and weight of contents of crops collected in this study was 3.1 cc and 3.5 g, respectively, for those containing food. The mean number of food items per crop was six. One hundred and eight plant species for 23 families were represented in the diet.

By volume, 49.7% of the food eaten was comprised of three genera: sumac (*Rhus glabra* and *R. copallina*), 19.1%; lespedeza (*Lespedeza striata*, *L. virginica*, and *L. intermedia*), 17.1%; and maize (*Sorghum vulgare*), 13.5% (Table 2). In Kansas, Robel (3) found sumac and maize to be important foods, but lespedeza was a minor item. The next most important foods identified in this study were animal, 4.8%; persimmon (*Diospyros virginica*), 4.7%; Oklahoma plum (*Prunus gracilis*), 4.5%; and ragweed (*Ambrosia artemisiifolia*, *A. bidentata*, and *A. psilostachya*), 4.4%. Included in the animal foods were snails, slugs, grasshoppers, bugs, beetles, flies, ants, and bees. The persimmon consumed was almost totally the pulp of the fruit. Forty species, found in very small amounts, were included in the miscellaneous plant species comprising 5.8% of the diet. Sixteen of the miscellaneous plant species were grass

TABLE 2. Percent volume and percent frequency of food items consumed by 302 bobwhite quail, September 1975 — February 1976, Rogers County, Oklahoma.

Food Item	Percent	
	Volume	Frequency
PLANT FOODS		
Strophostyles (<i>Strophostyles leiosperma</i>)	2.4	30.8
Oklahoma plum (<i>Prunus gracilis</i>)	4.5	7.6
Grape (<i>Vitis aestivalis</i>)	0.7	6.6
Lespedeza (<i>Lespedeza</i> sp.)	17.1	55.3
Horsenettle (<i>Solanum carolinense</i>)	0.2	1.0
Avens (<i>Geum canadense</i>)	0.2	12.3
Sumac (<i>Rhus glabra</i> and <i>R. copallina</i>)	19.1	29.1
Panicum (<i>Panicum</i> spp.)	1.3	10.9
Oak (<i>Quercus</i> spp.)	2.3	3.6
Smartweed (<i>Polygonum punctatum</i> , <i>P. scandens</i>)	0.2	6.6
Sedge (<i>Carex</i> spp.)	1.4	9.9
Persimmon (<i>Diospyros virginica</i>)	4.7	9.3
Paspalum (<i>Paspalum</i> sp.)	0.1	10.3
Woolly croton (<i>Croton capitatus</i>)	0.4	6.3
Ragweed (<i>Ambrosia artemisiifolia</i> , <i>A. bidentata</i> , <i>A. psilostachya</i>)	4.4	21.2
Maize (<i>Sorghum vulgare</i>)	13.5	15.6
Sorghum alnum (<i>Sorghum vulgare</i>)	0.1	0.7
Sedge (<i>Cyperaceae</i>)	1.3	4.3
Black walnut (<i>Juglans nigra</i>)	0.6	1.3
Hawthorn (<i>Crataegus pratense</i>)	1.2	4.0
Scleria (<i>Scleria pauciflora</i>)	T	2.6
Beggartick (<i>Bidens frondosa</i>)	0.8	1.7
Spurge (<i>Euphorbia spathulata</i>)	0.1	1.3
Roughleaf dogwood (<i>Cornus drummondii</i>)	1.2	3.3
Ironweed (<i>Vernonia</i> spp.)	0.2	2.0
Saw greenbrier (<i>Smilax bona-nox</i>)	0.1	1.3
Guara (<i>Guara biennis</i> , <i>G. sinnata</i>)	0.1	1.0
Miscellaneous plant species	5.8	32.5
Green vegetation	2.5	63.9
ANIMAL FOODS		
DEBRIS	8.8	67.9

seeds. Fruits and seeds of forbs and trees comprised 66.9% of the total diet. Maize and sumac were the most highly utilized grass and forb, respectively.

The most frequently eaten grasses were panicum (*Panicum* spp.) (10.9%) and maize (15.6%) (Table 2). Consumption of other grasses was rare. Green vegetation occurred in 63.9% and debris (sticks, stones, and litter) was present in 67.9% of the crops. The green vegetation was primarily leaves of forbs and cool-season grasses. The most frequently eaten plant seed was lespedeza (55.3%). Other forb seeds commonly consumed were strophostyles (*Strophostyles leiosperma*) (30.8%), sumac (29.1%), and ragweed (21.2%).

Lespedeza was consumed more frequently than any other food and provided the second largest volume of food (17.1% and 55.3%, respectively). Sumac provided the greatest volume and occurred in 29.1% of the crops. Maize also provided a large proportion of the food consumed but occurred in relatively few crops (15.6%). Maize was consumed in large quantities, when eaten, because it contributed a large volume but low frequency.

Temporal Trends in Diet

Seasonal consumption of many food items was highly variable (Table 3). Utilization of sumac increased to major importance during December (42.4%, 43.8%) and January (23.7%, 26.1%) by volume and frequency, respectively. Use of lespedeza was variable but judged significant throughout the collection period. Persimmon received substantial use only during November (13.0%, 28.2%). This implies that it was either preferred and consumed early in the fall when it became available or was abundant but not preferred later in the fall and winter. The former statement is most likely since the pulp of the fruit would decay soon after falling, becoming unavailable to quail. Maize was used substantially

TABLE 3. Percent volume, percent frequency, and sample size by month, of the foods commonly ingested by 302 bobwhite, September 1975 — February 1976, Rogers County, Oklahoma.

Food Item	Month											
	Sept (23)		Oct (24)		Nov (71)		Dec (73)		Jan (92)		Feb (19)	
	Vol.	Freq.	Vol.	Freq.	Vol.	Freq.	Vol.	Freq.	Vol.	Freq.	Vol.	Freq.
PLANT FOODS												
Strophostyles	27	44	2	38	2	61	1	15	1	13	T	42
Oklahoma plum	0	0	0	0	3	4	T	1	10	16	15	21
Grape	T	17	T	4	2	11	0	0	T	3	1	21
Lespedeza	6	39	20	54	37	62	12	67	4	41	49	77
Horsenettle	0	0	2	4	T	1	0	0	T	1	0	0
Avens	0	0	T	17	T	7	T	1	T	21	2	42
Sumac	3	9	11	42	7	25	42	44	24	26	2	11
Panicum	3	9	T	21	3	18	T	1	T	8	1	26
Oak	0	0	2	4	3	8	T	1	T	3	0	0
Smartweed	T	4	T	42	T	7	T	1	T	3	T	5
Sedge	T	9	T	13	T	14	T	6	T	5	T	32
Persimmon	0	0	0	0	13	28	2	7	T	2	2	5
Paspalum	1	13	T	17	T	11	T	1	T	12	T	21
Wooly croton	0	0	1	17	T	9	T	1	1	8	T	5
Ragweed	0	0	19	50	9	45	1	26	T	1	0	0
Maize	1	9	2	8	T	3	23	30	29	21	0	0
Sorghum alnum	0	0	0	0	0	0	1	1	T	1	0	0
Sedge	0	0	0	0	1	3	6	15	0	0	0	0
Black walnut	1	4	0	0	1	3	1	1	0	0	0	0
Hawthorn	0	0	0	0	T	3	4	10	1	3	0	0
Scleria	T	4	T	4	T	4	T	1	T	2	0	0
Beggartick	0	0	11	13	T	3	0	0	0	0	0	0
Spurge	3	9	T	4	T	1	0	0	0	0	0	0
Roughleaf dogwood	13	17	0	0	2	8	0	0	0	0	0	0
Ironweed	0	0	T	4	1	6	0	0	T	1	0	0
Saw greenbrier	T	4	1	8	0	0	0	0	T	1	0	0
Guara	0	0	T	4	T	1	T	1	0	0	0	0
Miscellaneous	1	18	T	50	11	56	T	21	12	24	T	26
Green vegetation	2	9	2	63	3	86	1	71	4	58	4	53
ANIMAL FOODS	41	57	4	21	7	37	1	21	1	21	2	53
DEBRIS	T	30	23	58	2	80	6	71	13	69	22	63

only during December and January. Beggartick (*Bidens frondosa*) received substantial use only during October 1975.

Consumption of animal food decreased in volume throughout the fall and winter. The frequency of consumption of green vegetation was high except during September. The frequency of consumption of debris was high throughout the collection period. Use of both spurge (*Euphorbia spathulata*) and strophostyles decreased during the collection period. Consumption of Oklahoma plum increased during the collection period.

DISCUSSION

Because the availability of food supplies was not measured it was impossible to determine which foods were eaten because they were highly preferred by quail and which foods were less preferred, but readily available. Many bobwhite sought and utilized maize provided in the feeders during inclement weather, but were seldom in the immediate vicinity during favorable weather. Sumac was used extensively in areas where it was abundant. Lespedeza was utilized throughout the study.

During December-January, maize and sumac accounted for more than 50% of the food consumed (Figure 1), whereas a maximum of 11.9% of the food consumed was lespedeza. During the preceding and following months, November and February, lespedeza approximated 40% of the diet while maize and sumac accounted for only 5%. This indicates that lespedeza was preferred but maize and sumac were more easily obtained during windy, cold, snowy, and rainy weather. Birds often remained in woody cover during these periods of inclement weather thus making sumac and maize (provided in feeders) more readily available than lespedeza. This implies that the presence of sumac and feeders were important in providing a late winter emergency food source.

Other researchers have reported similar food habits in studies conducted in Kansas and Oklahoma (1, 2, 3, 4, 20, 21, 22). Six of the above researchers reported sumac as a major food item (1, 2, 3, 4, 20, 22). Lespedeza (1, 2, 3, 20, 21, 22) and sorghum (1, 3, 4, 21, 22) were also important foods in some of the studies. Five studies reported substantial use of animal foods (2, 3, 4, 20, 21). Ragweed, which accounted for 4.4% of all foods eaten, was a major food item in all seven food habits studies (1, 2, 3, 4, 20, 21, 22). Strophostyles, which was important in five of the studies (1, 2, 20, 21, 22), accounted for 2.4% of the diet. Persimmon accounted for 4.7% of the diet but was reported in only one of the above studies (22) and in that study was seldom used. Oklahoma plum accounted for 4.5% of the diet but had no use reported by any of the above studies. The seed, not including pulp, of Oklahoma plum was consumed.

Several woody species provided substantial quantities of foods during late fall and winter. These include: Oklahoma plum, persimmon, hawthorn (*Crataegus pratense*), and sumac. Protection, by fencing, and culturing of these species may significantly benefit bobwhite during periods of mid-winter stress and the late winter scarcity of food.

Many researchers have discussed the use of supplemental feeding of bobwhite with feeders. Most agree that if supplemental feeding is used it should be as an emergency food source. In this study bobwhite did not utilize feeders appreciably except during December and January. Therefore, if

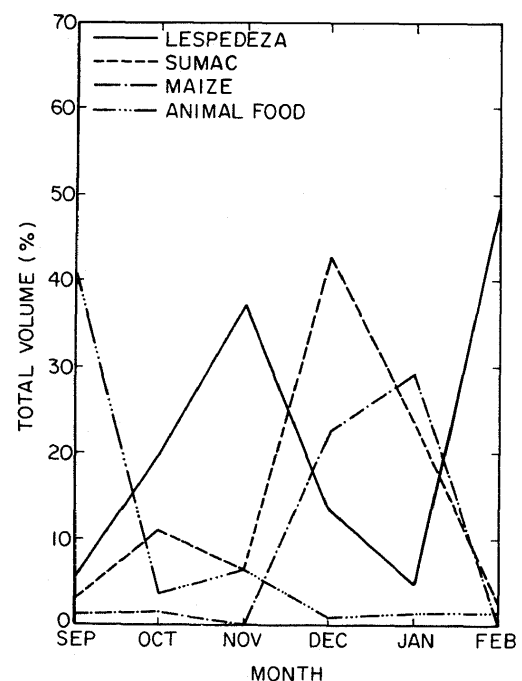


FIGURE 1. Relative volumetric proportions of the principal foods ingested monthly by 302 bobwhite collected in Rogers County, Oklahoma, September 1975 through February 1976.

supplemental feeding is used it should be initiated during November rather than August to reduce expenses in the form of manpower, machinery, and cost of grain.

Derdeyn (23) has shown that early spring burning and fertilization of rangeland vegetation can increase the production of insects and forbs used by bobwhite. He does state, however, that Scribner's panicum (*Panicum oligosanthos*) and strophostyles were the only species significantly increased by his treatments. Derdeyn's study area, although similar to the area used in this study, was not subjected to grazing by cattle. Therefore, I cannot state with certainty that the use of early spring burning and fertilization may be an effective management technique to increase quail foods on rangeland being grazed.

ACKNOWLEDGMENTS

The study was sponsored by the Oklahoma Cooperative Wildlife Research Unit. The Max McGraw Wildlife Foundation and the Oklahoma State University Environmental Institute provided financial support for this study. J. A. Morrison, former leader, Oklahoma Cooperative Wildlife Research Unit, prepared the initial research proposal and negotiated the contract for the study. J. C. Lewis was the major advisor and provided editorial assistance. W. W. Ingersoll helped extensively in the collection of quail.

REFERENCES

1. F. M. BAUMGARTNER, M. J. MORRIS, J. L. STEELE, and J. E. WILLIAMS, Trans. N. Am. Wildl. Conf. 17: 338-358 (1952).
2. L. G. BIRD and R. D. BIRD, Wilson Bull. 43: 293-305 (1931).
3. R. J. ROBEL, Trans. Kansas Acad. Sci. 66: 778-789 (1963).
4. R. J. ROBEL, J. Wildl. Manage. 33: 237-249 (1969).
5. F. GRAY and H. M. GALLOWAY, *Soils Of Oklahoma*, Okla. Agr. Exp. Sta. Misc. Pub. 56, 1959.
6. D. J. POLONE, *Soil survey of Rogers County, Oklahoma*, U. S. Dept. of Agr., 1961.
7. W. ROSENE, *The bobwhite quail: its life and management*, Rutgers Univ. Press, New Brunswick, N. J., 1969.
8. J. W. CARPENTER, J. Wildl. Manage. 35: 327-331 (1971).
9. R. J. DELORIT, *An illustrated taxonomy manual of weed seeds*, Agronom Pub., River Falls, Wisconsin, 1970, pp. 175.
10. A. C. MARTIN and W. D. BARKLEY, *Seed identification manual*, Univ. Calif. Press, Los Angeles, 1961.
11. U. T. WATERFALL, *Keys to the flora of Oklahoma*, Okla. State Univ., Dept. of Botany and Research Foundation, Stillwater, 1969.
12. R. A. DARROW, L. C. ERICKSON, J. T. HOSTUM, JR., J. F. MILLER, W. T. SCUDDER, and J. L. WILLIAMS, JR. Subcommittee on standardization of common and botanical names of weeds, Weeds 14: 347-386 (1966).
13. A. M. LAESSLE and O. E. FRYE, J. Wildl. Manage. 20: 125-131 (1956).
14. R. J. ROBEL and S. A. LINDERMAN, Trans. Kansas Acad. Sci. 69: 132-138 (1966).
15. I. O. BUSS, H. MATTISON, and F. M. KOZLIK, Wisconsin Cons. Bull. 12: 6-13 (1947).
16. A. S. LEOPOLD, J. Wildl. Manage. 9: 30-34 (1945).
17. H. L. STODDARD, *The bobwhite quail: its habits, preservation and increase*, Charles Scribner's Sons, New York, 1950.
18. J. L. ROSEBERRY and W. D. KLIMSTRA, Auk 88: 116-123 (1971).
19. T. R. EUBANKS and R. W. KIMMICK, *Dietary patterns of bobwhite quail on Ames Plantation: implications for management*, Agr. Exp. Sta. Bull. 534, Univ. Tennessee, Knoxville, 1974.
20. T. S. ROBINSON, *The ecology of bobwhites in south-central Kansas*, Univ. Kansas, Misc. Pub. 15, 1957.
21. L. J. KORSCHGEN, J. Wildl. Manage. 12: 46-57 (1948).
22. M. J. MORRIS, *An evaluation of plants suitable for bobwhite habitat management in central Oklahoma*, Ph.D. Dissertation, Oklahoma State Univ., Stillwater, 1957.
23. C. H. DERDEYN, *Manipulating central Oklahoma rangeland vegetation for bobwhite quail*, M.S. Thesis, Oklahoma State Univ., Stillwater, 1975.