HABITAT USE, FOOD HABITS, AND RESPONSE TO BIRD DOG FIELD TRIALS OF BOBWHITE ON NORTHEASTERN OKLAHOMA TALLGRASS PRAIRIE RANGELAND

By

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PREFACE

The purpose of this study is to reveal the manner in which bobwhite populations use habitat in tall grass prairie rangeland. Radiolocation telemetry was used to monitor movements of bobwhite coveys and to observe their utilization of habitat. Home range size, utilization of habitat and habitat preferrences were determined during fall, winter, and spring. Temporal trends in food habits and dynamics of weight of bobwhite were determined through the fall and winter. The behavioral response of coveys to bird dog field trials is also discussed.

It was anticipated that information would be obtained to measure seasonal age and sex ratios, and rates and sources of mortality. However, only a limited amount of data on these parameters was obtained while accomplishing the primary objectives of the study. Further graduate studies are planned by the Oklahoma Cooperative Wildlife Research Unit to provide additional information regarding these parameters and the responses of coveys to several land management activities.

Financial support was provided by Max McGraw Wildlife Foundation, Dundee, Illinois, and the Environmental Institute at Oklahoma State University. Housing, equipment, and horses were provided by the McFarlin-Ingersoll Ranch during the field studies.

I wish to express sincere appreciation to my major adviser, Dr. James C. Lewis, Assistant Leader, Oklahoma Cooperative Wildlife

Research Unit, for his guidance during the study and assistance in preparing this thesis. I wish to thank Dr. Jack Barclay, Associate Professor, Zoology; Dr. Jerry Crockett, Professor, Botany; and Dr. Jeff Powell, Associate Professor, Agronomy for their suggestions and assistance during the study and for serving as members of my graduate committee. Dr. William Warde, Assistant Professor, Statistics, and Dr. Ronald McNew, Associate Professor, Statistics, assisted in the statistical analyses of data. Dr. John A. Morrison, former leader, Oklahoma Cooperative Wildlife Research Unit, prepared the initial research proposal and negotiated the contract for the study.

Appreciation is extended to Winthrop W. Ingersoll, Owner-Manager, McFarlin-Ingersoll Ranch; Howard R. Jarrell, Associate Director, Environmental Institute, Oklahoma State University; George Wint, Director, Oklahoma Department of Wildlife Conservation; and Dorian E. Hawthorne, President, Oklahoma Open Shooting Dog Association, for their cooperation and assistance throughout the study.

Finally, I wish to thank my wife, Glenda, for her moral support, long hours afield, and help in preparing this manuscript.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

This thesis is comprised of three manuscripts written in formats which will facilitate immediate submission to state or national scientific journals for publication. These manuscripts are presented as chapters in the thesis and each is complete in itself without additional supporting materials. The manuscript entitled "Food habits and weights of bobwhite in northeastern Oklahoma tallgrass prairie" (Chapter II) was written in the style of the PROCEEDINGS OF THE OKLAHOMA ACADEMY OF SCIENCE. The manuscript entitled "Habitat utilization by bobwhite on northeastern Oklahoma rangeland" (Chapter III) is the principal paper of the thesis and was written to specifications of THE JOURNAL OF WILDLIFE MANAGEMENT. The manuscript entitled "Spatial responses of bobwhite to disturbance by bird dog field trials" is written to match the specifications of the WILDLIFE SOCIETY BULLETIN.

Information obtained during the study which was not suitable for immediate publication. These data include censuses helpful during this and later studies, and data of insufficient quantity to publish. All of the appendices complement other information provided in the manuscript.

Approval for presenting the thesis in this manner is based upon the Graduate College's policy of accepting a thesis written in manuscript form and is subject to the Graduate College's approval of the

major professor's request for a waiver of the standard format in a letter dated 9 February 1977.

CHAPTER II

FOOD HABITS AND WEIGHTS OF BOBWHITE IN NORTHEASTERN OKLAHOMA TALLGRASS 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.), sumac (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 through the collection period. No trend in weight was detected for adults.

INTRODUCTION

Populations of bobwhite (Colinus virginianus) in Oklahoma have benefited from agricultural practices in the past. Recently, however, the bobwhite has been systematically excluded by the reduction in available habitat as the economics of farming demanded more intensive use of 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 conducted, but grazing by cattle was not 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. The objectives of this study are to determine base-line information on the food habits and dynamics of weight of bobwhite on northeastern Oklahoma tallgrass prairie rangeland. Futher graduate studies are planned which will reveal management techniques applicable to bobwhite populations on rangeland.

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 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 introduced 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. Mean monthly temperatures and precipitation during the winter of the study and the previous growing season varied little from the normal for those months.

Bobwhite and their habitat 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 almum. 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 W. W. 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 189 g (Table 1). The mean weight of wild adults (194 g) was significantly ($P < 0.01$) heavier than wild juvenile birds (185 g). 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. The mean weight of pen-reared birds was 10 g more than the wild juvenile birds. 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 adult males and wild juvenile females averaged 3.9 g lighter than wild juvenile males (Table 1). These differences were significant at the 10% level. The lack of a significant weight difference between the sexes has also been

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

	Monthly Collection Period						
	September	October	November	December	January	February	Total
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.

reported by several researchers (14,15,16,17).

The mean weight of wild birds increased significantly during November 1975 ($P < 0.05$) and January 1976 ($P < 0.05$). The increase during both months was due primarily to the significant weight gains of juveniles (Table 1). Adults exhibited no significant monthly weight gains.

Regression analyses 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 (Figure 1). 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 g/month. 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 infer 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 infers an adequate if not abundant food supply. This is further substantiated by the lack of any significant monthly decrease for any segment of the population.

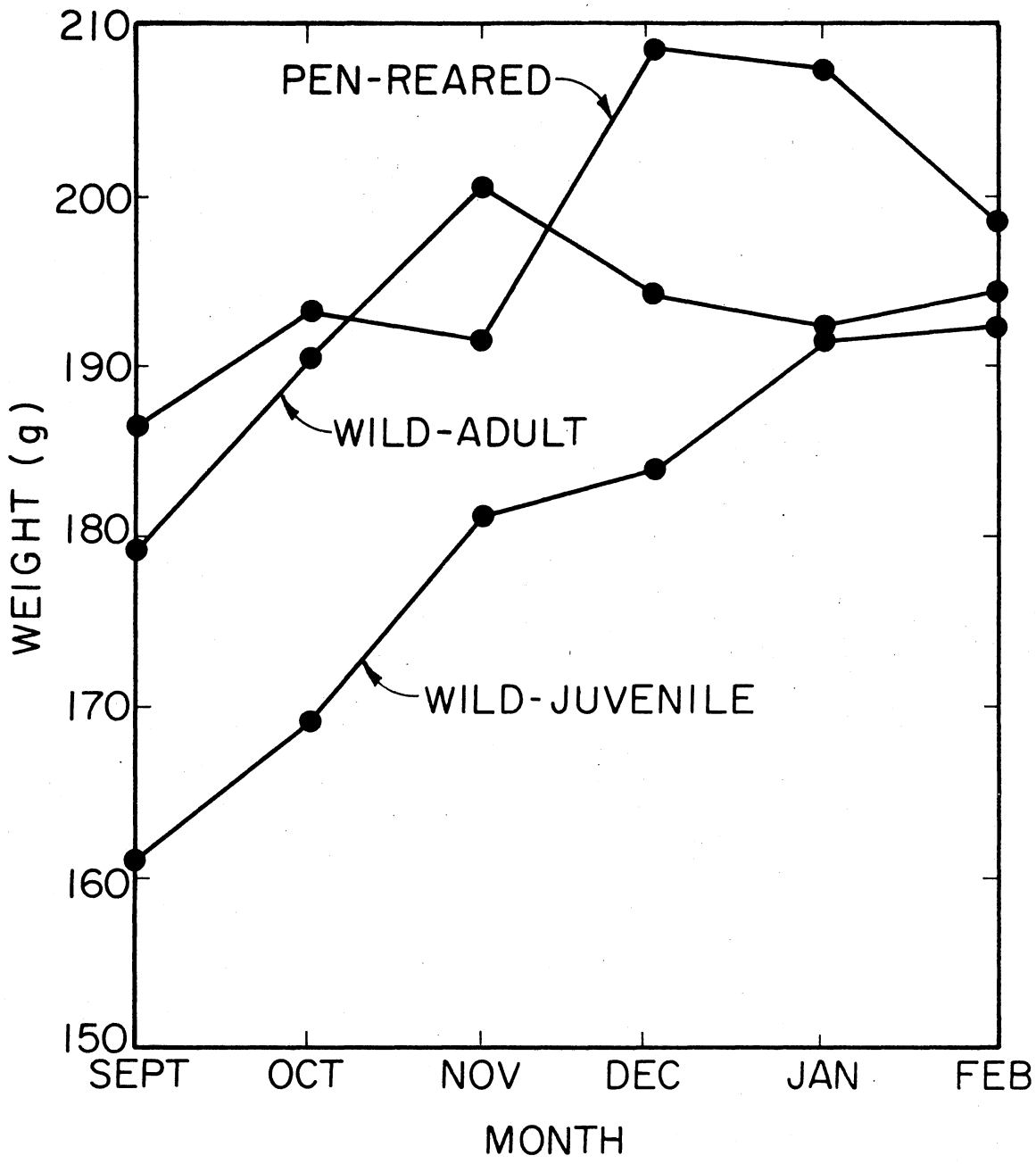

Fig. 1. Mean monthly weights of pen-reared, wild-adult, and wild-juvenile bobwhite collected September 1975 through February 1976 on the M-I Ranch, Rogers County, Oklahoma.

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 plants in three genera: sumac (Rhus spp.), 19.1%; lespedeza (Lespedeza spp.), 17.1%; and maize (Sorghum sp.), 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 virginana), 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 seeds. Fruits and seeds of forbs and trees comprised 66.9% of their total diet.

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

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

Food item	Percent	
	Volume	Frequency
PLANT FOODS		
Strophostyles (Strophostyles leiosperma)	2.4	30.8
Oklahoma plum (Prunus gracilis)	4.5	7.6
Grape (Vitis aestivalis)	0.7	6.6
Lespedeza (Lespedeza sp.)	17.1	55.3
Horsenettle (Solanum carolinense)	0.2	1.0
Avens (Geum canadense)	0.2	12.3
Sumac (Rhus glabra and R. copallina)	19.1	29.1
Panicum (Panicum spp.)	1.3	10.9
Oak (Quercus spp.)	2.3	3.6
Smartweed (Polygonum punctatum, P. scandens)	0.2	6.6
Sedge (Carex spp.)	1.4	9.9
Persimmon (Diospyros virginiana)	4.7	9.3
Paspalum (Paspalum sp.)	0.1	10.3
Wooly croton (Croton capitatis)	0.4	6.3
Ragweed (Ambrosia artemisiifolia, A. bidentata, A. psilostachya)	4.4	21.2
Maize (Sorghum vulgare)	13.5	15.6
Sorghum almum (Sorghum vulgare)	0.1	0.7
Sedge (Cyperaceae)	1.3	4.3
Black walnut (Juglans nigra)	0.6	1.3
Hawthorn (Crataegus pratense)	1.2	4.0
Scleria (Scleria pauciflora)	T	2.6
Beggartick (Bidens frondosa)	0.8	1.7
Spurge (Euphorbia spathulata)	0.1	1.3
Roughleaf dogwood (Cornus drummondii)	1.2	3.3
Ironweed (Vernonia spp.)	0.2	2.0
Saw greenbrier (Smilax bona-nox)	0.1	1.3
Guara (Guara biennis, G. sinnata)	0.1	1.0
Miscellaneous plant species	5.8	32.5
Green vegetation	2.5	63.9
ANIMAL FOODS	4.8	29.1
DEBRIS	8.8	67.9

was primarily leaves of forbs and cool season grasses. The most frequently eaten plant seed was lespedeza (55.3%). Other forb and woody plant seeds commonly consumed were strophostyles (Strophostyles leiosperma) (30.8%), sumac (29.1%), and ragweed (21.2%).

Lespedeza was consumed more frequently (17%) than any other food and provided the second largest volume (55%) of food. 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 because the pulp of the fruit would decay soon after falling, becoming unavailable to quail. Maize was used substantially 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

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.

	Month											
	Sept (23)		Oct (24)		Nov (71)		Dec (73)		Jan (92)		Feb (19)	
Food Item	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	?	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 almum	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

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 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 2), 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 a preference for lespedeza and that maize and sumac were more easily obtained during windy, cold, snow, 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).

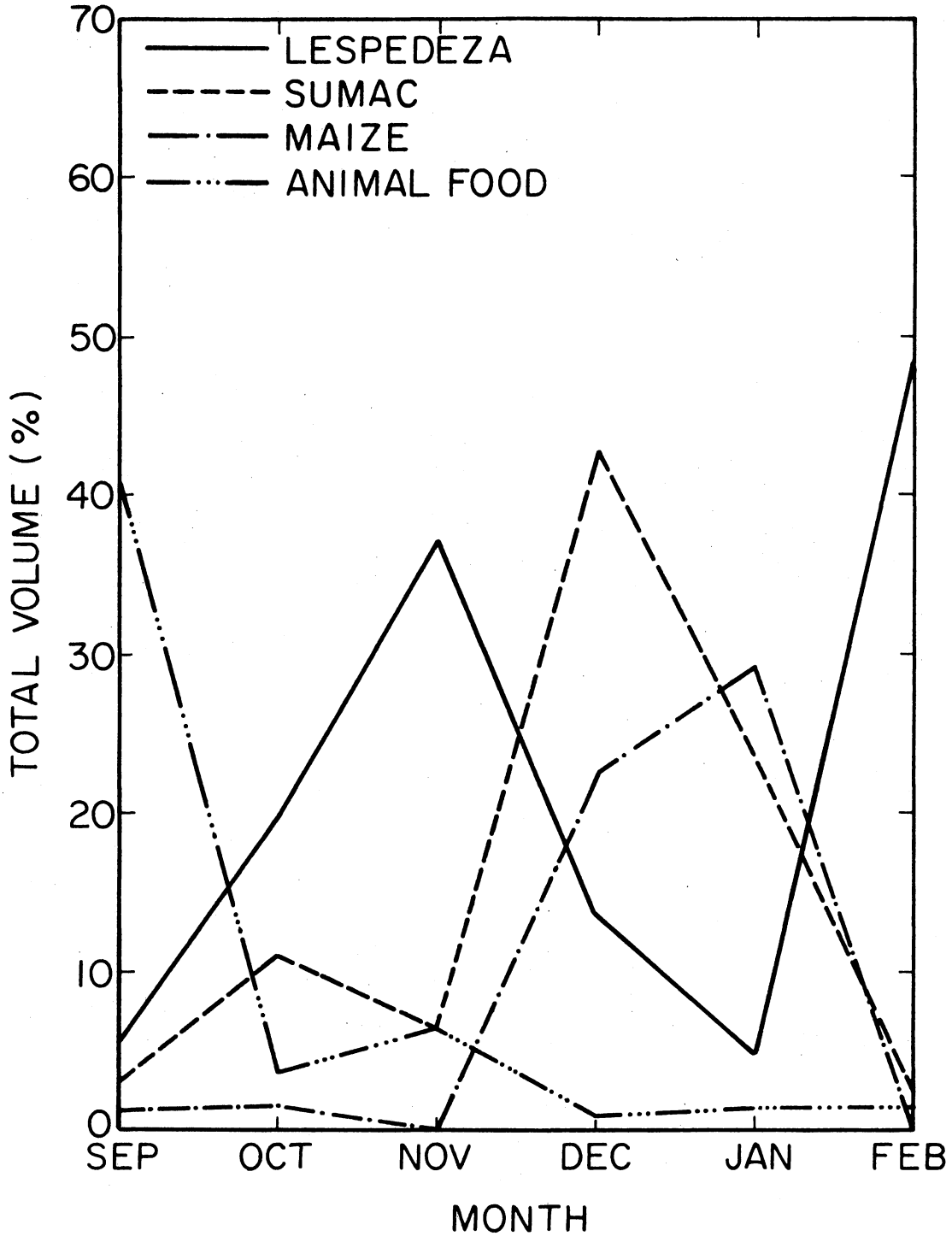

Fig. 2. Relative volumetric proportions of the principal foods ingested monthly by 302 bobwhite collected in Rogers County, Oklahoma, September 1975 through February 1976.

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 persimmon was seldom used. Oklahoma plum accounted for 4.5% of the diet but had no reported use 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 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. The use of food plots as a habitat management technique to increase food and cover for bobwhite is widely used. However, analysis of food habits of bobwhite on the M-I Ranch show their use of food plots to be very small. This lack of use relative to the abundant use of maize in feeders indicates the

food plots are of little food value in this circumstance.

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 oligosanthes) 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.

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REFERENCES

1. F. M. Baumgartner, M. J. Morris, J. L. Steele, and J. E. Williams. Trans. N. Amer. 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, Agronomu Pub., River Falls, Wisconsin, 175pp., 1970.
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, MS Thesis, Oklahoma State Univ., Stillwater, 1975.

CHAPTER III

HABITAT UTILIZATION BY BOBWHITE ON NORTHEASTERN OKLAHOMA RANGELAND

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Abstract: Habitat utilization and home range size of coveys were determined using radio-location telemetry. Average home range size was 4.4 ha and did not vary significantly ($P < 0.05$) between fall, winter, and spring. However, the location of the home range and habitat within it did vary considerably between seasons. All coveys studied showed significant preferences ($P < 0.05$) for specific cover types. Cover type preferences were the same in areas with either high or low density populations of bobwhites. Both tall and short shrub habitats were preferred by coveys during fall, winter, and spring. Woodland was used in proportion to its availability. Grassland was used less during fall, winter and spring than its availability would indicate. Fifty percent of the covey roost sites were located in grassland. Mean height of vegetation at roost sites was 68.5 cm and mean density was 168 stems per square meter. Vegetation analysis at six nest sites showed little bluestem to be the most prevalent plant species. Mean vegetation height and density of nest sites was 78.7 cm and 733 stems per square meter.

Habitat utilization and movements of bobwhite (Colinus virginianus) have received much attention throughout their occupied range. Earlier researchers, such as Lewis (1954), Robinson (1957), Stoddard (1931), relied on observations and trapping of quail to measure the habitat being used. These observations revealed the most often frequented areas. However, more detailed and accurate measurements of covey movements and habitat use have been possible since the development of lightweight radio-location transmitters.

The proportion of the available cover types used is a reflection of a covey's habitat requirements in a given geographic region. A major factor influencing the distribution and carrying capacity of bobwhite quail on tallgrass prairie rangeland is the presence of woody vegetation. The chief missing item in otherwise good quail range in Nebraska was suitable woody field borders (Damon 1946). Baker (1940) reported woody growth along gullies was the most favorable winter cover for bobwhite in Iowa. The most often used woody cover in south-central Kansas is termed the covey "headquarters" (Robinson 1957:53).

The present study was conducted to determine size of home ranges and use of habitat by bobwhite in tallgrass prairie rangeland in northeastern Oklahoma. Covey ranges were determined during September-October, December-January, and March-April to analyze the extent to which quail use the various cover types during different seasons.

The life-form approach has been used in this study as a tool for identifying and evaluating the habitat used by bobwhite. Pitelka (1941) found that association of birds with vegetation revealed no relationship to specific plant dominants or groups of dominants of a single biome, but that consistent associations did occur between species and

life forms of plants. The life-form approach seems specific enough to show differences in habitat (Jones 1960, Schemnitz 1961), yet is not as time consuming nor as potentially misleading as detailed analyses. To further complement the information found in this study, another project is being conducted to provide a detailed analysis of the vegetation occurring within the intensive study areas used in this project.

The Oklahoma Cooperative Wildlife Research Unit (OCWRU) administered the graduate studies of which this paper is a part. Financial support was provided by the Max McGraw Wildlife Foundation, Dundee, Illinois, Oklahoma State University Environmental Institute, Stillwater, Oklahoma, and the Oklahoma Department of Wildlife Conservation. The McFarlin-Ingersoll (M-I) Ranch also provided support in the form of housing and equipment. John A. Morrison, professor and former leader, Oklahoma Cooperative Wildlife Research Unit, prepared the initial research proposal and negotiated the contract.

STUDY AREA

The study area is the M-I Ranch located 32 km east of Tulsa, Oklahoma (Fig. 1). The major portion of the 4,696 ha ranch is located in T20N, R17E, in the eastern Cherokee prairie on the Parsons-Dennis-Bates soil association (Gray and Galloway 1959). The physiography is level to gently sloping plains broken by east facing escarpments and low, butte-like knolls. Approximately 85 percent of the ranch is native grassland interspersed with wooded draws. The remainder of the ranch includes introduced pasture and cropland. The mean annual temperature and precipitation are 15.8 C and 67.6 cm, respectively (Polone 1961). Winters are moderate and sunny with cold periods

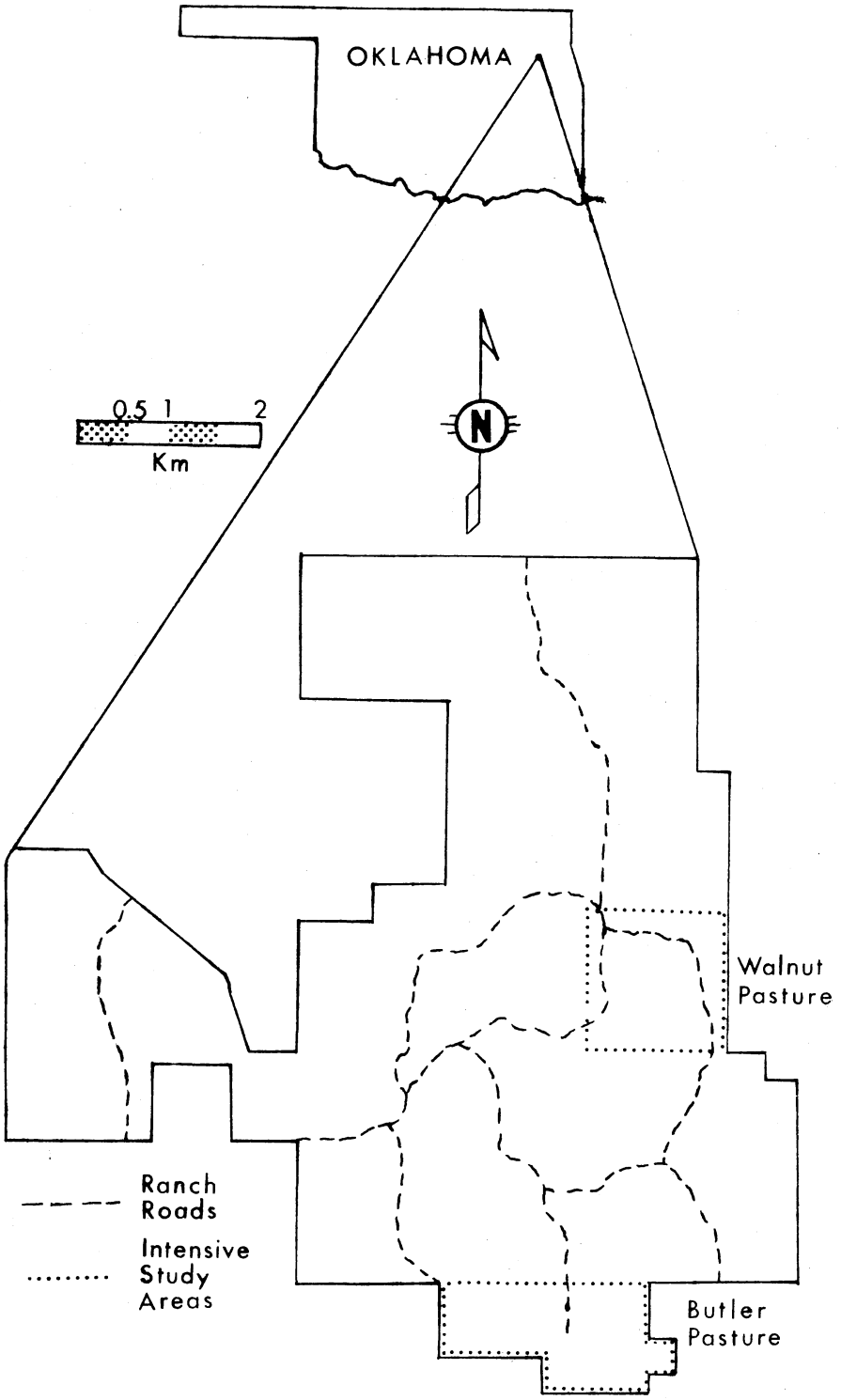

Fig. 1. Location of the McFarlin-Ingersoll Ranch and the intensive study areas in Rogers County, Oklahoma.

usually lasting only a few days. The seasonal precipitation pattern is of a spring-fall nature. The average freeze free growing season is 215 days. Weather conditions during the study were moderate with only small deviations from the mean monthly temperature and precipitation patterns for Rogers County.

Present habitat management for quail consists of 32 food plots planted to Sorghum almum. Most food plots are placed as near woody cover as possible. They measure approximately 15 m by 60 m and usually contain a feeder. There are approximately 60 feeders on the ranch in which maize or corn seed is available from September through February to supplement the quails' diet of naturally occurring foods.

The most significant member of the ranch's fauna is cattle. The ranch is used primarily as a cow-calf cattle operation with a stocking rate of approximately 1 cow (1 animal unit) per 2.8 ha. The grazing system is year-round grazing of all grazing units.

Two areas of approximately 250 ha each were selected for the intensive study of home range and habitat use. The first area, commonly termed the Walnut Pasture, is characterized by extensive grassland with a single major drainage which supports most of the area's woody vegetation. The second area, referred to as Butler Pasture, contains several small drainages and one major drainage. Butler Pasture contains much woody vegetation along its drainages which extend into the surrounding grassland. Butler Pasture was chosen as one of the intensive study areas because, based on censuses using bird dogs, trapping, and general observations (Appendix A), it supported a higher quail population density than the Walnut Pasture.

METHODS AND MATERIALS

Quail were live trapped at the beginning of each of the three telemetry periods (September-October, December-January, and March-April) to obtain birds for instrumentation. Each telemetry period lasted approximately 60 days. Trapping occurred where coveys existed or at locations that appeared likely to support a covey. The traps were the Stoddard collapsible style with swing wire entrances (Reeves et al. 1968). Burlap was stretched below the top of traps to prevent injury to the birds. Traps were checked at least twice daily, at midmorning, and again at dusk to insure that no birds would be left in traps overnight.

The age and sex of captured quail were determined and leg bands were placed on the birds. The heaviest bird captured in each covey was fitted with a radio-location transmitter to insure that the instur-mented bird would be able to fly well and perambulate with the covey. Each instrumented bird was released at the trapsite with the other captured birds. Attempts were made to recapture the covey for re-instrumentation whenever a transmitter failed to function properly for the desired length of time.

The radio telemetry equipment used in this study consisted of a model LA-12 portable batter-operated receiver manufactured by AVM Instrument Company, Champaign, Illinois,[1] a hand-held yagi antenna, and radio-location transmitters, manufactured by Wildlife Materials Incorporated, Carbondale, Illinois, equipped with harnessing designed for birds.

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[1]Mention of the manufacturer of a product does not constitute endorsement of their product by the Oklahoma Cooperative Wildlife Research Unit.

Transmitter frequencies were between 164.425 and 164.725 mHz. The transmitter assembly, including the 22 cm whip antenna, averaged 9 g as installed. Signal intensity of transmitters provided reception ranges of about 100 m to 500 m depending upon terrain and quality of individual transmitters. Transmitter battery life was approximately 30 days.

Instrumented coveys were located daily, and on at least one day each week they were triangulated at two hour intervals diurnally. Each instrumented bird was approached to within approximately 40 m and then circled to obtain a positive location of the covey. Coveys were only flushed when circumstances indicated that the birds might be dead or had lost the transmitters.

Covey locations were recorded on field data forms with an accompanying hand-drawn map. In addition to the location of the covey, a description of the vegetation was also recorded. Other information recorded was time of triangulation, weather conditions, presence of cattle, and activity of quail.

Vegetation maps were made of both the Walnut and Butler areas to a scale of 57 cm per kilometer to aid in analyzing the data. Aerial photographs and topographic maps were used to determine the physical features of the land and the woodland vegetation. The areas of shrub, grassland, and large seeded forb cover types were determined in the field using measurements of their dimensions and distance from recorded physical features.

Locations of coveys were transferred to overlays of the vegetation maps. All calculations of home range and habitat use were made using these maps. Maps of home ranges were constructed for each telemetry

period using the minimum home range technique as modified by Marchinton and Jeter (1966). Reduced examples of these vegetation and home range maps are presented for covey number four (Fig. 2) and covey number five (Fig. 3).

To facilitate analysis, each plant species was grouped into one of the following cover types: tall shrubs [i.e., persimmon (Diospyros virginiana), plum (Prunus spp.), dogwood (Cornus drummondii), sumac (Rhus glabra and R. copallina)], short shrubs [i.e., buckbrush (Symphoricarpos orbiculatus) and blackberry briers (Rubus sp.)], woodland [i.e., post oak (Quercus stellata), black jack oak (Quercus marilandica), hawthorn (Crataegus pratense), hickory (Carya spp.)], large seeded forbs [i.e., ragweed (Ambrosia spp.), lespedeza (Lespedeza spp.), ironweed (Vernonia spp.)], and grassland [i.e., big bluestem (Andropogon gerardii), little bluestem (Schizachyrium scoparium), indian grass (Sorghastrum nutans), switch grass (Panicum virgatum), and broomsedge (Andropogon virginicus)]. The criteria used in distinguishing large seeded forb cover from grassland was the sparseness or lack of the major warm season grasses and a greater abundance of large seeded forb plants than was generally observed in grassland.

A compensating polar planimeter was used to calculate home range sizes and the amount of each cover type within each home range. The proportion of a home range comprised by each cover type was then calculated.

The vegetation at covey roost sites located during the three telemetry periods was described, and analyzed using the point centered quarter method of vegetation sampling described by Dix (1961). Both dead and live shoots were recorded because sampling was conducted during

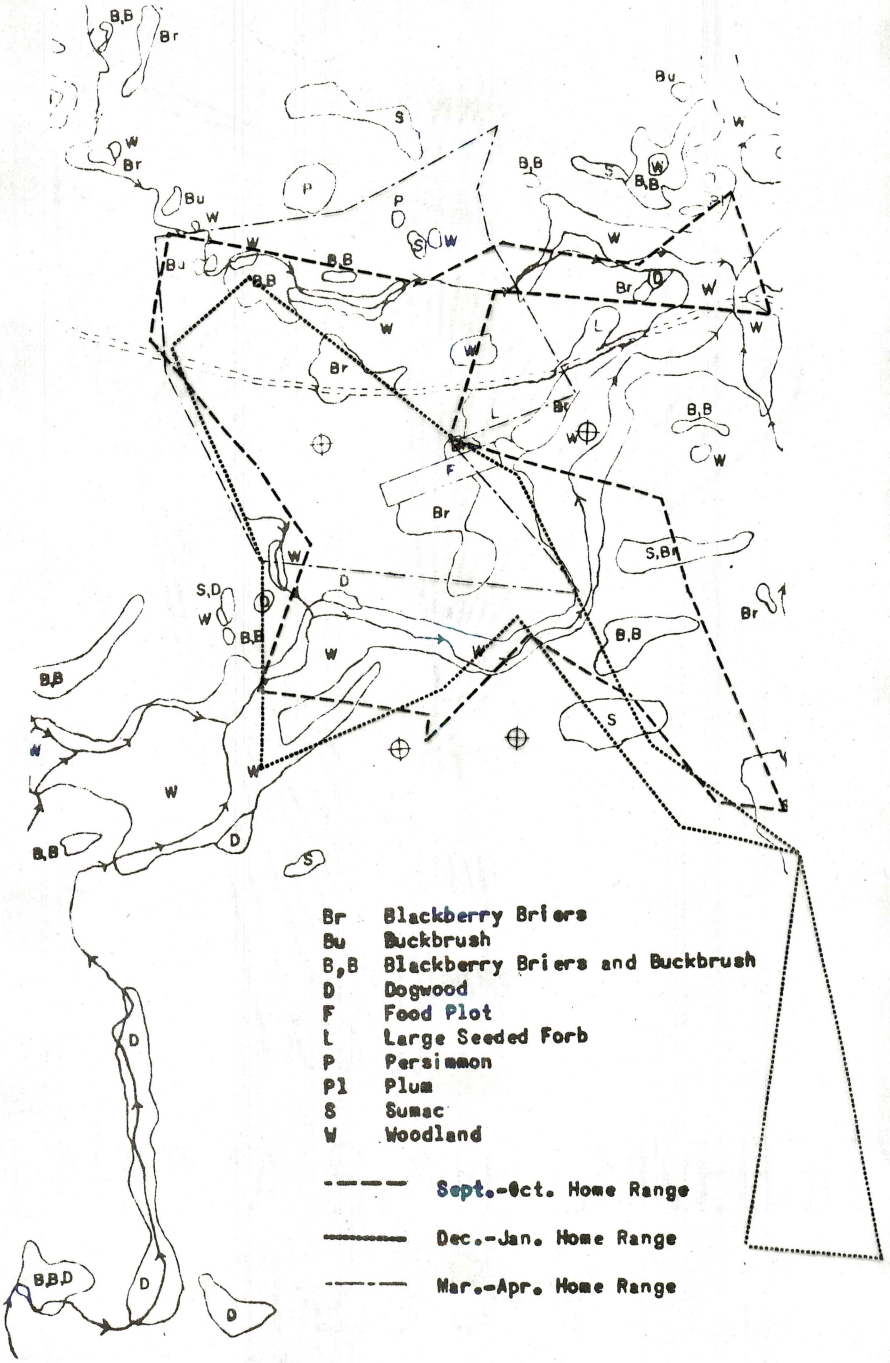
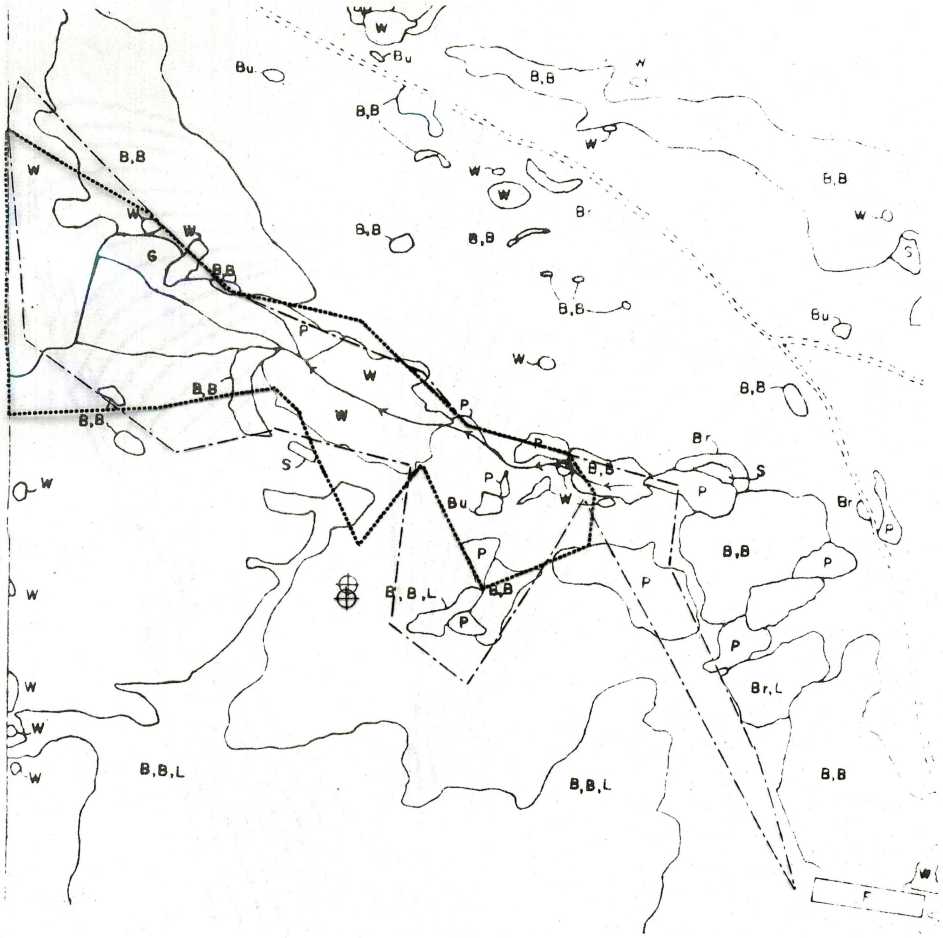


Fig. 2. Vegetation cover types and home ranges of covey number four in the Walnut Pasture during September-October, December-January, and March-April, 1975-1976, Rogers County, Oklahoma.



Br Blackberry Briers
Bu Buckbrush
B,B Blackberry Briers and Buckbrush
D Dogwood
F Food Plot
L Large Seeded Forb
P Persimmon
Pl Plum
S Sumac
W Woodland

..... Dec.-Jan. Home Range

——— Mar.-Apr. Home Range

Fig. 3. Vegetation cover types and home ranges of covey number five in the Butler Pasture during December-January and March-April, 1975-1976, Rogers County, Oklahoma.

the fall, winter and spring. Vegetation height and density were also measured. The majority of the roost sites were found by triangulating roosting coveys, although some were discovered by chance.

Searches were made for quail nests during the spring and summer of 1975 and 1976. The initial searching method was that used by Klimstra and Roseberry (1975), where an entire area is searched on foot. Other methods used were searching areas where male bobwhite were heard whistling, searching with a close-working pointer bird dog, dragging a rope with tin cans attached between two horses, and radio-location of hem bobwhite during the breeding season. Vegetation at the nest sites was sampled using a circular plot. Information gathered was vegetation species, height, and density. The plot dimension was 1 m^2 with the nest at the center.

RESULTS AND DISCUSSION

Thirty-nine telemetered quail provided data on eight coveys during the three telemetry periods: September-October 1975, December 1975-January 1976, and March-April 1976. All eight of the coveys were not instrumented during all three telemetry periods.

Sixteen home ranges were defined. The transmitter weight averaged five percent of the body weight of each telemetered bird. Even though Brander and Cochran (1971) recommend a transmitter weight of only four percent of the bird's weight, very few birds demonstrated any difficulty in flying with the transmitter after their initial flight.

The goal of 60 consecutive days of data on each covey was not achieved due to problems, which included premature transmitter failure and loss of transmitters by severing of the harness when the bird

became entangled in briers. The length of time during which data were collected on the 16 home ranges varied from 20 to 55 days (Appendix B) and the number of triangulations made on each covey ranged from 45 to 155. Eight home ranges were determined in both the Butler and the Walnut areas.

The mean home range size for the Butler and Walnut areas (3.6 ha and 5.1 ha respectively) was inversely proportional to the bobwhite density of the two areas (Table 1). The observed significance level of the difference in home range size between the two areas was between $P < 0.1$ and $P < 0.05$. The principal reason for the low level of significant statistical difference in the mean home range size between the two areas is the large variation in size of the individual home ranges. Home range size did not change significantly ($P < 0.05$) between any of the three telemetry periods.

The average home range size during this study (4.4 ha) was considerably smaller than home ranges reported elsewhere. The probable reasons for this are the size and shape of the woodland areas and the technique used for home range calculation. All coveys found on the study areas were closely associated with woodland cover along the intermittent streams. This restricted area of habitat may have caused coveys to venture less into the surrounding habitat than would have occurred if extensive areas of woodland were present. Also contributing to the small home range size was the use of the modified-minimum-area method of home range calculation which allows for the exclusion of habitat that is known to not have been used.

In western Tennessee, Yoho and Dimmick (1972), utilizing radio-location telemetry, found the average home range to be 6.8 ha.

Table 1. Summary and standard error of home range data of bobwhite coveys in Butler and Walnut Pastures during three radio-telemetry periods, September-October, December-January, March-April, 1975-1976, Rogers County, Oklahoma.

Telemetry period	Number of quail instrumented in covey	Number of days monitored	Number of triangulations	Home range size (ha)
Sept.-Oct.				
Seasonal total	11	150	337	18.34
Seasonal average	2.8	38±5.1	84±15.7	4.59±2.8
Dec.-Jan.				
Seasonal total	16	311	499	32.50
Seasonal average	2.3	44±2.1	71±4.2	4.64±1.3
Mar.-Apr.				
Seasonal total	13	210	494	16.68
Seasonal average	2.6	42±6.4	99±18.3	3.72±0.9
All Seasons				
Total average	2.5	42±2.5	83±7.2	4.42±0.6
Butler average	2.6	43±4.2	89±11.8	3.61±1.0
Walnut average	2.4	41±2.7	77±8.7	5.10±0.7

Bartholomew (1967), also using radio telemetry, calculated the average home range of 9.3 ha for 10 coveys during winter in southwestern Texas. Earlier studies in Texas (Lehmann 1946a), Missouri (Murphy and Baskett 1952, Lewis 1954), and Alabama and South Carolina (Rosene 1969), indicate larger home ranges, but this may be partially accounted for by the increased disturbance of frequent trapping and flushing to obtain home range data.

Habitat Utilization

To determine the relative importance of cover types the proportion of each type within each covey's home range was compared to the number of times each was used, as determined by radio location. Chi-square comparison of relative use of all cover types indicated highly significant ($P < 0.005$) non-random use by every covey (Appendix B). Yoho and Dimmick (1972) also found non-random use of habitat by four of the five coveys studied in southwestern Tennessee.

All 16 coveys utilized the tall shrub cover type in greater proportion than it was available within each covey's home range (Appendix C). The smallest ratio of tall shrub use was by covey 8B. Tall shrub cover type accounted for 5.2 percent of the home range of dovey 8B while 9.6 percent of the covey locations were in tall shrub cover.

Short shrub cover was also used by all coveys but to a lesser extent than tall shrub cover. Only one covey (1A) selected against the short shrub cover during the fall. However, this same covey used the short shrub areas in about the same proportion to short shrub's percentage of the home range during the last two telemetry periods. Covey 1A was the only covey with a home range containing more short shrub

cover than grassland, therefore increasing the relative availability of this cover type.

Neither the woodland nor large seeded forb cover types were clearly selected for or against (Table 2). However, chi-square analysis did indicate significant ($P < 0.05$, $X^2 = 543.6807$) variation in covey selection for large seeded forb cover.

Grassland was used less than would occur if use were totally random by all 16 coveys (Appendix C). Since grassland composed 48.3 percent of the total area occupied by the 16 coveys it might seem the method of home range determination caused an inaccurately large proportion of this cover type to be included in the covey home ranges. However, the minimum-home-range modification (Marchinton and Jeter 1966) of the modified-minimum-area method (Harvey and Barbour 1965) in effect reduced the amount of grassland included in more home ranges than would occur if either the maximum home range method or the modified-minimum-area method were used.

Summer whistle count censusing and fall censusing using bird dogs indicated the Butler area contained a substantially higher bobwhite population density than did the Walnut area (Appendix D and A). The whistle count censusing indicated 16.3 percent more whistling cocks in the Butler area than in the Walnut area. Censuses using bird dogs indicated 29 percent more bobwhite in the Butler area than in the Walnut area. Therefore, the home ranges of both areas were compared to detect density dependent differences in home range cover composition and cover use (Table 2).

The tall shrub composition and use for home ranges of both the Walnut and Butler areas was almost equal. However, covey home range

Table 2. Seasonal and intensive study area comparisons of availability and use of cover types by radio-instrumented quail, September-October, December-January, March-April, 1975-1976, Rogers County, Oklahoma.

Sample period	Cover types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of availability and use of cover types
Sept.-Oct.	Tall shrub	0.47	2.6	23.5	79	
	Short shrub	1.52	8.3	17.8	60	
	Woodland	3.54	19.3	29.4	99	714.95[a]
	Large seeded forb	2.22	12.1	12.5	42	
	Grassland	10.59	57.7	16.8	57	
Dec.-Jan.	Tall shrub	2.37	7.3	29.5	147	
	Short shrub	2.20	6.8	24.0	120	
	Woodland	10.90	33.5	28.3	141	666.61[a]
	Large seeded forb	3.25	10.0	4.4	22	
	Grassland	13.55	41.7	13.8	69	
	Water	0.23	0.7	00.0	0	
Mar.-Apr.	Tall shrub	2.36	12.7	39.5	195	
	Short shrub	2.26	12.1	27.3	135	
	Woodland	4.28	23.0	20.9	103	523.94[a]
	Large seeded forb	0.06	0.3	0.6	3	
	Grassland	9.43	50.7	11.7	58	
	Water	0.23	1.2	00.0	0	

Table 2. (Continued)

	Cover types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of availability and use of cover types
All telemetry periods						
Total	Tall shrub	5.10	7.5	31.7	421	
	Short shrub	5.98	8.6	23.7	315	
	Woodland	18.72	27.0	25.8	343	1728.89[a]
	Large seeded forb	5.53	8.0	5.0	67	
	Grassland	33.57	48.3	13.8	184	
	Water	0.46	0.6	00.0	0	
Butler Subtotal	Tall shrub	2.23	7.7	32.2	229	
	Short shrub	3.99	13.9	28.5	203	
	Woodland	8.26	28.6	26.9	191	856.56
	Large seeded forb	2.99	10.4	1.1	8	
	Grassland	10.91	37.8	11.3	80	
	Water	0.46	1.6	00.0	0	
Walnut subtotal	Tall shrub	2.97	7.4	31.0	192	
	Short shrub	1.99	4.9	18.1	112	
	Woodland	10.46	25.8	24.6	152	866.10
	Large seeded forb	3.51	6.2	9.5	59	
	Grassland	22.66	55.7	16.8	104	

[a]Use of cover types was not random ($P < 0.05$)

composition and use of short shrub cover in the Butler area was nearly double that of the Walnut area. The woodland cover type had nearly equal composition and use even though the Butler area contains considerably more woodland cover. The large seeded forb cover type composed roughly equal amounts of the home ranges in both the Butler and Walnut areas. However, the coveys in the Walnut area were found in the large seeded forb cover eight percent more of the time than were coveys in the Butler area (Table 2).

Grassland comprised a considerably larger proportion of the home ranges in the Walnut area (56 percent) than in the Butler area (38 percent). However, the extent of use of grassland differed only slightly (6 percent) between the Walnut and Butler areas. Changes in the percentage of use of shrubs, woodland, and grassland were closely proportional to the difference in percent composition of these cover types in the Walnut and Butler areas. However, covey home range composition and use of the large seeded forb cover varied considerably between coveys.

Chi-square analysis of cover availability and use within all home ranges indicated significant variation in the selection of habitat (Table 2). The most preferred cover type was tall shrub, which had 31.7 percent of the use but comprised only 7.5 percent of the combined home ranges. Preference for tall shrub cover was probably due to its characteristics which contributed to the coveys requirements for feeding, loafing, and escape cover (Appendix E). All of the shrub species in this category were used as a food source. The total quantity of food contributed by tall shrubs was 35 percent of all the plant seeds consumed by quail collected from September 1975 through February 1976

(Wiseman 1977). Coveys often spent several hours during midday in tall shrub areas indicating their attractiveness to coveys as loafing cover. Coveys often flew to tall shrub cover when disturbed, thus indicating its use as escape cover.

No evidence was found that coveys were using the short shrub species (blackberry and buckbrush) as a source of food during this study. However, short shrub cover was strongly preferred, apparently due to its physical features which supplied protective cover from both weather and predators. Short shrub areas were often used for loafing, escape, and occasionally for roosting. During periods of snow cover, rain and prolonged cold, coveys having supplemental feeding stations within their home range often spent most of the diurnal period in nearby short shrub cover. Four of the seven coveys instrumented during December and January often roosted in short shrub cover during these periods of inclement weather.

The availability and use of woodland was approximately the same, 27 percent and 26 percent respectively. Tree species accounted for only four percent by volume of the plant seeds eaten. However, many species, including grape (Vitis aestivalis), smartweed (Polygonus spp.), sedge (Carex sp.), and greenbrier (Smilax bona-nox), of woodland understory vegetation undoubtedly provided a source of food (Wiseman 1977). Several of the coveys used the woodland understory, principally greenbrier, as loafing and escape cover.

The analysis of total availability and use of large seeded forb cover within the covey home ranges, eight percent and five percent respectively, indicates that coveys did not favor large seeded forb cover. However, 87 percent of the large seeded forb cover was located

in only two of the home ranges, and in both of these home ranges coveys made only slight use of this cover type. The reasons that quail use this cover type was not determined due to the lack of knowledge about availability of natural foods there.

Grassland was the most abundant cover type (48 percent) but was used relatively little (14 percent), thus, indicating its availability within home ranges was far above the minimum amount required. Grassland was primarily used for escape, roosting, and nesting. Seeds of grass species provided less than two percent of the food consumed. However, many forbs are found in grassland subjected to grazing (Kelting 1954, Penfound 1964) and they undoubtedly provide a source of quail food.

Seasonal Trends

Coveys exhibited significant ($P < 0.05$) preferences in their use of cover during fall, winter, and spring (Table 2). However, the average home range size did not change significantly ($P < 0.05$) through the three seasons.

The amount of tall shrub habitat included in the home ranges increased through the three telemetry periods (Table 2). There was a corresponding rise in use and preference for this cover type during the same periods. Availability of the short shrub type within the home ranges generally increased during the three study periods. A constant increase in utilization and preference for short shrub cover was observed through the three seasons.

Availability of woodland within covey home ranges was highest during winter although use was similar in fall and winter and declined

in spring. Trends in preference for use of woodland cover were not evident. Use of the large seeded forb cover type and availability within home ranges declined through the three seasons. During fall and spring, use of large seeded forb cover was approximately proportional to its availability. During mid-winter, however, coveys avoided large seeded forb areas. Reasons for this behavior are unknown but may have been partially due to a lack of seeds or of a shortage of cover in this habitat.

Covey use of grassland was low throughout the three telemetry periods. The percentage of grassland that coveys included in their home ranges was lowest during December although the percent use of grassland remained approximately the same during fall, winter, and spring. The low amount of grassland included in the covey home ranges during December may have been due to the presence of snow cover on eight days during that month. Grassland was used primarily for roosting, feeding, and occasionally escape cover.

Roosting Cover

Fifty percent of the roost sites of coveys were located in grassland. Coveys used both short shrub and large seeded forb areas for 22.7 percent of their roost sites. The height of the tallest vegetation at each roosting site averaged 68 cm and ranged from 15 cm in large seeded forb cover to 148 cm in tall shrub cover. The height of vegetation at roost sites was similar to that reported by Klimstra and Ziccardi (1963) in Illinois (59 cm). The mean density of stems was 168 per square meter.

Twenty-eight species of plants were recorded in the analysis of

roost site vegetation (Table 3). Sixty percent of the stems were grass species and woody species accounted for 14 percent. Although the literature suggests considerable variation in the roosting requirements of bobwhite quail throughout its range, several researchers have reported roosting habits similar to those found during this study (Errington and Hamerstrom 1936, Green and Beed 1936, Klimstra and Ziccardi 1963). The more important species in order of importance were little bluestem, sorghum, brome, western ragweed, and broomsedge.

Characteristics of roost site vegetation show considerable variation through the fall, winter, and spring. The density of roosting cover increased significantly during spring as opposed to the fall and winter (239, 144, and 136 stems per m^2, respectively). This increase was primarily due to the increase in density of the cool season grasses.

The mean height of vegetation at roost site varied little through the fall, winter, and spring (64 cm, 70 cm, and 69 cm). Of the 5 most important species of plants associated with roost sites two (little bluestem and sorghum) decreased in frequency of occurrence and two (brome and broomsedge) increased in frequency occurrence.

Nesting Habitat

Extensive efforts were made during two breeding seasons to locate nests but only seven were located. Robinson (1957), using similar techniques on rangeland in Kansas during two breeding seasons, failed to locate any nests. However, Lehmann (1946b) found 194 nests on rangeland during 1942 and 1943.

Little bluestem was found in all the nest site plots and accounted for 80 percent of the stems in the plots (Table 4). Although different

Table 3. Percent frequency of occurrence of plant species at 128 night roosts used by bobwhite, Rogers County, Oklahoma.

Plant species	% frequency of occurrence			
	Sept.-Oct. (33 roosts)	Dec.-Jan. (58 roosts)	Mar.-Apr. (37 roosts)	Total (128 roosts)
Tall shrub				
Rhus glabra and *R. copallina* Sumac	12.8	0.0	2.0	3.9
Short shrub				
Symphoricarpos orbiculatus Buckbrush	29.2	25.2	28.4	27.3
Rubus spp. Blackberry	9.6	37.6	22.4	25.0
Large seeded forb				
Ambrosia psilostachya Western ragweed	38.8	43.6	34.8	39.1
Ambrosia bidentata Lanceleaf ragweed	22.4	18.8	20.4	20.3
Lespedeza striata and *L. stipulacea* Lespedeza	3.2	8.4	12.4	8.6
Carex sp. Sedge	0.0	6.4	10.4	6.3
Scleria pauciflora Scleria	6.4	8.4	4.0	6.3
Solidago spp. Goldenrod	0.0	4.0	4.0	3.1
Diodia teres Poorjoe	3.2	4.0	0.0	2.3
Geum canadense Avens	0.0	4.0	2.0	2.3
Vernonia spp. Ironweed	0.0	4.0	2.0	2.3
Gutierrezia dracunculoides Broomweed	0.0	6.4	0.0	2.3
Unknown forbs	9.6	12.4	14.4	12.5

Table 3. (Continued)

Plant species	% frequency of occurrence			
	Sept.-Oct. (33 roosts)	Dec.-Jan. (58 roosts)	Mar.-Apr. (37 roosts)	Total (128 roosts)
Grassland				
Schizachyrium scoparium Little bluestem	80.8	54.0	61.2	68.8
Sorghum vulgare Sorghum	58.0	48.0	40.8	47.7
Bromus spp. Brome	35.6	33.2	55.4	41.4
Andropogon virginicus Broomsedge	29.2	33.2	38.8	34.4
Panicum virgatum Switchgrass	19.2	2.0	8.0	8.6
Seteria spp. Foxtail	6.4	0.0	12.4	6.3
Andropogon gerardii Big bluestem	6.4	2.0	4.0	3.9
Panicum oligosanthes Scribner panicum	9.6	4.0	0.0	3.9
Aristida spp. Threeawn	3.2	8.4	0.0	3.9
Sorghastrum nutans Indiangrass	3.2	0.0	2.0	1.6
Unknown grasses	12.8	18.8	20.4	18.0

Table 4. Plants frequently occurring as cover at six bobwhite nests, Rogers County, Oklahoma, 1975-1976.

Species	Percent occurrence	Mean stem count per plot
Schizachyrium scoparium	100.0	500.5
Panicum virgatum	66.7	46.0
Ambrosia spp.	66.7	17.7
Seteria spp.	66.7	10.5
Panicum oligosanthes	50.0	16.2
Rubus sp.	50.0	8.7
Acalypha gracilens	33.3	10.5
Sorghastrum nutans	33.3	5.2
Lespedeza striata	33.3	5.2
Andropogon virginicus	33.3	4.5

species were encountered in Wisconsin (Errington 1933), Texas (Lehmann 1946b), Iowa (Klimstra 1950), Tennessee (Dimmick 1968), southeastern United States (Rosene 1969), and Illinois (Klimstra and Roseberry 1975) the most important vegetation at nest sites in all of the studies was perennial grasses.

The average height of the tallest vegetation within the nest site plots was 78.7 cm and ranged from 42 cm to 120 cm (Appendix F). Stem counts revealed a mean density of 733 stems per square meter and ranged from 194 to 1,417 stems. The nest with the lowest stem density was located near a large rock which covered approximately 40 percent of the plot. The height and density values exhibited by the nest site vegetation are similar to those reported by Klimstra and Roseberry (1975) in Illinois and Lehmann (1946b) in Texas. Analyses of vegetation at the nests found on the M-I Ranch indicate that under moderate grazing pressure tallgrass prairie rangeland supports perennial grasses of sufficient height and density to provide an abundance of suitable nest sites.

Management Implications

Management for quail habitat on rangeland should include practices that improve or increase the most highly preferred cover types. This study has shown that tall and short shrub cover are highly preferred by coveys, in the three seasons of the study, for feeding, loafing and escape. Therefore, these two cover types (life forms) should be managed to determine if the carrying capacity of rangeland can be increased for bobwhite. Management practices which might be economically used, either alone or in combination to enhance rangeland for

quail, include the following:

1. Fencing. Cattle often utilize the same habitat as quail but to the detriment of quail. There was no evidence that the presence of cattle per se adversely affected quail, however, the cattle may adversely affect the quantity and quality of food and cover available to quail. The shrub and woodland areas necessary for quail were often used for shelter by cattle during inclement weather and as a source of browse during winter. The trampling and consumption of understory herbaceous cover also reduces the food and cover available to quail. To provide quail with adequate food, loafing, and escape cover, potential areas of woody cover where coveys might establish new, permanent home ranges should be fenced to exclude cattle.
2. Grazing. Moderate grazing pressure by cattle can be used to increase the diversity and production of plant species surrounding areas of woody cover (Kelting 1954 and Penfound 1964). Analyses of vegetation indicate that bobwhite prefer moderate to heavily grazed areas during fall and winter for roosting and moderate to lightly grazed areas during the summer for nesting. Therefore, to insure adequate availability of cover for both roosting and nesting, grazing pressure should be maintained at a moderate level of forage removal.
3. Fertilization and Burning. Early spring burning followed by phosphorus fertilization of tall grass has been shown to increase quail food supplies in rangeland vegetation (Derdeyn 1975). The use of fertilization might also increase

both quality and quantity of shrubs and their seed production.

4. Woody Plantings. The potential use of woody cover plantings to benefit quail is suggested by the bobwhite's preference of shrubs for feeding, loafing, and escape. Using this management technique would require fencing to protect plots from grazing by cattle. Information regarding propagation of the major woody species used for food by bobwhite on rangeland (Wiseman 1977) is presented in the Woody-Plant Seed Manual (U. S. Department of Agriculture 1948).

Literature Cited

Baker, M. F. 1940. Age classes of winter cover used by the eastern bobwhite, Colinus virginianus L., in southern Iowa. Iowa State College, J. Sci. 15:3-11.

Bartholomew, R. M. 1967. A study of the winter activity of bobwhite through the use of radio telemetry. Adams Cent. Ecol. Stud. Occas. Pap. 17, Western Michigan Univ., Kalamazoo. 25pp.

Brander, R. B., and W. W. Cochran. 1971. Radio-location telemetry. Pages 95-103 in R. H. Giles, ed. Wildlife management techniques. The Wildlife Soc., Washington, D. C. 633pp.

Damon, David. 1946. Seasonal relationships of bobwhite quail to woody vegetation in Nebraska. Nebraska Bird Rev. 14:34-36.

Derdeyn, C. H. 1975. Manipulating central Oklahoma rangeland vegetation for bobwhite quail. M. S. Thesis. Oklahoma State Univ., Stillwater. 86pp.

Dimmick, R. W. 1968. A study of bobwhite quail nesting on the Ames Plantation, University of Tennessee. Tenn. Farm Home Sci. Prog.

Rept. No. 68:3-4.

Dix, R. L. 1961. An application of the point-centered quarter method to the sampling of grassland vegetation. J. Range Manage. 14:63-69.

Errington, P. L. 1933. The nesting and the life equation of the Wisconsin bob-white. Wilson Bull. 45:122-132.

_____ and R. N. Hamerstrom, Jr. 1936. The northern bob-white's winter territory. Iowa State Coll. Agric. Exp. Stn. Res. Bull. 201. 142pp.

Gray, F. and H. M. Galloway. 1959. Soils of Oklahoma. Oklahoma Agric. Exp. Stn. Misc. Pub. 56. 65pp.

Green, W. E., and W. E. Beed. 1936. Iowa quail and pheasants in winter. Am. Wildl. 25:83-84, 90-92.

Harvey, M. J. and R. W. Barbour. 1965. Home range of Microtus ochrogaster as determined by a modified minimum area method. J. Mammal. 43:389-402.

Jones, R. E. 1960. The life-form concept applied to prairie chicken habitat in Oklahoma. Proc. Okla. Acad. Sci. 40:134-136.

Kelting, R. W. 1954. Effects of moderate grazing on the composition and plant production of a native tall-grass prairie in central Oklahoma. Ecology 35:200-207.

Klimstra, W. D. 1950. Bob-white quail nesting and production in south-eastern Iowa. Iowa State Coll. J. Sci. 24(4):385-395.

_____, and J. L. Roseberry. 1975. Nesting ecology of the bobwhite in southern Illinois. Wildl. Monogr. 41. 37pp.

Klimstra, W. D., and V. C. Ziccardi. 1963. Night-roosting habitat of bobwhites. J. Wildl. Manage. 27:202-214.

Lehamann, V. W. 1946a. Mobility of bobwhite quail in southwestern Texas. J. Wildl. Manage. 10:124-136.

_____. 1946b. Bobwhite reproduction in southwestern Texas. J. Wildl. Manage. 10:111-123.

Lewis, J. B. 1954. Further studies of bob-white mobility in central Missouri. J. Wildl. Manage. 18:414-416.

Marchinton, R. L., and L. K. Jeter. 1966. Telemetric study of deer movement ecology in the southeast. Proc. Southeastern Assoc. Game and Fish Commissioners 20:189-206.

Murphy, D. A., T. S. Baskett. 1952. Bobwhite mobility in central Missouri. J. Wildl. Manage. 16:498-510.

Penfound, W. T. 1964. The relation of grazing to plant succession in the tallgrass prairie. J. Range Manage. 17:256-260.

Pitelka, F. A. 1941. Distribution of birds in relation to major biotic communities. Am. Mid. Nat. 25:113-137.

Polone, D. J. 1961. Soil survey of Rogers County, Oklahoma. U. S. Dept. of Agric. 65pp.

Reeves, H. M., A. D. Geis, and F. C. Kniffin. 1968. Mourning dove capture and banding. U. S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 117. 63pp.

Robinson, T. S. 1957. The ecology of bobwhites in south-central Kansas. Univ. Kansas Biol. Surv. and Mus. Nat. Hist. Misc. Pub. 15. 84pp.

Rosene, Walter, Jr. 1969. The bobwhite quail: its life and management. Retgers Univ. Press, New Brunswick, N. J. 418pp.

Schemnitz, S. D. 1961. Ecology of the scaled quail in the Oklahoma panhandle. Wildl. Mono. No. 8. 47pp.

Stoddard, H. L. 1931. The bobwhite quail: its habits, preservation and increase. C. Scribner's Sons, N. Y. 599pp.

U. S. Department of Agriculture. 1948. Woody-plant seed manual. Misc. Pub. No. 654. 416pp.

Wiseman, D. S. 1977. Food habits and weights of bobwhite from northeastern Oklahoma tallgrass prairie. Proc. Okla. Acad. Sci. 57:(In press).

Yoho, N. S., and R. W. Dimmick. 1972. Habitat utilization by bobwhite quail during winter. Pages 90-99 in J. A. Morrison and J. C. Lewis, eds. Proc. First Natl. Bobwhite Quail Symposium, Oklahoma State Univ., Stillwater. 390pp.

CHAPTER IV

SPATIAL RESPONSES OF BOBWHITE TO DISTURBANCE BY BIRD DOG FIELD TRIALS

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Abstract: The influence of bird dog field trials on bobwhite quail (Colinus virginianus) coveys in northeastern Oklahoma was investigated utilizing radio-location telemetry and general observations. Three field trials had only a minor measurable effect on seven coveys. Two coveys increased their home range size in response to disturbance by activities of the field trial. None of the seven coveys either temporarily or permanently abandoned their previously established home range. The number of disturbances to coveys being pointed or flushed was only 20% of the number possible. The gallery per se was responsible for a large percentage of the disturbance of coveys. Management implications of the study include modification of the field trial course to increase the potential for interception of coveys.

The influence of frequent exposure of bobwhite quail coveys to disturbance by the gallery of observers on horseback and by bird dogs during field trials has received little attention by the scientific community. However, Dimmick and Yoho (1972) studied the influence of the National Championship Field Trial, for pointing bird dogs, on bob-

white at the Ames Plantation in southwestern Tennessee. They concluded that large numbers of mounted riders were sufficient to cause coveys to shift from, or to occasionally abandon established home ranges.

The limited home range size of most bobwhite populations has been well documented in the scientific literature. Quail in most regions spend the time of year when they are in coveys within a cruising radius of 0.8 km (Stoddard 1931, Errington 1933, Lewis 1954, Bartholomew 1967). In southwestern Texas, coveys were also found to be relatively sedentary but individual quail sometimes moved more than 2 km during winter (Lehmann 1946). Duck (1943) found that bobwhite in western Oklahoma make a seasonal shift from summer to winter range. However, no evidence is reported to indicate extensive movements during the winter months.

This paper reports the influence of three bird dog field trials upon the size of home range of bobwhite in seven intensively studied coveys.

The Oklahoma Cooperative Wildlife Research Unit (OCWRU) administered the graduate studies of which this paper is a part. Financial support was provided by Max McGraw Wildlife Foundation, Dundee, Illinois, and Oklahoma State University Environmental Institute, Stillwater, Oklahoma. Housing, equipment, and horses were provided by the McFarlin-Ingersoll (M-I) Ranch during the field studies. J. A. Morrison, former leader, OCWRU, prepared the research proposal and directed the early part of the study. J. C. Lewis, assistant leader, OCWRU, was the major advisor during the latter portion of the study. The cooperation and assistance of H. R. Jarrell, W. W. Ingersoll, and D. E. Hawthorne is also appreciated.

STUDY AREA AND METHODS

The study was conducted on the M-I Ranch located in Rogers County, northeastern Oklahoma. The principal land use of the 4,700 ha tract is cow-calf ranching. The area is primarily tallgrass prairie rangeland on gently sloping plains with hilly areas and some low butte-like knolls. Quail inhabit wooded draws which extend into the extensive areas of grassland. Movements and habitat use of quail were intensively studied, using radio-location telemetry, on two 250 ha areas of the ranch, termed the Butler Pasture and Walnut Pasture.

Three field trials for bird dogs, two in November 1975 (American Field Quail Futurity, 3-6 November; Oklahoma Open Championship, 6-14 November) and one in March 1976 (Oklahoma Open Shooting Dog Championship, 22-26 March) were held on the M-I Ranch. Data were collected for 17 of the 18 days of field trials; four days during the Futurity, nine days during the Oklahoma Open Championship and four days during the Shooting Dog Championship. Each trial utilized a morning course (20 km) and an afternoon course (18 km) which was traversed by a brace (two) of dogs followed by handlers, judges and a gallery of 10 to 70 spectators on horses. Both courses were used once daily but not simultaneously. Each course was traversed at approximately the same time daily. Both courses were designed to minimize backtracking over previously covered areas. This design insured that coveys were seldom disturbed more than once daily.

Covey behavior and home range were determined utilizing radio-instrumented quail. Quail were instrumented during three 60-day periods (September-October, December-January, March-April) chosen primarily to study habitat use and home range size. Transmitters weighed approxi-

mately 9 g and were manufactured by Wildlife Materials Incorporated of Carbondale, Illinois.[1] Transmitter signals were monitored on an LA-12 model portable receiver (manufactured by AVM Instrument Company, Champaign, Illinois) at distances up to 300 m. The life span of transmitter batteries was approximately 30 days. Consequently, quail were captured at the beginning and the middle of each 60-day study period and fitted with a new transmitter. At the end of each study period the transmitters were recovered and returned to the manufacturer for replacement of batteries. However, all the birds caught from each covey were color marked with back tags (Wint 1951) so that positive identification of coveys was possible.

As previously noted, quail were not radio-instrumented during the field trials in November. The influence of the November field trials on coveys was judged from general observations of the immediate response of coveys to disturbance and by noting changes in size of home range. Home range size and shape, as determined in October prior to the field trials, was compared with general observations of the home range used during the field trials. During the field trial in March, coveys were radio-located before and after the dogs and gallery passed or after disturbances, such as being pointed, flushed by a dog, or rode up (flushed) by the gallery, were detected.

To distinguish the effect of the gallery on coveys, flushing of quail by the gallery was recorded separately from those instances when a covey was flushed by a dog. If a covey was pointed or flushed by the

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[1]Mention of the manufacturer of a product does not constitute endorsement of their product by the Oklahoma Cooperative Wildlife Research Unit.

dogs or flushed by the gallery it was considered "disturbed". The total number of times the field trial activities passed through each home range, multiplied by the number of intensively studied coveys in that area, was used to calculate the maximum number of potential disturbances.

RESULTS AND DISCUSSION

Home ranges of three, seven, and five coveys were defined during the fall, winter, and spring of 1975-1976, respectively. Seven different coveys were instrumented during the telemetry periods. Home range size varied from 2.7 ha to 10.8 ha, and averaged 5.2 ha (Table 1). The home ranges of six of the coveys were intersected by the field trial course and the home ranges of all seven were within the range of the competing bird dogs (Figs. 1 and 2). In addition to the coveys radio-instrumented there were four coveys present within the intensive study areas which were not instrumented. One of these coveys was in the Walnut Pasture and the other three were in the Butler Pasture. The approximate home ranges of these coveys are illustrated in Figs. 1 and 2.

In most cases, there were no clearly definable activity centers, within a coveys' home range, during a 60-day study period. Such activity centers were occasionally noted in use for several days in succession, but then changed when the covey moved to another part of their home range.

The least amount of disturbance to all coveys (10.6 percent of the total possible) occurred during the American Field Quail Futurity (Table 2). Disturbance was highest during the Oklahoma Open Champion-

Table 1. Home range size of seven bobwhite coveys before and during field trials in 1975-1976, as determined by radio-telemetry and general observations on the McFarlin-Ingersoll Ranch, Rogers County, Oklahoma.

Covey number	Days monitored	Covey triangulations	Covey home range (ha)		
			Before trial	During trial	Change
1	131	308	3.3	3.3	-
2	129	236	7.8	10.5	2.7
3	83	191	3.9	3.9	-
4	90	185	2.7	3.0	0.3
5	87	147	4.8	4.8	-
6	70	135	3.5	3.5	-
7	53	83	10.8	10.8	-
Total average	92	184	5.3	5.7	0.4

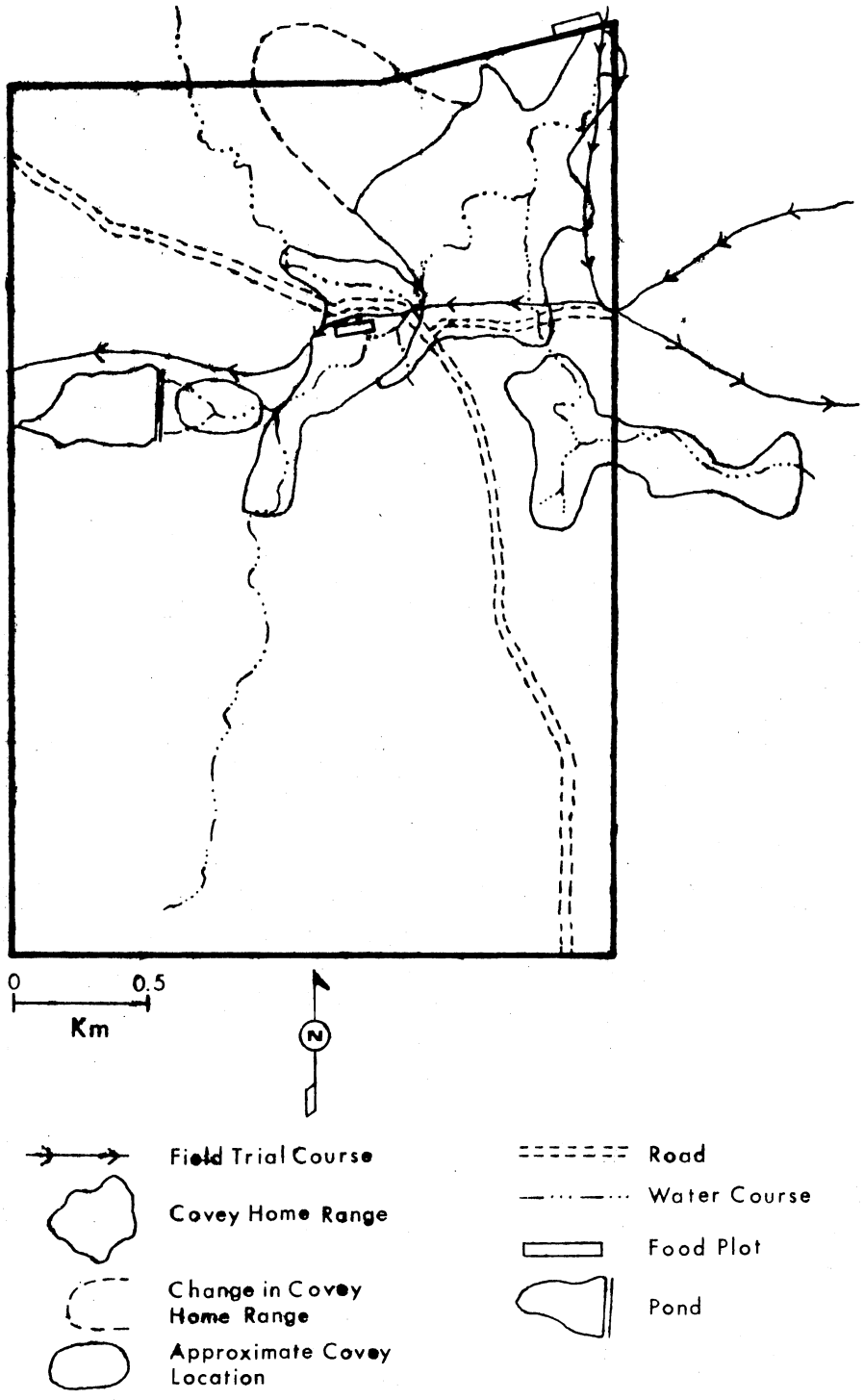


Fig. 1. Field trial course in relation to home ranges of three radio-instrumented coveys and one non-instrumented covey in Walnut Pasture intensive study area, Rogers County, Oklahoma.

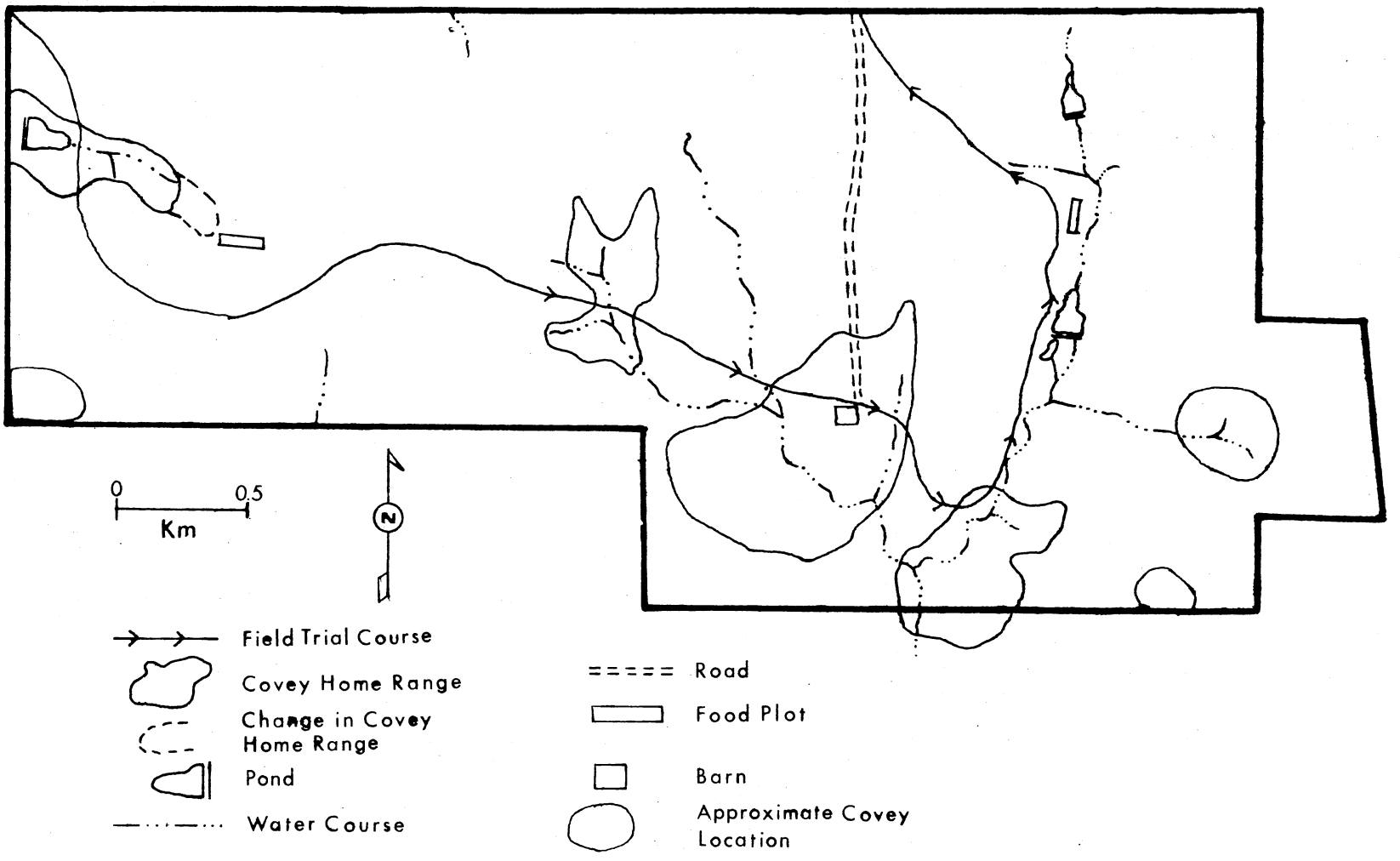


Fig. 2. Field trial course in relation to home ranges of four radio-instrumented coveys, [illegible] and two non-instrumented coveys in Butler Pasture intensive study area, Rogers County, Oklahoma.

Table 2. Effect of 17 days of field trials on bobwhite coveys, November 1975 (2 trials) and March 1976 (1 trial), Rogers County, Oklahoma.

Response	Field trial			
	American Field Quail Futurity (4 days)	Oklahoma Open Championship (9 days)	Oklahoma Open Shooting Dog Championship (4 days)	Total (18 days)
Flushed to				
Outside home range	1	1	0	2
Within home range	4	22	6	32
Not flushed	42	73	27	142
Moved > 10 m	Unk[1]	Unk	6	-
Moved < 10 m	Unk	Unk	21	-
Total number of disturbances	5	23	6	34
Number of potential disturbances	47	96	33	176
Percent of potential disturbances				
Times pointed	4.3	9.4	6.1	7.4
Flushed by dogs	6.3	8.4	6.1	7.4
Flushed by gallery	4.3	15.6	12.1	11.9
Total disturbance	10.6	24.0	18.2	19.3

[1]No transmitters installed, therefore no terrestrial movements were detected.

ship field trial when coveys were disturbed 23 of the possible 96 times (24 percent). The ability of dogs to locate and point coveys varied in the same manner as did the level of disturbance. The lowest percentage of disturbances by dogs on point (4.3) occurred during the American Field Quail Futurity and the highest percentage (9.4) occurred during the Oklahoma Open Championship (Table 2).

Both the amount of disturbance and the successfulness of dogs in locating coveys can be explained by characteristics of the three field trials. The American Field Quail Futurity trial was for dogs 1 to 2 years of age and, therefore, did not have dogs of the same ability as the other field trials. The gallery size during this field trial varied from approximately 20 to 45 riders. The Oklahoma Open Championship was a professional trial and hosted the largest gallery, up to 70 riders. The Shooting Dog Championship is a professional trial that ranked between the other two trials in abilities of the dogs and size of the gallery.

Disturbance to coveys was caused primarily by the gallery (62 percent). Only during the American Field Quail Futurity did the dogs disturb more coveys than the gallery (Table 2). However, during this field trial (5 days) the intensively studied coveys were disturbed only five times.

Coveys were often not flushed or pointed (81 percent of the time) during invasions of their home range by field trial activities. However, all but one of the seven coveys studied were flushed or pointed sometime during the 18 days of field trials. Although not directly on the gallery's course this covey's home range was visited several times by the bird dogs. The coveys were flushed 34 times due to the field

trial activities.

On only two occasions were coveys observed to extend the boundaries of their home range due to disturbance. During the American Field Quail Futurity a covey was flushed by the gallery to a persimmon (Diospyros virginiana) thicket approximately 250 m outside the covey's established home range (Fig. 1). Another covey was flushed by the gallery during the Oklahoma Open Championship and the movement increased the length of the covey's home range by about 150 m (Fig. 2). These movements increased the home ranged size of these two coveys by 2.7 ha and 0.3 ha, respectively, over the size of their established home ranges (Table 1). Neither covey permanently abandoned its established home range.

Running movements of quail, in response to disturbance, were detectable only during the field trial held in March because quail were not radio-instrumented during November. During March, coveys were flushed only 6 of the 33 times that field trial activities were in or near a covey's home range. Of the 27 times when coveys did not flush, running of distances greater than 10 m were detected only 6 times. Coveys showed no detectable response to disturbance by field trial activities on the other 21 occasions (64 percent).

Four basic differences exist between the characteristics of the M-I Ranch and the Ames Plantation where Dimmick and Yoho (1972) found that the National Championship Field Trial activities caused some coveys to shift from or abandon established home ranges. The M-I Ranch supports a quail population of approximately one bird per 3.6 ha in winter while the Ames Plantation supports a quail population of approximately one bird per 0.7 ha in winter (Dimmick and Yoho 1972).

The area used in field trials on the M-I Ranch is approximately 3,000 ha in contrast to the approximately 1,700 ha used on the Ames Plantation. Some of the dogs competing on the M-I Ranch also compete on the Ames Plantation, however, the average ability of dogs in the M-I Ranch trials is much lower. Probably more significantly, the size of gallery during field trials on the M-I Ranch rarely attained even the minimum size of the gallery (60 to 600 riders) reported at the Ames Plantation (Dimmick and Yoho 1972).

Most field trial activities are similar in size to those held at the M-I Ranch. Therefore, judging from the above differences between the M-I Ranch trials and the Grand National at the Ames Plantation, and considering the results of this study, the running of most bird dog field trials has little effect on quail coveys. Very large field trials, such as the National Championship, are an exception. To help insure that such major field trials do not adversely affect the distribution of quail coveys the course of the field trial should be designed to minimize the number of times each covey is daily exposed to disturbance. Another method of reducing the disturbance to coveys would be to limit the size of the gallery or to route it near the edges rather than through covey home ranges.

The other aspect of this study is the surprizing infrequency with which coveys were pointed or flushed. A goal of the manager of field trial areas is to maximize opportunities to observe bird dogs interacting with bobwhite. When 80 percent of these interactions fail to occur (Table 2) the manager is not achieving his goal. There appears to be great potential for increasing the opportunities for dogs to encounter birds without additional management expenditures. Designing

the average field trial course to bisect the heart of each coveys' home range should increase the potential for points by dogs. As long as the frequency of disturbance is not increased excessively there probably will not be a permanent change in location of the coveys' home range. Thus, this study indicates that the average field trial causes relatively little disturbance to bobwhite coveys and that there is considerable opportunity to increase the number of dog to bobwhite interactions without causing quail to desert the trial course.

LITERATURE CITED

Bartholomew, R. M. 1967. A study of the winter activity of bobwhites through the use of radio telemetry. Occas. Pap. 17, Adams Cent. Ecol. Stud., Western Michigan Univ., Kalamazoo. 25 pp.

Dimmick, R. W. and N. S. Yoho. 1972. The response of bobwhite coveys to disturbance during field trials. Pages 82-90 in J. A. Morrison and J. C. Lewis, eds. Proc. First Natl. Bobwhite Quail Symp., Oklahoma State Univ., Stillwater. 390 pp.

Duck, L. G. 1943. Seasonal movements of bobwhite quail in northwestern Oklahoma. J. Wildl. Manage. 7(4):365-368.

Errington, P. L. 1933. Mobility of the northern bobwhite as indicated by banding returns. Bird-Banding 4:1-8.

Lehmann, V. M. 1946. Mobility of bobwhite quail in southwestern Texas. J. Wildl. Manage. 10(2):124-136.

Lewis, J. B. 1954. Further studies of bobwhite mobility in central Missouri. J. Wildl. Manage. 18(3):414-416.

Stoddard, H. L. 1931. The bobwhite quail: its habits, preservation and increase. C. Scribner's Sons, N. Y. 559 pp.

Wint, G. B. 1951. Improved method for marking game birds for identification in the field. Biological Sci. Bull., Oklahoma A and M Coll. 48(3):1-7.

APPENDIX A

BOBWHITE POPULATION DENSITIES IN INTENSIVE STUDY PASTURES

NOVEMBER 1975 AND FEBRUARY 1976

Bobwhite populations were censused during November, 1975 and February, 1976 to determine the population density of the Butler and Walnut Pastures. Two close working bird dogs were used to cover all portions of both intensive study areas in each month. Two afternoons were required to census each area in each time period. The same dogs were used for all census work.

Field observations, which included trapping and collecting of quail, showed that these censuses did not reveal all the coveys within the intensive study areas. Field observations indicated approximately the same relative population density of quail between pastures and seasons as did the censuses. However, observations showed that censusing using bird dogs underestimated the population density by as much as 42 percent of the total population. Therefore, if total population density figures are required, the study area would need to be searched more thoroughly using bird dogs.

Table 1. Bobwhite population densities in intensive study pastures indicated by censuses using bird dogs, November 1975 and February 1976, McFarlin-Ingersoll Ranch, Rogers County, Oklahoma.

Date and pasture	Number of coveys	Number of quail	Number of hectare per quail	Covey size		
				Average	Maximum	Minimum
November 1975						
Butler	5	69	3.8	13.8	18	10
Walnut	3	38	6.8	12.7	15	11
February 1976						
Butler	2	31	8.4	15.5	17	14
Walnut	1	17	15.2	17.0	17	17

Table 2. Density information obtained from general observations and trapping compared to bobwhite densities indicated by censuses using bird dogs, Rogers County, Oklahoma.

Date and pasture	Number of coveys	Number of quail	Number of hectare per quail	% increase over census using bird dogs	Change in density (ha/quail) from con-censuses using bird dogs
November 1975					
Butler	6.5	90	2.9	13.2	- 0.9
Walnut	4.0	51	5.1	14.6	- 1.7
February 1976					
Butler	5.0	78	3.3	43.1	- 5.1
Walnut	2.5	42	6.2	42.4	- 9.0

APPENDIX B

HOME RANGE DATA OF EIGHT COVEYS IN BUTLER (B) OR WALNUT (W) PASTURES DURING THREE RADIO-TELEMETRY PERIODS, SEPTEMBER-OCTOBER, DECEMBER-JANUARY, MARCH-APRIL, 1975-1976, ROGERS COUNTY, OKLAHOMA

Table 1. Home range data of eight coveys in Butler (B) or Walnut (W) pastures during three radio-telemetry periods, September-October, December-January, March-April, 1975-1976, Rogers County, Oklahoma.

Telemetry period and covey designation	Number of quail instrumented in covey	Monitoring period	Number of days monitored	Number of triangulations	Home range size (ha)
Sept.-Oct.					
Butler coveys 1B	3	9 Dept-17 Oct	34	73	1.6
Walnut coveys 2W	3	8 Sept-29 Oct	52	110	8.2
3W	4	21 Sept-26 Oct	36	109	3.9
4W	1	11 Sept-17 Oct	28	45	4.6
Seasonal average			38	84	4.6
Dec.-Jan.					
Butler coveys 1B	3	9 Dec-21 Jan	42	80	2.1
5B	2	3 Dec-19 Jan	38	60	2.1
7B	2	10 Dec-28 Jan	50	73	2.8
8B	2	3 Dec-16 Jan	53	83	10.8

Table 1. (Continued)

Telemetry period and covey designation	Number of quail instrumented in covey	Monitoring period	Number of days monitored	Number of triangulations	Home range size (ha)
Walnut coveys 2W	2	5 Dec-20 Jan	41	65	7.7
3W	3	3 Dec-28 Jan	47	82	3.0
6W	2	12 Dec-27 Jan	40	56	3.9
Seasonal average			44	72	4.6
Mar.-Apr.					
Butler coveys 1B	4	4 Mar-30 Apr	55	155	3.2
5B	3	16 Mar-27 Apr	52	125	2.7
7B	2	8 Mar-28 Apr	20	62	3.4
Walnut coveys 2W	2	3 Mar-30 Apr	36	61	4.4
6W	2	12 Mar-19 Apr	47	91	4.8
Seasonal average			42	99	3.7
All Seasons					
Butler average	2.6		43	89	3.6
Walnut average	2.4		41	77	5.1

APPENDIX C

COMPARATIVE AVAILABILITY AND USE OF COVER TYPES BY RADIO-INSTRUMENTED QUAIL, SEPTEMBER-OCTOBER, DECEMBER-JANUARY, MARCH-APRIL, 1975-1976, ROGERS COUNTY, OKLHOMA

Table 1. Comparative availability and use of cover types by radio-instrumented quail, September-October, December-January, March-April, 1975-1976, Rogers County, Oklahoma.

Covey number, location, and sample period	Cover types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
Sept.-Oct.						
Butler						
1A	Tall shrub	0.13	8.1	26.0	19	
	Short shrub	0.66	40.9	16.4	12	
	Woodland	0.28	17.4	42.5	31	93.56[a]
	Large seeded forb	0.03	1.9	4.1	3	
	Grassland	0.51	31.7	11.0	8	
Walnut						
2A	Tall shrub	0.19	2.3	21.8	24	
	Short shrub	0.47	5.7	10.9	12	
	Woodland	2.00	24.3	32.7	36	165.33[a]
	Large seeded forb	0.16	2.0	10.9	12	
	Grassland	5.42	65.7	23.7	26	
3A	Tall shrub	0.02	0.5	22.0	24	
	Short shrub	0.24	6.3	30.3	33	
	Woodland	1.13	29.1	19.3	21	
	Large seeded forb	0.18	4.6	11.9	13	
	Grassland	2.31	59.5	16.5	18	

Table 1. (Continued)

Covey number, location, and sample period	Cover types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
4A	Tall shrub	0.13	2.8	26.7	12	
	Short shrub	0.15	3.3	6.7	3	
	Woodland	0.13	2.8	24.4	11	183.33[a]
	Large seeded forb	1.85	40.1	31.1	14	
	Grassland	2.35	51.0	11.1	5	
Walnut subtotal	Tall shrub	0.34	2.0	22.7	60	
	Short shrub	0.86	5.1	18.2	48	
	Woodland	3.26	19.5	25.7	68	737.82[a]
	Large seeded forb	2.19	13.1	14.8	39	
	Grassland	10.08	60.3	18.6	49	
Dec.-Jan.						
Butler						
1B	Tall shrub	0.11	5.3	38.8	31	
	Short shrub	0.58	27.9	30.0	24	
	Woodland	0.58	27.9	11.2	9	181.25[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	0.81	38.9	20.0	16	

Table 1. (Continued)

Covey number, location, and sample period	Cover types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
5B	Tall shrub	0.13	6.3	41.6	25	
	Short shrub	0.17	8.2	30.0	18	
	Woodland	0.73	35.1	16.7	10	171.36[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	0.82	39.3	11.7	7	
	Water	0.23	11.1	00.0	0	
7B	Tall shrub	0.25	8.8	38.4	28	
	Short shrub	0.38	13.3	23.3	17	
	Woodland	0.71	24.9	31.5	23	108.56[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	1.51	53.0	6.8	5	
8B	Tall shrub	0.56	5.2	9.6	8	
	Short shrub	0.27	2.5	22.9	19	
	Woodland	4.27	39.6	53.0	44	168.14[a]
	Large seeded forb	2.96	27.4	6.0	5	
	Grassland	2.73	25.3	8.5	7	

Table 1. (Continued)

Covey number, location, and sample period	Cover types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
Butler subtotal	Tall shrub	1.05	5.9	31.1	92	
	Short shrub	1.40	7.9	26.4	78	
	Woodland	6.29	35.3	29.1	86	528.82[a]
	Large seeded forb	2.96	16.6	1.7	5	
	Grassland	5.87	33.0	11.7	35	
	Water	0.23	1.3	00.0	0	
Walnut						
2B	Tall shrub	0.14	1.8	7.7	5	
	Short shrub	0.19	2.4	21.5	14	
	Woodland	3.46	44.4	46.2	30	126.13[a]
	Large seeded forb	0.14	1.8	4.6	3	
	Grassland	3.86	49.6	20.0	13	
3B	Tall shrub	0.26	8.6	24.4	20	
	Short shrub	0.35	11.6	28.0	23	
	Woodland	0.79	26.0	19.5	16	106.52[a]
	Large seeded forb	0.15	5.0	17.1	14	
	Grassland	1.48	48.8	11.0	9	

Table 1. (Continued)

Covey number, location, and sample period	Covey types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
6B	Tall shrub	0.92	23.7	53.6	30	
	Short shrub	0.26	6.7	8.9	5	
	Woodland	0.36	9.3	16.1	9	38.29[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	2.34	60.3	21.4	12	
Walnut subtotal	Tall shrub	1.32	9.0	27.1	55	
	Short shrub	0.80	5.5	20.7	42	
	Woodland	4.61	31.3	27.1	55	250.27[a]
	Large seeded forb	0.29	2.0	8.4	17	
	Grassland	7.68	52.2	16.7	34	
Mar.-Arp.						
Butler						
1C	Tall shrub	0.50	15.4	31.6	49	
	Short shrub	1.15	35.4	38.7	60	
	Woodland	0.30	9.2	18.1	28	71.40[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	1.30	40.0	11.6	18	

Table 1. (Continued)

Covey number, location, and sample period	Covey types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
5C	Tall shrub	0.20	7.3	32.8	41	
	Short shrub	0.26	9.5	28.8	36	
	Woodland	0.70	25.7	27.2	34	197.03[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	1.34	49.1	11.2	14	
	Water	0.23	8.4	00.0	0	
7C	Tall shrub	0.35	10.2	45.2	28	
	Short shrub	0.52	15.1	27.4	17	
	Woodland	0.69	20.0	19.4	12	105.19[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	1.89	54.7	8.0	5	
Butler subtotal	Tall shrub	1.05	11.1	34.5	118	
	Short shrub	1.93	20.6	33.0	113	
	Woodland	1.69	17.9	21.7	74	295.47[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	4.53	48.0	10.8	37	
	Water	0.23	2.4	00.0	0	

Table 1. (Continued)

Covey number, location, and sample period	Covey types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
Walnut						
2C	Tall shrub	0.16	3.6	27.9	17	
	Short shrub	0.05	1.2	13.1	8	
	Woodland	1.92	43.5	34.4	21	191.13[a]
	Large seeded forb	0.06	1.4	4.9	3	
	Grassland	2.22	50.3	19.7	12	
6C	Tall shrub	1.15	24.1	65.9	60	
	Short shrub	0.28	5.9	15.4	14	
	Woodland	0.67	14.0	8.8	8	116.27[a]
	Large seeded forb	0.00	00.0	00.0	0	
	Grassland	2.68	56.0	9.9	9	
Walnut subtotal	Tall shrub	1.31	14.3	50.7	77	
	Short shrub	0.33	3.6	14.5	22	
	Woodland	2.59	28.2	19.1	29	242.76[a]
	Large seeded forb	0.06	0.7	2.0	3	
	Grassland	4.90	53.2	13.7	21	

Table 1. (Continued)

Covey number, location, and sample period	Covey types in covey range	Hectares in covey range	% of all cover types	% of all triangulations	Number of triangulations in cover type	Chi-square comparison of relative use of cover types
Butler total	Tall shrub	2.23	7.7	32.2	229	
	Short shrub	3.99	13.9	28.5	203	
	Woodland	8.26	28.6	26.9	191	856.56[a]
	Large seeded forb	2.99	10.4	1.1	8	
	Grassland	10.91	37.8	11.3	80	
	Water	0.46	1.6	00.0	0	
Walnut total	Tall shrub	2.97	7.4	31.0	192	
	Short shrub	1.99	4.9	18.1	112	
	Woodland	10.46	25.8	24.6	152	866.10[a]
	Large seeded forb	3.51	6.2	9.5	59	
	Grassland	22.66	55.7	16.8	104	

[a]Use of cover types was not random ($P < 0.05$)

APPENDIX D

BOBWHITE WHISTLE COUNT CENSUSES

1975-1976

Bobwhite whistle count censusing was conducted during the spring and summer of 1975-1976. Censuses were started at sunrise on mornings having less than 50% cloudiness and less than 16 km/hr winds. Censuses were conducted twice weekly except when unsuitable weather conditions prevailed. The census route, illustrated in the accompanying figure, was run counter clockwise the first census of the week and clockwise the second census of the week. Bobwhite whistles and the number of quail whistling were recorded at each station for a two minute period. After recording the information I proceeded immediately to the next station. The length of time necessary to complete each census varied due to changes in road conditions but averaged approximately 1.3 hours.

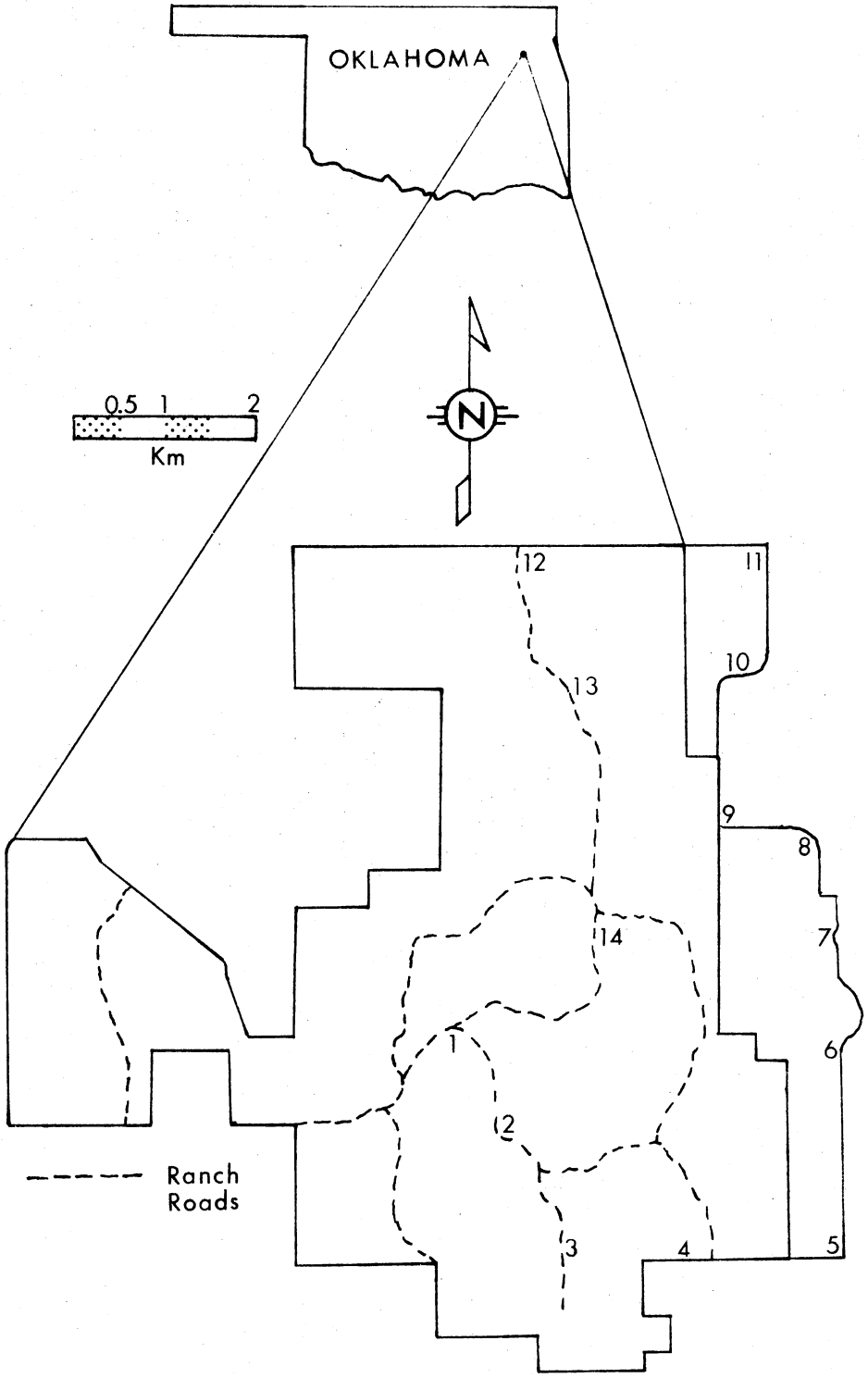
Descriptions of each census station are listed below according to the stations illustrated on the accompanying figure:

1. On south side of main corrals: NW corner of SE ¼ of Sec 16 R 17 E, T 20 N.
2. Top of knoll south of pond in NW corner of West Corral Pasture: NE ¼ of NW ¼ of Sec 21, R 17 E, T 20 N.
3. Main gate of Butler Pasture: NW corner Sec 27, R 17 E, T 20 N.
4. At creek intersection with road, 1.4 km east of station No. 3: 225 m east of NW corner Sec 26, R 17 E, T 20 N.
5. Section line corner 1.8 km east of station No. 4: NW corner Sec 25, R 17 E, T 20 N.
6. 2.4 km north of station No. 5: NW corner of SW ¼, Sec 13, R 17 E, T 20 N.
7. West siee of Scaly Bark Mountain: 400 m north of SE corner of Sec 11, R 17 E, T 20 N.
8. Entrance of Bob Moore Ranch: NW ¼ of NE ¼, Sec 11, R 17 E, T 20 N.

9. 1.2 km west of station No. 8: NW corner of Sec 11, R 17 E, T 20 N.
10. 1.6 km north of station No. 9: NW corner of Sec 2, R 17 E, T 20 N.
11. 1.6 km north of station No. 10: NW corner of Sec 35, R 17 E, T 21 N.
12. At north gate of ranch: NW corner of NE ¼, Sec 33, R 17 E, T 21 N.
13. At old wooden corrals in East Lortan Pasture (2 km south of station No. 12): SW corner of NE ¼ of NE ¼, Sec 4, R 17 E, T 20 N.
14. At feed ground of South Big Walnut Pasture: NW corner of SW ¼ of SW ¼, Sec 10, R 17 E, T 20 N.

Table 1. Bobwhite whistle count censuses, June-August 1975, and May-June 1976, Rogers County, Oklahoma.

Date	Number of whistles	Number of whistling quail
1975		
4 June	364	73
9	353	76
12	479	94
19	420	73
24	386	70
26	340	70
1 July	344	74
3	321	69
7	263	65
15	283	71
17	220	66
21	286	60
22	263	68
30	201	65
31	223	49
5 August	230	67
11	113	41
13	140	53
20	63	28
21	42	15
26	45	20
28	31	14
1976		
4 May	157	44
5	57	19
11	213	58
13	197	63
18	218	61
24	304	70
25	330	65
1 June	376	77
3	399	78
7	354	80
9	408	85
14	302	77
15	502	85
21	475	88
23	493	96
28	455	82



APPENDIX D. Bobwhite whistle count census route, used in 1975 and 1976, McFarlin-Ingersoll Ranch, Rogers County, Oklahoma.

APPENDIX E

ACTIVITY OF BOBWHITE AND THEIR UTILIZATION OF COVER TYPES ON RANGELAND

Table 1. Activity of bobwhite and their utilization of cover types on rangeland in September-October (S/O), December-January (D/J), March-April (M/A), Rogers County, Oklahoma.

	Sightings per time period and percent use															
	Feeding								Loafing							
Cover type	S/O	%	D/J	%	M/A	%	Subtotal	%	S/O	%	D/J	%	M/A	%	Subtotal	%
Tall shrub	21	22.9	50	46.7	69	50.7	140	41.8	22	26.8	56	35.2	47	34.1	124	33.0
Short shrub	6	6.5	3	2.8	7	5.1	16	4.8	19	23.3	36	22.6	52	37.7	107	28.2
Woodland	13	14.1	23	21.5	31	22.9	67	20.0	38	46.3	65	40.9	38	27.5	141	37.2
Large seeded forb	30	32.6	11	10.3	18	13.2	59	17.6	2	2.4	0	0.0	1	0.7	3	0.8
Grassland	22	23.9	20	18.7	11	8.1	53	15.8	1	1.2	2	1.3	0	0.0	3	0.8
Subtotal	92	100	107	100	136	100	355	100.0	82	100	159	100	138	100	379	100.0
Total			335								379					
% of activities			36.8								41.6					

Table 1. (Continued)

	Covey behavior																	
	Escape								Roosting									
Cover type	S/O	%	D/J	%	M/A	%	Subtotal	%	S/O	%	D/J	%	M/A	%	Subtotal	%	Total	%
Tall shrub	5	35.7	6	50.0	13	26.0	24	31.6	5	19.2	0	0.0	1	2.0	6	5.0	295	32.3
Short shrub	2	14.3	0	0.0	15	30.0	17	22.4	2	7.7	12	26.7	14	28.6	28	23.3	168	18.5
Woodland	5	35.7	0	0.0	9	18.0	14	18.4	0	0.0	0	0.0	0	0.0	0	0.0	222	24.4
Large seeded forb	0	0.0	0	0.0	2	4.0	2	2.6	6	23.1	16	35.6	12	24.5	34	28.4	98	10.8
Grassland	2	14.3	6	50.0	11	22.0	19	25.0	13	50.0	17	37.8	22	44.9	52	43.3	127	14.0
Subtotal	14	100	12	100	50	100	76	100.0	26	100	45	100	49	100	120	100.0	910	100
Total			76								120							
% of activities			8.4								13.2							

APPENDIX F

CHRONOLOGY AND VEGETATION OF BOBWHITE NESTS LOCATED IN 1975-1976

Table 1. Chronology and vegetation of bobwhite nests located in 1975-1976, Rogers County, Oklahoma.

Nest number	Number of eggs	Date of hatch	Success of hatch (%)	Predominant vegetation	Aspect	Nest opening orientation	Vegetation height at nest site (cm)	Vegetation density ($stems/m^2$)
1975								
1	0			*Schizachyrium scoparium*	S	SW	97	444
2	15	7 Aug.	100	*Acalypha gracilens*	N	S	86	194
3	10	23 Aug.	100	*S. scoparium*	SW	S	42	985
4	12	23 Sept.	100	*S. scoparium*	N	S	120	733
1976								
1	11	28 Jun.	81.8	*S. scoparium*	S	SE	84	1417
2	15	15 Aug.	100	*S. scoparium*	E	S	59	565
3	12	30 Aug.	100	*S. scoparium*	S	SW	63	790

VITA

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Master of Science

Thesis: HABITAT USE, FOOD HABITS, AND RESPONSE TO BIRD DOG FIELD TRIALS OF BOBWHITE ON NORTHEASTERN OKLAHOMA TALLGRASS PRAIRIE RANGELAND

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