SOME BACTERIAL AND PARASITIC DISEASES OF OKLAHOMA BOBWHITE QUAIL

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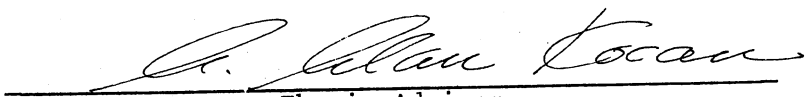

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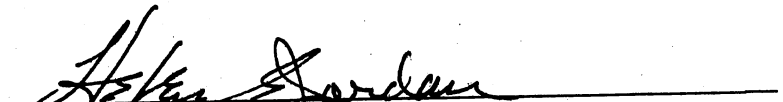

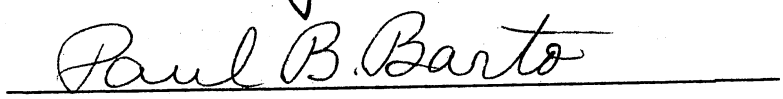

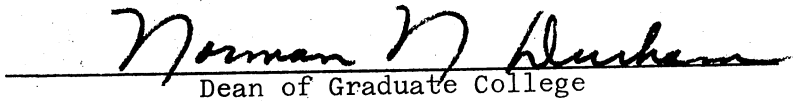

Dean of Graduate College

PREFACE

This study is concerned with the bacterial and parasitic diseases of Oklahoma bobwhite quail and the potential problems these diseases and parasites might impose to other animals. The objective of this study is to survey the Oklahoma bobwhite quail population and identify selected bacterial and parasitic organisms present. Also to estimate the potential problem these organisms might cause to domestic and other wild animals in the state.

The author wishes to express his appreciation to his major adviser, Dr. A. Alan Kocan, for his guidance and assistance through this study. The writer wishes to express his thanks to the other committee members, Dr. Helen E. Jordan and Dr. Paul B. Barto, for counseling during the research and for criticism of the manuscript.

A note of thanks is given to Mr. David Minnick and Mr. Gary Seagren for technical assistance in collecting data, and to Mrs. J. C. Grant for preparation of bacteriological media. In addition, appreciation is extended to Mr. Hammond Eve and the people in the State Wildlife Conservation Department who helped collect the quail. This project was funded in part by federal aid in wildlife restoration projects W-82-R of the Oklahoma Department of Wildlife Conservation. Identification of helminths and protozoa was confirmed by the USDA Poultry Protozoan Disease Laboratory, Animal Parasitology Institute, Beltsville, Maryland.

Finally, special gratitude is expressed to my wife, Sharon, for typing the manuscript, and also to my wife and sons, Larry D. and Shawn, for their understanding, encouragement, and many sacrifices.

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CHAPTER I

INTRODUCTION

Bacterial and parasitic diseases of the bobwhite quail (Colinus virginianus) have been reported by numerous authors such as Green and Wade (1929), Stoddard (1931), Shillinger and Morley (1937), and Kellogg and Doster (1972). The majority of this disease information has been gathered from the southeastern and northeastern areas of the United States. Little information is available, however, concerning the bacteria and parasites of wild bobwhite quail, since most studies were conducted using pen-raised quail.

Stoddard (1961), Green and Wade (1929), and Shillinger and Morley (1937) reported histomoniasis, tularemia, and ulcerative enteritis caused death in wild bobwhites, but Kellogg and Doster (1972) felt this information was insignificant due to the small number of wild bobwhite that were submitted to diagnostic laboratories. Kellogg and Prestwood (1968) conducted an extensive literature review to determine what diseases and parasites had been reported from bobwhites. This information was tabulated as to disease organism, location or lesion area, and geographical location if given. The review pointed out the possibility of the bobwhite serving as a reservoir host for various diseases and parasites in other species of birds as well as numerous mammals. Examples were fowl typhoid, pullorum disease, histomonas, coccidia, and helminths.

Kellogg and Reid (1970) studied the possibility of the bobwhite being a reservoir host for blackhead in wild turkey populations, and concluded that the possibility exists for the bobwhite quail to act as a reservoir for blackhead transmission from domestic poultry to wild turkeys. Lund and Chute (1971) reported the bobwhite as being a rather poor host for Heterakis gallinarum and Histomonas meleagridis, but postulated that bobwhites not kept in confinement could possibly acquire both of these species by visiting contaminated chicken yards.

In a study undertaken by Blakeney and Dimmick (1971), there were two nematode species (Heterakis bonasae and Cheilospirura spinosa) and two cestode species (Rhabdomeira odiosa and Raillietina cesticillus) found in a sample of 140 birds taken from a 4,000 acre plantation in Tennessee. There was no significant difference in parasite burdens between male and female birds, and no correlation between age and weight of quail and parasite burden. The authors pointed out that although H. bonasae had not been demonstrated to be able to transmit blackhead, the nematode should be considered a potential vector. From the published information available, it does seem possible for quail to be reservoir hosts and transmitters of one or more diseases as well as harboring their own potentially pathologic organisms.

Although various bacterial and parasitic organisms have been reported for the northeastern and southeastern areas of the United States, little information is available on the bacteria and parasites of native Oklahoma bobwhite quail. Consequently it is not known to what extent the native quail populations are affected by bacterial and parasitic organisms. Neither is it known if the quail can transmit diseases to mammals, domestic fowl such as chickens, turkeys, and

guinea fowl, or wild game birds native to Oklahoma, such as turkeys, pheasants, and prairie chickens.

This study was designed to conduct a survey of the native Oklahoma bobwhite population to identify Salmonella species, blood parasites, intestinal protozoa, and intestinal helminths. Once determined, an attempt will be made to estimate the potential problem these diseases and parasites might impose on domestic and other wild animals in Oklahoma.

CHAPTER II

MATERIALS AND METHODS

One hundred and six bobwhite quail were collected by the Oklahoma Department of Wildlife Conservation from 4 geographical areas composed of 16 different locations throughout the state. The areas and locations were: Northwest (Optima, Canton PHA, Black Kettle PHA, and Ellis County), Central (Oklahoma County, Lexington PHA, Hickory Creek, and Lone Grove), Northeast (Hula, Keystone, and Spavinaw Hills), and Southeast (Pushmataha, Pine Creek, Atoka, Tishomingo, and Texoma). The quail were delivered alive to the Veterinary Parasitology and Public Health Departmental Laboratory, College of Veterinary Medicine, Oklahoma State University. Figure 1 shows 24 birds were collected in July 1975, 49 in October 1975, and 27 in March 1976. The last 23 quail collected in March were shot at their respective locations and shipped to the laboratory, all other birds were live trapped. These last 23 birds were examined for adult worms only. The live trapped birds were collected by prebaiting a designated area for two weeks, then at the end of this time, quail traps were rebaited and placed in the area until 5 birds were collected or 3 weeks had elapsed, whichever came first.

Following arrival at the laboratory, the birds that had been collected alive were decapitated. Blood smears were made immediately and stained with Wrights or Geimsa stain. They were later examined under a microscope for any parasites present. As soon as blood smears were

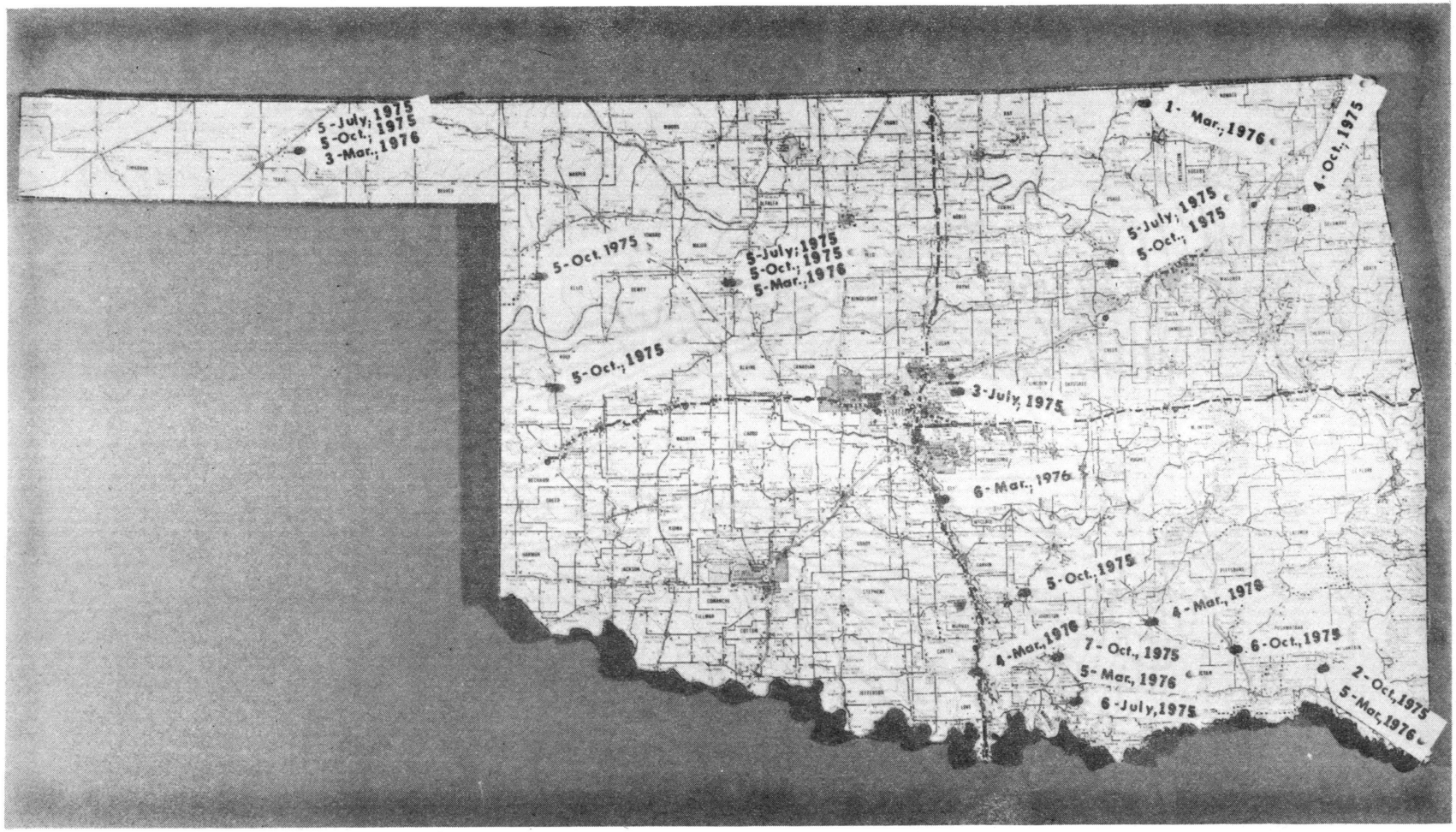

Figure 1. Number of Quail Collected at Various Locations in the State During the Corresponding Months of the Respective Year

made, the birds were necropsied and the large and small intestines were opened. Slide smears were made from rectal and cecal samples obtained with sterile cotton swabs. These smears were then fixed in Schaudin's Fixative and stained in trichrome stain to facilitate microscopic examination for protozoa. The procedure for staining and mounting the fecal samples was as follows:

1. Fix in Schaudin's Fixative - 30 minutes
2. Transfer to Iodine Alcohol for 1 minute
3. Transfer to 70% alcohol for 1 minute
4. Transfer to Gomovi stain for 5 minutes
5. Transfer to 90% alcohol with 1% picric acid for 10-15 seconds
6. Wash (DIP) in 100% alcohol
7. Wash (DIP) in 100% alcohol
8. Transfer to xylene for 3 minutes
9. Mount with permount.

After the slides were smeared with the swabs from the rectum and cecum, the swabs were placed in a tube of selenite broth and incubated for 24 hours in an attempt to isolate Salmonella spp. from each bird. At the end of 24 hours, a loop of the selenite broth culture was streaked on Brilliant Green agar. The agar was then incubated for 24 hours in a CO_2 jar, after which the plates were read for characteristic Salmonella colonies. Any colonies resembling Salmonella were transferred to Triple Sugar Iron agar (TSI). If the reactions on the TSI slant resembled those for Salmonella, the organism was inoculated into urea broth to distinguish between the genera Salmonella and Proteus. If the culture results still suggested Salmonella spp. (negative

urease), it was tested with polyvalent 'o' antiserum to determine if the isolate was a Salmonella species.

After the blood samples and swabs were taken, the remainder of the intestinal contents were opened and placed in individual jars of water in the refrigerator for 24 hours. They were then briskly shaken to remove any helminths that might have remained attached to the intestinal mucosa. The intestinal contents were then removed and the helminths individually removed from the water. The worms were fixed and stored in 70 percent alcohol until they could be identified to species.

Statistical significance was calculated using the t-test with a two sided "t" table. Significance was observed at the 0.05 level or lower.

CHAPTER III

RESULTS

Prevalence of Helminth Infections

Two groups of helminth parasites, representing the classes Nematoda and Cestoda, were identified from the intestinal tracts and gizzards of bobwhite quail from 4 geographical areas of Oklahoma. Table I shows the helminths recovered from the 4 geographical areas.

TABLE I

HELMINTHS RECOVERED FROM BOBWHITE QUAIL FROM FOUR GEOGRAPHICAL AREAS OF OKLAHOMA

Helminth	Areas			
	Northwest	Central	Northeast	Southeast
H. gallinarum	-	-	+	+
S. brumpti	+	+	+	+
Cestodes	-	-	+	+

The nematodes (Heterakis gallinarum and Subulura brumpti) were recovered from the quail's ceca while the cestodes were found in the small intestine. No attempts were made to identify the specific cestodes

recovered. The number of infected birds was not high, with only 36.79 percent of the quail harboring one or more species of helminths.

Subulura brumpti was the most common helminth found, with 27.36 percent of the birds being infected. The percentage of this parasite in the quail was higher than either H. gallinarum (3.77 percent) or cestodes (5.66 percent). There was no significant difference in infections between male and female ($P < 0.30$) or adult and juvenile quail ($P < 0.15$). Heterakis gallinarum occurred in 4 (3.77 percent) of the birds, with no significant difference observed in recoveries from adult and juvenile birds ($P < 0.25$) or male and female birds ($P < 0.30$). Six (5.66 percent) birds were found to be harboring cestodes as shown in Table II. The helminth species occurred singly except for one bird which harbored both H. gallinarum and S. brumpti.

Little difference was observed in the percentage of birds harboring helminths from the 4 geographic areas. Seventeen of 38 (44.74 percent) birds from the Northwest were observed to have helminth infections, 7 of 18 (38.89 percent) from the Central, 3 of 15 (20.00 percent) from the Northeast, and 12 of 35 (34.29 percent) from the Southeast. Heterakis gallinarum was found in the Northeast (Spavinaw) and Southeast (Pushmataha) areas only.

Worm-Burden Variations in Helminth Infections

The number of S. brumpti per infected bird ranged from 1-153 with an average of 19.72 (standard deviation = 35.01) worms per infected bird as shown in Table II. There was no significant difference in recovery of S. brumpti between sex ($P < 0.10$) or age ($P < 0.30$) of the birds.

TABLE II

PREVALENCE AND WORM-BURDEN VARIATIONS IN HELMINTHS RECOVERED FROM OKLAHOMA BOBWHITE QUAIL

Parasite	Age Sex	Total No.	Birds Infected No.	Birds Infected %	Parasite Burden Avg/Infected Bird	Parasite Burden Range/Bird
H. gallinarum	Adult					
	Male	47	3	7.14	13.7	6-26
	Female	19	1	5.6	8.0	8
	Subtotal	66	4	6.06	12.25	6-26
	Juvenile					
	Male	19	0	0	0	0
	Female	21	0	0	0	0
	Subtotal	40	0	0	0	0
	Total	106	4	3.77	12.25	6-26
S. brumpti	Adult					
	Male	47	9	21.43	26.56	1-111
	Female	19	8	44.44	7.25	1-17
	Subtotal	66	17	25.76	17.47	1-111
	Juvenile					
	Male	19	7	36.84	30.43	1-153
	Female	21	5	23.81	15.80	4-45
	Subtotal	40	12	30.00	22.91	1-153
	Total	106	29	27.36*	19.72	1-153
Cestodes	Adults				**	
	Male	47	2	4.26	-	-
	Female	19	1	5.26	-	-
	Subtotal	66	3	4.55	-	-
	Juvenile					
	Male	19	2	10.53	-	-
	Female	21	1	4.76	-	-
	Subtotal	40	3	7.50	-	-
	Total	106	6	5.66	-	-

*$P < 0.05$ **Cestodes not counted

The intensity of infection with H. gallinarum was lower, with four birds averaging 12.25 (standard deviation = 8.01) worms per infected bird with a range of 6-26 worms per bird. No significant difference was observed between sexes ($P < 0.30$), but adult birds showed a higher ($P < 0.05$) variation than did the juvenile quail.

Prevalence of helminth infection was recorded with regard to seasonal differences for Summer 1975 (Group I), Fall 1975 (Group II), and Spring 1976 (Group III) as shown in Table III. Group I had a higher average number of worms per infected bird than did group II and group III ($P < 0.05$), while group II had a higher average than group III ($P < 0.05$).

TABLE III

SEASONAL VARIATIONS OF HELMINTHS RECOVERED FROM OKLAHOMA BOBWHITE QUAIL

Group	Season	Total Birds	No. of birds Positive	Percent Infected	Avg. No. Parasites/ Infected Bird
I	Summer 1975	21	9	42.86	39.22
II	Fall 1975	49	19	38.78	12.74
III	Spring 1976	33	10	30.30	3.10*

*$P < 0.05$

Prevalence of Protozoan Infections

Eighty three bobwhite quail were examined for intestinal protozoa with 57 (68.67 percent) positive for 1 or more genera (Table IV). Four genera and five species were identified from the stained smears. More birds (44.58 percent) were infected by Trichomonas species ($P < 0.05$) than any other protozoa, with the least number of birds (7.23 percent) harboring Histomonas meleagridis ($P < 0.005$). There was little difference in the prevalence of Chilomastix sp. (30.12 percent), Eimeria sp., (27.21 percent), or Trichomonas gallinarum (25.30 percent). No significant difference was noted between adult and juvenile ($P < 0.35$) or male and female quail ($P < 0.30$) when the number of birds harboring 1 or more protozoa was compared.

TABLE IV

PREVALENCE OF PROTOZOA INFECTIONS IN OKLAHOMA BOBWHITE QUAIL

Protozoa	Age-Sex	Total No.	Birds Infected No.	Birds Infected %
Trichomonas sp.	Adult			
	Male	29	11	41.38
	Female	14	8	71.83
	Subtotal	43	19	44.19
	Juvenile			
	Male	19	6	31.58

TABLE IV (CONTINUED)

Protozoa	Age-Sex	Total No.	Birds Infected No.	Birds Infected %
Trichomonas sp.	Female	21	9	42.86
	Subtotal	40	15	37.50
	Total	83	34*	44.58
Trichomonas gallinarum	Adult			
	Male	29	5	17.24
	Female	14	6	42.86
	Subtotal	43	11	25.58
	Juvenile			
	Male	19	5	26.32
	Female	21	5	23.81
	Subtotal	40	10	25.00
	Total	83	21	25.30
Chilomastix sp.	Adult			
	Male	29	7	24.14
	Female	14	7	50.00
	Subtotal	43	14	32.56
	Juvenile			
	Male	19	5	26.32
	Female	21	6	28.57
	Subtotal	40	11	27.50
	Total	83	25	30.12
Eimeria sp.	Adult			
	Male	29	7	24.14
	Female	14	3	21.43
	Subtotal	43	10	23.26
	Juvenile			
	Male	19	9	47.37
	Female	21	4	19.05
	Subtotal	40	13	32.50
	Total	83	23	27.72

TABLE IV (CONTINUED)

Protozoa	Age Sex	Total No.	Birds Infected No.	Birds Infected %
Histomonas meleagridis	Adult			
	Male	29	1	3.45
	Female	14	3	21.43
	Subtotal	43	4	9.30
	Juvenile			
	Male	19	2	10.53
	Female	21	0	0
	Subtotal	40	2	5.00
	Total	83	6*	7.23

*$P < 0.005$

Seasonal differences were observed with regard to the number of quail infected during Summer 1975 (Group I), Fall 1975 (Group II), and Spring 1976 (Group III) as shown in Table V. Group III had the highest percentage of birds infected (100 percent) and group I the lowest (29.17 percent).

TABLE V

SEASONAL VARIATION OF PROTOZOAN INFECTIONS IN OKLAHOMA BOBWHITE QUAIL

Group	Season Year	Total Number of Birds	Number Infected	Percent Infected
I	Summer 1975	24	7	29.17
II	Fall 1975	49	40	81.63
III	Spring 1976	10	10	100.00

There were some differences in the number of birds infected with protozoan parasites from the 4 geographical areas studied. The Northwest (65.71 percent) and Northeast (42.86 percent) had the lowest percentages of birds infected with one or more protozoans, while the Central (87.50 percent) and Southeast (80.77 percent) areas showed the highest percentages. The protozoan Histomonas meleagridis was observed in the Northwest (Optima and Canton) and Southeast (Pushmataha and Tishomingo) areas only, as shown in Table VI.

TABLE VI

PROTOZOA RECOVERED FROM BOBWHITE QUAIL FROM FOUR GEOGRAPHICAL AREAS OF OKLAHOMA

Protozoa	Areas			
	Northwest	Central	Northeast	Southeast
Trichomonas sp.	+	+	+	+
Trichomonas gallinarum	+	+	+	+
Chilomastix sp.	+	+	+	+
Eimeria sp.	+	+	+	+
Histomonas meleagridis	+	-	-	+

Bacteriological Cultures

A total of 100 quail were cultured for Salmonella spp. from the cecum and intestine. All of the birds were found to be free from any Salmonella spp.

CHAPTER IV

DISCUSSION

Helminth Infections

This study was conducted to determine the presence of selected bacterial, helminth, and protozoan parasites in wild bobwhite quail from Oklahoma. The findings suggests the prevalence of helminth infection is quite low within the state, with only 39 percent of the birds harboring at least one of the three helminths identified, and only 1 quail having a concomitant infection of 2 or more helminths.

S. brumpti, the helminth most frequently encountered during the study, occurred in 27.36 percent of the quail examined. Venard (1933) reported 11.94 percent of 8 quail he examined in Ohio were positive for S. brumpti, while Ward (1945) found 2.12 percent positive from 273 bobwhite examined in Mississippi. Parmalee (1952) reported 100 percent of 6 quail examined in Texas.

The pathogenicity of S. brumpti is believed to be of no great importance. Parmalee (1952), however, stated that S. brumpti resembles Heterakis gallinae, which is known to be a vector for the protozoa Histomonas meleagridis. This raises the question of whether S. brumpti can also be a vector for Histomonas. This question is substantiated by the fact that Histomonas meleagridis was found in the Northwest area where the only nematode recovered was Subulura brumpti. Thus, it is

believed that S. brumpti could very possibly be a vector for Histomonos meleagridis, from these findings. It should be pointed out, however, that Heterakis gallinarum could be present, but was never found in the birds examined from that area. From these findings further analysis of the potential vectors for Histomonas would certainly be warranted.

Heterakis gallinarum did not occur as frequently as the other helminths, with only 3.77 percent of the birds being infected. H. gallinarum was only recovered from birds from the Northeast and Southeast areas. It should be remembered however, that this nematode is responsible for carrying and transmitting Histomonas meleagridis, the protozoan that causes blackhead disease in turkeys as well as other gallinacious birds.

The cestodes occurred in 5.66 percent of the birds examined in this study. Blakeney and Dimmick (1971) reported 11.4 percent of 140 quail from Tennessee were positive for cestodes. Also these authors were able to "identify 42 cestodes as to genus and 29 to species"; whereas, no cestodes were identified in this study. Parmalee (1952) reported 10 of 717 (1.39 percent) quail from Texas to be positive for cestodes, with the range being 1-15 tapeworms per bird. Kellogg and Prestwood (1968) reported the prevalence of cestode infection by species and county in South Carolina, Georgia, and Florida. The total percentage of infected birds was not computed, but the largest prevalence by county was 58 percent and the smallest 8 percent. These cestodes were identified to three species, Raillietina cesticillus, Raillietina sp., and Rhabdometra sp. Venard (1933) reported only 2

quail out of 67 (2.98 percent) examined from Ohio to be positive for cestodes.

It was concluded that the low percentage of cestode infection was due to the feeding habits of quail. The majority of avian cestodes require an arthropod as an intermediate host for development. Quail are not readily noted for feeding on large numbers of arthropods, but rather for being grain eaters. It is thus believed that quail would rarely ingest arthropods serving as intermediate hosts for cestodes, and therefore would have a low prevalence of cestode infection.

Adult birds showed a significantly higher worm-burden than did juveniles when infection with any helminths was determined. This is in agreement with the study conducted by Blakeney and Dimmick (1971) with quail infected with H. bonasae and Cheilospirura sponosa. These workers found a significantly greater proportion of adults were parasitized with each nematode species than were juveniles. Parmalee (1952) however, found no significant age differences in quail parasitized with H. gallinae and S. brumpti. The author's explanation for his findings was that quail, both adults and juveniles, become parasitized as a unit by contact with a source of contamination, which was speculated to be domestic fowl in many cases.

The differences of seasonal parasitism observed in this study suggests quail have a heavier helminth burden during summer and fall, and the lightest burden during the spring. However, further studies should be conducted utilizing greater sample sizes in order to further evaluate the seasonal differences. Data collected on percentage of birds infected with helminths from the various statewide locales suggests that all areas of the state are equally suited for bobwhite

quail. This study does suggest, however, that the Eastern area of Oklahoma may be better suited for H. gallinarum. Because of the potential for Histomonas-Heterakis transmission among wild and domestic gallinaceous birds, further study is certainly warranted.

Protozoan Infections

Since Trichomonas sp., Trichomonas gallinarum, Chilomastix sp., Eimeria sp., and Histomonas meleagridis were all identified in this study, the potential for disease and/or death for quail as well as other wild birds certainly exists. Shillinger and Coburn (1940) reported trichomoniasis was not infrequently found in quail, especially on game farms. They further stated that the protozoa causes a foamy diarrhea of grayish-white or greenish excrement in heavy infections, and concluded that if an infection were to continue for any length of time death would ensue. Davis, et al. (1964) reported Chilomastix sp. causing death in pen-raised quail from a Georgia game farm. The symptoms reported with infection by this protozoa were ruffled feathers, depression, anorexia, and a yellowish foamy diarrhea. The problem also exists for transmission of protozoans to other quail as well as other wild birds. Fecal droppings from infected bobwhite quail could contaminate water or feed sources with protozoans and serve as a source of infection for both domestic and wild birds.

Coccidiosis is one of the more important protozoa of primary concern in quail. Venard (1933) reported 32 of 67 (47.76 percent) adult quail infected with coccidia in Ohio. Three species were identified in the infected birds, and the pathological conditions ranged from none to enteritis, hemorrhage, and sloughed mucosa. Parmalee (1952)

reported finding no coccidia in 36 freshly killed bobwhite collected at various seasons of the year in two counties in Texas. However, this author quoted Stoddard in 1931 as reporting the frequency of coccidia in quail in several Southeastern states to range from 0 to 50 percent. Sneed and Jones (1950) observed 7 of 22 (31.80 percent) Oklahoma wild bobwhites to be infected with coccidia. They identified one species to Eimeria dispersa. The findings of this study are in agreement with those of Sneed and Jones (1950) with regard to prevalence of coccidiosis in Oklahoma bobwhite quail. The importance of this protozoan should be further evaluated in wild quail populations due to its pathologic potential.

Although Histomonas meleagridis was not observed in significant numbers, there is, nevertheless, cause for concern. H. meleagridis is not known to produce as severe a pathologic condition in quail as it does in turkeys, as reported by Kellogg and Reid (1970) and Lund and Chute (1971). but the possibility still exists that a few quail could be lost to the disease. The real potential, however, lies in the fact that bobwhite quail could serve as a vector for blackhead to wild turkeys and numerous domestic birds. The pathogenicity of H. meleagridis has been well documented for domestic turkeys. This has been substantiated by studies conducted by Malewitz, et al. (1958) and Doll and Franker (1963). Lund, et al. (1975) conducted a study on the susceptibility of young wild turkeys to infections with Histomonas meleagridis and Heterakis gallinarum. They concluded that Histomonas affected wild turkey poults similar to domestic poults, but strains of Heterakis that are well adapted to domestic turkeys are not necessarily well adapted to wild turkeys. Kellogg and Reid (1970) concluded that quail

could possibly come in contact with Heterakis and Histomonas through contact with domestic chicken flocks. The quail could then carry and transmit these parasites to the wild turkey. Lund and Chute (1971) concluded that unconfined bobwhites could possibly acquire the two parasites as the previous authors stated, but the latter felt it improbable that this could result in significant contamination of the birds own habitat or that of any other gallinaceous birds.

Chilomastix sp. did not occur at a very high percentage (30.12 percent), but the findings do show that the organism exists in wild quail. Davis, et al. (1964) reported a condition of Chilomastix sp. infection in pen-raised quail which produced 100 percent mortality in birds less than 1-week-old, and 50 percent in birds 5-6 weeks of age. Of approximately 35,000 young quail on a Georgia game farm, only 5,000 survived (86 percent mortality). These authors concluded that Chilomastix sp. can infect quail with a definite disease syndrome, especially in young birds. The birds examined in this study were all older than 6 weeks of age. Thus, the disease syndrome would have been passed, and the birds examined could have developed an immune response and overcome the disease. The potential definitely exists for large numbers of young Oklahoma bobwhite quail to be lost each year to Chilomastix sp. infections. If possible, younger birds should be examined by some system of monitoring during hatching season. There is also the potential for transmission to other gallinaceous birds.

The differences observed in the percentage of birds infected with protozoa from the 4 geographical areas suggests that the Central (87.50 percent) and Southeast (80.77 percent) areas have the highest total protozoa infections. However, Histomonas meleagridis was found only

in the Northwest (Optima and Canton) and Southeast (Pushmataha and Tishomingo) areas.

Blood protozoa were not observed in any of the 81 birds examined in this study. Wetmore (1941) reported one quail infected with Haemoproteus sp. and one with Plasmodium elongatum out of 93 birds examined from the District of Columbia area. Parmalee (1952) examined 73 blood smears from Texas quail and found neither Haemoproteus sp. or Plasmodium sp. Thus it is felt that neither of these two parasites significantly occur in bobwhite.

Bacteriological Infections

Relatively few positive reports of Salmonellosis have been recorded from the numerous surveys reported according to Steele and Galton (1971). Emmel (1935) reported an incidence of pullorum disease in captive birds from quail farms, but felt it was unlikely for the disease to be of any particular importance in wild birds. Other serotypes of Salmonella spp. have been reported in quail as evidenced in an extensive literature review conducted by Kellogg and Reid (1970). As to what extent an outbreak of salmonellosis in wild quail might account for widespread losses is unknown. It is felt that further and more extensive studies should be carried out to evaluate the feasibility for isolation of Salmonella spp., and to determine the true incidence of infection.

CHAPTER V

SUMMARY

This study was conducted to identify Salmonella spp., protozoa, and helminth parasites in Oklahoma bobwhite quail, and to estimate any potential problems these organisms might cause to domestic and other wild animals. The study was conducted statewide from July 1, 1975, through March 31,1976.

Two nematodes were identified with Subulura brumpti being the most common (27.36 percent) and Heterakis gallinarum the least (3.77 percent). Cestodes (5.66 percent) were recovered but were not identified. The prevalence and worm-burden was not high, but seasonal differences suggest helminth infections of either nematodes or cestodes are greatest during summer and fall. The potential problem of helminth infections with either of these two nematodes lies in the ability of H. gallinarum to harbor and transmit Histomonas meleagridis, and the possibility of Subulura brumpti to do the same. Little difference was observed in the percentage of birds infected from the 4 areas of the state studied, but findings suggest that birds from the eastern area harbor Heterakis gallinarum infections.

Four genera and five species of protozoa were identified from 83 quail with Trichomonas sp. being the most prevalent and Histomonas meleagridis the least. Chilomastix sp., Eimeria sp., and Trichomonas gallinarum were also identified. The total prevalence was not high,

but seasonal infections suggests that the highest percentage of infected birds occurred in the spring while summer showed the lowest. From 4 areas of the state it seems that the Central and Southeast areas have the highest prevalence of total protozoa infections. Histomonas meleagridis was found in the Northwest and Southeast areas only.

The findings of this study suggest that salmonellosis is of no apparent importance. However, this does not mean an outbreak cannot occur, in which case not only the quail population, but other wildlife could be affected.

Blood protozoa appear to be a rare occurrence in bobwhite quail, since no infected birds were found in this study and very few blood parasites have been reported from other studies.

This study suggests that the percentage of native Oklahoma bobwhite quail infected with helminths, protozoa, and selected bacterial organisms is relatively low. Several of the genera identified, however, are known to be capable of producing disease and/or death in quail and other wild and domestic gallinaceous birds. Periodic evaluations of birds from areas throughout the state are thus warranted, especially in areas where future introductions of native or exotic birds are contemplated.

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