

AGE IN RELATION TO THE WINTER FOOD HABITS
AND HELMINTH PARASITES OF THE BOBCAT
(LYNX RUFUS, SCHREBER) IN OKLAHOMA
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By

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TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION	1
II. REVIEW OF THE LITERATURE	2
Food Habits	2
Parasites	5
III. METHODS AND MATERIALS	9
IV. RESULTS	11
Introduction	11
Food Habits	15
Parasites	20
V. SUMMARY AND CONCLUSION	26
VI. LITERATURE CITED	31
APPENDIXES	34
APPENDIX A - TOOTH PREPARATION FOR DETERMING BOBCAT AGE	34
APPENDIX B - FORMULAE USED FOR STATISTICAL ANALYSIS OF FOOD HABITS AND HELMINTH PARASITISM	35

LIST OF TABLES

Table	Page
I. Published Bobcat Helminth Parasite Surveys	6
II. Total Number of Bobcats Collected Segregated by Month and Winter	12
III. Bobcat Age Classes as Determined by Tooth Cemental Layers	14
IV. Bobcat Food Habits Segregated by Age Class	16
V. Food Habits of Bobcats Less Than One Year Old and Those More Than One Year Old	19
VI. The Helminth Parasite Fauna of Bobcats Less Than One Year Old and Those More Than One Year Old	21

LIST OF FIGURES

Figure	Page
1. The Oklahoma Counties from Which Bobcats Were Collected, Including the Number of Bobcats from Each County	13
2. Occurrence of the Four Most Common Prey of 52 Bobcats	28
3. The Occurrence of Two Common Helminth Parasites of 66 Bobcats	30

CHAPTER I

INTRODUCTION

The bobcat (Lynx Rufus) is the only common wild felid occurring in Oklahoma; and it and the coyote (Canis latrans) are the only large carnivores found throughout the state. The bobcat is a fairly large (5.4-11.3 kg.), long-lived carnivore with a maximum life span in the wild of 10 or more years (Walker, 1975). Studies have shown that the diet consists primarily of lagomorphs and rodents. However, the diet is highly variable, and may include several game species as well as some livestock (Rollings, 1945 et al.). The bobcat is also becoming increasingly important as a game animal and furbearer.

While there have been several studies of bobcat biology performed in the United States, no comprehensive work has been done in the Oak/Bluestem Parkland and Bluestem/Grama Prairie ecoregions described by Bailey (1976) which encompass most of Oklahoma. This study was designed to provide basic information on the food habits and parasites of Oklahoma bobcats so that future management programs may be based on a better understanding of its biology.

This study was designed to meet two major objectives: 1) to illustrate the effect, if any, of age on parasite burdens, and 2) determine if age affected bobcat diet.

CHAPTER II

REVIEW OF THE LITERATURE

Food habits

Only one study has been published on the food habits of Oklahoma bobcats. Ellis and Shemnitz (1957) compared food habits of coyotes and bobcats based on the collection of 16 coyote and 10 bobcat stomachs from Cimarron County. They found mammal remains in all 10 bobcat stomachs, bird remains in two, and vegetation in two. Leporids were by far the most common food item, being recorded in six stomachs and accounting for over 70 percent of the total weight of food material. Other mammals included the kangaroo rat (Dipodomys ordi), grasshopper mouse (Onychomys leucogaster), pocket mouse (Perognathus sp.), and cattle. Eastern cottontail (Sylvilagus floridanus) occurred three times as often as black-tailed jackrabbit (Lepus californicus). Unidentified bird remains accounted for a total of less than 0.1 gram. The vegetation was thought to be present in the stomachs of prey at the time it was captured and eaten.

Several studies of bobcat food habits in surrounding states have been published. Fritts (1973) examined 150 bobcat stomachs collected from 1970 - 1972 in Arkansas. Swamp rabbit (Sylvilagus aquaticus) occurred most frequently (38.7 percent of all stomachs) and made up the greatest volume (40.6 percent). Sciurids, mainly fox squirrel (Sciurus niger) and grey squirrel (S. carolinensis), were recorded in 22 percent

of the stomachs and made up 10.2 percent of the total volume. Various cricetid rodents were found in 21.2 percent of the stomachs accounting for 10 percent of the total food volume. Domestic animals identified were chicken, cattle, and goat, together accounting for 4.3 percent of the total volume and occurring in 4.0 percent of all stomachs. He also related age to food habits and found that young adult bobcats (1 - 2 years) consumed relatively more cricetids and leporids, and fewer sciurids than did mature bobcats (2+ years). The diet of kittens (1 year) was essentially the same as that of the older age class.

In Texas Beasom and Moore (1977) found that bobcat diet changed with changes in the relative abundance of prey species. They identified 20 food species in 51 stomachs collected during 1971, a period when cotton rats (Sigmodon hispidus) and leporids were relatively scarce. Eastern cottontail and cotton rat occurred in 98 percent of those stomachs and made up 63.0 percent of the total food volume. They identified only six food species in 74 stomachs collected during 1972, a year when eastern cottontail and cotton rat were relatively abundant. They occurred in 96 percent of all stomachs, and accounted for 96.3 percent of the total food volume.

Hall (1973) found nine food species in 43 bobcat stomachs collected in Louisiana from April, 1969 to June, 1973. Rabbits were in 74.4 percent, cotton rat in 30.2 percent, various birds in 20.9 percent, and wood rat (Neotoma floridana) in 16.3 percent of all stomachs. The remaining food species accounted for no more than 4.4 percent occurrence.

Rollings (1945) recorded 11 food species in 50 stomachs from Minnesota bobcats. Snowshoe hare (Lepus americanus) was recorded in 26 stomachs making up 44.1 percent of the total food volume, white-tailed deer

(Odocoileus virginianus) in 22 stomachs making up 35 percent of the total volume, and porcupine (Erethizon dorsatum) in 10 stomachs making up 12.3 percent of the total volume. Other species accounted for less than 5.0 percent each of the total food volume.

Progulske (1955) analyzed 124 scats and 50 intestinal tracts to determine bobcat food habits in Virginia and North Carolina and identified 23 food species. Eastern cottontail, grey squirrel, and white-tailed deer were the three most common food species in both occurrence and percent volume.

Davis (1955) in a seasonal food habits study in Alabama identified nine bird and 17 mammals in the stomachs of 237 bobcats. Rabbit was the most common food item during all seasons and was highest in percent volume. White-tailed deer, cotton rat, and squirrels, depending on the season, were second, third, or fourth in percent of total food volume.

Gashwiler, Robinette, and Morris (1960) examined 53 bobcat stomachs collected in Utah and eastern Nevada and identified 15 prey species. Leporids were in 45.2 percent of the stomachs and comprised 48.9 percent of the total food volume. Mule deer (Odocoileus hemionus) occurred in 30.2 percent of the stomachs and made up 29.6 percent of the total volume. Domestic stock composed a significant portion of the diet. Domestic sheep made up 4.0 percent, chicken 2.9 percent of the total food volume and the two ranked third and fifth, respectively, in food volume percentages. They also identified leporids and mule deer as the most frequent of 12 species in 81 scats and intestinal fecal materials. Domestic sheep was found once and chicken not at all.

Nussbaum and Maeser (1975) used scat analysis to determine bobcat food habits in western Oregon. They identified 26 food species in 177

scats. They found leporids in more than 50 percent of the scats. Various small rodents made up the bulk of the rest of the food items with none occurring in more than 12 percent of all scats.

Leporids are shown to be a major food source for bobcats in nearly all published studies. In northern states the white-tailed deer is also an important food species, particularly in winter when it often becomes the main food source (Hamilton and Hunter, 1939; Marston, 1942; Pollack, 1951a; Erickson, 1955; and Westfall, 1956). The porcupine also appears to be an important food source in northern states. The bulk of the remaining diet is made up of small and medium-sized rodents. Smith (1945), Dill (1947), and Matson (1948) presented evidence that the bobcat actively preys on deer.

Parasites

Although there are no published studies on the parasites of Oklahoma bobcats, there have been at least three studies performed in Texas, one in Louisiana, and several in other regions. A complete listing of published bobcat parasite studies is included in Table I.

TABLE I

PUBLISHED BOBCAT HELMINTH PARASITE SURVEYS

Author(s)	Year	State(s)	No. of Specimens Surveyed	Parasite Species	No. of Specimens Infected
Little, et. al.	1971	Texas	9	<u>Ancylostoma caninum</u>	7
				<u>Toxascaris leonina</u>	6
				<u>Physaloptera</u> sp.	2
				<u>Troglostrongylus wilsoni</u>	2
				<u>Cylicospirura subaequalis</u>	1
Mitchell and Beasom	1974	Texas	81	<u>Ancylostoma caninum</u> and/or <u>A. brasiliense</u>	77
Stone and Pence	1978	Texas	66	<u>Alaria marciana</u>	3
				<u>Taenia rileyi</u>	60
				<u>Mesocestodes cati</u>	24
				<u>Physaloptera praeputialis</u>	58
				<u>Cyathospirura chevreuxi</u>	53
				<u>Cylicospirura felineus</u>	46
				<u>Didelphonema longispiculatum</u>	3
				<u>Toxascaris leonina</u>	60
				<u>Toxocara mystax</u>	11
				<u>Ancylostoma tubaeformae</u>	38
				<u>Pterygondermatites cahirensis</u>	2
				<u>Spirocerca lupi</u>	23
				<u>Vogeloides felis</u>	53
				<u>Metathelazia californica</u>	48
<u>Capillaria aerophila</u>	2				
<u>Onicola canis</u>	9				

TABLE I (Continued)

Author(s)	Year	State(s)	No. of Specimens Surveyed	Parasite Species	No. of Specimens Infected
Orihel and Ash	1964	Louisiana	3	<u>Dirofilaria striata</u>	3
				microfilaria	2
Miller and Harkema	1968	North and South Carolina	16	<u>Anafilaria canis</u>	5
				<u>Paragonimus rudis</u>	1
				<u>Mesocestoides variabilis</u>	1
				<u>Taenia macrocystis</u>	12
				<u>T. rileyi</u>	4
				<u>Centrorhynchus</u> sp.	1
				<u>Toxocara mystax</u>	12
				<u>Ancylostoma caninum</u>	5
				<u>A. braziliense</u>	3
				<u>Capillaria plica</u>	2
				<u>Anafilaroides rostrata</u>	2
Pollack	1951b	New England States		<u>Molineus barbatus</u>	6
				<u>Dirofilaria striata</u>	2
				<u>Taenia lyncis</u>	
				<u>T. laticolis</u>	
				<u>Toxocara cati</u>	
				<u>Physaloptera</u> sp.	
Sarmiento and Stough	1953	Virginia	64	<u>Poracaecum</u> sp.	
				<u>Anasakis</u> sp.	
				<u>Troglostrongylus wilsoni</u>	16

TABLE I (Continued)

Author(s)	Year	State(s)	No. of Specimens Surveyed	Parasite Species	No. of Specimens Infected
Hamilton and Hunter	1939	Vermont	140	<u>Physaloptera</u> sp.	16
Bursey and Burt	1970	Northern Maine & Eastern Canada	129	<u>Taenia macrocystis</u>	111
Manville	1957	Michigan	8	<u>Physaloptera praeputialis</u>	1
Rollings	1945	Minnesota	50	<u>Toxocara</u> sp.	1
				<u>T. cati</u>	21
				<u>Toxascaris leonina</u>	2
				<u>Physaloptera</u> sp.	2
				<u>P. praeputialis</u>	1
				Ascarinae	2
				<u>Spirocercasanguinolenta</u>	1
				<u>Taenia taeniaeformis</u>	7
				<u>T. pisiformis</u>	5
				<u>T. hydatigena</u>	3
				<u>T. rileyi</u>	2
				<u>T. monostephanos</u>	1
				<u>T. krabbei</u>	1

CHAPTER III

METHODS AND MATERIALS

During the years 1975 - 1977 bobcats were obtained, either as skinned whole carcasses, or as entrails with skull attached, from area hunters, trappers, and a fur buyer. Pertinent data concerning the date of collection, locale, and sex were provided by the collector on pre-printed manila shipping tags. Both carcasses and entrails were frozen until processed.

Food material was removed from the stomach and preserved in 10 percent formalin solution for later identification. When possible, items were identified by gross examination; but if the material was well-macerated, identification was based on hair, feather, and skull examination. Skull identification was based on Glass (1973). Hair was identified by comparing surface structure and color pattern with a reference collection. Bird remains were identified by comparing feathers and other external characters (mainly foot structure and leg scale patterns) with specimens in the Oklahoma State University Museum. Food items were enumerated and total food volume measured for each stomach.

All of the alimentary tract including the esophagus, stomach, small intestine, and large intestine, and most other major organs (trachea, lungs, heart, liver and kidneys) of each specimen were examined for helminth parasites. Recovered parasites were fixed in AFA fixative (25 parts 95% ethanol, 20 parts distilled H₂O, 5 parts 33% formaldehyde, and

1 part glacial acetic acid) and stored in 70 percent ethanol in labeled jars with the site of recovery and specimen number. Parasites were identified in collaboration with Dr. A. Alan Kocan of the Oklahoma State University School of Veterinary Medicine.

Bobcat age was determined by counting the cemental annular rings of an upper canine tooth. The sectioning and staining procedures were modified from Stone et al. (1975). Canine teeth were decalcified in dilute hydrochloric acid, sectioned at approximately 12 microns, stained with Giemsa Stain, and the stained sections mounted on 1 x 3 inch microscope slides (Appendix A).

Mounted slides were examined under a microscope equipped with a blue filter at 100X magnification. Age classification was based on criteria presented by Crowe (1975). Specimens whose canine tooth had an open root were classified as less than one year old. Those with closed roots but no rings were placed in the 1 - 2 year age class. Those with one annular ring were placed in the 2 - 3 year age class. All other age classes were assigned according to the formula:

$$\text{Age} = \text{Number of rings} + 1.$$

Bobcats were assigned to two age classes, those less than one year old and those greater than one year old. The data were then statistically analyzed to determine whether bobcat age affected its food habits or parasite fauna. Food habits were tested with z-tests and helminth parasitism was tested with t-tests. The formulae used in statistical analyses are provided in Appendix B.

CHAPTER IV

RESULTS

Introduction

A total of 81 bobcats were collected during the winters of 1975 - 1976 and 1976 - 1977 between the months of September and March. Seventy-one (88%) were collected during the winter, 1976 - 1977; and 10 (12%) were collected during the winter, 1975 - 1976. Fifty-eight (72%) were collected during the months of December, 1976 and January, 1977, coinciding with the Oklahoma furbearer hunting season (Table II).

Bobcats were collected in 16 Oklahoma counties. Twenty-nine bobcats (36%) were collected in Logan County; 11 (14%) were collected in Payne County. Five north-central Oklahoma counties (Creek, Lincoln, Logan, Oklahoma, and Payne Counties) accounted for 57 (70.4%) of the bobcats analyzed (Figure 1). County data were unavailable for four of the bobcats collected. However, it is known that these specimens were collected near Edmond, Oklahoma in either Logan or Oklahoma County.

Age was determined for 67 bobcats. Twenty-six were less than one year of age, 13 were 1 - 2 years of age, seven were 2 - 3 years of age, and 10 were 3 - 4 years of age. Eleven were older than four years. Age could not be determined for 14 of the bobcats analyzed because of imperfections of the ageing technique (Table III).

TABLE II

TOTAL NUMBER OF BOBCATS COLLECTED
SEGREGATED BY MONTH AND WINTER

Month	1975 - 1976		1976 - 1977		1975 - 1977	
	<u>Number Collected</u>	<u>Percent of Total</u>	<u>Number Collected</u>	<u>Percent of Total</u>	<u>Number Collected</u>	<u>Percent of Total</u>
September			2	2.47%	2	2.47%
October			1	1.23%	1	1.23%
November			2	2.47%	2	2.47%
December			25	30.86%	25	30.86%
January			33	40.74%	33	40.74%
February	8	9.88%	8	9.88%	16	19.75%
March	2	2.47%			2	2.47%
Total	10	12.35%	71	87.65%	81	100%

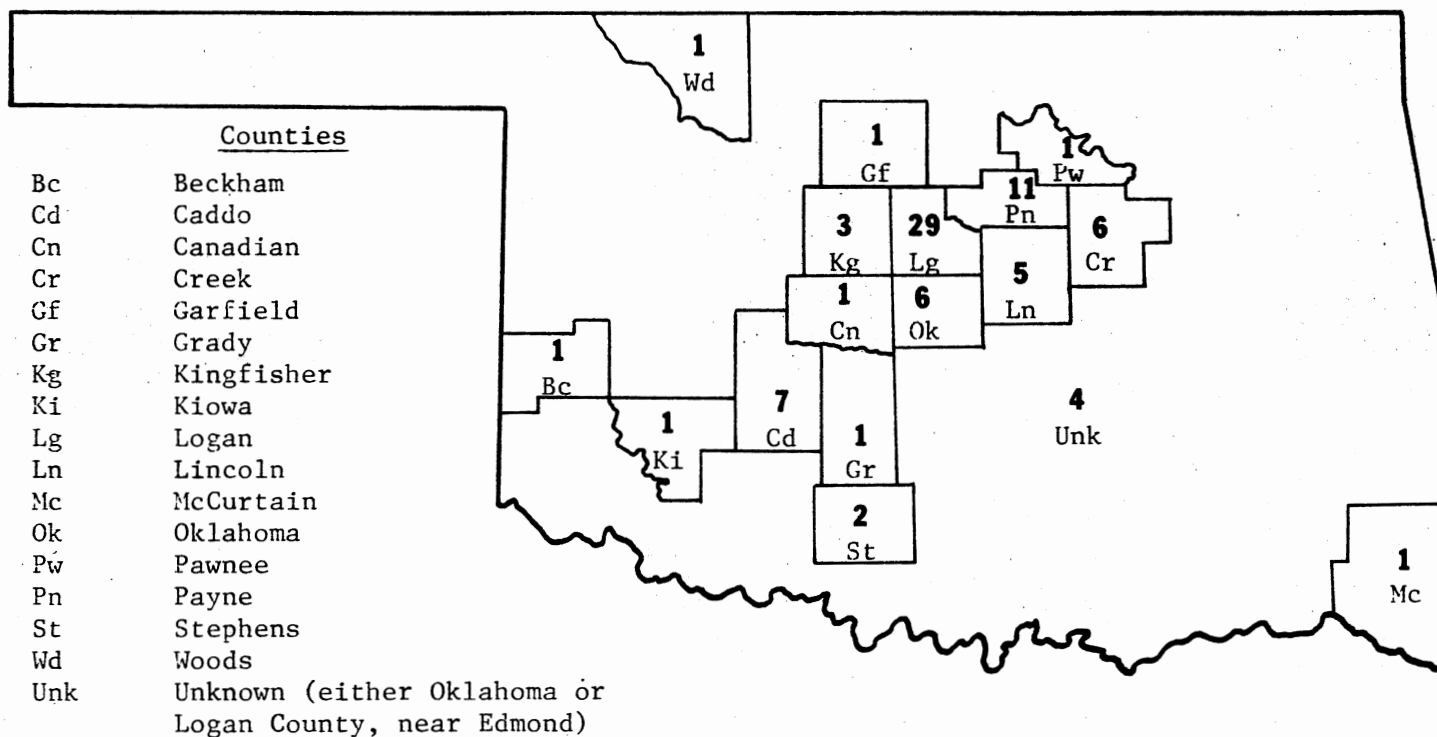


Figure 1. The Oklahoma Counties from Which Bobcat Specimens Were Collected, Including the Number of Bobcats from Each County.

TABLE III

BOBCAT AGE CLASSES AS DETERMINED
BY TOOTH CEMENTAL LAYERS

Annular Rings	Age	Number in Age Group	Percent Infected
Open Root	1 year	26	38.81
Closed Root, No Rings	1 - 2 years	13	19.40
1 Ring	2 - 3 years	7	10.45
2 Rings	3 - 4 years	10	14.93
3 Rings	4 - 5 years	3	4.48
4 Rings	5 - 6 years	2	2.99
5 Rings	6 - 7 years	3	4.48
6 Rings	7 - 8 years		
7 Rings	8 - 9 years	2	2.99
8 Rings	9 - 10 years	1	1.49
Total Number of Aged Bobcats		67	

Food habits

Table IV shows the results of the food analysis. Fifty-two (64%) of all stomachs surveyed contained food material. Cotton-tail was found most frequently (21 stomachs), followed by cotton rat (15 stomachs), Peromyscus spp. (12 stomachs), and wood rat (10 stomachs). Other mammals identified included fulvous harvest mouse (Reithrodontomys fulvescens) and plains pocket gopher (Geomys bursarius) in three stomachs each; muskrat (Ondatra zibethica) in two stomachs; and plains harvest mouse (Reithrodontomys montanus), fox squirrel, kangaroo rat, opossum (Didelphis virginiana), and striped skunk (Mephitis mephitis) in one stomach each. Birds identified were domestic chicken in two stomachs, blue jay (Cyanocitta cristata) in one stomach, bobwhite quail (Colinus virginianus) in one stomach, and turkey (Meleagris gallopavo) in one stomach. Unidentified bird remains were found in seven stomachs. Food volume ranged from six ml. to 637 ml., and averaged 175 ml. in the 67 stomachs containing food material.

Cotton rat was the most frequently occurring food species in bobcats less than one year of age (eight stomachs), followed by cottontail and Peromyscus spp. (five stomachs each). Wood rat and fulvous harvest mouse occurred in three stomachs each. Muskrat and plains pocket gopher were each found in two stomachs. Kangaroo rat was found in one stomach. Unidentified bird remains occurred in four stomachs. Food volume ranged from 14 ml. to 600 ml. and averaged 229 ml. in those stomachs with food.

A total of four food species were identified in seven of the 13 stomachs examined in the 1 - 2 year age group. Cottontail was found most often (four stomachs), followed by Peromyscus spp. (two stomachs), cotton rat (one stomach), and plains pocket gopher (one stomach). No

TABLE IV

BOBCAT FOOD HABITS SEGREGATED BY AGE CLASS

<u>Prey Species</u>	1 yr.		1 - 2 yrs.		2 - 3 yrs.		3 - 4 yrs.		4 yrs.		All Ages	
	Number		Number		Number		Number		Number		Number	
	With Food	Freq.	With Food	Freq.	With Food	Freq.	With Food	Freq.	With Food	Freq.	With Food	Freq.
Cottontail	5	.1923	4	.3077	2	.2857			5	.4545	21	.2593
Cotton rat	8	.3077	1	.0769	1	.1429			3	.2727	15	.1852
Wood rat	3	.1154					2	.2000	2	.1818	10	.1235
<u>Peromyscus</u> spp.	5	.1923	2	.1538	1	.1429	1	.1000			12	.1481
Fulvous harvest mouse	3	.1154									3	.0370
Plains harvest mouse							1	.1000			1	.0123
Muskrat	2	.0769									2	.0247
Fox squirrel					1	.1429					1	.0123
Plains pocket gopher	2	.0769	1	.0769							3	.0370
Kangaroo rat	1	.0385									1	.0123
Opossum											1	.0123
Unidentified bird	4	.1538					1	.1000	1	.0909	7	.0864

TABLE IV (Continued)

Prey Species	1 yr.		1 - 2 yrs.		2 - 3 yrs.		3 - 4 yrs.		4 yrs.		All Ages	
	Number With Food	Freq.	Number With Food	Freq.	Number With Food	Freq.	Number With Food	Freq.	Number With Food	Freq.	Number With Food	Freq.
Chicken	1	.0385							1	.0909	2	.0247
Blue Jay									1	.0909	1	.0123
Bobwhite quail									1	.0909	1	.0123
Turkey											1	.0123
All Stomachs With Food	18/26	.6923	7/13	.5385	4/7	.5714	3/10	.3000	9/11	.8182	52/81	.6420

bird remains were found in this age group. Food volume ranged from 40 ml. to 637 ml. and averaged 189 ml. in the seven stomachs with food.

Four of seven stomachs examined in the 2 - 3 year age group contained four mammal species. No bird remains were identified. Cottontail occurred in two stomachs. Peromyscus sp. and fox squirrel each occurred in one stomach. Food volume ranged from seven ml. to 571 ml. and averaged 377 milliliters.

Three of 10 stomachs analyzed in the 3 - 4 year age group contained food material. Woodrat was found in two stomachs. Peromyscus sp. and plains harvest mouse were each found in one stomach. Food volume ranged from 26 ml. to 155 ml. and averaged 87 milliliters.

Nine of 11 bobcats greater than four years of age had food material in their stomachs. Cottontail was identified in five stomachs, cotton rat in three stomachs, and wood rat in two stomachs. Domestic chicken, blue jay, bobwhite quail, and the remains of an unidentified bird were each found in one stomach. Food volume ranged from six ml. to 405 ml. and averaged 176 milliliters.

Thirty-four of the 41 bobcats older than one year of age had food material in their stomachs (Table V). Ten food species were identified. Cottontail was recovered most often (11 stomachs) and cotton rat second (five stomachs). Wood rat and Peromyscus spp. were each recovered in four stomachs. Plains harvest mouse, fox squirrel, plains pocket gopher, domestic chicken, blue jay, and bobwhite quail were each identified in one stomach. Food volume ranged from six ml. to 637 ml. and averaged 204 milliliters.

The cotton rat was the only prey species whose occurrence was significantly affected by age with more than 90 percent probability.

TABLE V

FOOD HABITS OF BOBCATS LESS THAN ONE YEAR OLD
AND THOSE MORE THAN ONE YEAR OLD

<u>Prey Species</u>	1 Year		1 + Years		All Ages	
	<u>Number With Food</u>	<u>Freq.</u>	<u>Number With Food</u>	<u>Freq.</u>	<u>Number With Food</u>	<u>Freq.</u>
Cottontail	5	.1923	17	.3091	21	.2593
Cotton rat	8	.3077	7	.1273	15	.1852
Wood rat	3	.1154	7	.1273	10	.1235
<u>Peromyscus</u> spp.	5	.1923	7	.1273	12	.1481
Fulvous harvest mouse	3	.1154			3	.0370
Plains harvest mouse			1	.0182	1	.0123
Muskrat	2	.0769			2	.0247
Fox Squirrel			1	.0182	1	.0123
Plains pocket gopher	2	.0769	1	.0182	3	.0370
Kangaroo rat	1	.0385			1	.0123
Opossum					1	.0123
Unidentified bird	4	.1538	2	.0364	7	.0864
Domestic chicken	1	.0385	1	.0182	2	.0247
Blue jay			1	.0182	1	.0123
Bobwhite quail			1	.0182	1	.0123
Turkey					1	.0123
All Stomachs With Food	18/26	.6923	34/41	.7419	52/81	.6420

Z-test analysis showed the cotton rat to occur in bobcats less than one year old than in those greater than one year old with a probability of 0.97. Cottontail, Peromyscus spp. and wood rat occurred more often in bobcats greater than one year old than in those less than one year old with probabilities of 0.89, 0.73, and 0.56, respectively. The probability that other prey species were affected by age was less than 50 percent.

Parasites

Table VI presents the results of the helminth parasite analysis. One or more helminths were recovered from the internal organs of all 66 bobcats surveyed for parasites. Twenty two of the bobcats surveyed were less than one year old, 30 were more than one year old, and the age was indeterminate for 14. Helminths were recovered from the esophagus, stomach, small intestine, trachea, and lungs. None were found in the large intestine, heart, liver, or kidney. With the exception of Physaloptera praeputialis and Spirocerca lupi, identified helminth species were restricted to specific organs. Physaloptera praeputialis was recovered from the esophagus, stomach, small intestine, and trachea. Spirocerca lupi was recovered from the esophagus and trachea.

Two nematode species were recovered from the esophagus. Physaloptera praeputialis was recovered from a total of seven and averaged 3.9 worms per infected esophagus. It was found in two of 22 (9.1%) bobcats less than one year old and five of 44 (11.4%) more than one year old, averaging 5.0 and 3.4 worms, respectively, in infected esophagi. Two S. lupi were recovered from the esophagus of one bobcat less than one year old.

TABLE VI

THE HELMINTH PARASITE FAUNA OF BOBCATS
 LESS THAN ONE YEAR OLD AND THOSE
 MORE THAN ONE YEAR OLD

Parasite	1 year old (22 bobcats)			1 year old (44 bobcats)			All Ages (66 bobcats)		
	N	%	\bar{x}	N	%	\bar{x}	N	%	\bar{x}
ESOPHAGUS									
<u>Physaloptera praeputialis</u>	2	9.1	5.0	5	11.4	3.4	7	10.6	3.9
<u>Spirocerca lupi</u>	1	4.6	2.0				1	1.5	2.0
STOMACH									
<u>Physaloptera praeputialis</u>	17	77.3	17.5	31	70.5	16.4	48	72.7	16.8
<u>Physaloptera sp.</u>	1	4.6	2.0	3	6.8	5.3	4	6.1	4.5
unidentified Nematode	1	4.6	1.0	2	9.1	1.0	3	4.6	1.0
SMALL INTESTINE									
<u>Ancylostoma caninum</u>	13	59.1	3.6	24	54.5	11.0	37	56.1	8.4
<u>Necator sp.</u>				1	2.3	3.0	1	1.5	3.0
<u>Physaloptera praeputialis</u>	6	27.3	11.7	17	38.6	8.9	23	34.9	15.2
<u>Toxascaris leonina</u>	12	54.6	4.4	29	65.9	8.3	42	63.6	7.0
<u>Toxocara caninum</u>	2	9.1	6.5	11	25.0	3.3	13	19.7	3.8
<u>Capillaria sp.</u>				1	2.3	2.0	1	1.5	2.0
<u>Alaria canis</u>				1	2.3	2.0	1	1.5	2.0
Unidentified Nematode	4	18.8	3.5	11	29.0	3.5	15	22.7	3.5
<u>Taenia sp.</u>	15	68.2	16.5	34	77.3	13.6	49	74.2	14.5
Unidentified Cestode	1	4.6	11.0	2	4.5	6.0	3	4.6	7.7

TABLE VI (Continued)

Parasite	1 year old (22 bobcats)			1 year old (44 bobcats)			All ages (66 bobcats)		
	<u>N</u>	<u>%</u>	<u>\bar{x}</u>	<u>N</u>	<u>%</u>	<u>\bar{x}</u>	<u>N</u>	<u>%</u>	<u>\bar{x}</u>
LUNG									
<u>Troglostrongylus wilsoni</u>	5	22.7	11.0	10	22.7	8.5	15	22.7	9.3
Unidentified Nematode	2	9.1	1.0	4	9.1	1.3	6	9.1	1.2
<u>Alaria canis</u>	1	4.6	2.0	1	2.3	2.0	2	3.0	2.0
<u>Paragonimus kellicotti</u>				1	2.3	9.0	1	1.5	9.0
TRACHEA									
<u>Physaloptera praeputialis</u>				2	4.5	1.0	2	1.5	1.0
<u>Spirocerca lupi</u>				2	4.5	1.0	2	1.5	1.0

Three nematode species were recovered from stomachs. Physaloptera praeputialis was recovered from the stomachs of 17 of 22 (77.3%) bobcats less than one year old, from 31 of 44 (70.5%) bobcats more than one year old, and from 48 of 66 (72.7%) of all bobcats. It averaged 17.5, 16.4, 16.8 worms, respectively, in infected stomachs. Four of the stomachs surveyed contained an unidentified Physaloptera sp., averaging 4.5 worms in infected stomachs. Two were found in one stomach of a bobcat less than one year old. Three stomachs of bobcats more than one year old had an average of 5.3 worms of this species. An unidentified nematode was found in three stomachs. One was found in the stomach of a bobcat less than one year old; and one was found in each of two stomachs of bobcats more than one year old.

Seven species of nematodes were identified from the small intestines. Toxascaris leonina was found most frequently, and was recovered from 12 of 22 (54.5%) bobcats less than one year old, 29 of 44 (65.9%) more than one year old, and 42 of all 66 (63.6%) small intestines examined averaging 4.4, 8.3, and 7.0 worms, respectively, in infected small intestines. Ancylostoma caninum was the second most frequently occurring nematode in the small intestine. It was recovered from 13 (59.1%) bobcats less than one year old, 24 (54.5%) older than one year old, and 37 (56.1%) overall, averaging 3.6, 11.0, and 8.4 worms, respectively, in infected small intestines. The third most frequently occurring nematode was P. praeputialis. It was recovered from the small intestines of six (27.3%) bobcats less than one year old, 17 (38.6%) more than one year old, and 23 (34.9%) overall. Physaloptera praeputialis was the most numerous nematode in infected small intestines averaging 11.7, 8.9, and 15.2 worms, respectively.

Other identified nematode species occurred infrequently. Toxocara caninum was recovered from the small intestines of two bobcats less than one year old, 11 more than one year old, and 13 overall, averaging 6.5, 3.3, and 3.8 worms, respectively, per infection. Three Necator sp. were found in the small intestine of the bobcat more than one year old. Two Capillaria sp. were recovered from the small intestine of a bobcat of unknown age. Unidentified nematodes were recovered from 15 small intestines, averaging 3.5 worms per small intestine.

Cestodes were frequently recovered from the small intestines. Taenia spp. was recovered from 15 (68.2%) bobcats less than one year old, 34 (77.3%) more than one year old, and 49 (74.2%) of all bobcats surveyed. They averaged 16.5, 13.6, and 14.5 worms, respectively, in infected bobcats. Cestodes of undetermined genera were recovered from a total of three bobcats. Two Alaria canis were found in one bobcat greater than one year old and they were the only trematode recovered from the small intestines.

Three nematode and one trematode species were recovered from the lungs. Troglostrongylus wilsoni was found in the lungs of five of 22 (22.7%) bobcats less than one year old, 10 of 44 (22.7%) more than one year old, and 15 of 66 (22.7%) bobcats overall. It averaged 11.0, 8.5, and 9.3 worms, respectively, in infected lungs. An unidentified filarial worm was found in the lungs of six bobcats.

Two trematode species were recovered from the lungs. Two Alaria canis were found in a bobcat less than one year old and in one more than one year old. Nine Paragonimus kellicotti were found in one bobcat more than one year old.

Two nematode species, Physaloptera praeputialis and Spirocerca

lupi were recovered from bobcat tracheae. One P. praeputialis was found in each of two tracheae; and one S. lupi was found in each of two tracheae. The four bobcats were more than one year old.

When the parasite data of bobcats less than one year old were compared with the data from bobcats more than one year old, using t-tests, no significant differential in infection according to age was found at the 90 percent confidence level. However, t-tests did show Toxascaris leonina to occur more often in bobcats older than one year old than in those less than one year old at the 85 percent confidence level. Confidence levels for age affects on all other tested parasite species were less than 50 percent.

CHAPTER V

SUMMARY AND CONCLUSION

This study was undertaken to determine the effect of age on bobcat food habits and helminth parasitism. A total of 81 bobcats were collected from 16 Oklahoma counties during the winters of 1975 - 1976 and 1976 - 1977. Age was determined for 67 bobcats and ranged from less than one year old to more than nine years old. Fifty-two of 81 stomachs surveyed (64%) contained food material. Twelve mammal and three bird species were identified. Cottontail was recovered from 21 stomachs, cotton rat from 15 stomachs, Peromyscus spp. from 12 stomachs, and wood rat from 10 stomachs. No other prey species was found in more than three stomachs.

Helminth parasites were recovered from all 66 bobcats surveyed. Worms were recovered from the esophagus, stomach, small intestine, trachea, and lungs. Physaloptera praeputialis was the nematode species found most frequently. It was also the most numerous nematode of all species recovered. It was the most common helminth in the esophagus and stomach, and was also found in the small intestine and trachea. Toxascaris leonina was the most frequently-occurring nematode in the small intestine. Spirocerca lupi and P. praeputialis were each found in one trachea and they were the only helminths recovered from the trachea. Troglostrongylus wilsoni was the most frequent and most numerous helminth recovered from the lungs. Taenia spp. were the only

cestodes identified, and all were found in the small intestine. Nine trematodes of an unidentified species were recovered from the lungs. Analysis using t-tests showed that Toxascaris leonina occurred more often in bobcats greater than one year old than in those less than one year old with a probability of 0.85. The probability that the occurrence of any other parasite was affected by host age was less than 0.50.

It appears that the cottontail is the major food source for Oklahoma bobcats, which agrees with the majority of the comprehensive food habits studies published to date. Various small and medium sized rodents also appear to be an important food source. Birds apparently make up a relatively small portion of the total diet.

The importance of cottontail as a food source becomes more apparent when prey size is considered. An adult cottontail weighs about 908 - 1816 grams, an adult cotton rat about 114 - 199 grams, an adult wood rat about 199 - 383 grams, and an adult Peromyscus spp. (P. maniculatus and P. leucopus) about 14 - 35 grams (Burt and Grossenheider, 1964). Therefore, not only is cottontail eaten most often, but, it provides considerably more food volume per unit than do other commonly eaten prey species.

It appears that age may affect diet. When bobcats are grouped into two age classes (those less than 1 year old, and those greater than one year old), the frequency of occurrence of cottontail and cotton rat is reversed for the two age classes. Cotton rat is eaten nearly twice as often as cottontail by young bobcats and cottontail is eaten more than twice as often as cotton rat by adults. The rate at which the next two most common prey (wood rat and Peromyscus spp.) are eaten appears to be relatively unaffected by bobcat age (Figure 2).

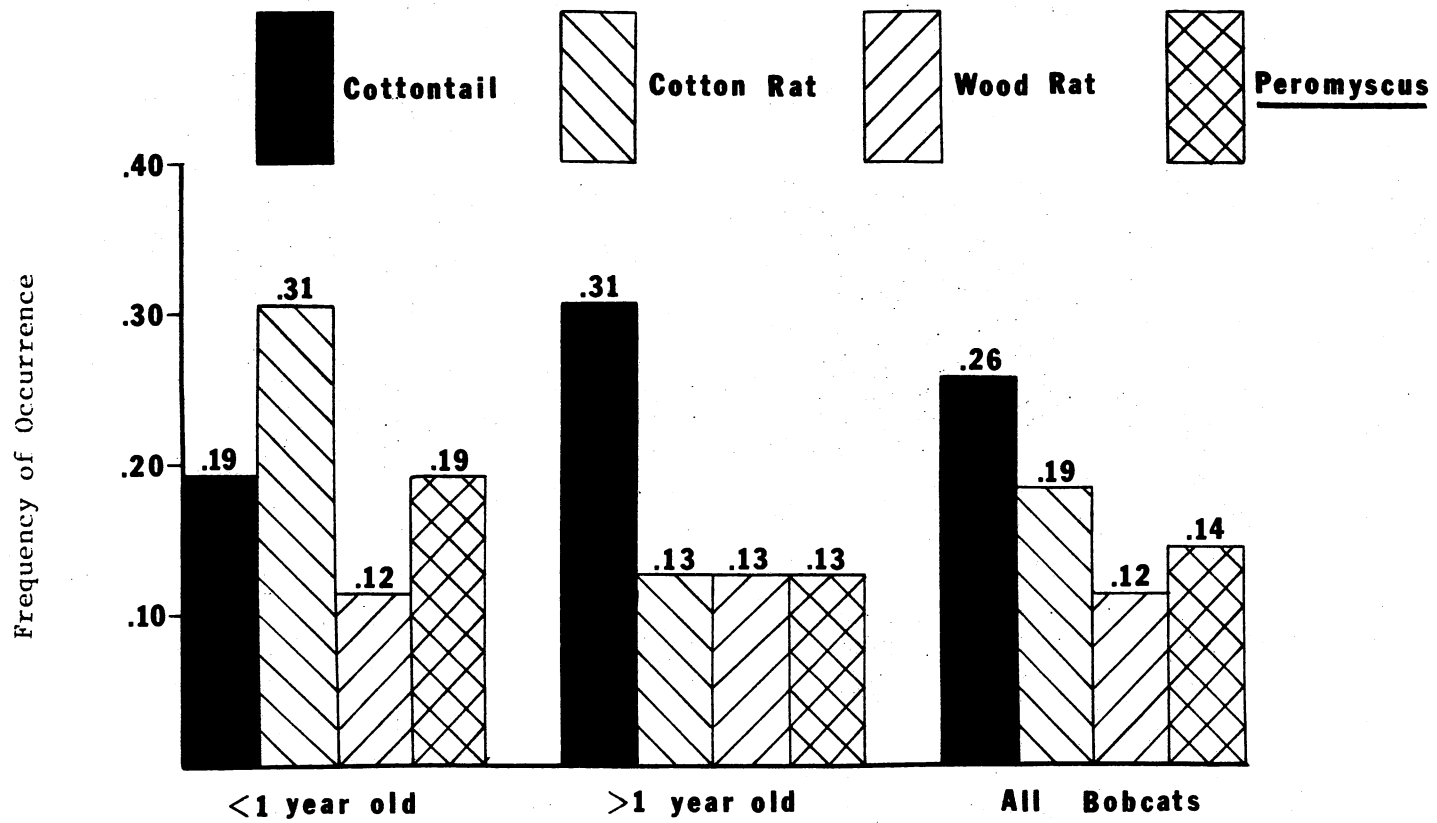


Figure 2. Occurrence of the Four Most Common Prey of 52 Bobcats.

Statistical analyses using z-tests appear to support the numerical evidence that cottontail and cotton rat predation was affected by bobcat age.

One might speculate that the cotton rat is a "training species" for young bobcats, and is the first easily available prey that the young cat learns to catch on its own. Cottontail, on the other hand, may be a food actually caught by the mother, but which is used as a supplement by the young cat while it is sharpening its own hunting skills on smaller prey.

The nematode parasites Toxascaris leonina and Toxocara caninum appear to be the only helminth parasites possibly affected by bobcat age. Both of these helminths occur in bobcats older than one year more frequently than in those less than one year old (Figure 3). Statistical analyses showed possible support for the numerical evidence that of T. leonina was affected by host age. The numbers of helminths in infected bobcats appear to be unaffected by host age.

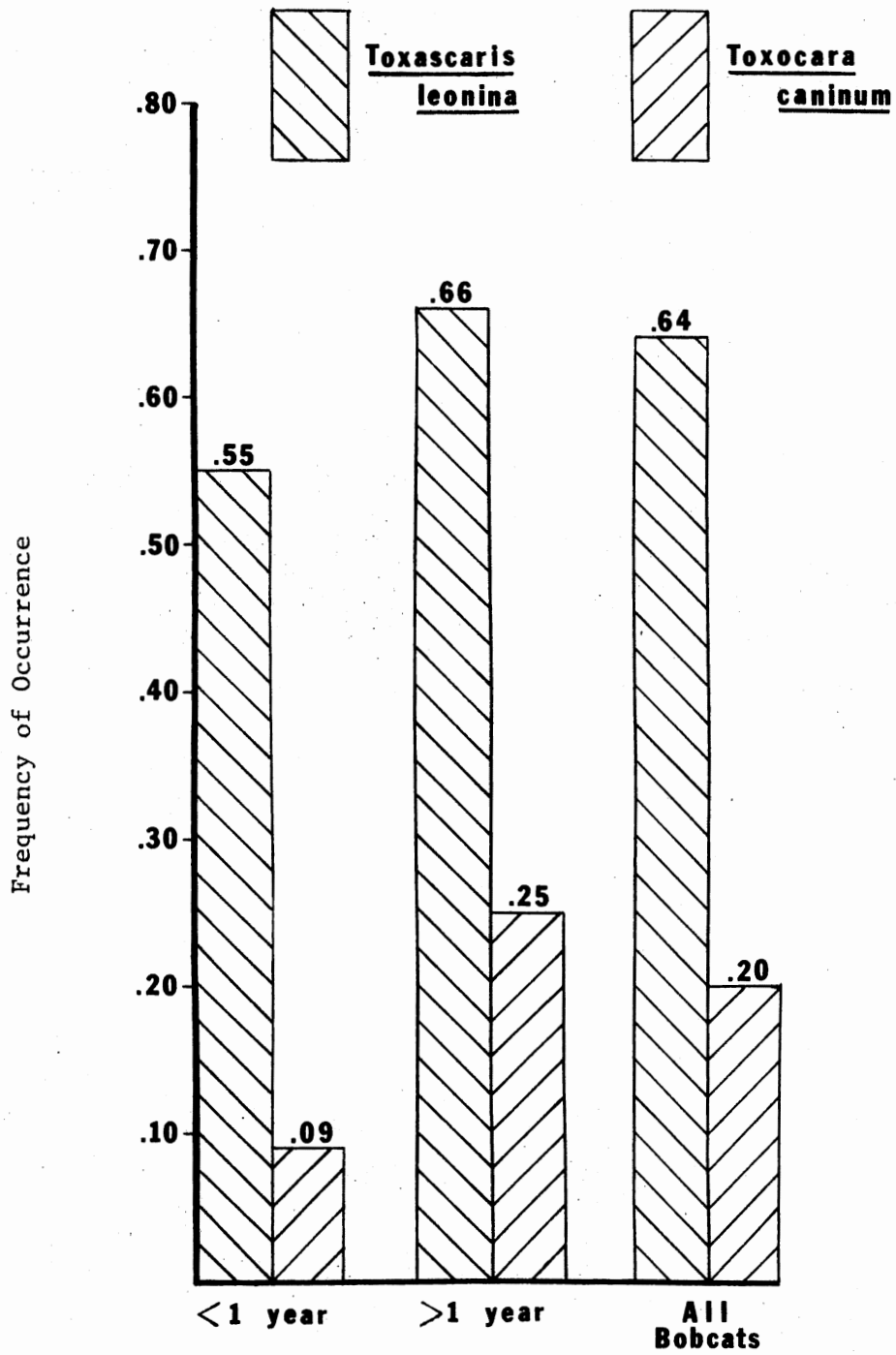


Figure 3: The Occurrence of Two Common Helminth Parasites of 66 Bobcats.

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APPENDIX A

TOOTH PREPARATION FOR DETERMINING

BOBCAT AGE

Bobcat age was determined by counting the cemental annular rings of an upper canine tooth. The sectioning and staining procedures were modified from Stone et al. (1975). Canine teeth were stored in 70 percent ethanol until decalcification. Teeth were decalcified for 3 - 5 days in five percent hydrochloric acid, rinsed in distilled water for 24 hours, and sectioned at approximately 12 microns on a cryostat. Sections were placed on 1 X 3 inch microscope slides and allowed to dry overnight at room temperature. When dry, sections were covered with a solution of two parts Giemsa Stain and 10 parts distilled water for 30 minutes at room temperature. After staining, slides were rinsed twice in tap water, once in distilled water, and allowed to dry. When dry, sections were cleared for 15 minutes in xylene and immediately mounted in Permount mounting medium (Fisher Scientific Company).

APPENDIX B

FORMULAE USED FOR STATISTICAL ANALYSES

OF FOOD HABITS AND HELMINTH

PARASITISM

z-Test

$$z = \frac{P_1 - P_2}{\sqrt{p(1-p)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where n_1 = number of bobcats less than one year old

n_2 = number of bobcats greater than one year old

p_1 = frequency of prey item occurrence in bobcats less than one year old

p_2 = frequency of prey item occurrence in bobcats greater than one year old

p = frequency of prey item occurrence in all aged bobcats

t- Test

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - 1) s_1^2 + (n_2 - 1) s_2^2}{n_1 + n_2 - 2} \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where n_1 = number of bobcats less than one year old

n_2 = number of bobcats greater than one year old

\bar{x}_1 = average number of a helminth species recovered from bobcats less than one year old

\bar{x}_2 = average number of a helminth species recovered from bobcats greater than one year old

s_1^2 = variance in the number of a helminth species recovered from bobcats less than one year old

s_2^2 = variance in the number of a helminth species recovered from bobcats greater than one year old.

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