

Analysis of Turkey Vulture Diet from Pellets Collected in Richmond, Indiana

An Honors Thesis (HONRS 499)

By

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A handwritten signature in black ink, reading "Kamal Islam". The signature is written in a cursive style with a horizontal line underneath the name.

Ball State University

Muncie, Indiana

May 2002

Expected date of graduation: May 2002

ABSTRACT

Although research on the eating habits and food preferences of Turkey Vultures (*Cathartes aura*) have been undertaken in other areas such as Pennsylvania and Wisconsin, little research has been conducted on the diet of Turkey Vultures in Indiana. A bird's feeding habits can vary across its range so it is important to determine the preferences of Turkey Vultures in Indiana. I analyzed 329 Turkey Vulture pellets that were collected weekly from 1994-1996 from the same roost site near Richmond, Wayne County, Indiana. Dr. Neil Sabine, Indiana University East, collected the pellets and analyzed them. Dr. Sabine gave me a subset of his sample to analyze and to verify the accuracy of the methodology employed in his analysis without knowing his results. The objective of my study was to determine if there was a shift in the vultures' diet over time, specifically with regard to mammalian species consumed. Guard hairs found in the pellets were analyzed using macroscopic and microscopic techniques to determine mammalian species consumed by Turkey Vultures. Chi-squared test of homogeneity was used to determine if there was a significant difference between the proportions of raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and other mammals consumed among years (1994, 1995, and 1996). My results indicated no significant differences in the proportions of mammals consumed from 1994-1996 ($p < 0.3$).

INTRODUCTION

Turkey Vultures (*Cathartes aura*) inhabit and breed in the entire continental United States (Kirk and Mossman 1998). Their year-round range is mostly in the

southeastern states, as far west as Texas and as far north as Maryland. Turkey Vultures are common in Indiana, but not much is known about their diet, locally. The birds' diet has been studied elsewhere. They are known to feed opportunistically on a wide range of wild and domestic carrion, but mammals are the most common food source (Kirk and Mossman 1998). Turkey Vultures in Pennsylvania during August, October and December consumed pig (*Sus Scrofa*; 14% of diet), cow (*Bos taurus*; 6%), sheep (*Ovis aries*; 1%), and kitchen scraps (6%). Wild animals included woodchuck (*Marmota monax*; 16%), striped skunk (*Mephitis mephitis*; 8%), raccoon (*Procyon lotor*; 13%), opossum (*Didelphis virginiana*; 10%), white-tailed deer (*Odocoileus virginianus*; 10%), squirrels (Sciuridae; 5%) and rabbits (Leporidae; 6%) (Coleman and Fraser 1987).

Turkey Vultures in Wisconsin (March through November) consumed pig (9% of diet), cow (30%), skunk (15%), raccoon (13%), white-tailed deer (21%), squirrels (1%), rabbits (2%), and birds (4%; Kirk and Mossman 1998). There is some evidence that Turkey Vultures prefer particular carrion in parts of their range (Kirk and Mossman 1998). In Pennsylvania and Maryland, there was no significant seasonal shift in food size or type between summer and winter (Coleman and Fraser 1987). No such research has been conducted in Indiana.

Turkey Vultures consume hair and bones while they are feeding on carrion. This material cannot be digested and Turkey Vultures regurgitate indigestible material in the form of a small pellet (Kirk and Mossman 1998). Examination of the contents in pellets allows one to determine which species is consumed. Pellets examined in this study were a sub-sample of pellets examined by Dr. Neil Sabine. This study will help assess the

accuracy of the methodology employed by Dr. Sabine without my having prior knowledge of his results.

OBJECTIVES

1. To determine mammalian species eaten by Turkey Vultures from a roost site near Richmond, Indiana from March through November, 1994, 1995, and 1996.
2. To determine if there is a significant change in the birds' diet among years.

METHODS

Collection Site

Turkey Vulture pellets were collected from a roost site near Richmond, Wayne County, Indiana by Dr. Neil Sabine. Every pellet found at the site was collected weekly from March-November, 1994-1996.

Pellet Analysis

Dr. Sabine examined guard hairs in the pellets collected, determined the proportion of mammalian species consumed across 3 years (1994-1996) without relaying the results of his analysis, and gave me a sub-sample (approximately 800) of these pellets to examine. However, due to limited time all of these pellets could not be analyzed; I examined a total of 329 pellets. Each pellet was assigned a number and a random numbers table was used to select approximately 100 pellets to examine at a time. Pellets were analyzed in batches of 100 to be certain that the sample size was not larger than could be examined in the available time. Guard hairs from each pellet were observed,

first macroscopically then microscopically. Banding patterns and coloration were the macroscopic characteristics examined to compare guard hairs obtained from the pellets with museum skins. From museum skins, it was determined that the banding patterns were as follows: raccoon - hairs with alternating black and white bands of equal length throughout the length of the hair, opossum - white hairs with a black tip, striped skunk - hairs were solid black, woodchuck - hairs were dark at the base fading to orange at the tip, eastern cottontail (*Sylvilagus floridanus*) - short hairs with a black band at the base and tip with a white band in the middle, fox squirrel (*Sciurus niger*) - hairs with alternating black, orange, and white bands of equal length. Comparison with museum skins allowed determination of mammalian species consumed by Turkey Vultures. Each pellet examined contained the remains of only one species. Based on these observations, pellets containing guard hairs from the same species were grouped together. Using a random numbers table, pellets were selected from each identified species group to make impression slides for microscopic examination. For every ten pellets of an identified species group, one slide was made. For groups with less than ten pellets, at least one slide was made for that group. A thin layer of clear fingernail polish was applied to a blank microscope slide and allowed to dry slightly. A guard hair from the pellet was then placed onto the fingernail polish. Once the polish was completely dry, the hair was removed, leaving an impression of the guard hair's scale pattern. A second party numbered the slides and recorded the slide number and from which pellet the slide was made. This was done so microscopic observations were not influenced by macroscopic observations. Scale patterns on the slides made from pellets were compared with a

reference set of slides made from museum skins obtained from Dr. Sabine. This allowed determination of mammalian species consumed by Turkey Vultures. Macroscopic conclusions were then compared with microscopic conclusions. If the microscopic and macroscopic conclusions were consistent, it was assumed that all pellets in that group were determined correctly macroscopically. If all microscopic conclusions for a group were not consistent with macroscopic conclusions, that group of pellets was re-analyzed using macroscopic and microscopic procedures until conclusions were identical.

STATISTICAL ANALYSIS

Pellets were examined and assigned to eight categories based on the pellet's contents. The categories were: raccoon, opossum, striped skunk, woodchuck, eastern cottontail, fox squirrel, birds, and unknown. Woodchuck, striped skunk, eastern cottontail and fox squirrel were grouped together and labeled "other mammals" because there were only a small number of each species (Table 1). A chi-squared test of homogeneity with an alpha-level of 0.05 was used (LeBlanc 2000) to determine if there was a significant difference in the proportion of opossum, raccoon and other mammals consumed from March through November, 1994 -1996. The unknown group was not included in the chi-square test because unknown pellets could possibly belong to an identified species group. The bird category was also not included in the chi-square test because I was mainly interested in mammalian species consumed by the vultures and this category was too small ($n = 16$) to properly incorporate into the test.

Table 1. The number of each species consumed by Turkey Vultures in Richmond, Indiana from March through November, 1994, 1995, and 1996.

Species	1994	1995	1996	Total
Raccoon (<i>Procyon lotor</i>)	20	74	89	183
Opossum (<i>Didelphis virginiana</i>)	8	28	23	59
Fox Squirrel (<i>Sciurus niger</i>)	5	14	3	22
Eastern Cottontail (<i>Sylvilagus floridanus</i>)	0	3	3	6
Striped Skunk (<i>Mephitis mephitis</i>)	3	10	10	23
Woodchuck (<i>Marmota monax</i>)	0	1	1	2
Birds	4	5	7	16
Unknown	2	7	9	18
<i>Total</i>	42	142	145	329

RESULTS

A total of 329 pellets were examined for the years 1994 (n = 42), 1995 (n = 142), and 1996 (n = 145) (Table 1). The percentage of each species consumed in 1994 was as follows: raccoon (47.6%), opossum (19.0%), fox squirrel (11.9%), eastern cottontail (0%), striped skunk (7.1%), woodchuck (0%), birds (9.5%), and unknown (4.8%) (Figure 1). The percentage of each species consumed in 1995 was as follows: raccoon (52.1%), opossum (19.7%), fox squirrel (9.9%), eastern cottontail (2.1%), striped skunk (7.0%), woodchuck (0.01%), birds (3.5%), and unknown (4.9%). The percentage of each species consumed in 1996 was as follows: raccoon (61.4%), opossum (15.9%), fox squirrel (2.1%), eastern cottontail (2.1%), striped skunk (6.9%), woodchuck (0.01%), birds (4.8%), and unknown (6.2%).

There was no significant difference between the proportion of opossum, raccoon and other mammals consumed by Turkey Vultures in Richmond, Indiana from March through November across 3 years (1994, 1995, and 1996) (chi-squared test of homogeneity: $\chi^2 = 5.276$, $df = 4$, $p < 0.30$, $N = 295$; Table 2).

DISCUSSION

My results differ from studies in Wisconsin and Pennsylvania. Cows and pigs were consumed often by Turkey Vultures in Pennsylvania (39% of diet; Coleman and Fraser 1987) and Wisconsin (20%; Kirk and Mossman 1998). Turkey Vultures from a roost in Richmond, Indiana did not consume cows or pigs. Cows and pigs may not be an accessible food source for these birds. However, it is possible that cows and pigs were

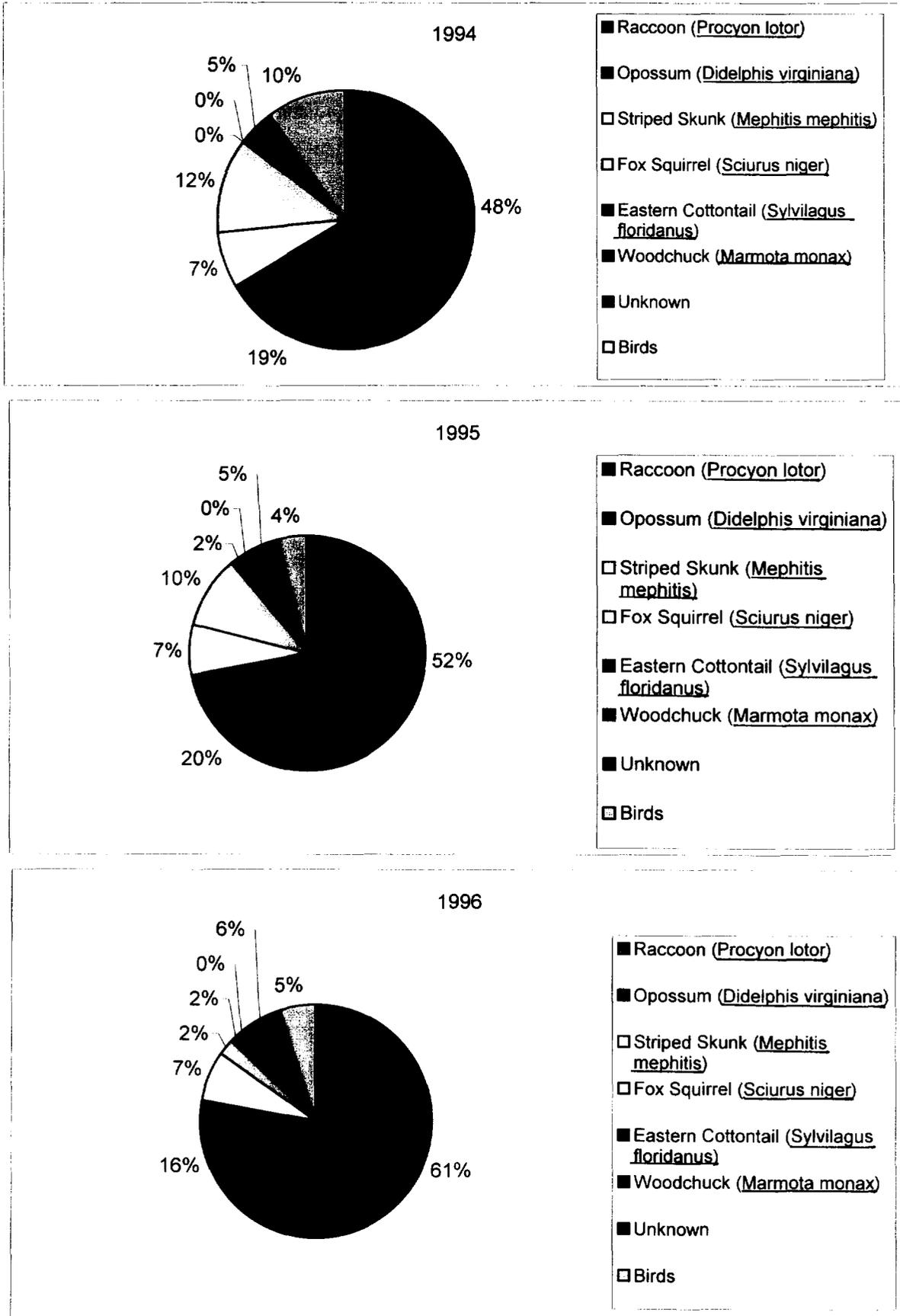


Figure 1 Percentage of each species consumed by Turkey Vultures in Richmond, Indiana from March through November, 1994, 1995, and 1996.

Table 2. Chi-squared test for homogeneity to determine if there is a significant difference in proportion of raccoon, opossum, and other mammals consumed by Turkey Vultures in Richmond, Indiana from March through November, 1994, 1995, and 1996.

	1994	1995	1996	Total	p [^] pool
Raccoon(<i>Procyon lotor</i>)					
Observed	20	74	89	183	0.62
Expected	22.32	80.6	79.98		
(O-E) ² /E	0.241	0.54	1.017		
Opossum(<i>Didelphis virginiana</i>)					
Observed	8	28	23	59	0.2
Expected	7.2	26	25.8		
(O-E) ² /E	0.089	0.154	0.304		
Other^a					
Observed	8	28	17	53	0.18
Expected	6.48	23.4	23.22		
(O-E) ² /E	0.357	0.904	1.67		
Obs. Total	36	130	129	295	
X ² Total	0.838	2.305	2.345	5.276	
df = 4					

^a Includes striped skunk (*Mephitis mephitis*), eastern cottontail (*Sylvilagus floridanus*), fox squirrel (*Sciurus niger*), and woodchuck (*Marmota monax*).

consumed, but could not be identified because there was no access to museum skins of these animals to compare with pellets. White-tailed deer were consumed by Turkey Vultures in Pennsylvania (10% of diet; Coleman and Fraser 1987) and Wisconsin (21%; Kirk and Mossman 1998), but not by Turkey Vultures in Richmond, Indiana; white-tailed deer might be more accessible in Pennsylvania and Wisconsin than in Indiana. Turkey Vultures have difficulty piercing the thick skin of deer (Wallace and Temple 1987) and must wait until it is opened by other animals or by a vehicle collision. There may be more animals to open the deer's skin or more deer-vehicle collisions in Pennsylvania and Wisconsin than in Indiana.

Raccoons and opossums were a major food source for Turkey Vultures in Indiana (74% of total sample), but not in Pennsylvania (23%; Coleman and Fraser 1987) and Wisconsin (13%; Kirk and Mossman 1998). Turkey Vultures in these different study areas may have different food preferences. There is evidence that Turkey Vultures prefer particular dead animals in different parts of their range (Kirk and Mossman 1998). Such food preference could explain why cows and pigs were consumed in Pennsylvania and Wisconsin, but not in Indiana. However, it could be that Turkey Vultures do not necessarily prefer raccoons and opossums, but that they are the most available prey in Indiana. Turkey Vultures adapt to local variety of available carrion (Hiraldo et al. 1991). Since live prey is rarely taken (Smith 1982), Turkey Vultures must find carrion. Raccoons and opossums are common road kills in Indiana (pers. obs.), thus providing an explanation why these mammals were consumed most frequently. Very few birds were consumed by Turkey Vultures in Indiana (5% of total sample), Wisconsin (4%; Kirk and

Mossman 1998) and Pennsylvania (0% Coleman and Fraser 1987). This is not surprising since mammals are known to be the most common food source for Turkey Vultures (Kirk and Mossman 1998).

It would be interesting to see if there is a significant difference in the proportion of mammals consumed from season to season as it would provide an insight into the food preferences of Turkey Vultures. However, my samples did not include any pellets from December, January or February and the sample size of pellets from 1994 ($n = 42$) was too small to separate into seasons. Consequently, a test to see if there is a significant difference in the proportion of animals consumed from season to season was not performed. It would also be interesting to see if there is a correlation between the amount of road-kill in a year and the amount of those animals consumed by Turkey Vultures during that year. This too will help determine if Turkey Vultures are feeding opportunistically or if they have a food preference.

ACKNOWLEDGEMENT

I want to thank Dr. Neil Sabine for providing the pellets used for my research. I am appreciative of the assistance I received from Dr. Sabine and Dr. Kamal Islam. I also thank Dr. Tom Morrell for allowing use of his lab and museum skins. NCG laboratories allowed use of their microscopes for this study.

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