BLACK AND TURKEY VULTURE ROOST DYNAMICS, MARKING, MORPHOLOGY AND NESTING IN VIRGINIA

by

Thomas Medrick Sweeney

Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Fisheries and Wildlife Sciences

APPROVED:

James D. Fraser, Chairman

C. S. Adkisson

R. L. Kirkpatrick

M. R. Vaughan

August, 1984
Blacksburg, Virginia

BLACK AND TURKEY VULTURE ROOST DYNAMICS, MARKING, MORPHOLOGY AND NESTING IN VIRGINIA

by

Thomas Medrick Sweeney

(ABSTRACT)

Black vulture (Coragyps atratus) and turkey vulture (Cathartes aura) roosting dynamics were studied at eight roosts near Radford, Virginia. Black vulture numbers at a permanent roost ranged from low monthly means in June 1982 and 1983 to peak monthly means in December 1981 and 1982. Turkey vulture numbers ranged from low monthly means in July 1982 and 1983 to peaks in December 1981 and 1983. Vultures used two temporary roosts at nearby landfills from March through October in 1983. Vultures marked with cattle eartags were observed moving among roosts. Road counts were poorly correlated ($r = 0.39$, $P = 0.05$, $r = 0.39$, $P = 0.12$, black vultures and turkey vultures respectively) with roosting vulture numbers, and may not be good indicators of vulture numbers. Long term monitoring of vulture populations is best accomplished by six counts in December, on the same date each year, as vultures leave permanent roosts. Movement of problem roosts may be most effective when accompanied by removal of attractants. Accretion of

fecal material on metal leg bands constricted tarsi of black and turkey vultures. Teflon bands did not constrict the tarsus, but tag loss was high. Adult black vultures had longer tarsi and shorter wing chords than juveniles. Two nests were used in 1983 and 1984 by two pairs of black vultures, consisting of one marked and one unmarked bird.

ACKNOWLEDGEMENTS

I would like to express my gratitude to my graduate committee, Drs. J. D. Fraser, C. S. Adkisson, R. L. Kirkpatrick and M. R. Vaughan. I would also like to thank the rest of the faculty, staff and graduate students for helping make my time here educational and enjoyable. I thank

for their assistance in many aspects of the vulture project. I also thank , , Dr. R. L. Kirkpatrick, and for early reviews of the thesis.

I thank those associated with the Radford Army Ammunition plant for allowing access to the plant, interest in the project, humor, and seemingly endless buzzard lore. I also thank for permission to trap vultures on his property and the use of his abundant carrion. I thank my wife, , for putting up with early departures, late arrivals, and vulturine odors. I also am grateful to for her secretarial assistance. Most of all I thank my parents, , for providing me

with the moral, educational, and philosophical background which structures my life and made this thesis possible.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 3

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Black vultures and turkey vultures (Coragyps atratus, Cathartes aura) are common throughout most of their ranges, and the black vulture appears to be expanding its range in the northeast (Arbib 1980). Both species however, appear to be declining in some areas (Tate 1981). Analysis of 24 years of the Christmas Bird Count (CBC) suggested that numbers of both species have been decreasing since the 1950's (Brown 1976). Unfortunately, discontinuance of CBC's in many localities and emergence in others and a two-fold increase in the total number of counts may be responsible for interruptions in the appartent decline (Brown 1976), and may otherwise confound the results. Additionally, local CBC methods prior to 1973 did not preclude counting individual vultures more than once as vultures disperse from roosts and then return during the day.

Summer roost counts also have suggested local declines in vulture populations (Tate and Tate 1982). However, summer roosts are not representative of the entire population as they are probably composed mostly of nonbreeding birds (Jackson 1982).

Accurate evaluation of vulture population status requires development of an effective method of estimating population size. Roosting groups seem to be the most

practical unit of measurement for monitoring vulture numbers. Knowledge of the daily and seasonal dynamics of vulture roost use and relationships among roosts is essential for interpretation of changes in roosting numbers. Monitoring movements of marked individuals will aid in the analysis of relationships among roosts. Development of practical sexing techniques and determination of reproductive characteristics will aid in long-term monitoring of population characteristics.

The first chapter of this thesis describes daily and seasonal changes in several vulture roosts in southwest Virginia and suggests methods for long-term monitoring of vulture populations. The second chapter evaluates marking techniques and their utility for population studies of vultures. The third chapter is a preliminary description of black vulture and turkey vulture morphology as a basis for development of morphometric sexing techniques. The last chapter describes nesting periodicity in black vultures.

LITERATURE CITED

Arbib, R. 1980. The Blue List for 1980. Am. Birds 33:830-835.

Brown, W. H. 1976. Winter population trends in black and turkey vultures. Am. Birds 30:909-912.

Jackson, J. A. 1982. Nesting phenology, nest site selection, and reproductive success of the black and turkey vulture in S. R. Wilbur and J. A. Jackson, eds. Vulture Biology and Management. Univ. of California Press, Los Angeles, CA. 550 pp.

Tate, J., Jr. 1981. The Blue List for 1981. Am. Birds 35:3-10.

_____, and D. J. Tate. 1982. The Blue List for 1982. Am. Birds 36:126-135.

BLACK VULTURE AND TURKEY VULTURE ROOST DYNAMICS AND MONITORING TECHNIQUES IN VIRGINIA

Black vulture and turkey vulture (Coragyps atratus, Cathartes aura) populations have reportedly declined in some areas (Brown 1976, Tate and Tate 1982). Both species prey upon young or injured livestock (Hamilton 1941, Lovel 1947, Parmalee 1954), damage crops (Scott 1980), and transmit diseases (Enright et al. 1971). These facts suggest a need to monitor and manage vulture populations. Because these species often roost in large numbers, roosting groups may be appropriate units for monitoring and management.

Effective management and interpretation of numerical changes however, require an understanding of normal fluctuations in numbers of roosting vultures and of the relationships among roosts in an area. In this paper we report a study of the daily and seasonal dynamics in vulture numbers at roosts in southwest Virginia, and suggest methods for long-term monitoring of vulture populations.

STUDY AREA AND METHODS

The study was conducted in a 2000-km^2 area in the southern Appalachian Mountains (Fig. 1). Mountain ridges were dominated by Appalachian oak forest (Bailey 1978) and

valleys were primarily pasture. Most (90%) of the primary study area was in Montgomery and Pulaski counties in Virginia. In 1983, these counties contained 60,200 cattle, 3,400 hogs, and 8,500 sheep (Dunkerly and Rowley 1983). The location and limited roost dynamics of the primary study roost (roost 1) was reported by Prather et al. (1976). Other roosts were discovered by observing flight directions of vultures in the morning and evening and by investigating reports from the public.

Counts of Roosting Vultures

During morning counts, vultures were tallied by species from 1/2 hour before sunrise until all vultures left the roost or until the few remaining birds could be easily counted. During evening counts, vultures in the roost were counted at about three hours before sunset, and arriving birds were tallied until all vultures entered the roost. Tally meters (Forestry Suppliers Inc., Jackson, Miss.) and 7 x 35 binoculars were used to count roosting vultures. Counts were made from a position that afforded visibility of all vultures entering and leaving the roost.

To test the accuracy of counts, two observers counted vultures simultaneously. Counts of black vultures and turkey vultures at roost 1 were paired for the same dates (± 5 days) for 17 September 1981-16 September 1982 with 17

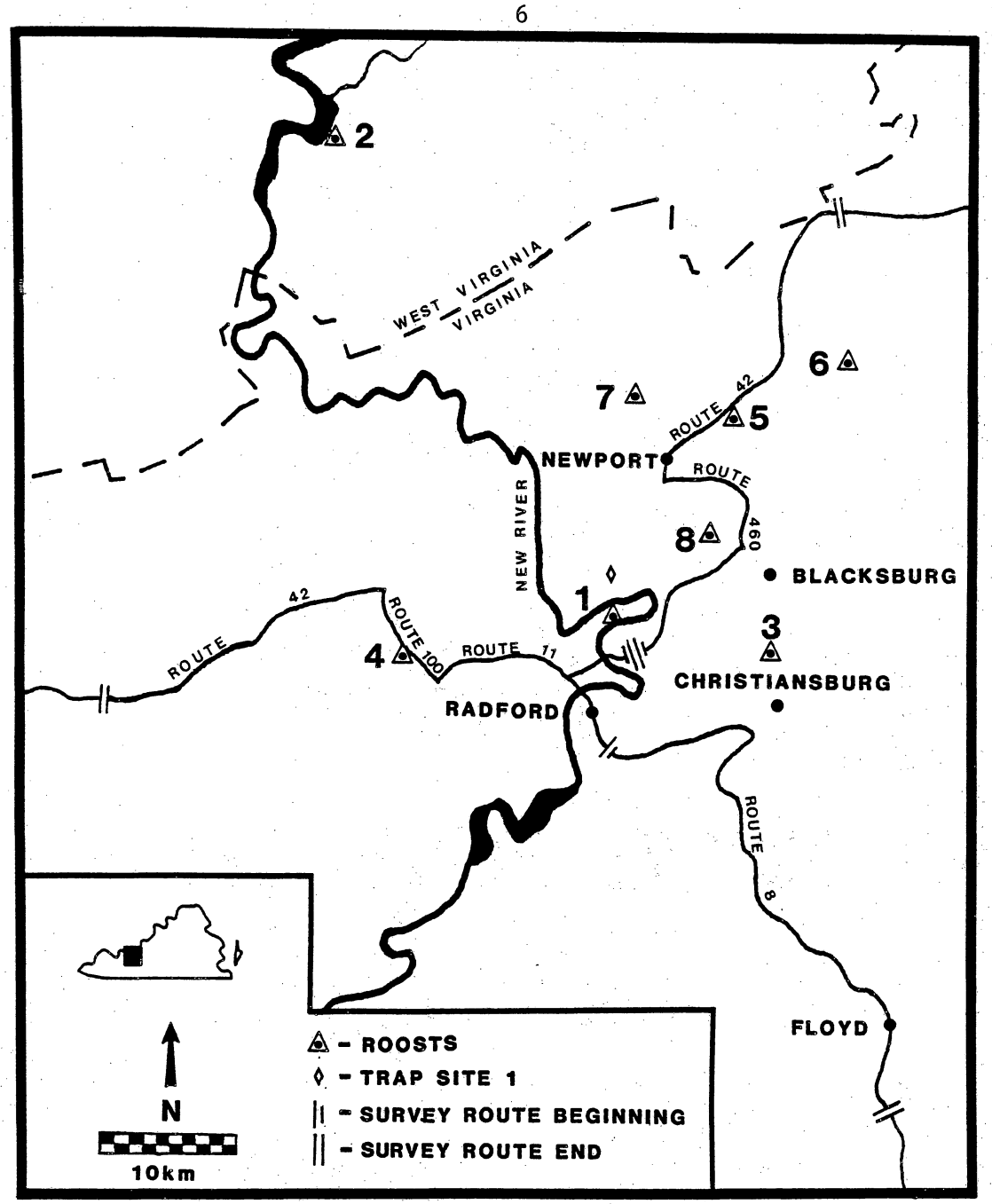

Fig. 1. The study area. Roosts 1-8, trapsite 1, and road survey routes.

September 1982-16 September 1983 to test for differences in numbers of vultures between years. The last count in November, four counts in December and the first count in January were similarly paired to test for differences between annual peaks. Annual minima were tested by pairing (± 5 days) the last count in May, four counts in June and the first count in July for black vultures. The last count in June, four counts in July and the first count in August were paired and tested for turkey vultures.

In some cases we were unable to successfully complete an attempted count because fog obscured the roost or because vultures moved in numbers too large to count. We investigated the effect of time and roost size on the probability of count sucess using loglinear models and the maximum likelihood ratio test statistic (Fienberg 1978).

Road Surveys

Semi-monthly surveys were conducted on three 50-km routes radiating from roost 1 (Fig. 1). Routes were traveled in random order during the middle six hours between sunrise and sunset, on two randomly chosen days each month. In the event of rain, an alternate day was randomly chosen from the remainder of the days in the month. Two hours were allotted for each survey, allowing ample time to return to the beginning of the next route after each survey was

completed. Each survey started at the end of the route closest to roost 1 and was conducted from a truck driven at approximately 55 km/hour. When vultures were sighted, the truck was stopped and the birds were observed with 7 x 35 binoculars or a 20-45x spotting scope. We recorded the number, location, and species of all vultures observed.

Survey routes have been used to obtain population indices for a variety of species (Howell 1951, Hewitt 1967, Walker and Cant 1977). This technique has also been used for counting vultures (Hubbard 1982). We therefore investigated the correlation between our survey results and the direct counts made at roost 1 near the date (± 5 days) of the survey.

Vulture Capture and Marking

Vultures were captured with a 9.5 x 18.0 m cannon net (Wildlife Materials Inc.) baited with dead livestock at trap site 1, roost 3 and roost 4 (Fig. 1) . Nestling and adult vultures were captured by hand or in their nest caves. We tagged vultures with Allflex Maxi cattle ear-tags attached through the patagia (Wallace et al. 1980).

Vulture Movements

Roost 1 was observed from 30 minutes before sunrise to four hours after sunrise and from five hours before sunset

to 1/2 hour after sunset approximately once weekly from October 1981 -November 1983. Roosts 2, 3, and 4 were observed opportunistically during counts of roosting vultures, observation of departures and during vulture trapping efforts. We also observed sporadic use of ephemeral roosts near food supplies. The presence of marked vultures at study roosts was recorded.

RESULTS

Vulture Roosts

Eight vulture roosts were studied (Fig. 1). Roosts 1 and 2 were occupied throughout the year (permanent roosts). Roost 1 had been used by vultures at least since 1939 (E. Parks, pers. commun.). Roosts 3 and 4 were used during the breeding season (seasonal roosts) and were located 300 m and 150 m from landfills, respectively. Roosts 5-8 were used for only 1-4 days each (ephemeral roosts, Table 1).

Count Success

Of 405 counts attempted at roosts 1-4, 171 (42%) were successful (Table 2). Counts were attempted on 339 mornings and 66 evenings from September 1981-November 1983. One hundred and fifty-four (45%) morning counts were successful compared to 17 evening counts (26%, $\chi^2 = 8.76$, 1 df, $\underline{P} = 0.003$).

Table 1. Number of black vultures (BV) and turkey vultures (TV) at roosts near food sources, southwest Virginia, 1982-1983.

Roost	Date	BV	TV	Food source
5	19 AUG 1982	0	12	calf
5	24 Aug 1982	0	0	calf
6	21 SEP 1982	0	23	calf
6	28 SEP 1982	0	0	calf
7	2 OCT 1982	3	31	sheep
7	3 OCT 1982	3	30	sheep
7	6 OCT 1982	0	0	sheep
8	23 SEP 1983	5	13	cow
8	24 SEP 1983	0	13	cow
8	25 SEP 1983	5	17	cow
8	26 SEP 1983	5	15	cow
8	27 SEP 1983	0	0	cow

Table 2. Success (%) of counts of black and turkey vultures at roosts 1-4, southwest Virginia, 1981-1983.

Roost	Time	Successful	Unsuccessful	Total
1	AM	119(42.5)	161(57.5)	280(100)
	PM	10(18.9)	43(81.1)	53(100)
2	AM	4(40.0)	6(60.0)	10(100)
	PM	1(50.0)	1(50.0)	2(100)
3	AM	17(63.0)	10(37.0)	27(100)
	PM	4(44.4)	5(55.5)	9(100)
4	AM	16(72.7)	6(27.3)	22(100)
	PM	2(100)	0(0)	2(100)
1-4	AM	154(45.4)	185(54.6)	339(100)
	PM	17(25.8)	49(74.2)	66(100)
	Am and PM	171(42.2)	234(57.8)	405(100)

Morning counts at roost 1 (N = 23) were frequently unsuccessful in April and October when fog obscured visibility until mid-morning; 147 morning and 43 evening counts failed when strong winds caused 25-200 vultures to fly out of the roost simultaneously. Five morning and four evening counts were unsuccessful because a single vulture, in each case, lost control of its flight while entering the roost and crashed into branches causing a large number of other birds to fly from the roost. Ten morning counts and 1 evening count were interrupted when large groups of vultures flew from the roost for no reason that was apparent to the observer. One evening count was unsuccessful because a boat floated under roost 1 which scared vultures from the roost.

Counts at seasonal roosts (roosts 3 and 4) were more successful than counts at permanent roosts (roosts 1 and 2) in the same season (χ^2 = 13.5, 1 df, P < 0.001), and morning counts were more successful than evening counts (χ^2 = 9.01, 1 df, P = 0.003), but no evidence was found that interactions between roost size and time of day affected the probability of successfully counting vultures at a roost (G^2 = 1.64, 3 df, P = 0.65).

The difference in success rate in counting the two classes of roosts is probably due to differences in vulture numbers. There were never more than 100 vultures at the

seasonal roosts and usually <50. When <50 vultures were using a roost they were relatively easy to count even when all birds flew into and out of the roost repeatedly. Evening counts were less successful because vultures commonly flew in and out of roosts repeatedly before roosting for the night. Vultures rarely flew back into a roost after departing in the morning. The success of counts were compared between those counts made from October to March for both years of count data. No significant difference in sucess of counts was found between seasons (χ^2 = 13.5, 1 df, $\underline{P}$ = 0.001).

Count Accuracy

Simultaneous counts ($\underline{N}$ = 6) by 2 independent observers (the author and his wife, Table 3) did not differ significantly for black vultures (Wilcoxon signed rank test $\underline{T}$ = 7.5, $\underline{P}$ = 0.28) or turkey vultures ($\underline{T}$ = 7.0, $\underline{P}$ = 0.28). No evidence was found that experience affects the accuracy of the count. Observed differences were small compared to counts; the mean differences in counts between observers was <1% of the smallest black vulture count and <2% of the smallest turkey vulture count.

Table 3. Simultaneous counts of roosting vultures at roost 1 by two independent observers, Radford, Virginia, 1981-1983.

Date (time)	Number of black vultures			Number of turkey vultures		
	Observer		difference	Observer		difference
	1[1]	2		1[1]	2	
03 Nov 1981 (AM)	222	227	-5	119	117	2
25 Oct 1982 (PM)	505	518	-13	156	162	-6
26 Oct 1982 (AM)	487	496	9	149	155	-6
27 Oct 1982 (PM)	462	453	-9	127	131	-4
28 Oct 1982 (AM)	498	509	-11	143	138	5
29 Oct 1982 (AM)	567	546	21	141	144	-3
$\bar{X}$	457	458	-1.3	139	141	-2.0
(SE)	(49)	(48)	(5.5)	(5.6)	(6.6)	(1.8)

[1] Observer 1 was an experienced counter, observer 2 had counted departing vultures only twice before these tests.

Roost Departures and Arrivals

During 14 roost departures 4-12% of black vultures ($\bar{X}$ = 8.6 ± 0.6 SE) and 0-7% of turkey vultures ($\bar{X}$ = 3.1 ± 0.6 SE) departed in a 30-minute period before sunrise. In the 2 hours following sunrise, 83-92% black vultures ($\bar{X}$ = 85.5 ± 0.6 SE) and 88-100% turkey vultures ($\bar{X}$ = 93.8 ± 0.9 SE) left the roost. Only 0-6% black vultures ($\bar{X}$ = 1.9 ± 0.05 SE) and 0-7% turkey vultures ($\bar{X}$ = 2.1 ± 0.005 SE) remained in the roost after four hours after sunrise. All vultures left seasonal roosts within one hour after sunrise ($\underline{N}$ = 21). Vultures returned to both seasonal and permanent roosts. as early as five hours before sunset They moved into and out of roosts, as they joined and left groups of circling birds or flew to and from other nearby trees.

Seasonal Dynamics

The number of both species peaked at roost 1 in December 1981 (black vultures, 481 ± 37.0 SE; turkey vultures, 229 ± 19.1 SE) and December 1982 (black vultures, 710 ± 63.0 SE; turkey vultures, 224 ± 14.9 SE). The fewest black vultures were found in June 1982 (174 ± 20.3 SE) and June 1983 (191 ± 10.5 SE) (Fig. 2). The fewest turkey vultures were found in July 1982 (37 ± 0.8 SE) and August 1983 (107 ± 7.3 SE)(Fig. 2).

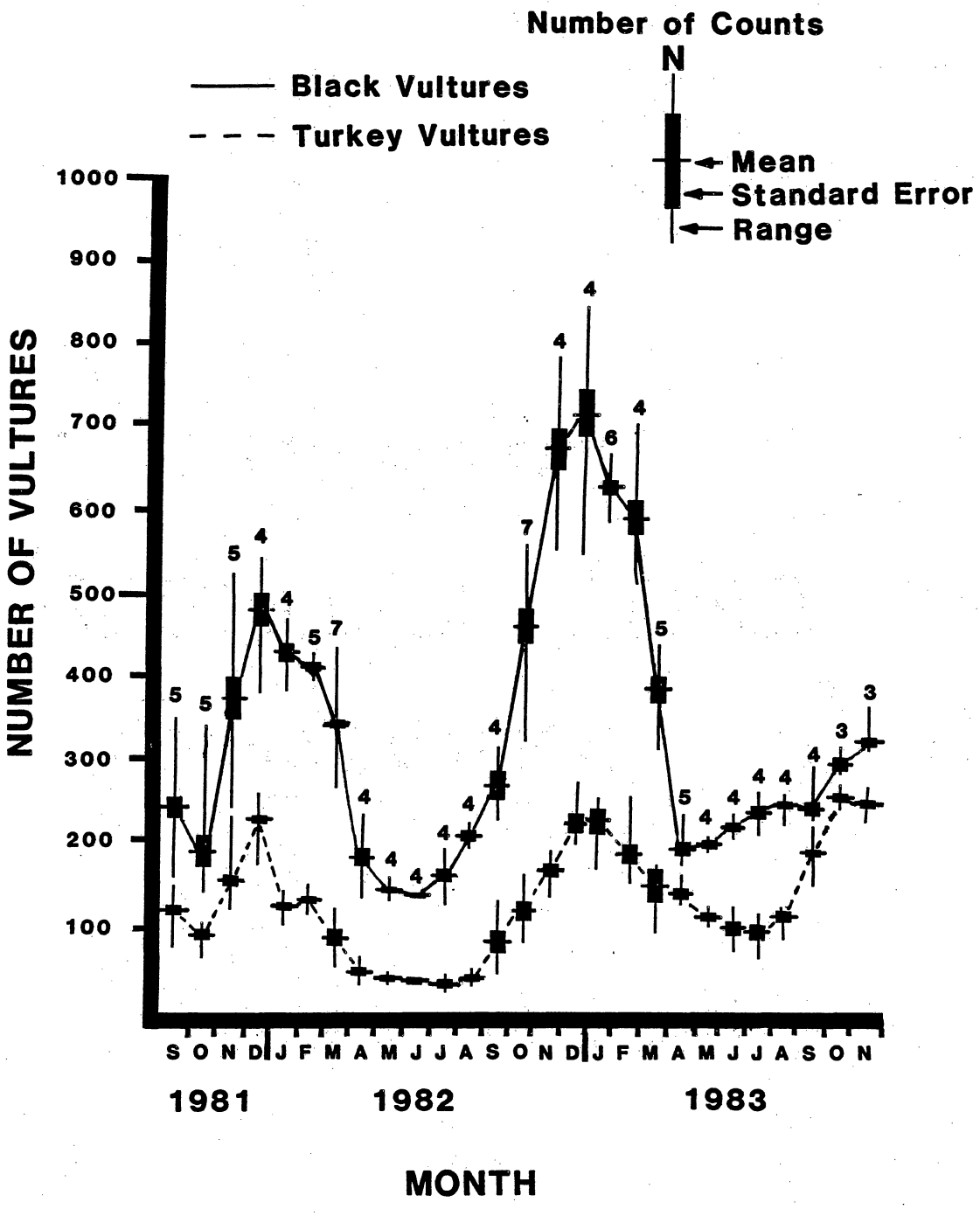

Fig. 2. Counts of black and turkey vultures at roost 1, southwest Virginia, 1981-1983.

More black vultures (Wilcoxon Signed Rank $T = 60$, $N = 37$, $P = 0.01$) and turkey vultures ($T = 53$, $N = 37$, $P = 0.008$) were counted in 1982-1983 than in 1981-1982. Counts were greater for black vultures in 1982 ($T = 0.0$, $N = 6$, $P = 0.02$) but not turkey vultures ($T = 11.0$, $N = 6$, $P = 0.99$). There were more black ($T = 0.0$, $N = 6$, $P = 0.02$) and turkey vultures ($T = 0.0$, $N = 6$, $P = 0.02$) present during the minimum in 1983 than 1982.

The number of vultures roosting at roost 2 appeared to cycle similarly to vulture numbers at roost 1 (Fig. 3). Vultures were first observed roosting at roost 3 on 15 August 1982. They were observed roosting there on 10 visits until 14 October 1982. No vultures were found roosting on 18 October or on 17 subsequent visits until 1 March 1983 when we observed 27 roosting black vultures. On 25 October 1983 vultures roosted until 25 minutes before sunset when they left in a single group in the direction of roost 1.

No roosting vultures were found on weekly visits to roost 4 during February and March 1983 until 9 march 1983, when we observed 19 turkey vultures depart from the roost at sunrise (Fig. 3). No vultures were observed on 25 March, but vultures were observed on 18 subsequent visits until 20 September 1983. The roost was not used during subsequent visits through 20 November 1983.

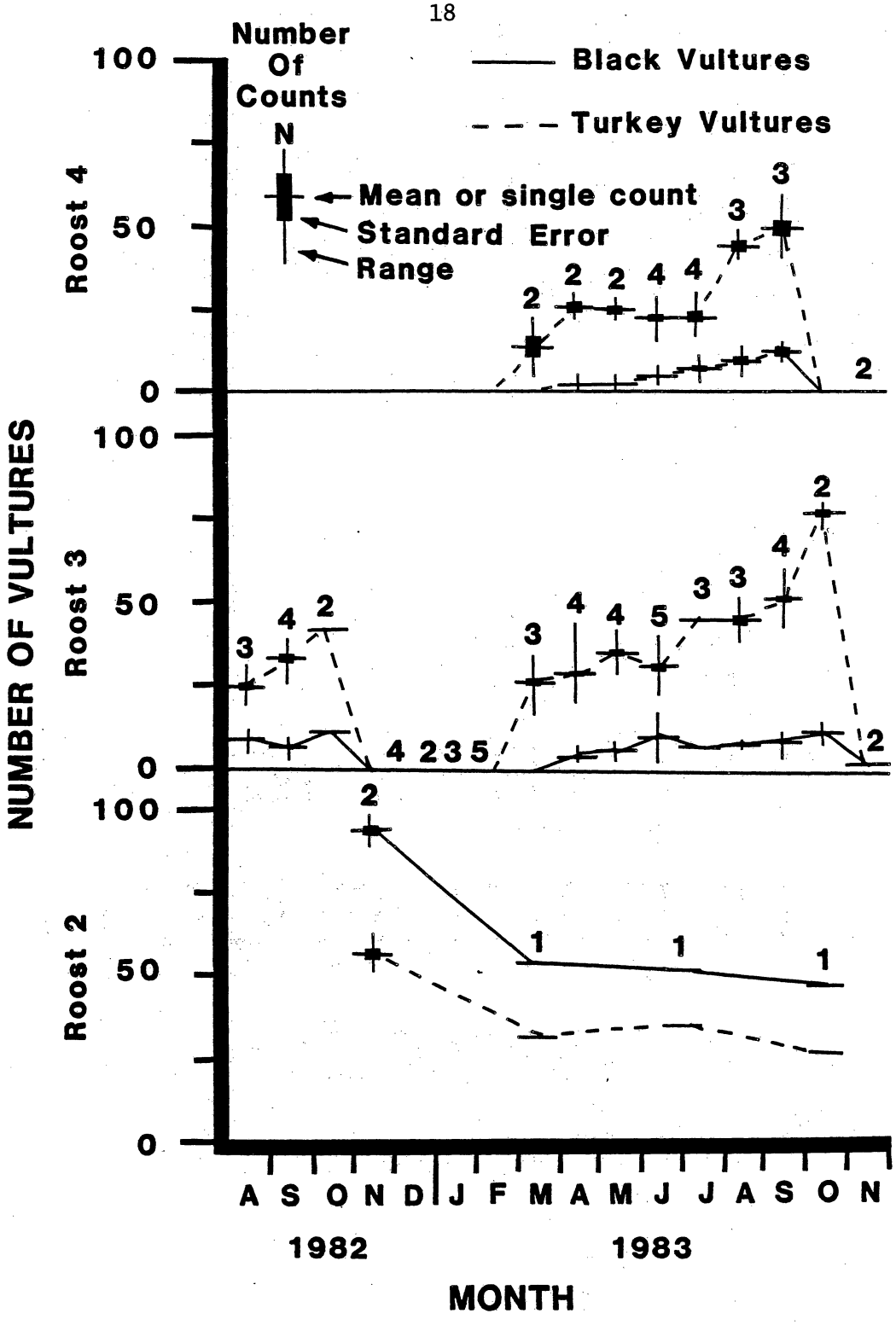

Fig. 3. Counts of black and turkey vultures at roosts 2-4, southwest Virginia, 1982-1983.

Road Surveys

Twenty-five surveys were conducted from July 1982-June 1983. A total of 56 turkey vultures and 160 black vultures were observed (Table 4). Black vulture foraging groups were larger than turkey vulture groups (Wilcoxon Rank Sum S = 3.88, $P < 0.001$) and were closer to roost 1 than turkey vulture groups (S = -2.59, P = 0.01). Black vulture groups were larger during the October-February peak at roost 1 than at other times of the year (S = 2.03, P = 0.04). Turkey vulture group size and distance from the roost were similar in winter and at other times of the year (S = 0.91, P = 0.36, and S=-1.12, P = 0.26 respectively). The numbers of black vultures and turkey vultures counted on surveys were poorly correlated with the number of black vultures and turkey vultures counted at roost 1 on the same date (± 5 days) (r = 0.39, P = 0.05, r = 0.39, P = 0.12, black vultures and turkey vultures respectively). No black vultures or turkey vultures were observed on surveys in three months; road surveys were also poor estimates of overall abundance.

Vultures Captured

Eighty-nine vultures were captured from 1 June 1982-30 August 1983 (Table 5). Fifty-three black vultures were caught at trap site 1 between 1 June 1982 and 6 July 1983.

Table 4. Size and distance (km from roost 1) of black vulture (BV) and turkey vulture (TV) groups, southwest Virginia, 1982-1983.

	Nov-Feb $\bar{X}$(SE)N	Mar-Oct $\bar{X}$(SE)N
Group size		
BV	27.5(5.9)4	9.7(2.4)6
TV	3.1(0.6)7	2.4(0.4)10
Distance (km)		
BV	9.5(3.2)4	13.6(1.9)6
TV	17.7(2.6)7	20.9(2.4)10

Table 5. Number of black vultures (BV) and turkey vultures (TV) marked and resighted, by roost, southwest Virginia, 1982-1983.

Number of birds marked		Resightings									
		Total		By Roost(s)							
Roost N	Spp	N	%	1 N	%[1]	1&3 N	%	1&4 N	%	1,3,&4 N	%
Roost 1											
	BV 59[2]	56[2]	84	47[2]	84	9	16	0	0	0	0
	TV 4[3]	2[4]	50	1[4]	50	1	50	0	0	0	0
Roost 3											
	BV 9	6	67	2	33	4	67	0	0	0	0
	TV 12	9	75	1	11	7	78	0	0	1	11
Roost 4											
	BV 1	1	100	0	0	0	0	1	100	0	0
	TV 1	1	100	0	0	0	0	1	100	0	0
Roosts 1, 3, and 4											
	BV 69	63	91	49	78	13	21	1	1	0	0
	TV 17	12	71	2	17	8	67	1	8	1	8
Total	86	75	87	51	69	21	28	2	2	1	1

[1] Percent of total resighted.
[2] Includes 6 nestlings marked at nest caves <1 km from roost 1.
[3] Four nestlings marked at nest caves <.5 km from roost 1.
[4] Resighting of a nestling marked at a nest cave <.25 km from roost 1.

Three hatching year black vultures and two hatching year turkey vultures were tagged in their nests within 300 m of roost 1 in each of the summers of 1982 and 1983. One adult black vulture was also marked in a nest near roost 1.

Four black vultures, and 12 turkey vultures were captured using the cannon net at roost 3 between 6 July 1982 and 2 August 1983 (Table 19). One black vulture and 1 turkey vulture were captured at roost 4 with a cannon net on 30 August 1983. One nestling turkey vulture was marked near New Castle, VA and two black vulture nestlings were marked in their nest cave at Rocky Knob north of Newport, VA.

Most vultures were captured at trap site 1 where a farmer dumped dead livestock. More calves and adult cattle were found there, per day of observation, from December 1982 to May 1983 ($\overline{X}$ = 0.3 ± 0.01 SE) than from June 1982 to November 1982 ($\overline{X}$ = 0.07 ± 0.09 SE)(Wilcoxon Rank Sum $\underline{S}$ = 56.0, $\underline{P}$ = 0.008).

Movements Among Roosts

Ninety-one percent of marked black vultures and 71% of marked turkey vultures were resighted in 348 and 84 total resightings respectively, from 3 June 1982 to 19 November 1983. No exchange of marked vultures was found between roosts 1, 3, and 4 and roost 2. Most vultures were sighted only at roost 1, but seven black vultures marked at roost 1

were sighted at roost 1 in winter 1983 and then sighted at roost 3 in summer 1983. One other black vulture and one turkey vulture marked at roost 1 were also sighted at roost 3 in summer 1983. All nine were resighted at roost 1 the following winter. Most movements of vultures were observed between roosts 1 and 3. Four black vultures and seven turkey vultures marked at roost 3 in the summers of 1982 and 1983 were resighted at roost 1 in the winter(s) following tagging. Three of these vultures, a juvenile of each species and an adult turkey vulture were sighted at roost 1 at least twice from 20 September to 24 October 1983. They were resighted at roost 1, three days after vultures stopped roosting at roost 3.

Eight black vultures marked at roost 1 in the winter of 1982 were observed at roost 3 at least once during the spring and summer of 1983. Three turkey vultures marked at roost 3 in the summer of 1982 were sighted at roost 1 in the winter of 1982 and then sighted again at least once at roost 3 in the spring and summer of 1983. One black vulture and four turkey vultures that were sighted at roosts 1 and 3 during the summer of 1982 were sighted at roost 1 in October and November 1983. Only one black vulture and one turkey vulture were marked at roost 4. They were resighted in September at roost 4 and then resighted at roost 1 in

September and October 1983, after vultures stopped roosting at roost 4. An adult black vulture tagged near Chapel Hill, N.C., 190 km from roost 1 (P. P. Rabenold pers. commun.) was captured at trap site 1 on 1 February 1983 and was resighted at roost 1 on 5 February 1983.

DISCUSSION

Roost Organization

Three types of vulture roosts were found in this study. Permanent roosts (1 and 2) were used throughout the year. Vulture numbers followed an annual cycle with peak numbers in December and minima during the summer months. Seasonal roosts (3 and 4) were used from March through October. Ephemeral roosts were used briefly, apparently to facilitate use of temporary food sources. Vultures moved among roosts 1, 3, and 4. Although we observed no movements between roost 2 and the rest of the roosts, we suspect that there were some, as we observed movement from a roost almost 5 times further away. Our observations of roost 2 were also limited as compared to the total hours of observations at roosts 1, 3, and 4. Observed movements among roosts suggest that vultures in southwest Virginia use "roost systems" as described by Rabenold (1982).

Annual Cycle

Discontinuance of roosting at seasonal roosts in the fall coincided with the period of rapid increase at the permanent roost (roost 1). Vultures from seasonal roosts shift to roost 1 in the winter. Black and turkey vultures marked at the permanent roost (roost 1) in the winter of 1982-1983 were resighted at both roost permanent roost 1 and seasonal roost 3 in the summer. Vultures marked at roost 1 and vultures marked at roost 3 were sighted at both roosts 1 and 3 in summer and then resighted at roost 1 in winter. The discontinuance of roosting at seasonal roosts in the fall and the commencement of use in the spring presumably contributes to the annual cycle of vulture numbers observed at roost 1. Roost 1 may be functioning as a sink for vultures from many seasonal roosts. Turkey vulture migration may also contribute to the annual cycle of vulture numbers (Stewart 1977). Although seasonal roosts found in this study were used by turkey vultures almost exclusively, black vultures may constitute larger portions of other seasonal roosts and/or travel great distances from other roosts which are part of the "roost system" which contributes to the winter increase of vulture numbers at permanent roosts.

The sighting of the vulture from Chapel Hill N.C. indicates that black vultures do come from distances at least up to 190 km. Parmalee and Parmalee (1967) found black vultures ranging up to 320 km, presumably in response to varying food supplies.

Communal Roosting

The reasons for communal roosting are not clear. Several factors that may explain the adaptive significance of this behavior are predator avoidance from the benefit of roosting in a buffer of birds (Lack 1968), energy conservation by roosting close to other birds which reduces heat loss (Kelty and Lustick 1977, Yom-Tov et al. 1977, Shaw 1979, Hendricks 1981), population regulation through emmigration in response to epidiectic displays (Wynne-Edwards 1962), coordination of communal migration through premigratory assemblages (Meinertzhagen 1956), roost site availability (Allen and Young 1982), food location information by following successful foragers (food-information hypothesis, Ward and Zahavi 1973), and other social functions such as facilitation of mate selection in congregations (Coombs 1961, Gurr 1968).

However, few of these seem applicable to black and turkey vulture communal roosting. The large size and few apparent predators of black and turkey vultures suggest that

predator avoidance probably is not a major factor influencing communal roosting. Energetics appears not to be an important function either because vultures roost communally in the tropics. Additionally, Stalmaster (1981) found no evidence that heat radiated by communally roosting bald eagles created a more favorable microclimate. It is unlikely that communal roosts function in population regulation through epideictic displays stimulating emigration (Wynne-Edwards 1962). These displays imply altruism, evolving from group selection, which is not likely (Barash 1977). Coordination of group migration is probably not an important function either, because many populations of black vultures and turkey vultures are apparently nonmigratory (Eisenmann 1963, Skutch 1969, Stewart 1977) and because communal roosting is common during the summer. Roost site availability also is probably not a factor stimulating communal roosting because there is an apparent abundance of suitable roost sites due to the general nonselectivtity of vultures for specific types of roost trees.

Two hypotheses seem to suggest reasonable adaptive benefits from communal roosting for black and turkey vultures. Ward and Zahavi's (1973) suggestion that communal roosts function as a food-information exchange center seems

reasonable because of the transient and clumped nature of the vulture's food base. Rabenold (1982) found indirect evidence, through an analysis of roost departures, that communal roosting increases food finding efficiency. Mate selection and pair bond formation may also be a function of black and turkey vulture roosts at least in winter when breeding vultures are present. Allen and Young (1982) suggest that late fall and early spring roosts function in pair formation in bald eagles.

Roost Cyclicity

In addition to the reasons for communality there may be additional reasons for the observed cyclicity in roosting. Cyclicity may be caused by changes in intensities of factors causing communality, of factors competing with communality or both. The food-information hypothesis predicts that when food becomes scarce the tendency or need to follow others to find food would increase. This suggests that roosting in larger numbers would be a result of decreased food availability because it would increase the probability of finding a vulture which had foraged successfully. However, in southwest Virginia food is probably more abundant in winter than other times of the year because of intensive livestock farming and of mortality associated with the rigors of winter weather and the timing of parturition of

livestock herds which occurs from January through March, at least in this area.

Permanent roost numbers began to increase as hatching year vultures fledged at the end of the vulture breeding season and then decreased at the beginning of the following breeding season. Although food-information may be a major reason for communality, it seems likely that mate selection and the need to disperse to find widespread nesting sites may, at least in part, cause the cyclicity of use of permanent and seasonal roosts.

MANAGEMENT IMPLICATIONS

Monitoring Strategy

Reports of possible vulture population declines is based on data from Christmas bird counts (CBC, Brown 1976) and summer roost counts (Tate and Tate 1982). Interpretation of CBC data is confounded by an almost two-fold increase (national scale) in CBC counts since the 1950's as well as emergence of counts in some areas and discontinuance in others. Additionally, CBC methods do not preclude counting individual vultures more than once. Hubbard (1982) suggests that roadside raptor counts are an effective means of assessing the number of turkey vultures in New Mexico. The poor correlation between road surveys

and roost counts and the low number of vultures observed on surveys in this study suggests that such surveys may not be a good method for monitoring vulture populations in all areas. The vegetation and topography in southwest Virginia probably obscured some flying vultures, resulting in few observations. It appears that CBC's and roadside surveys are ineffective methods of monitoring vulture populations.

We suggest that trends can be discerned by comparing annual variation in the means and peaks of six December counts. Vultures should be tallied as they leave roosts from 1/2 hour before sunrise until the roost is empty. Our results for black vultures demonstrate that such counts can vary substantially from year to year. Counting at all winter roosts in an area should reduce the "noise" caused by local movements and may provide a good estimate of the number of vultures in an area. Counts of birds at smaller roosts in June may provide an index to the nonbreeding population but the fact that some breeders join summer roosts while others roost near nest sites will hamper interpretation of such counts. Further research will be needed to determine the contribution of migrant vultures to winter roosts.

Vulture Population Status

It is difficult to interpret reports of declining populations (Brown 1976, Tate 1981, Tate and Tate 1982) because of the difficulties noted above. Prather et al. (1976) counted the vultures at roost 1 in December 1973-1975. Their counts of both species in 1974 and 1975 (1047 and 1133, respectively) were similar to our peak counts (789 and 1107 in 1981 and 1982 respectively), but their 1973 count of 401 was lower. Long term monitoring of both species using consistent methods will be required to determine the implications of such fluctuations for vulture populations.

Roost Manipulation

All roosts observed in this study and another associated study, (J. R. Coleman and J. D. Fraser Unpubl. data) were closely associated with either nest sites or food supplies. We envision roost formation to begin with attraction of a few birds to these resources. The species' aggregative tendencies then result in an influx of additional birds. If this model is correct, the movement of problem roosts may be most effective when accompanied by removal of the primary attractant. Conversely, roost maintenance may require protection of food supplies or nest sites.

LITERATURE CITED

Allen, H. L., and L.S. Young. 1982. An Annotated Bibliography of Avian Communal Roosting. Wash. Dept. of Game. 177pp.

Barash, D. P. 1977. Sociology and behavior. Elsevier, New York, NY.

Bailey, R. G. 1978. Description of the ecoregions of the United States. U.S.D.A. Ogden, Utah. 77pp.

Brown, W. H. 1976. Winter population trends in black and turkey vultures. Am. Birds 30:909-912.

Coombs, C. J. F. 1961. Rookeries and roosts of the rook and jackdaw in south west Cornwall. Part III. Roosting. Bird Study 8:55-70.

Dunkerly, C. and H. K. Rowley. 1983. Virginia Agricultural Statistics. Virginia Crop Reporting Service. 115 pp.

Eisenmann, E. 1963. Is the Black Vulture Migratory? Wilson Bull. 75:244-246.

Enright, J. B., W. M. Longhurst, M. E. Wright, V. J. Dudson, C. E. Franti, and D. E. Behymer. 1971. Q Fever antibodies in birds. J. Wildl. Dis. 7:14-21.

Fienberg, S. E. 1978. The Analysis of Cross-Classified Categorical Data. The MIT Press. London, England. 151pp.

Gurr, L. 1968. Communal roosting behavior of the Australian harrier Circus approximans in New Zealand. Ibis 110:332-337.

Hamilton, W. J., Jr. 1941. Turkey buzzards killing young pigs. Auk 58:254.

Hendricks, P. 1981. Observations on a winter roost of rosey finches in Montana. J. Field Ornithol. 52:235-236.

Hewitt, O. H. 1967. A road-count index to breeding populations of red-winged blackbirds. J. Wildl. Manage. 31:39-47.

Howell, J. C. 1951. Roadside census as a method of measuring bird Populations. Auk 68:334-357.

Hubbard, J. P. 1982. Roadside Raptor Counts as an Indicator of the Status of the Turkey Vulture in New Mexico. in S. R. Wilbur and J. A. Jackson eds. Vulture Biology and Management. Univ. of California Press, Los Angeles CA. 550pp.

Jackson, J. A. 1982. Nesting Penology, nest site selection, and reproductive success of the black and turkey vulture. in S. R. Wilbur and J. A. Jackson eds. Vulture Biology and Management. Univ. of California Press, Los Angeles CA. 550pp.

Kelty, M. P., and S. I. Lustick. 1977. Energetics of the starling (Sturnus vulgaris) in a pine woods. Ecology 58:1181-1185.

Lack, D. 1968. Ecological adaptations for breeding in birds. Methuen, London. 409pp.

Lovel, H. L. 1947. Black vultures kill young pigs in Kentucky. Auk 64:131-132.

Meinertzhagen, R. 1956. Roost of wintering harriers. Ibis 98:535.

Parmalee, P. W. 1954. Vultures: Their movements, economic status, and control in Texas. Auk 71:443-453.

Parmalee, P. W. and B. G. Parmalee. 1967. Results of banding studies of the Black Vulture in eastern North America. Condor 69:146-155.

Prather, I.D., R. N. Conner, and C. S. Adkisson. 1976. Unusually large vulture roost in Virginia. Wilson Bull. 88:667-668.

Rabenold, P. P. 1982. The communal roost in black and turkey vultures-- an information center? in S. R. Wilbur and J. A. Jackson eds. Vulture Biology and Management. Univ. of California Press, Los Angeles CA. 550pp.

Scott, T.G. (ed.) 1980. Fish and Wildlife Research. U.S. Fish and Wildlife Service, Denver, Colorado. 202 pp.

Shaw, G. 1979. Functions of dipper roosts. Bird Study 26:171-178.

Skutch, A. F. 1969. Notes on the possible migration of the black vulture in Central America. Auk 86:726-731.

Stalmaster, M. V. 1981. Ecological energetics and foraging behavior od wintering bald eagles. Ph.D. Diss., Utah State Univ., Logan. 155pp.

Stewart, P.A. 1977. Migratory movements and mortality rate of turkey vultures. Bird Banding 48:122-124.

Tate, J., Jr. 1981. The Blue List for 1981. Am. Birds 35:3-10.

_____, J., Jr. and D. J. Tate. 1982. The Blue List for 1982. Am. Birds 36:126-135.

Walker, P. L., and J. G. H. Cant. 1977. A population survey of the kinkajous (Potos flavus) in a seasonally dry tropical forest. J. Mammal. 58:100-102. 51:309-314.

Wallace, M. P., P. G. Parker, and S. A. Temple. 1980. An evaluation of patagial markers for cathartid vultures. J. Field Ornithol. 51:309-314.

Ward, P., and A. Zahavi. 1973. The importance of certain assemblages of birds as "information centres" for food finding. Ibis 115:517-534.

Wynne-Edwards, V. C. 1962. Animal dispersion in relation to social behaviour. Oliver and Boyd, Edinburgh.

Yom-Tov, Y., A. Imber, and J. Otterman. 1977. The microclimate of winter roosts of the Starling Sturnus vulgaris. Ibis 119:366-368.

FURTHER EVALUATION OF MARKING METHODS FOR BLACK AND TURKEY VULTURES

A safe and effective means for marking vultures has been sought since the suggestion by Henckel (1976) that lesions may be caused by fecal accumulation on leg bands used on Turkey Vultures (Cathartes aura) (Wallace et al. 1980). Use of patagial markers has been widespread and adapted to many species (Marion and Shamis 1977). Kochert et al. (1983) evaluated wrap-around patagial markers for their anatomical and behavioral effects and utility on Golden Eagles (Aquila chrysaetos), Red-tailed Hawks (Buteo jamaicensis), Prairie Falcons (Falco mexicanus), and Common Ravens (Corvus corax) from 1970 to 1980. Mossman (1976) used cattle eartags as patagial markers on six Turkey Vultures.

Wallace et al. (1980) evaluated the use of cattle eartags and vinyl streamers for use on Black vultures (Coragyps atratus) and Turkey vultures. They used 5.75 x 7.0 cm eartags, weighing 7.8 g to anchor a 15 x 8 cm vinyl streamer marked with a number. They reported eartags to be good permanent anchors for attachment of large, highly visible vinyl streamers. Vinyl streamers are subject to

wear and fading, however, and long-term studies entailing resightings of marked individuals require a more durable marking device. Because the Alflex cattle eartags are resist fading (Wallace et al. 1980), we evaluated the use of a larger cattle eartag as patagial markers for black vultures and turkey vultures. The intent was to use the numbers on the eartags for resightings, rather than to use the tag to anchor a marked vinyl streamer.

In this paper we evaluate the method of attachment of cattle eartags and their effect on the behavior and social status of Black Vultures and Turkey Vultures. We also compare and evaluate the results of using metal and teflon leg bands on captive vultures.

METHODS

We trapped Black Vultures and Turkey Vultures from January 1982 through September 1983 using a 9.5 by 18 m cannon net (Wildlife Materials Inc.). We marked the vultures with white maxi-size cattle eartags (Delta Plastics Ltd. of New Zealand, G. C. Hanford Mfg. Co., Syracuse, NY 13201). Our methods were similar to those of Wallace et al. (1980), but we did not affix vinyl streamers. Each tag was 9.5 x 10 cm, weighed 12.2 g, and was marked with a 4.0 x 4.5 cm black block alphanumeric. The message, "Write Wildlife, VPI, Blacksburg, VA 24061 USA and Bird Band, Washington, DC," was printed in 4 mm block letters on the back.

Attachment of patagial tags.--

The eartags were attached through the patagium of each wing approximately 3 cm anterior to the humerus to radius-ulna articulation with the large part of the tag on the top of the wing (Fig 1.). We were careful to avoid puncturing the tendon of the extensor patagii longus at the leading edge of the wing, muscles near the humerus and radius, air sacs and blood vessels and the tendinous slip which crosses the patagium. Before applying the tags, we wet the lower surface of the patagia with alcohol so that the muscle, tendons, air sacs, blood vessels, and particularly the tendinous slip were clearly visible. Feathers were plucked from the intended site of attachment when necessary to provide better visibility of the patagium.

Evaluation of patagial tag visibility.-- We compared the visibility of two sizes of eartags to determine the distance at which the alphanumeric codes were visible. Large tags (5.75 x 7.0 cm, 7.8 g with 3.25 x 3.0 cm block numbers) and maxi tags (7.5 x 10.0 cm, 12.2 g with 4.0 x 4.5 block numbers) were used. Sixteen people indicated when they could first be sure of the tag number as each tag was separately walked toward them from a distance of 50 m. No optical aids were used during this test. The test was conducted in an open field on a clear, bright morning.

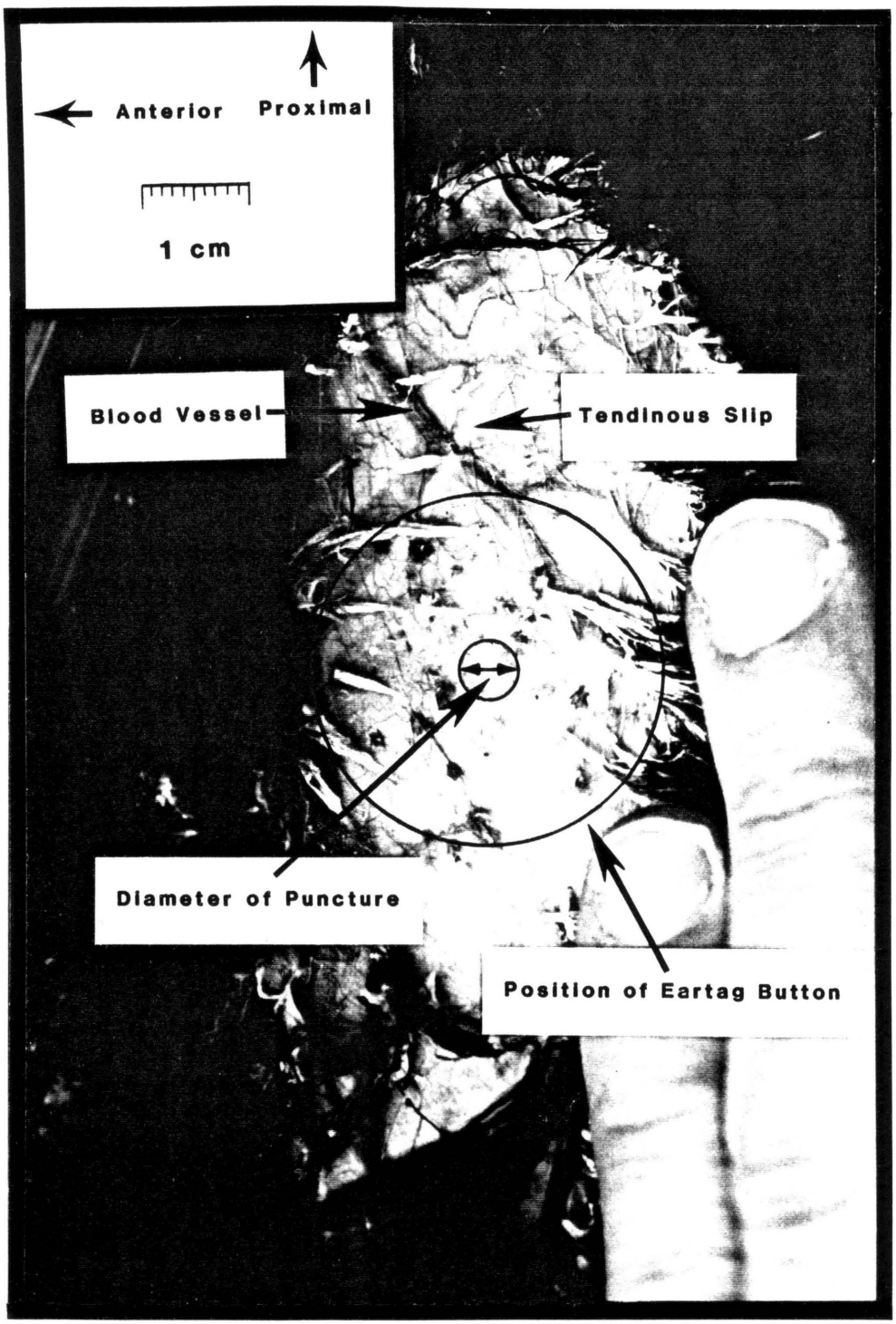

Fig.1. Ventral view of the patagium of a Black Vulture showing blood vessels and the tendinous slip near the site of puncture and position of attachment of cattle eartags.

Effect of patagial tags on behavior.--

Resightings of individuals were recorded at roosts and trap sites. We recorded the outcome of aggressive interactions between marked and unmarked vultures to evaluate the effect that tags had social status. We assumed that if tags do not effect social status, marked vultures would be dominant in half of the interactions observed.

Effect of patagial tags on flight.--

The effects of using eartags as patagial markers on vulture flight was assessed by comparing the proportion of marked vultures departing from a roost in the first half hour after sunrise with the proportion leaving in the second half hour after sunrise. Positions near two roosts which allowed a view of the top of the wings were chosen to sample departing vultures. We also assesed flight patterns and ease of flight of marked and unmarked vultures. We assumed that there would be no difference in departure times of marked and unmarked vultures and that they would not appear to fly differently.

Evaluation of leg bands.--

As an alternative to using metal leg bands, we evaluated the effects of teflon bands to determine if they would cause lesions as Henckel (1976) found with metal leg bands. Four vultures were kept in 6 x 4.5 x 3 m cages from 15 February

1983 through 10 February 1984; two others were kept from 11 November 1983 to 10 February 1984. We banded each vulture with an aluminum No. 28 (4.2 g, 2 cm inside diameter) metal leg band (National Band and Tag Supply Inc.), comparable to a No. 8 USFWS leg band on one leg, and an 0.8 cm wide, 4.6 g teflon locking loop band on the other leg (1.5 x 3.0 cm eliptic, Sherwood Research Corp., Fig. 2). The bands were inspected weekly to observe excrement accretion, and were replaced if the excrement caused constriction of the tarsus and foot swelling.

RESULTS AND DISCUSSION

Attachment of patagial tags.-- The eartags were easily attached with no apparent infliction of pain to the vultures. Only once in 91 taggings was bleeding observed at the site of attachment. Vultures immediately pulled at the tags with their bills, but this behavior was never observed more than one day after tagging. After one day subsequent to release, vultures were only observed touching tags when they were preening.

Evaluation of patagial tag visibility.-- Maxi-size cattle eartags were readable at a greater distance ($\bar{x}$ = 30 m, ± 1.2 SE) compared to large tags ($\bar{x}$ = 27 m, ± 1.0 SE, Paired t=3.88, 15 df, P=0.002). The proportion of resighted tagged Black Vultures was similar to the proportion of tagged

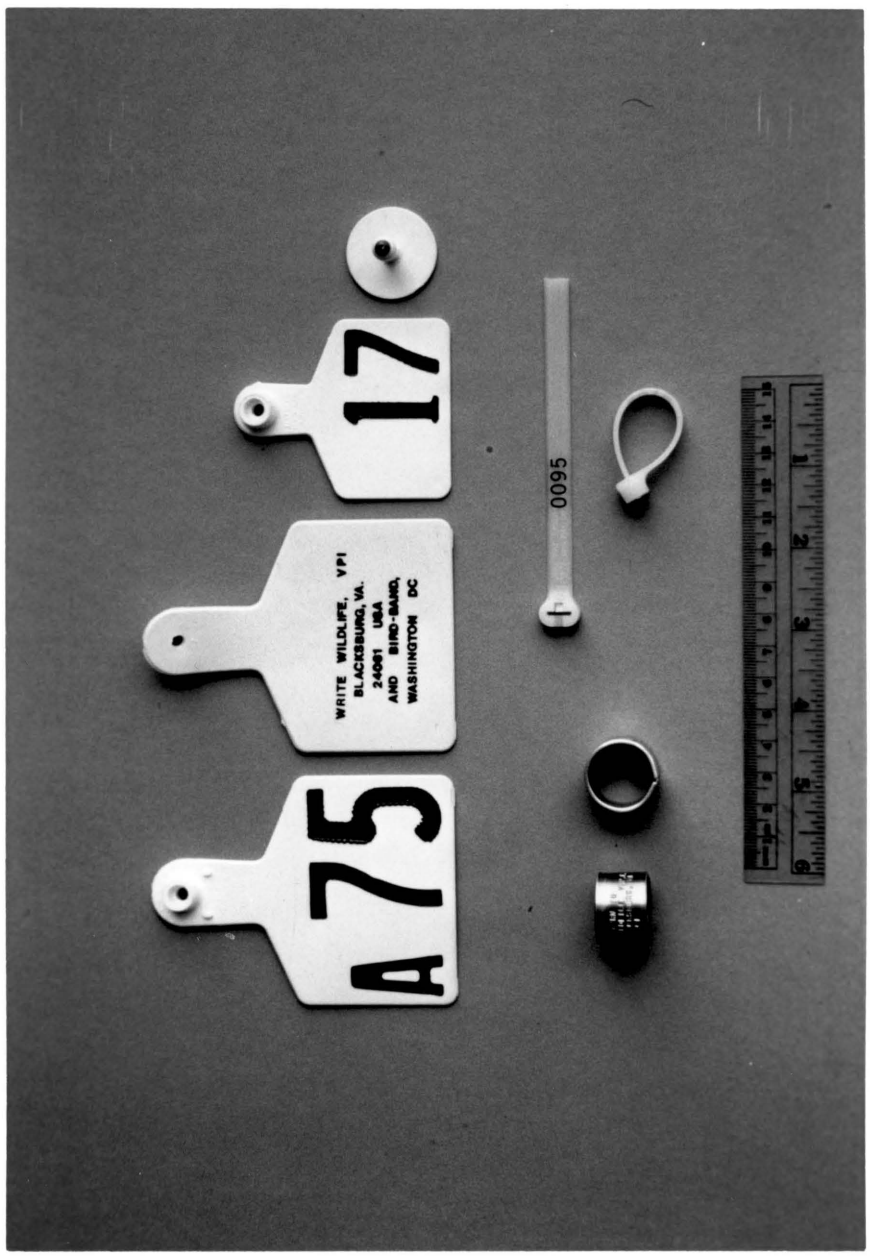

Fig. 2. Maxi (a) and large (b) cattle eartags, and metal (c) and teflon (d) leg bands used as markers for Black and Turkey Vultures.

Turkey Vultures resighted (1 df, $\chi^2 = 0.001$, $P = 0.98$, Table 1). The eartag alphanumerics were easily visible with a 20x spotting scope for distances up to 250 m. Use of eartags alone is sufficient if the purpose of marking is to observe vultures while perched, such as near a roost. Eartag alphanumerics were readable in only six of 53 (11.3%) sightings of flying marked vultures. Reading tags of flying vultures was limited by the frequency of opportunity to read the tags when the birds banked in flight. Tags were unreadable in 17 of 455 (3.7%) resightings of perched vultures because feathers covered part of one or both tags. The high percentage of resightings of marked individuals of each species suggests that the method is effective for this type of study.

Effect of patagial tags on behavior.-- The proportions of individuals dominant in interactions were not significantly different from the expected values of 0.5 for either Turkey Vultures ($Z = 0.02$, $P = 0.73$) or Black Vultures ($Z = 0.02$, $P = 0.15$, Table 2). This corroborates the findings of Wallace et al. (1980) in cases of aggressive interaction between marked and unmarked vultures. We found no evidence that the use of cattle eartags has any effect on the social status of Black or Turkey Vultures. We also observed successful nesting of two marked black vultures in two years after they

Table 1. Number of Black Vultures and Turkey Vultures marked, number (%) resightedat least once, and total number of resightings of Black Vultures and Turkey vultures, southwest Virginia, 1982-1983.

Species	Marked	Resighted	Total Resightings
Black Vulture	71	63(89%)	352
Turkey Vulture	18	15(83%)	86
Total	89	76(85%)	438

Table 2. Outcome of aggressive interactions between marked and unmarked Black and Turkey Vultures in southwest Virginia, 1981-1983.

Species	Dominant Bird: Tagged n(%)	Dominant Bird: Untagged n(%)	Total n
Black Vulture	34(42.0)	47(58.0)	81
Turkey Vulture	32(57.1)	24(42.9)	56
Total	66(48.2)	71(51.8)	137

were tagged. (chapter 4, this thesis). This also suggests that the eartags had no detrimental effect on their social status.

Effect of patagial tags on flight.--

We recorded five samples of marked and unmarked vultures departing two roosts from 1 April 1983 through 30 August 1983 to determine if marked vultures departed roosts later than unmarked vultures, suggesting that the eartags inhibited flight. We obtained one sample at a roost of approximately 45 Turkey Vultues and three Black Vultures and four others at a roost of approximately 200 Black Vultures and 100 Turkey Vultures. We pooled the samples to test for differences in the proportion of tagged vultures of each species between the first and second halves of one-hour observations commencing at sunrise (Table 3). We observed no differences in the proportions of marked and unmarked Turkey Vultures leaving in the first half-hour and second half-hour of observation (1 df, $\chi^2 = 0.81$, $P = 0.37$). All samples were obtained when winds were less than 5 km/hr. These conditions provided a good test compared to gusty conditions which allow relatively easy dynamic soaring. We frequently (n = 103) observed tags flapping up and down during flapping flight but we have not observed such movement when vultures were soaring.

Table 3. Period of departure (early = first half hour of departure, late = second half hour of departure) of Black and Turkey Vultures, southwest Virginia, 1983.

	Early	Late
Turkey Vultures		
Marked	4	6
Unmarked	18	14
Total	22	20
Black Vultures		
Marked	0	2
Unmarked	5	4
Total	5	6

Too few departing Black Vultures were observed in the tests to allow an accurate estimation of the effect of eartags on their flight. Twice we observed Black Vultures with one eartag rotated 180 degrees, extending over the leading edge of the wing. The tags flapped and dragged as the vulture flew. In one observation, the vulture was the second in a group of four. In the other case, the vulture was last in a group of four and appeared to lag behind and was flapping more laboriously than the birds it was following. This was observed in less than 0.5% of all observations of flying tagged Black Vulture and Turkey Vultures.

Evaluation of leg bands.-- During the banding test, five metal bands developed excrement accumulation that caused the foot to swell and the bands had to be removed (Table 4). No teflon bands developed this degree of excrement accretion; however, two teflon bands (33%) were found broken in the cages.

The results of using metal bands corroborate Henkel's (1976) findings. However, even though no potentially detrimental excrement accumulation was found using teflon bands, the tag loss observed suggests that they may be unsuitable for marking vultures.

Table 4. Replacements (n) and days between replacement (DBR) of metal and plastic leg bands on captive Black Vultures (BV) and Turkey Vultures (TV), southwest Virginia 1982-1983.

	n		DBR	
Species	Metal	Plastic	Metal	Plastic
TV	0	1[1]	--	44
BV	2[2]	0	97, 136	--
BV	2[3]	0	218, 107	--
BV	1[4]	1[5]	88	97
BV	0	0	--	--
TV	0	0	--	--
Total	5	2		

[1] Band found broken in cage on 30 March 1983 and replaced immediately.

[2] Bands were replaced immediately upon removal of a band causing leg constriction due to excrement accretion on 21 May and 4 October 1983.

[3] Bands were replaced immediately upon removal of a band causing leg constriction due to excrement accretion on 20 September 1983 and 4 January 1984.

[4] Band was removed on 13 May 1983 and replaced on 21 May 1983.

[5] Band was found broken in the cage and replaced on 21 May 1983.

SUMMARY

Cattle eartags are easily applied to patagia of Black and Turkey Vultures. Particular care should be taken in their application that the tag does not damage the tendonous slip that crosses the patagium. We found the eartags to be ideal for studies requiring identification of perched vultures. If observations of flying birds are desired, then a combination of eartags and streamers may be more appropriate.

Eartag patagial markers are a useful alternative to leg bands. Teflon leg bands did not have detrimental effects on banded vultures, but band loss was high.

LITERATURE CITED

Henckel, R. E. 1976. Turkey vulture banding problem. N. Am. Bird Band. 1:126.

Kochert, M. N., K. Steenhof, and M. Q. Maritsch. 1983. Evaluation of patagial markers for raptors and ravens. Wildl. Soc. Bull. 11:271-281.

Marion, W. R. and J. D. Shamis. 1977. An annotated bibliography of bird marking techniques. Bird Banding 48:42-61.

Mossman, M. 1976. Turkey vultures in the Baraboo Hills, Sauk County, Wisconsin. Passenger Pigeon 38:93-99.

Wallace, M. P., P. A. Parker, and S. A. Temple. 1980. An evaluation of patagial markers for cathartid vultures. J. Field Ornithol. 51:309-428.

MORPHOLOGICAL CHARACTERISTICS OF BLACK AND TURKEY VULTURES IN VIRGINIA

Three methods for sexing vultures are presently available: laparoscopy, karyotype analysis, and fecal steroid sexing (Fry 1983). Although karyotyping is tedious, it is the most generally useful because it is noninvasive, as applicable to juveniles as adults, and useful throughout the year.

A rapid and practical method of sexing vultures is desirable because of the technical and economical limitation of present methods. Gaby (1982) developed mathematical models which predict the sex of Turkey Vultures using two morphological measurements, body weight and tarsus length. If a similar method can be developed for use with Black Vultures and methods can be adapted for use on both Black and Turkey Vultures where clinal differences in body size may require adjustments in the method, it would provide a practical and rapid method of sexing these birds. In this paper we describe some morphological characteristics of Black and Turkey Vultures to provide a basis for further study of sexing vultures based on morphology.

METHODS

We trapped Black and Turkey Vultures near a large communal roost near Radford, Virginia (Prather et al. 1976) using a 9.5 x 18.0 meter cannon net (Wildlife Materials, Inc.). We measured each individual's total length, wing chord length, tail length, culmen length, tarsus length, middle toe length, weight, wing area, and calculated the wing loading (Baldwin et al. 1931). We measured the flattened wing chord length with a 72 cm wing board. Each vulture was weighed in a 300 g canvas bag on a 5.0 kg Homms spring scale. The wing area was determined by tracing a wing of each bird and then measuring the area using a planimeter. Wing loading was calculated by dividing weight by twice the area of one wing.

We classified both species into two age classes. Turkey Vultues that had red heads with bills that were 50% or greater white in color were classified as adult. Those with grey heads and less than 75% white bills were classified as juvenile (Friedmann 1950). We classified Black Vultures with bills that were 75% or greater gray as adults, and those with bills less than 50% gray as juveniles (Friedmann 1950).

We compared these characteristics by age class within both species using Wilcoxon Rank Sum tests. We also

compared measurements of vultures captured in January and February with those captured in June, July, and August.

RESULTS AND DISCUSSION

We captured 52 Black Vultures (29 juveniles, 55.8%) in January and February 1982, and 12 (3 juveniles, 25.0%) in the months of June, July, and August in 1982 and 1983. Adult birds had longer tarsi and juveniles had longer wing chords (Table 1).

We found no other significant differences in morphology of these two classes. If either tarsus length or wing chord length is found to be important for differentiating between the sexes, then separate models may have to be developed for adults and juveniles.

Since the number of Black Vultures at the roost near which we captured these vultures increases to three or four times the summer numbers in the winter (Chapter 1, this thesis), we suspected that some winter captured vultures might be representative of distant populations and have different mean body measurements. However, we found no significant differences between winter caught and other vultures in any of the variables we measured for either adult or juvenile classes (Tables 2 and 3). Wintering vultures may not come from so great a distance that clinal differences are apparent. This suggests that morphometric

Table 1. Body measurements ($\bar{x}$(SE)) of juvenile and adult Black Vultures, southwest Virginia, 1982-1983.

Body Measurement	Black Vultures Adult(n=32)	Juvenile(n=32)	S	P
Total length (cm)	64.2(0.31)	64.7(0.24)	949.0	0.223
Chord length (cm)	43.7(0.21)	44.2(0.16)	869.0	0.022
Tail length (cm)	19.9(0.23)	20.3(0.40)	1075.0	0.643
Culmen length(cm)	2.4(0.02)	2.4(0.01)	954.0	0.220
Tarsus length (cm)	9.2(0.07)	9.1(0.06)	1207.0	0.026
Middle toe length (cm)	5.0(0.04)	5.1(0.06)	1000.5	0.596
Weight (g)	2134(39.5)	2107(20.7)	1125.0	0.255
Wing area (cm^2)	3508(42.8)	3563(48.4)	974.0	0.379
Wing loading (g/cm^2)	0.62(0.014)	0.60(0.001)	1136.0	0.200

Table 2. Body measurements ($\bar{x}$(SE)) of adult Black Vultures trapped at two times of the year, southwest Virginia, 1982-1983.

Body measurement	Winter(n=23)	Other(n=9)	S	P
Total length (cm)	64.4(0.33)	63.7(0.69)	137.5	0.659
Chord length (cm)	43.6(0.25)	43.7(0.40)	142.5	0.817
Tail length (cm)	19.9(0.29)	19.7(0.36)	155.5	0.785
Culmen length (cm)	2.34(0.02)	2.43(0.47)	114.0	0.135
Tarsus length (cm)	9.3(0.09)	9.2(0.12)	167.0	0.449
Middle toe length (cm)	5.03(0.05)	5.01(0.08)	135.5	0.596
Weight (g)	2147(36.9)	2100(108.3)	152.0	0.900
Wing area (cm^2)	3527(56.1)	3462(52.6)	132.0	0.543
Wing loading (g/cm^2)	0.612(0.015)	0.608(0.033)	158.0	0.706

Table 3. Body measurements ($\bar{x}$(SE)) of juvenile Black Vultures trapped at two times of the year, southwest Virginia, 1982-1983.

Body measurement	Winter(n=23)	Other(n=3)	S	P
Total length (cm)	64.8(0.24)	63.8(1.20)	39.0	0.537
Chord length (cm)	44.2(0.18)	44.1(0.29)	42.5	0.674
Tail length (cm)	203(0.44)	20.0(0.15)	68.5	0.230
Culmen length (cm)	2.44(0.14)	2.43(0.06)	69.5	0.203
Tarsus length (cm)	9.03(0.06)	9.27(0.20)	69.5	0.203
Middle toe length (cm)	5.12(0.06)	4.99(0.15)	41.0	0.599
Weight (g)	2102(22.1)	2150(62.9)	55.0	0.743
Wing area (cm^2)	3571(53.0)	3488(65.0)	41.5	0.628
Wing loading (g/cm^2)	0.592(0.009)	0.616(0.007)	64.0	0.365

dependent critera for sexing Black Vultures are developed, then they might be applied with success to birds captured at this roost throughout the year.

We captured 13 Turkey Vultures (12 adult, 1 juvenile) in the months of June, July, and August in 1982 and 1983. These probably represent local populations (Table 4). Because all birds were trapped in summerand most were adults, seasonal and age comparisons could not be made.

SUMMARY

We recorded eight body measurements and calculated the wing loading of 64 Black Vultures and 13 Turkey Vultures. We found significantly longer tarsi in adult Black Vultures than in juvenile Black Vultures, but juveniles had longer wing chords. We found no differences in body measurements between winter and summer captured Black Vultures in either the adult or juvenile class. Only one of the captured Turkey Vultures was a juvenile. All Turkey Vultures were trapped in the summer and most were adults so no seasonal and age comparisons could be made. The results suggest that separate morphometric models for sexing Black Vultures will be needed for juvenile and adult birds if they are to be based upon tarsus and wing chord length. The similarity of morphology of winter and summer captured Black Vultures suggests that morphometric sexing criteria developed for

Table 4. Body measurements ($\bar{x}$(SE)) of Turkey Vultures, southwest Virginia, 1982-1983.

Body measurement	Adult (n=12)	Juvenile (n=1)
Total length (cm)	70.7(67.8)	71.0
Chord length (cm)	53.1(1.14)	53.2
Tail length (cm)	29.9(0.33)	29.4
Culmen length (cm)	2.58(0.024)	2.6
Tarsus length (cm)	7.79(0.13)	7.7
Middle toe length (cm)	5.0(0.08)	5.3
Weight (g)	2033(83.5)	2025
Wing area (cm^2)	4268(30.8)	4174
Wing loading (g/cm^2)	0.48(0.069)	0.49

vultures near this roost may be useful for vultures captured throughout the year.

LITERATURE CITED

Baldwin, P. S., H. C. Olberhoeser, and L. G. Worley. 1931. Measurements of Birds. Scientific Publications of the Cleveland Museum of Natural History, Volume II, Cleveland, Ohio. 65 pp. 198 pp.

Friedmann, H. 1950. The birds of North and Middle America. Part XI. U. S. Natl. Mus. Bull. 50.793pp.

Fry, D. M., 1982. Techniques for Sexing Monomorphic Vultures. in S. R. Wilbur and J. A. Jackson eds. Vulture Biology and Management. Univ. of California Press, Los Angeles CA. 550pp.

Gaby, S. R. P. 1982 Age-specifice resource utilization by wintering migrant Turkey Vultures (Cathartes aura) in south Florida. Ph.D. Diss., Univ. of Miami., Florida. 199pp.

Prather, I. D., R. N. Conner, and C. S. Adkisson. 1976. Unusually large vulture roost in Virginia. Wilson Bull. 88:667-668.

NESTING PERIODICITY OF BLACK VULTURES IN SOUTHWESTERN VIRGINIA

Black Vultures (Coragyps atratus) are conspicuous members of the avifauna of southwest Virginia. Although both species nest in this area, there has been no comprehensive study of their nesting behavior. Stewart (1974) described nesting behavior in detail for a single Black Vulture nest. The most complete compilation of both species' reproductive characteristics was developed by Jackson (1982), who described the nesting phenology, nest losses, and nest sites of Black and Turkey Vultures. Jackson (1982) describes nest site sitting, egg laying, incubation period, hatching, the nestling period and post-nestling dependency in the context of the nesting cycle. At least some general data are available for both species describing these aspects of reproduction.

However, little is known of the periodicity of nesting in either species. Jackson (1982) cited accounts of Black Vulture nests being used in successive years by unidentified pairs, but notes the lack of convincing data from observations of marked birds. Wallace et al. (1980) reported that of 10 Black Vultures captured during various stages of the nesting season, all that were tagged for more than one season returned to the same nest site. However, no

detailed account or exact sample size were given. In this paper we describe the use of nests by the same Black Vultures in successive years.

METHODS

Vulture nests were located in August 1982 by sighting nestlings perched outside their nest caves. We visited the nests during the breeding season in 1982, 1983, and 1984.

RESULTS AND DISCUSSION

We found two Black Vulture nests within 300 m of a large Black Vulture and Turkey Vulture roost (the primary roost (roost 1), this thesis, Prather et al. 1976) on 25 July 1982. One nest was in a cave large enough to walk in to about 10 m to where the eggs were laid. The eggs in the other nest were laid about 0.5 m from the entrance in a small tunnel. The adults and mobile nestlings were able to retreat about 2 m into a small chamber which could be reached only by crawling flat on the cave floor.

One adult in each nest had been previously marked by us with a cattle eartag attached through each patagium (Wallace et al. 1980). We visited the two nests seven times in three successive breeding seasons. The marked vulture at one nest was sighted once on 22 July 1982 when nestlings were present, on 19 April and 4 August 1983 when eggs were present, and nestlings were present respectively,. and on

31 April 1984 when eggs were present. The other marked vulture was sighted in another nest on 19 April 1983 when eggs were present and on 31 April 1984 when eggs were present.

SUMMARY

Jackson (1982) reported that although there are reports of Black Vulture nests being used in successive years, there have been no observations of marked vultures nesting with a yearly periodicity. Wallace et al. (1980) implied that some (less than 10) marked Black Vultures used the same nest in subsequent years. We found two marked Black Vultures, each one of a breeding pair, nest in successive years in the same nests. On vulture nested in three successive years and the other nested in two sucessive years. Our results from observations of two nests corroborate Wallace et al. (1980) that Black Vultures are annual nesters.

LITERATURE CITED

Jackson, J. A. 1982. Nesting phenology, nest site selection, and reproductive success of the black and turkey vulture in S. R. Wilbur and J. A. Jackson, eds. Vulture Biology and Management. Univ. of California Press, Los Angeles, CA. 550pp.

Prather, I. D., R. N. Conner, and C. S. Adkisson. 1976. Unusually large vulture roost in Virginia. Wilson Bull. 88:667-668.

Stewart, P. A. 1974. A nesting of Black Vultures. Auk 91:595-600.

Wallace, M. P., P. G. Parker, and S. A. Temple. 1980. An evaluation of patagial markers for cathartid vultures. J. Field Ornith. 54:309-314.

APPENDIX I

Table 1. Roost 1 counts, Radford, Virginia, 1981.

Date	BV	TV	TTL	Time Start	Time Finish	Temp °C	% Cloud cover
09/17/81	272	141	413	0531	0938	7.0	10
09/18/81	302	134	436	0525	0856	4.5	30
09/19/81	338	073	411	0531	0823	7.2	80
09/21/81	355	143	498	0520	0835	4.9	--
09/26/81	185	104	289	0530	0800	6.5	20
09/28/81	166	087	253	0520	0923	4.5	10
10/03/81	144	074	218	0545	1034	2.3	80
10/14/81	341	084	425	1600	2005	1.5	70
10/16/81	141	096	237	0540	0834	2.5	55
10/17/81	148	103	251	0450	0813	2.3	40
10/23/81	186	101	287	0550	0902	2.5	100
11/03/81	222	119	341	0546	1020	3.5	60
11/10/81	286	133	419	0538	0826	2.5	25
11/12/81	347	139	486	0540	0902	1.0	10
11/19/81	483	163	646	0540	0803	3.5	20
11/22/81	525	234	759	0540	0745	-1.0	25
12/03/81	536	251	785	0555	0712	-0.5	15
12/10/81	539	250	789	0547	0948	-2.5	90
12/19/81	467	243	710	0537	0822	1.0	40
12/21/81	382	172	554	0558	0803	0.5	00

Table 2. Roost 1 counts, Radford, Virginia, 1982.

Date	BV	TV	TTL	Time Start	Time Finish	Temp °C	% Cloud cover
01/05/82	441	121	562	0520	0802	-1.0	10
01/12/82	464	117	581	0530	0800	-0.5	20
01/16/82	390	129	519	0537	0904	-1.0	15
01/22/82	415	134	549	0523	1102	1.0	05
02/01/82	427	137	564	0529	0730	-1.5	100
02/07/82	403	137	540	0535	0837	2.5	50
02/13/82	414	131	545	0525	0828	3.5	50
02/20/82	408	123	531	0520	0926	3.0	45
02/28/82	397	121	518	0523	0847	2.4	--
03/01/82	410	117	527	0515	0828	3.5	20
03/05/82	418	117	535	0534	1036	3.5	10
03/11/82	402	109	511	0536	1036	4.0	35
03/18/82	330	089	419	0540	0759	4.5	40
03/22/82	318	076	394	0536	0934	3.5	90
03/26/82	268	077	345	0546	0902	4.3	95
03/28/82	274	068	342	0510	0836	2.0	90
04/02/82	231	068	329	0512	0803	4.0	50
03/13/82	172	051	223	0510	0959	3.0	50
04/10/82	138	059	197	1520	2056	3.5	00
04/27/82	154	047	201	1525	2200	3.0	00
05/05/82	150	045	195	0530	0930	1.6	00
05/06/82	145	048	193	0539	1038	2.0	100
05/12/82	151	045	196	0510	0903	---	--
05/31/82	143	042	185	0505	0801	1.5	00
06/10/82	145	044	187	0505	0849	1.8	30
06/14/82	142	043	185	0520	1044	3.0	60

Table 2(continued). Roost 1 counts, Radford, Virginia, 1982.

Date	BV	TV	TTL	Time Start	Time Finish	Temp °C	% Cloud cover
06/17/82	143	040	183	0523	0926	3.5	75
06/29/82	146	041	187	0517	1103	3.0	80
07/09/82	142	039	181	0525	0800	3.0	30
07/19/82	163	035	189	0525	0821	3.5	35
07/21/82	169	037	206	0530	0732	2.8	30
07/27/82	187	037	244	0530	1024	---	10
08/07/82	197	038	235	0532	0833	2.8	55
08/15/82	204	037	241	0214	0915	2.8	50
08/27/82	217	041	258	0534	0935	2.5	40
08/29/82	219	040	259	0530	0941	2.5	90
09/04/82	223	059	282	1515	2204	2.4	100
09/09/82	257	064	321	0535	----	2.9	80
09/12/82	316	097	413	0532	1045	2.0	30
09/18/82	303	133	436	1530	2100	3.8	40
10/08/82	302	087	389	1520	2130	3.8	10
10/14/82	419	117	536	0531	1134	3.5	25
10/21/82	505	156	661	1530	2134	3.0	45
10/22/82	462	127	589	0530	1003	3.8	40
10/28/82	498	143	641	0530	0904	3.5	40
10/29/82	567	141	708	0531	0820	3.0	--
11/04/82	554	159	713	0530	1021	3.9	95
11/09/82	618	169	787	0540	1157	2.8	20
11/22/82	758	186	974	0550	0812	-3.8	10
11/29/82	782	179	961	0552	0930	-3.5	10
12/08/82	084	267	1107	0555	0922	---	40
12/12/82	767	213	980	0556	0834	-3.5	25
12/14/82	687	198	867	0545	1002	-7.0	15
12/18/82	546	219	765	0545	1031	-4.5	15

Table 3. Roost 1 counts, Radford, Virginia, 1983.

Date	BV	TV	TTL	Time Start	Time Finish	Temp °C	% Cloud cover
01/05/83	619	198	817	0550	0802	-3.5	20
01/10/83	582	222	804	0550	0943	-1.0	15
01/11/83	645	206	851	0551	1002	1.5	30
01/13/83	671	173	844	0550	0840	-0.5	20
01/18/83	634	187	821	0555	0934	-3.0	80
01/20/83	626	167	793	0550	0801	-3.8	100
02/05/83	607	217	824	0540	0932	7.0	10
02/09/83	686	203	889	0554	0845	7.0	10
02/22/83	565	182	747	0555	0859	7.5	--
02/26/83	517	175	692	0535	0903	7.5	70
03/02/83	427	126	553	0500	1020	6.5	55
03/14/83	396	134	530	0555	0826	6.0	10
03/18/83	444	098	542	0557	0844	6.0	25
03/24/83	373	117	490	0530	0858	7.5	55
03/30/83	298	149	447	0532	1123	7.0	50
04/02/83	234	162	396	0539	0758	7.5	90
04/09/83	187	130	317	1522	2134	7.8	30
04/17/83	181	141	322	1500	2234	7.5	65
04/21/83	175	156	331	0505	0835	5.0	35
04/29/83	180	155	335	1530	2100	3.8	10
05/04/83	188	101	289	1530	2130	3.8	05
05/10/83	187	109	296	0510	0912	3.5	00
05/11/83	195	109	304	0510	0910	3.0	30
05/28/83	200	117	317	0522	1003	4.0	35
06/02/83	222	097	319	0520	1019	3.8	20
06/06/83	201	122	323	0533	0932	3.5	05

Table 3 (continued). Roost 1 counts, Radford, Virginia, 1983.

Date	BV	TV	TTL	Time Start	Time Finish	Temp °C	% Cloud cover
06/07/83	215	098	313	0525	0954	3.5	90
06/19/83	211	090	301	0525	1002	3.5	10
07/02/83	213	100	313	0525	0838	3.8	00
07/10/83	210	117	327	0530	0900	3.8	00
07/25/83	241	080	321	0525	1029	7.0	05
07/30/83	248	089	337	0521	0917	5.2	20
08/03/83	255	098	353	0532	0905	5.0	15
08/09/83	238	092	330	0530	0803	4.5	90
08/18/83	244	111	355	0543	0750	4.5	80
08/25/83	243	125	368	0547	0904	4.3	55
09/02/83	214	137	351	0535	0853	---	--
09/07/83	223	167	390	0540	0923	4.5	60
09/14/83	218	201	419	0530	0824	3.5	10
09/27/83	275	250	525	0543	0811	6.0	15
10/04/83	304	259	563	0540	0932	4.0	10
10/24/83	277	254	531	1544	2100	3.8	10
10/30/83	318	233	551	0533	0754	1.0	30
11/01/83	323	230	553	0524	0912	-1.5	25
11/02/83	329	247	559	0545	0830	-1.5	35
11/05/83	347	236	583	0545	0749	1.0	90

APPENDIX II

Table 4. Counts of black (BV) and turkey vultures (TV) at Roost 2, Shanklin's Ferry, West Virginia, 1982-1983.

Date	Number of BV	Number of TV	Time start	Time finish	Temp °C	% cloud cover
11/23/82	188	83	0540	0730	-3.5	10
11/28/82	192	71	0510	0800	-3.0	90
03/09/83	63	20	1600	2030	5.0	75
06/25/83	71	27	0545	0845	5.5	20
09/22/83	66	37	0550	0830	4.5	05

APPENDIX III

Table 5. Counts of black vultures (BV) and turkey vultures (TV) at Roost 3, Christiansburg, Virginia, 1982-1983.

Date	Number of BV	Number of TV	Time start	Time finish	Temp °C	% Cloud cover
08/05/82	1	33	0545	0710	4.5	10
08/09/82	3	33	0540	0703	4.0	90
08/27/82	3	23	1600	2000	4.5	25
09/04/82	1	30	0540	0700	4.5	10
09/07/82	2	33	0530	0655	3.8	50
09/09/82	1	35	0531	0705	4.0	15
09/22/82	3	38	0520	0600	3.8	50
10/10/82	3	42	0520	0610	3.8	20
10/14/82	3	42	0523	0730	3.5	100
10/18/82	0	0	0525	0815	2.5	100
03/01/83	0	27	0519	0831	1.6	75
03/09/83	0	21	0525	0745	1.6	95
03/22/83	0	37	0535	0732	2.5	60
04/05/83	0	25	0510	0715	4.0	65
04/08/83	1	29	0510	0715	4.5	75
04/16/83	1	43	1515	2030	5.0	00
04/23/83	0	37	1520	2000	4.6	10
05/05/83	0	35	0515	0700	4.5	05
05/07/83	3	35	0520	0645	4.5	10
05/23/83	0	41	0500	0650	3.8	25

Table 5(continued). Counts of black vultures (BV) and turkey vultures (TV) at Roost 3, Christiansburg, Virginia, 1982-1983.

Date	Number of BV	Number of TV	Time start	Time finish	Temp °C	% Cloud cover
05/24/83	1	38	0525	0700	4.5	95
06/08/83	3	39	1531	2015	5.0	00
06/15/83	8	27	0530	0635	5.5	--
06/18/83	1	34	0523	0900	4.3	10
06/21/83	1	31	0534	0801	4.0	20
06/25/83	3	31	0520	0730	4.0	100
07/06/83	1	45	0505	0630	4.3	90
07/09/83	2	43	0535	0645	4.0	25
07/21/83	1	44	0535	0637	4.5	40
08/02/83	3	39	0531	0659	4.0	60
08/05/83	3	47	0534	0704	4.0	--
08/20/83	3	46	0530	0830	3.5	100
09/04/83	3	45	0545	0731	3.8	90
09/08/83	7	51	0540	0801	3.5	25
09/19/83	3	47	0544	0734	4.0	50
09/28/83	3	59	0540	0710	2.5	55
10/06/83	4	74	0545	0705	3.0	25
10/23/83	5	80	0540	0710	2.5	00
10/25/83	0	0	0550	0700	2.3	10
11/04/83	0	0	0555	0700	1.0	--

APPENDIX IV

Table 6. Counts of black (BV) and turkey vultures (TV) at roost 4, Pulaski, Virginia, 1983.

Date	Number of BV	Number of TV	Time start	Time finish	Temp °C	% cloud cover
03/09/83	0	19	0530	0631	2.5	10
03/25/83	0	0	1613	2130	2.5	15
04/09/83	1	25	0535	0730	3.0	100
04/20/83	0	27	0530	0700	4.0	85
05/13/83	0	27	0533	0613	---	100
05/19/83	1	24	1545	2130	4.5	80
06/01/83	1	25	0540	0621	3.5	10
06/09/83	3	23	0540	0702	5.0	100
06/14/83	1	25	0534	0710	4.5	50
06/19/83	3	21	0532	0700	4.5	10
07/05/83	3	19	0543	0730	4.2	15
07/11/83	4	24	0540	0710	4.8	50
07/17/83	5	27	0531	0705	4.8	85
07/22/83	5	24	0540	0700	4.5	60
08/04/83	3	39	0540	0705	4.0	90
08/08/83	3	37	0543	0700	4.0	70
08/15/83	8	41	0545	0705	4.3	10
09/09/83	6	41	0535	0730	3.5	10
09/12/83	5	49	0550	0745	3.5	30
09/20/83	8	53	0555	0740	1.6	10

APPENDIX V

Table 7. Departures of black vultures from roost 1, Radford, Virginia, 1981-1982.

Date	Total	Number of Depart. during 1/2 hour before sunrise	Number of Depart. to 2 hours after sunrise	Number of Depart. to 4 hours after sunrise
10/03/81	144	6	132	141
10/13/81	341	23	329	339
12/09/81	539	56	533	538
12/22/81	382	46	376	380
01/05/81	441	38	417	432
01/22/81	415	47	393	413
02/01/82	427	31	426	426
02/20/82	408	41	398	403
02/28/82	397	23	384	391
03/11/82	402	32	385	391
03/26/82	268	21	268	268
11/22/82	758	71	749	753
11/29/82	782	76	761	779
12/08/82	840	75	831	836

Table 8. Departures of turkey vultures from roost 1, Radford, Virginia, 1981-1982.

Date	Total	Number of Depart. during 1/2 hour before sunrise	Number of Depart. to 2 hours after sunrise	Number of Depart. to 4 hours after sunrise
10/03/81	74	0	74	74
10/13/81	84	2	83	83
12/09/81	250	1	243	250
12/22/81	172	4	167	169
01/05/82	121	6	112	120
01/22/82	134	6	126	134
02/01/82	137	8	137	137
02/20/82	123	3	123	123
02/28/82	121	9	117	119
03/11/82	109	4	107	107
03/26/82	77	3	75	77
11/22/82	186	4	180	183
11/29/82	179	2	168	175
12/08/82	267	8	253	263

APPENDIX VI

Table 9. Results of road surveys and corresponding number of black (BV) and turkey vultures (TV) at roost 1, southwest Virginia 1982-1983.

Survey date	Number of BV	Dist. of BV (km)	Number of TV	Dist. of TV (km)	BV count	TV count	Count Day
07/10/82	00	00.0	2	23.0	142	39	07/09/82
07/18/82	00	00.0	0	00.0	163	35	07/19/82
08/02/82	00	00.0	0	00.0	187	37	07/26/82
08/09/82	00	00.0	2	29.5	197	38	08/07/82
09/07/82	00	00.0	3	27.0	223	59	09/04/82
09/08/82	00	00.0	1	10.0	257	64	09/09/82
10/07/82	00	00.0	4	18.0	302	87	10/07/82
10/14/82	00	00.0	6	16.6	419	117	10/14/82
11/11/82	39	5.2	0	00.0	619	169	11/09/82
11/26/82	00	00.0	3	31.5	758	186	11/22/82
12/17/82	23	7.5	0	00.0	687	198	12/14/82
12/18/82	13	18.9	1	10.5	546	219	12/18/82
01/25/83	00	00.0	2	14.8	626	167	01/20/83
01/28/83	00	00.0	2	19.8	607	217	02/05/83
02/13/83	35	6.2	4	12.8	565	182	02/22/83
02/22/83	00	00.0	0	00.0	565	182	02/22/83
03/02/83	5	8.7	2	27.0	427	126	03/02/83
03/29/83	18	13.3	2	25.0	298	149	03/30/83
04/09/83	00	00.0	0	00.0	234	162	04/02/83
04/09/83	6	13.1	3	21.0	180	155	04/30/83
05/13/83	00	00.0	1	19.0	195	109	05/10/83
05/26/83	00	00.0	0	00.0	200	117	05/28/83
06/04/83	14	8.3	5	6.3	222	97	06/02/83
06/15/83	12	19.4	3	20.7	215	98	06/17/83
06/22/83	3	18.8	0	00.0	211	90	06/20/83

APPENDIX VII

Table 10. Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A00	06/01/82	BV	06/02/82	1
A00	06/01/82	BV	01/27/82	1
A00	06/01/82	BV	03/22/83	3
A00	06/01/82	BV	05/12/83	3
A01	08/03/82	BV	08/04/82	1
A01	08/03/82	BV	09/04/82	1
A01	08/03/82	BV	02/05/83	1
A01	08/03/82	BV	03/10/83	1
A01	08/03/82	BV	03/22/83	1
A01	08/03/82	BV	04/17/83	1
A01	08/03/82	BV	04/21/83	1
A01	08/03/82	BV	04/29/83	1
A01	08/03/82	BV	05/06/83	1
A01	08/03/82	BV	05/10/83	1
A01	08/03/82	BV	06/06/83	1
A01	08/03/82	BV	08/25/83	1
A01	08/03/82	BV	09/02/83	1
A02	08/03/82	BV	08/04/82	1
A02	08/03/82	BV	11/09/82	1
A02	08/03/82	BV	02/04/83	1
A02	08/03/82	BV	03/01/83	3
A02	08/03/82	BV	03/02/83	1
A02	08/03/82	BV	03/15/83	3
A02	08/03/82	BV	03/22/83	3
A02	08/03/82	BV	04/03/83	3
A02	08/03/82	BV	04/22/83	3
A02	08/03/82	BV	04/29/83	3
A02	08/03/82	BV	07/10/83	1
A02	08/03/82	BV	07/26/83	1
A02	08/03/82	BV	07/30/83	1
A02	08/03/82	BV	08/09/83	1
A02	08/03/82	BV	08/16/83	3
A02	08/03/82	BV	08/31/83	3
A02	08/03/82	BV	09/04/83	3
A02	08/03/82	BV	09/12/83	3
A02	08/03/82	BV	09/14/83	1
A02	08/03/82	BV	09/20/83	3
A02	08/03/82	BV	10/21/83	3
A02	08/03/82	BV	10/24/83	3
A02	08/03/82	BV	10/28/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A02	08/03/82	BV	10/29/83	1
A02	08/03/82	BV	11/02/83	1
A02	08/03/82	BV	11/03/83	1
A02	08/03/82	BV	11/05/83	1
A02	08/03/82	BV	11/19/83	1
A03	08/03/82	TV	11/09/82	1
A03	08/03/82	TV	07/26/83	1
A03	08/03/82	TV	11/19/83	1
A04	08/03/82	TV	08/04/82	1
A04	08/03/82	TV	09/18/82	1
A04	08/03/82	TV	10/28/82	1
A04	08/03/82	TV	01/05/83	1
A04	08/03/82	TV	04/29/83	1
A04	08/03/82	TV	05/10/83	1
A04	08/03/82	TV	08/09/83	1
A05	08/04/82	BV	09/18/82	1
A05	08/04/82	BV	10/07/82	1
A05	08/04/82	BV	10/27/82	1
A05	08/04/82	BV	12/18/82	1
A05	08/04/82	BV	01/05/83	1
A05	08/04/82	BV	02/26/83	1
A05	08/04/82	BV	03/15/83	3
A05	08/04/82	BV	04/03/83	3
A05	08/04/82	BV	04/22/83	3
A05	08/04/82	BV	04/29/83	3
A05	08/04/82	BV	05/06/83	3
A05	08/04/82	BV	06/07/83	1
A05	08/04/82	BV	07/02/83	1
A05	08/04/82	BV	07/30/83	1
A05	08/04/82	BV	08/09/83	1
A05	08/04/82	BV	09/20/83	3
A05	08/04/82	BV	11/19/83	1
A06	01/04/83	BV	02/26/83	1
A06	01/04/83	BV	03/10/83	1
A06	01/04/83	BV	03/14/83	1
A06	01/04/83	BV	04/02/83	1
A06	01/04/83	BV	04/21/83	1
A06	01/04/83	BV	04/29/83	1
A06	01/04/83	BV	05/06/83	1
A06	01/04/83	BV	07/02/83	1
A06	01/04/83	BV	10/04/83	1
A07	01/14/83	BV	01/18/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A07	01/14/83	BV	01/20/83	1
A07	01/14/83	BV	06/29/83	1
A07	01/14/83	BV	07/02/83	1
A07	01/14/83	BV	07/09/83	1
A07	01/14/83	BV	09/02/83	1
A07	01/14/83	BV	09/17/83	1
A07	01/14/83	BV	10/24/83	1
A07	01/14/83	BV	10/29/83	1
A08	01/14/83	BV	07/03/83	1
A08	01/14/83	BV	07/09/83	1
A08	01/14/83	BV	08/16/83	1
A09	01/14/83	BV	08/09/83	3
A09	01/14/83	BV	09/07/83	1
A09	01/14/83	BV	10/04/83	1
A09	01/14/83	BV	10/24/83	1
A10	01/14/83	BV	(not resighted)	
A11	01/14/83	BV	09/14/83	1
A12	01/14/83	BV	04/29/83	1
A12	01/14/83	BV	09/07/83	1
A12	01/14/83	BV	10/28/83	1
A12	01/14/83	BV	11/01/83	1
A12	01/14/83	BV	11/02/83	1
A12	01/14/83	BV	11/05/83	1
A13	01/14/83	BV	01/20/83	1
A13	01/14/83	BV	09/14/83	1
A13	01/14/83	BV	09/17/83	1
A13	01/14/83	BV	11/02/83	1
A14	01/14/83	BV	11/01/83	1
A14	01/14/83	BV	11/03/83	1
A14	01/14/83	BV	11/19/83	1
A15	01/14/83	BV	05/28/83	1
A16	01/14/83	BV	03/10/83	1
A16	01/14/83	BV	03/22/83	1
A16	01/14/83	BV	04/02/83	1
A16	01/14/83	BV	04/21/83	1
A16	01/14/83	BV	04/29/83	1
A16	01/14/83	BV	05/05/83	1
A16	01/14/83	BV	05/28/83	1
A16	01/14/83	BV	06/03/83	3
A16	01/14/83	BV	07/02/83	1
A16	01/14/83	BV	07/26/83	1
A16	01/14/83	BV	08/18/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A16	01/14/83	BV	08/25/83	1
A17	01/14/83	BV	02/04/83	1
A17	01/14/83	BV	02/05/83	1
A17	01/14/83	BV	08/25/83	1
A17	01/14/83	BV	11/05/83	1
A17	01/14/83	BV	11/19/83	1
A18	01/14/83	BV	01/18/83	1
A18	01/14/83	BV	01/20/83	1
A18	01/14/83	BV	02/04/83	1
A18	01/14/83	BV	07/19/83	1
A18	01/14/83	BV	09/07/83	1
A18	01/14/83	BV	09/17/83	1
A18	01/14/83	BV	10/28/83	1
A18	01/14/83	BV	11/01/83	1
A18	01/14/83	BV	11/02/83	1
A19	01/14/83	BV	02/05/83	1
A19	01/14/83	BV	02/26/83	1
A19	01/14/83	BV	03/22/83	1
A19	01/14/83	BV	04/29/83	1
A19	01/14/83	BV	05/05/83	1
A19	01/14/83	BV	05/28/83	1
A19	01/14/83	BV	06/03/83	1
A19	01/14/83	BV	06/06/83	1
A19	01/14/83	BV	07/02/83	1
A19	01/14/83	BV	07/26/83	1
A19	01/14/83	BV	10/04/83	1
A19	01/14/83	BV	11/03/83	1
A20	01/14/83	BV	(not resighted)	
A21	01/14/83	BV	(not resighted)	
A22	01/14/83	BV	02/04/83	1
A22	01/14/83	BV	02/26/83	1
A22	01/14/83	BV	07/02/83	1
A23	01/29/83	BV	03/22/83	1
A23	01/29/83	BV	04/02/83	1
A23	01/29/83	BV	05/28/83	1
A23	01/29/83	BV	06/06/83	1
A23	01/29/83	BV	07/02/83	1
A23	01/29/83	BV	07/26/83	1
A23	01/29/83	BV	08/09/83	3
A23	01/29/83	BV	08/18/83	1
A23	01/29/83	BV	09/02/83	1
A23	01/29/83	BV	11/03/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A23	01/29/83	BV	11/05/83	1
A23	01/29/83	BV	11/19/83	1
A24	01/29/83	BV	04/29/83	1
A24	01/29/83	BV	08/25/83	1
A25	01/29/83	BV	02/04/83	1
A25	01/29/83	BV	02/05/83	1
A25	01/29/83	BV	03/10/83	1
A25	01/29/83	BV	04/02/83	1
A25	01/29/83	BV	11/05/83	1
A26	01/29/83	BV	03/10/83	1
A26	01/29/83	BV	05/05/83	1
A26	01/29/83	BV	05/06/83	1
A26	01/29/83	BV	07/09/83	1
A26	01/29/83	BV	07/10/83	1
A26	01/29/83	BV	07/19/83	1
A26	01/29/83	BV	07/26/83	1
A26	01/29/83	BV	08/09/83	1
A26	01/29/83	BV	09/02/83	1
A26	01/29/83	BV	09/07/83	1
A26	01/29/83	BV	11/05/83	1
A27	02/01/83	BV	03/10/83	1
A27	02/01/83	BV	04/02/83	1
A27	02/01/83	BV	04/29/83	1
A27	02/01/83	BV	10/04/83	1
A28	02/01/83	BV	08/09/83	1
A28	02/01/83	BV	08/25/83	1
A28	02/01/83	BV	09/17/83	1
A29	02/01/83	BV	02/04/83	1
A30	02/01/83	BV	02/26/83	1
A30	02/01/83	BV	03/22/83	1
A30	02/01/83	BV	04/03/83	1
A30	02/01/83	BV	04/29/83	3
A30	02/01/83	BV	08/09/83	1
A31	02/01/83	BV	05/05/83	1
A31	02/01/83	BV	05/28/83	1
A31	02/01/83	BV	09/02/83	1
A31	02/01/83	BV	10/04/83	1
A31	02/01/83	BV	11/03/83	1
A32	02/01/83	BV	02/04/83	1
A32	02/01/83	BV	03/14/83	1
A32	02/01/83	BV	06/06/83	1
A32	02/01/83	BV	11/02/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A32	02/01/83	BV	11/05/83	1
A33	02/01/83	BV	02/04/83	1
A33	02/01/83	BV	02/05/83	1
A33	02/01/83	BV	03/22/83	1
A33	02/01/83	BV	04/02/83	1
A33	02/01/83	BV	04/29/83	1
A33	02/01/83	BV	05/28/83	1
A33	02/01/83	BV	06/02/83	1
A33	02/01/83	BV	06/06/83	1
A34	02/01/83	BV	03/14/83	1
A34	02/01/83	BV	05/06/83	1
A34	02/01/83	BV	05/10/83	1
A34	02/01/83	BV	06/02/83	1
A35	02/01/83	BV	02/04/83	1
A35	02/01/83	BV	02/26/83	1
A36	02/01/83	BV	07/09/83	1
A37	02/01/83	BV	03/14/83	1
A37	02/01/83	BV	03/22/83	1
A37	02/01/83	BV	11/05/83	1
A38	02/01/83	BV	(not resighted)	
A39	02/01/83	BV	02/04/83	1
A40	02/01/83	BV	02/05/83	1
A40	02/01/83	BV	03/14/83	1
A40	02/01/83	BV	04/29/83	1
A41	02/02/83	BV	03/10/83	1
A41	02/02/83	BV	03/14/83	1
A41	02/02/83	BV	04/29/83	1
A41	02/02/83	BV	05/28/83	1
A41	02/02/83	BV	11/05/83	1
A42	02/02/83	BV	02/04/83	1
A43	02/02/83	BV	02/05/83	1
A43	02/02/83	BV	03/10/83	1
A43	02/02/83	BV	03/14/83	1
A43	02/02/83	BV	07/02/83	1
A43	02/02/83	BV	08/25/83	1
A43	02/02/83	BV	10/04/83	1
A43	02/02/83	BV	11/19/83	1
A44	02/02/83	BV	02/04/83	1
A44	02/02/83	BV	03/14/83	1
A44	02/02/83	BV	05/28/83	1
A45	02/02/83	BV	02/04/83	1
A45	02/02/83	BV	03/02/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A45	02/02/83	BV	03/22/83	1
A45	02/02/83	BV	04/29/83	3
A45	02/02/83	BV	05/28/83	1
A45	02/02/83	BV	06/02/83	1
A45	02/02/83	BV	06/06/83	1
A45	02/02/83	BV	07/02/83	1
A45	02/02/83	BV	07/09/83	3
A45	02/02/83	BV	07/26/83	1
A45	02/02/83	BV	09/04/83	1
A45	02/02/83	BV	10/04/83	1
A45	02/02/83	BV	10/24/83	1
A46	02/02/83	BV	02/04/83	1
A46	02/02/83	BV	02/05/83	1
A46	02/02/83	BV	03/10/83	1
A46	02/02/83	BV	03/14/83	1
A46	02/02/83	BV	07/19/83	1
A46	02/02/83	BV	08/09/83	1
A47	02/02/83	BV	02/04/83	1
A47	02/02/83	BV	02/05/83	1
A47	02/02/83	BV	02/26/83	1
A47	02/02/83	BV	03/10/83	1
A47	02/02/83	BV	03/14/83	1
A47	02/02/83	BV	03/22/83	1
A47	02/02/83	BV	04/02/83	1
A47	02/02/83	BV	04/21/83	1
A47	02/02/83	BV	05/06/83	1
A47	02/02/83	BV	05/28/83	1
A47	02/02/83	BV	06/02/83	1
A47	02/02/83	BV	06/03/83	3
A47	02/02/83	BV	06/06/83	1
A47	02/02/83	BV	06/29/83	3
A47	02/02/83	BV	07/09/83	3
A47	02/02/83	BV	09/07/83	1
A47	02/02/83	BV	11/01/83	1
A47	02/02/83	BV	11/19/83	1
A48	02/02/83	BV	02/04/83	1
A48	02/02/83	BV	07/19/83	1
A48	02/02/83	BV	08/18/83	1
A49	02/02/83	BV	02/04/83	1
A49	02/02/83	BV	04/17/83	3
A49	02/02/83	BV	04/29/83	1
A49	02/02/83	BV	05/06/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A49	02/02/83	BV	07/26/83	1
A49	02/02/83	BV	09/17/83	1
A49	02/02/83	BV	11/02/83	1
A50	02/02/83	BV	02/04/83	1
A50	02/02/83	BV	03/02/83	1
A50	02/02/83	BV	04/03/83	1
A50	02/02/83	BV	06/20/83	1
A50	02/02/83	BV	07/19/83	1
A50	02/02/83	BV	07/26/83	1
A50	02/02/83	BV	08/09/83	1
A50	02/02/83	BV	10/29/83	1
A50	02/02/83	BV	11/02/83	1
A50	02/02/83	BV	11/19/83	1
A51	02/02/83	BV	05/06/83	1
A52	02/02/83	BV	02/04/83	1
A52	02/02/83	BV	11/05/83	1
A53	02/02/83	BV	03/10/83	1
A54	02/02/83	BV	10/04/83	1
A54	02/02/83	BV	10/29/83	1
A55	02/02/83	BV	03/14/83	1

Table 10 (continued). Resightings of vultures marked at roost 1, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
A55	02/02/83	BV	06/02/83	1
A56	02/02/83	BV	02/04/83	1
A56	02/02/83	BV	02/05/83	1
A56	02/02/83	BV	03/10/83	1
A56	02/02/83	BV	04/17/83	1
A56	02/02/83	BV	04/29/83	1
A56	02/02/83	BV	06/06/83	1
A56	02/02/83	BV	06/07/83	1
A56	02/02/83	BV	07/02/83	1
A56	02/02/83	BV	09/02/83	1
A56	02/02/83	BV	09/20/83	1
A56	02/02/83	BV	10/24/83	1
A56	02/02/83	BV	10/29/83	1
A56	02/02/83	BV	11/02/83	1
A56	02/02/83	BV	11/19/83	1
A57	07/06/83	BV	11/02/83	1
A57	07/06/83	BV	11/19/83	1
A58	07/06/83	BV	10/29/83	1
A59	07/06/83	TV	10/29/83	1
A60	07/06/83	TV	10/21/83	3
A60	07/06/83	TV	10/24/83	3
A60	07/06/83	TV	11/01/83	1
A61	07/09/83	BV	11/01/83	1
A62	07/09/83	BV	11/01/83	1
A62	07/09/83	BV	11/02/83	1

Table 11. Resightings of vultures marked at roosts 3, 4, and by P. Rabenold, southwest Virginia, 1981-1983.

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
E00	07/06/82	TV	07/07/82	3
E00	07/06/82	TV	07/19/82	3
E00	07/06/82	TV	01/20/83	1
E00	07/06/82	TV	03/01/83	3
E00	07/06/82	TV	03/22/83	3
E00	07/06/82	TV	04/03/83	3
E00	07/06/82	TV	04/22/83	3
E00	07/06/82	TV	05/06/83	3
E00	07/06/82	TV	05/12/83	3
E00	07/06/82	TV	06/03/83	3
E00	07/06/82	TV	07/03/83	3
E00	07/06/82	TV	07/09/83	3
E00	07/06/82	TV	07/14/83	1
E00	07/06/82	TV	07/19/83	3
E00	07/06/82	TV	08/09/83	3
E00	07/06/82	TV	08/25/83	1
E01	07/06/82	TV	07/07/82	3
E01	07/06/82	TV	09/05/82	3
E01	07/06/82	TV	10/10/82	3
E01	07/06/82	TV	10/14/82	3
E01	07/06/82	TV	10/28/82	3
E01	07/06/82	TV	02/05/83	1
E02	07/19/82	TV	(not resighted)	
E03	07/19/82	BV	11/09/82	1
E03	07/19/82	BV	03/01/83	3
E03	07/19/82	BV	03/10/83	1
E03	07/19/82	BV	04/02/83	1
E03	07/19/82	BV	04/17/83	3
E03	07/19/82	BV	05/06/83	1
E03	07/19/82	BV	11/05/83	1
E04	07/19/82	BV	09/05/82	3
E04	07/19/82	BV	10/05/82	3
E04	07/19/82	BV	10/10/82	3
E04	07/19/82	BV	04/29/83	1
E04	07/19/82	BV	11/05/83	1
E05	07/19/82	TV	07/23/82	3
E05	07/19/82	TV	09/05/82	3
E05	07/19/82	TV	10/05/82	3
E05	07/19/82	TV	10/10/82	3
E05	07/19/82	TV	10/14/82	3

Table 11 (continued). Resightings of vultures marked at roosts 3, 4, and P. Rabenold, southwest Virginia, 1981-1983

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
E05	07/19/82	TV	01/05/83	1
E05	07/19/82	TV	01/20/83	1
E05	07/19/82	TV	02/05/83	1
E05	07/19/82	TV	04/21/83	1
E05	07/19/82	TV	06/02/83	1
E05	07/19/82	TV	11/02/83	1
E06	07/19/82	TV	07/23/82	3
E06	07/19/82	TV	10/05/82	3
E06	07/19/82	TV	10/14/82	3
E06	07/19/82	TV	02/26/83	1
E07	07/19/82	TV	03/15/83	3
E07	07/19/82	TV	03/22/83	3
E07	07/19/82	TV	04/03/83	3
E07	07/19/82	TV	05/12/83	3
E08	07/23/82	TV	03/14/83	1
E08	07/23/82	TV	06/02/83	1
E09	10/05/82	TV	01/18/83	1
E09	10/05/82	TV	08/16/83	3
E10	10/05/82	TV	10/14/82	3
E10	10/05/82	TV	11/22/82	1
E10	10/05/82	TV	01/23/83	1
E10	10/05/82	TV	04/29/83	1
E10	10/05/82	TV	08/31/83	4
E11	10/05/82	TV	10/10/82	3
E11	10/05/82	TV	10/14/82	3
E11	10/05/82	TV	11/22/83	1
E11	10/05/82	TV	12/18/82	1
E11	10/05/82	TV	02/05/83	1
E11	10/05/82	TV	02/26/83	1
E11	10/05/82	TV	03/25/83	3
E11	10/05/82	TV	04/02/83	1
E11	10/05/82	TV	04/17/83	1
E11	10/05/82	TV	04/21/83	1
E11	10/05/82	TV	04/29/83	1
E11	10/05/82	TV	05/12/83	1
E11	10/05/82	TV	06/07/83	1
E11	10/05/82	TV	06/20/83	1
E11	10/05/82	TV	07/26/83	1
E11	10/05/82	TV	07/30/83	1

Table 11 (continued). Resightings of vultures marked at roosts 3, 4, and by P. Rabenold, southwest Virginia, 1981-1983

Alpha-numeric	Date tagged	Species	Date sighted	Sighting roost
E11	10/05/82	TV	08/25/83	1
E11	10/05/82	TV	10/29/83	1
E12	07/11/83	BV	10/28/83	1
E13	07/11/83	BV	(not resighted)	
E14	07/19/83	TV	(not resighted)	
E15	07/21/83	BV	11/02/83	1
E16	07/21/83	BV	(not resighted)	
E17	07/21/83	BV	(not resighted)	
E18	07/21/83	BV	(not resighted)	
E19	08/02/83	BV	08/31/83	3
E20	08/02/83	BV	11/02/83	1
E21	08/02/83	BV	08/09/83	3
E21	08/02/83	BV	08/16/83	3
E22	08/02/83	TV	(not resighted)	
E23	08/02/83	TV	09/20/83	3
E23	08/02/83	TV	10/06/83	3
E23	08/02/83	TV	10/24/83	3
E23	08/02/83	TV	10/28/83	1
E23	08/02/83	TV	11/03/83	1
E23	08/02/83	TV	11/05/83	1
E24	08/30/83	BV	08/31/83	4[1]
E24	08/30/83	BV	09/12/83	4
E24	08/30/83	BV	09/20/83	4
E24	08/30/83	BV	10/24/83	1
E24	08/30/83	BV	10/29/83	1
E25	08/30/83	TV	08/31/83	4
E25	08/30/83	TV	09/20/83	4
E25	08/30/83	TV	10/20/83	1
285		BV	02/01/83	1[2]
285		BV	02/05/83	1[2]

1 Marked at roost 4.
2 Marked by P. Rabenold.

APPENDIX VIII

Table 12. Dates of discovery of calves or adult cattle at trapsite 1, Whitethorne, Virginia, 1981-1982.

Date	Number of calves	Number of Adult cattle
12/30/81	1	0
01/05/82	1	1
01/16/82	1	0
02/03/82	1	1
02/13/82	1	0
02/13/82	1	0
03/08/82	1	1
03/23/82	1	0
04/12/82	2	0
04/22/82	1	0
06/12/82	0	1
06/29/82	1	0
08/01/82	0	1
10/07/82	0	1
11/03/82	0	2
12/08/82	0	1

Table 13. Number of days of observation at trapsite 1 by month, Whitethorne, Virginia, 1981-1982.

Month	Year	Number of Days of Observation
December	1981	8
January	1982	12
February	1982	9
March	1982	8
April	1982	11
May	1982	12
June	1982	7
July	1982	10
August	1982	13
September	1982	16
October	1982	9
November	1982	10

APPENDIX IX

Table 14. Sighting distances (m) of large (L) and Maxi (M) cattle eartags (N=16), Blacksburg, Virginia, 1983.

Observer	L dist.	M dist.
1	25	21
2	36	30
3	33	30
4	30	23
5	28	27
6	28	23
7	30	28
8	32	28
9	32	29
10	27	25
11	36	29
12	36	32
13	33	31
14	32	29
15	28	25
16	21	19

APPENDIX X

Table 15. Morphometrics and capture information of vultures marked in this study.

AN is the alphanumeric, Sp is the species, A is the age class (A=adult, J=juvenile), Date is the date of capture, T is the number of wings tagged, TTL is the total length (cm), CHL is the chord length (cm), TLL is the tail length (cm), CUL is the culmen length (cm), TAL is the torsus length (cm), MTL is the middle toe length (cm), WGT is the weight (g), C is the culmen color ((1 = > 50% grey, 2 = < 50% grey), 3 = white, 4 = black), L = leg color (1 = grey, 2 = grey/pink, 3 = pink), TS is the time started tagging, TF is time finished tagging, F is feather collected (Y or N), B is blood collected (Y or N), S is tagged without bleeding (Y or N), K is healthy (Y or N), W is both wings traced (B = both, O = one), °C is Temp° C, WS is wind speed (mph), WD is wind direction, CC is cloud cover, D is missing toe (Y or N), WA is wing area (cm^2), WL is wing loading (g/cm^2).63

AN	SP	A	DATE	T	TTL	CHL	TLL	CUL	TAL	MTL	WGT	H	C	L	TS	TF	F	B	S	K	W	°C	WS	WD	CC	D	WA	WL
A00	BV	A	060182	B	66.0	44.6	11.5	2.5	8.7	7.8	2325	1	1	3	1036	1204	Y	N	Y	Y	B	75	05	NE	98	N	3702	0.63
A01	BV	J	073182	B							2725																	
A02	BV	J	080382	B							2450																	
A03	TV	J	080382	B							1900																	
A04	TV	J	080382	B																								
A05	BV	J	080482	B							2575																	
A06	BV	A	011483	B	64.4	44.4	17.9	2.5	9.4	5.2	2525	1	1	1	1120	1135	Y	N	Y	Y	B	42	00	00	05	N	4160	0.61
A07	BV	J	011483	B	66.3	46.0	19.6	2.5	9.2	5.1	2225	2	2	1	1136	1147	N	N	Y	Y	B	42	00	00	05	N	4066	0.56
A08	BV	A	011483	B	65.7	43.5	18.5	2.5	8.1	5.4	2225	1	1	1	1147	1205	N	N	Y	Y	B	42	00	00	05	N	3670	0.61
A09	BV	J	011483	B	66.5	44.2	19.1	2.5	8.8	4.9	2300	1	2	1	1206	1219	N	N	Y	Y	B	42	00	00	05	N	3384	0.68
A10	BV	J	011483	B	64.7	44.6	18.7	2.5	8.9	5.1	2100	2	2	1	1219	1234	N	N	Y	Y	B	42	00	00	05	N	3350	0.63
A11	BV	J	011483	B	65.0	44.5	19.7	2.5	9.1	4.9	2125	2	2	1	1237	1254	N	N	Y	Y	B	42	00	00	05	N	3872	0.55
A12	BV	J	011483	B	64.0	44.3	18.5	2.5	8.8	4.0	2175	2	2	1	1254	1315	N	N	Y	Y	B	42	00	00	05	N	3420	0.64
A13	BV	J	011483	B	64.5	45.2	19.4	2.5	8.9	4.9	1975	2	2	1	1315	1337	Y	N	Y	Y	B	42	00	00	05	N	3722	0.53
A14	BV	J	011483	B	65.5	45.5	21.5	2.5	9.1	4.8	2000	2	2	1	1343	1405	N	N	Y	Y	B	42	00	00	05	N	2970	0.67
A15	BV	J	011483	B	66.5	44.1	19.5	2.5	9.3	4.9	2100	1	2	1	1405	1433	Y	N	N	Y	B	42	00	00	05	N	3266	0.64
A16	BV	J	011483	B	65.5	44.1	19.5	2.5	9.6	4.2	2175	1	2	2	1435	1454	N	N	Y	Y	B	42	00	00	05	N	3488	0.62
A17	BV	J	011483	B	63.4	43.9	18.9	2.5	9.3	5.9	1975	2	2	1	1454	1516	N	N	Y	Y	B	42	00	00	05	N	3122	0.63
A18	BV	J	011483	B	64.9	44.0	19.6	2.4	8.6	5.8	2100	2	2	1	1516	1527	N	N	Y	Y	B	42	00	00	05	N	3460	0.61
A19	BV	J	011483	B	65.7	45.5	19.8	2.5	8.8	4.9	2100	2	2	2	1527	1541	N	N	Y	Y	B	42	00	00	05	N	3532	0.59
A20	BV	J	011483	B	65.0	43.7	19.8	2.4	8.6	5.9	2200	2	2	1	1541	1559	N	N	Y	Y	B	42	00	00	05	N	3762	0.58
A21	BV	A	011483	B	68.0	54.0	21.9	2.8	6.8	4.3	1925	1	1	3	1559	1614	Y	N	Y	Y	B	42	00	00	05	N	3910	0.49
A22	BV	J	011483	B	66.5	44.6	19.6	2.5	8.7	5.2	2100	1	2	2	1614	1636	N	N	Y	Y	B	42	00	00	05	N	3872	0.54
A23	BV	J	012983	B	64.0	45.5	25.5	2.4	1.8	8.1	2225	1	2	1	1347	1412	Y	N	Y	Y	B	10	05	SW	99	N	3242	0.67
A24	BV	J	012983	B	66.1	44.1	29.5	2.5	9.3	4.9	2100	1	2	1	1405	1433	Y	N	N	Y	B	42	00	00	05	N	3776	0.56
A25	BV	J	012983	B	64.0	45.5	19.6	2.5	9.1	4.9	2125	2	2	1	1237	1254	N	N	Y	Y	B	42	00	00	05	N	3912	0.54
A26	BV	J	012983	B	64.0	44.0	14.6	2.5	8.6	5.8	2100	2	2	1	1516	1527	N	N	Y	Y	B	42	00	00	05	N	3940	0.53
A27	BV	J	020183	B	64.0	44.3	25.0	2.3	9.5	4.8	2070	2	2	1	0000	1342	N	N	Y	Y	B	00	05	NW	99	N	3382	0.61
A28	BV	A	020183	B	64.0	45.5	25.0	2.4	1.0	8.1	2225	1	1	1	1347	1412	Y	N	Y	Y	B	10	05	SW	99	N	3422	0.65

Table 15 (continued). Morphometrics and capture information of vultures marked in this study.

AN	SP	A	DATE	T	TTL	CHL	TLL	CUL	TAL	MTL	WGT	H	C	L	TS	TF	F	B	S	K	W	°C	WS	WD	CC	D	WA	WL
A29	BV	A	020183	B	64.0	40.2	19.2	2.3	9.3	5.1	2365	1	1	1	1418	1433	Y	N	Y	Y	B	00	00	00	00	N	3346	0.71
A30	BV	J	020183	B	63.5	42.8	19.9	2.4	8.8	5.1	2100	1	1	1	1435	1457	N	N	Y	Y	B	00	00	00	00	Y	3408	0.62
A31	BV	A	020183	B	64.0	44.8	19.8	2.3	9.3	5.0	2200	1	1	1	1503	1519	N	N	Y	Y	O	17	10	ON	99	N	3462	0.64
A32	BV	J	020183	B	68.1	43.0	19.3	2.4	9.2	5.2	0000	2	2	1	1526	1538	N	N	Y	Y	O	00	00	00	00	N	3750	0.59
A33	BV	J	020183	B	64.2	42.3	19.4	2.4	8.9	5.1	2350	1	2	1	1542	1559	N	N	Y	Y	O	00	00	00	00	N	3870	0.61
A34	BV	A	020183	B	63.0	44.0	19.7	2.4	9.6	5.1	2100	2	1	1	1603	1618	N	N	Y	Y	O	00	00	00	00	N	3734	0.56
A35	BV	J	020183	B	63.9	43.5	19.9	2.2	9.3	5.1	0000	2	2	2	2040	2110	N	Y	Y	Y	O	00	00	00	00	N	3950	0.56
A36	BV	J	020183	B	63.4	45.0	20.3	2.4	9.5	5.1	1850	2	2	1	2110	2136	N	Y	Y	Y	O	00	00	00	00	N	3814	0.48
285	BV	A	020183	R	65.5	43.8	20.0	2.4	9.2	5.2	1975	1	1	1	2137	2219	N	N	Y	Y	O	05	00	00	00	N	3782	0.52
A37	BV	J	020283	B	64.5	44.5	19.4	2.4	8.6	5.2	1875	2	2	1	1430	1440	N	Y	Y	Y	O	00	00	00	00	N	3128	0.60
A38	BV	J	020183	B	63.8	43.6	19.8	2.4	9.6	4.9	2025	2	2	1	2223	2241	N	Y	Y	Y	O	07	00	00	00	N	3478	0.58
A39	BV	A	020183	B	64.5	43.1	19.0	2.4	9.8	5.2	2050	2	1	1	2256	2309	N	N	Y	Y	O	05	00	00	00	N	3468	0.59
A40	BV	J	020183	B	64.0	43.4	19.8	2.3	9.1	5.1	2175	2	2	1	0000	0000	N	Y	Y	Y	O	00	00	00	00	N	3508	0.62
A41	BV	J	020283	B	65.8	44.7	20.4	2.3	9.2	5.3	1950	0	2	0	1404	1417	N	Y	Y	Y	O	00	00	00	00	N	3480	0.56
A42	BV	A	020283	B	65.6	43.3	19.0	2.4	9.4	5.3	2175	2	1	1	1418	1428	N	Y	Y	Y	O	00	00	00	00	N	3644	0.60
A43	BV	A	020283	B	60.8	41.5	19.0	2.4	9.5	5.0	1740	2	1	1	1553	1612	Y	Y	Y	Y	O	00	00	00	00	N	3720	0.47
A44	BV	A	020283	B	61.5	43.3	19.0	2.8	9.1	4.8	1905	2	1	1	1649	1703	N	Y	Y	Y	O	00	00	00	00	N	3172	0.60
A45	BV	A	020283	B	63.2	41.8	20.2	2.4	9.1	4.6	2130	1	1	1	1525	1537	N	N	Y	Y	O	00	00	00	00	N	3930	0.54
A46	BV	A	020283	B	63.5	44.6	21.0	2.3	9.5	5.2	2190	2	1	1	0900	0908	N	N	Y	Y	O	00	00	00	00	N	3440	0.64
A47	BV	A	020283	B	63.1	43.4	19.9	2.5	9.2	4.7	2315	1	1	1	1824	1852	N	Y	Y	Y	O	00	00	00	00	N	3244	0.71
A48	BV	A	020283	B	64.5	43.4	20.5	2.5	9.3	5.1	2300	2	1	1	1447	0000	Y	Y	Y	Y	O	00	00	00	00	N	3168	0.73
A49	BV	A	020283	B	66.0	43.5	19.7	2.3	9.4	4.9	2330	1	1	1	1904	0000	N	N	Y	Y	O	00	00	00	00	N	3492	0.67
A50	BV	A	020283	B	66.0	45.7	19.0	2.5	9.8	5.1	2348	1	1	1	1711	1731	Y	Y	Y	Y	O	00	00	00	00	N	3220	0.73
A51	BV	A	020283	B	65.5	44.5	20.3	2.5	8.7	4.8	2030	1	1	1	1744	1856	Y	Y	Y	Y	O	00	00	00	00	N	3476	0.58
A52	BV	A	020283	B	63.2	43.6	20.2	2.5	8.8	5.1	2040	1	1	1	0000	1823	N	N	Y	Y	O	00	00	00	00	N	3244	0.63
A53	BV	J	020283	B	62.2	42.0	18.8	2.4	8.8	5.0	1950	2	2	1	1540	1551	N	Y	Y	Y	O	00	00	00	00	N	3654	0.53
A54	BV	A	020283	B	63.2	44.0	20.1	2.4	9.5	4.5	2040	1	1	1	1824	1841	Y	Y	Y	Y	O	00	00	00	00	N	3548	0.57
A55	BV	A	020283	B	65.5	44.0	19.5	2.5	8.5	4.8	2090	1	1	1	1626	1647	Y	Y	Y	Y	O	00	00	00	00	N	3196	0.65
A56	BV	A	020283	B	65.4	43.6	20.3	2.3	9.4	5.3	2165	1	1	1	1615	1623	Y	Y	Y	Y	O	00	00	00	00	N	3680	0.59
A57	BV	J	070683								1210																	
A58	BV	J	070683								2000																	
A59	BV	J	070683								2315																	
A60	TV	J	070683								2200																	
A61	TV	J	070683								1975																	
A62	BV	A	070683	B	64.7	43.4	20.6	2.5	9.3	5.2	2300	2	1	1	1447	0000	Y	Y	Y	Y	O	00	00	00	00	N	3148	0.73
E00	TV	J	070682	B	71.0	53.2	29.4	2.6	7.7	6.3	2025	3	4	2	0649	0724	Y	Y	Y	Y	B	79	05	ON	25	N	4174	0.49
E01	TV	A	070682	B	69.0	54.0	29.0	2.7	7.7	6.5	1850	3	3	2	0726	0740	Y	Y	Y	Y	B	79	05	ON	25	N	4304	0.42
E02	TV	A	071982	B	72.9	54.9	29.5	2.6	7.6	5.3	1950	3	3	2	0734	0759	Y	Y	Y	Y	B	81	05	SW	05	N	4180	0.47
E03	BV	J	071982	B	64.2	44.6	19.7	2.5	9.3	5.0	2075	2	2	1	0806	0829	Y	Y	Y	Y	B	81	05	SW	05	N	3420	0.61
E04	BV	J	071982	B	65.6	43.6	20.2	2.4	8.9	5.2	2275	2	2	1	0834	0846	Y	Y	Y	Y	B	81	05	SW	05	N	3618	0.63
E05	TV	A	071982	B	67.8	51.4	30.1	2.5	6.8	4.8	1925	1	3	2	0908	0923	Y	Y	Y	Y	B	81	05	SE	05	N	4030	0.48
E06	TV	A	071982	B	68.2	54.2	28.5	2.5	7.5	5.0	2075	3	3	2	0924	0000	Y	Y	Y	Y	B	81	05	SW	05	N	4336	0.48
E07	TV	A	071982	B	75.5	53.7	31.0	2.7	8.0	5.0	2125	3	3	2	0857	0907	Y	Y	Y	Y	B	81	05	SW	05	N	4234	0.50

Table 15 (continued). Morphometrics and capture information of vultures marked in this study.

AN	SP	A	DATE	T	TTL	CHL	TLL	CUL	TAL	MTL	WGT	H	C	L	TS	TF	F	B	S	K	W	°C	WS	WD	CC	D	WA	WL
E08	TV	A	072382	B	70.1	53.7	29.2	2.7	2.3	4.5	1900	3	3	3	0650	0710	Y	Y	Y	Y	B	80	05	ON	95	N	4234	0.45
E09	TV	A	100582	B	71.0	53.5	28.8	2.5	7.8	4.9	2759	3	3	1	1726	1743	Y	Y	Y	Y	B	78	05	SW	20	N	4280	0.64
E10	TV	A	100582	B	69.5	52.0	30.0	2.6	8.1	4.3	1752	3	3	3	1744	1756	Y	Y	Y	Y	B	78	05	SW	20	N	4320	0.41
E11	TV	A	100582	B	69.5	52.5	31.0	2.5	7.5	5.0	2325	3	3	3	1758	1816	Y	Y	Y	Y	B	78	05	SW	20	N	4280	0.54
E12	BV	J	071183																									
E13	BV	J	071183																									
E14	TV	J	071983																									
E15	BV	A	072183	B	62.0	44.0	19.7	2.1	9.5	5.1	2175	1	1	1	0900	0930	N	Y	Y	Y	B	95	00	00	00	N	3390	0.64
E16	BV	A	072183	B	64.0	42.7	18.4	0.0	9.7	5.0	0000	1	1	1	0930	0951	Y	Y	Y	Y	B	00	00	00	00	N	3420	0.52
E17	BV	A	072183	B	65.0	46.3	70.5	2.5	9.7	5.5	2475	1	1	1	0951	1004	Y	Y	Y	Y	B	95	00	00	00	N	3500	0.71
E18	BV	J	072183	B	61.5	44.0	20.1	2.4	9.6	4.7	2100	1	2	0	1005	1015	N	Y	Y	Y	B	00	00	00	00	N	3426	0.61
E19	BV	A	080283	B	60.1	42.7	19.4	2.1	8.9	4.8	1400	1	1	1	0858	0925	Y	Y	Y	Y	B	75	00	00	50	N	3542	0.40
E20	BV	A	080283	B	64.0	42.5	20.3	2.2	9.1	5.0	2200	1	1	1	0926	0948	Y	Y	Y	Y	B	75	00	00	50	N	3508	0.61
E21	BV	A	080283	B	66.0	43.5	20.5	2.3	9.4	5.0	2150	1	1	1	0948	1005	Y	Y	Y	Y	B	75	00	00	50	N	3380	0.64
E22	TV	A	080282	B	72.2	56.8	29.6	2.6	6.9	4.6	1810	3	3	2	1007	1020	Y	Y	Y	Y	B	75	00	00	50	N	4488	0.40
E23	TV	A	080283	B	74.5	58.0	32.5	2.5	6.0	5.0	2175	3	3	2	1021	1046	Y	Y	Y	Y	B	75	00	00	50	N	4294	0.51
E24	BV	A	083083	B	61.5	44.0	20.1	2.4	9.6	4.7	2100	1	1	0	1005	1015	N	Y	Y	Y	B	00	00	00	00	N	3468	0.61
E25	TV	A	083083	B	68.5	32.0	30.0	2.6	7.1	4.3	1752	3	3	3	1744	1756	Y	Y	Y	Y	B	78	05	SW	20	N	4240	0.41

APPENDIX XI

Table 16. Nest cave use by Black Vultures (BV) and Turkey Vultures (TV), Radford, Virginia, 1982-1984.

Nest number and location	Season used	Species	Number of eggs	Date observed	Number of nestlings	Date observed	Number of fledglings (number tagged)	Date observed	Known nestling mortality
1 New River (NR), Radford, Virginia	1982	BV	--	--	2	25 July	2 (1)	4 Sept.	0
	1983	--	0	22 Jan.	--	--	--	--	--
	1983	BV	2	19 April	2	4 Aug.	2 (2)	2 Sept.	0
	1984	BV	2	31 April	--	--	--	--	--
2 NR, Radford, Virginia	1982	BV	--	--	2	25 July	2 (2)	9 Nov.	0
	1983	--	0	22 Jan.	--	--	--	--	--
	1983	BV	2	19 April	2	--	2 (1)	19 Nov.	--
	1984	BV	2	31 April	--	--	--	--	--
3 NR, Radford, Virginia	1982	TV	--	--	2	25 July	2 (2)	4 Sept.	0
4 NR, Radford, Virginia	1982	unknown	1*	11 August	0	--	0	--	0
	1983	--	0	22 Jan.	--	--	--	--	--
5 NR, Radford, Virginia	1983	TV	2	19 April	2	6 July	2 (2)	29 Oct.	0
6 Rocky Knob, North of Newport, Va.	1983	BV	--		2	11 July	2 (2)	28 Oct.	0
7 North of New Castle, Va.	1983	BV	0		2	19 July	1 (1)	2 Nov.	1
8 NR, Shanklin's Ferry, W. Va.	1983	BV	2	21 April	--	--	--	--	--
9 NR, Shanklin's Ferry W. Va.	1983	BV	2	21 April	--	--	--	--	--

* abandoned

APPENDIX XII

Table 17. Observations of nest visits by adult black vultures, southwest Virginia, 1982-1983.

Nest	Date	Time of arrival	Minutes until departure	Nesting phase
1	07/25/82	0719	7.0	nestling
1	07/19/83	0801	11.5	nestling
2	07/29/83	0747	21.0	nestling
1	07/25/82	1537	13.5	nestling
1	07/19/83	1343	9.0	nestling
2	07/29/83	1630	12.5	nestling
1	04/29/82	1124	--	incubation
1	05/12/83	0755	19.0	incubation
1	05/24/83	0716	5.0	incubation

APPENDIX XIII

Table 18. Black and turkey vulture roosts, southwest Virginia, 1981-1983.

Roost	Location	Roost Tree Species
1	Radford Arsenal Radford, VA	Sycamore (Platanus occidentalis) Tulip Tree (Liriodendron tulipfera)
2	Shanklin's Ferry Shanklin's Ferry, West, VA	Sycamore (Platanus occidentalis)
3	Christiansburg Landfill Christiansburg, VA	Tulip Tree (Liriodendron tulipfera) Red Maple (Acer rubrum) Red Oak (Quercus rubra)
4	Pulaski Landfill Pulaski, VA	Virginia Pine (Pinus virginiana)
5	Route 42 Newport, VA	Red Oak (Quercus rubra)
6	Route 629 Simmonsville, VA	Eastern Hemlock (Tsuga canadensis)
7	Route 601 Newport, VA	Eastern Hemlock (Tsuga canadensis)
8	Toms Creek Rd. Blacksburg, VA	Red Maple (Acer rubrum) Tulip Tree (Liriodendron tulipfera)

APPENDIX XIV

VULTURE CAPTURE TECHNIQUES

Use of Walk-in Traps.

Two walk in traps were used. The first was a 3 x 3 x 2 m structure constructed of 0.4 cm mesh poultry wire attached to a 5 x 5 cm board frame. The entrance was a funnel, 50 x 50 cm on the outside and 25 x 30 cm on the inside, leading to a 15 cm drop into the trap. This trap was placed at trapsite 1, 4.0 km north of roost 1. This site was a regularly grazed pasture 10 m from the edge of a sink hole where a farmer frequently dumped dead livestock. The trap was constructed over a period of three weeks, during which time bait (calves, chickens, and deer (Odocoileous virginiana) was always present. This trap was set for approximately four days a week for the first eight hours of daylight, after which the funnel entrance was removed and the trap was left baited and open.

A second 3 x 3 x 1.5 m walk-in trap with a 1.5 x 1.5 m entrance and a manually operated drop net door was used at a vulture loafing area 450 meters from roost 1. This trap was constructed of 1.3 cm diameter aluminum tubing and 0.4 cm mesh monofilament netting.

Use of a Cannon Net

We also used a 9.5 x 18.0 m cannon net (Wildlife Materials Inc.) at Whitethorne, VA. at trapsite 1, roost 3 and roost 4 (Fig. 1) . Nestling and adult vultures were captured in their nest caves or outside their nests.

Vulture Capture Results

A total of 2570 trapping hours were spent between 15 January 1982 and 30 September 1983 (Table 5). Seventy-one black vultures and 18 turkey vultures were caught. A mean of thirty-five hours was necessary to catch each vulture.

The capturing of vultures in nests was the most successful method requiring the least amount of time to capture each vulture. However, this opportunity was limited. The best method of capture was using a cannon net. Eighty-four percent of the vultures captured in this study were caught using this method in spite of the low probability. Black vultures were five times more likely to be caught using this method than turkey vultures.

We were not successful in capturing vultures with walk-in traps. A trap was erected over the course of three weeks at a traditional feeding site near roost 1. Two sides of the trap were put out and baited at first. Each other side, the top and then the funnel entrance were added at five day intervals. The trap was kept baited so vultures were free

to feed in it. The vultures pulled the food from the trap whenever it was possible, so the bait was staked to the ground. After the funnel entrance was added no vultures ever entered the trap. The same methods were used with the trap set at roost 1. No vultures were caught using this type of walk-in trap either.

A cannon net was used after 135 days of attempting to trap vultures with the walk-in trap. The cannon net was set at the trap site 1 and baited. We left it set and baited for three weeks before any vultures would land near it.

A vulture was first trapped on 1 June 1982 at trapsite 1 (Fig. 6). Fifty-three black vultures were marked there between 1 June 1982 and 6 July 1983. Three hatching year black vultures and two hatching year turkey vultures were tagged in their nests within 300 m of roost 1 in each of the summers of 1982 and 1983. One adult black vulture was also marked in a nest.

Nine black vultures, and 12 turkey vultures were captured using the cannon net at roost 3 between 6 July 1982 and 2 August 1983 (Table 19). One black vulture and one turkey vulture were captured at roost 4 with the cannon net on 30 August 1983. One nestling turkey vulture was marked near New Castle, VA and two black vulture nestlings were marked in their nest cave at Rocky Knob north of Newport, VA.

Table 19. Number (N) of black (BV and turkey (TV) vultures caught and number caught per trap hour (N/hour), Southwest Virginia, 1981-1983.

Trapping Method	Hours of Trapping	N		N/hour	
		BV	TV	BV	TV
Walk in traps	720	0	0	0.000	0.000
Cannon Net	1803	62	13	0.037	0.007
Capture at Nests (includes time spent searching for nests)	87	9	5	0.190	0.100
Total	2570	71	18	0.205	0.107

APPENDIX XV

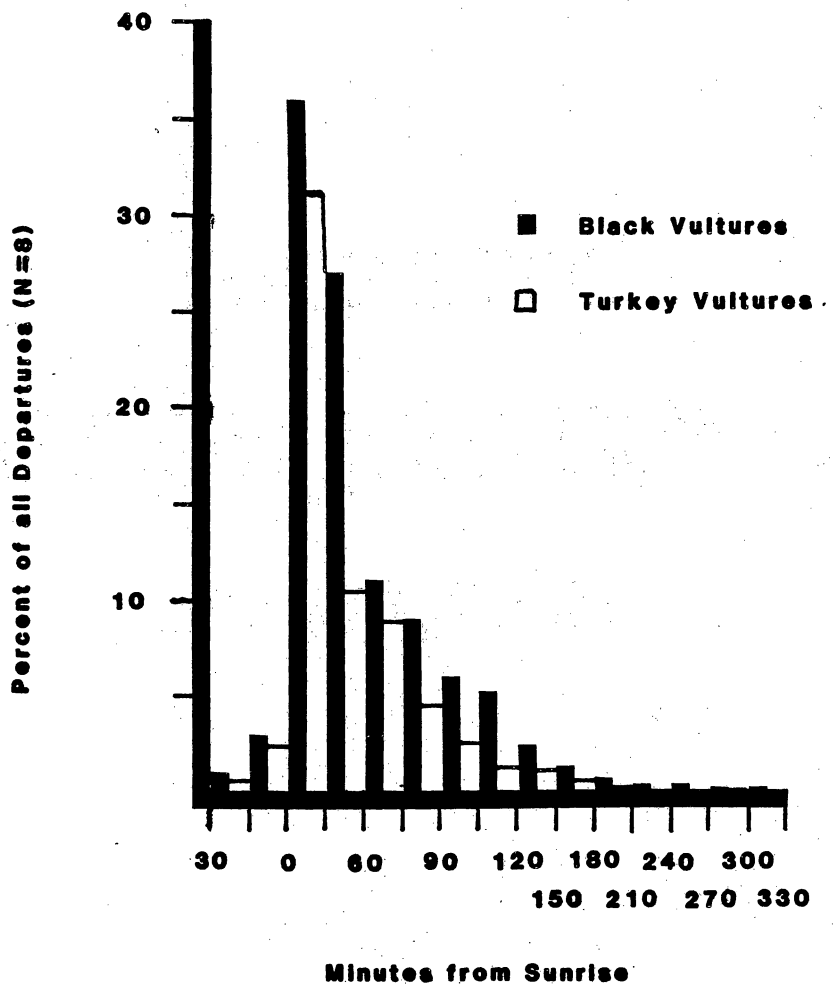

Fig. 1. Departures of black and turkey vultures from roost 1 (N=8), Radford, Virginia, 1981-1982.

DEPARTURES AND ARRIVALS OF BLACK AND TURKEY VULTURES AT ROOST 1, RADFORD, VIRGINIA, 1981-1983

Vulture Behavior

Observations of vulture behavior during daylight hours were made about four times monthly at Roost 1. Typical daily behavior of vultures start with vulture movements within the roost and vocalizations of black vultures at about one half hour before the first daylight. Pre-departure behavior includes feather ruffling, head shaking, pellet casting, preening, wing spreading and perch changing. Many black vultures start to glide away from the roost to perch in other trees as soon as the first light appears. Turkey vultures begin to depart soon afterward.

On clear, calm days, at least eighty percent and frequently all of the vultures will leave the roost within one hour after sunrise (Fig. 2.). Most vultures move to any of five staging areas close to the roost. They remain in these areas preening, ruffling feathers and wing-spread posturing until they depart the roost area. Less than five percent of the total number of roosting vultures depart immediately without first perching in a staging area. Ninety-five percent of the vultures leave the staging area singly or in groups up to 100 over the four hours following sunrise.

A few vultures may be seen in the roost throughout the day about five percent of the time. Vultures have been observed returning to the roost singly and in groups of up to 300 birds. Few vultures return to the roost as early as 1300. The mean group size of black vultures returning to the roost within one hour before sunset is eleven (N=8), whereas the mean size for turkey vultures is five. About eighty-five percent of the vultures return to the roost trees from staging areas or from outside the roost area within one hour of complete darkness. Seventy-five percent of the vultures are usually in the roost and staging areas by two hours before sunset. The settling of vultures into the roost starts within four hours of sunset. Rarely are more than 15 percent of the vultures found in the roost before one hour before sunset. Groups of vultures may move into and out of the roost frequently throughout the late afternoon. From this point on vultures move into and out of the roost singly and in groups estimated up to 250 birds. However there is a net increase in the number of birds in the roost after one hour before sunset. Upon entering the roost vultures choose perches in the upper half of the roost. Very few birds alight in the bottom quarter. As more birds enter the roost there continuous displacement of the birds in the upper perches.

In the last half hour before sunset there is a considerable amount of redistribution of vultures among the perches. This usually continues at least ten minutes after total darkness so it is not possible to discern the final distribution of vultures by species. However, it is obvious that the vultures distribute themselves lower, occupying only the lower two thirds of the roosting area used before sunset.

The daily pattern of vulture behavior at the two roosts 3 and 4 is different from the behavior seen at the larger year-round roosts. At first light movement away from the roost begins. Some vultures fly directly to traditional pearching sites near the active part of the landfill. Others fly to stage trees first and then fly to the active dumping site. All vultures fly from the roost by one half hour after first daylight. Here, the vultures preen, and wing spread as they do in stage trees, but about twenty five percent are usually seen foraging in areas of exposed garbage. The vultures remain here until the employees begin work. When vehichles approach, all vultures fly away and remain away until early afternoon. Vultures may start to return as early as two hours before the men quit work. Eighty percent of the vultures return between one half hour before and one half hour after quitting time. The vultures

then alight in stage trees near the landfill and slowly perch closer and closer to the area where fresh garbage is found. After on vulture lands on the qround at this area 50 to 80 percent of the others usually follow quickly. The vultures pick and forage through the refuse any scraps found are quickly consumed, fought over and dominated by one or two vultures or carried away by either species. The foraging continues with interchange of vultures actively foraging and those perched nearby. At about one half hour before sunset vultures will start to return to the roost singly or in groups up to eighty percent of the number of roosting vultures. Two to five vultures typically remain near the foraging site until 15 minutes before total darkness.

There is much variation in the daily pattern of vulture behavior in response to different weather conditions. During windy conditions all vultures typically depart from the roost within one half hour after sunrise. On foggy, snowy or rainy days, departure of 50 percent of the vultures were delayed an average of two hours. During extremely inclement weather, 50 percent of the vultures were observed within the roost throughout the entire day.

APPENDIX XVI

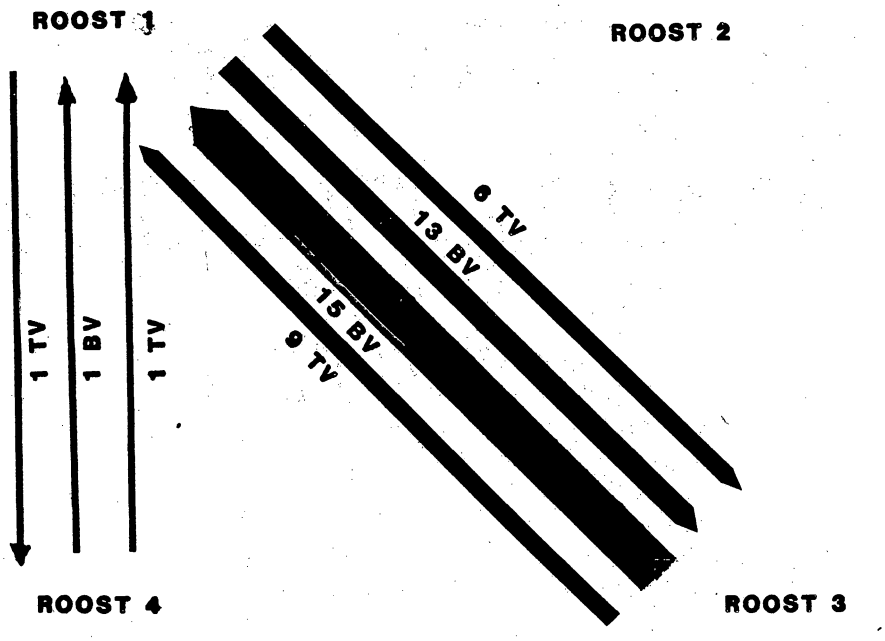

Fig. 2. Diagram of movements of black and turkey vultures among roosts 1, 3, and 4, southwest, Virginia, 1981-1982.

APPENDIX XVII

Movements Among Roosts

Ninety-one percent of marked black vultures and 71% of marked turkey vultures were resighted in 348 and 84 total resightings respectively, from 3 June 1982 to 19 November 1983. No exchange of marked vultures was found between roosts 1, 3, and 4 and roost 2. Most vultures were sighted only at roost 1, but seven black vultures marked at roost 1 were sighted at roost 1 in winter 1983 and then sighted at roost 3 in summer 1983. One other black vulture and one turkey vulture marked at roost 1 were also sighted at roost 3 in summer 1983. All nine were resighted at roost 1 the following winter. Most movements of vultures were observed between roosts 1 and 3. Four black vultures and seven turkey vultures marked at roost 3 in the summers of 1982 and 1983 were resighted at roost 1 in the winter(s) following tagging. Three of these vultures, a juvenile black and turkey vulture and an adult turkey vulture were sighted at roost 1 at least twice from 20 September to 24 October 1983. They were resighted at roost 1, three days after vultures stopped roosting at roost 3.

Eight black vultures marked at roost 1 in the winter of 1982 were observed at roost 3 at least once during the spring and summer of 1983. Three turkey vultures marked at

roost 3 in the summer of 1982 were sighted at roost 1 in the winter of 1982 and then sighted again at least once at roost 3 in the spring and summer of 1983. One black vulture and four turkey vultures that were sighted at roosts 1 and 3 during the summer of 1982 were sighted at roost 1 in October and November 1983. Only one black vulture and one turkey vulture were marked at roost 4. They were resighted in September at roost 4 and then resighted at roost 1 in September and October 1983, after vultures stopped roosting at roost 4. An adult black vulture tagged near Chapel Hill, N.C., 190 km from roost 1 (P. P. Rabenold pers. commun.) was captured at trap site 1 on 1 February 1983 and was resighted at roost 1 on 5 February 1983.

The vita has been removed from the scanned document