

SOME WINTER AND NESTING SEASON FOODS OF THE COMMON RAVEN IN VIRGINIA

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LITTLE is known of the ecology of the Common Raven (*Corvus corax*) population that inhabits the narrow belt of mountains from north Georgia to northern Pennsylvania. This disjunct group is a remnant of a previously larger, contiguous population (A.O.U. 1957).

To our knowledge, only one account of the food habits of this isolated population has been published. Murray (1949) reported the animal remains found below two cliff nests in Rockbridge County, Virginia. Included were the bones of flying squirrels (*Glaucomys volans*), gray squirrels (*Sciurus carolinensis*), a Norway rat (*Rattus norvegicus*), a Mourning Dove (*Zenaida macroura*), a Blue Jay (*Cyanocitta cristata*), a Ruffed Grouse (*Bonasa umbellus*), a snake, and remains of grasshoppers.

Reports from other regions indicate that Common Ravens rely heavily on carrion (Ratcliffe 1962, White and Cade 1971, Dorn 1972). Some students believe the raven has considerable potential as a predator (Craighead and Craighead 1956: 339; White and Cade 1971; Dorn 1972). That ravens frequent garbage dumps is well-known (Bent 1946: 227-262).

Our objectives of the research were to determine the food habits of Common Ravens in Virginia during two critical periods of the year—winter and the nesting season. Of particular interest were (1) the importance of prey as a food source, (2) possible economic implications of their food habits, and (3) the importance of garbage dumps as a food source.

The study was made possible by the discovery of a nocturnal winter raven roost and the relocation of the apparent nonbreeding segment of the roost following the dispersal of the winter roost at the beginning of the nesting season. A concurrent study of nesting habitat made possible a search of 20 active nest sites for castings.

The research was conducted in the Ridge and Valley Physiographic Province of Virginia, a region of parallel ridges that rise 1000 to 2000 feet above the intervening valleys. The ridges are covered by oak forests (Braun 1967) while the valleys are interspersed forest and pastures. The numerous cliffs and remote woodlands have provided a refuge for the species at a time when its numbers were being reduced throughout the eastern United States.

MATERIALS AND METHODS

During January and February 205 raven castings were collected from a winter roost at Mountain Lake in Giles County (Lucid and Conner 1974). Approximately 100 ravens occupied this roosting site prior to dispersal in mid-February. In March 116 castings were collected from a nocturnal roost apparently occupied by nonbreeding ravens early in the nesting season. This roost, about 3 miles northwest of the winter roost, was used by at least 60 ravens in early March, but by mid-April only seven birds remained. During March, April, and May 114 castings were collected at 10 nests in Giles, Montgomery, Alleghany, Rockbridge, and Bath Counties. At 10 additional active nest sites checked for castings we found none because of heavy rains that apparently fragmented them, or steep terrain below the nest cliff that made them scatter too widely.

Castings were dried and constituents separated and identified with the aid of a 7×-30× binocular microscope. Volume of individual foods was determined in dry form by pressure from a metal dowel applied over the items placed in a graduated cylinder. The aggregate volume (Martin et al. 1946) and the frequency of occurrence of items in castings were calculated.

Hair and bones were identified by comparison with: (1) reference material from a mammal collection at Virginia Polytechnic Institute and State University, (2) castings from a tame raven fed seven species of mammals, and (3) known hair specimens by electron microscopy. Mammals weighing less than 1 pound were classified as small, less than 100 pounds as medium, and over 100 pounds as large.

Garbage dumps regularly used by humans within 20 miles of the winter roost were watched regularly to determine their use as feeding grounds. Blinds and vantage points approximately one-fourth mile from the dumps were used to count ravens as they arrived. The blinds helped us watch feeding activities and the vantage points helped delineate direction of flight.

RESULTS AND DISCUSSION

Contents of castings from a winter roost.—In castings collected from the winter roost (Table 1), the volume and occurrence of domestic sheep (*Ovis aries*) remains were greater than any other identified mammal, but the combined volume and occurrence of small mammals exceeded sheep wool. Other mammalian remains occurring frequently were cottontail rabbit (*Sylvilagus* spp.), Virginia opossum (*Didelphis marsupialis*), and white-tailed deer (*Odocoileus virginianus*).

The abundance of wool is explained by the natural mortality of unattended winter-born lambs, which averages 25% and, during inclement weather, can reach 50% (G. A. Allen, Jr., pers. comm.). Young, weak lambs are susceptible to wet, chilly weather and often succumb to pneumonia. Additionally, adult sheep have their highest mortality during this period. Most of the castings were collected during January and February, which corresponds with the height of the winter lambing period in southwestern Virginia. Castings composed of wool decompose slowly. Other castings break up faster, particularly in wet weather. In England Rat-

TABLE 1

CONTENTS OF 205 RAVEN CASTINGS COLLECTED IN JANUARY AND FEBRUARY FROM A
WINTER ROOST, SOUTHWESTERN VIRGINIA

Items	Occurrence %	Volume %
ANIMAL	95.1	69.3
MAMMAL (hair, skin, skeletal remains)	90.7	66.2
Small	24.4	16.1
White-footed mouse (<i>Peromyscus</i> spp.)	9.8	6.5
Unidentified	9.3	5.9
Meadow vole (<i>Microtus pennsylvanicus</i>)	2.9	2.0
Bat (Chiroptera)	0.9	0.4
Mole (Talpidae)	0.5	0.6
House mouse (<i>Mus musculus</i>)	0.9	0.2
Shrew (Insectivora)	0.5	0.1
Chipmunk (<i>Tamias striatus</i>)	0.5	0.4
Medium	38.0	26.7
Cottontail rabbit	6.3	8.1
Virginia opossum	7.8	7.6
Unidentified	15.6	5.5
Striped skunk (<i>Mephitis mephitis</i>)	1.9	1.9
Dog (<i>Canis familiaris</i>)	4.9	1.9
Raccoon (<i>Procyon lotor</i>)	1.4	0.5
House cat (<i>Felis domesticus</i>)	1.4	0.9
Woodchuck (<i>Marmota monax</i>)	0.5	0.3
Large	28.3	23.4
Domestic sheep	15.1	13.8
White-tailed deer	7.8	5.8
Cattle (<i>Bos taurus</i>)	4.9	3.3
Hog (<i>Sus</i> spp.)	0.5	0.3
Goat (<i>Capra</i> spp.)	0.5	0.1
BIRD (feathers, skeletal remains, eggshell fragments)	4.4	3.0
SNAIL (shell fragments)	1.5	0.1
CRAYFISH (exoskeleton)	0.5	T ¹
INSECT (beetle exoskeleton)	1.5	T ¹
REPTILE (part of skin)	0.5	T ¹
PLANT	54.1	21.0
DRY, SHREDDED STEMS, LEAVES, ROOTS OF FORBS, AND GRASSES	46.3	20.1
FRUIT	9.2	0.3
American holly (<i>Ilex opaca</i>)	1.5	0.1
Grasses (Gramineae)	1.5	T ¹
Forbs	3.9	0.1
Hemlock (<i>Tsuga canadensis</i>)	1.9	0.1
Corn (<i>Zea mays</i>)	0.5	T ¹
LEAVES	2.0	0.1
Hemlock	1.5	T ¹
Other	0.5	0.1
BARK	4.9	0.3
TWIGS (dead)	1.5	0.2
STONES (quartz, shale, sandstone)	30.2	2.2
REFUSE (cloth, paper, plastic, aluminum foil, rubber, glass)	30.7	7.5

¹ T (trace): less than 0.05% volume.

cliffe (1962) found sheep wool occurred in 40%, small mammals in 35%, rabbits in 9%, and birds in 6% of raven castings. Ratcliffe thought the raven's staple diet was carrion, mainly mutton. He noted that ravens seldom attack birds or larger animals unless such animals are incapacitated.

Plant material was high in occurrence and volume in our samples. Major items were dry, shredded stems, leaves, and roots of grasses, sedges, and forbs. Refuse and small stones occurred in 30% of the castings (Table 1).

Contents of castings from a spring roost.—Sheep wool sharply declined in occurrence in the spring roost castings (Table 2) with the end of the winter lambing period. The most prominent food item in the castings, excluding plant material, was medium-sized mammals, whose occurrence increased over that of the winter roost sample. The frequency of occurrence in castings of small and large mammals was about equal, but the occurrence of small mammals increased and that of large mammals decreased compared to castings from the winter roost. The most prevalent mammal was the Virginia opossum. The occurrence of opossum in castings more than doubled compared to the winter roost castings, apparently reflecting increased movements of opossums with milder weather and thus their greater exposure to roadway traffic. The percent volume and occurrence of plant material increased slightly above the winter level. Refuse declined in occurrence in castings to one-half the winter level.

Contents of castings from nest sites.—The changes in occurrence of animal remains noted in the winter and spring roost samples (Table 2) continued into the nesting season (Table 3). The incidence of sheep wool continued to decline as did the occurrence of larger mammals. Small and medium-sized mammals continued to increase in occurrence.

Cottontail rabbit, Virginia opossum, gray squirrel, and white-tailed deer were prominent in nesting season castings similar to the spring roost castings. Bird remains were absent from the spring roost but occurred in substantial amounts during the nesting season. The increase in avian remains may reflect an increase in the bird population during the spring migration. Refuse increased in percent occurrence to the winter roost level and doubled in volume. As many of these nest sites were several miles from dumps, the occurrence of refuse suggests another source, such as highways. Ravens with nests near roads were seen several times picking up roadside refuse. Plant material and stones decreased in occurrence compared to the other sampling periods.

Use of garbage dumps.—Early morning observations at seven dumps within 20 miles of the winter roost showed that about 40% of the ravens used these dumps. Several other dumps within 30 miles of the winter

TABLE 2
CONTENTS OF 116 RAVEN CASTINGS COLLECTED IN MARCH FROM A SPRING ROOST,
SOUTHWESTERN VIRGINIA

Items	Occurrence %	Volume %
ANIMAL	95.7	70.1
MAMMAL (hair, skin, skeletal remains)	93.9	70.0
Small	32.7	14.4
Unidentified	19.8	6.4
White-footed mouse	11.2	4.9
Meadow jumping mouse (<i>Zapus hudsonius</i>)	0.9	2.4
House mouse	0.9	0.7
Medium	47.4	41.1
Virginia opossum	20.7	26.9
Unidentified	16.4	6.2
Cottontail rabbit	7.0	5.3
Muskrat (<i>Ondatra zibethica</i>)	0.9	0.5
Bobcat (<i>Lynx rufus</i>)	0.9	0.8
Striped skunk	2.6	1.1
Gray squirrel	0.9	0.3
Large	24.1	14.5
Domestic sheep	8.6	7.1
White-tailed deer	9.4	4.3
Cattle	2.6	1.5
Unidentified	3.4	1.5
Horse (<i>Equus caballus</i>)	1.7	0.1
BIRD (eggshell fragments)	4.3	0.1
SNAIL (shell fragments)	2.6	T ¹
PLANT	56.0	24.7
DRY SHREDDED STEMS, LEAVES, ROOTS OF FORBS, AND GRASSES	52.6	23.2
FRUIT	3.5	0.1
Hickory (<i>Carya</i> spp.)	0.9	0.1
Forbs	2.6	T ¹
BARK	2.6	1.4
STONES (quartz, shale, and sandstone)	14.6	0.4
REFUSE (paper, cloth, plastics, sponge, rubber, aluminum foil, glass)	16.4	4.8

¹ T (trace): less than 0.05% volume.

roost were not checked for raven activity. Marked birds were not used in this study, but the direction of flight of ravens approaching the dumps and the low probability of another roost in the area support our conclusions. We think the ravens used five of the dumps rarely because they were regularly burned. Small groups of ravens were occasionally flushed from three of these dumps.

The two dumps visited regularly by ravens were sanitary landfills where refuse was partially covered with soil daily. Based on five surveys between 26 January and 11 February 1973, one of the dumps 5.6 miles

southeast of the winter roost was visited regularly each morning by 25 to 30 ravens. The morning arrival of ravens decreased with the dispersal of the winter roost in mid-February. We counted 16 ravens on 15 February, 10 birds on 17 February, 6 birds on 28 February, and 7 birds on 1 March.

The other regularly used dump was 17 miles west of the winter roost. Here on 6 February 17 ravens and on 10 February 20 ravens arrived from the direction of the roost. Similarly with flights to the other dump, a decline was noticed in mid-February. On 12 February and 13 February, seven and eight ravens, respectively, arrived at the dump.

Ravens arrived at the dump nearest the roost shortly after daylight and at the one farthest from the roost about 20 min later. At 0800 the dumps were opened to the public and usually truck traffic arrived immediately and flushed the ravens in several directions. While a few ravens may have remained at the dumps throughout the day, most left when the dumps opened and did not return until the following morning.

As most of the ravens fed at dumps in the morning, they may have ejected their castings before returning to the roost in the evening. This would bias the interpretation of the casting analysis. To gain insight into this problem, we fed a tame adult raven seven species of carrion. Without known exception this bird regurgitated castings only at night, irrespective of diurnal feeding time. Dorn (1972) found castings at dumps she studied, but neither searching the ground for castings nor watching from a blind revealed similar behavior in the ravens we studied. If ravens do eject their castings soon after feeding, the castings we analyzed would represent afternoon feeding and may underestimate the value of dumps as a food source.

Raven activity was watched from a blind on 4 separate days for a total of 8 h. These observations, coupled with 6 h of more distant watching with a spotting scope, indicated that the birds did little feeding when at dumps. They spent most of their time perched about the dump, singly or in small groups, and we noted little aggressive behavior over food. Some ingestion of food did occur, but much of the material consumed appeared to be wads of paper or plastic. A considerable amount of the garbage in the seven dumps was unavailable to ravens because it was either burned or buried. Common Crows (*Corvus brachyrhynchos*) outnumbered ravens by about four to one at two of the dumps and were more persistent feeders, thus reducing the food supply even more. Ravens were dominant over crows while feeding, and several times the approach on foot of a single raven displaced three to 11 feeding crows.

Feeding habits.—Based on analysis of castings, the Common Raven in southwestern Virginia is omnivorous. Mammals are the predominant item,

TABLE 3

CONTENTS OF 114 RAVEN CASTINGS COLLECTED IN MARCH, APRIL, AND MAY FROM NEST SITES, SOUTHWESTERN VIRGINIA

Items	Occurrence %	Volume %
ANIMAL	96.5	73.6
MAMMAL (hair, skin, skeletal remains)	88.6	65.2
Small	33.3	24.7
Unidentified	21.9	13.5
Meadow vole	1.8	3.2
Deer mouse	5.3	3.1
Mole	0.9	2.1
House mouse	1.8	1.4
Bat	0.9	0.8
Chipmunk	0.9	0.6
Medium	50.8	35.0
Unidentified	17.5	10.1
Cottontail rabbit	9.6	9.4
Virginia opossum	14.9	7.9
Gray squirrel	3.6	4.9
Dog	2.6	2.2
Striped skunk	2.6	0.5
Large	18.4	5.5
White-tailed deer	7.9	2.6
Domestic sheep	2.6	1.0
Domestic goat	0.9	0.5
Cattle	4.3	0.3
Horse	0.9	0.3
Unidentified	3.6	0.8
BIRD (feather, skeletal remains, skin, eggshell fragments)	25.4	7.8
SNAIL (shell fragments)	10.5	0.3
INSECTS (beetle exoskeletons)	1.8	0.3
PLANT	54.3	9.7
DRY SHREDDED STEMS, LEAVES, ROOTS OF FORBS, AND GRASSES	46.5	9.1
BARK	9.6	0.5
LEAVES	5.0	0.1
Oak (<i>Quercus</i> spp.)	2.6	0.1
Other	2.6	T ¹
TWIGS	0.9	T ¹
Blackberry (<i>Rubus</i> spp.)	0.9	T ¹
FRUITS	2.7	T ¹
Legumes	1.8	T ¹
Other	0.9	T ¹
STONES (quartz, shale, sandstone)	29.8	1.3
REFUSE (paper, cloth, plastics, aluminum foil, glass)	27.2	15.4

¹ T (trace): less than 0.05% volume.

at least during winter and spring. Remains of mammals averaged 91% in occurrence for the three samples.

The grouping of mammals by species provides further insight into the raven's food habits. Medium-sized mammals, such as the cottontail rabbit, Virginia opossum, dog, striped skunk, raccoon, and house cat, were apparently located by ravens as highway and railroad kills. Large mammals, primarily livestock, were probably a result of natural mortality. White-tailed deer remains were more abundant after the hunting season and occurred less frequently throughout the year, probably as roadway kills. Animal remains were rarely found at dumps because depositing dead animals in them is prohibited. Thus, the large and medium-sized mammals representing carrion averaged 69% in occurrence for the three samples.

Small mammals are probably difficult to secure as carrion because of their size and rapid deterioration. Therefore, their presence in castings suggests that they were taken alive. Apparent prey species averaged 30% in occurrence for the three samples.

The predominance of shredded stems, leaves, and roots of grasses, sedges, and forbs suggests that some of this material may have been masticated and ingested by herbivores and taken from their stomachs by ravens. The occurrence of fruits not readily available during winter and spring also suggests that the fruits may have come from stomachs of rodents that store fruit. Ravens may also have cached some fruits. We do not know if bark, twigs, and leaves were taken for food. Displacement behavior, e.g. slashing at twigs, leaves, and stems with the beak, may account for this consumption. Because bark is commonly used as a nest lining, the increased occurrence of bark in castings from nest sites may reflect incidental consumption.

Refuse averaged 25% in occurrence for the three samples. Observations at dumps accounted for about 40% of the ravens that used the winter roost. It appears that dumps regularly used by ravens probably supply only a portion of their daily diet. We believe that part of the population frequents dumps while the balance seldom uses them.

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SUMMARY

An analysis of 435 castings collected at Common Raven aggregations, a nocturnal winter roost, a nocturnal roost during the early part of the nesting season, and at active nest sites in southwestern Virginia indicated that ravens are primarily scavengers. In descending order of occurrence, carrion of opossum, sheep, deer, and rabbit was recorded. Ravens may be predatory when small mammals are available. Small mammals frequently found in castings were mice, moles, and shrews. The consistent presence of refuse in pellets indicates that dumps and other refuse sources, e.g. roadways, constitute a regularly used supply of food.

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