

ANALYZING AMERICAN CROW BEHAVIOR IN RURAL AND
SUBURBAN REGIONS IN BLOUNT COUNTY, TENNESSEE

A Report of a Senior Study

by

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Spring, 2024

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ABSTRACT

The American crow (*Corvus brachyrhynchos*) is a renowned synanthrope and occasional agricultural nuisance. Like other birds of the Corvidae family, they have displayed their intelligence in maintaining pace with human development to continue this synanthropic status. As humanity consistently and continually develops and expands, the environment and ecosystems around us are being impacted. This study aimed to investigate the behaviors of rural and suburban crows and how these different levels of development may influence them. This was investigated utilizing a behavioral observation study and approach distance measurement via rangefinder, with results from each region being compared. Both groups of crows preferred large open fields for gleaning. There was no statistical difference between flock counts, behaviors, or approach distances. However, the suburban crows had more variety in their behaviors than the rural crows. The two most observed behaviors in both locations were vocalization and gleaning. The rural crows interacted with more threats than the suburban crows, though the suburban crows were observed alongside more passive species. Overall, the two groups live similar lifestyles with behavioral variances, much like their human counterparts in the same regions.

ACKNOWLEDGEMENTS

I want to thank the private landowners in Walland, TN, for letting me wander up and down their road watching crows and even allowing me to get out there multiple times a week.

I also want to thank Dr. Drew Crain for being my thesis advisor and helping me navigate this senior study. I want to thank my friends for constantly asking me crow and other animal behavior questions (I love answering them).

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CHAPTER I

INTRODUCTION

The American crow (*Corvus brachyrhynchos*) is extremely intelligent and adaptable, but has not gained much attention in scientific and popular literature. Crows are of the Corvidae family, with corvids being known for their interesting behaviors and adaptations to the spread of humans. Unfortunately, the literature on how they have adapted to various environments is scarce.

American crows are perhaps one of the most notable passerines (perching birds) in the United States, excluding the other often romanticized songbirds, with their large size and solid black coloring. Besides being iconic synanthropes, these birds play a generalist role and are distributed throughout most of the contiguous United States and southern Canada (see Figure 1). This widespread distribution occurred relatively recently. In the early 1800s, it was observed that the American crows were not present west of the Appalachian Mountains but were numerous in the settled coastal states (Gade 2010). As colonial Americans ventured west and deforested the landscape, American crows moved in where the common raven (*Corvus corax*) was displaced, effectively replacing them and filling their niche in the altered landscape. It has also been suggested that the movement of maize across North America through the trades of Indigenous Americans brought the American crow with it, following a

similar pattern that it would later with colonial Americans (Gade 2010). Both ideas are perhaps the most likely, with the crows having followed both developments.

The ecological role of the American crow varies from predator to prey to seed carrier. The crows play a role in controlling the populations of their prey, such as the common nighthawk (*Chordeiles minor*). The common nighthawk is a ground-nesting insectivore, often laying eggs in the rocky substrate of urban rooftops. This has left their eggs vulnerable to the American crow, where the eggs are visible among small, dark gravel. While the depredation of their nests by the crow is natural, the choice of nest substrate is not. The nighthawk population is declining, though this may also be due to the declining populations of insects, rather than just the over-predation from crows (Latta and Latta 2015). As the opportunists that these corvids are, the American crow is not threatened by the possible loss of this food source, considering their wide variety of potential prey and other options.

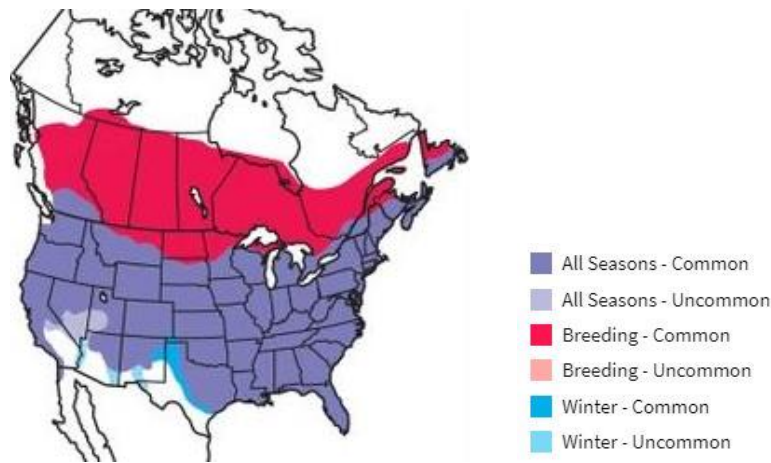


Figure 1: The distribution range of the American crow (*C. brachyrhynchos*) as it reaches across most of the contiguous United States and southern Canadian provinces (Kaufman 2014).

Besides being a predator, the American crow is the prey of several larger birds. On the East Coast of the United States, the crow is prey to the great horned owl at all stages of life (Yorzinski and Vehrencamp 2009). As nestlings (and as eggs), the red-tailed hawk is another crow nest predator (Marzluff et al. 2015).

Aside from being both the predator and the prey, the American crow aids in the spread of various trees as a seed carrier. As one of their many ecological functions, these corvids, like squirrels, with their caching of tree nuts, disperses seeds across landscapes through their scattered caches. This mode of zoochory (synzoochory) allows for a mutualistic relationship between the crow and the tree of interest. Known trees of American crow interest are the English and black walnut trees (Cristol 2005). The English walnut is notably non-native to North America but offers more dietary benefits and a lower effort-to-reward ratio than the black walnut (Cristol 2001).

Behaviors

American crows, if not all corvids, are extremely intelligent, making them interesting subjects of study. Their adaptive nature as generalists has piqued the interest of many ecologists, birders, and ornithologists alike, from observations of unexpected perching to dunking dry food items into pools of water to allow consumption (Katzner 2016, Gorman 2023, Morand-Ferron 2005).

Community Behaviors – These corvids are social with fission-fusion group-forming tendencies (Cornell et al. 2012). They are often found in familial groups with a set of parents and various young from different nesting seasons (McGowan 2001). These familial flocks, dubbed “murders,” have distinct territories where they spend their days while not away

foraging. They tend to coalesce in the morning at these territories after returning from where they spent the night, either on-site or away at a communal roost. The arrival and departure of crows to territories are seemingly decided upon by the individual, despite the group cohesion when in the territory or heading to roost (Caccamise et al. 1997). This group cohesion versus individual choice of departure relates to their fission-fusion structure. In these fission-fusion structures, the group stays together (fusion) if there are enough resources for all, typically when foraging. Conversely, the group may split (fission) based on individual needs and decisions for foraging needs (Cornell et al. 2012).

Roosting is a common avian behavior, offering warmth and safety in numbers through the dilution effect, and the American crow is a communal rooster. This behavior is more common in the winter months for the warmth and safety of a large conglomeration of multiple family groups. Notably, roosting still occurs in the summer, although the trees of choice are often seasonally available deciduous trees compared to the winter choice of evergreen trees (Gorenzel and Salmon 1995).

Crows, like other corvids, have been observed to perform social play. While this play seems to be a product of convergent evolution and separate from the play of other animals, it also alludes to the higher order of their intelligence (Diamond and Bond 2003). Play behaviors include chasing, fighting, and object playing. Chasing and fighting as play are as they sound. Like humans and our favored canine companions, chasing involves the back-and-forth pursuit of two individuals. Play fights are the same between species, often initiated with specific invitation actions (Marzluff and Angell 2013). For familiarity, the invitation action between dogs is what is known as the play bow- where the initiating canine lowers their chest to the ground and leaves their rear in a standing position. An initiation behavior has not been

reported in the literature among the American crows. However, it has been reported in a handful of other species of the Corvidae family, such as the common raven (*C. corax*) and white-winged cough (*Corcorax malanorhamphos*). The American crow has been reported to partake in social object play, though the characterization of crow play is lacking in the scientific literature (Diamond and Bond 2003, Kilham 1984).

The behavior of mobbing is not uncommon amongst birds despite the inherent risk of confronting possible predators. The American crow is a notorious mobbing species with their bold swooping and diving at potential predators. Crows have been observed mobbing birds of prey, such as the osprey and great-horned owl, to protect their young from predation (Marzluff et al. 2015, Yorzinski and Vehrencamp 2009). However, mobbing does not always target predators. Mobbing also deters unwanted visitors, such as the common raven (Freeman and Miller 2018). As previously mentioned, the raven fills a niche similar to the crow in a different environment (Gade 2010). The prospect of crows mobbing other competitors is something lacking in literature, and perhaps in reality. There are not many other large avians that fulfill a comparable niche to the American crow that pose as competition to the point of mobbing.

Communication – Like the young of any animal, young crows learn how to navigate the world through observation and guidance from their parents and their peers. A particular experience that crows are taught is who and what to mob. Crows appear to not innately distrust birds of other species, which further supports the idea of crows being conditioned by their surrounding conspecifics (Ramsay 1950). Crows are taught of these threats through vertical and horizontal transmission of this information from their parents and peers, respectively (Cornell et al. 2012). A large part of mobbing is the calls involved, which alert

nearby conspecifics to the threat. The urgency of the call and the exact use of caws relay the specific message.

The vocalizations of crows are perhaps more detailed and convoluted than one may think. Their various calls have many meanings depending on context, as well as the tone. From mobbing to assembly, the calls rely on the call's grittiness and the phrases' timing to work together to form seemingly different communication (Yorzinski and Vehrencamp 2009). The individual caws appear to function as syllables and, when combined, form complex sentences, like our own languages, which also house the duality of patterning (Richards and Thompson 1978). Similarly structured calls have also been observed in other corvid species as well (Thompson 1982).

Foraging Behaviors – The foraging behaviors of the American crow are wide and well-varied, as are most other behaviors of these large birds. Like their fellow passerines, they glean on lawns, forage seeds, and eat stranded French fries found in parking lots.

These crows have also been observed to participate in the fly-and-forage strategy, where the birds migrate by day to distant foraging sites and forage alongside their conspecifics (Ward and Raim 2011). These foraging sites, unlike territories, are not unique to specific groups of crows and are often shared with migrant flocks. The arrival and departure of crows to these sites, as they are to territories, are also not group movements and are rather decided upon seemingly by the individual (Caccamise et al. 1997).

Crow foraging extends farther beyond what we picture as the typical passerine diet. These synanthropes, known for shadowing humans and their activities and feasting on the waste left behind us, have been historically observed as harbingers of war. However, these intelligent birds only learned to associate the marching movements of humans in armor with

their next food source- carrion. This negative association has birthed many other poor associations with the corvids, such as illness, death, and other associated topics worthy of omens (Król and Hernik 2020). Carrion is not the only meat that these birds have been observed to feast on. In one instance, an American crow was observed depredating (or perhaps hunting) bats in a mine in the Upper Peninsula of Michigan (Flaspohler 2017). In another instance, an American crow was observed caching a few rabbit kits that it had depredated from their nest and even flying off with one for presumably immediate consumption (Shew 2006). The behavior of caching is well known amongst American crows, from caching nuts or seeds to caching small vertebrates (Cristol 2005, Shew 2006).

Individual Behaviors – As previously mentioned, crows routinely decide whether to act as a group or as an individual, from moving to the overnight roost or staying within their territories for the evening (Caccamise et al. 1997). This exhibition of individuality alludes to their intelligence and elevated thought process, much like many other behaviors portrayed by these multifaceted corvids.

While individual personality has not been deeply studied in the American crow, there has been evidence found of group personality in corvids, specifically the common raven. With these group personalities, the young raven groups had inconsistent responses across groups, but within their groups, the individual ravens had similar responses (Miller et al. 2016). Furthermore, in a more recent study, it was noted that in the American crow, there were differences in the birds' responses to novel objects and changes to the objects across the sample group by age. However, there was a similarity within their groups, as the crows were rarely alone given the social nature of the species (Pearce 2023). It is uncertain if the

groupings of these corvids are causing group personalities to overpower the urge of individual personality, and more research is needed on that subject.

Habitat Influence on Behavior

American crows are fast, adept learners, adapting to their environments with relative ease. For example, rural crows are less likely to be confrontational toward humans invading their nests, even going as far as staying far enough away to be out of reliable range of a firearm. Their urban counterparts, however, are much more vocal as intruders approach (Knight et al., 1987).

Crows flock to urban centers for the vast resources that are wasted by humans daily, from dropped foods to dumpsters. These city-dwelling crows tend to reside in smaller territories than their countryside relatives, akin to urban humans. Presumably, the rich resources with less hospitable nesting and roosting options result in these smaller territories (Marzluff et al., 2001). Aside from the more readily available and more consistent resources offered in the big city, crows are less likely to be shot at in the city than in the countryside (Knight et al. 1987, McGowan 2001). Another possibility in the urban appeal to the American crow could be the slightly higher temperature of urban centers, known as the urban heat island effect. While the temperature difference is not drastic, most animals would choose the warmer option despite the difference seeming trivial.

Notably, it has been said that the adaptability of crows is "...just adequate to keep pace with the urban fast lane" (Marzluff et al. 2001, p. 351). As human development has expanded quickly, the species must either adapt or become locally extirpated by urban sprawl. The adaptability of these corvids is impressive, if not expected of generalists, though

it has been seen that urban survivorship and fecundity are unsustainable in urban environments (Withey and Marzluff 2005). This observation, however, comes with conflict, as urban crow populations increase yearly. The dissonance between the demography and observed population growth suggests slow population growth, while the population seems to be more resemblant of a population boom instead. It is believable that the mobility of the species influences the immigration (or emigration) of crows into (or out of) urban areas. The prospect of urban centers of the crow population being a sink, with rural and suburban populations being the source is dismissible, and instead, the prospect of urban centers being labeled as “sponges” is more apt. This “sponge” population supports its own natality and mortality rates, while also accepting mass, and perhaps seasonal, intake (Marzluff et al., 2001). Other factors of population fluctuation are applicable, though those are not discussed here.

Research Question

This study will investigate the differences between the behaviors of American crows (*C. brachyrhynchos*) within rural and suburban environments to better understand how these corvids may adapt to continued human sprawl. Additionally, observed behaviors will be compared to those observed in relative literature (see Table 1). I hypothesize that rural crows will behave more reclusively compared to suburban crows, but not in a fearful manner.

Table 1: Ethogram based on behaviors from published literature.

Behavior	Definition	Related Literature
Foraging	Unspecified act of gathering food items; grasping at human food litter with beak or picking at scattered seed/food.	n/a
Gleaning	Birds are poking at the ground with their beak to unearth and capture small invertebrates with their beak for consumption.	n/a
Depredation	The act of pilfering eggs or other materials for consumption from other avian nests.	Latta and Latta 2015
Stalking	The scouting and waiting of the bird to assess prey; typically succeeded by hunting.	Flaspohler 2017
Hunting	The active behavior of targeting and attacking another animal with the end goal of predation.	Flaspohler 2017
Dunking	Food items held in beak and then submerged into a water source, often just dipped or swirled around. Precedes consumption.	Gorman 2023, Morand-Ferron 2005
Mobbing	The surrounding and pestering of a group of defenders; often to dissuade would-be predators from encroaching on territory or nesting sites.	Knight et al. 1987, Marzluff 2015
Perching	General resting on an object's branch, ledge, or otherwise edge.	Katzner 2016
Vocalizing	Making communicative sounds to other nearby members of the population.	Cornell et al. 2012, Knight et al. 1987
Caching	The act of removing food items from a foraging site to a distinct storage location for later consumption.	Cristol 2005
Tool use	Brandishing an object for a specific use, such as foraging, clearing debris, or defense.	Balda 2007

CHAPTER II

METHODS

All observations were conducted in compliance with the Maryville College Institutional Animal Care and Use Committee (IACUC). A copy of the approval form can be found in Appendix 1.

Study Populations – The two populations used in this study were both wild populations of American crow. The suburban population was observed from the Maryville College campus in Maryville, Tennessee. For the rural population, private property located in Walland, Tennessee was used. The private property was previously a beef cattle farm but now grows baling hay. It is located right alongside the northwest border of the Great Smoky Mountains National Park.

Observations – To investigate any alleged behavioral differences, three distinct periods of study were needed. The first period (18 Oct. 2023 – 30 Oct. 2023) was preliminary observations and research. This pilot period included observations from around the locations, in hopes of forming a clearer image of where the crows may frequent for the actual observation periods. These sightings were not sought out and were recorded as they were observed. With these observations, the number of crows, date, time, and location were

recorded. The observation points from this were used in scouting locations for the observation period, along with hypothesizing additional locations when combined with literary research.

The second period (31 Oct. 2023 – 8 Dec. 2023) was the late fall period. This period focused mainly on behaviors and some rangefinder data. During this period, observations were recorded from various locations at either study site. All activities were recorded as they happened and were observed, assuming the crows were present at that time. Regarding the rangefinder data, the data were procured by slowly approaching the crow(s) either on foot or within a vehicle with the rangefinder (Gogogo Sport Vpro GS03) set to meters on the hunting setting and trained on the crows. The distance at which they flew off was recorded. If the rangefinder data was taken from the vehicle (on the road), the crows were slowly approached (~5mph) alongside the road. When the crows flew off, the vehicle was promptly stopped, and the approximate location was marked with the rangefinder was recorded.

The third period (22 Jan. 2024 – 7 Mar. 2024) was the early spring period and followed the same methods as the second period. Notably, more emphasis was placed on the number of crows within a murder and rangefinder data. Additionally, behaviors of the suburban crows were recorded as they were observed in day-to-day function due to the lack of data from the second period, where the crows were not present in most of the scheduled observation times.

Data Analysis – The various data were separated and organized into their respective pools to analyze the qualitative and quantitative data. The first pool was that of the qualitative data or the observed behaviors. These data were compared to the literature ethogram and between locations. These comparisons were based on occurrences, where they

were then compared as qualitative data. They were then arranged into a graphical representation based on the percentage of occurrences. Observed locations were recorded in the same manner as the behaviors. Flock sizes were then compiled into a box-and-whisker chart for visual comparison and compared using a two-sample student's t-test, assuming equal variance. The quantitative data from the rangefinder at the two locations were analyzed and compared using a two-sample student's t-test, assuming unequal variance.

CHAPTER III

OBSERVATIONS AND RESULTS

The pilot period of observations returned thirteen different locations, with varying re-occurrences. The two most popular locations for the campus (suburban) crows were the Willard House (WH) and the upper football practice field (UFB), with 15% and 18%, respectively, of these occurrences (Figure 2). Pilot period observations were unable to be made in Walland, TN (rural).

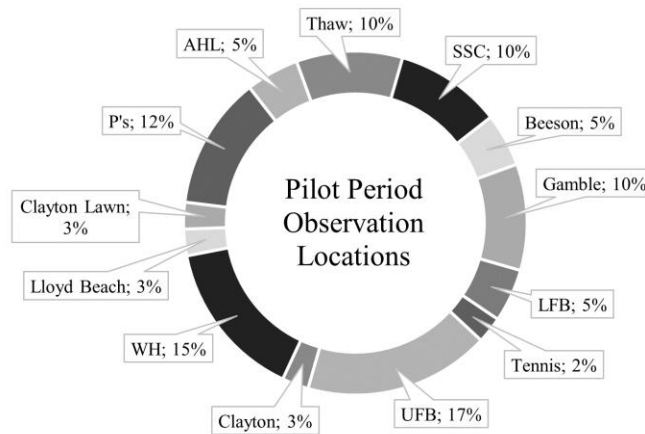


Figure 2: The locations of pilot period observations by the percentage of observations on the Maryville College Campus ($n = 40$). SSC, Sutton Science Center; LFB, lower football practice field; P's, Pearson's Dining Hall; AHL, Anderson Hall lawn.

In the observation periods, fourteen suburban locations and five rural locations were recorded (Figures 3 and 4). Compared to the pilot period, one of the most abundant locations on campus (the suburban site) was the upper football field (UFB, 11%). The UFB was tied with the lower football field (LFB), the steam plant, and the Willard House. The most popular rural location was the northern field (NF, 58%), with the most popular subsections of it being tied at 37% in the eastern and middle-most sections (Figure 4b). Like the practice football fields (UFB & LFB), the northern field was used as a gleaning location. The Willard House did not have any one specific common use. The steam plant was often used as a perching location.

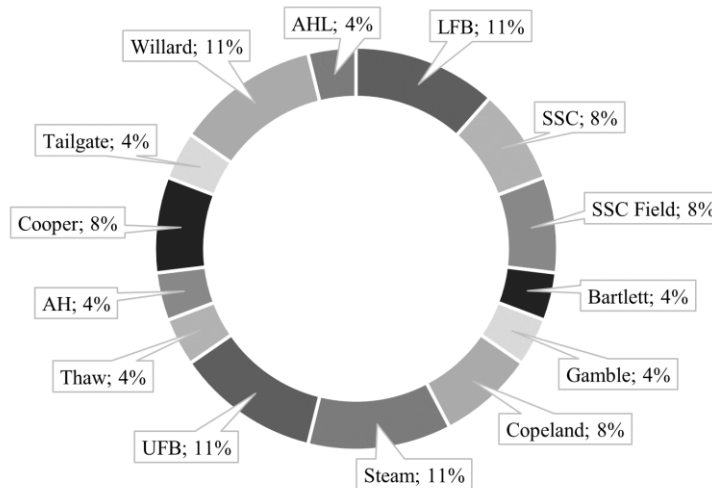


Figure 3: American Crow observations on the Maryville College campus (suburban) by the percentage of occurrences. AH, Anderson Hall.

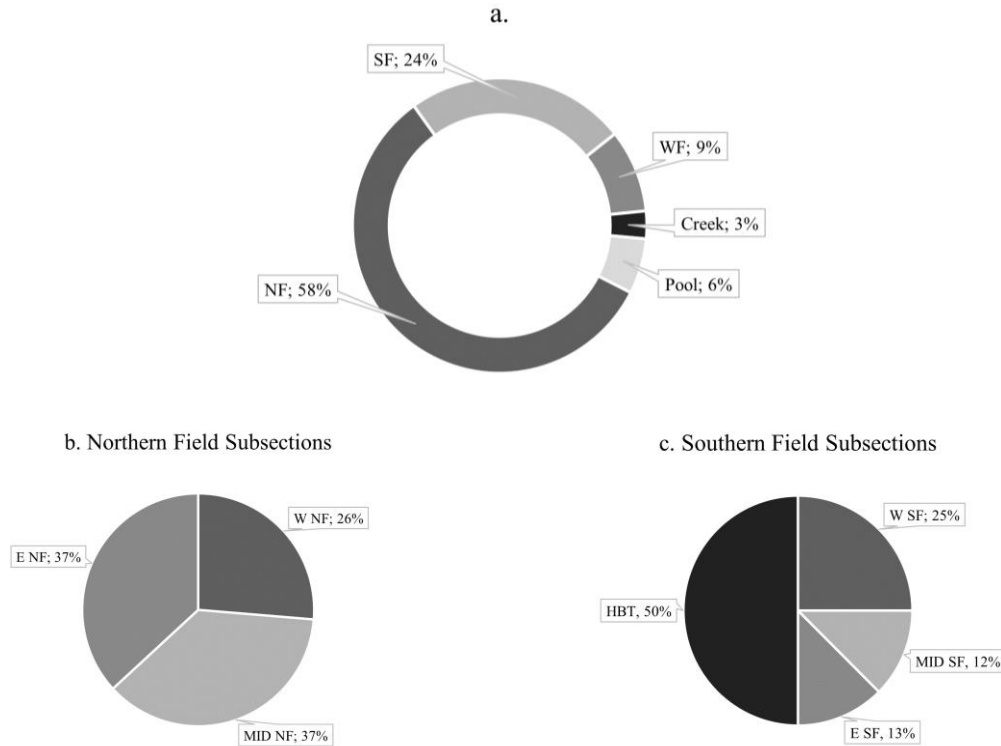


Figure 4: (a) Observation locations in Walland, TN (rural). SF, southern field; WF, western field; HBT, hay bale tree. The southern and northern fields were large enough for the fields to be divided into subsections (b & c).

Suburban Crow Behaviors – The suburban crows of the Maryville College campus performed a wide variety of behaviors, totaling 13 observed behaviors (Table 2). The most observed behavior was vocalization making up 22% of them, followed by gleaning, which made up 18% of observations (Figure 5b).

Rural Crow Behaviors – The rural crows were observed performing fewer behaviors than their suburban counterparts, though all eight of their observed behaviors were also observed on campus (Table 3). The most observed behaviors of the rural crows were gleaning, which accounted for 37% of observations, followed by vocalization, which accounted for 26% of observations (Figure 5a).

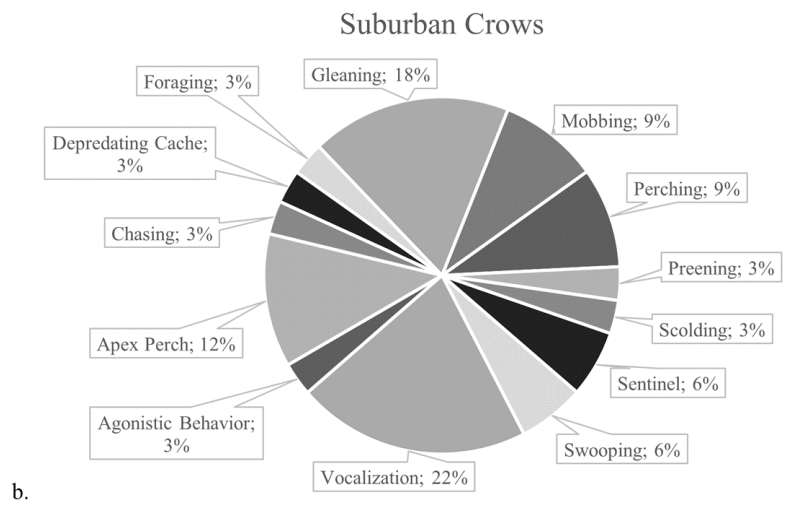
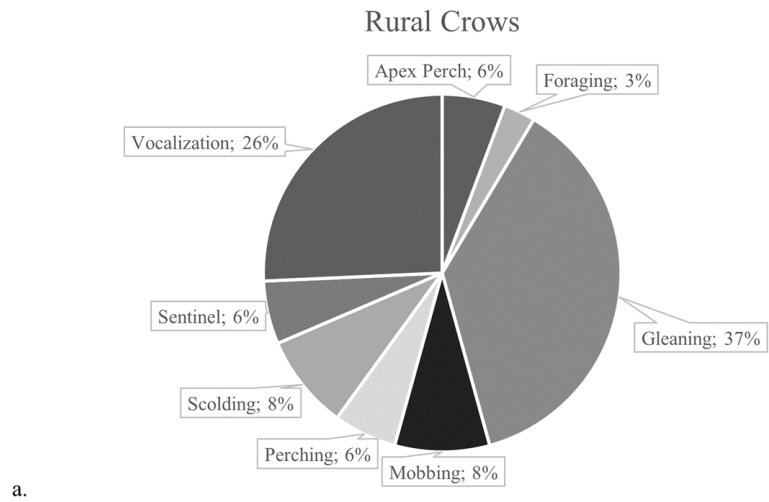


Figure 5: The behaviors, by percentage, observed in (a) Walland, TN ($n = 31$) and (b) the Maryville College campus ($n = 23$).

Table 2: The observed Ethogram of the suburban crows located at Maryville College.

Behavior	Definition
<i>Agonistic Behavior</i>	The bird instigates interspecific interaction to deter another.
<i>Apex Perch</i>	A crow that is perched at the top-most available perch within a tree or structure but is not acting as a sentinel.
<i>Chasing</i>	A crow or multiple crows pursue an invader or threat.
<i>Depredation</i>	The act of pilfering hard mast from a cache of unknown origin.
<i>Foraging</i>	Unspecified act of gathering food items; grasping at human food litter with beak or picking at scattered seed/food.
<i>Gleaning</i>	The bird is poking at the ground with its beak in an effort to unearth and capture small invertebrates with their beak for consumption.
<i>Mobbing</i>	The surrounding and pestering of a group of defenders; often to dissuade would-be predators from encroaching on territory or nesting sites.
<i>Perching</i>	General resting on a branch, ledge, or otherwise edge of an object.
<i>Preening</i>	The bird is combing and rearranging feathers for hygiene and flight efficiency.
<i>Scolding</i>	Repeated vocalizations with the intent to annoy or harass an invader or threat; often accompanied by or preceding mobbing.
<i>Sentinel</i>	A crow that is perched above gleaning crow(s); often calling out nearby threats.
<i>Swooping</i>	Mobbing crows dive at and rush an invader or threat; specific behavior during mobbing.
<i>Vocalization</i>	Making communicative sounds to other nearby members of the population.

Table 3: The observed ethogram of the rural crows located in Walland, TN.

Behavior	Definition
<i>Apex Perch</i>	A crow that is perched at the top-most available perch within a tree or structure but is not acting as a sentinel.
<i>Foraging</i>	Unspecified act of gathering food items; grasping at human food litter with beak or picking at scattered seed/food.
<i>Gleaning</i>	Bird is poking at the ground with beak in an effort to unearth and capture small invertebrates with their beak for consumption.
<i>Mobbing</i>	The surrounding and pestering of a group of defenders; often to dissuade would-be predators from encroaching on territory or nesting sites.
<i>Perching</i>	General resting on a branch, ledge, or otherwise edge of an object.
<i>Scolding</i>	Repeated vocalizations with the intent to annoy or harass an invader or threat; often accompanied by or preceding mobbing.
<i>Sentinel</i>	A crow that is perched above gleaning crow(s); often calling out nearby threats.
<i>Vocalization</i>	Making communicative sounds to other nearby members of the population.

Behaviors Comparatively – The two representations are seemingly different when compared graphically (Figure 5). Observed flock size averages and standard deviations between the two locations were not statistically significant when outliers were removed (determined using Grubbs’ test). However, with outliers still considered, the standard deviations were statistically different (determined using Fisher’s F-test, 95%). Flock sizes (sans outliers) were similar on average and in their standard deviations (Figure 6).

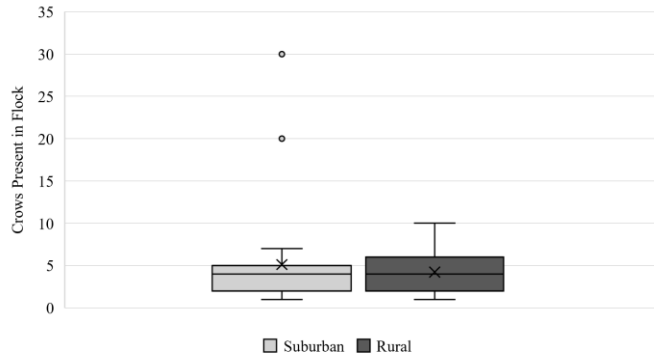


Figure 4: Box-and-Whisker chart of suburban crow flocking sizes (3 ± 2 crows [$\bar{x} \pm s$], $n = 23$) and rural crow flocks (4 ± 3 crows, $n = 31$). The two suburban outliers were not accounted for within the average and standard deviation calculation.

Rangefinder Data – Minimal rangefinder data points were attainable (Figure 7). The data attained from both sites were not significantly different ($p = 19$).

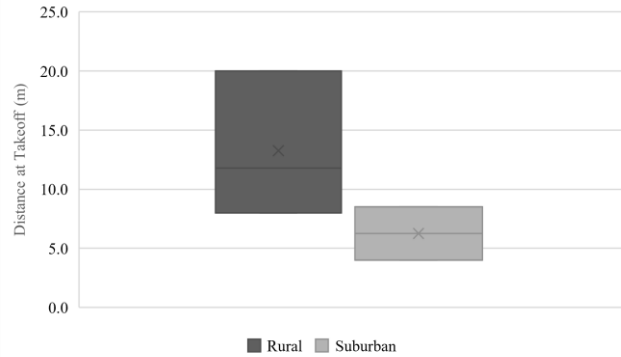


Figure 7: Box-and-Whisker chart of the rangefinder data. Distances were recorded at the point of takeoff by the crow. The dark gray represents the rural crows (13.3 ± 6.1 [$\bar{x} \pm s$], $n = 3$). The lighter gray represents the suburban crows (6.3 ± 3.2 , $n = 2$).

Interspecific Observations – The suburban crows had less hostile heterospecific species than the rural crows, with either one or two species of *Buteo* hawks (red-shouldered [*Buteo jamaicensis*] and/or red-tailed hawks [*Buteo jamaicensis*]). Both species of the *Buteo* hawks have been seen on the Maryville College campus, though neither site could be reliably differentiated between the two. The rural crows were observed in hostile interspecific behaviors (mobbing, scolding) with either three or four species, the bald eagle (*Haliaeetus leucocephalus*), the common raven (*Corvus corax*), and either one or two species of *Buteo* hawks (red-shouldered or red-tailed). Notably, the rural crows did not always mob or otherwise deter the *Buteo* hawks when they were within sight.

Two weeks after the second observation period concluded, a bald eagle was witnessed on campus without mobbing. On the same day as the first observation, a Cooper's hawk (*Accipiter cooperii*) was also observed on campus. The Cooper's hawk flew above the Sutton Science Center and was cawed at once by an approaching crow.

Both locations had indifferent cohabitations and co-foraging with other species. The suburban crows were observed foraging alongside eastern gray squirrels (*Sciurus carolinensis*) and sharing spaces with fish crows (*C. ossifragus*). The rural crows were not observed alongside any heterospecifics as the campus crows were, but other species of birds of prey were observed within sight of the crows. These species include the American kestrel (*Falco sparverius*) and northern harrier (*Circus hudsonius*); the crows deterred neither. Additionally, the suburban crows were observed swooping at a group of three rock pigeons (*Columba livia*) to deter them from their perch atop the steam plant.

CHAPTER IV

DISCUSSION

Locations – Both crow populations preferred large, open areas for gleaning. Other animals also favor these wide-open areas at the suburban site for gleaning, foraging, and hunting and were observed sharing the spaces (see more information on this in the *Interspecific Observations* subsection). The campus (suburban) crows' preference for the practice football fields could relate to their open area and lack of consistent daily human activity. Their preference for Willard House coincides with the sidewalk that is often used by students returning to their dorms, where food may be dropped. Parking lots were included with their respective buildings, but crows were observed foraging from fast food bags that had been littered in said lots. The steam plant offered a considerable vantage point above the northwestern corner of the campus, along with an open area of grass that lies just off-campus next to a church.

The rural crows were most often observed gleaning in the northern field. In the eastern subsection of the field, there was often a sentinel crow who would watch over their gleaning conspecifics. On multiple occasions, when attempting to slow down to observe the crows from the road alongside this section, the sentinel crow vocally alerted to the gleaning group, leading to the flock dispersing and disrupting any possible counts. This sentinel

behavior was not observed in the middle and western sections of the northern field, where there were fewer elevated perches that the sentinels could use.

There was an attempt at following a flock of crows to an on-campus nesting or roosting site within the Maryville College Woods, but no site was successfully located. From further into campus, the crows could be seen flying towards the northeastern corner of the college woods and landing within the trees. A *Buteo* hawk was also mobbed by a small group of crows above the eastern half of the college woods, which could allude to a possible nesting or roosting location. Notably, the second observation period ended in early March, when crow nesting season was beginning, which could mean that this preferred section of woods could be a roosting location instead of a nesting location.

Behaviors – The suburban crows had a broader repertoire of behaviors than their rural counterparts. However, none of the behaviors were starkly different enough from the rural crows for it to be a regional behavioral difference. The suburban crows were observed partaking in more foraging than the rural crows, largely the depredation of a hard mast cache of unknown origin and the foraging of littered fast food takeout bags.

The insignificant difference in flock sizes was surprising, but probably due to limited sampling opportunities. In literature, it has been noted that crows flock with and commonly glean with their familial groups, which tend to be smaller and significantly different in the rural setting (McGowan 2001). The two observed large flocks on the Maryville College campus were over 20 individuals, which coincides with large communal flocking and group diurnal migrations in the late winter (Ward and Raim 2011). With more flock count data points taken, the difference could be found to be significant between the rural and suburban crow flock sizes.

Approach Distances – While the approach distances (measured via a rangefinder) appear to be different, they were not found to be significantly different. This could be largely due to the very minimal attainable data points. The campus crows were often perched high in trees or would take off when the rangefinder was turned on and ready for use. All three rural crow rangefinder data were taken alongside the main road between the northern and southern fields. The fields were fenced in, which discouraged the retrieval of more data.

Interspecific Observations – The suburban crows had more variety in their passive and indifferent interspecific interactions than rural crows. They were observed gleaning alongside American robins (*Turdus migratorius*) and eastern gray squirrels (*Sciurus carolinensis*), unbothered and unthreatened by their presence. Fish crows (*Corvus ossifragus*) were observed on campus on warmer days, often perched in a tree near Pearson’s Dining Hall or gleaning on the lawns nearby. The American crows were not disturbed by the presence and acted passively near them. Remarkably, the suburban crows were less accepting of the rock pigeons (*Columba livia*) perched atop the steam plant’s stacks. The crows swooped down and scolded these pigeons to deter them from this substantial perching location.

The crows were also seen picking at a roadkill squirrel (which was noted as foraging), showcasing their generalist diet. The presence of our campus squirrels could be another enticing draw to suburbia (like human refuse is), namely due to their caches and carrion. There is a similar reason to believe that is what draws in at least three different hawk species: the red-tailed hawk (*Buteo jamaicensis*), the red-shouldered hawk (*Buteo lineatus*), and Cooper’s hawk (*Accipiter cooperii*). The abundant squirrel population living in the College Woods on campus could draw these larger birds of prey, encouraging these interspecific

reactions with the American crows. The two most common locations where these interactions occur are above Anderson Hall Lawn and over the woods. Both locations are prime squirrel areas.

Reverting to the topic of hawks, the crows were observed mobbing the two *Buteo* hawk species, but not the smaller Cooper's hawk. The *Buteo* hawks are nest predators of the American crow, while the Cooper's hawk may not be on the Maryville College campus. This observation of the crows' indifference to the Cooper's hawk juxtaposes what is found in some literature, which states that the Cooper's hawk is a predator (McGowan 2001). Notably, a Cooper's hawk was approached by a nearby crow and cawed at once before the crow disengaged after it appeared to realize, once close enough, that it was not a *Buteo* or other species of significant threat.

When a bald eagle (*Haliaeetus leucocephalus*) was observed on campus, nearby crows did not approach it, unlike the rural crow response. Bald eagles are not a common sight on campus, as the campus is in the middle of a developed city and not near any major or considerable bodies of water. It is likely that this was something relatively novel to the crows and that they were not inclined to make contact out of precaution. Notably, the rural location is not near any considerable bodies of water but is within two miles of the Little River. The river is not an ideal location for spotting a bald eagle, but it is more considerable than the lack of a body of water the campus has. However, it is possible that the eagles were traveling through the area to a more apt location for hunting or dispersal.

The different reactions to bald eagles offer support for the cognition that allows American crows to recognize and decide if another animal is a threat and if the risk is worth addressing this possible threat. Furthermore, the indifference to the presence of the American

kestrel (*Falco sparverius*) and northern harrier (*Circus hudsonius*) spotted in the overlapping territory in the rural location adds to this theory of cognitive discrimination between possible threats. Currently, it is believed that cognitive ability is not determined by brain size but rather by the abundance of neurons within the pallium. In humans, this structure is known as the cerebral cortex. The birds of the family Corvidae do not possess the same abundance as humans. Still, the quantity is comparable to that of monkeys- which are held to a higher standard of intelligence for non-human animals (Herculano-Houzel 2020). These “bird brains” are just as well developed and functional as our distant primate relatives, allowing for corvids, especially the American crow, to make decisive choices on the execution of behaviors, such as mobbing. These same cognitive abilities enable the bird to discriminate between what is and is not a perceivable threat.

The rural crows not only respond to possible threats but also to possible competitors. A group of rural American crows was observed mobbing a lone common raven (*C. corax*). As discussed in Chapter 1, ravens fill a niche similar to that of the crows in a different ecosystem. They prefer forested areas, whereas crows prefer open areas and edge habitats. The raven was spotted above the edge habitat, exiting from a forested area that extends into the Great Smoky Mountains National Park. Ravens are mutual nest predators to the American crow *and* resource competitors (Gade 2010). It was, however, odd that only one raven was spotted. This could have been an unpaired, young raven actively dispersing and finding their territory.

In Conclusion – Both groups of crows preferred large, open areas for gleaning. Overall, they lived similar lives with slight variances in behavior and interactions with different heterospecifics. In a humanizing way of speaking, the rural crows live a simple

country life where they are exposed to more “wild” animals than their suburban counterparts- much like their rural human neighbors. Conversely, the suburban crows live alongside our common (suburban- and urban-wise) synanthropic species, such as the eastern gray squirrel and American robin.

The American crow has shown that the species can adapt to the ever-changing human world in published literature and this study (Withey and Marzluff 2005, Clucas and Marzluff 2012, Flaspohler 2017, McGowan 2001, Gade 2010, Cornell et al. 2012). Considering these large passerines' cognitive ability and reputation, this is not a surprising revelation. The American crow is both an exemplary generalist and a synanthrope.

Future studies could focus more on the difference between rural and suburban crow approach distances to compare the findings (with more data points) to those found in the literature. Other studies could focus on larger regional differences, such as East versus West coast or Northwest versus Southwest. A possible theme for meta-analysis could be to compare these regional findings with other published studies, considering that most of the literature for this study originates from the Pacific Northwest or more towards the New England region and not the Southeast. The different reactions to different species could be compared between regions as well.

APPENDIX 1: IACUC Form

MARYVILLE COLLEGE INSTITUTIONAL ANIMAL CARE & USE COMMITTEE
Application for Use of Vertebrate Animals in Student Research

Provide information after each bold item

Student Name:

Devin Dittenber

Student Email Address:

devin.dittenber@my.maryvillecollege.edu

Date:

October 16, 2023

Senior Study Advisor:

Dr. Drew Crain

Species to be used:

American Crow

Age of animals:

Variable

Number of animals in study:

n/a

Duration of study:

Oct. 18, 2023 - Dec. 8, 2023; Jan. 10, 2024 - Mar. 1, 2024

Location of animals during the study (building and room):

n/a

List personnel to call if problems with animals develop:

Name	Daytime Phone	Nighttime Phone	Emergency No.
Devin Dittenber	931-801-8897	931-801-8897	
D. Andrew Crain	8238	292-8737	

What will happen to the animals at the end of the study? If euthanasia is required, state the specific methods.

n/a: wild animals

(Do not write below line: For IACUC Use)

Maryville College IACUC Approval Number: 202304

Date Approved: Oct. 18, 2024

Signed:



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