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Using community science data to investigate urban Coyotes (*Canis latrans*) in Atlanta, Georgia, USA

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ABSTRACT
Coyote activity was investigated in Atlanta, Georgia from 2015 to 2018 using publicly collected data. More than 500 reports were received annually (1,672 total) and analysis revealed bias toward areas of higher income and education. Human-coyote encounters, defined as an interaction at close range, were rare (196; 12% of observations), but 124 of those reports (63%) indicated the presence of pets nearby. Coyotes were less likely to be observed in areas of high human population density, farmland, and managed clearing, and more likely to be seen in riparian wetlands and areas of low-density development (e.g., parks, golf courses, large-lot homes). Coyote sightings are now relatively common in Atlanta and their presence is generally benign. However, negative coyote interactions do occur and pets should be kept under close supervision and coyote access to anthropogenic food resources prevented. This study demonstrates the effectiveness of using community science to understand urban coyotes.

KEYWORDS
Canis latrans; coyote; community science; human-coyote conflict; Atlanta

Introduction

Public observations of coyotes (*Canis latrans*) have become increasingly more common in the southeastern U.S. as these animals have immigrated eastward over the past several decades. Historically found west of the Mississippi River, the coyote steadily expanded its geographic range during the past century and it is now found throughout North America living in nearly every major metropolitan area (Hody & Kays, 2018; Poessel, Gese et al., 2017). Human extirpation of congeneric red wolves (*C. rufus*) accelerated the southeastern range expansion of the coyote by eliminating its primary non-human competitor, while deforestation, urbanization, and the resulting increase in edge habitat were also all likely contributors (Gompper, 2002; Parker, 1995; Thurber & Peterson, 1991).

In Georgia, coyotes first appeared in the central portion of the state in the 1960s (Hill et al., 1987; Hody & Kays, 2018; Parker, 1995), and 20 years later they were found statewide (Hody & Kays, 2018). By the late-1990s, coyotes were becoming prevalent in metropolitan Atlanta (C. Mowry & L. Wilson, personal observations) and they are now seen throughout

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the region. A survey of 2,000 Atlanta residents found that more than 80% of respondents reported seeing or hearing a coyote near their home between 2012 and 2014, whereas nearly half perceived an increase in nearby coyote activity during that same three-year period (Hooper, 2016). The increase in coyote observations in Georgia was coincident with the state's pattern of urban development. Georgia's overall urban population increased from 3.4 million people in 1980 to 7.3 million in 2010, and the Atlanta region added more than 660,000 residents between 2010 and 2018 (U.S. Census Bureau, 2018). Concurrently, urban land cover in Georgia increased from 6,880 km^2 to 16,188 km^2, and much of that occurred in metropolitan Atlanta (U.S. Department of Agriculture, 2016). Atlanta was the third fastest growing metropolitan region in the U.S. from 2016 to 2017 (U.S. Census Bureau, 2018).

Public attitudes toward the presence of coyotes typically generate a wide range of responses. For example, 681 Atlanta residents who responded to the aforementioned survey strongly disagreed with the statement "I enjoy seeing coyotes in the area near my home," yet 242 strongly agreed with this statement (Hooper, 2016). Krester et al. (2009) found a similar range of responses toward coyotes when they surveyed people in northern New York State. In Tucson, Arizona, favorable public reaction toward coyotes actually increased from 1992 to 2007, although a consistent 30% of survey respondents viewed coyotes as a nuisance during the same time period (Lawrence & Krausman, 2011). Vaske and Needham (2007) quantified public beliefs about coyotes in the Denver, Colorado metropolitan area and found that 23% of 457 survey respondents viewed lethal coyote management as unacceptable, 42% found it acceptable only when coyotes injured or killed pets, and 35% found it to be an acceptable management strategy. Urbanization has meant that humans and coyotes are now often in close proximity to one another, which has led to much interest and debate about their presence and role in urban ecosystems (Gompper, 2002). Not surprisingly, human conflicts with coyotes, including negative interactions with pets, have been found to be more prevalent in larger urban areas (Poessel, Gese, et al., 2017). More than 50% of Atlanta survey respondents perceived coyotes as a threat to pets (Hooper, 2016).

Public curiosity and concern over a relatively large and charismatic animal such as the coyote provide an opportunity to leverage those emotions toward the collection of useful scientific data. Public Participation in Scientific Research (PPSR), also known as community or citizen science, has become an important tool in ecological research. For example, the Cornell Lab of Ornithology has successfully put PPSR into practice studying birds for many years, with such projects as eBird, Project FeederWatch, and the Great Backyard Bird Count (Bonney et al., 2009). PPSR can be particularly useful when investigating the distribution and abundance of organisms across space and time (Dickinson et al., 2010). It is also a way to learn more about global biodiversity (Bonney et al., 2014; Pocock et al., 2018) and can lead to better natural resource management (McKinley et al., 2017). Coyote ranging patterns, which are typically wide and temporally unpredictable, can be difficult to study without the use of costly and intrusive electronic-tracking devices. Fortunately, the gathering of opportunistic public sightings has been proven effective at overcoming these challenges in previous studies of urban carnivores (Lukasik & Alexander, 2011; Poessel et al., 2013; Quinn, 1995; Walter et al., 2018; Weckel et al., 2010; Wine et al., 2015). In addition, by engaging the community in the collection of data, PPSR can also promote broad public education and potentially mitigate human-wildlife conflict (Dickinson et al., 2012; Larson et al., 2016).

One method used in community science data analysis is to randomly generate non-observation locations in the study area of interest (Wine et al., 2015) and compare those to reported observation locations. However, there is a need to address and adjust for sample selection bias in community science data (Bird et al., 2014; Dickinson et al., 2010; Phillips et al., 2009). For example, what is the probability that an observation of an organism will actually be reported to researchers? Are there socioeconomic factors that would make it more likely that a community member would use an online tool to record an animal observation? Is there a socioeconomic bias toward individuals who are aware of and able to use the technology required to report a community science event? Readily available data on such factors as human population density, household income, and educational attainment can be used to potentially adjust for sampling bias in community science data.

The objective of this study was to gain insight into human-coyote interactions in Atlanta, GA using publicly reported data. Specific research questions included: (a) were there temporal patterns associated with coyote observations, (b) how common was human conflict with coyotes and what form did it take if/when it occurred, (c) were socioeconomic variables related to publicly reported coyote observations, and (d) were coyotes more often observed in certain types of landscape features?

Methods

Study Site

The study site consisted of the Atlanta, Georgia metropolitan area (Figure 1). Located in north-central Georgia, Atlanta sits in the foothills of the Appalachian Mountains at approximately 320 m above sea level. The humid subtropical climate supports mixed hardwood forests and pine dominated communities. National Land Cover data indicates that 45% of the study area is covered by forest, 25% by low-density development, 13% by farmland, 7% by cleared land, 6% by high-density development, and 2% each by open water and wetlands (US Geological Survey, 2011). Atlanta has a population of 5.9 million people and covers an area approximately 22,500 km^2 in size. Average household income is 65,400 USD and 38% of residents hold a Bachelor's degree or higher (U.S. Census Bureau, 2018). However, as with most large cities, there is considerable variation in income and educational attainment.

Online Data Collection

Data were gathered from the general public living in the Atlanta, Georgia area through a web-based platform (http://cs.berry.edu/coyote/report.php) for self-reporting coyote observations. Launched in October 2015, the service was modeled after a similar reporting interface hosted by the Edmonton Urban Coyote Project (http://www.edmontonurbancoyotes.ca/reportsighting.php). A prominent "Report A Coyote Sighting" link was added to the header of the Atlanta Coyote Project website (https://atlantacoyoteproject.org). Public participation was encouraged opportunistically during media interviews, public lectures, social media posts, and through word of mouth.

Only the date, time, and type of observation (sighting/encounter) were required on the reporting form, although additional fields for comments and a return e-mail address were

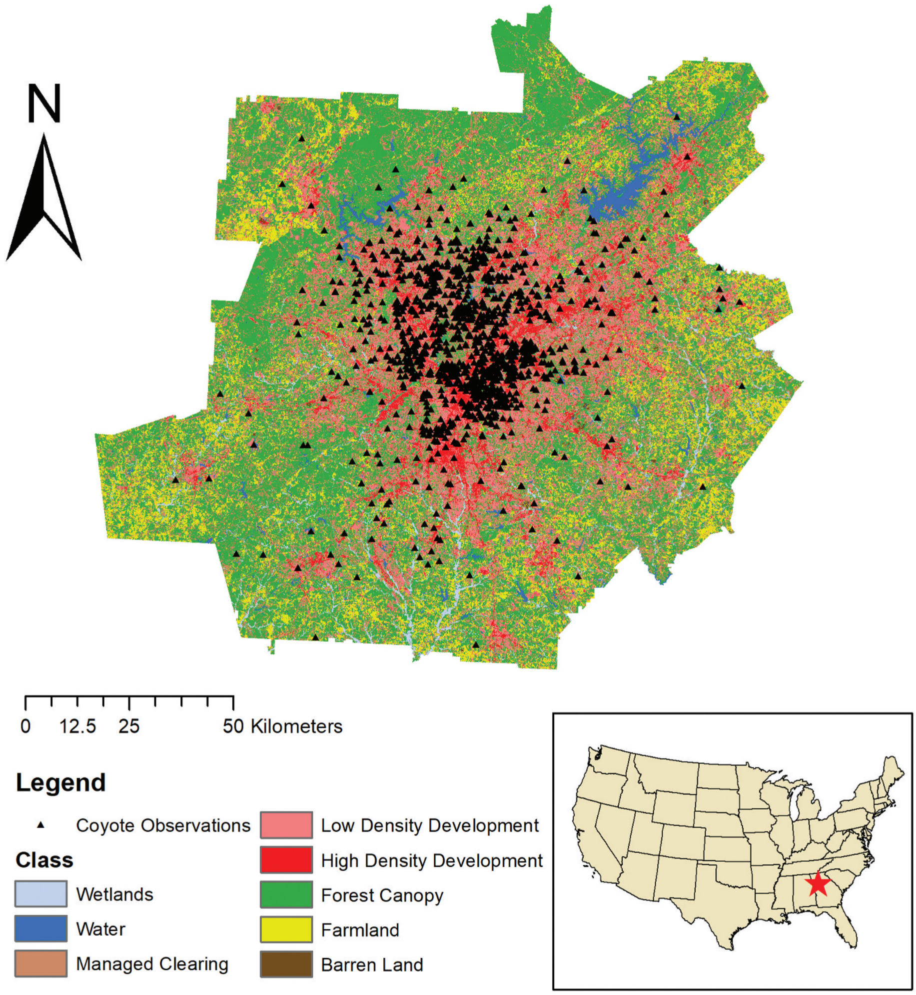

Figure 1. Reported coyote observations from October 2015 through December 2018 in Atlanta, Georgia, U.S.A.

also present. A sighting was defined as a coyote observation at a distance with no interaction, whereas an encounter was defined as an interaction with a coyote at close range. A minimal interface was intentionally adopted to encourage participation. No user registration or login was required, nor was a Completely Automated Public Turing Test to Tell Computers and Humans Apart (CAPTCHA) integrated in the form. Nonetheless, there was minimal spam in collected data. Given that the distinction between a sighting and an encounter was somewhat open to interpretation, some reports were ultimately reclassified based on further review of respondent comments, if available. Upon submission, a unique number was immediately generated for each report and respondents could then reference that number if they had further information to provide (e.g., images of the sighting) by sending an e-mail attachment to info@atlantacoyoteproject.org.

The map on the form allowed respondents to either interactively drag and drop a location marker or to enter a street address and have the marker automatically moved to that location. The map marker was set as a default to a point in the center of Atlanta at the state capital building. Thus, if a user did not actively note the location of their observation, that observation was tagged at that default latitude and longitude point.

The back-end architecture of the software system consisted of a set of web scripts hosted locally on a server at Berry College. The server-side scripts were developed in PHP and recorded data in a MySQL database. A simple facility was provided for site administrators to preview and download a comma-separated values (CSV) spreadsheet with a dump of all available data for separate analysis. Google Maps Platform API was used for enabling mapping and address location functionality. Other than user-provided data, a minimal amount of additional information was collected and recorded from the web server interaction log. The date and time of the user's session initialization (i.e., their first arrival at the reporting page), the date and time of report submission, the IP address, and the browser/device type were all collected, but none of these data were immediately relevant to this study.

The number and type (sighting or encounter) of coyote reports received during each year and month of the study were counted, monthly report averages were calculated, and all observations were sorted by time of day using one-hour increments. Observations were also sorted by type and the encounter reports were further scrutinized when possible based on comments provided by respondents for additional insight (e.g., any mention of pets or domestic animals as part of an aggressive encounter, death or injury to a pet or domestic animal, human attacks).

Coyote Observation Locations

Reported observation locations were mapped in ESRI ArcMap 10.7.1 (Redlands, CA). Land cover data from the 2011 National Land Cover Database were used, although some categories were combined and reclassified (U.S. Geological Survey, 2011; Table 1). At each reported coyote location, a 2 km buffer was drawn to estimate the mean home range size of a resident urban coyote (Gehrt et al., 2009; Way et al., 2002; Wine et al., 2015), and

Table 1. Landcover categories used in the analysis and their corresponding National Land Cover Database values.

Category	Landcover Classes (Values)	Description
Wetlands	Woody Wetlands (90), Emergent Herbaceous Wetlands (95)	>80% vegetation; substrate periodically covered or saturated with water
Water	Open Water (11)	streams, lakes, ponds; <25% vegetation or soil
Forest Canopy	Deciduous Forest (41), Evergreen Forest (42), Mixed Forest (43)	trees >5 m tall; >20% vegetation
Farmland	Pasture/Hay (81), Cultivated Crops (82)	Pasture/crop vegetation >20%; includes active land tilling
Managed Clearing	Grassland/Herbaceous (71), Shrub/Scrub (52)	grasses >80% of total vegetation; shrubs or young trees <5 m tall
Low-Density Development	Developed Open Space (21), Developed Low Intensity (22)	<50% impervious substrate; parks, golf courses, large-lot housing
High-Density Development	Developed Medium Intensity (23), Developed High Intensity (24)	>50% impervious substrate; high density single-family homes, apartments, commercial/industrial sites
Barren Land	Barren Land (31)	<15% vegetation

the total area of each of the reclassified land cover categories within this circle was calculated. Coyote locations were then overlaid onto a map containing 2016 United States Census American Community Survey data and the values for median household income (Median HH), educational attainment (Percent BA, which is the proportion of people with a Bachelor's degree or higher), and population density (Population Density) were extracted (U.S. Census Bureau, 2016). Socioeconomic and population density values were measured at the census track level.

Non-Observation Locations

Non-observation locations were generated using ESRI ArcMap 10.7.1 in areas with similar socioeconomic features as the observation locations. A two-dimensional density of Median HH and Percent BA was measured at each reported location using the kernel density estimate function kde from the R package ks (R Core Team, 2018; U.S. Census Bureau, 2016). A rejection sampling algorithm (acceptance-rejection method) was then used for sampling non-observation locations with an income-education distribution that matched the target Median HH and Percent BA density (Robert & Casella, 2004). The algorithm iterated between the following steps to sample the non-observation locations: (a) a random point/location was selected with uniform probability across the study area, (b) the median HH and Percent BA values associated with this location were obtained (U.S. Census Bureau, 2016), and (c) the location was either accepted as a non-observation point if it had income-education features that agreed with the target density or it was otherwise rejected. These three steps were repeated 15,000 times and generated 1,107 bias-adjusted non-observation locations, which reflected the socioeconomic profile of individuals who were likely to report a coyote observation. Landcover variables for these non-observation locations were calculated in the same way as for reported observation locations.

In an attempt to assess the validity of the bias-adjusted non-observation locations, 1,100 completely random non-observation locations were also generated within the study area. The values of Median HH and Percent BA associated with these locations were extracted (U.S. Census Bureau, 2016) and the densities of Median HH and Percent BA for the actual observation locations are plotted in Figure 2. The matching densities for the random non-observation locations (Figure 2a,c) and the bias-adjusted non-observation locations (Figure 2b,d) were then overlaid on this plot. There was a clear shift toward the right in the distributions of Median HH and Percent BA at observation locations, relative to the random non-observation locations, meaning that reported observations were far more prevalent in areas with higher Median HH and Percent BA. The non-observation locations that adjusted for sampling bias in the socioeconomic variables Median HH and Percent BA provided a far better representation of reported observations compared to randomly generated non-observation locations. Therefore, bias-adjusted non-observation locations were used in all subsequent analyses.

Statistical Analyses

A logistic regression model examined the association between coyote observations and landcover variables (Barren Land, Forest Canopy, Farmland, Managed Clearing, Water, Wetlands, Low-Density Development, High-Density Development) and socioeconomic

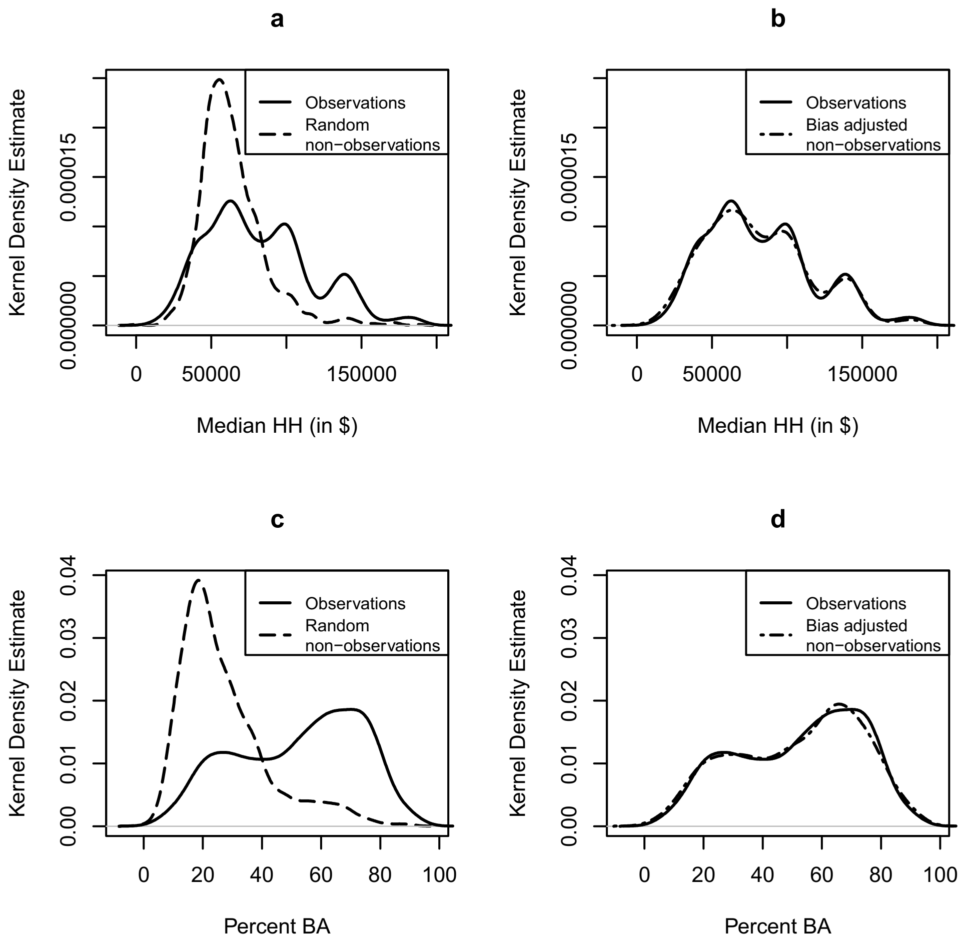

Figure 2. Density plots of the socioeconomic variables household income (Median HH; a and b) and educational attainment (Percent BA; c and d). The densities of Median HH and Percent BA at 1407 reported coyote observation locations in Atlanta, GA (solid lines) were overlaid with corresponding densities for 1100 randomly generated non-observation locations (dashed lines) and 1107 bias-adjusted non-observation locations (dash-dot lines).

variables (Median HH, Percent BA, Population Density). The binary response variable indicated observation and non-observation locations and the landcover and socioeconomic variables were the predictors.

Assessment of the initial logistic model indicated that the variables Barren Land, Water, and Wetlands were highly skewed to the right, and as a result they were log-transformed. Potential collinearity among the predictor variables was tested using the R function vif (variance inflation factor) from package car (Fox & Weisberg, 2019). Forest Canopy, Low-Density Development, and High-Density Development were found to have a high degree of collinearity (vif greater than 10), with a correlation of −0.91 between Forest Canopy and the sum of Low-Density Development and High-Density Development. As a result, Forest Canopy was removed from the analyses. All predictors, including the three log-transformed variables, were mean centered and scaled to have a standard deviation of one.

A Moran's I test from R package APE (Paradis et al., 2004) indicated significant levels of residual spatial autocorrelation, so the model was further adjusted by including an auto-regressive covariate as a predictor. This covariate was calculated as the weighted sum of outcomes within a 5 km radius of each observation and non-observation location. The distance between each pair of location points was calculated based on the Haversine formula using the R package Geosphere (Hijmans, 2017). The final adjusted logistic regression model, therefore, had the following predictors: Median HH, Percent BA, Population Density, logBarren Land, Farmland, Managed Clearing, logWater, logWetlands, Low-Density Development, and High-Density Development, plus the auto-regressive covariate.

Diagnostic plots indicated that model assumptions were well met and that spatial residual autocorrelation was successfully accounted for by the autoregression covariate. The Moran's I test indicated that no significant autocorrelation remained. No influential observations were found based on the Cook's distance (Cook, 1977).

Model selection was used for determining the subset of predictors that would most accurately predict coyote encounters. Starting with the null model, one variable at a time was added using the R function step based on minimizing the Akaike Information Criterion (AIC) (James et al., 2013). This forward selection algorithm resulted in a set of p submodels, where p was the total number of predictors considered. Ten-fold cross validation on each model was used for calculating the out-of-sample prediction error and area under the curve (AUC). The submodel with the lowest prediction error and the highest AUC was selected as the optimal model.

Results

A total of 1,672 coyote observations (44 with images) were reported between October 2015 and December 2018. Forty-four reports were received in 2015, 472 in 2016, 597 in 2017, and 559 in 2018. Geolocation information was lacking for 265 observations, so they were excluded from the socioeconomic and landcover dataset, although they were included in all other analyses. The vast majority of reports (96%) included additional comments provided by respondents. Coyotes were observed in all years and months of the study and at all times of day. The highest monthly report averages occurred in November (54), December (49), and January (56), whereas the lowest averages were in April (32), August (30), and September (23) (Figure 3). There were particular peak times of observations, including 05:00, 10:00, 15:00, 18:00, 22:00 hours (Figure 4).

Sightings of coyotes were much more common than encounters (88% vs. 12%). Of the 196 reported encounters, 124 (63%) included comments that pets or other domestic animals were nearby at the time, and 33 of those encounters resulted in the death or injury of a pet cat or dog. The remaining 72 reported encounters made no mention of the presence or absence of pets, although the form did not specifically ask for that information. Only three encounters consisting of direct human contact with coyotes were reported and each involved confirmed cases of a coyote infected with the Eastern Raccoon (*Procyon lotor*) variant of the rabies virus (A. Feldpausch, GA Dept. of Public Health, personal communication). Two of those encounters were perpetrated by the same coyote at the same location within a 24-h span, and that coyote was killed shortly after the second encounter. The third human encounter occurred 7 months later, but less than 5 km away from the

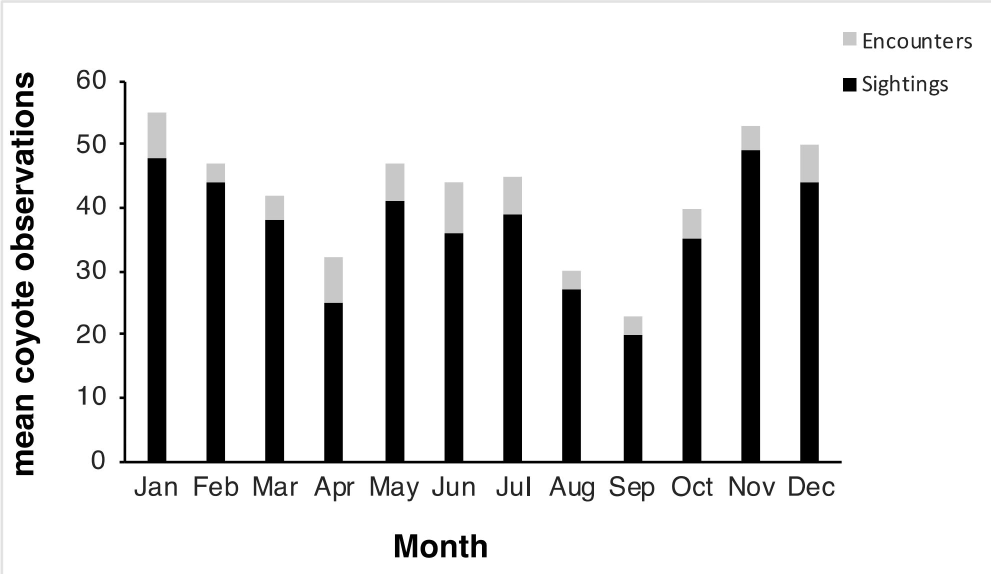

Figure 3. Average number of monthly reported coyote observations from October 2015 through December 2018 in Atlanta, Georgia, USA.

previous encounters. Each of these encounters involving humans occurred during daylight hours.

Reported observations were more commonly received from regions of higher household income and educational attainment (Figure 2) and they were significantly more likely to occur in woody/emergent herbaceous wetlands and riparian zones (logWetlands; p = .003) or in areas with <50% impervious substrate, including parks, golf courses, and large-lot neighborhoods (Low-Density Development; p < .001). Conversely, observations were significantly less likely to occur in pasture and crop lands (Farmland; p < .001), in grasslands with shrubs and young trees < 5 m tall (Managed Clearing; p < .001), as well as in areas with high human population density (Population Density; p < .001; Table 2).

The model selection procedure selected the following subset of statistically significant predictors: PopulationDensity, FarmLand, ManagedClearing, autoregression, DevelopedOpenLow, and logWetlands. This subset resulted in optimal out-of-sample (cross-validated) performance in predicting coyote observations with a minimum prediction error of 0.17 and a maximum AUC of 0.82. Fitting the logistic regression model to this subset of predictors yielded effect estimates and p-values matching those reported in Table 2 very closely.

Discussion

Public observations of coyotes in Atlanta, Georgia are now commonplace, with reports coming into the Atlanta Coyote Project website on a nearly daily basis. A sharp increase in the number of reports from 2015 to 2016 was simply due to the fact that data collection only occurred during the last three months of 2015, whereas the increased number of annual reports from 2016 to 2017 and 2018 was likely attributable to a higher level of

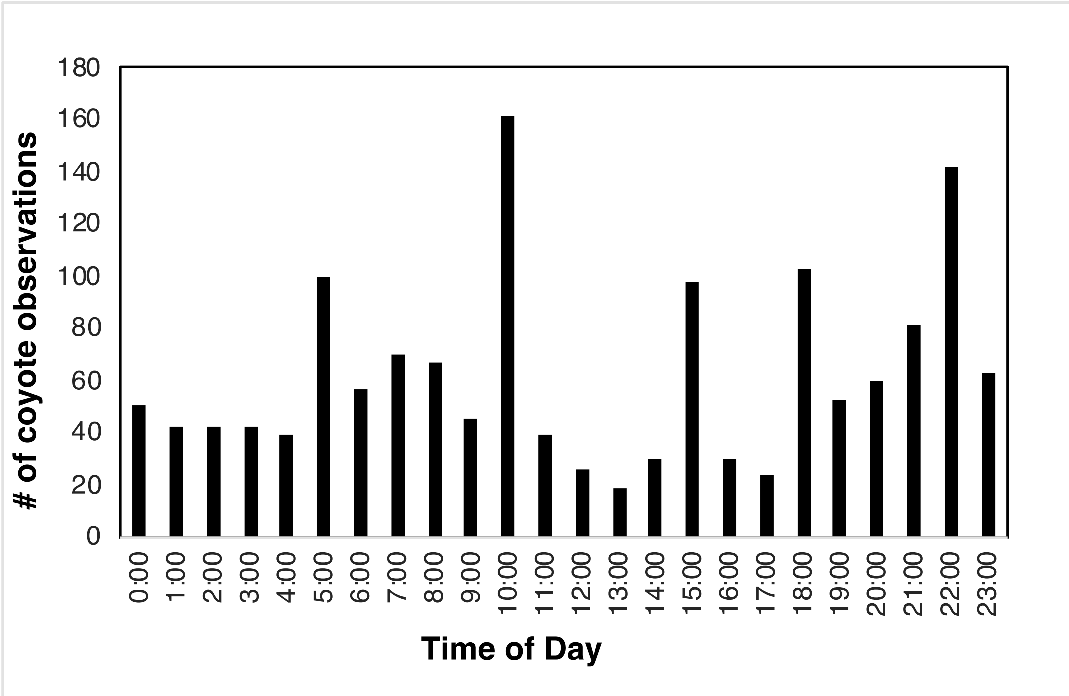

Figure 4. Total number of reported coyote observations based on time of day from October 2015 through December 2018 in Atlanta, Georgia, USA.

Table 2. Logistic regression model for reported coyote observations and bias-adjusted non-observations. All predictors were mean centered and scaled to have a standard deviation of 1. (AIC = Akaike Information Criterion).

Coefficients	Estimate	Std. Error	z value	p value
(Intercept)	0.143	0.052	2.766	.006
Median HH	−0.086	0.086	−0.999	.318
Percent BA	0.022	0.083	0.266	.790
Population Density	−0.386	0.067	−5.763	.000
logBarren Land	−0.088	0.056	−1.581	.114
Farmland	−0.380	0.102	−3.724	.000
Managed Clearing	−0.603	0.126	−4.778	.000
logWater	0.012	0.056	0.209	.835
autoregressionH5	0.716	0.056	12.849	.000
Low-Density Development	0.373	0.103	3.621	.000
High-Density Development	0.070	0.067	1.057	.290
logWetlands	0.163	0.055	2.974	.003
AIC: 2606.1				

public awareness of the Atlanta Coyote Project's "Report A Coyote Sighting" website. The majority (88%) of reports received were benign sightings of coyotes, whereas human conflicts with coyotes (e.g., agonistic encounters) during the 39-month study were proportionally low and typically involved the presence of pets when they did occur. Direct human encounters with coyotes were extremely rare (0.2%) and were associated with two rabid coyotes. This low level of conflict is quite similar in proportion to that seen in other urban coyote studies (Gehrt et al., 2009; Lukasik & Alexander, 2011; Poessel et al., 2013).

Although coyote pup-rearing season has typically been classified as occurring from May to August (Morey et al., 2007), the appearance of pups is consistently seen in Georgia by the middle of March (C. Mowry & L. Wilson, personal observations). As a result, the lower number of reports received throughout this study each April was likely due to the fact that adult female coyotes were in dens nursing pups at that time of year and therefore less visible. Fewer reports were also received during the months of August and September, which was likely a temperature-related effect. These are typically the hottest months of the year in Georgia (National Weather Service, 2019) and a time during this study when both coyote and human outdoor activity was lower as a result.

The central role that pets play in coyote conflict has been well established (Gehrt & Riley, 2010; Lukasik & Alexander, 2011; Poessel et al., 2013) and this study is no exception. The majority (63%) of reported encounters mentioned cats or dogs in some form, and of the 196 reported encounters received, 90 (46%) occurred between March and July, which is when coyote pup-rearing season is considered to occur in Georgia (Mowry & Wilson, 2019). However, caution should be exercised in drawing strong conclusions on temporal or other associations between aggressive coyote encounters and pets in Atlanta. These encounters happened throughout the year, not just during pup-rearing season, and the specific circumstances surrounding each encounter were important to fully understand the situation. For example, one of the few encounters that resulted in the death of a dog occurred in March 2016 (i.e., during pup-rearing season) in close proximity to an active coyote den. There is little doubt that the coyotes were protecting their newly born pups and killed the dog in defense, but other attacks on dogs and cats, although rare, occurred in both the coyote breeding and dispersal seasons. Not surprisingly, a number of encounter reports inferred the presence of outdoor food sources (e.g., cat food). The unpredictability of aggressive coyote encounters was further illustrated by several reports of coyotes and dogs actually playing together. Similarly, a landscape analysis of encounters alone produced the same results as the combined dataset (i.e., sightings and encounters). In other words, coyote observations in general were associated with herbaceous wetlands, riparian zones, and low-density development, but there was no further association specifically between encounters and landscape type.

Reported coyote observations were more prevalent from regions of Atlanta that have annual household incomes of 50,000 USD – 150,000 USD (Median HH) and higher levels of education (Percent BA). Other recent studies of urban canids have found similar significant predictive value in socioeconomic variables (e.g., Magle et al., 2016; Walter et al., 2018; Wine et al., 2015). However, the Atlanta results must be interpreted with caution and they do not necessarily provide evidence that coyotes were actually selecting for areas associated with relative human affluence and education. When bias-adjusted non-observation locations were incorporated into the overall analysis, the influence of human income and education level was insignificant in predicting coyote locations. It could be that people living in these areas were more inclined or able to report an observation and the results simply reflect regions within the metro Atlanta area where individuals who were likely to report coyote observations more commonly resided. Ecological studies aimed at species distributions and presence-absence data, particularly those that involve community science datasets, can be vulnerable to spatial bias and should be adjusted accordingly (Bird et al., 2014; Parsons et al., 2009; Phillips et al., 2009; Phillips & Elith, 2013). Results also indicated that, within regions with higher income and education levels, coyotes were avoiding densely populated areas. These findings dispel the assumption that coyote observations might more commonly come from densely populated areas because there would be more humans to see them. This was not the case and there was also no positive association between coyote observations and more highly developed areas (High-Density Development) where human population density would likely be highest.

The more common observation of metro Atlanta coyotes in wetlands, riparian zones, golf courses, parks, and low-density neighborhoods (i.e., Low-Density Development landscapes) and their avoidance of highly developed and high human population areas is consistent with patterns seen in other studies of urban coyotes, including in Chicago (Gehrt et al., 2009; Magle et al., 2016), Detroit (Dodge & Kashian, 2013), Rhode Island (Mitchell et al., 2015), Denver (Poessel et al., 2016; Poessel, Mock, et al., 2017), New York (Weckel et al., 2010), Tucson (Grubbs & Krausman, 2009), Charlotte (Wine et al., 2015), and Calgary (Lukasik & Alexander, 2011). Use of these types of landscapes within the urban matrix of metropolitan Atlanta can ostensibly allow coyotes to maintain a diet of natural food items, as has been seen in other urban settings such as Chicago, Denver, urban western Washington, and Calgary in Alberta (Gehrt et al., 2009; Gese et al., 2012; Lukasik & Alexander, 2012; Poessel, Mock et al., 2017; Quinn, 1997).

The messages that the Atlanta Coyote Project has been providing to the public over the past several years include: (a) coyotes are now common in Atlanta, (b) the vast majority of observations across the city are without incident, (c) the chances of a human being attacked by a coyote are extremely low, and (d) nevertheless, coyotes are wild animals that should be treated with caution, particularly when pets are present. Results of this study provide quantitative data to substantiate these statements, while also giving further insight into socioeconomic and landscape features most commonly associated with coyote observations. The continued collection of observational data can dispel misinformation and misconceptions about coyotes, and provide wildlife managers with targeted sites for the dissemination of public information. For example, people living in low-density development areas and/or riparian corridors, which collectively comprise nearly 30% of the Atlanta landscape, should expect to see coyotes and learn how best to coexist with this species. This would include keeping pets under close supervision and limiting coyote access to food sources. Ongoing data collection can also potentially identify areas that might exhibit higher incidences of human conflicts with coyotes and community science is an effective tool for obtaining these data. Furthermore, this approach promotes community members as stakeholders in urban wildlife and can lead to informed decisions about wildlife management. However, efforts must be taken to ensure equal socioeconomic participation, access, and involvement.

Coyotes are now partially serving the role of apex predators in the southeastern U.S. and their presence can promote biodiversity and lead to healthy ecosystems (Mowry & Wilson, 2019). It is hoped that this study will provide the public with a realistic view of the urban coyote population in Atlanta, Georgia and an understanding that coexistence is the best management strategy.

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