Being Coyote-Smart: Developing a Rapid Assessment Protocol to Aid Coyote (*Canis latrans*) Management in NYC

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Abstract

We developed a pilot coyote (*Canis latrans*) rapid assessment protocol (Coy-RAP) to quickly survey various public parks in the Bronx, NY for potential human-coyote conflict. We collected data on factors that could be attractants to coyotes (food, garbage, natural cover, and water) and human use of the area. The Coy-RAP showed that it can be an effective tool for wildlife managers to quickly identify priority sites for coyote management measures including education. This system allows a more efficient use of limited resources and staff to reduce the potential for human-coyote conflict in NYC. A map of priority sites for increased coyote management measures was created through ArcGIS. Finally, we proposed management solutions to mitigate human-coyote conflict in NYC. For example, we proposed eliminating intentional or unintentional coyote feeding in human environments as an important safety step for coyote management. It is important that New Yorkers become more proactive and educated about living with coyotes to increase public safety and promote a better understanding of how to coexist with wildlife.

Introduction

Coyote (*Canis latrans*) populations in North America have expanded their range and habitat over the last 50 years despite persistent efforts to kill them. Along their way, coyotes in the eastern U.S. have hybridized the gray wolf (*Canis lupus*), eastern wolf (*Canis lycaon*) and domestic dog (*Canis lupus familiaris*, Monzón et al. 2014). Fast forward to today and coyotes are full-time residents in urban environments (Gehrt 2006) like New York City (Nagy et al 2016).

Research across the U.S. has found that this trend has become more and more widespread, as coyotes are now found living in or around parks in urban and suburban areas where they scavenge for food, build dens, and breed. Many notable research studies have shown that their home ranges and movement patterns have become increasingly complex, with territories of packs average about three square miles, and solitary coyote home ranges averaging up to twenty-five square miles (Gehrt 2007). This was an adaptation they had to make in order to acclimate to the new and still-changing urban environments.

Continued research into the behavior and ecology of urban coyotes NYC is integral to the safety of the public and coyotes. Recognizing a clear need to develop wildlife management plans to mitigate the risk of human-coyote conflicts (Toomey et al 2012), we developed and tested a rapid assessment protocol (Coy-RAP) that identifies priority sites to implement preventative management measures. We used camera trapping and telemetry data collected by the Gotham Coyote Project to identify parks in the Bronx, NY that contained resident coyotes. Then we surveyed sites using the Coy-RAP in order to determine the potential risk of human-coyote conflict.
The rapid assessment data we collected could be an extremely helpful tool for wildlife managers to (1) prevent human-coyote conflict and (2) identify priority sites for management and education efforts. Our goal is to help create a coyote-smart NYC through a better understanding of coyote and human behavior.

Methods

We performed rapid assessments of site conditions in parks and natural areas where there are known resident coyotes (Nagy et al. 2016) within the Bronx, NY. The ongoing presence of coyotes was also verified by camera trapping data collected by the Gotham Coyote Project. The coyote rapid assessment protocol (Coy-RAP) was developed from similar rapid assessment protocols developed by the Natural Resource Group of the New York City Department of Parks and Recreation.

We collected information about potential physical, natural and human-made features in the site that may be attractants for coyotes and increase the risk of human-coyote conflict. Sites within each park were identified by through satellite imagery obtained from Google Earth. Preliminary boundaries for the site unit was drawn on a map before field visits. During the field visit, we collected data for both buffer and field conditions.

In buffer conditions, we collected the following information:
Land use patterns (% residential, commercial, parks, roads)
Natural features (% woodlands, grasslands, wetlands, sources of freshwater)
Presence of garbage or human sources of food (litter, cat food, etc.)

In site conditions, we collected the following information:
Land use patterns (% residential, commercial, parks, roads)
Natural features (% woodlands, wetlands, grasslands, sources of freshwater)
Vegetation (% canopy cover, shrub layer, grass/herb layer, dirt/mud)
Presence of garbage or human sources of food (litter, cat food, etc.)
% cover at eye level (i.e., how easily can a coyote hide in this environment?)
Fauna observed

In addition, we briefly interviewed park visitors and NYC Department of Recreation staff members to obtain additional information about coyote behavior.

We gave each of our parameters a "risk score" that indicated its potential to increase negative interactions between coyotes and humans. Risk score parameters ranged from 1-10 (1=low risk, 10=high risk). Certain parameters like open sources of food were given high risk scores.
Risk scores were also higher depending on the likelihood of humans to be present. For example, the presence of apartment buildings was scored higher than the presence of single or dual family homes. Natural areas (woodlands, wetlands, grasslands) had lower risk scores because humans were less likely to visit those areas than well-manicured parks.

Risk scores were generated for each site assessed by the Coy-RAP. The scores of each site were color-coded and displayed on a map generated with ArcGIS.

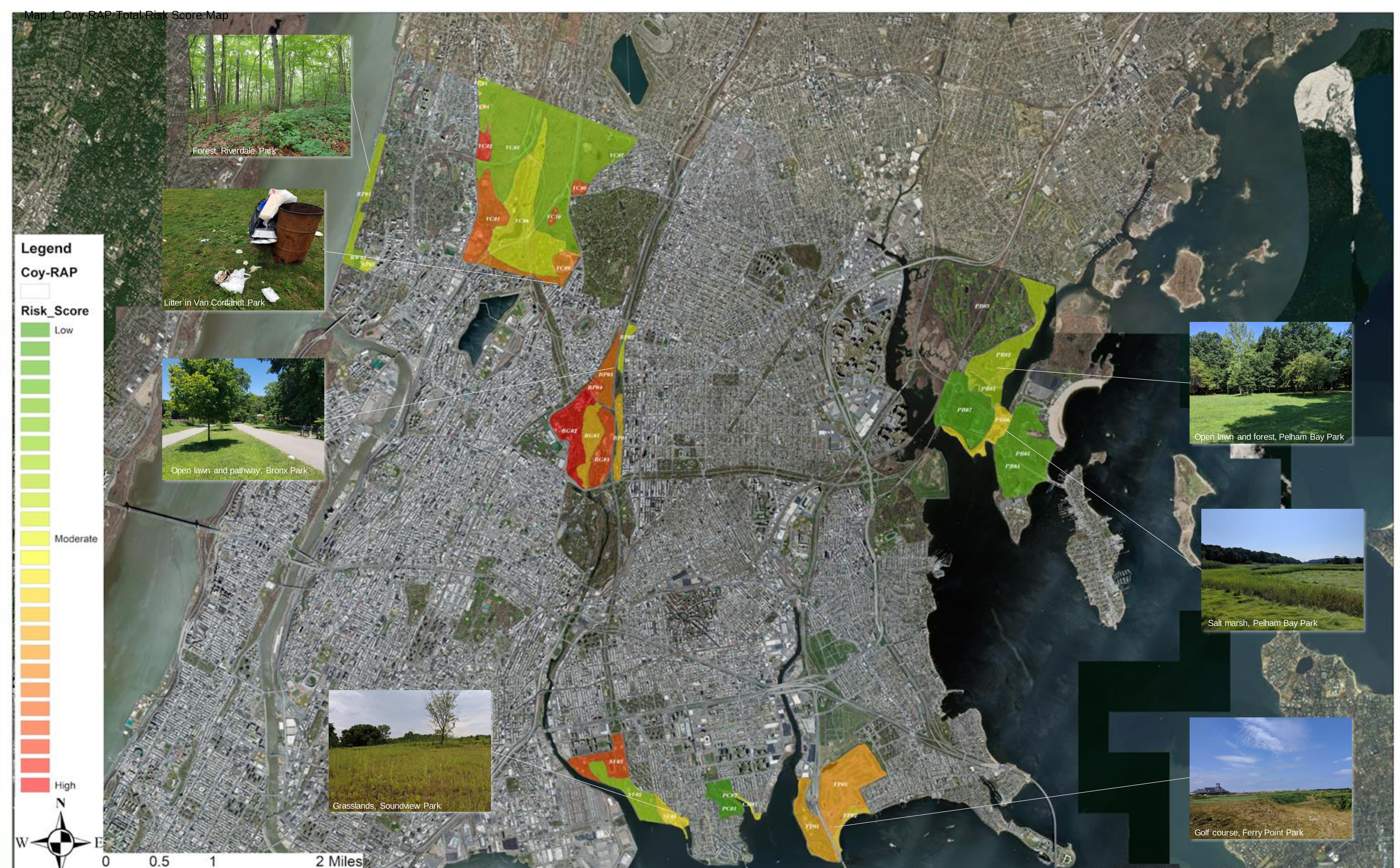
Results

We visited 11 different parks and assessed 36 sites (Table 1). Site conditions included well-manicured parks (both active and passive recreation), golf courses, saltwater marshes, grasslands and woodlands.

Overall, Coy-RAP predicted that larger tracts of more wooded areas (PB05, PB07, PC01, VC03; Table 1) had lower overall risk scores in general. Open well-manicured parks (both passive and active recreation) that were adjacent to large natural areas scored the highest risk (BP04, SV03, BG02, VC02; Table 1).

Only three sites (8.3%, 3 out of 36) had covered garbage containers effective at keeping out coyotes. 30.6% of sites (11 of 36) contained large amounts of human-sourced food waste found on the ground.

The resulting map of overall risk score indicates areas that could potentially be at higher risk for human-coyote conflict (Map 1).



Map 1. Coy-RAP Total Risk Score Map

Table 1. Coy-RAP Risk score table with total risk score.

BUFFER CONDITIONS

Site ID	Date	Residential: single/dual family	Residential: apartment complex	Commercial: retail, public facilities, institutions	Commercial: parking lot	Commercial: industrial, utilities	Open space-passive: managed lawn	Open space-passive: garden	Open space-recreational: athletic fields/courts	Open space-recreational: golf course	Open space-recreational: playground	Open space-natural: woodlands	Open space-natural: grasslands	Open space-natural: wetlands	Freshwater: stream/creek	Freshwater: river	Freshwater: pond/lake	Freshwater: pool	Freshwater: fountain	Roads/railroads: dirt/gravel	Roads/railroads: 2-laned paved	Roads/railroads: 4-laned paved	Roads/railroads: 6+ laned paved	Roads/railroads: railroad
VC01	7/1/2019	2	7	3	1	0	3	3	2	3	0	1	0	0	0	0	1	0	0	0	2	2	0	0
VC02	7/1/2019	2	5	3	0	0	3	3	2	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0
VC03	7/1/2019	4	7	3	1	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0
VC04	7/1/2019	2	7	3	1	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0
VC05	7/1/2019	0	7	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
VC06	7/1/2019	0	3	0	0	0	3	0	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
VC07	7/1/2019	4	0	3	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	2	2	0	0
VC08	7/8/2019	4	3	3	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0
VC09	7/8/2019	0	5	3	0	4	0	0	0	3	0	1	0	0	0	0	0	0	0	0	2	2	0	2
VC10	7/8/2019	0	0	0	0	0	0	0	0	3	0	7	0	0	0	0	0	0	0	0	0	0	3	0
SP01	7/8/2019	2	5	3	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	2	2	0	0
RP01	7/8/2019	4	3	3	1	0	3	0	2	0	1	1	0	0	1	2	0	0	0	0	2	0	0	2
RW01	7/8/2019	2	3	0	0	0	3	0	2	0	1	7	0	0	0	0	0	0	0	0	4	0	0	0
BG01	7/15/2019	0	0	5	1	0	5	5	0	0	0	1	0	1	0	1	1	0	1	0	0	2	0	0
BG02	7/15/2019	0	3	5	3	0	3	0	2	0	1	5	0	1	0	1	0	0	0	0	2	4	0	2
BG03	7/15/2019	0	0	0	0	0	5	3	2	0	1	3	0	1	0	1	0	0	0	0	2	2	3	0
BP01	7/15/2019	0	0	3	0	0	3	0	2	0	0	1	0	0	0	0	0	0	0	0	2	2	0	0
BP02	7/15/2019	2	5	3	1	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	2	2	0	0
BP03	7/15/2019	2	5	3	1	0	3	3	2	0	1	1	0	0	0	0	0	0	0	0	0	2	0	2
BP04	7/15/2019	0	5	3	1	0	0	0	0	0	0	5	0	1	0	1	0	0	0	0	2	2	0	0
CH01	7/22/19	6	0	3	0	0	3	3	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0
PC01	7/22/19	4	0	3	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	2	2	0	0
PC02	7/22/19	0	0	3	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
SV01	7/22/19	6	0	3	0	0	0	0	2	0	0	1	1	1	0	2	0	0	0	0	2	2	0	0
SV02	7/22/19	2	0	0	0	0	3	0	2	0	0	3	0	0	0	1	0	0	0	0	2	2	0	0
SV03	7/22/19	2	5	3	1	0	3	0	0	0	0	3	3	1	0	1	0	0	0	1	2	2	0	0
FP01	7/22/19	0	0	3	1	0	3	0	0	3	0	0	1	0	0	2	0	0	0	0	2	0	0	0
FP02	7/22/19	2	3	3	1	0	3	3	0	3	0	1	1	1	0	0	0	0	0	0	2	0	0	0
FP03	7/22/19	2	3	3	1	0	3	0	0	0	0	1	0	0	0	1	0	0	0	0	2	2	0	0
PB01	7/29/2019	0	0	0	1	0	0	0	0	0	0	5	0	0	1	0	0	0	0	0	2	2	0	0
PB02	7/29/2019	2	0	0	1	0	5	0	0	5	0	1	1	1	2	0	0	0	0	0	2	0	0	0
PB03	7/29/2019	2	0	0	0	0	0	0	0	0	0	3	0	1	1	0	0	0	0	0	2	2	0	0
PB04	7/29/2019	0	0	0	1	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	2	2	0	0
PB05	7/29/2019	0	0	0	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	2	2	0	0
PB06	7/29/2019	0	0	0	1	0	3	0	0	3	0	3	1	3	0	0	0	0	0	0	2	2	0	0
PB07	7/29/2019	0	0	0	1	0	3	0	0	0	0	3	1	3	1	0	0	0	0	0	2	2	0	0

SITE CONDITIONS

Site ID	Residential: single/dual family	Residential: apartment complex	Commercial: retail, public facilities, institutions	Commercial: parking lot	Commercial: industrial, utilities	Open space-passive: managed lawn	Open space-passive: garden	Open space-recreational: athletic fields/courts	Open space-recreational: golf course	Open space-recreational: playground	Open space-natural: woodlands	Open space-natural: grasslands	Open space-natural: wetlands	Freshwater: stream/creek	Freshwater: river	Freshwater: pond/lake	Freshwater: pool	Freshwater: fountain	Roads/railroads: dirt/gravel	Roads/railroads: 2-laned paved	Roads/railroads: 4-laned paved	Roads/railroads: 6+ laned paved	Roads/railroads: railroad	Site vegetation: % Canopy cover	Site vegetation: % shrub layer	Site vegetation: % herb/grass layer	Site vegetation: % asphalt/impermeable surface	Human-related food: garbage co0tai0ers	Human-related food: closed?	Human-related food: litter	Human-related food: i0te0tio0al feedi0g	Cover at eye level: % Cover	Area	Total Risk Score
VC01	0	0	0	0	0	2	2	6	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	7	0	1	1	1	2	0	0	4	6	64
VC02	0	0	4	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	8	5	1	1	2	0	0	2	10	71
VC03	0	0	2	0	0	0	0	0	0	0	1	0	7	6	0	0	0	0	0	0	0	0	0	1	4	0	0	0	2	0	0	1	1	48
VC04	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	1	0	1	2	0	0	6	10	58
VC05	0	0	0	0	0	4	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	7	8	0	0	1	2	0	0	4	10	55
VC06	0	0	2	2	0	2	0	8	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	5	8	3	0	1	2	0	0	4	1	54
VC07	0	0	0	0	0	0	0	8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	1	2	0	0	2	10	46
VC08	0	0	0	0	0	2	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8	1	1	1	2	0	0	4	10	66
VC09	0	0	0	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	3	1	1	2	3	0	2	8	62
VC10	0	0	0	0	0	2	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8	5	3	1	2	3	0	4	10	64
SP01	0	0	0	0	0	4	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	1	2	1	2	0	0	4	10	54
RP01	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	5	1	0	2	0	0	2	8	50
RW01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	2	3	0	1	10	43
BG01	0	0	0	0	0	0	0	0	0	0	1	0	0	0	6	0	0	0	0	2	2	0	0	1	4	7	1	0	2	0	0	1	8	58
BG02	0	0	4	2	0	6	2	0	0	0	0	0	0	0	0	6	0	0	0	2	0	0	0	5	6	1	2	1	0	0	0	2	6	77
BG03	0	0	2	2	0	8	4	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	8	1	1	1	0	0	0	2	8	66
BP01	0	0	0	0	0	6	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8	3	1	1	2	0	0	2	10	58
BP02	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	3	1	1	2	3	0	4	10	54
BP03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	3	6	5	1	1	2	3	0	1	10	63
BP04	0	0	2	0	0	4	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8	1	1	1	2	3	0	4	10	70
CH01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	6	3	1	0	2	3	0	4	10	55
PC01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	1	0	2	0	0	1	10	34
PC02	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	4	5	1	0	2	0	0	4	10	40
SV01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	7	0	3	2	1	2	3	0	2	10	56
SV02	0	0	2	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	6	5	1	0	2	0	0	2	8	49
SV03	0	0	2	0	0	4	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	5	6	1	1	1	2	3	0	2	8	66
FP01	0	0	0	0	0	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	8	1	1	1	2	3	0	4	8	60
FP02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	5	0	0	2	0	0	6	10	57
FP03	0	0	0	0	2	2	2	0	9	0	0	0	0	0	0	6	0	0	0	2	0	0	0	0	8	1	1	0	2	0	0	4	4	61
PB01	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	7	8	1	0	0	2	0	0	6	10	50
PB02	0	0	2	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	4	5	1	0	2	0	0	2	6	51
PB03	0	0	2	0	0	8	0	0	9	0	0	0	0	0	0	0	0	0	1	2	0	0	0	5	0	1	1	1	0	0	0	2	1	44
PB04	0	0	0	0	0	8	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	3	0	6	10	52
PB05	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	3	4	5	1	0	2	0	0	2	2	36
PB06	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	7	4	7	0	0	2	0	0	6	8	56
PB07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	7	0	0	2	0	0	1	4	35

Discussion

This was a pilot study to determine if the Coy-RAP could be a useful tool to help wildlife managers to rapidly identify sites for prioritizing coyote education and management. It is important to note that the risk scores predicted by the Coy-RAP are not an indication of how likely a person will have a negative encounter with a coyote. It is to be used as a tool to identify potential "hotspots" for focused coyote management and public education. We developed the Coy-RAP with an understanding of coyote ecology, behavior, and the factors that increase the risk for human-coyote conflict (Gehrt 2007).

By visiting public parks on Mondays in July-August 2019, we were able to observe the garbage and litter left behind by park users over the weekend. Several sites we visited were used for picnicking and open grilling. Intentional or unintentional feeding of coyotes can often attract coyotes and result in conflict in urban areas (Gehrt 2007, Grant et al. 2011, Lawrence and Krausman 2011). Only 8.3% of the sites had covered garbage containers) showing that even simple and relatively inexpensive measures could be implemented at a larger scale.

As shown on the map (Figure 1), we found that the lowest risk scores were associated with large, relatively intact natural areas like woodlands and grasslands. However, the highest risk scores occurred in the heavily used (by humans) and well-manicured sites adjacent to large tracts of natural areas. These sites were used for both active and passive recreation and essentially created a green buffer area between the deeper forest and more urban environments. The presence of nearby roads also increased risks through vehicle collisions.

The natural areas were relatively safe habitats for coyotes where they could largely go undetected because of high vegetative cover and relatively fewer human visitors. However, well-manicured open lawns used for passive or active recreation and adjacent to natural areas were heavily used by humans and often contained open garbage or food-related litter that could attract coyotes. The higher risk score is a result of their smaller size, relative proximity to residential neighborhoods, increased use by humans, amount of garbage and litter, and the lack of natural cover where coyotes can find safety away from humans. These factors increase the risk for human-coyote encounters. Notable examples include athletic fields or playgrounds. Grant et al. (2011) noted that small children are at a higher risk of attack than adults.

Food-related garbage and litter act as attractants to coyotes. Intentional or unintentional feeding of coyotes may lead to coyotes associating humans with food or habituating to human environments. Food may also attract rodents which

Although this is the first iteration of the Coy-RAP and it will need more testing and refinement, our pilot study indicates that it can be an effective tool to help wildlife managers to quickly identify priority sites for coyote management measures. Since living with coyotes is a relatively new phenomenon for New Yorkers, it would be wise to be proactive and implement protocols to prevent human-coyote conflicts. Sites with higher risk scores should consider management to keep park users and wildlife safe.

Management Recommendations

1. Do not feed coyotes. Elimination of wildlife feeding is the most effective way to prevent coyote attacks. Even bird feeding can attract rodents which, in turn, attract coyotes. Coyotes may lose their fear of humans by associating humans with food or habituating to human environments. Parks should provide wildlife-proof garbage containers and park staff should prioritize efficient removal of garbage immediately after summer weekends in areas for popular picnics and grilling.
2. Keep pets on-leash.
3. Fencing may help. Fencing at least 6 ft high with a roll bar across the top can be used to enclose small areas (e.g., playgrounds) or create a physical barrier at along some boundaries of natural areas (e.g., next to picnic areas, pathways, playgrounds).
4. Habitat modification. Woodland edges with lush or overgrown vegetation (tall grass, woody shrubs and vines) provide cover for prey and coyotes such that people may not see nearby coyotes. Regularly maintaining a wide mowed buffer zone along pathways adjacent to natural areas can be used as a preventative measure.
5. Education programs. Education may be in the form of signs, public presentations, workshops, social media, websites, videos, and direct communication by park staff or volunteers.
6. Report aggressive, fearless coyotes immediately to appropriate officials.

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