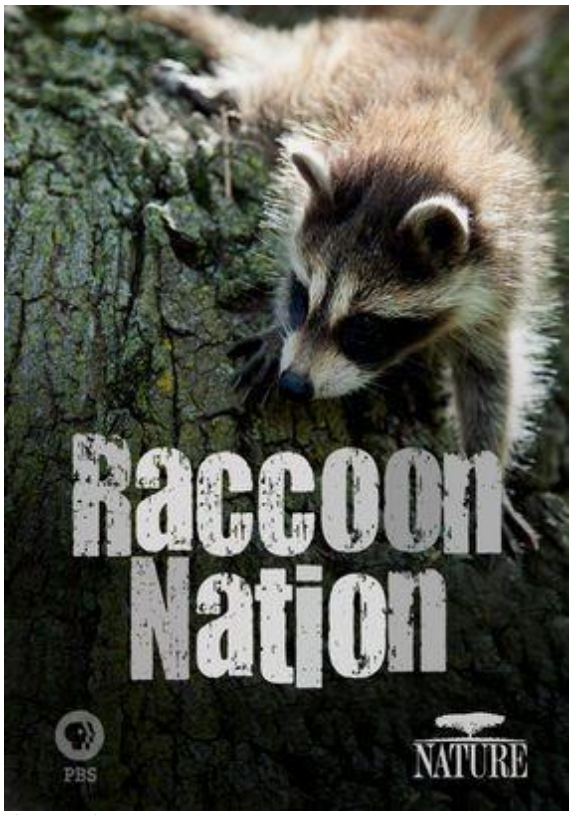

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RACCOONS' INTRUSION INTO URBAN DWELLINGS

GIS application on urban wildlife study

ABSTRACT

Raccoons invade urban life of human through anywhere they could fit. A spatial analysis of how they enter the houses may be helpful to investigate their movements and improve wildlife control practices.

Xiaotian Wang
ENVS 4520

Introduction

The history of raccoons entering urban life of human can go back to the beginning of the 20th century (Lariviere, 2004; Bateman & Fleming, 2012). While some people see this animals as rewarding wilderness encounter, others may considers them as threatening safety concerns. (Clark, 1994) Indeed, the discussion around these highly adaptive creatures living in the cities has been going on for decades. A study in Texas, US shows that since 1980s, raccoons have been recognized as the second largest cause of complaints regarding human-wildlife conflict, after rats and mice (Chamberlain et al., 1981). Raccoons are rabies-vector mammals, and also carry at least 13 other pathogens which are potential threats to human's health (Lotze & Anderson, 1979; Wolch, 1995; Bateman & Fleming, 2012). Furthermore, there are evidences showing that driving by anthropogenic food sources and shelter, raccoons not only wander in the yards and raid garbage cans, but also settle down in houses as their den sites (Bateman & Fleming, 2012; Prange et al., 2003). They invaded through anywhere they could fit, such as roofs, chimneys, vents and even underneath the porches (Wolch et al., 1995; Clark, 1994). The facts that raccoons carry diseases around and cause destruction to the buildings brought urban residents to professional wildlife management organizations for help.

On the other hand, the encounter of raccoons to urban people seems unavoidable. Raccoons living in the urban cities are considered to have better physical conditions and therefore higher survival rates, compared to their rural neighbours (Prange et al., 2003; Bateman & Fleming, 2012). Their major predators in the cities are cars, which is the number one cause of death according to Bateman and Fleming's investigation (2012). Some scholars believe that raccoons tend to avoid roads and build-up areas (Bateman & Fleming, 2012), while other researchers, such as Ditchkoff and her colleagues (2006), suggested that raccoons forage on road-killed animals, which indicates their presence alongside the roads. Overall as natural creatures,

raccoons have favor in parks and green spaces in the cities (Bateman & Fleming, 2012). It is worthy to notice that in many new suburban areas, larger areas with trees and other vegetation are preserved to separate the houses, which provides perfect wildlife habitats (travel, forage, cover etc.) for the animals (Ditchkoff et al., 2006).

Project Objectives

I would like to investigate the spatial pattern of raccoons' intrusion to dwellings in Toronto, Canada, in terms of which part of house they were found. Raccoons are highly adaptive mammals living in the urban settings, therefore it is possible to assume that the animals living nearby or having overlapped home range may learn from each other, which may be reflected by their den choices. A spatial illustration could help us learn more about raccoons' behavior and adaptation to new environment, which is important to urban wildlife management practices.

Methods

The data used is the records from a wildlife removal company called AAA Gates' Wildlife Control, dated from 2000 to 2013. I received the records from Prof. Justin Podur and it was anonymized for privacy purpose. Since the records were not collected for research purpose, there are not any detailed metadata available. Therefore organizing and sorting work is very essential to generate clean and efficient data.

The software used for spatial analysis is ArcGIS 10.2.2. The base maps for mapping the data are Toronto neighbourhoods and Toronto city wards. The result maps with area coverage are expected to show potential clustering patterns and the projection is NAD83 UTM, Zone 17 North, Meter.

Results

Figure 1 is a summary graph listing all the major choices of raccoons' intrusion into dwellings based on the Gates' records. Attic has almost 8,000 records, nearly half of the total number, which is over 16,000. The other top nine choices are chimney, deck, upper deck, roof, garage, soffit, addition, porch roof and porch. Although "in building" has high number of records, it will be excluded from the analysis since the term is too vague to classify (same principle applies to "in house").

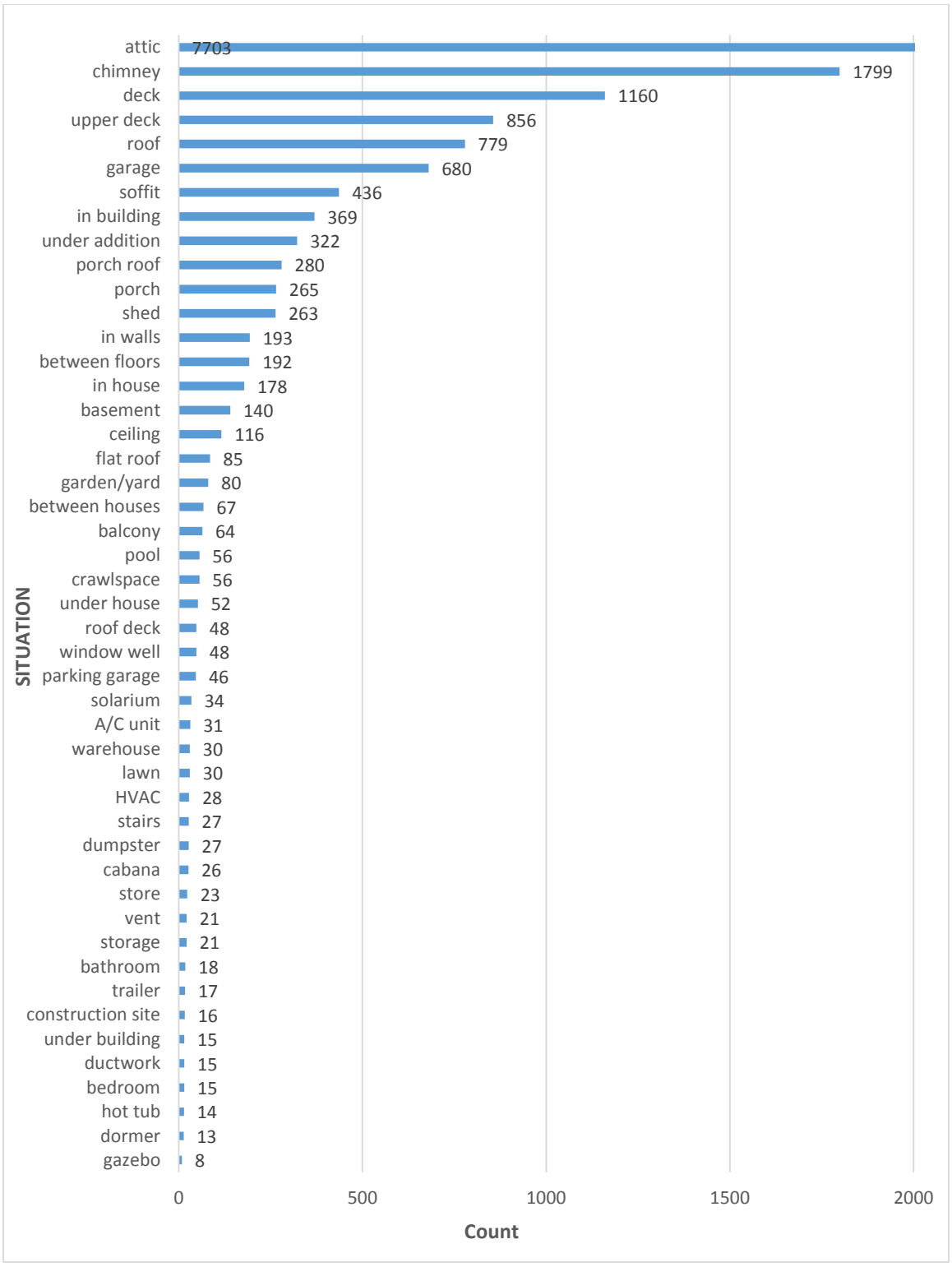
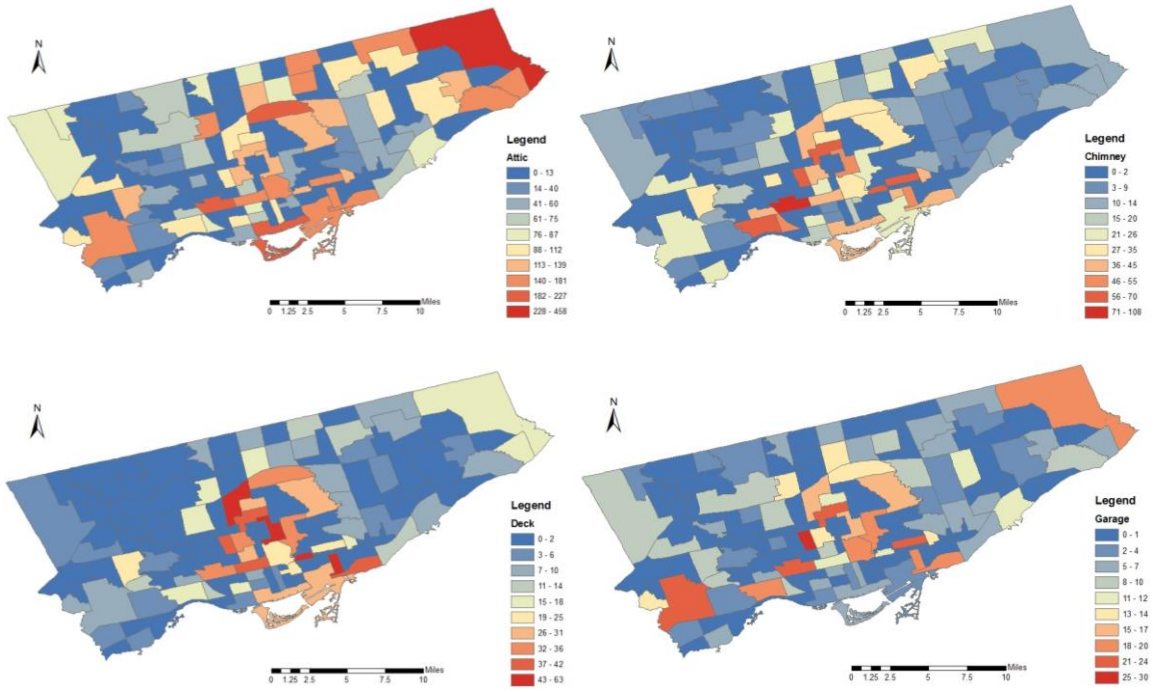


Figure 1. The counts of raccoons' intrusion into dwellings in Toronto from the year 2000 to the year 2013, according to the Gates' records.

Figure 2 (a)-(j) show the above ten choices accordingly by Toronto's neighbourhood coverage. For each "SITUATION", the number of records in one neighbourhood is classified into 10 classes, based on Jenks natural breaks classification method. It is obvious that raccoons' invasions are not randomly distributed and the hotspots for different intrusion choices are relatively diverse. Figure 3 combines the counts for the top ten "SITUATION", while excluding the top three ones who easily outweigh the others. Figure 4 (a)-(j) & Figure 5 with Toronto city wards as the base map help us to look at the same spatial data in broader boundaries. The "hotspot" polygons show more intense congregation in city wards maps than neighbourhoods' maps.



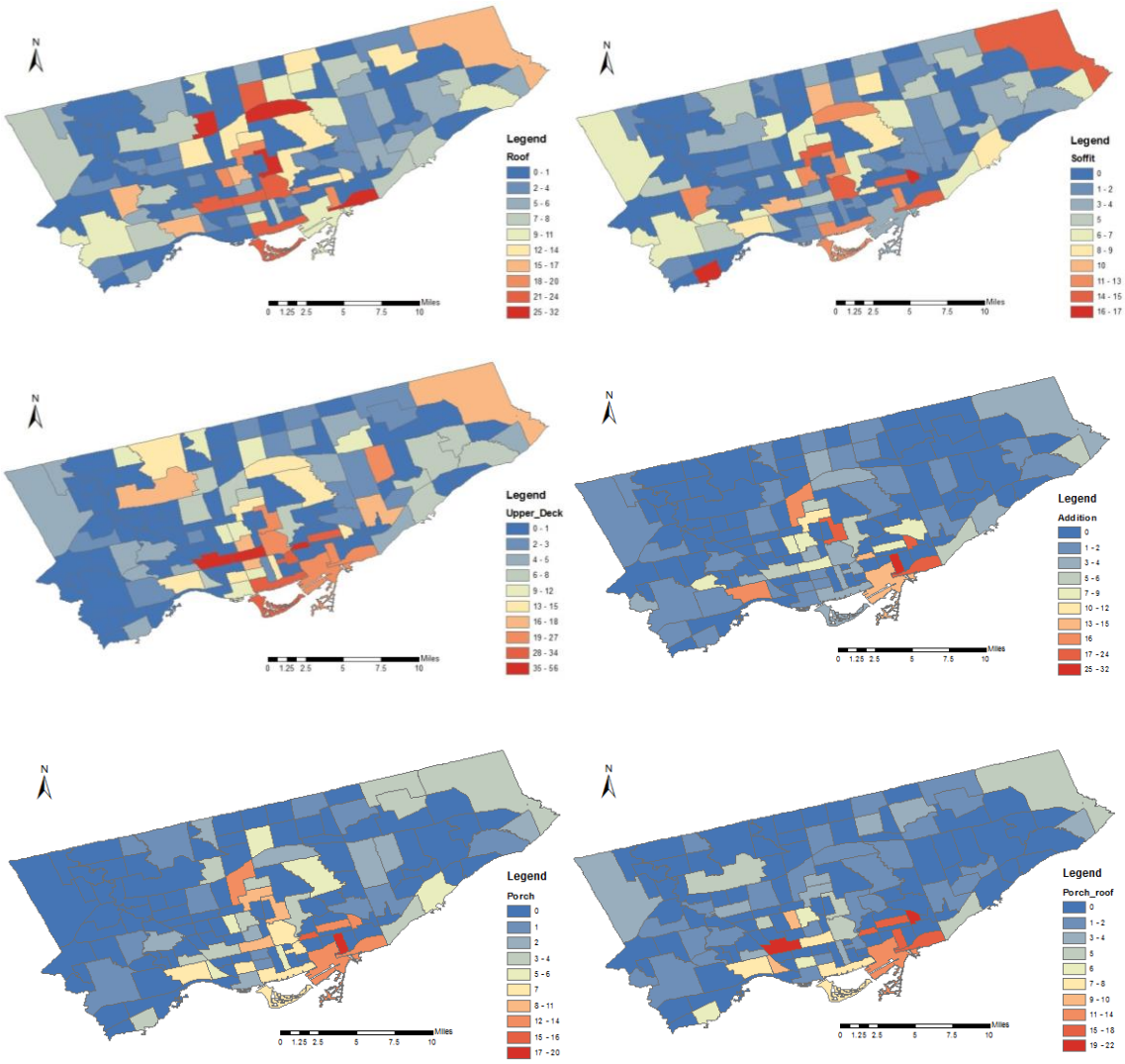


Figure 2 (a)-(j). Raccoons' intrusion choices by Toronto neighbourhoods.

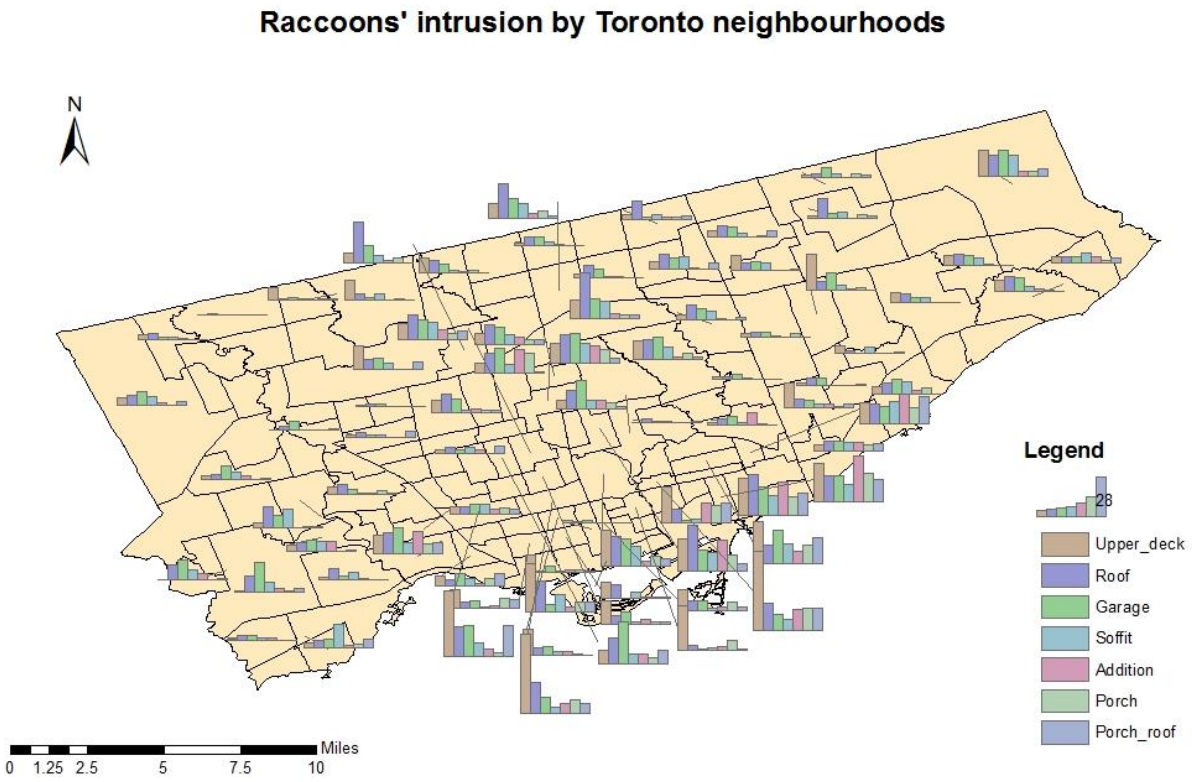
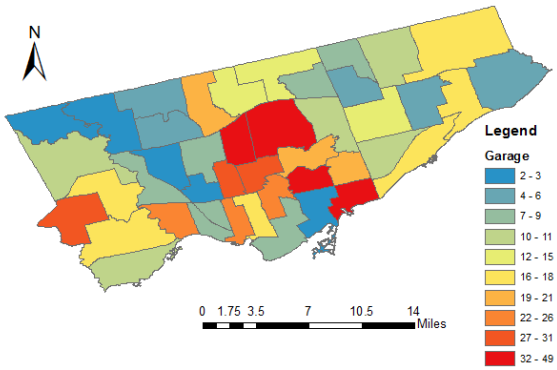
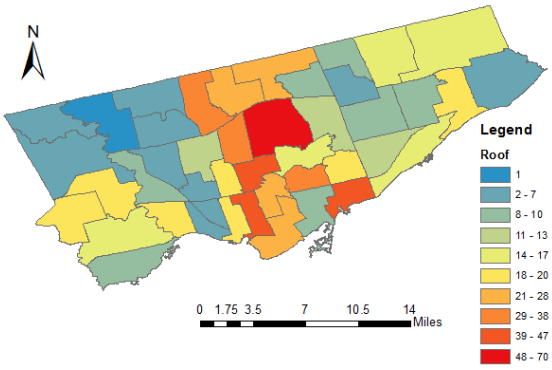
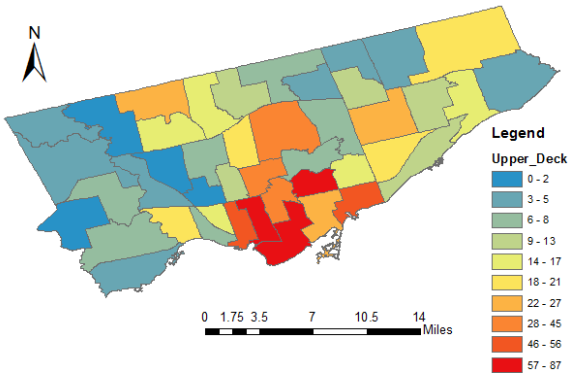
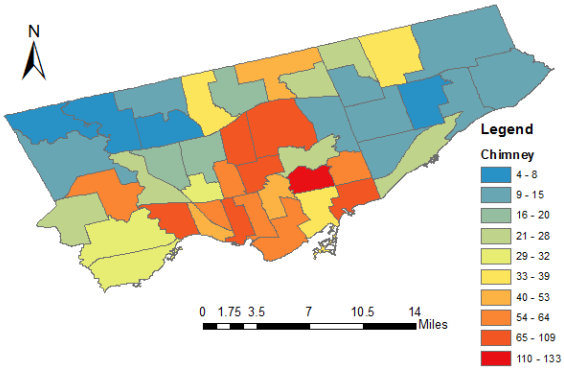


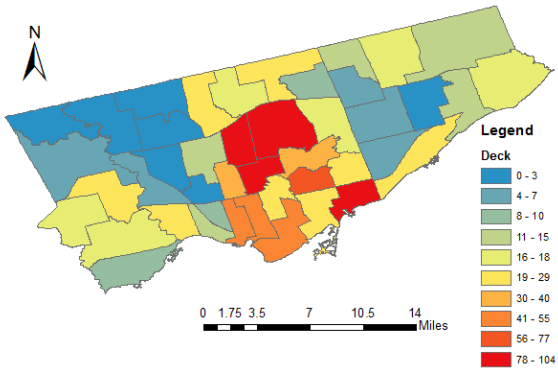
Figure 3. The top ten (excluding first three) intrusion choices of Raccoons on the Toronto neighbourhood coverage.

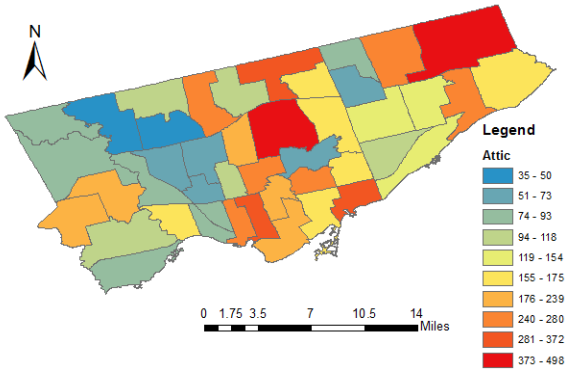

N
Legend
Garage
2 - 3
4 - 6
7 - 9
10 - 11
12 - 15
16 - 18
19 - 21
22 - 26
27 - 31
32 - 49
0 1.75 3.5 7 10.5 14
Miles

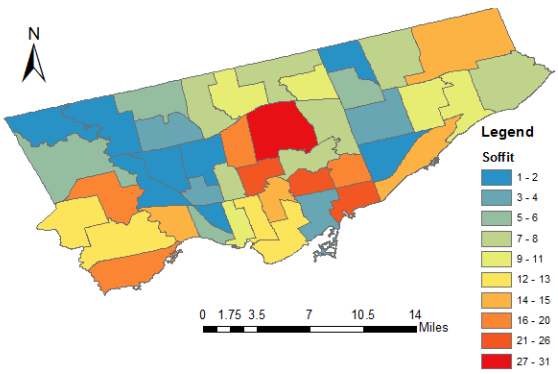

N
Legend
Roof
1
2 - 7
8 - 10
11 - 13
14 - 17
18 - 20
21 - 28
29 - 38
39 - 47
48 - 70
0 1.75 3.5 7 10.5 14
Miles

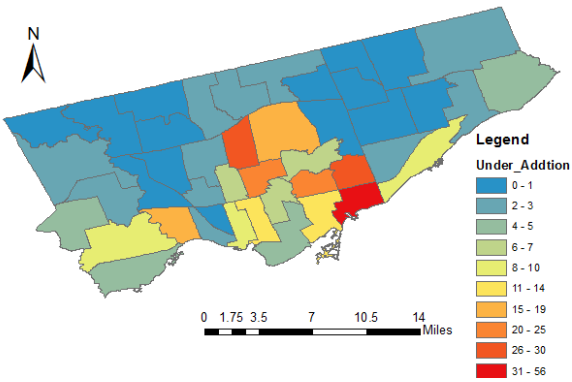

N
Legend
Upper_Deck
0 - 2
3 - 5
6 - 8
9 - 13
14 - 17
18 - 21
22 - 27
28 - 45
46 - 56
57 - 87
0 1.75 3.5 7 10.5 14
Miles


N
Legend
Chimney
4 - 8
9 - 15
16 - 20
21 - 28
29 - 32
33 - 39
40 - 53
54 - 64
65 - 109
110 - 133
0 1.75 3.5 7 10.5 14
Miles


N
Legend
Deck
0 - 3
4 - 7
8 - 10
11 - 15
16 - 18
19 - 29
30 - 40
41 - 55
56 - 77
78 - 104
0 1.75 3.5 7 10.5 14
Miles


N
Legend
Attic
35 - 50
51 - 73
74 - 93
94 - 118
119 - 154
155 - 175
176 - 239
240 - 280
281 - 372
373 - 498
0 1.75 3.5 7 10.5 14
Miles


N
Legend
Soffit
1 - 2
3 - 4
5 - 6
7 - 8
9 - 11
12 - 13
14 - 15
16 - 20
21 - 26
27 - 31
0 1.75 3.5 7 10.5 14
Miles


N
Legend
Under_Addtion
0 - 1
2 - 3
4 - 5
6 - 7
8 - 10
11 - 14
15 - 19
20 - 25
26 - 30
31 - 56
0 1.75 3.5 7 10.5 14
Miles

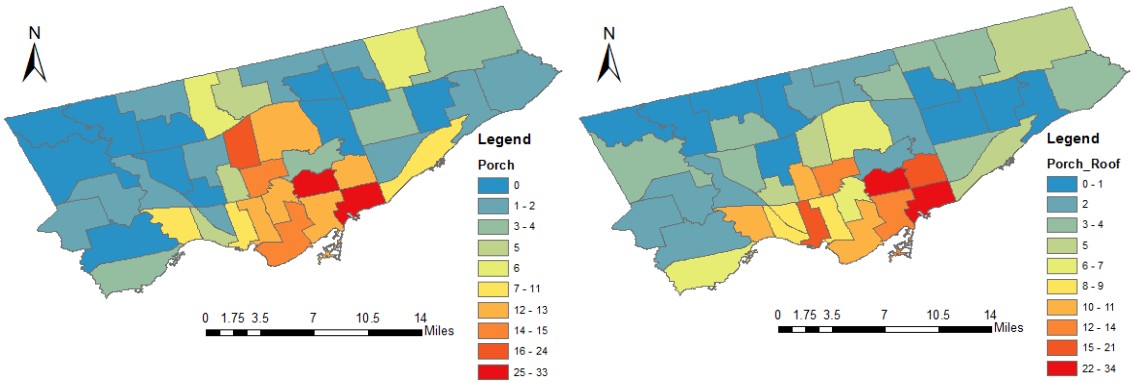


Figure 4 (a)-(j). Raccoons' intrusion choices by Toronto city wards.

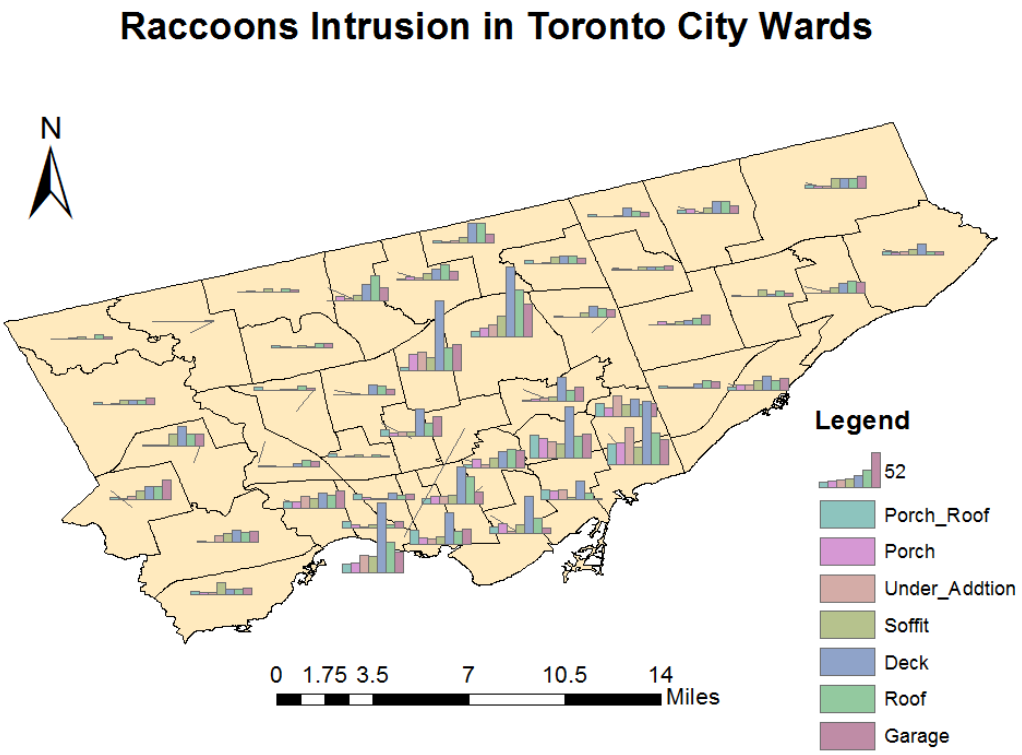


Figure 5. The top ten (excluding first three) intrusion choices of Raccoons on the Toronto city wards.

Since the records spread over 14 years, it is also necessary to look into the spatial patterns by time periods. Due to the limit of time, “soffit” and “crawlspace” are selected as two “novel” representatives from medium and low number of records. The number of records is shown by area coverage and the projection is WGS84. From Figure 6 (a) to (b), the invasion of raccoons through soffit spreaded out based on previous years’ locations. A similar temporal relation of spatial patterns can also be found in “crawlspace”, according to Figure 7.

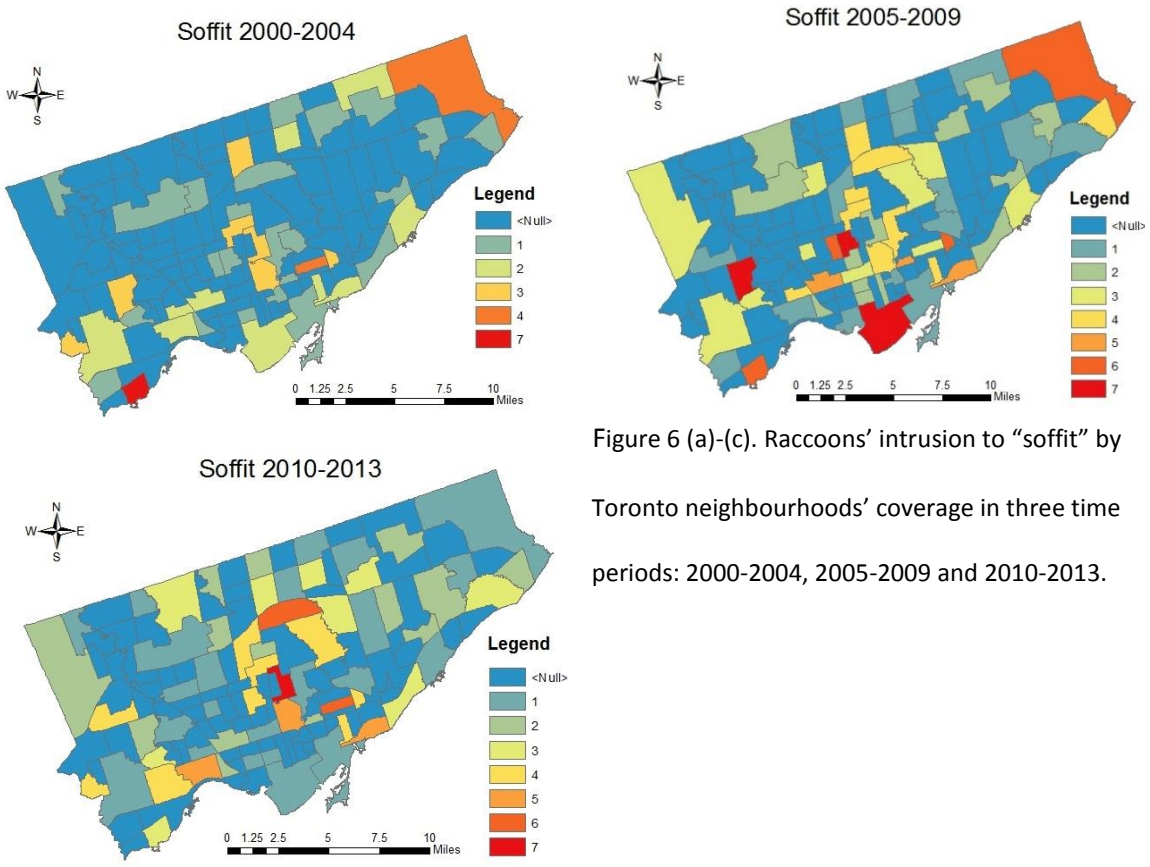


Figure 6 (a)-(c). Raccoons’ intrusion to “soffit” by Toronto neighbourhoods’ coverage in three time periods: 2000-2004, 2005-2009 and 2010-2013.

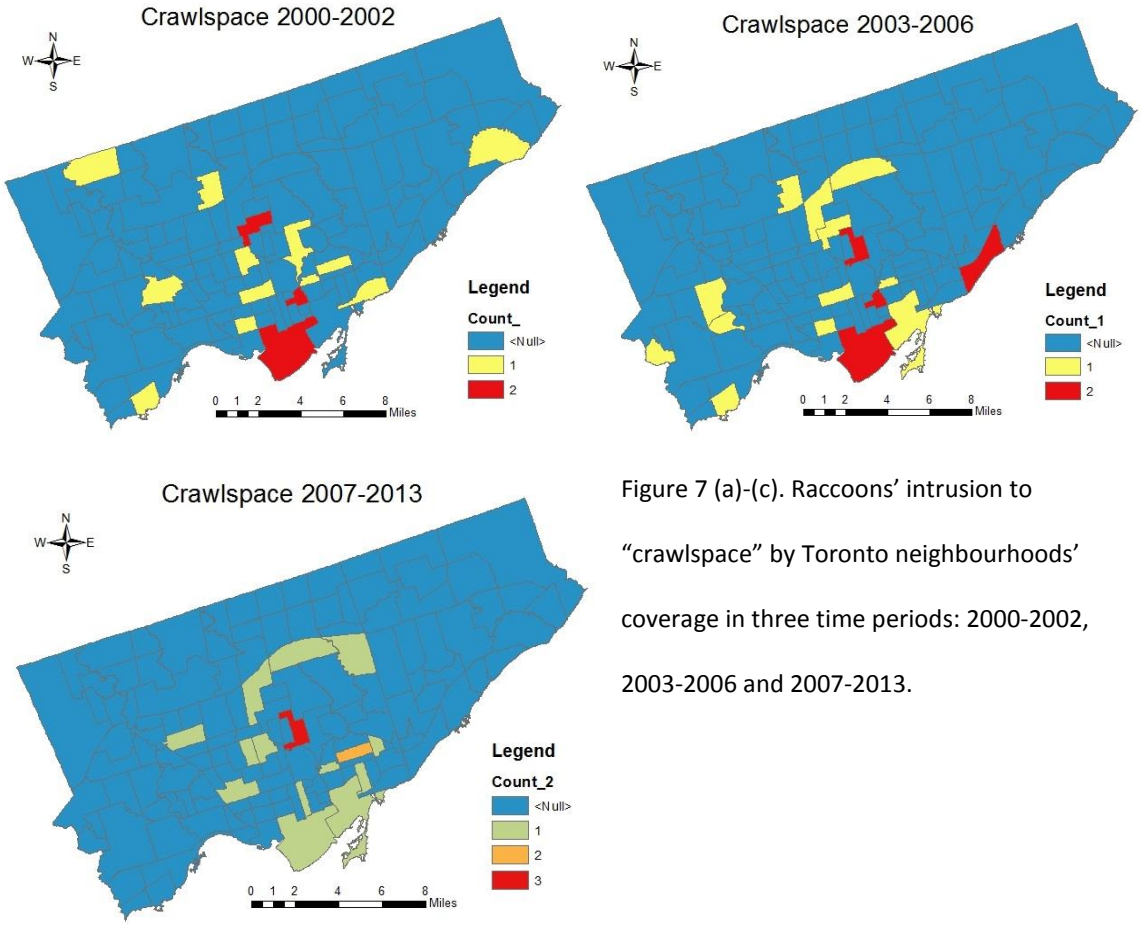


Figure 7 (a)-(c). Raccoons' intrusion to "crawlspace" by Toronto neighbourhoods' coverage in three time periods: 2000-2002, 2003-2006 and 2007-2013.

Discussion

This project is an attempt to study raccoons' intrusion into particular parts of urban dwellings using spatial analysis. The spatial visualization of raccoons' behavior in urban settings helps us see their movements in a more straightforward way. Figure 1 gives us a brief idea of choices raccoons could use to enter residence. The ones with very high number of records like "attic", "chimney" and "deck" are indeed not the main interests, because they have been known long time ago as the common entries of raccoons. This also explains why the "hotspots" get more congregating with each other once the total number of records for one "SITUATION" drops. When comparing changes of movement during time periods, it is also important to notice that lower number of records may also mean small population to live sustainably in one area. In conclusion, although the spatial analysis alone cannot imply that raccoons learn intrusion

methods from nearby community, it can provide strong support for behavioral studies and management practices.

Acknowledgement

I would like to thank Gates' Wildlife Control for sharing their records, and Professor Justin Podur and TA Tannaz Zargarian for providing suggestions and coordination for this project.

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Contact Information

Name: Xiaotian Wang

Email: traceyxwang@gmail.com