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Effects of the COVID-19 Lockdown on Mammal Activity in Western North Carolina

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Abstract

The COVID-19 pandemic has put a normally bustling world on hold. Earlier this year North Carolina's governor, Roy Cooper, issued a stay-at-home order (or lockdown) that took effect on March 30, 2020. The stay-at-home order stayed in effect until May 8, and during this time roads, towns, and parks slowed their foot and car traffic. This study used camera traps to compare wildlife activity during and after the lockdown in three different locations: the rural Owen Park, the semi-urban Beaver Lake Park, and a control site at Sandy Bottom. The camera traps recorded animal activity during four weeks of lockdown and four weeks post-lockdown. The camera trap software Camera Base was used to identify and label more than 3,000 photographs of all mammals taken by the camera traps. Camera Base then created a spreadsheet of each site including the mammal, time the picture was taken, and the date. This data was then used to create activity graphs for mammal species, which were used to compare lockdown and post lockdown mammal activity. Based on the results of the number of photographs recorded during and post-lockdown, only Eastern Gray Squirrels and Virginia Opossums indicate potential effects of human activity during the COVID-19 lockdown. Based on the activity graphs, only Eastern Gray Squirrels at Owen Park show a slight indication of potential lockdown effects.

1. Introduction

Near the end of 2019, the coronavirus (COVID-19) pandemic originated in Wuhan, China, and spread throughout the world in the following months. Many countries experienced lockdowns and mandated stay-at-home orders during this time, and as human activity began to decrease in public spaces, stories of altered animal behavior began coming up more frequently. Some stories claimed that dolphins and swans were appearing more commonly in Venetian canals, while others told of elephants appearing in the Chinese town of Yunnan to eat produce; these kinds of activities were supposedly out of the norm when humans were around. Despite the optimism produced on social media, Natasha Daly from National Geographic wrote an article debunking these claims. Swans normally swam in Venetian canals, the pictures of dolphins were not located in Venice, and elephants were normally spotted in Yunnan[1].

Despite having little evidence of the effects of COVID-19 lockdowns on animal species, researchers have begun to try to quantify animal activity changes. Erik Stokstad compiled a few studies that had begun earlier in 2020[2]. One study, conducted by Eduardo Silva-Rodríguez, used camera traps in urban spaces in Chile. Because of decreased human activity, southern river otters and the güiña wildcat were recorded in urban spaces they had never been seen in before[2]. Nicola Kopler organized research at the University of Manitoba to see if less noise pollution from airports, and less road traffic, increased activity in some bird species[2]. Some of the results Kopler's study hoped to find were increased bird activity near airports in species such as the yellow-rumped warbler, which is a species negatively impacted by noise pollution. Kopler's study was also hoping to observe fewer deaths from low-flying bird species who normally collided with cars on busy roads. Ari Friedlaender, a marine ecologist at the University of California

Santa Cruz, worked in the Monterey Bay of California to observe if noise pollution caused by marine vessels negatively impacted whales[2]. Friedlaender was collecting blubber samples from humpback whales to measure cortisol, a stress hormone, to test whether noise pollution reduction had a positive impact on the whale's stress. Though just a handful of various studies, one can see that scientists are using this brief pause in human activity to see there are impacts humans have on animals around them.

The brief pause in human activity requires a term that people can refer to when studying change in species behavior. Since the pause, some scientists have concocted a word to represent this duration of time where human daily activity had slowed down: "anthropause"[3]. Manenti et al. also found that in heavily industrialized countries such as China, air and water pollution had noticeably decreased as well[4]. A combination of less human activity and a cleaner environment might be enough to change animal behavior. One noticeable difference during anthropause is how rare species were appearing in areas that people did not normally see them. Rutz et al. mentioned that pumas were spotted in downtown Santiago, Chile, and jackals in urban parks in Tel Aviv, Israel[3]. They also found animal feeding behaviors changed negatively. In some areas of the world where animals were used to feeding on food scraps and garbage left by humans, the absence of humans caused stress on feeding routines. Temporal analysis was also discussed by Rutz et al.; a process of documenting temporal changes in animal activity due to short-term changes in human behavior[3].

Change in seismic activity also might have had an effect on animal behavior. With humans being forced inside during COVID-19 lockdowns, noise and vibration from our vehicles and activities had decreased seismic noise. Lecocq et al. found that global seismic noise reductions were around 50%[5]. Seismic noises might have been decreasing animal activity in busier areas of the world.

Though there are many methods to observe and record animal activity, one of the most non-invasive ways is to use camera traps. Lyra-jorge et al. conducted a study on the advantages and disadvantages of camera trap research and were able to conclude that camera traps allow for more precise animal identification, allow for better investigation of species activity pattern, and can allow for estimation of population density[6]. Some disadvantages from the study include the exclusion of smaller animals, the expensive cost of cameras, the flash that a camera produces, and film. By using newer camera traps, some of these disadvantages can be eliminated; newer camera traps have a black flash and store pictures in a digital format, allowing for clear pictures at night without a bright light that could scare the animals away, and for a simple way to take many photos without having to constantly replace and process films.

On March 30, 2020, North Carolina governor Roy Cooper issued a stay-at-home order for the state. With a slowdown in towns, parks, and roads in the state, it was a perfect time to observe changes in animal's frequency. Three sites were chosen to observe in the vicinity of Asheville, NC: Owen Park, Beaver Lake Park, and Sandy Bottom. Owen Park is located in the rural part of Buncombe County, while Beaver Lake Park is located in the semi-urban neighborhoods of North Asheville. Sandy Bottom was chosen as a control site due to naturally low human foot traffic, and the only contact for humans to enter the site being a road that parallels the forested site. Camera traps were chosen as the best and least invasive method of measuring animal's frequency during and post lockdown, due to the fact that they can go unnoticed by animals and not create any noise or visible disturbance. The camera traps used were digital, so they did not require film for processing and changing often. These camera traps also utilized a black flash, which does not create a noticeable disturbance to animals. The cameras were set to record data from April 9, 2020, and ran until June 8 of the same year. These dates were chosen as they represented four and a half weeks of data collected both during and post lockdown, which was lifted on May 8, 2020. Mammals were chosen as the main variable of observation, as they are constrained to moving on the ground and are easily identifiable in photographs. Camera Base software was then used to record which animals were in each photograph, and to create frequency graphs for each species. The aim of this study was to test whether decreased human activity in greenspaces during the lockdown resulted in altered animal activity. This study will try and find evidence that decreased human activity in greenspaces will increase mammal activity patterns within them.

2. Methodology

Two wildlife cameras were deployed in different areas at each of three sites: Owen Park, Beaver Lake, Sandy Bottom. These wildlife cameras are motion-activated, and were set to take photographs when activated all day and night during deployment. Cameras were set up on April 9, 2020, and taken down June 8, 2020 These dates were chosen as North Carolina began stay-at-home orders on April 9, and the order was lifted May 8, 2020. Four and a half weeks of lockdown and post-lockdown data were gathered. Cameras were placed on trees facing open areas within each greenspace. Each camera had sightlines that encompassed an open area within each forested greenspace (with the

exception of one camera trap at Beaver Lake facing a small creek). The cameras began taking photographs on April 9, 2020, and kept taking photographs through June 8, 2020.

Photographs from the camera traps were imported to the software program Camera Base. Cameras were marked to match each survey site in the program (for example, OP1 stands for Owen Park camera 1), and the photographs were imported to match the camera they came from. Mammals were identified and labeled, and Camera Base automatically recorded the time and date stamp from each photograph.

A spreadsheet of all mammals at each site, including the date and time stamp, was downloaded from Camera Base. This data was then moved into the program R Studio, from which activity plots were created for each focal mammal species, during and post-lockdown, for each site.

3. Results

3,163 photographs of 9 mammal species at Owen Park, Beaver Lake, and Sandy Bottom were labled (Table 1).

Table 1. Total number of photographs of all animals at all sites: Owen Park (OP), Beaver Lake (BL), and Sandy Bottom (SB).

Species	Site			Total Species Photographs
	OP	BL	SB	
American beaver, *Castor canadensis*	0	10	0	**10**
American black bear, *Ursus americanus*	5	0	200	**205**
Bobcat, *Lynx rufus*	0	0	4	**4**
Coyote, *Canis latrans*	0	3	20	**23**
Eastern chipmunk, *Tamias striatus*	10	5	0	**15**
Eastern cottontail, *Sylvilagus floridanus*	191	231	27	**449**
Eastern gray squirrel, *Sciurus carolinensis*	218	516	11	**745**
Groundhog, *Marmota monax*	0	0	2	**2**
Virginia opossum, *Didelphidae virginiana*	85	35	46	**166**
Common raccoon, *Procyon lotor*	28	594	13	**635**
White-tailed deer, *Odocoileus virginianus*	0	0	909	**909**
Total Site Photographs	**537**	**1394**	**1232**	**3163**

Of the eleven species listed, American Beaver (*Castor canadensis*), Bobcat (*Lynx rufus*), Groundhog (*Marmota monax*), and White-tailed Deer (*Odocoileus Virginianus*) were only recorded at a single site. The American Black Bear (*Ursus americanus*), Coyote (*Canis latrans*), and Eastern Chipmunk (*Tamias striatus*) were recorded at two of the three sites. Eastern Cottontail (*Sylvilagus floridanus*), Eastern Gray Squirrel (*Sciurus carolinensis*), Virginia Opossum (*Didelphidae virginiana*), and Common Raccoon (*Procyon lotor*) were the only four species photographed at all three sites. Of the four species photographed at all three sites, both the Eastern Gray Squirrel and Common Raccoon had significantly fewer photos at Sandy Bottom (11 and 13 respectively). The Virginia Opossum, despite being photographed at all three sites, had fewer photographs in general than the Eastern Cottontail, Eastern Gray Squirrel, and Common Raccoon (449, 745, 635 respectively).

Activity graphs were created for the four species photographed at all sites, and compared to the number of photographs between species and sites (Table 2).

Table 2. Number of lockdown (Lock) and post lockdown (Post) photographs of species by site. The numbers in green are the ratio of post lockdown to lockdown photographs.

Species	Site		
	OP	BL	SB
Eastern Cottontail			
Lock	163	156	21
Post	28	75	6
Ratio of Post to Lock	0.17	0.48	0.29
Eastern Gray Squirrel			
Lock	138	280	5
Post	80	236	6
Ratio of Post to Lock	0.58	0.84	1.20
Virginia Opossum			
Lock	53	22	24
Post	32	13	22
Ratio of Post to Lock	0.60	0.59	0.92
Raccoon			
Lock	13	200	7
Post	15	394	6
Ratio of Post to Lock	1.15	1.97	0.86

The number of Eastern Cottontail photographs decreased by 83% for Owen Park and 52% for Beaver Lake from lockdown to post lockdown. The number of photographs for the Eastern Cottontail also decreased by 71% at Sandy Bottom, showing a trend in decreased sightings post lockdown. The number of Eastern Gray Squirrel photographs decreased by 42% at Owen Park, and 16% at Beaver Lake post lockdown. The Eastern Gray Squirrel photographs at Sandy Bottom increased by 120%, showing an increase in squirrels post lockdown. Virginia Opossum photographs at Owen Park and Beaver Lake decreased by approximately 40%, while decreasing by only 8% at Sandy Bottom. Common Raccoons showed an increase of photographs post lockdown at Owen Park by 115% at Owen Park and 197% at Beaver Lake. The Common Raccoons photographs decreased by 14% post lockdown at Sandy Bottom.

Activity graphs showed the times species were active during a twenty-four-hour day. Figures 1, 2, and 3 show the activity graphs for the Eastern Cottontail at Owen Park, Beaver Lake, and Sandy Bottom, comparing activity during lockdown to post-lockdown.

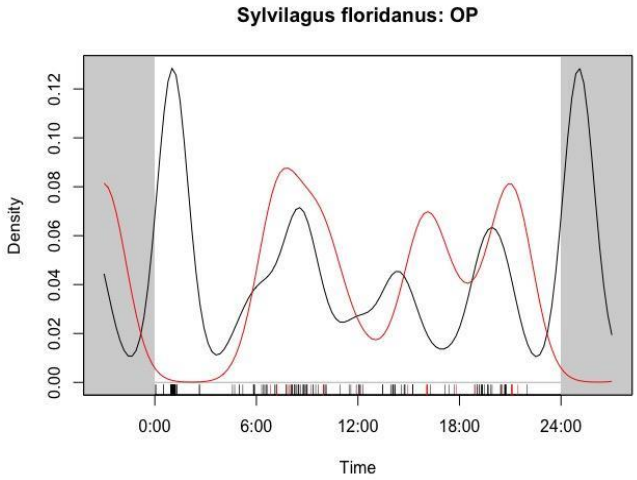

Figure 1 Activity patterns for the Eastern Cottontail at Owen Park during the lockdown (black line) and post lockdown (red line). Tick marks on the x-axis indicate individual lockdown recordings (black tick) and post lockdown recordings (red tick).

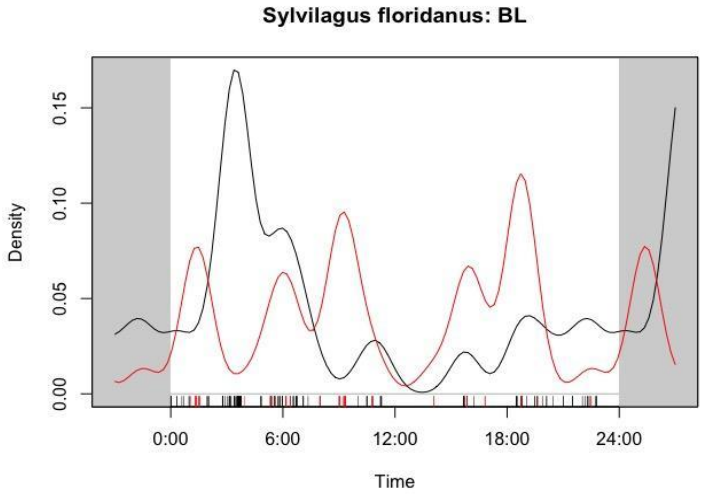

Figure 2 Activity patterns for the Eastern Cottontail at Beaver Lake during the lockdown (black line) and post lockdown (red line). Tick marks on the x-axis indicate individual lockdown recordings (black tick) and post lockdown recordings (red tick).

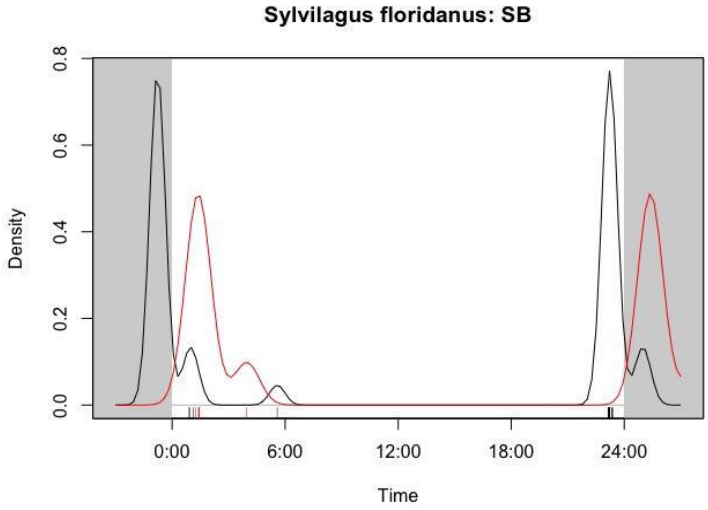

Figure 3 Activity patterns for the Eastern Cottontail at Sandy Bottom during the lockdown (black line) and post lockdown (red line). Tick marks on the x-axis indicate individual lockdown recordings (black tick) and post lockdown recordings (red tick).

The Eastern Cottontail shifted the times it was active from lockdown to post lockdown to later in the morning and evening. The Eastern Gray Squirrels at Owen Park, however, shifted to earlier activity during the day during post lockdown (Figure 4).

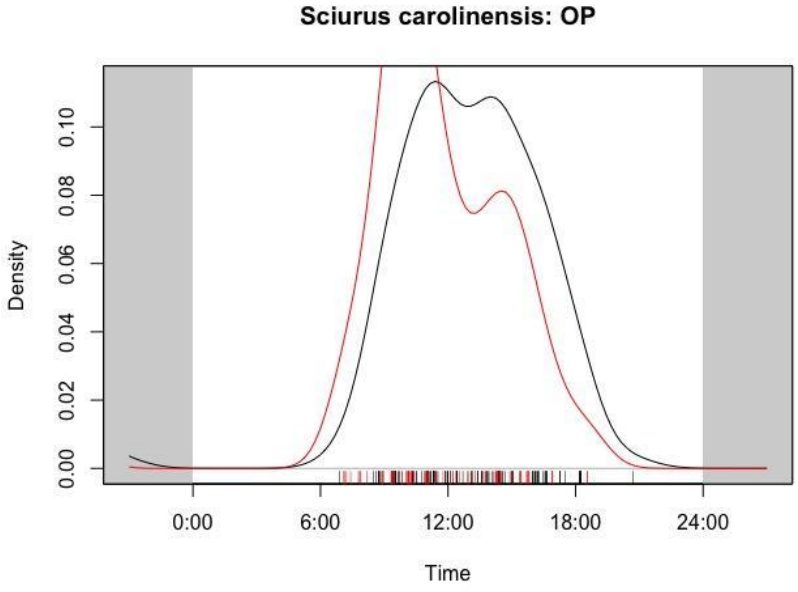

Figure 4 Activity patterns for the Eastern Gray Squirrels at Owen Park during the lockdown (black line) and post lockdown (red line). Tick marks on the x-axis indicate individual lockdown recordings (black tick) and post lockdown recordings (red tick).

Raccoons and Virginia Opossums showed no changes in the activity graphs from during to post-lockdown (figure 5).

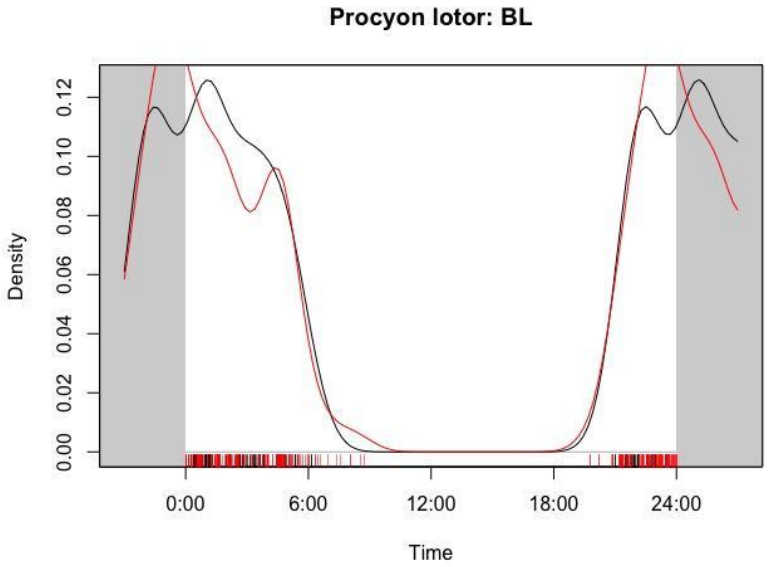

Figure 5 Activity patterns for the Raccoons at Beaver Lake during the lockdown (black line) and post lockdown (red line). Tick marks on the x-axis indicate individual lockdown recordings (black tick) and post lockdown recordings (red tick).

4. Discussion

More animal recordings and historical data would have been helpful for this study. Eastern Gray Squirrels at Owen Park showed supporting evidence of the hypothesis in Figure 4. The activity graphs in Figure 4 showed Eastern Gray Squirrel activity occurring earlier during the day post lockdown than during lockdown. While this might prove that the Eastern Gray Squirrels started being more active earlier during the day due to human activity, we cannot be fully certain that this is the case. There are not enough photographs at the control site of Sandy Bottom of the Eastern Gray Squirrel to compare to Owen Park.

The Virginia Opossum also might have shown an effect of decreased human activity during the lockdown, based on the number of photographs taken rather than the activity graphs. The activity graphs for the Virginia Opossum were all similar in showing no shift in activity from lockdown to post lockdown, so the number of recordings needed to be used instead. Using the number of photographs taken of Virginia Opossums, there looked to be some evidence that human activity decreased their activity. At Owen Park and Beaver Lake, post lockdown photographs of Virginia Opossums decreased approximately 40%. Virginia Opossums only showed an 8% decrease in photographs post lockdown at Sandy Bottom. Seeing very little change in sightings at Sandy Bottom for Virginia Opossums might prove that lack of human activity during the lockdown increased their activity during the day.

There are problems with using the number of recordings however, and a study by Johansson et al. found some issues with this method[7]. The study used separate individuals to record animal sightings to try and build a model for population size for particular species. Animals with distinct marking were recorded, which allowed individuals to identify recaptured animals. The study found that even when looking for recaptures, 12.5% of animals were mistakenly recorded as a new animal rather than a recapture. With our study, we did not look for distinct markings on animals or mark recaptures. A better trained eye might have been able to distinguish recaptured animals in the study, and allow for us to not have recorded the same animal more than once. Other camera trap studies also rely on animals being active during the peak of the day. Rowcliffe et al. found that assuming that all animals are active during the peak of daily activity is the most efficient way of measuring animal activity with camera traps[8]. The issue with our study is that some animals observed were nocturnal, and could not be assumed to have peak activity cycles during the middle of the day.

A better study might have been recording emptier streets in cities to see if rarer animals started occurring where they were not before. Harekrishna Bar put together a study recording some of the rarer species spotted in once heavily trafficked cities[9]. The study showed mountain goats moving through the streets of Llandudno, Wales in the United

Kingdom, which is somewhere they never would have approached when people were present. If some of our camera traps were placed in city areas, it is possible that recordings of rare animals might have occurred.

Size of the research area also might have been important to record. Wegge et al. recorded tiger sightings in the Royal Bardia National Park in Nepal with camera traps[10]. The study made sure to include the size of the research area, which was used to estimate the true number of tigers in the specific area. The area of Owen Park, Beaver Lake, and Sandy Bottom were never measured. Using similar sized research sites might minimize any confounding variables in the study. Another possible issue that could have occurred with the study was not finding well-traveled animal paths. Harmsen et al. looked at how jaguars and pumas used forest trails with camera traps, and recorded which species used trails more frequently[11]. Some of the species in our study might have been using trails, while others might have not been. The reason for saying this is that Common Raccoons at Beaver Lake seemed to travel using the creek. The Common Raccoons also seemed to always wipe their paws on the same spot on a fallen tree trunk, meaning it was possibly a common pathway for them to travel.

It is safe to say that it is possible that a decrease in human activity during the COVID-19 lockdown in Western North Carolina might have increased some mammal activity. More than one control site might have been needed for this study, and historical camera trap data could have been used as a reference point.

5. References

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