

*The Effects of Habitat
Fragmentation on Biodiversity
Levels in Woodland Ecosystems*

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Review of Literature

Habitat fragmentation is the emergence of discontinuities in an organisms ideal habitat. There are both natural causes for habitat fragmentation as well as human related causes. Natural disasters such as volcanic eruptions or forest fires can cause wide spread fragmentation. Human activities such as urbanization are frequent causes of habitat fragmentation. Urbanization is when towns and cities are formed and become larger as more and more people begin living and working in central areas. Urbanization affects species in many ways because it alters their environment and decreases biodiversity (Fahrig 2003). The goal of our study was to observe the animals in Teatown Lake in a non-invasive way and to see how habitat fragmentation was affecting the biodiversity levels of the area.

Teatown lake is mainly old-hickory forest with some rocky slopes. However due to human interventions there are now shrublands, and large wetland areas. The appearance of these areas are probably due to humans altering the environment by cutting down trees for hiking trails and building man-made streams for agricultural purposes. Both of these man-made environments are not ideal for many of the species observed in this experiment. White-tailed deer were the main focus of our experiment as well as their top predator, coyotes.

White tailed deer is one of the most abundant animals east of the Rock Mountains. White-tailed deer can adapt to a variety of habitats but are mainly

found in the temperate region of the United States. Even though they are highly adaptable they are still affected by habitat fragmentation. Research has shown that large patches of certain habitat yield higher numbers of large herbivores than the same habitat scattered over small areas. Even if the patches are well connected there is likely to be a lower number of large herbivores because only a small amount of the animals disperse (Shippers 2013).

They are an important part of the forest ecosystem because they have a large effect on their environment because their action affect many other organisms and help to determine the numbers of other species within in the ecosystem (Waller 1997). Due to these characteristics White-tailed deer as known as a keystone species.

One species that is affected by the white-tailed deer is the Coyote. Coyote's rely on deer as a food source and help keep the population in check. However due to human intervention that causes habitat fragmentation the number of coyotes is decreasing causing a spike in the white-tailed deer population. (Quinn 1997). Coyotes are having to learn to adapt to the presence of humans. Unlike smaller carnivores such as raccoons or skunks who have adapted well to the presence of humans, coyotes are having more trouble. Coyotes do not benefit from human-associated foods such as garbage or ornamental fruits like smaller carnivores (Riley 2001). Research has suggested

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that coyotes prefer undisturbed habitats and tended to prefer densely mixed vegetation over moderately and sparsely mixed vegetation (Quinn 1997).

Due to these habitat preferences we were curious to see how the urbanization of Teatown lake affected these two species. We decided to go with a non-invasive technique for several reasons. We wanted to observe the species in their natural environments without putting stress on them. Our choice of which non-invasive method to use was dictated by several factors. We ultimately decided to use camera traps due to their easy set-up and ability to be left out for long periods of time. Had we used another method like track plates we would have had to check them more frequently (Gompper 2006).

This purpose of this experiment to see how biodiversity is affected by human interaction. Before Teatown lake was founded the area was an undisturbed forest. After the area was urbanized with roads, buildings and trails the ecosystem was altered. Animals like the coyotes began to move out of the area seeking a habitat with less human presence therefore affecting the ecosystem. Using camera traps to monitor the population of different species gives us an idea on how affected this woodland area has become by heavy human presence.

Research Questions

1. How does habitat fragmentation affect keystone species like the White-tailed deer and coyote?
2. How are other woodland species affected by habitat fragmentation?

Hypothesis

1. The coyotes will be more affected by habitat fragmentation therefore affecting the ecosystem and biodiversity levels of this woodland area
2. Other species will be more abundant due to their ability to adapt to human presence.

Methods

Our research was conducted within the property of Teatown Lake in Ossining New York. The most abundant cover types were oak-hickory forests. However there are other habitats present in Teatown Lake and they were what dictated where to set up our cameras. We used 10 of the Reconyx HC600 camera traps (5.5" x 4.5" x 3").

We chose this model in place of the Reconyx HC500 because of its ability to take pictures both day and night. Since coyotes are nocturnal animals it was essential that we use a camera with infrared ability. Both pictures were taken during the first round of data collection and are from the same cameras. Cameras were placed on trees about 1 to 1 1/2 feet of the ground depending on the habitat and incline. There was then a lure placed 3-4 feet away from the camera in order to entice any animals in the area to come into the range of the camera.

Our ten cameras were placed strategically according to habitat. There were two rounds of data collection due to the size Teatown Lake's property. We wanted to cover all the property and we had a limited number of cameras. Therefore we split up the collection into two sessions. The first session focused on the areas in the northern region of the property and the second in the south. We placed our cameras in all of Teatown Lake's habitats. Data collection started on June 20th. Cameras were left out for 25-30 days.

After the cameras were collected they were uploaded and sorted through. We went through each camera individually and sorted the pictures according to 11 categories. In each camera we were looking for how many animals there were in total as well as how many species were spotted. We counted the deer separately since they were the most abundant animal and the main focus of our experiment. Since this was a non-invasive study the deer were not tagged. If 30 minutes had passed by between two deer pictures it would be counted as two separate individuals. The intervals we used for categorizing night pictures was 8pm to 5am. All the others were considered day pictures. Then we used google earth to measure the distance of each camera to the closest wetland, stream, rocky slope and lake. We also measured the distance to the nearest road and house. Table one demonstrates how the data was organized in an excel spread sheet.

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Table 1.

Camera	Animals	Species	Deer	Day	Night	Wetland	Stream	Rock	Lake	Road	House
R1C1	299	4	13	249	93	124.4	131.2	235.5	77.4	1045.6	985.1
R1C2	22	2	2	16	22	102.2	113.9	28.1	189.5	809.1	748.7
R1C3	156	3	7	112	94	7.6	92.2	104.6	314.9	384.3	251.4

Results

After the pictures were counted it was evident that the most abundant species in Teatown Lake was the white-tailed deer. Over 150 individuals were spotted with the camera traps. The results were the exact opposite for the coyotes. Throughout the whole experiment only 3 coyotes were captured by our cameras. These results suggest that coyotes have been affected by urbanization and therefore have moved to areas that have less human activity. However the deer as well as the other animals have learned to adapt well to human presence. Among the many deer our cameras also captured many raccoons, turkeys, possums and a variety of small birds.

Pearson was used to analyze the data collected. Several significant correlations were recognized. There is a negative correlation between the number of day pictures to the distance to the nearest road and house. However here is a positive correlation between the number of night picture found and the distance to the nearest road or house. These correlation suggest that animals may restrict themselves to a small range during the day but venture farther during the night. Since humans are mostly sleeping at night it would make sense for a deer or another animal to be more comfortable coming near a house when the humans are inactive. Another significant correlation was between the deer and the nearest wetland. This graph shows that the farther away the wetland was the more deer there were. This correlation suggests that even though deer are high adaptable creatures they are still affected by

habitat fragmentation. They were most likely avoiding the areas like the wetlands and staying within the fragmented areas of the oak hickory forests. The cameras emphasized this because only two deer were spotted in an area of Teatown that was considered a wetland. In the areas that were oak-hickory forest there was up to 24 individuals spotted. The scattergrams below show these correlations.

Discussion

This experiment proved both of our hypotheses to be correct. We expected to see more deer than coyotes and an assortment of other woodland species. However the numbers were still surprising. The ratio between coyotes and deer was 3 to 56. Such a small number of predators allow the deer population to skyrocket, thus disturbing the ecosystem. Deer can alter the structure of woodland communities. The vegetation that they eat often respond in unique way since deer have the tendency to decrease habitat modification (Rooney 2003). With so many deer and not enough predators to keep the population in check the woodland ecosystem has lost its high level of biodiversity. An abundant amount of deer means a lot of vegetation being consumed. Many small woodland creatures rely on the cover of the shrubs and trees that deer feed on. (Auken 2009) If the deer consume the plants there is no

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Where for the small creatures to hide or make home therefore causing them to leave the area as well.

This data that was collected shows how habitat fragmentation affects an ecosystem on a large scale. Without coyotes to consume the deer the population will increase to higher and higher levels.

Conclusion

There were several limitations to the study. Due to a small time frame we were only able to collect data from each area once. Our original attention was to survey each area twice but we only had a short window of time to conduct the experiment. As always, there were financial limitations. We were only able to two rounds of data because we only had 10 cameras. The cameras that we purchased cost around 450 dollars making the option of buying more cameras virtually impossible. Also, in the second round of collection one of our cameras failed and the data was lost. Despite these limitations the experiment was still successful in showing that habitat fragmentation has a negative affect on ecosystems by decreasing the levels of biodiversity.

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