Flooding and Invasive Species Study of Rock Creek in Montgomery County, Maryland

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Abstract

The investigation of Rock Creek's habitat is the focus of this study conducted by a high school student conducting the research for this scientific paper. This research matters because it explores a detailed area of Rock Creek and its surroundings. Rock Creek is primarily a woodland forest, and is used for biking, hiking, or observing wildlife. The signs of flooding and invasive species of Rock Creek were investigated, as well as the environment between the trail and the creek.. The measurement of the creek's water levels, the use of the Plant ID APP, habitat assessment tables, and a number of other techniques were implemented in this study. This work supplements previous work by providing detailed insights into what is off the trail, and also the parts of the creek prone to flooding and invasive species. Several signs of flooding and invasive species were found, including garlic mustard which is one of the most prevalent invasive species in Maryland. Throughout the study, a central question regarding the nature of flooding at Rock Creek was explored.

Fig 1. Rock Creek (Wikipedia).

Introduction

This study's main objective is to determine how the area between the park trail and Rock Creek impacts the creek's natural features. As climate change has intensified in recent decades, scientists have become increasingly interested in the ecological factors that might be impacting Rock Creek's health.

Background

Rock Creek, a tributary of the Potomac River, spans 33 miles originating in the agricultural and suburban areas of Maryland and continues through the more urbanized District of Columbia, ultimately running into the Chesapeake Bay (4). Rock Creek has a very rich sense of history, and this is apparent in the field visit, because the infrastructure along the trail is very strong and not seen to be carried away with time. The foresight of our ancestors in the establishment of the Rock Creek Park has managed to preserve many vestiges of our past within its bounds (5). Some stones are still original, while others were county stones they established within their stream rehabilitation projects (2).

Rock Creek was an appropriate space to conduct this study because of its diverse environments. Rock Creek was known to have both sandy tributaries androcky tributaries.

Rock Creek directly flows down to Washington D.C. Rock Creek Park. Rock Creek Park is truly a gem in our nation's capital (8). This 1,754 acre city park was officially authorized in 1890, making it the third national park to be designated by the federal government. It offers visitors the opportunity to escape the bustle of the city and find a peaceful refuge, recreation, fresh air, majestic trees, wild animals, and thousands of years of human history. The Rock Creek watershed is a Maryland 8-digit hydrologic unit code level watershed located in central Montgomery County (10).

Rock Creek is not surrounded by shopping areas. A great change in the area's economy took place about the middle of the 18th Century (5). Soil exhaustion and the settlement of the Piedmont region to the north and west by European immigrants caused a shift away from tobacco to grain production. This soil depletion resulted from rapid erosion and poor farming practice, especially the continued planting of tobacco year after year.

The Potomac River has dams, but the Rock Creek tributary does not. The original dam was above the site of the present one (5). It raised the water level sufficiently to let the water into the millrace and turn the water wheel. The dam was washed away by floods and rebuilt several times, the last in 1904. The mill was restored by the National Park Service in 1936 and operates on an intermittent basis.

The geology of the Rock Creek Park Watershed demonstrates some of the more spectacular natural features to be found in the area (5). By the author’s own geology knowledge a comprehensive detail of geology was used in this study as well. The geology of rocks, for example, varies at each location in the survey of this creek. There are areas where the rocks are dominant on the hills facing East, other dominantly facing west, and have algae where sunlight can not penetrate through much of the time of the day. The Montgomery County Department of Environmental Protection has done extensive work and maintenance for Rock Creek within the county limits within the last couple of years (2). The Rock Creekhas a history that is filled with conserve movements and tree-forest management, especially deer management. Rock Creek Park works with many park partner organizations to manage our volunteer program (8). Depending on the volunteer position or event, volunteers will work with staff from the National Park Service, one of our park partners, or our trained volunteer event

leaders.Volunteers help at our Nature Center, on the trails, throughout the forest, within our community, and at park events.

Climate, water, and human activities are tightly connected (11). And due to large scale variability in their coupling behavior, water security in terms of quantity and quality is a significant issue worldwide. Although water quantity related problems get more attention, water quality is equally important and vital for maintaining a healthy ecosystem and human well-being. So it is vital to make sure Rock Creek stays healthy.

This project focuses on two aspects of Rock Creek's health: flooding and invasive species. Rock Creek's invasive species are quite common in the Montgomery County area (2). These can include animals, plants, that are invasive. For example, we found garlic mustard. The author considers the essence of this study to be vital to understanding these invasive species to help preserve the biodiversity and healthy streamway of Rock Creek. Flooding and erosion are critical issues in Rock Creek, as the flooding could impact the daily lives of local resident's. Specifically, flooding can damage home resources and make driveways not usable. There are homes right along the periphery of the park, and also Wood Middle School and Rockville High School are near the creek as well.

Climate change may also play a role in the flooding as an issue because climate change predictions show increased, more severe flooding events (4). Some of the natural factors impacting erosion in a landscape include climate, topography, vegetation, and plate tectonics activities (3).

Rock Creek is mainly a woodland area, and the creeks' park has a clear division between the biking and pedestrian trail and the wildlife area. There is a wide range of terrain, from hills to sloping valleys, and a wide variety of trees, bushes, wild grasses, and soils (5). The first part of the author's experiment, observing plants and invasive species, is being focused. The author's last session visiting the bank area to observe signs of flooding and erosion is focused, rather. This study will focus on flooding and invasive species because these are the primary environmental concerns regarding the health of Rock Creek. The county installed a sewage system for the Rock Creek as well. Three major drainage areas form the Rock Creek Watershed: the mainstream of Rock Creek (on the northwestern side), the North Branch (on the northeastern side), and the tidal drainage area (4).

Fig 2. Rock Creek (Author).

Fig 3. Rock Creek (Author).

Information about plants habitats and their related reliability problems, including invasive species at the field site were assessed in this study, as part of the scopes of flooding and also partially with regards to invasive species. Flooding is a main topic here in this research paper (4). Invasive species are commonly spread through human interaction such as . These are most talking about plants, like garlic mustard and other plants that normally one would not expect to find in a creek of native species. Many invasive animals in the county include: northern snakehead, green sunfish, and corbicula.

Flooding is a major disturbance that impacts aquatic ecosystems and the ecosystem services that they provide (9). Predicted increases in global flood risk due to land use change and water cycle intensification will likely only increase the frequency and severity of these impacts. Extreme flooding events can cause loss of life and significant destruction to property and infrastructure, effects that are easily recognized and frequently reported in the media.

Montgomery County's watershed, especially Rock Creek, impacts the greater water system and health of this ecosystem (5). Montgomery County installed various flooding sensors, including one on Baltimore Road, which is close to Rock Creek (1). The flood sensors automatically detect rising water levels and focus on early warning signs such as the increase of bugs near the lower range of water, and the mass accumulation of sediments in the creek (4). The Montgomery County Department of Environmental Protection recognizes lower Rock Creek as having one of the first county stream valley park systems (4). Over the years, the watershed as a whole, and in particular the lower section, has felt the greatest pressure of development. The main driver of this development has been due to many residents of Washington D.C. building summer homes in the area or transitioning their residence or employment to the suburbs. From recent observations, industrial sites between Avery Road and Baltimore Road have not been common. The Rock Creek within the park is very near E. Wood Middle School, like one kilometer, which could be a leading cause to the high number of hikers, bikers, casual walkers, and dog walkers in the park. For the public's convenience, there are several benches and water fountains for use as well.

Water quality is further influenced by transport, mixing, and dilution within the river network (9). As a result, the spatial pattern of water quality degradation depends on the extent of the extreme event relative to pollution sources, the amount of runoff from clean water generating regions, and their spatial connectivity, which is also a question of scale. For example, a pollution source located downstream may be considerably diluted during extreme events due to massive upstream water inputs.

The Lake Frank mainstream watershed is adjacent to where this study takes place (10). Lake Frank mainstream is a vast area covering the region from the lake to down here. The Lake Frank mainstream subwatershed covers 1,004 acres (1.57 square miles) in Upper Rock Creek. This mainstem subwatershed lies east of the Lake Needwood Mainstem and downstream of the Manor Park subwatersheds. Parkland and single-family residential land uses comprise the majority of this subwatershed. Lake Frank is a 262-acre catchment located in the Lake Frank Mainstem subwatershed. The catchment has 7% impervious cover and is roughly 67% low-density residential land use. Stream restoration projects are good opportunities in this catchment.

Streams are often at the receiving end of rainfall (stormwater) runoff from land surfaces and local stormwater drain-pipe systems (1). Stormwater pollution, as well as sewage from leaky sewer lines and contamination from landfills, can shock a stream system for a brief period. f these influences are persistent and repeated, they can degrade streams and the aquatic habitat for insects, fish, stream salamanders, and other biological communities (1).

The hypothesis is that: there would not be many invasive species in "this area" but there might be a wide range of plants. There are plants that might have been planted by county officials of the Department of Environmental Protection as well. It is also possible that the location under the state route of Norbeck Road could impact the flow of the creek. This is likely due to the state route in this area being directly above the creek, which allows for debris and

garbage to fall into the creek (3). From the author's field visits, a takeaway is that this area of the Rock Creek has experienced a lot of human activity and county management. There are a lot of intentionally cut trees and many trees were not taken after cutting, but instead lay there in the open grasses between the woodland. This is likely from the park management and could be meant to help create new flowers and plant colonies to help preserve wildlife. So it might not be negative from that point of view. And also, there are piles of branches on one side of the creek, as shown the county is doing a lot of work in this area. This study covers the approximately two kilometers trail near Avery Road and Baltimore Road.

Although flooding and invasive species are common in this Rock Creek region, the hypotheses deem it appropriate to include elsewise data as well. For the perfect example, Rock Creek is full of unique landscapes and interesting activities of human hiking or biking, so the paved road may or may not have some impact on the Rock Creek. However, on an overall standpoint, the bicyclists constantly tramping the road may cause the central area of the dirt hill to be decreasing in its capabilities.

Rock Creek Regional Park has facilities for fishing and boating rental in the Lake Needwood region, and it has a Meadowside Nature Center (7).

Fig 4. Rock Creek Environment (Author).

Methodology

This study included four field visits. The first visit was a preliminary one-hour research visit to gather background information on Rock Creek. This included recording which plants and animals were present at three separate locations.

Results

First Field Visit (Sunday, May 7, 2023)

The author of this field visit went first to the Rock Creek area on a sunny Sunday. He realized the most important thing was to memorize the trail maps. And the creek was very unique in this region, so it is easy to get lost. The familiarity of the landscape is thoroughly important. The idea of Rock Creek being chosen for these three spots is the proximity to the author's city, but also the idea of Rock Creek within these three sites is also that because these sites are not too far from the water source, in Lake Needwood, so it is pretty good to see what is

out there that can impact the creek from an early point of view, instead of going down to Beach Drive and Takoma Park, where the water pollution might be more severe, because of all the accumulation of dusts and detailed impacts of the climate change. The blue dots on the map of the creek are the sites.

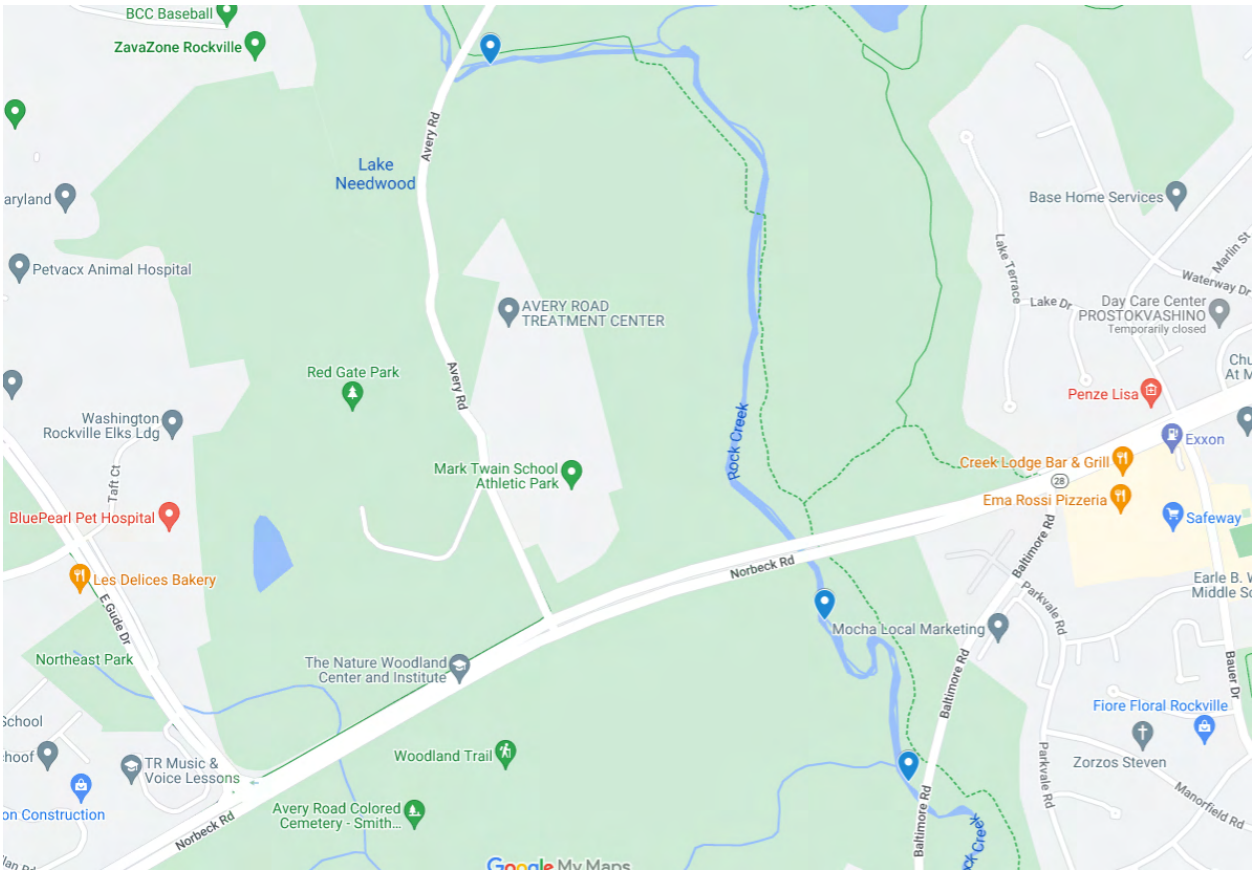

Fig 5. Rock Creek Study (Author).

Second Field Visit (Saturday, May 13)

On the second field visit we went to the area between the trail and the creek itself to determine different plant and animal species. The streambanks were also observed for possible flooding or erosion signs.

Third Field Visit (Saturday, May 20)

This week's field visit was centrally structured around observing evidence of flooding. Flooding is a dominant issue in our creek, Rock Creek. The author was spending about an hour in the creek area. During this time, pictures of the flooding, and the creek streambank were taken. The author, this time at the creek, also went on the streambank in an effort to research the overall creek, to do this will do the field data sheet. The experiment also included: bring a tape measure to measure the width and depth of the creek at the appropriate places; record

information on the data sheet as well. And also the author used Picture This to do plants analysis, and found garlic mustard, an invasive plant species.

The next presented were only the Picture This plants and also the water data table, nothing included the data habitat sheet because of page overflow. But a summary of the data sheet would be that the Rock Creek area saw few human usage, as it was mainly surrounded by wild grass and natural trees. There were signs of corn but that was mainly near the fence of where people lived. The main environment is woodland and prairie, as the grasses within the open space of the creek. Recording included spotting deers and other animals were noted in the sheets too. Overall, the data sheet told the author that the area was mainly primitive, and nothing industrial was going on. Similar data was applied for three sites, except for the big overhead bridge at Site 2.

Plants Found Using Picture This

Site 1	Site 2	Site 3
Northern sea oats		
Wingstem	Wingstem	Wingstem
Garlic mustard	Garlic mustard	Garlic mustard
American red maple	American red maple	American red maple
New York fern	New York fern	
American oak	American oak	American oak
Baby rose		
Multiflora rose		
	Wineberry	Wine berry
American sycamore		

Crownbeard		
Chinese silver grass		
	Arrowhead	
	River birch	River birch
	Water plantain	
	Tussock sedge	
	Marsh marigold	
		Green and gold
		Christmas fern
		Rudbeckia
		Cardinal flower

Water Measurements of the Stream

	Site 1	Site 2	Site 3
Water Width:	6.2 m, 6.4 m, 5.1 m	5 m, 5.5 m, 5.7 m	10 m, 5 m, 12 m
Water Depth:	60 cm, 30 cm, 50 cm	80 cm, 160 cm, 120 cm	120 cm, 130 cm, 140 cm

Fig 6. Garlic Mustard (King County).

Discussion

A diversity of plants and flora, as well as invasive species, were found in both creeks at Numbers 1 and 3. Due to the creek's proximity to an industrial region, it was surprising that plants were still present. The author measured several bodies of water and stream banks in various locations. The purpose of gathering so much water data was to understand the Rock Creek as a whole from the standpoint of flooding, invasive species, and human impacts on the area. hence it was essential to perform this type of measuring as well. The author took three measurements using different procedures at each location to ensure maximum accuracy.

The author was able to utilize the water to approximate the level of width and depth, but the data are simply approximations because the water was continually flowing and the measuring tape the author was using was only 5 m long. The stream's width ranges from 5 to 12 meters, and its depth also varies; at site 3, it is both widest and deepest. This demonstrated that the creek widened at Baltimore Road for the construction of the pedestrian bridge, and the creek had a shallower and wider angle at that point. It also revealed that the creek had a few small tributaries flowing into it from the sides, with rocks and muddy hills over the side of the tributaries, as well as a lot of black rocks and a prestigious rock at the turn of the creek when the bridge was there. Data results can also be inferred that further study is necessary to determine the natural habits of these plants, as this study was only a “survey”.

The author observed that the Rock Creek had numerous rocky outcrops surrounding it. These outcrops are affected by flooding because many of them have algae on them, and they also need to be moved because the author can see that some of the Rock Creek's original locations had very peculiar landscapes because of obvious holes in the creek area that were not natural. In fact, the author speculates that there may have been extensive building due to the numerous broken branches.

Even in dry weather, harmful levels of bacteria lurk in Rock Creek's waters (13). Numerous municipal sewers in Rock Creek run under roads and creek channels. Most of these pipes are made of vitrified clay and were installed around 1910. After a century, they are beginning to fail. Erosion, traffic and the passage of time have produced cracks, fissures, deformations and joint separations. The result: These old pipes are leaking sewage into Rock Creek. This can negatively determine the health of the creek, and therefore can be harmful to the animals and creatures involved in the creek.

In the author's research of the garlic mustard, in North America, the plant offers no known wildlife benefits and is toxic to larvae of certain rare butterfly species that lay eggs on the plants, as it is related to native mustards but creates chemicals that they are not adapted to, according to material (6). Native species, including two stem-mining weevils, a stem-mining fly, a leaf-mining fly, a scale insect, two fungi, and aphids were found attacking garlic mustard in North America. However, their attacks were of little consequence to plant performance or reproduction of garlic mustard. But the presence of the garlic mustard in this creek can cause damage to wildlife, as the author mentioned before there are presence of ducks, geese, frogs, and deers at the creek, so it is vital that the prevention of garlic mustard is enacted.

Conclusion

The author now returns to the hypothesis presented early on in this research paper. The author of this research paper explored various issues of flooding, invasive species, and field related issues. Flooding is heavily impacting the Rock Creek area, and from the author's field observations this fact is being confirmed.

Then the return to the research question is made: How does the surrounding area of Rock Creek impact the creek in terms of flooding and invasive species? The surrounding areas created sloppy hills or rocky shapes to block up some water while other spaces allowed rapid water flow, as seen from the instability of the different water depths, therefore, a conclusion was that the flooding issue was prevalent at Rock Creek. In terms of invasive species, no damage was found, but a variety of plants were found near garlic mustard.

This field research is only a slight overview of what is ahead of Rock Creek. There are many important methods to achieve health. Scientists can use nets to study the invertebrates by collecting them using a big net system in the creek, to study the diversity of such species of animals in a creek setting.

A conclusion about the flooding would be that from the data, the understanding of different water levels and so much difference with regards to the width and depth of the creek really showcased that the Rock Creek really do have a flooding problem, as one would not expect to see a normal creek to vary so much in so little space.

Fig 7. Rock Creek Environment (Author).

Another conclusion on a slightly off side view is that because of the limitation of the study the only parts surveyed was the floor plan of the area within the two kilometers, a well-made conclusion is still not readily available, because some areas of the creek are truly different from others, and it is still vital to compare these with a sense of honesty, from time to time.

Environmentalists can also use a floodplain mapping system to walk the route of the creek on a larger scale, and determine the creek health using that, as a reference to possible flooding.

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