

Utilizing Volunteers to Save the Văcărești Wetlands

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gr-vacaresti-d21@wpi.edu

Erik Herrera

Ryan Hanna

Catherine Masiello

Andrew Yatsunami

Professor Melissa Butler, WPI

Professor Robert Kinicki, WPI



WPI



Utilizing Volunteers To Save the Văcărești Wetlands

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Submitted by:

Ryan Hanna
Erik Herrera
Catherine Masiello
Andrew Yatsunami

Date:

13 May 2021

Submitted to:

Dan Bărbulescu
Nicoleta Marin
Văcărești Nature Park Association (VNPA)

Project Advisor:

Professor Melissa Butler
Professor Robert Kinicki
Worcester Polytechnic Institute (WPI)

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Abstract

Since 2019, the Balkans has experienced a severe drought, which has accelerated water loss in Văcărești Nature Park, an urban wetland in Bucharest, Romania. In collaboration with Dan Bărbulescu and Nicoleta Marin of the Văcărești Nature Park Association (VNPA), this project evaluated options for water management techniques utilizing volunteers to aid the organization in addressing the park's falling water levels. The team remotely completed VNPA member interviews, wetland specialist interviews, technical research, and a volunteer survey. These tasks contributed to a series of recommended solutions to the VNPA that include crowdsourcing monitoring data, clearing vegetation, rain gardens, digging wells, and topographical and hydrogeological studies to address the falling water levels.

Executive Summary

Motivation

The Văcărești Nature Park (VNP) is an urban green space in the heart of Bucharest, Romania. The area was once the site for a communist era hydrological project to create a lake in the 1980s; however, since the project's abandonment, a diverse wetlands ecosystem has taken root (see Figure E.1) (Bărbulescu & Marin, 2021).



Figure E.1: View of the Văcărești Nature Park (Văcărești Nature Park Association - Exploring nature, n.d.)

After becoming a nature protected area in 2016, the park provides recreation and relaxation space for Bucharest's residents and tourists alike (Văcărești Nature Park Association - Who we are, n.d.). The Văcărești Nature Park Association (VNPA), a Romanian non-government organization currently takes care of the park. In 2017, the National Agency for Nature Protected Areas in Romania granted the VNPA administrative authority over the park, but in 2019, government regulations rescinded this authority and now prevent the VNPA from legally managing the park outside of general custodial duties (Romanian Ministry of Environment, Water and Forests, 2017; Bărbulescu & Marin, 2021). Despite this administrative challenge, the VNPA oversees numerous projects in the VNP from wildlife documentation to trash pickup with the help of volunteers.



Figure E.2: Satellite images of the Văcărești Nature Park from 2016 to 2021 (Google Earth, 2021)

Since 2019, the Balkan region has experienced a severe drought, and the VNP has seen a noticeable decrease in water levels (see Figure E.2) (Copernicus, n.d.; Bărbulescu & Marin, 2021). Expansive reed areas overtaking ponds, limited government action to enforce park management plans, and the altered hydrology of the area from the original hydrological project further worsened the water level decrease. The VNPA does not have the means to fully quantify the water level decrease, but the impact is evident through the loss of ponds, which threatens wildlife and puts the survival of this fragile wetland ecosystem at risk (see Figure E.3). Presently, the VNPA is not managing any volunteer projects to address the water decrease. To address the lack of a water management plans in the VNP, the goal of this project was to evaluate options for water management techniques utilizing volunteers to aid the organization in addressing the park's falling water levels in collaboration with Dan Bărbulescu and Nicoleta Marin of the VNPA.



Figure E.3: Wildlife in the VNP (Văcărești Nature Park Association - Exploring nature, n.d.)

Approach

To identify specific water collection techniques, the team defined three objectives to achieve their goal:

1. Investigate the VNPA's strengths and limitations with water management and volunteer practices, and available resources.
2. Research how wetland specialist groups outside the VNPA manage water and utilize volunteers.
3. Evaluate water collection systems that help to manage the water levels in the VNP.

To investigate the VNPA's existing practices and resources, the team interviewed eight of the twelve organization members via Zoom and email, revealing the park's equipment, budget, administrative roles, media resources, and network. Members with biodiversity expertise addressed the current water management techniques and the challenges facing implementation. Members who manage volunteers expanded on the available labor resources and provided information regarding their volunteerism practices. Information from this objective provided the foundational knowledge and established the project's scope.

Subsequently, the team interviewed seven wetland specialists with expertise ranging from wildlife to hydrology to research how specialist groups manage wetlands considering the VNPA's resources.

The team identified wetland specialists through the previous year's IQP report, the project's collaborators, and databases (Rando et al, 2020). Two of the seven were familiar with the VNP's situation, while the other five based in the United States provided their expert advice on park issues. Interviewee responses provided solutions and considerations for the team to evaluate.

Results from the VNPA and specialist interviews informed a volunteer survey and

technical research to evaluate water management solutions based on the capabilities and limitations of the VNPA.

The online survey, which garnered 101 responses, measured levels of volunteer engagement and identified volunteer interest in the necessary tasks for each solution (see Figure E.4). Technical research investigated specialists' recommendations further to evaluate if the VNPA could implement them given their resources and the context of Văcărești's ecosystem.



Figure E.4: Volunteers in the VNP (Văcărești Nature Park Association - 600 trees, 2019)

Results

Equipment and financial resources are in short supply for VNP projects.

Due to the 2019 government decision, NGOs in Romania are unable to receive government funding for projects (Marin, 2021). Limited financial resources led the organization to rely on private companies, which is volatile given that companies can withdraw support at any time, such as during the COVID-19 pandemic (Bărbulescu, 2021). The absence of government aid and a stable budget means the VNPA is limited to an assortment of hand tools, cars, and measuring equipment (Bărbulescu, 2021).

Regulations make park projects difficult, but current talks with the municipality may improve the situation.

The Romanian government's 2019 decision also limits the VNPA's park activities to ecosystem monitoring or trash pickup while large scale projects must have

government approval. The government has not implemented any park management plans since removing the VNPA from park administration. However, ongoing talks with the Bucharest municipality could allow the VNPA to take on larger projects.

Media and networking promote Văcărești at the national and international level.

The VNPA has a strong online media presence with a park website, Facebook, Instagram, YouTube, WhatsApp group, and a podcast. This online presence, alongside other promotional materials such as brochures and flyers, have helped to promote park events in the past (Vasilescu, 2021). Additionally, the VNPA has a very extensive network with Romanian and global partners that creates collaborations and support between similar organizations.

Future volunteer projects must acknowledge volunteers' capabilities.

Volunteers have participated in park cleanups, planting of trees, and categorizing trees. Currently, they are restricted to cleanups and park patrols because a lack of software or equipment training limits the volunteers from technical infrastructure projects, but VNPA members said that the volunteers can dig pilot rain gardens (Mihalache, 2021).

Despite these constraints, results from the volunteer survey indicated strong interest in future tasks, where five is most interested and zero is least interested (see Figure E.5). The top responses to this question were planting vegetation and monitoring at 3.4 and 3.3 respectively (red). In contrast, the most physically demanding task, digging test holes, had the lowest average rating of 2.5 (purple). The highest and the lowest scores are within one point of each other demonstrating that even though there is a preference, it is not strong.

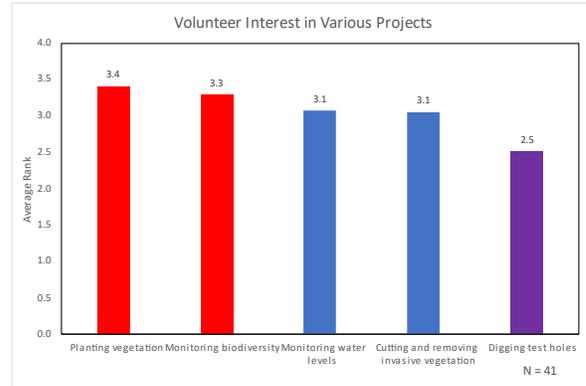


Figure E.5: Volunteer interest in various projects

Limited knowledge of the park's hydrology makes large scale water management difficult.

The VNPA does not have a complete hydrological picture of the park, meaning they do not know if projects introducing large quantities of water into the area will have a negative impact on park ecology. In VNPA interviews, members revealed that the park may be sitting on a discontinuous two-meter-thick layer of clay. Interviewee C indicated that this may be “a restrictive layer that isolates surface and groundwater,” and if the wetland sits on clay, an unsealed well could drain the ponds into the lower ground levels (Scweisberg, 2021).

Rain gardens are a nature-based solution for managing stormwater.

VNPA members have expressed interest in expanding their current pilot rain garden project and several wetland specialists support this plan. The VNPA wants to use rain gardens to direct water off pathways and into wetland ecosystems while specialists have suggested the VNPA might use rain gardens to collect city rainwater outside of the park.

Wells have potential to bring water into the park but come with risk.

The VNPA expressed interest in digging wells to supply groundwater to surface ponds and lakes to combat the drought's

effects. The wetland specialists explained that this is an option; however, they all expressed the importance of understanding the hydrology of the area before taking any such action. The use of monitoring wells before constructing wells to draw groundwater enables the VNPA to monitor the park's water table and underground layer composition to determine the impact of digging wells on the water table.

Volunteers can remove reeds without mechanization.

The *Phragmites australis* reed is drying up shallow ponds and crowding out habitat space (see Figure E.6), so wetland specialists and technical research identified mowing, solarization, herbicides, and shading as removal methods. Volunteers could use these methods to clear vegetation, but they would require constant upkeep due to the invasive nature of reeds.



Figure E.6: Reeds in Văcărești Nature Park (Văcărești Nature Park Association- Exploring nature, n.d.)

Digging provides a more permanent solution to reed clearing.

Specialists recommended using digging to stop reed expansion. The park's reeds cannot grow in water over two meters, meaning that deepening ponds prevents further reed growth. Digging removes the root system of the reeds and makes their reestablishment more difficult. However, excavating submerged land is beyond the

abilities of a volunteer and requires mechanization.

Time lapse photography can monitor water levels and vegetation growth.

Through technical research, the team found that crowdsourcing monitoring data could be an effective method to monitor an area for ecological effects. Fixed frames allow visitors to take pictures and send them back to a central database where software can stitch the pictures into a time lapse of the area (see Figure E.7). This time lapse of photos provides an evolution of slow processes such as vegetation spread or falling water levels. This will show the effectiveness or necessity of an intervention.



Figure E.7: A monitoring frame for crowdsourcing (Nerds for Nature, 2015).

Conclusion and Recommendations

The team concluded that the VNPA has a strong volunteer base, online presence, and public perception, but they are limited by their finances, government relationship, physical resources, and team members available to train and supervise volunteers. As the VNPA moves forward, the team created a set of recommendations split into four short-term and three long-term recommendations reflecting these strengths and weaknesses.

The VNPA can execute short-term recommendations within weeks to months and are as follows. The team recommends the VNPA crowdsources monitoring data in the park by installing phone stands for park

visitors to place their phones and take pictures at specific locations to monitor the area. This would provide the VNPA with inexpensive and documentable progression of vegetation growth and water level evolution. The next short-term recommendation is for the VNPA to continue promoting the concept of nature-based solutions. The VNPA should do this by providing information on nature-based solutions online through their various sources of social media and by adding information panels near their nature-based solution efforts, such as the rain gardens.

For physical interventions, the team recommends they use their strong volunteer base to cut vegetation and introduce vegetation shading to slow regrowth. The team also recommends that the VNPA dig monitoring wells to track changes in the VNP's hydrology for future large-scale projects.

The long-term solutions fit into the order of months to years and are the following. First, the team recommends a hydrological survey to assess the risk of negatively impacting the water table with wells or large influxes of water. The next recommendation is to conduct a topographical survey, which will allow the VNPA to understand how water will flow on the surface of the park.

This is essential in predicting the effectiveness of their rain gardens to capture water. As a long-term solution to the reeds issue, the team recommends that the VNPA work to steepen the shorelines of the ponds and lakes in the VNP. This helps to cut down on the habitable zones for the reeds and deepens the ponds and lakes.

Finally, the team recommends that the WPI Bucharest project center continue to create opportunities for collaboration with the VNPA through engineering thesis projects focused on maintaining the VNP's water levels for majors such as civil engineering or botanical sciences. All of these efforts will help protect the natural beauty of the VNP wetlands in Bucharest (see Figure E.8).



Figure E.8: Văcărești Nature Park at sunrise (Ignat, 2011)

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Table of Authorship

Author	Sections of Authorship
All	Abstract, 1.0, 2.0, 4.0, 5.1, 5.4, 5.5
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All authors contributed extensively to revisions and edits of all sections.

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1.0 Introduction

Climate change threatens the stability of ecosystems and increases biodiversity loss. The International Panel on Climate Change predicts that global temperatures will increase by 1.5 °C between 2030 and 2052 (Angearu, 2020). Warmer temperatures increase the frequency of droughts, leading to a lack of water available to fragile, water-dependent ecosystems, such as wetlands. Wetlands possess multiple environmental benefits, including promoting biodiversity, mitigating flooding, and aiding in the regulation of the nitrogen and carbon cycles (Keddy, 2013). Furthermore, wetlands provide other economic and social benefits to surrounding communities by promoting recreational activities and increasing local property value (Keddy, 2013; Czembrowski, 2016).



Figure 1.1: Aerial view of Văcărești Nature Park (Ignat, 2011)

Beginning in 2019 and continuing into 2021, the Balkans have been experiencing a drought. Due to this drought, Romania lost two million hectares of arable crop land last year and desertification threatens many Romanian ecosystems (Chirileasa, 2020; Copernicus, n.d.). One such ecosystem is the Văcărești Nature Park (VNP), an urban wetland and green space park in Bucharest, Romania (see Figure 1.1). Even though the park's water levels fluctuate naturally with the seasons, the drought worsened the dry season resulting in the loss of lakes within the park (Bărbulescu & Marin, 2021). Inaction of the local government and Ministry of the Environment, who have failed to provide funding and park protection, has exacerbated the effects of the drought. The lack of regulations contributed to increases in invasive species and expansion of water vegetation, such as reeds, which deplete water levels faster than they can recover (Bărbulescu, 2020). Compounding this problem is the lack of reliable statistics surrounding water loss in the VNP. The severe water level change and drier conditions within the park threaten wildlife survival, decrease visual appeal, increase the risk of vegetation fires, and lead to the devaluation of land in the surrounding residential and commercial areas (Bărbulescu, 2020).

Despite these challenges, Văcărești Nature Park Association (VNPA), the organization managing the VNP, recognizes that the park serves as a cultural heritage site and offers residents and tourists a variety of activities, such as walking and cycling trails,



Figure 1.2: VNP volunteers in the park (Văcărești Nature Park, 2021)

nature observation, and educational programs (Rando et al, 2020). To make these experiences possible, the VNPA recruits volunteers, “Urban Rangers,” to assist in park patrols, sanitation, and guiding tourists (see Figure 1.2) (Văcărești Nature Park Association - Urban Rangers, n.d.). In addition, the VNPA hosts volunteer-led educational events to engage the public in ecology (Văcărești Nature Park Association - Projects, n.d.). While these programs make a positive impact, the VNPA currently does not have plans to utilize the volunteers in water management projects to address the issue of the VNP’s decreasing water levels. The goal of the project was to recommend water management techniques that utilize park volunteers to aid the VNPA in addressing the falling water levels in the VNP. The team defined three objectives to achieve the goal:

1. Investigate the VNPA's strengths and limitations with water management and volunteer practices, and available resources.
2. Research how wetland specialist groups outside the VNPA manage water and utilize volunteers.
3. Evaluate water collection systems that help to manage the water levels in the VNP.

The outcome of the project was to present to the VNPA a set of four short-term and three long-term recommendations aimed at increasing the VNPA’s ability to effectively use volunteers to address falling water levels when circumstances permit their involvement.

An evaluation of the VNPA’s resources and current programs dictated interviews with other established conservation groups to provide recommendations on relevant projects. Technical research then determined the necessary steps and details to carry out such water management solutions. Finally, a volunteer survey gauged the abilities and interest of the park volunteers to measure the feasibility of solution implementation.

2.0 Background

This chapter introduces the general problem regarding wetlands conservation, beginning with a description of urban green spaces and wetland ecosystems. The chapter then discusses the history of Văcărești Nature Park (VNP) and examines the environmental and administrative problems facing the Văcărești Nature Park Association (VNPA). The following sections review how the VNPA uses volunteerism to carry out projects for the betterment of the park. The chapter concludes with three examples of potential water collection systems the VNPA proposed.

2.1 The Importance of Urban Green Spaces and Wetland Ecosystems

Urban green spaces are areas in cities containing natural or artificially planted vegetation (World Health Organization, 2017). The presence of green spaces provides numerous environmental, social, and economic benefits to the people living in the surrounding area. Green spaces improve pollutant filtration and climate mitigation in cities (Kabisch, 2015). In addition, green spaces promote better mental and physical health by reducing feelings of anxiety or isolation and providing recreational activities and easy means of exercise (Maund, 2019). The presence of green spaces draws tourists to the area and closer proximity to green spaces improves property value (Cianga, 2013; Czembrowski, 2016).

Among the different types of urban green space environments are wetlands, which are ecosystems inundated with water that have characteristics of both aquatic and terrestrial environments (Keddy, 2013). Wetlands are productive ecosystems that provide the surrounding area with environmental benefits such as supporting high levels of biodiversity, cycling groundwater recharge and discharge, aiding in water purification, and regulating the nitrogen

cycle (see Figure 2.1) (Lambert, 2003; Keddy, 2013). Additionally, wetlands regulate the climate through carbon storage (United Nations, 2018). Outside of these environmental impacts, wetlands promote recreation and cultural heritage for the local area (Keddy, 2013).

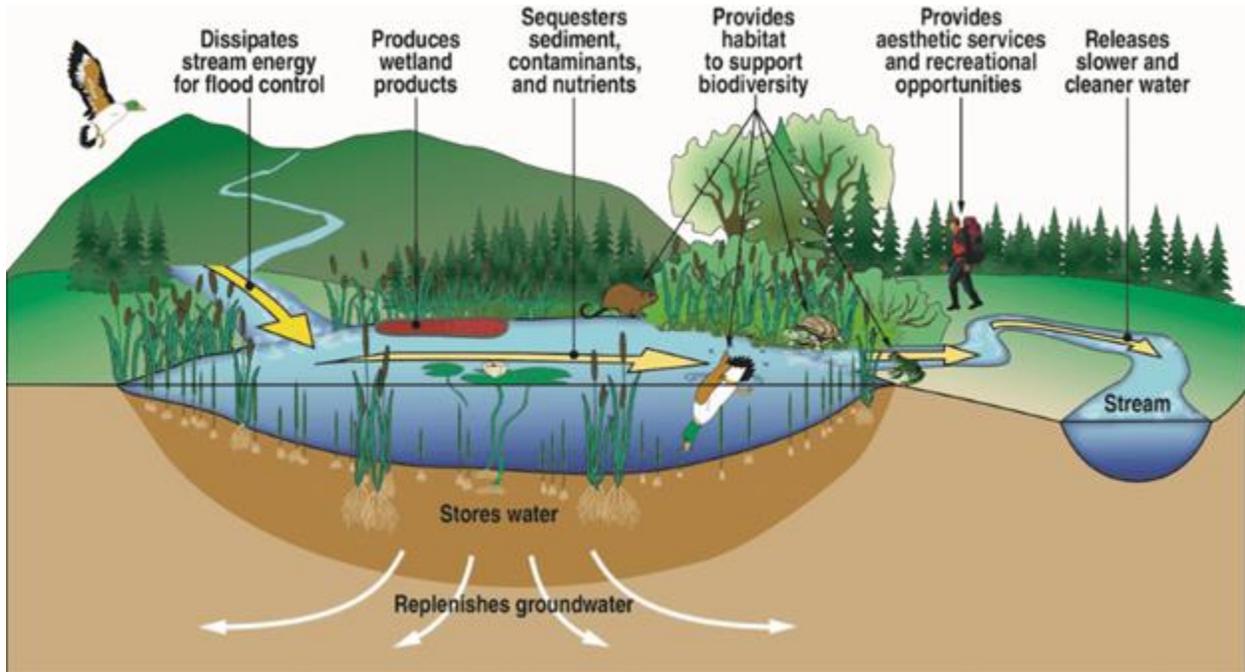


Figure 2.1: Diagram of the benefits of wetland ecosystems (Brockton Conservation Commission, n.d)

Climate change, urbanization, and water drainage are just a few factors contributing to wetland loss, making wetlands vulnerable ecosystems and sensitive to changes in water quality, precipitation levels, and temperature among other environmental aspects (United Nations, 2018; Erwin, 2009). Between 1970 and 2015, countries around the globe lost 35% of wetland ecosystems, and according to the Ramsar Convention, an intergovernmental treaty for wetland use and conservation, wetland destruction is three times faster than that of forests (United Nations, 2018).

2.2 A Brief History of Văcărești's Wetlands to Present Day

Prior to 1989, the Văcărești neighborhood, located on the banks of Dâmbovița River, consisted mostly of farmland and individual dwellings. Figure 2.2 displays the former Văcărești neighborhood in present-day Bucharest. The neighborhood once contained the Văcărești Monastery, a church built between 1724 and 1728 (see Figure 2.3) (Petrescu & Pintilescu, 2017).

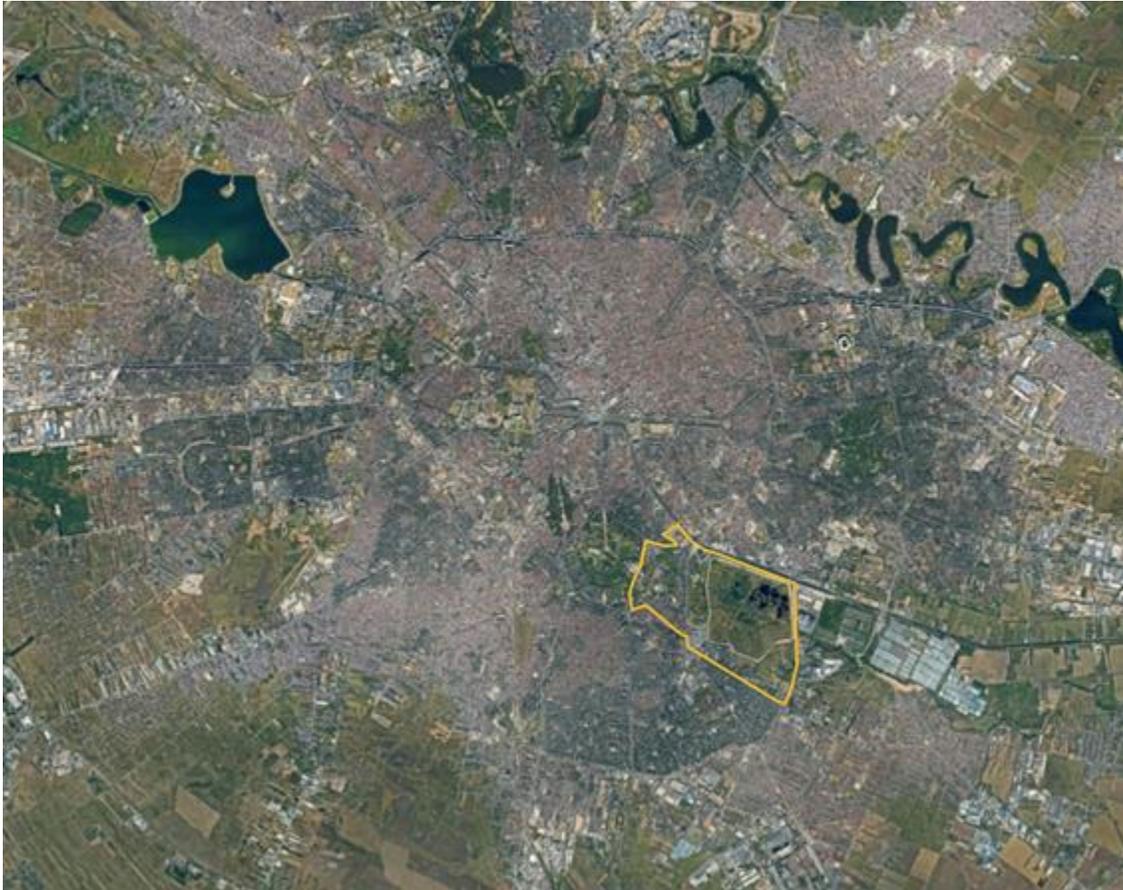


Figure 2.2: Location of Văcărești Neighborhood and Nature Park in Bucharest (Google Earth, 2021)

In 1983 to 1984, the Ceaușescu regime ordered the destruction of the Văcărești neighborhood to make space for a massive 184-hectare hydrological project known as Lake Văcărești (Bărbulescu & Marin, 2021). The communist government justified the project as a means to control flooding in Bucharest and envisioned it as a small port in the heart of the city. While the area was mostly farmland, the project still displaced a number of residents living in the

Văcărești neighborhood. Once the Romanian people overthrew the communist regime in 1989, the new government abandoned the lake for the next 25 years until the founding of VNP in 2016 (Ianoș et al., 2014; Ianoș et al., 2017).



Figure 2.3: Painting of Văcărești Monastery: “The Văcărești Monastery before the Storm.” (Petrescu & Pintilescu, 2017)

Efforts to revitalize the park began in 2012 when Cristian Lascu published “The delta among the blocks” in the May edition of National Geographic Romania. The article revealed the biodiversity in the park and called for the government to classify it as a protected area. After the publication of Lascu’s article, a group of four, including Dan Bărbulescu, set out to perform a Scientific Substantiation Study required to declare the park as a protected area. The study necessitated classifying biodiversity and documenting the ecosystem. After a year of field work, the Romanian Academy, the most prestigious scientific institution in Romania, endorsed the study and recommended the Romanian government declare protection for the VNP. After three years of lobbying and garnering public support with photography exhibitions, environmentalism and urbanism conferences, and projects in the field with volunteers, Government Decision no. 349/2016 formally established Văcărești Nature Park in 2016 (Văcărești Nature Park Association - Who we are, n.d.).

Along with the formation of the VNP, the National Agency for Protected Natural Areas (ANANP) granted park administration to the VNPA in a 2017 government contract (Romanian Ministry of Environment, Water and Forests, 2017). In January of 2018, the VNPA sent regulations for the VNP to the Ministry of Environment but never received official approval. Additionally, the Ministry of Environment cancelled the contract for administration in 2019 after the Romanian government passed a law prohibiting NGOs from managing nature protected areas. Currently, the VNPA is the organization taking care of the park, but they must appeal to the ANANP for large-scale projects (Bărbulescu & Marin, 2021; Cioflec, 2021). Previously, the VNPA could appeal for funding for these projects through the ANANP, but roughly 98% of their monetary assets comes from private sources. The private sources, mostly companies, provides a 150,000 euro yearly budget, which pays the NGO employees, the projects, and other needed expenses (Bărbulescu, 2021; Bărbulescu & Marin, 2021).

2.3 Present Day Văcărești



Figure 2.4: Aerial view of the Văcărești Nature Park (Gillet, n.d.)

Văcărești Nature Park, (see Figure 2.4) is a wetland surrounded by commercial and residential areas in the heart of Bucharest, spanning approximately 200 hectares (Bărbulescu,

2021). Apartment complexes, medical centers, sports and wellness clubs, and a variety of stores comprise the assorted buildings just outside the park. A five-meter dam around the area, constructed during the original Lake Văcărești project, isolates the VNP from these city areas and the park itself sits eight to ten meters below street level (Bărbulescu & Marin, 2021). While the VNP's environment developed naturally, additional park infrastructure allows the local community, school groups, and tourists to access the area for recreational and educational purposes, including walking and cycling trails, birdwatching platforms (see Figure 2.5), and a boardwalk (Gillet, 2021; Văcărești Nature Park Association - Who we are, n.d.).



Figure 2.5: Birdwatching tower in the park (Bărbulescu, 2021)

Sustained by the presence of natural areas including virgin forests in the Carpathian Mountains and the Danube Delta, Romania has the highest biodiversity in the European Union (Stoican, 2021). The VNP is one of these rich natural areas, harboring a high level of biodiversity for both plants and animals. Of the species found within the park there is a wide range of common, rare, and exotic organisms, such as the threatened *Wolffia arrhiza* (see Figure 2.6) and the native *Salix alba* (see Figure 2.7), which are two flora species out of over 330 growing in the VNP (Văcărești Nature Park Association- Biodiversity, n.d.; Cioflec, 2021). There is a variety of aquatic life consisting of seven species of fish and six species of amphibians, including the protected fire-bellied toad and great crested newt, found among the park's several lakes (Văcărești Nature Park Association- Văcărești Nature Park, n.d.; Văcărești Nature Park Association- Biodiversity, n.d.). Other park fauna include over 10 species of mammals, such as otters, and 175 bird species, including a colony of white terns that migrate to the area each spring (Cioflec, 2021; Bărbulescu & Marin, 2021). The park stands as an oasis of biodiversity in one of Europe's largest cities, and as a result of its unique position, Văcărești has a complicated vegetation and hydrological profile.



Figure 2.6: *Wolffia arrhiza*
(Fryš, 2019)



Figure 2.7: *Salix alba*, also known as the white willow
(White willow, n.d.)

2.3.1 *Phragmites australis*

Phragmites australis, the common reed, is the most widespread plant species and provides species with shelter, food, shade, and nests. However, dense reed stands can limit available habitat space to larger predatory animals like otters or birds, which cannot hunt properly. Reptiles also lose areas for sunbathing, and amphibians do not have adequate areas for spawning in the spring (George, 2021).

Common reeds dominate ecosystems after a fire or storm because the cleared areas allow the reeds to quickly colonize, spreading up to four centimeters a day. Typically, the reeds spread via rhizomes, an underground root-like stem that grows horizontally, and new reed stems can grow from the rhizomes (see Figure 2.8).

In well-established reed ecosystems, the rhizomes form a dense mat along the upper six to eight inches (15 to 20 cm) of soil. *Phragmites australis* stems grow quick and tall, so other native plants cannot compete due to the reed's shading. Storms or fires can also kill the surface stems of the reed, but if the rhizomes survive, the stems can regenerate. The fires in Văcărești continue to kill native vegetation while the common reed reestablishes,

owing to its nearly 70% park surface coverage (Bărbulescu, 2021). Shading from direct sunlight does not kill the reeds completely but a woody canopy can significantly decrease reed density. Water levels of greater than 50 centimeters prevent propagation of the stems from the rhizomes and mature reeds can survive in waters less than two meters. Văcărești's ponds are shallow and

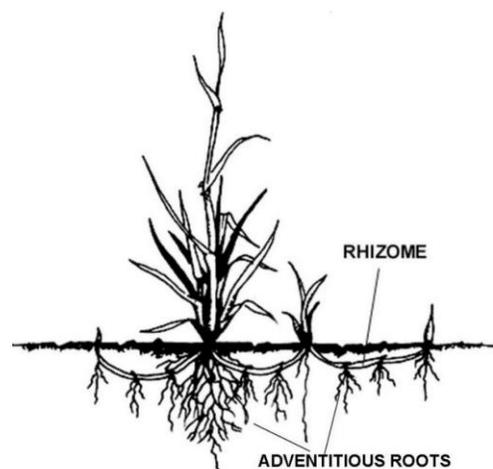


Figure 2.8: Diagram of rhizomes propagating new shoots
(1st Chinese Herbs, n.d.)

only shrinking which enables the reeds to take over water bodies. The reeds in the shallow ponds use more water than what enters naturally (Bărbulescu, 2021) (Gucker, 2008).

2.3.2 Hydrology of the VNP

The way in which water moves relative to land, or the hydrology defines and creates wetland ecosystems (McManus, 2021). The hydrology of the VNPA is unique in that it does not conform to a typical wetland's hydrological features. When communist-era Romania was attempting to construct a lake at the site of the VNP, as discussed in Section 2.2, the construction of the dam near the park completely altered the hydrology of the area (Stoican, 2021). Despite not being the original intent of the communist government's construction plans, the alteration of the hydrology allowed the VNP to become a wetland. Now, wetland specialists believe the entire park and a few surrounding areas sit on an old riverbed of sand and gravel layers that were once part of the Dâmbovița River. This forms an intricate layering of soils with high hydraulic conductivity (see Figure 2.9). On top of the old riverbed sits a layer of clay that averages around two meters deep. Topsoil of around 40 cm deep that makes up the surface ground layers covers the clay layer (Gaitanaru, 2021). This type of layering results in an aquiclude, or an area hydrologically secluded from the greater hydrology of the area. In an aquiclude, the water table that exists above the clay layer does not interact with the aquifers below the clay layer, therefore the VNP's lakes are likely just expressions of surface waters. This also categorizes the VNP as a perched wetland system, or one which is separated from stream or river influence and receives water by general drainage (Interviewee C, 2021).

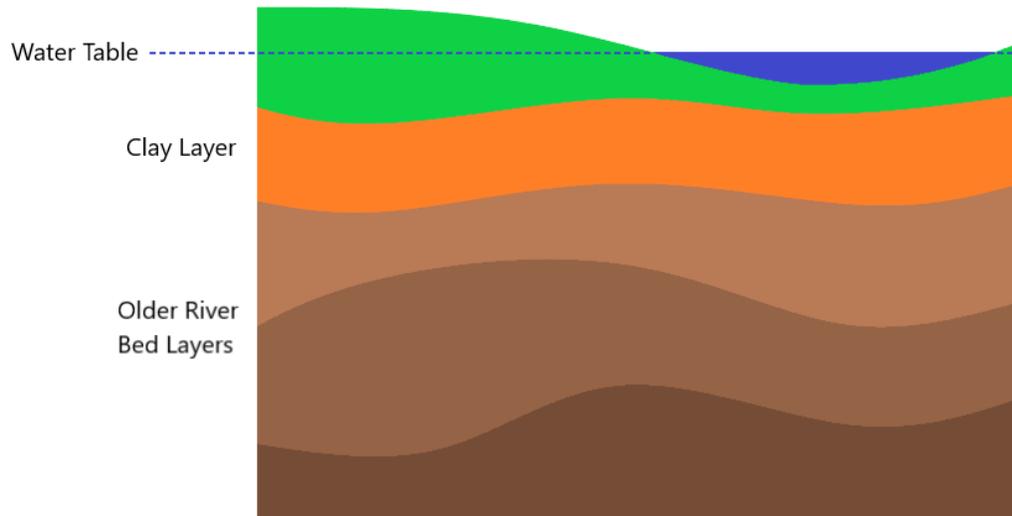


Figure 2.9: Văcărești hydrology sketch

2.4 Problems Facing Văcărești Nature Park

There are a number of serious issues currently facing the VNP, including declining infrastructure from the original lake project, invasive species, poaching, illegal logging, and decreasing water levels (Gillet, 2021; Bărbulescu, 2020). While environmental changes cause several of the problems, other issues stem from a lack of governmental park management to maintain and monitor the infrastructure and landscape as the Romanian government has not passed official park regulations or a management plan (Bărbulescu & Marin, 2021). Though the VNPA has extensive data on park biodiversity, the organization lacks statistics on water levels, which makes quantifying the water fluctuation difficult (Bărbulescu & Marin, 2021).

2.4.1 The Causes and Impacts of Decreased Park Water Levels

A recent drought beginning in 2019 affected much of the Balkans area, though Romania in particular suffered major losses (“100-Year Drought Hits Poor EU Region Already Reeling from Virus,” 2020). A USDA report on Romanian agriculture predicts a 19% decrease in wheat

production and 16% decrease in barley production between 2020 and 2021, giving a sense of the severity of the drought's effects (Dobrescu, 2020). Alongside the agricultural impacts, the drought affects other natural environments in Romania, including the VNP. Open water accounts for about 29% of the VNP's surface area (Bărbulescu & Marin, 2021). These water levels naturally fluctuate with yearly dry seasons, but the drought dramatically altered the natural cycle (Bărbulescu & Marin, 2021). The vegetation in the VNP is another contributing factor to the lower water levels, as increasing amounts of invasive species and reed areas have begun overtaking the available surface water (Văcărești Nature Park Association & et al, 2020). While there are no definitive statistics on the water decrease, the VNPA estimated that the water levels dropped by about one meter as a result of the drought and vegetation (Bărbulescu & Marin, 2021). Figure 2.10 illustrates that the decrease in water levels is so severe that lakes in the park are beginning to dry up, which threatens the park's aquatic species (Văcărești Nature Park Association & et al, 2020). Aquatic species are an integral part of the park ecosystem, so their loss would put bird and mammal species at risk as well (Cioflec, 2021).



Figure 2.10: Satellite images of the VNP from 2016, 2018, and 2021 (left to right) (Google Earth, 2021)

The combination of lower water levels and increased vegetation also creates more dry vegetation, therefore increasing the amount of flammable fuel in the park (Bărbulescu, 2020; Littell, 2016). Consequently, higher levels of fuel may increase the risk of vegetation fires in the VNP, which is most prevalent in the dry season that typically lasts from September to March (Bărbulescu, 2020). Not only do these fires pose a risk to the park's wildlife, but they threaten the surrounding area. A VNP fire in February of 2020 damaged more than 90 hectares of the wetland, over 50% of the park area (see Figure 2.11) (Bărbulescu, 2020). Given the VNP's location in Bucharest, surrounding buildings are at risk when in close proximity to massive fires (Bărbulescu, 2020).



Figure 2.11: A VNP fire in February 2020 (Văcărești Nature Park Association - A year of fire, 2021)

2.4.2 Problems with Park Administration and Management

Since gaining authority of the VNP, the ANANP has not implemented widespread park regulations nor assembled scientific and advisory councils to properly protect the park ecosystem and improve the declining infrastructure (Văcărești Nature Park Association - Authorities decline responsibility, 2020; Bărbulescu, 2020). To address the lack of effective administration, the

VNPA sent a joint letter in 2020 to the ANANP and the Ministry of Environment, Waters, and Forests requesting emergency intervention in the park, including implementation of park regulation, a management plan, and a park guard (Văcărești Nature Park Association & et al, 2020). Despite the letter, the ANANP provided no timeline on implementation of the proposed intervention implementation nor procedures on how the organization would approve such interventions (Văcărești Nature Park Association - Authorities decline responsibility, 2020). Furthermore, the ANANP is unclear on the potential likelihood of monetary funding for the park (Văcărești Nature Park Association - Authorities decline responsibility, 2020). As discussed previously in Section 2.2, the VNPA has not received this financial support from the government thus far. Additionally, the organization does not charge for admission into the park so they have no means to supplement the privately sourced funding (Bărbulescu & Marin, 2021).

2.5 Volunteerism in Văcărești Nature Park

Despite facing these problems, the VNPA has been active in garnering public support to maintain the VNP. They have done this through various educational efforts, including a park visitor app, where the user can virtually tour routes in the park with guided information. The app highlights many of the trails that the VNPA created for cyclists and hikers to encourage Bucharest residents and tourists to visit the park. A reporting feature on the app allows visitors to take a picture and report an issue directly to the VNPA team as well.

Additionally, the park hosts awareness days such as “Journey to the Hive,” where kindergarten students participated in guided tours about how pollinators help the park. These educational components promote awareness of the park’s benefits, such as biodiversity, which is key to increasing interest in the VNPA’s volunteer projects.

The VNPA utilizes volunteerism for day-to-day management as well as larger scale projects. Currently, the association has about 150 active volunteers, but maintains a list of approximately 300 people who occasionally volunteer in the park



Figure 2.12: Volunteers for the OMV Petrom collaboration project (Văcărești Nature Park Association - 600 trees, 2019)

(Poiană, 2021). Common volunteer activities within the VNP include cleaning up trash in sections of the park, monitoring biodiversity, and informing visitors of park rules (Poiană, 2021). One of the most recent projects was with the OMV Petrom company, an energy company, who financed planting 600 trees in 2019 and the planting of 6,000 trees around the park over the span of three years (see Figure 2.12) (Bărbulescu & Marin, 2021). Additionally, the project involved creating an inventory of the trees within the VNP. The result was two-fold because the VNPA started conserving 30 hectares and exposed more than 100 volunteers to their mission (Văcărești Nature Park Association - 600 trees, 2019).

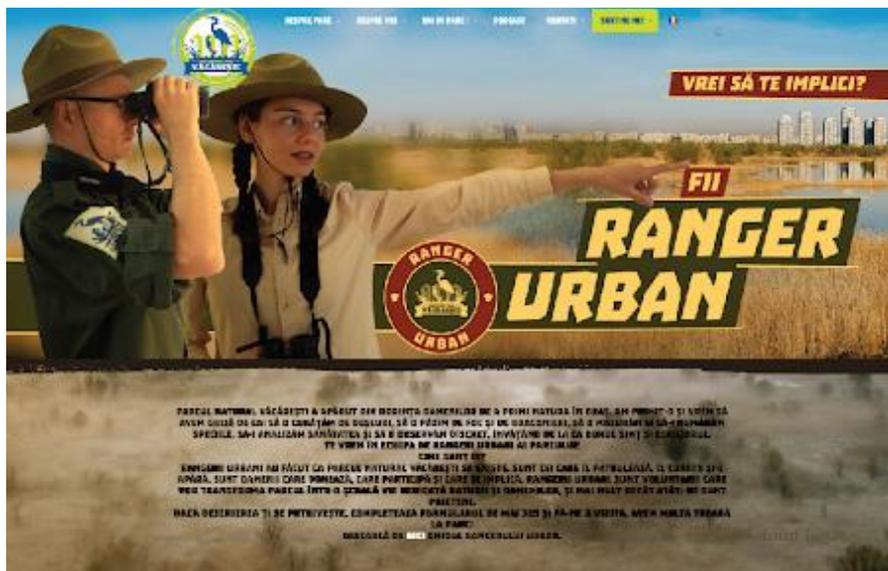


Figure 2.13: Urban Ranger page on VNPA website (Văcărești Nature Park Association-Urban Ranger, n.d)

Additionally, the VNPA has an Urban Ranger program, a formal volunteer program that began in 2016, where volunteers can help patrol the park, give tours, and contribute to projects. The organization first promoted this program on their website, to a large reception (see Figure 2.13). Even today, the VNPA is still receiving Urban Ranger Applications, even though they are not actively promoting the program and recruiting volunteers (Poiană, 2021). One of the projects that the Urban Ranger's assisted in was the "The Living Water of the City," a day event to raise awareness about the importance of the wetlands (see Figure 2.14). This project produced an infographic about urban wetlands as well as installed a play panel in the park for children to understand the water table in VNP (Văcărești Nature Park Association - Projects, n.d.). Volunteers greatly support the VNPA, and without them, the park could not remain clean and would lack much of its infrastructure (Văcărești Nature Park Association - Urban Rangers, n.d.). The result of bolstering community involvement is a positive feedback loop that propels the park into becoming a communal center.



Figure 2.14: Living Water of the City (Văcărești Nature Park Association – Living Water of the City, 2019)

2.6 Water Management

Though the park has many volunteer programs and event days, the VNPA has yet to fully explore water management projects because the drought is quite recent. There are numerous existing water collection systems to address droughts, but the team's collaborators at the VNPA suggested the use of shallow wells, vegetation clearing, and rain gardens (Cioflec, 2021; Mihalache, 2021).

2.6.1 Shallow Wells

Wells can be shallow or deep, and for the purposes of this study, the team is investigating shallow wells due to the VNPA's resource limitations. A well is a hole dug for the purpose of collecting water from the water table. Water is present within the spaces between the dirt particles and rock grains beneath the land surface, and the water table is the boundary between the saturated and unsaturated zones where water completely fills the spaces between grains and particles (see Figure 2.15) (USGS, n.d.). Digging into the water table will pool water in the resulting hole.

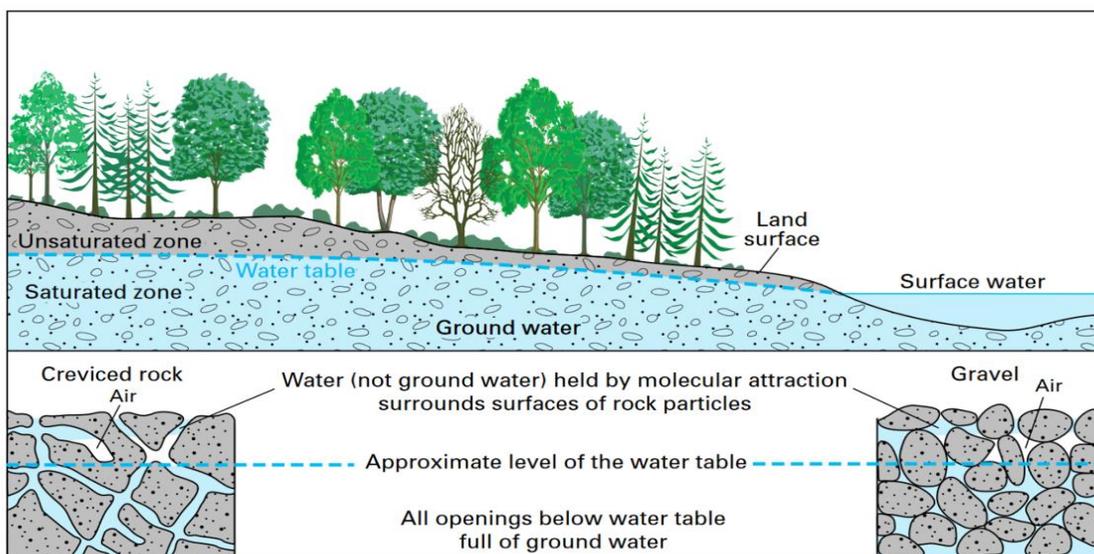


Figure 2.15: Description of water table and water saturation of the area below the water table (USGS, n.d.)

There are two types of shallow wells: dug wells and driven wells (see Figure 2.16). Dug wells extend below the water table until the incoming water exceeds the digger's bailing rate. These are typically large in diameter and expose a large area to the aquifer, the water in the saturated zone illustrated in Figure 2.15. Rock, brick,

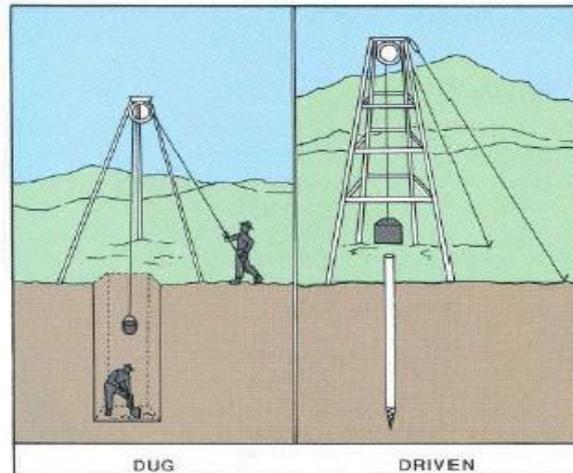


Figure 2.16: Dug wells versus driven wells (Waller, 2016.)

concrete, or other materials line these types of wells to prevent collapse. Driving a small-diameter pipe into soft earth like sand or gravel constructs driven wells. These types of shallow wells require less manpower to install than dug wells but require heavier equipment (Waller, 2016). The use of these wells is just one method that collaborators at the VNPA want to investigate to introduce water into the park.

2.6.2 Vegetation Clearing

Another water management solution is vegetation clearing. Currently, reeds in the park have overwhelmed the Văcărești's ecosystem by taking up roughly 70% of the available surface area (see Figure 2.17) (Mihalache, 2021). The reeds displace other native plant species, disturb other wildlife habitats, and dry up smaller bodies of water, exacerbating the drought's effects (Wisconsin Reed Canary Grass Management Working Group, 2009).

To combat the reeds' impact, park managers can use a variety of physical, mechanical, and chemical means of clearing the reeds though the VNPA prefers not to use chemical means of removing the vegetation due to the sensitivity of the ecosystem (Mihalache, 2021). Mechanical

solutions require the VNPA to dig out the matted root system around the shorelines to prevent the species from reestablishing. This is quick, but it necessitates utilizing a mechanized digger and can easily displace other desired plant species. Physical means such as cutting down the reeds below water levels or repeated cutting after the growing season starves the plants of resources and kills them. Workers could then plant annual ground cover over the cleared land because annual plants grow fast, and the shade will stop reed germination. This allows the establishment of native perennial species while eliminating reed overcrowding (Wisconsin Reed Canary Grass Management Working Group, 2009). These perennial species will use up less water and prevent reeds from encroaching into the open surfaces of the ponds.

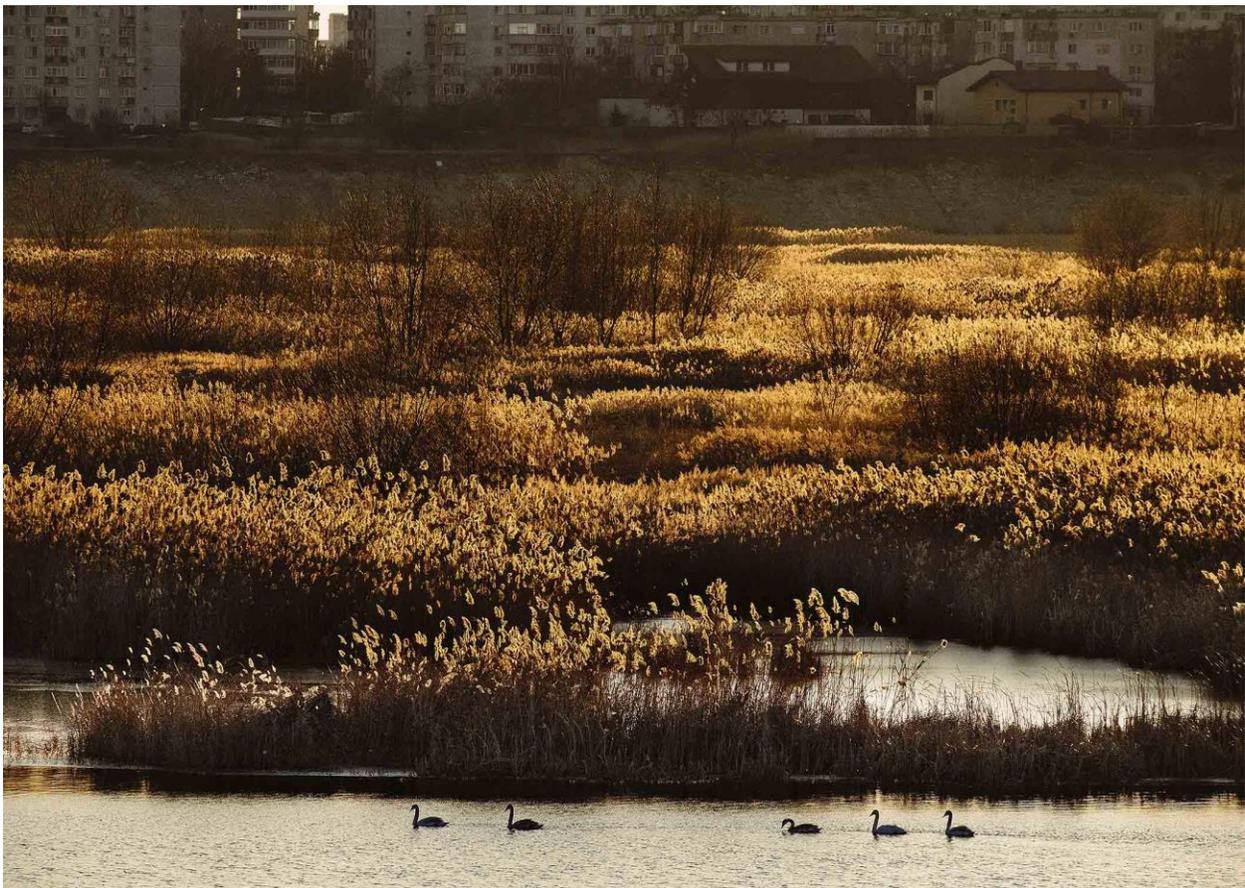


Figure 2.17: Reeds near a pond in the Văcărești Nature Park (Văcărești Nature Park Association- Exploring nature, n.d.)

2.6.3 Rain Gardens

A third water management solution is the implementation of rain gardens. There are multiple uses of rain gardens, one of which a Japanese case study details. Researchers in Kyoto Prefecture sought to reduce the impact of heavy rainfall through the construction of rain gardens. Though this is a different issue than Văcărești's water problem, the general purpose of rain gardens is to collect rainwater and transfer the water into the ground through infiltration. The case study focuses on designing the optimal tank model to accompany two types of general rain gardens (see Figure 2.18).

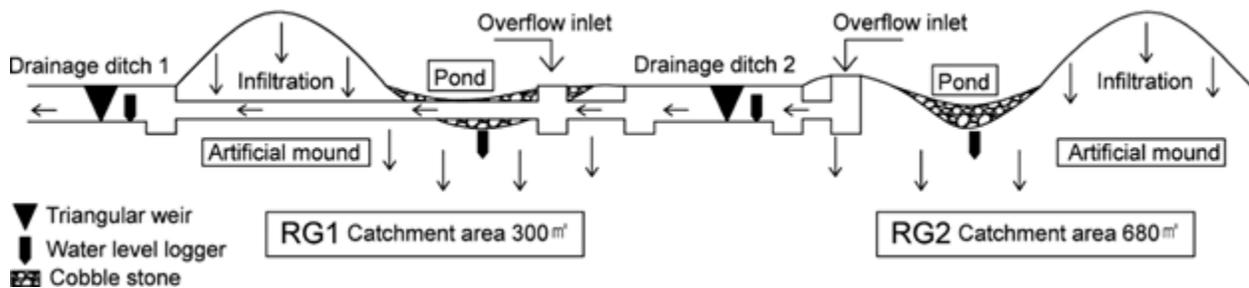


Figure 2.18: Diagram of the rain garden designs used in the Kyoto Prefecture study (Zhang et al., 2020)

The designs for rain garden one (RG1) and rain garden two (RG2) consist of the same fundamental parts. The inundation areas (namely, the artificial mounds) capture water and provide surfaces for trapping rainwater. The runoff then flows into a catchment area (shown as the cobblestone pond) that collects runoff and supplies the plants in the rain garden with water. The infiltration of the water into the ground occurs at the inundation and catchment areas. If excess water collects in the catchment area, an overflow inlet allows for spillage of excess water from the catchment area into the drainage system (shown as the drainage ditch). The drainage system then carries water away from the area. This case study outlines the general parts that go into rain gardens, which are just one example of the many types of water collection systems possible for implementation in the VNP (Zhang et al., 2020). These solutions comprise short-term and long-term options for water management plans in the VNP that the team investigated

through expert interviews with conservationists, archival research, and a volunteer survey. The next chapter details these project activities.

3.0 Methodology

The goal of the project was to recommend water management techniques that utilize park volunteers to aid the Văcărești Nature Park Association (VNPA) in addressing the falling water levels in the Văcărești Nature Park (VNP). The team defined three objectives to achieve the goal:

1. Investigate the VNPA's strengths and limitations with water management and volunteer practices, and available resources.
2. Research how wetland specialist groups outside of the VNPA manage water, and recruit and utilize volunteers.
3. Evaluate water collection systems that could help manage the water levels in the VNP.

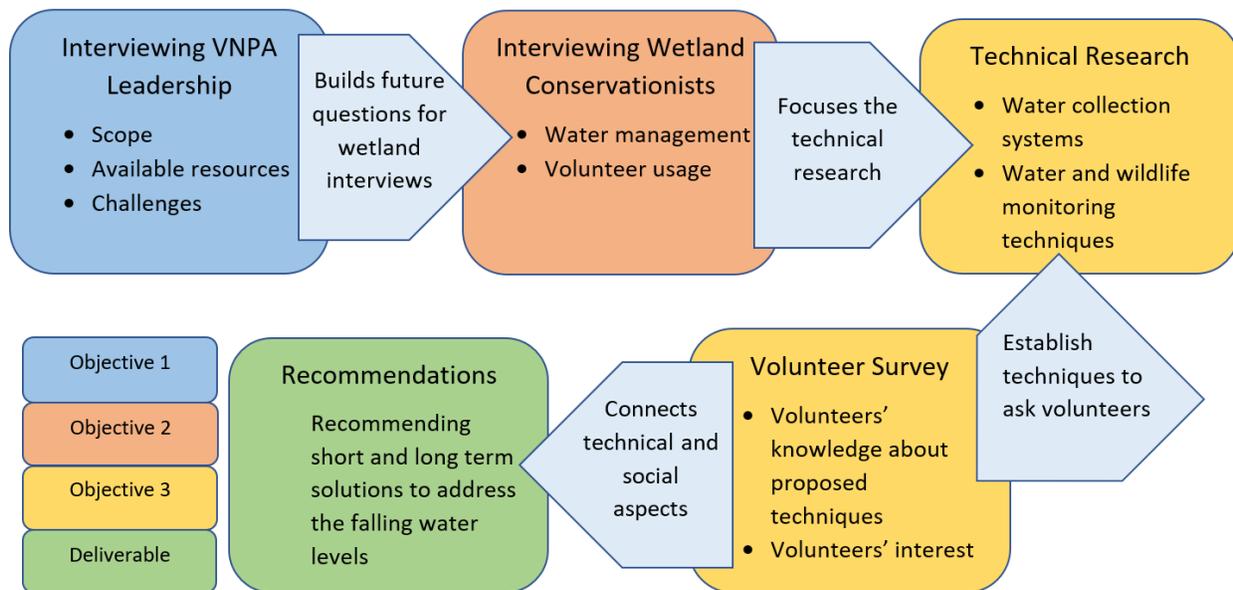


Figure 3.1: Flow chart of the tasks that fulfill objectives to reach the final recommendations

The team completed these objectives through a series of tasks conducted remotely during the IQP term from March 24 to May 13. Figure 3.1 shows a flow chart of the completed tasks that addressed each of the goal's objectives. An arrow connects each of these tasks to demonstrate the dependencies each task and objective has on one another. VNPA interview information dictated the questions asked in wetland conservationist interviews to identify water management and volunteer usage ideas. Then, technical research refined and narrowed these

ideas to specific short-term and long-term solutions. Short term solutions are within the current resource constraints of the VNPA, and volunteers can complete them. Long term solutions are not necessarily within the current limitations of the park, but instead they are pathways for the VNPA or another project to pursue. The volunteer survey provided insight on activities volunteers are willing to do and the additional steps the VNPA might take to inform the volunteers of the water issues in the VNP. The results from each method factored into assessing feasible implementation of volunteer-based solutions by the VNPA to address the park's falling water levels. The project members recognized that the government and general public surrounding the park were not directly approached given the timeline constraints of the IQP term, though results from the other methods provided insight on the perspective of these two groups. In the short two-month timeframe, the team and project collaborators did not find effective remote methods to reach these stakeholders. Given the health situation of the COVID-19 pandemic, the team executed the following methods remotely, which ultimately constrained the available resources to complete this project.

3.1 Interviews

Interviews with VNPA members and wetland specialists outside the organization yielded in-depth responses on project scope, VNPA resources, challenges in the project, volunteerism practices, and water management ideas based on interviewee's expertise. The team's interviews were semi-structured with at least two team members present. Before asking questions, the team requested and received explicit permission to record interviews and transcribed the recordings afterward (see Appendix A). Some of the interviewees wished to remain anonymous by only

agreeing to publish results. To maintain the interviewees confidentiality, the team redacted the interviewee’s name, title, and workplace from the transcripts.

The team conducted interviews over Zoom, email, and phone. For the Zoom and phone interviews, the team conducted semi-structured interviews based on a list of prepared questions tailored to each interviewee. For email interviews, the team prepared an initial list of questions for the interviewee and then responded with follow-up questions in a subsequent email. Table 3.1 describes the average duration, advantages, and disadvantages of Zoom, email, and phone interviews.

Table 3.1: Interview formats

Interview Format	Approximate Duration	Advantages	Disadvantages
Zoom	35 minutes	Faster interview process Semi-structured questions based on responses	Language barrier Time zone differences
Email	1 week	No scheduling conflicts Time zone compliant Gives time for prepared responses from interviewee Mitigates language barrier Occasionally more comfortable for the interviewee	Much slower interview process Lack of instant feedback Questions are up for interpretation by interviewee
Phone	25 minutes	Faster interview process Semi-structured questions based on responses	No body language Time zone differences

Out of these three formats, the team found that the best interview method was over Zoom, since it was the closest format to in-person, where interviewer and interviewee can both see and hear each other. Email interviews took too long to conduct given the limited time for data collection, and phone interviews were akin to Zoom but without the ability to see body language.

3.1.1 Interviewing VNPA Leadership

The first task of objective one, evaluating the VNPA’s available resources and scope for water management projects, involved interviews with the organization’s leadership. The current VNPA comprises four founding members and eight other employees, all with various administrative and field duties (Văcărești Nature Park Association- Team, n.d.; Marin, 2021). Of these members, the team conducted interviews with all of the VNPA members that collaborator Dan Bărbulescu indicated as accessible. In total, the team conducted interviews over both Zoom and email with eight of twelve VNPA members (see Table 3.2 and Table 3.3).

Table 3.2: Zoom interviews with VNPA leadership

Interviewee	Title	Area of Expertise	Date
Dan Bărbulescu	Executive Manager	Administration	29 March, 2021
Vlad Cioflec	Biologist	Biodiversity	30 March, 2021
Gabriela Poiană	Communicator	Volunteerism	31 March, 2021
Nicoleta Marin	Project Manager	Administration Volunteerism	2 April, 2021
Bogdan Mihilache	Landscape Ranger	Biodiversity Infrastructure	2 April, 2021
Florin Stoican	President	Administration	7 April, 2021

Table 3.3: Email interviews with VNPA leadership

Interviewee	Title	Area of Expertise	Date
Interviewee A	Redacted	Water Management Infrastructure	7 April, 2021
Bogdan Vasilescu	Ranger	Volunteerism	14 April, 2021

The high sample size (67%) effectively represents the VNPA, as the team was able to interview members with expertise in park administration, biodiversity, volunteerism, and infrastructure, therefore encapsulating all project-relevant areas of expertise. Before each

interview took place, the team tailored the interview questions to the expertise of the interviewee using background information available on the VNPA website (see Table 3.2 and Table 3.3).

(Văcărești Nature Park Association- Team, n.d.). The team developed interview questions based on a general guide (see Table 3.4 and Appendix B).

Table 3.4: VNPA interview subjects and corresponding questions

Subject	Questions
Interviewee Background	B.1 - B.3
VNPA Resources	B.4 - B.7
Water and Biodiversity in the VNP	B.8 - B.12
Volunteerism in the VNP	B.13 - B.20

The questions were in a semi-structured format, meaning the interviewer did not strictly adhere to the guide based on their responses. Additionally, during the interview, the interviewer reworded questions as necessary since the VNPA team members are native Romanian speakers with varying levels of English skills. After learning of potential solutions in early VNPA interviews, the team asked later interviewees questions about these specific solutions. A few interviewees had specific or limited areas of expertise and could not answer the majority of the questions on the original interview guide. For these interviews, the process became more unstructured, and the interviewer asked questions directly relevant to the interviewee’s background and responses. These unstructured topics focused on park administration and the VNPA’s network (see Appendix G.6). The results from the completed VNPA interviews informed the questions for the conservationist interviews, described in the following section.

3.1.2 Interviewing Wetland Specialists

The sole task of objective two, researching how wetland specialist groups outside the VNPA manage water and utilize volunteers, was to interview specialists. The team first identified specialists to contact from the project's primary collaborator Dan Bărbulescu, who provided a list of professors and wetland specialists in Romania and the UK (see Table 3.5). The team reached out to all four contacts via email and received initial responses from two of the four within three days. Secondly, the team contacted a second set of wetland specialists based on the previous year's IQP and the Society of Wetland Scientists database through a combination of emails and phone calls (see Table 3.5 and Table 3.6) (Rando, 2020). Additionally, the team emailed other groups like Wetlands International, The Wetlands Initiative, and environmental consulting firms without success.

The interviewer asked about specific water collection methods and technical aspects that appeared in the previous interviews. For each email interviewee, the questions (see Table 3.7 and Appendix C) focused on methods that matched the interviewee's expertise, such as wildlife, administration, and hydrology (see Table 3.5) which team members found on their organization website. Table 3.6 lists the specialist's expertise as consultant because they have a broad range of expertise in their work in consulting positions, rather than a specific area of study (see Table 3.8 and Appendix D). The team conducted email interviews with the three respondents by sending a list of interview questions via email with an average response time of one week. The phone interviews were similar to the Zoom interviews where at least two team members were present on the call, one to record notes and another to ask the questions. Responses from this method directed investigation into specific water management topics detailed in the following section.

Table 3.5: Wetland specialist email interviews

Interviewee	Title	Area of Expertise	Date
Interviewee B	Redacted	Administrative	12 April, 2021
Dr. Bouroș George	Conservation Officer	Wildlife	14 April, 2021
Dr. Dragos Gaitanaru	Lecturer, Postdoc Researcher Technical University of Civil Engineering	Hydrology	14 April, 2021

Table 3.6: Wetland specialist phone interviews

Interviewee	Title	Area of Expertise	Date
Interviewee C	Redacted	Wetland Consultant	13 April, 2021
Matt Burne	Senior Ecologist at BSC Group	Wetland Consultant	14 April, 2021
Matt Scweisberg	Principal of Wetland Strategies and Solutions LLC	Wetland Consultant	22 April, 2021
Paul McManus	President of EcoTec, Inc.	Wetland Consultant	22 April, 2021

Table 3.7: Wetland specialists email interview subjects and corresponding questions

Subject	Questions
Interviewee Background	C.1 - C.3
Văcărești’s Hydrology and Infrastructure	C.4 - C.10
General Water Management	C.11 - C.14
Wildlife Management	C.15 - C.18

Table 3.8: Wetland specialists phone interview subjects and corresponding questions

Subject	Questions
Interviewee Background	D.1 - D.2
Technical Solutions	D.3 - D-6

3.2 Technical Research

The team used technical research to address objective three, evaluating water collection systems that could help manage the VNP's water levels. To begin the research, collaborator meetings and VNPA interviews identified three topics to investigate: shallow wells, vegetation clearing, and rain gardens. The first step to the general researching process was to gain surface level knowledge about the topic through basic search engine results. This foundational information provided key words to search for reliable sources from government databases and scientific journals. Next, the VNPA interview information regarding resources and park space instructed the usefulness of each article or topic found. If a topic fit in the context of the VNP, the team incorporated questions about it in the conservationist interviews whose expertise might point out knowledge gaps. Through these interviews, the wetland specialists provided information that refined the searches for additional information. This cycle was complete after the final wetland specialist interview and subsequent research on those insights.

3.3 Surveys

The volunteer survey was the final task of objective three to gauge VNPA volunteers' interest and capabilities in future project tasks. The anonymous and confidential survey on Qualtrics took approximately five minutes to complete and contained 15 questions (see Appendix E). Responses from interviews and technical research completed at the time of survey creation informed the questions pertaining to potential water management projects (see Table 3.9).

The survey was a convenience sample of VNP volunteers, as the team distributed it through a post on the VNPA's Facebook pages and WhatsApp group. The team opened the

survey for responses on April 14, 2021 and the VNPA distributed it to the closed Facebook group. On April 21, 2021, the VNPA posted it on their public Facebook page, with an additional reminder post on April 23, 2021. The team ended the survey on April 24, 2021. Qualtrics security settings prevented double responses from the same devices. English and Romanian questions and answers were interleaved in the survey with the project collaborators providing the Romanian translation (see Appendix F).

Table 3.9: Survey subjects and corresponding questions

Subject	Questions
Demographics	E.1 - E.4
Volunteerism in VNP	E.5 - E.11
Knowledge of VNP Issues	E.12 - E.15

3.4 Data Analysis

Upon completion of the interviewing and surveying methods, the team coded the resulting data. Coding consisted of a review of the compiled data, either the interview transcript or survey open responses, and placing key terms and phrases into themes. The coding method was an inductive coding scheme. The inductive coding scheme does not have bins created before data review, instead involving the review of all the data and developing bins afterward based on identified themes. Quantitative survey analysis involved simple statistics on volunteer's responses, and the team employed this on the close-ended survey questions.

3.4.1 VNPA Interview Analysis

To analyze the VNPA interviews, the team used an inductive coding scheme to create themes for the responses. The first interview with Dan Bărbulescu, the VNPA's Executive

Director, determined the preliminary themes, as he provided a strong overview of the organization. These original themes were as follows: Administrative, Partners/Sponsors, Public Perception and Engagement, Project, Water, Biodiversity, Volunteers, Resources, and Our Project. After coding each interview into these preliminary themes, the team used further inductive coding to refine the themes into a more comprehensive and organized list of information about the VNPA (see Table 3.10).

Table 3.10: VNPA interview themes

Theme	Sub-Theme
Resources	Network Financial Administration Process Media Resources Physical Resources
Solutions	Non-Water Projects Water Projects
Problems	Water Administration Biodiversity Visitors Fire
General Public	Positive Negative
Volunteerism	Volunteer Work Volunteer Outreach Volunteer Pool Volunteer Attitude Volunteer Improvements
Park Ecology	Biodiversity Water

The refined themes identified key information from the interviews that created a comprehensive overview of the VNPA’s current standing. The team used this picture of the organization’s resources and structure to inform the wetland specialist interviews to account for

the limitations of the VNPA along with potential water management solutions that VNPA members suggested for further investigation. The newfound knowledge about the organization gained from this overview factored into determination of the feasibility of potential water management solutions.

3.4.2 Wetland Specialist Interview Analysis

The team used an inductive coding scheme to make themes for responses from wetland specialist interviews (see Table 3.11). These bins were different from those of the VNPA interviews, as VNPA responses informed the wetland specialist interview questions and the wetland specialist interviews had a greater focus on the technical details of potential water management or monitoring techniques based on the expertise of the interviewees.

Table 3.11: Wetland specialist interview bins

Bin	Sub-Bin
Volunteerism	
Water Management	General Considerations Solutions Storm Water Management Rain Gardens Increase Pond Depth Vegetation Clearing Bank Stabilization Wells
Monitoring	Water Monitoring Biodiversity Monitoring
Ecology	Wetlands Biodiversity
Hydrology	General VNP
Other	

After completion of the email interviews and phone interviews, the team coded the responses. The coded data identified key water management or monitoring techniques and solutions brought up by the conservationists. A compiled list of these solutions dictated further technical research and provided the basis for formation of project recommendations.

3.4.3 Technical Research Analysis

Technical research analysis was comprised of evaluating a solution on its general advantages and disadvantages while also comparing the solution to considerations from the VNPA and wetland specialists. First, the analysis sorted each solution into short-term and long-term categories due to the differences in time considerations. Short-term solutions can happen over weeks to months while long-term solutions can happen over months to years. The team evaluated the solutions based on any ecological, financial, and labor impact. The team chose these factors based on the strengths and limitations revealed in the VNPA interviews.

3.4.4 Survey Analysis

The two open-ended survey questions, E.10 and E.11, required an inductive coding scheme (see Appendix E). After closing the survey, the team created bins for those questions centered around volunteers' past experiences. The bins for question E.10 were Impact, Nature, Community, Work, and Other, while the bins for question E.11 were Management, Safety, Impact, Park Conditions, Frequency/Involvement, and None. The coded responses informed the evaluation of areas for potential improvement and expansion of the VNPA's volunteerism practices. The team analyzed the closed-ended questions by creating bar charts of results to questions E.7 and E.8 using Microsoft Excel.

3.5 Timeline Changes

The four methods described above provided a strong framework to complete the three project objectives. VNPA interviews and the volunteer survey addressed objective one, conservationist interviews addressed objective two with the assistance of technical research completing objective three. Figure 3.2 shows a timeline of the methods execution. The team originally planned to complete conservationist interviews in parallel with VNPA interviews and survey distribution but learned from the first VNPA interview that they would need to conduct multiple interviews with VNPA members to completely understand the organization before executing the other methods. Additionally, the team decided to distribute the survey during conservationist interviews to incorporate water management solutions learned from those interviews. These changes did not affect the technical research timeline. The following chapter discusses the results from the completion of the three project objectives via the four described methods.

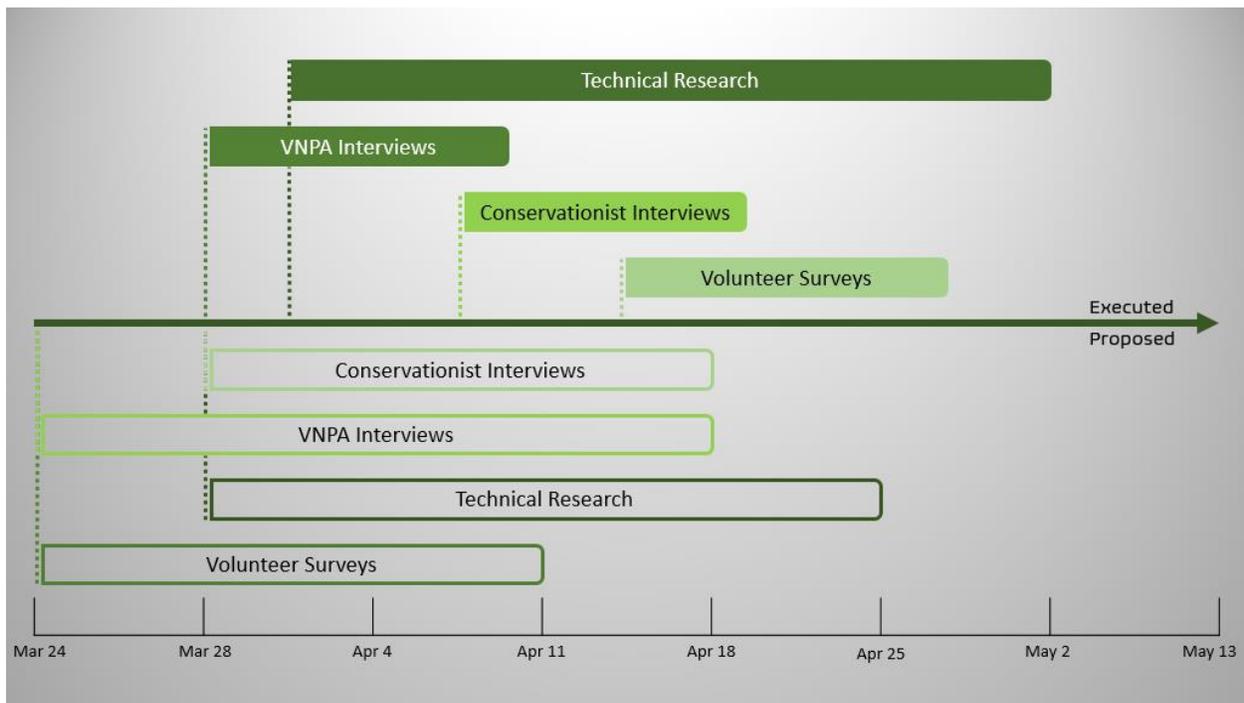


Figure 3.2: Executed versus proposed timelines

4.0 Results and Analysis

This chapter details the team's findings and analysis of the methods described previously. The team gained an overview of the VNPA resources that could either aid or constrain VNP projects through interviews with members of the organization. The VNPA member interviews and volunteer survey revealed perspectives and attitudes on the VNPA's current volunteerism practices, as well as ways in which the organization could utilize volunteers in implementing water collection systems. Discussion with both VNPA members and wetland specialists outside the organization provided insight into important features of park hydrology relevant to water management project implementation. Further conversation in both interviews, alongside technical research, revealed possible water management solutions and monitoring techniques.

4.1 Evaluation of VNPA Resources and Public Opinion

In order to evaluate the current resources of the VNPA, the team conducted eight interviews with VNPA members as discussed in Section 3.1.1. The interview results revealed key information about the strengths and limitations of the organization's resources, with 100% of the interviewees contributing to the resources discussion. Through the process described in Section 3.4.1, the team coded these responses into the theme of resources, then within this overarching theme further categorized individual responses into five sub-themes: network, financial resources, administration process, media resources, and physical resources (see Table 4.1). Additionally, interviewees discussed the general public's opinion of the park and the manner in which those opinions influence park endeavors, similarly revealing strengths and limitations for the VNPA. The team coded these responses, which came from 62% of the

interviewees, into the general public theme and further grouped them into sub-themes of positive and negative responses (see Table 4.1).

Table 4.1: Resource and general public themes discussed by VNPA members

Interviewee	Expertise	Resources Sub-Theme Discussed	General Public Sub-Theme Discussed
Dan Bărbulescu	Administration	Network Financial Administration Process Physical Resources	Positive Negative
Vlad Cioflec	Biodiversity	Administration Process Media Resources	Positive Negative
Gabriela Poiană	Volunteerism	Network Financial Media Resources	Positive Negative
Nicoleta Marin	Administration Volunteerism	Network Financial Administration Process	Positive Negative
Bogdan Mihilache	Biodiversity Infrastructure	Network Administration Process	Positive
Florin Stoican	Administration	Network Financial Administration Process	Not Discussed
Interviewee A	Infrastructure	Administration Process Physical Resources	Not Discussed
Bogdan Vasilescu	Volunteerism	Financial Administration Process Media Resources	Not Discussed

4.1.1 Equipment and financial resources are in short supply for projects.

The VNPA has limited equipment to document park water levels and carry out large scale projects. While the organization can support park projects on a small scale, they have limited capacity to handle large scale projects given financial constraints. Therefore, water management

projects that are easily within the organization's current abilities include those that require either a volunteer group or just a few VNPA members and do not need expensive or high-tech equipment. Twenty-five percent of the interviewees provided an overview of the VNPA's current array of physical resources. Presently, the organization owns an assortment of hand tools, ten bicycles, and two cars, and while this does give them some "physical capacity...to mobilize" (Bărbulescu, 2021) supplies are insufficient to support a large-scale water management project. In addition to a lack of physical resources to carry out a highly technical project, the organization lacks the equipment to properly measure water level fluctuations, as at present they only have two water gauges to measure pond water levels (Interviewee A, 2021). This contributes to the lack of water level data, as discussed in Section 2.4, which may increase the difficulty to get government approval for a water management project or to find an outside sponsor to financially support such a project.

Alongside the equipment limitations on projects, the organization receives no public funding from the Romanian government (Bărbulescu, 2021). Instead, the VNPA relies on private funding sources, such as fundraising, sponsorships, or grants, which often require detailed project proposals to finance park projects. A large majority of the interviewees (75%) spoke about this financial situation by outlining the process of acquiring funding and providing examples of budget sources and circumstances where this type of financing has been a challenge. Several of the private, outside sources that provide funds for the VNPA, such as the Active Citizens fund, require financial applications and project proposals for review before approving the budget (Marin, 2021). This application process further increases the need for the VNPA to document and quantify the falling water levels in the VNP, as evidence of the severity of the decrease in water strengthens the probability that an application will receive funding.

Additionally, these applications increase the need for the organization to fully understand the hydrology of the park, discussed further in Section 4.3, as the intricate details of the VNP's hydrology impact any project plan the VNPA submits in these project proposals.

The VNPA wishes to expand their financial resources in the future, given that their reliance on private funding sources can serve as a limitation for projects by making project financing volatile since sponsors can withdraw their support at any time. The 2019 bill preventing NGOs from managing nature protected areas, described in Section 2.2, resulted in the loss of park sponsors (Mihilache, 2021) and more recently the COVID-19 health crisis has caused even more private sponsors to discontinue their support (Bărbulescu, 2021). Loss of these sponsors jeopardizes project support and further underscores the need to have better water level documentation to solidify project proposals and strengthen the VNPA's ability to find replacements for lost sponsors to carry on with their current and future projects.

4.1.2 Regulations make park projects difficult, but current talks with the municipality may improve the situation.

The VNPA currently maintains the VNP but does not have the legal authority to implement large scale projects without government approval. This presents another challenge in addition to acquiring equipment and financial support because before the VNPA executes any large water management projects they will need backing from the Romanian municipality. Though the government does not provide public funds for VNP projects or actually work to maintain the area, they act as the legal body overseeing the area as discussed in Section 2.2. Eighty-seven percent of interviewees provided insight into these administration practices regarding the park. When describing the association's administrative role, Dan Bărbulescu called

the VNPA “the organization taking care of the park right now” while Vlad Cioflec depicted the VNPA as park custodians doing “guerilla conservation.” The VNPA monitors aspects of the VNP, such as wildfire watch, and completes tasks like trash pickup around the park (Cioflec, 2021), but implementation of large-scale projects that have the potential to impact the VNP’s natural ecosystem requires government approval (Bărbulescu, 2021). Thus, if the VNPA seeks to implement a project that may substantially alter the park’s hydrology, they must have documentation that supports their plan and an evaluation of the project’s ecosystem impact that proves the project will not negatively affect the VNP to gain the needed approval (Bărbulescu, 2021). This is in addition to finding an outside project funding source (Bărbulescu, 2021). This restriction on project management and implementation is a challenge for the organization, as the historically conflicting relationship between the VNPA and the government, described as “Văcărești versus government” (Poiană, 2021), does not guarantee the support the VNPA needs for these projects even if the organization does provide documentation. Given these circumstances, in regard to water management projects Vlad simply said, “There are solutions, but it’s not up to us [the VNPA] to implement them as we speak.”

This analysis of the VNPA’s administrative capabilities is based on the results of VNPA interviews that took place from March 29 to April 9, 2021. On April 22, 2021, the Romanian president visited the VNP and provided verbal support for the park. Additionally, the VNPA and Romanian municipality plan to discuss the park management plan, which may expand the VNPA’s administrative powers in the park and provide financial backing to the organization. These circumstances may result in increased government support for the VNP and collaboration with the VNPA, which would prove to be beneficial for successful implementation of larger scale or highly technically demanding water management projects.

4.1.3 Media and networking promote Văcărești at the national and international level.

Media resources, including both online platforms and promotional materials, are an asset to the VNPA, as these resources have been successful in increasing the VNP's visibility and attracting community support. While only 37% of the interviewees spoke about these media resources, they all had positive things to say. The VNPA has developed a strong online presence with a park website, Facebook, Instagram, YouTube, WhatsApp group, and a podcast on multiple streaming platforms including Spotify and Google Podcasts (Poiană, 2021). This online social network promotes park events alongside radio and TV appearances and printed brochures and flyers (Vasilescu, 2021). The visibility gained from this successful media presence is pivotal in maintaining and expanding the VNPA's supportive network.

Within their network, the VNPA has an extensive list of partners, both nationally and internationally. This expansive network acts as a reservoir of information exchange, collaboration, and promotion and is a key strength of the organization, as these supporters are able to back the VNPA's endeavors to protect and spread awareness of the Văcărești wetlands both within Romania and globally. Sixty-two percent of the VNPA interviewees discussed the importance and reach of this network by providing a few examples of network members. Two interviewees discussed the National Network of Urban Natural Areas, which uses the VNP as a model urban protected area and consists of Romanian protected areas that collaborate to increase government protections and promote environmental activism in the public (Marin, 2021; Poiană, 2021). In addition to the relationship with national organizations, the VNPA interacts with international organizations, including Wetlands Link International, the European Union, and the International Union for Conservation of Nature's commission of urban protected areas, which act as a source of information, guidance, and project support for the VNPA (Stoican, 2021).

Furthermore, well-known figures back the VNPA, such as various ambassadors and bird watcher Jonathan Franzen, who pay visits to the VNP and increase the park's visibility at the international level among foreign governments and environmental enthusiasts (Poiană, 2021). To summarize the VNPA's relationship with their network, Nicoleta Marin said, "It's just [a] connection. Facilitating connections with other NGOs, communication, promotion, information, shared experience, shared lessons learned."

With the help of these media resources and the network's influence, the majority of the surrounding community in Bucharest has a positive opinion of the park and enjoys its natural environment, which increases community interest and support for park activities. Sixty-two percent of the VNPA members described this positivity, explaining that the VNP is "very close to the people" (Bărbulescu, 2021). Surveys the VNPA recently distributed to the public revealed an appreciation for the nature found in the wetland as a major reason for supporting the park (Poiană, 2021).

Conversely, negative opinions surrounding the VNP stem from lack of exposure to the space and center around a disregard for the value of nature and wildlife in the park as well as for the VNPA's role in preserving the wetland. Overcoming this negative perspective requires continued promotion of the VNP focused on educating the public on the importance and impact of the wetland ecosystem and the VNPA's work. Half of the interviewees mentioned these negative opinions, but they stressed that only a small portion of the public held them (Poiană, 2021). The people with negative opinions often expect the VNP to look more like a "concrete park" and do not understand the importance of nature in their everyday lives or have a fear of nature, specifically of commonly disliked wildlife such as snakes, frogs, and insects (Poiană, 2021). Other people would prefer the VNPA "leave that place [the VNP] to go wild and free,"

(Bărbulescu, 2021), as they do not understand the organization's key role and contribution to sustaining the Văcărești wetlands through their park projects.

4.2 Volunteerism

In addition to asking volunteerism questions in VNPA interviews, the team distributed a survey to the organization's volunteers through their WhatsApp and Facebook groups, collecting 101 total responses with over 40% of respondents indicating that they had previously volunteered in the VNP at least once. This section details findings about volunteerism within the VNP from both interviews and the volunteer survey.

4.2.1 Future volunteer projects must acknowledge volunteers' capabilities.

From both VNPA interviews and the survey, the team learned that volunteers are not involved in every project in the VNP. When asked if volunteers are involved with infrastructure projects, one VNPA member responded with: "We have very low help in infrastructure because of the lack of needed skills from their side..." (Interviewee A, 2021). This response implies that future volunteer projects must account for the lack of skills, or the VNPA must train their volunteers to involve them in technical projects. Question E.8 from the survey asked volunteers what projects they had worked on in the past, and Figure 4.1 shows the responses to this question.

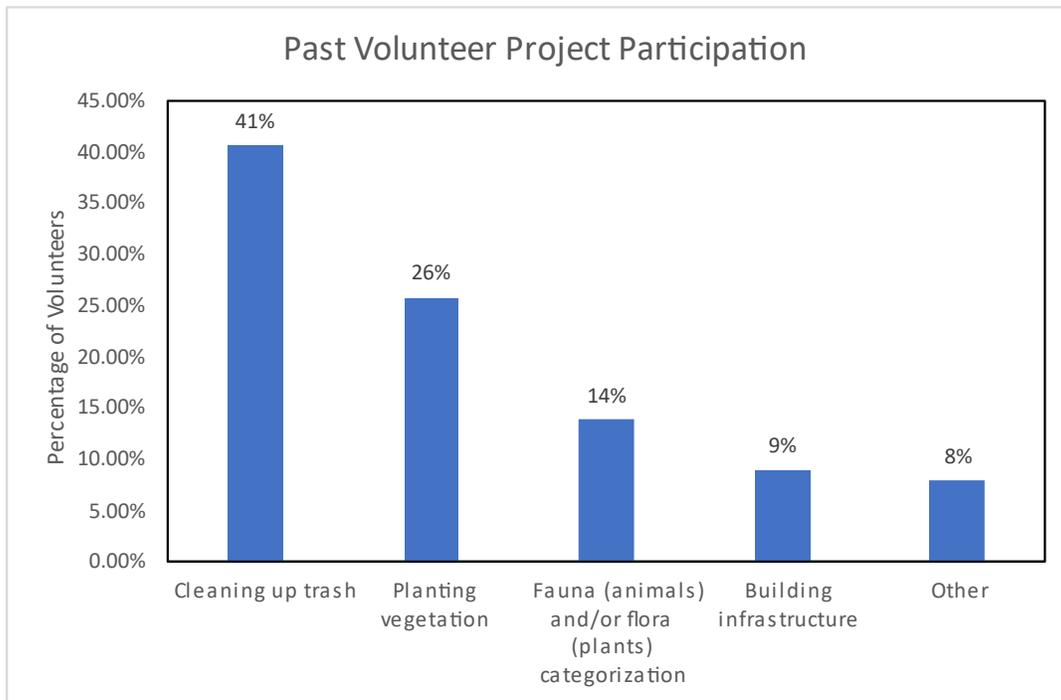


Figure 4.1: Past volunteer project participation

Cleaning up trash was the top response at 41%, with planting vegetation following at 26%, and neither of these tasks require technical skills. The remaining three technically oriented choices received low responses, which paralleled the prior VNPA member’s statement that volunteers lack infrastructure skills. One volunteer responded in the free response “other” category with observing visitors, and another respondent said they helped with marking paths. The results show that volunteers do not have the necessary skills for these projects due to a lack of training or that the VNPA is not pursuing technically oriented projects. Gabriela’s plan for improving the volunteer program is to expand training, but due to time and labor constraints, outside of park maintenance projects implemented via volunteers are difficult (Poiană, 2021). Any future technical project would face early hurdles with developing an effective training program.

Even though volunteerism in the park is limited to simple projects, volunteers are active outside of the VNP. Vlad Cioflec mentioned that volunteers are active in online promotion by

sharing park pictures and fundraising (Cioflec, 2021). While the VNPA’s volunteers may be limited in regard to infrastructure given a lack of training, they have a wide range of abilities, both physically in the park and online, that contribute to project success.

4.2.2 Volunteers have varying interest in future VNP projects.

The volunteer survey revealed that while the VNPA does have a strong volunteer base, the volunteers have limited skillsets and are not necessarily interested in every conservation project within the VNP. Figure 4.2 shows responses to survey question E.7: Please determine your interest in performing the following activities: on a scale of zero to five with zero as the least interested and five as the most interested.

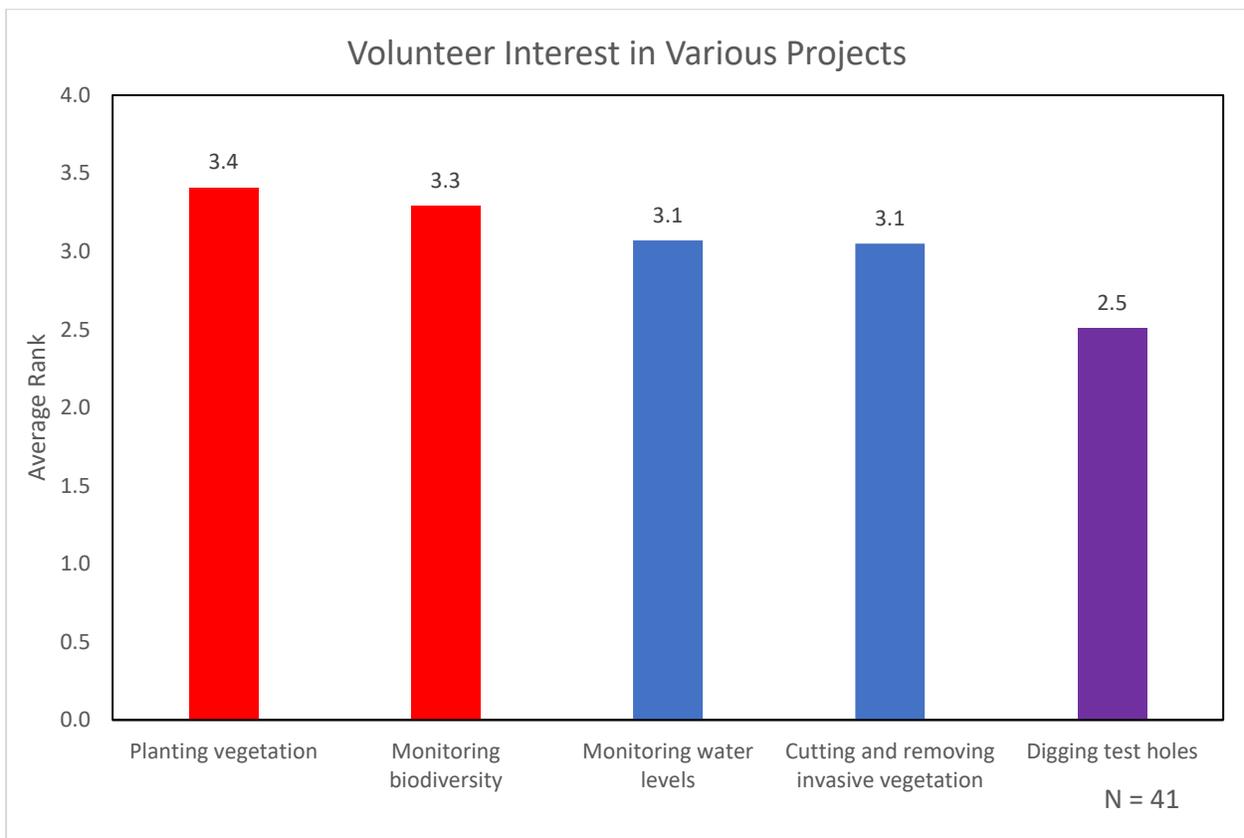


Figure 4.2: Volunteer interest in potential projects.

The top responses to this question were planting vegetation and monitoring at 3.4 and 3.3 respectively (red). In contrast, the most physically demanding task, digging test holes, had the lowest average rating of 2.5 (purple). The highest and the lowest scores are within one point of each other demonstrating that even though there is a preference, it is not strong.

The survey responses to question E.7 show that volunteers are most interested in planting vegetation as well as monitoring water levels and biodiversity while the most physically challenging tasks score the lowest interest. These interest levels are key to determining the most supported water management projects for the VNPA, as projects with a higher level of interest may be more successful in involving volunteers.

4.2.3 Volunteers are hardworking and self-motivated.

The VNPA's volunteers are hardworking and maintain a positive attitude, as indicated by Gabriela Poiană in her interview. She said: "We have these group of volunteers ...They are available and are usually waiting for us to ask them for help" (Poiană, 2021). This quote indicates that the volunteers are willing to participate in more park projects. Paralleling Gabriela's quote, one survey respondent wrote: "...[The VNPA is] not leveraging the talent of the volunteers" when asked if there was anything that they did not like about their volunteer experience (Question E.11).

Several volunteers work so diligently that they do not wait for the VNPA to call upon them, as Gabriela explained: "they are cleaning up the park even though it is not an organized activity" (Poiană, 2021). This shows that volunteers are willing to clean up the park even without the VNPA asking them, and this attitude may lead to support for future water management projects and training. Another interviewee explained that park volunteers monitor visitors as well

and contact the VNPA if they see visitors doing something illegal in the park, such as smoking, poaching, or setting fires (Poiană, 2021), which shows that volunteers are invested in the park and maintaining the area.

4.3 The Significance of Wetlands Hydrology

To assess the impact of the VNP's hydrology on water management projects, the team discussed the significance and impact of hydrology on wetlands ecosystems with wetland specialists and VNPA members.

4.3.1 Wetlands exist because of their hydrology.

Wetland specialists emphasized during their interviews the significance of the hydrological features under the VNP. Paul McManus stated this distinctly: “The hydrology is what creates a wetland, and further, creates what type of wetland exists.” Paul explained that the existence of a wetland is so closely tied to its hydrological features that work centers and wetland protections exist on the basis of hydrology. When developing solutions to manage or restore wetland environments, experts read the landscape and understand what hydrological features connect to surface water (Burne, 2021). Matt continued with this point by explaining that the dependency of wetlands on their hydrological features is what makes issues such as invasive phragmites so devastating because they change the hydrology of the areas they inhabit. In a park as unique as the VNP, outlined in Section 2.6.2, understanding its hydrology is the most important step to finding a solution.

4.3.2 The VNPA does not understand the park's hydrology.

In interviews with the VNPA, the team never got a sense that the organization had adequate data to understand the hydrology of the VNP. The interviews did yield several descriptions of the hydrology, which the team pieced together to form a lithographic map of the park's hydrology (see Figure 4.3).

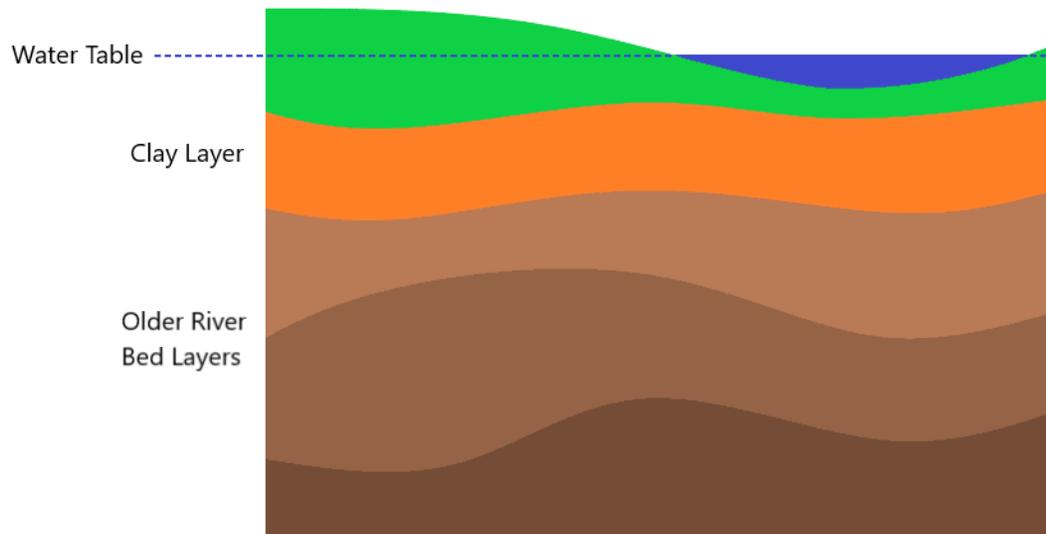


Figure 4.3: Văcărești hydrology sketch

When Romania's communist-era government attempted to create a lake where the VNP currently sits, they completely changed the natural water system (Stoican, 2021). This change in the system made the VNP the wetland system it is today, but additionally makes interpreting the VNP's current hydrological system very difficult for the VNPA. One VNPA member speculated that all the water in the park stems from two natural aquifers, but "we [the VNPA] don't know yet what the impact of the springs are because we don't have exact studies about the quantity and quality of the water that enters and exits from the park (Stoican, 2021)." Another VNPA member described how when digging test holes for a project, the VNPA encountered a clay layer that was saturated with water after digging through 40 cm of topsoil, which presents an obstacle for water management given its incredibly slow rate of transferring water (Mihilache, 2021).

4.4 Solutions

To determine potential avenues of water management, the team took findings from the previous sections on hydrology, volunteerism, and resources to ask for the VNPA's and wetland specialists' recommendations on mitigating the falling water levels. In both sets of interviews, the interviewees identified potential solutions, solution considerations, and steps the VNPA must take before beginning these projects. The mentioned recommendations directed the technical research necessary for understanding the project's details. Such project recommendations included reed removal, digging wells, and rain gardens while time lapse photography and monitoring wells can track the impact of each solution.

4.4.1 Monitoring wells help monitor the hydrology of the VNP.

The use of monitoring wells to gauge the location of the water table and composition of the layers beneath the VNP would give the VNPA a clearer understanding of the park's hydrology, discussed in Section 4.3 and is key to implementation of water management systems. Monitoring wells can be shallow, approximately half to one and a half meters deep since wetland hydrology is shallow (Wetlands Regulatory Assistance Program, 2000). The surface level wells are simply constructed by digging out the land and inserting a PVC pipe as walls to the well. Workers or volunteers can measure the water level inside of the well with a simple measuring stick or by visual observation (Scweisberg, 2021).

4.4.2 Volunteers can remove reeds without mechanization.

Multiple wetland specialists and VNPA members indicated mowing down with hand tools the reeds with hand tools as a solution to the dense vegetation coverage (see Appendix H).

Mowing is a multi-season solution because simply cutting does not remove the rhizomes, so the plants can reestablish themselves. Phragmites often grows much taller and denser than native species can, and mowing can allow native species to try to re-establish where the phragmites were (Gucker, 2008). Additionally, conservationists strategically mow down reeds just before they make seeds so that the root bed is doubly deprived of food resources because this destroys the plant stem containing the food and the seed development uses up food reserves (Wisconsin, 2009). In small areas, volunteers could carry this out with hand tools like hedge trimmers.

Technical research identified solarization, which works through heating up the ground by trapping a layer of air and humidity above the invasive vegetation to kill it over the course of four to six weeks. Opaque plastic can do the same but less effectively since the plastic heats up instead of the ground, leading to increased time to kill vegetation. Before covering the ground, the area needs to be damp to allow for water to infiltrate the soil, which conducts heat better than dry soil. Workers or volunteers need to bury the edges of the plastic covering or adhere them to another plastic tarp to prevent loss of this water. Solarization will indiscriminately kill many species below the tarp including some microorganisms, and the tarps can block normal water flow, leading to changes in surface soil hydrology. (Elmore, et al., 1997)

Interviewee C brought up shading as a technique to slow down germination to stunt the growth of reeds as discussed in Section 2.3.1 (Interviewee C, 2021). Conservationists start this task after clearing of a space of reeds with one of the above methods. Once the space is clear, conservationists will plant native ground cover to prevent the takeover of the reed species. Native ground cover includes herbaceous plants like sedges, grasses, flowering plants, and various annual plants so that a diverse plant ecosystem can compete year-round with the phragmites. Next, woody plants will grow in tandem with the ground cover, so that eventually,

they will shade the land that was once covered by reeds. The other vegetation shades the reeds, therefore the phragmites will have a tougher time establishing themselves (Wisconsin, 2009).

All the other wetland consultants mentioned herbicides as another non-mechanized solution. However, some VNPA members have indicated that they only want to pursue nature-based solutions (Mihalache, 2021). Moreover, if the organization uses herbicides, like glyphosate, they may target other desired species, and the VNPA must collect the dead stems or they will pose a fire risk (Natural Resources Conservation Service, n.d.; Gucker, 2008). To avoid spraying desired species with the herbicides and the associated fire risk, after completion of a clearing method like mowing, the VNPA should spray severed stems with the herbicide to kill the rhizome (McManus, 2021). Despite targeted application, glyphosate and the chemical that the herbicide breaks down into, aminomethyl phosphonic acid (AMPA), can persist in clay layers from year to year without being removed by microorganisms (Van Bruggen et al., 2018).

4.4.3 Digging provides a more permanent solution to the reed problem.

Both wetland specialists and VNPA members recognized the limitations of non-mechanical solutions because the reeds will often quickly reclaim areas due to their rhizomes (Gucker, 2008). Without the elimination of the rhizomes, the reeds can regrow from the extensive rhizome system, and the root network can continue to spread to other areas propagating more growth. Digging would physically remove all parts of the plant to disallow this. Additionally, if a worker would dig out phragmites along the shoreline, not only would this remove the plant, but also deepen the water to a point where phragmites could not grow. A Canadian study has shown that prolonged bodies of standing waters of greater than one meter led to death of the reeds (Shay, J., Shay, T., 1986). However, digging requires a place for the

excavated dirt to go, so that the dirt that contains rhizomes or seeds does not rekindle an infestation. Similar to most of the solutions, immediate action with any unsubmerged land is necessary (Wisconsin, 2009). Phragmites will take over any previously inhabited space if given the opportunity, so repeated implementation of these reed clearing solutions may be necessary on unsubmerged or shallow areas.

4.4.4 Rain gardens are a nature-based solution for managing stormwater.

Three VNPA interviewees discussed the possibility of using rain gardens as a solution to the falling water levels in the park. As described in Section 2.6.3, the rain garden's purpose is to take storm water in and manage peak flows to prevent flooding and provide a method of infiltrating the water into the ground to supply the water table. While a large-scale rain garden that utilizes the surrounding neighborhoods in Bucharest may be infeasible for the VNPA (Cioflec, 2021), the organization has already begun testing out smaller rain garden projects by planting water resisting species and making rain gardens at the base of the dike surrounding the park (Mihalache, 2021). This prototype project resulted in the formation of small ponds in these areas that supported rich biodiversity, as Bogdan described, "It's a very beautiful...system, you go here...in the springtime [and] you find a lot of these little ponds full of life and that's amazing". The VNPA is similarly hoping that these prototypes will draw from rainwater that is pooling on park trails near the rain gardens. The rainwater pools on the trail the organization uses as an access road for vehicles like cars and trucks, and by creating more rain gardens in this area, the VNPA expects that water will collect in the rain gardens and not on the trails.

Four of the wetland specialists expanded upon rain gardens and stormwater management. Interviewee C summed up that the "goal of managing runoff is that precipitation landing on the

earth would be allowed to soak into the ground as close to where it's landing as possible.” The water that infiltrates the ground from this process then supplies the aquifers and the water table. In an urban environment like Bucharest, a surplus of impermeable surfaces, such as concrete, asphalt, and building roofs, prevents this from happening, forcing water to move elsewhere along the ground. Matt Burne explained that rain gardens take “advantage of water that’s being managed from the built infrastructure from impermeable surfaces and turning that into a way to grow plants for a lot of different benefits.”

The primary concern with infiltrating managed storm waters in an urban environment is that as the water travels along the ground, it picks up pollutants that are potentially harmful to plants and can contaminate groundwater supplies. Interview C explained that “rain gardens are one method of helping to treat closer to the source, meaning the surface area where it is collecting.” Along with cleaning pollutants, Matt Burne stated that rain gardens fix the temperature of the storm water before it infiltrates into the ground and aid in “attenuating some of the urban heat island effect,” which increases city temperatures due to light reflecting off the buildings. He put simply, “[a] rain garden is a good example of an essentially nature-based solution to storm water.”

4.4.5 Wells can pump water into the park but come with risk.

During the VNPA interviews, half of the respondents suggested digging wells in the VNP as a potential water management system, though one member mentioned that the organization would need to acquire documentation before carrying out a project of this nature (Bărbulescu, 2021). Bogdan Mihilache explained that these wells would tap into the underground water in the clay layer previously described in Section 4.3.

To supplement the interview discussions, the team gathered information from technical research on wells in order to fully understand the implications of this solution. Wells work because groundwater will seep into any hole dug below the water table. As described in Section 2.3.2, the water table is an artificial line where below it the water completely saturates the soil. Below this line, water from the surrounding rocks will constantly fill the hole. The deeper and more surface area exposed to the saturated rocks in a well, the more water that will fill the hole. Aquifers are areas of water-bearing rocks and one can enclose the aquifer with other non-water-bearing rocks. Most deeper wells seek to access specific aquifers (USGS, n.d.). Table 4.2 outlines the differences between types of wells.

Table 4.2: Types of wells

Well Type	Description	Advantages	Disadvantages
Dug Well	Excavated by hand shovel or machine to below the water table	<ul style="list-style-type: none"> • Able to obtain water from less permeable materials • No machinery is required 	<ul style="list-style-type: none"> • Highly sensitive to water table change • Has a large diameter hole • Subject to contamination from nearby sources
Driven Well	A small diameter pipe is driven down into the soft earth until an aquifer is reached	<ul style="list-style-type: none"> • Fairly low cost • Less work is required as the process can be automated 	<ul style="list-style-type: none"> • Can only tap shallow water • Contamination from surface pollutants can occur
Drilled Well	A large machine bores a hole deep into the ground to access an aquifer	<ul style="list-style-type: none"> • Able to work in soft and very hard earths • Can drill more than 1000ft to tap deep aquifers 	<ul style="list-style-type: none"> • Very expensive drill rig • Might need a pump for very deep wells

During interviews with the wetland specialists, the team asked questions about the proposed solution of creating wells, specifically shallow wells, to tap aquifers that would pump water to the VNP's water table. Dragos Gaitanaru explained that a shallow well would be a well

that is 15 meters deep, as opposed to several other types of wells that can reach 1000 meters deep (Gaitanaru, 2021). The idea behind digging wells is to hopefully tap into what one specialist identified as artesian aquifers (Interviewee C, 2021). These types of aquifers are under sufficient pressure to push the water that fills them up over the water table line. Some are under even higher pressure to lift the water up out of the well. One of the wetland specialists, Matt Scweisberg, stated that while working on a wetland restoration project in China he had recommended drilling wells, “to try and supplement water input to the ones [ponds] that they had in this park.” However, he also warned that there is risk involved in digging wells without understanding the shallow and deep hydrology of the area (Scweisberg, 2021).

Since the VNP sits atop a restrictive layer of clay, described in Section 4.3, there is little to no interaction between the aquifers below and the water table of the VNP. This puts the park in an unorthodox position where, as described by Matt Scweisberg, the VNP is a “bathtub.” Should the VNPA choose to dig a well, it could be like drilling a hole through the bottom of the bathtub and the whole park would drain. This result would require large amounts of intervention to reverse (Scweisberg, 2021).

Similarly, Matt Scweisberg outlined a second risk. Namely, digging a well and pumping water out could lower the water table of that aquifer. If the VNPA over-sources water from one aquifer to supply the park, they could potentially lower the aquifer’s water table and dry it out for other nearby locations that are also sourcing water from that aquifer, such as the surrounding city. Matt Scweisberg simply said, “it’s all connected as you know.” (Scweisberg, 2021)

Although the option of digging wells can supply water to the VNP and wetland specialists have employed this method for several cases in other wetlands, the VNPA does face significant risks in implementing such a solution. Without a proper understanding of the

hydrology below the VNP, the VNPA may drain the park's current water sources or dry up other areas that source from the same aquifer.

4.4.6 Time lapse photography can monitor water levels and vegetation growth.

On hiking trails, rangers encourage visitors to take fixed images of an environment to send back to them for monitoring purposes. Crowdsourcing these pictures cuts down on time rangers need to spend on monitoring the ecosystem, and this approach collects images from the same location to observe its changing landscape. The user places their camera in a fixed metal bracket, takes a picture, and can post that picture on social media with a hashtag (see Figure 4.4) (Nerds for Nature, 2015).

The rangers aim the frame at a region of interest that evolves slowly over time, such as a pond or vegetation. An example of such a region is monitoring vegetation recovery after a fire. Frame placement is roughly at chest height off the ground for accessibility, and instructions near the frame direct the user on how to align and send the picture (Nerds for Nature, 2015).

In addition to posting the images on social media, rangers collect the pictures using a QR code or an app that sends the data into a spreadsheet like Excel. To make data processing easier, the spreadsheet can limit the number of



Figure 4.4: A monitoring frame for crowdsourcing (Nerds for Nature, 2015).

photographs submitted per day. This described system allows rangers to construct a time lapse of the area to track changes (Droege, 2013).

Different devices will take photographs with different resolutions and formats. To stitch these images together into a time lapse, the data processing must standardize them. By using a software like PTGui, the user imports a reference picture of the desired location and all crowdsourced images. The user selects “control” points, which are distinct points like a rock, tree limb, or fence post. The software uses several control points to overlay the crowdsourced data with the reference (Droege, 2013).

5.0 Conclusions, Recommendations, Future Works

The results and findings described in Chapter 4 formed the basis of the conclusions and recommendations for the project. This chapter details the team's final conclusions from the project, a set of recommendations for Văcărești Nature Park Association (VNPA), and future WPI project groups.

5.1 Conclusions

From the project results, the team concluded that the VNPA has a strong volunteer base, online presence, and public perception; however, they are limited by their budget and funding sources, relationship with government, physical resources, and the number of team members required to effectively utilize their volunteer base. To address the lack of statistics surrounding water levels, the VNPA can utilize volunteers and park visitors to monitor biodiversity and water levels in Văcărești Nature Park (VNP). The team concluded that while the VNPA members have speculated about the hydrology and geology underneath the park, they do not know all of the details for certain; therefore, the organization needs to perform a hydrogeological study of the park. In addition, the VNPA needs to conduct a topographical study of the park to maximize the effectiveness of their current pilot and future rain gardens and stop water pooling on their trails. These conclusions led the team to write the following set of four short-term and three long-term recommendations.

5.2 Short-Term Recommendations

This section details four short-term recommendations that the VNPA could implement within weeks or months with volunteers and park visitors.

5.2.1 Crowdsourced Monitoring Data

The team recommends that the VNPA utilize their mobile park application infrastructure to involve volunteers and park visitors in crowdsourced monitoring data of reed areas and water levels. The VNPA should install a stand with an informational panel detailing information on reeds and their role in the VNP's water problem. The user would scan a QR code that opens the VNPA's park visit app and then place their phone in a frame such that everyone takes a picture at the same angle (see Figure 5.1)

The app would send these pictures to the VNPA and they could then evaluate reed expansion over the course of weeks or months to determine whether or not they need to clear vegetation. Photographs of the reed area from the same angle would allow the VNPA to easily discern how much the reeds are expanding by visual inspection, but they can also use software packages to quantify the expansion. Volunteers could also help the VNPA analyze data by editing the submitted pictures such that they are a uniform size, further simplifying visual inspection. The same principle of using the VNPA

app to monitor vegetation areas applies to water monitoring as well. The VNPA can have volunteers or visitors take a picture of water monitoring gauges in their lakes or monitoring well gauges and send them to the organization for review. Volunteers could help analyze water



Figure 5.1: Diagram of a crowdsourcing monitoring stand (Nerds for Nature, 2015)

monitoring data by entering it into a spreadsheet for the VNPA, and the time lapse can show the public abstract problems like reed takeover with a series of images.

Crowdsourcing data takes pressure off the VNPA members to conduct reed and water level monitoring on their own, allowing them to focus on other projects in the park. This benefits the organization given that time constraints have been a limiting factor for the VNPA's plans for park projects and improvements thus far. Additionally, this technique increases the VNPA's ability to collect data from multiple areas in the VNP in a shorter amount of time. Because this solution also involves park users, it has the potential to improve their relationship with the VNPA because they will be actively engaged in sharing and monitoring the park's health. The crowdsourcing endeavor is also an opportunity for the VNPA to engage with their volunteers in data analysis and offers a different method of utilizing the volunteers' expertise, since many of them work day jobs and they may be able to use their skills from their job for the VNPA.

5.2.2 Continue Promoting Nature-Based Solutions

The VNPA indicated that the concept of a nature-based solution is new to Romania, and in a meeting with the collaborators, the team learned that there is no phrase for nature-based solutions in Romanian. The team recommends that the VNPA continue their work in promoting nature-based solutions and using their volunteers to disseminate information and education about nature-based solutions. Since volunteers are already involved in the organization's online presence, they can add nature-based solutions to their current efforts. The VNPA can add information panels near their pilot rain gardens in the south side of the park and include the QR code monitoring described in Section 5.2.1.

5.2.3 Vegetation Clearing

The team recommends the VNPA utilize their volunteers to cut reed areas once the VNPA decides that intervention is required. Because the VNPA relies on volunteers to execute projects in a cost-effective manner, the VNPA should explore using a combination of mowing and vegetation shading. First, the VNPA can clear the land with mowing techniques with hand tools, and then, the volunteers can plant ground cover. The only costs are the basic hand tools like hedge clippers and the plants used for shading. Additionally, subsequent clearings of the reeds would be less intensive because the shading would decrease reed germination. The team also recommends using solarization on the severed stems of the reeds to kill the rhizome mat before planting native ground cover.

The team does not recommend herbicides because the VNP is a very confined “perched” wetland. The herbicides may target rarer plants, and these chemicals may linger indefinitely in the clay layers further impacting vegetation growth. Especially without knowledge of the hydrological layers, herbicides could have long lasting negative impacts.

While solutions like digging are more effective in the long term, they require mechanization, which means that the VNPA would not be able to use volunteers to execute these projects without a significant training program.

5.2.4 Monitoring Wells

Since the monitoring wells are so shallow, the team recommends that they install these around the entire park. Collecting data from these wells will start to construct a hydrological picture of the VNP, which is necessary for large-scale water projects. Volunteers can be involved in this solution by helping to dig the wells, although the survey results show that only 51% of

volunteers are currently interested in digging, so it may a better use of the volunteer resource to monitor the wells. The organization can use crowdsourcing in this monitoring process similar to the time lapse recommendation, and the VNPA can put instruction panels on the side of the wells for volunteers to routinely check.

5.3 Long Term Solutions

Long term solutions are significantly more involved than those described in Section 5.2, and consequently will require government approval, funding from park sponsors, and outside contractors to execute. These solutions are on the order of months to years and may not involve volunteers, however these solutions are necessary before the VNPA implements any large-scale water management projects. Additionally, these projects could involve WPI civil engineering or biology students completing a thesis project who could work alongside the contractors.

5.3.1 Hydrogeological Study

The team recommends that the VNPA perform a hydrogeological study of the park since there is no definitive data detailing the hydrology and geology of the VNP. The VNPA expressed interest in digging wells in the park to bring in groundwater; however, if the VNP is an aquiclude, then digging a well might have the opposite effect: the well could drain the park's surface water instead of bringing groundwater up into the park's ponds. The hydrogeological study will confirm or reject the idea that the VNP is a perched wetland and inform the VNPA as to whether or not a well will be an effective water management solution. Monitoring the hydrology of the park is a matter of digging and sealing pilot monitoring wells and monitoring them over the period of "at least a year, preferably two or three" (Scweisberg, 2021). The

hydrological aspect of the proposed study could involve volunteers with the QR code info panels described in Section 5.2.1. The results from this study will uncover the hydrology of the park and provide the VNPA or future research groups with the information needed to research and decide upon the most effective long-term water management solutions.

5.3.2 Topographical Survey

Since the VNPA is interested in using rain gardens to direct storm water and already has a pilot project in the park, the team recommends that the VNPA conduct a topographical study of the VNP to identify the high and low points in the park. The results from this study will aid the VNPA in deciding where to implement more rain gardens in the park. This could be funneling water out of any low point in the park to the lowest point in the park or directing runoff from a local high point to a specific low point.

5.3.3 Pond Expansion

The team's final long-term recommendation for the VNPA is to make pond shorelines steeper and deepen the park's ponds to limit reed expansion. Steeper shorelines decrease the habitable space for the reeds and combats their expansion. Volunteers cannot execute this solution since they do not have the skills to operate an excavator. This solution brings significant administrative, financial, and logistical limitations. Similar to the other long-term solutions, the VNPA would need government approval and funding, but they would also need to organize the logistics of bringing an excavator into the park and a location to put the excess dirt in order to minimize the damage to Văcărești's fragile ecosystem.

5.4 Summary of Recommendations

The combination of short- and long-term water management recommendations to the VNPA will allow them to immediately take water management actions with their volunteers while they work to develop stable long-term solutions for managing water in the VNP. Table 5.1 shows a summary of these recommendations with the expected results and limitations of each.

Table 5.1: Summary of recommendations

Short Term		
Recommendation	Result	Constraints
Crowdsourced Monitoring Data	Less pressure on the VNPA Volunteer and park visitor engagement	Does not directly help water levels
Vegetation Clearing	Water management Volunteer engagement	Not a permanent water management solution
Online Nature-Based Solutions Promotion	Public education Volunteer engagement	Does not directly help water levels
Monitoring Wells	Collect updated hydrological data of the VNP Volunteer engagement	Low volunteer interest in digging wells
Long Term		
Recommendation	Result	Constraints
Hydrogeological Study	Eliminates risk of ignorance on action with wells Provides official documentation on hydrology of the VNP	Requires experts Will take years
Topographical Study	Informs best places to install rain gardens Provides official documentation on topography of the VNP Provides description of how surface waters will move	Requires experts
Pond Expansion	More permanent water management solution Limits reed areas	Requires mechanization Logistical challenges

5.5 Future Work

While the team provided the VNPA with a set of recommendations on water management, they mostly focused on monitoring and identifying areas for intervention. This allowed the team to identify areas for future work, projects that future IQP groups can investigate and implement. Table 5.2 summarizes these areas for future work.

Table 5.2: Future works

Future Work	Project	Group
Habitat Observations	Survey pond and reed area habitats to evaluate potential wildlife disturbance if ponds are deepened or reeds are removed	VNPA Volunteers Future IQP Group
Volunteer Training	Create a training plan for volunteers to prepare them for running guided tours	VNPA Future IQP Group
Rain Garden Construction	Occurs post-topographical survey Identify best areas in the VNP for rain garden placement Construct rain gardens	VNPA Volunteers Future IQP Group

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Appendices

Appendix A: Interview Informed Consent

Informed Consent

We are students from Worcester Polytechnic Institute, Massachusetts, United States, and we are here to talk more in depth about the Văcărești Nature Park Association’s (VNPA) current process of water management, resources, and volunteerism practices. This interview will take approximately 30 minutes. Your participation is completely voluntary, and you may stop the interview at any time or refuse to answer any question that we ask. This interview is confidential unless you agree to have your name published. We will publish the results, though the respondent has the right to retract any statements said during the interview before May 1st, 2021. We can be reached at gr-vacaresti-d21@wpi.edu.

For more information about this research or about the rights of research participants, in case of research-related injury, contact the WPI IRB Manager Ruth McKeogh at (508) 831-6699 or irb@wpi.edu and the Human Protection Administrator Gabriel Johnson at (508) 831-4989 or gjohnson@wpi.edu.

By typing your name below, this will be an electronic signature stating that you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

_____ Date: _____

Study Participant Signature

_____ Date: _____

Signature of Person who explained this study

_____ Date: _____

Sign here if you consent to having your name published

Appendix B: VNPA Interview Guide

Interviewee Background

- B.1. Describe your role at the VNPA.
- What is your title within the VNPA?
 - How long have you worked at the VNPA?
 - Why did you first get involved with the organization?
 - What is your motivation for working in the park?
- B.2. Describe your involvement in the park's volunteer-based projects.
- Do you work directly with park volunteers? If so, how?
- B.3. Can you describe projects you are currently involved with?
- What is the goal of these projects?

VNPA Resources

- B.4. Describe the financial resources of the VNPA
- Where does the VNPA get its budget from (i.e. government, other organizations, donations, etc.)?
 - How has financial resources impacted VNPA projects?
 - Has the pandemic been a factor?
- B.5. Describe the physical resources of the VNPA (i.e., people, networking, equipment, etc.)?
- What connections does the VNPA have with other organizations?
 - Describe the public's perception of the park and how it impacts the VNP or VNPA.
 - How has physical resources impacted VNPA projects?
- B.6. Describe what makes up the infrastructure in Văcărești Nature Park.
- B.7. Describe the public perception of Văcărești Nature Park
- Describe the media's perception of Văcărești Nature Park
 - How does the VNPA reach out to the general public?

VNP Water Levels

- B.8. How has the recent drought specifically impacted biodiversity, fire risk, and water levels in the park?

- a. Has this impacted tourism or public perception of the park? Please describe.
 - b. Has this led to more or less support towards the park? Please describe.
 - c. Has the government stepped in to aid in drought relief? Please describe.
- B.9. Describe the biodiversity in Văcărești Nature Park
- a. How did the park become so diverse?
 - b. How dependent is the ecosystem on water?
- B.10. What are the current measures in place to lessen the drought's effects and improve water levels?
- a. How have the water levels been monitored thus far?
 - b. Are there locations that are at highest risk from decreasing water levels?
 - c. What were the obstacles facing these measures?
 - d. What resources were used to complete these measures?
 - e. Did finances play a role in the project, if so how?
 - f. Were these projects successful? Please explain why or why not.
- B.11. What is the most difficult aspect of managing water levels?
- B.12. What locations are at highest risk from falling water levels?
- a. Are there any critical areas within the VNP that should be prioritized in terms of increasing the water levels?

Volunteer Specific Questions

- B.13. Are you involved with volunteers in the VNP?
- B.14. How does the VNPA recruit volunteers? Describe your current volunteer outreach efforts.
- a. Is there anything in particular that the VNPA is looking to improve in terms of volunteerism (i.e., expand volunteer pool, create more volunteer projects, etc.)?
 - b. Are there any problems that you have had with volunteers?
- B.15. What are ways in which the VNPA uses volunteers? In what ways do you find volunteers most useful?

- B.16. Tell me about the success of previous volunteer projects and how volunteers helped to achieve the goal of the project.
- B.17. Have any of these projects not achieved the intended goal? Describe a particular example.
- B.18. Do volunteers help with infrastructure projects?
- B.19. Do volunteers help monitor biodiversity?
- B.20. Do volunteers help monitor water levels?

Appendix C: Conservationist Email Interview Guide

Background

- C.1. What is your current role at the [place of employment]? What does your work involve doing?
- C.2. Can you describe your current relationship with the Văcărești Nature Park Association?
- C.3. Have you worked in collaboration with anything in Văcărești Nature Park? If so, please describe.

Văcărești's Hydrology and Infrastructure

- C.4. Do you have any knowledge about the impact the Dâmbovița River has on the Văcărești's water table?
- C.5. Do you know what ground layers underlie the park and what their compositions are? If you do, how good are those specific layers at moving groundwater?
- C.6. We learned through VNPA pilot testing that at 40 centimeters into the ground they found groundwater is held in a layer of clay. Is this the shallow aquifer below Văcărești?
- C.7. Would it be feasible at this depth of about 1-2 meters to construct a shallow well to extract water?
 - a. How would this impact the water table?
 - b. How would the VNPA measure the well's impact if at all?
 - c. Do you have a recommendation for how a well should or should not be constructed given your knowledge of Bucharest's groundwater?
- C.8. Another solution to increase water levels is increasing the pond's depth to prevent reed growth to 2 meters.
 - a. What would be the impact on the water table if this would be done?
 - b. Is there a way to measure the effect?
- C.9. A third water management solution is to collect rainwater from the dike surrounding the park.
 - a. How would we measure the impact of an increased amount of water on the area?
- C.10. In general, what documentation or guidelines do you need when working with water tables?

General Water Management

- C.11. Do you have knowledge about the current state of water management in [parks/location of employment]?
- a. Do you monitor park water levels, if so how?
 - b. Does nature regulate water or have you had to do any infrastructure projects to manage water? Describe them.
 - i. What were the obstacles facing these measures?
 - ii. What resources did you need to complete these?
 - iii. Did finances play a role in the project, if so how?
 - c. Were these projects successful? Please explain why or why not.
 - d. What was the biggest challenge in carrying out this project?
- C.12. In general, what is the hardest part about managing water levels?
- C.13. In your water management projects, did you utilize volunteers and can you describe why or why not?
- C.14. If you use volunteers, do train your volunteers for a project? If so, how?
- a. If you use volunteers, are their specific jobs or projects in which you find them most useful?

Wildlife Management

- C.15. Are you familiar with techniques for monitoring biodiversity? If so, can you describe these methods for monitoring the wildlife?
- a. Would any of these monitoring methods be feasible for volunteers to carry out? If so, then how?
 - b. 70% of Văcărești is covered in reeds, not all of the reeds are harmful but due to the current drought, puddles and ponds are drying up or being covered completely in reeds. Can you speak to what the impact would be for a wetland ecosystem to be taken over by reeds?
- C.16. Do you know of any methods of removing excessive reed vegetation? Or are there different ways of rehabilitating the ecosystem?
- a. Would volunteers be able to help in any aspect of this?
- C.17. How do you increase public support for nature and biodiversity?
- a. How do you help to build long term volunteer programs in [specific project]?
- C.18. How do you measure the ecological impact of any solution that alters the ecosystem?

Appendix D: Conservationist Phone Interview Guide

D.1. Can you describe your role at [employer]?

D.2. What do you do with wetlands?

Technical Solutions

D.3. When you are doing a project, how do you monitor your ecological impact?

- a. e.g. If more water is introduced, then what is the impact?
- b. Is there a standard method to measure impact?
- c. Do you measure biodiversity?
- d. Do you measure water levels or water tables?

D.4. Do you deal with hydrological aspects of wetlands?

- a. In Văcărești park, there is a 2 meter layer of clay that was laid below the park in a past construction project. Does this affect the natural water table's access to the park's lakes?
- b. Would a shallow well that extends 2 to 4 meters below the surface deplete this aquifer?
- c. Is there a way to get a picture of the water table and aquifers? Is there a cost effective way of surveying this?

D.5. Do you know anything about implementing Rain Gardens?

- a. Would a project like this be even feasible to transport water across restrictive layers in the wetland or would this be too hard?
- b. What do you look for in an area to dictate whether a Rain Garden is suitable for implementation?

D.6. How do you deal with invasive reeds, like phragmites?

Appendix E: VNPA Volunteer Survey

Informed Consent

To continue please confirm you are 18 years or older.

- a. Yes (proceeds to survey)
- b. No (exits the survey)

We are a group of students from Worcester Polytechnic Institute, Massachusetts, United States and are working on a collaborative project with the Văcărești Nature Park Association (VNPA). Our project is to help develop volunteer-based solutions to address falling water levels that were caused by the ongoing drought in Romania.

We are conducting this survey to understand volunteer efforts in Văcărești Nature Park to help us design an effective water management system.

This survey will take approximately 5 minutes to complete. Your participation is completely voluntary and you may skip or not answer questions. You may also exit the survey at any time. Your responses will remain anonymous and confidential, meaning no identifying information will be collected. We will publish the aggregate data. If you have any questions or concerns, we can be reached at gr-vacaresti-d21@wpi.edu.

For more information about this research or about the rights of research participants, in case of research-related injury, contact the WPI IRB Manager Ruth McKeogh at (508) 831-6699 or irb@wpi.edu and the Human Protection Administrator Gabriel Johnson at (508) 831-4989 or gjohnson@wpi.edu.

Demographics

- E.1 What is your age?
- a. 18-24
 - b. 25-34
 - c. 35-44
 - d. 45-54
 - e. 55-64
 - f. 65+
- E.2 What is your highest level of education?
- a. High school
 - b. Associate's degree
 - c. Bachelor's degree
 - d. Masters degree
 - e. Prefer not to say
 - f. Other
 - i. Please specify: _____
- E.3 What is your occupation? [open response]
- E.4 What is your proximity to the VNP?
- a. I live within 1 km of the VNP
 - b. I live within 10 km of the VNP

- c. I live within 50 km of the VNP
- d. I live greater than 50 km from the VNP

VNP Volunteerism

- E.5 How often do you volunteer in the park?
- a. More than once a week
 - b. Once a week
 - c. Once a month
 - d. A few times a year
 - e. I have not volunteered before
- E.6 On average, how much time do you spend volunteering in the park in a single day?
- a. 30 minutes
 - b. 1 hour
 - c. 2 hours
 - d. 3+ hours
- E.7 Please determine your interest in performing the following activities:
- a. Planting vegetation
 - i. Very Interested Interested Neutral Not interested
 - b. Cutting and removing invasive vegetation
 - i. Very Interested Interested Neutral Not interested
 - c. Digging test holes
 - i. Very Interested Interested Neutral Not interested
 - d. Monitoring biodiversity
 - i. Very Interested Interested Neutral Not interested
 - e. Monitoring water levels
 - i. Very Interested Interested Neutral Not interested
 - f. Water management research in the VNP
 - i. Very Interested Interested Neutral Not interested
 - g. Biodiversity research in the VNP
 - i. Very Interested Interested Neutral Not interested
- E.8 What projects have you volunteered for in the past, or are currently involved in? Select all that apply.
- a. Cleaning up trash
 - b. Planting vegetation
 - c. Building infrastructure
 - d. Fauna (animals) and/or flora (plants) categorization
 - e. Other
 - i. Please specify: _____
- E.9 What motivated you to volunteer? Select all that apply.
- a. Value of the park

- b. Personal connection to the park
 - c. Concern for the current state of the park
 - d. Interest in the environment
 - e. For school
 - f. For your profession
 - g. Looking for volunteer experience
 - h. Looking to do community service
 - i. For social connections
 - j. Other
 - i. Please specify: _____
- E.10 Was there anything you particularly liked about your experience as a volunteer? [open response]
- E.11 Was there anything about your experience as a volunteer that you did not like? [open response]

VNP Issues

- E.12 It is important to protect biodiversity in the VNP.
- a. Strongly Disagree Disagree Neutral Agree Strongly Agree
- E.13 Fires in the VNP are a pressing issue.
- a. Strongly Disagree Disagree Neutral Agree Strongly Agree
- E.14 Before taking this survey, I was previously aware of the falling water levels in the VNP.
- a. Strongly Disagree Disagree Neutral Agree Strongly Agree
- E.15 I am interested to learn more about falling water levels in the VNP.
- E.16 Strongly Disagree Disagree Neutral Agree Strongly Agree

Appendix F: VNPA Volunteer Survey Romanian

Consimțământ

Pentru a continua, va rugăm să confirmați că aveți vârsta de 18 ani.

- a. Da (continuați sondajul)
- b. Nu (Iesiti din sondaj)

Suntem un grup de studenți de la Institutul Politehnic din Worcester, Massachusetts, Statele Unite ale Americii și lucrăm într-un proiect colaborativ cu Asociația Parcul Natural Văcărești. Proiectul ajută la crearea unei soluții de voluntariat privind scăderea nivelurilor apei cauzate de seceta continuă din România.

Scopul acestui sondaj este de a înțelege eforturile voluntarilor din Parcul Natural Văcărești pentru crearea unui sistem eficient de management al apei.

Durata sondajului este de aproximativ 5 minute.

Participarea la acest sondaj este pur voluntară și puteți evita să răspundeți la unele întrebări sau puteți ieși din sondaj oricând doriți. Răspunsurile dumneavoastră rămân anonime și confidențiale, ceea ce rezultă ca nicio informație legată de identitate nu va fi stocată.

Rezultatul sondajului va fi publicat sub forma datelor agregate și, pentru eventuale întrebări și neclarități, ne puteți contacta la gr-vacaresti-d21@wpi.edu.

Pentru mai multe informații despre această cercetare cât și legat de drepturile cercetătorilor, și-n eventualitatea unor accidente cauzate de propriu-zisă cercetare, va rugăm să contactați WPI IRB Manager Ruth McKeogh la (508) 831-6699 sau irb@wpi.edu și administratorul Protecției Umane Gabriel Johnson la (508) 831-4989 sau gjohnson@wpi.edu.

Demografice

F.1. Care este vârsta dumneavoastră?

- a. 18-24
- b. 25-34
- c. 35-44
- d. 45-54
- e. 55-64
- f. 65+

F.2. Care este nivelul studiilor dumneavoastră:

- a. Liceu
- b. Postliceal
- c. Licență
- d. Master
- e. Prefer să nu spun
- f. Altul
 - i. Va rugăm specificați _____

- F.3. Care este profesia dumneavoastra?
 a. [raspuns deschis]
- F.4. Care este distanta dintre locuinta dumneavoastra si Parcul Natural Văcărești?
 a. Locuiesc pana intr-un 1 km de Parcul Natural Văcărești
 b. Locuiesc pana in 10 km de Parcul Natural Văcărești
 c. Locuiesc pana in 50 km de Parcul Natural Văcărești
 d. Locuiesc mai departe de 50 km de Parcul Natural Văcărești

Voluntariat in Parcul Natural Văcărești

- F.5. Cat de des faceti voluntariat in parc?
 a. Mai mult de o data pe saptamana
 b. data pe saptamana
 c. data pe luna
 d. De cateva ori pe an
 e. Nu am mai facut voluntariat pana acum
- F.6. Per ansamblu, cat te mult timp petreceti facand voluntariat in parc, intr-o singura zi?
 a. 30 minute
 b. 1 ora
 c. 2 ore
 d. 3+ ore
- F.7. Va rugam sa specificati interesul in urmatoarele activitati de voluntariat
 a. Plantare
 i. _Foarte Interesat _Interesat_Neutru _Neinteresat
 b. Taierea si toaletarea vegetatiei invazive
 i. _Foarte Interesat _Interesat_Neutru _Neinteresat
 c. Saparea sondelor de testare
 i. _Foarte Interesat _Interesat_Neutru _Neinteresat
 d. Monitorizarea biodiversitatii
 i. _Foarte Interesat _Interesat_Neutru _Neinteresat
 e. Monitorizarea nivelurilor apei
 i. _Foarte Interesat _Interesat_Neutru _Neinteresat
 f. Cercetare pentru managementul al apelor
 i. _Foarte Interesat _Interesat_Neutru _Neinteresat
 g. Studiul biodiversitatii in Parcul Natural Văcărești
 i. _Foarte Interesat _Interesat_Neutru _Neinteresat
- F.8. Ati mai participat sau inca participati la proiecte aflate in derulare?
 Incercuiti raspunsurile.
 a. Strangerea gunoaielor.

- b. Plantarea vegetatiei
 - c. Construirea infrastructurii
 - d. Monitorizarea faunei (animalele) si/sau florei (plantele)
 - e. Altul
 - i. Va rugam sa specificati: _____
- F.9. Ce v-a motivat sa faceti voluntariat?
- a. Valoarea parcului
 - b. Conectarea personala cu acest tip de parcuri
 - c. Ingrijorarea fata de starea actuala a parcului
 - d. Protejarea mediului inconjurator
 - e. Pentru studiu
 - f. Pentru locul de munca
 - g. Cautarea unui loc pentru voluntariat
 - h. Ajutarea comunitatii
 - i. Pentru socializare si cunoastere de noi oameni
 - j. Altul
 - i. Va rugam sa specificati: _____
- F.10. Va rugam sa ne comunicati daca a fost ceva care v-a placut, in mod special?
- a. [Raspuns deschis]
- F.11. Va rugam sa ne specificati, daca in aceasta experienta de voluntariat, a fost ceva ce v-a deranjat?
- a. [Raspuns deschis]

Nivelurile apei in Parcul Natural Văcărești

- F.12. Este important sa protejam biodiversitatea in Parcul Natural Văcărești
- a. Nu sunt deloc de acord_Nu sunt de acord _Neutru_De Acord _Foarte de acord
- F.13. Incendiile in Parcul Natural Văcărești sunt o problema ce necesita atentie?
- a. Nu sunt deloc de acord_Nu sunt de acord _Neutru_De Acord _Foarte de acord
- F.14. Pana sa particip la acest sondaj, auzisem de nivelurile scazute din ultima vreme ale apei in Parcul Natural Văcărești.
- a. Nu sunt deloc de acord_Nu sunt de acord _Neutru_De Acord _Foarte de acord
- F.15. Sunt interesat sa aflu mai multe despre fluctuația apei in lacurile și bălțile din Parcul Natural Văcărești.
- a. Nu sunt deloc de acord_Nu sunt de acord _Neutru_De Acord _Foarte de acord

Appendix G: VNPA Interview Transcripts

Appendix G.1: Zoom Interview with Dan Bărbulescu

Interviewer	Note Taker	Date
Ryan Hanna	Erik Herrera	29 March 2021

RYAN: So if you could, please describe what your role is at the VNPA, the Văcărești Nature Park.

DAN: Okay, so I’m Executive Manager, and this is the CO of the Văcărești Nature Park Association right now. We’re the organization taking care of the park right now and official partner of the Minister of Environment in Romania and the Agency for Nature Protection. So we’re working in partnership with central administration to manage the park right now. And my position is CO, I’m the coordinator of the organization, and also I’m a founding member of the organization.

RYAN: When did your involvement with the organization begin? When did you start the founding process?

DAN: 2012. I was representing another NGO in a group of stakeholders. In 2014 we decided to found a specific organization on this issue. So, I’m involved from the very beginning, first as a stakeholder and then as a founding member of the organization. So 2012. February 2012. I can remember exactly the moment when my colleague called me and asked me to help them to, okay this is history, yeah.

RYAN: No, that’s great and what was your motivation for getting involved?

DAN: I was working in a non-governmental organization, an environmental conservation non-governmental organization. So, it was a professional reason but the main reason was the newness

of the project. So, yeah, for me and for our group of people the idea of having the nature protected area in the city was huge, and this was the main reason for us to involve and stay together, to have this place protected in the city. And another motivation was, I was born in a city in Romania close to the Danube river. This is a second river in Europe. And my childhood, I spent my childhood on the Danube river. You know, in a wetland area with marshes and ponds and birds and all the animals, so this was my childhood (laughs) and after 30 years I found myself in the same situation but of course with other motivations. So yeah, I have a lot of reasons to be involved in this project.

RYAN: And you recently said you were the CO. And now, how do you go about trying to involve other people in park projects? How do you go about trying to get volunteers involved?

DAN: Mm, I don't have a direct relationship with this program in the organization. So it's indirect. I mean yeah, I present myself, I represent my organization in the public, in the media, in I don't know, in the meetings. [...]

RYAN: So you handle more, like, the logistical side of things where you handle more of the setting up of things rather than the outreach, per say.

DAN: Yeah, I'm not directly involved in this program. But, I had the idea to develop volunteer recruitment projects in 2016 called Urban Rangers. So, yeah, as a CO I presented my team this idea and they were very excited and we started at the end of 2016, or 2017 I think, to build this program of volunteers. To build a volunteer community for the park. And, we have now 150 to 200 volunteers in the community and we want to raise these numbers in the future.

[...]

RYAN: Do you have knowledge about the financial resources of the park?

DAN: Yeah sure, I mean this is my job actually [laughs]. I mean, yeah, I also cover this responsibility, fundraising, to find financial resources, to apply to develop projects, to, yeah, to fundraise actually. This is, I mean, I'm also a coordinator but I also submit financial application, and I also discuss with potential sponsors.

RYAN: So that kinda answers where you get the budget from. Do you also get, government support or is that been not present and do you have to reach out to sponsors.

DAN: 28% from our budget comes from private sources, and so and from this number I think, I don't know, say 90% comes from private sources and 8% from donations. But no public support, no public money. So far, I don't know. I hope, as a partner of the municipality, to have access to public funding, yeah, because we want to diverse our funding resources in the future because right now we are completely exposed, let's say, to privates. yeah. We suffer, for example last year, because some of our sponsors, mainly companies, private companies, decided not to continue because of the, I don't know, the medical situation and all the crisis. We're very uncovered to this kind of situation. This year will be a good year, in spite of our thoughts in January, but we have positive signals. So let's hope for a good year [laughs]

RYAN: Definitely can you give us an idea of what your total budget looks like, what you spend the most on, what you spend the least on, and what you want to spend money on?

DAN: Yeah, I can give you. So, basically we have a yearly budget of around 150000 euros, and this is more or less dollars, it's a difference, 10%. This is around 170 thousand dollars. And, I think, from this amount, around 60% goes to the salaries, 30% to the, activities in the park, investments, infrastructure, and 10% administration, communication, and yeah.

RYAN: Alright, thank you. And now we are going to pivot to physical resources that you guys have. Can you describe what type of connections you have with other organizations, like do you partner with other NGOs, have you partnered with other organizations-

[...]

DAN: In Romania, were people working in this area, and organizations active in this subject conservation and nature protection very close. We collaborate, we easily collaborate, We have a lot of partners in Romania, like WWF, Romanian bird society. We are part of a coalition of NGOS working in conservation, its a coalition Nature 2000 in Europe. It's a European program, it's a European policy actually. This is the EU protects nature in Europe by developing a network of nature protected areas named nature 2000 and we are part of this coalition. Together with another around 20 conservation organizations in Romania. I mean, we are part of relevant coalitions and group of organizations as I said. We working closely with NGOS and initiative groups, citizen groups. In Romania, we have this situation. We easily collaborate within our sector of NGOS, conservation groups, but we have difficulties in collaborations with the government, with state organizations. We're mostly a watchdog watching the state to do its job, and if there are troubles, we have [inaudible]. We also have a good collaboration with ministry of environment, the agency for nature protection in Romania, we also have a good collaboration with the municipality in Bucharest, we have a very good collaboration with the States embassy in Bucharest. Friday I have a meeting with the person in charge of science environment, and conservation from your embassy here. So yeah, we collaborate.

RYAN: Ok awesome-... Can you describe the public's perception and involvement with the park and how it impacts you guys?

DAN: ... the park has a good, , good name. It's a good situation. A good image in the community and I would say in Romania because, -I think- hm, a lot of people have heard about our park and if you ask someone about Văcărești Nature Park they would say, "Ah yeah, this, this is a wild place in Bucharest. It's very interesting. It is like a delta" or something. So yeah, we, this place and this project, this hm... this story... its very present. Its very, yeah in the community. And there are people calling us, Saturday evening at 11, 12 pm asking to intervene because its a, I don't know. Birds somewhere in the park or something, I mean its- its very close to the people and Its very present in their life. So from this point of view, umm of course this is something positive but its, there are situations when we prefer not to be that present in the people's lives because, for example last week we had- two weeks ago we had a tree planting campaign, and there are people, calling the police to check if our activity was legal. For example. Because they didn't know that. And the police came and that has you know there is a complaint here assigned by someone living here- near the park and. Or for example if we want to build a bird watching tower inside. We have a lot of, complaints coming from the people. What do you want to do? Do you want to intervene- want to build something- no. Leave that place to go wild and free- heh. So yeah... this is not something- this is not general attitude of course, but we also have this kind of, you know, yeah, signals coming from the people. But anyway, we feel this I wouldn't say pressure. This is a positive energy coming from the community, and support. And for sure if, we will have troubles from the I don't know real estates investors or something we have this support coming the community and we, we can mobilize local community for the park.

RYAN: ... and what other physical resources do you have at your disposal? Do you have mechanization? Do you have the ability to bring in workers-

DAN: Mhm, mhm... yeah we have, we have ten bicycles

[...]

DAN: We have, we don't have big, I don't know machines, kind of big digging machines where other I don't know. We have two cars, a lot of tools, but, we can mobilize this kind of support to intervene in the park so... from this point of view yeah, I would say yeah we have this physical capacity- not a huge physical capacity- but enough to mobilize.

[...]

RYAN: Yes. So how has the drought specifically impacted the biodiversity, fire risk, and water levels in the park in the recent years?

DAN: So the water level decreased last year, I mean I cannot say how much because, I don't know. I wouldn't expect actually to-to, to decrease at this level. I mean I saw, ponds in the- in the, in the park completely empty, with no water in it, so it was "My god" for us. We were shocked. I can - I cannot say right now what was the impact on the biodiversity or and because we don't have data. but from another point of view we are talking about, wetlands, and a wetlands it's also affected by the weather, the climates. So it's -I think this is how do you call... evolution of- of water level fluctuation. -Is it okay? Fluctuation? No?

RYAN: Yeah

DAN: It's something common for a wetland area and we are happy right now to see that the water is coming back and ponds are refill. But I believe- I strongly believe that in the future this will be a problem. Keeping fair enough level water in the park for the biodiversity and for the... So yeah. From this point of view I'm quite stressed I would say.

RYAN: Is the public or volunteers aware of this situation?

DAN: Yeah. I mean last year in August and September, we... received a lot of pictures and, a lot of messages from the people in the park, saying “Oh my god”. “This is an empty lake right now”. “This is a pond with not water”. Of course we knew, yeah. But they keep sending us, a lot of pictures asking “What about the water?” “What’s the...” yeah. And we of course explain them the situation and, drought and, -and for example, there were some lakes in Romania- in the south part of Romania- that completely disappear. So we were lucky to have to still have, a huge area in the park with water so. This made us confident that, we’re talking about resilient area and maybe the-the solution we need aren’t that difficult to, to apply.

RYAN: Definitely... and what are the current measures that you guys have tried to put in place to - to manage the water levels?

DAN: Practical measures, or...? -how?-can -can you?

RYAN: Like, ... Have- have you- have you cleared vegetation to try to improve -

DAN: -No

RYAN: -water levels or have you tried to make drainage ditches or...?

DAN: No, we started last year to discuss with the national water administration in order to bring water into the park but it was impossible I don’t know why. And we start thinking to how do you call drill? When you dig for water

RYAN: Like a well?

DAN: Yeah, yeah, because this is apparently the easiest because the shallow water is two meters deep so we could easily have access to this level of water and to start pumping water from the underground water so this is a solution for us so we need some documents to do this but maybe not this year nor next year but on the medium? Term we will be able to apply this

DAN: Just a second and we started to discuss with the city municipality water company and we had a meeting and we are about to start a three year project to start pumping rainwater in the park for example but we are talking about 2034 or 2024 we're not a hundred percent sure that we'll be able to start this project, we're only talking about possible interventions

[...]

RYAN: I was just wondering what is the difference, you don't need permission to plant trees or anything like that so what's where's the boundary between needed and not needing permission on a project

DAN: I don't know, this is a very good question I think when we're talking about bringing rainwater in the park this could have a direct impact on the biodiversity in the park u at least in some significant places in the park I think we need at least impact analysis before we start pumping water in the park just to make sure our intervention is ok if we are talking about planting trees, we plant two years all the trees outside the park on the outside limits of the park so we're not intervening directly with to impact the landscape or biodiversity but if we're talking about pumping water in the park from outside it doesn't matter the sources I think we need to take into consideration impact analysis, I don't know, biodiversity assessment and of course we need to have documents from the government of course we have this solution, I wouldn't say legal but guerilla intervention if we say that nobody will have intervention we have this solution but something ultimate urgent intervention but for the moment we want to develop our approach step by step and to be aware of everything that might have negative impact on the park

RYAN: this concludes the time we allotted for the interview if you still have any comment questions or concerns or anything you want to elaborate on you can bring them up now but we don't want to take any more time than we already have

DAN: It's ok one of the solutions we were thinking about is regarding the vegetation so we want to start this year pilot projects in an area of the park to try to mow? Is this ok? To mow the reeds with volunteers and maybe on your suggestions study research to have pilot intervention this year and to start making some [inaudible] and some areas in the park so this is a solution if we're talking about water I don't think it's just one solution but a mix of interventions, rain water, water from the channel, vegetation management with volunteers, and water pumping from the underground

RYAN: Thank you, I think we'll probably be emailing you some follow up questions to maybe explore different avenues because this has certainly helpful in clarifying direction and scope and everything

Appendix G.2: Zoom Interview with Vlad Cioflec

Interviewer	Note Taker	Date
Andrew Yatsunami	Catherine Masiello	30 March 2021

ANDREW: So Vlad, can you please describe your role at the Văcărești Nature Park Association, including your title?

VLAD: Okay, so I'm Vlad Cioflec. I'm an ecologist by training and at Văcărești Nature Reserve I do consultancy on regarding biodiversity aspects and politics in urban protected areas. I also conduct field trips with kids and nature enthusiasts. I also did some PR and interviews and articles for the reserve. Currently I'm doing, by choice, lots of maintenance work. I find it soothing working with my hands again, building observation towers, all sorts of that, birds nests and what not. So, to sum it up, I'm a jack of all trades for the past 10 years at Văcărești Nature Park.

ANDREW: So you've been working in the Văcărești Nature Park for 10 years?

VLAD: I started there as a volunteer researcher in 2006 on the 27th of November. And I've been gathering data regarding reptiles, mammals, birds, and amphibians for that past...I don't know how much it's been, 15 years or so. So I've been part of designation process for it as a reserve cause prior to that it was just an abandoned land but it spoke to me on some metaphysical level way back before it was a reserve or there was even talk about it being a reserve. So looking back I can't believe it's been actually 15 years in that little swamp but, well, time flies.

ANDREW: Yeah, that's cool. So you said it spoke to you on a metaphysical level, is there any other way to put your motivation for working in the park into words?

VLAD: [thinking] Well [pause] when, uh, living in a busy city or town, nature pockets are few and far between and as a wannabe explorer like all biologists are at some level I was kind of growing tired of the same urban parks, reservoirs, forests, and everything that lies within the city. And upon discovering this rough gem I saw the potential for my own personal recreation, my family's weekend outings, and the possibility of flipping stones and finding what nobody else dare dream of finding nor did anybody care to at that moment in time. So it was like my own private jungle let's say, and my kid, my daughter Maria, grew up in there and called it her favorite place in the whole world. So, I had this kind of personal connection with Văcărești going way back. And I found out later, I think I was working at the reserve at that point, my mother told me that when she was young and Văcărești was not a reserve, was just some, I don't know, gardens and lots owned by private individuals, that she used to go there with my great grandfather looking for wildflowers and water snakes. So that was like, whoa how cool is that! And upon hearing this my father told me that when he was working as an, some sort of engineer, has to do something with water actually, uh, he was part of the project of building, designing the lake. Something like that. But...or his best friend was, I don't know, chief of operations, something like that. So I discovered some family ties with Văcărești that I didn't know about until my passion for it began to grow. And I'm still waiting for some distant relatives to give me a call and say "Hey, I know that place, I buried treasure there" or something, or "I own land there". So that about sums it up.

ANDREW: That's awesome to hear that you have such a deep family connection with the space as well as your own personal motivation. One more question before we move on. When did you first get involved with the Văcărești Nature Park Association?

VLAD: I think it was 2010 or 2012. Things go like this. I got a call from a friend of the Institute of Biology here in Bucharest and they said to me “Vlad how much would you charge to give your data on birds, mammals, frogs, whatever I collected to an NGO that wants to declare Văcărești as a nature park. They reached out to us but we don’t have people nor the time nor data, so I thought to phone you.” And I was like “What! Somebody wants to do something in Văcărești, there’s no charge for this just hook me up.” And I started pouring data to the founding members of the association for the study that allowed it to be declared as a nature reserve. So I think it was 2012. All I remember was that I was on the balcony in another apartment that I lived in. So about that time. I think Florin or Dan should have that noted down.

[...]

ANDREW: Okay, we’ll move on, that wraps up the first part of the interview. We’ll move on to start talking about some biodiversity stuff, your specialty. So I guess the first broad question is what does biodiversity look like in the park and is there anything unique about the species in the space?

VLAD: Well, the biodiversity of Văcărești exceeded all expectations. And I’m not only talking about reptiles and amphibians, I’m talking about, for example, new species of insects for Romania being discovered in Văcărești. For an entomologist, it’s a huge thing to have your name associated with a new species for the fauna of Romania, and I’m not talking about invasive, exotic [unintelligible] species, new wasps species and stuff. So it’s a place of discovery. And I think most important lesson that I’ve received while working on biodiversity of Văcărești is you never know what’s going to show up next. You think you have a list of amphibians or snakes or lizards and then you flip a stone and find something totally, totally unexpected with the closest population being, I don’t know, 20 miles outside of the city but somehow it reached Văcărești.

So imagine 184 hectares, less than, let's say around 1 square kilometer, less than a square mile, it's a tiny, tiny lot of land. So, 6 amphibians, 6 reptiles, close to 200 bird species recorded, and around 30 or 40 that actually breed there. Over 10 species of mammals, excluding bats we have hedgehogs, foxes, otters, many mammal species that were persecuted in communist and post-communist Romania now find a safe haven here. And, I'm gonna close it up with the fact that it has over 330 plant species. For me, and for any biologist, it's a lot. Over 300 plant species with new plant species for Romania being discovered here again. It's amazing because looking at it on Google Maps or on your first visit there, it was a bunch of reeds, some lakes, lots of concrete, and a few young trees, but with each passing season it never, never stopped to shock us in terms of ecological rarities or new invertebrate species, scorpions and what not. One would not expect such biodiversity in a crowded and polluted city such as Bucharest. So, I would be very happy for more and more Romanian biology or ecology students to be interested in starting in their field works here but unfortunately there is this, I don't know, fear of the great outdoors within the city and not too many faculties come to us looking for a natural space to understand what's being said in the classrooms. But maybe this will change in time, but it's a very rich place.

ANDREW: Yeah so considering how rich the space is, do you have any idea of how, how the space came to be so diverse, or do you just not know?

VLAD: Looking at the construction that later becomes Văcărești nature reserve, it's easy to see that it's easy to its connected with the river Dâmbovița that crosses Bucharest from west to east. And knowing about water tables of the Dâmbovița river, I know that from time to time all the water is drained out of the river, and there is a canal that connects the square reserve with the river bed. So when the water is dropped, it's just a mushy, muddy, few miles long canal rich with animals that have no place to go and start looking for any way out. And Văcărești was a way

because there is a huge round pipe that can allow passage back and forth. So the otters enter through said pipe, the muskrats, the turtles, the snakes, frogs, newts, this is how they reached Văcărești, I'm talking about aquatic species of course. birds migrated and first they fed in the swamp, they nested there when vegetation allowed, and bats were just feeding over the swamp anyways back in the day. But this is the most important aspect. The small connectivity with [unintelligible] Bucharest that's like been totally neglected by the authorities as we speak and has been for many years. That small pipe actually allowed the biodiversity to colonize Văcărești without dying on the streets that are on top of it because many foxes, and otters and turtles while trying to reach Văcărești using the surface were ran down using vehicles. So if it were not for this pipe connecting Dâmbovița I think we would have a smaller number of species and a smaller number of individuals actually.

ANDREW: So that's wild. That's absolutely wild. You just mentioned that the river drains every once, that the river will ruin dry, and that there's a pipe connecting a pipe to the river, so that brings me to my next question: How dependent is the Văcărești ecosystem on the amount of water in the park?

VLAD: [exhales] Well, I think it's close to crucial. In terms of the ecosystem, it has, which is basically a marshland, and in terms of how it is, how this reserve is perceived by the general public without of course, without water all the amphibians, all the fish will eventually die out, and all the birds and mammals that are depending on the food resource will go someplace else and will lose I don't know over half of its biodiversity. But also, people see Văcărești as the delta between the apartment buildings which it was named. So losing the water, and turning it into I don't know, a grassland, or urban forest, will alter the general public's perception of what an urban wetland reserve is. It's all very new to the Romanian public, and losing water will mean

losing the delta, whatever this delta is. So whatever this little support this project has within the community of Bucharest nature lover, environmentalist whatever you want to call it, will kind of be gone because we lack ecological education and Văcărești benefited from the fact that it looked like a delta. Danube delta is far away in eastern Romania, it costs quite a lot to visit it, you need rent a boat, but this an accessible delta, it has this kind of, value about it. Nobody could care less about an accessible urban forest or an accessible, I don't know, another green lot. So water is crucial, crucial for the survival of Văcărești as, a self-supporting ecosystem and as a reserve. Because losing water could mean that in the near future some growing pressure on the surrounding lots or within the reserve. There is no lake here, we can build something, I don't know, a small shop, then another building close to it, and in 10 years you could see urban sprawl inside the reserve. So water keeps developers, at bay.

ANDREW: Alright, so talking about water takes us into my next question: What is the current risk to the biodiversity and wildlife due to the drought of the past couple years?

VLAD: Its a fluctuating water tables go together hand in hand with the tourism that is taking place in Văcărești. By that I mean we don't have regulated access or pathways or designated areas that aren't allowed or open to the general public. So when the water tables drop, people start searching far and wide for a secluded spot to the best I don't know, to have the best Instagram photograph, smoke some weed, or something like that. They are going into birds nest and otter burrows and there's great disturbance for wildlife. There is pressure that the water is dropping, food is becoming scarcer, and people are coming over to see what's going on. We need high water levels to keep the non-informed tourists a safe distance from all the nesting birds and animal burrows. We've also had because eastern Europe is very poor, and poachers. When the water table dropped to its minimum, people were coming in and taking the dying fish and I

don't know, looking for other morsels of food to take home. Of course the fish could have survived if they burrowed into the mud or they could've been eaten by birds. People were taking that little protein resource away from the reserve and there was nothing we could do about it. This is how I want you to understand the problem of dropping water levels in Văcărești compared to other big lakes or aquatic ecosystems, that people are like vultures, they try to take, I don't know, scrap metal that they find on the lakebed in order to sell it and buy a beer with it. With the low water table, comes great disturbance. And of course the stray dogs that are always a problem in Bucharest go further into the peninsula and um, they killed some foxes, some otters, mauled a swan, because nasty. So we need a safe surface of constant water at least in one part of the park.

ANDREW: Yeah, so it's a much bigger thing than we originally thought, and how much damage the water drops actually causes. It's not just the water goes down is the problem, it brings a whole host of problems with it. Do you have any programs to measure this damage when the water drops?

VLAD: Unfortunately no because we are an NGO. We are no longer administrators, custodians of the reserve because the state banned all NGOS from nature protection. So we were kinda in a guerilla conservation, part of the organizations life last year and the year before. So we cannot afford to have programs regarding every little aspect of Văcărești. We try to have wildfire watch, stray dog watch, picking up trash that the municipality simply does not care about. But other than that, it is resource consuming for us. But maybe we will address this in the future I don't know.

ANDREW: Yeah so do you have any plans to improve measuring damages or addressing, trying to mitigate the problem of damages?

VLAD: It would be quite simple to designate the strict-strictly protected areas within the reserve, and -I don't know put, psychological fence around the perimeter. And people should understand that, even if it is water in here or if it's not water in here, just read this. One should not cross this imaginary line, and this will have minimize the damage -but in order to have this simple solution, uh placed with in the reserve you have to go through a un-imaginary bureaucracy, so ... its best to use our resources -I don't know- planting trees and uh, having, talks with the children about biodiversity. But there are solutions, but its not up to us to implement them as we speak. I we become managers of the reserve, of course then we will take action first and this is a protected area, this is for the people, this is for the biologists, this is for wildlife, and this is for general entertainment. These are the [air quotes] "Laws of the land", and you should uh respect it. I when I was a ranger thing were very black and white. Are you a poacher or are you a visitor? You're a visitor? Okay stay here. You're a poacher? I'm calling the cops and I'll have you escorted off the reserve. Don't, tempt me, but now you cannot enforce this. You can only dream of what it would be for would have water and public support and authority support, so -so it's a mental gymnastics for the moment. But, if we become managers, in partnership with the city hall, the water resources would be one of the main focuses. The safety of the reserve per say and, protecting its most important asset which is which is the water.

ANDREW: [Nods in agreement] Sounds like something you guys should keep pushing for as much as you can. Sou-sounds like one-once you -If your organization can become a managing - can become manager of the park you can get a lot of the things you want done.

VLAD: We will. We will. You im -imaging this, we were manager of the reserve. We started all of this projects. And then they say, go home and all our projects were banned for the next ten years. Including... pumping water from Dâmbovița River when needed be inside the reserve

with our own money, our own generators, our own pumps, but now the city won't even let us do this. River is like, right here. It's... I have one foot in the reserve and one foot in the city river so, we'll see.

ANDREW: Alright, you just mentioned that one way you guys are managing water was just pumping it in from the river. Is there -is there anything else you're doing to manage water in the park?

VLAD: We were planning on pumping water. We never did it because while we were managers there were not problems with the water table. One thing we did while we were managers was renting reed cutting amphibious, bull(bolt) thing, in order to reduce the reed beds because they suck up, water and, create a problematic aspect for- for the reserve and diminish the feeding grounds of some important bird species. But other than that we did not intervene. If we were to become managers, of course we would consider pumping water from Dâmbovița river and we are also considering the idea of drilling some holes and pumping water out of the active well. I - I - I don't know the legal aspects of this operation. I'm sure its doable with all if all political figures agree that it's very simple and ecological sound idea to bring some water. That its kind of in the reserve, but only its under the reserve, but its same thing. But other than that I don't know what's doable ideas and projects that could bring water in Văcărești. Of course there was talk of some huge rain garden project regarding all the neighborhoods that bordered Văcărești Nature Park, but in order to do that you have to change the whole piping and infrastructure of this part of Bucharest, so I don't know how SiFi that idea is, and how realistic -It could be done in the U.S. I'm -I'm quite sure. No problem. To do a rain garden in Romania its -its not as easy as it sounds . So we'll stick to pumping water from Dâmbovița and some drilling. Best idea... for me as we speak would be to divert Dâmbovița River just upstream of Văcărești, where our offices are. You

saw some photos of google maps. Let it flow through Văcărești because -and I think you don't know this one- at around 1600 a German explorer mapped Bucharest and the whole empire that was Romania back then. And I saw a very old map that depicted Dâmbovița River flowing through the southern part of Văcărești nature reserve, so. Maybe bringing it back to its origins state could solve many many problems or divert -I don't know- half of the water flow of Dâmbovița through Văcărești. Of course it would be very costly to tend -I don't know- tens of hundreds of millions of dollars or for euros but maybe the infrastructure is there, built in the communist eras of flood safety device and we don't have access to the main plans and could be as simple as; okay, you open up this valve and the Dâmbovița will flow into Văcărești. Poof! (Vlad snaps fingers). I don't know. It -it needs to be, investigated by -by the authorities that actually have this paperwork at hand.

ANDREW: Alright. Sounds like you've put a lot of thought into how to address the water problem, it's just a matter of jumping- jumping through all the hurdles to do so. We're -we've hit about thirty minutes. We have a couple more questions if you want to keep going. Otherwise you can-

[...]

ANDREW: Alright, so another -one -one more follow up question about water. Are there any specific locations in the park that are at a particularly higher risk from dropping water? You had mentioned that sometimes it dried up and you get the tourists walking around, stomping on all the land, but is there any specific location where it's -that's a particular problem or something like it?

VLAD: (Nods yes) There is one particular lake that, if it will drown it would be like irreversible damage. And I am talking about the north... eastern... lake. If you look at the map, we go

through to the Dâmbovița River through the -to that intersection. The north eastern corner. That's the biggest lake we have, and it's the last to be affected by drought. When all other lakes dry out -was for the first time that I've seen for the first time in my life last year- that is the only one that was still has population of fish and a place for the otters to breed and take cover. [...] What- if that lake would be gone I -I -I don't know what could be done to bring biodiversity back because it acts as a reservoir for all the frogs, all the fish and all the aquatic invertebrates that are needed for this little ecosystem. So that lake is -is very very important. I hope that it has some underground spring underneath that we don't know about that allows it to survive when all other dry out. But, god forbid we lose that lake because it will be very hard to get to Văcărești colonized again by this array of full species. Of course it would take place but to take another -I don't know- ten to fifteen years and I don't know if it could guard Văcărești for as long as that would take in order to be accepted again by the general public as the home of the cute otters and all the turns that fly and a show. So that's the lake I'm counting on for you guys to save. [Shakes his head] Whatever it takes.

[...]

ANDREW: Alright, we'll move on then, , to -and just -then we -we have two more questions and we are -we're going to pivot a little bit. Do you -do you work at all with volunteers or park volunteer projects?

VLAD: I was manager of the volunteer project in 2017 it was called urban ranger and I used to select some rangers have trainings I don't know catch invasive turtles or recognize mammal species, track birds in winter at the feeding stations, how to give presentation on the park so I was at that moment in time very very involved with the volunteers. We had a little wooden hut to build up for them in the park to have our meetings there in time the sponsor of the project pulled

out of Văcărești when we were no longer managers but we managed somehow to keep many of our hard core volunteers around the team even though we had no more small gifts to offer, you know your a volunteer, have a cap have a t-shirt. In the first few months of the project it's really cool to be part of this whole wetland movement and I have this pen. They had official ID's with the official signature and stamp of the reserve it was very cool I forgot about that. So yeah it was like 50 volunteers when we started and now I've heard Gabriela said something about 300 but maybe most of them do their part in online dissemination of what we discover or sharing of photograph and fundraising. Maybe they are more involved in this aspect but regarding field work and picking up trash and cleaning after a wildfire I think there are around 50 volunteers that are dependable as we speak

[...]

Andrew: Awesome, one more question to tie it all together. Are there any projects currently or have you done any projects in the past specifically dedicated to biodiversity awareness or protection? And are volunteers involved in that?

Vlad: Alright here we go , the first project we got in the biodiversity of Văcărești was called Birds of the City. It was aimed at discovering the bird fauna of Văcărești and there were volunteers involved in monitoring but volunteers from the company that funded us it was an energetic company that gave us like 50,000 dollars maybe to work on the birds of Văcărești. Building bird houses, having talks, monitoring all that it takes, removing fishing nets and we had volunteers from that company. The second one was about the turtles of Văcărești and removal of invasive American sliders that are a problem here in Europe. And there were volunteers involved not from the company that supported us but our own volunteers were required to send photographs of turtles sunning themselves on the platforms we built, you send me the picture I

decide what's invasive what's not catch it and dispose of it, take it into adoption if you want. here was a project involving mapping all the trees of Văcărești it was like 4000 trees to be noted on an app and of course the volunteers had to be involved. I think there were other projects managing invasive weed it's called [scientific name] it's some kind of weed that give breathing problems. It comes from the US actually and so its called [scientific name] you google it and you will find out what's it --royal weed or something like that -- volunteers were called upon to take it out of by root its a lot of work and it gives you rashes but it offers occasion to ID invasive plants versus native protected ones so 10s of volunteers were circling the concrete dike where this resides and what's this, this is protected we leave and what's this? Invasive take it out so it kinda had to do with biodiversity. I'm sure there were a few smaller projects mainly education work that took place and of course volunteers were involved but otherwise most of our projects target biodiversity in some way. Even removal of litter and abandoned fishing nets. It somehow targets volunteers and biodiversity. You cannot do something in Văcărești without some outside help and that won't benefit biodiversity. everything you do in Văcărești if you [inaudible] biodiversity at some level. Of course my colleagues will have better memory than I do and say there lots of projects Vlad's lost his marbles there was this and that but that's the projects I can recall because maybe they were close to my heart or the most recent, I don't know.

Appendix G.3: Zoom Interview with Gabriela Poiană

Interviewer	Note Taker	Date
Erik Herrera	Ryan Hanna	31 March 2021

ERIK: Could you describe your role at the VNPA?

GABRIELA: I am responsible with communication. Every project, each of our projects has a communication part. We have to inform the public about the collaboration between we and the company that is--which is sponsoring us or the grant that is giving money to us in order to develop each project. More about this, each of our projects have a part of communication and education. Every...I think that you already know that education is a very important part of our activity and I'm also responsible for this too. I'm making materials, educational materials, and stuff like that. I'm also managing, if I can say so, the volunteer team. We have more than 300 volunteers and I'm responsible for social media and everything that's happening online. And this is it, yeah.

ERIK: Okay. So, do you have an official title?

GABRIELA: Yeah, I'm a communicator.

ERIK: Okay, communicator. And how long have you worked at the VNPA?

GABRIELA: I'm here since 2018. Since January. So I have three and a half, three years and a half.

ERIK: Why did you get involved in the first place with the VNPA?

GABRIELA: When I found out about the park I was studying. I was in the University and I've studied ecology and environmental protection. And when I first saw Văcărești Park, which was in a very sunny and beautiful day after the classes, I came here to drink beer with my friend and I

definitely fall in love with this place and I said to myself that I have to do something about this no matter what. So I searched for the people that were involved in this project, which at that time were Dan, Vlad, Florin, and Nicoleta. I stalked them [laughs], I was a stalker because I really loved the project and I was very happy to do everything in order to be part of the volunteers team. And I decided to do my final thesis at the University about the educational potential of Văcărești Nature Park. And as a volunteer I started to implement some of the ideas that I had in the thesis. And [thinking] after a few months of intense volunteering, they had an offer for me because the team was getting larger, they had more and more projects, and I found my place in here.

[...]

ERIK: So, not like “How many shovels do they have” or something like that. I guess more tailored to your social media side. Where, it’s like, do you guys have a Facebook page, Instagram page? Like what’s your reach and extent?

GABRIELA: Oh, okay okay. Materials in terms of communication, digital communication. We have a Facebook page, an Instagram account, a website, a YouTube channel, and a lot of platforms for podcast streaming which aren’t fully developed by now, I’m still working on them. Platforms like Spotify, Google Podcasts, and other platforms like it. Well we have a podcast, this is why we have those platforms active. And this is it in terms of digital.

[...]

GABRIELA: Yep, we will be on Spotify. For the moment we are locally, so we are only talking in Romanian but who knows maybe at some point--actually we have in our plan, in our subjects plan for the podcast, we were thinking to invite some international people who are advocating for

nature. Maybe, I don't know, very well-known bird watcher or someone from the European Union responsible for the environment. Why not. We are thinking about this. Maybe Greta Thunberg, why not.

[...]

ERIK: What connections do you guys have to other organizations? You talked about European Union, inviting some people on the podcast. What kind of connections, I guess within the podcast and outside, do you guys have in general?

GABRIELA: We are very well connected to other organizations locally, nationally, and even international. I mean Văcărești, it's very ambitious and bold project and it became very well known. For example, Princes Charles is one of our supporters, the ambassador of the UK, the ambassador of the United States, the ambassador of...not Norway it's Switzerland, the ambassador of Switzerland, and we have a partnership--it's not a partnership actually but we have, like a, we visited the Norway [inaudible] Organization for an exchange and some Icelandic organizations and municipality in Reykjavik in Iceland. We are part, actually the park is part of Wetland International Link, Wetland Link International. It's a network of wetlands actually. Yeah, and this is like the international background that we have. We have a very well-known bird watcher that visited us and is supporting us. He's Jonathan Franzen. He's from America, as far as I know, or maybe UK, I'm sorry I don't know. But he's very well-known between bird lovers. And in terms of national network, we are connected to other projects, other organizations who are having similar initiatives as Văcărești. And now we have a project, I think that you already know probably, through Norway [inaudible] we are now funding national network of urban protected areas, beginning with the model of Văcărești. And we already have two cities, two big cities in Romania, Brasov and Cluj, in which two organizations are having similar

projects as Văcărești. They are trying to protect some specific, two specific areas from those cities

[...]

ERIK: So would you say the public's perception is good or bad, or neither [laughs]? What do you think they think about the park?

GABRIELA: The public perception about the park it's good. This is the long story short.

Obviously there are people, a very small percent of people are not necessarily supporting the idea of having wildlife in the middle of the city, but this is like maybe 1%, or less than 1%. They are people who are not really understanding the importance of nature in their life. But besides them, Văcărești is a very loved project.

ERIK: Okay, I don't know if you want to get into particularly what they're saying that they don't want about Văcărești. If you don't want to, that's fine we can move on, but I would love to hear why in particular people like the park and why in particular people don't.

GABRIELA: Okay. As far as we know because we had a survey, we had two surveys actually, actually three surveys among people. Three different research among our visitors and the number one reason people are visiting Văcărești Nature Park is because of the silence and wild background, not necessarily the biodiversity. But the people of nature, people love to be in nature. They love the silence, they love the bird songs, they love that it is possible to [see] animals that you cannot see otherwise in the city or in other parks. And it isn't, they love Văcărești because it is not anthropic place if it is that, I am not sure? Yes, and because it is different from other parks which are very high, they have a lot of human interventions. [...]Those were the reasons why they love Văcărești. The reason why people, I wouldn't say they don't love

Văcărești, I'd rather say they don't understand Văcărești, that 1% or less, is because they are afraid of nature. They are afraid of some certain species, for example snakes or frogs. I think snakes are the enemy number one, that some of people think, and they are afraid of insects, and they are also afraid of some aspects from the history of Văcărești. For example, wild dogs? I wouldn't say wild but you know what I mean?

ERIK: Yes.

GABRIELA: Stray dogs, stray dogs, yep. In the present moment we don't necessarily have this problem, they appear from time to time, but it's not the biggest problem of the park right now. Another reason could be that they don't feel safe, some of them. Even the people who are visiting Văcărești and love Văcărești would love to feel a little bit safer. This not a common answer to the survey. They would love to know that the park is having someone watching it. Yep. And a lot of people from this 1% that I am telling you about, they don't understand maybe this concept of loving the nature as wide as possible. And the concept of a park, of an urban park, it's more like concrete park, with concrete and trees and grass, but yeah you should, in their opinion, you should have some concrete parks in order to I don't know, to walk without getting mud on your shoes.

[...]

ERIK: So what is other media's perception of Văcărești?

GABRIELA: Generally it's a good, the status is very good. Media is getting activated usually when Văcărești is having some big issues. For example we had a big fire in 2020, and the press went crazy on this subject, Even though the good news are sparkling harder than the bad news, the image of Văcărești if you search for it in media is a good one usually. We do have [...] some problems in its history with stray dogs, with fires, with people who were catching fish and birds

illegally, with trash, and the media wrote about this in order to make the subject more visible, but the image if you could only have media, as the only way to have an image about Văcărești, this would be a good one.

ERIK: Okay.

GABRIELA: Like Văcărești is a good guy. The image is like Văcărești versus government, who will win? We want Văcărești to win, this is like the battle. We also have the public support, the community support.

[...]

ERIK: How does the VNPA recruit volunteers?

GABRIELA: Why do we recruit volunteers? Or why do we have a group of volunteers?

ERIK: More on how you guys get volunteers.

GABRIELA: Ah, how. Oh okay. It depends. We have these group of volunteers. It's a Facebook group and a WhatsApp group. They are available and are usually waiting for us to ask them for help. But some of them, like the most engaged people in the park activity, they are just active without a necessity to ask for help. For example they are walking in the park daily or weekly and they are sending us picture with new stuff that they saw, with new species that they saw, with observations. Different observations about flora, fauna, infrastructure. Yeah, usually that's the dynamic. They are available for us to help when we ask them to do, but some of them are just involved because they are very active people who love to be here. They are very conscious in terms of Văcărești. We usually--we are asking them for help when we have something to do, some specific activities like monitoring the visitors, cleaning up the park, or biodiversity monitoring or stuff like this.

ERIK: Okay.

GABRIELA: But, I think that the most common activity among the volunteer group, it's cleaning up.

ERIK: Do you have specific outreach programs? How do you get in contact with the volunteers to let them know that you have something going on?

[...]

GABRIELA: Mhm, we have this informations on our website. In the moment when we started this program in 2018--I think so--we had a very big mass media call to action. It was a program sponsored by a bank in Romania, The Transylvania Bank, and we got known among people in this project. The project last for one year. Even though we are not promoting in an active way right now, but we have a lot of visitors on our page--our Facebook page and our website and people just see this offer on our platforms and they are contacting us. But right now we are not actively searching for the volunteers, but they are still coming.

ERIK: Is there anything in particular that you guys are looking to improve in terms of volunteerism? Or--I know you said people are coming in and there is actually a lot of help--is there anything that could be better about that?

GABRIELA: There are a lot of things to improve. The reality is there is no time right now to do this. It's not one of our priorities. It's important that we have those people, we reach them, and we can count on them when we need help. Right now this year we have a lot of projects. We cannot afford to spend more time in doing certain things with volunteers besides the needs of the park that they just appear from time to time. For example, cleaning up and stuff like that. But if I were to dream about it, maybe for the next year, we have a vision to training the volunteers in

order to become guides to guide groups of people in the park. And yeah I think that this is one of the most important thing that the volunteer could do in the near future.

ERIK: Okay.

GABRIELA: Yeah. But we should invest some time and energy that we--time actually. Time that we don't have right now in order to training the team. To train them in terms of biodiversity, in terms of the ecology of the park for example, the history of the park. But some of them, they are so passionate about the park. They just find them out about all of those things. And they participate at our guided tours in that last two years when we could have them, the guided tours, and they got so much information about the park that they became able to help some guided tours and some of them guided groups of people in the park. In the last two years of course.

ERIK: Now would you prefer to have more formal form of getting the volunteers educated? Like you mentioned? Or do you prefer them kind of going and doing their own research? I know it's a passion thing but... What do you guys prefer?

GABRIELA: I would say we need both of them. Because, the first one--the formal--I wouldn't say formal actually. It's like the standard information. It's full of insights from our team, full of insights that you cannot find on the internet, and those are the most interesting informations about the park--maybe--that you could only get from us. And the second option that you said. The volunteers researching on their own. This is also important because this means that they are really into it, they are really involved in that and it's important to have this natural drive through to this thing. This kind of activity.

ERIK: Okay I'm going to have to say we [have] come to the end of the normal time limit of the 30 minutes. We do have more questions and if you have time, if you want to, we would love to get some answers on some of those.

[...]

ERIK: So, what ways are you specifically using the volunteers? I know you touched on it a little bit but could you really get into what they're actually doing?

GABRIELA: They are patrolling the park independent, that's one of the activities that they have now and they are informing us about things happening in the park as I told you.

[...]

GABRIELA: They are cleaning up the park even though it is not an organized activity, like tomorrow at 10 pm or 10 am we are cleaning up the park, they are doing this when they are patrolling. They are cleaning up the trash that they see on the path. For the moment this is it, for the moment in this pandemic period that is the situation.

ERIK: What is the most useful use of the volunteers?

GABRIELA: Everything they do is very useful I wouldn't say something is...more useful than other things because having volunteers even just patrolling the park, having them walk the park, is also helpful because in their walk, because of the fact that they know a lot of things about the park, sometimes they are talking to the people when they see people asking around or, I don't know or doing things that are not allowed. For example smoking in the park, volunteers are going to those visitors and talking to them explaining why it is not okay to smoke and other stuff. It depends on the volunteer to another but everything they [do] is a help, it's important.

ERIK: Are there projects that are more urgent than others?

[...]

GABRIELA: If we have some projects with priority in terms of volunteer implication or if we wish to have the specific activities. No, I think that I already told you my vision about this there is nothing more to say in my opinion.

ERIK: We know that you have an Urban Rangers project, can you describe that a little bit?

GABRIELA: The Urban Ranger is the name of the project. We called ourselves Urban Rangers also. What exactly do you want me to say about this?

ERIK: What are the urban rangers doing?

GABRIELA: Okay, urban rangers is doing exactly what I already told you but at the moment when we launched the project we had specific actions. For example, in the first year of the project when we have financial resources, so more time to spend on this topic, we had specific training for them. We had discussions with the professionals about biodiversity, about specific animals, about specific topics, and this was very important part of the urban rangers program but mostly that's it. And we launched the project, we had the call to action to the community around the park, community from Bucharest, if you can you see the level of the city, because we have volunteers from the whole city not just from the neighborhoods and we had this call to action for the people to come and get involved in the Văcărești Park's life, in order to have a better park we need you to help us make it more safer, beautiful to maximize its educational potential, why not, and stuff like this this

ERIK: That's great, that's great. Thank you for your time. I know that we are at the end of your ten minutes extra. I just want to thank you.

Appendix G.4: Zoom Interview with Bogdan Mihalache

Interviewer	Note Taker	Date
Ryan Hanna	Erik Herrera	2 April 2021

RYAN: So, let's start with your role at the park. So what is your official title and what are your official duties?

BOGDAN: Okay, so I will begin with my background. I graduated [from a] Landscape Architecture section at the Horticulture Faculty in Bucharest. The University was agronomical sciences, so my background is as a landscape architect. After I worked at a couple of--actually there were three landscape architecture-oriented companies. I thought that it [was] best for my personal experience[s] to orient towards the NGO environment because my personal view was [that] it's better for me as a professional to go in this direction. And for the environment as well because in Romania specifically, you'll find companies that are only into not the quality, but more to the quantity regarding the projects. So here I found my place better. Yeah, in the present [...] moment as a landscape architect in the park, or landscape ranger you can call me now, my duties are to design and take care of implementing the projects within the field, so I do a lot of field research. And two of my main objectives I manage[d] to accomplish this year, and that is the mapping of vegetation habitats and the inventory of the trees in the park with tree plotter applications. If you've heard of it, that's what we use. And we managed to collaborate a couple of studies based on this mapping and inventory of trees. Yes.

RYAN: Nice. And, why did you get involved with the organization in the first place? Was it just [that] you wanted to just get more involved with environmentalism?

BOGDAN: Yes that's one of the purposes and the second one was because I saw more motivation in this direction, and personal development as a professional. I study a lot better the

native plants and the dynamic of the plants inside the park, and the dangers of the invasive plants, and the possibilities of other advantageous plants to become invasive and attack the potential of the native plants.

RYAN: So you said you're a landscape ranger. So what kind of resources do you have at your disposal to do projects?

BOGDAN: What kind of disposal?

RYAN: Like, to categorize trees or to plant trees or to take out invasive species. Do you have any equipment for that? Do you have, like -how many volunteers do you get for each project?

BOGDAN: Oh, okay. First of all, for the mapping of the trees, which was done two years ago, I had a team. We were four landscape architects on this team, and basically we used remote sensing for detection from satellite of the main tree covered areas and then we did field research in which we identified which areas are covered, are groves, which areas are isolated groups of trees, which areas are just pastures, just plains, and then we went on the further step of identifying the species, the main species in the groups. So yes we did, we used Landsat Argos Monitoring sites like this for the remote sensing part and then edited the plans in AutoCAD Illustrator. We synthesized the plans in editing programs. And in the inventory part, I used G Plotter. Most of the research with inventorying the trees was my job. I also had help from a few volunteers. And we used a few specific instruments which I don't know their name in English, but I can tell you one was for measuring the diameter of the tree or the stems because lots of trees had multiple stems, and another instrument for measuring the height of the tree. And then we determined the species, and it was another element--the land used a criterion in which the eco-benefits of the trees are measured because the main purpose, the final purpose of this inventory was to find out what eco-benefits the trees bring within the city. So, the main criteria

were species, trunk diameter--the height wasn't a criteria but it was important--and the third one was the location. Like it's a park, not a personal garden or an industrial place. It's a natural park, it's a park. And that was the criteria in the application. Yeah.

RYAN: Alright. Did financial resources play a role in this project? Was budgetary constraints or budget in general a limitation to what you could do in this project or was the project designed so that it didn't have to involve much money?

BOGDAN: It was a financed project. We had a partner supplier for this project--a partner actually. Yes. I don't know figures and stuff like that.

RYAN: No, it's fine, but it's just the idea that matters... and have you had--

BOGDAN: --yeah, sorry. I was thinking about the question. Probably were wondering if we had any funding from the states. Zero funding I can tell you.

RYAN: (No we definitely know that, we've heard it from everyone.

BOGDAN: I believe so. I wanted to state it.

RYAN: No worries. So in the recent year, especially in light of the pandemic, have you had any issues carrying out projects?

BOGDAN: ...I personally didn't have problems with that, because during the pandemic --that means the whole 2020 year-- I was involved in tree inventory, so I can say that was a help for me, because while during the lockdown I had an excuse to go in the park to work. Which was actually work and relaxing.

[...]

RYAN: That's good to hear. Has the restrictions --because we know that in 2018 the Romanian government passed a bill stripping NGOS of a lot of rights and responsibilities-- Has that impacted any of the projects you want to do?

BOGDAN: The restrictions. I can speak in the name of the park from this point of view. As I told you, the field research and inventory went on because it was a long-term project. So it was affected on other domains let's say. We lost a few principal fundraisers. Fundraisers? No, I don't think fundraisers is the right term. People that helped us. So [this] year was [a] difficult year for most of us, but we managed to pass through it.

RYAN: Mhm. So you mentioned that you do a lot of field work. Does this also include monitoring biodiversity, like the mammals and bird species?

BOGDAN: No, that is not my job, but I like to learn a lot from Vlad, my colleague, about bird species mostly, amphibians and reptiles. But that's not my attribute

RYAN: Ok, so your expertise is mostly just focusing on trees and the plant life, right?

BOGDAN: Yes

RYAN: So do you know what the impact of pollution from the surrounding city is on the plant life? Like from runoff from the roads?

BOGDAN: The impact of the city? Like pollutants and...

RYAN: Yes

BOGDAN: I can say what the impact of plants upon the city based on the research I did. And one of the biggest impacts in the city is the reduction of pollutants by absorbing them into their leaves, bark, and roots. The oxygen quantity released in the air, of course that's unknown. But also, not just the physiological benefits, but the social benefits. Like it's a park. It's a place where

people come to relax and have more psychological relief, and a social place for people to meet. It has a lot of social benefits that can't be quantified in money. The other benefits like water retention, microclimate change in the zone, absorbing the carbon, can be monetary benefits, estimated monetary, and that's what we did. So the park actually brings out of the city in direct -- I think it was-- a million dollars per year. Something like that.

RYAN: That's pretty cool.

BOGDAN: Yeah. It's not the final figure as we still work on it. So in May we will have the results for the eco benefits.

RYAN: So do you have a study for that, like a link for that?

BOGDAN: For the eco benefits? No, but we have a study for the habitats and for the results of the inventory. Like figures regarding the trees, what species there are, what dynamics. But for the eco benefits not yet. Unfortunately, we're working on them. Probably in May we will release another study on it because it's very very important. Yeah.

RYAN: It'll be good to look forward to. Yeah. Let's pivot to talk about the current drought. So how has the trees and wildlife dealt with the drought so far?

BOGDAN: That's a good question. The trees hang on very well, mostly because the trees are adapted for these conditions, for this type of terrain and soil. The soil is a wetland, of course. A lot of willows live up there and that's the first type of tree that developed. But willows develop very very fast, and in 5-10 years they were already mature, and they managed to cover a lot of the surface of the park. So now they also absorb a lot of water. That's kind of a problem. It's an eco-benefit in most of the places to absorb the water so you don't have in the floods, but inside the park absorbing the water is not a good thing that you want. More like maintaining the water

in the system. That's your project as well, so now the willows have done their job. They are pioneer plants, so when the first willows appeared on the surface of the lakes where the level of soil was a little higher. They managed to create little islands within lakes where other species developed, and that's [a] good thing for the biodiversity, but now you have to manage this expansion of the soil. Mostly the soil is [not] the problem, the reeds [are]. That's a plant that's very very expansive. It's native, it doesn't have a problem of inventive origins, but within the park it's a different kind of dynamic. Because it's surrounded by the concrete dike, the heat reflects in the summer and evaporates a lot of the water, and the reeds are actually expanding because of this evaporation. So you can find very hot environment within the park during the summer times. You say "oh I am going to the park to refresh myself and have a cooler place" but actually you don't. It's even hot in there. It's like a sauna because of this phenomena. And so the reeds expanded a lot, and they absorb a lot of water, and they expanded to rate that they have 70% of the surface in the park, which is a lot. The plants are not affected by this water loss, more like the other habitats, the other animals. Otter which is a very important element in the park. Birds that don't have lake surfaces. That's the things that area affected.

RYAN: That's interesting to think about. I would have thought the opposite with respect to the evaporation. Also we've read on your website you published an article called *2020 the Year of Fire*. Can you talk about how vegetation fires have impacted what you do? How do you mitigate that? How do you monitor fires and everything like that?

BOGDAN: Yes... that big fire from 2020 was kind of a wake-up call for all of us. Especially because of the importance of managing... to keep an eye on the park. Like we don't have... guard... to guard the park. So we don't have any guards here. That's a very important aspect. The impact on the vegetation was big of course how you see it, first sight. A lot of willows burned. A

lot of reeds burned. The reed is not the problem, so again it is very good that it burns. It's actually an advantage for us. Not so good for the willows actually. They are trees and they are little tiny ecosystems. Birds come and feed and nest in there, and other benefits. But a lot of willows are on tracks where people walk and they can become a kind of a public terror because their structure was affected, and being very old now, they can fall or something and we have to take care of this. And the other plants regenerated; even the reed. Now, three months after the fire, you could walk in the park and never see was a fire there because the reeds recovered very very fast. Ash is a very good fertilizer as well for the plants. Controlled fires are as well done in the United States as far as I know in Phragmites the reed, which is invasive in that part because it's not native. If it's controlled I think it's a good thing. If it's in controlled area. But in this particular... case, it wasn't very good for the park. It was just refreshing, but not good for the insect species. Because a lot of insects have eggs and --it wasn't bad for the bird species. They weren't hatching at that moment. Also the other mammals were hibernating, so we're good. But for the insects, it's more of a problem. And plants and insects have a more tight relationship than mammals and plants.

RYAN: Yeah... so kind of following up on reeds, because it sounds like it's a little bit of a problem. Do you have any plans to mow down the reeds or clear them?

BOGDAN: What I can say about the reeds is that they grow at a faster rate than you can mow them. And that's what we observed while doing that. And we don't have the capacity to mow as much in that. And it's not about the mowing, because they grow back. It's about their roots that's the main problem. The roots are extending horizontally, and they can even go on concrete areas where there is no water. But you find reeds because their ventricular system, their underground system, is dependent on horizontal axis. So what you can do best is to excavate their

underground root system on different portions. And with this operation you also dig holes in which water can be retained more efficiently. Also you can dig to the level of clay in the park which is a lot of clay that contains water. We did this experimentally behind our info point behind the park. We dug a little... pond let's say. A little pond behind the info point in our park. After 40 centimeters let's say, we found the clay and we found a level of water. Natural underground water, because we had a lot of water this year. After 2020, in 2021... January February were very rich in precipitations. That was lucky for us. And you have a good clay underground resource, so if you dig with a big excavation instrument you can also remove the reed root systems and also make place for the water to accumulate. And another thing I wanted to say was... reeds don't grow if the water is too high. So if you have the perfect amount of depth, like over 2 meters, the reeds won't extend their roots. Because the sunlight doesn't reach the roots and it's too deep for them. So we have to take care of that too. As well, I have the proposal to fill, with water, some areas that were over 2 meters and see if reeds survive there, in the next years.

RYAN: So what you'd be doing is trying to go over to the shore line and depress that shore line down so that it was not as shallow where the reeds are growing?

BOGDA: Yes. And also reduce the reeds from the shore. And eliminate them in the exterior of the lakes.

RYAN: Ah ok... And now we were --because Dan actually brought this up-- we were talking about it as maybe a potential avenue to go down. Do you think that this is something that volunteers could carry out potentially? Or is this just something that is a little bit too technical or not safe enough for volunteers to do?

BOGDAN: You mean about the reeds removal?

RYAN: Yeah, but digging on the shoreline there to make it greater than 2 meters.

BOGDAN: Need mechanical excavation for that. If you use volunteers you just do what the communists did with the Danube and the Black Sea canal where they used people --no it's too much. Volunteers can help with other things. Digging small portions for experimental ponds. Something like that.

RYAN: Do you have any other plans for water management other than trying to clear out the reeds?

B: We have a project that we focused at the start of this year especially done in [inaudible]. Vlad was involved in it. [He] probably told you [about the] rain garden project in which we tried to collect lots of the water from the concrete dike at the base of the dike, because we have lots of places near the dike where the water naturally accumulates, and we hope to do this more efficiently. Like reducing the underground absorbing of the water, maintaining it on the surface. Digging maybe a lot at the base of the dike and planting a few water resisting species that aren't absorbent, like tree species but maybe more like shrub species, to maintain shadow, shade the place and maintain the water as much as possible. Because a lot of interesting water species are developing there like... I don't know their names in English sorry.

RYAN: No that's fine.

BOGDAN: It's very beautiful like a system. You go here in the spring time you find a lot of these little ponds full of life, and that's amazing if we can keep them as long as we can for the rest of the year. It's perfect.

RYAN: I know. We see the beautiful photographs on your webpage and we are bummed out that we can't be there with you guys.

BOGDAN: Yeah it's a pity

RYAN: Alright, so thirty minutes has passed. So to not keep you any longer, we will conclude here. Do you have any comments, questions or any other things that you want to bring up that you didn't get to in your interview?

BOGDAN: I have a question about your project. What are your main intentions with the project?

RYAN: Our goal is to try to create two types of projects: a short-term project and a long term project. And the short-term project is going to try to use volunteers to try to help manage water levels. So any type of water collection system is what we are looking for that can be carried out by a volunteer.

BOGDAN: Ok, yes.

ERIK: I can add to this too. So it's going to involve a little bit of what we're going to be able to carry out with the volunteers as we talk to you guys at the VNPA and we talk to other groups, and it does also look like we're going to look at what the volunteers can do to help towards creating a solution. So that doesn't mean actually doing the stuff either, sometimes, so it could be they're doing the research like you mentioned or helping doing the research.

BOGDAN: Oh ok. I see. Yeah the volunteers can be involved as I told you, but small portions like digging parts near the dike or maybe using clay and different materials to retain the water. We try to use a lot of natural materials, of course, not synthetic materials because that would be bad for the plants as well. I think I can get you more details email about kinds of solutions for water retain(tion) in which we can involve volunteers. I will gladly send you those.

Appendix G.5: Zoom Interview with Nicoleta Marin

Interviewer	Note Taker	Date
Catherine Masiello	Andrew Yatsuhashi	2 April 2021

CATHERINE: And we'll start with just going over a little bit of your background. So if you're able to, could you describe your role at the VNPA and if you have an official title there what that is?

NICOLETA: Mhm. I have the role of coordinating projects, various projects, and education on (*thinking*) conservation infrastructure. Actually, almost all our projects have these three components: education, conservation, and visiting infrastructure. And I have written so far various project proposals either for sponsorships or for grants or for competitions. Basically, this would be my main role. And the name, the title of my job position is Project Manager.

CATHERINE: Okay.

NICOLETA: And I'm currently coordinating the projects, our newest project on building the National Network Urban Natural Areas.

CATHERINE: Oh, that's interesting. So it's [...] like a network of organizations in just Romania or like globally?

NICOLETA: Exactly, exactly. We are working already with four partners. We have one partner in Bucharest that would come up with the vital support on mobilizing people and active citizenship because this is their area. And we have other three partners in three other main, major cities of the country. And we are looking for other seven partners because our main objective is to reach at least ten cities in which to identify, to document, map, ten urban natural area. Then, together with our partners, existing partners and future partners, we will submit information on

these areas to the municipalities and we will ask them to protect those areas that we have identified and studied. And we will do so, a network of urban natural areas on our side and on the other side and it will help initiators of these urban natural areas which would be most probably NGOs or initiative groups.

CATHERINE: Oh, that's very cool. So you're like the main point of contact for that, setting that up?

NICOLETA: Yes.

CATHERINE: Okay.

NICOLETA: And [...] I work with my team. There is a communications specialist, which is Gabi, Vlad also in biology, Florin on protected areas expertise, and Bogdan on flora and mapping, and the other Bogdan on identifying, documenting, and organizing events in those urban natural areas so that more and more people will come and will start to talk about them and will start to ask municipalities to protect those areas. So the target would be, the purpose, the main objective would be to gather a lot of people, more and more people, that would ask the municipalities to protect those areas. So to integrate them in the urban planning processes and documents and to obtain protection so that they will not be threatened by urban development or other potential negative impacts.

CATHERINE: Okay, that, yeah that sounds very cool actually.

NICOLETA: Yeah, yeah it's a very close to heart project. Yeah, it's a project that actually goes in line with one of our three main strategic objectives. One is to make Văcărești a model of management, best practice for the management of urban protected areas. Another, the second one is to go with the example of Văcărești and to build this network of urban natural areas. And the

third one would be to have here in Văcărești like an embassy or for all protected areas in the country so anybody that would come here would have the opportunity to find out information about all the other protected areas in the country and the value of our natural patrimony because we are one of the few countries in Europe that have the most valuable biodiversity and the largest number of large mammals. And still the natural patrimony is in some parts of the country still intact.

CATHERINE: Oh, okay.

NICOLETA: We are the country with the richest biodiversity in Europe.

CATHERINE: Interesting, I didn't know that actually, that's very cool.

NICOLETA: Mhm, mhm, yeah. Because lots of the western Europe countries already have cut a lot of trees, a lot of their forests. They hunted a lot of their animals, large animals in the forest. And now they don't have as many as we have. So the challenge is for us as a country to learn from their experience because they feel sorry now that they cut their forest and they hunt their animals, and they tried to recover, to restore what it was before but it's very difficult to do that so we need to learn to take their lessons so that we won't be in that point at all. We won't get there, to have, to diminish our biodiversity.

CATHERINE: [...] And can I ask you how long you have been working with the VNPA?

NICOLETA: I joined the team in 2017, in March 2017.

CATHERINE: Okay and [...] why did you first get involved with the VNPA and what was your motivation for [...] joining that organization

NICOLETA: The novelty, the novelty of the job position. The novelty of the working place. It was an urban protected area and everything was new. And I was previously volunteering in a

national park that has been founded by another NGO I am a member of called Kogayon that has been founded by Florin and two other friends. So I have been volunteering there, and I knew how the projects on education and tourism in protected areas work, so when I had this opportunity to work in a protected area close to my house, in the same city, absolutely I said yes.

CATHERINE: That's very cool. Okay so I think we're going to move on to talk a bit more about VNPA resources. Moving back to when you said that you're helping to set up that networking connection of different NGOS and organizations in Romania, besides that specific project you're working on now, are there other connections that you guys have to other organizations nationally or internationally?

NICOLETA: Yes. We are members of a foundation, federation of NGOs that work in nature protection. And we are also members of Wetlands Link International, which is an international network of wetland education centers.

CATHERINE: And [...] when you're part of those organizations do they provide support in your projects? Like any financial support, or like equipment stuff, or is it more like connections between groups?

NICOLETA: Yeah. It's just connection. Facilitating connections with other NGOs, communication, promotion, information, shared experience, shared lessons learned, more on this. It's on this area. It's not about finance or something else. And we have also partners from other previous projects. For example with organization on bird monitor, bird organization, Romanian Ornithological society, which is a member of Birdlife International. We have organized with them some information and education events in the park. For example we do occasional birds international day. Or we have partners, we have partners with an association for the protection of wild pollinators, with which we have implemented a project on protecting, researching and

protecting wild pollinators the park. We have partnerships with WWF, Worldwide Fund, World Wildlife Fund? These are the first that came up into my mind. But ah! It is something that is very new, but we are very happy that we have a partner, as partner in a project that we are running now. It's about an organization that works on design, on inclusive design. Designing urban infrastructure, creating context for socializing between difficult people with people that have various disabilities.

CATHERINE: Oh interesting, that's very cool actually.

NICOLETA: Yeah, yeah yeah. They are designed, architects, IT engineers in their team. And their purpose is exactly this one. To create context for difficult to people to have the occasion to socialize with people with disabilities and vice versa actually. They are more dedicated to the people with disabilities, to make the people an inclusive space for all. Yeah

CATHERINE: [...] Could you describe a bit about, I guess the general public's perception of the VNP and how that impacts your guys' work in away?

[...]

NICOLETA: Okay I have very fresh news in my mind, because we have implemented a qualitative monitoring questionnaire last Sunday, and one of the main points that came into my mind from all the other reasons that we put there, the majority of the had chosen the closeness of the nature as the reason to come into Văcărești. So they appreciate the nature, the sounds, the diversity of forms. All this that actually creates the feeling of being in nature. This is what people look for in Văcărești when they come. I guess I can say that the perception of the majority of the people that came and visited the park, it's something that we absolutely need to protect, and we should have more areas like Văcărești in other cities. For me this is the perception of the most

people that came into the park. Of course there are people that didn't get here yet, and they are still frightened by some gossips like “oh there are homeless people living there, it might be a dangerous area.” It is still very dirty, there are still a lot of garbages that are discharged there. But from my experience from talking with these people is that they didn't come to see with their own eyes how is it, what is Văcărești actually. They just talk from what they heard, at the second hand, or third hand from other persons. So they didn't have the direct experience of the park. And there are other people that came in the park, and they are bit confused. They expect to find something more similar to an urban park, with alleys, concrete alleys, and a lot of benches, lots of terraces, or bars or restaurants. They are not able to make a difference between a natural area where the landscape is protected per say for what it is because its nature and other typical urban parks.

CATHERINE: [...] I kind of want to talk about any financial resources that you guys have, if you have information on that. Like I guess along the lines of where your guys' budget comes from, if you have a budget.

NICOLETA: Basically our main financing source is from--or it was, it was from until this year--from sponsorships. Various private companies that are interested in what we are doing that have already seen the results of our work wanted to support us and they give a specific amount of money for our activities. Basically for education and infrastructure, visiting infrastructure in the park. Until this year this was our main financing source, but from this year once we have started the project of the national network of natural open areas we have added another source which is from Norwegian funds. These are non-reimbursable. I don't know if this is the word but. They provide--they finance projects without requiring the money back.

CATHERINE: Oh okay.

NICOLETA: Yeah... Specific project of course, which have already have been already proposed before with objectives, with activities, with budgets, [...] it is normal for them to ask reports, to ask justifying documents for all the expenses because actually these are public funds. Public funds that are put together by Norway, Iceland, and Liechtenstein, three states in Europe, for various NGOs. So we have submitted a proposal, we have entered into a competition with other NGOs in various fields and we have won this project and now we have started to implement it.

CATHERINE: [...] So you guys have to go through the process of like, doing documentation and proposals before you can get the funds from these other organizations basically?

NICOLETA: Yes. [...] This is something that applies to a competition of projects. [...] At this--it was--this one was one of them. But for sponsorships on the other side, money are given to us based on a sponsorship contract. [...] So we have now two main financing sources. One is sponsorships and the other one is public funds through this Norway, Iceland, and Liechtenstein funds. [...] It's a program called 'Active Citizens Funds.'

CATHERINE: [...] When you get the funds from one of these two sources, does that impact the types of projects that you guys are able to do? Like are there specific funds that you have to use for specific projects or do you guys have more leeway in what kind of projects you can do with the money?

NICOLETA: Yeah, for this project financed by the three countries Norway, Iceland, and Liechtenstein, through 'Active Citizens Fund,' we need to use the funds specifically for what we have assumed we have committed to do in the project. We are not allowed to use the money something else because we won't receive the money actually if we spent the money for something else. We won't receive them back. For the other serves of financing it's more or less the same but it's more like an easier way to report how we have spent the money. But, we come

also with the proposal to the company, so the company comes to us and they say “Look, I know what you are doing. I like what you are doing there in the park. I appreciate your work and I want to support you with some sponsorships. What you can propose so that [...] you can convince me that you’re really worth this money that I want to give you.” And at that moment we come up with a proposal and we say “Look, we want to arrange a rain garden here or we want to organize this workshops with children or we want to do these actions with the volunteers and we estimated that we need this amount of money for this activities. Or we want to make [...] one of the trail in the park, make it accessible for all the people. We need to arrange this entrance point. We need to arrange this path and we need this money for this one and this one and this one”, and we estimate a budget and we go, we meet together with the representative of those companies and we discuss. And in the end we complete the sponsorship contract.

CATHERINE: [...] I want to talk a little bit more about [...] the volunteer projects that you guys have in the parks. Do you personally work with these volunteer projects or have any knowledge about that?

NICOLETA: Yes, actually we have specific activities either educating volunteers or when we plan a project we know that, for example, for planting activities we can rely on volunteers in this project, for example this project of the national network of urban natural areas we rely on volunteers to help us with project assistance work and for that we will design a green program for volunteers for one year, 12 months, and we will have specific activities that the volunteers can do for the project. We have another very important support from volunteers when do the monitoring of visitors we started last year in December to monitor the visitors in the park and we have [inaudible], which means that two days a week somebody is watching the park with the binoculars or being directly in the park and counts how many people have entered in the park,

where they are going in the park, how they are using the park, either for walking or for cycling or for collecting nettles or other small fruits that can be found in the park, and we have volunteers that help us with this work also. And then we have this is a monitoring program that will last until December, beginning of December this year, so it's important to rely some volunteers that know how to collect data how to record and we know that on Thursday or on Sunday these are the two monitoring days we can rely on them. And we have all the other specific activities, specific like [inaudible] activities when we make a call for cleaning the park or for planting trees or for supporting with the organization of different events and then the volunteers come based on our call in advance.

CATHERINE: Do you put those calls on your social media or do you have a specific kind of emailing list for them?

NICOLETA: We have a group on Facebook that we use to communicate with volunteers and we also have a group of WhatsApp, and we put the announcements both Facebook and on WhatsApp.

CATHERINE: Okay and [...] when you put out those calls--come plant trees or pick up trash or whatever--is this typically a good response rate from your volunteers, like does it seem like the people you currently have in your organization, do they seem pretty eager to help out in these projects?

NICOLETA: Yes, yes until now we received responses. We have volunteers for all, almost all activities, but there is another type of volunteers I was talking about so far about the volunteers that we have in our core volunteers in the Urban Rangers but we have some other volunteers. For example the employees of the specific company contact us to tell us that they want to come and clean the park and they come for a specific day we arranged together a day and they come and all

together they deal with the cleaning of a specific area in the park and that's all, they come for one time event.

CATHERINE: Oh okay, so these are separate companies from the VNPA. Are these just local companies that are interested in the park or do they have reasons for ...

NICOLETA: Yeah mostly our companies are from Bucharest.

Appendix G.6: Zoom Interview with Florin Stoican

Interviewer	Note Taker	Date
Ryan Hanna	Catherine Masiello	7 April 2021

RYAN: Alright, so starting off this interview. Can you describe what your role is at the Văcărești Nature Park Association?

FLORIN: I am one of the four founders of the natural park and now I am President of Văcărești.

RYAN: And now, when did you start working with the Association? How did you start?

FLORIN: Actually I start before to be Association. I start in 2012. When Cristian and Helmut proposed to help for establishment of the natural park because I have experience in nature conservation and establishment of protected areas with another organization in my county in South Carpathian, we put in place a natural park in 2004 and because of that they ask me to help the process of establishment of the natural park. And my main role, the first role, was to coordinate researchers and scientists to write a scientific study for scientific permit for the park. I'm geologist and this is my background to working in geodiversity and biodiversity conservation.

RYAN: Nice. What is your motivation for working with environmentalism?

FLORIN: Oh, I don't know exactly. It's my way to live. I don't have any specific purpose of this kind. I live in nature, I was born in nature and I live there in the mountains. I learned a lot about nature from my grandparents, from my parents, from my friends. I spend a lot of time in nature. I make biking, trekking, climbing, caving, a lot of mountain activities, especially related to mountains area. And it's a natural way to live.

RYAN: And now as President of the Association, what do you exactly do? What do you oversee and what do you lead?

FLORIN: First I am volunteer President. I'm not member of the staff of our Association. Til two years ago, I was full volunteer involved in natural park in another conservation project and I have a job, full time job, for different companies or corporation. Last job was Sustainability Manager of [inaudible] Romania. And, starting two-thousand...two years ago, I am a fellow and Ashoka support me to be involved 100% in this project, including Văcărești Natural Park.

[...]

FLORIN: And my role now, I'm board member and I'm part of a project, an actual project, for scaling of our impact. We have a project to establish national network of urban protected areas and I'm responsible with focus in lobby with our decision makers, including Parliament members, and with scientific support for establishment of a lot or a few natural protected areas in different cities of Romania.

RYAN: Cool. Can you speak more to what you do with the volunteers on a day-to-day basis?

FLORIN: Here in Văcărești I'm not too much involved in volunteers activities. My colleagues work with volunteers. I just support the volunteers activities with the technical and scientific support. For example, because I work in forestry I advise all the plantation and ecological restoration of forests, these kinds of activities. But direct with volunteers, I don't work directly. My colleagues, they coordinate volunteers. I just give my support.

RYAN: Mhm. Now, with the technical side of things, do you focus more on coordination aspects of the organization or do you deal with, per say, doing the actual field research of determining what solutions work best and what activities are best for volunteers to be doing?

FLORIN: Both, but now I focus more in strategic aspect of our organization because I am involved in discussion with the local authorities and Environmental Ministry for administration of the natural park. But in the same time, I coordinate also management plan of the park and for our organization. And, this management plan include also study, for example hydrogeological study cause I'm geologist I discuss with a geology university and another specialist and geology companies to have a hydrogeological study of the park.

RYAN: And now is this geological study underway right now or is it being planned in the future?

FLORIN: It's planned. We have some information because we obtained the information of, from 30 years ago when they start the hydrotechnical project and we obtain all the information. And now together with some colleagues and students, so in geology, we refresh this data and we put it in the report. And now we work to establish the needs for the future studies to complete our data and to make more studies to obtain more information. But will be part of the management plan.

RYAN: And now can you describe more of your role with how you, talk to local authorities and how you administer things in the park from that perspective?

FLORIN: I was involved from the beginning because we work 5 years to convince the authorities including the environmental ministries but also local authorities to obtain the permits for the natural park and in the end the governmental decision. We discuss with the 4 environmental ministries until we obtain the final results: governmental decision. Now we have some difficulties because after 1 year of administration of the park we sign a contract with environmental ministry for 10 years, but after 1 year they cancelled the contract because the changed the legislation. And after 2018 the NGOs don't have possibilities to be administrator of the natural park and the administration responsibility, formal responsibility of administration is

under the National Agency of Protected Areas, but it's just formal. Practically we are administrator because we are here, they are just on the paper. And now we discuss with the municipality, because we have new mayor and we have possibility to discuss humanly with this guy. In in the last 4 years it was impossible with the one other lady as mayor. And now, we negotiate partnership for administration role of the natural park, and I am directly involved in negotiation with local authorities writing the partnership, and after that I will be responsible with proposal for environmental ministry to have, to take administration of the park in partnership.

[...]

FLORIN: But in that same time I discuss with the member of Romanian parliament because we promote law, national law for urban protected areas. And I was involved write this law, and now I am involved with advocacy, activities with different members of Romanian parliament to approve this law.

RYAN: This new law, how, how have you taken steps, I mean of course you're talking members of parliament and you're trying to coordinate with local authorities. But in the meantime how does your organization try to deal with the legal boundaries of trying to accomplish things within the park? Is there some sort of guidelines that were put in place after NGOs were stripped of administrative responsibilities?

FLORIN: No no, is very tricky. [...] We are here, we care about the park, we run the projects and activities without any support, without any responsibilities because the authorities come and say go away, go home, it's our responsibility. [...]. We don't have any guidelines from authorities until now, they don't care about urban protected areas, but we hope we obtain the good results because we are on the same way with European Union policies. Because we have now European Green Deal, we have biodiversity strategy of European Union, we have some

requirements for, from EU. And now we obtain after 2 years of discussion, to include this network of urban protected areas, national network in the governmental plan, its official now. We obtain also some money to support this network from European Union of course, but is approved also by our government, and I think we are in the good way to obtain big results for not only Văcărești Nature Park, but entire country.

RYAN: Mhm. And now, can you describe a little more of what your partnership with like the municipality of Bucharest is? How did this partnership come about and how did it circumvent the Ministry of Environment?

FLORIN: We don't know exactly how it will be. We will discuss and negotiate the partnership. To understand how it will be, you need to understand our status in Romania. We have a national agency, more or less similar to the US National Park Service, but it's a new agency without any resources without any experience, with just a few people in Bucharest and 2-3 people in each county, but they don't do nothing yet directly for protected areas. And we have possibility under Romania legislation to delegate the management of different protected areas including national parks and natural parks to different authorities and stakeholders. NGOs are not any more eligible, but local authorities has possibility. For example universities, museums, research institutes, different stakeholders including local authorities. And because local authorities want to be involved in administration, we want to have these kind of partners, big partners with resources. We propose them to write together a proposal for environmental ministry, but its not only up to us. We have a partnership, we negotiate with establish how will be involvement of each part in the administration, but, let's say ball is under the hands of the authorities. Because they want, they need to open the call for administration of the park. And will be the open call, will put the offer, maybe somebody will come with another offer? And in the end, the environmental

authority will decide who will be administrator of the park. And we'll have some obligations, and we split this obligation between us, us NGOs, for example we take ecological aspects of the park, research ecological reconstructions, and other activities, and we want to involve the authorities to be responsible for guarding the national park, for maintenance, and infrastructure. And together with different partners, if we put together all the resources because we as an NGO we have possibility to access some resources impossible to be access by authorities, and vice versa. And we try to put on the same table different stakeholders, including private companies, local authorities, academic institutions, organizations, NGOS, and all kinds of stakeholders.

RYAN: Certainly. Can you talk a little bit more about -I know this is a little bit ago but you mentioned some partnership with the EU with a specific organization within the conservation- can you talk a little bit more, like what type of support you received from them and -and what type of network that that exactly is?

FLORIN: First I'm member of different organization -global organization. I'm member global commission of UCN of protected areas. I'm member of commission of urban protected areas of UCN. We as organization were a member of Wetland league international, network of wetlands in, all over the world not only in Europe, and on the European level, because we are a EUs member -as Romania is EUs member- we have some obligation. And for conservation of nature we have two directives of European Union. One is for protection of birds and second one is for protection of another species and habitats. And, under these two directives we have all of our European union, including Romania, nature two thousand network. It's a network of protected areas. Văcărești Natural Park is not yet inside this network but soon will be in future. In few years I think and only collaborate with different NGOs on the European level. For example I am member also E.U.R.O. Park Federation. It's a federation of NGOs involving nature conservation

in Europe. And we discuss with them we are partners in different events on the European and global level and we search for some partners. Til now we don't have yet any projects around directly with some European partners. We just collaborate which change the information and w - we stay close of what will be on the European policies but there are lots of perspectives to collaborate directly with some projects. We'd focus directly in Văcărești or to be partners in different parts of Europe.

RYAN: Mhm. Now let's, change the topic and talk about the water levels a little bit. How has the drought affected what you do administratively?

FLORIN: It's one of the main problems of the park because the life in park is maintained by water. And because of the status of the park its former hydrotechnical projects and communists want to construct a dam, they made some big works in the park and they construct the dam around. They changed totally all the natural water system. And now all the water park are coming from two springs, two natural springs. And this springs are -actually we don't know yet what is the impact of the springs because we don't have exact studies about the quantity and quality of the water enter and exist from the park. It's one of the main objective of the management plan of the park. And we discuss with different stakeholders including a scientist about different way to keep the balance of the water in the natural park. Even to drill and extract water from underground to welling -to put in the lakes. Even to pump the water from the river. There are different solution and we have another projects but it's the long term project together with municipality to make a project to collect all the rainwater around the natural park and to drain from inside the natural park.

[...]

RYAN: And now can you discuss some of the proposed solutions, or anything like that, to try to manage and collect water?

FLORIN: No we ju- we are just on the discussion level.

[...]

FLORIN: But still last year in 2020 we don't have so big problem, but because in 2020 was year almost without rain from this... from this cause we have a problem last year. But now the level of water it's rising. There are 56 centimeters more than normal. We hope we don't have any problem but -but it's a real risk because the climate change will impact bigger and bigger cities and all the water systems of the Bucharest. And we need to take care about this problem because without water the park will die.

RYAN: Yes, definitely. And now... I think that answers a lot of our questions actually because, we primarily -cause we're focusing of course on water solutions and everything and obviously your coordination with the local government is going to dictate a lot of what we can propose. Probably one last question is, what is allowed within the park under your current administrative restraints? Like what types of solutions are allowed versus what types of solutions need to appeal to authorities to carry out?

FLORIN: We don't have too much restriction. First because the status, protected status, of the park it's five category use. It's the protected areas for landscape and interaction of humans and landscape. And sure, the park will be, will have three zones. Will be core area, it's around 30% of the park. We don't know how this will be, but we'll propose this to authorities based on available data have now by us and with the input of different scientists that are partners. 30% of the natural park will be strictly protected. Strictly protected means only scientific activities and

some small ecotourist activities will be permitted. Around this core area will be management zone, it's called in Romanian legislation, will be the area where ecotourists--eco-touristic and eco-education activities will be allowed. And around will be around let's say 35 or 40% of the natural park, including the concrete areas and impacted, already impacted antropic areas, will be the area with infrastructure, including infrastructure for visiting of the natural park, for ecological activities, including also investment for management of water. I think for my opinion, this category of natural park will don't impact the possibility to manage the water, including the investment for management of water. There is not any problem to do this.

RYAN: Definitely. And I think that covers virtually everything we had prepared for today and it is 30 minutes after. So we'll conclude the interview here. Do you have any comments, questions, concerns, or anything that you didn't bring up that you want to bring up now?

[...]

FLORIN: We know about the huge potential of this natural park. It's the first natural park, urban natural park in Romania. And because it's in the middle of 10% of Romanian population, it has a huge potential for ecological education of kids and citizens, not only kids. And second, it's not normal to put in the end the conservation of nature because this is the purpose of the natural park but the status of this park is special because it's in the middle of the city. It's more or less Central Park of New York for Bucharest, this natural park. And the second advantage of the park, it's for all Romania because we know about the biodiversity of Romania. We are in the first position in European Union as biodiversity because we still have virgin forests, bears, wolves, lynx, Danube Delta, Carpathians, and a lot of heritage, natural heritage. But we are in the end of the list with conservation resources. And we have possibility here in Văcărești to show to all Romanians, to all foreigners, about the importance of the natural heritage of Romania. And I really know we

have possibility as a country to base all our development based on natural and cultural heritage. And I think because we are the leader in biodiversity in Europe, we need to be the leader in nature conservation of Europe, in Europe. And for this reason we develop this project and for this reason now we work to develop the natural network of urban protected areas and we're involved in different network to touch this target and to push our politicians and decision makers to listen the civil society and the big number of citizens in big cities to go in this direction, as a country not only as city or--.

RYAN: No it's definitely, definitely it's something more. It's definitely a cultural shift that you're trying to cause.

FLORIN: Yeah, it's not easy but to, but I think we need to work together to touch this target. I really believe as a Romanian, as a citizen of this planet, of the importance of nature in our life. Including nature inside the city. Because otherwise, I don't know how will be, because we are so proud about the social and economical system but sometime we forgot about the importance of natural system. Because without the natural basis, will destroy social and economical ones without any doubt.

RYAN: It's, yeah, it's definitely, definitely a much bigger umbrella than just nature and environment and ecosystem. It's a societal problem.

FLORIN: Yeah sure, because small natural park in a small country of Europe but I'm sure, I think we'll have big impact on the global scale.

Appendix G.7: Email Interview with Interviewee A

Date: 7 April 2021

Describe your role at the Văcărești Nature Park Association (VNPA)

My role is to facilitate the access in the park, to get the park close to the community.

What is your official title?

[Redacted]

How long have you worked at the VNPA?

From 2017.

Why did you first get involved with the organization?

I have a previous solid background in volunteering with other NGO.

What was your motivation for getting involved with the VNPA?

To be able to get involved in a ambitious project.

Describe what makes up the infrastructure in Văcărești Nature Park (VNP)

Involving of same dedicated people.

What is the general process for implementing infrastructure projects in the park?

Idea > plan > finance > resources (including people) > implementation.

What tools or equipment do you have access to for infrastructure projects?

Power tools, hand tools, 4x4 car, trailer.

How do you maintain this infrastructure like trails, signage, or structures?

First of all, with skills and second with dedication, with a very efficient and effective plan, regarding the low number a field people. Financial, with money from projects and sponsors.

What are the challenges to maintaining infrastructure?

The logistic effort.

How has the recent drought specifically impacted the infrastructure of the park?

The infrastructure is not really affected, only the Hide was indirect affected by missing water in the adjacent lakes.

Is there an increased fire risk in the park from the drought? If so, has the increased fire risk impacted any structures in the park?

Yes. We have an observation tower affected by the fire in 50%, but not in recent drought. We have a secured perimeter around all the relevant structures, the wood is treated with fireproof solution.

Do you have future measures in mind to lessen the drought's effects and improve water levels? If so, what are they?

Only a few ideas but seems to be too ambitious in this times. To pump water from Dâmbovița river, to drill some wells in the park, or to bring the rain water from surrounding neighborhoods, but in drought situations, is irrelevant.

How have the water levels been monitored thus far?

We have installed two water level gauges in two important lakes.

What are the primary obstacles to managing the park's water levels?

The lack of approved management plan, the current legally situation of VNP.

Do the volunteers help in infrastructure projects? If so, what is their role?

We have very low help in infrastructure because of lack of needed skills from their side and from our side, lack of people available to supervise the volunteers.

Do the volunteers help monitor water levels? If so, what is their role?

No.

Appendix G.8: Email Interview with Bogdan Vasilescu

Date: 14 April 2021

Describe your role at the Văcărești Nature Park Association (VNPA). What is your official title?

I don't have an official one, I don't know, ranger?

How long have you worked at the VNPA?

4 years

Why did you first get involved with the organization?

I organized an event within the Night of the Houses festival and I invited several civic organizations and freelancers with challenging projects in the community to present and discuss them in an informal, friendly setting, including APNV, 6 years ago, 2015.

What was your motivation for getting involved with the VNPA?

I started with my own project that I wanted to implement in a natural space open to the public. At the time, it was a versatile modular structure of 60 square meters that would offer multiple leisure options, from a work hub in nature to movie nights or painting workshops. I proposed this project and then worked with Dan to obtain funding and the project was modified for a bird observatory and event space. That was in 2016 and then, in 2017, after the project was funded, Dan offered me to work for APNV and I liked the openness for bold ideas that we can do.

Describe the visitation resources of the VNPA ? What do you offer tourists to the park?

Brochures? Binoculars? Tours?

Until 2020, APNV organizes guided tours and various events in the built spaces and infrastructure, for example on International Bird Day or Environment Day or Park Days. During these events we offer brochures, binoculars for wildlife observation and any other thematic materials

How do you manage tourists? I.e. how do you make sure they don't stray off the trail or damage the environment? Are there designated trails?

If APNV organizes guided tours, we coordinate visitors only on the marked areas, paths and dedicated infrastructure. But the park is open and free to the general public and this aspect is not regulated and we do not have the resources to control it. Basically, yes, the entire park is exposed to any risks, including environmental damage and biodiversity.

How do you reach out to tourists and residents in the area? Are there any promotional things that you do to get more visitors?

In general, the promotion is done on social networks and during certain big events announced, the process is amplified by offering brochures, flyers or other materials.

At the same time, our colleague Gabriela started last year a series of podcasts that popularize, through the guests, both the science of nature and civic messages of protection and quality of human interaction with natural space. Occasionally, part of the communication team also participates in radio or TV shows.

Also, a major role is played by civic involvement projects through which we attract groups of volunteers from companies or the urban community as well as organized events dedicated to them.

APNV also has a program of sports events, cycling, running, through which the public becomes extremely numerous and thus the promotion is made, later and word of mouth through thousands of mouths, photos or stories.

How has the current health situation impacted visitors?

From my own observations, because during 2020 I was quite often in the park for various works, but also due to the fact that I live relatively close, I can say that the park was a welcome refuge

for many visitors, especially during the lockdown. Many natural areas, the shade of trees, isolated meadows, but especially the free and immediate access to wildlife in the urban space in such a period of major restrictions, was certainly a remedy for mental and physical health alike.

Can you describe the park's outreach to the public? Are there programs for this?

Access is free and can be done from any perimeter point. However, there are 7 easier access points which are, in fact, the consecrated entrances, both by visitors and by the organization.

There is no established access or visitation program, everything is free.

Has the drought affected tourism or the number of visitors? If so how?

In periods of drought or extreme heat, the park offers a state of comfort only in the first part of the day.

There are several aspects that lead to a decrease in the number of visitors.

- being mostly a wetland, the temperature-humidity discomfort appears around May-June, plus the whole park is surrounded by a concrete dam that maintains this aspect

- drought also affects visual comfort, dry lakes, lack of birds, natural dryness of vegetation

- also, between May and October is the period of mosquitoes that are active at any time of the day, but especially after 6-7 in the evening when walking and relaxing in the park become an adventure and a game of palms

The best periods are in spring, until May-June and in autumn, after September, the summer period, if it is also dry, often offers a desolate landscape of drought and exhaustion.

Can you describe what projects you are currently involved with?

For the park I work on infrastructure, organization and logistics projects. I also have a project to sanitize the Danube segment south of Bucharest, within a financing program.

We have recently started work on a project to increase the number of natural areas in urban

areas. All these projects are carried out together with APNV.

My own projects are organizing camps, expeditions and trips to natural areas, using green trails combined with water routes. Participants can ride bicycles, kayaks or horses.

What are the goals of these?

Few, let us enjoy life, what nature offers us and maybe we can keep for those who will live in the future, the wonders that surround us today, anywhere in this world

Do you have any involvement with volunteers in the park?

In the park I don't have activities with volunteers in the next period, but at the sanitation camps on the Danube, yes.

What are ways in which the VNPA uses volunteers? In what ways do you find volunteers most useful?

Generally for sanitation activities, waste collection and, occasionally, for infrastructure maintenance activities or larger public events

Tell me about the success of previous volunteer projects and how volunteers helped to achieve the goal of the project

I think it would be very useful for guiding activities with groups of visitors, for activities to promote nature and the benefits that access to nature offers, but to be with the physical presence and to talk to visitors during busy periods.

At the same time, they can become an important resource for civic mobilization in communities for various purposes, including public pressure on the authorities, critical mass in achieving certain objectives, advocacy or community facilitation.

Have any of these projects not achieved the intended goal? Describe a particular example.

Of course, as in any process or in life as a whole, there are as many successes as there are

failures.

At APNV, being an organization with limited resources, both financial and human, often the continuity and even the achievement of goals in the natural course is slowed by the accumulation of other activities that team members are forced to do.

Also, most of the projects, from the initiative phase, are thought to work in the long run, but the lack of resources and the permanently insecure or changing financial support in requirements, have always led to the abandonment of certain projects / initiatives and the beginning of others that represented in the near future a resource for the functioning of the organization.

I don't have a single example, but most have the same causes described above.

Among those that have been designed to increase biodiversity:

- stopping the invasion of reeds and the segmentation or permanent loss of certain wetlands*
- population with fish seedlings of lakes*
- attracting certain avifauna species, for which we started projects, but now they are abandoned because we have others in progress*
- monitoring the fauna through an audio-video network mounted inside the park*
- attracting pollinators by increasing the areas of honey meadows*
- creation of areas for composting biodegradable household waste*
- opening beaches around lakes to attract certain bird species*

Among those intended for medium-long term objectives:

- the transformation of certain infrastructure objectives within the park into workspaces in nature*
- combined events dedicated to nature and public knowledge of various topics, from biodiversity*

to the festival of astronomy and science of the universe

- the continuation of the visiting infrastructure for the areas still abandoned or left degraded

after the initial project during the communist period

Appendix H: Conservationist Interview Transcripts

Appendix H.1: Email Interview with Interviewee B

Date: 12 April 2021

What is your current role at [Redacted]? What does your work involve doing?

[Redacted] In this role, I oversee the administrative and technical functions of the [Redacted] in implementing the Massachusetts Wetlands Protection Act and Boston Wetlands Ordinance, including developing wetlands legislation and regulations, reviewing all wetland permit filings and technical documents, drafting wetlands permits, determinations, enforcement orders, hearing agendas, project review comments and all correspondence.

What is your involvement in projects? Do you directly work in these projects?

Under the Massachusetts Wetlands Protection Act and Boston Wetlands Ordinance, the Commission does not undertake its own projects but is the regulatory body that must review and ultimately approve of any work within a wetland, within 100ft of a wetland, or within the floodplain. I am tasked with reviewing all project applications for completeness and compliance with the Act and Ordinance. Once an approval is issued, I oversee the project at certain touch points to ensure compliance with the permit the Commission has issued.

Do you have knowledge about the current state of water management in the areas around Boston? Do you monitor park water levels, if so how?

No. Water levels in the Charles River are regulated by the Charles River Dam which is operated by the Department of Conservation and Recreation. Water levels in other wetland systems tend to ultimately entire the Boston Water and Sewer Commission's stormwater system and they manage that infrastructure.

Does nature regulate water or have you had to do any infrastructure projects to manage water? Describe them.

In Boston, there is a strong co-management of stormwater where natural systems play their part but due to centuries of development it is also managed through manmade stormwater infrastructure. In Massachusetts, all projects are required to comply with the Stormwater Standards, to a certain extent depending on the project. While compliance with the Standards varies with each project, the most common is requiring infiltration of stormwater that falls on the site.

What were the obstacles facing these measures?

The greatest obstacle in Boston is the poor soil conditions (use of urban debris as fill, clay, etc.) which can provide a challenge to infiltration.

What resources did you need to complete these?

No additional resources as it is an additional requirement added to an existing permitting process.

Did finances play a role in the project, if so how?

No, the Standards allow for the Applicant to propose a compliance pathway allowing for them to choose a cost-effective solution.

Were these projects successful? Please explain why or why not.

To an extent. Only projects proposing new construction or substantial reconstruction are typically required to infiltrate their stormwater. Over time more of the city will need to comply with the requirement but it will take time.

What was the biggest challenge in carrying out this project?

Ensuring projects are adequately managing their stormwater.

In general, what is the hardest part about managing water levels?

Climate change. Precipitation levels can change dramatically from year to year so it is never certain how much water over what duration of time will need to be managed.

In your water management projects, did you utilize volunteers and can you describe why or why not?

No, all of these projects were designed and implemented by civil engineers.

Appendix H.2: Email Interview with Dr. Bouroș George

Date: 14 April 2021

Is Asociația pentru Conservarea Diversității Biologice (ACDB) your current place of employment?

Yes, one of the employers at the moment is ACDB, but I also work as an independent consultant on various conservation projects.

What is your current role at the ACDB or your current place of employment if it is not the ACDB? What does your work involve doing?

My position within ACDB is as a conservation officer, but within an NGO in Romania due to lack of staff we fulfill several roles and perform various activities, such as:

- Assessment and monitoring of wildlife (especially carnivores);*
- Writing projects and grant proposals;*
- Coordination and management of volunteers;*
- Watchdog activities;*
- Awareness and educational activities;*

Can you describe your current relationship with the Văcărești Nature Park Association?

I have joined the team of volunteers in 2013, with my expertise on the protection and study of otters before the establishment of the Văcărești Natural Park in 2014. I'm still volunteering in Văcărești Natural Park Association.

Have you worked in collaboration with anything in Văcărești Nature Park? If so, please describe.

Yes, I make otter surveys in Văcărești wetland. Also, I made conservation measures for the otters in Văcărești Natural Park and the surrounding area.

At the same time, I carried out educational activities for the public on mammals in the protected area.

Are you familiar with techniques for monitoring biodiversity? If so, can you describe these methods for monitoring the wildlife?

Yes, there are many methods of monitoring wildlife, but the methods must be customized according to the specific area and species we are monitoring. In order to give examples of monitoring methods, I will take as example the area of Văcărești Natural Park and as a target species: the Eurasian otter.

The main method of otter monitoring are the transects. The transects have a length of 600 m, on the banks of a lake or river. This transects will be made inside the the UTM grid of: 1x1 km, or 5x5 km, 10x10 km, depending on the level of detail required for the study. Durning the transects you search for otter signs. Signs checked for were: spraints, tracks including footprints and trails, holts (otter dens), slides on the riverbank and resting places.

Other method is camera traps monitoring. Camera traps with IR-Flash are placed in the selected otter observation sites at about 0.5 metres above the ground and attached to firm structures such as tree stems and stumps from otter's habitat. From 2016, when the Văcărești area became more and more popular, camera trapping became a challenging task, because many visitors appeared in the area and the risk of stealing the camera traps has increased.

Another method is called "spot check". This method involves identifying areas of territorial marking of otters (prominent objects such as stones, tree trunks, construction debris, etc.) or even placing prominent objects close to the water banks to be marked with excrement and / or anal jelly by otters. In order to observe the activity of the otters in the area, it is necessary to visit these marking sites (otter latrine) and to count their excrements and their type (wet, dry

intact, dry fragmented). Wet droppings are recent 1-2 days depending on weather conditions and the fragmented ones are old, so we are able to know the activity of the otter in that area of the park or study area.

Other method is to study the otter spraints in order to know their diet and the resources that they prey in the study area.

Another method for determining as accurately as possible the number of individuals using the space of the study area are the genetic studies. Genetic samples are extracted from feces and anal jelly and can give us information about the number of individuals, their sex and the degree of kinship. They can also provide information on the territories used by each individual.

However radio telemetry or GPS transmitters will provide better information on territories and home range. However, these methods are quite expensive and invasive. The mortality of animals wearing a harness with GPS or radio transmitter or subcutaneous implant is very high.

Would any of these monitoring methods be feasible for volunteers to carry out? If so, then how?

The “spot check” method and “transect” method can be easily used by volunteers. However, the data should still be validated and analyzed by a specialist.

70% of Văcărești is covered in reeds, not all of the reeds are harmful but due to the current drought, puddles and ponds are drying up or being covered completely in reeds. Can you speak to what the impact would be for a wetland ecosystem to be taken over by reeds?

Reeds are an important part of Văcărești Natural Park ecosystem, because they provide many services to aquatic species in the area: shelter, food, shade, nests, etc. However, many aquatic and semi-aquatic species will suffer if the water holes are completely covered by reeds.

The ichthyophagous species will suffer the most: such as cormorants, kingfisher, seagulls but also mammals such the otter. Due to the dense vegetation these predatory species will be difficult to hunt, especially birds. At the same time, large fish will find it difficult to move. At the same time, reptiles and amphibians will suffer, reptiles will no longer have enough places to sunbathe, and for amphibians the water temperature will be too low in spring to stimulate spawning.

I have not studied the impact of reeds on the Văcărești ecosystem but these are some ideas that come to me at the moment, there are certainly many more implications.

We know that you are an expert on otter conservation and that otters are a component of the Văcărești ecosystem. What role do otters play in wetland ecosystems?

Otters are top predators of wetland ecosystems. They control and feed on populations of amphibians, reptiles, fish, mollusks, invertebrates and small mammals.

How are the otters impacted by excessive reed growth?

Over 50% of the otter's food consists of fish, a higher density of reeds and a total coverage of the ponds in Văcărești will lead to the temporary use of otters in this area and the use of the Dâmbovița River as a feeding area. But all this daily migration between Dâmbovița and Văcărești involves a major risk of collision with cars.

Do you know of any methods of removing excessive reed vegetation? Or are there different ways of rehabilitating the ecosystem?

Most of the reeds were controlled before by burning, this was a destructive method and the whole ecosystem suffered, but since it has the status of a protected area, fires are no longer frequent and a solution must be found to remove the reeds.

One way to prevent the spread of reeds is to cut the aerial part of the plant until early June - July when the plant has a fast growth rate.

Another option is to graze it out, we can use sheep, goats and cattle to graze it.

Other option is controlled burning – although this method is often destructive to wildlife.

The machine cutting and removal is a fast way to cut the reeds, but can be also destructive to wildlife.

Would volunteers be able to help in any aspect of this?

Yes, volunteers can help in manual reeds cutting and root removal.

Can you describe the “Activism de mediu pentru arii naturale protejate REALE” Project with the ACBD?

Most of the protected natural areas from Romania are threatened by irreversible degradation, they are only included in the legislative acts but they are not really managed by any entity.

In this daily context, the media and NGOs notify and report flagrant abuses and violations of the specific environmental legislation, which lead to irreparable degradation of the natural values for which these protected natural areas have been designated.

NGOs such as ACDB and Propark have the obligation to be actively involved in attracting citizens in educational, monitoring and civic activism activities in order to maintain on long-term, the values of natural heritage existing in the region of Moldova and to contribute as much as possible in the fight for reducing climate warming, accentuated in our case by deforestation.

For ACDB, the establishment of the volunteer center is a strategic objective, because volunteering is an important factor in the development of education and training of prospective team members and to increase social solidarity of the target groups that contribute to achieving our mission.

Another important direction of action of ACDB and Propark in this project is the education, empowerment and activation of the general public regarding the necessity of nature

conservation and combating climate change. The target group is young people aged 14-35, characterized by the desire for change, citizens are saturated with discussions without visible results on this topic and want concrete actions and immediate involvement

The implementation period of the project is 36 months, between 05.02.2021 and 04.02.2024

PROJECT MAIN OBJECTIVE:

Increasing the capacity and sustainability of civil society in preserving the values of biological diversity in the region of Moldova and facilitating the production of a current of public opinion in which caring for nature is an important part of people's daily lives.

How do you increase public support for nature and biodiversity?

Strengthen civic awareness by increasing the level of information and involvement of young people in advocacy activities in the field of biodiversity protection and climate change.

Strengthen the watchdog capacity of civil society in the region of Moldova by monitoring public policies and advocacy on environmental protection and climate change.

How do you help to build long term volunteer programs in Moldova?

By developing and maintain an active and long-term volunteering program for monitoring protected natural areas and lobbying and advocacy activities in the field of biodiversity protection and climate change. We will make an environmental volunteering center.

How do you measure the ecological impact of any solution that alters the ecosystem?

In order to measure environmental impact of any solution, you must collect all relevant environmental data before implementing that solution, during the building that solution and when you use that solution. In this way you will know which is the environmental impact of that solution on the ecosystem.

Appendix H.3: Email Interview with Dr. Dragos Gaiatanaru

Is the Technical University of Civil Engineering your current place of employment?

Yes

What is your current role at the University or your current place of employment if it is not the University? What does your work involve doing?

I am currently a postdoc researcher and a university lecturer.

Can you describe your current relationship with the Văcărești Nature Park Association?

We participated in several research calls for projects and have a good collaboration for different specific projects (eg. Bachelor's degree thesis).

Have you worked in collaboration with anything in Văcărești Nature Park? If so, please describe.

I have coordinated a Bachelor's degree thesis regarding the pollution with heavy metals in the park and participated a PhD thesis directly focused on the park.

Do you have any knowledge about the impact the Dâmbovița River has on the Văcărești's water table?

It is very difficult to asses and to give a straight answer regarding the impact of Dambovita river, for 2 main reasons. (1) Dambotiva river is completely modified, and it is actually a man-made channel, where the levels are artificially controlled. (2) The park is located somehow upstream on the groundwater direction from the terrace to the river.

Do you know what ground layers underlie the park and what their compositions are? If you do, how good are those specific layers at moving groundwater?

The first ground layer is a discontinuous clay layer with low values of permeability. Under this layer there is an actual aquifer formed by sand and gravel with high values of hydraulic conductivity.

We learned through VNPA pilot testing that at 40 centimeters into the ground they found groundwater is held in a layer of clay. Is this the shallow aquifer below Văcărești?

The answer is detailed in the previous answer.

Would it be feasible at this depth of about 1-2 meters to construct a shallow well to extract water?

Yes, it would be feasible, but the depth of the well should be around 15 m.

How would this impact the water table?

It is impossible to foresee this without a proper hydrogeological model.

Another solution to increase water levels is increasing the pond's depth to prevent reed growth to 2 meters.

Without a proper map of the thickness of the clay layer this solution is rather inappropriate.

A third water management solution is to collect rainwater from the dike surrounding the park.

This is a good solution, but some contamination study on storm water should be carried out.

In general, what documentation or guidelines do you need when working with water tables?

A proper hydrogeological study based on modelling is the first step in order to understand the water budget and water cycle in the VNP.

Appendix H.4: Phone Interview with Interviewee C

Interviewer	Note Taker	Date
Ryan Hanna	Erik Herrera	13 April 2021

RYAN: Alright, and how long have you been doing environmental engineering for?

INTERVIEWEE C: Not environmental engineering. Environmental science and planning. I’m not an engineer. I’m a marine bio, environmental scientist with an environmental analysis background and consulting field. Let’s see, probably 35 years or so. Roughly.

RYAN: Now what is your expertise with wetland environments?

INTERVIEWEE C: Well in the northeast region of the United States, wetlands [inaudible], functions, and values assessments, wetland permitting, you know, botanical surveys, registering invasive species type work. That type of background related to wetlands. Wetland mitigation, compensation design, monitoring, restoration plans, stream restoration, tank stabilization. That type of work.

RYAN: And now, when you say wetland mitigation do you mean conserving the space or...what do you mean by that?

INTERVIEWEE C: Well, mitigation comes in various forms. The regulations will tell you mitigation is avoidance of the impact area, minimizing impact and providing some sort of compensatory mitigation, which is one way of offsetting it. So when I talk about mitigations, I’m talking about both. Perhaps preservation of wetland areas but more typically it’s in the form of restoring a wetland that’s been degraded or possibly constructing a wetland from a non-wetland area.

RYAN: And now, when you do these assessments and studies and things like that, how do you measure your ecological impact on the space? Or is that something that you have to do?

INTERVIEWEE C: Yes, well we do, that's all part of it. We identify wetlands formally ahead of time, when we evaluate impacts we look at whatever the proposed action may be in terms of how much of the wetlands going to take, what the wetland type is, what functions and values it's providing whether it's going to, you know the type of work is going to have than a direct impact, just with a footprint, going to have greater secondary impacts, if it's going to perhaps change the characteristics over a much greater area, if it's going to take away some sort of a critical habitat, and so on. And then, you evaluate the proposed action, if it's a road, or a bridge, railroad, or marine court, whatever it happens to be. You report on the direct impacts, the effects on the functions and values, and these other indirect effects. And then typically, it's assessed based on permit allowances and thresholds and requirements and different degrees of impact, the different types of wetlands have different thresholds and impacts, and then an impact request is made through permit applications and it may or may not be approved depending on the type of project and whether it's federal wetlands, or state wetlands, or local. And it's reviewed by some sort of agent, whether it's a permitting manager at a state PEP or an army corps of engineers, the US coast guard, or local conservation commission depends. So. But we typically do the evaluation, evaluate the existing conditions, the proposed impacts, and, you know, what's being done to mitigate or offset some of the impacts. And then the decision is not ours, it's dependent upon whoever the permitting authority is.

RYAN: Certainly, certainly. Now, do you deal mostly with this administrative aspect that you're talking about? Do you work with, any implementation of doing any of these assessments?

INTERVIEWEE C: I'm involved with field work. Not as much as I used to, but I still have done field work and helped fill in on certain things, or if there's a specialty area that I need to participate in. So, I'm kind of wide range in both field work and administrative managing, reviewing, quality checks, things like that. Directing others.

RYAN: Perfect, do you do anything with measuring biodiversity levels when you try to enter a space, to try to assess it. Do you have to measure the biodiversity? Do you have to try to characterize what types of species are there? Or is that something that's outsourced to somebody else?

INTERVIEWEE C: That is entirely variable. It really depends on the nature of the project. Biodiversity is a massive subject area, so I mean it, you can understand all the different factors involved. It's generally the characterization assessment level, best professional judgement with some specialists involved in what we're doing. When we're evaluating wetlands we don't necessarily evaluate every, you know, insect or bird or plant but you do a characterization. In some instances if there's a specialty need for that it'll be done, more often it's based on indication of perhaps a less common species assemblage or rare species or uncommon habitat, then you may take it to a greater level and sometimes we'll bring in specialists. For instance mussels surveys, freshwater mussels surveys, things like that. So yeah, it's variable.

RYAN: Interesting, and now, along the same lines of assessments and everything like that, when you are going to wetland space or anything like that, when you're trying to do anything with the space, do you try to measure the water levels or the water table at all or anything like that to measure the impact you're having? Or, what type of thing you're trying to change about the water tables or water level?

INTERVIEWEE C: It depends again on the project, the nature of the project. Some projects, not my area, but other folks work on things like dams and rivers, things of that nature are way more likely to do that type of work. We will evaluate the project to decide whether or not its likely to underdrain a wetland, have an effect on it, or if it constrains a water course and raise water levels upstream, which could have an effect, could change the hydraulic characteristics, then sure we would do that. Most often the starting point on those types of projects are to not cause that to happen. So it's not something essentially that's measured, per se. but in some instances, for instance, if we're looking at places for wetland mitigation design, or to restore a wetland, then sure we would be in the surface water and or groundwater elevation monitoring mode for that, whether it's some sort of a direct visual observation through a piezometer, or some sort of a well, or some sort of a recording device which records the data in whatever increment you set it up, daily, hourly, whatever it happens to be. And then you would use that information to help project, predict and project groundwater levels if you're going to be something with the design, most often for mitigation.

RYAN: And now, you deal a little bit with the hydrological aspects and such. And , to give you a little bit of context. In Văcărești park, the Romanian park that we're working with in collaboration, it has a very interesting quality, when it was constructed, the communist regime decided to dig out a pit about, you know, 10 meters below the level of the land surrounding the area and decided to lay down a 2 meter layer of clay down, so underneath the entirety of there's a layer of clay. We were wondering if you could speak to anything about how a layer of clay would affect mobilities of aquifers or the ability of aquifers to affect surface lakes or surface water, or it's that...?

INTERVIEWEE C: Yeah I mean I hypothesize on that, I don't know the specifics of that circumstance, so I don't want to come across as a unilateral statement, but I mean basically you're describing an aquiclude, which is a restrictive layer that isolates surface and groundwater designed to basically act like a pool so it fills with water, either surface water or rainwater. And then, you know, it has sufficient volume to not dry out, unless you have an extended period of time, or you know, evaporation and so on outpaces the replacement rate. So I mean, that would more than likely not be an interactive system, it would kind of be an isolated system. And, there's circumstances like that, that naturally occur. There's systems set up in bedrock, there's systems that are set up in clay, naturally occurring clays, poorly drained, very poorly drained soils, silt soils, clay soils, and basically you would more likely have a parched wetland system in that case where it's just basically an expression of the surface water. Some, some, you know I'm not going to say some moisture doesn't get through those clays, but it's very very very slow transmissivity rate.

RYAN: So, one of the solutions is because the park right now is undergoing a drought and everything like that, and it's only being exacerbated by the fact that they can't get water in the area effectively, one of the ideas is to potentially construct a shallow well that extends maybe 2 to 4 meters below the surface or something like that. But there's always this worry that ... we've been reading some literature about it, kind of talking about the mobility, or lack thereof through that clay, would that be, even putting a well through the clay level, would that be per se in general [be a] bad idea because we would be depleting that area, or would that not matter because it's just going to be so immobile for the water to get through?

INTERVIEWEE C: Good question. I mean it's, what really matters is the state of the soil types and water characteristics prior to the construction of that feature with the clay. So I mean if that

feature, I'm guessing, I have no knowledge of it, but I'm guessing that there's no water within the surface depth of the feature, because if it were, it would probably be pushing inwards towards the banks, hydrostatic pressure and you may have bank failure. I don't know how thick the clay is, but sounds a little bit at risk, but if it's not, the water levels are down, you don't have any kind of hydrostatic pressure from the other side of the clay, you're probably above a normal routine groundwater level, so you're talking about some method of replenishing water into that feature, clearly that would have to be pumped, I don't think it would be an artesian, maybe it would, I don't know. You know, that's a good question, and you know, if you were to divert groundwater from that area into that feature, it may, depending on the size of the source, the area, and all that, it may deplete water levels somewhere else, don't know, could have an expression on nearby wetlands. It may be far enough away that it wouldn't. It's a pretty big amount of information to get your head around to make a decent interpretation of what could happen without collecting data and researching it.

RYAN: Now, is there any types of techniques that your firm employs to measure this? Like do you[measure]the effects like measuring seeing if there's you know like where the water table sits at, where aquifers sitting at there, a way that you guys manage or ways that you measure in general?

INTERVIEWEE C: Yeah, I mean that's fairly routine through monitoring wells and that may be done at different depths paired couplets things like that to try and make sure that your you know if your going through different soils soils aren't constant and waters that aren't constant you may have separate isolations of water tables like Long Island New York has kind of restrictive layers you have surface water groundwater deep groundwater if you had you know something like that you'd want to have wells at different depths to understand you know deep water shallow water

things like that if you have artesian conditions and so one but that's typically done through wells there's probably other methods of I don't know GPR, ground penetrating radar, its not a method I'm using or anything but there may be other techniques, I'd want to talk to more geophysical people for that but I'm more on the biology side so ..

RYAN: No that's fair... all this information has been super helpful, and now, do you deal at all with implementing rain gardens per se or anything like that if you were trying to introduce more water to a wetland ecosystem?

INTERVIEWEE C: Yes, so again relating to the permitting topic at hand there's a number of laws state and federal laws and some local laws that address water quality and so on stormwater runoff from roads and parking lots things like that tends to be degraded with pollutants and there's you know rain gardens are one method of helping to treat closer to the source meaning the surface area where its collecting from we've done a number of rain garden designs and roadways side roads parking lots things like that so that's certainly a method that can be employed that we've done and whether it -- and I think part of the question you said was would that help with -- what was it again --

RYAN: Introducing, yeah, introducing higher water levels to a wetlands potentially.

INTERVIEWEE C: Well, yeah I mean a goal of managing runoff is that you know precipitation landing on the earth would be allowed to soak into the ground as close to where it's landing as possible. You're not diverting. You're not gathering a big giant surface area and putting it into a pipe and running it far away from where it is and depleting that area from the ability to recharge ground water. So, rain gardens typically are on the edge of parking areas or roads or whatever sometimes roof water are designed to try and treat the water through biological properties and settling and things like that and some of them but not all are designed to infiltrate water as well

which is going to get some of that water back in the same vicinity kind of a tough question to answer it really site specific but you know it could I mean the benefit of a rain garden would be then remove some pollutants before getting water to your wetlands if its adjacent to your restoration area where you are talking about... but not necessarily provide the groundwater you know the water level that you need it really depends on where your water is going and how much water you have and so on.

RYAN: Yeah, yeah sure I mean what they're thinking about is the entire park because its originally its supposed to be a lake designed in the communist era and they sunk the land down about 10 meters put a concrete dike around the whole thing and they were going to try and fill it up to make a lake but of course that didn't happen for the last 30 years it sat abandoned right? And you know it somehow by some miracle it developed into a wetland ecosystem so one of the ideas now is trying to develop a way of collecting the rainwater and distribute it further into the park or not have it completely absorb at the base of the dike when it rains so to try to shade that area as much as possible so that we don't get evaporation and things like that or trying to get it to have ditches to direct where the water is going to maybe not necessarily raise water levels but at least maintain the falling water levels in some of the larger ponds.

INTERVIEWEE C: Sure, so you're talking about potentially diverting some surface water from collection areas whatever it happens to be and getting it to this specific facility you know not going to raise water levels in the whole facility but you may have some surface water expression that could help kind of irrigate if you will the wetland area and enhance it it sounds like but it really depends on how far through your restrictive layer it's going to be so you know if you're many feet above your restrictive layer it's probably not going to help a lot but if your close to your restrictive area it may help quite a bit, which wetlands have pretty shallow unless it's a deep

pond pretty shallow range of hydrology that [inaudible] the various wetland types that we typically . . .

RYAN: That's certainly an issue and I mean one of the issues right now is because of some of the ponds are so shallow not that they're invasive especially in Europe but the reeds they're taking over the entirety of the pond and they're expanding the shoreline and its causing the ponds to dry up a little faster then they really should and so I didn't know if you had any experience with like trying to deal with invasive vegetation stuff like that if your trying to rescue a wetlands area or making it to something else.

INTERVIEWEE C: Yup, that's actually fairly common to try and manage invasive species. You know it's just costly. Some of it is not overly effective. It really depends on the species and the location and so on and so forth. But, now when I had mentioned mitigation or compensatory mitigation, that's, you know, typically one of the requirements --if you're allowed to a permit to do some sort of compensatory mitigation- that you, have a plan --an effective plan-- for identifying, managing, and controlling invasive species. You know there's a few target species. There's quite a few that have been identified depending on where you are, but I'm sure world wide obviously. Now that is a fairly common practice to try and deal with it but, you know, ... some of the methods are a little less comfortable with people, like herbicide. Some are just mechanical removal. Some are hand removal. Some are biological control agents. There's a variety of methods, but it's costly, time consuming and not usually a permanent solution. Unless you can get --like in some species the right hydrology cannot have invasive come in, like a salt marsh. If you get the soil salinity high enough you can keep out *Phragmites*, some of the common reeds, things like that that are a little more invasive but. Yeah, no it's practices employed routine and...

RYAN: We were looking into it and it's just sort of these battles that we have to deal with because the park doesn't have the funding to continually maintain the vegetation clearance, but one of the biggest problems that they have is just losing habitat after habitat to reed take over. I mean it's just unfortunate but I mean you know, it's the reality of the situation. You know.

INTERVIEWEE C: It's a tough one. I mean it's one of the tougher ones to deal with, it's like cable. But, know if you can crowd it out, you can flood it out maybe but then, you know, you're just making a pond but then. Sometimes you can shade it out but it doesn't go away it just stunts it quite a bit but it will probably outgrow the pace of a tree. That's how aggressive it is.

RYAN: We were looking into methods where they were using a really tiered way of growing stuff that they put down annual ground cover and they kept doing that until the perennial species could catch up, to try to out pace the reeds and everything like that. But it looks very intensive. It looks like a 3 or 4 season job to try to get them established.

INTERVIEWEE C: Yeah, I'm curious to see how that works. It's just the reed is -You know we are talking *Phragmites* I assume but-Yeah so I know there's European ones. I mean there's different types but it's just designed...“designed” by nature it's really really adapted to monopolize areas. It's very very very durable. So, it's a tough one.

Appendix H.5: Phone Interview with Matt Burne

Interviewer	Note Taker	Date
Ryan Hanna	Erik Herrera	14 April 2021

RYAN: Can you describe your role at BSC?

MATT: Yeah, I'm a senior ecologist with BSC. I've been here for just a little over a year at this point. I do wildlife survey work, regulatory permitting. For wetlands work I do a variety of projects, you know in terms of looking at ecological restoration and you know helping to avoid, minimize, mitigate development impacts, that kind of thing.

RYAN: Perfect, and now what are some of like the techniques that you use to monitor wildlife?

MATT: We do a lot of survey work. So just going out and looking for target species, and there's a whole--depending on the species that you're concerned with--there's any number of different approaches to detecting and quantifying populations of species of interest. And quite often it is a process of evaluating habitat, available habitat, so sometimes you're not actually expecting or intending to find, you know, to actually encounter species but you might be looking to determine whether or not habitat is available for a particular suite of species.

RYAN: That makes sense, yeah. Do you deal at all with monitoring like any of the plant vegetation or things like that?

MATT: We certainly, BSC certainly does. We do rare plant surveys as needed. We do vegetation, a variety of vegetation inventory and monitoring, given different project goals quite often we'll do invasive species inventory. We do a lot of work in developing management plans for native vegetation. We do wetland replication, restoration, monitoring, that kind of thing. So

as an organization we do a lot of vegetation work and personally I do some of that but I'm more focused on wildlife.

RYAN: And now when you make like a wildlife survey and things like that, how does that factor into the actual project when you're trying to execute something? Does that mean you can't go into certain areas or does that mean that you have to scale back some of your efforts when you're affecting some of the ecosystems? How does that really play in?

MATT: Yeah, there's a lot of different ways that that information is used. In Massachusetts particularly, there's fairly significant regulatory protection for particularly wetland wildlife habitat and so the, you know, the process primarily is designed to help avoid impact to the wildlife habitat in wetlands and so, you know, our work is...can run [inaudible] but often we are charged with figuring out how a wetland functions and why it's important to wildlife and then, you know, working to avoid impacts and where they can't be avoided to minimize them and then finally to mitigate any impacts that do result from project work.

RYAN: When you're evaluating an available habitat, just returning to that, what is--how do you actually do that like what is your criteria for establishing what is a habitat that takes up whatever wildlife species that you're trying to protect or mitigate impacts to?

MATT: Yeah, you start with figuring out organisms are likely to be in a particular kind of habitat. So you start with some assumptions about the species that might be encountered or supported that can include, you know, finding out about any known occurrences of rare species, that sort of thing. And then, within a particular unit of habitat, whether that's a swamp or you know a portion of a property or something like that. We inventory the different features of the landscape that are significant to wildlife, so you know, ponds that might function as vernal pools, standing dead trees, tree cavities--you know, we inventory a whole list of different features that

might be present and provide important habitat to species. And then that gives you a baseline understanding of how the wetland is functioning or how a piece of property is functioning for a variety of species. That's kind of the primary way that most of that work begins.

RYAN: Alright, that makes sense. And, do you deal with any of the hydrological aspects of any of these projects?

MATT: Yes, we--that's always an important consideration, you know, any project that's going to potentially affect wetlands has to account for hydrological impacts. And so, you know, ecologists, myself and my colleagues have to be cognizant of, you know, how to read the landscape and understand what hydrological features are and how they're working and where water is coming from and going to and so forth. But we also have engineers on staff that we bring in to do project review to make sure that something with, you know, engineering training and hydrological training actually is putting some thought into the projects we're looking at.

RYAN: You know, just for context, the park that we're working with, collaborating with, has a very interesting hydrological profile, because it was initially designed to be an artificial lake. They sunk the ground about 10 meters down during the communist era in the 1980s and put a concrete dike around the entire divot. And then they decided to lay about 2 meters of clay at the bottom to make an impermeable layer. So now the issue is that now that the droughts here and starting to dry up some of the water, we're really trying to wonder how to access the groundwater and if we're accessing it an appropriate way for pumping out water for wells and things like that. So we're wondering, what's your opinion about that, have you had to encounter layers of clay in lake beds, due to river beds, in your work?

MATT: I have not, no. Most of the wetlands I tend to deal with, mainly because we're in the northeast here, mostly groundwater fed, or you know, have surface water connections. We don't

have, in my experience, I have not encountered a lot of wetlands that are, that exist because of a confining layer, because of clay lands or something like that, although I certainly know that those exist, but I haven't dealt with them very much.

RYAN: Yeah certainly, it's a much different thing. And now, have you dealt with using wells as a means of restoring a wetland environment, to introduce more water?

MATT: No, but I think that's a pretty interesting idea. Yeah that would be, you'd be tapping into groundwater to bring that up to the surface to feed your wetland. Is there a reason you've identified for the drought? I mean is it just a large scale shift, is it a temporary kind of situation?

RYAN: It's been both large scale and long lasting. It started back in early 2019, actually I believe 2017, and it's been continuing throughout the entire Balkan peninsula. What it's doing is destroying crop yields, there's been millions of hectares lost in arable crop land and everything. It's crazy.

MATT: Wow.

RYAN: Yeah I know. Just recently though, they've had good precipitation over this winter season, but you know it's still not going to, if it doesn't let up it's still going to destroy so much crop land and everything.

MATT: Well interesting, yeah.

RYAN: So part of the issue with what we're trying to do, because Romania is still -- a lot of things are still transitioning, some of the agencies aren't fully fledged and everything like that, so the environmental ministry over there is having issues managing some of the park lands and stuff like that. So what's happening is this NGO we're collaborating with, they're trying to identify

those volunteer friendly activities because of budgetary constraints to conserve this area so it doesn't dry up completely because of the drought.

MATT: Ah I see. Yeah interesting, interesting, ok.

RYAN: Yeah so one of the ideas is to potentially break through that restrictive layer, and go you know 2-4 meters down with the shallow well and try to access that, you know. The idea is to try to avoid affecting the surface groundwater, because we might deplete that faster than we think.

MATT: And is there demand for that water supply for other purposes? You know that would be a public perception problem if you were seen as kind of taking water out of crop irrigation in order to keep a wetland, an artificial wetland.

RYAN: Well the thing is that this park is in the heart of Bucharest, it's in the middle of the city, it's got high rises around it and everything. It's a very unique situation.

MATT: Yeah, yeah. You know, one thing, I don't mean to hijack your interview, but something that might be interesting to look at is storm water management. And you know, taking advantage of you know, storm water that's collected from built infrastructure, which usually gets shunted off somewhere, might get you know, kind of redirected into this wetland as a potential augmentation to groundwater sources. You know, that something a lot of urban settings struggle with, what to do with storm water, and that might be an interesting approach. Although that's not volunteer level kind of stuff. Anyways sorry.

[Both parties talking over each other]

RYAN: No no no you're good. All information is good information.. That's something we've been considering because one of the aspects that could be volunteer driven or something like that is to maybe set up rain gardens, right, or something that would catch the storm water and filter it.

Is there any kind of good way you can [inaudible] talk and expand on rain gardens? Because our information is fairly limited because we are still in the beginning stages of developing this?

MATT: Yeah so we've, BSC, has done a fair bit of work with kind of, what's referred to as nature based solutions, so these are trying to use natural models for dealing with you know problems that we encounter in the build environment. So, a rain garden is a good example of a essentially a nature based solution to storm water because you get all this you know in a very kind of intense flashy way particularly in urban settings you have to deal with lots of runoff all at once periodically and that's not very natural right, that's not how a wetlands system functions its essentially acts as a buffer to that flashy kind of response that you see in an urban setting so rain gardens and built wetlands, you know, artificial wetlands can provide an attenuation of peak flows, so you get storage and uptake by plants and soil. And you're taking advantage of your cleaning -- you're changing -- you're fixing the temperature of runoff water that comes from roofs and pavement and so forth you're kind of moderating that. You can polish storm water and take out, use wetlands to filter solids that are being transported the soil. The wetlands soil are very valuable in absorbing water and holding it for a period which can either then be discharged into the ground in a more you know in a slower fashion and also recharge ground water, which is valuable so you don't just shunt it out of the city and get it into drains and away. And then you can also use that to grow stuff so you can change by introducing natural vegetation in constructed wetland you can end up attenuating some of the urban heat island effect that you get so you can some really good stuff for the urban environment with constructed wetlands and that can be -- rain garden is a good euphemism for what that is taking advantage of water that's being managed from the built infrastructure from impervious surfaces and turning that into a way to grow plants for a lot of different benefits.

RYAN: Yeah definitely you mentioned at the beginning you deal with other nature based solutions can you talk about in general what other solutions you employ that are nature based are?

MATT: -Dealing with storm water is one of the major things I'm just trying to think we're doing a big effort in central Massachusetts right now to identify a whole bunch of different nature based solution for various things, you know, road crossings culverts invasive species management creating re-creating wildlife habitats where its been impacted or lost those are some of the things that we work towards doing.

RYAN: Yeah that makes sense. Sorry, lost my train of thought right there. Because you deal with a lot with wildlife and things like that, do you deal with invasive plant species like reeds that take over wildlife habitats?

MATT: Unfortunately yes a lot and it's a big problem.

RYAN: Now, how do you go about trying to mitigate the effects of reed growth. Is that something that you can really deal with or do you just have to repeatedly try to clear up that land?

MATT: It'll depend on the species. There are lots of different approaches to dealing with invasive plants, and the approaches depend a lot on what species you are dealing with. You know, when you have *Phragmites*, as a primary example, a lot of times *Phragmites* become a problem because of hydrology changes in a wetland, because of salt incursion based of, you know, like road salt and that kind of thing because *Phragmites* prefer a little brackish setting. So you know, trying to fix the problems that led to the growth of an undesirable species is one part of it. And the other part of it is actual active management of an infestation, and that can be

cutting and using herbicides or just herbicide application. Or you know, there are a lot of different --depending again-- depending on the species, there are a lot of actual on the ground approaches that are taken for dealing with infestations. Those are the kind of two primary things. You deal with the infestation itself, but then you also get to deal with the reasons that it was -- became a problem in the first place.

RYAN: Yeah certainly, and in the park itself, one of the main issues is that they are losing shoreline ecosystems and habitats to overcrowding of the reeds.

MATT: Ah, yeah. Yeah, so evaluation why they are flourishing is important.

RYAN: Yeah, part of the issue is bank failure. They're having [this] --because the ponds are drying up so fast because they don't really have a true hard edge between what's ground and what's pond. So it's expanding out the surface area which leads to way too much Do you deal with this at all or a lot? Trying to prevent bank failure?

MATT: It's a topic that comes up in a variety of situations we refer to it as 'bank stabilization'. It's a practice that is most often employed in riverine systems, where you're encountering erosion for a variety of different reasons. But, you know, when erosion is severe and undercutting banks, you know, depending on the situation bank stabilization is an important tool to minimize impacts and loss of land or what have you. So there'd be some applications for bank stabilizations. But, you know like, you have to put that in context of, you know, what the long term prospect is. You know, if you're in a drought that might reverse ... you know you'd have to be careful not to go too far in one direction so that you don't create a situation that's problematic if water does return. You know, that would be something you have to think about.

Appendix H.6: Phone Interview with Matt Scweisberg

Interviewer	Note Taker	Date
Ryan Hanna	Erik Herrera	22 April 2021

RYAN: Can you describe your role Wetlands Strategies and Solutions LLC?

MATT: I am the principal and a wetlands ecologist. I’m also a wildlife expert. So those three roles.

RYAN: And now do you specifically deal with field work, like I’ve read a little of your bio and everything, do you still deal with that or still more on the administrative side of things?

MATT: No I’m a solo operator here, so, you know, sort of chief, cook, and bottle washer if you will. I do field work, office work, whatever is needed.

RYAN: Cool. So when you do a project for a client, how do you monitor your ecological impact? The ecological impact of a project you’re working alongside of.

MATT: Well I’m not sure I completely understand the question. When you say ecological impact are you talking about my impact or the proposed project?

RYAN: The proposed project. So like if they’re coming in and potentially changing the water table or habitat space.

MATT: Oh, yeah. It, you know, it depends on the project and whether there are other consultants working on that project. It can be as simple as somebody hiring me to delineate wetlands on the property. It can be a little more complicated when it involves an assessment of the ecological impacts of the proposed project on wetlands and waters. Sometimes it can include assessment of wildlife and fisheries impacts and it can include coming up with proposed compensatory mitigation to mitigate for the expected adverse impact. So it really varies widely.

RYAN: So like how bout specifically for habitat space. How do you identify what spaces are occupied by species of interest and then how do you go ahead and quantify that?

MATT: Not sure you can--and again when you say spaces I assume you mean the various niches that wildlife tend to occupy, different...

RYAN: Yeah, for instance--like if a bird nested in specific trees or whatever.

MATT: Well, again it really depends on how much specific information is needed for a particular project. In many instances it's just involving a general assessment of habitat quality, the types of wildlife that are expected to be present and that includes looking at surrounding land use, services, things of that nature to come up with what I might expect to find on the property. I also would involve reconnaissance of that property in looking for signs of wildlife, bird songs, nesting, tracks, scat, you name it, whatever can be found.

RYAN: Okay, yeah that makes sense. And now do you deal with monitoring hydrology?

MATT: Usually I don't. Not me specifically. But often when I'm working with others and if the project requires it, then yes I'll certainly be involved with monitoring hydrology and trying to interpret what the data say and how that might change a project proposal. More often than not, that kind of monitoring involves or stems from the need for some sort of wetland restoration or compensatory mitigation and needing to know what the hydrology of the site and surrounding area really is.

RYAN: Yeah and, if you could, could you speak to how you try to measure aquifers or the groundwater in the space? Like for instance, if you have some sort of infrastructure project that you're working alongside of and it impacts the aquifers to some degree is there some way that you can measure that impact on the aquifer and then try to reestablish them somewhere else?

MATT: Well, a couple of thoughts on that. One, yes, you can put in or install a series of monitoring wells. They'd have to be installed properly. And there are transducers that you can install in the wells themselves at different levels to measure fluctuation of water tables. You need to, some are really high tech and will transmit data remotely, others you have to go to the well and download data. And if it's just really basic you can simply still kind of do it the old fashion way and eye ball with a graduated stick if you will, eye ball where the water table is at different points in the year or on different visits. And you have to really do that to get a somewhat accurate picture of the water table. You have to monitor it for a period of time through the [inaudible], typically at least a year, preferably two or three

RYAN: And now, how typically how do you take these monitoring wells? Do you take them at different steps to look at the water table, or do you just standardly dig them at like five meters or something?

MATT: Well again it depends on the kind of surficial geology that you're working in, you know, are you dealing in coarse textured soil, like the sands of southeastern Mass or Rhode Island, or down in southeastern Connecticut. For working in glacial film, very tight soils. So it really depends. But typically, you can install a well, a series of well. And they don't have to be terribly de de, because most of the water tables in at least in New England. There are variations, but generally speaking, you can install a well let's say the three scenes? and have it screened at different heights. So you might put in. I'm just picking numbers out of the air here but you might put six different PVC wells in and have them screened at different depths. So you can track the fluctuations in the water table over time.

RYAN: Yeah that makes sense. At least for the geology of the park in specific it's, I guess it's maybe closest to like glacial till it's, it's a compacted layer of clay on because we're the, The, the

park was constructed. It wasn't supposed to be a wetlands at all it was supposed to be a lake built in the Ceausescu regime in the communist era. And they laid, they put down a two meter thick layer of clay, so that the lake wouldn't drain as fast. So I mean I guess it's like in the same way that it's like the wetland is perched on top of that restrictive layer

MATT: So that's, you know, again, you'd have to know things like that in the water to know where you want to put your wells and how deep you want them installed and screened and that kind of thing. So, when you see the data. If you see some odd results you can better understand and know how to interpret that.

RYAN: Yeah, yeah, for sure. And I mean, one of the big areas, we're interested in, because the hydrology and geology of it is of the park so interesting is that one of the proposed ideas to try to mitigate the damages of the drought is too deep in the pond, so that it doesn't have as much shallows or shoreline area so that the reeds can take it over and start to overwhelm the water body, but we're really kind of the question that we really haven't thought about a lot recently because we don't really know where to start is. If we dig down deep enough, and we penetrate through the clay layer to add more connective ground for groundwater. Could that potentially drain the pond if we're not careful?

MATT: What do you think about that?

RYAN: Well I'm just thinking that if if the water body is accessing this conductive groundwater, or this conductive soil layer, and that aquifer isn't as highly placed up to the clay level then it could drain.

MATT: Sure. So, so think of it as a bathtub that's been created. And if you were to drill a hole in the bottom of the bathtub. It would drain. And the same thing would happen in the situation you described there.

RYAN: Okay, I yeah I would there any way of measuring, like say we penetrated through clay layer. And we want to measure the aquifer down there could we do that with a monitoring well, or would we have to set with a different method because would be moving through such different geologies.

MATT: Well, off the top of my head. I can. I would think you could you could drill a deep well through that clay layer under the lake, the pond. It would have to be sealed properly so you don't drain the pond above. And you might have the water level go down initially and once it was sealed properly at the base of the well, it probably fill back up. But then you would have to install some sort of electronic device, a transducer. That would monitor the water levels. Far much farther down and give you a sense of where that deeper water table, what you might call the regional water table is actually sitting and how it is fluctuating. Then you'd be able to compare the deeper one to the one for the pond.

RYAN: Yes, certainly Okay. Yeah, that makes sense. And now, kind of changing topic here to you specifically deal with invasive vegetation in wetlands.

MATT: Occasionally, yes

RYAN: So in the, in the park. They're dealing with a *Phragmites* invasion as as probably most wetlands at this point. And so, what they're trying to do is not necessarily remove the *Phragmites* because that's probably near impossible. But to try to thin them out so that habitats aren't

completely destroyed and overwhelmed by the species. Do you have any recommendations on how to go about that in a non-invasive way?

MATT: The \$64 question. Yeah, I mean with *Phragmites*, the best you can do is manage it.

And you seem to recognize nearly impossible to eradicate unless you want to use a really heavy hand herbicides and that kind of thing. So, I guess you want to get a sense of whatever area you're working in, and what sort of plants diversity is there now. You want to manage try to manage that. So that your *Phragmites* is not becoming a monotypical stand with rather just a piece of the overall plant community, adding a little bit to the diversity. *Phragmites* can be beneficial. In some instances, and it diversifies the habitats and as well. You just as you said a minute ago you don't want to taking over everything which is prone to do. You have to look at. In order to manage it you have to look at how you can best go about that is, is mowing possible, is treating individual plant stalks with some sort of herbicide like a touch stick, where you're not just broadcast herbicide in that rather very specifically targeting individual stems and trying to knock it down, knock it back some. So it really depends on the habitat you're working in what you may be trying to promote to take its place. And then some of it is probably a little trial and error, in terms of how often you have to do that and monitoring the results in whatever your preferred replacement plant species might be seeing how they invade themselves as to how they colonize areas that were dominated by *Phragmites* and trying to give them an opportunity to survive and reproduce.

RYAN: And now, one of the. Yeah, it's, it's definitely something to consider. Take into account when when you hold report. Now how do we prevent because like one of the issues that because the whole entire park sits on top of this restrictive layer right, the shorelines to these ponds are all extraordinarily shallow and the edge is taken over by the reeds. Is there any way to not necessary

because I know this is more of a river, riverine system kind of type term but to do bank stabilization to have more of a sharper barrier between the water body in the shore, or the ground rather than some.

MATT: The only way to do that is to excavate around the margins of the lake or pond and deep in it, you know, leave a, maybe leave a bit of a shelf. I don't know how many feet wide, but the only way to to manage the water depth is to actually act excavate whatever sediment you have there and deepen it. And you might not want to do that all the way around, you might want to do that in sections, particularly just see whether that's a useful way to prevent the Phragmites from coming back in,

RYAN: For sure. Looking at it that almost pretty much covers all the prepared questions we had for today, you have any other suggestions for drought mitigation in wetlands that you typically employed with [inaudible].

MATT: Well, it wasn't the only. If it is for long droughts and you're trying to mitigate the effects. You've got the option of trying to dig a well, the deep well for use of groundwater. But, you know, there's a risk in that you have to really understand the shallow and the deep hydrology of the area. You don't want to drill a deep well and start pumping water out and wind up lowering the water table because it's all connected as you know. So you have to be a little careful with that. You've got to study and know what you're dealing with, but that's probably the only way to deal with a drought like what you're describing as a prolonged drought to supplement the water table into the water. Actually, a couple years ago I had to do a project in China. I was over there for 10 days or so, in a Park, one of their state, national parks, working on specific deer species that only breeds in wetlands, Phragmites wetlands and they were in a prolonged drought. And I was recommending drilling to wells, two deep wells, to try and supplements water input to the

ones that they had in this park. Other than other than finding another water source of some type. I don't know what that would be. I can't imagine there's too much else you could do. Short of doing a rain dance.

Appendix H.7: Phone Interview with Paul McManus

Interviewer	Note Taker	Date
Ryan Hanna	Erik Herrera	22 April 2021

RYAN: Can you describe your role in Ecotech?

PAUL: I am the president and owner of the company, which I founded in 1990. So I'm the, you know, chief admin person but also still do a lot of technical work. We do environmental consulting work which relates primarily to wetlands and wildlife regulations. Essentially we help people to comply with those regulations.

RYAN: Mhm. And now, when you're doing a project, you're consulting for a client, how do you go about the monitoring of wildlife for something like that to monitor the ecological impact of something, infrastructure, that's going to impact a wetland?

PAUL: We don't, we don't do much actual wildlife monitoring. It's the regulations are focused more on habitat. So as someone described recently, the, you know, the land and the features of the land are what's protected and the assumption obviously is that if you protect the important habitat features then you're going to protect the ability of the critters to survive there.

RYAN: When you say you want to protect the features and everything like that, maybe you're doing like a hydrological study or are you doing surveys of the area that certain habitats take up in a certain space?

PAUL: Well, it's, a lot of our work centers on wetlands protection and wetlands are defined on the basis of, you know, they exist on the basis of hydrology. So then the classical definition of a wetland is where the root zone is saturated for a significant part of the growing season. The result of that, the manifestation of that, is that within a wetland you get an observable plant community

of species that are adapted to that hydrology. Now, we have different types of wetlands based upon just how wet it is. So kind of our, on the wettest end of the wetlands that we protect are water bodies, you know lakes and streams, those are regulated wetland resource areas. As you move towards the drier end of the spectrum, you get in a situation where you have shallow and potentially ephemeral ponding, where you get things like a cattail marsh. Again, a step up from that in terms of dry areas is you get areas that maybe are prolonged saturation with a little bit of flooding, that is typically a shrub swamp type community. So certain woody plants can grow there. Typically too wet for trees. Kind of the last category, the driest category of wetland is a wooded swamp. Most of the wetlands that we have in Massachusetts, in the Northeast really, are wooded swamps. So they are the type of areas that in the summer you can generally walk through a wooded swamp in your sneakers and not get your feet wet, but this time of year we're in the early part of the growing season, the ground is saturated right to the surface. So, so the hydrology is what creates a wetland and further creates what type of wetland exists. So when a project gets permitted one of the things that if a project reaches a certain scale then it has to comply with state storm water standards. And those standards relate to water quality, so treating the water that comes off of a proposed road or parking lot for example, treating it for water quality, but also quantity. And the quantity is really in two parts. One is, relates to controlling peak flows because if you take an area that's vegetative and you pave it, when you get a rainstorm the water's going to run off much more quickly, potentially cause a flooding problem downstream. The other thing that is required is that the infiltration of the runoff is maintained to predevelopment conditions and that's probably from, for you project that, I think, is really a critical component is that you want to make sure that as much of the precipitation that falls on the site or in the contributing watershed as much as that as possible you can capture and then

infiltrate because that's going to then maintain groundwater levels which often are important for wetlands in the vicinity.

RYAN: Yeah, yeah definitely. And now more on the topic of infiltration, are any of the wetlands that you consult for or work with, are they typically wetlands that are found on top of prior existing riverbeds, that there'd be some sort of layer clay there?

PAUL: Not usually around here. I mean we have, we don't have a lot of clay around here. We have, as you probably know this area was subjected to the glaciers not too long ago, so we have a lot of compact glacial till around here which is pretty dense, soil doesn't infiltrate a lot of water. So we frequently will see wetlands where the surface hydrology is--we use the term perched--is perched on top of that till. But again, not usually clay.

RYAN: Okay, I mean that's still relatively similar cause clay's still a restrictive layer.

PAUL: Right.

RYAN: And so, you know, because if you had like a wetland that was on top of or perched on top of some sort of restrictive layer, whether it's the compact to ground replay. It was losing water for you had a drought situation. How, how would you try to introduce more service features to that area or is it even really possible to do that in an active way?

PAUL: Well, I guess the first thing I would do is look at, you know, what is your contributing watershed. And you know what happens when, when rain falls on that watershed, does it, you know. Is it just running off, and, and, and, leaving the leaving the local, the local system. [...] If so, you know, can you can you capture it? Can you can you route, you know, can you route the existing storm water to created structures, where you can capture it and infiltrate it from either and above ground containment or some sort of subsurface infiltration system. That would be my

first. That would be my first approach is to, you know, is to define the contributing watershed and see what's happening there. You know Is it is it is it natural, you know, naturally vegetated Is it, is it hard scape, you know buildings and roads. If it is naturally vegetated is it steep, such that the water is not going to hang around. And, and I would look, I would look for ways to grab that precipitation and put it in the ground.

RYAN: Yeah, in, in on the topic of infiltration methods, and everything like that. What types of what types of methods you do you typically employ in the field, what are what are the most common ones like I've seen like kind of types of French Drains kind of used to get water, soil as quick as possible.

PAUL: Yeah, I mean the simplest, the simplest things that we see, if, if someone takes an undeveloped property. And, you know, wants to put it in a residential subdivision for example, so they're going to build a road and, and, and, you know, houses and driveways. So you're adding in impervious. That that situation would typically involve you know hard drainage catch basins and pipes in the street, which would then, which would then route that water by gravity to a constructed storm water basin, that storm water basin and, you know, is basically just an open. You know, an open air base and that will be one of two types, a retention basin is is a basin and that's designed to to totally capture all the runoff, up to a certain design storm. Ideally 100 year frequency storm. And, and, and then it would, and then it would infiltrate that water through would would necessitate fairly permeable soils. So that's a retention base and retains all the water. A detention base and detains or slows down the water. Similar typically excavated or, or, created by a berm, large open basin. But that will have a restricted outlet, such that the water coming in, can't, can't, can't leave at the same rate. So, you know, these are typically have a V notch weir or, you know, one or more, you know rounds outlet culvert pipes. But again in a big

storm, those pipes throttle back throttle back the water. Now, when, when one builds a detention basin.

[...]

PAUL: ... I don't know how much you got there; I was describing 2 types of stormwater basins: retention and detention. And the point I was going to make is even with a detention basin, which has a restricted outlet, then there's typically an area within the basin, the bottom part of the basin, that's below that lowest outlet elevation, which is then supposed to capture and infiltrate some amount of stormwater, even if not all of it. Again, that's an important component of all those designs.

RYAN: Now with like the detention basin would a type or the same kind of concept of that would be a rain garden?

PAUL: A rain garden is on the, you know, generally speaking a small scale, small scale version of that, the one difference is that the, the rain garden has typically a very structured profile on the bottom to provide you know filtering and growing medium for plants. But, but yeah rain garden is akin to that.

RYAN: And now you don't necessarily in like a detention basin try to employ any filtration techniques or anything like that you just let it in the open air sit out in and infiltrate the ground naturally right?

PAUL: Yeah I mean it's required there, they're required to have a separation above the seasonal high water table. So that, so that there is, you know, the water has to pass through at least two feet of soil before it contacts the before contacts the ground water. So, so the intent there is that there will be some, some filtering through the soil. You know before, before the water merges

with the underlying ground water. But it's not a, it's not it you know it's not it's not any sort of mechanical filter. It's just relying on the natural soil properties.

RYAN: I know, if you went ahead and constructed some sort of ditch or something like that that was, that was filled with gravel or something like that to try to catch the water, and directed specifically into certain areas of the ground or, or something like that.

PAUL: Yeah, I mean there's, you know, we still see you know what I described earlier was, you know, typical modern construction of, you know, catch basins the hard pipe to some sort of a base and we still see from time to time so called country drainage and country drainage is just kind of a catch all term, but typically involves, rather than putting curbing on the side of the road that directs water to a catch basin, country but drainage will not have curbing allows the water to just flow off the road in a, in a vegetative swale along the side of the road. That, that will then typically again direct the water to. To some, some centralized point or. Ideally, and people are moving more and more towards this to having a decentralized storm water so rather than, rather than collect all the storm water from the site, bring it to one big basin and treated there to to decentralize, you know, see how, essentially a lot of small systems such as rain gardens that are scattered throughout the site. Again, that depends you know takes depends on the scale of the project. It also requires that you have, you know that your typography allows you to do that because you know obviously you need the water flow downhill. And then you need the, you know, relatively flat area, relatively flat area to capture it, and whether they infiltrate. So, you know the ideal site for doing these things has just a little bit of grade just an up grade to make the water move, but not enough to make it move real fast and not enough to make it hard to capture.

RYAN: Yes, certainly. Yeah. That's something to look into. I do think there's a slight grade from the in the part where the dike comes down and meets the ground. I think there is a slight tilt inwards to towards the center of the park, but that would be definitely something to consider.

PAUL: Yeah, Yeah, I mean you want to really understand that and you know you have to you have to use you have to use the grade rather than fight it, because gravity always wins

RYAN: And now. Yeah. Now, do you do you specifically deal with vegetation issues in wetlands?.

PAUL: Well I mean we use, we use vegetation to identify wetlands, you said the boundaries based upon boundary of wetlands, which often the first thing we do on a project will identify the, you know what, what is the jurisdictional well and is based upon you know wetland plant community, and wetland hydrology indicators which is most often hydric soils, you know soils that show evidence of seasonal growing season saturation.

RYAN: Yeah, sorry I should have been a little more specific. Do you deal with invasive vegetation in wetlands.

PAUL: Oh yeah. Yeah, I mean we, you know, often as you know as a, as a permit condition for doing some work. You know, as part of as part of the mitigation. Part of a mitigation package. We might we might develop a plan to control we never say remove to help control invasives which typically involves. You know removal of invasive and planting of natives. Because if you just if you just take them out, and don't put anything in their place then you're just opening up. You know I have a niche for them to recall and eyes which they're obviously very good at.

RYAN: Have you specifically dealt with *Phragmites*?

PAUL: A little bit. Yep. Yeah *Phragmites* at your park?

RYAN: Yeah, yeah, yeah, it's not necessarily a problem because it creates habitat space but they get to a point where the crowd out habitat space. And that's the problem we're having. Do you have any methods that you use to thin out the reeds not necessarily go in there and full on move them but to do something like that?

PAUL: *Phragmites* is pretty tough. You know, really the only way to really you know to deal with *Phragmites* it is, you know, is to is to alter the hydrology such that it's not, you know, really favorable to it. You know in Massachusetts along the coastline. You know, a lot of our *Phragmites* is due to salt marshes not getting not getting enough salt water. But I'm assuming that's not your problem.

RYAN: Yeah.

PAUL: And then, and then, you know, once it gets a foothold it's hard I mean it's modest stands can be treated with, you know, a couple called cutting down technique we cut the stem. In the fall, you know you got the climate right, cut the stem in the fall and then dab the cut stem with herbicide, which, you know, as an alternative to broadcast spray, which still gets done by the way, you know, for, for large stands you know people go out with backpacks prayer with herbicide and, and, you know, knock it down. So, but it's *Phragmites* is tough it's very good at what does. You know, in terms of in terms of colonizing and taking over.

RYAN: Yeah, we were looking into some USDA studies where they went out and tried to least cut down on the *Phragmites* is germination by trying to shade them out with woody species and everything like that to try to over couple years of cutting them down. season after season and then trying to plant perennial species though, hopefully tried to cover the area with shade and had moderate success with that. They still have the *Phragmites* come in and everything like that

but it wasn't as overcrowded. So, I mean, like it. So, would. Is there any methods. Besides like excavation that you could recommend for dealing with *Phragmites* or is it just herbicides?

PAUL: I mean the ... you know it really amounts to... You know if you can't, if you can't change the hydrology I mean I've seen. I've, I've read of situations where you know the phragmites doesn't do well in, you know, prolonged standing water of any of any substantial depth. So, you know, one thing that people have looked at is trying to essentially flood it out.

So if there's a you know if there's a situation of, you know, you have kind of a mud flat that's gotten colonized by *Phragmites* if you can raise the raise the water level, long enough you'll make it inhospitable to the, to the *Phragmites*, but you know there's a lot of . . . there's a lot of issues that go along with that you need to have the ability to control it. And then you need to consider. You know what else you know what else you're affecting. And then the other part is you know you're taking when you do that, you're probably taking at least some finite area that was to dry for the *Phragmites*. And now, you're just pushing its habitat out further, you follow?.

RYAN: Yeah, yeah. that makes sense.

PAUL: You know, so, you know, if you have a really you know if you ever really, you know, kind of steep transition zone, and a substantial area at the same grade that, you know, maybe you can do that but, but, but any success that I've seen with *Phragmites* is really on the coast with introducing more salt water or inland using herbicides.

RYAN: Yeah, that that any sense, it's, it's a rough species. And, now yeah I think that actually handles all of our questions because we're nearing that 30 minute mark and everything like that so I don't want to use up too much your time. Do you have any questions, comments, or concerns or anything that you wanted to bring up they didn't bring up in the interview today?

PAUL: No I don't think so I'd be interested. I'd be interested in, in, in having you let me know what you, what you come up with and, and, you know, so please do. Please do copy me on your final, final, final project, which I guess will probably would be a written report I assume Correct?

RYAN: Yes that that will be yes and it'll be sometime early to mid May. So, yeah, we'll contact you a little bit before then, and touch base on everything like that. Yeah, I think, I think with this project and everything like that most most of our solutions are probably going to be from a hydrological standpoint trying to mess around with that restrictive clay layer and get below it and tried to make wells, or something like that, that to reduce water because it's very difficult the position of the park within the city.

PAUL: Yeah -- one thing that you know because it is an urban environment obviously I don't know what it looks like. But one thing that you might want to consider is can you for example capture you know other substantial buildings nearby, where you can capture roof run off. And, you know, with fairly simple fairly simple. You know management of that roof runoff, get it, directed to your park and you know infiltrate it, you know, for example, create a, an infiltration swale around the, you know, around the upper edge so that you, you know, grab this roof front off that's probably just, you know, in a city is probably just getting into some.--