Biodiversity in Aarhus

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Abstract:

The purpose of our project is to find a way to use the extra amount of rainwater, which periodically hits the urban areas as a result of global climate change, in a positive way. We are examining how the collection of rainwater can contribute to increasing small scale biodiversity. We are doing this by planning, constructing and studying a new pond at Langkaer Gymnasium STX/HF/IB World School. One part of the project is focus on the construction of the pond in order to obtain a standardized system for future studies of a variety of biologically interesting parameters including nutrient loading, oxygen and carbon dioxide content, water quality all of these as contributors to biodiversity. Another part of the project will include the initial measurements of these parameters during spring 2016. A third and essential part of the project covers the dissemination of the project and its research activities.

Introduction:

Water in the city is often considered a problem that needs to be solved, especially when the summer's cloudbursts create major flooding. The urban areas face significant challenges regarding rain and runoff because the sewage system does not have the capacity for clearing the large amount of water resulting from the torrential rain periods. At the same time water is a very important condition for life, and for many animals and plants in the city, during dry periods. That is why water basins and village ponds, that can retain the rainwater, are important initiatives when you want to create better living conditions in the city, partly because it gives the city an opportunity to have a broad collection of animal and plant species that normally would not be able to live here, and partly as recreational areas for people [Pers. Comm. Lars Brøndum, biologist at The Natural History Museum, Aarhus].

Biodiversity is an important parameter in the description of the quality of a biotope and an important basis for understanding the world around us. It is not easy to get a simple measure of biodiversity since it depends on the species diversity, genetic diversity and ecosystem variation each interacting with each other and contributing to the overall measurement. But if we try to split it up into its components we can begin to get a glimpse of is value [1]. The species diversity and the parameters contribution to this diversity will be the focus of this study.

Keywords:

Biodiversity, climate change, rainwater, pond, sustainable

Purpose:

The purpose of our project is to find a way to use the extra amount of rainwater, which periodically hits the urban areas as a result of global climate change, in a positive way. We would like to examine how the collection of rainwater can contribute to increasing small scale biodiversity. We will do this by planning, constructing and studying a new pond at Langkaer Gymnasium STX/HF/IB World School. One part of the project will focus on the construction of the pond in order to obtain a standardized system for future studies of a variety of biologically interesting parameters including nutrient loading, oxygen and carbon dioxide content, water quality and their contribution to the biodiversity of the pond. Another part of the project will include the initial measurements of these parameters during spring 2016. A third and essential part of the project covers the dissemination of the project and its research activities. We wish to make the pond a place for future students to come take samples and tests that can be used in class projects and as a as an integral part of the curriculum in biology classes.

We are also creating this pond as part of a large-scale project in Aarhus named Wild Aarhus. More of these ponds are being created in the area, and ours will be a leading example of how these ponds could be used.

Methods of the investigation:

In this project we will focus on the actual construction of the pond and developing a healthy biodiversity for our pond. We will regularly gather samples of animals living there and measure different parameters the quality of the water by looking at different specific parameters. We will investigate the flora and fauna found in the pond and compare the amount of species to the amount of individuals in the pond we will hereby be able to determine a crude measure of the biodiversity of the ecosystem.

We will measure the primary production, the amount of nitrate and phosphate in the water, as this affects the plants and animal species capability of living there.

Biodiversity by number of species:

Materials:

- Ketcher (fishing net)
- Glass (storage of the found species)
- Ethanol (to preserve the species)
- Tweezers
- Storage box

Biodiversity can be expressed as the relationship between the amount of species and the amount of individuals in the ecosystem.

$$Diversity = \frac{amount\ of\ species}{amount\ of\ individuals}$$

This formula makes it possible to calculate the biodiversity-index, so that we can compare two biotopes of the same type.

We collected different species by grubbing the bottom of a limited area of the lake. Afterwards we put the different species in the glasses that was filled with ethanol, so we could preserve the species for analysis later [2].

Primary production:

Materials:

- Lake-water
- Two 500 ml bottles (bluecap)
- Oxygen flowmeter
- Aluminium foil

It is important to know the level of primary production because it is the food basis for the rest of the ecosystem. The two bottles are filled with water from the pond, and the initial oxygen level is measured (S = starting level). One bottle (L = light bottle) is left in a bright place for a suitable amount of time (t). Typically for 4-5 hours or one day. The other bottle is wrapped in aluminium foil (D = dark bottle) and left for the same amount of time as L. The amount of oxygen in the two bottles can then be used to calculate the primary production (NPP = net primary production, GPP = gross primary production) and the respiration (R):

NPP = L – S

R = S – D

GPP = (L – S) + (S – D) = L – D [3]

Other relevant measurements:

The amount of different plant species in connection to the pond and its nearby surroundings is relevant to measure as well.

The content of nitrate, phosphate and pH measured in the pond water.

Results:

Constructing the Pond:

In order to be able to use the pond for successful and trust-worthy studies, we need to consider where and how to place the water and its surroundings.

Figur 1: The area where the pond is to be constructed.

We found a place near our school with a good location – it is at the bottom of a small hill, so the rain water landing on the top of this hill will be drained down into the pond – see fig. 1.

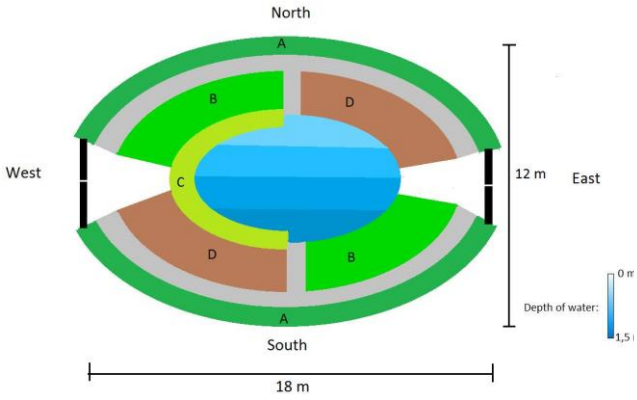

Figure 2: Sketch of the pond which will be established may 2016. A: Hedge. B: Greenery. C: A small hill to create some elevation and thereby cast shadow. D: Deserted area.
The pool will have a depth ranging from 0.3 meters to roughly 1.5 meters, sloping downwards from north to south.

The thoughts that went into shaping the pond in this specific way was concentrated about splitting the place into different areas, as you can see in the sketch above – fig. 2. We wanted half of the ground area covered in different naturally occurring plants species spread out as seed mixtures (B), and half of them to be open areas (D). Placing the plants in this specific way allows us to follow the developments of the plants and species living within these. It should also allow us to tell them apart, as the amount of sunlight they are going to receive should differ, because the area towards the northern hedge is facing south and will be getting more sun than the areas at the southern hedge.
The plants placed on the small hill (C) should follow a similar development, as some of them will be on the northern facing side and get covered in the shadows cast from the hill [Pers. Comm. Lars Brøndum, biologist at The Natural History Museum, Aarhus]..

Reference pond:

Our school is placed on the top of a hill. This means that the rainwater runs down towards the lower areas of our city. What we want to do is to capture the rainwater and use it to fill up the village pond. By doing this we are using the extra rainwater in a positive way and in the meantime increasing the biodiversity. Before we establish our village pond, we need to look at our prospects. We need to have an idea of what we are expecting to discover of species and biotopes in our own village pond. Therefore, we went to visit a large village pond in the area near our school. We chose this lake in the belief in that a lot of the species will migrate from this pond to our village pond [Pers. Comm. Lars Brøndum, biologist at The Natural History Museum, Aarhus].

Figure 3: The pond used as a reference near Hasle Bakker

We made a few tests studies to analyse the amount of different spcies in the area around the lake and to compare the results with the upcoming results from our village pond. The species list is presented below:

Species found in the nearby lake:

- Dragonfly nymphs *(Anisoptera sp.)*
- Pond snails *(Lymnaea stagnalis)*
- Waterlouses (*Asellus Aquatics)*
- Fresh water gammarus *(Gammarus Pulex)*
- May fly nymphs *(Ephemeroptera sp.)*
- Water beetles *(Coleoptera sp.)*
- Black fly grubs *(Simuliidae sp.)*
- Turbellarians *(Turbellaria)*

Conclusion:

At present our project only at the initial stage but we hope that our project will contribute in a positive way toward using the extra amount of rainwater that periodically hits our local area to increase small scale biodiversity and generating recreational areas for the students. We hope that a standardised study area and measurement methods will provide us with a time series of the different parameters that will make the pond a perfect area for geography and biology class projects and as an integral part of the curriculum in biology classes at years to come.

Acknowledgements:

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References:

[1] Frykman, K. and Vire, A.M. (2015). Undersøg Naturen Elevens Bog. Nucleus. pp. 20.

[2] Frykman, K. and Vire, A.M. (2015). Undersøg Naturen Elevens Bog. Nucleus. pp. 26, 41-44.

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