Developing metrics and instruments to evaluate citizen science impacts on the environment and society

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Abstract (for dissemination)	Deliverable 4.3 introduces the MICS citizen science case study at Creek Rákos, Hungary. The deliverable outlines the potential nature-based solutions which could be implemented at the creek and the co-design process used to develop the citizen-science activities. The citizen-science activities that have taken place so far are described, with an outlook on their continuation and the ongoing impact of COVID-19 on these activities.			
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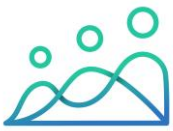
Contents



Executive Summary

The MICS project is developing metrics and tools to measure the impacts of citizen science which are validated in hands-on citizen-science activities in four case study sites in Europe. Deliverable 4.3 provides a description of the site and set up of citizen-science activities in the Hungarian case study where the MICS impact assessment framework will be applied. The MICS Hungarian case study explores the set-up and impact of hands-on citizen-science activities along Creek Rákos. Creek Rákos is a heavily modified stream in District 17 of Budapest. The potential restoration of the Creek has been discussed repeatedly, but has never progressed further than some initial concept diagrams. The ambition of the citizen-science activities in this case study, is to identify sites for river restoration and raise awareness of the ecology of the creek.

Four co-design workshops were held with various stakeholders interested in the Creek. From these workshops different environmental aspects were prioritised for monitoring:

1. Mapping of typical indicators species along the Creek Rákos, including: Bats, (Praying) mantis and grasshoppers (specifically, Acrida ungarica), Amphibians, Black woodpecker;
2. Habitat mapping and naturalness measurements;
3. Water quality monitoring for physical, chemical and biological factors.

Citizen-science activities were formulated within the co-design workshop groups with the assistance of expert advisors. All of the citizen-science activities started with an introduction and training for the methodology the citizen scientists will use.

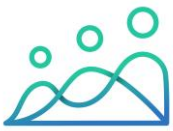
The first group of citizen science-activities explore indicator species that tell us about the status of the ecosystem in the riparian zone (the land alongside the river banks). Habitat mapping and naturalness assessment is the second citizen-science activity that provides a comprehensive overview and understanding of the riparian areas of the creek that are subject to potential restoration. Finally, the third group of citizen-science activities will involve water quality measurements. Water quality is a key ignition point for the implementation of the nature-based solutions in the creek, because this is the major objective of the Water Framework Directive (WFD). Citizen scientists will regularly monitor several physical, chemical and biological parameters. The measurements are taken in conjunction with official measurements and provide a broader understanding of water quality in the creek.

1 Introduction

1.1 Background on MICS

The MICS project develops approaches and tools to assess citizen science impacts. These approaches and tools can help to plan and implement projects in ways that lead to more robust results. The MICS project specifically aims to:

- provide comprehensive, participatory and inclusive metrics and instruments to evaluate citizen science impacts;
- implement an impact-assessment knowledge-base through toolboxes for methods application, information visualisation, and delivery to decision makers, citizens and researchers;



- improve the effectiveness of nature-based solutions through test-site development and citizen-science tool validation;
- generate new approaches that strengthen the role of citizen science in supporting research and development;
- foster a citizen-science approach to increase the extent to which scientific evidence is taken up by policy makers through recommendations and guidelines.

The result is an integrated platform where these metrics and instruments are available for use by anyone involved in a citizen-science project wanting to understand its impact, whether at the planning stage or several years after the project's conclusion. This platform is validated by pilot testing in test and validation sites across Europe. The test and validation sites are in the UK, Italy, Hungary and Romania. These sites explore the applicability of MICS impact-assessment tools in regions with differing needs, contexts, and approaches to nature-based solutions, and with various levels of citizen-science application. For example, in Western Europe, river restoration is increasingly carried out within an ecosystem-based management framework at river or catchment scale; in Southern Europe, river restoration tends to be issue-specific with some ecosystem relevance; in Central and Eastern Europe, river restoration is about ecosystem protection and related to existing infrastructure.

1.2 Purpose

The MICS project is tasked with setting up and implementing an Impact Assessment framework, tools and metrics for citizen-science projects that serves to capture impacts in five distinct domains: society, science, environment, economy and governance. This report is a deliverable of Work Package 4 (WP4) – 'Test-site development and tool validation' which will develop and organise the pilot testing of the MICS Impact Assessment framework and tools in the test and validation sites in the UK, Hungary, Romania and Italy. The purpose of Deliverable 4.3 is to provide a description of the Hungarian case study and the set-up of citizen-science activities in which the MICS impact assessment will be tested on and reported on in the comprehensive evaluation report (D 4.5) in 2021.

1.3 Structure of the report

This deliverable reports on the set up and co-design of citizen science activities following the Ground Truth 2.0 light methodology in the Creek Rákos MICS case study in Hungary. Section 2 describes the case study including location and the nature-based solution. Section 3 describes the set up and outcomes of the co-design workshops and the citizen-science activities that have taken place so far. Section 4 provides an outlook on the upcoming activities planned.

2 Creek Rákos Citizen Science project

2.1 Introduction

The Hungarian case study is called: 'Rákos-patak civil tudomány projekt' or 'Creek Rákos Citizen Science project'. Creek Rákos is the largest tributary of the Danube near Budapest and it has been heavily regulated and modified over the last 50 years. The ultimate goal of the local citizen-science projects is to facilitate the ecological restoration of the creek. The case study lead team comprises of the MICS project partners (GeoEcoMar, IHE Delft, RRC, Earthwatch) who prepared the local co-design actions and the local community and scientific partners (GREEN XVII Association and the Hungarian Biodiversity Research Society), who carry out the co-design process and citizen-science activities.

2.2 Location of site

The location of the Hungarian case study site is in the middle section of the Creek Rákos watershed in Budapest (District) 17, where the watercourse enters the area of the Hungarian capital city. The creek is heavily modified in Budapest; with the river flowing through an artificial U-shaped concrete river bed. This was created to increase floodwater retention capacity due to a large flood in the early 70s, which washed away old bridges along this section. Today, urban pressure on building on the watershed, close to natural areas along the creek and the increasing importance of recreational functions characterizes the area.

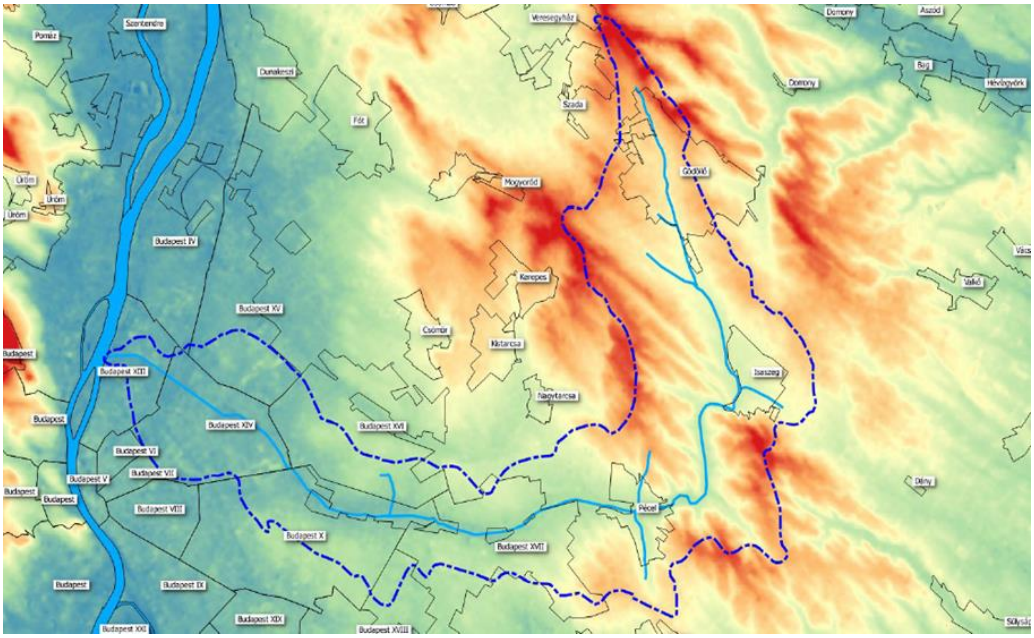


Figure 1 - Overview of the relief and the watershed of Creek Rákos (Source: Budapest Municipality)

Figure 2 - Satellite view of the section of Creek Rákos in Budapest District 17, where the project takes place (Source: Google Maps)

2.3 Nature based solution summary

The idea of restoration or 'revitalization' of Creek Rákos began in the early 90s, however, only draft template plans were produced. The topic of restoration of the creek is discussed every 5-10 years, however, it is always considered as a low priority project when it comes to resource allocation by decision makers.

Changing lifestyles have highlighted the need for a green corridor through District 17 along the creek to enable recreation. Decision-makers consider recreation as a major point and driver for change. Indeed, a master plan for Creek Rákos revitalization on the Budapest Municipality highlights the recreation benefits by building a cycle path, whilst trying to shed light on the ecological aspect too. Nevertheless, the focus is on recreation.

The facilitation of the long-term ecological restoration of Creek Rákos is the ultimate goal of this MICS case study, and gathering of information about the restoration sites along District 17, that still has a wide close-to-natural riparian zone, but limited river-riparian zone connectivity. The restoration concept includes the recreational activities in such a way that it does not harm the exploitation of the natural ecological potential of the Creek.

With the help of the expert advisors in the co-design process a detailed recommendation for ecological restoration was published, that is open to public discussion (http://zoldxvii.hu/eljen-a-rakos-patak/).

The goal of the citizen-science project is to gain supporters for restoration by involving them in the collection of information about the potential restoration sites, and strengthening their connection to the Creek. The citizen-science projects will create baseline data that can be used to support a more detailed restoration concept at a later stage.

It is important to make the local stakeholders understand the point of ecological restoration. Hand in hand with the citizen-science activities, awareness raising of the key players in the restoration occurs, focusing their attention on the potential benefits that nature-based solutions have. The communication of the case activities is primarily through a website (http://zoldxvii.hu/rakos-patak-civil-tudomany-projekt/) and the Facebook site of the local NGO carrying out the activities: https://www.facebook.com/zoldxvii.

Figure 3 - Creek Rákos with relatively wide unbuilt valley surrounded by mostly low- and high-density residential areas in the outskirt of Budapest (Source: ittlakunk.hu)

The regulated Creek was just able to carry away the flash flood of 2016 June (Source: ittlakunk.hu)

Pedestrian and cycle road along the central part of District 17 along the Creek Rákos (Source: Péter Horváth)

The regulated Creek Rákos in the outside the residential areas near the border of Budapest (Source: Balázs Kozák)

Riparian vegetation at Creek Rákos close to the Budapest border.

Figure 4 – Photographs of Creek Rákos

2.4 Impact of COVID-19 on Citizen Science Activities

The COVID-19 pandemic has disrupted citizen-science activities at Creek Rákos. The first wave of the pandemic hit Hungary when the Creek Rákos citizen science project was in the co-design phase, when the actual citizen science monitoring activities were being formulated. The process was paused in the spring of 2020. After some restrictions were lifted during the summer, the co-design activity was continued with open-air events, and speeded up in order to produce tangible results and to start monitoring activities in 2020 before the second wave of the pandemic was foreseen.

In the engagement process, personal meetings and discussions are vital, but restrictions due to the pandemic restricted face-to-face meetings and people became overwhelmed with online activities. The citizen scientists and the organizing team had to adapt to the new circumstances, and the project had to compete with dozens of other activities that went online from offline and took the attention of our target group. The changing circumstances made the organizers cautious, and they waited for the right time to engage participants and brought people together offline, whenever possible.

Finally, the citizen-science activities started at the end of summer 2020, however, the new gradually introduced restrictions did not let us progress as we had hoped.

3 Co-design of Citizen Science Activities

In the case study we follow the Ground Truth 2.0 co-design methodology light (MICS deliverable D4.6, based on Wehn and Pfeiffer, 2020) to guide the development and set up of citizen-science activities. This section will describe the set-up of these activities.

3.1 Ambition of Citizen Science Activities for NBS

The ambition of the citizen science activities in Creek Rákos are to:

1. Gather information about potential restoration sites

   Restoration activities at Creek Rákos have been discussed for a long time. Beyond some initial plans, there has been no baseline environmental measurements taken in the area. The focus of citizen science activities is to develop the baseline.

2. Raise awareness of current condition of Creek Rákos and revitalization amongst key stakeholders

   Involving key stakeholders in the revitalization is one of the added values of the project. This will make them not only aware of the current condition, but also focus their attention on the potential creek restoration and the benefits that nature -based solutions can have on society.

The following stakeholders were identified for this case study:

- *Citizens:* engaged individuals for the Creek Restoration or the citizen science activities (based on existing relationship from previous activities or newcomers)
- *Scientists:* Local inhabitants, professionals dealing with some subtopics which are covered by the project.
- *Public sector:* legislative (policy makers): city hall departments of Budapest 17 / Municipality of Budapest, municipal environmental counsellor of Budapest 17
- *Public sector:* actors - executive (local authorities; RBO; implementing agencies): Municipality of Budapest 17, Municipality of Budapest, Budapest Sewage Works Plc., Budapest Capital City Planning Ltd.
- *Industry/Private sector:* Chamber of Commerce Trade and Industry - local group representative, larger firms with site in the District 17
- *Educational institutions:* East-Pest School District, individual high schools and elementary schools

3.2 Co-design workshops

Four co-design workshops were held with various stakeholders interested in citizen science and restoration of Creek Rákos (Table 1). The co-design workshops investigated the challenge associated with the NBS and citizen-science activities.

Table1 - summary of co-design workshops held in the Creek Rákos Case Study

Date of workshop	Location	Number of attendees and stakeholder type	Title of event
15/01/20	BP17, Vigyázó Sándor Culture House (Pesti út 113., 1173 Budapest, Hungary)	36 attendees: 2 organizers 3 expert advisors 1 Industry/private sector 13 Public sector - legislative 12 Public sector – executive 5 Educational institutions	1st Creek Rákos co-design workshop (Group A: public sector)
01/02/20	BP17, Hall of Baptist Community (1173 Bp. Pesti út 165. I. floor)	20 attendees: 3 organizers 2 expert advisor 8 Citizens 2 Educational institution 5 NGO representatives	1st Creek Rákos co-design workshop (Group B: civil society)
03/03/20	BP17, City Hall (1173 Budapest, Pesti út 165.)	21 attendees 3 organizers 3 expert advisors 1 Public sector – legislative 1 Public sector – executive 2 Educational institutions 4 Citizens 6 NGO representatives 1 Industry/private sector	2nd Creek Rákos co-design session (both groups)
07/07/20	BP17, Maros Cinema (Maros Mozi) 1172 Budapest, IX. U. 2.	20 attendees 2 organizers 4 expert advisors 1 Public sector – legislative 1 Public sector – executive 3 Educational institutions 5 Citizens 4 NGO representatives	3rd Creek Rákos co-design session (both groups)

3.2.1 Co-design workshop 1 (Group A and Group B)

3.2.1.1 1st Creek Rákos co-design workshop (Group A)[1]

The objective of the event was to introduce the MICS project, raise awareness on the Creek restoration, map the inner engagement/expectation, preparing the ground for citizen participation in the scientific method and engage the relevant stakeholders.

Date: 15/01/2020

Location: Vigyázó Sándor Cultural House (Pesti út 113., 1173 Budapest, Hungary)

Participants: 36 people, mostly from the public sector: local authorities, policy-makers, decision-makers, private sector, and education.

[1] http://zoldxvii.hu/elindult-a-rakos-patak-civil-tudomany-projekt/

Methods used: Participatory workshop methods, instant feedback and conclusion drawing, loops of emotional and rational engagement and ambitions.

Quotes from participants in the workshop:

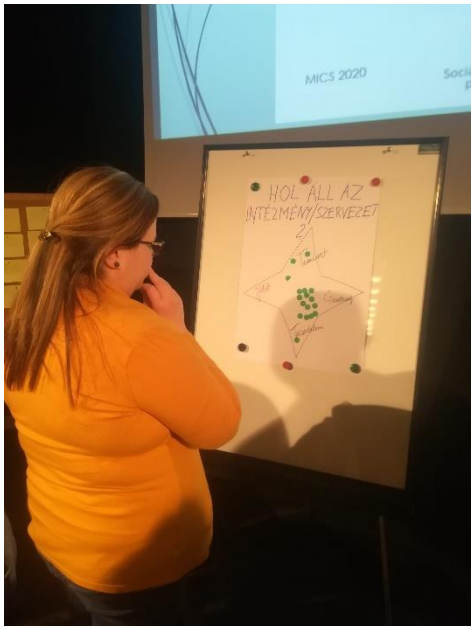
"In 1995 I would have never thought, that 25 years later, we are still at the same place/situation"

"Creek Rákos has an untapped potential and let's look rather at that, than a problem"


First workshop, scene prepared for welcoming the members of the institutions (Photo: Balázs Kozák, Péter Rózsahegyi)

The audience and active participants of the first co-design workshop (Photo: Balázs Kozák)


Workshop activities about what hindering factors and possibilities exist for the Creek Restoration (Photo: Balázs Kozák)



Where would you put your organization in terms of sustainability? (Photo: Balázs Kozák)

Figure 5 – Photographs from the first Co-design workshop with Group A.

3.2.1.2 1st Creek Rákos co-design workshop (Group B)[2]

The objective of the event was to introduce the MICS project, raise awareness on the Creek restoration, map the inner engagement/expectation, preparing the ground for citizen participation in the scientific method and engage the relevant stakeholders.

Date: 01/02/2020

Location: 1173 Bp. Pesti út 165. I. floor (Hall of Baptist Community)

Participants: 20 people, mostly from the local civil sector and from education institutions (participants were different to workshop A).

Methods used: Participatory workshop methods, instant feedback and conclusion drawing, loops of emotional and rational engagement and ambitions.

Quotes from participants in the workshop:

"I have never been at an event like this, where I can hear the opinions of the people effected by my work" – retired engineer, who designed the Rákos-creek correction.

"Having the opportunity to take students to the water for teaching sessions" is an essential part of my life as an educator" – local teacher and higher positioned school administrator.

[2] http://zoldxvii.hu/elindult-a-rakos-patak-civil-tudomany-projekt/

"I would like more publicity for this project" - local high school pupil.

Participants (citizens, NGOs, educational institutions) of the first co-design workshop (Photo: Balázs Kozák)

Images from the past, present, and the participants had to describe how they imagine the future of the Creek Rákos (Photo: Balázs Kozák)

To what extent do factors count to you in terms of sustainability? (Photo: Balázs Kozák)

Fruitful group discussion during the co-design meeting (Photo: Balázs Kozák)

Figure 6 - Photographs from the co-design workshop with Group B.

3.2.2 Co-design workshop 2 (joint)

The 2nd co-design workshop session took place and invited both Group A and Group B members. It was a compromise to find a suitable time, as the public workers do not easily stay longer than working hours, whereas citizens can only participate during off-working hours.

The objective of the event was to formulate a citizen-science project from previous ideas and discussions, and learn what projects and themes the participants prefer.

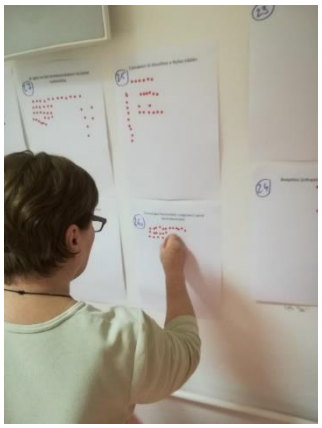
Date: 03/03/2020

Location: 1173 Budapest, Pesti út 165, City Hall

Participants: 21 attendees, mostly from the local civil sector and citizens.

Methods, tools used: Video, Participation based decision making processes, Role play for better understanding of other views, dotmocracy: prioritization, Open-brainstorming on the topics, Group feedback

The workshop began with a video about the Creek Rákos in the city hall's council room (Photo: Balázs Kozák)



Interactions between the themes and citizen scientists (Photo: Balázs Kozák)

Figure 7 – Photographs from the Joint Co-design workshop

Silent-brainstorming, how to continue with the shortlisted project ideas (Photo: Balázs Kozák)

Dotmocracy – vote for the best ideas to formulate citizen science project (Photo: Balázs Kozák)

The most engaged participants stayed long and discussed about the restoration of Creek Rákos at the end of the 2nd (joint) co-design workshop (Photo: Balázs Kozák)

Figure 7 – continued.

3.2.3 Co-design workshop 3

The 3rd co-design workshop was planned to take place at the end of March. However, the first wave of COVID-19 hit Hungary and all public events were cancelled, so the event was postponed. We were more cautious with the new event regarding the COVID-19 restrictions; therefore, it was an open-air event. The objective of the event was to co-design the final citizen science projects that have been narrowed down by the expert advisor group and inform participants about the upcoming steps and engage them to get involved in the activities.

Date: 07/07/2020

Location: 1172 Budapest, IX. U. 2., Maros Cinema

Participants: 25 participants, mostly from the civil sector, citizens and from educational institutions.

Methods, tools used: Workshop method, Project method (learning by doing, constructive strategy design, story/script-telling/writing)

Quote from participant in the workshop:

"I was working in one group, but I am interested in almost all activities! It is a pity we did these activities parallel."

Discussing the separate CS project ideas in groups (Photo: Balázs Kozák)

Drafting ideas, scenarios for each CS project (Photo: Balázs Kozák)

Concluding the findings of the workshop (Photo: Balázs Kozák)

Figure 8 – Photographs from Co-design Workshop 3

3.3 Citizen Science Activities

The co-design process was disjointed in 2020 due to the COVID-19 pandemic but still identified three types of activities. The citizen science monitoring and training activities started at the end of summer 2020 (Table 2). Citizen science activities were identified during the co-design workshops were:

1. Mapping of indicators species along the Creek Rákos: finding typical indicator species: (1) Bats, (2) (Praying) mantis and grasshoppers (specifically, Acrida ungarica), (3) Amphibians, (4) Black woodpecker;
2. Habitat mapping and naturalness measurement
3. Water quality monitoring for physical, chemical and biological factors were decided

Unfortunately, citizen-science activities had to stop at the end of 2020 due to the second wave of COVID-19. Citizen-science activities are foreseen to continue early spring or when the restrictions on open-air organized group activities will be lifted.

Table 2 - Citizen Science activities for bat, amphibian, black woodpecker, habitat mapping and water quality monitoring along Creek Rákos.

Number	Date	Activity	Venue
1	06/08/2020	Bat monitoring	Vegyi-tó at Creek Rákos, BP 17
2	04/09/2020	Amphibian monitoring	Along one section of the Creek Rákos, BP 17
3	19/09/2020	Black woodpecker observation	Along one section of the Creek Rákos, BP 17
4	27/09/2020	Praying mantis monitoring	Nyilas-meadow at Creek Rákos, BP 17
5	04/10/2020	Habitat mapping, naturalness assessment	Nyilas-meadow + one riparian area near Creek Rákos, BP 17
6	22/10/2020	Water quality physical & chemical monitoring	Creek Rákos, BP 17
7	23/10/2020	Water quality biological monitoring	Creek Rákos, BP 17

3.3.1 Citizen Science activity 1 – Mapping of indicators species along the Creek Rákos

3.3.1.1 Bat monitoring[3][4]

Date: 06/08/2020
Location: At Creek Rákos (BP17) at 'Vegyi-tó', artificial pond

The objective of the event was to monitor which species of bats live in the selected area along the creek and to show volunteers a citizen science activity they can be involved with in the future. The local organizers the Hungarian Biodiversity Research Society and the ZÖLD XVII Association recruited local people of all age. Approximately 15 people participated in the event next to an artificial pond, next to Creek Rákos. It was an ideal venue with a wide water surface area to set up the bat catching net and the nearby surrounding riparian zone with reed and open areas was also ideal for bat observation around sunset.

The event started before sunset, participants learnt about the bats in general, and participated in bat counting around sunset. Afterwards, the results were collected, there was a discussion about bats (e.g. ringing, why they are useful for humans) and the bat catching net was set up. A bat detector was used to monitor the appearance of the bats. One bat was caught in the net and described to the audience.

Figure 9 - Venue of the bat monitoring - artificial lake at Creek Rákos (Photo: Balázs Kozák)

[3] http://zoldxvii.hu/rakos-patak-civil-tudomany-projekt-denever-felmeres/
[4] https://www.facebook.com/permalink.php?story_fbid=2819481321607056&id=1667764593445407

Introduction of the event (Photo: Balázs Kozák)

Learning the task before going out at sunset for bat spotting (Photo: Balázs Kozák)

Setting up the bat catching net next to the open water-surface (Photo: Balázs Kozák)

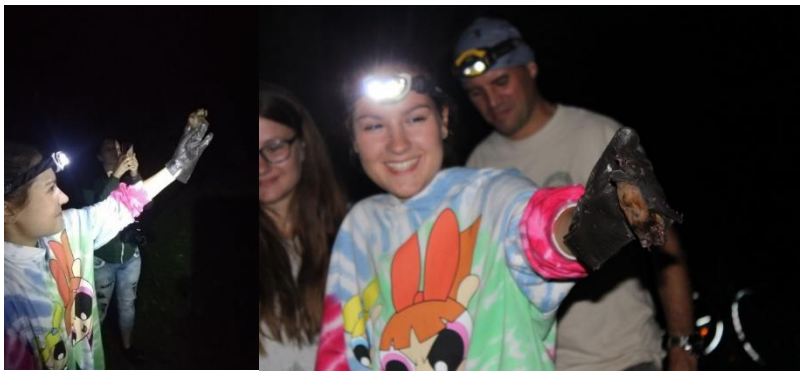
Assessment of the bat spotting's after sunset (Photo: Balázs Kozák)

Introduction of the bat species in Hungary (Photo: Balázs Kozák)

Introduction to bat ringing (Photo: Balázs Kozák)

The bat catch under investigation (Photo: Balázs Kozák)

The bat catch under investigation (Photo: Balázs Kozák)



A young volunteer releases the bat (Photo: Balázs Kozák)

Figure 10 - Photographs from the bat monitoring workshop

3.3.1.2 Amphibian monitoring

Date: 04/09/2020

Location: Creek Rákos, BP 17

The aim of the event was to identify the most typical frog species and count their presence along the bank of the canalized Creek Rákos. A herpetologist expert also joined us in the field, and lizards were counted on a riparian meadow.

One high-school was targeted to attend the event, with 5 volunteers, 2 teachers and 3 students participating. The herpetologist expert, introduced the goal of the event and the monitoring method, as well as transect visual observation. After having introduced the importance of amphibians, and the typical frog species that live along this section of the creek, the volunteers took part in a simple activity: walk along the riverbank and count the number of jumping frogs into the water on both sides of the creek. This way, data was gathered about the number of the frog population along the designated section of the creek that has been determined by GPS device. The volunteers covered about 700m along the creek on both directions from the bridge at Szabadság sugárút. The citizen scientists found 13 frogs along this section. In addition, after finishing the citizen scientist event, the volunteers screened through a section of a field for lizards. However, they could not spot any in the habitat types investigated.

The citizen scientist group learning the method to be used (Photo: Éva Bogát)

Figure 11 - Looking for lizards in the riparian zone (Photo: Éva Bogát)

3.3.1.3 Black woodpecker observation[5][6]

Date: 19/09/2020
Location: Creek Rákos, BP 17

The aim of the event was to locate black woodpeckers along one riparian zone of the Creek Rákos from Rákoscsaba train stop to the city border. This location was selected deliberately being a close-to natural wetland remnant with reeds and old trees, also the area is part of the revitalization focus. Multiplicators (teachers, prominent people from NGOs) were deliberately invited to learn and pass on to other local communities the knowledge of the event, eight stakeholders were present at the event.

[5] http://zoldxvii.hu/rakos-patak-civil-tudomany-projekt-fekete-harkaly-beszamolo/
[6] https://www.facebook.com/permalink.php?story_fbid=2848335665388288&id=1667764593445407

At the beginning of the event, the black woodpecker was introduced to the volunteers and they learnt how to identify them by sound, how to track and record data observations on a smartphone application. During the 2-3 hours of the event, the volunteers had to use sounds of the woodpecker to attract the bird, and one was found. The place for the spotting was tracked by GPS coordinates and if the bird is nesting in its location it will be monitored later on.

Introduction of the woodpecker species in Hungary, esp. the black woodpecker (Photo: Ágnes Balázs)

Spotting typical leftover trees as ideal habitat (Photo: Ágnes Balázs)

Looking for the black woodpecker (Photo: Ágnes Balázs)

Figure 12 – Photographs from the black woodpecker observations

Happy team after the event (Photo: Ágnes Balázs)

Figure 12 – continued.

3.3.1.4 (Praying) mantis & Acrida ungarica monitoring

Date: 27/09/2020
Location: Nyilas-meadow at Creek Rákos, BP 17

Before the citizen science event, an expert field survey identified that the southern bank of the creek and the meadow called Nyilas-tábla (or in English: Nyilas-meadow) would be appropriate for the activity.

Originally one indicator species, the praying mantis was the subject of monitoring, but local citizens called attention to the existence of the endemic species, Acrida ungarica that is typical for the creek valley.

Approximately 20 volunteers joined the event from elementary school to pensioners. The expert introduced the 2 protected species then, did a primary search with the participants. The expert showed the species, then introduced monitoring techniques: walking along the field in a chain and recording observations (photos, noting down on paper) of the two species of interest, as well as other species of insect. The species would be recognized by an entomologist later on. The volunteers learnt the quadrant method, to encircle few relatively representative 10x10m field sections with thin rope in which research could go on, and then make extrapolation of the results to the field scale.

The gathering team at the venue of the monitoring (Photo: Balázs Kozák)

Looking for the species as a first screening (Photo: Balázs Kozák)

Looking for the species as a first screening (Photo: Balázs Kozák)

Praying mantis found, taken, then released (Photo: Balázs Kozák)

Cone-headed grasshopper (mantis) found, taken, then released (Photo: Balázs Kozák)

Designating the monitoring quadrant and monitoring (Photo: Balázs Kozák)

Figure 13 – Photographs from the (Praying) mantis & Acrida ungarica monitoring

3.3.2 Citizen Science activity 2 - Habitat mapping, naturalness assessment[7]

Date: 04/10/2020
Location: Nyilas-meadow + one riparian area near Creek Rákos, BP 17

The objective of this citizen-science activity is to assess the naturalness of the riparian areas and to show people potential locations for restoration. This required training citizen scientists: what is habitat mapping, why is it important to have these surveys; what kind of literature could they use before going on the field (old maps, satellite images etc.). Citizens also learnt the basic of the habitat type categorization system which is used in Hungary.

A naturalness assessment form was used with the citizen science. This form was prepared for laymen to be involved. The naturalness assessment form was completed at two locations with the citizen scientists. First together on the Nyilas meadow going from point to point to interpret the activity and learn more about the background. Such as, there is no need to identify 30-50 plant species, but to differentiate that many from each other is a relevant task, that laymen could do in a 5x5m typical quadrant, and how to extrapolate if necessary.

The second habitat was a freshwater wetland type of habitat, where the citizen scientists worked in smaller groups independently assessing the naturalness of the area. Citizens could pose their relevant question, weighing the answer, clarifying point, for which the botanist leading the event, István Hahn could help them. The issue of invasive species in the riparian zone was a long-discussed topic in both habitats.

15 people participated of mixed age and gender. This event was announced with age limit, 16+ years old volunteers were invited as the topic needs more common sense, focus and a little background knowledge about the topic or open-minded to learn.

Follow up activity was planned, however, the COVID-19 virus stopped us from organizing public events.

[7] http://zoldxvii.hu/beszamolo-elohelyterkepezes-es-termeszetessegmeres-2020okt/

Introduction of the day with the citizen scientists (Photo: Balázs Kozák)

How to differentiate plant species? Practice with the citizen scientists (Photo: Balázs Kozák)

Recognizing invasive plant species and learning, why they are not welcome (Photo: Balázs Kozák)

Practicing together the naturalness assessment of a riparian wetland area (Photo: Balázs Kozák)

Practicing together the naturalness assessment of a riparian wetland area (Photo: Balázs Kozák)

Figure 14 – Photographs from the habitat mapping, naturalness assessment

3.3.3 Citizen Science activity 2 – Water quality monitoring[8]

3.3.3.1 Water quality monitoring – physical and chemical

Date: 22/10/2020, 16:00 – 17:00
Location: Creek Rákos, BP 17

Before the Hungarian national holidays, water quality monitoring began at Creek Rákos. The regular water quality monitoring, sampling of the Budapest Sewage Works (local water authority) was organized deliberately on the same day along the same section of the Creek.

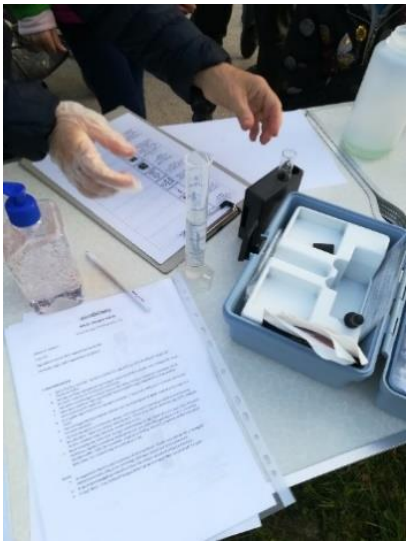
Basic physical and chemical factors were measured with colorimetry toolkits of the HACH company. Citizen scientist measured the following parameters: pH, water temperature, salinity, conductivity, dissolved oxygen, oxygen saturation, NH4-N, NO2-N, NO3-N, PO4-P.

The event was well attended, approx. 20 people were at the sampling of the Budapest Sewage Works and 12 citizen scientists helped with the water quality monitoring at a more frequented venue along the creek to make the event visible among other users of the area. This way, the event went on social media “on its own”.

Each component is measured by one toolkit, except for the temperature-salinity-conductivity that is done by a portable device. Each toolkit had a report template with a Hungarian manual, how to use it. Each component was measured separately, one measured, others helped the volunteer, and another citizen scientist wrote the report on the observation and results.

[8] http://zoldxvii.hu/oktoberi-vizminoseg-meresek-a-rakos-patakon/

The experts of the Budapest Sewage Works taking their regular, bi-annual water sample for monitoring (Photo: Balázs Kozák)



Introduction of the citizen science toolbox and the colorimetric measurements (Photo: Balázs Kozák)

Introduction of the citizen science toolbox and the colorimetric measurements. Citizen scientists have to find the right colour shades to determine the component's content (Photo: Balázs Kozák)

Learning how to use a portable device (Photo: Balázs Kozák)

Figure 15 – Photographs from the water quality monitoring.

3.3.3.2 Water quality monitoring - Biological[9]

Date: 23/10/2020
Location: Creek Rákos, BP 17

Biological water monitoring started the following the physical and chemical factors were monitored.

The biological water quality monitoring is carried out by the Danube-Ipoly National Park's mobile citizen science bus, the so called "Dunavirág Vízibusz". Debris-like sample was taken from the creek with a simple sieve, then the tiny macroscopic creatures were collected and the similar ones separated. Once most of them in each sample were separated, they were magnified and the species identified based on a simple method with yes/no questions about the features of the animals. This way based on the presence of the species and their tolerance range; conclusions can be drawn about the water quality.

Taking sample from the creek with simple kitchen sieves (Photo: Balázs Kozák)

Separating the macroscopic species and collecting alike ones into one box (Photo: Balázs Kozák)

Figure 16 – Photographs from the water quality monitoring

[9] http://zoldxvii.hu/biologiai-vizminoseg-meres-a-rakos-patakon-2020-oktober/

Separating the macroscopic species and collecting alike ones into one box (Photo: Balázs Kozák)

Identifying the type of species with the help of a magnifier and a yes/no guidance (Photo: Balázs Kozák)

Figure 16 – Continued.

4 Next steps

4.1 Citizen-Science Activities

The second wave of the COVID-19 hit Hungary in autumn, and the government banned all events from the end of October. This stopped face-to-face activities and therefore citizen-science activities will restart when restrictions relax. The following activities are planned:

- Amphibian monitoring after the first trial would continue after the COVID, once the weather will be ideal for the species.
- Black woodpecker monitoring could continue during the wintertime as well, though there is a prohibition of assembly right now due to the pandemic. Once the ban is lifted, open-air public

events in small groups could continue. For the interim period, an online presentation about the species and the monitoring activity is planned for the wintertime.

- Water quality monitoring is planned for one complete year, taking samples possibly every month to measure physical and chemical components to assess water quality according to the Water Framework Directive. Monthly biological water monitoring would continue whenever in springtime the nature will revive again until the end of September 2021.
- Vegetation naturalness assessment along the Creek.

The local organizer NGO, GREEN XVII foresees to continue the citizen science activities beyond the project along Creek Rákos depending on the COVID situation.

4.2 Impact Measurement

We will begin to identify indicators to measure impact related to the case study's aims and objectives. This will be achieved through workshops with all stakeholders involved or through discussions with project managers. Once indicators have been selected, we will measure the impact of the citizen science activities on the five MICS domains: environment, society, economy, governance, science & technology. We will review the usability of the impact assessment and produce guidance and training so the MICS tools and metrics can be applied to any type of citizen science project. The results from these activities will be reported on in the comprehensive evaluation report (Deliverable 4.5) in 2021.

5 References

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