D7.2 Report on outcomes of the field trials in Danube Delta

Smart Toolbox for Engaging Citizens into a People-Centric Observation Web

Abstract

Whilst citizen participation in environmental policy making is still in its infancy, there are signs of a growing level of interest. The majority of citizens, though, both as individuals and as groups often feel disengaged from influencing environmental policies. They also remain unaware of publicly available information, such as the GEOSS or Copernicus initiatives. The SCENT project will alleviate this barrier. It will enable citizens to become the 'eyes' of the policy makers by monitoring land-cover/use changes in their everyday activities. This is done through a constellation of smart collaborative technologies delivered by the SCENT toolbox in TRLs 6-8.

This deliverable describes details about the citizen science field campaigns conducted in Danube Delta pilot area. In particular, it addresses aspects regarding the organisation and execution of the campaigns, while also provides an overview of the citizen-generated observations, the feedback received and the evaluation of the activities from the participants and, recommendations towards facilitating the conduction of citizen science campaigns.

Keywords: citizen science, Danube Delta, field campaigns

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Acronyms and abbreviations

Table 1. List of Abbreviations

Abbreviation	Description
DD	Danube Delta
SOR	Societatea Ornitologica Romana (Romanian Ornithological Society)
DDNI	Danube Delta National Institute
DDBR	Danube Delta Biosphere Reserve
POI	Points of Interest
LC/LU	Land cover and land use
GNSS	Global Navigation Satellite System
GCP	Ground Control Points
RGB camera	Red-Green-Blue camera
DEM	Digital Elevation Model

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Executive Summary

This deliverable provides evidence of advances towards the achievement of project objectives by documenting the activities under the "Task 7.4 Danube Delta Pilot". In particular, this deliverable provides details about the organization of the field campaigns in Danube Delta pilot area carried out through the use of SCENT toolbox. Besides describing the technical activities behind the implementation of the campaigns, the deliverable also illustrates activities carried out as regards the user experience, including the overall campaign experience.

More specifically, this deliverable starts by providing an overview of Danube Delta pilot site where the SCENT field campaigns were organized. It defines key concepts such as the thematic focus of the data collection activities, organisation steps and end-user engagement activities. In addition, it identifies from the perspective of the campaign participants (citizens, volunteers) the challenges, needs and lessons learnt from the Danube Delta pilot campaigns. Therefore, it describes the theoretical methods and real-life implemented solutions to engage citizens in data-gathering activities in the light of citizens observatories activities.

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1 Introduction

This document describes the locations in the Danube Delta (DD) pilot where the field campaigns have taken place, the methodology followed in the organization of the field campaigns, and well as information about the newly generated text and imagery data relevant to these sites. This is a key deliverable within the integration and real-life large-scale demonstrations of the SCENT project, focused on promoting citizen engagement in environmental monitoring. Additionally, this deliverable explains how the SCENT project activities were performed during the field trials in Danube Delta pilot sites with a wide set of volunteers including SOR members. Various types of data were collected, such as: river data (water level & velocity), data from low-cost portable sensors measuring soil moisture and air temperature, images depicting land-cover/use, location data of volunteers participating in the demonstration campaigns and responses to questionnaires circulated by the consortium on citizen viewpoints on the impact of land-cover/use to environmental phenomena such as floods. SOR and DDNI organised different data collection sessions and validated the SCENT toolbox in the DD pilot (Table 2). The fieldwork was organised so that the morpho-hydrographic configuration of the area, its flora and fauna communities and the impact on local communities as well as ecosystem species preservation is taken into account.

The subject of environmental monitoring is the main topic of the project, so the main objective of the campaigns was to engage and recruit citizen volunteers to gather data to fill the gaps in our current knowledge from existing infrastructural sources, specifically in relation to flood risk management. It is envisioned that the improved data will help shape public policy around the issues while, at the same time, provide for a positive example of the benefit of active citizen involvement in shaping policy.

Engaging citizen volunteers in collecting data trough serious gaming methods helps to obtain additional data about the Danube Delta natural and rural area, and places people, as volunteers at the centre of environmental monitoring and relevant policies.

The planned pilot was conducted in specific locations where teams of volunteers participated in field visits, which was accompanied by prior training organised through meetings addressing the field work, field applications and the overall participatory approach.

After this real-life field validation of the SCENT toolbox and components, the SCENT end-users - pilot participants participated in the evaluation and provided their feedback.

Table 2. List of campaigns organized in DD pilot area

Theme of campaigns	**Dates of campaigns**
LC/LU image collection campaign	12th – 19th of August 2018
River data measurement and additional LC/LU image collection campaign	27th – 30th of September 2018
River data measurement and additional LC/LU image collection campaign	2nd – 5th of May 2019
LC/LU image collection and sensor measurements campaign	24th – 26th of May 2019
LC/LU image collection and sensor measurements campaign	31st of May – 2nd of June 2019

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1.1 Purpose of the Document

The purpose of this deliverable is to serve as a comprehensive description and evaluation about the integration of the SCENT toolbox components in real-life large-scale demonstrations. This deliverable aims to showcase the toolbox potential through informing and creating awareness about the project and engaging society in its actions. The objective is to present the strategy of engaging citizens, and actions conducted for different stages of citizen science campaigns. The purpose is also to outline the results and the participants' feedback about their campaign experience. Finally, the report concludes with recommendations towards streamlining the conduction of the citizen-science campaigns in relevant rural areas.

1.2 Intended readership

This deliverable is public, aiming to provide insights to stakeholders that want to learn more and get involved with the conduction of citizen-science campaigns. Such stakeholders include:

- Policy makers and public authorities (local, regional or national) associated with monitoring the environment for purposes such as flood management or preservation of the local ecosystem;
- Environmental protection and conservation agencies, NGOs and other environmental organisations at local, regional, national and EU level involved in the protection of the environment.
- General public and volunteer organisations with an interest and sensitivity in environmental issues.

1.3 Relationship with other SCENT deliverables

The starting points for this deliverable are D1.1 ("SCENT Stakeholder analysis and End User Requirements") & D1.2 ("Benchmarking of available in-situ infrastructure") describing the end user requirements and existing in-situ monitoring systems in Danube Delta pilot area respectively, as well as D1.4 ("SCENT toolbox system architecture definition") defining the high-level SCENT toolbox system architecture deployed in the pilots. The present deliverable was written in parallel with D7.3 that presents the outcomes of the field trials in the Attica region, and is in close relation with D8.2 ("Communication strategy and plan ") which presents the Communication strategy and plan for citizen engagement, and D8.5 ("Information Packs for Citizen led communities, networks and associations") providing relevant communication resources to facilitate the interaction with citizen and relevant stakeholders. The deliverable complies also with the relevant procedures described in D8.3 Data Management and POPD Requirements (mid-term review update) and D9.3 Ethical Issues Clearance Plan. Finally, D7.3 will provide with useful information and data for deliverable D7.4 ("Evaluation of SCENT toolbox").

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1.4 Document's structure

Being a descriptive report, the document is organized in four main parts. Section 2 provides details about the areas in Danube Delta where the SCENT citizen-science campaigns took place, while elaborating on the types of data collected and the rationale for identifying the various points of interest. Section 3 tackles aspects regarding the organisation and the execution of the campaigns whilst Section 4 presents details from the evaluation of the activities from the participants. The report concludes with lessons learnt and a summary of recommendations to facilitate the undertaking of relevant initiatives.

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2 Danube Delta pilot sites

The Danube River is one of the most important natural axes in South-East Europe, linking most of the countries in that area. Located in Eastern Europe, Danube Delta (DD) is the largest wetland in Europe, protected under three international conventions: 1990 – UNESCO "Man and Biosphere Program", 1990 - the List of the World Cultural and Natural Heritage, and 1991 - RAMSAR Convention[1]. Danube Delta was declared a biosphere reserve (DDBR) in 1990 and it includes the maritime Danube, the Danube flood plain, Razelm – Sinoe lagoon complex, the Black Sea coast, and the coastal marine waters up to 20 m depth. Danube Delta, the youngest geological unit in Romania, has the general tendency to be in a long lasting and continuous territorial extension. This aspect is due to the accumulation of the alluvia brought by the Danube (45-48 mil. tons/year in the last years) and is deposited in front of the three branches (Chilia, Sulina and Sfantu Gheorghe), to the material produced from the north-west cliff of the Black Sea and transported by sea currents. DDBR contains a greater range of habitat types, lower and higher plants, invertebrates and vertebrates than all other deltas in Europe. Many of the species that live within the delta are unique to it; these include plants and animals. During the last decades, Danube Delta has suffered from human interventions that led to dramatic changes in some areas. These interventions consist of damming large areas for agricultural use (polders), intensive fish-farming and forestry, which resulted in dramatic alterations or disturbances of the water balance. This again had effects on the alteration of natural processes and on the ecological balance of wetlands and led to deterioration, or worse, to the loss of specific habitats and biodiversity. Flooding is a normal event within the delta's annual cycle and floods normally occur between April – June, when 33 % of the Danube's annual flow may pour into the delta (P. Gâștescu, 2005). Thus, it is a strategic goal for the local, regional, national and European environmental policy makers to safeguard the flood protection, biodiversity conservation, increased resilience of DD ecosystems by mainstreaming climate change adaptation and improving the dynamic adoption of land-use changes in local and regional policies and strategies.

2.1 Description of the Danube Delta pilot sites

2.1.1. Geography

Danube Delta, representing in a concrete sense the most important terminal field of a European river (exception being the Volga River), is situated in the North-West part of the Black Sea basin, in a mobile region of the Earth's crust (preDobrogean basin) (Romanescu, 1995).

The general geographic characteristics (Figure 1) of Danube Delta, can be summarized as follows:

- *Boundaries*: the biosphere reserve includes the proper delta, Razim-Sinoe lacustrine area, sea coast waters as far as the –20m isobath, non-arranged Danube holm between Isaccea and Tulcea, Danube riverbed (Romanian side) between Cotul Pisicii and Ceatalul Chiliei.
- *Geographical coordinates*: 45˚24'30" north latitude and 28˚10'50" east longitude at Cotul Pisicii, 45˚9'30" north latitude and 29˚42'45'' east longitude east of Sulina, 44˚ 20'40'' north latitude and 29˚19'20'' east longitude at Chilia Veche.

[1] https://www.mdrap.ro/userfiles/delta_dunarii/Danube_Delta_Diagnostics_Report.pdf

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- *Total area*: 5,800km^2 out of which: 3,510km^2 the proper delta – Romanian sector, 1,145km^2 Razim-Sinoe lacustrine area, 1,030km^2 sea waters as far as –20 isobath, 13km^2 Danube riverbed between Cotul Pisicii and Isaccea (Romanian territory) and 102km^2 Danube holm between Isaccea and Tulcea.

The river starts from Ceatal Izmail, between Chilia (117 km) to the north, Tulcea (19 km) and continues to St. Gheorghe, covering a total of 2540 km^2 (Romanian territory). This area continues to expand as a result of the action of the river; due to the presence of 6473 m^3/s of water and 58 million tons /year of silt on one hand and to the action of the waves on the shore, on the other hand. Danube River is and has been a flora and fauna reserve that is unique in Europe.

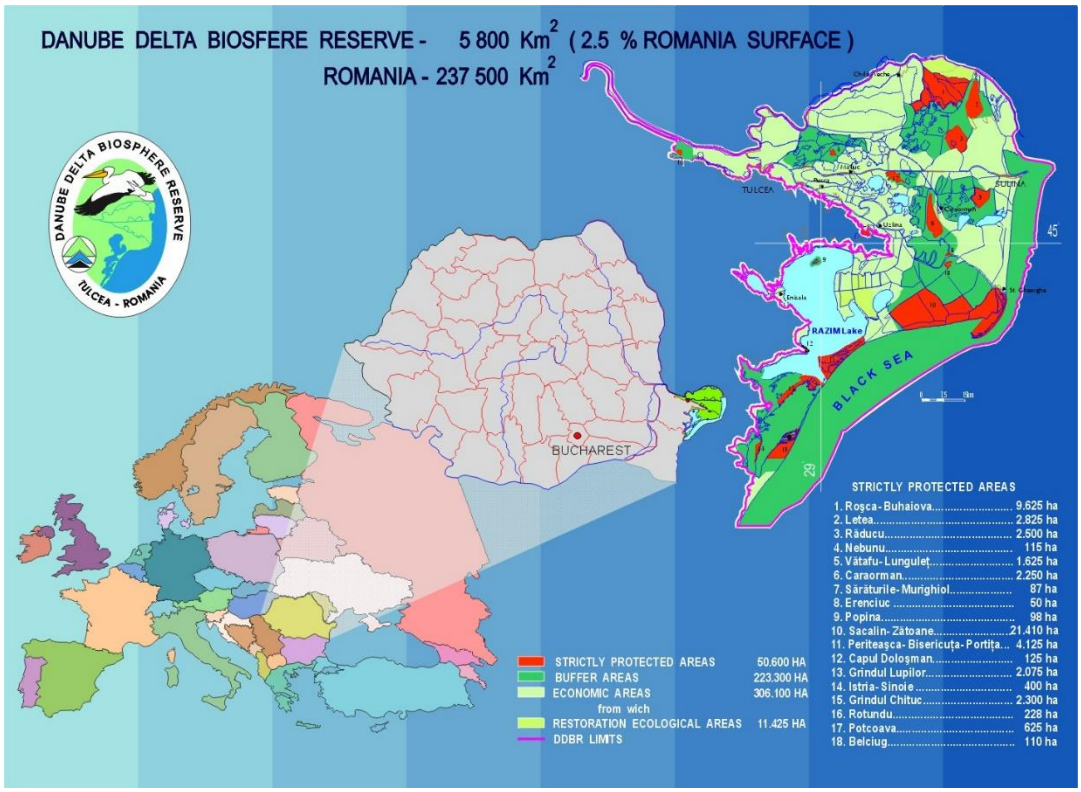

Figure 1. Geographical location of Danube Delta biosphere reserve

2.1.2 Sontea Fortuna region for the SCENT pilot campaigns

One of the areas selected for the SCENT pilot campaign and where the method is applied is the fluvial part of Danube Delta. The exact area is the so called Sontea-Fortuna and it is situated in the Central-West part of the entire Danube Delta (Figure 2). The Sontea-Fortuna area presents an elongated shape between Tulcea and Chilia branches from West to East. Given the dominant influence of the river, the majority of the constructed canals are with large dimension and aim to permanently and intensively replenish the waters of the large lacustrine complex.

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Due of its hydrological properties, its position and size, Sontea-Fortuna is a very important environmental monitoring area, with gaps and insufficient available data. The location of the area, its unique landscape and the wide natural habitats with numerous species of birds offers for potential visitors an unforgettable experience. The data which are collected can used to help improve the accuracy of existing flood models and maps and thus allow decision makers to take better adaptation different measures.

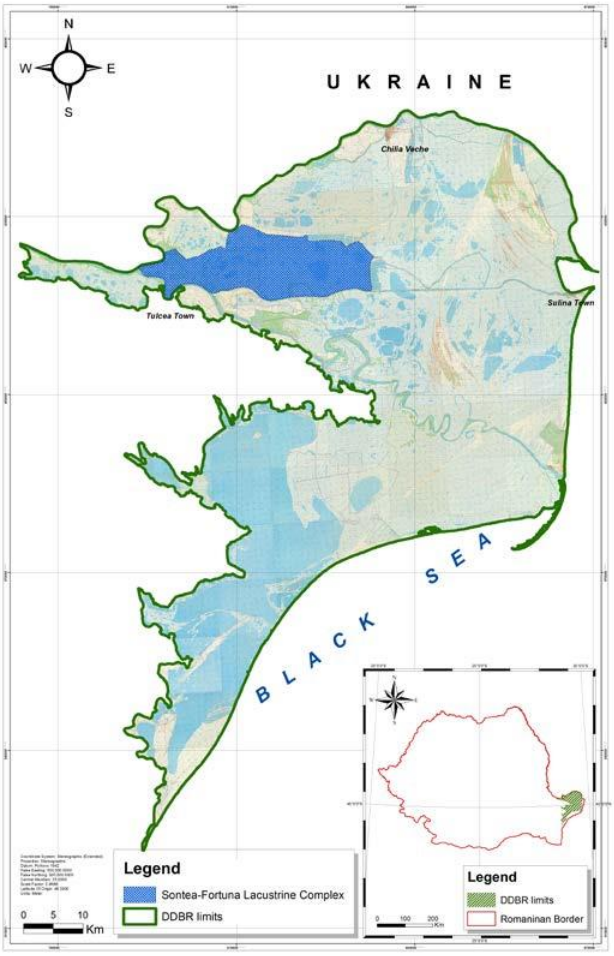

Figure 2. Location of the Lacustrine Complex Sontea-Fortuna (Mierla and Romanescu. 2012)

2.2 Types of thematic campaigns conducted

The field visits organized in the context of SCENT Citizen Observatory were with a thematic focus that was aligned with project's goals and types of information needed in the areas of interest. In the case of Danube Delta, several thematic campaigns were conducted focusing on the collection of Land Cover / Land Use (LC/LU) images, river parameters, and soil measurements. The concept of the thematic campaigns was carefully chosen, to allow the organization of a dedicated workshop (training session)

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at the start of each campaign where volunteers were not only informed about the project, but also trained in the use of the SCENT tools and applications they used during the campaign.

Dedicated points of interest were defined and routes were designed in the context of each thematic campaign, so as to enable the collection of the needed environmental information. In addition, the pilot area where the thematic campaigns took place was quite remote and the field activities were conducted through the use of boats.

2.2.1 Land Cover / Land Use

In the case of Danube Delta, LC/LU thematic campaigns, involve the acquisition of observations about the natural environment. Particular focus is given in elements such as the coverage of the river bank, areas occupied by forests and woodlands, shrub and/or herbaceous vegetation associations as well as wetlands. Through the use of SCENT Explore[2], participants were able to collect images (Figure 3) of the LC/LU elements and provide relevant textual descriptions (annotations, according to the previously developed LU/LC taxonomy).

Figure 3. Shrub and/or herbaceous vegetation associations riverbanks (left); LC/LU image collection through the use of SCENT Explore (right)

2.2.2 River measurements

River data collection involves the acquisition of measurements related to water level and water surface flow velocity. The water level in Danube Delta was measured by taking images of portable measuring rods that are partly submerged into water, whilst the measurements of water velocity were performed by recording videos of a pre-defined floating object (i.e. tennis ball) moving on the water surface (Figure 4). The acquisition of both images and videos was achieved through SCENT Explore application.

[2] https://scent-project.eu/scent-toolbox#scent_explore

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Figure 4. Measurements of water velocity (left); Measurements of water level (right)

2.2.3 Soil moisture & air temperature measurements

Portable sensors were used by citizens along with user friendly mobile application (SCENT Measure[3]), so as to monitor and record changes in soil conditions, and in particular of soil moisture and air temperature, in different location of the Danube Delta pilot area. Users simply insert the portable sensor into the soil (Figure 5), select whether to measure air temperature and/or soil moisture, and receive the measurements directly in the application.

Figure 5. Portable sensors used by citizens

2.3 Points of Interest and routes selection rationale

In the Sontea-Fortuna area, floods are studied in terms of the flow circulation patterns, through a hydrodynamic model that simulates these flows. In such models, datasets for different variables and parameters are used to explain flood processes. Therefore, the rationale for the selection of points of

[3] https://scent-project.eu/scent-toolbox#scent_measure

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interest (PoIs) and routes for data collection varies according to the type of thematic campaign executed, which are explained separately in the following subsections.

Model results vary in time and space, depending on the flow conditions at the boundary of the considered modelled domain. PoIs need to be selected based on specific locations in the model, hence the PoIs and routes selection was designed and proposed by modelling experts (IHE Delft), with the support of the beneficiaries of the model (DDNI) that have set also its main objectives.

2.3.1 Land Cover/Land Use campaigns in relation to flood modelling

Land cover information is used for flood modelling to characterize how rough the surface is, i.e. how much resistance (opposition) the flow encounters when passing through a land feature. Floods are very dynamic in the Sontea-Fortuna area and, consequently, they ultimately cover the whole region, at different moments. This requires a land cover map of the entire area.

Therefore, there were two main principles guiding the definition of PoIs and routes for LC/LU:

- Representativeness of land cover classes: all the main land cover features over the entire area should be captured;
- Spatial coverage: cover as much of the terrain as possible.

Because land cover varies, depending on the type of vegetation on it, the cover is classified in categories, meaning that land cover is the same over patches of land with the same land cover. Therefore, it is only necessary that points within each land cover patch/segment are recorded while collecting data.

For understanding where different classes were located in the Sontea-Fortuna area, in order to represent them better, a preliminary map of land cover classes along the river was generated (Figure 6), based on satellite imagery.

Based on this information, routes were designed to maximize representatives and spatial coverage. Similarly, to what was explained in the previous section, other practical aspects were taken into account. It was defined that for LC/LU the boat should sail at a constant velocity for citizens to take pictures.

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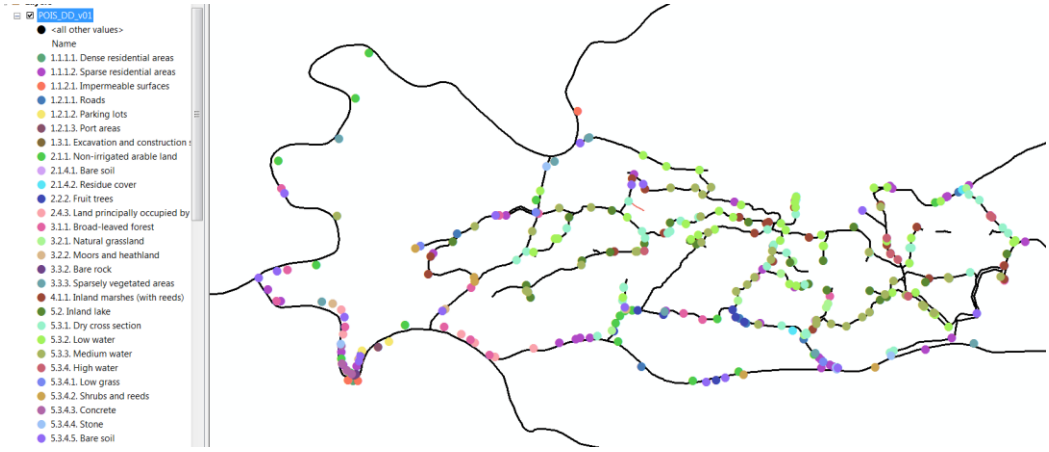

Figure 6. Preliminary land cover classes in Sontea-Fortuna

2.3.2 River Data Collection campaigns

Measurements of water depth and velocity are used in hydrodynamic modelling as boundary conditions as well as for calibration and validation of the model. In other words, in order to simulate flows within an area, it is necessary to know how much inflows and outflow at the boundaries; and it is also important to have data to check if the results are close to what is observed on the field. However, Sontea-Fortuna is an extensive area where water depths and velocities vary greatly and its large dimensions also pose logistic challenges.

In view of that, a study was conducted to define an approach for PoIs and routes selection for collection of water depth and water velocity. As described by Venturini et al. (2019), the main steps of this approach are to evaluate (Figure 7):

- Actor coalitions interests: defining what is of interest for the local authorities and how strong their interest was (by giving scores).
- Case-study characteristics: consider the time the citizens should spend in the boat and how long it would take for them to capture the images/videos; as well as the accessibility of the region.
- Selection of possible pathways based on the defined criteria: calculating how long the paths are and which incorporates more of the stronger interests from actors (which has the highest score).

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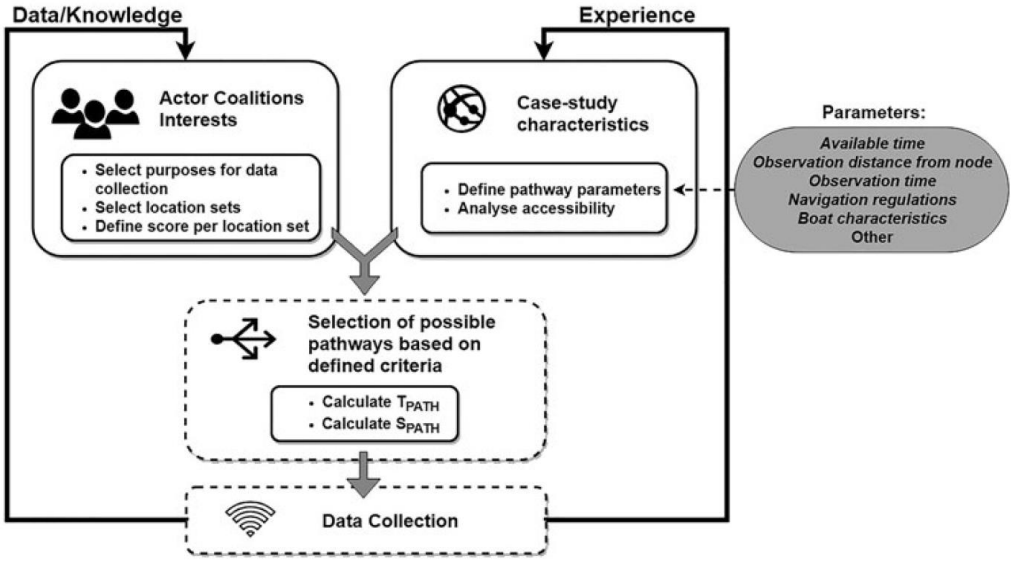

Figure 7. Pathway selection approach concept (Venturini et al., 2019)

For the Sontea-Fortuna area, local authorities were more interested in improving the model (improved calibration), gather more knowledge of the flow over the Canal Mila 35 and identify the reaches with stagnant water, together with understanding the causes for such conditions. In terms of accessibility, a small number of canals were not accessible and Nebunu Lake could not be considered as a PoI because it is a protected area.

Based on PoIs, the time available for collecting data and the other aspects described in the study, the conclusion was that multiple points of interest could be considered, although some canals were preferable to others, proving that the scoring system was robust. Also, it was evaluated that pathways closest to the start/end point would gather data in areas of stronger interest (Venturini et al., 2019).

This study was the theoretical basis for the definition of PoIs and routes for SCENT's river data collection campaigns. When applying the methodology, insights from the first LC/LU campaign were incorporated and adjustments were made:

- Boat accessibility map was updated:
  - Based on the previous campaign and local partners knowledge (Figure 8);
  - Based on feasibility for tape measurements (Figure 9);
- Case study characteristics parameters were defined:
  - Observation time:
    - Water level (1 spot): 3 min
    - Velocity (1 spot): 10 min (1 ball throw); 15 min (2 throws)
    - Water level & velocity (3 spots along cross section): 30 min
    - Maximum boat velocity: 17 km/h
  - Campaign time: 5-6 hours
  - Start/End points: varied between Tulcea, Vulturu (first river collection campaign) and Partizani (second river collection campaign)

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- Refined criteria for pathway selection: different water depth and velocity ranges should be sampled, for better calibration (Figure 10).

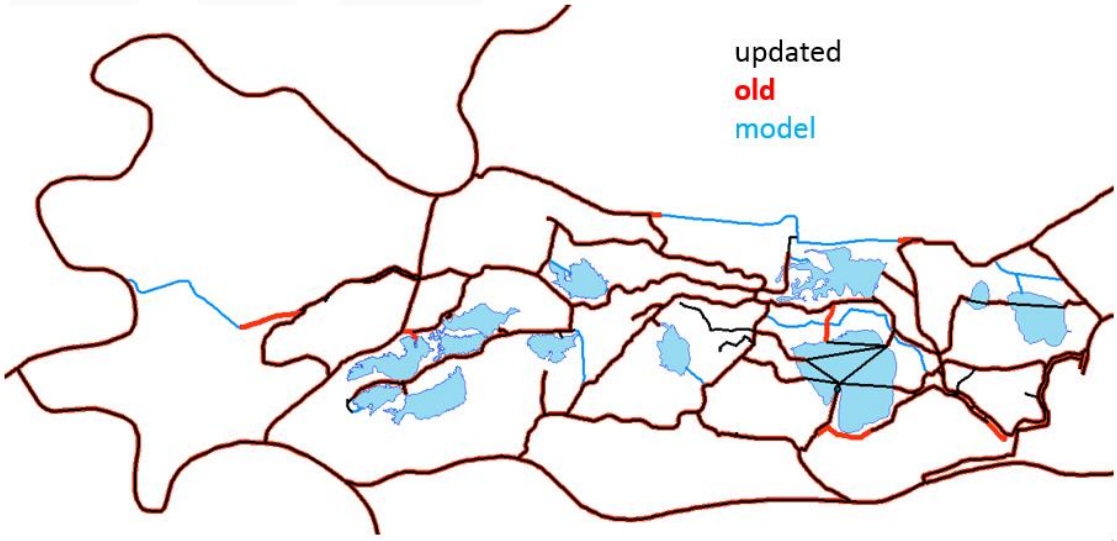

Figure 8. Accessibility map and evaluation of feasibility for tape measurement in Sontea-Fortuna area, based on local partner knowladge

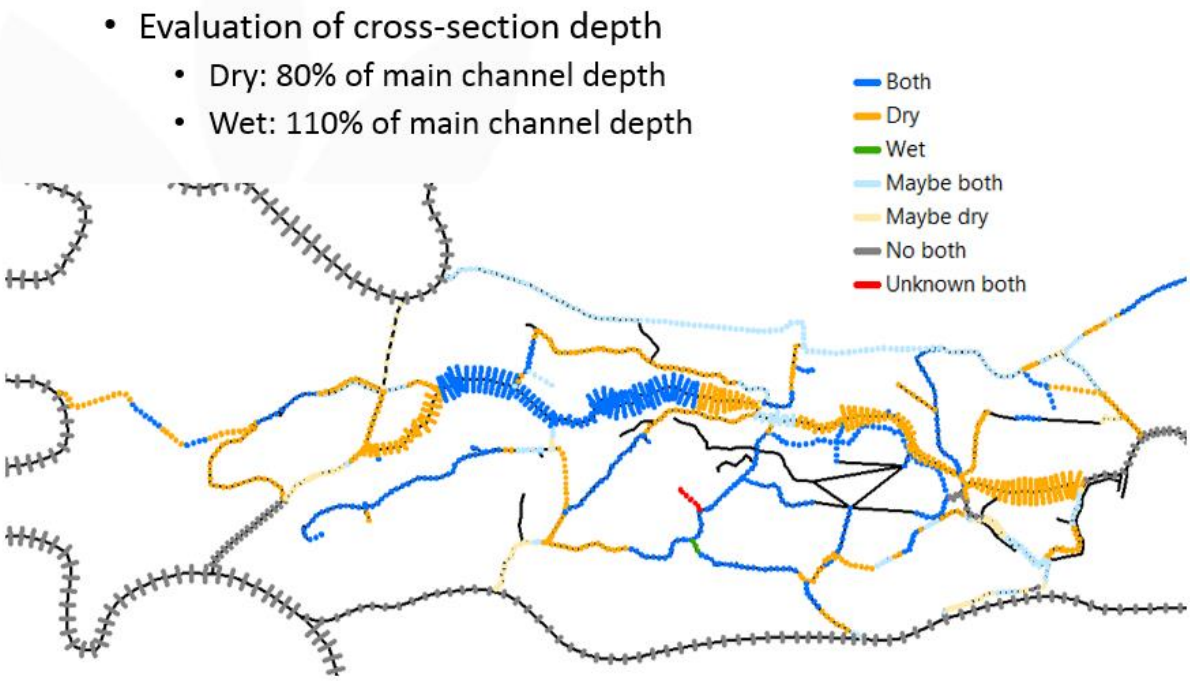

Figure 9. Accessibility map and evaluation of feasibility for tape measurement in Sontea-Fortuna area,

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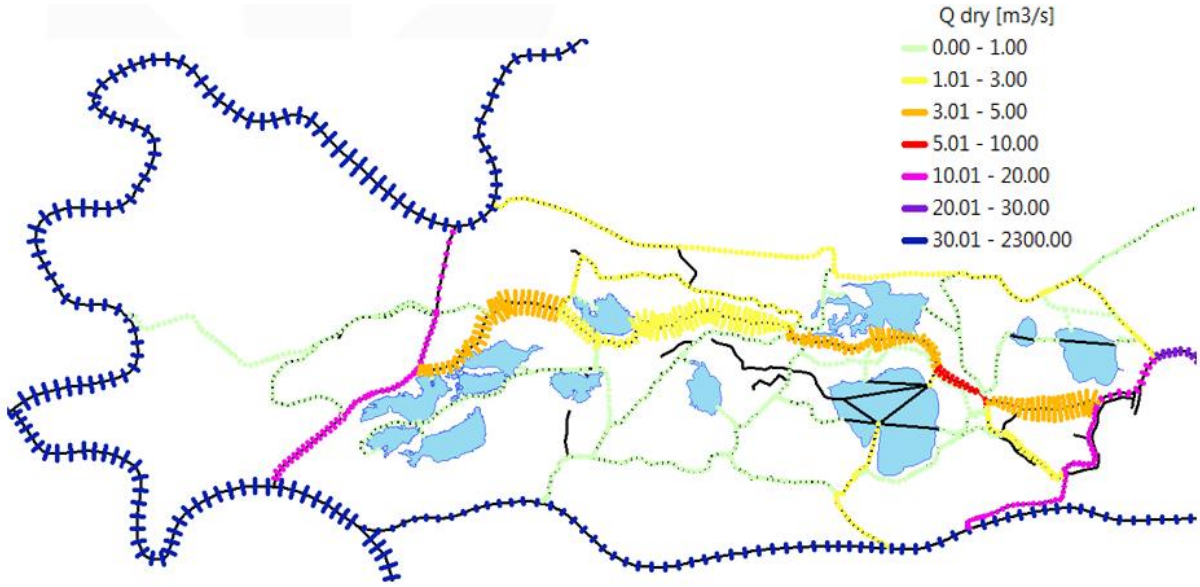

Figure 10. Simulated discharge differences in the Sontea-Fortuna area in the dry period

Pathways were designed prior to the campaigns as soon as the campaign organization logistics were available. Pathways for all days of a campaign were designed together in order to maximize the mentioned actors' interests. Due to the dependency on citizen participation, and therefore the number of boats and accommodation location, it was not possible to optimize the routes as such details can only be confirmed at the start of the campaign. Moreover, in multiple occasions, routes were changed midway through the campaign due to inaccessible points discovered on the fly (e.g. a fallen branch over the river). Regardless, in all campaigns most of the points of interest, routes and most of the Sontea-Fortuna area were covered.

2.3.3 Soil moisture/Air Temperature campaign

Measurements of soil moisture and air temperature were made during the last two LC/LU campaigns of the Danube Delta. Due to the lesser role that these environmental aspects play on the flood dynamics in Sontea-Fortuna, the routes used for LC/LU were also used for soil moisture and the PoIs were not fixed, they followed the principle that:

- 4-5 boat stops should be made per route to collect data;
- The stops should be spaced evenly in time, to not tire the citizens.

2.4 Drone Campaigns

In addition to the citizen campaigns, additional campaigns for the collection of drone data were conducted. Different areas over the Sontea-Fortuna area were covered for the dry and wet season and for different purposes.

For the dry period, IHE representatives took part in the field work for two days in November 2018 and together with the local drone operator from DDNI two proposed areas were flown. During this period, Ground Control Points (GCPs) were also surveyed by the team. The remaining of the proposed zones

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were collected by the same local drone operator from DDNI at a later moment. Data processing and integration into modelling were performed by IHE Delft (Phung, 2019).

For the dry period, there were 12 proposed drone flight zones in the protected Sontea-Fortuna complex. Their areas ranged from 0.74 ha to more than 10 ha. Adapting to the technical capability of the drone and the geographical circumstances, there were adjustments into smaller flight zones and a substitution one area to another. The covered areas are shown in Figure 11.

Figure 11. *Drone flight blocks in Sontea-Fortuna. Orange zones were collected by IHE and DDNI joint team, the others were acquired by DDNI operator.*

In total, three different drones were employed in Sontea-Fortuna case (Table 3). Parrot Disco is a fixed-wing drone that is used by DDNI to collect most of the proposed flight areas. It is the drone attached with an integrated spectral camera (Green, Red, NIR) and RGB camera.

Table 3. *Summary of collected image collections in Sontea-Fortuna.*

Drone	DJI Phantom 4 Standard	DJI Mavic 2 Pro	Parrot Disco
Image size	4000×3000	5472×3648	4608×3456
ISO speed	200		
Exposure time	1/1250		
Geotag	Yes		
Flight height	120 m		
Flown areas	SF01-01	SF01-02	The rest
	SF12-01	SF01-03	
	SF04	SF01-04	
	SF11	SF12-02	

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2.4.1 Ground control point surveying

GCPs is the requirement for accurate DEM reconstruction. dGNSS techniques were used to collect GCPs. Two GNSS receivers were used to do the survey, one base and one rover. GCPs were made from thick cardboard boxes so they had some extra weight and this allowed them to stay still on the ground. A black-white checkboard 40 cm by 40 cm was printed and stuck on each cardboard plate (Figure 12).

Figure 12. *A GCP was laid out in the field.*

The task of GCP surveying was carried out during the participation of IHE representatives on the fieldwork, in two proposed area SF01 and SF12. Even though much effort was made to establish and maintain the surveying technique, most of the collected points did not meet the strict demand for GCP accuracy (centimetric error). Due to this condition, GCPs were not acquired for any of the areas.

2.4.2 Challenges and lessons learned

Danube Delta is situated next to the border with Ukraine. Flying drones over the sensitive location drew an issue on international safety and security. As a consequence, one of the proposed flight areas located by the border was discarded.

GCP surveying with dGNSS techniques requires a clear view of the sky to communicate with GNSS satellites. It also needs fewer obstacles in the line of sight, to transfer between the base and the rover. In this case of Danube Delta, it was the bad weather conditions and the dense coverage of vegetation that block GNSS communication signal, causing the poor quality of measurements. In addition, a DDNI drone encountered a serious crash into the water due to unknown reason.

Weather condition is the challenge for any kind of field work, including drone flights. During the campaign period, the bad weather (rain, hail) slowed down significantly the drone mission progress. Romanian Danube Delta has a dynamic microclimate, for instance, dense fog rapidly can cover parts of the Delta.

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In order to make the drone flight efficient, it is obligatory to start the flight close by the proposed area. Accessibility of Danube Delta can be considered a great challenge for drone campaigns since boats are the only suitable transport. Depending on the locations and type of boat, it might take more than an hour to get to the furthest location. The campaign took place in low water condition, when some channels were blocked and accessibility was further restricted.

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3 Organization of field campaigns

3.1 Campaign organization

The objective of the organized campaigns in Danube Delta was to collect valuable environmental information, at frequent time intervals, that could be further analysed and utilised (i.e. in the context of hydrodynamic modelling, etc) whilst raising awareness and sensibility of "experts" and "non-experts" in citizen science activities and thereby leading to stronger collaboration between involved stakeholders as well as to active participation in SCENT citizen science campaigns.

More specifically, the steps towards the organisation of each of the DD field campaigns are described in the following sections.

3.1.1 Formulation of data collection needs

The dates and the periods of the campaigns as well as their scope (thematic focus) were planned well in advance, involving internal discussions between the project partners as well as interactions with local stakeholders, who could easier cope with the aspects of the organization. The campaigns were designed to cover both the dry and wet season (from hydrological point of view) in Danube Delta.

In addition, online registration forms (Appendix A1) were produced to facilitate the engagement of the participants in the DD campaigns and to support organisational aspects in relation to the participation levels (i.e. expected number of volunteers per campaign day). The design of registration forms was according to the SCENT brand guidelines, containing general information about the project, details about the goal of the campaign, the areas to be visited and the accommodation arrangements as well as specific information about the SCENT application.

Last but not least, it should be noted that the campaigns were planned at frequent time intervals within the project's duration; yet with the possibility to be re-planned and re-designed according to the covered area, the weather conditions and the interest of the participants.

3.1.2 End-user engagement activities

The DD pilot was organized by mobilizing various stakeholders so as to take part in the field visits, aiming to conduct a large-scale demonstration of the SCENT Toolbox. Taking into consideration the location and the planned duration of the campaigns, different citizens groups were identified after a specific portrait of characteristics including: i) familiarity with the Danube Delta pilot area, ii) desire to spending time in nature, iii) acquaintance with vegetation and water environments, and iv) familiarity with boat trips (without sea sickness or any special medical condition).

The volunteers were identified and engaged from different networks and associations (Table 4) involved with bird-watching, nature and wildlife monitoring, nature photography as well as from educational institutions. The interaction with the relevant groups was achieved through email exchanges, phone calls, social media and local press. All the participants that were registered via the online forms, were afterwards contacted via emails and phone calls, so as to confirm their participation and provide further details about the activities. These activities led to the mobilisation

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of a total of 193 participants (169 unique individuals) in the context of all Danube Delta field campaigns.

Table 4. List of the stakeholders that were engaged in the Danube Delta pilot campaigns

Type of organization	**Organization name**
NGO	EnviroTeam Association
NGO	Society for the Protection of Birds and Nature
Radio	Rfi radio
University	Faculty of Biology and Geology, Cluj-Napoca
University	Faculty of Environmental Science and Engineering, Cluj-Napoca
University	Faculty of Biology, Iasi
University	Faculty of Biology, Bucharest
University	Faculty of Geography, Iasi
Facebook Group	SOR Volunteer Facebook Group
Private sector	Napoca Black Box
Tour guide/tour operator	Ibis Tours
Activists	Eugen Petrescu
Activists	Daniel Petrescu
Tour guide/tour operator	Pelican Travel
Private sector	CampoEuroClub

3.1.3 Campaign design and considerations

In general, based on the expected number of volunteers, each of the campaigns in Danube Delta was planned for an overall duration of 3-7 days. As the Sontea-Fortuna area is remote, with difficult access, all volunteers were present during the whole campaign. In addition, the conduction of the routes of each campaign was conducted only by boats. This aspect needed a rigorous and accurate organization in terms of the participation levels and logistics (i.e. boat availability).

The organisation of each campaign was always falling within weekends (including weekdays as well) and/or national holidays, so as to enable the participation of more volunteers. The points of interest and the routes were identified by the project's domain experts, taking into account the identified data needs. The schedule and route planning varied for each campaign, considering the number and profile of the volunteers, their accommodation location, the case study characteristics and local conditions (i.e. water level, channels accessibility, weather etc). Once it was decided which places were suitable for holding campaigns, logistics efforts were made to group PoIs that were close to each other and to form the routes. The routes were designed to have an average duration of 4,5 to 6 hours.

In addition, arrangements regarding the transportation of the volunteers to the field and their accommodation were also taken place in the context of each campaign.

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3.2 Campaign execution

In the beginning of each campaign (first day), a training session was organised aiming to introduce the SCENT project to the participants as well as to explain the scope of the campaign, aspects regarding the utilisation of the data to be collected and guide the volunteers in using the SCENT applications. This session was lasting for approximately 1-2 hours and was conducted either in the accommodation location of volunteers or in a meeting room close to the starting point of the campaign in Tulcea.

The starting point of each campaign day was the accommodation location of the volunteers. During the execution of the campaign, participants were being provided with meals, snacks and water, whilst they were given free time after the data gathering activity so as to create an enjoyable experience. To support the efficient realization of the data collection activity, taking also into account the boats' capacity and safety considerations, small groups of volunteers were being formed, usually not exceeding 15-20 people per route, 8-10 volunteer per boat in a given route.

In addition, the following equipment was in place to facilitate the smooth execution of campaigns:

i) vehicles (motor boats) for enabling the volunteers to carry out the routes;
ii) mobile devises and/or tablets, that were provided to participants whose devises could not support the SCENT applications;
iii) signal amplifier antenna and internet connectivity to enable the volunteers to upload the data collected in case of bad network coverage;
iv) SCENT portable sensors for the collection soil moisture and air temperature data;
v) auxiliary equipment for river measurements collection (tennis balls, portable water level indicators, fishing nets).

At the end of the campaign, the participants were evaluating different aspects of the event through dedicated questionnaires (i.e. campaign experience, applications performance, etc), providing valuable feedback that was considered in the organisation of subsequent activities.

As described in detail in the following sections, five large scale citizen-science campaigns were organised in Danube Delta pilot area, in the period between August 2018 and June 2019, focusing on several themes of interest to the local communities and the policy makers: collection of LC/LU images, soil moisture and air temperature measurement collection by portable sensors, and river data collection.

3.2.1 1st SCENT Pilot Campaign (Land Cover / Land Use)

The first DD thematic campaign was organized between 12th – 19th of August 2018 at Sontea-Furtuna area, focusing on the collection and annotation of images for LC/LU information. The campaign took place in the context of SOR summer camp. The SOR summer camp is a yearly organized camp (Figure 14) for the active SOR members and volunteers. Usually in this camp there are over 100 participants, which was therefore a good opportunity to initiate the SCENT campaigns with a large group of citizens. The base of the camp was settled between Maliuc Village and Fortuna lake (coordinates: 45.202326˚, 29.113053˚) (Figure 13).

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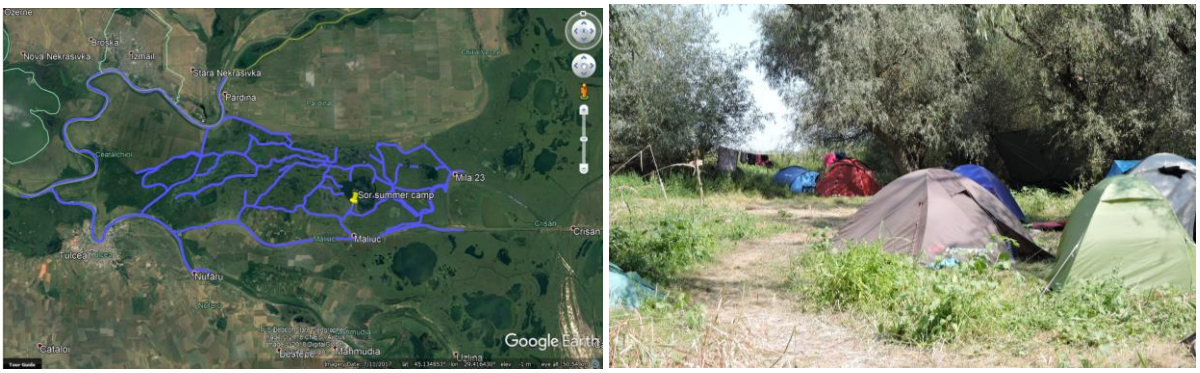

Figure 13. Overview of the area covered during 1st *SCENT* campaign in Danube Delta (left), and campsite (accommodation of the volunteers) location (right)

Figure 14. Preparation of the campsite for the campaign

In the first day the meeting with the volunteers was set up in the closest big city of the area of interest (Tulcea), from where they were transported via boats to Maliuc village and subsequently to the camping area. This was followed by the conduction of an introductory / training session with the participants. Each day of the campaign, a different group of 20 volunteers participated in the LC/LU image collection campaign, being in the field for approximately 6 hours (Figure 15). A summary of the schedule of the campaign as well as the routes conducted by the volunteers are provided in Appendices A2 & A3. Taking into account the duration of the campaign and the location, the safety of the participants was assured by the presence of medical personnel and an experienced boat driver. During each field campaign the participants were wearing lifejackets.

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Figure 15. Arriving, transportation and training of the participants in DD 1st campaign

During this campaign volunteers contributed by providing important land cover and land use data, by using SCENT Explore to search and capture images of augmented reality creatures hiding in areas of important environmental interest. In particular, 4725 images have been collected, consisting of LC/LU elements such as inland marsh, coverage of the river bank (with shrubs, low grass, bare soil, stone/concrete), forest, trees and reeds.

A total number of 63 volunteers participated in the whole duration of the campaign. Details about the gender and occupation of the participants are presented in Figure 16. Age-wise the group was very heterogenous, divided equally, with 32% in the range of 25-34 years old, about 28% a bit younger (18-24), 19% in the range of 35-44 years old and 14% were older (45-54), whilst the remaining preferred not to say.

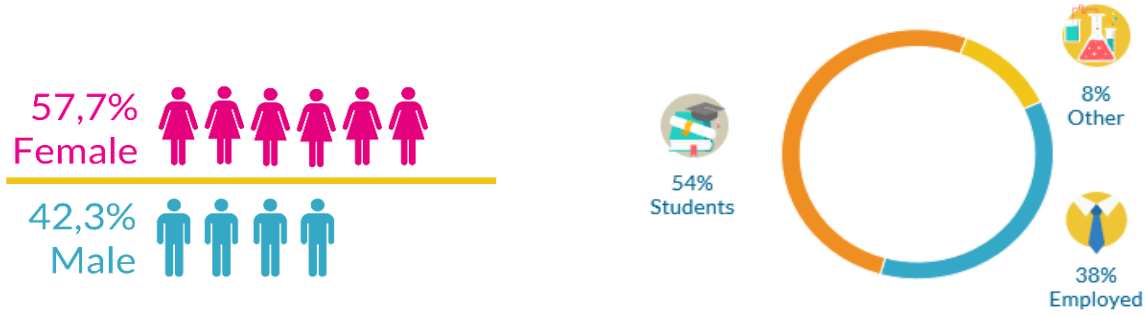

Figure 16. Gender and occupation details of the participants in DD 1st campaign

3.2.2 2nd SCENT Pilot Campaign (River measurements, Land Cover / Land Use)

The second DD thematic campaign was organized between 27th – 30th of September 2018 at Sontea-Fortuna area focusing on the collection of river measurements (Figure 17) as well as of LC/LU information. The base of the volunteers was at Maliuc village (coordinates: 45.173183˚, 29.113343˚).

In the first day of the meeting, the training of the volunteers was set up in the closest big city of the area of interest in Tulcea, and after its conclusion the volunteers were transported by speed boats to Maliuc village.

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Figure 17. Starting the 2nd DD campaign (left); water level measurements (right)

During the second campaign, the foreseen routes were conducted by a group of 25 volunteers, being in the field for approximately 5 hours per day. The routes visited by the volunteers each day of the campaign are provided in Appendix A4. The safety of the participants was assured by experienced boat driver, whilst they were wearing lifejackets during each boat trip. The campaign resulted to the collection of more than 2500 citizens' observations consisting of 2251 images of LC/LU information, 162 images of water level information and 96 videos of water surface flow velocity.

A total number of 25 volunteers participated in the duration of the campaign, while counting 20 unique participants. Details about the gender and occupation of the participants are presented in Figure 18. Age-wise the group was very heterogenous, with 65% in the range of 35-44 years old, about 25% a bit younger (25-34) and the remaining 10% were older (45-64).

Figure 18. Gender and occupation details of the participants in DD 2nd campaign

3.2.3 3rd SCENT Pilot Campaign (River measurements, Land Cover / Land Use)

The third DD thematic campaign was organized between 2nd – 5th of May 2019 at Sontea-Fortuna area focusing on the collection of river (Figure 19) and some LC/LU parameters. The base of the volunteers was at Partizani village (coordinates: 45.192955˚, 28.95610˚). According last year's meteorological events and water flows, this campaign was planned to be organized in the wet period of the year. River data collection was intended to gather, as usually in this period high waters are already present in the Delta. The year 2019 was quite unusual, and in the 3rd campaign period the high-water levels hadn't yet been occurred.

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The training session (Figure 19) and the transfer of the participants at the accommodation location was conducted in a similar way as in the previous campaign.

Figure 19. DD 3rd campaign - Training of the volunteers; Velocity measurements

During the third campaign, 2 routes were conducted per day, with a group of approximately 20 volunteers fulfilling each route, 8-10 volunteers per boat one average in a given route. The routes visited by the volunteers each day of the campaign are provided in Appendix A5. Considering the foreseen points of interest, the average duration of the data collection activity per day was 4 hours. As a result, 2160 images of LC/LU information, 908 images of water level information and 1218 videos of water surface flow velocity were collected.

A total number of 53 participants joined the campaign, whilst also counting 42 unique volunteers. In the 3rd campaign the majority of the participants were students. The gender and occupation distribution of the participants is presented in Figure 20. Age-wise the majority of the group (69%) was in the range of 18-25 years old, and the remaining of the participants were falling within the category of 25-34 years old.

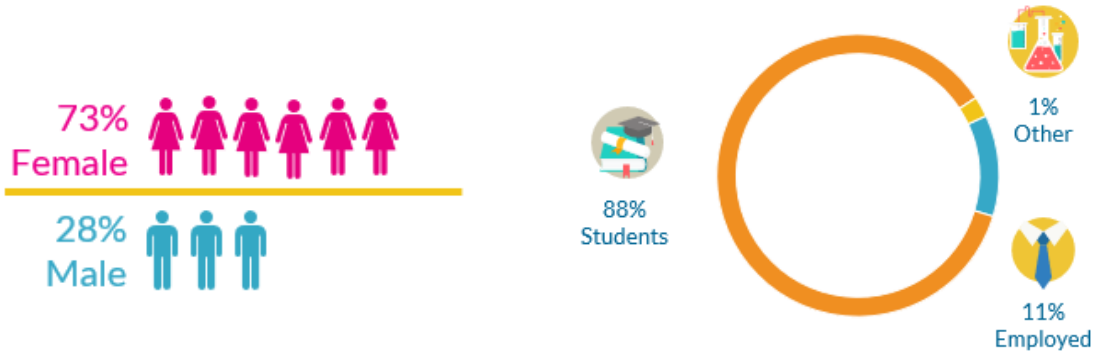

Figure 20. Gender and occupation details of the participants in DD 3rd campaign

3.2.4 4th SCENT Pilot Campaign (Land Cover / Land Use, Soil moisture and air temperature measurements)

The fourth DD thematic campaign was organized between 24th – 26th of May 2019 at Sontea-Fortuna area. The base of the volunteers was at Partizani village (coordinates: 45.192955˚, 28.95610˚). The

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thematic focus of the campaign was the collection of images of LC/LU (Figure 21) as well as measurements of soil moisture and air temperature via portable sensors. However, after realizing that wet flow conditions were present, missing in the previous period when it normally should have been present, a small amount of river measurements was also collected in some dedicated PoIs. This was also due to the fact that the designed routes were covering locations of importance for the acquisition of such measurements that were not fulfilled in relevant previous campaigns.

The training session and the transfer of the participants at the accommodation location was conducted in a similar way as in the previous campaign.

Figure 21. DD 4th campaign – LC/LU data collection; Channel with low grass and shrubs river bank

In this case, 2 routes were conducted per day with a group of 7 volunteers (per route). Considering the foreseen points of interest, the average duration of the data collection activity per day was 4 hours. The routes visited by the volunteers each day of the campaign are provided in Appendix A6. In the context of this campaign, 1832 images of LC/LU elements and 1313 measurements of soil moisture and air temperature were collected. In addition, 112 images of water level information and 36 videos of water surface flow velocity were captured in some dedicated locations.

A total number of 18 participants joined the campaign, whilst counting 14 unique volunteers. In the fourth campaign the participants' majority was female 78.5% the male population was in a lower percentage (21%). Age-wise the group was homogeneous; participants were students and employees and belonged from 18-24 to 45-54 years range The gender and occupation distribution of the participants is presented in Figure 22.

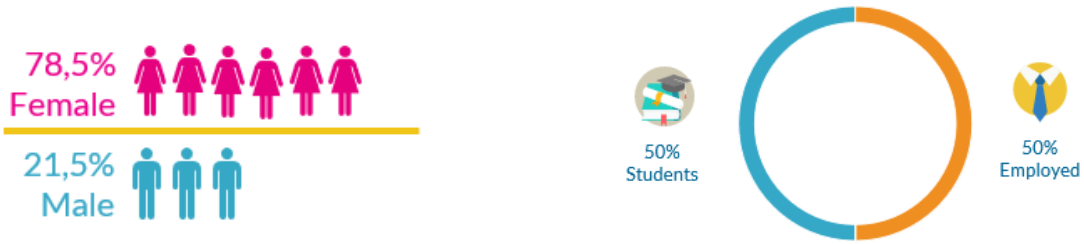

Figure 22. Gender and occupation details of the participants in DD 4th campaign

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3.2.5 5th SCENT Pilot Campaign (Land Cover / Land Use, Soil moisture and air temperature measurements)

The fifth DD thematic campaign was organized between 31st of May – 2nd of June 2019 at Sontea-Furtuna area. The base of the volunteers was at Partizani village (coordinates: 45.192955˚, 28.95610˚) (Figure 23). The thematic focus of the campaign was the collection of images of LC/LU as well as measurements of soil moisture and air temperature via portable sensors. However, a small amount of river measurements (Figure 23) was also collected in some dedicated PoIs.

During the first day, the meeting and training of the volunteers was set up in the closest big city of the area of interest in Tulcea, assured by the presence of the partners, from where they were transported with speed boats to Partizani village.

The main difficulty during this campaign was that, due to the wet conditions, most of the river banks were flooded and it was very hard to find a location that the boat could stop and the citizens could find non-flooded terrain.

Figure 23. DD 5th campaign – volunteers' accommodation; Water level measurements; Wetland with inland – reeds and water lily.

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During the fifth campaign, 2 routes were conducted per day, with a group of 15 volunteers fulfilling each route. The routes visited by the volunteers each day of the campaign are provided in Appendix A7. The campaign resulted in 2976 images of LC/LU elements and 1027 measurements of sensor measurements were collected. In addition, 18 images of water level information and 180 videos of water surface flow velocity were captured in some dedicated locations.

A total number of 34 participants joined the campaign, whilst counting 30 unique volunteers. The participants were approximately equally divided gender-wise: 46.7% male and 53.3% female during the 5th campaign. The gender and occupation distribution of the participants is presented in Figure 24. Age-wise the group was very homogeneous, with 29% in the range of 18-24 years old, 41% belonged in the range of 25-34 years old, a lower percentage belong to the 35-44 (23.5%) and 45-54 (5.8%) range.

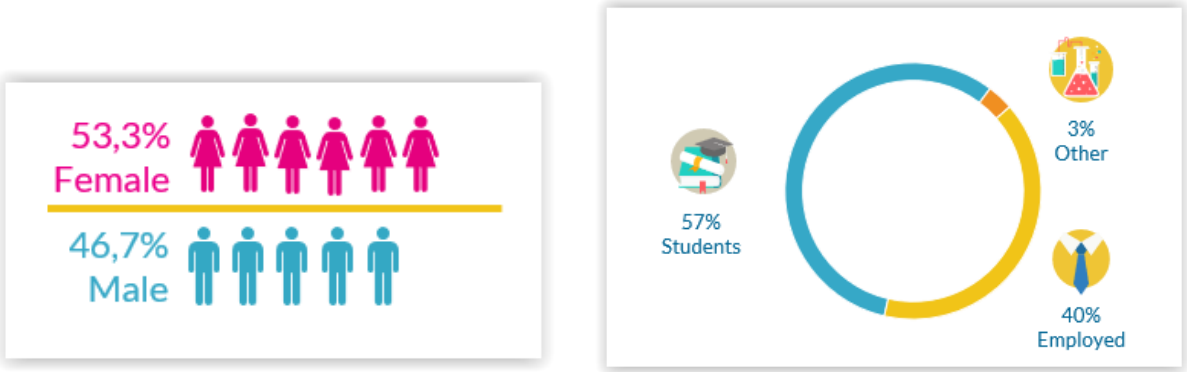

Figure 24. Gender and occupation details of the participants in DD 5th campaign

3.2.6 Drone SCENT Pilot Campaign in Danube Delta

The collected photos from drone missions were processed in the commercial software Agisoft PhotoScan. Details on the workflow and computing platform can be found in Deliverable D3.1.

Below are typical outputs (DEM and orthophotos) of the drone mission within the proposed area SF01 near Tulcea (Figure 25). The DJI Mavic 2 Pro was employed to collect photos in this zone. All other flights have similar characteristics as described here.

The elevation model shown is a digital surface model. It includes all features above the ground which are easily identifiable as groups of elevated features. This can be cross-checked with its corresponding orthophotos. However, the elevation of this raster ranges from -81 meter to +26 meter, and the raster is tilted with the Northwest side higher than the opposite side. Based on the observation in the site, this output is not correct in Sontea-Fortuna which is a flat delta area and vegetation is not greatly high.

It is due to the fact that no ground reference was introduced to the processing workflow. No high accuracy GCPs were able to be obtained in the fieldwork. DEM with this issue is not acceptable as it requires precise reflection of the real characteristics. The problem does not influence the orthophotos.

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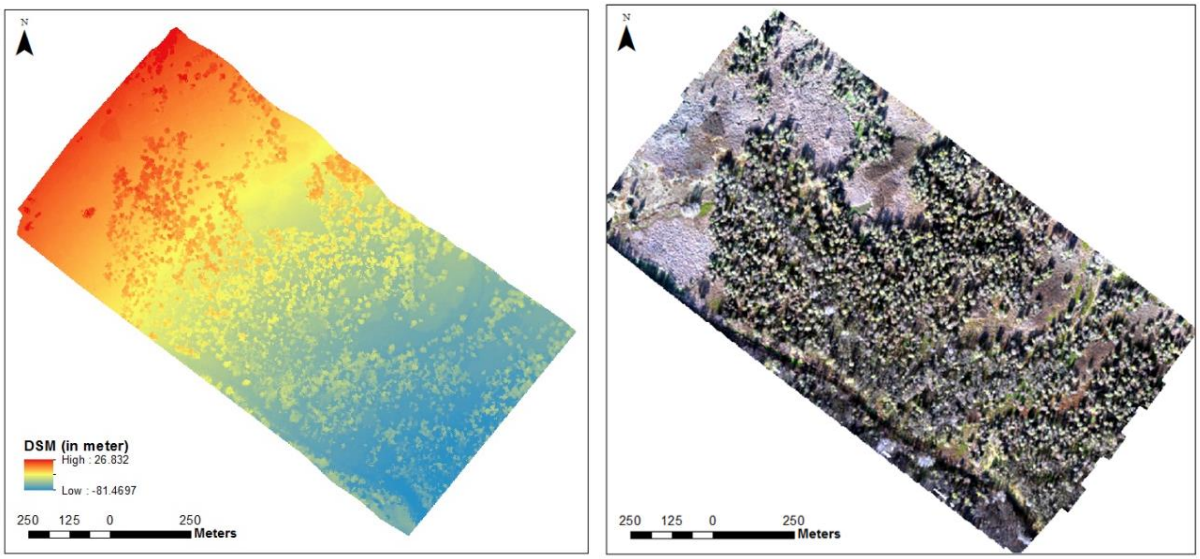

Figure 25. Digital surface model (left) and orthophotos (right) of a drone flight in Danube Delta.

The majority of proposed areas have been collected using fixed-wing Parrot Disco equipped with a Sequoia+ camera. The similar processing workflow in Agisoft PhotoScan (D3.1) was applied to Parrot Disco. However, the intermediate outputs (sparse point cloud and dense point cloud) were with abundant noise (Figure 26, upper photo). No plane of the elevation or ground features could be identified in the point cloud despite attempts to fix the situations. Equivalent experiments were also executed in Pix4D, but still arriving at similar issues (Figure 26, lower photo).

It was believed that the algorithm was not capable to find and match unique features among input photos. When carefully inspecting input photos, they appear to be sharp at normal scale, however, the blurriness can be seen easily when it is magnified (Figure 27). This issue might be due to photo compression of the camera of Parrot for efficiently storing after being shot. After personal communication with Agisoft PhotoScan team for technical support, it was found that this was a common issue with the camera attached in the Parrot Disco. The rolling shutter of the camera is relatively slow, when a photo is captured during a fast or unstable flight, it causes the motion blur effect on the photo.

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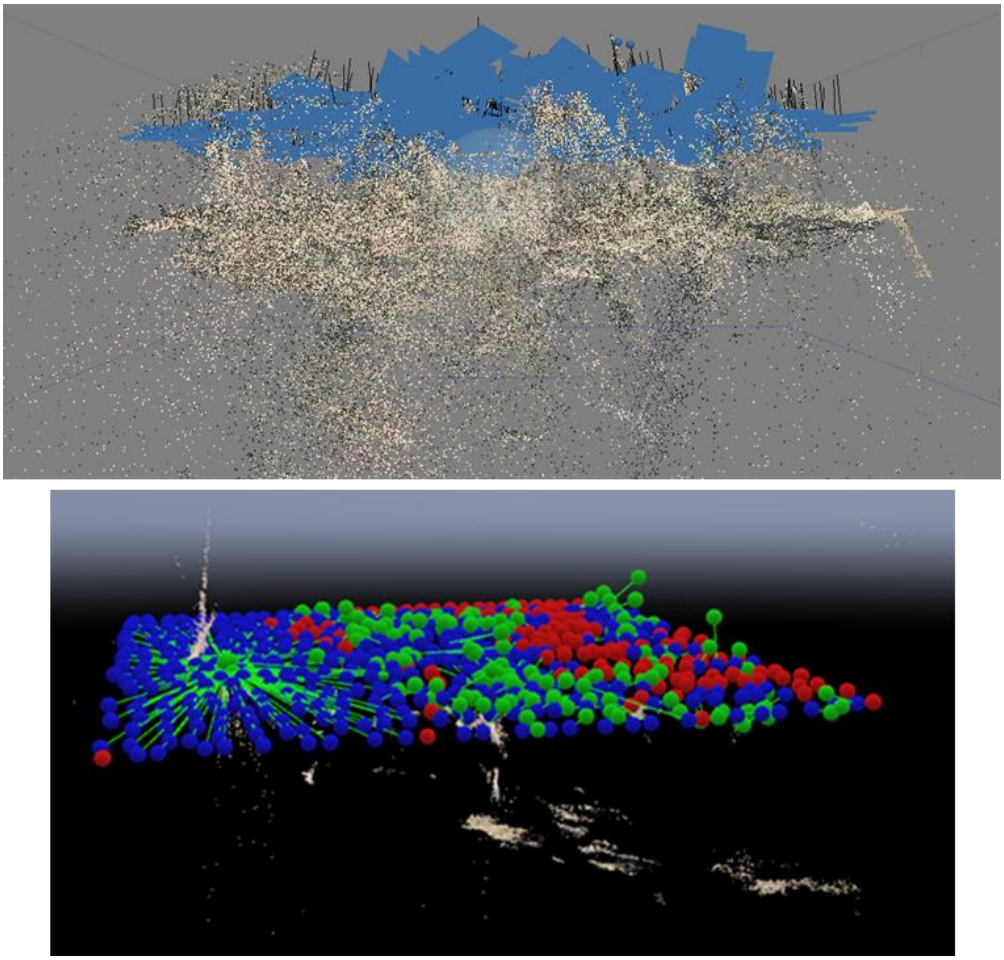

Figure 26. Screenshots on sparse PC of an area. The upper photo is taken from PhotoScan, blue squares above the PC represents calibrated input photo positions. The lower photo is from Pix4D. Blue, green and red dots are respectively initial, computed and uncalibrated photos.

Figure 27 A 10x-zoomed portion of a photo captured by the Sequoia camera on Parrot Disco.

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4 Evaluation of field campaigns

4.1 Thematic campaigns evaluation

In the Danube Delta pilot area, 193 total participants and 169 unique participants attended the total five campaigns. The feedback was collected from the volunteers after each campaign and corrective actions were established to ensure improved campaign experience. The evaluation form is presented in Appendix A8.

The main challenge for the execution of the field campaigns was the time spend on the boats. The initial estimation that the volunteers would be able to spend up to 6 hours per day on the boat was proven to be too much. The weather along with the fatigue and the repetitive environment made trips with such durations disengaging. As a result, the time spend on the boats was reduced from 6 to 4 hours, which was the preferred time as indicated by the volunteers and the boats selected after the first campaign were speed boats that were making the trips faster.

On the positive side, the unique topology of the area, the nature, birds and habitats as well as the visits in remote and not commonly visited parts of the Danube captured the interest of the volunteers. The volunteers were excited about the Explore application, the challenge of capturing the characters and the innovation behind the SCENT toolbox, how their contributions were of high importance for scientists and how they were contributing data for an important cause. There were some technical challenges with the application that were reported and were taken into consideration with ongoing updates and enhancement of the application. The volunteers found the training offered before the campaigns to be adequate and some provided feedback that helped in improving the overall process. As an example, each boat had a coordinator who provided technical support during the field trip.

The collected feedback from the volunteers will be presented in the following tables (from Table 5. to Table 9) along with the improvement measures taken.

Table 5. Evaluation of the 1st Campaign – LC/LU image collection

Boat Experience	
Pros	**Cons**
[**P**] Routes included smaller channels and areas with birds.	[**C**] The application was draining the phone battery relatively fast; some volunteers did not have enough batter for the duration of the campaign.
[P] Routes included areas of the Delta that are not usually visited, giving the participants a unique experience not normally offered to tourists and visitors.	[**C**] In 3 days we went with 2 boats for 6-hour trips. The participants were very tired afterwards, mainly the teenagers.
[P] As people had experience with the camp setup, most had participated in the previous years too. They were prepared for the weather and the conditions which made the boat experiences smoother.	[**C**] Training sessions held in the morning before the start of the boat trip caused some delays in starting the day. In some cases, the trips were starting at around 10h, when it was already hot.
[P] Due to the theme of the campaign, which was focused on collecting LC/LU information the routes were flexible to accommodate unexpected obstacles and inaccessible channels.	[**C**] There were a few problems with the boat engine, documents were required and fuel was needed, but these were easily resolved.

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Campaign Experience	
Pros	**Cons**
[**P**] Electrical power was ensured with solar panels.	[**C**] Unstable mobile signal coverage. Signal boosters were helpful but not completely eliminating the problem.
[**P**] It was a very sunny week, so there was no problem in recharging the big batteries using solar panels.	[**C**] Due to the internet problem, there was no training session with each group. App training was performed in a one-to-one basis, consuming a lot of the trainee's time.
[**P**] Participants had mobile data and had no problem in using it.	[**C**] About 15% of the people needed to borrow phones. In some instances, we had to re-manage people to different days because the extra phones available were not enough.
[**P**] Some people preferred the personalized attention of the one to one training.	
[**P**] Every day the list of volunteers was screened and restructured to ensure the next boat trip. This was only possible if we talk to people in a personal basis.	
App Experience	
Pros	**Cons**
[**P**] Many people said that the app is fun and that it run better than they thought.	[**C**] People expected to see their picture numbers but also their pictures after the boat trip.
	[**C**] Because of the sun, the characters that were in shadow, in the contrast, were very hard to see.
	[**C**] When people capture the characters by tapping on it, the picture is taken only after the animation and, by then, many of the participants had moved the phone from the initial position.
	[**C**] The characters didn't appear in some smartphones. In some it was 'on top' of the person, in others it was never there.
	[**C**] About 5 or 6 land cover types were mainly used and it was boring to have to go through the taxonomy all over again to use the same tags.
	[**C**] The app crashed when the phone was connected or disconnected to the internet while using the app. Also, it would crash when outside the app for a while or when switching between apps. Sometimes it would crash out in usage.
	[**C**] The app showed delays. The main bottlenecks were: logging in with internet; loading the map and the POIs after catching a character; waiting for the upload menu when connected to the internet.

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	[**C**] People needed to keep checking the phone for when there were animals (sounds were not possible to hear because of the boat's motor sound).
	[**C**] The random character generation wasn't the same for everybody. For two volunteers, the animals came one after the other, while for some, it would take the expected time.

The feedback received from the volunteers that participated in this campaign was crucial, given that this was the first real test of the Scent Toolbox in real conditions and many issues not previously foreseen were raised. Regarding the organisation of the campaign it was obvious that the six hours were too many for the volunteers so the following campaigns utilized faster boats and shorter routes limiting the time the volunteers were spending on the field. Regarding the accommodation of the volunteers the availability of internet connection was very important so measures were taken in the following campaigns to identify camping locations with better network coverage.

The feedback received regarding the experience with the Scent Explore application resulted in a major update in many features. To begin with, the touch screen of the phone was made less sensitive to compensate with the accidental selections due to the boat movements. Also, many features of the application such as the route planning on the map and the graphics of the Augmented Reality animals were adapted to reduce the battery consumption. A tutorial was added to the application to support the training and facilitate the volunteers with familiarizing with the application. Furthermore, sound levels for the notifications were increased and additional vibration options were added.

Last but not least, the volume of the available taxonomy tags that were available for the users to choose from was proven confusing and disengaging. Examining the annotations provided from the users it was proven that only a very limited subset of them was used. This led to the introduction of a normal mode to the taxonomy selection, that had only a limited amount of taxonomy tags. These tags were defined upon the creation of a new campaign through the Campaign Manager. The complete taxonomy was still available to the user but this time it should be explicitly chosen through the expert mode.

Table 6. Evaluation of the 2nd Campaign – River data measurement and additional LC/LU image collection

Boat Experience	
Pros	**Cons**
[**P**] Routes included many natural places and smaller channels. Many of the participants really appreciated the places with many birds.	[**C**] In 4 days we went with the boats for 5-hour trips. The participants were very tired afterwards, mainly because of the cold wind.

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Many of them would never be accessible through touristic boats and would be very expensive if done apart.	
[P] As people knew they would be in the boats for a while, some had their own power banks.	[**C**] During the river data measurements data gathering the routes weren't flexible.
[**P**] The routes were better planed and discussed with the boat driver beforehand; some issues arose and detours were made because of the low water level but were handled accordingly.	[**C**] Some detours could not be predicted.
The opinion about boat stops was distributed; half considered it was ok, about 30% thought it was too much and about 20% thought there could be more. The ones that said it was too much had more PoIs in their route.	
Campaign Experience	
Pros	**Cons**
[**P**] What volunteers liked the most about their boat experience was the scenery: the view, birdwatching, the Danube Delta habitats.	[**C**] The participants' feedback was required in the final day, overall, the answers to the open questions were very shallow and many participants didn't answer all boxes. We assume the reasoning is that due to the cold wind generated by the wind speed, the participants didn't want to stay with their hands out for too long. Three volunteers didn't answer the open questions and for some questions there were only 60% of responses.
[**P**] Some of the volunteers appreciated that they spent time with nice people.	[**C**] It was an autumn time, so most of the days it was changing weather and cold wind. The least liked aspects in the questionnaires were the cold and the wind.
[**P**] The method of small volunteers group works as well as planned.	
[**P**] The volunteer's accommodation was selected based on mobile signal coverage and wireless internet connection.	
Considering the capturing of animals, opinions were divided; about half of the volunteers considered it hard to capture animals with the boat moving, and the other half considered it easy.	
Around 60% of the people thought the amount of characters appearing was good, whilst the other 40% considered they were too many.	
Around 60% of the people thought the amount of characters appearing was good, whilst the other 40% considered they were too many.	
App Experience	
Pros	**Cons**
[**P**] The two main aspects of the app that people liked the most were that it was fun to catch the characters and that the app is innovative, with an interesting way of gathering data and a potential to citizen science.	[**C**] People expected to see their picture numbers and their pictures after the boat trip.

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	[**C**] Some problems were reported regarding the response time of the application.

This campaign highlighted how important the weather conditions are for the execution of the pilot activities. While the updates in the application were welcomed by the volunteers, further steps were taken to ensure the GPS accuracy. In addition, the duration of a video was limited to 15 seconds as the examination of the collected data showed that this was more than enough for the extraction of the water velocity. This limitation helped with the preservation of the phone battery and the video uploading time.

Table 7. Evaluation of the 3rd Campaign – River data measurement and additional LC/LU image collection

Boat Experience	
Pros	**Cons**
[**P**] Many of the participants really appreciated the landscapes and the bird species we passed through. Many of the channels would never be accessible through touristic boats and would be very expensive if done apart.	[**C**] The weather was misleading, some of the participants were cold.
[**P**] Compared to previous campaigns phone battery last longer time (depending from phone to phone).	[**C**] Due to the limited space and surrounded by water some of the participants was feeling anxious, with the fear to not drop their phones.
[**P**] It was a relaxing experience	
[**P**] Traveling through the Delta was breathtaking because its fauna and flora.	
[**P**] It was a nice experience to meet new people, and saw new places	
[**P**] The boat was very beautiful and very clean.	
[**P**] The speed boats were managed by experienced boat drivers.	
Campaign Experience	
Pros	**Cons**
[P] Learning from previous experiences it was communicated to the participants to have their own power banks.	**[C]** Some detours could not be predicted.
[P] The routes were discussed with the boat driver beforehand. During this campaign didn't occurred any problem with the boat or fuel, because there was bigger speed boats.	**[C]** For river data measurements the routes aren't that flexible.
[**P**] Participants had mobile data and had no problem in using it.	[**C**] Some phones were overheating.
[**P**] During this campaign all of the participants were above 18 years.	
[**P**] The method of small volunteers group works as well as planned.	

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[**P**] For some of the participants it was a new experience and learned new things	
[**P**] Learning things about the Delta and admiring the landscapes.	
[**P**] The tasks were easy to understood	
[**P**] Great experience and combination to collected data with the app and also enjoying the beautiful Delta	
[**P**] Constant support	
[**P**] Extra phones were available to the participants	
App Experience	
Pros	**Cons**
[**P**] The interactive way of presenting the app.	[**C**] People expected to see their pictures and videos after the boat trip.
[**P**] The feeling of implication from the participants, the idea of the app was appreciated also.	[**C**] In some cases, the data uploading took too much time whilst uploading of the data was confusing (the loading percentage didn't always correspond)
[**P**] User friendly interface and easy to use (intuitive).	[**C**] Annotating pictures in the normal mode doesn't always worked, the photo/video features don’t start on its own when volunteers arrived at POI's
[**P**] Implementation in SCENT Explore of the normal mode taxonomy, facilities the images annotations.	
[**P**] It was appreciated the app was worked offline	
[**P**] The design of the characters gets more popularity	
[**P**] The real time map usage and implementation was useful.	
[**P**] Diversity of the tags in the expert mode taxonomy, makes the data gathering process fun and easy	
[**P**] Competition has occurred between the participants, thereby they considered the app fun.	
[**P**] It was considered an exciting app which takes quality pictures and the interactive catching characters idea resulted a fun experience	
[**P**] Mapping an area with a lot of precision and gather useful data, like the water level, with the SCENT application, by using your phone even without the internet	

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[**P**] During this campaign it was assured speed boats, in conclusion larger area could be covered and more routs and POIs visited in less time than the previous campaigns	
[**P**] It announced when the character appeared and when pictures needed to be taken	

Following the feedback collected by this campaign the uploading of the data was reconfigured, an upload manager was introduced that was balancing the data uploading process. This resulted in an improved user experience. A leader board was also created to introduce a competition among the participants regarding the points collected.

Table 8. Evaluation of the 4th Campaign – LC/LU image collection and sensor measurements campaign

Boat Experience	
Pros	**Cons**
[**P**] Compared to previous campaigns phone battery last longer time (depending from phone to phone).	[**C**] At some places the boat was riding too fast and became too windy
[**P**] For land cover data, routes were flexible.	[**C**] During the sensor measurements data gathering it was request more often stops and often landing and boarding.
[**P**] The sightseeing and useful time spending was a good combination for some participants	
[**P**] Appreciated part of the campaign: the boat trip, new places, easy use of app, meeting new people, sharing the experience, nice weather, friendly captain and fantastic location.	
Campaign Experience	
Pros	**Cons**
[**P**] Considering that the participants have accommodation in settlement with electrical power. Charging the phones wasn't an issue.	[**C**] Some phones were overheating.
[**P**] Participants had mobile data and had no problem in using it.	
[**P**] It was a very sunny week, the perfect weather condition for that period of year.	
[**P**] The method of small volunteers group working better.	
[**P**] Extra phones were available to the participants	
[**P**] During this campaign it was assured speed boats, in conclusion larger area could be covered and more routs and POIs visited in less time than the previous campaigns	
App Experience	

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Pros	Cons
[**P**] Easy to use with friendly interface application.	
[**P**] Appreciated part of the app: the way it is organized, its functions, it works on GPS and does not need mobile data connection.	
[**P**] It was considered that could become a useful tool in collecting data from a large number of persons/volunteers and involve them in surveying, through this increase the opportunity to contribute to science	
[**P**] It was considered challenging, interactive, educational and funny due to the game part.	

In the context of the campaign faster boats were utilised and shorter routes were conducted to create an enjoyable activity. Regarding the accommodation of the volunteers the availability of internet connection was very important so measures were taken and accommodation with better network coverage was selected.

Table 9. Evaluation of the 5th Campaign – LC/LU image collection and sensor measurements campaign

Boat Experience	
Pros	**Cons**
[P] For land cover and land use data gathering, routes were flexible.	[**C**] The noise of the boat engine when it rides at higher speed.
[**P**] The method of small volunteers group working better.	
[**P**] The driver was very nice; the boat was safe and comfortable	
Campaign Experience	
Pros	**Cons**
[**P**] Compared to previous campaigns phone battery last longer time (depending from phone to phone).	
[**P**] Participants had mobile data and had no problem in using it, also at need they providing hotspot for others.	
[**P**] Extra phones were available to the participants	
[**P**] It was a very sunny week, the perfect weather condition for that period of year.	
[**P**] During this campaign also the landscape and Danube Delta possibility of exploring for several days was really appreciated.	
[**P**] The routes were nice chosen because of the diversity of plants and species occurred.	

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

[**P**] During this campaign it was assured speed boats, in conclusion larger area could be covered and more routs and POIs visited in less time than the previous campaigns	
App Experience	
Pros	**Cons**
[**P**] Implementation of vibrating announcement when a photo should be taken.	
[**P**] Easy to use app, the real-time map implementation	
[**P**] Consideration of the SCENT explore: dynamic, useful, making the real time measurements, Fun+Science!	
[**P**] It was appreciated the idea of the gamification for collective data used in research	
[**P**] The characters gained more popularity during this campaign.	

The last campaign of DD pilot had implemented all the experience gained from the previous campaigns regarding the number of engaged participants, time spent on the boats, location of the accommodation and the duration of the organized campaign. The feedback received from the volunteers that participated in this campaign shows the campaign was successful and appreciated by the participants.

4.2 Overall experience evaluation

4.2.1 Campaign experience

Analysis of the completed feedback forms from the participants, shows that the amount of time spent in the boat per day (Figure 28), was perfect in case of the 3rd, 4th and 5th campaign, considering that the duration of the field trip was between 4 and 5 hours. In case of the 1st and 2nd campaign the participants felt that the time spent in the boat was a bit too much, in this case the field trip duration was between 5 and 6 hours.

Further insights regarding the abovementioned figure are illustrated in Figure 29 which shows that 57.14% of the participants in the 1st campaign, and 64.7% of the participants in the 2nd campaign considered that the campaign was “a bit too much-3-4 hours would be better”. After reducing the amount of time spent in the boat to 4 hours per route, in the 3rd, 4th and 5th campaign participants considered in 68.18%, 58.33% and 50% that it was perfect.

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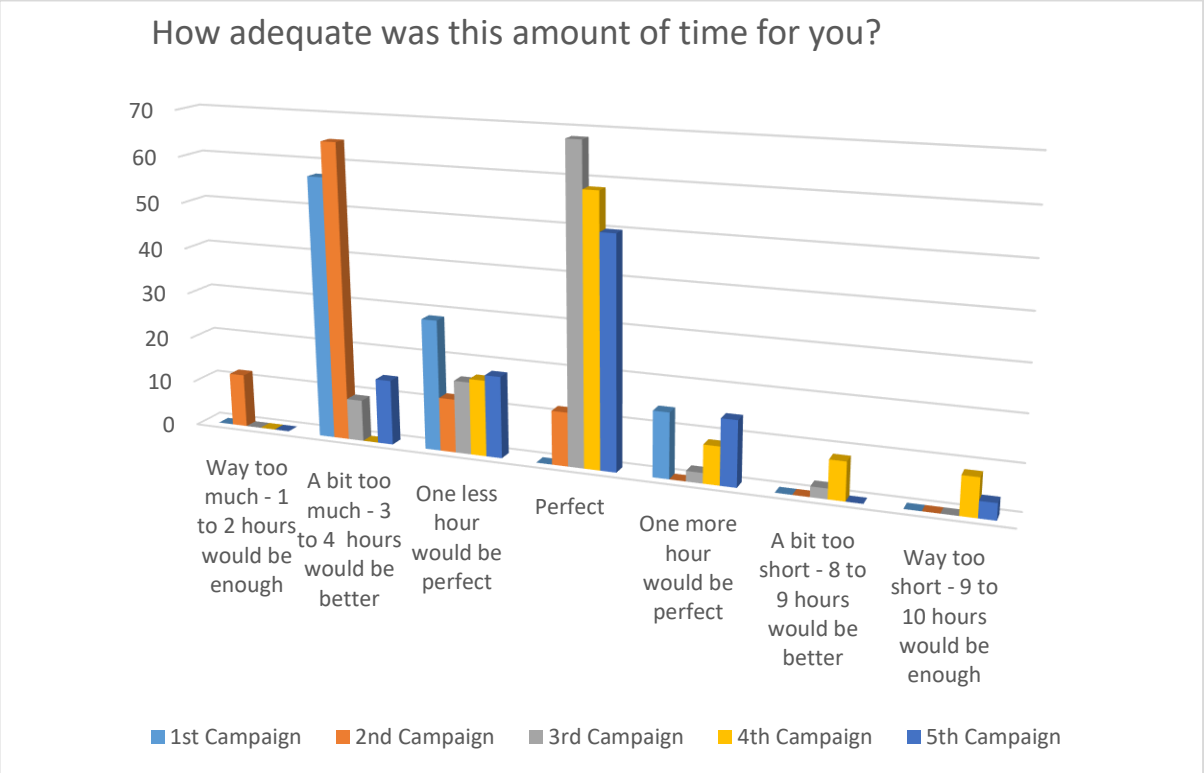
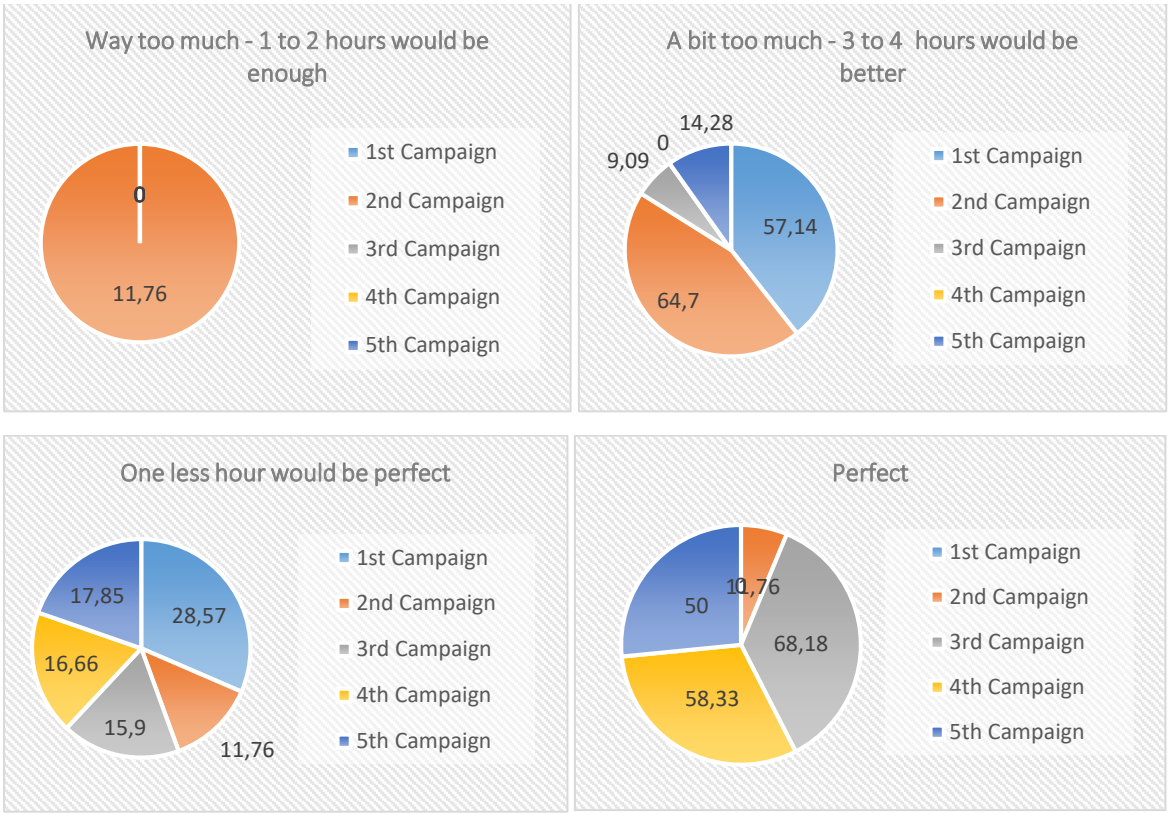


Figure 28. Results (%) of the evaluation form regarding the amount of time spent during the field campaigns



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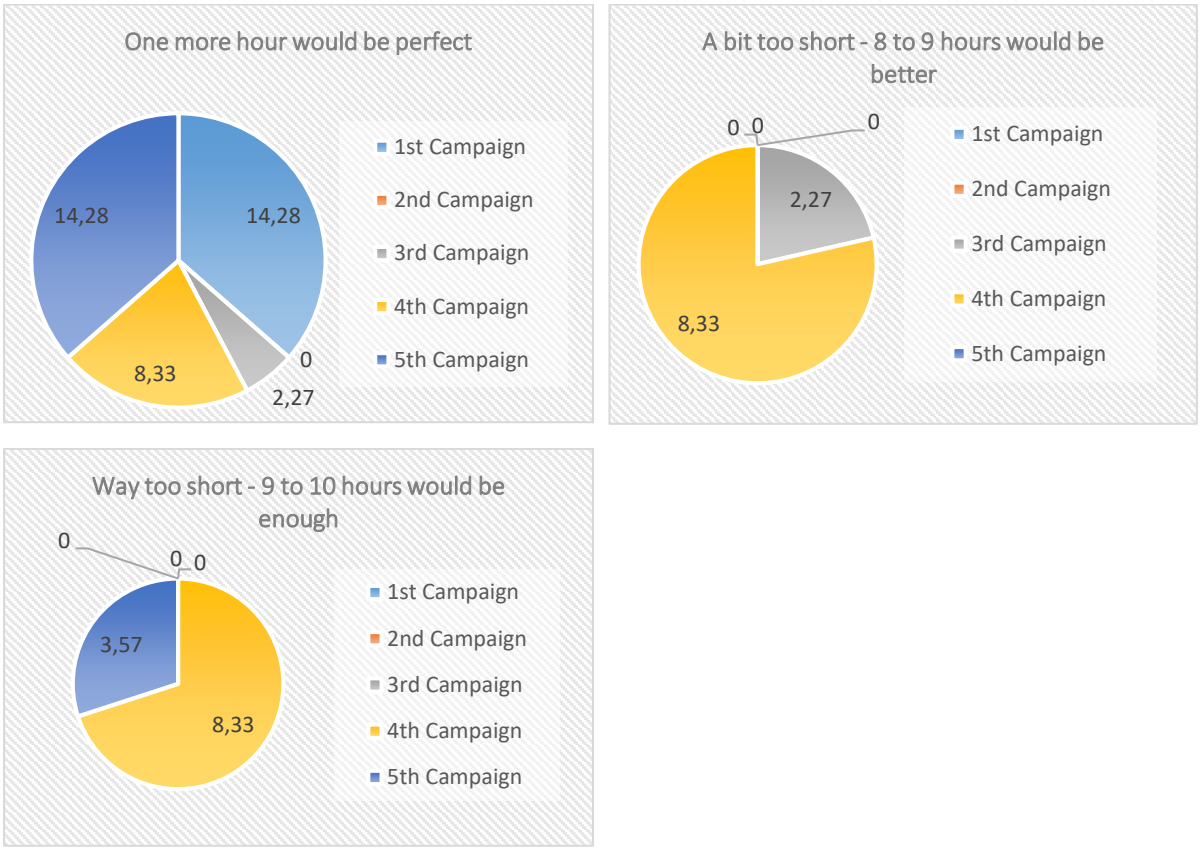

Figure 29. Overall percentages of the amount of time spent during the field campaigns for all campaigns

Analysing the completed feedback forms from the participants, regarding the reasons for not enjoying the field trip (Figure 30), the majority in each campaign wanted to capture more SCENT characters, some of the participants got tired and some of them, mostly in the 3rd and 5th campaign wanted to enjoy more free time in the trip. During the summer and the autumn campaigns (1st and 2nd) the participants felt that the weather wasn't that pleasant, too hot or too cold.

According to Figure 31, mostly in the 1st and 2nd campaign, during summertime and autumntime the 28.57% and 35.29% of the volunteers complained about too hot and too windy and cold weather.

Also, in these two campaigns, presented in Figure 31, 42.84% and 35.29% of the volunteers got tired faster. After reducing the amount of time spent in boat, organizing the spring time campaigns the volunteers in 61.36%, 41.66% and 32.14% wanted to capture more characters using the SCENT app.

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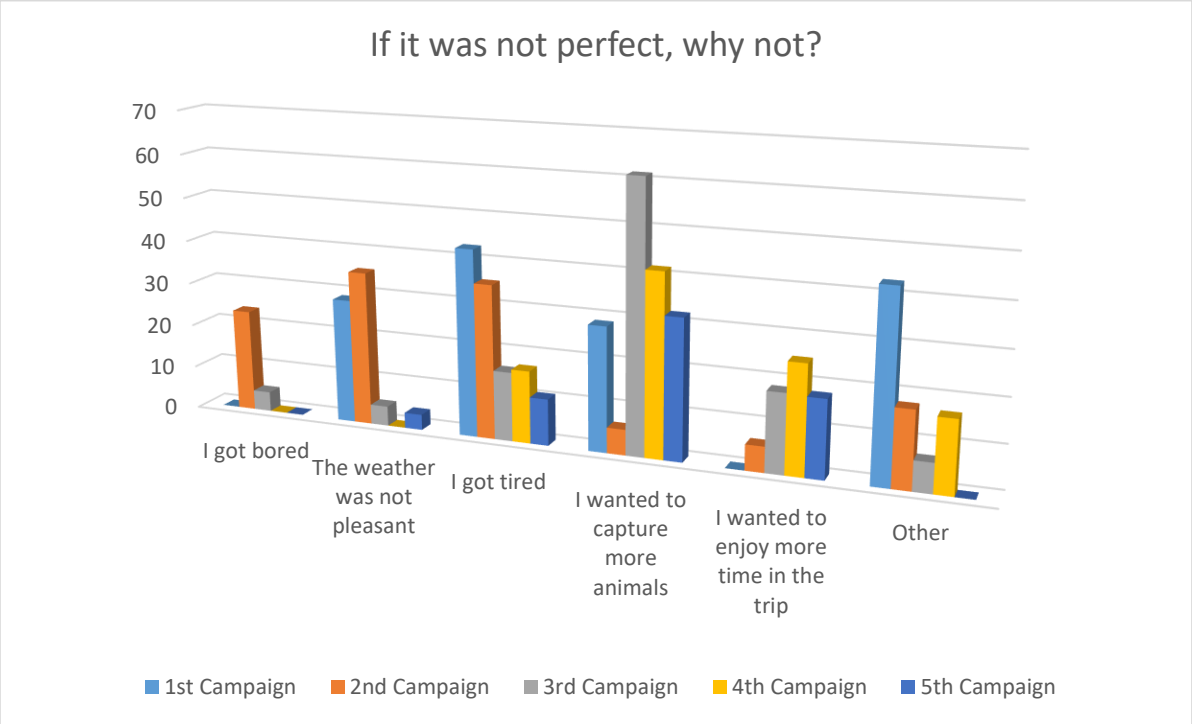
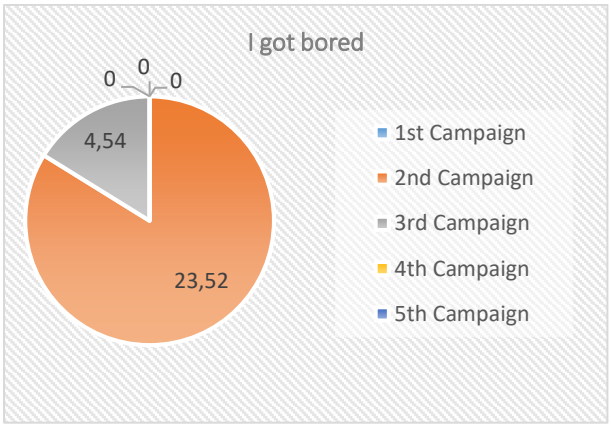
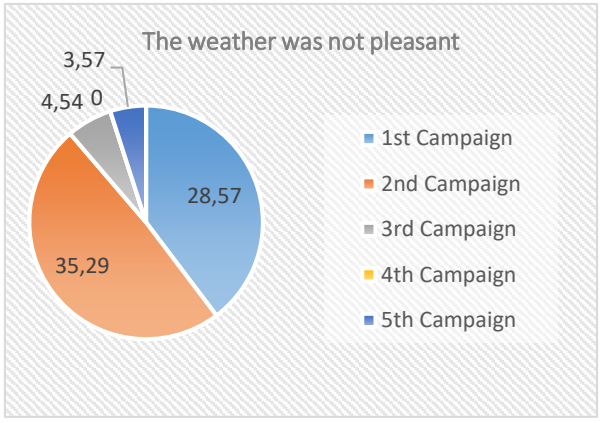
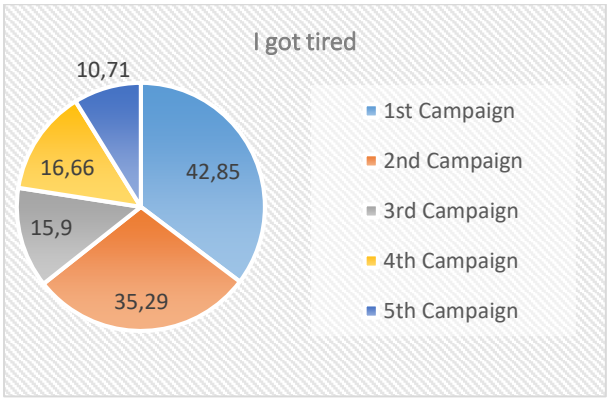
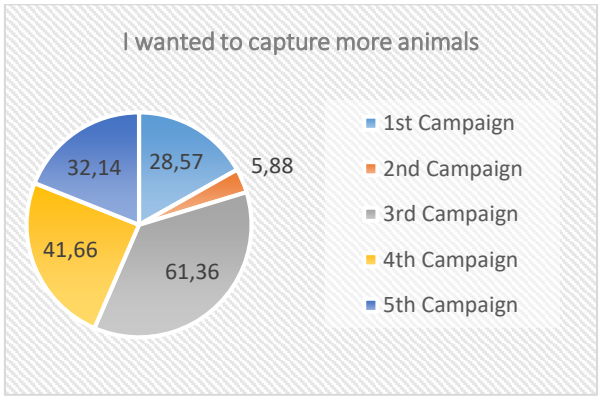


Figure 30. Results (%) of the evaluation form regarding what restrained the participants campaign experience









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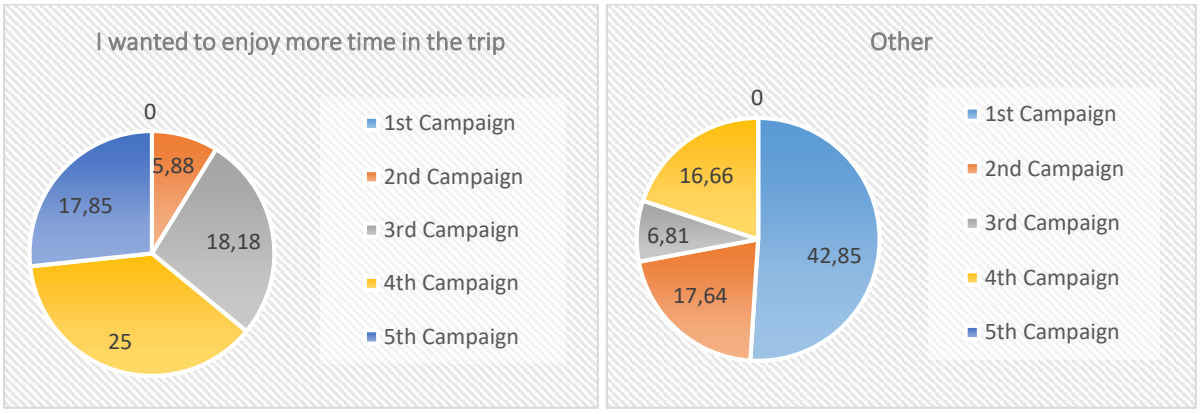

Figure 31. Overall percentages regarding what restrained the participants for all campaigns

The results of the preferred amount of time spend on the boat shows us that on average the participants prefer to stay on the boat up to 4 hours. During the spring time campaigns (3rd, 4th and 5th) the volunteers would prefer to stay up to 6 or 8 hours in the boat, according to Figure 32.

A more detailed analysis shows in Figure 33, that the preferred hours spent on boats is up to 4 hour, but 52.27% and 32.14% of the volunteers would prefer to stay up to 6 hours in the boat, during the springtime campaigns, even up to 8 hours 41.66% of the volunteers considered suitable to make the field campaigns.

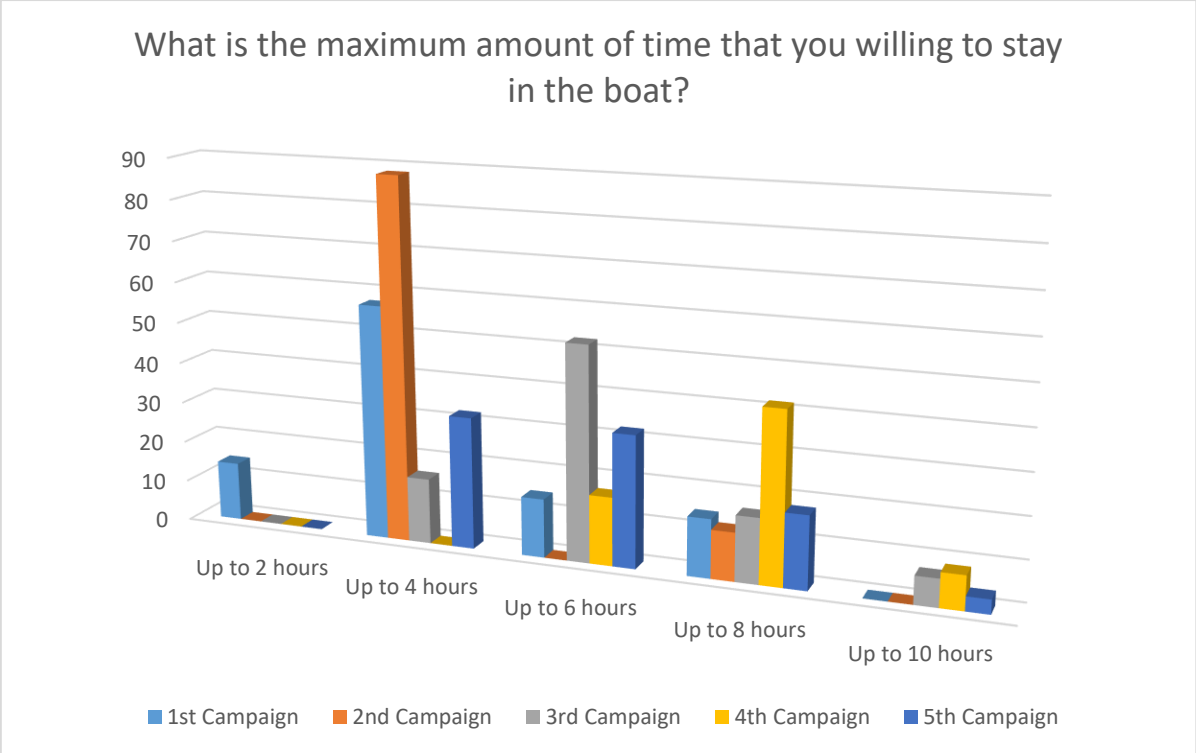

Figure 32. Results (%) of the evaluation form regarding what is the maximum amount of time that participants prefer to stay in the boat during the DD campaigns

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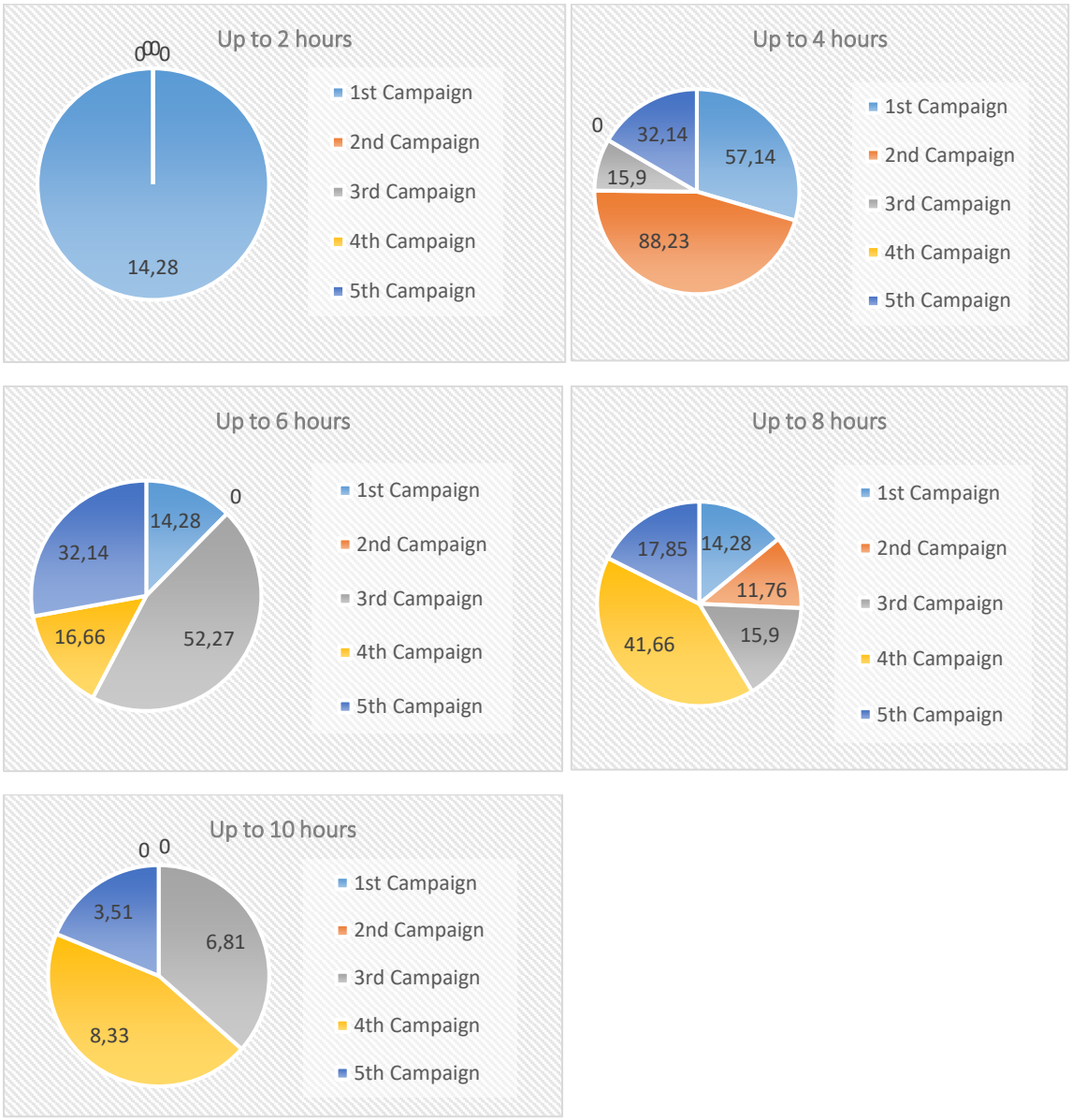

Figure 33. Overall percentages regarding what is the maximum amount of time that participants prefer to stay in the boat for all campaigns

Regarding on how easy it was to capture the characters, presented in Figure 18, during LC/LU data collection in the DD campaigns using the SCENT Explore app, the majority of the volunteers thought that it was easy enough, sometimes a bit hard- mostly when the boat was going faster.

Analysing the Figure 35 in the 2nd and 3rd campaign 52.94% and 34.09% of the participants considered that it was a bit hard to capture the characters using the SCENT Explore, because the boat was moving too fast. In the 1st, 2nd, 3rd and 4th campaign, more than 50% of the volunteers considered that it was easy to capture the characters, considering that all the campaigns were executed on moving boats. A small percentage of the volunteers considered very easy to catch the SCENT characters.

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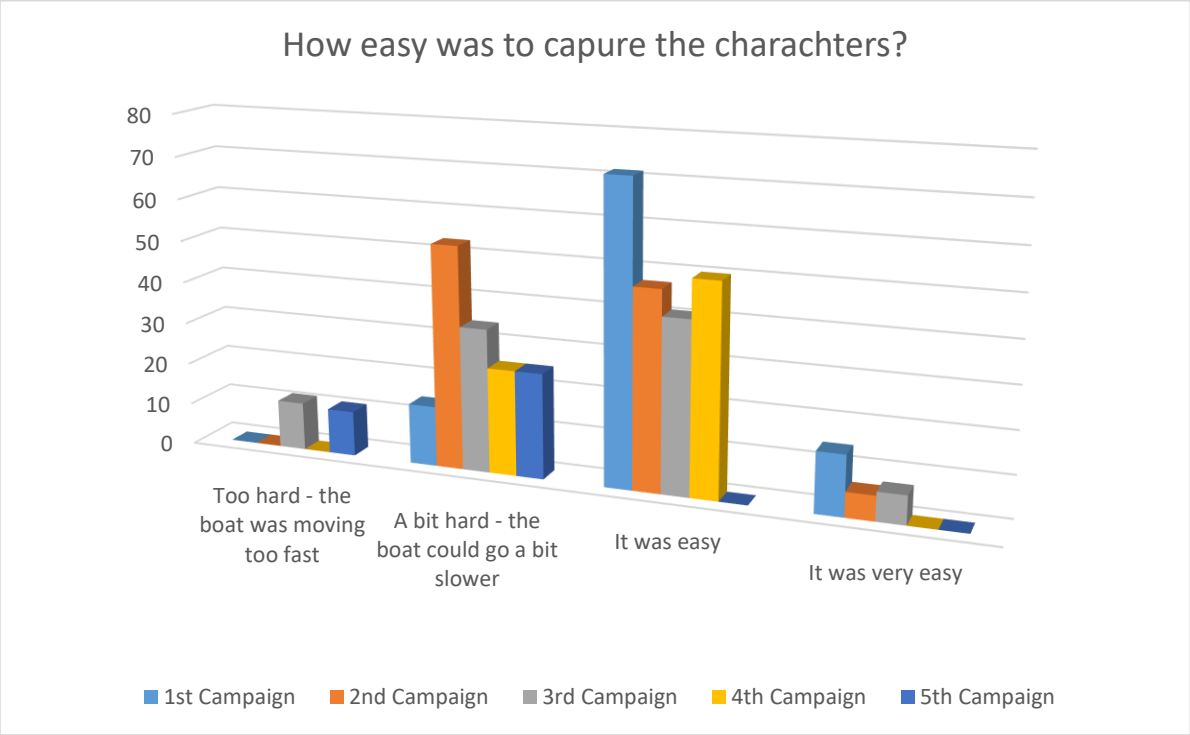
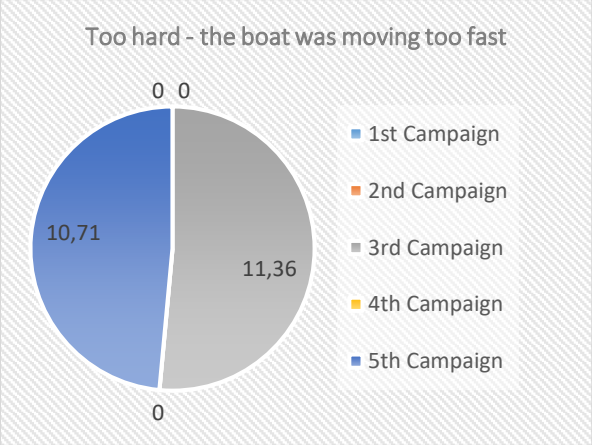
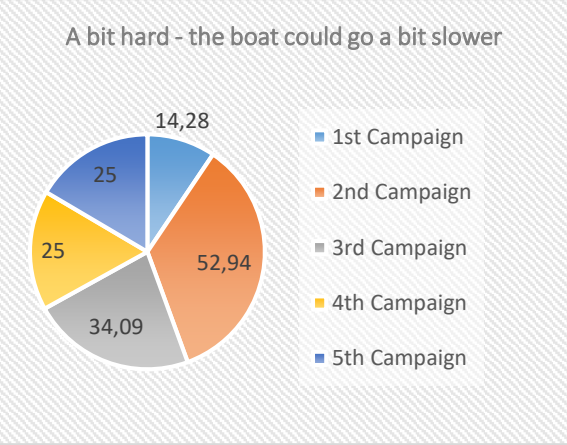


Figure 34. Results (%) of the evaluation form regarding easiness of capture the characters using SCENT Explore app, during the DD campaigns.





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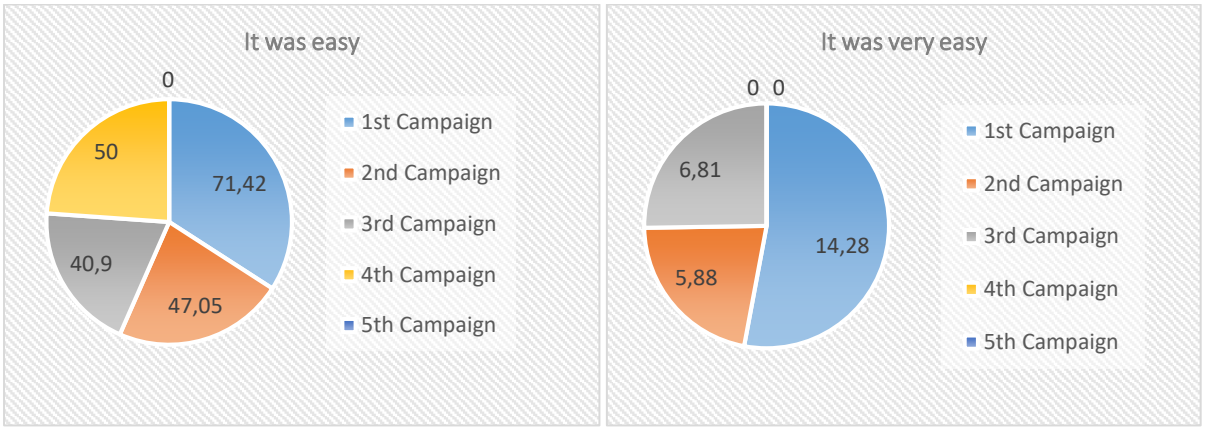

Figure 35. Overall percentages regarding easiness of capture the characters using SCENT Explore app for all campaigns

From the point of view of the participants the number of characters appearing while the boat was moving (Figure 36) - was perfect for the majority. Additionally, some of them felt there were too few, and wanted to catch more.

Further details are provided in Figure 37, where is presented that in each campaign at least 50% of the volunteers considered perfect the amount of the characters appearing while the boat was moving.

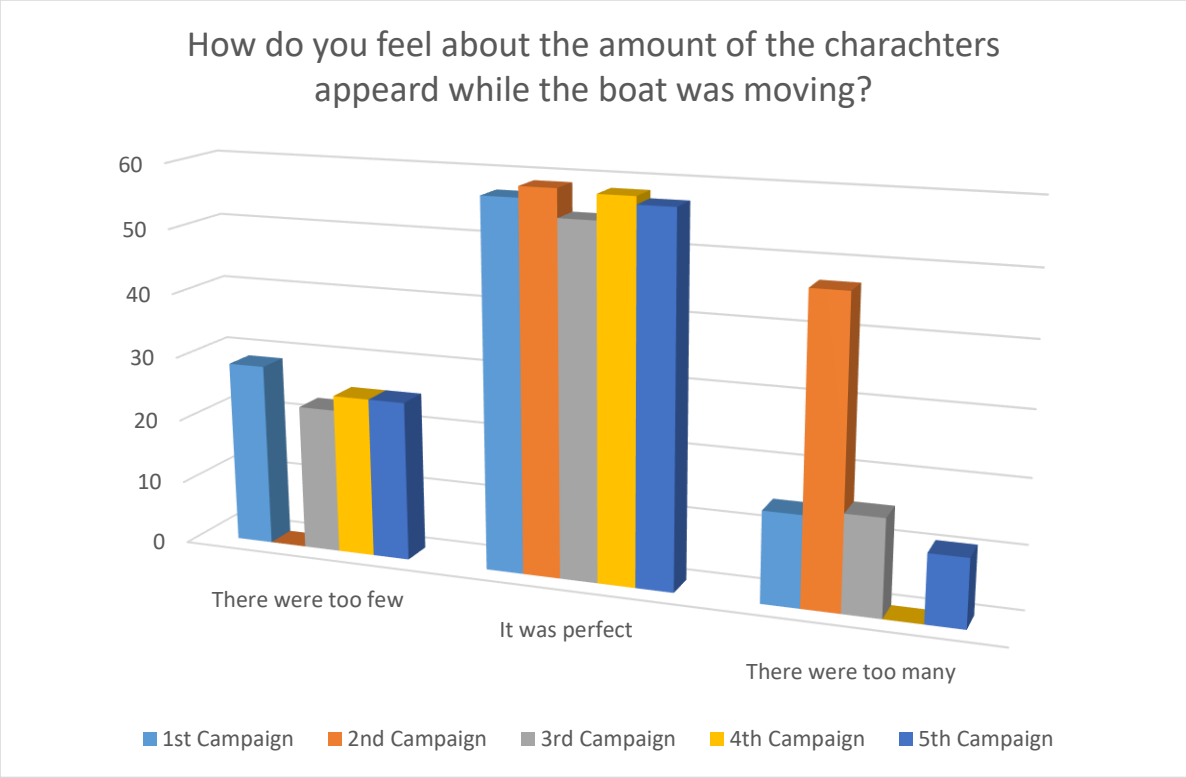

Figure 36. Results (%) of the evaluation form regarding amount of the characters appeared using SCENT Explore app, during the DD campaigns.

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 688930.

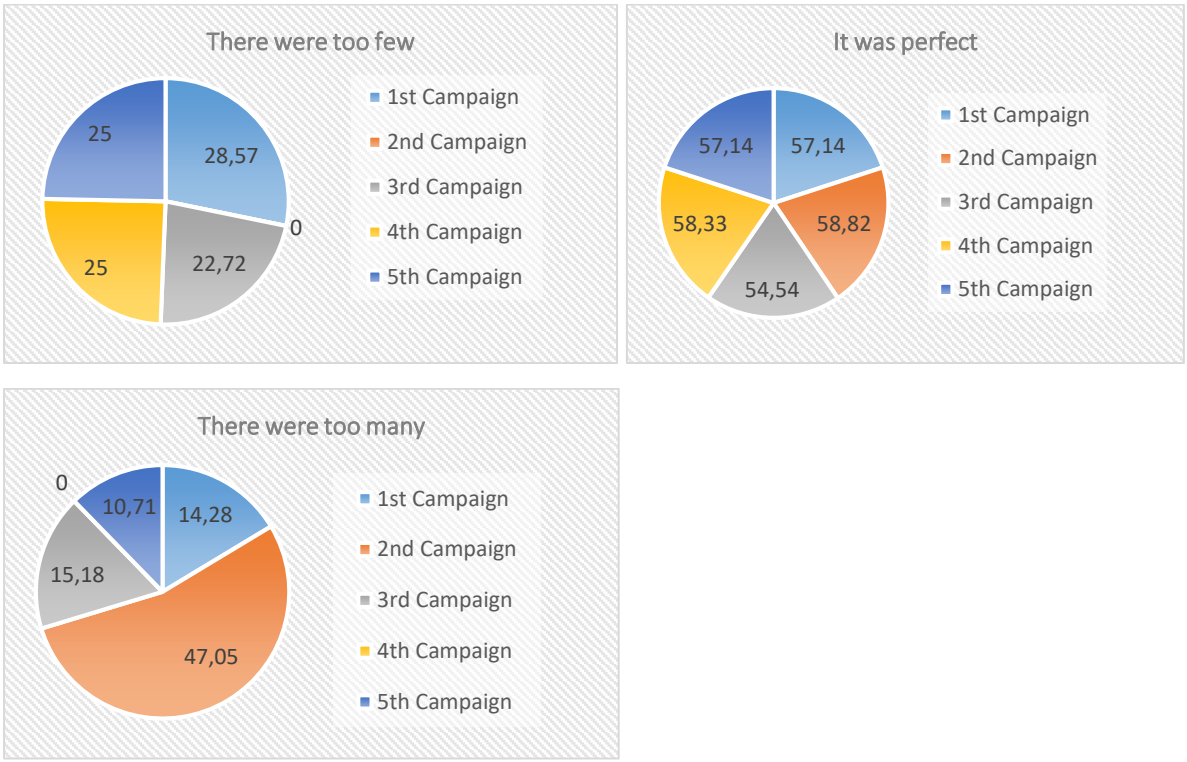

Figure 37. Overall percentages about the amount of the characters appeared using SCENT Explore app for all campaigns

The amount of time spent during the field campaigns to capture the characters (Figure 38) and when the boat stopped for the volunteers was judged as ' it was nice', but it could be more often and also in the 2nd campaign the participants thought that the boat stopped too many times, they would have preferred less often.

The subsequent pie charts (Figure 39) show that 29.41% of the participants from the 2nd campaign, during the river measurement data collection considered that the boat stopped too many times. In the 1st campaign, 28.57% of the participants considered that the times the boats stopped was too short. Being a LC/LU campaign, the volunteers didn't need to stop such as in the case of gathering water level and water velocity measurements. From all the campaigns the majority: 57.14% in the 1st campaign, 47.05% in the 2nd campaign, 72.72% in the 3rd campaign, 100% in the 4th campaign and 96.42% in the 5th campaign considered that the amount of time the boat stopped to capture the characters was nice. The increase of the percentages in the last campaigns is related to both the camping type conducted as well as from the period and season when the campaign was organized.

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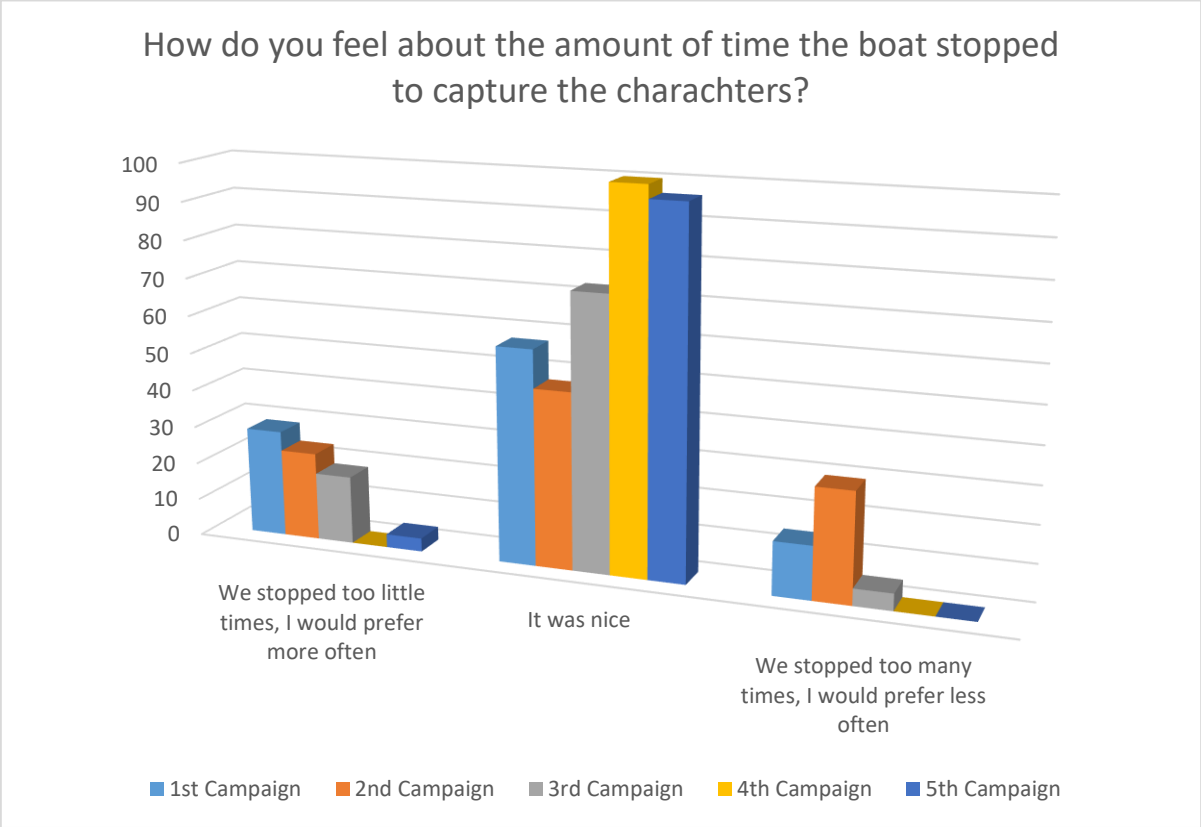
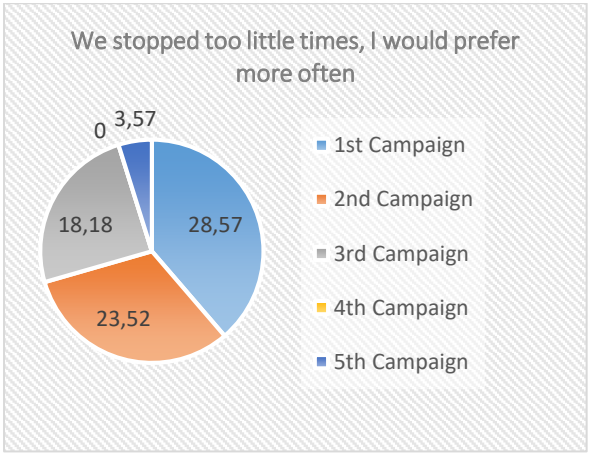
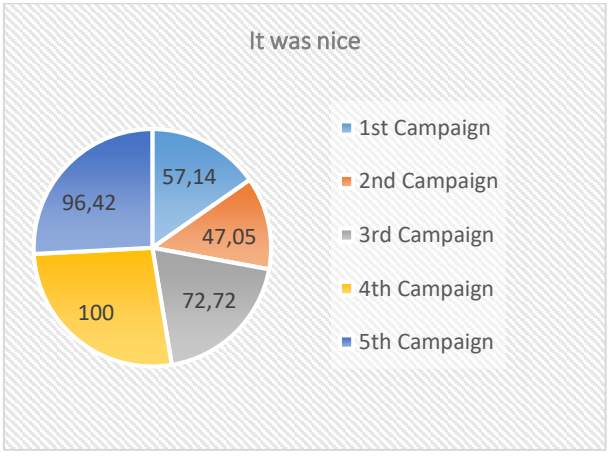


Figure 38. Results (%) of the evaluation form regarding the amount of time the boat stopped to capture the characters using SCENT Explore app, during the DD campaigns.





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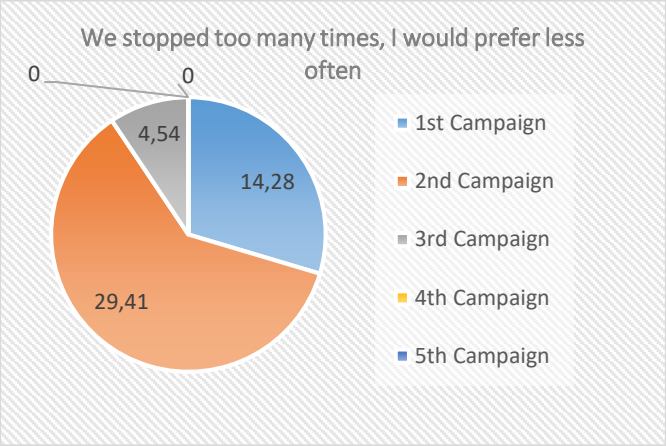


Figure 39. Overall percentages about the of time the boat stopped to capture the characters for all campaigns

To express their opinion about the boat experience the volunteers had three open questions. The participants liked the most, 'landscape and nature' from the boat experience during the field campaigns. In large numbers, they also liked the people, the group with whom they shared this experience (Figure 40). It was also mentioned that this was a new experience for them and it was relaxing and fun to experience boat trips and using an app to gather useful data. According to the graphs from Figure 41 in each campaign more than 50% of the volunteers liked most the pilot area landscape and nature, whilst in the 2nd (29.41%), 3rd (31.81%) and 4th campaign (33.33%) the volunteers enjoyed the company of the other participants.

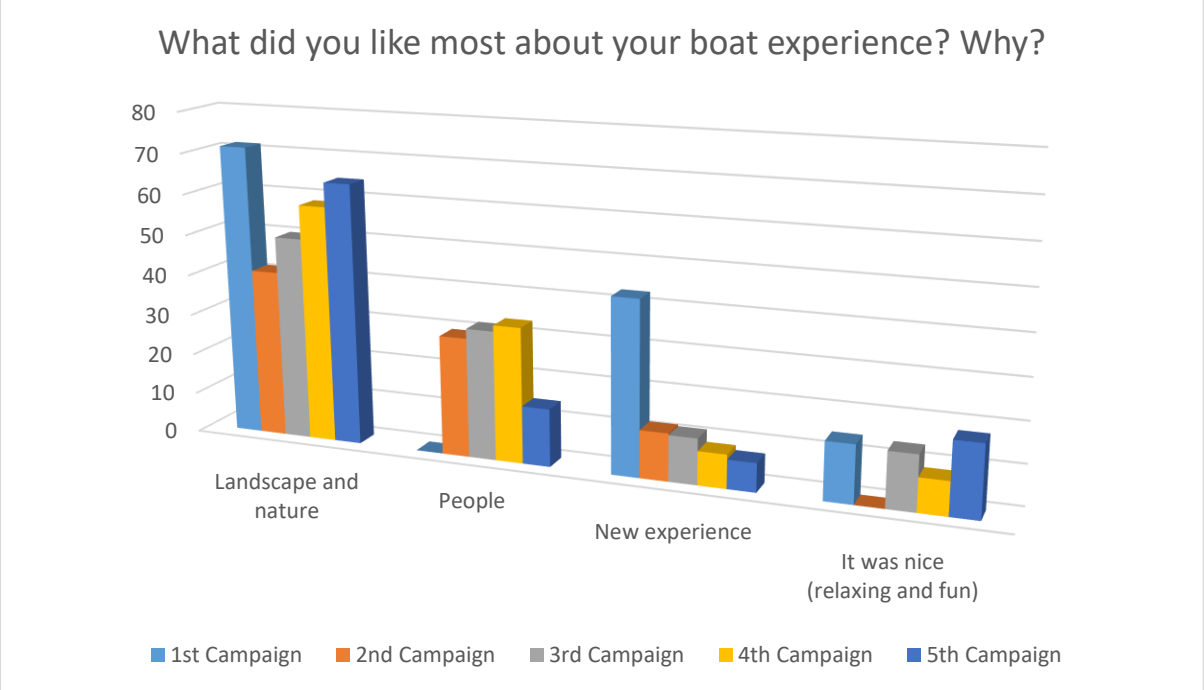


Figure 40. Results (%) of the evaluation form regarding the most liked aspect of the boat experience, during the DD campaigns.

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

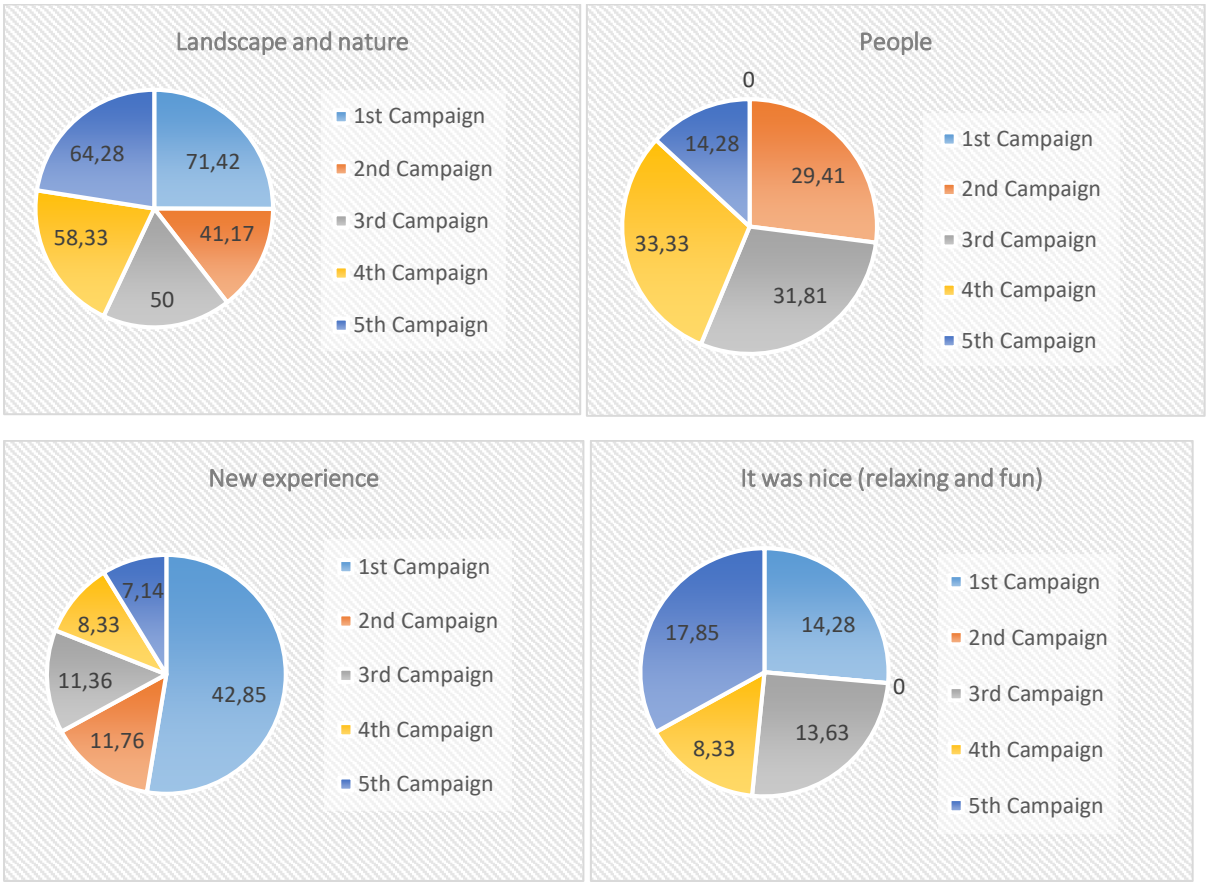


Figure 41. Overall percentages about the most liked aspect of the boat experience for all campaigns

The least liked aspect about the boat experience for the participants was the weather condition, too fast motor boats, and too much time spent on the boat. Mostly from the 2nd, 3rd and 5th campaign the volunteers didn't find any 'least liked' aspect in the boat experience.

According to the graphs from Figure 42Figure 41 the opinions were divided about the least pleasant aspect of the campaign between the weather condition and the duration of the trips. In the 1st campaign both aspects were represented in high percentage, 57.14% of the participants didn't like the weather condition and 28.57% didn't like the duration of the field trips. This data may be the result of the campaign organized during summer, with slower and smaller boats than the following campaigns.

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

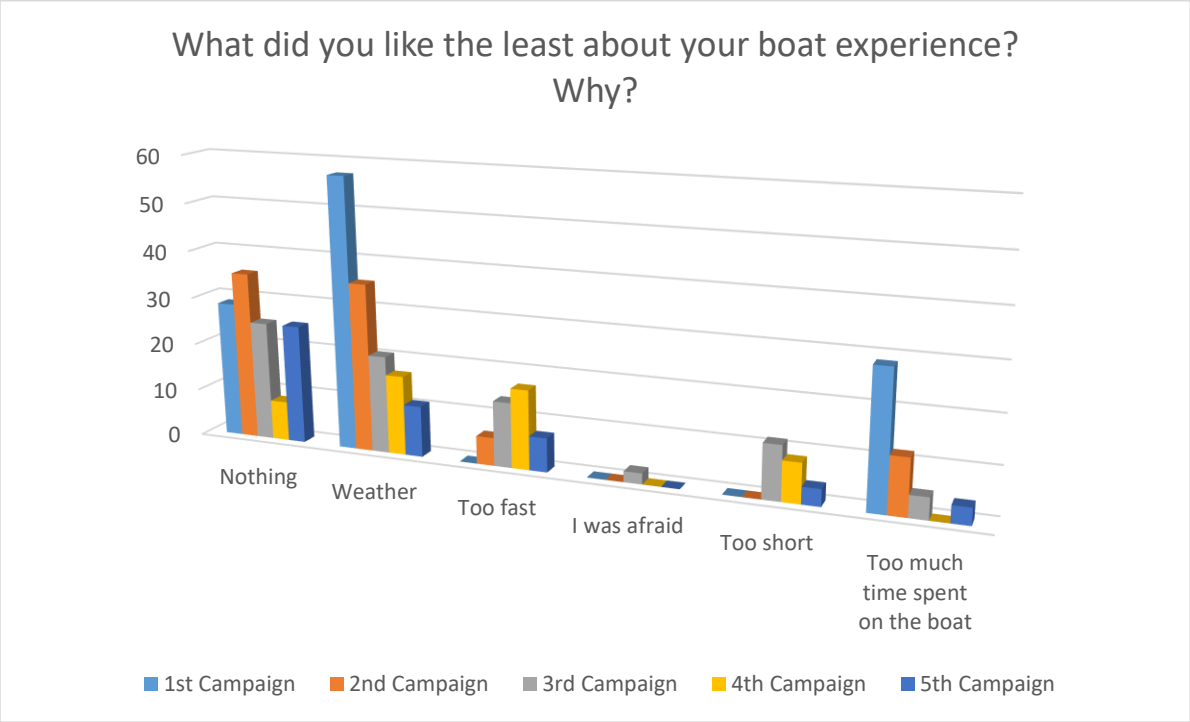
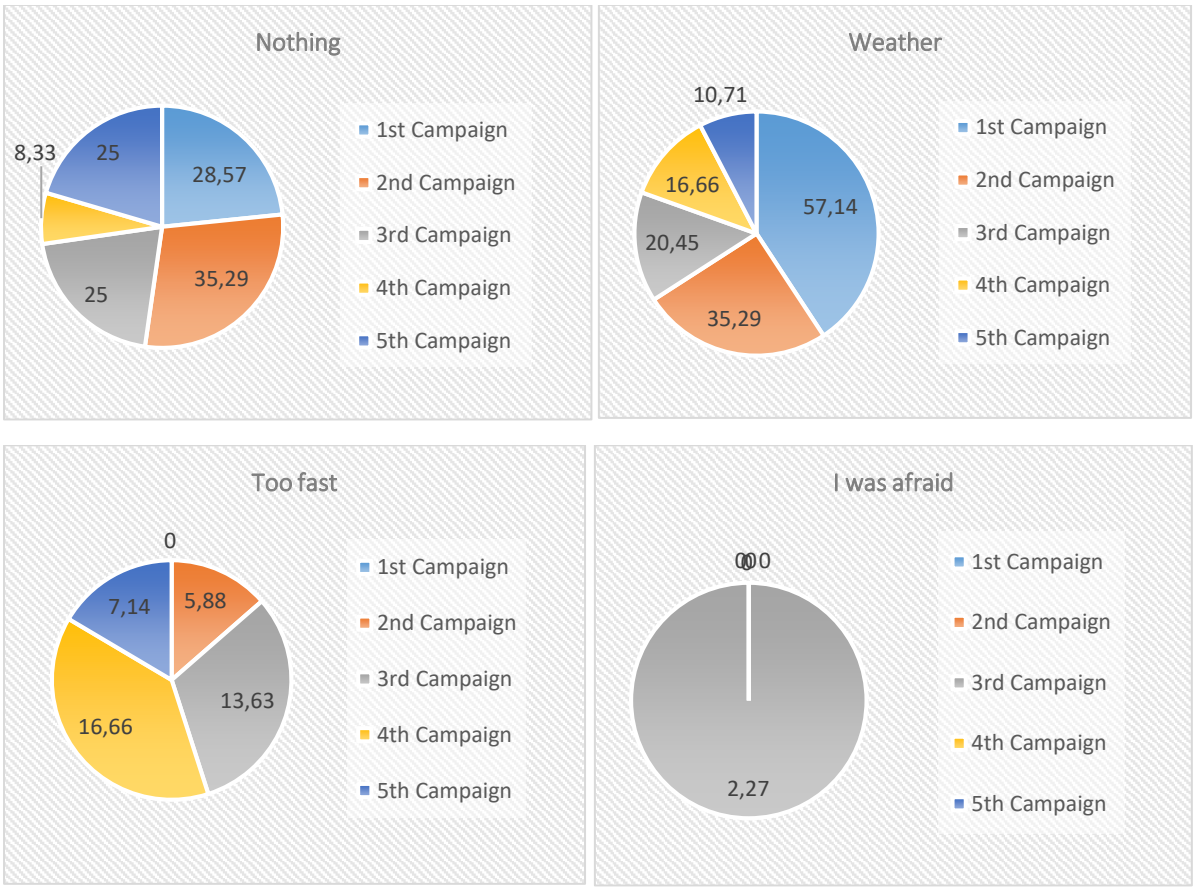


Figure 42. Results (%) of the evaluation form regarding the least liked aspect of the boat experience, during the DD campaigns.



The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

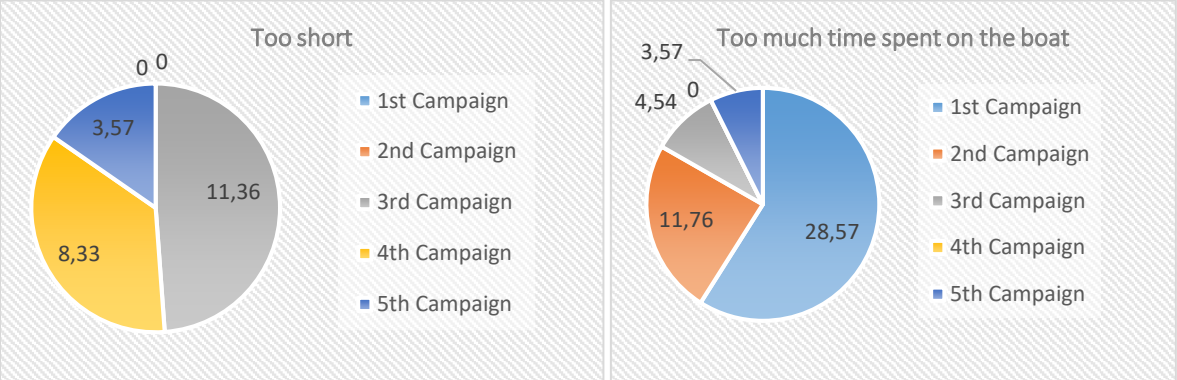


Figure 43. Overall percentages about the least liked aspect of the boat experience for all campaigns

From the point of view of the volunteers the boat experience could be improved (Figure 44) if the boats go slower, get more time to spend in the boats to enjoy the area landscape and birds, get more information about the Danube Delta and the routes where they surveying, have a guide in each boat, and diversify activity during the field campaigns. According the graphs from Figure 45 the needed improvements in the 1st campaign were indicated by participants in 57.14% to reduce the time spend on the boat to up to 4 hour and diversifying the activity during the campaign in 48.57%. For the 2nd campaign after switching partially from slower, small boats to faster bigger boats the indicated improvements were also to reduce the time spent in the boats, diversify the activity and to get more information about the routs and DD area. Taking into consideration the proposed improvements in the 3rd campaign the participants in 18.18% suggested the improvement aspect would be to spent more time on the routes. Also, in 4th campaign the participants in 33.33% would like to reduce the speed of the boats to get time to enjoy the activity and the surroundings.

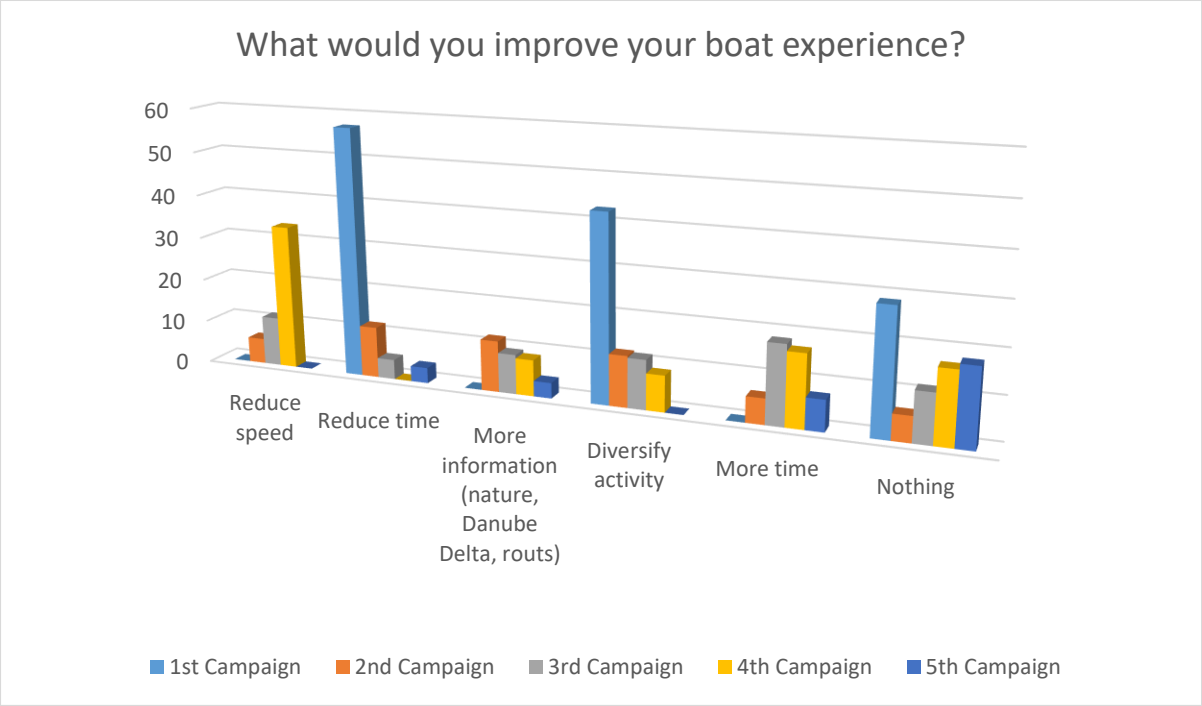


Figure 44. Results (%) of the evaluation form regarding how to improve the boat experience, during the DD campaigns.

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

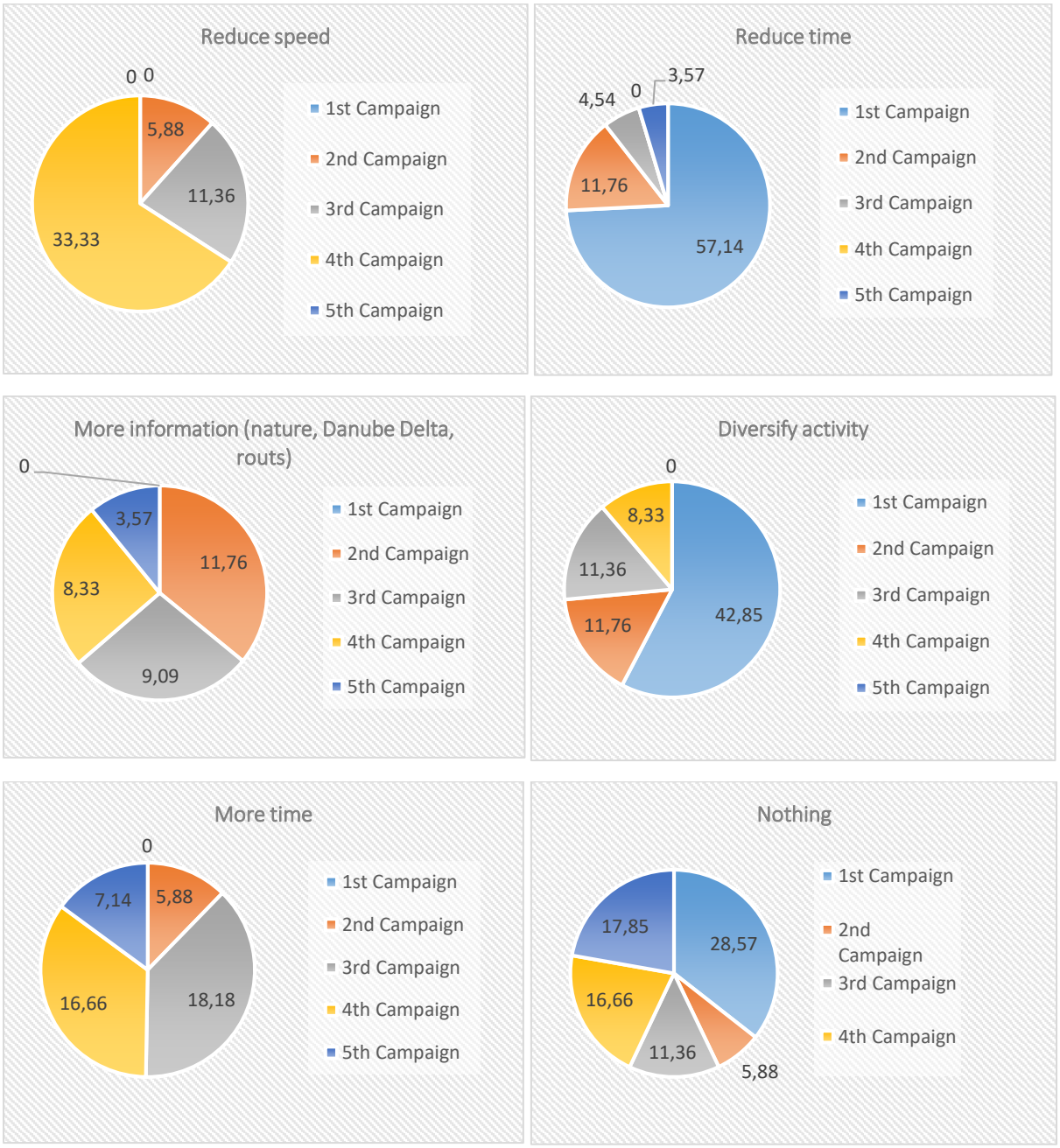


Figure 45. Overall percentages about how to improve the boat experience for all campaigns

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

4.2.2 App experience

The app experience questions were open questions in the evaluation form received by volunteers.

Analysis of the completed feedback forms from the participants, shows that the participants liked mostly about the SCENT apps (Figure 46) (SCENT explore, SCENT Measure) the characters, the concept of the application and the project, the interactive aspect of the app, which was easy to use and it's user-friendliness, and the offline-mode of the app which was a very important element used during the field campaigns. Some of the participants liked also the presence of the map and the design of the app.

Analysing the results of the graphs presented in Figure 47 the concept of the project and the activity was liked in each campaign as follows: in the 1st campaign 42.85%, in the 2nd campaign 17.64%, in the 3rd campaign 22,72%, in the 4th campaign 16.66% and in the 5th campaign 25% by the participants. The interactive way (33.71%) and simple and user-friendly way the app works was mostly appreciated by students in the 1st campaign (42.85%). The offline mode of the app was appreciated in the 5th campaign mostly by young, employed participants in 35.71%.

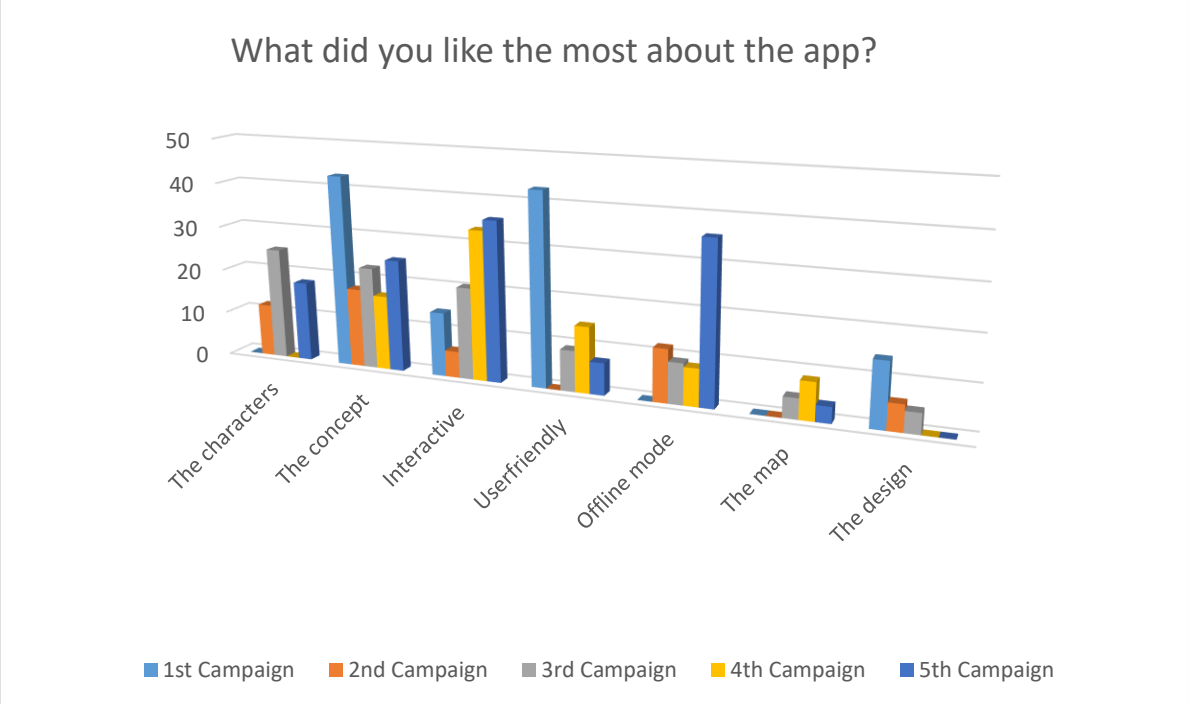
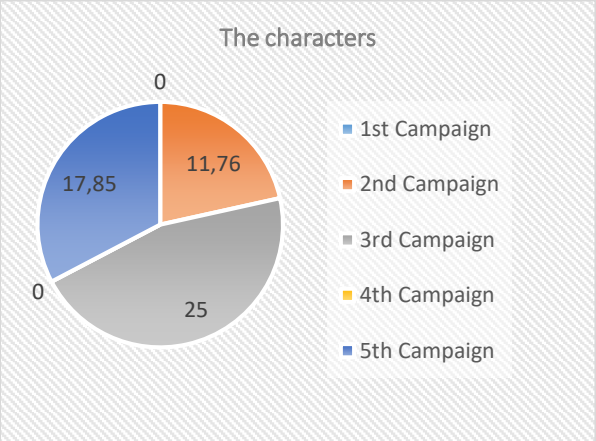
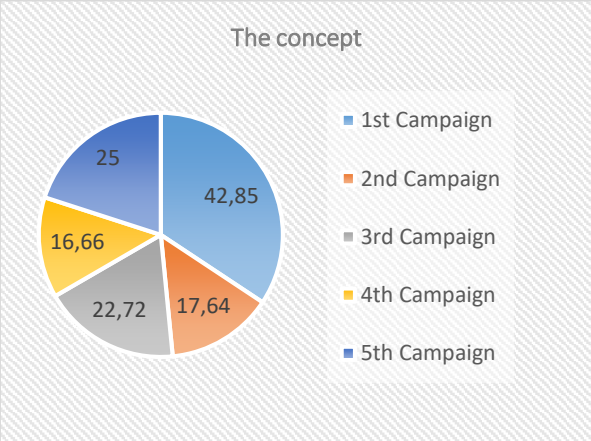
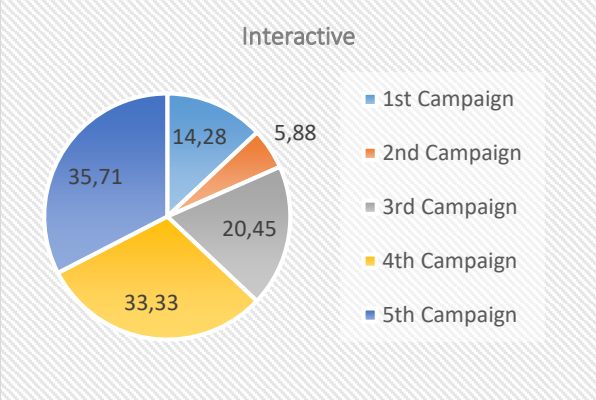


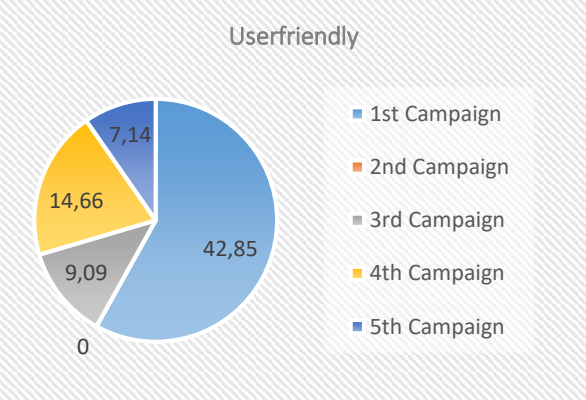
Figure 46. Results (%) of the evaluation form regarding the most liked aspect of the SCENT app, during the DD campaigns.

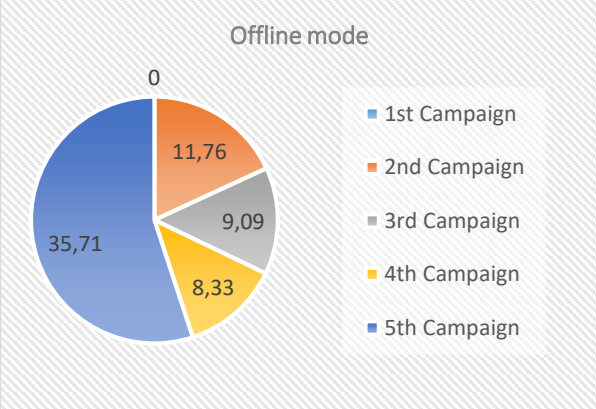
The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

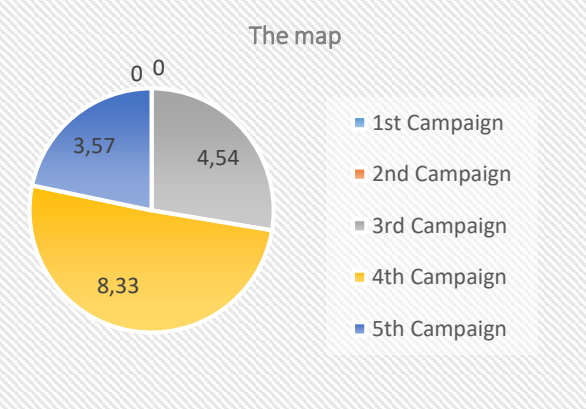












The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

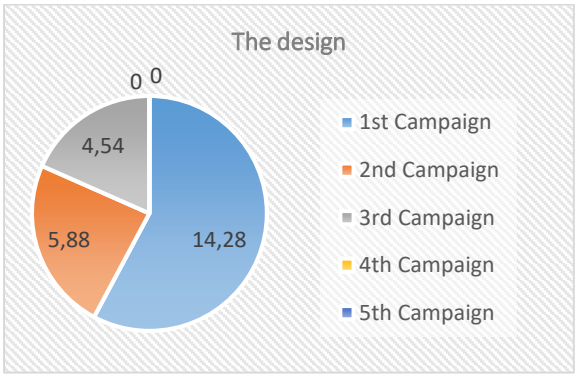


Figure 47. Overall percentages about the most liked aspect of the SCENT app for all campaigns

The least liked aspect about the app experience for the participants (Figure 48) was the fact that there were crashes of the app, and the processing speed. The complex taxonomy, high battery usage also the design was also less liked by some users. Mostly from the 1st and the 2nd campaign the volunteers didn't find any 'least liked' aspect of the app.

Regarding the offline usage of the app the least liked aspect by the participants was slow processing speed in the 3rd campaign by 40.9% of participants and when the app crashes occurs in the 4th campaign by 66.66% of participants. In the 1st LC/LU campaign 71.42% of the participants didn't pointed out any unpleasant aspect of the app usage.

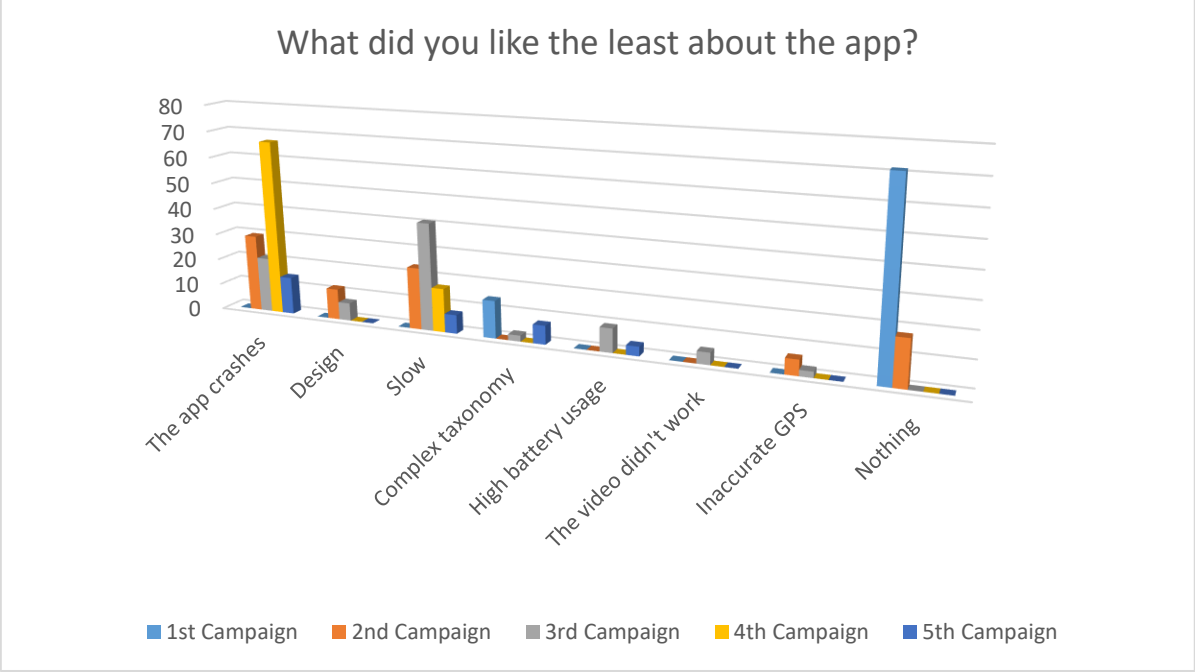
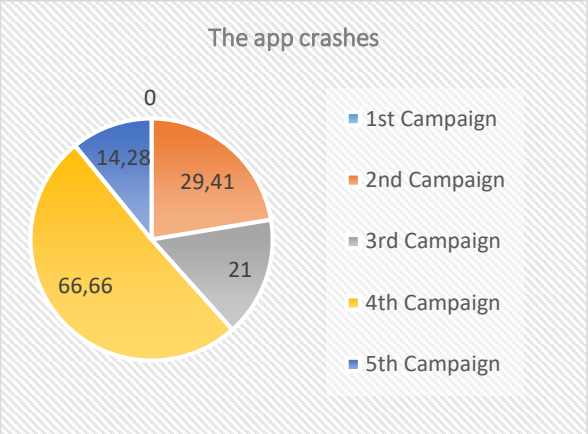
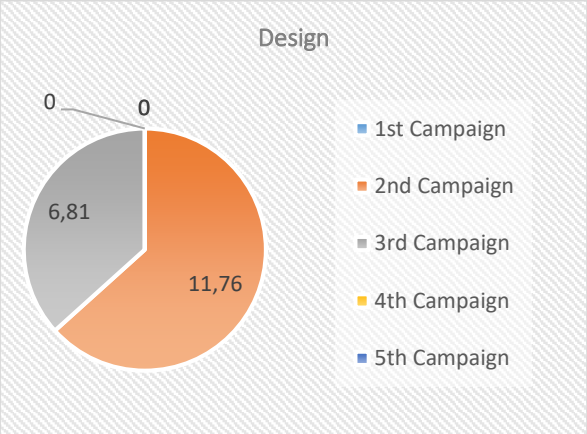
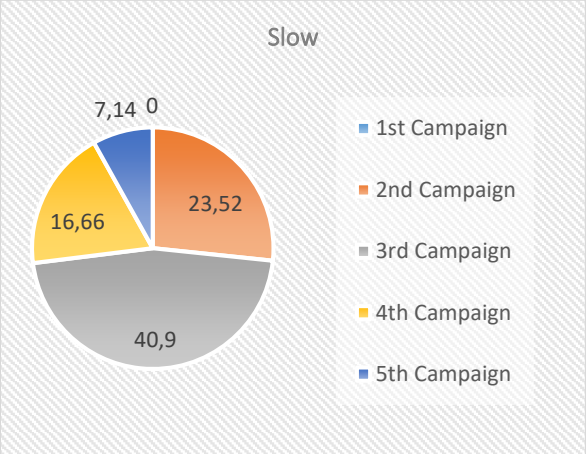


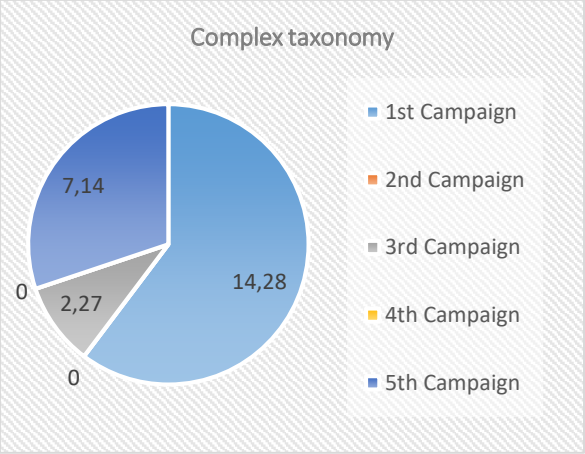
Figure 48. Results (%) of the evaluation form regarding the least liked aspect of the SCENT app, during the DD campaigns.

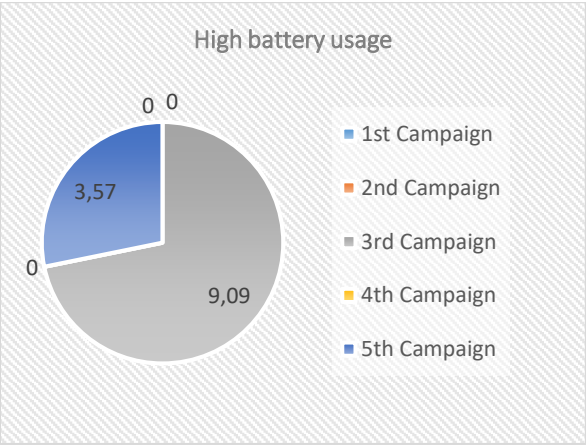
The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

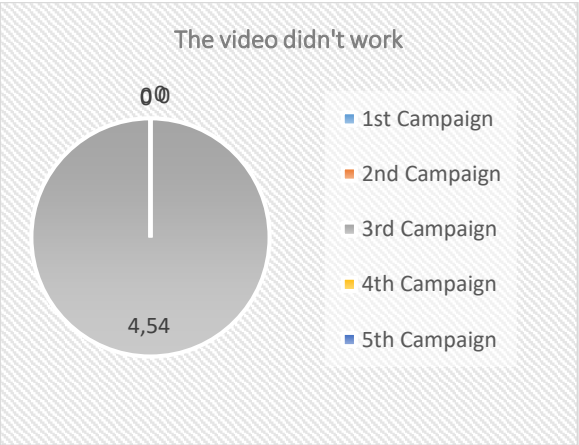












The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 688930.

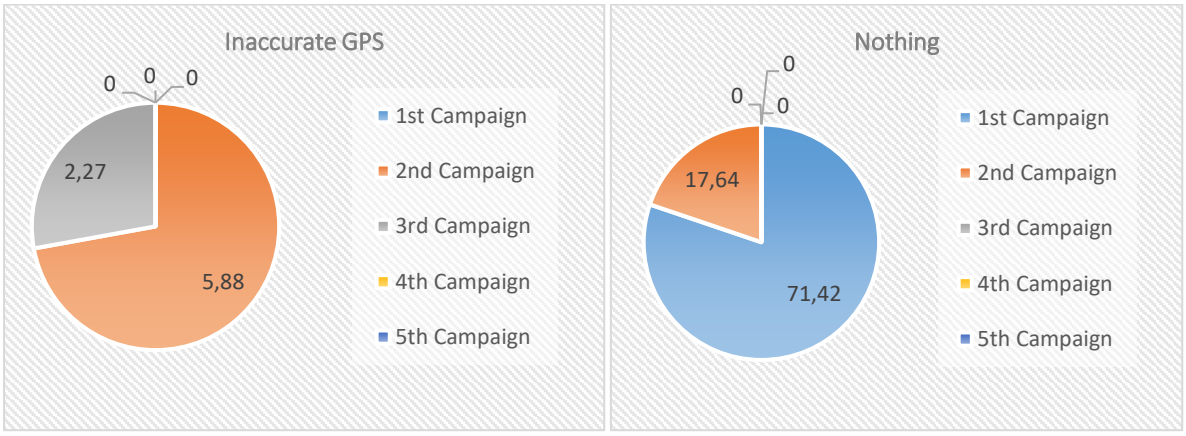


Figure 49. Overall percentages about the least liked aspect of the SCENT app for all campaigns

As a result of the volunteers' feedback the SCENT app could be improved (Figure 50) if the processing speed is increased, the battery consumption is optimized, the app is optimized for more type of phones, the interface becomes more intuitive, the map is more accurate and the features causing the crashes are repaired. Also, mostly from the 1st, 2nd and 5th campaign the volunteers didn't find any aspect to improve on the app.

From the 3rd, 4th and 5th campaign participants completed in a higher rate the open question about how the application can be improved. Regarding the graphs from Figure 51 in the 3rd campaign participants suggested improvements in higher rating regarding the increase of the processing speed (43.18%), the battery consumption optimization (11.36%), to get more intuitive interface (18.18%) and repair the occurred crashes (20.45%). In the 4th campaign mostly the same aspect was pointed out by participants like in the previous campaign. In the 1st and the 5th campaign 57.17% of the participants considered there is no need for any improvement. The results and suggestion proposed by participants to improve the app can also vary depending of the thematic focus of the campaign and different functionality usage of the app (photo, video, sensor).

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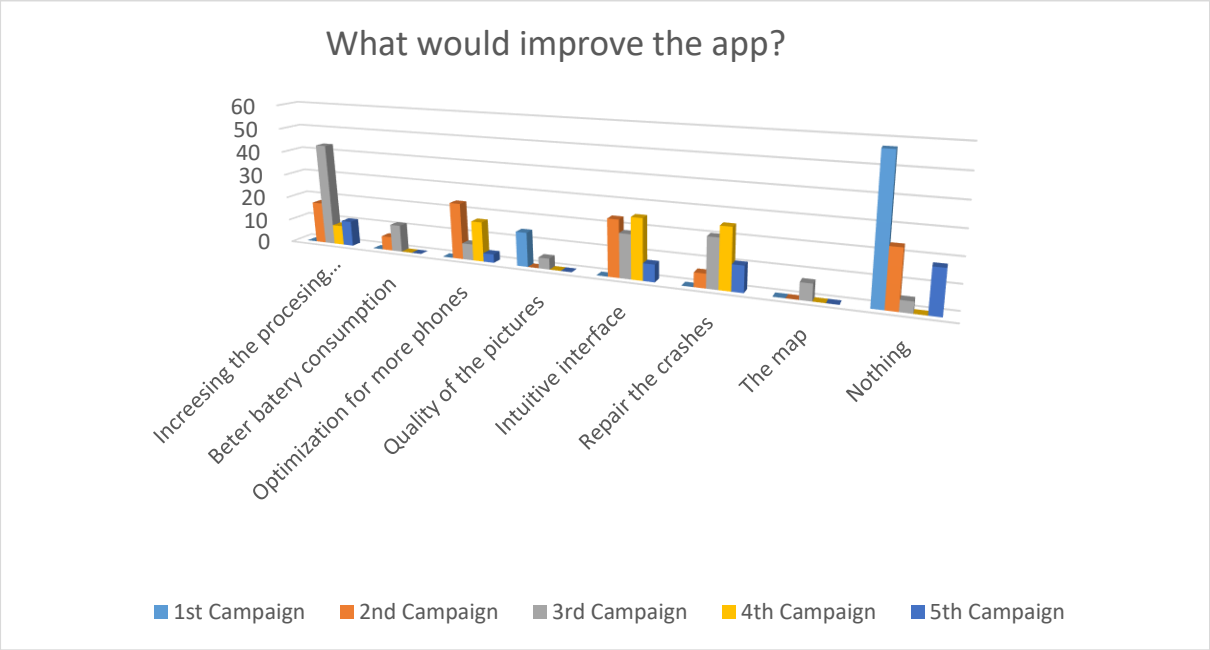
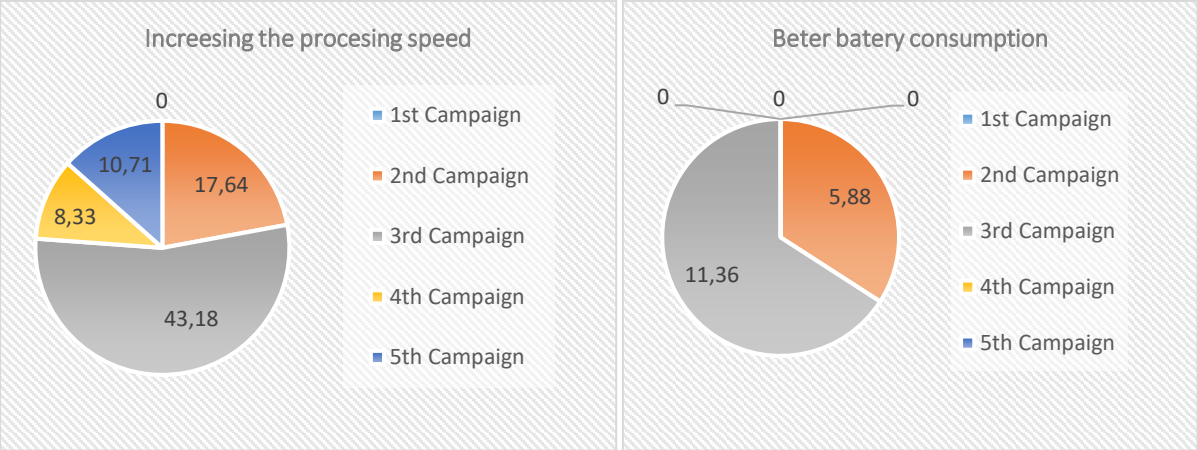


Figure 50. Results (%) of the evaluation form regarding improvement of the SCENT app, during the DD campaigns.



The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

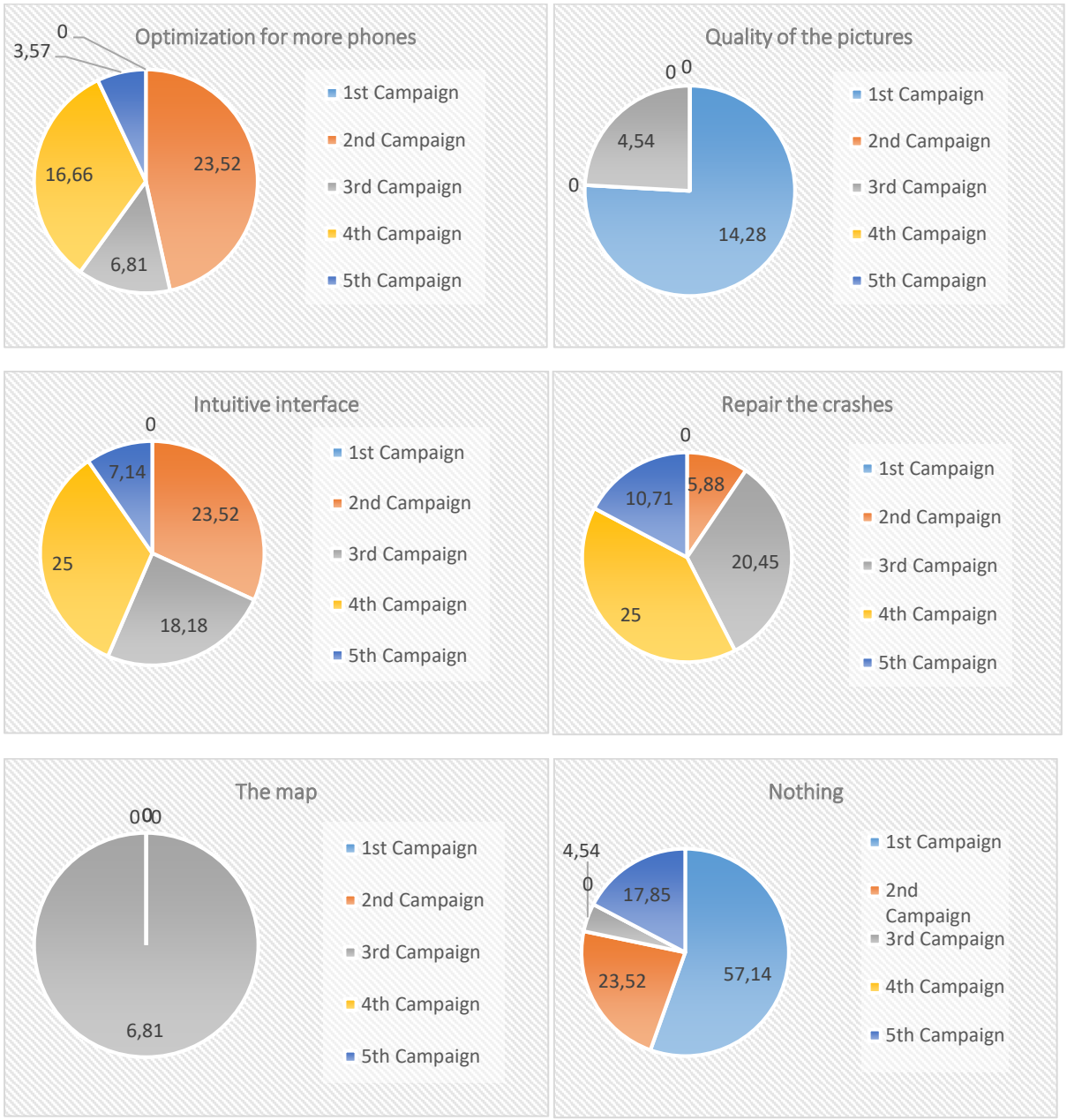


Figure 51. Overall percentages about the improvement of the SCENT app for all campaigns

4.2.3 Demographics

In Danube Delta pilot site, the campaign implemented was of large-scale demonstrations category. According to this, the participants were from a wide age and occupation category range. In the DD campaigns were mostly volunteers between 16 and 50 years old (Figure 52), students, employed and pensioners.

Age wise in the 3rd campaign 69% of the participants were from the 18-24 year range, mostly students, they considered perfect the amount of time spent in the field campaigns. Having a characteristic of intensely using mobile phones at a younger age, volunteers found it easy and also wanted to capture

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more SCENT characters during the field trips. They liked the landscape, nature and spending time with people during the campaign.

Volunteers from the 25-34 year range participated in a large number in all the campaigns: 32% in the 1st campaign, 25% in the 2nd campaign, 21.6% in 3rd campaign, 22.22% in the 4th campaign and 41% in the last campaign. Taking into consideration the level of participation of the volunteers from this year range it is a result of mixt occupation of the group, together with students and employees belonging to this year range.

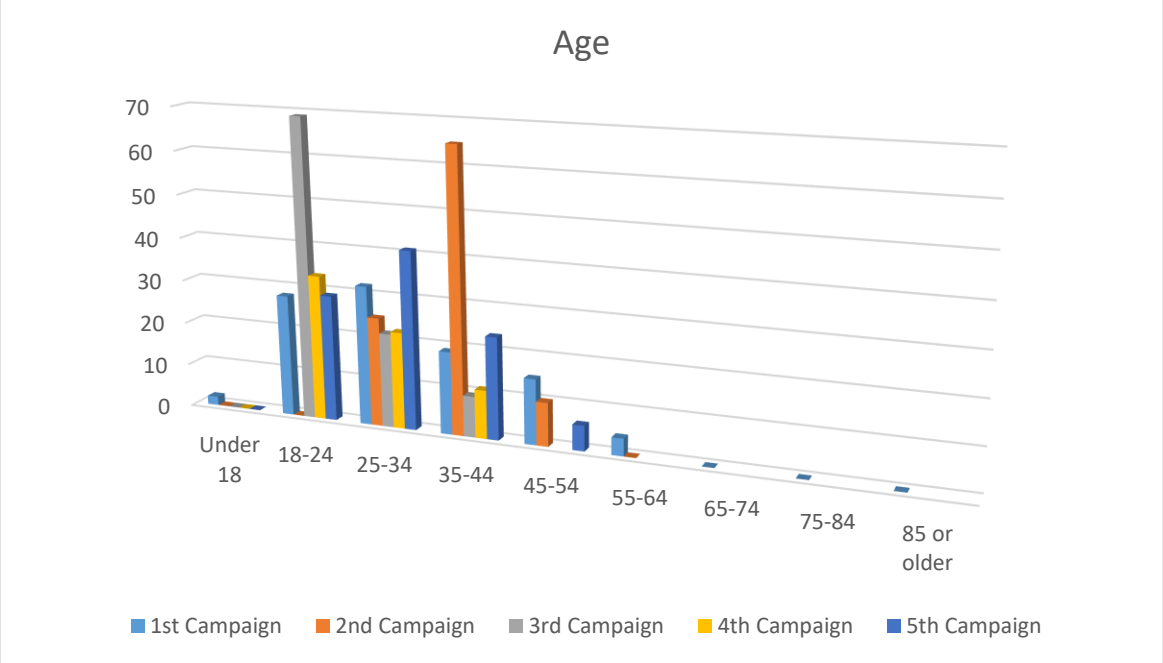
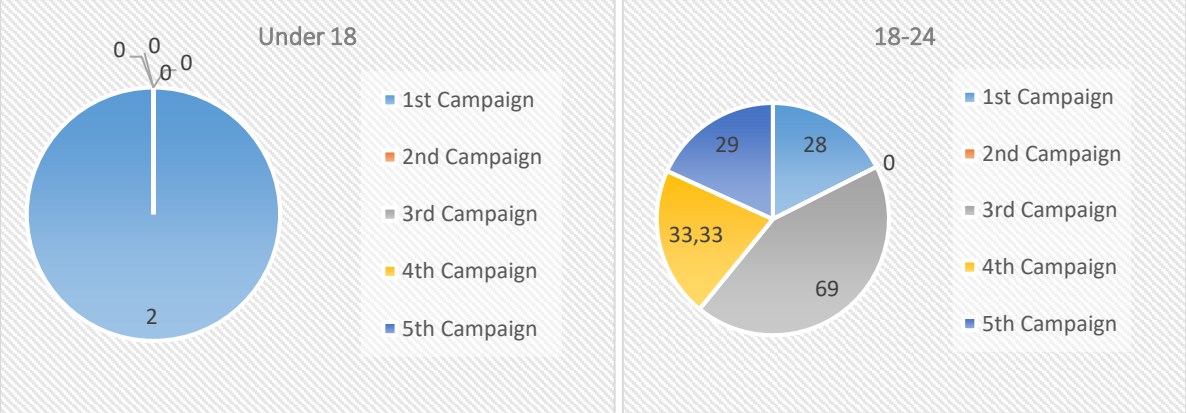


Figure 52. Results (%) of the evaluation form regarding the age of the participants, during the DD campaigns.



The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

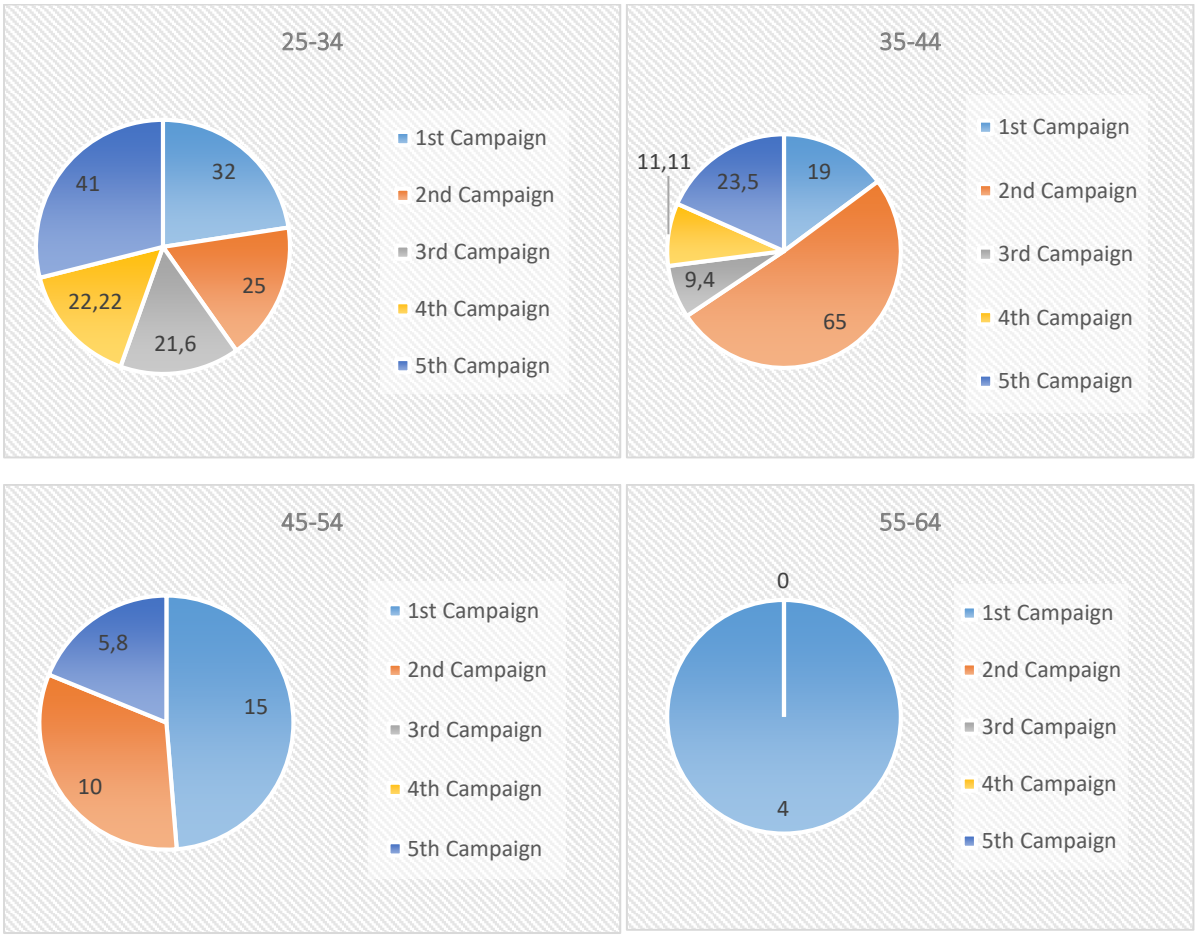


Figure 53. Overall percentages about the age of the participants for all campaigns

The gender distribution was mostly equal in three campaign, with slightly higher percentage of female participants in the 1st campaign and 2nd campaign, whilst in the 5th campaign the balance changed and the males participants had a higher percentage, as Figure 55 shows. According to the graphs in the 3rd campaign the males represented 27% and the females 73%. In the 4th campaign 21.5% males took part in the pilot activity and 78.5% were females.

According to the results of the graphics (Figure 54) the females represented slightly higher number than males in the DD campaigns.

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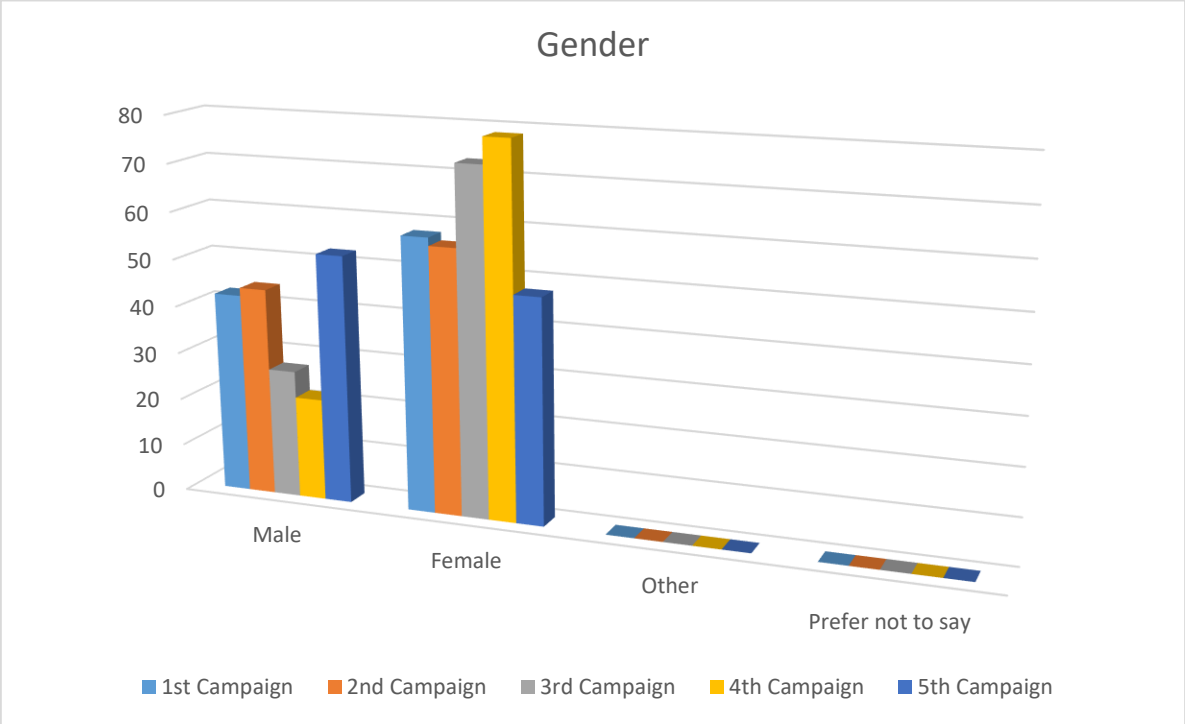

Figure 54. Results (%) of the evaluation form regarding the gender of the participants, during the DD campaigns.

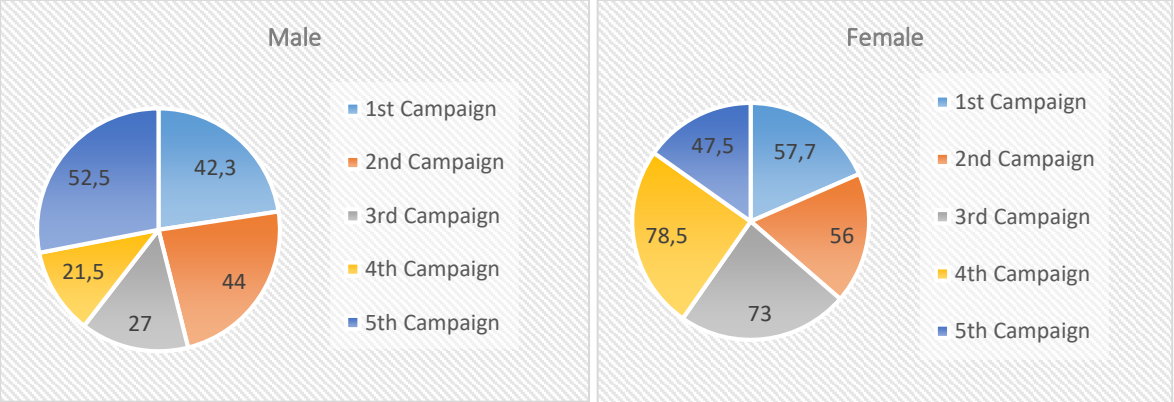

Figure 55. Overall percentages about the gender of the participants for all campaigns

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

5. Recommendation

Danube Delta, due to its unique morphology and topology as a vast wetland, poses many practical and technical challenges when organizing citizen campaigns.

The area has very limited and unpredictable accessibility, only with boats and only through specific channels depending on the size of the boat, the water levels and the presence of obstacles such as tree trunks. Also, it is an area with few establishments that can accommodate large groups of volunteers and provide the needed infrastructure, such as electricity to charge mobile phones and power banks and high-quality Wi-Fi connection for data uploading. Also, the fact that the pilot area is extended with unpredictable accessibility makes the design of the pilot routes and study areas a challenging and critical task. In addition, the area has poor and unstable network coverage and areas with weak and unreliable GPS signal which are main challenges for an application aiming to record data at specific locations and upload them to the back end.

All these challenges led to many important insights to the proper way to design and organise citizen science campaigns. The key recommendations are:

- **Route design.** The most important aspect to ensure the success of a citizen science campaign is the design of the route that will be followed. The demographics and profiles of the participants should be taken into consideration. The duration of the campaign should be such that will ensure that the important data will be collected but the volunteers will not overtire. Also, the area visited should combine areas important for the case study but also areas unique or isolated that will motivate participants.
- **Careful planning.** Knowing the needed infrastructure, ensuring its availability and providing additional equipment that may be needed by the participants is important to a smooth campaign. As an example, having additional phone devices or powerbanks that the participants can borrow may ensure their engagement for the duration of the campaign.
- **Volunteer briefing.** Another important aspect is the planning of the campaign. Ensuring that the volunteers are fully informed about the duration of the campaign, the weather conditions, the requirements for participation (phone requirements, health issues) and the tasks that they will be asked to perform will limit disappointment or false expectations.
- **Training & support.** An initial workshop to allow the volunteers to familiarize with the applications to be used and the tasks that they are required to carry out is needed to get everyone started. It was proven however that constant support, during the campaign, is also required and highly appreciated by the volunteers. Proper arrangement should be made so as each group of volunteers is accompanied by at least one expert in the usage of the applications.
- **Entertainment aspects & socialization.** Based on the feedback received from the volunteers making new friends, socializing and spending time with them but also competing against them in the collection of data and points were key to their engagements. Ensuring that volunteers have fun, time to relax and socialize are important to boost participation, engagement and volume of contributions.

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6 Conclusions

Danube Delta pilot was very important part of the SCENT project implementation, for provision and consolidation of results from application of the SCENT toolbox in real citizens' data gathering campaigns.

The core theme of SCENT is environmental monitoring - specifically changes in land cover and land use over time from the perspective of flood risk management. The project aims to fill the gaps in our existing knowledge resulting from there being insufficient available data. The project is based on recent years smartphone technologies to collect crowdsourced data from citizens on a large scale through custom-developed 'serious gaming' apps.

The centre of the whole project are the end-users, the volunteering citizens, and their help to obtain valid data for further analyses and decision taking. Entire communities of people, along with all other locally resident species, are affected by these environmental changes. Therefore, common people can add a significant contribution by gathering information about areas with incomplete data, also add an input that influences the policy makers. This project was created and designed for this purpose.

Taking into account that in Romania citizen involvement is still at the beginning, it was a pleasure to observe the involvement and enjoyment of young people in citizen observatories campaigns within SCENT.

The Danube Delta a widely fantastic natural area which can attract different types of citizens, who by participating in the organized campaigns would combine the useful with pleasure activities, and in this way help us achieve our collective aims.

Furthermore, the participants appreciated the whole idea of the project, finding attractive and useful the way they needed to be involved trough the application use. Some feedback from the volunteers:

"The idea of the app is nice. I felt involved while using it"

"Many tags available to tag the pictures, makes the data gathering process fun and easy"

"I liked the idea that you can inform other people about a certain area by tagging pictures"

"The fact that you can map an area with a lot of precision and useful data, like the water level."

"Making the real time measurements that would bring contribution to the project"

"The idea of the gamification for collect data, used in research"

"Fun+Science! The app managed to gain some scientific sense to an app with an idea I didn't like (pokemon idea) …so that's great"

As a conclusion regarding the technical aspects of the organized campaigns it can be summarized that in restricted and limited areas like DD, for purpose of efficiency it is suggested to organize more campaigns of smaller groups of people and it is necessary to start the campaigns in the proposed area (without losing too much travel for reaching the area).

Ultimately the more people who participate, the more data become available.

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Overall judgement of the executed campaigns, in terms of number of people, data gathered, SCENT apps experiences is considered successful. During the SCENT citizen science campaigns actively involving the citizens and raising awareness and sensibility in citizen science activities. The organized field campaigns were conducted as a large-scale demonstration of the SCENT Toolbox through mobilizing various stakeholders.

Most critical issues to be considered in future similar campaigns are related to the rigorous and accurate organization in terms of the participation levels and logistics, also taking into consideration the areas technical characteristics (i.e. mobile signal availability, mobile data coverage, other country mobile signal interferences).

Broad recommendations of the applicability in similar pilot areas is considering the aspects of the accessibility of the area, planning according to the different types of seasons (i.e. summer, autumn) which leads to the availability and comfort aspects of the citizens.

The result of this process is an important and useful dataset, which is a significant contribution to the environmental monitoring, and increases available data for flood modelling and management.

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 688930.

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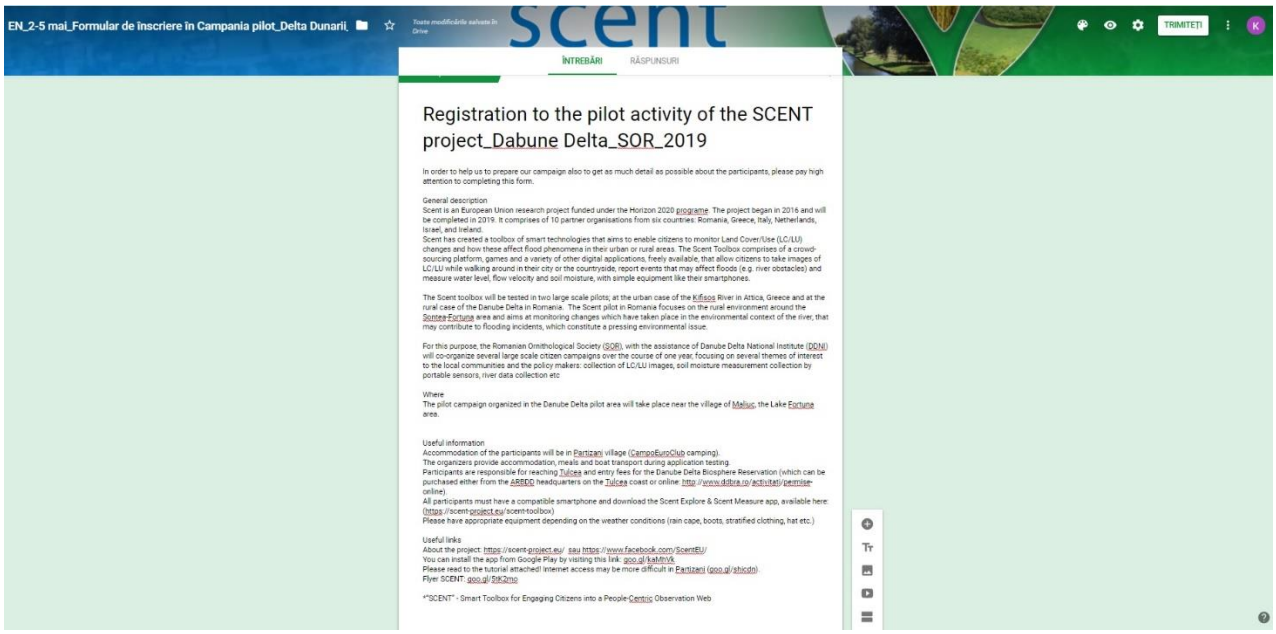
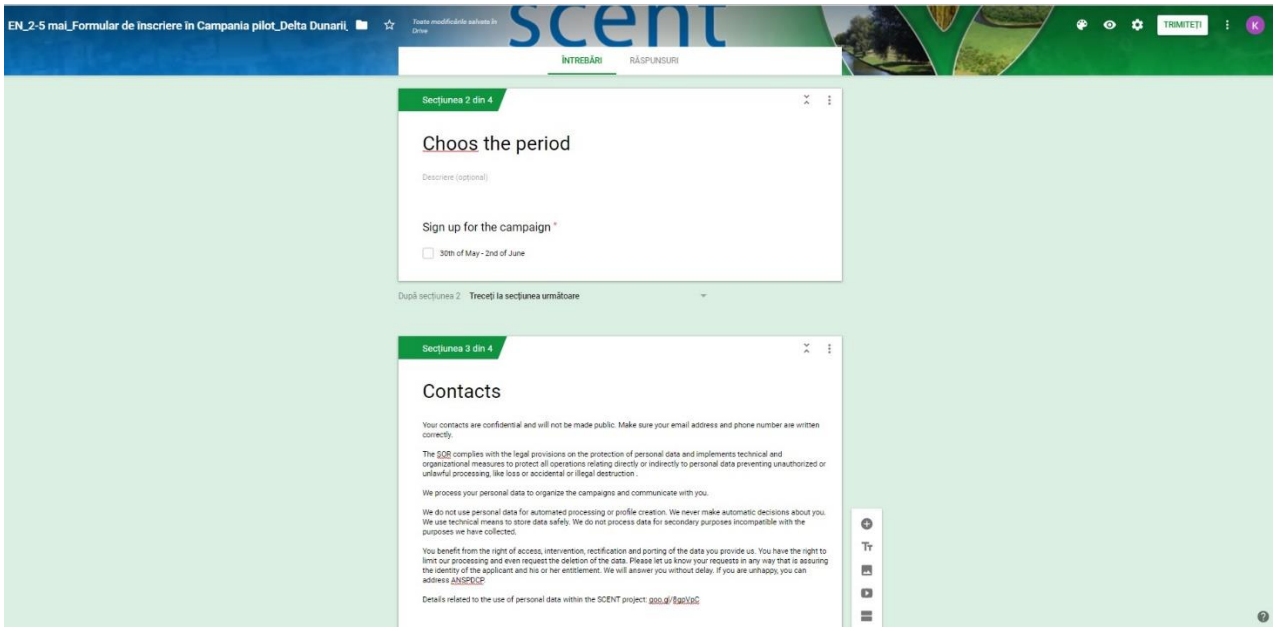
The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

Appendices

A 1: SCENT volunteers registration form

Produced as a google form to engage the participants in the DD campaigns and to help organizing the campaigns. The initial language of the registration form was Romanian.





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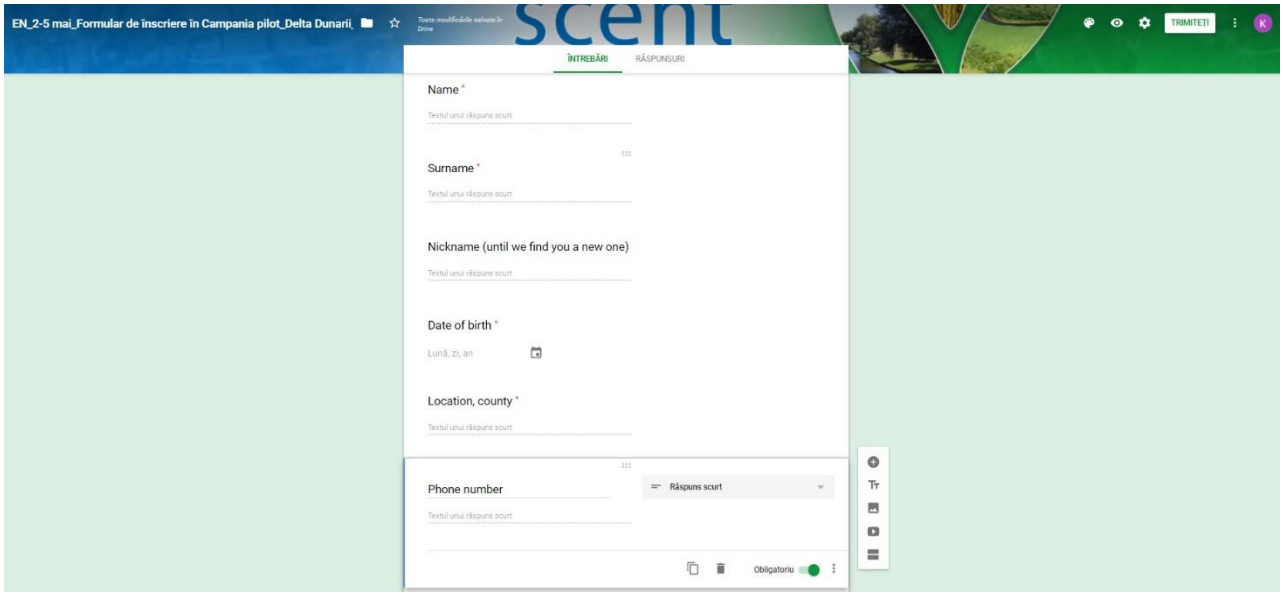

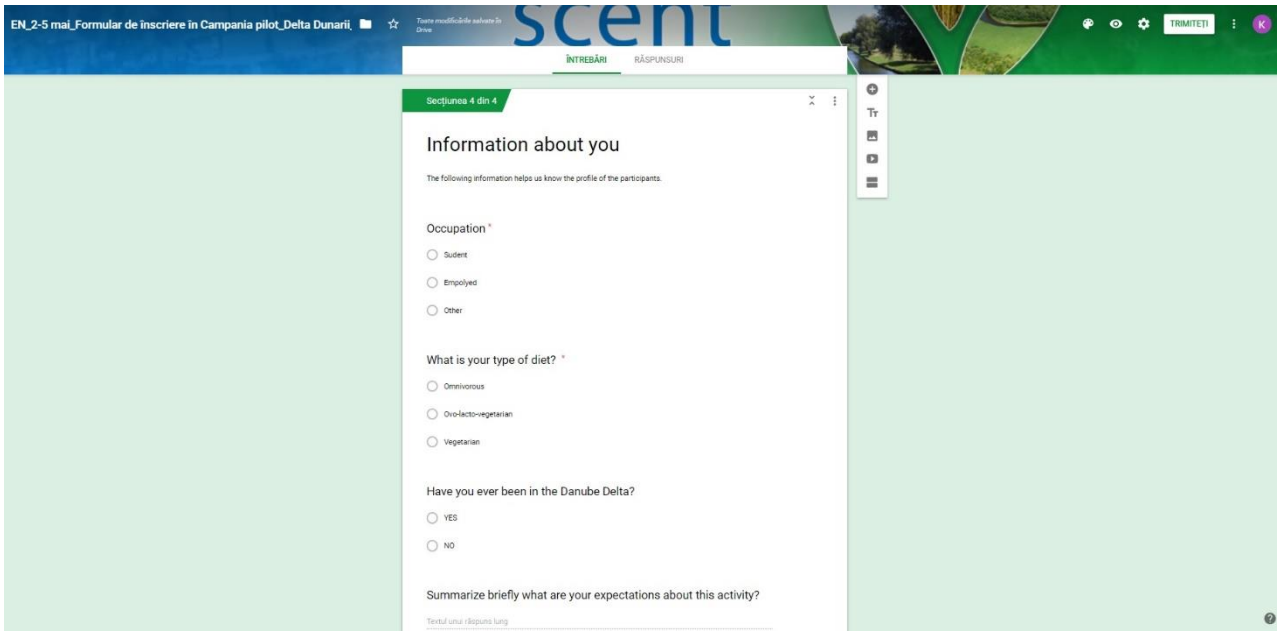

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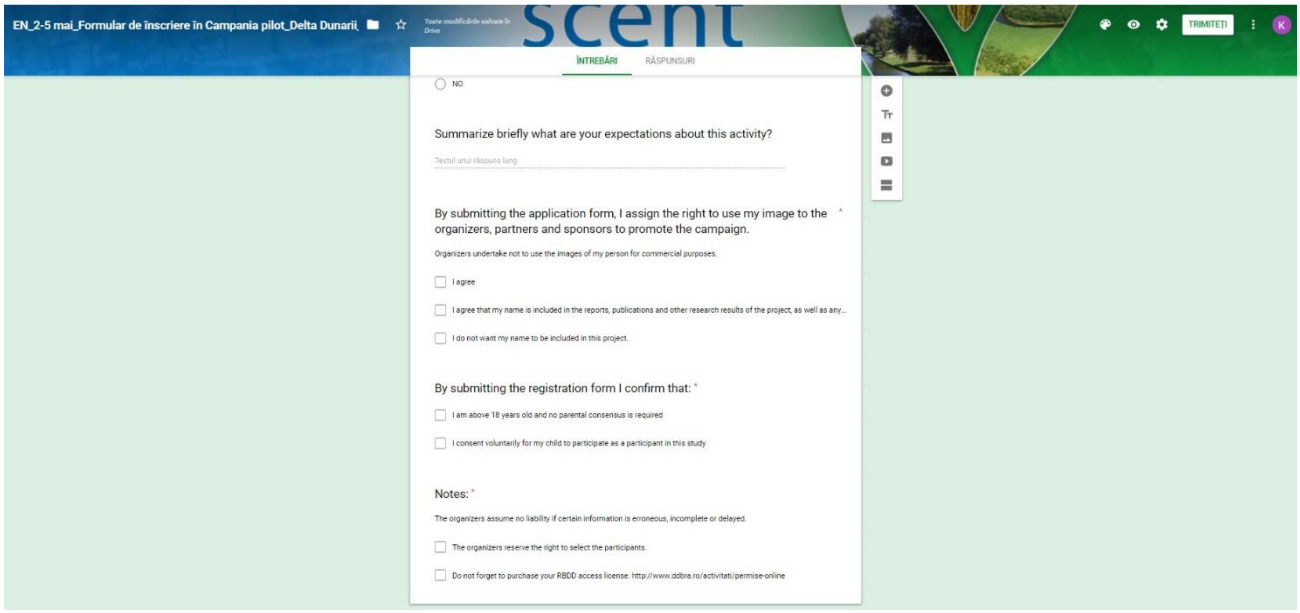

A 2: Summary of Danube Delta 1st campaign schedule.

Danube Delta_Pilot Campaign_SCENT	
PERIOD	12th – 19th August 2019 LC/LU image collection campaign
	Day 1 (Sunday, August 12th)
	Arriving of the volunteers
08:00-13:00	Arrival of the participants in Tulcea
13:30-17:00	Departure from Tulcea to Maliuc (by boat)
18:00	Arrival in Maliuc – transport of the participants to the camping place by boats
20:00	Training the participants and communicating them the rules and regulation of the camp
21:00	Dinner
	Day 2 (Monday, August 13th)
	LC/LU image data collection
08:00-09:00	Breakfast
09:00-10:00	SCENT campaign – installing the app and training of volunteers
10:00-17:00	Field campaign for 20 volunteers on the Maliuc pathway
18:00	Dinner
	Day 3 (Tuesday, August 14th)
	LC/LU image data collection
08:00-09:00	Breakfast

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09:00-10:00	SCENT campaign – installing the app and training of volunteers
10:00-17:00	Field campaign for 20 volunteers on the Mila 23 pathway
18:00	Dinner
	Day 4 (Wednesday, August 15th)
	LC/LU image data collection
08:00-09:00	Breakfast
09:00-10:00	SCENT campaign – installing the app and training of volunteers
10:00-17:00	Field campaign for 20 volunteers on the Maliuc pathway
18:00	Diner
	Day 5 (Thursday, August 16th)
	LC/LU image data collection
08:00-09:00	Breakfast
09:00-10:00	SCENT campaign – installing the app and training of volunteers
10:00-17:00	Field campaign for 20 volunteers on the Mila 23 pathway
18:00	Diner
	Day 6 (Friday, August 17th)
	LC/LU image data collection
08:00-09:00	Breakfast
09:00-10:00	SCENT campaign – installing the app and training of volunteers
10:00-17:00	Field campaign for 20 volunteers on the Maliuc pathway
18:00	Diner
	Day 7 (Saturday, August 18th)
	LC/LU image data collection
08:00-09:00	Breakfast
09:00-10:00	SCENT campaign – installing the app and training of volunteers
10:00-17:00	Field campaign for 20 volunteers on the Mila 23 pathway
18:00	Diner
	Day 8 (Sunday, August 19th)
	Departure of the volunteers
06:00	Leaving the camp site
07:00	Departure from Maliuc to Tulcea
10:00	Arriving in Tulcea

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A 3: Routes conducted during the 1st Danube Delta campaign

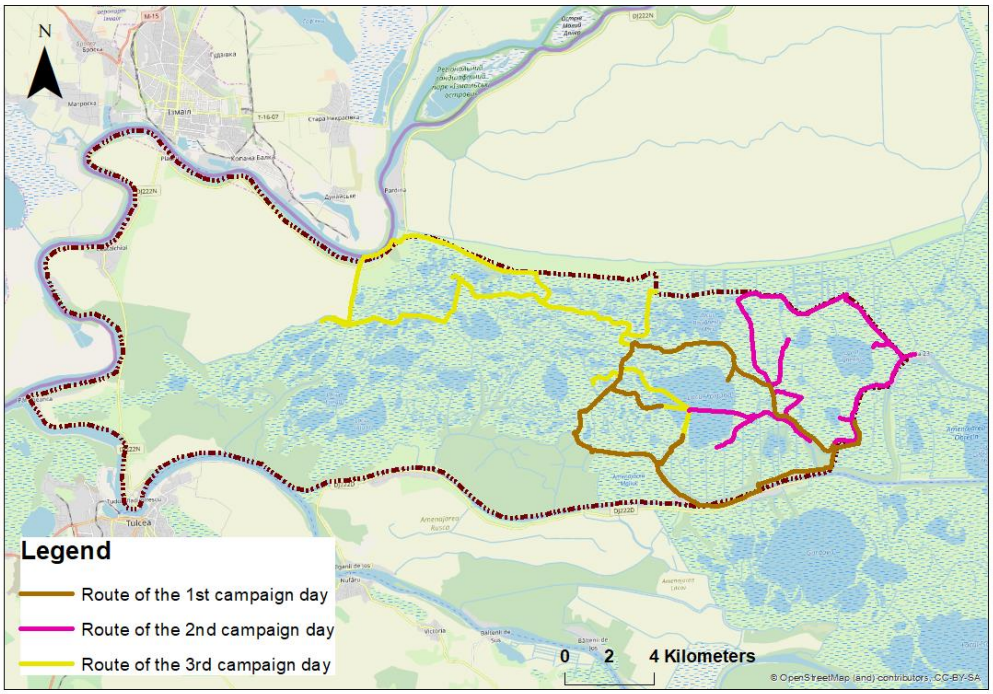

Figure 56. Routes conducted during the first 3 days of the 1st field campaign in Danube Delta

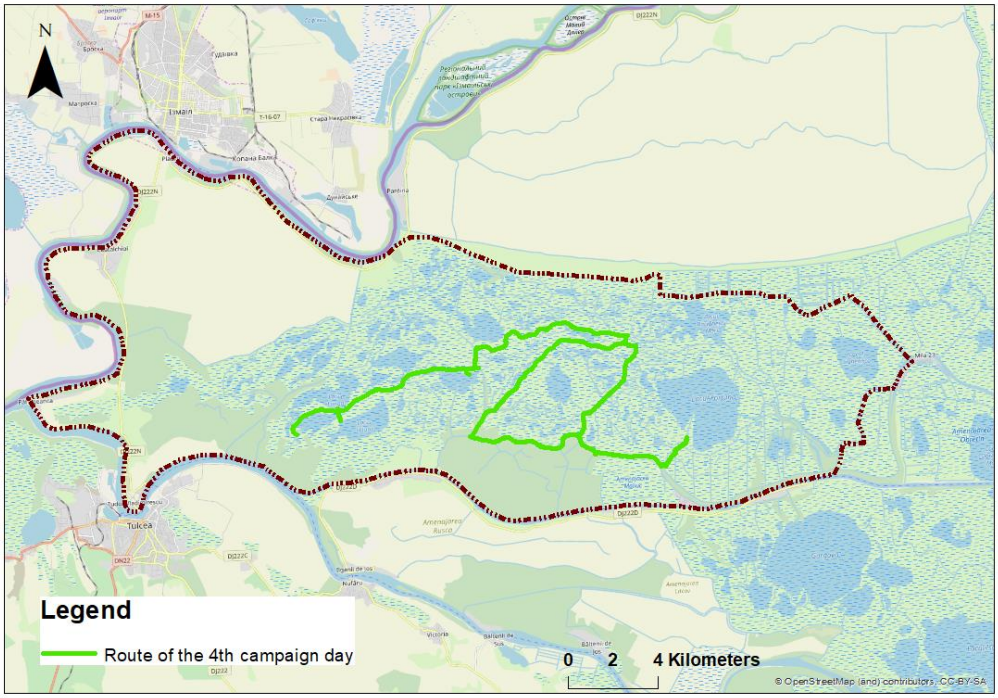

Figure 57. Routes conducted during the 4th day of the 1st field campaign in Danube Delta

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

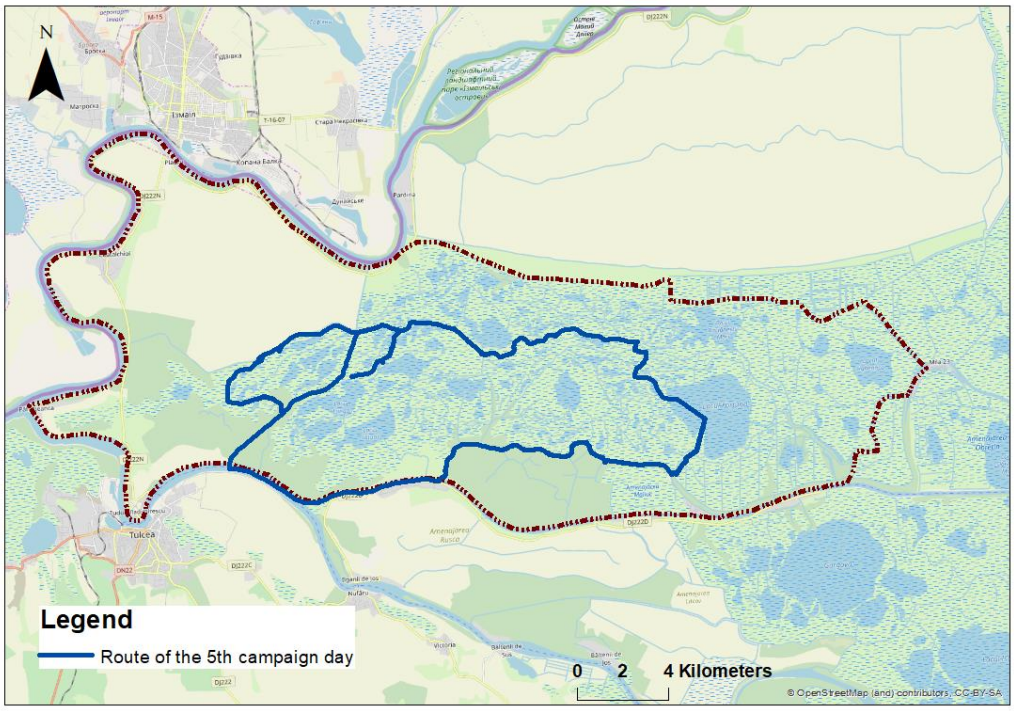

Figure 58. Routes conducted during the 5th day of the 1st field campaign in Danube Delta

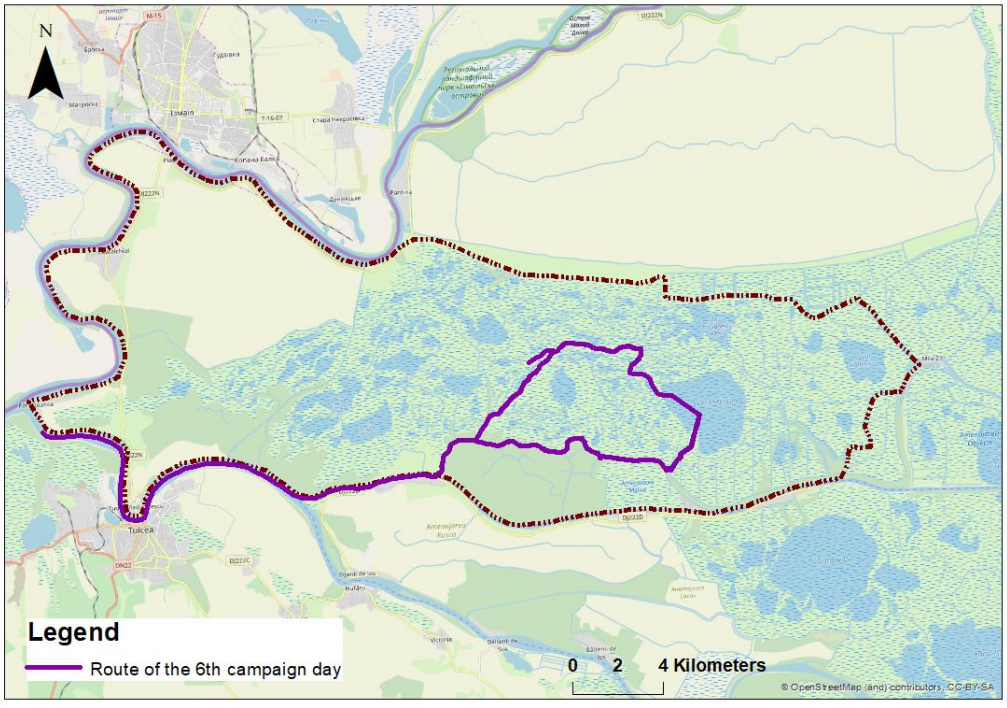

Figure 59. Routes conducted during the 6th day of the 1st field campaign in Danube Delta

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

A 4: Routes conducted during the 2nd Danube Delta campaign

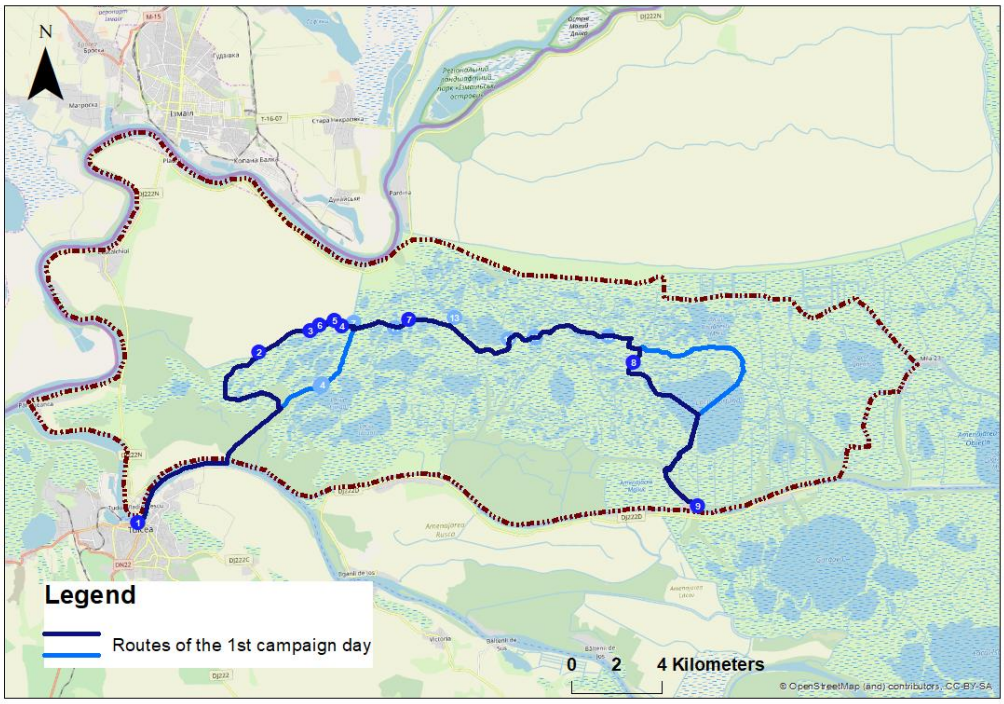

Figure 60. Routes conducted during the 1st day of the 2nd field campaign in Danube Delta

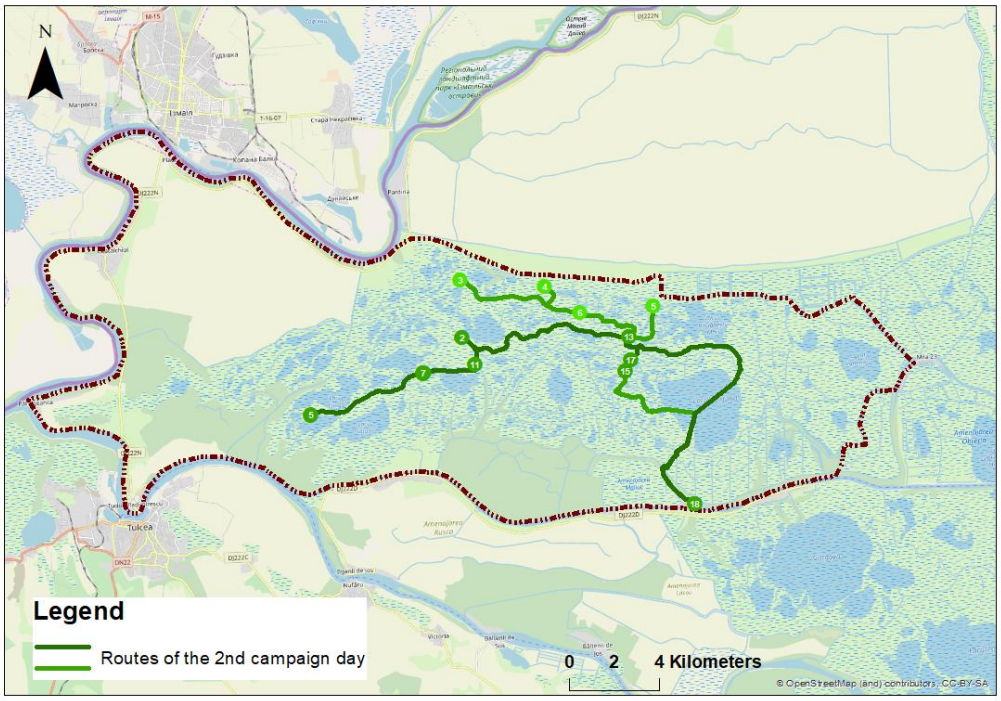

Figure 61. Routes conducted during the 2nd day of the 2nd field campaign in Danube Delta

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

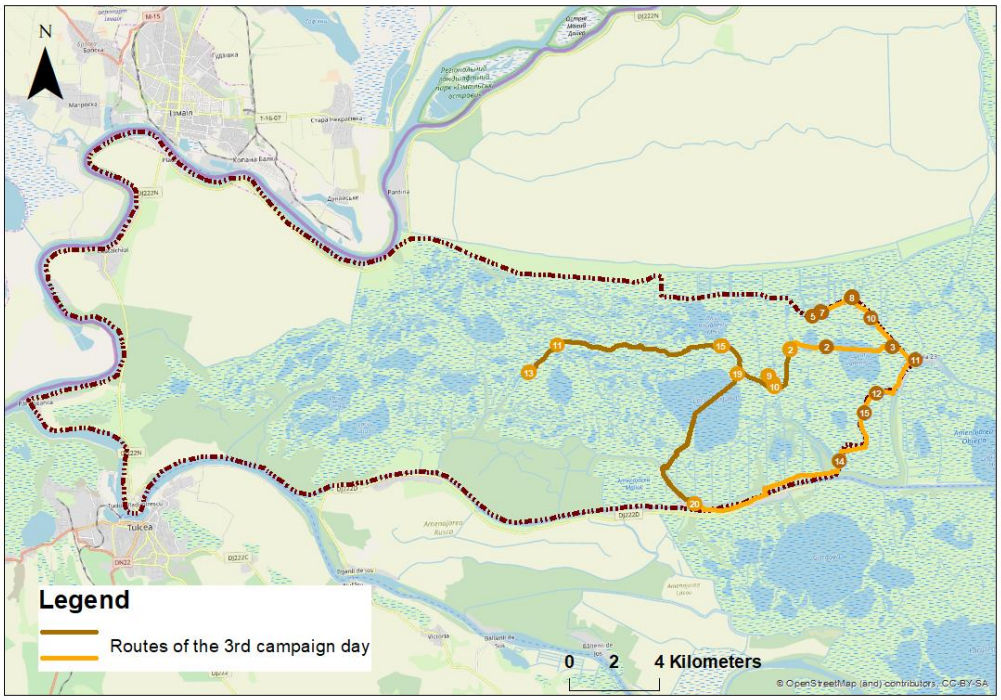

Figure 62. Routes conducted during the 3rd day of the 2nd field campaign in Danube Delta

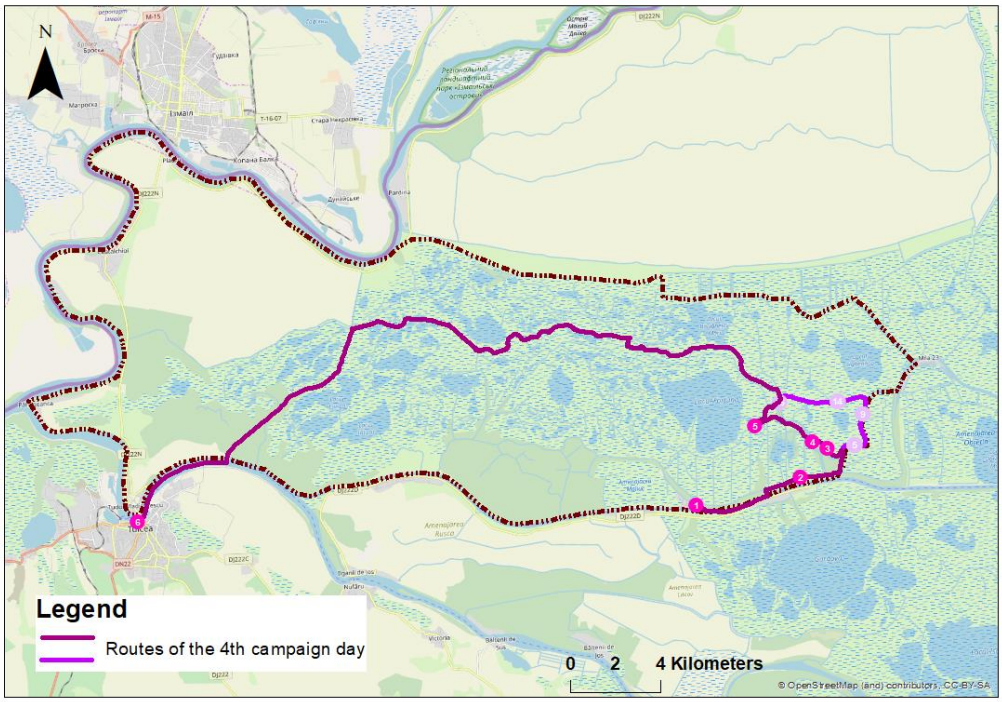

Figure 63. Routes conducted during the 4th day of the 2nd field campaign in Danube Delta

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A 5: Routes conducted during the 3rd Danube Delta campaign

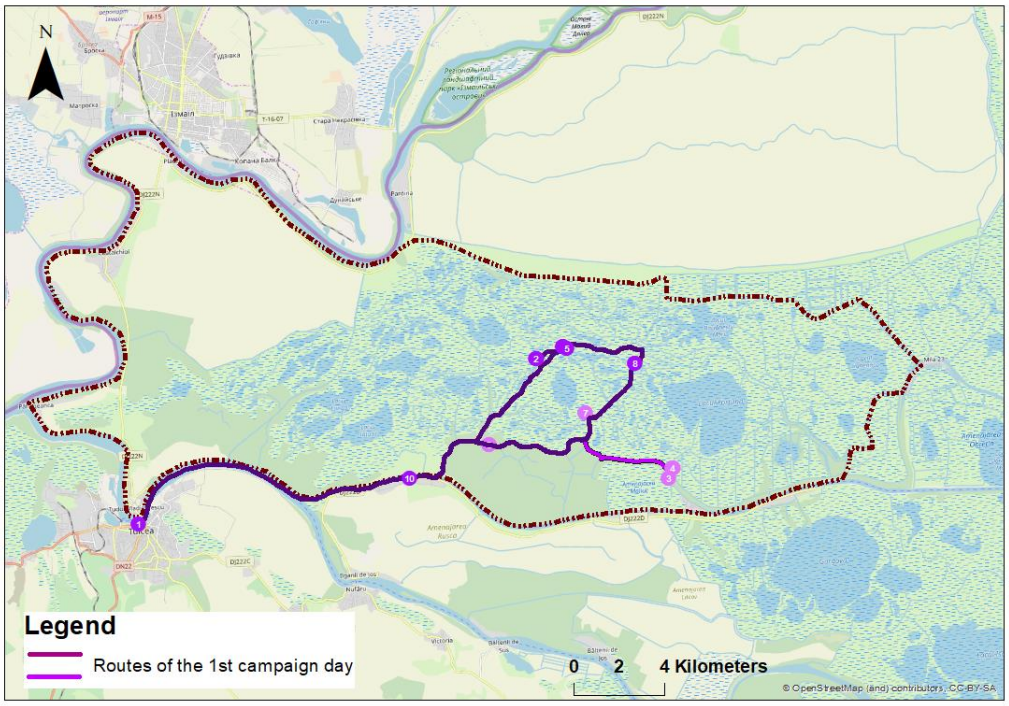

Figure 64. Routes conducted during the 1st day of the 3rd field campaign in Danube Delta

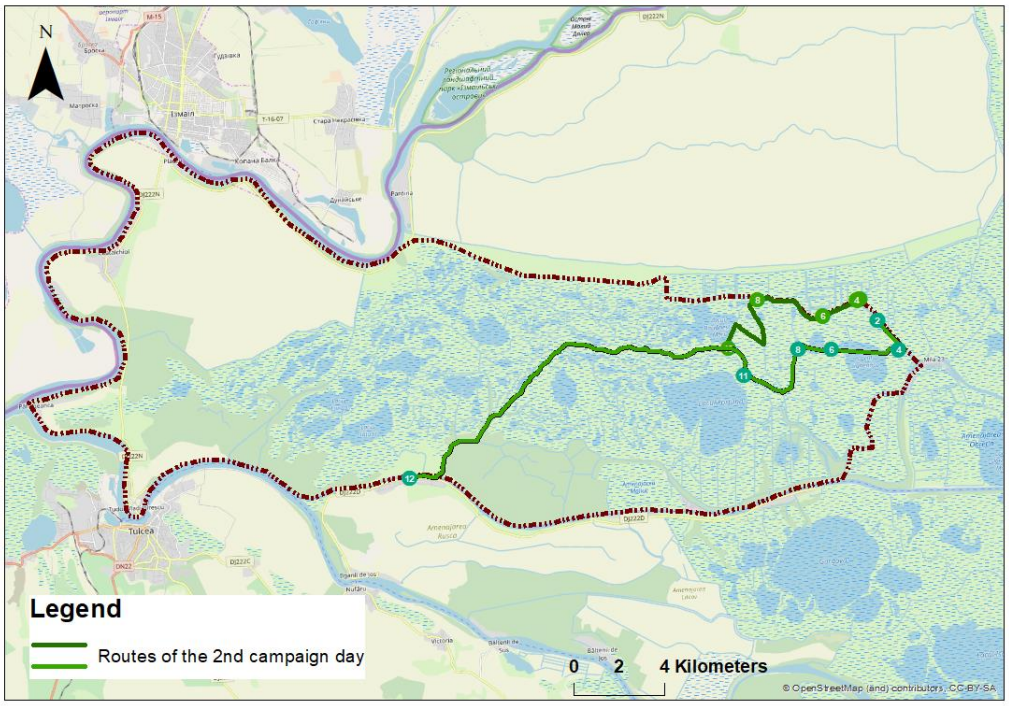

Figure 65. Routes conducted during the 2nd day of the 3rd field campaign in Danube Delta

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

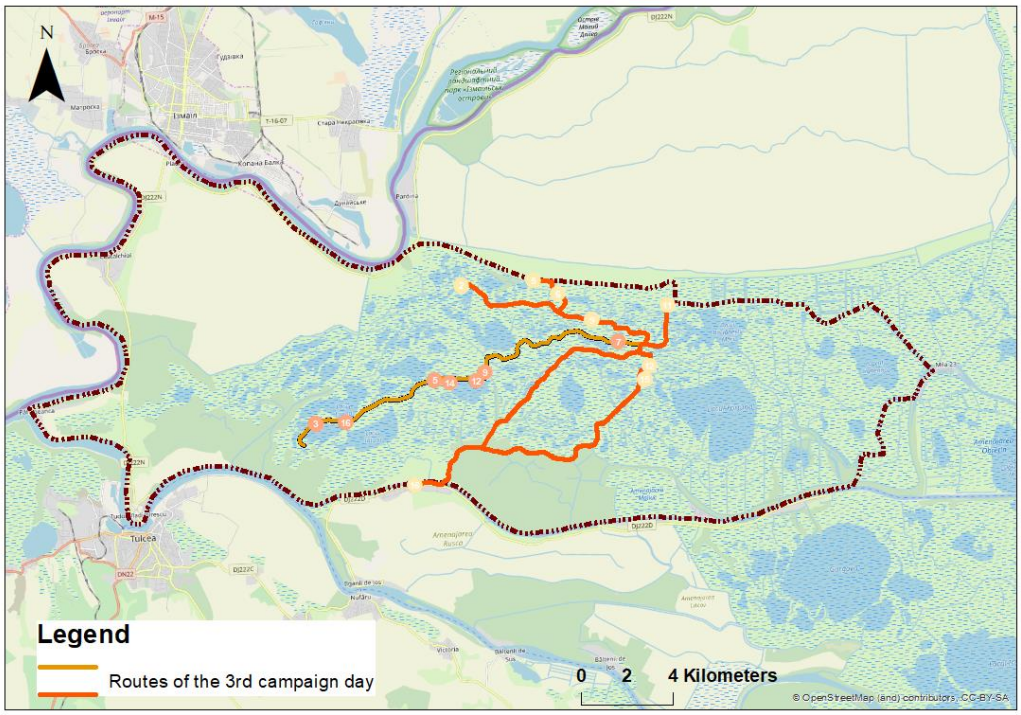

Figure 66. Routes conducted during the 3rd day of the 3rd field campaign in Danube Delta

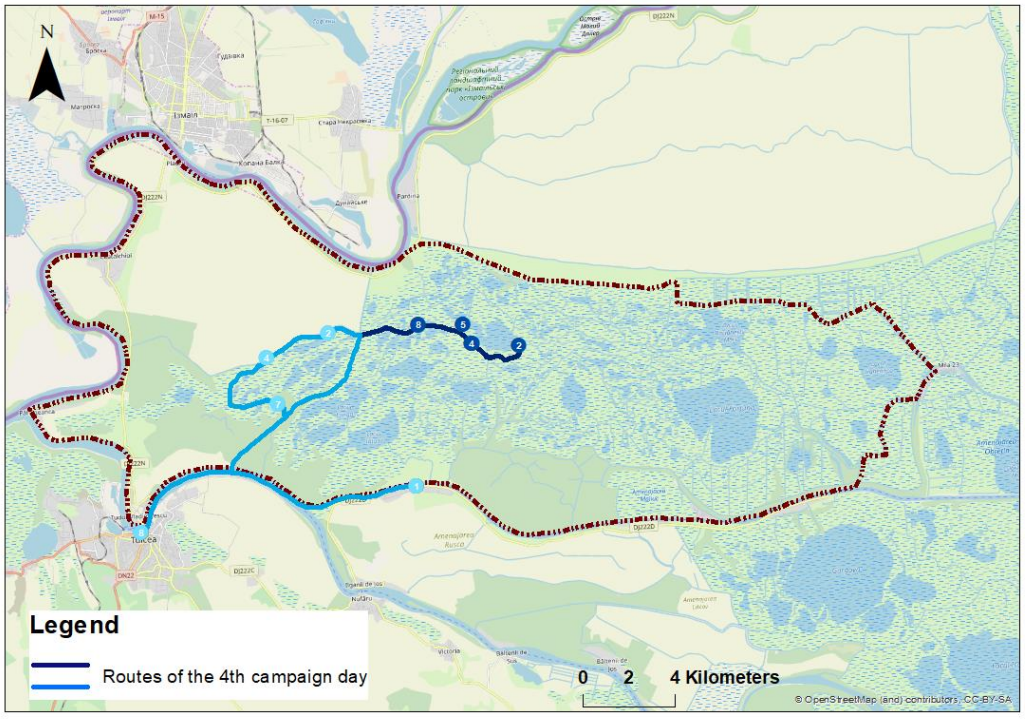

Figure 67. Routes conducted during the 4th day of the 3rd field campaign in Danube Delta

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

A 6: Routes conducted during the 4th Danube Delta campaign

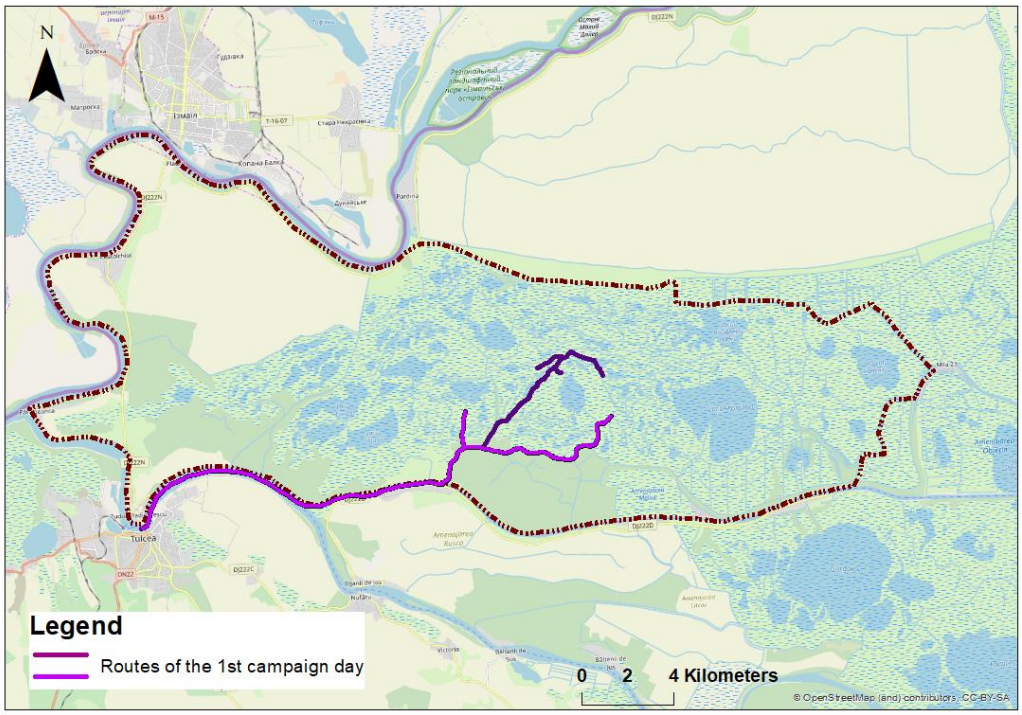

Figure 68. Routes conducted during the 1st day of the 4th field campaign in Danube Delta

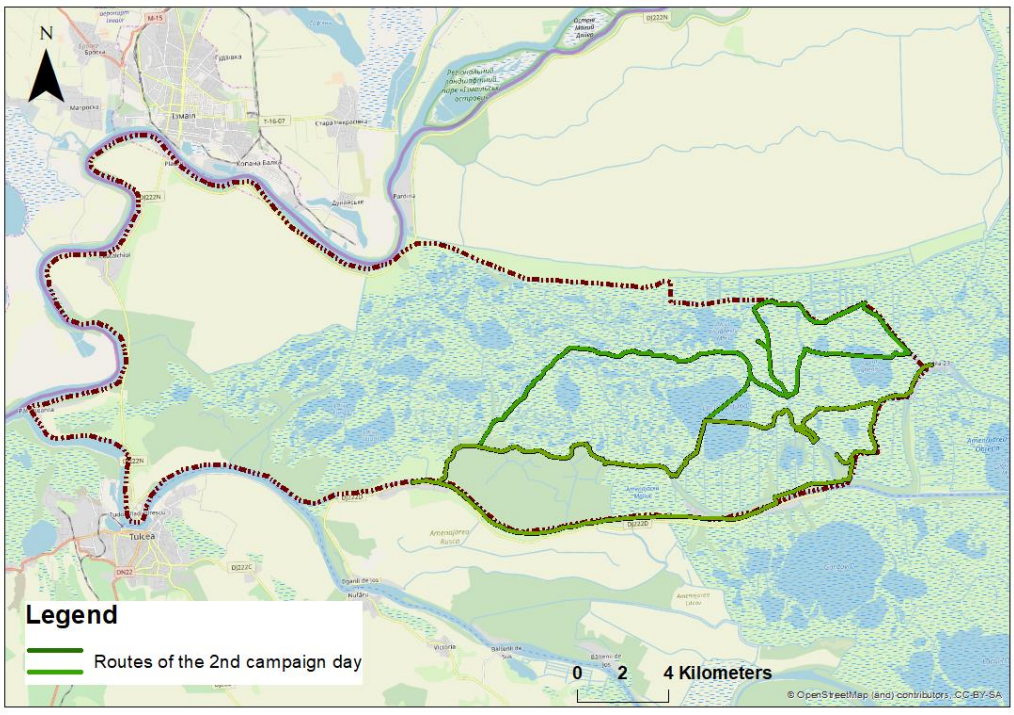

Figure 69. Routes conducted during the 2nd day of the 4th field campaign in Danube Delta

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

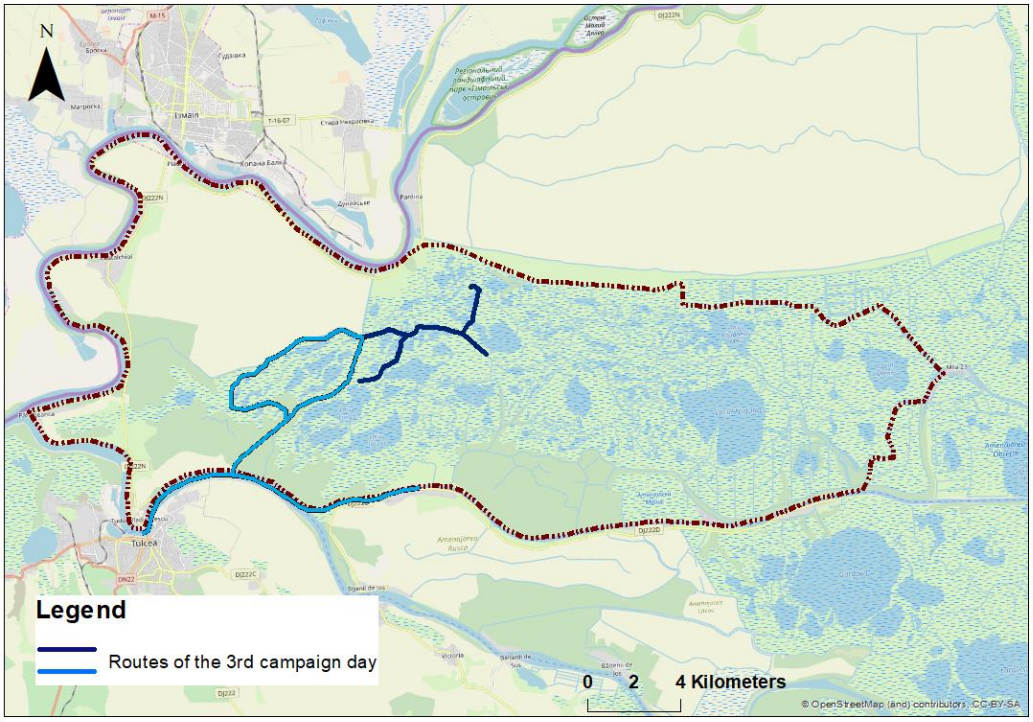

Figure 70. Routes conducted during the 3rd day of the 4th field campaign in Danube Delta

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A 7: Routes conducted during the 5th Danube Delta campaign

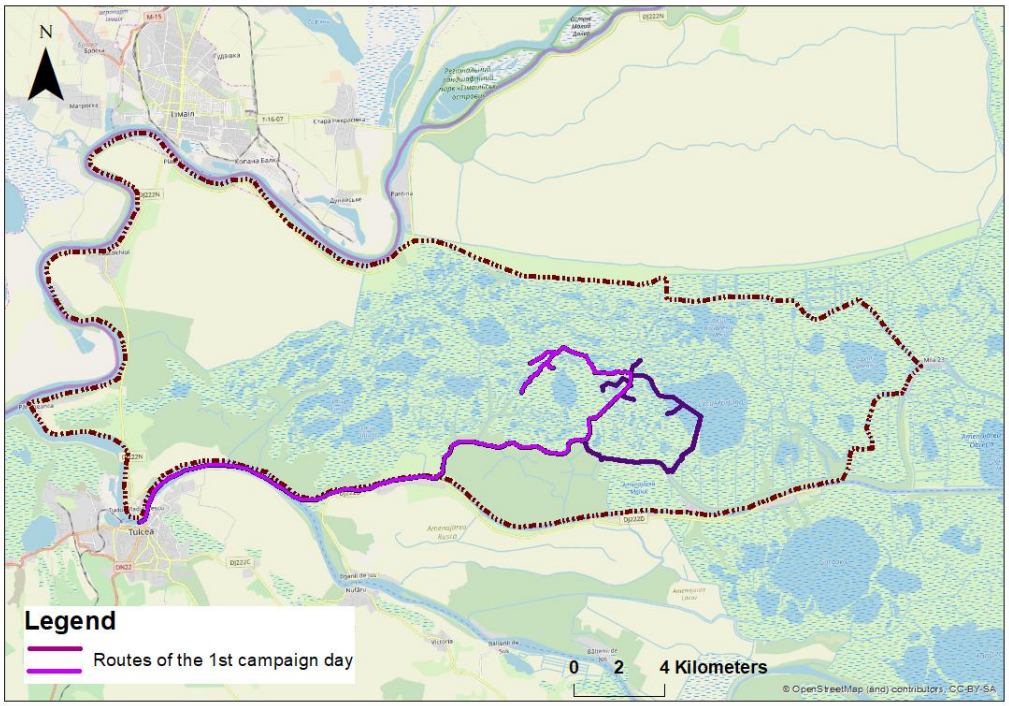

Figure 71. Routes conducted during the 1st day of the 5th field campaign in Danube Delta

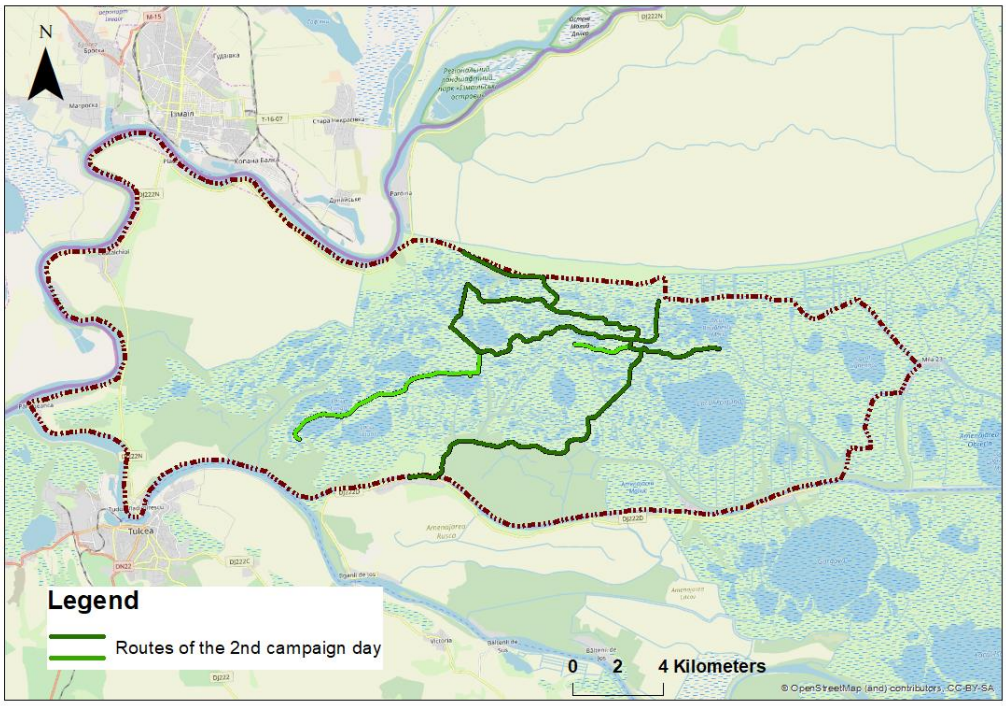

Figure 72. Routes conducted during the 2nd day of the 5th field campaign in Danube Delta

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement nº 688930.

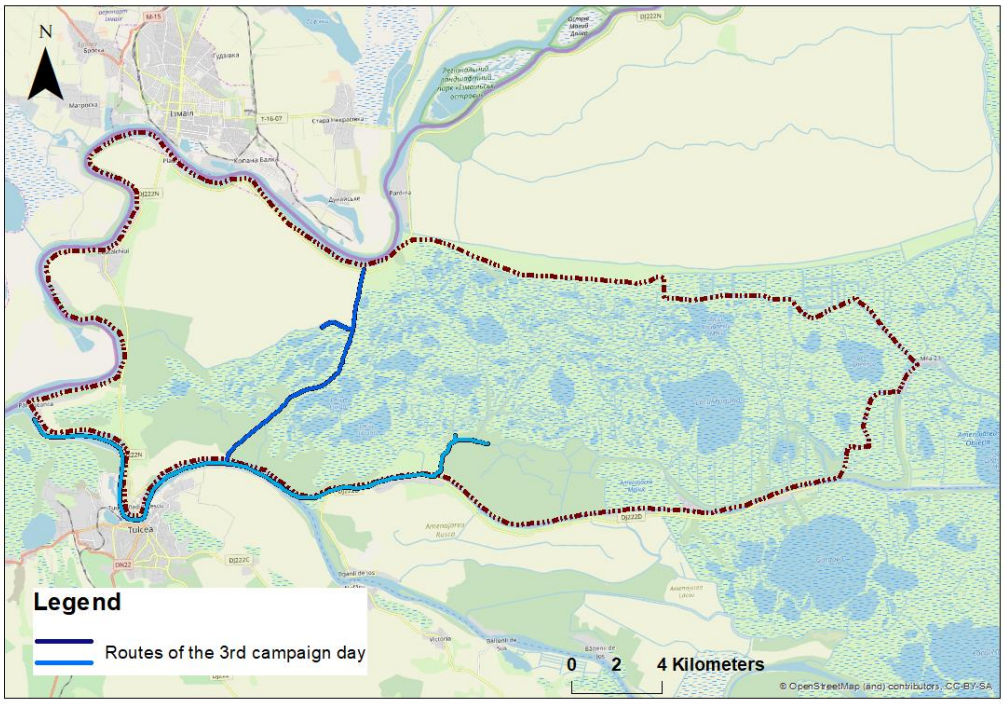

Figure 73. Routes conducted during the 3rd day of the 5th field campaign in Danube Delta

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A 8: SCENT evaluation form

Produced as purpose to receive the volunteer's feedbacks systematically, from the DD campaigns and to help to improve the campaign and app experience. The initial language of the evaluation form was English, those volunteers who was limited by English language, had the possibility to write their thoughts, impressions, comments and proposals in Romanian, been translated afterwards.

Campaign Experience Survey

Objective: to investigate the suitability of campaign elements, according to the experience of volunteers.

Date: _____

Campaign Experience

Q1.1 We just spent around 6 hours in the boat. How adequate was this amount of time for you?

- ❍ Way too much – 1 to 2 hours would be enough
- ❍ A bit too much – 3 to 4 hours would be better
- ❍ One less hour would be perfect!
- ❍ Perfect!
- ❍ One more hour would be perfect!
- ❍ A bit too short – 8 to 9 hours would be better
- ❍ Way too short – 9 to 10 hours would be enough

Q1.2 If it was not perfect, why not?

Please tick all that apply.

- ❑ I got bored
- ❑ The weather was not pleasant
- ❑ I got tired
- ❑ I wanted to capture more animals
- ❑ I wanted to enjoy more time in the trip
- ❑ Others: _____

Q1.3 What is the maximum amount of time that you are willing to stay in the boat?

- ❍ Up to 2 hours
- ❍ Up to 4 hours
- ❍ Up to 6 hours
- ❍ Up to 8 hours
- ❍ Up to 10 hours

Q1.4 Some animals were capture while the boat was moving. How easy was it to capture them?

- ❍ Too hard – the boat was moving too fast
- ❍ A bit hard – the boat could go a bit slower
- ❍ It was easy
- ❍ It was very easy

Q1.5 How do you feel about the amount of animals that appeared while the boat was moving?

- ❍ There were too few
- ❍ It was perfect!
- ❍ There were too many

Page **1** of **3**

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Q1.6 How do you feel about the amount of times the boat stopped to capture animals?

- ❍ We stopped too little times, I would prefer more often
- ❍ It was nice
- ❍ We stopped too many times, I would prefer less often

Q1.7 What did you like the most about your boat experience? Why?

Q1.8 What did you like the least about your boat experience? Why?

Q1.9 What would improve your boat experience?

Scent Explore app Experience

Q2.1 What did you like the most about the app? Why?

Q2.2. What did you like the least about the app? Why?

Q2.3. What would improve the app?

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About yourself

Q3.1 Please indicate which age category you belong to.

- ❍ Under 18
- ❍ 18 - 24
- ❍ 25 - 34
- ❍ 35 - 44
- ❍ 45 - 54
- ❍ 55 - 64
- ❍ 65 - 74
- ❍ 75 - 84
- ❍ 85 or older
- ❍ Prefer not to say

Q3.2 Please indicate your gender

- ❍ Male
- ❍ Female
- ❍ Other
- ❍ Prefer not to say

Q3.3 Your town / city, county, country

Q3.4 Your group/organization

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