



# PILOT ACTIONS FINAL REPORT

- High Modenese Apennine Regional Park
- Salse di Nirano Natural Reserve

---

D.T2.5.1 -Emilia-Romagna Region (PP01) -  
Central Emilia Park's Managing Authority

---

Ver. 1.3  
11/2019





## Table of Contents

<b>1. Introduction.....</b>	<b>2</b>
<b>1.1. Participatory processes .....</b>	<b>4</b>
<b>1.2. Developed Strategy .....</b>	<b>6</b>
<b>2. Pilot Action Design Phase .....</b>	<b>7</b>
<b>2.1. Monitoring Activities .....</b>	<b>7</b>
<b>2.2. Forecasted Managing Activities .....</b>	<b>8</b>
<b>2.3. Expected results .....</b>	<b>9</b>
<b>2.4. Pilot Action Workplan.....</b>	<b>13</b>
<b>3. Pilot Action Implementation Phase .....</b>	<b>14</b>
<b>3.1. Monitoring activities and achieved results .....</b>	<b>14</b>
<b>3.2. Implemented Management Activities .....</b>	<b>15</b>
<b>3.3. Deviation from the forecasted workplan activities .....</b>	<b>17</b>
<b>4. Achieved Results .....</b>	<b>17</b>
<b>4.1. Touristic pressure reduction .....</b>	<b>19</b>
<b>4.2. Tourist experience improvement .....</b>	<b>25</b>
<b>4.3. Socio-Economic Benefits .....</b>	<b>26</b>
<b>5. Conclusion.....</b>	<b>26</b>

## 1. Introduction

The Ente di Gestione dei Parchi e la Biodiversità Emilia Centrale (Central Emilia Park's Managing Authority), has joined the Interreg CEETO project "Central Europe Eco Tourism: tools for nature protection" - CE 926 with the aim of testing a model of governance of tourist flows within protected areas in order to reduce environmental impacts and improve the socio-economic benefits that can result from a sustainable tourism approach.

Two Pilot Areas were therefore selected for the implementation of the Interreg CEETO project: The Pilot Area of the Lago Santo modenese within the Regional Park Alto Appennino Modenese and the Nature Reserve of "Salse di Nirano" (Nirano's Mud-bursting).



*Fig. 1 - View of the Lago Santo Modenese (1'501m a.s.l.) from the trail to Monte Giovo (1'997m a.s.l.).*

The pilot area of Lago Santo Modenese is characterized by a high tourist presence, especially in summertime (July and August). The area is experienced by visitors mainly for its recreational use, less like a treasure of natural value and landscape, especially out of season.

The main problem is, in fact, related to traffic congestion, overcrowded parking and lack of safety along the access roads (both for trekkers and drivers). Moreover, visitor behaviour, which is not always adequate (illegal camping), contributes to a general sense of chaos and disorder.

The pilot area of "Salse di Nirano", on the other hand, is characterized by a high degree of frequentation throughout the year, mostly by daily excursionists. The main objective in the sustainable tourism development was, therefore, the protection and preservation of the Reserve, accompanied by the preparation of a varied and well-structured offer of educational and play activities for students, families

and associations. In the Nature Reserve of “Salse di Nirano”, it was strategic to acquire as much data as possible to document the main factors of threat to the Reserve deriving from poor or incorrect use even by visitors, in support of feasible defensive actions, that should be harmonized with the already existing activities.



*Fig. 2a,b - Typical mud “volcanoes” and detail on mud and gas eruption (locally called “Salse” because of the high content in salt of the mud) at the Salse di Nirano Natural Reserve.*

The main challenge faced by the Central Emilian Parks Managing Authority, was to ensure that the Sustainable Tourism Action Plan (D.T2.2.3) could become the basis for developing the actions that can bring up to the European Charter for Sustainable Tourism (ECST) award, methodology and certification issued by the EUROPARC Federation.



*Fig. 3 - One moment of the participatory process at the High Modenese Apennine Regional Park.*



Following an internal reflection by the Institution, aimed at reshaping its proposals in light of the result of the first meeting, the Park proposed a new moment of confrontation, the World Cafè Workshop, held in the Municipality of Pievipelago on 11/22/2018, where each participant was given the opportunity to propose his own scale of action priorities (fig. 5). From this experience we've realized that it's very important to involve stakeholders in our projects/decisions with periodic meetings and on strategic issues. This type of involvement encourages more responsible participation in more transversal projects or initiatives that take account of conservation and protection aspects as well as sustainable tourism planning.



*Fig. 5 - Implementation of a shared planning "tool", applied during the second meeting in Pievipelago (High Modenese Apennine Regional Park), where stakeholders are invited in virtually invest on the preferred strategies and actions.*

The pilot area of the "Salse di Nirano" Nature Reserve was identified at a later stage, because of the impossibility of implementing the planned pilot action at Lake Pratignano due to the withdrawal of clearance by private landowners. For this reason, it was not possible to carry out the participatory process as it was carried out in the High Modenese Apennines Regional Park.

On March 19<sup>th</sup>, 2019, the institutions (Managing Authority and Fiorano Municipality), publicly shared and proposed a Pilot Action to the active associations already involved in the territory of the Salse di Nirano, as stakeholders of the area. These stakeholders are, in fact, the main driving force behind the development of sustainable tourism within the Reserve. This was possible because the dialogue and the comparison between the bodies, the associations and the interested parties in the Reserve area, were already consolidated by previous partnership on projects implemented in the Salse di Nirano territory. The pilot action was in fact received with interest and enthusiasm, entering with consistency between the activities and projects already underway in the protected area.



*Fig. 6 - Presentation of the Pilot action in the Cà Rossa visitor Centre - Salse di Nirano Natural Reserve.*

## 1.2. Developed Strategy

With regard to the pilot area of Lake Santo modenese, the analysis carried out with the stakeholders participating the aforementioned meetings, to discuss on the positive and negative aspects of different solutions for the sustainable tourism development, produced a first draft of the strategic themes and priorities, on which the related action plan (and pilot actions) should be based upon:



*Fig. 7 - Landscape of the Santo Lake Area. Here the Lago Baccio (1'550m a.s.l), 20' of walk from the Santo Lake. Above the lake, the Rondinaio peak (1'964m a.s.l).*

1. (PRIORITY 1) - Seasonal adjustment of the tourist offer;
2. (PRIORITY 2) - Information, education and monitoring;
3. (PRIORITY 3) - Accessibility, mobility and trekking trails;
4. (PRIORITY 4) - Conservation, protection and monitoring of the environment and landscape;
5. (PRIORITY 5) - Hospitality, tradition and typical local products.



*Fig. 8 - In contrast with the amazing and peaceful landscape of fig. 7, this is the typical summer situation on the parking below. The situation of the municipal road to reach the parking is even worse due to its tightness.*

As far as the Nature Reserve of the “Salse di Nirano” is concerned, it was strategic to acquire as much data as possible to document the main factors of threat to the Reserve deriving from poor or incorrect use even by visitors, in support of possible defensive actions, to accompany what already exists.



*Fig. 9 - Mud cones protected by fences, along the municipal road. This is one of the points where barriers are most frequently crossed by excursionists, in order to approach the eruptive apparatus, in Zone A, of maximum protection of the reserve.*

## 2. Pilot Action Design Phase

### 2.1. Monitoring Activities

The two pilot areas have different characteristics and criticalities and, therefore, the monitoring activities implemented in the two pilot actions have provided for different approaches and systems.

In the **Lago Santo modenese** area, the monitoring objective had to concerned:

- The promotion of sustainable forms of accessibility instead of the car, to reduce traffic congestion between the village of Tagliole (1'158m a.s.l.) and the end of the road at Lake Santo parking (about 4.5 km - 1'470m a.s.l.);
- Use the parking and the InfoPoint, to acquire a better knowledge about the characteristics, choices and degree of awareness of visitors about the specific nature of the Santo Lake and its natural surroundings.

The monitoring of changes in the use of the area will be carried out:

1. as regards the reduction of car access to the Lago Santo car park, it had to be confirmed by the number of tickets issued by parking meters for a parking fee (which will be compared with data from past summer seasons);





2. the evaluation of the number of people who will benefit from the alternative routes to reach the area of the Santo Lake, will be based on the e-bike rental data, on the number of people transported by the shuttles that will depart from Tagliole (or even from the village of Pievepelago), with destination Lago Santo and an indirect estimate of the number of hikers who will use the reopened hiking path that joins Tagliole to Lago Santo.

Within the pilot area of the **Salse di Nirano**, the monitoring purposes were mostly aimed at improving the knowledge of managing authorities about the tourist presence and behaviours, to the purpose of planning suitable activities to steer the behaviour of visitors that access to the whole area, preserving its unique and fragile landscape.

To the purpose of both: 1) monitoring the presence of excursionist in the area; 2) monitoring the main threats to the integral protection zone by fence crossing excursionists, and planning the right countermeasures to obstacle this behaviour, the use of a multi-Video Cameras system, was chosen. Particularly, the desired system was not just a video-recorder system: the need was to implement a system able to automatically identify, distinguish and count vehicles (cars, bikes, motorbikes), pedestrians and animals. Another purpose of the system was to acquire as much data as possible to document the main factors of threat to the Reserve arising from poor or incorrect use even by visitors, in support of possible defence actions, to empower the existing ones.

## 2.2. Forecasted Managing Activities

As part of the CEETO project in the pilot area of **Lago Santo modenese**, the governance strategies that the managing body agreed to implement with the involved stakeholders were related to three important sustainability cornerstones: 1) better mobility in the area; 2) tourist awareness improvement; 3) Seasonal peak flow redistribution (deseasonalisation).

For the mobility purpose the Action Plan implemented:

1. Free shuttle service from Tagliole for 2 busiest weeks (10th to 25th of August);
2. E-bikes, can be hired in Tagliole and used to get to Lake Santo Modenese, return can be by the same bicycles, shuttle bus or on foot
3. Restoration and securing of the path from Tagliole to Lake Santo: opened at the end of July 2019 and currently practicable in its total length (3.5 km).

The tourist awareness improvement was necessaire since most of them are daily “excursionists” (using the “” is not accidental), since few of them really enjoy the area for naturalistic leisure purposes but they reach the area, usually by car, with the only purpose to escape the summer heat and go to have lunch in the local refuges (at few hundreds of meters from the parking area), but that pay very little attention to the nature of the places. For this issue, the Action Plan followed the purpose to raise the tourist’s awareness of the naturalistic peculiarities and fragility of the area. To this purpose the managing authority thought to take advantage of the monitoring activities at the parking, to not only obtain information from tourists but also to improve their awareness by explaining the correct rules of conduct and foster a more responsible behaviour within the Park.

The third purpose was to distribute tourist over a longer period of time (seasonal adjustment), especially during the autumn and winter, and develop some activities in order to improve a more conscious use of the sustainable territory and low emission transport and promote tradition and hospitality throughout the area of the Tagliole valley.

At the **Salse di Nirano Natural Reserve**, the governance goals were concerned to:

- making visitors responsible for their own behaviour in the Salse di Nirano area, by providing them with adequate information on the correct rules of conduct;
- the protection and conservation of the local environment and landscape.

To this purpose, the objective of the pilot action was to collect data useful to a better planning of the activities aimed at protecting and preserving this unique and delicate area, its habitats and landscape in the best possible way. Actually, the data collected by the monitoring system, will be useful to plan visitor's sensitization actions and to stimulate correct styles and behaviours, inducing them to a responsible fruition of the reserve areas, and in particular area A, the most significant and delicate one.

### 2.3. Expected results

In the pilot area of **Lago Santo\_modenese**, the data acquisition and analysis, refers to the summer 2019, the period of the most significant tourism flows. The testing of alternative accessibility systems should have a significant impact on the reduction of private motor vehicles that travel the road to the parking lot of Lago Santo. Therefore, the implementation of alternative mobility actions seeks to affect the reduction of motor vehicles in the Tagliole valley and, at the same time, the implementation of responsible and sustainable behaviour in the areas of greatest protection. The results expected from the Pilot Action of Lake Santo modenese are mainly two:

- To acquire a detailed knowledge about the visitors (local residents, hikers and tourists) of Lake Santo Modenese;
- The observation of the changes in the responses regarding mobility and the awareness of being in a Protected Area allowed to evaluate the effectiveness of the previous Pilot Actions, related to the provision of a shuttle service and the implementation of an InfoPoint.



*Fig. 10a,b - For the Lago Santo area, two alternative ways to reach the lakes are the restored hiking trail path (on the left), and the E-Bike rental service (on the right). These two opportunities were expected to register a good number of excursionist frequentation and usage.*



Fig. 11a,b - Three video-cameras system setting, placed on an existing pole (on the left), and the industrial PC embedding the software for images acquisition and processing with Artificial Intelligence features (on the top right of the right photo).

Within the pilot area of the **Salse di Nirano**, the purpose was to have: 1) a more quantitative assessment of the Reserve attendance by excursionist; 2) to monitor the main threats to the integral protection zone and to the "sauces" and to direct the behaviour of visitors and access to the whole area, preserving its unique and fragile landscape.

The only way to reach this double purpose (without the need of an operators that spends days in front of a monitor to analyse records), was using a Video Content Analysis (VCA) System, that is an infrastructure made by video cameras, acquisition and recording system and a software, equipped with Artificial Intelligence algorithms, that automatically extract information, populate a database and elaborate images statistics. To this purpose it has been predisposed a tender for this kind of high-level specialization service and it was chosen a company (Vision-e) that provided the whole service (fig. 11).

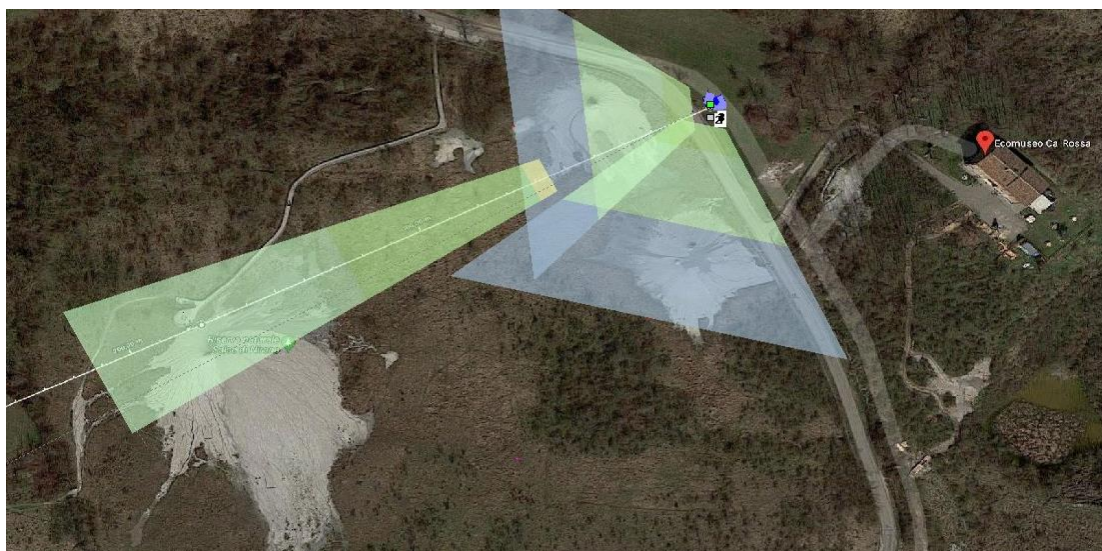


Fig. 12 - Aerial photo with the map of the fields of view of the three cameras of fig. 11a. Two out of three cameras have a wide-angle view while the central one has a much higher focal length, to better focus on the mud-bursting apparatus in the lower left part of the picture. On the right the Cà Rossa Visitor Centre.



The purpose of the system, in fact, was to acquire as much data as possible to document the main factors of threat to the Reserve arising from poor or incorrect use even by visitors, in support of possible defence actions of and accompanying what's already existing.

The monitoring service foresees the restitution, with spatial and temporal precision, of the following information:

1. The number of cars and people, divided by means of transport( by car, motorcycle, on foot), that travel the municipal road Via Rio Salse, near the Cà Rossa visitor centre (fig.12), with distinction, where possible, of the travel direction. The system allows, in particular, the aggregation of data on an hourly, daily, weekly, monthly and overall basis, with reference to the entire monitoring period;
2. Statistical data aggregated on an hourly, daily, weekly, monthly and overall basis, with reference to the entire monitoring period;
3. The numerical and temporal evidence of the episodes of overcoming physical barriers and invasion of Zone A;
4. Maps of the usage density (so called "heat map") of the routes of visitors along the street and, most of all, in the Zone A of the Natural Reserve, giving those complete numerical and temporal evidence of the episodes of overcoming physical barriers and invasion of Zone A that are impossible to obtain from the surveillance activities of a park ranger;
5. Video recordings of overcoming events, for their entire duration and with the automatic distinction between incursions of people and animals;
6. "Time Lapse" mode videos of the framed areas, to assess the seasonal evolutionary reconstruction of the landscape and the morphological change of the mud-bursting apparatus. These videos could be useful both for research purposes and for the realization of promotional materials for the Natural Reserve.



Fig. 13 - The system, used for the very first time in such a natural environment was called NEMOS, acronym of Nature Reserve Monitoring System.

The Video Content Analysis (VCA) system was denominated “NEMOS” (Nature Reserve Monitoring System) (fig. 13). Actually, while this kind of VCA systems are successfully used by security staffs and offices in closed spaces or urban environments, this is the first time that they are used in such a natural context.

The system acquires data continuously, from the mid of June 2019. The acquisition starts from 30 minutes before sunrise and stops 30 minutes after the sunset. Every second the scene is analysed and numerical position and type (person animal bike motorcycle car) of each object detected is saved.

Video Content Analysis (VCA) system was tested, equipped with automatic data extraction algorithms that make use of Artificial Intelligence to monitor and document the main threat factors supporting possible defence actions.

As shown from the [explanation video](#), the system detects the transits of vehicles and people along the access road to Zone A and acquires the most data on any episodes of overcoming physical barriers and invasion of Zone A by both people and animals resulting from incorrect use. The images of the framed areas are then processed in "Time Lapse" mode: every 5 minutes an image of the mud-bursting apparatus is saved in order to study the morphological changes for the seasonal evolutionary reconstruction of the landscape and the morphology.



Fig. 14 - Testing phase of the system. Combination of the views of the three cameras, with the recognition of people walking on the street and invading the Zone A of the Natural Reserve, beyond the fences. From the entire explanation video: [https://www.youtube.com/watch?v=6mbOOV\\_c0FI&feature=youtu.be](https://www.youtube.com/watch?v=6mbOOV_c0FI&feature=youtu.be).



## 2.4. Pilot Action Workplan

			2019											
N°	Tasks	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>1</b>	<b>Monitoring Plan</b>													
<b>1.A.</b>	<b>Fiorano Modenese - Salse di Nirano</b>													
1.A.1.	Realization of visual monitoring system with VCA - Video Content Analysis.						■	■						
1.A.2.	Monitoring access to the reserve, with particular reference to Zone A, of complete protection, by people and animals, and automated statistical extraction.							■	■	■				
1.A.3.	Intensification of supervisory activities with coordination of all supervisory bodies, both orderly and voluntary (GGEV and GEFI) GGEV and GEFI.							■	■	■	■			
1.A.4.	Data analysis and evaluation of results.										■	■	■	■
<b>1.B.</b>	<b>Pievepelago - Lago Santo</b>													
1.B.1.	Access monitoring with reference to the variation of the influx of cars in the parking lot of the Lake								■	■				
1.B.2.	Access monitoring through the use of the shuttle service as an alternative to the use of the car								■	■				
1.B.3.	Monitoring of alternative access to cars through distribution and completion of questionnaires at the Info Point and at the Tourist Office in Pievepelago								■	■	■			
1.B.4.	Data analysis										■	■	■	
1.B.5.	Evaluation of the results with the aim of reducing motor vehicles in the upper Tagliole valley and implementing an increase in responsible and aware use of the area.											■	■	■

## 3. Pilot Action Implementation Phase

### 3.1. Monitoring activities and achieved results

With regard to the pilot area of **Lake Santo Modenese**, a paper survey was conducted among visitors of the Lake Santo Modenese area, with the aim of collecting this information:

- Identity (age, sex, residence);
- The tourist behaviour (visit during the day or with overnight stay, if not inhabitant of the place), the choices in terms of overnight stay (place and type of accommodation) and the duration of the stay;
- The means of transport used to reach Lake Santo Modenese and the availability to use alternative modes (shuttle, e-bike or hiking trail);
- The awareness of being in a Protected Area and the existence of specific rules of conduct;
- The activities usually carried out during the visit to Lake Santo Modenese.
- For those who used the Shuttle service, an evaluation on the quality of the shuttle service has been inserted.



*Fig. 15 - Questionnaire and CEETO leaflets and gadgets (bag, pen), available at the Santo Lake InfoPoint.*

The complete questionnaire is available as annex to the deliverable D.T2.4.3.

The survey was carried out between July and September 2019 and the questionnaires were distributed to:

- The InfoPoint located near Lake Santo Modenese and Pievepelago;
- The shuttle bus stops;
- The headquarters of the Ente Parchi Emilia Centrale di Pievepelago, with the possibility of downloading them from the website ([http://www.parchiemiliacentrale.it/pdf/Questionario\\_LagoSanto.pdf](http://www.parchiemiliacentrale.it/pdf/Questionario_LagoSanto.pdf)).

Incentives were provided to tourist to fill in the questionnaires, such as the gift of a canvas bag, marked with the logos of the Park and the CEETO Project, and a pen to those who answered the questionnaire during the shuttle journey (fig. 15).

A total of 120 questionnaires were collected in the period from July 14<sup>th</sup>, 2019 to September 30<sup>th</sup>, 2019 taking into account that the InfoPoint at Lake Santo remained open until September 1<sup>st</sup>, 2019.

Another monitoring data on tourist attendance comes from the number of tickets printed by the parking meters of the parking lot of Lake Santo.

At the **Salse di Nirano Natural Reserve**, near the Cà Rossa Ecomuseum, 3 cameras have been installed, 2 framing the two small volcanoes in front of the house and the access road to Zone A for full protection and the last framing the reserve's pedestrian walkway and a third small volcano (§.2.3).

The cameras are connected to an industrial PC, where is embedded an automatic data processing and extraction unit, which uses state-of-the-art Artificial Intelligence algorithms to recognize people, vehicles and animals. Such an architecture is called “Video Content Analysis (VCA)”. The system, in addition to monitoring (quantifying and qualifying) the actual use of the area, also documents the main factors of threat to the Nature Reserve of Nirano Saucis, to support the design of possible defensive actions.

The implementation of this remote monitoring service has actively involved the Municipality of Fiorano Modenese and the collaboration as owner of the Cà Rossa Visitor Centre. The ancillary works carried out for the activation of the experimentation of the system called NeMOS - Nature rEserve MOonitoring System (fig. 13) have been:

- Laying of UTP cable lines for outdoor use in existing piping for connection from the ENEL pole to the box in the Cà Rossa structure via a counter compartment;
- Certification of wired connection on LAN cables for the transmission of the measured data;
- Bracket of the cameras through the supply of new outdoor brackets with a special attachment on an existing ENEL pole.

### 3.2. Implemented Management Activities

In the pilot area of Lake Santo Modenese, the survey involved the training of operators both at the InfoPoint located near Lake Santo Modenese and at the headquarters of the Ente Parchi Emilia Centrale in Pievepelago so that they could give the correct information about the Project CEETO and the right directions to complete the questionnaire.

With regard to the pilot action at Lake Santo Modenese, the InfoPoint located near Lake Santo Modenese and the headquarters of the Ente Parchi Emilia Centrale in Pievepelago were set up with the following material:



*Fig. 16 - Lago Santo InfoPoint, equipped with the CEETO Roll-Ups.*



- Roll-up display panels including a rewindable aluminium structure for the CEETO project (fig. 16);
- Posters placed on tripods to communicate the mobility initiatives (shuttle and e-bike) and the proposal of the new hiking trail from Tagliole to Lake Santo Modenese activated during the summer;
- Stickers printed on UV-protected film to be applied to sheet metal signs including a 200 cm pole mounted on a mobile base with a diameter of 60 cm to indicate the entrance to the hiking trail at the 2 points of access, 1 road sign to indicate the parking area and 2 road signs to indicate the stop of the shuttle at the 2 points of departure/arrival.
- Materials and gadgets of the CEETO project such as shoppers and biro for the promotion of the pilot action, in order to facilitate the filling in of the questionnaires drawn up for the purposes of monitoring tourist flows and sustainable mobility initiatives.



*Fig. 17 - Educational event at the Cà Rossa Visitor Centre, during the Salse di Nirano Natural Reserve Open Day (September 1<sup>st</sup>, 2019).*

The monitoring service of the Salse di Nirano Natural Reserve has been entrusted to the company Vision-e, which is responsible for data collection and processing. To show the acquired data, in “almost real-time”, the company provided the access to a web portal for consultation of the data collected and trained the staff to use it. During the Open Day, organized on September the 1st, 2019, the company Vision-e showed a demonstration video on the VCA system, which was called NEMOS (Nature rEserve MOnitoring System), that’s still available at this link: [https://www.youtube.com/watch?v=6mbOOV\\_c0FI](https://www.youtube.com/watch?v=6mbOOV_c0FI).

During the Open Day, other initiatives were also organized, dedicated to raising awareness of the territory and hikers on the specific environmental and landscape of the Salse di Nirano and the communication of the appropriate rules of conduct during the visit (fig. 17). The event, organized in collaboration with the Municipality of Fiorano Modenese and by G.E.Fi., Ecosapiens and Ideanatura, included a guided tour of the field of Sauces and the visitor centres of the Reserve. On this occasion, the CEETO project and the presence of the VCA system were illustrated, describing its objectives and operating methods.



### 3.3. Deviation from the forecasted workplan activities

In the **Lake Santo Area**, after a more complex phase of consultation than expected, in the definition of the Action Plan and the Pilot Action, the rest of the implementing process has not seen substantial deviations from what was planned.

The pilot area of the **Salse di Nirano Natural Reserve**, instead, was identified at a later date, following the impossibility of implementing the planned pilot action at Lake Pratignano (located in the same Regional Park as the Santo lake), where the participatory process was conducted as expected by the CEETO Project Capacity Building Workplan (D.T2.1.1) forecasted. The VCA system application for the monitoring of natural areas, that was forecasted to test the methodology to monitor the Pratignano's Lake shores (following the Inventory of Monitoring Tools - D.T1.2.1), found, in any case, a perfect setting also at the Salse di Nirano Area. The real deviation, in this way, was basically the absence of the participatory process and the public presentation of the Pilot Action essentially defined.

Technically speaking, the NEMOS system had a black-out in the period 12/09/2019 to 19/09/2019 due to some connectivity works on the installation site of Cà Rossa, on which the system's power supply depended; so, this fault was independent by the service provider. In addition, there were some further technical problems:

- Camera1: on 20/08/2019, a technical problem blocked the camera for the whole day;
- Camera3: in the first days, until 22/07/2019, the view shot was too wide, and the fence caused problems in detecting people. A zoom was made to have more detail and to allow the neural network (Artificial Intelligence algorithm) to work properly.
- Camera3: on 23/09/2019 a technical problem caused a partial recording of the data of that day.

The remote connection of the cameras and the portal for data consultation, allowed the company - Vision-e, to face the problems and to solve them promptly, reducing at the minimum the data loss that, for the whole period of the CEETO Pilot Action, have been very moderate. In the following period of monitoring (since the System will keep-on acquiring data), due to the maturing system, it's expected that the data loss will be even less.

## 4. Achieved Results

In both pilot actions, the overall evidence gathered through these monitoring systems constitutes the basis for the implementation of the activities foreseen in the five-year Action Plan.

The data acquired at **Lake Santo modenese** will be used to replicate and improve the initiative experimented in the summer period in collaboration with the Municipality of Pievepelago. Through the monitoring system implemented, it was possible to:

- Encourage sustainable forms of accessibility instead of the car (fig. 18);
- Acquire a better knowledge of the characteristics, choices and degree of awareness of visitors regarding the specific nature of Lake Santo area;
- Make visitors responsible for their own behaviour in the Park, through adequate information on the correct rules of conduct.



*Fig. 18 - The village of Tagliole di Pievepelago, in the High Modenese Apennine Regional park, where the Pilot Action of Santo Lake has realized the exchange parking with the departure of the shuttles, the rental of e-bikes and the start of the hiking trail towards Lago Santo.*

The data acquired at the **Salse di Nirano Natural Reserve**, allowed the Managing Authority to identify the weakest points of the fence system and statistically more used by the intruders. It will be possible to study a suitable signage that tries to dissuade intrusion actions and then monitor, with the same tool of VCA, if the number of intrusions or the points of intuition are actually reduced.



*Fig. 19 - The wooden footbridge that enters zone A of the Salse di Nirano Nature Reserve. This is the area furthest away from the cameras, where it is possible to recognize the overcoming of the fences (fig. 12).*



## 4.1. Touristic pressure reduction

With regard to the pilot area of **Lake Santo Modenese**, the Pilot Action Indicators and future targets forecasted for the closure of the Pilot Action (September 2019) are as follows:

- Total number of shuttle passengers per direction of travel;
- Length of the route served by shuttle bus;
- Average journey time by shuttle bus;
- Average journey time by car, with reference to August 2018.

For the pilot area of Lake Santo in Modena, the following data are described in greater detail in the D.T2.4.3:

- Database, in .xls format, of the daily number of tickets for access to the parking lot located at Lake Santo Modenese, with reference to the months of July, August and September 2018 and 2019;
- - Complete database, in .xls format, of the results of the survey, with commentary on the main evidence collected.

Below are the graphs of the questionnaires completed in the period July - September 2019:

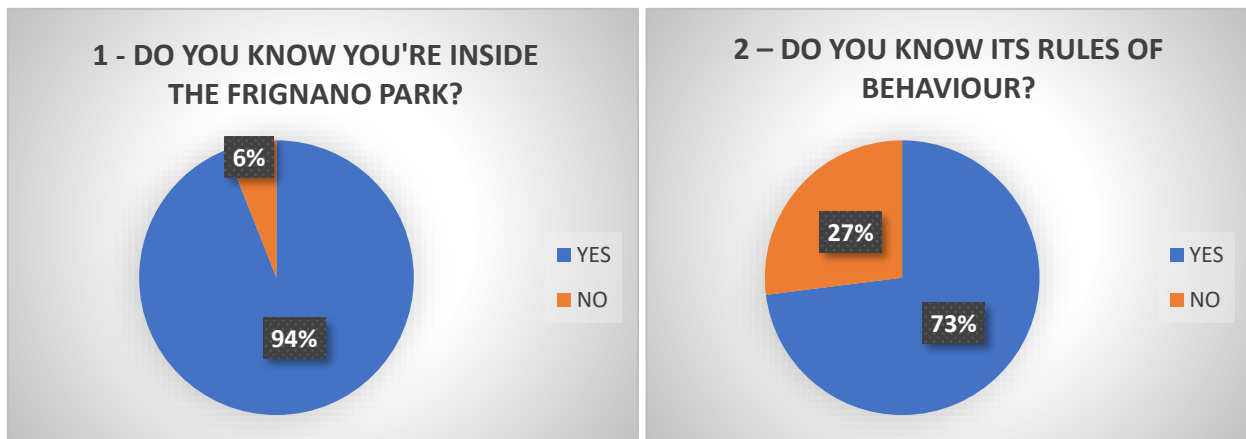


Fig. 20a,b - Questionnaire results on the awareness of tourist of the place where they are and on the behaviour rules.



Fig. 21 - Questionnaire results on the leisure activity carried out by tourists in the Lake Santo area.

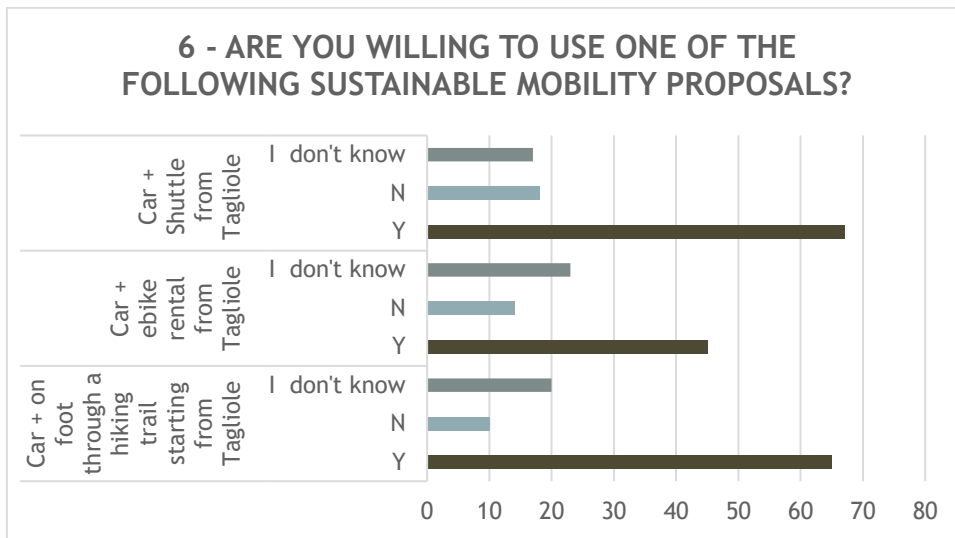


Fig. 21 - Willingness of tourists to use alternative ways to reach the Lake Santo area.

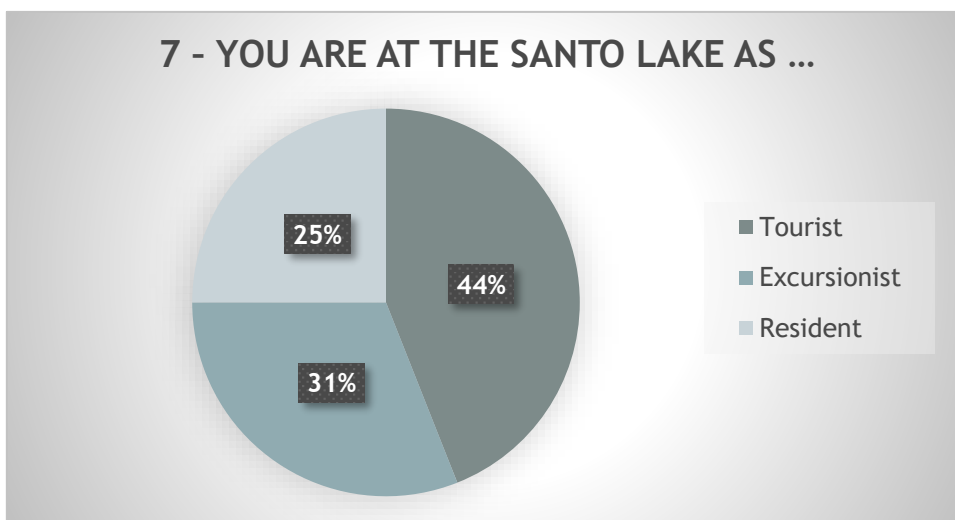


Fig. 22 - Classification of people visiting the Lake Santo area.

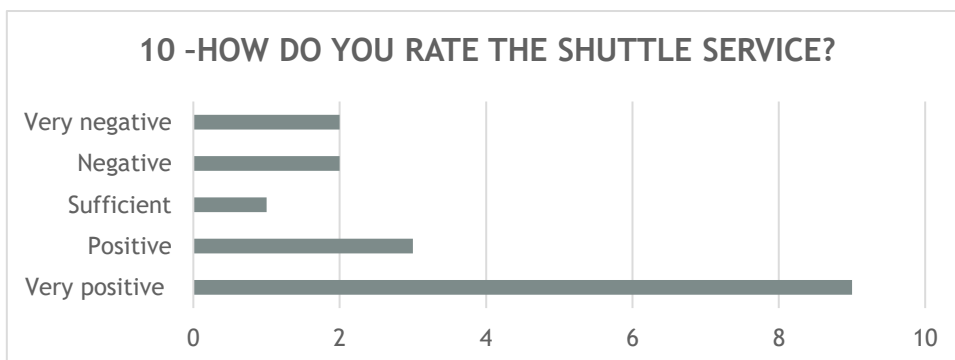


Fig. 23 - Tourist satisfaction about the Shuttle Service to reach the Lake Santo area.

Within the framework of the Interreg CEETO Project in the pilot area of Salse di Nirano, the main objective concerns the conservation and protection of the Reserve, given the high level of enjoyment by visitors throughout the year, flanked by a varied and well-structured offer of educational and recreational activities for schools, families and associations. It is therefore strategic to acquire as much data as possible to document the main threat factors for the Reserve, deriving from a poor or incorrect use even by visitors, in support of feasible defence actions to accompany what's already existing. The video-analysis service aimed at monitoring the use of the Reserve, meets both the needs of obtaining a quantitative view on the current state of affairs regarding the leisure usage of the reserve and to identify the misconduct that requires mitigation measures aimed at safeguarding the natural assets. The implementation of such an innovative analysis and monitoring system required a lot of commitment, but this but this has allowed us to obtain images, statistics, video-recordings, maps, etc., very useful for the next decisional phases.

The quantitative data acquired from the day of installation (19/07/2019) and elaborated by the VCA system, using state-of-the-art Artificial Intelligence algorithms, include the following data:

1. Daily (weekly, monthly, etc) number of people on foot, by bicycle, by motorbike, on horseback, etc. and number of cars travelling along the Municipal Road "Via Rio Salse", near the locality of Cà Rossa (location of one of the two Visitor Centres of the Reserve), with distinction between ascending (from valley to mountain) or descending (from mountain to valley) route and aggregation of the hourly, daily, weekly, monthly and overall data over the entire monitoring period;
2. Heat Map of the routes of the tourists/hikers of Zone A of the Reserve (considering the maximum surface area that can be framed by a single position of installation of the cameras), with aggregation of daily, weekly, monthly and total data over the entire monitoring period;
3. Number and statistical data (duration, route, etc.), on overriding of physical barriers (fences) and invasion of the areas of mud-bursting volcanoes, forbidden to access and trample<sup>1</sup>;
4. Video in "Time Lapse" mode of the framed areas (minimum sampling of 1 image every 5'-10'), for the seasonal evolutionary reconstruction of the landscape and of the morphologies of the mud-bursting apparatus (mud volcanoes).

The daily data on the use of the area and the overruns recorded in 2 Excel files are attached in the D.T2.4.3.:

- - 2019-10-29\_SDN\_Presences\_until\_30sep2019.xlsx with attendance data;
- - 2019-10-29\_SDN\_Intrusions\_until\_30sep2019.xlsx with intrusion data.

The following charts and maps show the statistic on the acquired data, from the onset of the monitoring system, up to the end of the Pilot Action (September, 30<sup>th</sup>, 2019).



*Fig. 24 - Enel concrete pole with the three cameras installed.*

<sup>1</sup> 1. In cases of fences overriding, after the distinguish between animals and people overriding, in the second case and in compliance with the new European Privacy Code (Legislative Decree 196/2003 coordinated with Legislative Decree 101/2018 and the EU General Data Protection Regulation - GDPR 2018), the recorded images of "human offenders", are automatically made unrecognizable and anonymous, for the entire duration of the exceedances themselves.

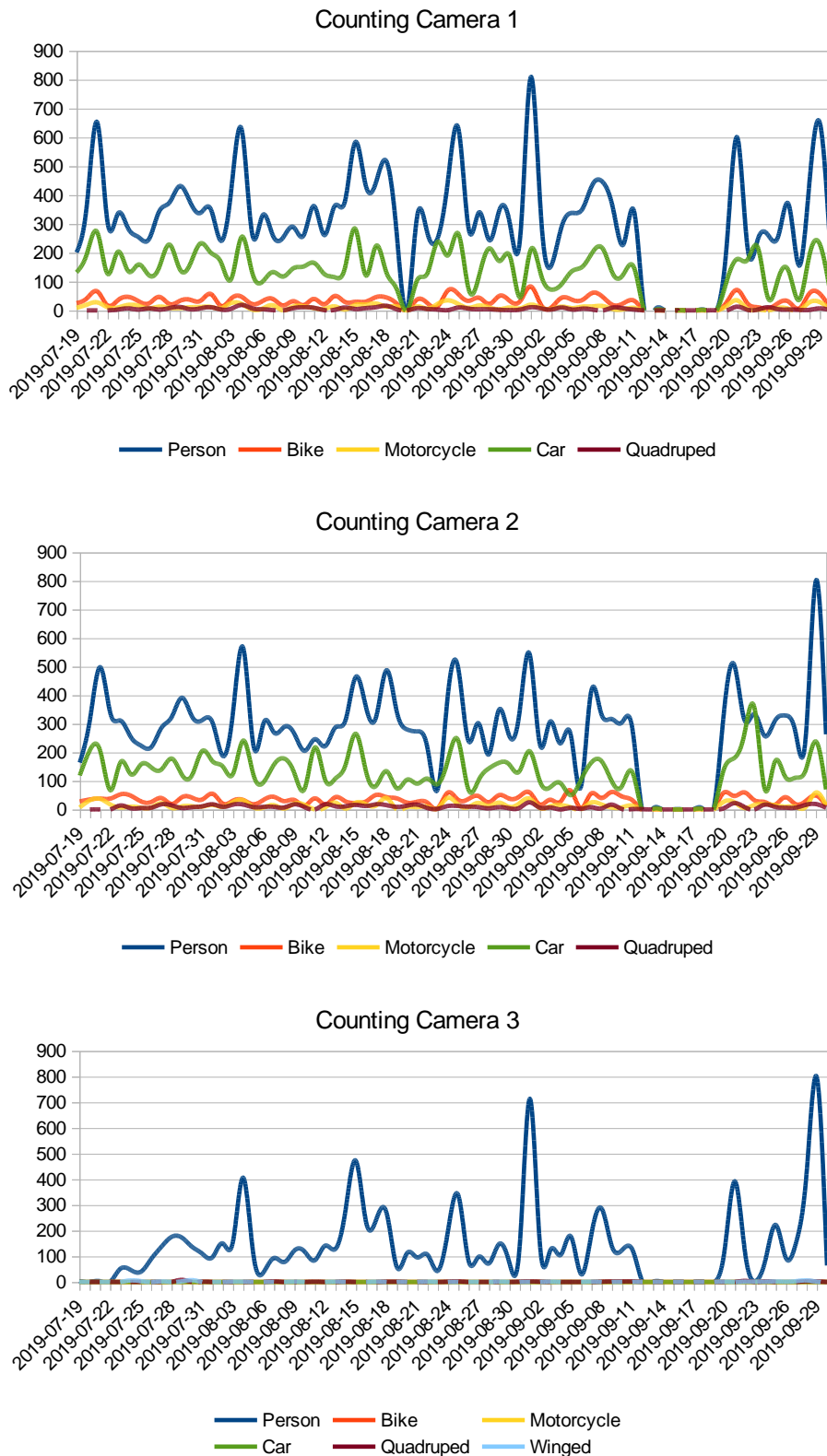


Fig. 25a,b,c - Statistic on the three cameras acquisition. Cam 1 and 2 results are, as expected, very similar while the third camera, looking away from the street, recognized essentially only persons, quadrupeds and birds.



Class distribution Camera1

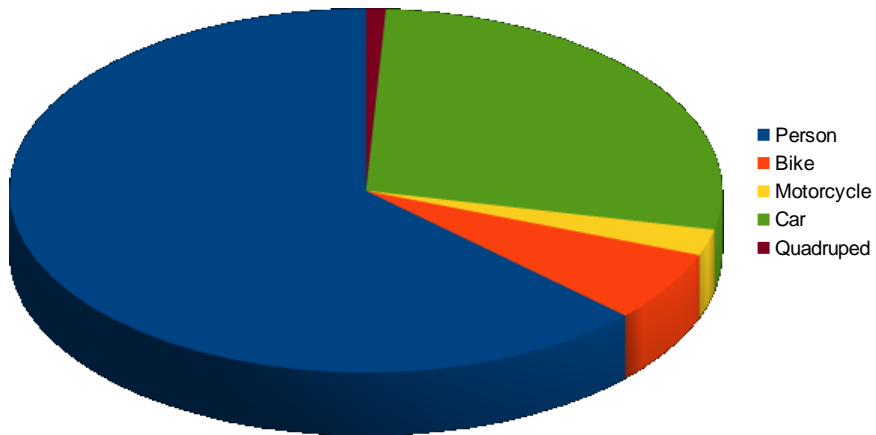
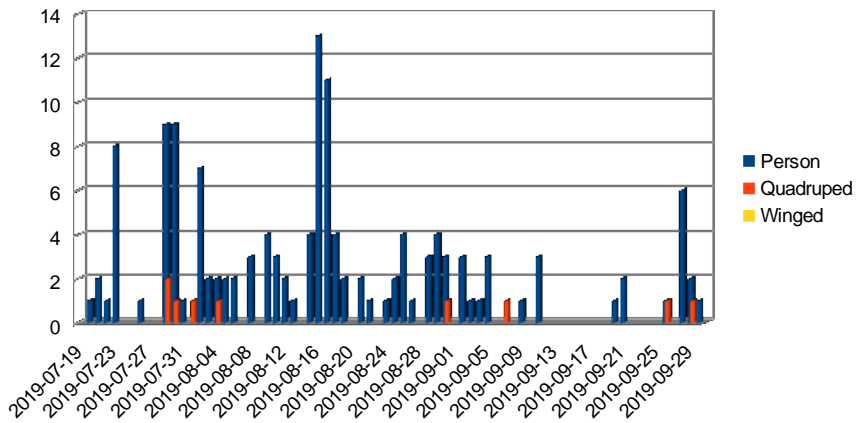
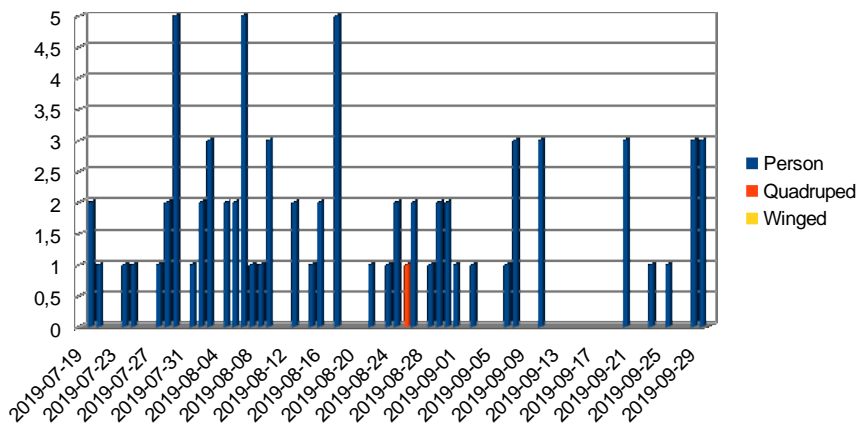


Fig. 26 - Example of the distribution of the recognition of means of transport which, during the period in question, have passed through camera 1.

Intrusions Camera1



Intrusions Camera2





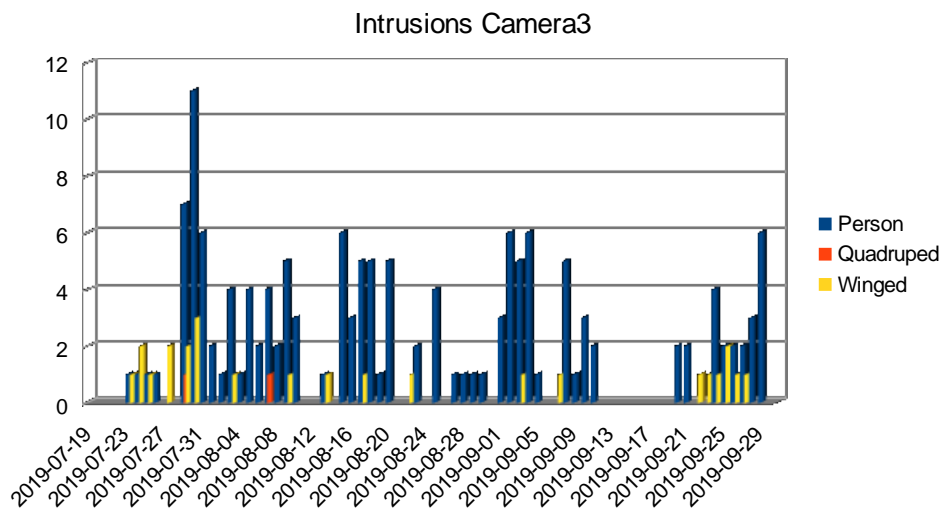


Fig. 27a,b,c - Statistics on intrusion events in Zone A of the Natural Reserve.

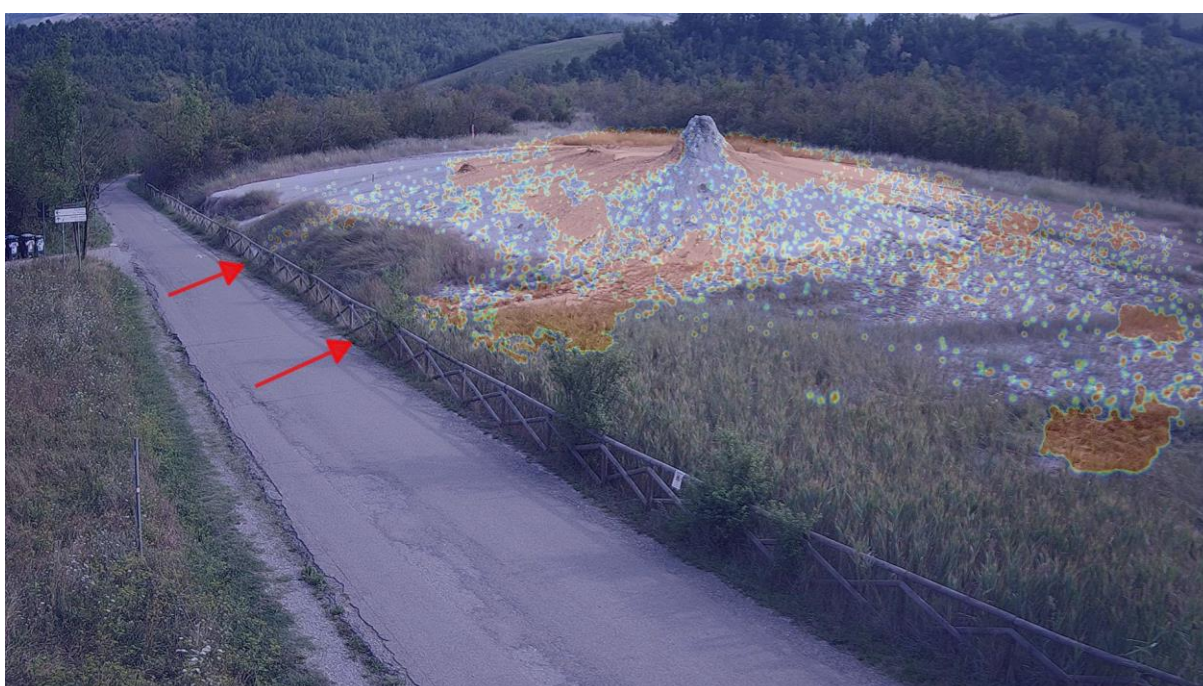
Analysing the data of fig. 27, reporting the daily statistics of the overcoming of physical barriers, recognized by the three cameras, we can confirm that the phenomena is quite frequent but, unlike what was expected at the moment of the monitoring system setup (i.e. that the areas framed by cameras 1 and 2 which, being positioned close to the road, would have been the areas that would have induced hikers to climb over to get closer to the eruptive cones), the highest number of overshoots is actually that recorded by camera 3, the one pointing to the most distant apparatus and to the area shown in the picture in fig. 19). The cause of this could be the visibility of the cameras in areas 1 and 2 while in area 3, being far from the cameras, probably leads people to think they are not "observed".



Fig. 28 - General HeatMap. As expected, the flow of vehicles and pedestrians, saturates the information along the municipal road. In any case it can be noted the splitting in two main parts, related to the go/back flows.

To get into more detail and exploit the power of the VCA, we can analyse the frequentation and intrusions from the heatmaps, that are the overlapping, on the real image, of a semi-transparent colour scale that, from blue to brown colour, gives the double information of position and frequency/time of the stay of people and vehicles on a certain area.

In fig. 28 it's mostly visible the transit of people and vehicles along the Municipal Road, plus some stays, on the roadside, corresponding to the preferred points to look at the mud cone. Some hotspots are also visible on the path to Cà Rossa (on top left of the image). The much higher presence on the road "saturates" all the information. If we exclude from the heatmap analysis the area of the street, it emerges the information related to the Zone A of the Natural Reserve (fig. 29). Here it is possible to highlight: 1) the overriding points mostly used by offenders' people (the two arrows in the image); 2) the position of walking/stay inside the Zone A of the reserve. The first points are those where the managing authorities can strengthen the dissuasive plates or more precise indications to the footbridge access to the area (fig. 19).



*Fig. 29 - HeatMap of the only Zone A of the Natural Reserve (excluding the transit along the road). The two red arrows indicate the most common points of intrusion of overriding people.*

## 4.2. Tourist experience improvement

For the area of Lake Santo in Modena, it is strategic to share the results of the monitoring with all the local stakeholders who have played an active role in the experimentation, i.e. the Municipality, in order to understand how to implement in a more structured way the actions experienced in the coming years and make them consolidated over time. The promotion of alternative accessibility systems should have significant impact on the reduction of private motor vehicles that travel to the parking lot of Lake Santo. The idea is to replicate and improve the initiative experimented in the summer period in collaboration with all stakeholders and in particular with the Municipality of Pievepelago.

For the area of Salse di Nirano, it is essential to understand if possible and where to replicate the experimentation of the VCA NEMOS system (Nature rEserve MOnitoring System) as a data acquisition system on the use and possible threats that a protected area may incur.



### 4.3. Socio-Economic Benefits

In the pilot area of **Santo Lake**, through the monitoring system implemented, an attempt was made to:

- Encouraging sustainable forms of accessibility instead of the car;
- To acquire a better knowledge of the characteristics, choices and degree of awareness of visitors regarding the specific nature of Lake Santo Modenese;
- To make visitors responsible for their own behaviour within the Park, through adequate information on the correct rules of conduct.

The promotion of alternative accessibility systems should have a significant impact on the reduction of private motor vehicles that travel the road to the parking lot of Lake Santo.

In the pilot area of **Salse di Nirano**, the monitoring has allowed, in particular thanks to the heatmaps (fig. 28 and 29), to identify the weakest points of the fence system and statistically more used by the intruders. It will be possible to study a suitable signage that tries to dissuade intrusion actions and then monitor, with the same tool of VCA, if the number of intrusions or the points of intuition are reduced or changed. In the area of Salse di Nirano, instead, the tested monitoring system can be replicated in other protected areas aimed at the conservation of habitats in relation to the control activity of the territory.

## 5. Conclusion

The aim is to give continuity to the Pilot Action in the: the Area of Santo Lake (the largest lake in the Park) experimented this summer, concentrating on one of the most delicate and frequented areas of the Park, will be to monitor and manage the important tourist flows that invade the area, especially during the summer weekends, managing the traffic and proposing "alternative ways" to reach the lake and the shelters. The Park's Managing Authority wants to give continuity to the activation of the following experimental services to improve accessibility to the Santo Lake:

- Free shuttle bus to the route from the parking lot of Casa Mordini to Lake Santo;
- Use of the Casa Mordini car park (70 parking spaces) and possibility of reaching Lake Santo by shuttle bus or through the open footpath (journey time of about 1 hour);
- Promotion of the use of bikes and e-bikes.

In order to improve the tourist hospitality and provision of information and education at the information points of Pievepelago and Lago Santo, the presence of the visitor centres and information points has been strengthened, increasing the number of opening days to the public during the summer period, with particular reference to the month of August.

In order to give continuity to the pilot Action experimented within the Interreg CEETO project referred to zone A of the Salse di Nirano Natural Reserve, aimed at a remote control of "risk behaviours" by tourists and at a more conscious and respectful use of places, the NEMOS - Nature rEserve MOnitoring System - Video Content Analysis (VCA) experimental system will continue to record access and use data. The system will then allow the comparison of the number of incorrect behaviours, once the dissuasive information actions will be implemented. At the same time, a targeted surveillance activity of the Authority will be intensified on the basis of the survey found.



Fig. 30 - CEETO Roll-Ups into the Cà Rossa Visitors Centre.



Starting from the experience of the CEETO Project, the Central Emilia's Parks Authority decided to face a new challenge: that of achieving the certification of the European Charter for Sustainable Tourism, for all the 8 protected natural areas it manages. The procedure started in April 2019 and will conclude at the end of the 2020. In this path, the 2 Pilots Actions tested through the CEETO Project will be a strategic example both from the point of view of tourism development and conservation of the territory. Most of all, the experience matured on this new way of collaboration with local stakeholders to define an action plan based on a thorough analysis of the local situation, will be very useful for the success of the ECST initiative.

Further, the importance of continuous improvement in these Protected Areas for sustainable and responsible tourism development, finds a further guarantee in the achievement of the environmental certification system (EMAS) and the dissemination and promotion of the Emilia Central Parks Quality brand to agro-food companies.

