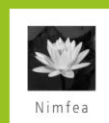




PILOT ACTIONS FINAL REPORT

D.T2.5.1 - Public institution Nature Park
Medvednica (PP09)

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Central Europe Eco-Tourism: tools for Nature Protection, CEETO, CE926

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List of Abbreviations

CEETO	Project “Central Europe Eco-Tourism: tools for nature protection”
CMHS	Croatian Meteorological and Hydrological Service
ECST	European Charter for Sustainable Tourism in Protected Areas
ERDF	European Regional Development Fund
LAC	Limits of Acceptable Change methodology
OG	Official Gazette
PINPM	Public Institution “Nature Park Medvednica”
SCI	Site of Community Interest
WWF	World Wildlife Fund
ZET	Zagreb electric tram - Zagreb public transport company



1. Introduction

Nature Park Medvednica (Park) is located in the area of three counties: Zagreb county, Krapina-Zagorje county and the City of Zagreb, with more than 1,2 million inhabitants living in the Park's surroundings, mostly residents from Zagreb, the capital of the Republic of Croatia (Figure 1).

The main feature of the Park are preserved natural forests and diversity of forest communities, including 8 special reserves of forest vegetation within the Park. Diversity of species and habitat types is also recognized at the European Union level, which is the reason for inclusion of the Park area in Natura 2000 Ecological Network as the SCI (HR2000583 Medvednica), with 22 target species and 8 habitat types listed in the Governmental Ordinance on Ecological Network and Competences of Public Institution responsible for the management of Ecological Network (OG No. 80/19) (Annex 1).

Among numerous animal species living within the Park, particularly significant are bats, with 24 resident species, including 8 Natura 2000 species. Furthermore, altogether 1.205 various plant species inhabiting the Park was confirmed by previous researches and studies. The area of the Park is rich in aquatic habitats, such as mountainous springs and streams. Medvednica is also known for its rich geological diversity, with all three types of rocks present, magmatic, sedimentary and metamorphic. As determined according to graptolite fossils, the oldest rocks date from the Ordovician period, 440 million years old.

The area of the Park is recognizable for its cultural and historical heritage, such as old forts, abandoned mines, churches and chapels, mills and watermills, and for its intangible cultural heritage. Medvedgrad and Zrinski Mine, cultural properties of the Republic of Croatia, are intended for visitors and they represent parts of the visitor infrastructure.

The Park offers various recreational and touristic possibilities, such as mountaineering, cycling, jogging, hiking, sports and religious tourism and cultural events. Numerous visitor infrastructure and facilities have been developed, including mountain huts, restaurants, hotels, educational trails, 70 hiking trails and 9 bicycle trails. The Park is known for the uniquely designed Bliznec Forest Trail, adapted for people with disabilities and the Veternica Cave, intended for tourist visits.

The intensive Park visitation is linked with high population density, and the fact that the Park is easily accessible, especially due to good traffic connections and no boundaries. There are three main road entrances to the Park, large number of forest roads and over 90 pedestrian entrances. There is very high visitor intensity during weekends, especially in the spring and fall, as well as during the ski season. The highest pressure and traffic load are in the peak zone, due to highest concentration of visitor infrastructure. This results in traffic congestion, inability to properly park the vehicles due to lack of parking spaces, and inadequate experience of the protected area. All of the above often disables passing of emergency vehicles, regular public transport lines and service vehicles.

Public Institution "Nature Park Medvednica" (PINPM) has started to address the traffic congestion issue more intensively through the process of nomination for the European Charter for Sustainable Tourism in Protected Areas - ECST, through a participatory approach and involvement of all stakeholders by establishing a Stakeholder Forum. The Charter was granted in 2014.

Implementation of the project *Central Europe Eco-Tourism: tools for Nature Protection (CEETO)* is a step further to achieve principles of the ECST. The CEETO project, which started in 2017, aims to establish an innovative sustainable tourism management system in the Park area, based on a participatory approach. In this way, efforts are being made to improve the capacity of protected area managers for the sustainable management and use of nature and its values.

The CEETO project is co-funded from the European Union’s European Regional Development Fund (ERDF). Altogether 11 partners from 6 countries are involved in project implementation (Italy, Austria, Hungary, Germany, Slovenia and Croatia), including Public Institution “Nature Park Medvednica” as Croatian partner. Nature Park “Medvednica” is one of 8 project pilot areas where innovative sustainable tourism management tools will be tested.

PINPM had a significant support of number of external experts in implementation of the CEETO project activities, including preparation of the Sustainable Tourism Action Plan (Action Plan) (Annex 2).

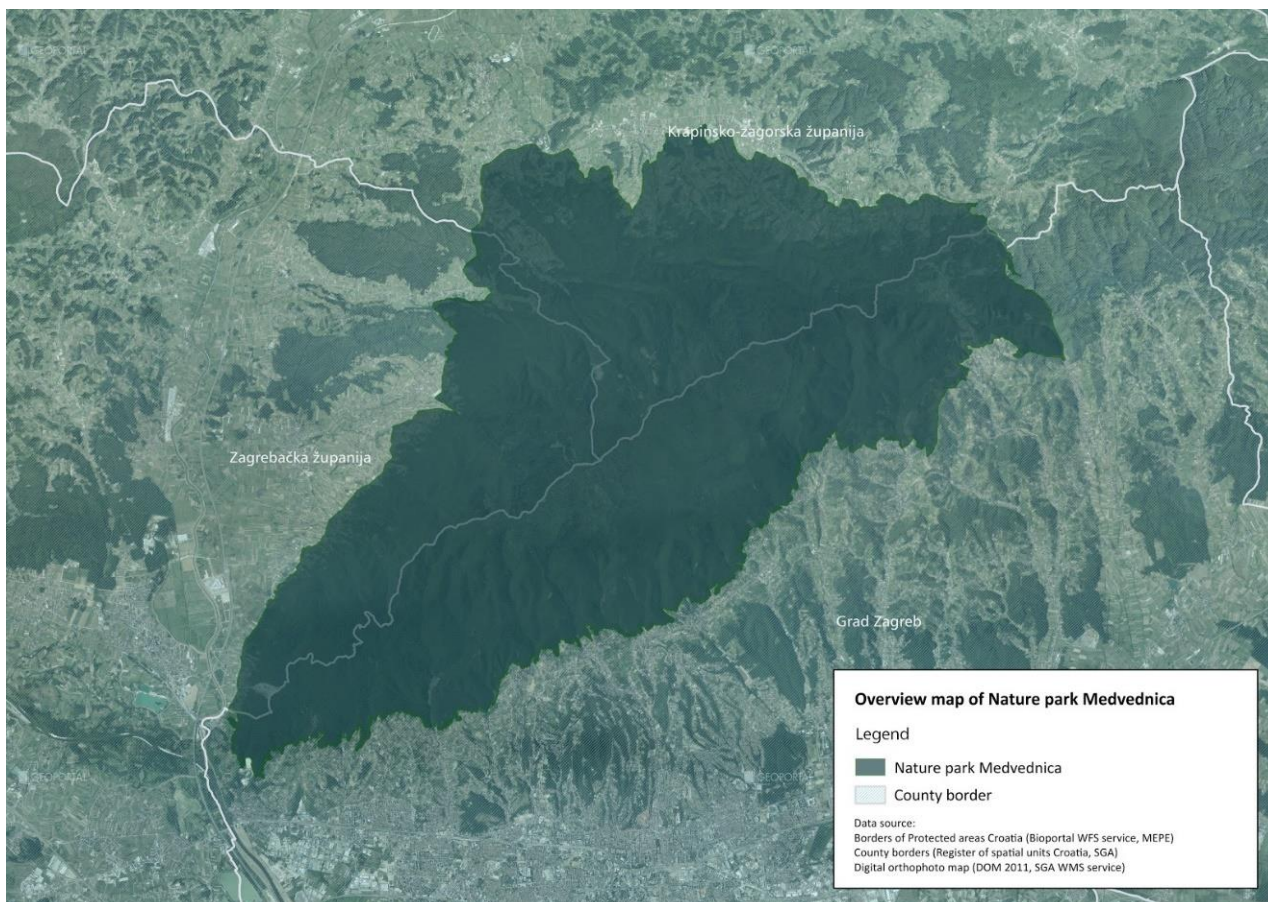


Figure 1. Map of the Nature Park Medvednica with administrative borders

1.1. Participatory processes

Public Institution “Nature Park Medvednica” already established mechanisms for continuous communication and cooperation with Park’s stakeholders in 2013; already mentioned PINPM Stakeholders Forum (Forum). Forum enables more effective approach to solving stakeholders’ related issues, as well as more active cooperation in implementation of joint projects.

Members of the Forum were actively involved in the implementation of the CEETO project, primarily in the elaboration of the Park’s Sustainable Tourism Action Plan. More specifically, the institutions that could actively contribute in the development of Action Plan and ultimately its implementation, to enable sustainable development of tourism and recreational activities were selected among the members of the



Forum. It includes 26 representatives of sport related service providers and users, local community, hikers, institutions and entities responsible for security, transport sector, accommodation and gastronomic facilities, nature and environment protection, forestry and tourism institutions as well as external consultants (Annex 3).

In accordance with *D.T2.1.3. Report of the on-the-spot assistance workshops on action plans elaboration and implementation* as well as *D.T2.2.2 Workplan/road Map Sustainable Tourism Action Plan*, five stakeholders' meetings were held in the period between February 2018 and April 2019. (Table 1)

The first two meetings were attended by experts, representatives of scientific and expert organizations, other entities, and representatives of the PINPM as Park's managers. At the meetings the guidelines for monitoring programme for Sljeme ski area and the Park area were defined. The other three meetings were organized as workshops, meetings and field trips for preparation of the Action Plan. Altogether 38 representatives of 17 organizations participated in the Action Plan development, among them predominantly Park area users (Table 2).

Workshops participants identified roles of stakeholders, visitors' management issues and possible solutions with concrete measures. All results were integrated in the Action plan proposal which was presented during the last workshop (*D.T2.2.3. Sustainable Tourism Action Plan*).

Table 1. Overview of meetings organised in the scope of the CEETO project

MEETING/WORKSHOP	DATE	THEMES	PARTICIPANTS/STAKEHOLDERS
First Stakeholders' Meetings	16 Feb 2018	Establishment of Monitoring Protocol for Sljeme ski area. Presentation of application of the LAC methodology in visitors' management.	21 participants from 11 scientific and expert organizations and PINPM
Second Stakeholders Meetings	07 May 2018	Selection of indicator for monitoring of Sljeme ski area	11 participants from 8 scientific and expert organizations and PINPM
On-the-spot assistance workshop on Action plan elaboration and implementation	02 July 2018	Field visit of the Pilot area (Nature Park Medvednica peak zone) and the agreement on guidelines for the work with stakeholders at the workshop	Representatives of PINPM and Italian association Federparchi
21th Forum's meeting - Workshop on Action plan elaboration and implementation	03 July 2018	Identification of roles of stakeholders, visitors' management issues and proposal of possible solutions.	20 participants from 13 organizations and their branches and local offices, mostly Park area users
22th Forum's meeting - Workshop on Action plan elaboration and implementation	10 April 2019	Presentation of the Action Plan proposal and announcement of the Open doors event	18 participants from 9 institutions/organizations and their branches and local offices, mostly Park area users



Table 2. List of institutions - participants of the Workshop on Sustainable Tourism Action Plan elaboration and implementation

INSTITUTION
City of Zagreb, City Office for Physical Planning, Construction of the City, Utility Services and Transport
Croatian Forests Ltd. - Regional forest administration Zagreb
Croatian Mountain Rescue Service
Croatian Ski Association
Federparchi (Italy)
Ministry of the Interior, Police department Zagreb
Ministry of Environmental Protection and Energy
Mountaineering Association Zagreb
Public Institution "Nature park Medvednica"
Ski club „Sljeme“, Zagreb
Sports Facilities Management, Ski Resort Sljeme
Vita projekt ltd.
WWF Adria
Zagreb holding ltd. - Vladimir Nazor Branch, Hotel Tomislavov dom
Zagreb holding ltd. - Zagrebačke ceste
Zagreb holding ltd. - Zagrebparking
ZET ltd.

Stakeholders participated in the meetings as well as in the implementation of the CEETO project through **visitors' survey** in the Pilot area, which was carried out in order to provide inputs to the Action Plan. The aim of this research was to collect information about profiles, habits and opinions of Park area users, primarily those that use ski areas and other related facilities in the peak zone, as well as their perception of impacts on natural values of the Nature Park "Medvednica" and role of the PINPM. The final version of the survey form was designed by PINPM and company Vita projekt ltd.

The survey was conducted on a sample of 406 respondents; 56% by direct questioning (field survey) and 44% by indirect questioning (online survey, distribution and gathering of surveys from other locations of visitors' interest). All survey results were also integrated in the Action Plan. More details are available in the chapter 3.1.2.



1.2. Developed Strategy

Nature Park “Medvednica” Management Plan (Management Plan) is the basic management document of PINPM and is prepared for a period of 10 years. It was adopted in 2010 for the period from 2011 to 2020, with defined management goals and planned implementation activities, as well as management effectiveness indicators. In the last year of the current Management Plan’s implementation, it is planned to start with preparation of the new Management Plan for the Nature Park “Medvednica” for the period from 2021 to 2030, as well as the Management Plan for the Ecological Network Area HR2000583 Medvednica.

The Park is divided into several zones and subzones, in order to soundly plan the use of area and implement adequate nature protection and sustainable use measures (Figure 2). All three zones allow visitation, including I. Zone of strict protection - IB. Zone of strict protection with visitation.

One of the key topics of the Management Plan is *Tourism and visiting*. The aim is to *Enable a good experience of visiting and enjoying the natural and cultural values of the Park with as few as possible negative impacts on nature and environment*. The Plan further stipulates 14 actions under 2 subthemes: Establishing visitors’ infrastructure and Visitors management.

In accordance with the Management Plan and based on principles of the ECTS, the Strategy and Action Plan of Sustainable Tourism 2014 - 2018 (Strategy) was developed. The Strategy’s Vision was: *“By 2018 Nature Park Medvednica will be nationally and internationally recognized as a sustainable tourist destination, which through the implementation of quality and enriching programs for visitors, makes possible the preservation of natural and cultural heritage, prosperous business of local entrepreneurs and a better quality of life of local residents”*.

Action Plan developed within the scope of CEETO project (*D.T2.2.3. Sustainable Tourism Action Plan*) represents a continuation of efforts to pursue a strategic approach to implement sustainable tourism development measures in the Park in cooperation with relevant stakeholders.

Three key objectives were identified, which correspond to the themes from the ECTS:

- Objective 1. Protection of natural and cultural values
- Objective 2. Visits management
- Objective 3. Communication with stakeholders

In order to achieve these objectives, the Action Plan elaborates 18 activities (Table 3). All activities are elaborated and based on the results of the workshops with members of Forum and survey of profile, habits and opinions of visitors.

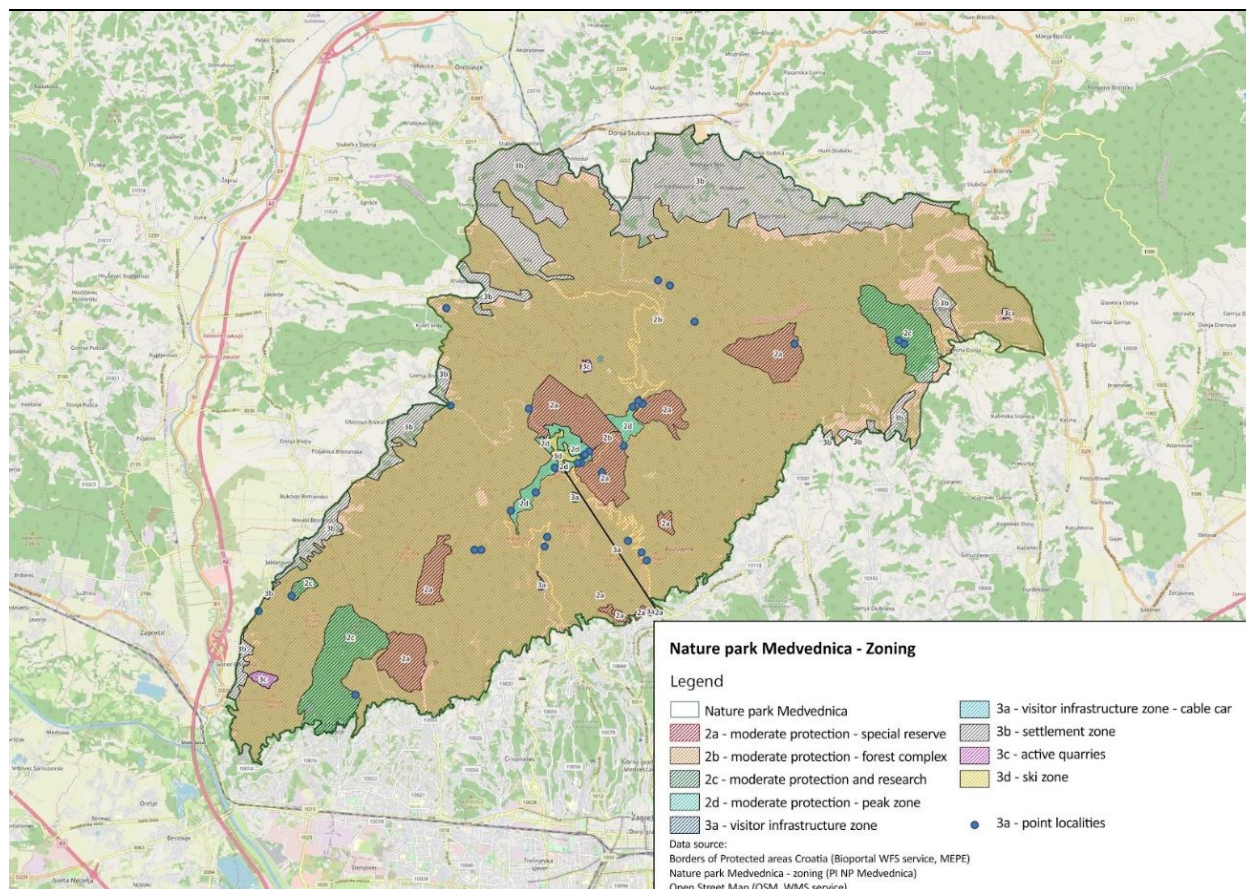


Figure 2. Zonation of the Nature Park Medvednica. Source: *PI NP Medvednica*

Table 3. List of activities for achievement of key objectives of the 2019 Sustainable Tourism Action Plan

OBJECTIVE	ACTIVITIES
Objective 1. Protection of natural and cultural values	Activity 1.1. Continue with the monitoring of the Veternica cave
	Activity 1.2. Continue with the monitoring of the Zrinski mine
	Activity 1.3. Continue with the monitoring of the ski slopes
	Activity 1.4. Reconstruction of the Visitor Centre Medvedgrad
Objective 2. Visits management	Activity 2.1. Reconstruction of Sljeme cable car
	Activity 2.2. Establish a bicycle offer in PPM
	Activity 2.3. NPM visitor survey
	Activity 2.4. Improve the CPM touristic value
	Activity 2.5. Improve NPM touristic offer



Activity 2.6. Improve traffic signs outside the Park

Activity 2.7. Visitors' infrastructure regularly maintained and adapted to new demands

Activity 2.8. Improve and upgrade traffic solutions for accessing the peak zone and traffic at standstill

Objective 3.
Communication with
stakeholders

Activity 3.1. Redesign of the Nature Park Medvednica website

Activity 3.2. Regularly create and publish leaflets, posters and other promotional and educational materials

Activity 3.3. Encourage media participation in education and information on the protection of natural and cultural heritage in the Nature Park Medvednica and establish a permanent partnership

Activity 3.4. Support Forum members and other stakeholders in developing visitor content which protect and contribute to the values of the Park

Activity 3.5. Educate the members of the Stakeholder's Forum and the wider public on sustainable tourism and other relevant topics

Activity 3.6. Continue cooperation with stakeholders



2. Pilot Action Design Phase

2.1. Monitoring activities

The CEETO project's *D.T2.4.1 Monitoring Work Plan* foresees implementation of the following activities, in the period between October 2018 and September 2019:

- Visitors survey - carry out quantitative and qualitative survey of visitors' profile, habits and views, with constant monitoring of visiting dynamics during the CEETO project implementation period,
- Involvement of relevant stakeholders - actively involve relevant stakeholders in elaboration and implementation of the Monitoring Work Plan, particularly through contribution in certain data collection, such as data on overnight stays and number of visitors - skiers,
- Installing car counters and cameras - install 2 car counters and 3 cameras for real-time surveillance,
- Monitoring of selected indicators of environment and nature - monitor selected indicators linked to impacts of visitation on nature and environment. Based on LAC (*Limits of Acceptable Change*) methodology and in consultations with experts, a set of relevant indicators was defined, as follows:
 - *Environment indicators: hydrological, soil and edaphic indicators, climatological indicators,*
 - *Nature indicators: vegetation records; stream and wells fauna - stone crayfish, yellow-bellied toad and Italian crested newt; meadows and lichens biodiversity; (other) invertebrates' indicators - Rosalia longicorn and long-horned beetle*

The selected indicator species are targeted by Natura 2000 species of Medvednica Nature Park and Natura 2000 site HR2000583 Medvednica.

2.2. Forecasted Managing Activities

During the implementation of the project, the necessary management activities were undertaken to ensure proper implementation of the planned pilot actions and the Sustainable Tourism Action Plan.

Implementation of the CEETO project in the Park does include particular concrete visitors' management activities, such as i.e. certain form of visitors or visits limits. The emphasis is given on monitoring of selected indicators of visitation related pressures and elaboration of the Sustainable Tourism Action Plan in cooperation with stakeholders.

2.3. Expected results

Based on the research carried out within the scope of the CEETO project, following results were generated and included in the Final report:

- insight in the visitors' profiles and opinions,
- surveillance of vehicles number,
- insight in the traffic intensity on the Park's main access road,
- overload of parking space,
- identification of visiting pressure on environment and nature,
- defining possible solutions,



- raising awareness of visitors on visitation intensity and pressures on the Park's natural values,
- stakeholders' involvement in problem solving,
- improvement of Park's visitors' satisfaction,
- improvement of inter-sectoral cooperation.

2.4. Pilot Action Workplan

Besides the *D.T2.4.1. Monitoring Work Plan*, PINPM and stakeholders developed the *D.T2.2.2. Work Plan/Roadmap for Sustainable Tourism Action Plan* (more details provided in chapter 1).



3. Pilot Action Implementation Phase

3.1. Monitoring activities and achieved results

Implemented monitoring activities, focused on selected indicators, can be grouped in three pilot actions:

- monitoring of visitation impacts on nature and environment
- survey of visitors' profile, habits and opinions
- analysis of car counters and surveillance cameras data

3.1.1. Monitoring of visitations impacts on nature and environment

The planned monitoring of selected indicators of visitation related pressures on nature and environment (Table 4) was implemented in the period between June and September 2019. The research was focused on the peak area of the Park, as well as the broader area influenced by intensive visitation. The selected locations were: the ski track *Crveni spust*, artificial water retention (*Jezero*), surrounding forest area and watercourse Bistra. *Hunjka* meadow, as a location under lower visitation pressure, was selected as a control point and as such, used for benchmarking against samples collected from the locations under intensive visitation pressures. The selection of particular research locations was proposed during the first two stakeholders' meetings, and was further confirmed after the field visits.

Table 4. Overview of visitation pressures indicators analysed within the scope of the CEETO project, in cooperation with external experts

INDICATOR	ORDER NO.
Soil and edaphic indicators	8/19/SS
Freshwater analysis - microbiological parameters	9/19/SS
Climatological indicators (10-year analysis based on data collected by CHMI)	10/19/SS
Streams and wells fauna - stone crayfish	11/19/SS
Streams and wells fauna - yellow-bellied toad and Italian crested newt	12/19/SS
Vegetation mapping - determination of bioindicator species of meadows	13/19/SS
Invertebrates indicators - <i>Rosalia longicorn</i> and long-horned beetle	14/19/SS

Comparative analysis of selected **soil and edaphic indicators** sampled on the ski track *Crveni spust* (start, central part and finish area) and *Hunjka* control meadow, as already indicated location under lower visitation pressure (Figure 3) was carried out. Different soil acidity was recorded in the soil samples from *Crveni spust*, as well as more significant difference in levels of ammonium nitrogen, readily available phosphorus and level of zinc. According to the Soil map of the Park, all locations have the same or similar



soil type, hence the expected soil acidity (pH) should measure between 4 and 5,5. However, this value is recorded only on *Hunjka*, whilst the soil on *Crveni spust* is twice as high and mildly alkaline.

Nitrogen is usually present in the soil in its organic form (humus) and to a lesser extent in inorganic, ammonium form. Expected percentage of nitrogen in analysed soil samples measures from 4,4 to 14,5 %. This corresponds to the actual values recorded in soil of *Hunjka* and at the start of the *Crveni spust*, whilst soil on other locations shows lesser values. Furthermore, the concentration of ammonium nitrogen in soil of *Hunjka* is three to four times higher than the one recorded on *Crveni spust*. On the other hand, the soil at the start of *Crveni spust* measures almost 12 times higher concentration of readily available phosphorus than the soil on *Hunjka*.

These results could be correlated with the incline of the slope and skiing, as the predominant use of *Crveni spust* during winter. Namely, according to the research conducted during the last decades, changes in soil acidity and nutrient availability are linked to the use of artificial snow. The artificial snow could be twice as alkaline than the natural snow.

Preparation of the ski track could cause leaching of the soil's surface and thus decrease availability of nutrients on slopes, whilst mechanical pressure decreases the soil's volume.

Different chemical composition of the soil could be linked to the use of salt in snow maintenance on ski tracks. The higher concentration of soil's salinity causes the increase of soil's acidity. However, the research of the soil and edaphic indicators did not include the detailed analysis of the salinity, particularly the presence of chlorides. In order to have a clearer picture on visitation impacts to the soil, more soil samples from more control points should be analysed.

Analysis of **microbiological parameters of freshwater** was conducted on three locations in the peak area and northern part of Medvednica: water retention *Jezero* (lower part of the *Crveni spust* ski track), tributary *Rasuha* and stream *Bistra* (Figure 3). It shows that analysed samples do not meet the standards prescribed in the *Ministerial Ordinance on compliance parameters and methods for analysis of water for human consumption* (OG No. 125/17). Namely, the significant number of intestinal enterococcus *Pseudomonas aeruginosa* was recorded in all three sampling locations, as well as faecal coliform bacteria in tributary *Rasuha* and stream *Bistra*, and pathogenic bacteria *Salmonella ser. Veneziana* in *Jezero*. This finding indicates the anthropogenic wastewater pollution, most probably coming from gastronomic and accommodation facilities concentrated in the peak area (Figure 3).

The results of analysis of **climatological indicators** recorded in the period between 2009. to 2019. show that average air temperature in January is mostly in compliance with the average of the standard climatological period; from 1961 to 1990. However, it was recorded that winters of 2014 and 2016 were warmer than average, which f.e. resulted in cancellation of traditional FIS ski races. Furthermore, in the last decade number of days with snow coverage decreased for almost 50%, when compared to the period between 1961 and 1990. According to the Regional Climate Model system (RegCM), a decrease of so-called frost days (days with daily temperature lower than -10°C) for 2 to 5 is expected by 2040, depending on the scenario, with an increase of average winter temperature for 1 to 2°C. These predictions do not favour long-term sustainability of skiing in the Park.

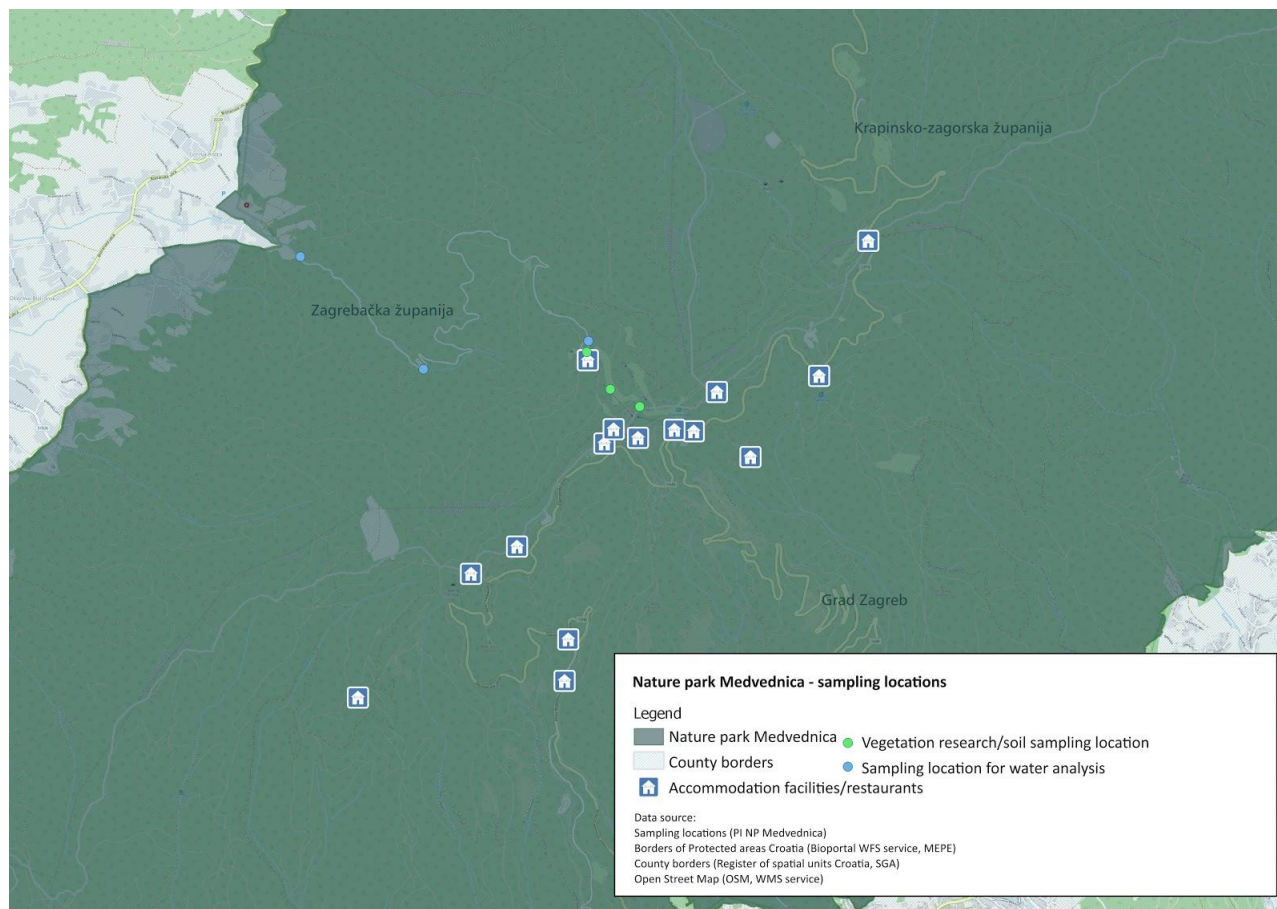


Figure 3. Sampling locations of freshwater, soil and vegetation and locations of visitors' infrastructure (gastronomic and accommodation facilities). Based on reports prepared in the scope of the CEETO project

Systematic research of **wells and streams fauna - stone crayfish (*Austropotamobius torrentium*)** was conducted in the period between 2010 and 2017 on several locations in the Park. The research within the scope of the CEETO project was further continued on the several micro-localities on the streams *Bistra* and *Kraljevečki potok*. Both watercourses are shown to be good habitats for the stone crayfish.

However, a positive population trend is recorded in *Bistra*, whilst *Kraljevečki potok* has a negative trend with insufficient genetic pool to establish the stone crayfish population. The latter is a result of a long-term presence of crayfish plague (*Aphanomyces astaci*). This disease is also recorded in *Bistra*, but at present without any negative consequences. Although the stream *Bistra* contains high concentration of faecal coliform bacteria, it is not known whether this pollution has any impact on resilience of crayfish population to plague or other threats.

Populations of **Italian crested newt (*Triturus carnifex*)** and **yellow-bellied toad (*Bombina variegata*)**, as other representatives of wells and streams fauna, were analysed within the scope of numerous research activities in the Park, conducted in the period between 2006 and 2018. The CEETO project research was focused on the stagnant water bodies of *Jezero* and *Tigrovo oko*. *Tigrovo oko* is shown to be a good habitat for amphibians, however the presence of fish species gudgeon (*Gobio gobio*) unables establishment of viable amphibians' population. On the other hand, artificial retention *Jezero* is unfavourable habitat for Italian



crested newt, but it is a good habitat for yellow-bellied toad, with recorded positive population trend. Due to such a positive population trend of yellow-bellied toad (also recorded in the entire Park area), the planned discharge of the water from the retention *Jezero* would probably have negligible temporary impact on this species. Furthermore, this species has a high migratory potential. Hence, should the unfavourable habitat conditions emerge, the adults could easily move to another location. Since the Italian crested newt was not recorded in the Park during recent studies, it is not possible to talk about the population state, nor the conservation of species habitats. However, more research efforts should be invested in the future.

Vegetation mapping conducted at the same sampling locations as soil and edaphic indicators analysis (Figure 3) shows difference between plant composition of the ski track *Crveni spust* and *Hunjka* meadow, as location with no skiing, but the biodiversity of plant species is not necessarily lower on ski track. For instance, the highest number of plant species is recorded in the finish area of *Crveni spust* and the start of *Crveni spust* and *Hunjka* have the most similar composition of plants. The diversity of plants could be result of various parameters (such as land use, position, slope etc.), but due to limited number of samples used for the research, it is not possible to define precisely which parameter is the most relevant one. Plants on all locations are predominantly hemycryptophyts or those plants with buds at or near the soil surface. It is highly probable that skiing and mowing contribute to domination of such plant life form.

Invertebrates indicators *Rosalia longicorn* (*Rosalia alpina*) and **long-horned beetle** (*Morimus funereus*), are so called saproxylic beetles that depend on dead and decaying wood for at least a part of their lifecycle. The targeted research of *Rosalia longicorn* in the Park was conducted twice in recent years (2012-2013 and 2015), and of long-horned beetle only once (2015), although some specimen were recorded sporadically within the scope of other similar research. The Park accomodates healthy population of saproxylic beetles, which also indicates that existing management of forests is adequate for the preservation of these species (it leaves sufficient quantity of deadwood). Since the saproxylic beetles were also recorded in the ski area, it seems that visitation does not limit their presence, as long as there are trees which they use, particularly beech trees.

3.1.2. Monitoring of visitations intensity

Surveys of visitors' profiles and opinions were conducted two times before the start of CEETO project; in the period from May 2007 to May 2008 and during 2012. Research has shown, among other, that the Park is primarily visited by local visitors (an average of 99.3%) from the immediate vicinity (City of Zagreb and Zagreb County), and majority of them visit the Park peak area. A visitors' survey conducted under *D. T2.2.3 Sustainable Tourism Action Plan* during January and February 2019 confirms that the highest number of Park visitors comes from Zagreb (76.8%). Most visitors use their own cars to get to the Park, and the most common reason is simple access, but often it is due to the lack of a cable car or low public transport capacity.

The most common visitation motive is recreation. Almost all visitors (96.6%) are aware that the Park needs protection, and they recognize that the most significant pressures are logging, too many cars and (over) construction (Figure 4).

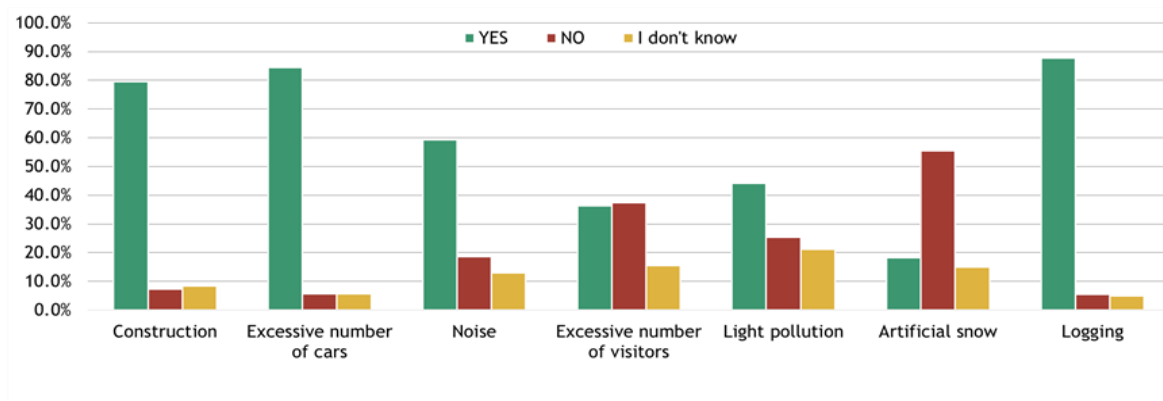


Figure 4. Opinions of the respondents about the impacts from which is necessary to protect Medvednica

Visitors are mostly bothered by the number of cars and they are dissatisfied with the organization of parking in the peak zone. Among all the solutions offered to reduce traffic pressure, visitors responded most positively to the construction of a cable car, additional parking at the foothill with the organized transportation to the peak zone (Figure 5), and they generally showed a willingness to pay for the reservation of parking places (Figure 6). These results correspond to the previous research conducted in 2009 and 2012.

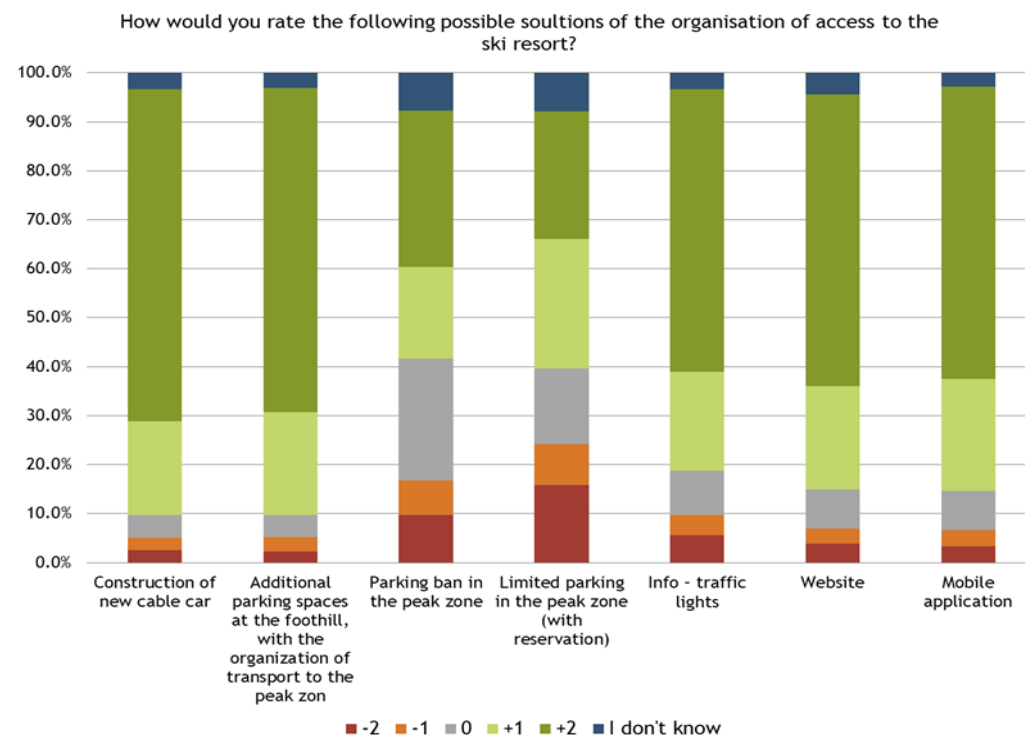


Figure 5. Attitudes of the respondents regarding the usefulness of possible future solutions of the organization and access to the ski resort and the Pilot area

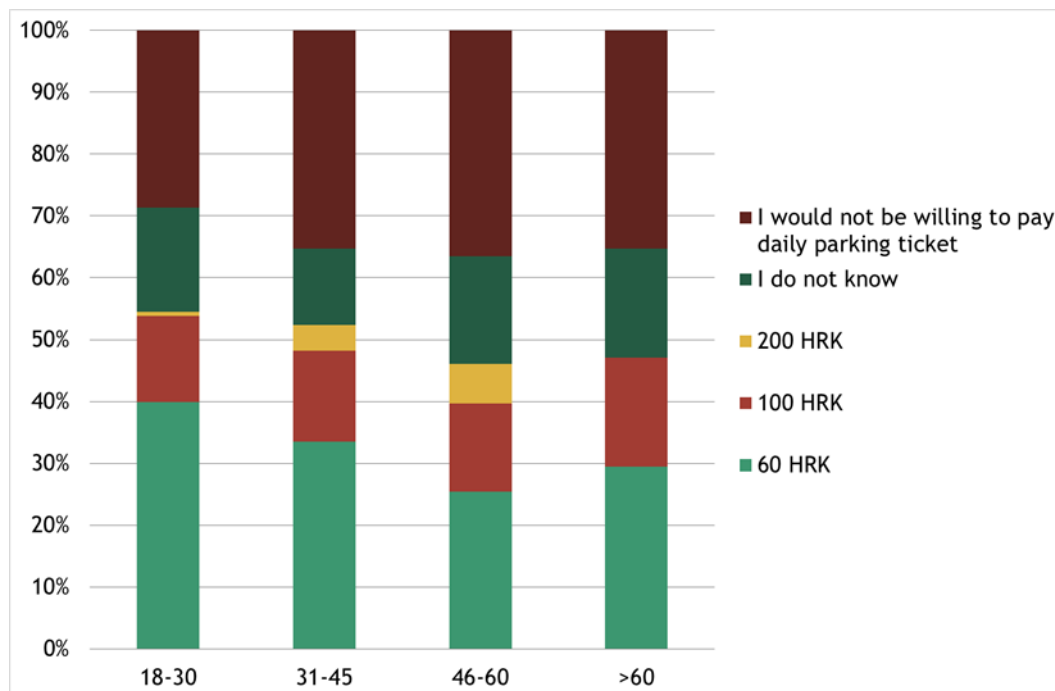


Figure 6. Willingness to pay a reserved parking space in the Pilot area - according to the age of the respondent

3.1.3. Road traffic counters' and surveillance cameras' data analysis

Road traffic intensity monitoring was conducted with the help of the road traffic counters, installed in November 2018 on two locations within the Park. Counter 1 was installed at the one-way entry road near to the Park headquarters, with the aim to monitor all road traffic coming from Zagreb via Bliznec and going to the Park peak zone. Counter 2 was installed at the peak area, near the two-way main road in the vicinity of Hunjka, the road that goes in the direction of Krapina-Zagorje county (Figure 7).

Road traffic counter data analysis covers the period from 1 December 2018 until 30 September 2019¹. It is important to emphasize that, in accordance with the Decree of City Office for the Local Self-Administration (City of Zagreb), the road traffic to Sljeme was banned at the road section from Bliznec (Pilana Bliznec) to Stara Lugarnica, every week day from 09:00 - 16:00 hours in the period from 18 February until 15 November 2019. During the mentioned period it has been possible to use Sljeme Road from 11.30 to 13.50 hours following regular public transport.

¹ Data was also available for part of November 2018 but data was excluded from the analysis because it did not cover the entire month. Also, in accordance to the official notice from the counters' manufacturer, in December 2018, as well as January 2019, due to a technical error, both counters registered 20% more traffic. This information was taken into account during data analysis by reducing the number of registered vehicles by 20% for the indicated months.

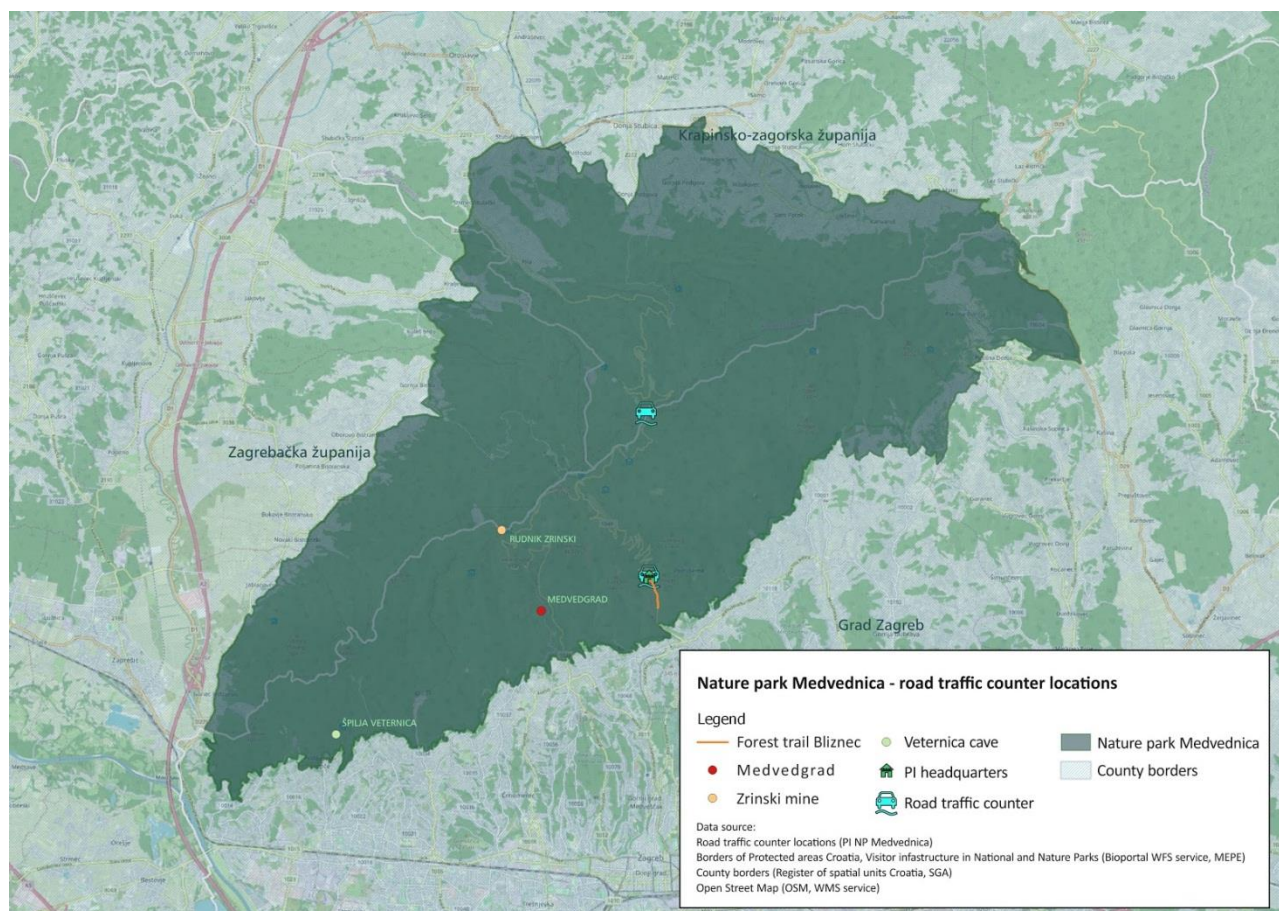


Figure 7. Road traffic counter locations. Prepared in accordance with CEETO Monitoring Work Plan Counter 1 registered in total 240.872 vehicles (Table 5), with the majority of vehicles recorded in December 2018 and January 2019, on average almost 1.800 vehicles daily (about 2.400 vehicles during weekends). These results could be correlated with already mentioned skiing season and the FIS ski races, as well as the normal traffic regulation (absence of the traffic ban). During other months, average daily traffic included around 529 vehicles (876 during the weekends). Furthermore, based on the data analysis of two months without traffic ban, it was concluded that almost 40% of all traffic takes place during the weekends.

Weekend traffic analysis for the entire period (the only days in the week when there was no traffic ban) showed the largest number of vehicles in the period from 07:00 to 16:00 hours. During the weekends the counter registered 104.656 vehicles (10.466 vehicles monthly) (Figure 8) with the majority of vehicles coming in December and January, and the least in May. Although May is usually considered as one of the most visited months, the May of 2019 was predominantly rainy.



Table 5. Counter 1 - Bliznec - Number of registered vehicles

YEAR-MONTH	NO. OF VEHICLES	DAILY AVERAGE	REMARK
2018-12	57.368	1.851	<i>Skiing season</i>
2019-01	55.885	1.803	<i>Skiing season (Snow Queen Trophy)</i>
2019-02	18.924	676	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
2019-03	17.640	569	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
2019-04	12.463	415	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
2019-05	10.871	351	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
2019-06	17.715	591	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
2019-07	15.910	513	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
2019-08	17.755	573	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
2019-09	16.341	545	<i>Traffic ban - weekdays from 09:00 - 16:00 hours</i>
Total	240.872		

Compared to the data registered by road traffic counter that was installed in the period from November 2008 until November 2009 on approximately the same location as the current Counter 1 (Bliznec), the number of registered vehicles arriving from the direction of Zagreb increased by around 36%². It can be assumed that the increase of number of the registered vehicles would have been significantly higher, if there was no traffic ban in place on monitored road. The vehicles number increase over the past 10 years can also be related to the discontinuation of the cable car operation in June 2007, which was common and most favourable system of visitors' transportation to the peak area. However, it is not certain whether this also implies an increase in the total number of Park visitors. It should be also mentioned that in the period from November 2008 until December 2012 a visitor counter was operational at the entrance to the Bikčević hiking trail, as one of the most popular hiking trails in the Park, which enabled the monitoring of visitors that arrive to the peak area on foot.

²For the purposes of the road traffic intensity data comparison with the same period 10 years ago (11/2008 - 11/2009 and 11/2018 - 11/2019), monthly average was used for October and November 2019 (calculated based on the previous months of the same year).



Road traffic counter 1 - Number of vehicles during weekends, overview by months

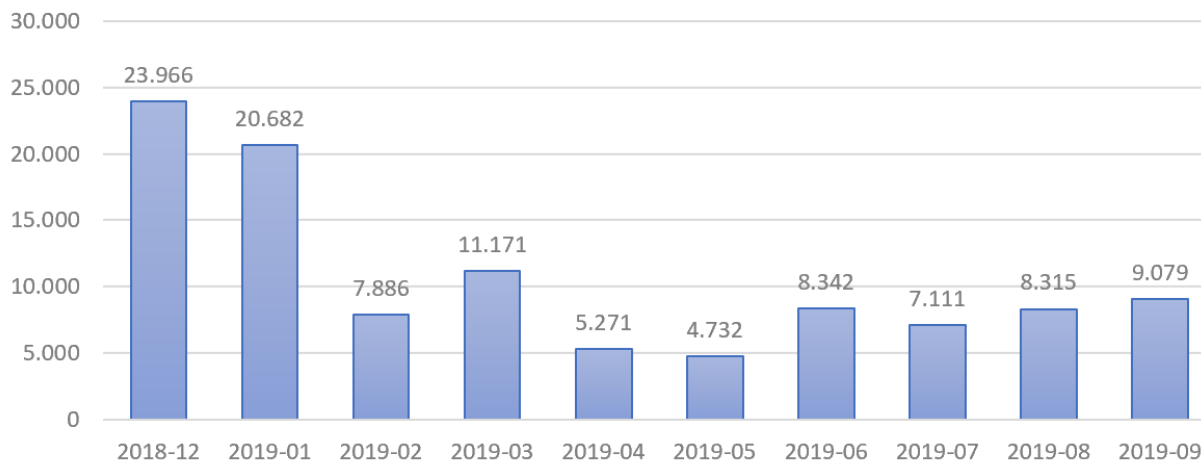


Figure 8. Counter 1 - Number of registered vehicles during weekends, overview by months (data for the November 2018 was excluded from the analysis because data was not available for the entire month period)

In the same period, Counter 2 registered in total 59.082 vehicles, with a daily average of almost 195 vehicles and monthly average of 5.908 vehicles. This most intensive registered traffic was in July and August 2019, and the lowest in December 2018 (Figure 8). Analysis confirmed that almost 40% of all traffic takes place during the weekends and the highest traffic intensity in the period from 07:00 to 16:00 hours (both weekdays and weekends).

Since the road section covered by the Counter 2 is the two-way road, it is not possible to distinguish the share of vehicles that were moving from the peak area towards Zagorje and coming from Zagorje.



Road traffic counter 2 - Number of registered vehicles, overview by months

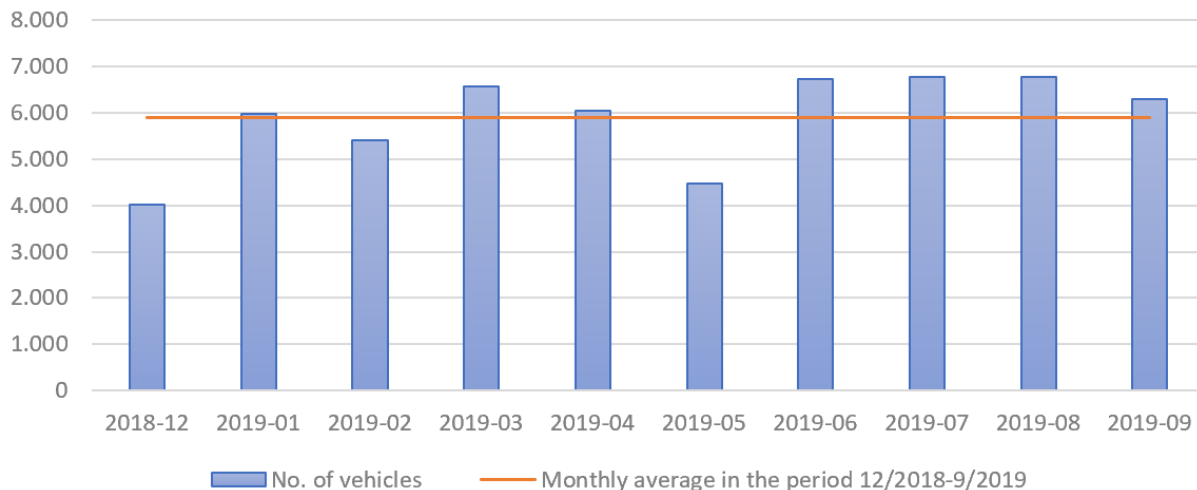


Figure 9. Counter 2 (Hunjka) - Number of registered vehicles, overview by months

The Figure 9 shows road traffic data comparison for both counters. Based on the presented 10-month period, 75% of all road traffic is coming from the direction of the city of Zagreb and just 25% is coming from the direction of Zagorje.

Road traffic data comparison for Counter 1 and Counter 2, monthly overview

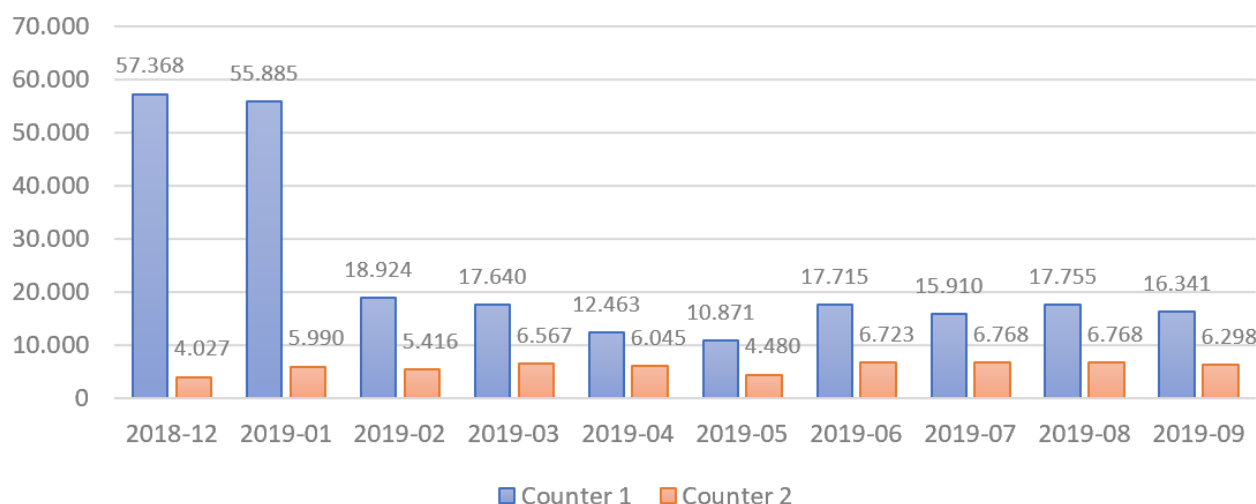


Figure 10. Road traffic data comparison for Counter 1 and Counter 2, monthly overview

In addition to road traffic counters, three **surveillance cameras** were installed in the Park at the following locations (Figure 11):

1. at the main entrance to the Park headquarters (near Info center Bliznec)
2. at the parking lot in front of hotel Tomislavov dom
3. at the intersection of roads in the peak area near Stara Lugarnica

The cameras capture only live feed and the footage is available to the Park personnel via EasyLive application. Since the camera footage is not stored (there is no backup), it is not possible to examine the video captures of the previous period. PINPM Park rangers capture cameras' screenshots every Monday, Friday, Saturday and Sunday, to be able to monitor the parking spaces and determine the number of the vehicles. Video surveillance equipment upgrades are required for better vehicle timing distribution analysis.

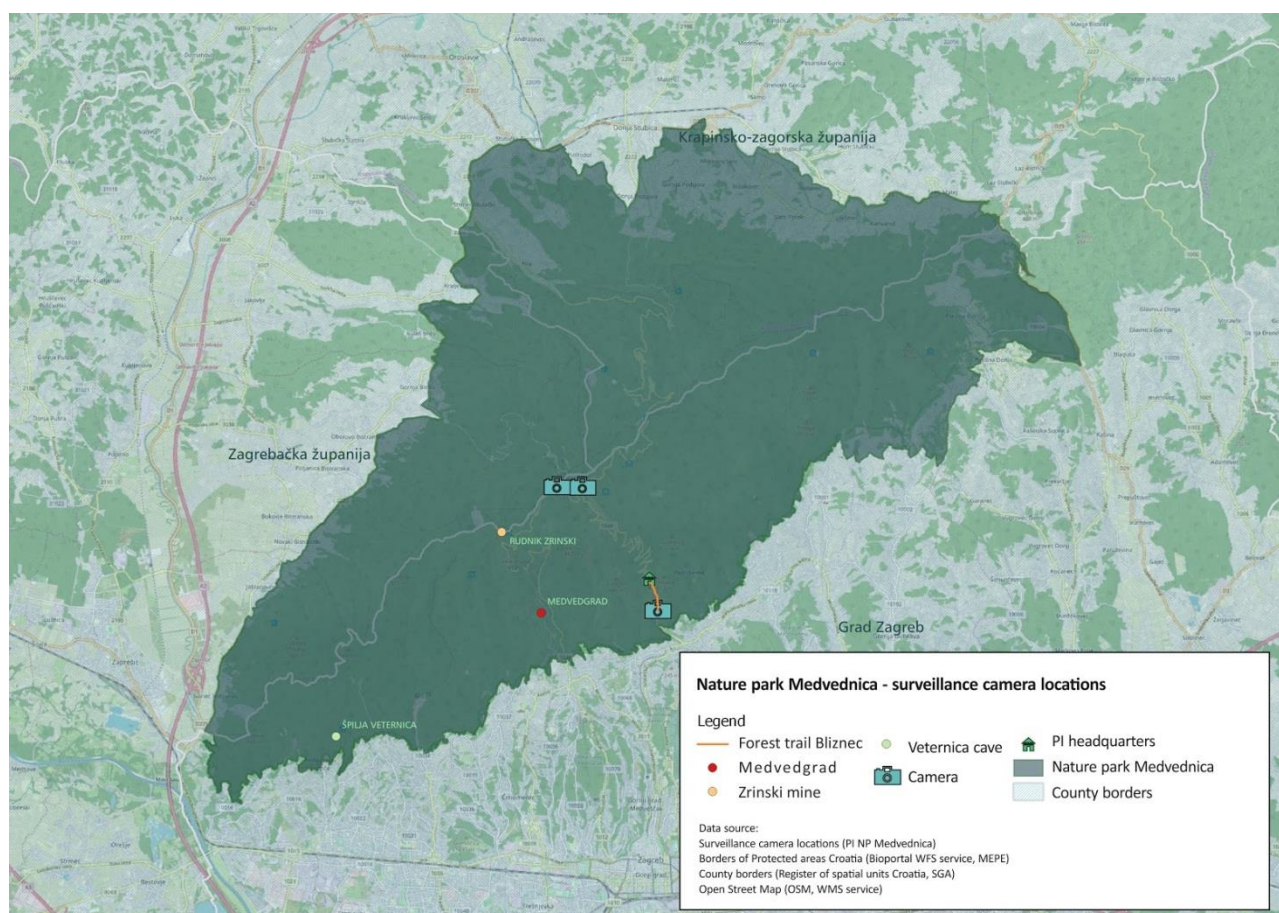


Figure 11. Surveillance camera locations. Prepared in accordance with CEETO Monitoring Work Plan

3.2. Implemented Management Activities

As already indicated in the chapter 2.2., the implementation of the CEETO project in the Nature Park “Medvednica” did not foresee any particular management activities. However, one of the projects’ outputs is the Sustainable Tourism Action Plan, which represents a basis for future management activities. This



Action Plan will be used when developing the Visitor Management Plan and the Management Plan for the Nature Park “Medvednica” for the period from 2021 to 2030. as well as the Ecological Network Management Plan HR2000583 Medvednica.

Several specific management measures were conducted through the implementation of the pilot actions:

- Pilot action monitoring the pressure of visitation on nature and the environment: Lake reservoir is important for the amphibians and their life cycle. Period needed for the development of amphibians and their complete reproduction cycle defined the drainage of the Lake reservoir, also approved by the ski resort manager, Sports Facilities Management Institution, Sljeme Ski Resort, which enables the development of amphibians and their complete reproduction cycle. An important management activity is achieved by continuous water and soil monitoring (microbiological and chemical parameters), to be conducted by the Croatian Ski Association, as an integral part of the concession approval: CLASS: 612-07/18-01/182, REGULATION: 251-510 -01-18-03.
- Pilot action installation of counters and cameras: The ongoing work on the cable car that will improve public transport has an impact on the current traffic flow and the number of vehicles operating towards the peak area. During the week, from Monday till Friday, between 9am and 4pm, the road to the peak zone is closed, except at two intervals, one at 11:30 am and the other at 1:50 pm, both coordinated with regular public transport (Sljeme Road leading to the peak zone has such regime since February 2019). The mentioned traffic regime has somehow reduced the traffic pressure, but only through working days of the week, confirmed by the analysis results of the traffic counter No. 1, installed close to the PPM Management headquarters. According to the results, the traffic intensity recorded on the No. 1 counter was the highest in December 2018 and January 2019 when traffic was running normally.

It is also planned to present the results of the pilot activity and the D.T2.5.1. to the stakeholders in December 2019.

3.3. Connection with the Action Plan activities

Reconstruction of Sljeme cable car, which should be finished by mid-2020, is one of the most significant managerial activities that is implemented parallel with CEETO project and it is also in accordance with the developed Sustainable Tourism Action Plan. It is expected that operability of cable car will contribute to decreased intensity of road traffic in the Park.

The other visitors’ management and monitoring activities stipulated in the Action Plan are being implemented, mostly within the scope of the project supported by the EU funds “Improvement of visitation capacities for sustainable management of Nature Park KK.06.1.2.01.0012”

3.4. Deviation from the forecasted work plan activities

Almost all activities stipulated by the Work Plan were implemented, except the research of lichens and implementation of the visitors’ researching LAC methodology.



4. Achieved Results

4.1. Touristic pressure reduction

The project activities, notably monitoring of selected visitation indicators and elaboration of the Sustainable Tourism Action Plan, represent the basis for implementation of particular management activities related to tourism and visitors. The research results represent guidelines in visitor management planning and tourism development in the Park, which will contribute to sustainable tourism in the long run. Apart from the reconstruction of the cable car, Action Plan also stipulates activities aimed at improvement and upgrade of traffic solutions for accessing the peak zone, as well as traffic at standstill.

Furthermore, the results of monitoring of certain indicators pointed out the necessity to implement as soon as possible specific measures to mitigate recorded negative impacts of tourism. Such an example is pollution of surface fresh water with anthropogenic related bacteria (faecal coliform), coming most probably from gastronomic and accommodation facilities that do not have an adequate system of wastewater treatment in place. The necessary measures require analysis of current treatment of wastewater and implementation of remedy actions and solutions beneficial to the environment.

Possible measures to mitigate the Tourist pressure reduction:

- reconstruction of Sljeme cable car
- creating a Traffic study which will analyze the possibility of re-categorization of the Sljeme road from the direction of Zagreb following the opening of the cable car
- developing and installing traffic and tourist signs
- installing additional counters (people and bicycle counters)
- cooperating with all the stakeholders (through meetings, field work etc.).

4.2. Tourist experience improvement

Some of the activities from the Sustainable Tourism Action Plan are already being implemented, including regular maintenance and improvement of visitors' infrastructure, improvement of touristic offer and other mentioned activities to reduce tourism pressure. Equally important is monitoring of profiles, habitats, opinions and satisfaction of visitors, which will be continued periodically after the project is finished.

Possible measures for the improvement of touristic experiences are:

- creating a Visitor management study
- creating a marketing plan for online communication
- producing educational and promotional materials
- improving visitors' infrastructure
- organizing different workshops.

4.3. Socio-economic benefits

In order to accomplish significant socio-economic benefits, it is necessary to implement management activities during a longer period of time. As already indicated in the previous chapters, activities



implemented within the scope of the CEETO project represent an important step towards future benefits of all Park users.

The implementation of the activities of the CEETO project and the Action Plan will contribute to the protection and conservation of the protected area natural and cultural values and the Natura 2000 Ecological Network. An innovative sustainable tourism planning model and reduction of the pressures of Park area usage will create social and territorial cohesion and will contribute to the quality of life of the local community and encourage the development of the tourism sector in a sustainable way.



5. Conclusion

The implementation of the CEETO project activities in Nature Park “Medvednica”, as one of the project’s pilot areas, contributed significantly to the improvement of knowledge about the Park’s visitation pressures and impacts, as well as to planning of specific management activities with high level of relevant stakeholders participation - Park users.

The monitoring of selected indicators indicates certain impacts of visitation on Park’s natural resources, in particular on surface fresh water and soil, as well as increased intensity of road traffic coming from Zagreb. Although no significant pressures on biodiversity were recorded, it is necessary to conduct more systematic research in order to come to more comprehensive conclusions.

Regular monitoring of all selected indicators should be continued after the project is finished, as a part of organised systematic monitoring, taking into account the need for certain amendments to the existing monitoring approach, according to the following recommendations:

- Extend the existing soil analysis method with more detailed analysis of salts at selected locations and in the vicinity of roads in the peak zone, as additional indicator of impacts of artificial snow production and maintenance of ski tracks and roads
- Monitor biodiversity of plants on more locations and with more samples
- Monitor stone crayfish population (*Austropotamobius torrentium*) and Italian crested newt (*Triturus carnifex*) on all already known and potential locations
- Analyse correlation between fresh water pollution and resilience of stone crayfish population to existing pressures
- Continuously monitor number of Park visitors
- Install additional car counter on the one-way road from the peak zone to Zagreb /via Kraljičin zdenac), in order to specifically distinct the share of traffic coming to the peak zone from Zagreb and from Zagorje
- Prepare an analysis of the intensity of road traffic according to data collected from all car counters before and after reconstruction of the cable car
- Ensure backup of data collected by surveillance cameras, at least for 24 hours, as a contribution to more efficient monitoring and more swift response to situations such as irregular parking or similar events challenging the fluent traffic

Taking into account the indicators’ monitoring results, it is recommended to implement the following specific measures as soon as possible:

- In cooperation with competent institutions and within the scope of the existing sanitary regulations, analyse the state of existing wastewater treatment solutions in gastronomic and accommodation facilities (i.e. through regular inspections), particularly in those objects that use septic tanks, and propose remedy actions and solutions that will not deter the environment



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Appendix 1. Natura 2000 species and habitat types of the SCI HR2000583 Medvednica

SPECIES AND HABITAT TYPES WITH CODES	
<i>Euphydryas aurinia</i>	
<i>Lycaena dispar</i>	
<i>Lucanus cervus</i>	
<i>Rosalia alpina*</i>	
<i>Morimus funereus</i>	
<i>Cerambyx cerdo</i>	
<i>Austropotamobius torentium*</i>	
<i>Bombina variegata</i>	
<i>Triturus carnifex</i>	
<i>Rhinolophus hipposideros</i>	
<i>Rhinolophus ferumequinum</i>	
<i>Rhinolophus euryale</i>	
<i>Barbastella barbastellus</i>	
<i>Miniopterus schreibersii</i>	
<i>Myotis bechsteinii</i>	
<i>Myotis emarginatus</i>	
<i>Myotis myotis</i>	
<i>Leptidea morsei</i>	
<i>Cordulegaster heros</i>	
<i>Barbus balcanicus</i>	
<i>Osmoderma eremita*</i>	
<i>Himantoglossum adriaticum</i>	
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (Convolvulion sepii, Filipendulion, Senecion fluviatilis)	6430
Illyrian oak-hornbeam forests (Erythronio-carpinion)	91L0
Castanea sativa woods (Castanea sativa)	9260



Luzulo-Fagetum beech forests	9110
Illyrian Fagus sylvatica forests (Aremonio-Fagion)	91K0
Tilio-Acerion forests of slopes, screes and ravines	9180*
Caves not open to the public	8310
Calcareous rocky slopes with chasmophytic vegetation	8210



Appendix 2. Expert teams involved in the implementation of the CEETO project

COORDINATION, IMPLEMENTATION AND PARTICIPATION IN PROJECT ACTIVITIES	EXPERT TEAM	
Public Institution “Nature Park Medvednica”	<ul style="list-style-type: none"> ● Dr. sc. Marina Popijač ● Tajana Ban Ćurić, mag. geol. ● Ivona Đuričković, mag.oec ● Martina Belović Kelemen, mag.silv. ● Martina Jurjević Varga, mag.silv. ● Goran Škrlec mag.silv. ● Andrea Kostelić, prof, geogr. ● Marijana Ferenčak mag.silv. ● Kristina Vugrek Petljak, mag. biol. ● Marija Kulić, prof. geogr. 	
PROJECT ACTIVITIES IMPLEMENTED IN COOPERATION WITH EXTERNAL EXPERTS	SUBJECT IN CHARGE	ORDER/ CONTRACT NO.
Monitoring of indicators		
Soil and edaphic indicators	Labosan d.o.o., Laboratory Virovitica	8/19/SS
Freshwater analysis - microbiological parameters	Labosan d.o.o., Laboratory Zagreb	9/19/SS
Climatological indicators (10- year analysis based on data collected by CHMI)	Oikon d.o.o. Zagreb Expert team: <ul style="list-style-type: none"> ● Nebojša Subanović, mag. phys. geophys., meteorologist - team leader ● Silvia Ilijanić Ferenčić, mag. geol. geophys. 	10/19/SS
Fauna of streams and wells - stone crayfish	Oikon d.o.o. Zagreb Expert team: <ul style="list-style-type: none"> ● Dr. sc. Ana Ostojić, mag. biol. - team leader ● Vjera Pavić, mag. biol. exp ● Jelena Mihalić, mag. ing. prosp. arch. ● Matija Kresonja, mag. prot. nat. et amb. ● Željko Čučković, univ. bacc. inf. 	11/19/SS
Fauna of streams and wells - yellow-bellied toad and Italian crested newt	Oikon d.o.o. Zagreb Expert team: <ul style="list-style-type: none"> ● Dr. sc. Ana Ostojić, mag. biol. - team leader ● Vjera Pavić, mag. biol. exp. ● Jelena Mihalić, mag. ing. prosp. arch. ● Matija Kresonja, mag. prot. nat. et amb. 	12/19/SS



Vegetation mapping - determination of bioindicator species of meadows	Oikon d.o.o. Zagreb Expert team: <ul style="list-style-type: none"> • Nela Jantol, mag. oecol. et prot. nat. - team leader • Dr. sc. Ana Ostojić, mag. biol • Dr. sc. Vladimir Kušan, mag. ing. silv., CE • Medeja Pistotnik, mag. biol. • Dr. sc. Zrinka Mesić, mag. biol. • Jurica Tadić, mag. ing. silv. 	13/19/SS
Invertebrates indicators - <i>Rosalia longicorn</i> and long-horned beetle	Oikon d.o.o. Zagreb Expert team: <ul style="list-style-type: none"> • Marta Mikulčić, mag. oecol. - team leader • Jurica Tadić, mag. ing. silv. • Ksenija Hocenski, mag. biol. exp. • Rita Guić, mag. oecol. 	14/19/SS
SUSTAINABLE TOURISM ACTION PLAN		
Sustainable Tourism Action Plan	Vita projekt d.o.o. Zagreb Expert team: <ul style="list-style-type: none"> • Ivana Šarić, mag. biol. - team leader • Domagoj Vranješ, mag. ing. prosp. arch., univ. spec. oecoing. • Ivana Tomašević, mag. ing. prosp. arch. • Mihaela Meštović, mag. ing. prosp. arch. • Katarina Dujmović, mag. soc. • Goran Lončar, mag. oecol., mag. geogr. • Josip Biondić, mag. ing. oecoing. • prof. dr. sc. Ivan Martinić, mag. ing. silv. (external expert) 	Ugovor broj 2/2019
Final report CEETO project		
Final report on the CEETO Project Pilot Actions in the Nature Park Medvednica	Stenella consulting d.o.o. Zagreb Expert team: <ul style="list-style-type: none"> • Ana Štrbenac, M.Sc. (Management of Protected Areas), mag. biol. - team leader • Petra Štrbenac, mag.oec. 	16/19/SS



Appendix 3. Members of the Stakeholders Forum involved in the implementation of the CEETO project and elaboration of the Sustainable Tourism Action Plan

LOCAL COMMUNITY
Bistra Municipality
MOUNTAINEERING ASSOCIATION
Mountaineering Association Zagreb
Croatian Mountain Guide Association
TRANSPORT SERVICES
City of Zagreb, City Office for Physical Planning, Construction of the City, Utility Services and Transport
Ministry of the Interior, Police department Zagreb
Zagrebački električni tramvaj ltd.
Zagrebački holding ltd. - Zagrebačke ceste
Zagrebački holding ltd. - Zagrebparking
ACCOMMODATION AND GASTRONOMIC SERVICES
Aparthotel Snjezna Kraljica
Restaurant Kućica
Restaurant Stara Lugarnica
Restaurant Vidikovac-Sljeme
Zagrebački holding d.o.o. - Hotel Tomislavov Dom
SPORT SERVICES
Emergency interventions
Croatian Mountain Rescue Service - Unit Zagreb
Croatian Ski Association
Ski Resort Sljeme
Ski club „Sljeme“ Zagreb
Institution for the management of sports facilities - Ski Resort Sljeme
FORESTRY
Croatian Forests ltd., Horticulture Zagreb
Croatian Forests ltd. - Regional forest administration Zagreb
TOURIST SERVICES



City of Zagreb Tourist Board
ENVIRONMENT AND NATURE PROTECTION
City of Zagreb, City Office for Economy, Energetics and Environment protection
Croatian Agency for the Environment and Nature
Ministry of Environmental Protection and Energy, Nature protection administration
WWF ADRIA