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# USE OF MONITORING SYSTEM OF TOURIST TRAFFIC (MSTT) IN STOŁOWE MTS. NATIONAL PARK FOR VISITORS DESCRIPTION

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**ABSTRACT:** The development of tourism in valuable natural areas is becoming increasingly dynamic, and therefore this phenomenon requires a more thorough investigation. An increased tourist traffic in a national park entails a range of consequences, which are not irrelevant for the protected nature. The aim of the study is a spatial and quantitative description of tourist traffic in the Stołowe Mountains National Park, basing on the data received from pyro-electric counters in Monitoring System of tourist traffic. The system was created through to cooperation between national park staff and Department of Tourism and Recreation Adam Mickiewicz University in Poznan (Rogowski, Małek, 2016). In the period from 16th September 2016 to 31th August 2017 were 858 346 entries to national park. July and August were the most popular months which accounts for 22% of the total number of entries. All data was presented the visitors flow indicating the most popular areas and regions and the trails sections.

**KEY WORDS:** tourist flow, monitoring, Stołowe Mountains National Park, infrared traffic counters

## Introduction

National parks covering areas with valuable natural assets constitute areas which are highly attractive for tourism, with more and more tourists choosing them as their destination. As a result of all this, dynamic increase in tourist traffic in the national parks located in the mountains that we are currently witnessing leads to an uncontrolled mass tourism, which has a negative impact on the natural environment. This fact may lead to many irreversible effects and conflicts, among which a very important issue from the point of view of the nature itself is the conflict between the need to protect, preserve and make available the natural assets for tourists. This situation has particular implications for the mountain areas with a high natural value, uniqueness and sensitivity, which provides for their attractiveness and popularity of destinations. The aim of the study is a spatial and quantitative description of tourist traffic in the Stołowe Mountains National Park, basing on the data acquired from infrared traffic counters (one's component of MSTT) of period from 16th September 2016 until 31th August 2017.

The Stołowe Mountains, due to their uniqueness and easy availability, are among the areas with a high degree of susceptibility to strong and multi-dimensional impact of tourism. For that reason, an appropriate model should be developed to manage tourism, taking into consideration a proper way to make available precious natural assets and a high tourist traffic in specific spots without causing the degradation of assets. To do this, it is necessary to understand the specificities of the tourist traffic participants, and then, by taking appropriate action, to shape their ecological awareness and sensitivity by making the assets available in the conditions of sustainable development. Within areas which are highly attractive for tourism, like the Stołowe Mountains, the developing tourism with heavy traffic may reach the size of mass tourism. According to Rogowski and Małek (2016), this is the case of two most popular areas of the park, namely Szczeliniec Wielki and Błędne Skały. These areas generate the heaviest tourist traffic, and therefore they should be put under a constant and comprehensive observation.

## An overview of literature

Visitor flow monitoring in national parks in Poland is performed basing on different quantitative data. As indicated by Cessford and Muhar (2003), Spychała and Graja-Zwolińska (2014), there are four distinguishable methods of monitoring: direct observation, measurement with sensors, recording of visits, and estimations. In addition, as indicated by Hibner (2014), direct observation

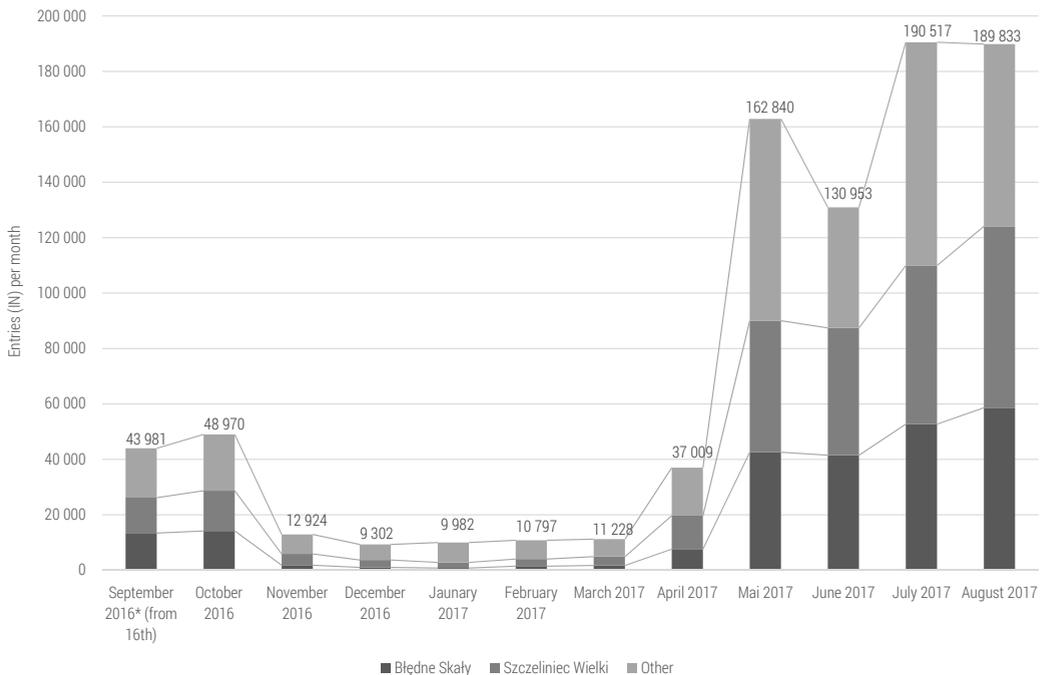
includes direct measurement and the use of cameras and aerial imagery. Infrared traffic counters which serve for automatic traffic count, according to Spychała and Graja-Zwolińska (2014), were used in 14 national parks in Poland. The authors believe that these are among the most effective and useful devices in daily operation of the park. Other advantages include, for example, easy measurement without participation of additional persons, easy use and low risk of failure. Moreover, according to the manufacturer's specifications, the margin of error for quantitative reading is 5%. The data acquired from infrared traffic counters allowed, among others, to describe the tourist traffic in the following national parks: Tatrzański (Fidelus, 2010, 2014; Hibner, 2014; Taczanowska et al., 2014), Babiogórski (Buchwał, Fidelus, 2010), Bieszczadzki (Prędko, 2012) and Stołowe Mountains (Rogowski, 2016). Further analysis of the information allowed determining that motion sensors were installed in the following national parks: Świętokrzyski, Pieniński, Karkonoski and Słowiński.

## Research methods

The Monitoring System of tourist traffic (SMTT) was planned, created and installed in 2016 by Rogowski (Department of Tourism and Recreation Adam Mickiewicz University in Poznań) and Małek (Stołowe Mountain National Park). Detailed assumptions for the design of the monitoring system for tourist traffic observation have been presented by Rogowski and Małek (2016) and Rogowski (2017a). The system consists of quantitative and qualitative monitoring and was started 16 September 2016. The qualitative monitoring made up of data coming from tourist surveys, covering two seasons so far (years 2015 and 2016), the results of which have been presented in separate studies (Rogowski, Małek, 2016; Żyto et al., 2017; Rogowski 2017b). The quantitative monitoring gathers data from 38 infrared traffic counters installed on the tourist trails at the park's border and along the public road called "The Road of A Hundred Bends" (Droga Stu Zakrętów). The sensors have been installed most densely in most popular attractions: Błędne Skały "rock-city" (4 sensors) and Szczeliniec Wielki "rock-city" (3 sensors), along the public road (mentioned above) in the area of Fort Karola, Narożnik and Białe Skały (5 sensors) Radkowskie Skały and Skalne Grzyby (2 sensors each). The scope of data includes hourly, daily, weekly, monthly and annual reports, taking into account the direction of traffic: entries (IN), exits (OUT) and passings (IN+OUT). Each day approximately 912 automatic measurements are made. Data is downloaded from the devices via "Bluetooth" technology through an application on a mobile device. Data was analysed in a spreadsheet using the statistical measurements.

## Results of the research

The tourist traffic in the Stołowe Mountains National Park is distinguished for its strong concentration in time and space. In the period from 16th September 2016 to 31th August 2017, 858 346 entries (IN) were recorded. The greatest number of entries is observed in the summer months (July 191 517 and August 189 833, which accounts for 22% of the total number of entries) and in the spring (May: 162 840 – 19%, and June: 130 953 – 15%) (figure 1). These months generate 80% of the total number of entries to the park, and therefore this period may be defined as a high tourist season. Lower values are recorded in October and April (30-50 thousand tourists), so these months may be considered a medium tourist season. September is a transition period between a high and a medium season, as 44 thousand entries were recorded in the second half of that month. The lowest tourist traffic has been recorded in the remaining autumn and winter months – from November to March (approximately 9-10 thousand tourists), and therefore this period may be referred to as a low tourist season.



**Figure 1.** Tourist entries (IN) in a monthly scale to the Stołowe Mountains National Park and on the tourist routes in Szczeliniec Wielki and Błędne Skały (from 16th September 2016 to 31th August 2017)

Source: (Rogowski, 2017a).

A short-term increase in tourist traffic is observed on consecutive days free from work related to bank holidays and the so-called “long weekends” (table 1).

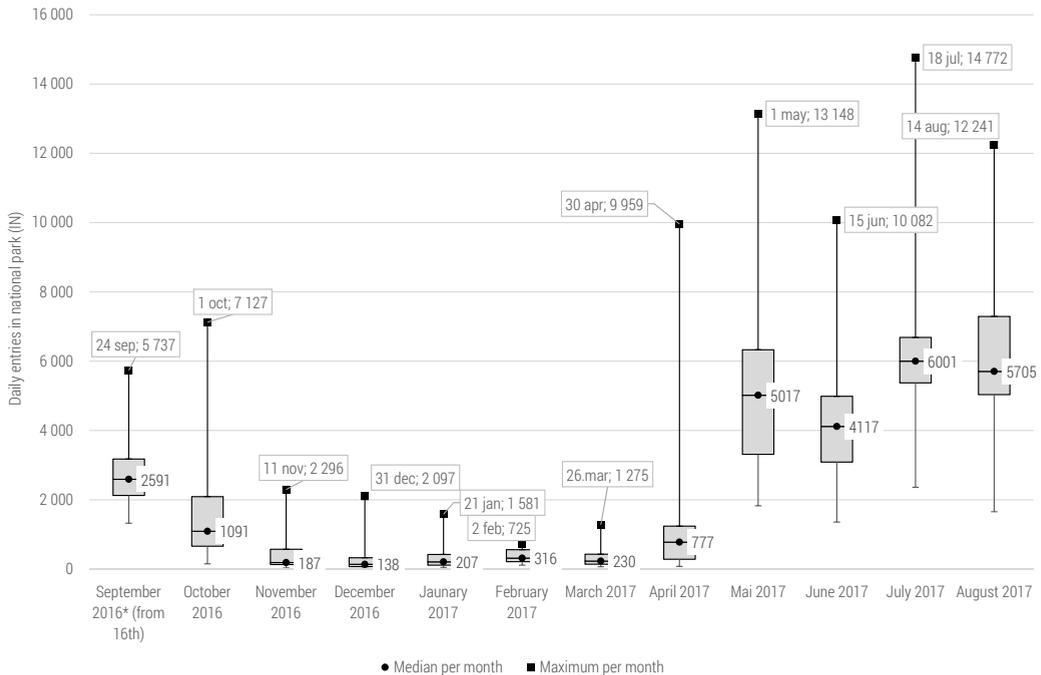
**Table 1.** The size of the tourist traffic (IN) in selected holiday periods

Period	Number of entries (IN)	Percentage of monthly entries (IN)
11-13 November 2016 (Independence Day)	5.632	44%
24-31 December 2016 (Christmas and New Year's Eve)	5.786	62%
14-17 April 2017 (Easter)	7.182	19%
29-30 April 2017 (beginning of the 1st of May weekend)	13.027	35%
1-3 May 2017 (1 <sup>st</sup> of May – 3 <sup>rd</sup> of May National Holiday)	31.451	19%
15-18 June 2017 (Corpus Christi Holiday)	27.690	64%
12-15 August 2017 (Assumption of the Blessed Virgin Mary)	40.774	21%

Source: author's own work.

Holiday periods generate from 19% to 64% of the total monthly number of entries to the park, an example of which may be Christmas with the New Year and the so-called “long weekend” in May and in June. In these periods, tourist traffic is the highest in a given month. Due to a high occurrence of such periods, in most of the analysed months such dynamic and short increases can be observed. In addition, a peak season of school excursions may be indicated (16-25 May 2017) with almost 65.6 thousand entries to the park, which accounts for nearly a half of the total number of entries in the given month.

The analysis of the number of entries to the park in the consecutive days of the period in question shows that the increased popularity of the specific month goes together with a greater variation in the number of daily entries (figure 2). Months with the highest footfall have the widest distribution of data, and for those with the lowest – the distribution is more focused. An exception is April, which belongs to the low season, but due to the sequence of days free from work, on 30 April a dynamic increase in the tourist traffic was recorded. In the period under analysis, most tourists entered the park on the following days: 18 July (14 722), 1 May (13 148), 2 May (13 092), 14 August (12 241), 13 August (11 221), 15 August (10 496) and 15 Jun (10 082).



**Figure 2.** Daily tourist entries (IN) to the Stołowe Mountains National Park (from 16th September 2016 to 31th August 2017)

Source: author's own work.

Spatial concentration of the tourist traffic was related to the main attractions, because approximately half of the tourists trails the routes in Szczeliniec Wielki and Błędne Skały. In the summer months the rate is as high as 2/3 of tourists (June 2017 – 67%, August 2017 – 65%, July 2017 – 58%), whereas outside the tourist season the percentage drops to 1/3 of the value (January 2017 – 28%, February 2017 – 37%, December 2016 – 40%). Such differences be caused by official closing of the tourist trails in Szczeliniec Wielki and Błędne Skały and the fact that the entries to the park are also generated by the local community inhabiting the towns near the park. This factor is not driven by seasons.

The count of entries (IN) allows to indicate the attractions visited most frequently, which undoubtedly include: Szczeliniec Wielki (269 958) and Błędne Skały (237 411). However, as shown in Tab. 2 the greatest number of entries (IN) was recorded on the route to Szczeliniec Wielki from the side of Karłów (365 627). The remaining areas are less popular, as evidenced by the following data (IN): Narożnik (18 194), Radkowskie Skały (14 917), Karol's Fort (8 061) and Białe Skały (4 047). The number of entries (IN) compared

for particular sensors allows to determine the popularity of certain areas of the park. The most popular regions include the areas of: Szczeliniec area (422 273), Skalniak – Błędne Skały area (258 336), Skalne Grzyby area (27 464), Narożnik – Białe Skały area (23 549), Karola’s Fort area (20 925) and Radkowskie Rocks area (14 917).

Location of the sensors, most of which were installed in the most popular areas of the national park, also allows to determine approximate tourist traffic loads for some sections of the routes. This may be presented for the network of tourist routes located in the area of Szczeliniec Wielki “rock-city” (table 2, figure 3) and Błędne Skały “rock-city” (table 3, figure 4).

**Table 2.** Tourist traffic loads (IN+OUT) for measuring points in the area of Szczeliniec Wielki “rock-city”

Measuring points	Number of entries (IN)	Number of exits (OUT)	Load (IN+OUT)
Szczeliniec Wielki – tourist route	269 958	21 571	291 529
Karłów	365 627	324 819	690 446
Parking area at the bottom of Szczeliniec	34 638	17 880	52 518
Parking area near Pośna Waterfalls – green route	15 648	12 686	28 334
Parking area near Pośna Waterfalls – blue route	4 470	5 858	10 328
Radków Baza – yellow route	1 168	1 261	3 229

Source: author’s own work.

In the period under analysis, the greatest number of passings (IN+OUT) was recorded at the measuring point in Karłów (690 446), which accounts both for entries to and exits from Szczeliniec Wielki. This is the most popular place in the park for tourists. From there, most tourists go to the fork of the routes between Szczeliniec Mały and Szczeliniec Wielki. Then, most people continue the route to Szczeliniec Wielki, but some go down north to the parking area at the foot of Szczeliniec. This is, at the same time, an alternative way for the blue tourist route running via the western foot of Szczeliniec Mały. The fork mentioned above is also reached by tourists from the parking area at the foot of Szczeliniec, Pasterka and Radków. As a result, the final section of the approach to the mountain shelter “Pod Szczelińcem” has the heaviest tourist traffic load in the whole park. On mesa of Szczeliniec Wielki, a tourist route is running from the mountain shelter, and 76% of the tourists who reached the shelter decided go that route. From that group, 93% of persons decided to go down to Karłów – according to the principles of tourist traffic specified at the mesa – whereas 7% returned to the shelter taking the same way, which is contrary to the park’s regulations.

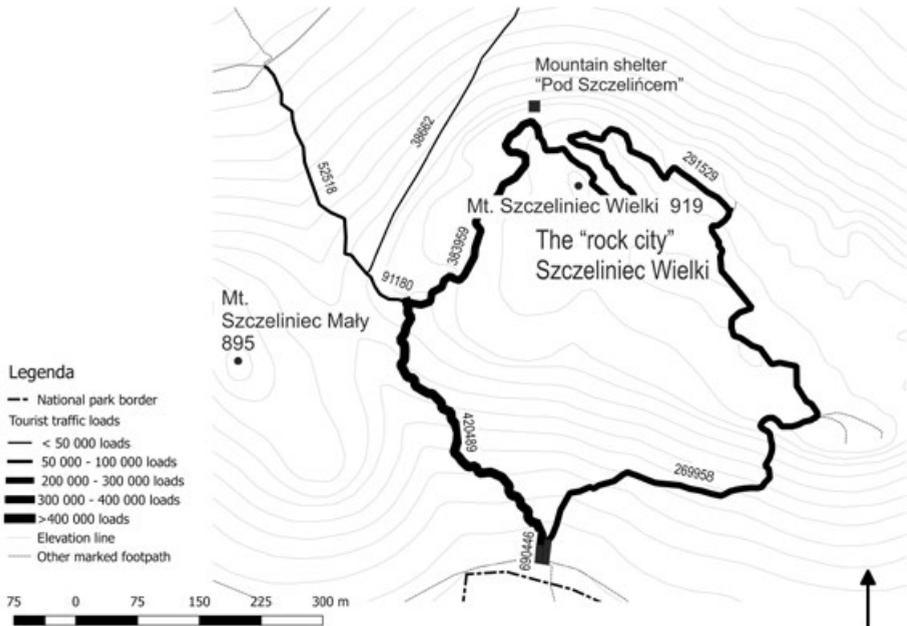


Figure 3. Tourist traffic loads (IN+OUT) for specific sections of the routes in the area of Szczeliniec Wielki "rock-city"

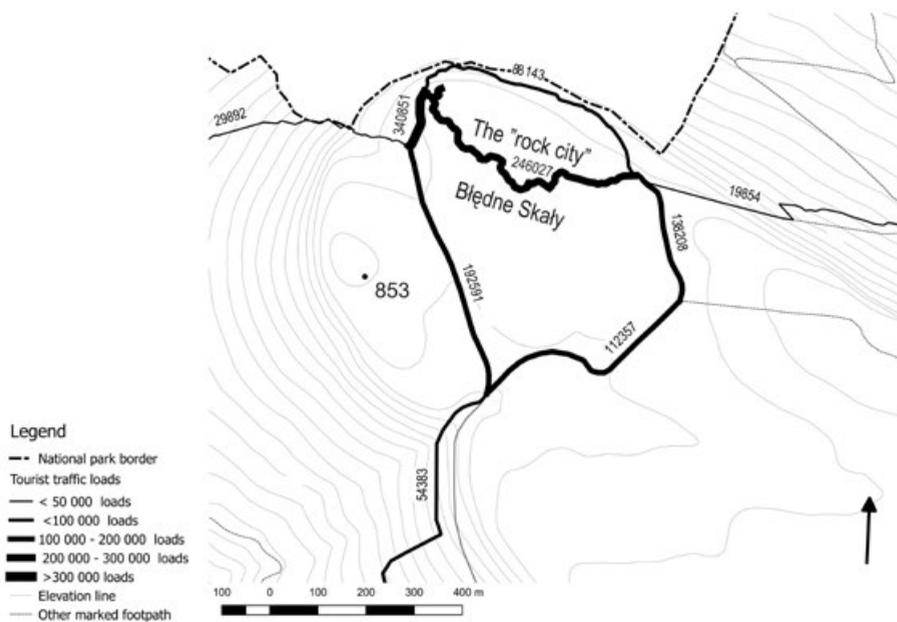
Source: author's own work.

In the trail network in the area of Błędne Skały, the most heavily loaded section is the one between the upper parking area and the entrance to the tourist route, and then the tourist route itself in Błędne Skały (340 851 passes IN+OUT). From that group, 70% of tourists decided to enter the trail on Błędne Skały "rock city". The access traffic for that place has an uneven distribution. Approximately half of tourists drive to the upper car park and return from there. Other tourists go on foot. Most of them get there from the lower parking area, "YMCA", and from the side of Bukowina Kłodzka. A secondary access is the climb route from the north, from Ostra Góra, and from the side of Skalniak, although in this case these are only estimates, because there is no such sensor in that place. After leaving the tourist route in Błędne Skały, tourists can choose between two return routes: one along the state border and the other running around the rock labyrinth from the south. As a result, the return traffic is distributed between both return routes (table 3, figure 4).

**Table 3.** Tourist traffic loads (IN+OUT) for measuring points in the area of Błędné Skały "rock-city"

Measuring points	Number of entries (IN)	Number of exits (OUT)	Load (IN+OUT)
Błędné Skały – tourist route	237 411	8 616	246 027
Błędné Skały – return route	84 591	3 552	88 143
"YMCA" parking area	25 894	21 990	47 884
Błędné Skały – green route	18 849	11 043	29 892
Ostra Góra	8 569	7 545	16 114
Jakubowice	3 482	3 017	6 499
Zielona Droga – state border	1 963	1 777	3 740

Source: author's own work.



**Figure 4.** Tourist traffic loads (IN+OUT) for specific sections of the routes in the area of Błędné Skały "rock-city"

Source: author's own work.

## Conclusions

The Monitoring System of tourist traffic (MSTT) which serves to gather data regarding the number of passings allows to developing a detailed and comprehensive description of the tourist traffic in the Stołowe Mountains National Park, both in terms of quantity and space. This is an extremely important tool in the current functioning of the park and tourist traffic management, and it is compatible with the idea of sustainable tourism defined in World Conference of Sustainable Tourism (Charter..., 1995).

The monitoring data allows determining tourist footfall in selected locations in the park, directions where the tourists go and loads on route sections. Footfall, if determined, allows to indicate a high and low tourist season, an exact number of visitors to the most popular attractions and regions of the park, and to specify the tourist traffic loads in those locations. The most important findings include the following:

- an estimated number of tourists entering the Stołowe Mountains National Park within twelve months (from 16th September 2016 until 31st August 2017), which is as many as 858 346 entries, and this allows to verify the current data obtained solely on the basis of the tickets sold for the tourist routes to Szczeliniec Wielki and Błędné Skały “rock-cites”,
- determination of the share in the amount of entries to the park for two most popular months (July and August, per approximately 190 thousand), which is as much as 40% of the counted entries; May is third in the row, and this is the month when visitors come mainly in groups as part of tourism organised by schools,
- indication of the occurring phenomenon which involves a dynamic increase in the tourist traffic in the periods of consecutive days free from work, in particular during the so-called long weekend in June and the period of Christmas and New Year,
- indication of two most popular attractions of the park – Szczeliniec Wielki and Błędné Skały – generating half of the tourist traffic, and in the summer months it reaches as much as 2/3 of the total tourist traffic,
- indication of the routes which are most loaded with the tourist traffic (by comparing entries – IN and exits – OUT), which includes the climb route from Karłów to the mountain shelter “Pod Szczelińcem” and the section from the upper parking area near Błędné Skały to the entrance on the tourist route, and also tourist routes in Szczeliniec and Błędné Skały.

Quantitative data from infrared traffic counters may be useful in many works and studies. After determining the indicators of volume and throughput, it is possible to see the periods when those indicators are exceeded, because the phenomenon of mass tourism increases, as also observed by the

park's staff. That fact may cause many threats to the natural environment and for that reason it is very important to provide diagnosis for this state of the matters. Currently, the working values of the tourist volumes and throughput for the most popular sections of routes are being determined, which will be verified further against opinions of the national park staff, ticket sellers and tourists themselves. As a result, the method for determining the tourist throughput and volume will be developed, taking into account the opinions of all the stakeholders. That fact may provide the basis for the discussion on the ways to re-organise the tourist traffic management in specific hours on the tourist routes in Szczeliniec Wielki and Błędne Skały "rock-cites". The cause is a relation to excessive numbers of entries and decreased satisfaction drawn from experiencing nature among tourists. In addition, taking into consideration the social participation in generating tourist traffic, the plans are to provide, on an ongoing basis, current information about the entries on the tourist routes on Szczeliniec Wielki and Błędne Skały "rock-cites", so that tourists themselves can decide whether to go on the route at a specific time.

The data collected in the following months will allow to creating a model of forecasting the size and variability of tourist traffic. In addition, by aggregating the acquired results with the data characteristic for other phenomena, we could answer the question which factors drive the size and variability of tourist traffic. An example may be meteorological data, the aggregation of which will allow determining the degree of interrelation between the tourist traffic and the current weather. Further works envisage also relocating some of the infrared traffic counters to other sections of the routes, in order to examine more thoroughly the tourist traffic loads in those areas. In addition, further plans include investigating a phenomenon of illegal dispersion of tourists outside the routes, by relocating the devices to paths and ways not made available for tourism.

## Acknowledgements

This research has been cooperate with Stołowe Mountain National Park, supported by Fundusz Leśny, within the framework of the project: *Monitorin-gowy system obserwacji ruchu turystycznego w Parku Narodowym Gór Stołowych – badanie preferencji krajobrazowych.*



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