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TOURISM AND RECREATION IN POLISH NATIONAL PARKS BASED ON SOCIAL MEDIA DATA

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ABSTRACT

Motives: Matters related to monitoring recreational use of national parks and identifying sites with high cultural values of ecosystem services are essential elements for the efficient management of these areas.
Aim: The objectives of this study were to: 1) recognize the spatio-temporal distribution of activities in national parks by users of selected social media platforms; 2) identify the locations with the highest activity among the various groups visiting the national parks; 3) identify the locations (hot spots) with the highest potential for providing cultural ecosystem services (CES).
Results: The spatial and temporal distribution of activities among various user groups in the national park areas was displayed using data from social media platforms and applications. Additionally, CES hotspots for the five most popular national parks were found.

Keywords: recreation, tourism, national park, user-generated geographic information, visitor monitoring

INTRODUCTION

Interest in outdoor leisure and tourism has substantially expanded as a result of changes in recent decades in areas such as: environmental awareness, population mobility, economic conditions, and lifestyle (Ode & Fry, 2002; Kaczmarska, 2014). The beneficial effects of nature on human health and well-being also contribute to this rise (Staats et al., 2013; Furuyashiki et al., 2019). Society's needs for contact with nature and recreation is realized among others, in areas with high natural and cultural values, such as national parks.

The findings show, recreational use of national parks is increasing, which emphasizes their popularity as a travel destination. Due to high demand for recreation in national parks, it is becoming more difficult for management entities to balance the two primary purposes of parks: nature protection and tourism (Ciapała et al., 2010). Excessive recreation and poorly managed tourist traffic may bring threats to national parks, in the form of, among others congestion on tourist routes, fires, damage of vegetation, and ecosystems being used beyond their natural capacity (Hadwen et al., 2007; Lyon et al., 2011). Furthermore, conflicts can also arise

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within the tourism function and affect different user groups (Hunter, 2001). Information on tourist pressure and the needs of different user groups is in interest of national parks management entities in order to provide effective tourism management (such as traffic channelization and zoning) (Matczak, 2002). One of the tools that can support management is the concept of ecosystem services developed in recent years, i.e., the concept of the streams of services that environment provides to humans and that can be identified and valued (Burkhard et.al., 2014; Elmqvist et al., 2015). There are several subdivisions of ecosystem services, and the most popular ones list the following categories: provisioning, regulating, supporting, and cultural (Maes et al., 2016). From the perspective of this paper, the most important category is cultural ecosystem services, which we define as follows: "nonmaterial benefits people obtain from ecosystems", and specifically lists "cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation and ecotourism" (MEA, 2003; 2005). According to Kremer et al. (2016), studies aimed at better understanding and evaluating CES have only grown in popularity in recent years, so research in this area is still required.

LITERATURE REVIEW

Costanza (2008) argues that for ecosystem services related to tourism and recreation to take place, users must be present in the ecosystem. The assessment of ecosystem services for tourism requires not only the character and availability of these natural resources, but also the demand for specific services (Kulczyk et al., 2014). As a result, data on tourism is crucial in terms of determining CES. For a long time scientific study has focused on the problem of recreational use of natural areas. A comprehensive analysis of the monitoring was offered by Cesfford & Muhar (2002). The authors distinguished, among others, the following methods: surveying, direct observation, indirect observation, mechanical computing equipment, ticket sales records. There are many ways to conduct surveys, including direct interviewing (Paper and Pencil Interview (PAPI)); direct interviewing with the assistance of computer techniques (Computer Assisted Personal Interview – CAPI); web surveys (Computer Assisted Web Interviewing – CAWI); telephone surveys (Computer Assisted Telephone Interview – CATI). Direct observations, on the other hand, can be conducted stationary or by personnel in the field, usually continuously on scheduled survey days. Aerial photography, pictures from unmanned aerial vehicles, camera traps, and video monitoring are examples of indirect approaches (Arnberger et al., 2005; Arnberger, 2006; Leggett, 2015). Pyroelectric sensors, which use infrared radiation to register movement are a popular monitoring tool in Polish national parks (Spychała & Graja-Zwolińska, 2014). Data from the sensors have enabled the characterization of movement in the following national parks, among others: Stołowe Mountains National Park (Rogowski, 2017; 2020), Tatra National Park (Hibner, 2014) and Bieszczady National Park (Szybki, 2012). However, the approach that counts visitors based on the number of entry tickets sold is the one that is most frequently deployed (Skawiński, 2010).

All these methods have their advantages and disadvantages and, to different extents, allow us to answer the fundamental question related to the recreational use of natural areas. Following questions have been defined by Daniel (2002): "Who is Where and When Doing What?" Willberg (2021) pointed out another important question, namely: "Why does the activity take place?". To find answers to such posed questions, recreational monitoring gathers data on visitor counts, movement patterns, travel routes, spatial distribution, group sizes, demographic characteristics, or behaviour. Currently, there is no single method that allows for the potential of obtaining all pertinent information for natural area management. Indeed, many of them are time-consuming and costly (Heikinheimo et al., 2017), and some of them are conducted in a point-wise manner on small areas. Therefore, it is very common to integrate data from multiple sources when undertaking monitoring

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(Rogowski & Małek, 2016). New methods of data acquisition are also being sought, including data from telecommunication network operators (e.g., data from phones with built-in GPS or data on so-called logs, i.e., places where actions such as text messages are recorded) (Shoval & Isaacson, 2007; Raun et al., 2016), as well as data generated by users of social media and applications (Majewska et al., 2016; Ciesielski & Stereńczak, 2021). Data generated by network users is called user-generated geographic information. In principle, social media data was to share one's experiences and information among a specific community of people. Much of this data also include geo-location information (X, Y coordinates), its creation date, as well as descriptions (hashtags) and images. The characteristics of the data generated by web users, mainly the photos, suggest that it is possible to identify, among other things: locations the authors are attracted to (analysis of coordinates); factors that make a place appealing (title analysis, photo); evaluation of a particular object based on descriptions or tags (Majewska et al., 2016). In the end, the potential of CES can be deduced from the examination of photographs by determining how desirable a location is. This is significant because CES are considered the most subjective and anthropocentric of all ecosystem services (La Rosa et al., 2016). They are therefore challenging to quantify (Keeler et al., 2015). For this reason, in recent years, photographs have become a valuable source of information on public activity in natural areas. Access to data from social media platforms and applications is constrained by their privacy policies and, as a rule, external users have access only to data with public data status (Di Minin et al., 2015). The size of data means that using application programming interfaces to collect and process them typically requires programming knowledge (Antoniou et al., 2016). The data obtained are typically impacted by the overrepresentation of a particular group (portal users) (Li et al., 2013) and the fluctuation in data-recording caused by factors like site availability (Balmford et al., 2015). Despite their limitations, data from Twitter, Flickr, and Instagram have been successfully implemented in studies (Ghermandi & Sinclair, 2019) that identify hot spots of cultural ecosystem services in natural areas at various spatial scales (Willem et al., 2015; Haines-Young & Potschin, 2018); map the distribution of cultural ecosystem services like aesthetic value or recreation (Becken et al., 2017; Figueroa-Alfaro & Tang, 2017) and analyze temporal and spatial distribution of recreational activities (Wood et al., 2013; Ciesielski & Stereńczak, 2020; 2021); differences in spatial use between visitors and locals (Tenerelli et al., 2017); assessing landscape aesthethic appearance and tourist satisfaction (Tenerelli et al., 2016; Tenkanen et al., 2017). According to Majewska et al. (2016), multimedia content published online can be compared to the presentation of particular tourist attractions that have been considered appealing by Internet users, and therefore have high CES potential. It is worth highlighting that the use of social media data, including the studies on the number of tourists in national parks, have confirmed that there is a correlation between the quantity of images taken and the number of admissions sold (Session et al., 2016). This reveals the applicability of these data. The analysis of recreation in forest areas (Ciesielski & Stereńczak, 2021; Grzyb et al., 2021), urban space (Zasina, 2018), the description of the attractiveness of tourist space (Majewska et al., 2016) and urban green infrastructure planning (Guerrero et al., 2016) are just a few of the research that have been done so far in the Polish literature utilizing data from social media.

Considering the significance of issues relating to tourism and recreation in national parks, we defined following objectives for this study:

1. recognize the spatio-temporal distribution of activities in national parks by users of selected social media sites and applications;
2. identify the locations with the greatest activity among the various groups visiting the national parks;
3. identify the locations (hot spots) with the greatest potential for providing CES.

The aforementioned goals were accomplished using information from social media and applications.

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MATERIALS AND METHODS

Study area

The research area included 23 national parks in Poland, created under Article 8(2) of the Act on Nature Conservation (Act on Nature Conservation, 2004) to "preserve biological diversity, resources, formations and components of inanimate nature, and landscape values, to restore proper condition of resources and nature components, and to reconstruct deformed natural habitats, plant habitats, animal habitats, or fungal habitats". Collectively, the national parks in Poland cover an area of about 315,000 hectares. The smallest is Ojców National Park (approximately 21.5 km^2) and the largest is Biebrza National Park (about 592 km^2). The majority of Poland's national parks are forested, with woods covering 70% of their area, waterbodies 10% and other areas 20%. A little over 24% of the national park's areas are under strict protection, while about 66% are partially protected and the remaining area fullfills service functions (privately owned agricultural and forest land, occupied by park infrastructure, etc.).

Because of their natural and landscape values and their role in ecological education, parks are a subject of public interest in terms of tourism and recreation. The areas of national parks are thus accessible to visitors, with the restriction that tourist traffic is limited to specific locations, trails, roads, and paths.

According to the Statistics Poland (Environmental Protection, 2020), the number of visitors to national parks in 2019 ranged from 12.8 thousand in the Narew National Park to 3947.4 thousand in the Tatra National Park (Fig. 1). In addition to Tatra National Park, the top five most visited national parks in Poland are: Karkonosze National Park (with 2160.0 thousand visitors), Wolin National Park (with

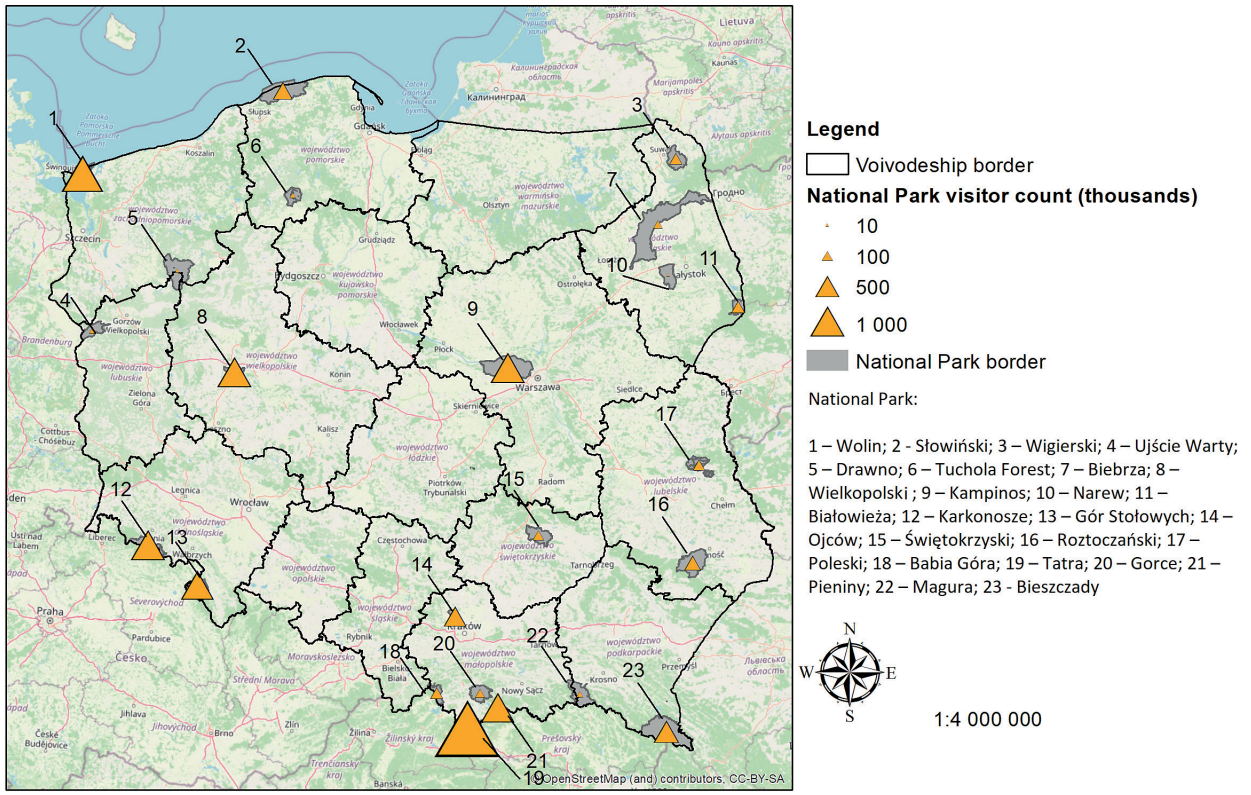

Fig. 1. Number of visitors to national parks in Poland in 2019
Source: own preparation based on data from Statistics of Poland.

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1500.0 thousand visitors), Kampinos National Park (with 1000.0 thousand visitors), and Wielkopolski National Park (with 1000.0 thousand visitors). Nearly 75% of all visits to national parks in Poland are made up of tourists who visit the five most well-known parks. It should be emphasized that some of the data presented are estimates and only few parks monitor their tourist traffic, for example, based on the quantity of tickets sold.

Data description

Photos from the social network Flickr were requested and gathered using the Flickr Application Programming Interfaces and a query built in R software (version 3.6). (Bernetti et al., 2019). Only data with a public status and those with geolocation (X, Y coordinates) were collected in accordace with the platform's privacy policy. The nickname and unique ID of the author of each image, the date and time the image was taken, the image's title and its description were also extracted. For the territory of the entire extent of Poland, 1,035,539 photos were collected, covering the time frame from January 1, 2010, to December 31, 2018. Then from the downloaded dataset, only the photographs that fell within the borders of national parks were selected. Further filtering were done in accordance with the presumptions made in the literature, leaving one image taken by one user on a certain day (photo-user days – PUD) (Tenkanen et al., 2017). In this case, the aim was to eliminate redundant data from a single contributor. Finally, 6787 photos were examined.

GPies.com, Endomondo, and MapMyRide were used to collect data on the activity of users of selected sports apps. The data search was conducted at the applications level. The following criteria were established for the search:

a. the activity or its part took place within the national park area or within 25 km of its boundaries;
b. the activity was recorded using a GPS device;
c. the type of activity included cycling, biking, mountain biking, running and walking;
d. in the Endomondo application, each searched route was linked to the number of recorded activities.

There is a limitation of the GPies.com application as it only allows users to download just the most recent 250 GPS tracks for a particular type of activity. Furthermore, only the GPies.com portal provided details about the date the track was registered and the time it started. In all portals it was possible to search for activities with public status, which means that the user who registered the activity permitted other portal users to view it. Due to the disparity in data types, they had to be converted to shapefile format. This layer was also utilized to determine the locations from which the activities initiated (starting points). The total number of activities included in the analysis was 15,220, with 3,980 falling into the running category, 1,060 under walking and 10,180 under cycling (biking, cycling and mountain biking).

Analysis of spatio-temporal distribution of activities (GRID mesh)

Based on data from GPies.com and Flickr, differentiation of the temporal distribution of activities was performed for all national parks for the aggregated periods (hours, days of the week and months). Data aggregation was designed to allow for a visual comparison of the variation in activity registration between different users. In addition, following the guidelines of Toivonen et al. (2019), the analysis of the temporal distribution of activities was performed for the entire analysis period, without breaking it down by years. Such procedure makes it possible to minimize the impact of gaps in data collection.

For the five national parks with the highest recorded number of activities from social networks (cumulative condition: Flickr data number > 350, Endomondo, GPies.com, and MapMyRide data number > 320), the analysis of spatial distribution of activities was performed using the modified approach described by Nogueira Mendes et al. (2012). The condition defined was met by five national parks: Tatra National Park, Karkonosze National Park, Ojców National Park, Kampinos National Park and Bieszczady National Park. According to the adopted methodology, a grid of 500 × 500 m was created

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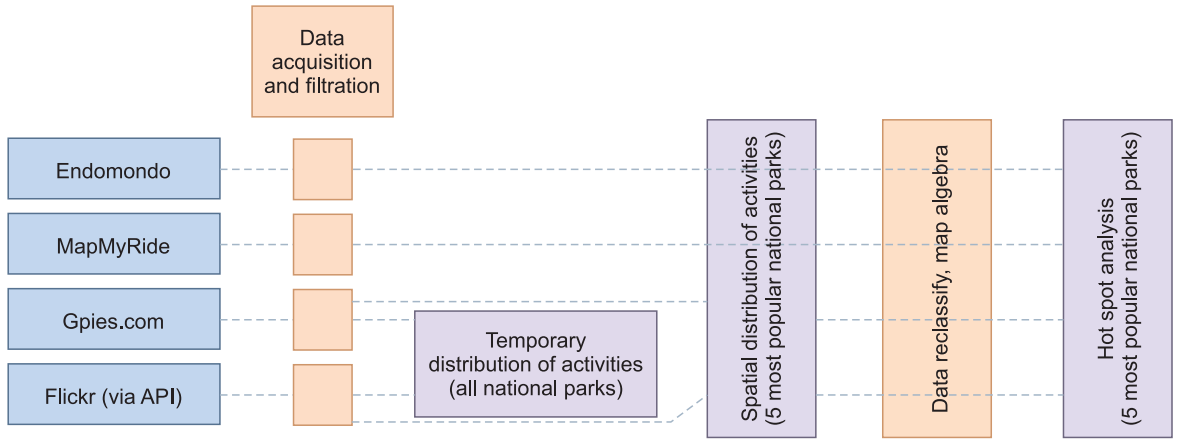

Fig. 2. Workflow
Source: own preparation.

to perform the analysis. The selection of the grid size was conditioned, among others, by the size of the analyzed area. Each grid cell was given information on the number of activities, one for each activity, such as photography (Flickr), running, walking, and cycling. The following phase involved converting vector data to raster data, while taking into account the partition into 10 deciles. The numerical values characterising each decile were reclassified, after creating rasters for all activities (separately for each national park), where:

a. class 1 (deciles 1–3) – low intensity of use;
b. class 2 (deciles 4–7) – moderate intensity of use;
c. class 3 (deciles 8–10) – high intensity of use.

Then, using map algebra, the raster values were aggregated (range 0–12), where the higher the value, the greater the potential to provide cultural ecosystem services (the top quantile – 30% of data) was taken into account. To test the consistency between the number of activities on websites and social network applications and the number of visitors to national parks, the coefficient of determination R^2 was also calculated.

RESULTS

A general overview of recreational activities in the parks

A total of 6787 photos were downloaded from Flickr social network website, with the highest number of images from Tatra National Park (1520), followed by Karkonosze National Park (858) and Ojców National Park (575). The least amount of photographs were taken in Drawno (11), Narew (39) and Magura National Park (48). In the national parks areas: 3,980 jogging, 1,066 walking and 10,058 cycling activities were registered. The parks located within metropolitan areas such as Kampinos National Park (Warsaw agglomeration) and Wielkopolski National Park (Poznań agglomeration), were the most frequently used for running and cycling. Tatra National Park was noted as the one most popular for walking. While data for each national park were recorded on Flickr, there were data gaps on the other portals. The strongest correlation between the number of different activities and the number of walks is found

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Table 1. Registered activities on individual social media data. For Endomondo portal, the number of routes and the number of activities are given (in parentheses)

National Park	Endomondo			GPies.com			MapMyRide			Flickr
	Running	Walking	Cycling	Running	Walking	Cycling	Running	Walking	Cycling	Photo
Babia Góra	6 (6)	3 (15)	3 (46)	6	11	21	7	15	7	217
Białowieża	-	-	3 (4)	-	1	17	-	-	-	126
Biebrza	5 (5)	-	9 (28)	-	1	7	3	1	3	232
Bieszczady	13 (137)	12 (58)	-	3	51	23	15	48	15	421
Tuchola Forest	3 (28)	-	11 (288)	1	5	14	1	5	1	70
Drawno	-	-	4 (17)	-	-	1	1	2	1	11
Gorce	5 (43)	6 (17)	17 (193)	4	25	17	3	19	3	299
Kampinos	65 (745)	10 (15)	68 (5523)	1	6	78	27	25	27	524
Karkonosze	19 (519)	8 (27)	15 (142)	5	37	36	30	69	29	858
Magura	4 (5)	-	7 (23)	1	14	6	-	-	-	48
Narew	2 (171)	1 (2)	3 (10)	-	-	-	-	-	-	39
Ojców	7 (78)	1 (1)	19 (523)	-	6	56	7	8	7	575
Pieniny	10 (58)	3 (3)	1 (6)	-	7	47	5	14	5	196
Polesie	4 (14)	-	4 (23)	-	1	2	5	-	5	98
Roztocze	2 (45)	-	13 (65)	-	-	22	1	-	1	190
Słowiński	3 (208)	-	1 (1)	2	2	15	9	10	9	223
Stołowe Mountains	6 (43)	3 (11)	9 (34)	-	5	15	7	11	7	493
Świętokrzyski	4 (14)	2 (26)	10 (139)	1	1	22	1	6	1	190
Tatra	26 (578)	33 (161)	8 (125)	12	74	50	34	203	35	1520
Ujście Warty	4 (5)	-	2 (4)	-	-	4	-	-	-	98
Wielkopolski	24 (594)	4 (23)	45 (1697)	7	3	6	33	-	33	152
Wigry	11 (276)	-	17 (450)	-	3	22	2	-	2	140
Wolin	13 (154)	3	6 (32)	-	-	-	20	9	13	67
Total	236 (3726)	89 (368)	275 (9373)	43	253	481	211	445	204	6787

Source: own preparation.

in the Flickr data. The coefficient of determination calculated was 0.79.

The number of registered activities from social media websites partially corresponds with the statistical data on the number of visitors to a given park. The coefficient of determination between the Flickr data, walking and running activities, and the number of visitors was 0.66, 0.70, and 0.41, respectively. For the last activity, associated to cycling, it was only 0.03, which is mainly related to the absence of opportunities to practice this sport in difficult-to-reach parts of the national parks (e.g., trails in areas with steep slopes).

Table 2. Comparison of the coefficient of determination between the number of visitors to national parks and data from social media data

	Flickr	Walking	Running	Cycling
Statistic data	0.66	0.70	0.41	0.03

Source: own preparation.

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Temporal distribution of activities national park areas

Daily, about 48% of Flickr photos were taken between 10 a.m. and 2 p.m. In comparison more pictures were shot in the afternoon and evening than in the morning. The temporal distribution of activities recorded on GPies.com indicates that most of them (about 42%) began between 8 a.m. and 1 p.m. The relatively highest percentage of activities was reached at 9 a.m. and accounted for nearly 11% (Chart 1). Grouped by day of the week, data show that about 40% of all activities, regardless of portal, occurred during weekends. On weekdays, the average percentage of registered activities was about 11% (Chart 2). On a monthly basis, we can see intensified activity in the summer months of July and August, with nearly 34% of activity registered on the Flickr portal and 41% on the GPies.com site. Compared to the rest of the year, social network users were much more active from April to September (about 70% Flickr photos and over 77% of GPies.com data) (Chart 3).

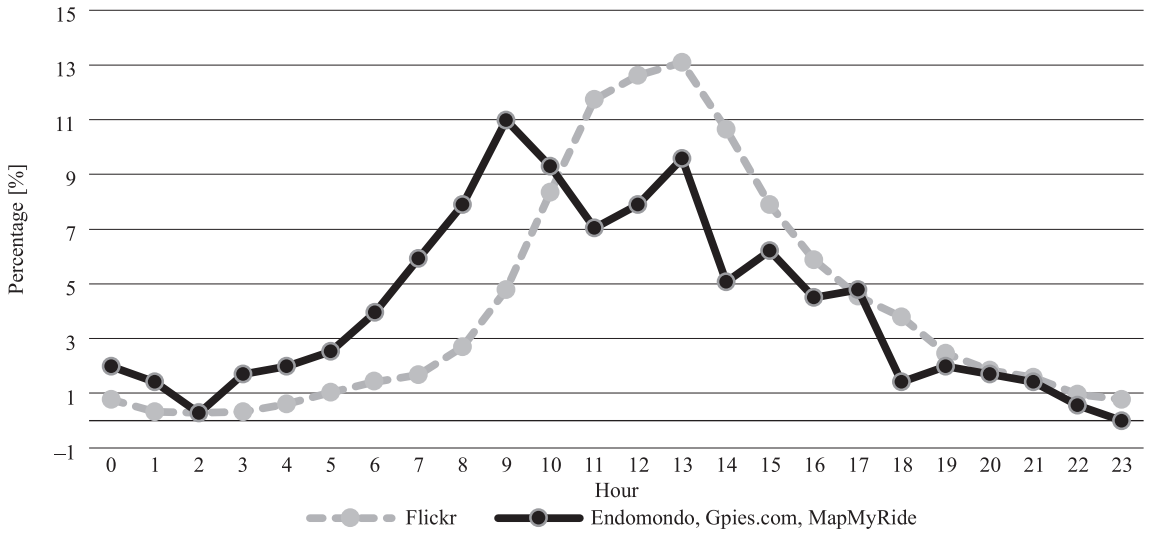

Chart 1. Hourly distribution of photos taken in percentage [%]
Source: own elaboration.

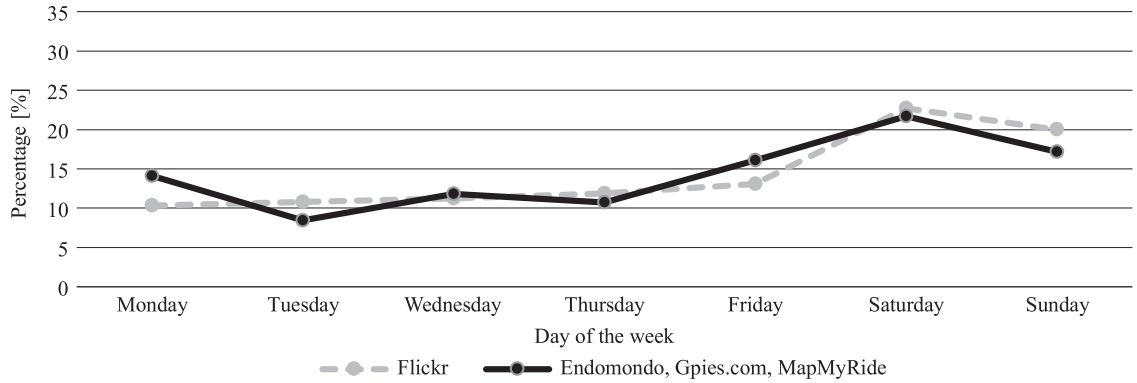

Chart 2. Percentage distribution of photos taken in weekly basis
Source: own elaboration.

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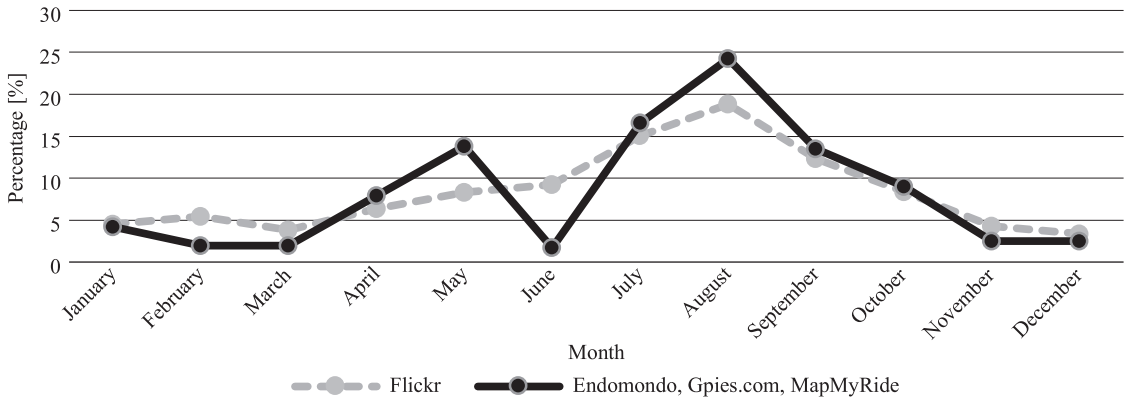

Chart 3. Percentage distribution of photos taken in monthly basis
Source: own elaboration.

Spatial distribution of activities

We were able to show the spatial distribution of activities in selected national parks areas by combining various data sets. The outcomes of two of them, Karkonosze and Kampinos National Park are shown in Fig. 3 and 4. It is evident that various groups of users of the region use and enjoy different locations to different extents. This is linked to the accessibility (adjustment of infrastructure and topography), legal restrictions or tourist attractiveness.

The output of the map algebra facilitated to identify areas with the highest intensity of use by all user groups (hot spots) (Fig. 5). Considering

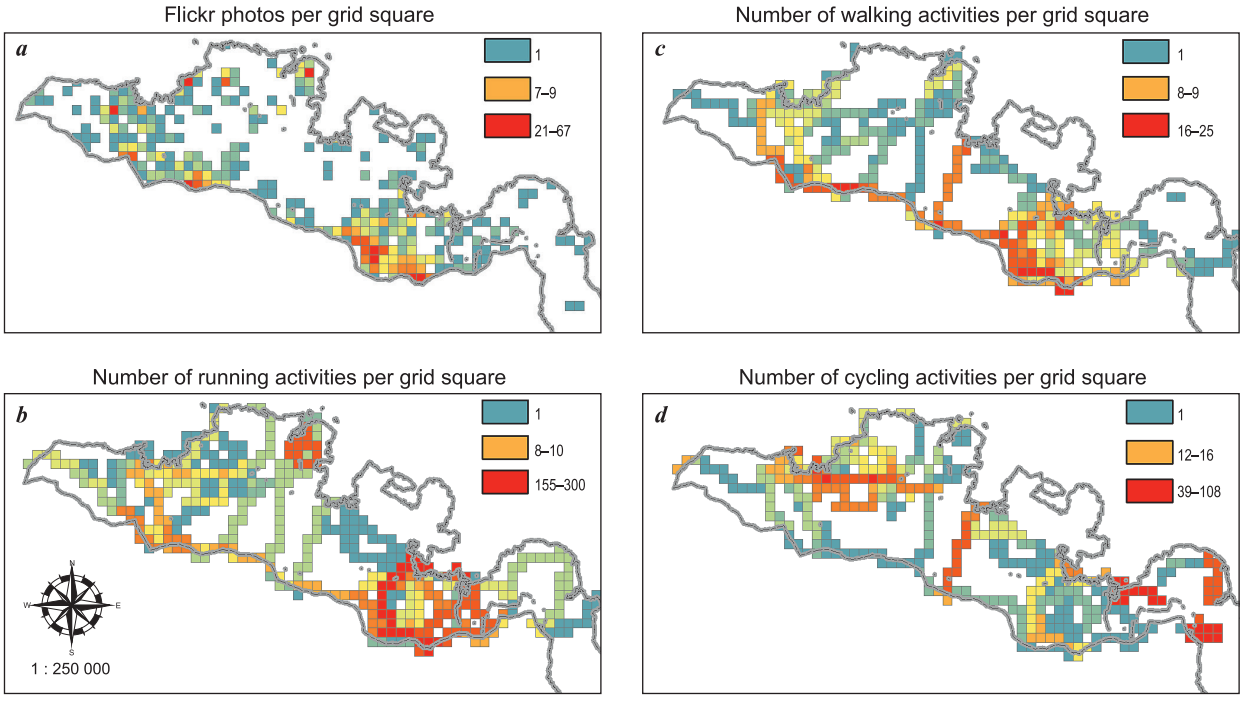

Fig. 3. Spatial distribution of different types of activities in Karkonosze National Park represented as quantiles (blue – quantiles 1–3; orange 4–7; red 8–10) in square grids (500 × 500m): a) Photos (Flickr); b) Running; c) Walking; d) Cycling
Source: own preparation.

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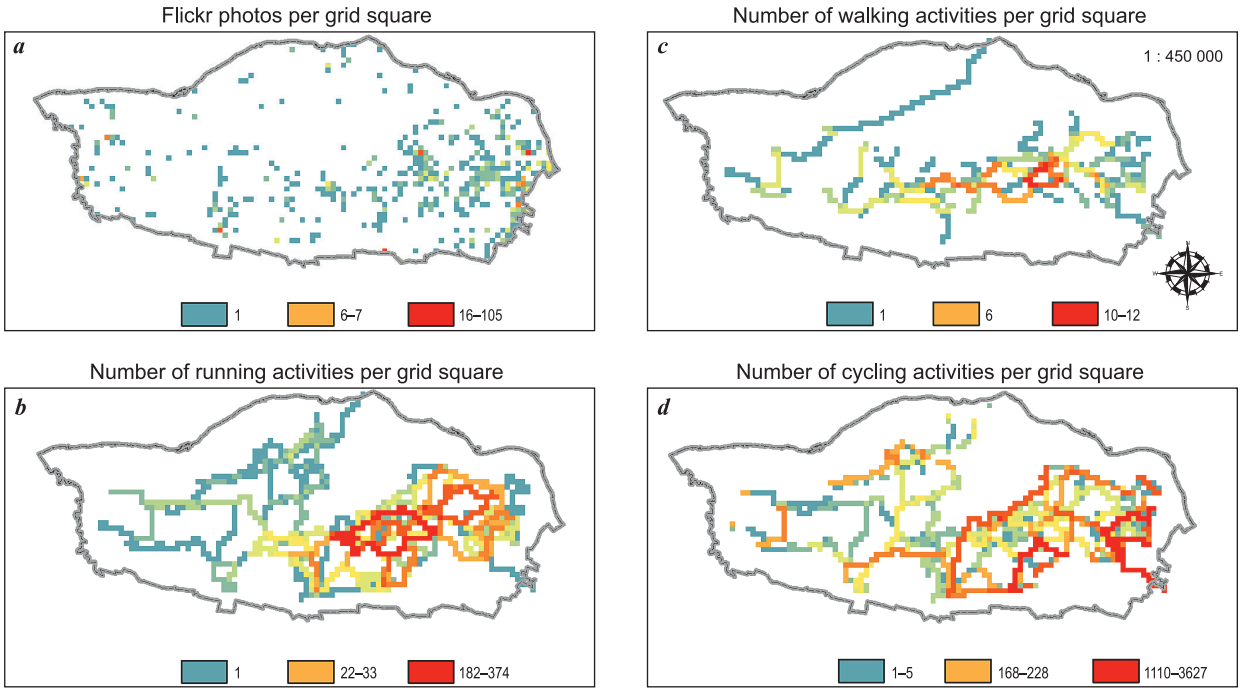

Fig. 4. Spatial distribution of different types of activities in Kampinos National Park represented as quantiles (blue – quantiles 1–3; orange 4–7; red 8–10) in square grids (500 × 500m): a) Photos (Flickr); b) Running; c) Walking; d) Cycling
Source: own preparation.

the size of national park, the proportion of locations with the highest recreational potential (values 10–12) for each park was: 1.70% for Karkonosze, 0.25% for Kampinos, 0.30% for Bieszczady, 3.84% for Tatra and 1.15% for Ojców National Park. In general, the points of the greatest interest are typically clustered around objects with excellent tourist and landscape potential, through which tourist routes pass, with the exception of Kampinos National Park. Only for Kampinos National Park, one can notice a significant impact of the distance from Warsaw. The majority of the park's activities take place in its eastern part, which borders directly with Warsaw, and where access to the park boundaries is also possible thanks to the proximity of a major public transportation hub. Hot spots can either be dispersed, as in Tatra National Park, where the most of them are spread out along the most popular routes or more concentrated, as in Ojców National Park, where the majority of the main attractions are in relative proximity to each other.

DISCUSSION

Our study shows that social media data and applications can be used to determine the spatial and temporal distribution of activities in national parks, as well as identify areas with the greatest potential to provide CES. Prior studies aimed at monitoring recreational traffic in national parks in Poland used traditional methods such as surveys, ticket sales, or pyroelectric sensors (Szybka, 2012; Hibner, 2014; Rogowski, 2017; 2020). Among the authors' knowledge, there has never been a study that used data generated by Internet users within Polish national parks.

According to the finding, the temporal distribution of social activity is similar to that found by, among others, Rogowski (2017; 2018). It is interesting to note that the number of user-generated data (Flickr users and hiker) and the number of national parks tourists match quite well. This shows how useful and credible the data are. Evidently, social media and applications

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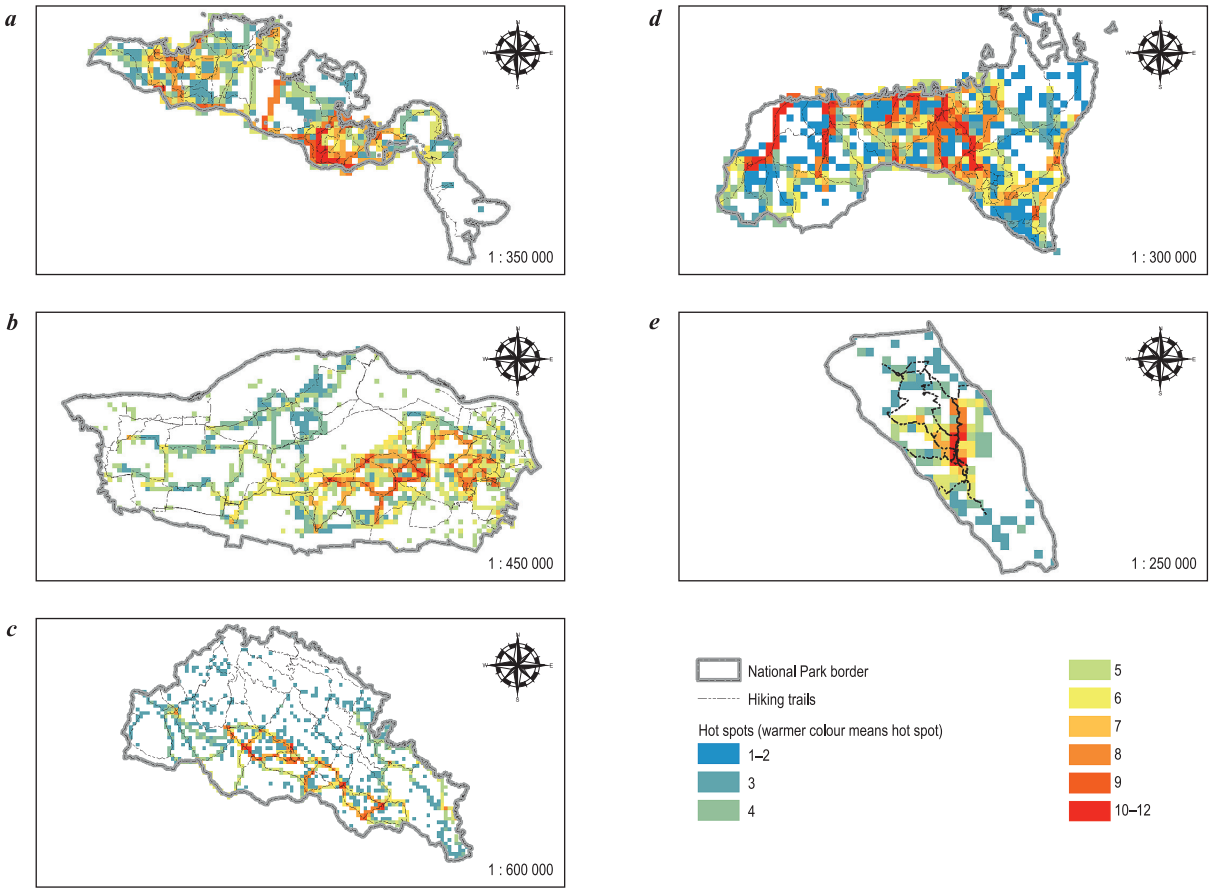

Fig. 5. Spatial distribution of hot spots in national parks: a) Karkonosze; b) Kampinos; c) Bieszczady; d) Tatra; e) Ojców
Source: own preparation.

data do not provide continuous information like pyroelectric sensors and it is avised against using them for one-year analyses, in favor of long-term observations to prevent errors caused, for instance, by missing data or errors in the way events were planned (Toivonen et al., 2019). However, their undeniable advantage, is that the activity occured, because it was recorded by a GPS device and is not a kind of declaration, as in some survey studies (Ciesielski & Stereńczak, 2021). Additionaly, it is possible to obtain spatial information using both point-based (Flickr data) and linear data from many portals (data from sports applications). This enables evaluations of the entire park area, such as the location of public gathering spots outside of designated areas or the disputes arising between various beneficiary groups. Data was acquired for all national parks, including those for which there is no continuous monitoring of the use park exploitation by tourists, which is a substantial advantage. It was possible to identify areas with high potential for CES provision, through the processing of the data i.e. sites that are relevant and valuable from the point of view of particular user groups. Similar studies in the CES field have indicated great potential for applied use of the findings (e.g., Peng & Shen, 2017; Ghermandi et al., 2020).

Undoubtedly, the data from social networks and applications, as well as the results presented, can be used by relevant authorities in the decision-making process of the relevant authorities in terms of channeling tourism, building new infrastructures or protecting areas from overexploitation (Ghermandi

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et al., 2020). These data have their advantages and disadvantages, which are primarily caused by the technological aspects of retrieving them.

Data from applications and social networks both have their limitations. One of them is the sample's lack of representativeness. It must be assumed that the sample population is composed of people who use the chosen portal. Therefore, there is a certain overrepresentation of a particular group, probably younger than the general population or those engaged in the chosen sport. It is quite challenging to construct a user profile because of limitations on access to the users' records, their place of residence and their social status. However, existed advanced data analysis methods can only partially determine such information (Heikinheimo et al., 2017; Lenormand et al., 2018; Sinclair et al., 2020). It is crucial to keep in mind that the privacy regulations of the portals have an impact on the studies when using data from social networks and applications. Only publicly available data (with public status) can be accessed using external queries. Many of the available data can be prohibited since portals policies are subject to change over time (Lomborg & Bechmann, 2014). This creates many problems when multiannual research must be repeated (Heikinheimo et al., 2017). The size of the available data sample is just one of the many benefits of using data coming from portals and social networks, that have been demonstrated by the research provided. It is typically several times bigger than the sample like in survey research. The advantage of this type of data is also its rapid acquisition, which can be facilitated by the use of appropriate tools for automatic data processing (API, scripts, etc.) (Antoniou et al., 2016), making it possible to retrieve the information more quickly and affordably than with traditional research (Ciesielski & Stereńczak, 2021).

CONCLUSIONS

Despite their limitations, information from social media networks and applications enables to map the spatio-temporal distribution of leisure and tourism activities among various user groups in naturally valuable areas. In addition, they provide details on the locations with the greatest potential of offering CES. The information discovered through the analysis of user-generated data can be utilized as supplemental data for tracking recreational use in particular national parks and serve as an important element of the decision-making process in shaping tourism traffic and protection of natural resources. Future research should be steered in two key directions. In order to perform advanced analysis on various aspects of CES it is first necessary to design an automated system for content classification of data descriptions (hashtags, metadata) and photos. Second, the creation of an application for automatic data collection and processing for staff members of national parks to utilize directly.

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