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ASSESSMENT OF THE SEASONALITY AND VARIABILITY OF VISITOR FLOW IN A NATIONAL PARK – A METHOD FOR REGIONAL TOURISM POLICY (CASE STUDY: KARKONOSZE NATIONAL PARK IN POLAND)

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Abstract

Purpose. The objective of research was to understand visitor flow changes in the spatio-temporal distribution at Karkonosze National Park (KNP). The main focus is highlighting relationships in visitor flow successive years and months of the 2010-2022 study period, describing the variability and seasonality of visitors.
Method. The applied method was analysis of the data regarding the sales of admission tickets. The Visitor Index and Gini coefficient were used.
Findings. 1. The number of annual visitors increased 2.5 times in the period 2010-2022. The temporal concentration and seasonality of visitors in KNP is very high and the period from May to September had 2/3 of yearly visitors. The spatial concentration of visitors in KNP is high and gradually dispersed. This is due to the greater increase of visitors in less popular places.
Research and conclusions limitations. The admission tickets are a reliable but not very detailed source of visitor characteristics.
Practical implications. The research allows to diagnose and forecast trends as well as changes in visitor flow at the studied national park.
Originality. A long measurement of data collection (2010-2020) for forecasting changes in visitor flow.
Type of paper: Research article.

Keywords: Visitor flow, Visitor Index, Seasonality, Karkonosze National Park

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Introduction

The Karkonosze National Park (KNP), as one of the most frequently visited national parks in Poland, is not only a traditional tourist destination but, in recent years, has also become an increasingly popular place for active, open-air recreation, offering unique nature surroundings. Due to its high popularity, the visitor flow assumes a mass form there. It is a well-known statement that mass visitor flow exerts a negative impact on the natural environment, residents and visitors, called overtourism in literature on the subject. Overtourism describes destinations where hosts or guests, locals or visitors, feel that there are too many visitors and that the quality of life in the area or the quality of the tourist experience has deteriorated unacceptably (Goodwin 2019).

Tourism policy refers to actions undertaken by the state through various institutions operating at various levels of government and local administration [Alejziak 2009]. One of the tasks of tourism policy is to shape the optimum size and structure of visitor flow by applying economic laws in the sphere of tourism economy, coordinating the development of tourism taking its functions into account and the diversity of its relations with other spheres of national activity [Panasiuk 2010].

The knowledge of visitor flow volume, structure and, in particular, its seasonality, allows to make numerous management decisions aimed at counteracting the negative effects of mass visitor flow, protecting the most precious natural values and improving the quality of tourist services. The aim of the study is to understand the visitor flow changes in spatio-temporal distribution at KNP. The main focus is to highlight relationships in visitor flow during successive years and months of the 2010-2020 study period, describing the variability and seasonality of visitors.

Literature review

The problem of visitor flow in national parks is extensive and has been discussed by many researchers [i.e. Krakowiak 2000, Partyka 2002, 2010, Skawiński 2010, Mroczka, Adamski 2010, Hibner 2013, Kruczek, Przybyło-Kisielewska 2019, Miazek 2019]. The list given below includes mainly studies providing an analysis of visitor flow in mountain national parks. The analysis of visitor flow intensity based on the sales of admission tickets is characterised by relatively easy access to data, accuracy and efficiency in observing as well as describing the occurring changes. According to A. Spychała and S. Graja-Zwolińska [2014] and B. Zawilińska [2021], this method is most frequently applied in the analysis of visitor flow. The measurements of visitor volume and spatial distribution at KNP have been performed for a dozen or so years and include the analysis of data from the sales of admission tickets.

The presented research is a continuation of the reserach conducted by B. Wieniawska-Raj [2004, 2007, 2010] in which it has been shown that: the visitor flow is the highest in July and August and the lowest in November, December and March. This is confirmed by the current spatio-temporal distribution of tourism at Krkonoše National Park (KRNAP) [Erlebach, Malkova, 2021, Erlebach, Romportl 2021]. The most frequently visited places are Śnieżka – 650 thousand visitors [Rogowski 2018], the plain below Śnieżka and also Kamieńczyk and Szklarska Waterfalls, which are among the most popular attractions of the Polish part of the range. Individual visits are the most popular form of tourism, with mainly motivation of leisure, nature and actively spending one's free time[Rogowski 2021a].

The variability and seasonality of visitor flow is an important and repeatedly addressed problem. The seasonality of visitor flow is defined as a temporal imbalance which can be presented using various indexes [Butler 1994]. According to N. Koenig-Lewis and E.E. Bischoff (2005), the tools most often applied for analysing tourism seasonality are as follows: coefficient of variation, seasonality ratio, Gini coefficient. G. Þorhallsdóttir and F. Ólafsson [2017] used the Gini coefficient and L.A. Gil-Alana and E.H. Huijbens [2018] implemented fractional integration to describe tourism seasonality in Iceland. M. Ferrante et al. [2018] also used the Gini coefficient and their own Seasonality Index to analyse the seasonality of tourism demand across European countries. Such an analysis was also performed for the region of Andalusia by J.M. Martín et al. [2014], the VFR, holiday and business segments in Scotland [Coshall et al., 2015], and throughout the United Kingdom, specifically the English regions [Fernández-Morales et al., 2016]; the events segment in Scotland [Connell et al. 2015], the cultural segment in Sicily [Cuccia, Rizzo, 2011] and in Argentina [Cisneros-Martínez, Fernandez-Morales, 2016]. A.J. Duro [2018] proposed a complementary decomposition form for the Theil index in the case of Spain.

Materials, Methods

For the aim of the conducted analysis, the data regarding the sales of admission tickets to KNP between 2010-2022 were used, which allowed to determine the temporal structure, taking the annual and monthly volume and variability into account, as well as the spatial structure through identifying individual entry points. The types of tickets allow to determine the visitor characteristics: individual, groups, reduced-price. The sales of admission tickets to the KNP takes place at 8 entry points (Figure 1).

Ticket sales data are the most reliable source of information about visitor flow at KNP. Their analysis allows to characterise the spatial distribution of visitor flow to determine its volume and intensity in selected places

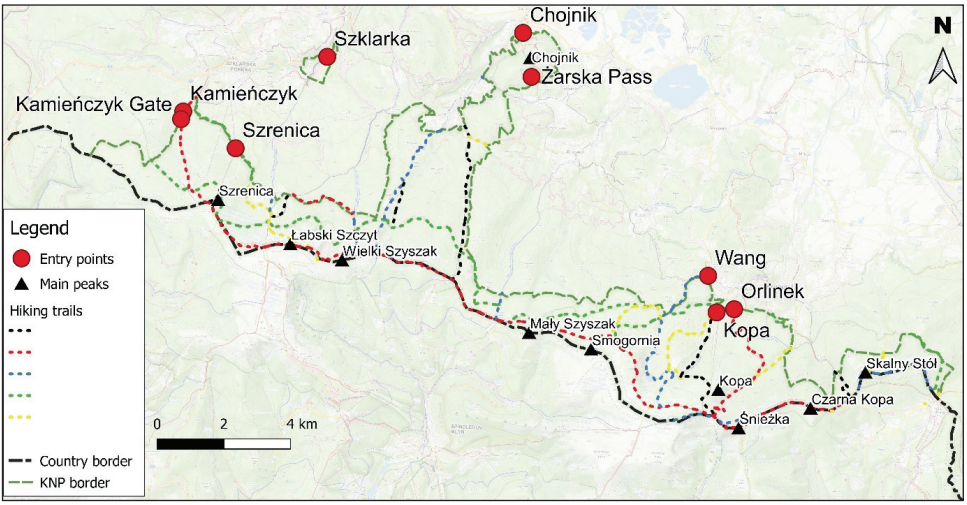

Figure 1. The location of entry points in KNP.

Source: own research.

within the park area, its temporal variability and also to identify the most popular forms of visits. Despite that, these data do not address the entire phenomenon covered by the study. There are at least a dozen unchecked entries to the park. In addition, it is possible to enter the park without purchasing an admission ticket from the KRNAP along trails that cross the state border. This results in the discussed data being underestimated and not reflecting the actual visitor flow. The interviews carried out with the park employees reveal that, in their opinion, the visitor flow is approx. 20-30% higher than resulting from the number of tickets sold.

The annual sales of admission tickets were compared for the purposes of characterising the visitor flow volume. Next, using monthly comparisons, the variability was analysed and the particular months were grouped depending on attendance. In addition, the largest average growth and changes which occurred in 2020 as a result of the outbreak of the COVID-19 pandemic were indicated.

In the analysis of the visitor flow, the Visitor Index (VI) and Gini coefficient (GC) were used. The Visitor Index (VI) is defined as the ratio of the number of visitors for an analysed period to the average number of visitors for the whole period [Rogowski 2021b]. If the VI is equal, then the number of visitors in the defined period of time is equal to the average of the whole analysed period. If the VI is less than 1, this means that the number of visitors for the defined period is smaller than the whole of the analysed period. If the VI is greater than 1, this indicates that the number of visitors in the defined period is greater than the whole analysed period. Once the visitor index values for given periods in particular years have been computed, they can be com-

pared. If the VI is smaller for consecutive years, this means that the share of visitors of the defined periods during the whole analysed period is decreasing.

The Visitor Index for the defined period can be referred to: (1) year; (2) period of several years. In this case we used modified VI (period) (2) which used monthly data. The formula of VI is as follow:

$$\mathrm{VI}\ (2010-2022) = \frac{\mathrm{Xv_{dp}}}{\overline{\mathrm{X}}\mathrm{v_{ap}}}$$

where:

$\mathrm{Xv_{dp}}$ – number of visitors in a defined period (in this case: in month)

$\overline{\mathrm{X}}\mathrm{v_{ap}}$ – average number of monthly visitors in analized period (in this case: 2010-2022)

The Visitor Index (period) allows to determine the trend and size of variability in visitor flow over the entire period, in relation to the corresponding average value. In this case, VI (period) was implemented using the example of the 2010-2020 period. The VI (period) is the ratio between the monthly number of entries and the average value in the analysed period as well as the size of variability.

The Gini coefficient is used to measure the inequality of distributing goods, in particular, the distribution of household income, and therefore, it is often referred to as the Social Inequality Index. However, due to the structure of this index, based on the Lorenz curve, it can also be used to measure the inequality of visitor seasonality [Duro, 2016, þorhallsdóottir G, Olafsson 2017]. The Gini coefficient takes values in the range (0; 1). This index, according to Þórhallsdóttir and Ólafsson [2017], is less sensitive to peaks but more sensitive to off-peak changes. The formula can be expressed in the following manner, as presented in Lundtorp [2001]:

$$\mathrm{G} = \frac{2}{\mathrm{n}}\sum_{i=0}^{n}(Xi - yi)$$

where:

n = the number of fractiles, months, weeks, days or other units;

x_i = the rank of fractiles, for example: 1/12, 2/12… when using months, or when using weeks 1/52, 2/52…, or days 1/365, 2/365… etc. So xi = i/n;

y_i = the cumulated fractiles on the Lorenz curve.

The Gini coefficient is equal to the area between the Lorenz curve (area A) and the 45° line divided by the whole area below the line (area B). To find the area between the Lorenz curve and the 45° line, area B needs to be found. The Gini coefficient can equally well be calculated from monthly, weekly or daily values. The values are first ordered by size from the lowest value to the highest and then normalised by the total number of visitors over the year (v_t). Below, the following formula is presented:

$$\frac{v1}{vt}, \frac{v2}{vt} \ldots \frac{vn}{vt}$$

where:
n equals the number of fractiles, 12 when using months, 52 when using weeks and 365 when using days.

The sum of the normalised values should be 1. The normalised values are then accumulated and the highest of the accumulative values should be 1, the largest fractile.

The next step in finding the Gini coefficient is to determine the area below the Lorenz curve (area B). That is done by finding the mean of 2 neighbouring values and multiplying the mean by the width. The x-axis is normalised to 1 and, therefore, the width of each bar is 1/n. When the n values are summed up, we have area B. Area A is given by:
A=0.5-B

The Gini coefficient is finally found:

$$Gini\ coefficient = \frac{A}{0.5}.$$

In this case, to find similarities in the variability of entry volumes, a correlation matrix was used to assess a large amount of linear correlations between the data. As a result, the correlation index between all entry points was determined. For the purposes of characterising visitors based on the type of tickets purchased, the number of sold types of tickets for individual entries and the share of individual tickets in the total sales were compared.

Results

Temporal structure

At KNP, a gradual increase was noted in the number of visitors during the pre-COVID-19 period. Until 2017, the growth dynamics remained at a level of approx. 7% per year, although in recent years, its level has significantly strengthened. Only in 2020 the number of visitors decreased by -8.8%, due to the Covid-19 pandemic (Rogowski 2021, 2022). In 2021, the record number of visitors was recorded - 2,422 million and in 2022 the respective number was higher than 2,400 million. This confirms that in Post-COVID-19 period the number of visitors remains at a recurrently high level (Fig. 2).

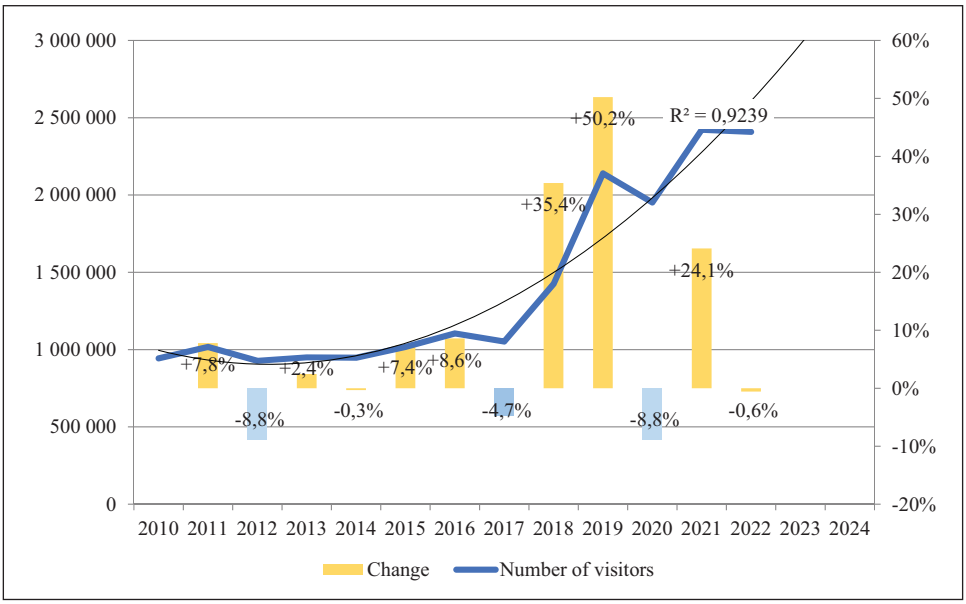

Figure 2. Annual visitors at KNP between 2010-2022.
Source: own elaboration based on data from Karkonosze Mts. National Park.

The trend lines with a greatest positive slope relate to July and August. Furthermore, a high positive trend was observed in September, which was higher than in June. The positive trends for October and February moved them from Low Season in 2010 to Mid-Season currently. A particularly large increase of visitors in January of 2021 makes this month incompatible with the low season. The increases of monthly visitors are also explained by the high R-squared coefficients for the chosen month ranging between 0.76 to 0.90. The highest R-squared coefficients also apply to July and August, as well as November, February and June. The trend lines also confirm the division into 3 groups of months, according to high, mid- and low-season (Fig. 3).The variability of monthly visitors over the period 2010-2022 resulted in changes in the identification of high, medium and low-seasons:

The variability of monthly visitors over the period 2010-2022 resulted in changes in the identification of high, medium and low-seasons:

1. High season invariably covers July and August,
2. Mid-season has lengthened from three months (May, June and September) in the initial period to five months; now including also October and February,
3. Low season has shortened to include currently March, April, November and December. The large increase in the number of visitors in January made the month incompatible with either the low-season or mid-season (Fig. 3). The same may prove true for November in future.

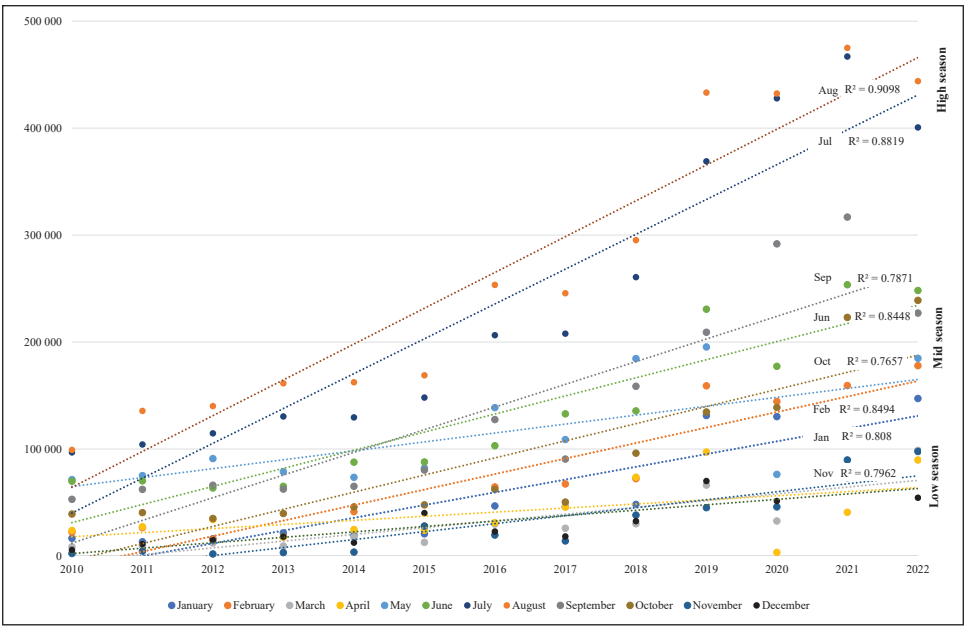

Figure 3. The trendline of monthly visitors at KNP in (2010-2022).
Source: own elaboration based on data from Karkonosze Mts. National Park.

In 2020, as a consequence of the COVID-19 pandemic outbreak, certain changes were observed in the temporal structure of visitors (Fig. 4). Already in March, the first drop in the number of visitors was reported, which reached its maximum in April (-96.7%). In May and June, the declines were smaller, whereas in July and September, an increase was evidenced. It was large enough to compensate for the slumps in the first half of the year. The highest growth in visitor flow was noted in September (+39.5%), since this month was approached by the public as an alternative to the crowded summer months and in order to avoid the accumulation of tourists, many people decided to visit the park specifically in this month. In the following two months, the situation did not change significantly, except for December, when a decline of approx. 20% was recorded. Pandemic restrictions and the increase in the number of infections changed the temporal structure of park visitors, causing an even greater peak in summer and fewer visits during the rest of the year, including the turn of the year.

The Visitor Index (VI) showed an increase of large disproportion in its value in the following years (Tab. 1). It is significant, that the high season months did not reach 1.0 in 2010. This shows a huge increase in visitors during these months in the period 2010-2022. In 2011-2015, there was a gradual increase of the VI for July and August only. The other months did not show a large increase in the VI. These changes had the effect of defin-

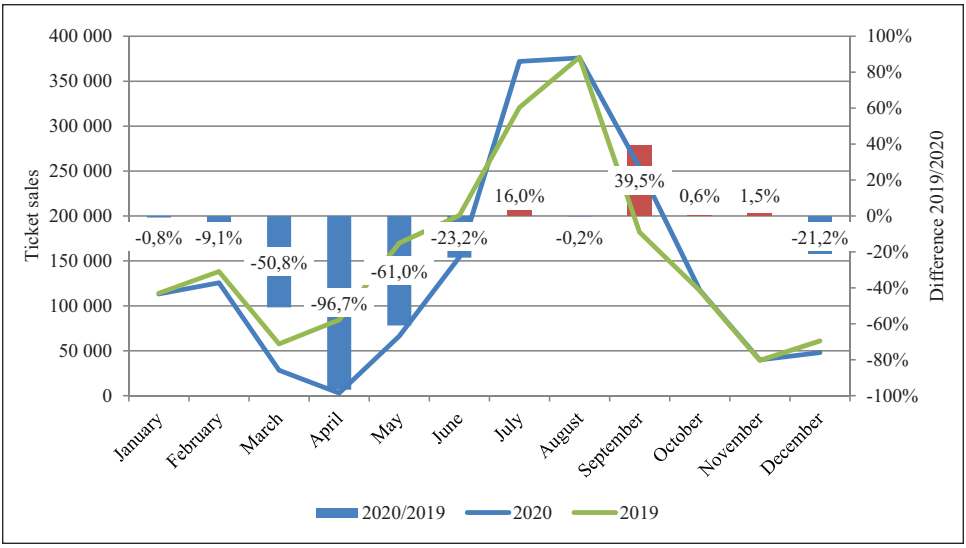

Figure 4. Monthly ticket sales for KNP during 2019-2020 and noted differences.
Source: own elaboration based on data from Karkonosze Mts. National Park.

ing the seasons: the VI>1.0 defined high season and the VI<0.4 defined low season in this period. Since 2016, the changes have intensified especially in mid-season and high season. For the first time the VI exceeded 1.0 for May and September lengthening the period with the VI>1.0. The VI for July and August exceeded 2,0 and in 2019 exceeded consecutively 3,0 and 4,0. This confirms intensive increase of visitors in high season resulting in the first problems of overtourism. Tourist traffic has intensified in spring and autumn which launched an off-season trend of avoiding summer crowds. Furthermore, tourist traffic has also intensified in January and February, with the VI exceeding 0.4. This launched a winter tourism trend. These changes defined the seasons: the VI>2.0 defined high season and the VI<0.7 defined low season at this period. In 2010, none of the months recorded the VI>1.0 while in 2019 as many as eight months noted the VI>1.0, an above-average over the entire period of 104 thousand visitors. In 2020, only for May did the VI<1.0, while the VI for the high season months increased further.

Currently the winter season trend is highly indicating for January and February when the VI exceeds 1.0. There is also a noticeable trend of autumn season in September and October. Since 2021 a large increase in the VI for November (from 0.4 to 0.9) was noted showing that the autumn season is getting longer. The VI for the spring months and high season has been high and stabilized.

During the 2010-2022 period the difference between the lowest and highest VI in a given year quadrupled, indicating high temporal variation in visi-

tor flow throughout the year. The highest values of the VI were always noted in August. However, the lowest values of the VI were recorded for various months. In the pre-Covid-19 period, the lowest VI was mostly recorded in November, with the exception of 2015 and 2018 when it was in March. Since 2020, the lowest VI was recorded for March or April and in 2022 for December. This confirms dynamic changes in the temporal structure of visitor flow.

Table 1. Visitor Index (VI) and seasonality for monthly visitors at KNP

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
January	0.16	0.13	0.15	0.21	0.19	0.20	0.45	0.44	0.46	1.26	1.25	1.12	1.41
February	0.21	0.25	0.15	0.17	0.40	0.27	0.62	0.65	0.69	1.53	1.39	1.53	1.71
March	0.08	0.09	0.12	0.09	0.17	0.12	0.29	0.25	0.29	0.64	0.31	0.70	0.95
April	0.23	0.26	0.33	0.17	0.24	0.23	0.30	0.44	0.71	0.93	0.03	0.39	0.86
May	0.69	0.72	0.87	0.76	0.71	0.79	1.33	1.04	1.77	1.88	0.73	1.29	1.78
June	0.67	0.67	0.61	0.62	0.84	0.84	0.99	1.28	1.30	2.22	1.70	2.44	2.38
July	0.93	1.00	1.10	1.25	1.24	1.42	1.98	2.00	2.50	3.54	4.11	4.49	3.85
August	0.95	1.30	1.35	1.55	1.56	1.62	2.43	2.36	2.84	4.16	4.15	4.56	4.26
September	0.51	0.60	0.63	0.60	0.62	0.77	1.22	0.87	1.52	2.01	2.80	3.04	2.18
October	0.38	0.39	0.34	0.38	0.44	0.46	0.60	0.48	0.92	1.29	1.33	2.14	2.30
November	0.02	0.04	0.02	0.03	0.03	0.13	0.19	0.13	0.37	0.43	0.44	0.86	0.94
December	0.05	0.11	0.14	0.17	0.12	0.19	0.22	0.17	0.31	0.67	0.49	0.70	0.52

Visitor Index 1.00 = 104 073

Source: own elaboration based on data from Karkonosze Mts. National Park.

In 2020, the disproportion between the VI increased due to changes in the temporal structure of visitor flow. The maximum VI was recorded for August and July (VI exceeded 4.0). The high increase of VI was also noted for September, whereas the lowest VI was reported for the months when lockdown occurred. It is also worth highlighting that in January and February, the VI was approx. 1.00, which is confirmed by a winter tourism trend.

The average VI (Tab. 1) shows the seasonality of monthly visitors. Fluctuations were observed in January each year, while the number of visitors would have been 40% of the average monthly visitors. Similarly, the number of visitors would have been (51%) in February, in March (24%), in April

(48%), in October (80%), in November (20%) and in December (27%). However, in May each year, the number of visitors would have been 33% higher than the average monthly number of visitors. The hypothesis about the high seasonality of the visitor flow in the KNP area is also confirmed by the values of the Gini concentration coefficient (Table 1). For the 2010-2020 period, this index ranged from 0.86 in 2018 to 0.92 in 2010. This proves a very strong concentration of visitor flow in particular months of the year. The cumulative percentages of visitors show that an above 50% of visitor flow was observed in the 3 summer months — July and August, and depending on the year, June or September, i.e. 25% of the year. In fact, it can be said that these 4 months take over 60% of the total annual visitor flow. This tendency confirms the identification of the high season. In 2015-2019, the value of the Gini coefficient fell below 0.90, which means a slight decrease in the concentration of visitor flow over time and an increase in this flow during the off-season periods. However, in 2020, due to travel restrictions imposed in connection with the COVID-19 pandemic, the visitor flow was yet again rapidly concentrated in the summer. For the analysed period, the number of tourists visiting KNP doubled, which meant that despite the low percentage share of low season periods in the overall visitor flow, the absolute numbers of tourists visiting KNP were high enough for the visitor flow to be experienced by the hospitality sector entrepreneurs and the park staff as noticeably lengthening.

Spatial structure

The highest number of visitors – except for 2019 – was recorded at the Szklarka Waterfall, i.e. on average 150.0 thousand visitors per year, next the Kamieńczyk Waterfall (126,100), for which the record of entries was reported in 2019 – 201,200 (Tab. 2). The third most popular was the Wang entry point, which is the most frequently visited in the Karpacz area, with the average of 95,400. The majority of visitors were evidenced in the vicinity of Szklarska Poręba and Karpacz, among which waterfalls are the most popular spots. The Szklarska Poręba region is significantly more popular, as there are 4 out of 9 entry points in this region, generating almost 2/3 of all entries.

In the case of Kamieńczyk, the number of visitors fluctuated during the initial period, and since 2016, there was a significant increase, which culminated in 2019. For Szklarka, high and relatively stable values were recorded each year, culminating in 2016. In recent years, slight downturns and upturns in the number of entries were recorded. A different situation occurred in the case of the Wang entry point, for which each year, an increase in the number of sold tickets was observed, also in 2020. It can, therefore, be concluded that for this entry point, the COVID-19 pandemic did not change the number of visitors. Regarding Szrenica entry point, up until 2016, an

increase in ticket sales was reported, followed by a gradual decline lasting till 2019, whereas in 2020, an increase was observed. In the case of Kopa entry point, the number of entries was lower in 2018, which could have been caused by the return to service of the chairlift to Kopa after renovation. In the case of the remaining entries, a gradual increase was recorded in the analysed period.

Table 2. Annual sales of admission tickets for KNP at individual entry points

Years	Number of sold admission tickets (thous.)									The share of sold tickets sold								Gini coefficient
	Kamieńczyk	Kamieńczyk Gate	Szrenica	Szklarka	Orlinek	Kopa	Wang	Chojnik	Total	Kamieńczyk	Kamieńczyk Gate	Szrenica	Szklarka	Orlinek	Kopa	Wang	Chojnik	
2010	108,600	29,200	50,900	137,900	19,300	34,900	74,900	44,200	499,900	21.7	5.8	10.2	27.6	3.9	7.0	15.0	8.8	**0.73**
2011	126,100	37,100	62,900	138,900	19,000	48,800	93,400	51,900	578,100	21.8	6.4	10.9	24.0	3.3	8.4	16.2	9.0	**0.72**
2012	103,800	37,200	75,300	147,500	18,900	60,100	95,300	65,200	603,300	17.2	6.2	12.5	24.4	3.1	10.0	15.8	10.8	**0.70**
2013	107,800	38,500	79,100	152,200	29,600	53,100	96,900	65,400	622,600	17.3	6.2	12.7	24.4	4.8	8.5	15.6	10.5	**0.69**
2014	111,700	46,000	78,400	171,100	32,700	59,400	109,300	72,600	681,200	16.4	6.8	11.5	25.1	4.8	8.7	16.0	10.7	**0.69**
2015	131,800	56,700	91,000	181,600	29,700	58,700	105,100	79,000	733,600	18.0	7.7	12.4	24.8	4.0	8.0	14.3	10.8	**0.69**
2016	168,000	67,700	109,800	194,400	32,700	66,200	120,600	93,500	852,900	19.7	7.9	12.9	22.8	3.8	7.8	14.1	11.0	**0.69**
2017	172,800	68,900	106,500	179,600	33,200	73,800	117,600	87,200	839,600	20.6	8.2	12.7	21.4	4.0	8.8	14.0	10.4	**0.69**
2018	155,500	60,500	90,900	161,200	28,600	63,400	101,400	78,400	739,900	21.0	8.2	12.3	21.8	3.9	8.6	13.7	10.6	**0.69**
2019	201,200	85,400	70,800	186,600	46,700	78,200	135,400	102,200	906,500	22.2	9.4	7.8	20.6	5.2	8.6	14.9	11.3	**0.68**
2020	140,000	83,700	99,000	155,300	49,300	76,200	135,600	85,800	824,900	17.0	10.1	12.0	18.8	6.0	9.2	16.4	10.4	**0.65**

Source: own elaboration based on data from Karkonosze Mts. National Park.

When characterising the share of visitors in the spatial structure (Tab. 2), its relative stability should be indicated, as the average difference is 4.4 percentage points. The largest drop in the share of visitors was noted for Szklarka, totalling 8.8 percentage points and for Kamieńczyk from 4.4. In the case of Kamieńczyk, the highest slump was listed in 2020 and caused by the pandemic restrictions – from 50 to 30 visitors – which also reflects the decline of the recorded entries in 2020. The smallest difference in the share of visitors was noted for Kamieńczyk Gate (+4.3 percentage points) and occurred in the case of other less popular entry points, where a slight increase in the share of entries was recorded: Orlinek Kopa (+2.2), (+2.1) and Wang (+1.6). This illustrates a greater dispersion of visitors across the park area.

Visitor flow in the KNP area should be considered highly concentrated, which is confirmed by the value of the Gini concentration coefficient (Tab. 2). In the period between 2010 and 2020, every year, the Gini coefficient exceeded the value of 0.6 in the range. However, this concentration decreased from the value of 0.73 in 2010, down to 0.65 in 2020. It should also be emphasized that in 2010, the 4 most popular entry points were responsible for 75% of the total visitor flow, whereas the remaining 4 entry points to the park accounted for only 25.0% of this flow. In 2020, these disproportions were slightly reduced. The 4 most popular entry points to the park accounted for only 64.2% of the entire visitor flow, and the remaining four entry points, for as little as 35.8% of this flow.

By comparing the number of monthly visitors from the entry points, a correlation matrix can be developed to check which places are similar in terms of its variability (Tab. 3).

Table 3. Correlation matrix of the number of visitors for entries at KNP

	Kamieńczyk	Kamieńczyk Gate	Szklarka	Orlinek	Kopa	Wang	Chojnik
Kamieńczyk	-						
Kamieńczyk Gate	0.00	-					
Szklarka	-0.04	0.92	-				
Orlinek	0.91	0.08	0.08	-			
Kopa	0.91	0.03	0.04	0.90	-		
Wang	0.95	-0.03	-0.01	0.93	0.97	-	
Chojnik	0.96	-0.06	-0.07	0.89	0.91	0.96	-

Source: own elaboration based on data from Karkonosze Mts. National Park.

The entry correlation variability between individual entry points was either high or non-existent. It results from the fact that the visitor flow to the KNP is characterised by similar fluctuations. The determining factor is the location of an entry point in the vicinity of cities serving as the main accommodation and departure base. The entries located around Karpacz and Szklarska Poręba characterised by a similar fluctuation, while in the vicinity of less popular cities, by no correlation. The highest correlation index was recorded between the following entry points:

- Wang / Kopa (0.97);
- Wang / Chojnik (0.96);
- Chojnik / Kamieńczyk (0.96);
- Wang / Kamieńczyk (0.95).

The above-mentioned places are characterised by a large number of entries throughout the year, good accessibility, a well-developed network of tourist trails allowing a multi-variant realisation of trips and the possibil-

ity of reaching the most popular attractions of the park. The variability in the number of entries depends on the days off work and working days. The entries featuring a slightly lower degree of correlation (0.93-0.89) are located at large distances from each other, not being directly connected with one another by a network of tourist trails but in the area of Karpacz and Szklarska Poręba:

- Wang / Orlinek (0.93);
- Szklarka / Kamieńczyk Gate (0.92);
- Kamieńczyk / Orlinek (0.91);
- Kamieńczyk / Kopa (0.91);
- Chojnik / Kopa (0.90);
- Kopa / Orlinek (0.90);
- Chojnik / Orlinek (0.89).

The characteristics of visitors

The most frequent purchase was a 1-day full-price ticket, making up 57.9% of the total sales and 1-day reduced-price tickets equalling 29.2%. Adding the 3-day reduced-price and full-price tickets, the result was 88.8% of the individual visitors, while 11.2% of tickets referred to guided tour groups, of which 9.5% constituted reduced-price (school groups) and 1.8% full-price tickets. Despite the general growth in admission ticket sales, including higher sales of individual tickets, the sales of group tickets remained at a relatively constant level (70,000-80,000), with the variability oscillating around a dozen or so percent. When comparing the sales of both types of tickets, it should be noted that the difference between them is higher each consecutive year. This was confirmed by the sales structure, as a gradual increase in the share of individual visitors, i.e. from 82.6% in 2010 to 89.8% in 2019, and to 96.6% in 2020, due to the sanitary restrictions in force.

The sales of full-price tickets went up by more than 3 times – from 249,600 in 2010 up to 648,500 in 2020 – compared to the reduced-price tickets. For the first ones, the increase was 141.8%, and for the latter – only 34.7%. This shows a much smaller increase in the number of individual visitors purchasing reduced-price tickets, i.e. children and senior citizens, as compared to the much larger increase in adults. It is also noticeable in the case of a gradual decline in the share of people buying reduced-price tickets from 41.3% in 2010 to 29.8% in 2019, and 27.4% in 2020 (Tab. 4).

The share of individual tickets ranged from 78.4% at the Żarska Pass to 92.4% at the Kamieńczyk Gate. The most popular entry points among tourist groups were the Szklarka Waterfall followed by the Kamieńczyk Waterfall and the Wang entry point. Despite the fact that these entry points were most popular for groups, and compared to other points, the share of

Table 4. Types of admission tickets sold for KNP

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1-day	246,0	296,6	328,6	344,0	400,6	433,5	513,7	518,1	447,0	590,7	631,8
1-day reduced-price	172,4	187,3	181,1	195,9	197,1	208,5	243,2	231,8	219.9	250.3	237.7
1-day with a guide	13,4	14,2	15,1	11,9	10,5	12,6	11,6	12,6	11,5	15,3	3,5
1-day with a guide reduced	67,8	71,4	68,5	61,5	63,0	69,2	74,5	74,0	64,8	64,7	10,3
3-day	3,6	4,6	4,8	5,6	5,9	5,9	5,9	7,0	7,5	11,8	16,7
3-day reduced-price	3,4	3,8	5,2	3,9	4,0	4,0	4,2	4,3	4,3	5,7	6,5
Individual	425,4	492,3	519,6	549,3	607,7	651,9	766,9	761,2	678,8	858,5	892,7
Including individual reduced-price	175,9	191,1	186,3	199,8	201,2	212,5	247,3	236,1	224,2	256,0	244,2
Group	81,1	85,7	83,6	73,3	73,5	81,7	86,1	86,6	76,3	80,0	13,8

Source: own elaboration based on data from Karkonosze Mts. National Park.

groups was small, amounting to 14.2%, 12.0% and 12.9%, respectively. Certain changes can also be identified in the case of individual entries. For the Chojnik entry point, a decrease by more than half in the share of group entries was recorded, including the reduced-price tickets with a guide, in the years 2017-2019, from 19.3% to 8.5%. For the Kamieńczyk Waterfall entry point, in the 2018-2019period, there was a decline in the share of groups from 11.5% to 8.1%, of which an even greater drop for the reduced-price groups from 10.2% down to 6.5%. Contrary to the Szklarka Waterfall, an increase in the share of groups for the aforementioned period from 10.5% to 12.4% was observed, including both reduced-price ones from 9.4% to 10.1% and for other groups from 1.1% to 2.3%. Such changes were also reported earlier, although the differences were not that significant. This resulted in the Szklarka Waterfall being the most popular destination for tourist groups in 2019. In the case of the Kopa entry point, a huge slump in the share of group entries was evidenced from 5.6% in 2018 to 0.8% in the following year. It could have been caused by restarting the cableway to Kopa after modernisation (Tab. 5).

In 2020, for each entry point, a decrease in the sales of group tickets was recorded, reaching 70-90% compared to 2019. The largest declines were evidenced for the most popular entry points: Kamieńczyk, Szklarka, Wang and Chojnik. In the case of waterfalls, the biggest downward trend in individual tourists' entries was recorded: for Kamieńczyk, by 46,000, which made up 30.4% and Szklarka, by over 13,000, i.e. 16.7%. Moreover, there was a slump in the entries for Chojnik by 8,500, which constituted 16.1%. This resulted

Table 5. Types of admission tickets sold at entry points to KNP

	Kamieńczyk Waterfall	Kamieńczyk Gate	Szrenica	Szklarka	Orlinek	Kopa	Wang	Chojnik	Żarska Pass
1-day	802,9	311,9	534,5	870,6	171,5	390,2	616,5	385,1	8,6
1-day reduced-price	417,3	153,4	223,1	525,6	84,7	160,7	272,7	234,6	6,2
1-day with a guide	28,1	5,1	15,6	33,0	4,9	4,9	22,1	13,3	0,4
1-day with a guide reduced	138,8	34,9	34,1	202,1	24,2	29,5	112,8	97,4	3,7
3-day	0,0	121,1	5,0	11,3	3,1	6,9	15,4	4,4	0,2
3-day reduced-price	0,0	9,5	2,9	8,0	1,7	4,0	10,2	4,6	0,9
Individual	1 220,3	487,1	765,7	1 415,6	261,2	562,0	914,9	628,9	15,2
Group	167,0	40,0	49,7	235,1	29,1	34,4	134,9	110,7	4,2
Group (%)	12.0%	7.6%	6.1%	14.2%	10.0%	5.8%	12.9%	15.0%	21.6%

Source: own elaboration based on data from Karkonosze Mts. National Park.

in a decline in the total number of tourists for the most popular destinations. Slight drops of 2-3 percentage points were also recorded for such entry points as Kamieńczyk Gate and Kopa, although it was due to eliminating the decrease in group entries through an increase in individual entries. The highest growth in individual entries was recorded for the Szrenica entry point by 30,000, which caused the largest increase in the total entries by 39.9 percentage points. In the case of Wang, an increase in individual entries by 13,000 was observed, which fully compensated for the smaller number of group entries.

Discussion

The increase of visitors at KNP was confirmed by P. Miazek [2019] at other Polish national parks, and by M. Erlebach, J. Malakova [2021] at Krkonoše National Park (KRNAP). However, it should not be forgotten that in recent years, at KNP, the system of charging admission fees has been tightened, which probably also contributed to the increase in the recorded visitor flow. Despite that, it should definitely be emphasized that the higher number of

visitors in the analysed period is undoubtedly noticeable. In 2021, the majority of national parks in Poland were avoided by a part of society for fear of high probability of overcrowding and COVID-19 infection. These people decided to visit less popular parks [Rogowski 2022]. Nonetheless, generally, the PNAs were assessed as safe in terms of sanitation. According to B.D. Taff [2020], the role of parks as oases of human health and well-being increased during the COVID-19 pandemic.

The variability of visitor flow at KNP was similar as at the most popular national parks in Poland: Tatra NP (Ćwiek, Pater 2020), Bieszczady NP [Prędki, Demko 2018], Pieniny NP [Bołoz, Jucha 2016] and KRNAP [Erlebach, Romportl 2021]. Cyclically re-occurring seasons (i.e., high-, mid- and low-seasons) characterise the seasonality of visitor flow, not only at KNP. The number of visitors during these seasons are characterised by different intensities. The intensity of visitor flow in each of the 3 types of seasons increases proportionally. The autumn trend of extended high visitor number especially in September and October and the trend of winter tourism in January and February have been confirmed in other national parks. There has also been a noticeable increase in visitors in November since 2021. Highly coherent results for visitor seasons obtained during the pre-COVID-19 period indicates that the variability and seasonality of visitor flow is associated with factors such as timing of summer vacations at a national level, presence of the weekends and national holidays [Rogowski 2021b].

The seasonality of tourist traffic at KNP was high, and in the subsequent years, prior to the COVID-19 pandemic, it was slightly weakened. This was caused by a much larger increase in visitors for the off summer periods as opposed to a much smaller increase in summer visitors, eliminating the differences between these periods. However, in 2020, visitor flow was rapidly concentrated in the summer, reversing the trend of visitor deglomeration. The useful temporal dispersion of visitors observed in recent years began to recede in 2020 [Rogowski 2022].

An increasing upward trend in visitors was reported for KNP in the winter months due to the growing popularity of winter activities in protected mountain areas. This corresponds to a similar situation in the areas with outstanding winter advantages [i.e. Tatra NP - Bielański et al. 2018, Taczanowska et al. 2019]. The second trend was an increase in autumn visitors which was noted in recent years. This was confirmed by Erlebach and Romportl [2021] at KRNAP. If both trends continue, the number of visitors in the winter period increases above average, creating yet another mid-term peak and, in addition, the autumn period is lengthened during which the number of visitors remains at an average level.

The impact of the COVID-19 pandemic on visitor flow is also similar to other national parks in Poland. The number of visitors at less popular locations increased, driven by the need to avoid large groups of people in

the midst of the COVID-19 pandemic. According to a previous study, comparing monthly data of visitor flow between most frequent visited national parks in Poland confirms general trends [Rogowski 2022]. The results confirm the trends accompanying the COCID-19 pandemic period in tourism described for KNP are in separate papers [Rogowski, Rusztecka 2021, Rogowski 2022]. The pandemic has undoubtedly reduced the pressure on PNA, given the decline in visitor numbers caused by travel restrictions and park closures, especially at popular, nature-based destinations [Corlett et al. 2020]. As in the case with Snowdonia National Park [Jones 2021], in the Karkonosze Mts., the crisis in tourism was seen in a broadly positive way by a significant number of respondents, while benefit sharing issues from tourism also emerged.

Taking the sales of admission tickets into account, it can be indicated that KNP is mostly visited by individual visitors. These results were confirmed by H. Prószyńska-Bordas (2017), indicating around 90% of individual visitors at national parks. These tendencies correspond to the contemporary trends connected with an increasing mobility of society and freedom in choosing the arrival time, which results in multiple individual arrivals.

Conclusions

Monitoring visitor flow at a national park is a tool that provides data on its volume, variability and seasonality. This makes it possible to diagnose the occurrence of overtourism which can be managed and counteracted. What is needed in this respect is a tourism policy at a regional level, which should be consistent and helpful in tourism management by national park staff. This requires the coordination of tourism policy and national park management aimed at methods of managing overtourism.

The above results allow to describe the changes in visitor flow at KPN in 2010-2022 so that it is possible to forecast further changes, in response to which it is necessary to prepare properly. There is no doubt that the greatest challenge is the increasingly dynamic growth of visitor flow, as confirmed by the data presented in Fig. 2 and 3.

1. The number of annual visitors increased 2.5 times in the period 2010-2022. The differences in the VI increase associated with monthly visitor numbers caused changes in the temporal distribution of visitors. Tourist traffic has intensified in spring and autumn which launched an off-season trend of avoiding summer crowds. Furthermore, tourist traffic has also intensified in January and February, with the VI exceeding 0.4. This launched a winter tourism trend. Along with the increase in the number of annual visitors in the following years, further increase of crowds in high season is expected making overtourism increasingly

problematic, lengthened and resulting in further growth of visitors in mid-seasons, especially corresponding to the autumn season trend, separated form the winter season trend.

2. The temporal concentration and seasonality of visitors at KNP is very high. July and August together generate 1/3 of visitors and the period from May until the end of September – 2/3 of visitors. However, the share of the quietest period (from November to the end of March) doubled, totalling 1/5. This situation shows that with the increase in monthly visitors (according to Fig. 3), visitor flow increases most dynamically in the off season. In following years, we will expect a disappearance of the off season and a seamless transition between the end of the extended high season in autumn, the winter ski season and the beginning of tourist season in spring.
3. The spatial concentration of visitors at KNP was high and gradually dispersed. This is due to the greater increase of visitors in less popular places. The dispersion was confirmed in the declining share of the 3 most popular entries from 74.2% in 2010 to 61.1% in 2019. In 2020, the deglomeration was strengthened, therefore, it cannot be concluded whether this trend is permanent or caused by the COVID-19 pandemic.

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