www.gi.sanu.ac.rs, www.doiserbia.nb.rs
J. Geogr. Inst. Cvijic. 2025, 75(2), 269–283

Original scientific paper

UDC: 338.48:502/504(497.5)
https://doi.org/10.2298/IJGI250211008T

Received: February 11, 2025
Reviewed: March 1, 2025
Accepted: April 1, 2025

PROTECTED NATURAL AREAS AT THE INTERSECTION OF TOURISM GROWTH AND THREATS: RESILIENCE CHALLENGES IN CROATIA

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Abstract: As a key element in the global development of sustainable tourism, protected natural areas play a particularly important role in local and regional development and are important for strengthening resilience to crises. In Croatia, where sustainable tourism is a one of the development goals, there is a significant risk that growing tourism activities in protected areas may result in the degradation and destruction of these sites. This paper presents the results of the first survey conducted in Croatia examining the correlation between visitor numbers in national parks and nature parks and the identified threats between 2018 and 2023. The findings highlight the relationship between the level of protection, the geographic location of the parks (coastal vs. inland), and three distinct periods: before, during, and after the COVID-19 pandemic crisis (from 2018 to 2023). The findings of the research were also placed in the context of sustainable local and regional development for future planning of resilience to the well-being of the local population. The results indicate interesting changes in park visitation over the observed periods, as well as shifts in pressures on the core phenomenon. The recommendations highlight the necessity of monitoring and managing risks through a model of strengthening the resilience of protected areas. They can also support policymakers, park managers, local communities, and the tourism sector in ensuring the long-term sustainability of both Croatia's protected areas and its tourism.

Keywords: protected natural areas; sustainable tourism; visitor-threat correlation; crisis resilience; Croatia

1. Introduction

Protected areas offer unique opportunities for the development of sustainable tourism which can contribute to the preservation of nature and the improvement of the quality of life of local communities (Eagles, 2014). In Croatia, national and nature parks are becoming increasingly important tourist destinations contributing not only to economic growth, but also to environmental education and raising awareness of nature conservation. However, the intensification of tourism activities in these areas poses significant risks to ecosystem stability and the preservation of natural resources (Schägner et al., 2013) and often leads to pollution, wildlife disturbances, and illegal activities which threaten the integrity of ecosystems. Newsome et al. (2012) indicate that higher tourist numbers are directly linked to the increased environmental degradation making it more challenging to balance tourism growth

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with nature conservation efforts. In times of crisis, the number of tourists tends to decrease. However, this was not the case during the COVID-19 pandemic in Croatia. The pandemic altered tourist dynamics with certain protected areas experiencing reduced visitation while others saw unexpected surges. This trend presents a unique opportunity to study the long-term impacts of the crisis on Croatia's protected areas.

The main goal of this paper is to presents the findings of the first comprehensive survey conducted in Croatia to examine the relationship between visitor numbers and identified threats in national parks and nature parks from 2018 to 2023 including the period of the COVID-19 pandemic. The research explores the trends and relation between the level of protection, the geographic location (coastal vs. inland) of the protected areas, and three distinct time periods: before, during, and after the COVID-19 pandemic. By examining these trends, this paper seeks to identify the challenges posed by intensified tourism pressure and develop concrete recommendations for improving the management and preservation of these areas. The findings contribute to a better understanding of the risks associated with tourism in protected areas and provide insights into effective strategies for balancing the needs of tourism with the goal of preserving natural heritage for future generations.

2. Literature review

The increase in visitor numbers to protected areas, while being positive for the local economy, can have detrimental effects on the environment. As Hall and Page (2009) warn, overtourism can lead to habitat degradation and ecosystem disruption. Therefore, it is essential to develop sustainable tourism models that involve local communities and ensure equitable revenue distribution, as suggested by Andries et al. (2021).

The increase in visitor numbers to protected areas can heighten the risks posed by various threats to fundamental natural phenomena such as soil erosion, habitat destruction, water pollution, and air pollution (Belsoy et al., 2012). In Croatia, which aspires to develop sustainable tourism, there is a significant risk that the intensification of tourism activities could lead to the degradation and devastation of protected areas (Funduk & Tišma, 2009). The problem is particularly evident when systematic planning for protected area management is lacking and the monitoring system is weakened. Therefore, park management plans should include risk and challenge management as priority goals to strengthen their resilience to future crises (Bertini & Vitolo, 2023).

Climate change challenges are especially significant for management of protected areas. Its impacts are complex and depend on numerous factors including geographical location, ecosystem and management practices. Emerging climate scenarios challenge the existing nature conservation models as demonstrated by Olmos-Martínez et al. (2022). Despite these challenges, protected areas remain crucial for biodiversity conservation and mitigating the impacts of climate change. However, as highlighted by Cillis et al. (2023), the growing frequency and intensity of wildfires, particularly in the Mediterranean region, represent a serious threat to the preservation of these areas.

While many countries have recognized the importance of protected areas over the past decade and adopted policies for their development, on-the-ground realities often fall short of ambitious goals. As case studies from Italy and Spain (Bertini et al., 2022; Sánchez-Rivero et al., 2022) illustrate, despite political willingness to invest in inland areas and protected spaces, their development often faces obstacles, particularly in rural and remote regions. The sustainable

use of natural resources and tourism development hold significant potential for these areas, but careful planning and management are required to avoid negative environmental impacts.

The concept of resilience, as defined by Šimundić et al. (2021), offers a comprehensive framework for understanding the complex relationships between nature conservation, the provision of ecosystem services, and local community development. Environmental resilience refers to an ecosystem's ability to adapt to changes and withstand external pressures, such as an increased number of visitors, without experiencing long-term degradation. In the context of protected areas, resilience includes the capacity of national parks to maintain their ecological functionality despite the impacts of tourism and other external factors. Holling (1973) emphasizes that resilience theory is particularly relevant as it explains how natural systems can endure stressful events, such as intensified tourism activities, provided that appropriate management and control measures are in place. He also relies on the pressure and response theory, which posits that an increase in external pressure (e.g., visitor numbers) leads to a proportional response in the form of ecosystem degradation or other negative consequences. According to this approach, national parks that have developed tourism management mechanisms are better equipped to withstand pressures and maintain their resilience.

In protected areas, particularly those with high visitor numbers, resilience becomes essential for maintaining a balance between tourism development and nature protection. As highlighted by Piñeiro-Chousa et al. (2021), sustainable tourism can drive local development, but only if carefully planned and managed to minimize negative environmental impacts. Therefore, understanding and strengthening the resilience of protected areas is crucial for their long-term conservation and sustainable development.

Research on the impact of tourism on protected areas provides diverse perspectives. While Eagles (2014) emphasize the potential of tourism to generate revenue for nature conservation, Schägner et al. (2013) warn about the possible negative consequences of overtourism. These differing viewpoints highlight the complexity of the relationship between tourism and environmental protection, underscoring the need for careful planning and management of tourism activities in protected areas.

In Croatia, the existing research highlights specific challenges associated with tourism in protected areas. Mileusnić Škrtić et al. (2024) indicate that the lack of adequate management strategies exacerbates the problem, as local administrations and protected area managers are not always equipped to address the challenges posed by tourism growth.

Previous research suggests that it is essential to establish a balance between tourism development and nature conservation, particularly in national parks, with a focus on the need to implement measures that prevent the overburdening of sensitive ecosystems. However, there is a lack of precise analysis of the specific correlations between visitor numbers and threats to natural ecosystems in Croatian national parks, which this research aims to address.

3. Materials and methods

For this research, a combination of methods—literature review, statistical analysis and semi-structured interviews—was used to gather detailed information for scientifically relevant analysis. Both quantitative and qualitative research methods were used. A survey was conducted to examine the correlation between visitor numbers in national and nature parks and the identified threats between 2018 and 2023. Interviews with relevant stakeholders were carried out to obtain deeper insights into the situation in the field. Quantitative

methods were applied to analyze statistical data collected from publicly available sources, while qualitative methods (interviews) were used to gather the opinions and views of relevant stakeholders, supporting a deeper understanding and development of the research, as well as forming conclusions and recommendations. The literature review provided insights into the existing studies, theories, and research on sustainable tourism, protected natural areas, and their management in correlation with risks and threats. Along with the findings related to visitor trends in Croatian national parks, information was collected regarding environmental threats, including illegal construction, illegal fishing, poaching, capturing of strictly protected plants and animals, deforestation, arson, waste disposal outside designated areas, driving or parking outside designated areas, anchoring or boat docking in internal waters or on maritime property, camping and swimming in restricted zones, entering without a ticket, damaging infrastructure, and installing signs or advertisements without permission.

The data collected were processed using quantitative methods of statistical analysis. Visitor and threat data from 2018 to 2023 were gathered from official annual reports on a sample of 20 protected areas, including national parks and nature parks in Croatia, available online on the websites of Croatian national and nature parks. The dataset included geographic classifications of parks (coastal vs. inland parks and natural vs. national parks). The analysis focused on the following:

- Attendance trends: Year-over-year changes in visitor numbers were calculated to identify growth patterns and fluctuations, with particular attention to the pre-COVID-19 (2018–2019), COVID-19 (2020–2021) and post-COVID-19 (2022–2023) periods;
- Threat patterns: Frequency and types of illegal activities were analyzed by park type and location to assess their correlation with visitation trends; and
- Comparative analysis: Differences between coastal and inland parks, as well as between national and nature parks, were statistically examined.

Two-sample *t*-tests were applied to determine the significance of changes in visitation and threats between the three analyzed periods. This quantitative analysis enabled a detailed understanding of the impact of tourism trends and external events on protected areas in relation to changes in visitor numbers during the pandemic.

To complement and validate the quantitative findings, semi-structured interviews were conducted between January 1 and April 30, 2024, with 8 key stakeholders, including 4 park managers, 2 local government officials, and 2 representatives of tourism boards. During the preparation of interviews via email, phone, or face-to-face, all the participants were informed about the goals and purpose of the research, both orally and in writing. The privacy of the participants was respected and their data were used exclusively for research purposes, thereby ensuring that all ethical principles were respected. These interviews provided qualitative insights into the perceived challenges and opportunities associated with increasing visitation to protected areas, the effectiveness of the existing management practices and strategies for mitigating environmental threats, and recommendations for improving resilience and ensuring sustainable development in local and regional contexts.

The combination of literature review, quantitative analysis, and qualitative insights enabled the identification of key factors influencing visitor trends and environmental threats in Croatian protected areas. By synthesizing findings from these complementary methods, the research offers scientifically grounded conclusions and actionable recommendations for

policymakers and park management. The research focuses on eight Croatian national parks and ten nature parks distributed across coastal/sea and inland areas. These parks, which are officially designated as protected natural areas, vary in geography, ecosystems, and visitor profiles. The categorization of parks is as follows:

- National parks:
  - Coastal/Sea parks: Brijuni, Kornati, Mljet and
  - Inland parks: Krka, Paklenica, Plitvice Lakes, Risnjak, Northern Velebit.
- Nature parks:
  - Coastal/Sea parks: Biokovo, Lastovo Islands, Telašćica and
  - Inland parks: Dinara, Kopački Rit, Lonjsko Polje, Medvednica, Papuk, Učka, Velebit, Vransko Lake.

Visitor and threat data were categorized to compare trends across different types of protected areas.

- National vs. nature parks:
  - Research significance: National parks and nature parks often have different levels of protection, management strategies, and regulations which can influence both visitor behavior and the prevalence of environmental threats. National parks are usually subject to stricter regulations and might have more controlled visitation, whereas nature parks may have different levels of human activity and less stringent enforcement;
  - Purpose: By categorizing the data into national and nature parks, the research can identify whether there are significant differences in how these two categories of protected areas are affected by visitation rates, types of threats, and the ability to manage or mitigate those threats; and
  - Research outcome: This categorization allows for an understanding of how different management frameworks and protection levels influence the trends in both visitation and threats in these areas.
- Coastal/sea vs. inland parks:
  - Research significance: Coastal parks, especially those near the sea, are typically more vulnerable to tourism and environmental threats due to their popularity, international appeal, and exposure to marine-related issues. Oppositely, inland parks may experience different threats due to local agricultural practices. The geographical distinction also addresses how physical accessibility influences both visitation patterns and threat levels;
  - Purpose: This grouping helps to assess whether the location of a park (coastal vs. inland) impacts its visitation trends and exposure to certain types of threats. Coastal parks may face greater tourism pressure, especially during the peak season, leading to increased environmental degradation. In contrast, inland parks may be subject to threats related to land-based activities, which may be less influenced by global tourism, but more by local economic practices; and
  - Research outcome: This geographic classification enables the study to determine if coastal parks face higher levels of certain threats due to tourism pressures or if inland parks experience more localized, but potentially severe threats. Additionally, it offers insight into whether visitor behavior is more pronounced in coastal areas due to the ease of access and international tourism.

3.1. An overview of the Croatian national and nature parks

There are 8 national parks in Croatia. The largest and oldest national park is Plitvice Lakes, covering an area of 300 km², while the smallest national park is Brijuni, with an area of 33.9 km². Croatia has 12 nature parks, with Velebit being the largest at 2,200 km² and Vransko Lake the smallest at 57 km² (Parks of Croatia, n.d.). Table 1 lists all the national and nature parks by size, indicating the year of designation as a national/nature park, their area, and the characteristics for which they are protected.

Table 1. Main characteristics of Croatian national and nature parks

Name of the park	Year of establishment	Surface (km^2)	Reason for declaration
National parks			
Plitvice Lakes	1949	300	Unique cascading lakes, rich biodiversity, and stunning karst landscape.
Kornati	1980	220	89 islands, rich marine biodiversity, unique natural and cultural landmarks.
Krka	1985	109	The cascading waterfalls, diverse ecosystems, and cultural heritage.
Northern Velebit	1999	109	The diversity of karst formations, diverse flora and fauna, and pristine wilderness.
Paklenica	1949	95	Beech forest, canyons, rich biodiversity, and unique karst landscape.
Risnjak	1953	63.5	Dense forest, diverse wildlife, and the critical habitat of the lynx.
Mljet	1960	53.7	Exceptional landscapes, pristine forests, unique saltwater lakes, and rich marine and terrestrial biodiversity.
Brijuni	1983	33.9	14 islands and islets, rich biodiversity, and significant cultural and historical heritage.
Nature parks			
Velebit	1981	2,200	Karst landscape, rich biodiversity, and cultural heritage.
Dinara	2021	630.52	Diverse ecosystems, unique karst formations.
Lonjsko Polje	1990	506.5	Extensive wetlands, rich biodiversity, and vital habitat for migratory birds.
Žumberak–Samobor Mountains	1999	342	Diverse flora and fauna, rugged landscapes, and cultural heritage.
Papuk	1999	336	Diverse ecosystems, rich geological features, and unique biodiversity, including ancient forests.
Lastovo Archipelago	2006	196	46 islands, islets and rocks, rich marine biodiversity, and unique ecosystems.
Biokovo	1981	195.5	Mountain landscapes, diverse flora and fauna, and unique geological features.
Medvednica	1981	179.4	Rich biodiversity, stunning landscapes, and cultural heritage.
Kopački Rit	1967	177	Wetlands, rich biodiversity, and crucial habitat for numerous bird species.

Table 1. Main characteristics of Croatian national and nature parks (*continued*)

Name of the park	Year of establishment	Surface (km^2)	Reason for declaration
		Nature parks	
Učka	1999	160	Diverse ecosystems, unique flora and fauna, and stunning landscapes, including the Učka mountain range.
Telašćica	1988	70.5	Unique bay, diverse marine life, rich biodiversity, and dramatic cliffs.
Vransko Lake	1999	57	The largest natural lake with an important wetland ecosystem and rich birdlife.

Note. Adopted from *Parks of Croatia*, n.d. (https://www.parkovihrvatske.hr/en/parks). In the public domain.

3.2. Statistical analysis

Annual changes in visitor numbers were analyzed to identify trends and fluctuations over the study period. Year-over-year percentage changes were calculated to measure growth or decline in attendance. To evaluate the impact of the COVID-19 pandemic, mean visitor numbers were calculated for the three analyzed periods using two-sample *t*-tests. The *t*-test was applied to determine whether the observed differences in mean visitor numbers between these two periods were statistically significant.

The null hypothesis (H_0) assumed no difference in visitor numbers between the pre-COVID-19 and during-COVID-19 periods, while the alternative hypothesis (H_1) suggested a significant difference. The formula used for the *t*-test is:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad (1)$$

where:

- $\bar{x}_1$, $\bar{x}_2$ are the sample means for the two groups: the pre-COVID-19 and during-COVID-19 periods, respectively;
- s_1^2, s_2^2 are the sample variances of the two samples; and
- n_1, n_2 are the sample sizes for each group.

A *p*-value less than .05 indicates that the difference in visitor numbers is statistically significant, while a *p*-value greater than .05 suggests no significant difference between the two periods. Attendance trends were also analyzed geographically to compare coastal and inland parks, assessing whether location influenced the observed changes. Recovery trends were examined for the post-COVID-19 period (2022–2023) to determine whether visitor numbers had returned to pre-COVID-19 levels.

The analysis of threats focused on the changes in the frequency of the reported illegal activities across the three analyzed periods. Temporal comparisons were conducted to identify trends in threats over time. To quantify changes, the percentage differences in threat frequencies across the periods were calculated using the formula:

$$Percentage\ Change = \frac{Average\ Threats\ in\ During/Post\text{-}COVID\ 19\ Period\ -\ Average\ Threats\ in\ Pre\text{-}COVID\ 19\ Period}{Average\ Threats\ in\ Pre\text{-}COVID\ 19\ Period} \cdot 100 \quad (2)$$

Two-sample *t*-tests were used to compare the mean frequency of threats across the pre-COVID-19, during-COVID-19, and post-COVID-19 periods. The statistical analysis included two primary comparisons:

- Pre-COVID-19 vs. During-COVID-19: H_0 assumed no significant difference in the mean frequency of threats between the pre-COVID-19 and during-COVID-19 periods, while the H_1 suggested a significant increase or decrease during COVID-19; and
- Pre-COVID-19 vs. Post-COVID-19: H_0 assumed no significant difference in the mean frequency of threats between the pre-COVID-19 and post-COVID-19 periods, while the H_1 suggested a significant change after the pandemic.

The *t*-tests assessed whether the changes in threat frequencies across these periods were statistically significant. A *p*-value of less than .05 indicated sufficient evidence to reject the H_0, suggesting a meaningful difference in threat levels between the compared periods.

Threat trends were also analyzed geographically to evaluate regional variations between coastal and inland parks. To compare visitor recovery, total visitor numbers for coastal and inland parks were analyzed and the percentage difference was calculated using the formula:

$$Percentage\ Difference = \frac{Inland\ Visitors - Coastal\ Visitors}{Coastal\ Visitors} \cdot 100 \quad (3)$$

This metric provides insight into how inland parks outperformed coastal parks in terms of visitation during and after the COVID-19 pandemic.

4. Results and discussion

The COVID-19 pandemic had a dramatic impact on the global tourism industry causing a significant decline in travel all around the world. According to the UN Tourism (n.d.), international tourist arrivals declined by 74% in 2020. Europe experienced a similar trend, with arrivals in 2020 dropping by 67.8% compared to 2019. Although the number of travelers gradually increased in 2021, tourism remained significantly below pre-pandemic levels. It was only in 2022 that a notable recovery occurred, with tourist arrivals increasing by 98% compared to the previous year, although there was still a 20.1% decrease compared to 2019.

In Croatia, tourism suffered significant losses, with the number of overnight stays by foreign tourists in 2020 dropping by 58% (Krešić & Mikulić, 2020). However, the pandemic accelerated the development of rural areas, reflected in increased demand and a higher number of visitors to less touristically developed areas (Cimerfraj.hr, 2021). The research results indicate that this trend is also visible in protected areas. During the pandemic, a significant decline in the number of visitors was recorded, especially along the coast, where tourism depended on international visitors. On the other hand, inland parks, which were more accessible to domestic visitors, showed greater resilience with smaller declines in visitor numbers. Previous research confirms the need for long-term planning in the management of protected areas to strengthen their resilience to future challenges, both pandemic-related (Marković Vukadin et al., 2020) and those arising from illegal activities affecting the ecological sustainability of protected areas (Mileusnić Škrtić et al., 2024) and environmental challenges (Andries et al., 2021; Belsoy et al., 2012).

Between 2018 and 2023, there was a fluctuation in the number of visitors to Croatia's national and nature parks. Visitor trends in coastal and inland national parks from 2018 to 2023 reveal contrasting responses to the COVID-19 pandemic and subsequent recovery phases. In the analyzed period, from 2018 till 2023, coastal national parks recorded a total of 2,857,561 visitors while inland national parks received 7,263,864 visitors. Inland national parks attracted 154% more visitors than coastal parks driven by the increase during and after the COVID-19 period. Coastal parks, heavily reliant on international tourism, saw significant declines during the pandemic, while inland parks, more popular among domestic visitors, recorded substantial growth. Nature parks displayed similar trends.

In the pre-COVID-19 period (2018–2019), in national parks, those coastal ones recorded 1,097,862 total visitors with relatively stable attendance (554,624 in 2018 and 543,238 in 2019). Inland national parks had significantly fewer visitors, totaling 69,080 over the same period, with lower baseline attendance and smaller fluctuations (47,444 in 2018 and 21,636 in 2019). Coastal national parks, such as Kornati and Mljet, recorded higher visitor numbers than inland parks, highlighting their dependence on international tourists. Coastal nature parks also followed this trend, with Biokovo and Telašćica seeing substantial visitation.

In the COVID-19 period (2020–2021), in national parks, visitor numbers in coastal national parks dropped drastically, falling to 154,665 in 2020, which was a 71.5% decrease compared to 2019. Partial recovery was observed in 2021, with attendance rising to 420,179, though still below the pre-COVID-19 levels. Inland national parks, in contrast, saw significant growth with visitor numbers increasing to 507,097 in 2020 and surging further to 1,680,347 in 2021. Kornati, for instance, saw a 56% drop during this period. Inland nature parks, particularly those with better accessibility to local visitors, like Medvednica and Kopački Rit, showed smaller declines as domestic tourism became more prominent. This trend reflects a shift toward domestic tourism as inland national parks became more attractive to local travelers during the pandemic.

In the post-COVID-19 period (2022–2023), visitor numbers began recovering, though not all the parks returned to pre-COVID-19 levels. Visitor numbers in coastal national parks recovered to 583,625 in 2022 and 601,230 in 2023, nearing pre-COVID-19 levels, but not fully stabilizing. Inland national parks sustained strong growth with attendance reaching 2,390,740 in 2022 and 2,616,600 in 2023, significantly surpassing pre-COVID-19 levels and indicating a permanent shift in domestic tourism trends. While coastal parks, like Kornati and Telašćica, continued to report attendance below pre-COVID-19 figures, inland parks, including Plitvice Lakes and Medvednica, experienced strong recovery, surpassing previous visitor numbers.

COVID-19 impact on visitor trends in nature parks shows that coastal nature parks were heavily affected by the pandemic, experiencing significant declines in attendance due to the restrictions on international travel. Inland nature parks benefited from a surge in domestic tourism becoming key destinations for local visitors (Figure 1). Coastal nature parks have shown a steady recovery, but have yet to surpass the pre-COVID-19 attendance levels. Inland nature parks, on the other hand, have established a higher baseline of visitor numbers in the post-COVID-19 period, reflecting a long-term shift in domestic tourism preferences. Coastal nature parks' reliance on international tourists made them more vulnerable to the pandemic's impacts. Inland nature parks, with greater accessibility to local visitors, demonstrated resilience, capturing a larger share of domestic tourism during and after the pandemic.

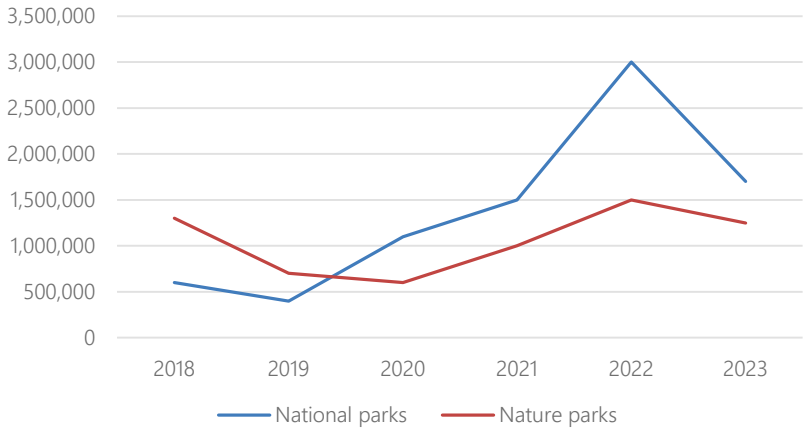

Figure 1. Visitor trends in Croatian national and nature parks (2018–2023).

The analysis revealed significant differences in visitor attendance across the pre-COVID-19 and COVID-19 periods:

- The pre-COVID-19 mean attendance was 548,931 calculated from 2018–2019 visitor data;
- The during-COVID-19 mean attendance increased to 1,093,722 based on the data from 2020–2021; and
- *t*-test results confirmed a statistically significant change in attendance during the COVID-19 period (p-value < .05).

Coastal parks were disproportionately affected, experiencing greater declines compared to inland parks, which demonstrated resilience due to their appeal to domestic tourists. Figure 2 illustrates these variations in visitor attendance between coastal and inland parks during the research period.

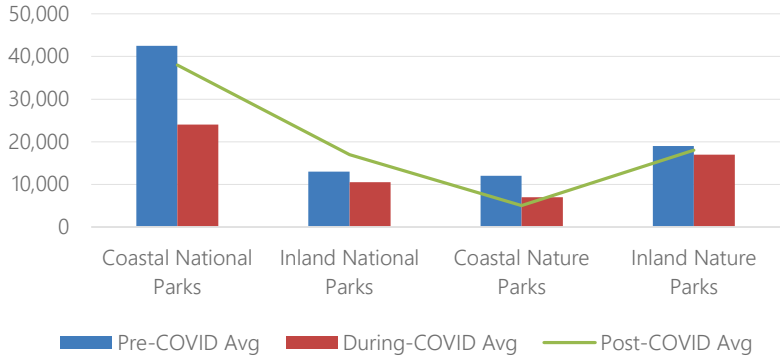

Figure 2. Changes in threat frequencies due to COVID-19 period in coastal and inland parks.

The patterns of recovery after the COVID-19 pandemic varied significantly between coastal and inland parks. Coastal parks exhibited a slower recovery. For instance, Kornati

National Park remained 20% below the pre-COVID-19 attendance levels in 2023, reflecting its reliance on international tourism. Inland parks recovered more rapidly with some surpassing pre-COVID-19 figures. Medvednica Nature Park, for example, recorded a 15% increase in visitor numbers compared to the pre-COVID-19 period by 2023, indicating a sustained shift toward domestic tourism. These recovery patterns are also illustrated in Figure 2, highlighting the differences in visitor attendance recovery between coastal and inland parks.

4.1. Impacts of COVID-19 on threats in national and nature parks (2018–2023)

According to the research results, the frequency and types of threats varied across park categories during the COVID-19 period. During the pre-COVID-19 period (2018–2019), threat levels were relatively low, averaging 12.67 threats per year across all parks. In the COVID-19 period (2020–2021), threat frequencies rose to an average of 19.00 per year. Coastal parks experienced fewer threats due to reduced visitation, while inland parks, particularly nature parks, saw an increase in illegal activities such as logging and littering. In the post-COVID-19 period (2022–2023), threat levels remained elevated, especially in inland nature parks like Lonjsko Polje and Kopački Rit where illegal logging and waste disposal persisted.

A statistical analysis was conducted to evaluate changes in threat frequencies across the pre-COVID-19, during-COVID-19, and post-COVID-19 periods. Two-sample *t*-tests were used to compare the mean threat levels between these periods.

The comparison between the pre-COVID-19 and during-COVID-19 periods showed an increase in average threats from 228 to 425.5 per year. However, this increase was not statistically significant (p-value = .286). For the comparison between pre-COVID-19 and post-COVID-19 periods, the difference in mean threat frequencies was statistically significant (p-value = .031) indicating a meaningful rise in threat levels after the pandemic. These results suggest that while the COVID-19 period did not result in a statistically significant change in threats, the post-COVID-19 period saw a notable increase, particularly in inland parks where illegal logging and waste disposal were prevalent. The impact of COVID-19 on the frequency and types of threats varied between coastal and inland parks. In coastal national parks threats decreased during the pandemic likely due to a significant reduction in visitor numbers. For example, Kornati National Park saw a 56% drop in threats during the COVID-19 period. In contrast, inland nature parks experienced significant increases in threats. Parks like Kopački Rit and Lonjsko Polje reported a rise in illegal activities, including illegal logging and waste disposal, as these areas became more vulnerable due to changes in human activity and reduced enforcement during the pandemic.

4.2. Recovery and percentage changes in threats due to COVID-19

Table 2 shows the percentage change in the frequency of reported threats during the COVID-19 period (2020–2021) and post-COVID-19 recovery period (2022–2023) compared to the pre-COVID-19 period (2018–2019). The percentage change is calculated for each park, broken down by park type: coastal national parks, inland national parks, coastal nature parks, and inland nature parks.

Table 2. Percentage change in threat frequencies in national and nature parks due to COVID-19

Park Type	Pre-COVID-19 (average)	During-COVID-19 (average)	Post-COVID-19 (average)	% Change During COVID-19	% Change Post-COVID-19
Coastal national parks	42.17	24.33	38.17	–42.29%	56.85%
Inland national parks	13.75	10.40	17.60	–2.36%	69.23%
Coastal nature parks	12.50	7.5	5.33	–40.0%	–28.89%
Inland nature parks	19.13	17.36	19.43	–9.24%	11.93%

Table 2 illustrates the varying impact of the pandemic on different park types, helping to highlight areas with increased or decreased threat frequencies during and after the pandemic. The most prevalent threats in coastal/sea national parks are illegal fishing, anchoring or boat docking in internal waters or on maritime property, entry without a ticket, and illegal construction. In inland national parks, the main threats include swimming in prohibited areas, driving or parking outside designated areas, camping in restricted zones, and entry without a ticket. The most prevalent threats in coastal/sea nature parks are waste disposal outside designated disposal sites, starting fires, entry without a ticket, and illegal fishing, while in inland nature parks, the main threats include illegal construction, driving or parking outside designated areas, as well as illegal fishing and waste disposal outside designated disposal sites.

During the COVID-19 period, coastal national parks experienced a notable decline in threat occurrences due to the reduced number of visitors in the time of lockdowns. However, with the return of tourism, the frequency of threats increased again, reaching and even surpassing pre-pandemic levels. Inland national parks also saw a reduction in threats during the pandemic, primarily as a result of decreased human activity. After the pandemic, these threats surged, presenting long-term challenges in managing visitor impacts and illegal activities. In coastal nature parks, threats significantly decreased during the pandemic and continued to decline even after restrictions were lifted, suggesting improved management. Inland nature parks, on the other hand, experienced only a slight reduction in threats during the pandemic, but after restrictions were lifted, the number of incidents increased again, indicating a potential long-term challenge related to illegal logging and improper waste disposal, which remain pressing issues for park management (Table 2).

These trends highlight the profound impact of the COVID-19 pandemic on the frequency of environmental threats in Croatian national and nature parks. Coastal parks experienced a significant reduction in threats during COVID-19, while inland parks showed resilience and, in some cases, increases in illegal activities. Threat levels in inland parks continue to rise, posing long-term management challenges. Coastal parks returned to near pre-COVID-19 levels indicating a resumption of pre-pandemic challenges. Coastal parks were more sensitive to changes in visitation while inland parks exhibited ongoing vulnerability to threats regardless of visitor patterns (Figure 2).

5. Conclusion

Protected areas in Croatia are very important for local and regional development. However, there has been little research on the resilience of protected areas to crises. Therefore, for the first time in Croatia, research was conducted on park visitation, threats, and the consequences of the COVID crisis. The analysis covered the period from 2018 to 2023. For the statistical

analysis, publicly available data from park reports were used, while the qualitative analysis was conducted using the method of semi-structured interviews with key stakeholders.

The key research findings indicate that the COVID-19 pandemic has undoubtedly left a significant mark on tourism in Croatia, affecting visitor trends, as well as the scale and type of threats in protected areas. A drastic drop in the number of visitors in 2020 was expected given the introduced restrictions and general uncertainty caused by the COVID-19 pandemic. However, the rapid recovery in the coming years, and in some cases even exceeding the numbers before the pandemic, indicates the great resilience of the tourism sector and the attractiveness of Croatian national parks. This data points to the need for long-term planning and management in order to avoid the negative effects of excessive tourism in the future.

Coastal parks experienced significant drops in attendance during the COVID-19 period largely due to restrictions on international travel. In contrast, inland parks showed greater resilience with smaller declines in visitation, likely because they were more accessible to domestic visitors. Coastal parks were more vulnerable to fluctuations in visitation and threats during the pandemic, while inland parks demonstrated greater stability. The nature of threats varied across park types and seasonal variations in threats became more pronounced during COVID-19. Peak threat periods shifted due to the restrictions and changes in visitor behavior.

Post-COVID-19 recovery patterns revealed strong attendance growth by 2022–2023 for most parks with inland parks, such as Plitvice Lakes and Medvednica, exceeding pre-COVID-19 visitor numbers. Coastal parks, however, took longer to recover, reflecting their heavy reliance on international tourism which was slower to resume.

National parks consistently maintained higher visitor numbers compared to nature parks. This trend underscores their broader appeal and more established tourism infrastructure. Nature parks exhibited more variable recovery patterns while inland nature parks demonstrated stronger resilience both during and after the pandemic.

Temporal patterns in threats became more pronounced during the COVID-19 period. Seasonal variations in threats shifted with peak periods of illegal activity occurring at different times due to changes in visitation and restrictions. These shifts were influenced by lockdowns and varying access to parks, highlighting the impact of human activity on threat patterns.

Despite the availability of data and the scientific progress made through the triangulation of results, the conducted research has certain limitations related to the accuracy and lack of data for certain parks. Visitor and threat data provided by park authorities are assumed to be accurate and consistent. Variations in data collection methods could affect results. Some parks did not provide data for the pre-COVID-19 period (2018–2019) and COVID-19 period (2020–2021), limiting the ability to assess trends in those parks during the pandemic. The following parks are missing data for the pre-COVID-19 period: Brijuni, Krka, Paklenica, Plitvice Lakes, Risnjak, Biokovo, Medvednica, Papuk, Velebit and for COVID-19 period (2020–2021): Brijuni, Krka, Paklenica, Plitvice Lakes, Risnjak, Biokovo, Lastovo Archipelago, Medvednica, and Velebit. Also, the limitation of the research may be that the analysis mainly focuses on numerical trends in visitor attendance and threats, but does not incorporate qualitative insights into visitor behavior or experiences. Additionally, influences such as weather, marketing, or economic conditions were not considered, despite their potential impact on visitor numbers.

The research results confirm the assumption that there is a relationship between the number of visitors and the frequency of illegal activities in Croatian protected areas. However, this connection is not necessarily linear and depends on many other factors such as the effective management of protected areas, monitoring activities, the awareness of visitors about nature protection, and the carrying capacity of certain areas. In order to reduce the threats, it is necessary to combine different measures including education of visitors, increased monitoring, development of visitor management plans, coordination with local communities, or development of alternative tourism products in critical areas. There is a strong need for a comprehensive and integrated approach to the management of protected areas, with an emphasis on strengthening their resilience to crises. This approach should include:

- Long-term planning: Development of long-term management plans that consider park-specific threats such as the number of visitors, climate change, demographic trends, and similar factors;
- Monitoring and evaluation: Regular monitoring of implemented management plans, tracking key indicators for park development, visitor numbers, types, quantities, and dynamics of threats, as well as planning mitigation measures to preserve fundamental natural phenomena;
- Cooperation with the local community: Involvement of the local population in the decision-making process and the implementation of protection measures;
- Education: Implementation of educational programs for visitors, employees, and local residents about the importance of nature conservation; and
- Innovative approaches: Application of new technologies and innovative solutions for presenting, monitoring, and managing protected areas.

Through this approach, it is possible to ensure that Croatian national parks and nature parks remain a valuable heritage for future generations.

Acknowledgement

The research used in this paper is funded by the NextGenerationEU as part of the project Essence and Colors of Sustainable Regional Development in the Republic of Croatia – BORE.

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