Interreg VI-A Italia - Austria
Cooperation Program

Sustainable Tourism Development in the Alps-Adriatic Region

Final Report with Guidelines Based on the Analysis Results

Europe even closer

Interreg Italia–Österreich

Co-funded by the European Union

INDIALPS

Imprint

Sustainable Tourism Development in the Alps-Adriatic Region
Final Report with Guidelines Based on the Analysis Results

Publisher:
Carinthia University of Applied Sciences
UNESCO Chair for Sustainable Management of Conservation Areas
ICEB - Interdisciplinary Center for Ecosystem Services and Biodiversity

Authors:
Elisabeth Wiegele[4], Lilia Schmalzl[4], Julian Greiler[4], Sabrina Muscolino[4], Mara Thiene[3], Cristiano Franceschini[3], Federica Amato[3], Vanessa Jreissaty[3], Nicola Ceschia[2], Stefano Santi[2], Alessandro Benzoni[2], Cristina Comuzzo[2], Robert Heuberger[1], Ines Schäfer[1]

With the collaboration of:
Claudia Gioitti (Consorzio di Promozione Turistica del Tarvisiano, Sella Nevea e Passo Pramollo)
Overs Georg, Marc Horbal, Ines Bellwald (Region Villach Tourismus GmbH)

INDIALPS Partners:
[1] Dobratsch Nature Park
[2] Parco Naturale delle Prealpi Giulie
[3] University of Padua
[4]Carinthia University of Applied Sciences / UNESCO Chair for Sustainable Management of Conservation Areas / ICEB
Consorzio di Promozione Turistica del Tarvisiano, Sella Nevea e Passo Pramollo
Region Villach Tourismus GmbH
Interreg VI-A IT-AT 2021-2027 - INDIALPS (ITAT-46-007)

DOI: 10.71911/itat46-007_wp2

Publication of the administrative authority:
Autonomous Province of Bolzano - South Tyrol
Department Europe
Joint Secretariat
Gerbergasse 69 - 39100 Bolzano
T.: +39 0471 41 31 10
gs-sc@provincia.bz.it
www.interreg.net

Recommended citation: Wiegele E.[4], Schmalzl L.[4], Greiler J.[4], Muscolino S.[4], Thiene M.[3], Franceschini C.[3], Amato F.[3], Jreissaty V.[3], Ceschia N.[2], Santi S.[2], Benzoni A.[2], Comuzzo C.[2], Heuberger R. [1], Schäfer I.[1] (2026). Sustainable Tourism Development in the Alps-Adriatic Region. Final Report with Guidelines Based on the Analysis Results. Carinthia University of Applied Sciences, Villach. https://doi.org/10.71911/itat46-007_wp2

Sustainable Tourism Development in the Alps-Adriatic Region

Final Report with Guideline Based on the Analysis Results

Contents

1 Introduction into the Sustainable Tourism Development in the Alps-Adriatic Region Report

The INDI Alps project focuses on innovative and sustainable tourism development in the Alpine-Adriatic region. Since 2018, there has been a trilateral collaboration between the Dobratsch Nature Park (AT), the Prealpi Giulie Nature Park (IT) and the Triglav National Park (SI). This cross-border cooperation brings together for the first time the three major European language and cultural groups – Slavs, Romansh and Germans – with the aim of institutionalized cooperation.

The project aims to promote sustainable tourism development and nature conservation by analyzing and managing visitor flows. This approach helps to reduce the pressure on overcrowded areas and make less visited regions more attractive. Through close cooperation between tourism stakeholders and nature parks, the project takes an innovative approach to preserving the region's natural and cultural resources over the long term and making them more accessible.

The INDI Alps project brings together various stakeholders from the participating countries. The overall coordination is led by Naturpark Dobratsch, project partners (PP) are responsible for the management of the work packages (Parco naturale delle Prealpi Giulie, Region Villach Tourismus GmbH, Università degli Studi di Padova, FH Kärnten and Consorzio di Promozione Turistica del Tarvisiano).

One of the project's main objectives is to manage visitor flows in order to promote sustainable tourism. The Alpen-Adria region faces various tourism-related challenges: some areas are subject to excessive tourist pressure, while others are under-visited. Through data-driven analysis and targeted measures, the project aims to promote sustainable development and distribute tourism activities more evenly.

The close cooperation between the nature parks helps to reconcile tourism and nature conservation. The development of a long-term tourism strategy will not only ensure environmental sustainability, but also strengthen the cultural and linguistic diversity of the region.

Figure 1 - Region from above (Photo: Elisabeth Wiegele).

2 Touristic Areas and Protected Areas in the Cross-Border Area between Dobratsch and Prealpi Giulie Nature Parks

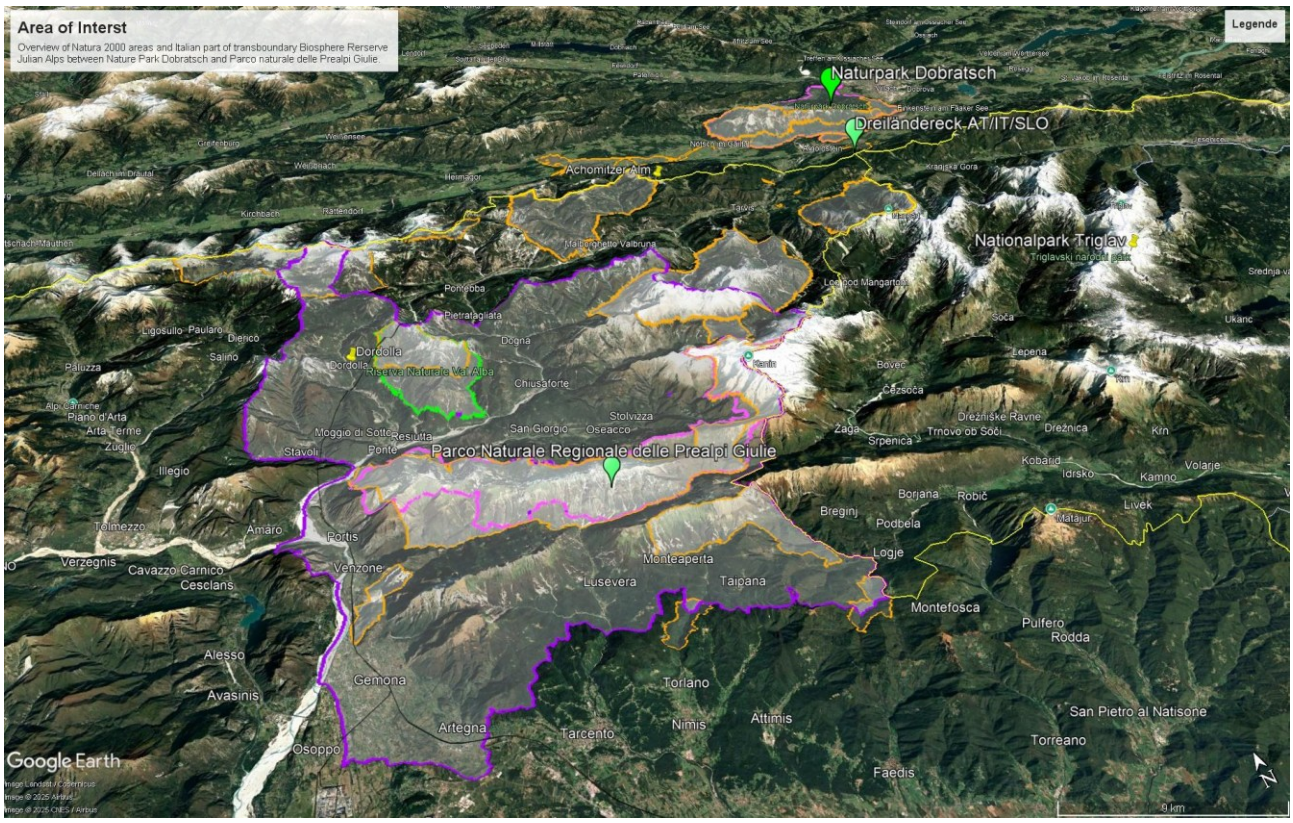


Figure 2 - Areas of interest (Source: Google Earth).

2.1 Inventory of the Most Important Promoted Hiking and Cycling Tourism Offers in the Dobratsch Nature Park

2.1.1 Dobratsch Nature Park – Hiking Routes

The Dobratsch Nature Park has a well-developed and marked system of hiking trails with a wide range of possible hikes and walks. The spectrum of hikes ranges from very easy (short tours on wide paths / forest roads) to very challenging (narrow, steep paths) and alpine hikes. The nature park is crossed by the Villach Alpine Road (Villacher Alpenstraße), which provides easy access for many hikes.

Trail no. 229: Parts of the Julius Kugy Trail lead directly over the Dobratsch summit and across the nature park from Hermsberg in the west to Warmbad Villach in the east. The Julius Kugy Trail is a challenging long-distance hiking trail that leads through the Carnic and Gailtal Alps, the Karawanks and the Kamnik–Savinja Alps to the Julian Alps. The very alpine and challenging stages are currently being revised and reorganised.

Trail no. 291: Starting from the parking space in Heiligengeist, this trail initially leads along the so-called *Köflersteig* trail and then continues through the *Waagtal* valley to the hut *Aichingerhütte*. From here, the route follows a pleasant hiking trail and finally the panoramic path (Panoramaweg) to the Dobratsch summit.

Trail no. 292: Hiking trail from the parking in Heiligengeist to the *Kaserin* (1400 m).

Trail no. 294: Starting from parking no. 11/Rosstratte, this trail leads initially via the panoramic path (Panoramaweg) to the Zehnernock and then westwards through the Bärengraben to the Dobratsch summit.

Trail no. 295: This trail reaches the Dobratsch summit from the north via the *Alpenlahner*. The trail starts at the avalanche site in Bad Bleiberg. Shortly before the hut at the Dobratsch summit, the trail joins trail no. 291 /no. 229 (panoramic path to the summit).

Trail no. 296: This trail leads from the railway station in Nötsch i.G. via Nötscher Berg through the *Alplgraben* past the *Alplhütte* (unmanaged) to the Dobratsch summit (from the western side). From Hermsberg, the trail continues as trail no. 229.

Trail no. 297: From Wurzach (between Bleiberg Kreuth and Bleiberg Nötsch) via the *Tor* into the *Alplgraben* to the Dobratsch summit. The trail joins trail no. 229 (also known as Julius Kugy Trail) at an altitude of aprox. 1200 metres above sea level.

Dobratsch circular trail: The Dobratsch circular trail is a 'short long-distance hiking trail' with a total of 5 stages. It leads through the many different and diverse natural and cultural areas of the Dobratsch Nature Park with its municipalities Villach, Arnoldstein, Nötsch and Bad Bleiberg:

- Stage 1: Villach Warmbad - Bad Bleiberg
- Stage 2: Bad Bleiberg – Nötsch
- Stage 3: Nötsch - Thörl Maglern
- Stage 4: Thörl Maglern - Arnoldstein (via the three countries border/Dreiländereck)
- Stage 5: Arnoldstein - Villach Warmbad

Alpe-Adria 3 countries circular tour:

In addition to the well-known Alpe-Adria Trail, which leads from the foot of the Grossglockner to Muggia, there is a circular tour variant known as the Three Countries Tour. Small sections of this trail lead through the Dobratsch Nature Park in the south. The starting point for this circular tour variant (according to the website) is the Baumgartnerhof above Lake Faaker See. The tour has a total of 7 stages and leads through Austria (Carinthia), Italy (Friuli) and Slovenia:

- Stage 1: Lake Faaker See/Baumgartnerhöhe - Warmbad Villach
- Stage 2: Warmbad Villach - Nötsch i.G.
- Stage 3: Nötsch i.G. - Valbruna
- Stage 4: Valbruna - Tarvisio
- Stage 5: Tarvisio - Rifugio Zacchi
- Stage 6: Rifugio Zacchi - Kranjska Gora
- Stage 7: Kranjska Gora - Faaker See /Baumgartnerhöhe

2.1.2 Dobratsch Nature Park - Cycling Routes

The Dobratsch Nature Park and its surrounding areas are integrated into a network of regional and international cycling routes. These routes connect different parts of Carinthia and neighbouring regions, offering opportunities for both leisure cycling and longer tours.

R 3 Gail cycle path - The cycle path leads from the railway station in Kötschach Mauthen to Villach, where it joins the R1 Drau cycle path. The cycle path has a total length of around 95 km (source: Land Kärnten, Outdoor active) with 144 metres uphill and 290 metres downhill.

Alps-Adriatic Cycle Path: This cross-border cycle path has a total length of 415 km and 8 stages from Salzburg (AT) to Grado (IT). The 5th stage leads from Villach via Arnoldstein and finishes in Tarvisio (IT). Even though this cycle path is not located directly in the nature park, it is one of the most important connections and common attractions between the Dobratsch Nature Park and the Prealpi Giulie Nature Park and a major tourist attraction due to its popularity among locals and visitors.

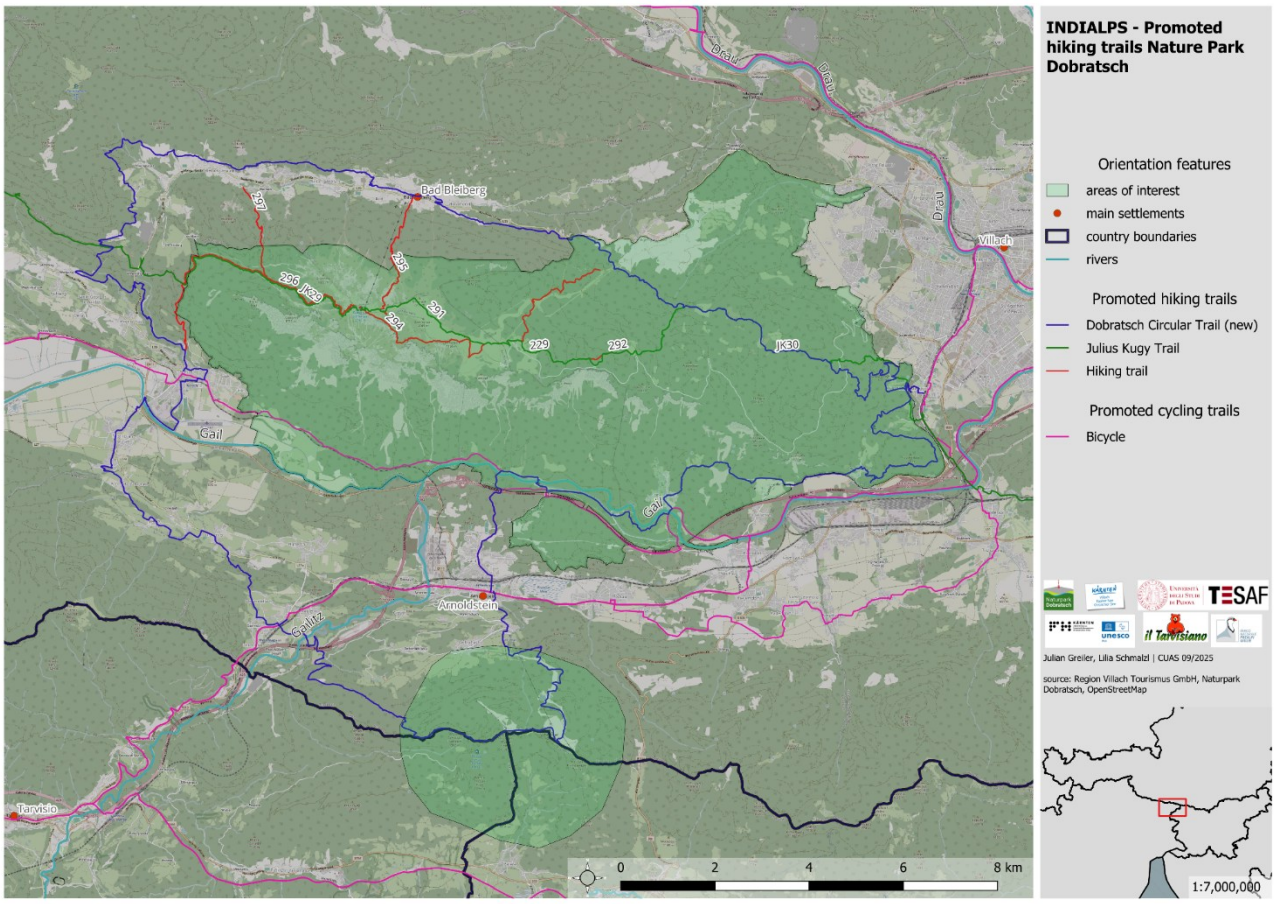


Figure 3 - Hiking trails in the Dobratsch Nature Park.

2.1.3 Dreiländereck / Three Borders Triangle – Hiking Routes

The Dreiländereck, where Austria, Italy, and Slovenia meet, offers a variety of hiking routes that combine natural landscapes with cross-border cultural and historical experiences. The area is well known for its accessible trails and thematic routes that highlight both the region's geography and its historical significance.

Hike GRENZgenial - GRENZgänger: Moderately difficult hike on the "Grenzgenial" theme trail from the valley station of the Dreiländereck in Seltschach to the Dreiländereck. A total of 13 stations provide information about the formerly well-guarded border between Austria, Italy and Slovenia.

Three-Countries hike: From the mountain station on the Seltschacher Alm, the trail leads to the intersection of the three countries (Austria/Italy/Slovenia). With a hike to the Madonna della Neve chapel (IT) and past the fortifications on the ascent to the red Madonna. After a detour to Slovenia, the hike returns to the Seltschacher Alm.

Southern Alpine Trail, E17: The Southern Alpine Trail (E17) stage leads from the Wurzen Pass to the border village of Thörl-Maglern. Right from the start, the route climbs steeply up to Seltschach Alm and continues to Hahnenwipfel as well as the Dreiländereck, the final peak of the Karawanks.

2.1.4 Nature Park Dobratsch and Dreiländereck – POIs

The Nature Park Dobratsch and the Dreiländereck region feature a diverse range of points of interest that reflect the area's natural, cultural, and historical diversity. Visitors can experience a combination of alpine landscapes, educational trails, traditional mountain huts, and historical sites, making the region attractive for both nature enthusiasts and culturally interested guests.

- Aichingerhütte
- Almgasthof Hundsmarhof
- Almwirtschaft Schütt
- Alpengarten Villach
- Aussichtsplattform Rote Wand (Skywalk)
- Bergbaumuseum Bad Bleiberg
- Deutsche Kirche (Maria am Stein)
- Dobratsch Gipfelhaus
- Dobratsch Gipfelkreuz
- Dreiländereck
- Feistritz an der Gail (Ort)
- Gams- und Gipfelblick
- Geolehrpfad (barrierefreier Lehrpfad von der Rosstratte)
- Greißlermuseum Thörl-Maglern
- Klosterruine Arnoldstein
- Museum Nötscher Kreis
- Natuschutzgebiet Natura 2000 Schütt
- ORS-Sendemast
- Ortskern Saak
- Pfarrkirche Göriach (Mariä Namen)
- Rosstrattenstüberl
- Römerweg Warmbad Villach
- Schaubergwerk Terra Mystica
- Schloss Wasserleonburg
- Skywalk
- Sonnenwege inklusive Aussichtspunkt beim P11
- Sprungschanze Achomitz
- Therme Warmbad Villach
- Villacher Alpenstraße
- Wetterstation
- Windische Kirche (Filialkirche Mariä Himmelfahrt)
- Zehnerhütte

2.2 Inventory of the Most Important Promoted Hiking and Cycling Tourism Offers in the Biosphere Reserve Italian Julian Prealps and Tarvisiano

2.2.1 Julian Prealps Nature Park – Hiking Routes

The area, formed by the union of the Italian Julian Alps Biosphere Reserve and the Tarvisio-Gemonese Tourism Consortium, extends for several kilometres from the municipality of Tarvisio, on the border with Austria and Slovenia, to the Friuli hilly region. Due to its extension, the environments are very varied: they range from the plains and hills, to gentler mountains and the highest peaks of the Italian Julian Alps exceeding 2700m.

This multitude of environments translates into a wide range of outdoor sports and activities for both beginners and experts such as hiking and trekking, mountain biking, mountaineering and ferrate, free climbing, paragliding, canyoning, rafting and kayaking, ski mountaineering, alpine skiing, cross-country skiing and snowshoeing.

The Julian Prealps Nature Park offers a wide network of hiking routes of varying lengths and difficulty levels, managed by the park authority. These trails extend across the protected mountain areas as well as the valley floors within the park's municipalities, providing opportunities to explore both the natural environment and the cultural landscape of the region.

- **Foran dal Mus geological trail** - short and long route: The route allows to visit the karstic plateau of Mount Canin. The long version starts from the Gilberti hut and follows CAI trails no. 632, 632/a, 645, and 645/a or 659 to Sella Nevea. The short version follows CAI trails n. 632 and 632/a and makes it possible to reach the Marussich bivouac and return to the Gilberti hut.
- **MIRABILA - Botanical Path of Bila Peč :** The route is of low difficulty and, by means of information panels, allows to discover the alpine flora of the Canin massif. The start is at the Gilberti hut to Sella Bila Peč and back along CAI path no. 635.
- **Mount Plauris Botanical Trail:** The route is of high difficulty and follows CAI paths 702/a, 702, 701, 728/a, 728 and 726. The departure is from malga Confin until reaching the summit of Mount Plauris from which it continues, closing a loop by walking along ridges and grassy slopes.
- **Coot malga - Costantini bivouac - monte Guarda loop:** The route of medium-high difficulty starts from the car park near malga Coot and makes a loop along CAI paths 624, 731 and 741. The summit of Mount Guarda is reached by walking along the border ridge with Slovenia.
- **Borgo Cros - Rio Serai loop**: The itinerary takes place along CAI trails nos. 743 and 743/B and is a medium-easy route. It departs from the hamlet of Povici and loops through woods, scree and streams.
- **The Resartico Mine:** The route is of medium difficulty and runs entirely along CAi trail No. 702. From the hamlet of Povici one reaches the old mining village and the Resartico stream mine.
- **Barman Waterfall**: A short, easy walk along a beautiful beech forest leads to the Barman stream waterfall. The departure point is near the hamlet of Lischiazze.
- **Goriuda Waterfall**: A short and easy walk starting from Pian delle Strege (Chiusaforte) to the beautiful Goriuda waterfalls and the other small waterfalls of the stream.
- **Valle Musi Nature Trail**: The trail follows the entirety of CAI path no. 719, with a brief section on CAI path no. 737. It is an easy trail that starts from Borgo Simaz (Lusevera) to the Pian dei Ciclamini hut.
- **Route out:** This easy route starts from the Pian dei Ciclamini hut until reaching Passo Tanamea. It is a loop through woods and meadows, following some information boards.
- **Loop of the little churches of Venzone - Nature Trail:** Easy route starting from the square in Venzone, which runs along paths and asphalted roads allowing visits to the old churches in the village.
- **Pradieli - Micottis loop**: A short and easy loop itinerary starting from the hamlet of Pradielis and leading to Micottis (Lusevera). The route follows a path and paved roads.

2.2.2 Resia Valley Ecomuseum – Hiking Routes

The hiking routes managed by the Resia Valley Ecomuseum are designed to highlight the natural, historical, and cultural features of the Resia Valley. These trails connect the hamlets, landscapes, and traditions of the valley, offering visitors an insight into local life, history, and the distinctive Resian culture.

- **The route of the stavoli:** This route of medium difficulty starting from the hamlet of San Giorgio allows you to visit some old *stavoli* (local huts). The trail runs along asphalt roads, forest roads and paths.
- **The route of ancient glaciers:** This route of medium difficulty starts from the hamlet of Lischiazze and arrives, walking on paths and asphalt road, to the church of Sant'Anna, at sella Carnizza. Some tables explain the glacial phenomena in the area.
- **Taste trail:** This medium-easy route starts from the headquarters of the Julian Pre-Alps Park and passes through several hamlets in the Resia valley. It takes place on paths and asphalted roads.
- **The route of alpine pastures:** A route of medium difficulty that starts from the hamlet of Oseacco and leads to Provalo, a place where alpine grazing was practised. The route follows a path.
- **The route of music:** A route of medium-high difficulty starting from the hamlet of Stolvizza and dedicated to the theme of traditional Resian music. The route follows paths and asphalt roads.
- **Ta Stara Pot - the old route:** The route is of medium difficulty, starts from the headquarters of the Julian Pre-Alps Park in Prato di Resia and passes through many hamlets in the valley. It retraces old roads and takes place on paths and asphalt roads.
- **Ta Lipa Pot -** This moderately easy loop trail starts in the hamlet of Stolvizza and circles around the Resia stream. It follows CAI trails 662 and 662/a, with a few short sections on paved roads. It is one of the most popular routes in the area.

2.2.3 Biosphere Reserve Italian Julian Alps – Hiking Routes

Within the Biosphere Reserve of the Italian Julian Alps, numerous hiking routes are available in municipalities located outside the Julian Prealps Nature Park. These trails are maintained by local associations and municipalities and are accessible through the Friuli Venezia Giulia Outdoor mobile app. They vary in length and difficulty, offering a broad range of opportunities for nature exploration, recreation, and environmental education.

- **Mount Cumieli and Minisini Lake loop:** A popular and easy trail in the municipality of Gemona del Friuli. Along dirt roads and hiking paths, it offers the chance to explore a variety of natural habitats within the SAC “Lago Minisini e Rivoli Bianchi” and sites of historical interest.
- **Waterfall trail in the Orvenco stream valley:** A moderately difficult route between the municipalities of Artegna and Montenars. Following hiking trails and dirt roads, it leads to the Orvenco stream waterfalls and climbs to the summit of Mount Faeit.
- **Cornappo springs loop:** A medium-difficulty loop trail in the municipality of Taipana. It winds through forest and riverine environments on hiking paths.
- **Mount Chiavals loop from Val Alba:** A demanding hike in the Val Alba Nature Reserve, in the municipality of Moggio Udinese. It follows CAI trails 450, 425 and 428/a (graded E and EE), reaching the summit of Mount Chiavals via Bianchi bivouac.
- **Venzonassa valley loop:** A moderate hike starting in the municipality of Venzone, along trail CAI 705 and paved roads. The trail passes through lowland woodlands and the dramatic gorge of the Venzonassa stream.
- **Flop mountain loop from the Aupa Valley:** A moderately strenuous route due to its elevation gain, located in the municipality of Moggio Udinese. The route follows CAI trails 437, 436 and 435 (difficulty E), crossing beech woods, shrublands, alpine meadows and scree slopes. The Monte Grauzaria refuge is a useful support point.

- **Mount Cuarnan:** An easy and panoramic hike in the municipality of Gemona del Friuli. Starting near the namesake mountain hut, the route follows CAI trails 717, 715 and 714 to the scenic summit of Mount Cuarnan, where the Church of the Redentore stands. The unmanaged Elio Pischiutti refuge provides a rest stop.
- **Cima di Terrarossa al Montasio, in the realm of ibexes:** A well-known hike in the municipality of Chiusaforte to the most accessible summit in the Montasio group: Cima di Terrarossa. Starting from the Montasio plateau, it passes near the G. Di Brazzà refuge and follows CAI trails 622 and 664. A moderate route, though the final stretch is classified EE.
- **Mount Faeit hiking trail from the village of Artegna:** A moderately easy trail that climbs to the summit of Mount Faeit from the village of Artegna, along hiking paths and dirt roads.
- **Bernadia, a ridge suspended between history and karst:** This route starts in the hamlet of Villanova delle Grotte (Lusevera municipality) and reaches the summit of Mount Bernadia, where a WWI fort stands. The path follows hiking trails, paved and dirt roads through a karstic landscape.
- **Villanova delle Grotte geological trail:** Beginning in the hamlet of Villanova delle Grotte (Lusevera), this trail leads to the Vigant abyss in the municipality of Nimis. The loop highlights the area's karst features and visits the entrances to several caves, along hiking trails and a paved road.
- **Upper Torre Valley Ring - Lusevera:** An easy trail in the municipality of Lusevera, exploring old paths and hamlets via hiking trails and paved roads.
- **10 thousand steps of health FVG - MONTENARS:** An easy walk in the municipality of Montenars, part of the "FVG IN MOVIMENTO. 10mila passi di salute" initiative.
- **10 thousand steps of health FVG - GEMONA DEL FRIULI:** An easy walk in the municipality of Gemona del Friuli, part of the "FVG IN MOVIMENTO. 10mila passi di salute" initiative.
- **10 thousand steps of health FVG - VENZONE:** An easy walk in the municipality of Venzone, part of the "FVG IN MOVIMENTO. 10mila passi di salute" initiative.
- **10 thousand steps of health - ARTEGNA:** An easy walk in the municipality of Artegna, part of the "FVG IN MOVIMENTO. 10mila passi di salute" initiative.
- **10 thousand steps of health - RESIA:** An easy walk in the municipality of Resia, part of the "FVG IN MOVIMENTO. 10mila passi di salute" initiative.
- **Ring of Montemaggiore:** A moderately difficult to challenging trail between the municipalities of Lusevera and Taipana. Starting from Passo Tanamea, it climbs to Punta di Montemaggiore, following part of the ridge. The trail follows CAI paths 742 and 711/a (graded E and EE), with the unmanaged Monteaperta A.N.A. refuge along the way.
- **Ring of Zore:** An easy loop through the woods and meadows surrounding the village of Taipana, along hiking trails and a mix of paved and dirt roads.
- **Itinerary from the ancient Roman bridge of Montemaggiore to Prossenicco:** An easy trail in the municipality of Taipana that starts in the hamlet of Montemaggiore and reaches Prossenicco. The route is shared with the Cammino Celeste and Sentiero Italia.

2.2.4 Tarvisio – Hiking Routes

The Tarvisio area, located at the meeting point of Italy, Austria, and Slovenia, offers a rich network of hiking routes promoted and maintained by the Tarvisian consortium. The trails cover a wide range of difficulty levels and environments, from gentle lakeside walks to demanding alpine ascents, reflecting the region's diverse landscapes and cultural intersections.

- **Rifugio Zacchi e Porticina dai Laghi di Fusine trail:** Panoramic ascent with a splendid view of the Laghi di Fusine and the surrounding peaks. Ideal for those who enjoy an alpine environment without high technical difficulties (Difficulty level is Medium Main).

- **Orrido della Slizza**: A charming walk among footbridges and gorges carved out by the water, suitable for families and children. A fresh and spectacular natural environment (Difficulty is easy Main feature).
- **Lynx Trail:** From Tarvisio a medium hike: Well-marked nature trail through woods frequented by lynx, with information panels on the local fauna.
- **Tour of the Fusine Lakes**: Ring route around the two splendid glacial lakes, set in a fairytale landscape. Perfect for a relaxing walk (Easy Hike).
- **Cima del Cacciatore:** A demanding hike with exposed sections and breathtaking views of the Julian Alps. Requires good training and an absence of vertigo (Difficult hike).
- **Monte Re from Cave del Predil:** A steep and strenuous hike, with exposed sections and wild environments. Ideal for experienced hikers in search of wide views and solitude. Remarkable views of Lake Predil and the surrounding peaks (Difficult hike).
- **Picco di Mezzodì from Lago Superiore di Fusine:**Spectacular views of the Julian Alps and the Fusine Lakes from above, with glimpses of rock faces and overhead ridges (Difficult hike).
- **Passo degli Scalini:** The trail offers spectacular views of the Julian Alps, in particular of the Jôf Fuart and Canin group. The environment is lonely and wild, and often offers sightings of ibex. CAI 625: starts from Sella Nevea and ascends towards the Scalini Pass. It is the main path to reach the pass, crossing woods and pastures.(Optional, for a loop) CAI 628a - Sentiero dei Tedeschi: connects the Corsi Refuge to Malga Grantagar with more exposed stretches, suitable for expert hikers (EE), possibly used to complete a loop (Difficult hike).
- **Malghe del Montasio ring:** The route offers spectacular views of the Montasio Plateau AND SPLENDID views of the Canin and Jôf di Montasio groups. The route crosses alpine pastures, traditional alpine huts and offers sweeping views of the surrounding valleys. CAI 624: Main route connecting the various mountain huts; CAI 625: Used to reach Malga Cregnedul Alta; CAI 623: Connects Casera Larice to Casera Pecol (Difficult hike).
- **Malga Grantagar and Passo degli Scalini:** Medium The CAI 625 path up to Passo degli Scalini is classified as E (Excursionist), while CAI 628a (Sentiero dei Tedeschi) for the descent is classified as EE (Experienced Excursionist), due to exposed stretches and equipped passages. The route offers panoramic views of the Jôf Fuart group and the Canin group. The Scalini Pass, at an altitude of 2022 m, offers a spectacular natural amphitheatre. The Sentiero dei Tedeschi has exposed sections with ledges and equipped passages, but also offers breathtaking views (Medium hike).
- **Ring of Lake Predil from Cave del Predil:** Easy A ring-route around the picturesque Lake Predil, with views of the turquoise mirror of water framed by thick forests and mountain walls. Quiet and very scenic route (Easy hike)
- **Riofreddo Valley and Sella Carnizza:** Medium A hike in a wild and cool valley, through dense forests, streams and rock faces, until reaching the saddle with wonderful views of nearby valleys. Intimate and uncrowded atmosphere (Medium hike).
- **Monte Forno (Dreiländereck - Triple Boundary):** Medium A panoramic and symbolic route leading to the meeting point of Italy, Austria and Slovenia. From the summit there is a sweeping view of the Julian Alps, the Karawanken and the valleys of the three countries. Wooded environment in the initial part, more open and panoramic at higher altitudes (Medium hike).
- **Rutte Ring:** Easy and peaceful route through coniferous forests, meadows and streams in the Rutte area, near Tarvisio. Ideal for a walk immersed in nature, with glimpses of the surrounding mountains (easy hike).
- **Val Filza Ring:** Easy varied trail through coniferous forests and wide alpine clearings with beautiful huts where you can stop for lunch with typical dishes.
- **Monte Cocco:** Wide high-altitude meadows and a spectacular view over the Ugovizza basin and the Lussari mountain and Alpine village and all the Julian Alps.

- **Nordio Ring - Feistritzer Alm - Acomizza**: A cross-border route between Italy and Austria, rich in Alpine pastures, open pastures and 360° panoramic views of the Julian Alps and the Tauern.
- **Mount Osternig**: A panoramic route on a grassy peak, across pastures and alpine pastures, with spectacular views of the Carnic and Julian Alps and the Austrian Gailtal plain.
- **Monte Cocco and Cocco Mining Village Ring**: Excursion to the scenic peak of Monte Cocco, observing along the trail the remains of a mining village and rocks that are among the oldest in Italy.

It is possible to walk some of the stages of long-distance trails in Tarvisiano, such as the Cammino Celeste, the Alpe adria Trail (3 countries circular tour) and MADE TREK and MADE BIKE.

2.2.5 Cammino Celeste – Hiking Route

The Cammino Celeste connects Aquileia, a Friulian town with a glorious thousand-year history, to Mount Lussari, in the heart of the Julian Alps, on whose peak a Marian Sanctuary was built; about 200 kilometers long, it can be covered in approximately ten days, mostly on dirt roads, country lanes and mountain trails.

This itinerary allows hikers to admire the beauty of the Friuli Venezia Giulia landscape in all its nuances, starting from the sea and arriving at the mountains.

- Stage 1: Aquileia – Aiello
- Stage 2: Aiello – Cormons
- Stage 3: Cormons – Castelmonte
- Stage 4: Castelmonte – Masarolis
- Stage 5: Masarolis – Montemaggiore
- Stage 6: Montemaggiore – A.N.A. Refuge
- Stage 7: A.N.A. Refuge – Prato di Resia
- Stage 8: Prato di Resia – Dogna
- Stage 9: Dogna – Valbruna
- Stage 10: Valbruna – Sanctuary on Mount Lussari

2.2.6 Made Trek – Hiking Route

The hiking route Made trek joins Sappada and Tarvisio, extending over 200 kilometres along the main Carnic ridge, characterised by a varied and articulated route. Along the way, one encounters alpine huts, agritourisms and refuges on both the Italian and Austrian sides. The route, which can be covered in both directions, runs along dirt roads, paths and old mule tracks, without presenting any particular technical difficulties for walkers.

The tour has a total of 8 stages and leads through Austria (Carinthia), Italy (Friuli):

- Stage 1: Cima Sappada - Rifugio Calvi
- Stage 2: Rifugio Calvi - Rifugio Lambertenghi
- Stage 3: Rifugio Lambertenghi - Casera Lavareit
- Stage 4: Casera Lavareit - Malga Pramosio
- Stage 5: Malga Pramosio - Cason di Lanza
- Stage 6: Cason di Lanza - Passo di Pramollo
- Stage 7: Passo di Pramollo - Rifugio Nordio
- Stage 8: Rifugio Nordio - Monte Lussari

2.2.7 Tarvisiano – Cycling Routes

The Tarvisio area offers a diverse selection of cycling and mountain biking routes that connect alpine landscapes, valleys, and cross-border destinations. Managed and promoted by the Tarvisio consortium—also the Italian contact point for the Alpe Adria Cycle Route—these itineraries provide opportunities for both leisurely rides and more challenging mountain routes.

- **Rio Freddo-Sella Prasnig-Valbruna** - MTB route through beautiful valleys and mountain landscapes starting from the mountain village of Riofreddo.
- **Ciclovia Alpe Adria Radweg:** Cycle path connecting the mountains of the Tarvisio and Julian Pre-Alps Park with the Adriatic Sea, following the course of the crystal-clear Fella River in the mountain section.
- **Rifugio Zacchi dai Laghi di Fusine (o Aclete):** Ascent to an alpine hut nestled in the mountains via a forest track with beautiful views of the glacial lakes of Fusine
- **Anello CAAR- Val Dogna:** Route along a splendid section of the alpe adria cycle route and through a long valley that is almost uninhabited but full of history, small mountain villages and spectacular views of the northern slope of Jof di Montasio.

2.3 Inventory of Existing Protected Areas and Applicable Rules and Regulations between Dobratsch and Prealpi Giulie Nature Park

Between the Dobratsch Nature Park in Austria and the Parco naturale delle Prealpi Giulie in Italy lies a dense network of protected areas with different protection categories, including Natura 2000 sites (under the Habitats and Birds Directives), nature and landscape conservation areas, nature parks, and national and regional nature reserves. These areas serve to protect ecologically valuable habitats, rare species, and unique landscapes.

Strict rules apply to protect nature in Austrian protected areas such as the Villacher Alpe (Dobratsch), Schütt-Graschelitzen, and the Görtschacher Moos European protected area. These include, among other things, a ban on altering natural watercourses, entering caves, disturbing bat colonies, and boating on waterways. Activities such as skiing, climbing, model flying, paragliding, camping, and noise from sound sources are also prohibited. Dogs are allowed, but only on a leash. Hiking, cycling, and horseback riding are generally only allowed on designated trails. While some landscape conservation areas do not have specific regulations in their ordinances, higher-level provisions from adjacent Natura 2000 areas usually apply.

On the Italian side, for example in the Parco naturale delle Prealpi Giulie or in various SCI areas such as Conca di Fusine, Rio Bianco, or Creta di Aip e Sella di Lanza, similarly strict protection regulations apply. Visitors are not allowed to leave marked paths, especially in ecologically sensitive biotopes such as the Scichizza. Among other things, camping, flying over the area with aircraft or drones, collecting mushrooms, plants, minerals or fossils, lighting fires and feeding wild animals are prohibited. Loud noise is also undesirable. Activities such as caving, horse riding, and cycling are only permitted in clearly defined areas and with permission. The use of unauthorized watercraft and entering protected gravel banks during the breeding season are also prohibited.

Overall, the regulations on both sides of the border show a high degree of agreement with regard to nature conservation. The central principles are the restriction of human activities to sensitive areas, the channeling of visitor flows onto official paths and the consistent control of disruptive influences on flora, fauna and the landscape. At the same time, there is still room for nature-friendly forms of recreation, environmental education and sustainable use. The cross-border protected area structure thus forms the basis for coordinated nature conservation management in the sensitive Alps-Adriatic region.

Via the Spreadsheet all the detailed rules and regulation of the protected areas can be found:

https://docs.google.com/spreadsheets/d/1KuJan7zsCebcF-3OM6jUGqCC_bB4XQqi/edit?usp=sharing&ouid=102925995414785385697&rtpof=true&sd=true

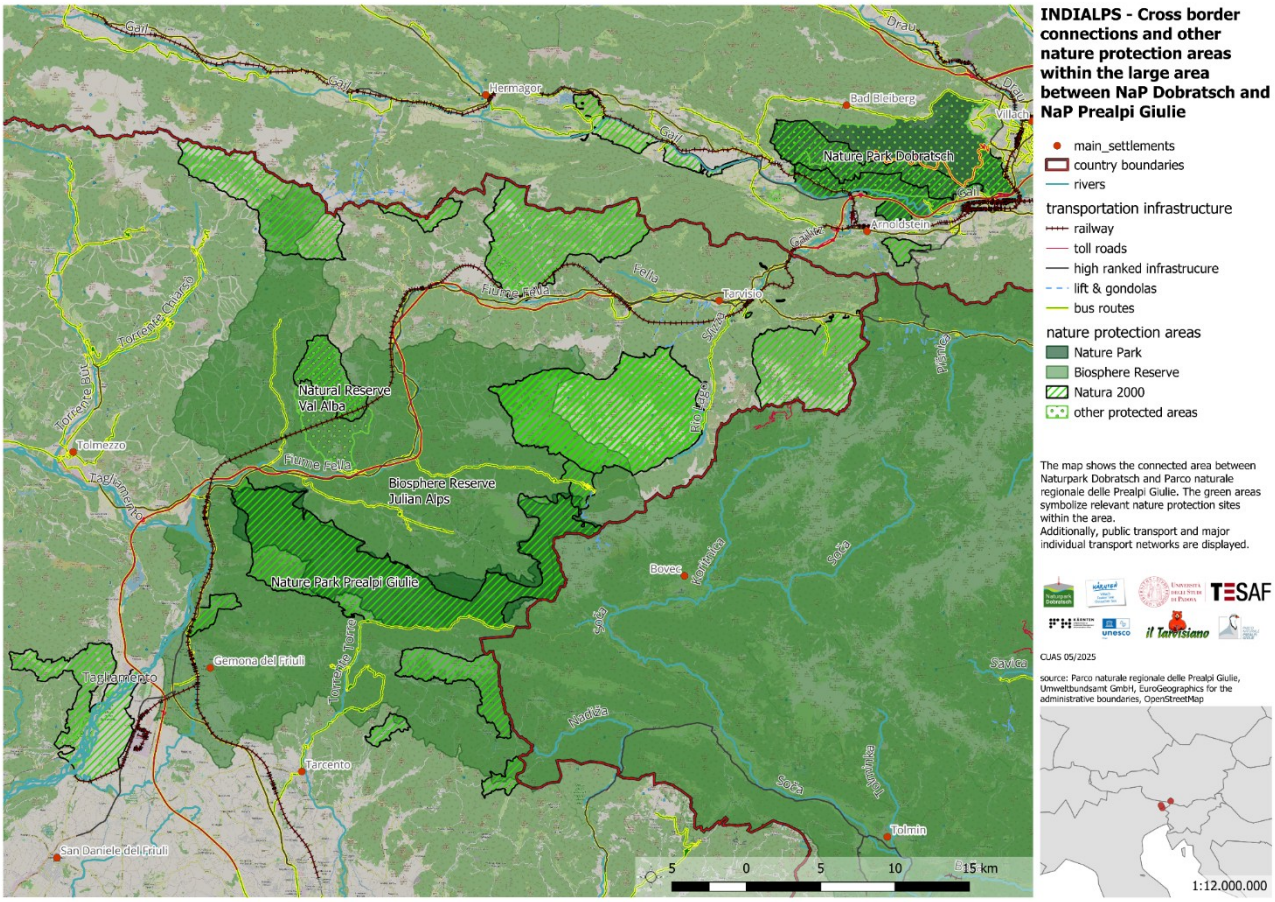


Figure 4 - Existing protected areas between Dobratsch and Prealpi Giulie Nature Park.

3 Outdoor and Fitness App Data in the Cross-Border Region Between the Dobratsch Nature Park and Prealpi Giulie Nature Park

Data from the outdoor and fitness apps Bergfex, Komoot, Outdooractive and Strava were analyzed to estimate spatial hot and low spots of visitors within our pilot areas. The goal was to identify official and unofficial user activities that are frequently promoted on these platforms, potentially pointing to future potential for touristic / recreational development or conflicting activities within protected areas.

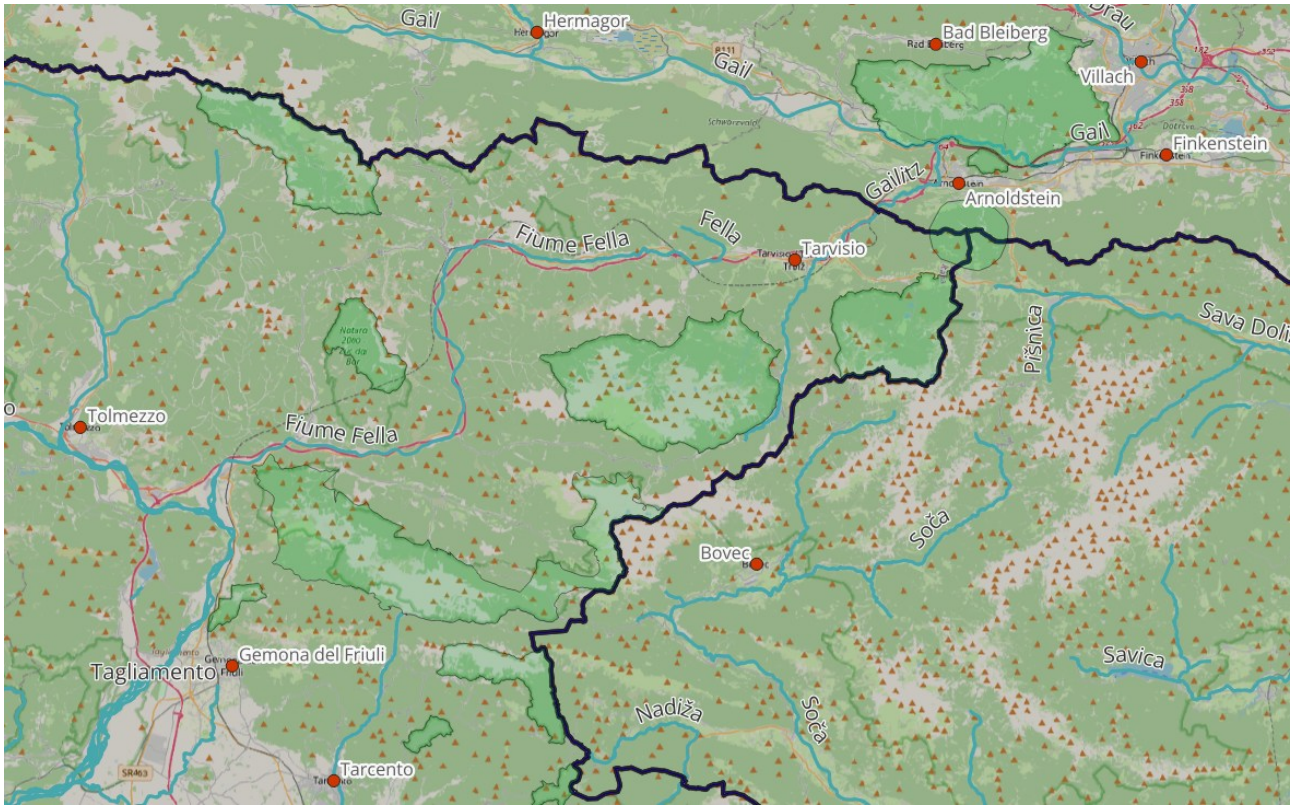


Figure 5 - Areas of interest for the evaluation of outdoor and fitness app data.

Most of the outdoor apps provide gpx files showcasing tour suggestions that were uploaded either by official tourist operators, Alpine Associations (i.e. ÖAV) or regular “community” users. Other apps allow users to share POIs with other app users. Some apps suggest tours based on automatic algorithms. Tour suggestions and POIs can be rated and commented on. Tour suggestions can also be downloaded, some apps require a “Pro” account to do so. The fitness app Strava provides a service for companies and organisations involved in active transportation planning, allowing the estimation of trail users along each segment of the street network (based on OSM).

Depending on the app, several information about the suggested tours are available online. The following section provides a short overview about the data sources and functionalities of individual apps as well as the information extracted for our visitor analysis. When analysing the data it is important to keep in mind that it only represents complementary information about visitor's spatial distribution. It is not representative of the total visitor activities of an area, as it only addresses the individual app users.

3.1 Komoot

The following provides an overview about data sources and functionalities of the outdoor app Komoot:

- **Komoot is built on the following data sources:**
  - OSM data (roads, trails, permissions, POIs (train stations, parking, cafés, huts, etc.), protected area information, which it uses for routing, mapping and tour information;
  - Community inputs via Highlights, user tours, feedback / editing;
  - Partner content (tourism boards, parks, outdoor brands, guides) - can group routes into "Collections" of an area.
- **The Komoot route planner and tour suggestor is a rule-based routing engine:**
  - The route planner uses sport type + OSM tags + surface + elevation to build or suggest routes; users can refine tours by setting waypoints or using the drag-and-drop function;
  - For tour suggestions in a selected area Komoot layers Highlights and OSM POIs on top and adds user information about frequently used trails to suggest ready-made tours.
- **Komoot's tour planner and route suggestor respects local restrictions and provides information about protected areas when tagged correctly on OSM:**
  - Protected area information is shown if a tour is planned within its boundaries;
  - Restrictions are enforced when route segments are tagged (i.e., access=no; bicycle=no, etc.);
  - Warnings alert users if their route may violate local rules.
- **Komoot cannot yet handle temporal closures or access restrictions in a consistent way** (i.e. wildlife quiet zones, storm damages). OSM allows conditional tags (i.e. access:conditional = * (e.g. foot=no @(Nov-Mar) or bicycle=no @ (dusk-dawn)) but in practice Komoot only partially interprets them. Possible workarounds are:
  - Manually change the access restrictions seasonally on OSM;
  - Use of Highlights as warnings to communicate seasonal restrictions or trail damages.
- If map data is wrong (permissions, trail access etc.), there is an established feedback channel (OSM edits, access claims) so over time the data can be corrected.

3.1.1 Data Processing for Visitor Monitoring

For the purpose of visitor monitoring, the following workflow was used to collect and analyse data from Komoot:

- Gpx-tracks of Komoot tour suggestor were selected by radius on the map and downloaded manually within our areas of interest;
- Tour ID (from URL) and metadata were documented in an Excel file (metadata: "used by" (how many people used the tour), "rating" (average rating of the tour), "number of ratings", "actuality" (date of download - date of last update), and "Link to the tour");
- The downloaded gpx-tracks were named with the Tour ID (from URL);
- Conversion of gpx-tracks to shapefile, adding Tour ID to each feature using a python script;
- Link Excel file to shapefile via Tour ID;
- Calculation of a "Tour Score" to rank the tours by importance based on estimated usage. The Tour Score provides a standardized measure of route popularity and user engagement. To create the "Tour Score" the metadata "used by", "rating", "number of ratings" and "actuality" were min-max scaled, weighted and summed up. To ensure comparability across different activity measures, all raw values were rescaled to a common range using min–max scaling. This step prevents measures with larger numerical ranges from dominating the Tour Score;
- Min–max scaling transforms each value x of a measure according to the formula:

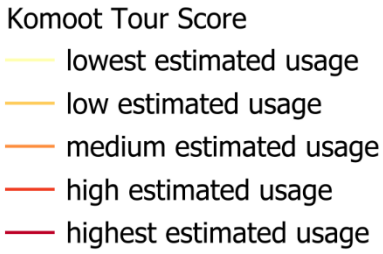
$$\text{Scaled value} = \frac{x - \min(x)}{\max(x) - \min(x)}$$

- This procedure rescales all values to fall within the interval [0,1], where 0 corresponds to the lowest observed value and 1 corresponds to the highest observed value. The resulting scaled values are dimensionless and directly comparable across measures.

For the parameter "actuality", the formula had to be inverted, as shorter timespans with high rating indicate a stronger impact of the route (1 - Scaled value).

Tour Score = 0,6"used by" normalized + 0,15*"rating" normalized + 0,15* "number of ratings" normalized + 0,1* "actuality" normalized*

All values that are empty will be set as "0" for the formula.



Limitations of the workflow:

- The Komoot tour suggestor generates tours by a selected radius on the map. When the browser window is closed, the same tours cannot be reproduced. Starting from selected highlights, Komoot also allows users to generate tours around these highlights. This way usually more tours are suggested then generating them by a selected radius on the map. This means that not all routes are represented in our analysis;
- There is no information in which period these visits occurred and not every route suggestion has metadata;
- As Komoot is updating their content on a regular basis, the provided content (and eventually the ID) is fluent.

3.2 Outdooractive

The following provides an overview about data sources and functionalities of the outdoor app Outdooractive:

- **Outdooractive is built on the following data sources:**
  - Official geodata / topographic & cadastral sources, like the Digital Landscape Model (DLM) from BEV (Bundesamt für Eich- und Vermessungswesen) (since 2023);
  - Open Street Map (OSM) for complementary data on trails, paths, POIs, restrictions, protected areas;
  - Partner / tourism / destination content can contribute routes, POIs, current trail conditions, closures;
  - Community / User contributions, like routes, photos, comments, current trail conditions.
- **Outdooractive offers an API service meaning it is a shared content database:**
  - Once data is entered to Outdooractive database it is available across various apps (i.e. Kärntner Tourenportal, Bergfex, etc.);
  - Various organisations, including tourist operators and protected areas use Outdooractive to manage their tourist offers within their respective areas (i.e. Tourism Region of Villach, Nature Park Prealpi Giulie, Triglav National Park).

- The **Outdooractive route finder** suggests routes to users that are provided by Outdooractive partners or community members. They can be filtered by category, length or difficulty.
- **The Outdooractive route planner** suggests suitable routes between user defined waypoints. "Route options" allow you to consider lifts or ferries. It is a rule-based routing engine that respects trail restrictions or closures. The user has the option to ignore closures in the route planner.
- **Outdooractive explicitly supports temporal closures or seasonal restrictions** (i.e. bird nesting, trail damage). They can be created via area or path closures by official partners with Outdooractive's Content Management System. Community users can report "Current conditions" which are shown for a limited time (usually around 14 days) Outdooractive offers users to include information about trail closures, notices and current conditions:
    - Closures: officially declared closed paths or areas (temporary or longer-term) (i.e. wildlife quiet zone, seasonal bans, storm damage);
    - Notices: diversions, hazards or temporary obstacles (less strict than closures);
    - Current conditions: provided by community, i.e. "wet", "muddy" trails.
- **Protected areas** can include information about the code of conduct in the area using the following services:
    - Digitize the planet (DtP) is a non-profit initiative that collects, standardizes and publishes digital data on nature conservation rules. It provides general rules (e.g., "Dogs with leash is allowed", "Cycling is only allowed on Designated paths/places") based on the legislative documents of the protected area. The database can only be fed by nature conservation authorities or other authorized organisations and provides an API that is used by a couple of outdoor apps (Outdooractive, alpenvereinaktiv.com). Kompass and Bergfex plan to include the API within their app. Information about the code of conduct can be found under current information of the selected route;
    - Open Street Map data on protected area boundaries is visualized on selected basemaps (OpenStreetMap, Outdooractive Map, Kompass Map);
    - Outdooractive closures / notices can be used for additional, detailed or short-term updates about trail closures.

3.2.1 Data Processing for Visitor Monitoring

For the purpose of visitor monitoring, the following workflow was used to collect and analyse data from Outdooractive:

- Gpx-tracks of Outdooractive tours were manually downloaded. A simple query of the areas of interest were made (e.g., Nature Park Dobratsch). Additionally, the Tourism Region of Villach and the Parco Naturale delle Prealpi Giulie provided a content report of their uploaded partner content;
- Tour ID (from URL) and metadata were documented in an Excel file (metadata: "Created on", "Teasers", "Page views", "Actions", "Printouts downloads", "Link to the tour");
- The downloaded gpx-tracks are automatically named with the Tour ID (from URL) by Outdooractive;
- Conversion of gpx-tracks to shapefile, adding Tour ID to each feature using a python script;
- Link Excel file to shapefile via Tour ID;
- Calculation of a "Tour Score" to rank the tours by importance based on estimated usage. The Tour Score provides a standardized measure of route popularity and user engagement. To create the "Tour Score" the metadata/statistics "Created on", "Teasers", "Page views", "Actions", "Printouts downloads", "Link to the tour" were min-max scaled (see description for Komoot app), weighted and summed up;
- To ensure comparability between routes of different ages, the score is based on *average daily activity* rather than total accumulated activity. Since routes that have been online longer naturally collect more views and interactions, each activity measure is normalized by the number of days the route has been published;
- The Tour Score is then calculated as a weighted sum of the normalized activity measures:

Tour Score = (0,17 "Page views" per day normalized + 0,45* "Printouts and downloads" per day normalized + 0,35* "Actions" per day normalized + 0,03* "Teasers" per day normalized)*

3.3 STRAVA (Metro)

Strava Metro is a data service that provides aggregated, anonymized insights from the global Strava community to urban planners, transport authorities, and researchers. Strava aggregates millions of user activities and snaps them to a routable street network which is based on OSM data (highway edges). Strava removes personal identifiers, and produces heatmaps, user counts, statistics and peak usage times. Metro data is offered via dashboard and map, data can be visualized and downloaded for further use following the Strava Metro Terms of Use prior to downloading. Prior consent needs to be required from Strava Metro before publication of any analysis.

- **Strava is built on the following data sources:**
  - Community activity data recorded via GPS devices, smartphones, and wearables/watches (e.g. Garmin, Suunto, Wahoo, Polar, Apple Watch, etc.) including route geometry, speed/pace, elevation, heart rate, and power data;
  - Community contributions via shared activities, photos, kudos, comments, and public route sharing. Derived data from collective user activity: Segments, leaderboards, Heatmaps, and Popularity Routing;
  - Third-party integrations: imported activities from partner apps. For basemap rendering, Strava uses OpenStreetMap, Natural Earth Data and other commercial providers (e.g. Mapbox).
- **Functions:**
  - Activity tracking and logging (running, cycling, hiking, skiing, and more);
  - Segments and competitions: predefined sections of routes where times are ranked on leaderboards;
  - Heatmap: visualization of the most popular paths based on aggregated community activity;
  - Social network features: feeds, groups, challenges, kudos, and comments**.**
- **Local restrictions, protected areas, temporal restrictions:**
  - Strava currently does not systematically incorporate legal restrictions (access bans, seasonal closures, wildlife zones);
  - Protected areas on Strava are displayed on the basemap, if entered correctly on OpenStreetMap;
  - Heatmap and route suggestions are based on user activities, which may include routes through restricted areas. Warnings about protected areas are not displayed.
- **Feedback channel:**
  - Users can report segments (e.g. unsafe, inaccurate, inappropriate);
  - Users can comment on published activities of other users;
  - Strava does not yet provide a direct workflow for reporting temporal closures or official restrictions.

3.3.1 Data Processing for Visitor Monitoring

For the purpose of visitor monitoring, the following workflow was used to collect and analyze data from Strava Metro:

- CUAS was granted access to the regions of Carinthia (Austria) and Friuli Venezia Giulia (Italy) for the INDIALPS project;
- Monthly and yearly data were downloaded for the past 6 years (2019 - 2024). Theoretically, daily and hourly values are available from Strava Metro but as the accuracy of the data is indirectly proportional to the length of the timespan (minimum valid count is 5 users per time span and users are counted in steps of 5) we decided

to focus on monthly and yearly values. The time resolution will be dependent on the context of the study area (rural or urban area), the amount of users and the research question;

- STRAVA Metro provides a shp file with a corresponding csv file with metadata for every download. Every edge in the shp file has a unique ID that can be linked with the csv file;
- The files were processed via different python scripts:
    - Monthly and yearly data tables are created that are suitable for symbolization in QGIS;
    - Empty edges are deleted for data efficiency;
    - Data is clipped to our areas of interest (protected areas between Nature Park Dobratsch and Prealpi Giulie Nature Park) and cleaned of double datasets.
    - The following result layers were included into our project:
      Yearly data is available from 2019 to 2024 in separate layers;
      Yearly data from 2019 to 2024 were merged to a joint layer, summed up;
      Monthly data is available from 2019 to 2024 in separate layers, each column representing one month.
- The data was symbolised in QGIS as a vector line heatmap;
- The categories are based on the statistical method by Jenks, which means that the values within a group are as similar as possible and the groups are as different as possible. For different areas of interest different extends were used, as the visitor counting differs highly between the project sites.

3.4 Bergfex

In contrast to Komoot or Outdooractive, Bergfex does not provide data usable to calculate an estimated usage of their tours. Gpx-tracks of Bergfex tours were manually downloaded by selecting individual tours on the map for different activity types (pedestrians and cycling).

3.4.1 Data Processing for Visitor Monitoring

The main workflow was divided into three steps:

- Preparation of a network layer: OSM data with the key:highway were downloaded for the areas of interest. The OSM data needed to be cleansed and processed, to establish a correct network layer
- Preparation of Bergfex layer:
    - Segmentation of all Bergfex tours into single edges (= vector between two nodes of a line).
    - Spatial join counting all adjacent edges of Bergfex tours in a dedicated buffer zone around each edge. To prevent double counting, each Bergfex tour edge received a unique ID, each unique ID was only counted once per edge.
    - The result is a “tour count value” for each segment.
- Transferring the tour count value on the network layer: The “tour count value” was interpolated onto the network layer. The distance parameter of the buffer was manually corrected to ensure a minimal error for the attribution.

The resulting network layer shows the density of promoted tours along a dedicated path. With a higher number of promoted tours a higher usage can be assumed. The result is similar to the STRAVA Metro data, except it is not showing the user count for each path section, but the tour count provided on this path.

3.5 Combined Outdoor Activity Offers Outdooractive, Komoot and Bergfex:

Finally, all downloaded gpx tracks from Outdooractive, Komoot and Bergfex were combined and processed in the same way as the Bergfex data. The resulting layer shows the content density for all three outdoor apps, concerning the provided tours. The higher the density the more usage can be assumed.

3.6 GIS-Project as Basis to Identify Management Hot Spots Potentially Created by Outdoor App Content

To provide the administrative organs of the protected areas with an easy method to manage externally promoted outdoor activities on outdoor and fitness apps CUAS created a QGIS project as a result of the INDIALPS project.

The QGIS Project provides:

- Clear structured layer management of the analyzed data (Komoot, Outdooractive, Strava Metro, Bergfex);
- Clear symbolisation of each dataset;
- All map layouts of the report to reprint and modify;
- Access to the collected metadata, including hyperlinks to most of the provided outdoor activities (Outdooractive, Komoot) at the time of data.

The QGIS project is provided as a Geopackage for three areas:

- Complete transboundary area;
- Austrian side of our project area;
- Italian side of our project area.

The advantage of this format is, that all settings and data are saved within one file, that can be opened and is easily accessible, even for inexperienced users. Additionally, a metadata table is provided that explains each attribute of the analyzed data layers.

It includes the following datasets:

- General orientation features;
- All collected Outdoor and Fitness app data;
- Boundaries of protected areas;
- Official and unofficial routes;
- Major streets, paths and tracks from OpenStreetMap;
- Selection of touristic POI;
- Major public transportation features.

The following pages showcase the results of the analysed outdoor and fitness app data downloaded for our areas of interest. To visualize identified hot and low spots of digital trails two map extends (1) Austria (2) Italy are provided.

Digital trails from pedestrians and cyclists are included in the report:

- Komoot Hiking Tours - Average use;
- Komoot Bike Tours - Average use;
- Outdooractive Hiking Tours - Average use;
- Outdooractive Bike Tours - Average use;
- Strava Metro Hiking - Average use of trail network;
- Strava Metro Biking - Average use of trail network;
- Bergfex Hiking Tours - Number of tours per trail;

- Bergfex Bike Tours - Number of tours per trail;
- All Hiking Tours - Number of tours per trail from Komoot, Outdooractive and Bergfex;
- All Biking Tours - Number of tours per trail from Komoot, Outdooractive and Bergfex.

4 Visitor Analysis in the Dobratsch Nature Park

The project applied a multi-method approach to gain a comprehensive understanding of visitor behavior, experiences, and movement patterns within the Dobratsch Nature Park and surrounding areas. The methods combined direct survey techniques (visitor questionnaire), sensor-based visitor counting, mobile phone data analysis, and the integration of app-based user data.

The overall aim was to assess visitor flows, perceptions, and potentials for cross-border cooperation in the Alps-Adriatic region, with a particular emphasis on sustainable tourism and regional planning. Methods were selected to complement one another, allowing for both qualitative and quantitative insights.

Site selection for data collection was carried out together with Nature Park Dobratsch Management to ensure representation across diverse zones within and around the Nature Park, including hot spots, low spots and border regions. Data integration involved aligning outputs from the different sources, enabling cross-validation of data.

The following section provides a detailed description of each method used in the project, including the rationale behind site selection and the practical steps taken during implementation.

4.1 Visitor Survey

The aim of the visitor survey was to better understand visitor satisfaction, mobility behavior, the use of digital tools for planning and navigation, and perceptions of visitor pressures. Particular interest was placed on visitors' attitudes towards the idea of establishing a cross-border protected area ("Peace Park") connecting Austria, Italy, and Slovenia.

The questionnaire was based on an existing survey instrument from Dobratsch Nature Park and was adapted and expanded for the purposes of this study. In its development, findings and recommendations from recent literature were incorporated (e.g., Arnberger & Brandenburg 2007; Behrens-Egge et al. 2023; Gonson et al. 2018; Koller 2019). The goal was to create a user-friendly survey format that combined both, closed and open questions, to allow for a nuanced analysis of visitor experiences and expectations. The visitor survey draft was presented to the Nature Park Council during their biannual council meeting and their feedback was considered for the finalization.

The final version of the questionnaire covered the following key topics:

- Basic sociodemographic data (e.g., age, gender, place of residence);
- Information on visitors' travel mode and destination within the region;
- Frequency of visits and typical activities;
- Sources of information and navigation methods;
- Use of outdoor and fitness apps;
- Perceptions of visitor numbers and infrastructure quality;
- Attitudes towards sustainability and cross-border cooperation.

To accommodate different visitor preferences, participants were given the choice to either complete the questionnaire directly on-site (paper-based) or online via a QR code.

Survey locations were selected based on visitor frequency and cross-border relevance. The primary sites included:

- Dobratsch Nature Park (summit area, hiking trails, Rosstratte, Alpine Botanical Garden);
- Dreiländereck (the border triangle between Austria, Italy, and Slovenia);
- Warmbad Villach (nature and archaeology trails, Maibacherl);
- Bad Bleiberg (Stollen hiking trail);
- Selected tourist facilities such as the Skywalk and geological trails.

The project team deliberately included both highly frequented areas and less visited locations to obtain a comprehensive picture of visitor flows and experiences.

Fieldwork was conducted during the main visitor season in order to capture a broad and diverse sample. A small team of interviewers (NADO interns and FFG interns) approached visitors at the selected sites, explained the purpose of the survey, and invited them to participate voluntarily and anonymously.

To minimize potential bias, data collection took place at different times of day and on both weekdays and weekends. This approach enabled the recording of seasonal and temporal variations in visitor behavior. Particular attention was paid to ensuring compliance with data protection standards (GDPR), and participants were informed about the anonymity and confidentiality of their responses.

In addition to the field survey, the QR code option provided an opportunity to reach visitors who preferred digital participation or who wished to complete the survey at a later time. The QR Code was promoted on NADO's, Region of Villach's and CUAS social media channels (Instagram and LinkedIn). Furthermore, Nature Park Dobratsch's municipalities published the questionnaire in their municipality's newspaper. Additionally, NADO prepared postcards that were distributed on the parking places of Villacher Alpenstraße.

4.2 Visitor Counting Devices

Within the INDIALPS project area nine visitor counting devices were installed for the purpose of monitoring the frequency of visitors along selected trails. Depending on the type of trail users (pedestrians and cyclists) different monitoring devices served for data collection.

The aim of this project was to establish a functioning system for automatic visitor counter data collection. We aimed to check the functionality of devices, the accuracy of data and the practicality for the purpose of visitor management in the Nature Park Dobratsch.

For this purpose (1) the functionality and accuracy of counters is being validated for the most visited paths (Rosstratte, Gipfelweg, Jägersteig, Almwirtschaft) using manual observations and trail cameras and estimating correction factors and (2) the data of all counters is continuously integrated into the EcoViso Dashboard, which serves the Nature Park as the platform for further data analysis and interpretation.

Due to the short period of data collection, it is not possible to interpret yearly trends, but of course the available data is summarized within the results section of the report.

At the Alpine Zone and Peak Zone of Nature Park Dobratsch one dual counter, monitoring pedestrian and cycling activities (Rosstratte) and two hikers' counters (Gipfelweg & Jägersteig) were installed:

- The dual counter at Rosstratte allows to estimate pedestrian visitor numbers on an hourly basis, adding to the already available monthly visitor numbers, collected for the past 10 years by the Nature Park Dobratsch. Additionally, it should allow to keep track of unofficial cycling activities on the alpine pastures;
- The dual counter at Nepomukbrücke was installed along the cycling trail near the Almwirtschaft Schütt. It is a highly visited location for both cyclists and pedestrians;
- Two pedestrian counters were installed along hiking trails in the Erlachgraben (municipality of Bleiberg - *Dobratsch Circular trail Stage 2*) and on the Kranzwandsteig (municipality of Arnoldstein). In the Erlachgraben the counter aims to monitor activities along the Dobratsch Circular trail. At Kranzwandsteig the Nature Park Management aims to understand the amount of visitor activities in the Nature protection area and Natura 2000 site Villacher Alpe;
- Two cycling counters were installed to monitor unofficial mountain bike activities at the New Kids trail (near Hundsmarhof) and the hiking path 17 (*Dobratsch Circular trail Stage 5*) between Oberschütt and Federaun;

- One hiking counter was installed on Dreiländereck on the newly established stage of the Dobratsch Circular trail (*Stage 4*). The “Via Alpina”, “Südalpenweg Stage 17”, “Kärntner Grenzweg”, “Panoramaweg Südalpen”, and “Karawanken Wanderweg” also pass along this trail.

Table 1 - Counter description with deployment place and time.

Counter	Type	Active since
Nepomukbrücke / Almwirtschaft	Dual (Pedestrian & Cyclists)	22.08.2024
Gipfelweg	Pedestrian	07.08.2024
Jägersteig	Pedestrian	05.08.2024
Kranzwandsteig	Pedestrian	07.08.2024
Rosstratte	Dual (Pedestrian & Cyclist)	23.06.2025
Schütt	Cyclist	23.06.2025
New Kids	Cyclist	05.08.2024
Dreiländereck	Pedestrian	23.05.2025

To check the accuracy of the devices, the counters along the most frequented trails were selected for validation. Rosstratte, Gipfelweg, Jägersteig and Nepomukbrücke counters were chosen for this purpose. This process is advisable, as automatic visitor counters tend to over- or undercount the number of visitors. This inaccuracy can be a result of the counter location, width of the path, the surrounding air temperature (in case of infrared sensors), the speed of passing visitors (especially relevant for bicycles), the group size (visitors passing very closely behind each other might be undercounted, visitors walking next to each other might be undercounted) and other factors, like big backpacks which can lead to double counts.

By comparing the manual counts (from field observations and/or trail camera recordings) and automated counts of the visitor counting devices during a fixed period, the potential miscounting and errors can be estimated. The over- and undercounting is mathematically determined and calculated via a linear regression analysis. Afterwards all counting data from the devices can be multiplied by the given factor to correct the data from errors.

The cameras were installed for a limited period of one to two weeks and removed immediately afterwards; all recordings were deleted in line with data protection requirements after counting the number of passes. Visitors were informed about the monitoring through signs placed between 20 to 100 meters before and after the camera, stating the purpose, time frame, and contact details. The recordings were used solely for statistical comparison, without any identification of individuals. This temporary and transparent approach ensured compliance with GDPR principles of purpose limitation, data minimization, and proportionality.

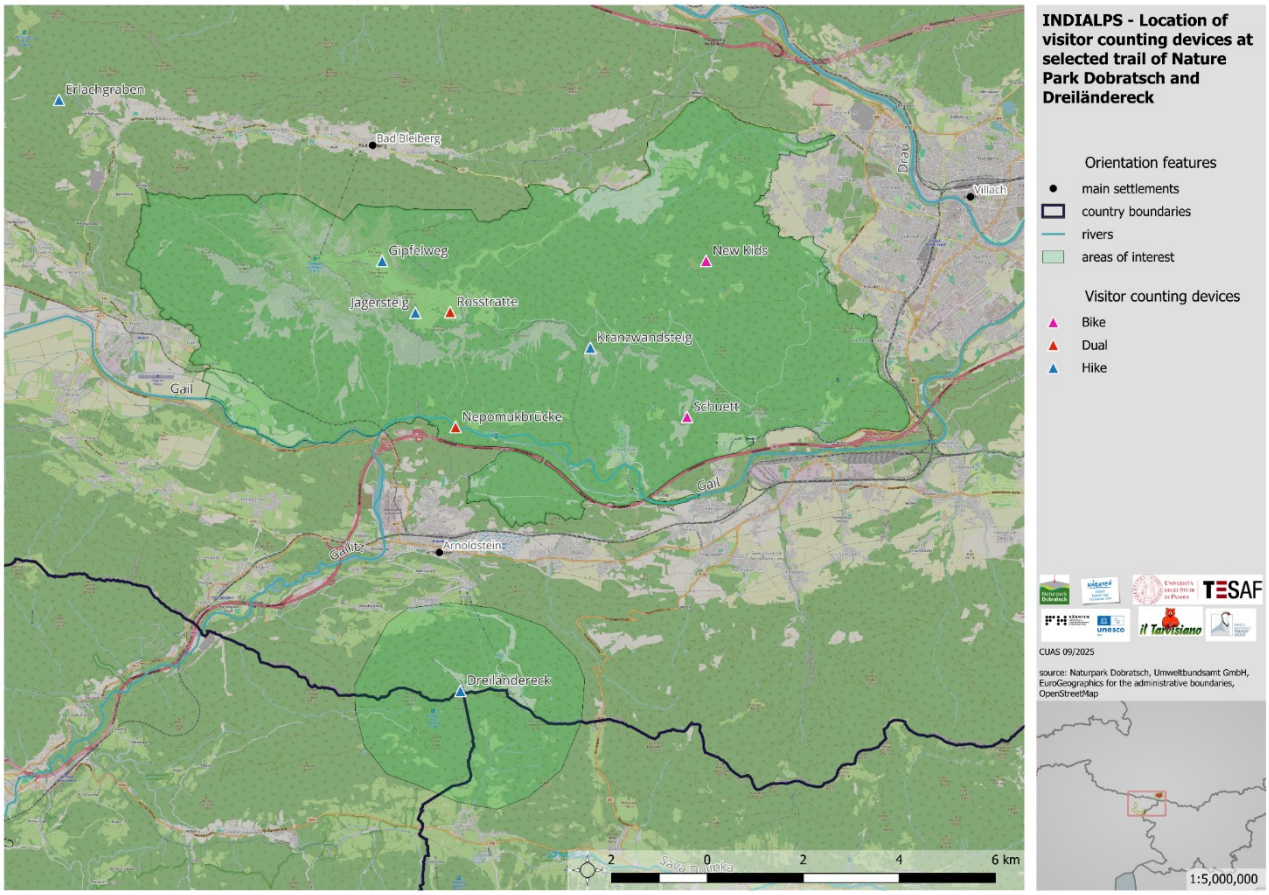


Figure 6 - Locations of visitor counting devices in the area of Dobratsch Nature Park and Dreiländereck.

4.3 Mobile Phone Data

Data from the mobile phone network provider A1 was acquired for the evaluation of visitors in the Nature Park Dobratsch. We received visitor data for the winter season 2023/24 (3 month - December - February) as well as for the summer season 2024 (4 month - June - September) for the time between 5.00 a.m. to 12.00 p.m.

The data was provided on the dashboard "Mobility Insights" as well as in CSV tables, including the following information:

- Total visitors: Daily count of visitors
- Daily distribution of visitors: Daily count of visitors in 10-minute-steps
- Socio demographics: Daily count of gender and age groups (<18 | 18 - 29 | 30 - 39 | 40 - 49 | 50 - 59 | 60 - 69 | 70 - 79 | >= 80) and
- "Home Location" - Origin analysis: Origin of visitors at municipality and district level (only for Austria). SIM ID of visitors is reassigned every 24 hours. Origin analysis indicates where visitors have spent their night prior to their visit.
- Arrivals - Departures: Arriving and departing visitors per hour from 5.00 until 23.00
- Duration of stay arrival time: Average time staying in the area in relation to arrival time (hourly)
- Duration of stay distribution: Daily duration of stay of visitors (10-minutes-steps)

Visitors are counted in steps of 10. Less than 20 visitors are marked as < 20 for data privacy reasons.

Nine areas of interest were defined together with the data provider, NADO and CUAS, addressing the needs of the Nature Park Management. Due to an unstable GSM connection due to bad network coverage within the Nature Park the areas of interest were defined broader to ensure that visitor's signals are counted during their stay in the dedicated areas.

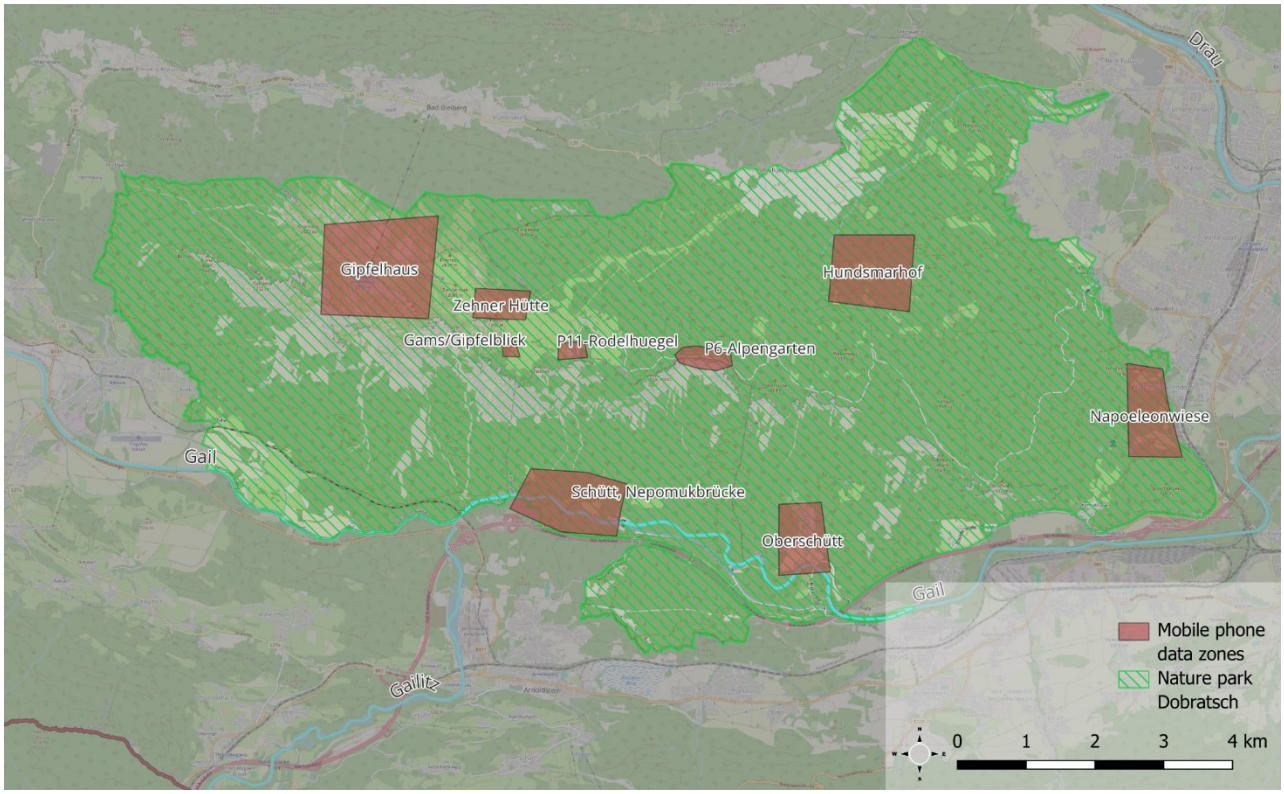


Figure 7 – Spatial distribution of mobile phones data.

Table 2 - Minimum and maximum length of stay at areas of interest.

Area of Interest	Minimum Length	Maximum Length
P6 - Alpengarten	0 h 1 min	4 h 0 min
P11 - Rodelhügel	0 h 1 min	5 h 0 min
Zehner Hütte	0 h 5 min	4 h 0 min
Gams/Gipfelblick	0 h 5 min	10 h 0 min
Gipfelhaus	0 h 5 min	10 h 0 min
Schütt - Nepomukbrücke	0 h 1 min	4 h 0 min
Oberschütt	0 h 5 min	4 h 0 min
Napoleonwiese	0 h 5 min	4 h 0 min
Hundsmarhof	0 h 5 min	10 h 0 min

4.3.1 Preprocessing of A1 Data in a Nutshell

To estimate visitor numbers from mobile phone data, the counted SIM cards need to be extrapolated with the market share of A1. The extrapolation is individually calculated for each SIM card "profile" and is based on up to 10 parameters. First, the visitor's "Home Location" is extracted. This information is derived from the area where the SIM card was logged in for at least 45 minutes in the time between 2.00 and 5.00 a.m. For each "Home location" an individual extrapolation

factor is used resulting in a “regional projection factor per municipality”. The factor is based on the market share of A1 within the municipality, touristic statistics like overnight stays, country of origin and other influencing factors. For foreign guests roaming in the A1 network “country-based projection factors” are used. These country based extrapolations are based on the percentage of roaming share per country.

One limitation of the mobile phone data is that it is not possible to derive the place of origin of visitors. This means that it is not possible to differentiate between a domestic tourist or local visitor unless the tourist has spent his/her night at his/her home location (i.e. Vienna) and went straight to Dobratsch on the next day. If he/she spent one or more nights at an accommodation in Villach or elsewhere he/she is counted as a visitor from this municipality. For foreign tourists it is possible to differentiate between country of origin as explained above. Another limitation is that visitors from outside of EU countries (i.e., Switzerland, US, Asia) often use E-Sim cards. This obscures their nationality as they are counted as Austrian citizens.

Depending on the area of interest the estimation of visitor numbers can be calibrated by changing the minimum or maximum time of stay of a visitor within the defined area. For example, at the Napoleonwiese in Warmbad a maximum duration of stay of 4 hours was defined, to exclude guests and staff from the spa resort, indoor pool, hotels, cafés and restaurants.

Data processing for Visitor Monitoring

As the data of A1 mobility insights was already provided in a processed format the report summarizes the main findings of these data. To understand the reliability of visitor estimation we are comparing the mobile phone data with data from our automatic visitor counter devices.

4.4 Trail Camera Analysis

This methodology comparison utilizes two of-the-shelf pre-trained models for the task counting vehicles. The first method is YOLOv12 (You Only Look Once version 12) (Tian et al., 2025). YOLO is a state-of-the-art object detection model, for real-time identification and localization of objects in images and videos. By default, YOLO comes pre-trained on the COCO (Common Objects in Context) dataset which is a large-scale benchmark for object detection, segmentation, and captioning, originally developed by Microsoft and collaborators, featuring 91 object categories, over 330,000 images, and 2.5 million labeled instances for computer vision research (Lin et al., 2014). By utilizing its built-in tracking capabilities, YOLO detects and tracks vehicles from selected classes (bicycle: class 1, car: class 2, motorcycle: class 3, bus: class 5) in short motion-triggered videos.

The second method is to use Microsoft's MegaDetector (MD). Developed by Microsoft's AI for Earth team, MD is an open-source object detection model designed to identify animals, people, and vehicles in camera trap images (Beery et al., 2019). MD comes with capability to detect three classes (person, animal and vehicle). Our focus is to leverage the “vehicle” class detection coupled with analysis of the detected vehicle bounding box to split “bikes” from larger vehicles.

The key element in this experiment is to avoid custom model training and to examine the feasibility and accuracy of relying on a stock model for such task.

4.4.1 YOLO approach

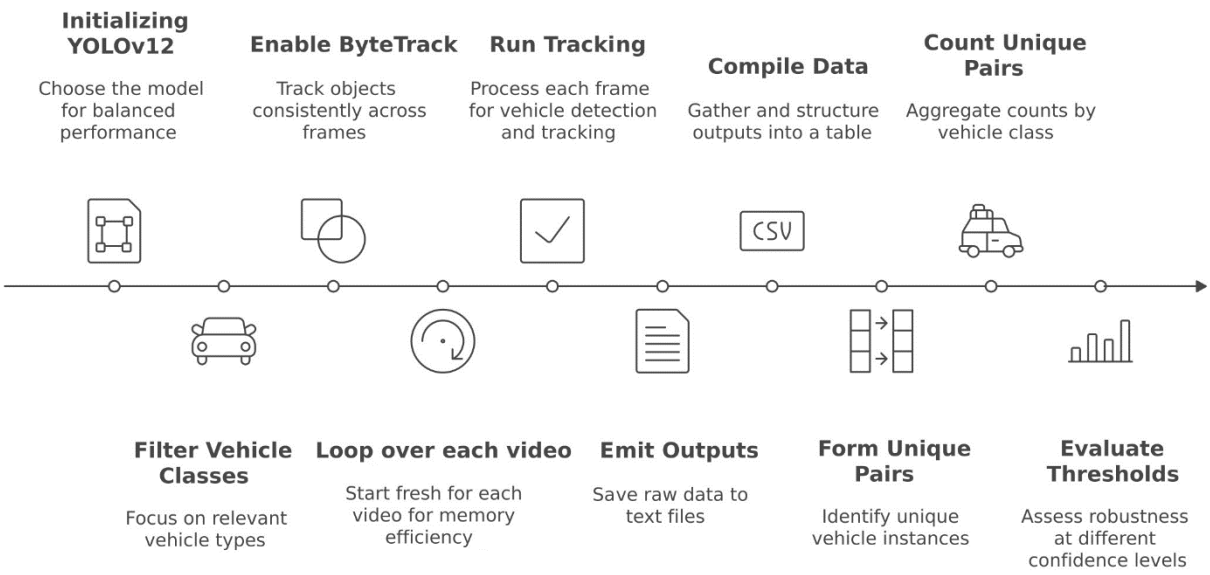


Figure 8 - YOLO Workflow.

The core of the pipeline uses YOLOv12's small variant (yolov12s.pt) for its balance of speed and accuracy on resource-constrained setups. The model processes each video independently, applying detection only to bicycles, cars, motorcycles and buses to filter irrelevant objects.

Tracking is enabled via the built-in ByteTrack algorithm, which assigns track IDs to detected objects across frames.

The code iterates over videos, reinitializing the model per file to manage memory and prevent memory outage.

Detection outputs are aggregated from text files into a structured format (e.g., CSV) via a simple gathering script. This stage compiles per-frame data across all videos without altering the raw detections.

Counting employs a unique combination approach: for each video, distinct pairs of (vehicle class, track ID) are identified. Since track IDs are unique per object within a video, the number of such pairs represents the count of unique vehicles of each type in that clip. Aggregation across videos yields total counts per location.

To evaluate sensitivity, the process is repeated at five confidence thresholds (0.25, 0.40, 0.50, 0.60 and 0.70):

Lower thresholds (e.g., 0.25) increase recall, capturing more detections but risking overcounting due to false positives.

Higher thresholds (e.g., 0.70) enhance precision, ensuring accurate detections but potentially undercounting faint or partial vehicles.

Figure 9 – YOLO tracking visualization.

4.4.2 MegaDetector approach

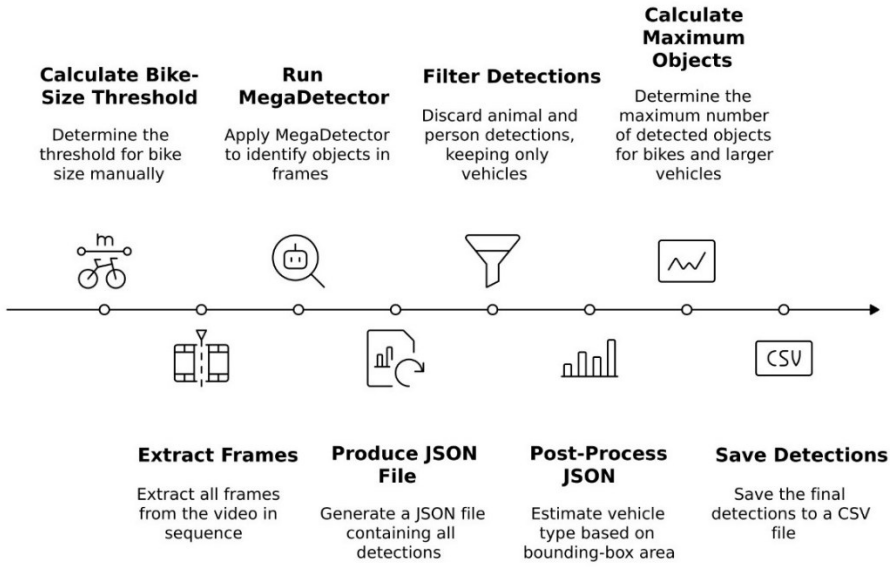


Figure 10- MD counting approach.

This approach starts by extracting all frames for each video in order. MD is then called leveraging the `run_detector_batch.py` script from the MD framework to process each frame. detection output is a JSON file containing the detection of each image. Because MD detects three classes we will suppress “animal” and “person” detections and process the “vehicle” detection. The JSON file undergoes further processing to enable vehicle type estimation. For each frame record within the JSON file, the code executes the following operation:

Vehicle Detections Undergo Further Classification based on Bounding Box Size

Larger vehicle: If the bounding box area is larger than a “bike-size threshold”; the vehicle is classified as larger vehicle

Bike: If the bounding box area is smaller than or equal to “bike-size threshold”, the vehicle is classified as a bike.

The “bike-size threshold” calculation is established by examining sample videos where bikes pass the frame. The maximum area of a bike observed in these videos will be considered “bike-size threshold”. This number differs from location to another depending on the camera placement at each location. Since we have two locations, it was calculated that the “bike-size threshold” is 26,000 pixels and 200,000 pixels for Villacher Alpenstraße and Dobratsch locations respectively.

As video frames are processed, the code keeps track of the maximum number of detected objects from each class (larger vehicles and bikes) at any given frame. Once the video processing is complete, a record is saved for the video, containing the maximum number of objects from each class that were detected throughout the entire video. To provide a quantitative summary of the results, a CSV file is generated for each video. This CSV file lists the maximum number of larger vehicles and bikes detected within the video.

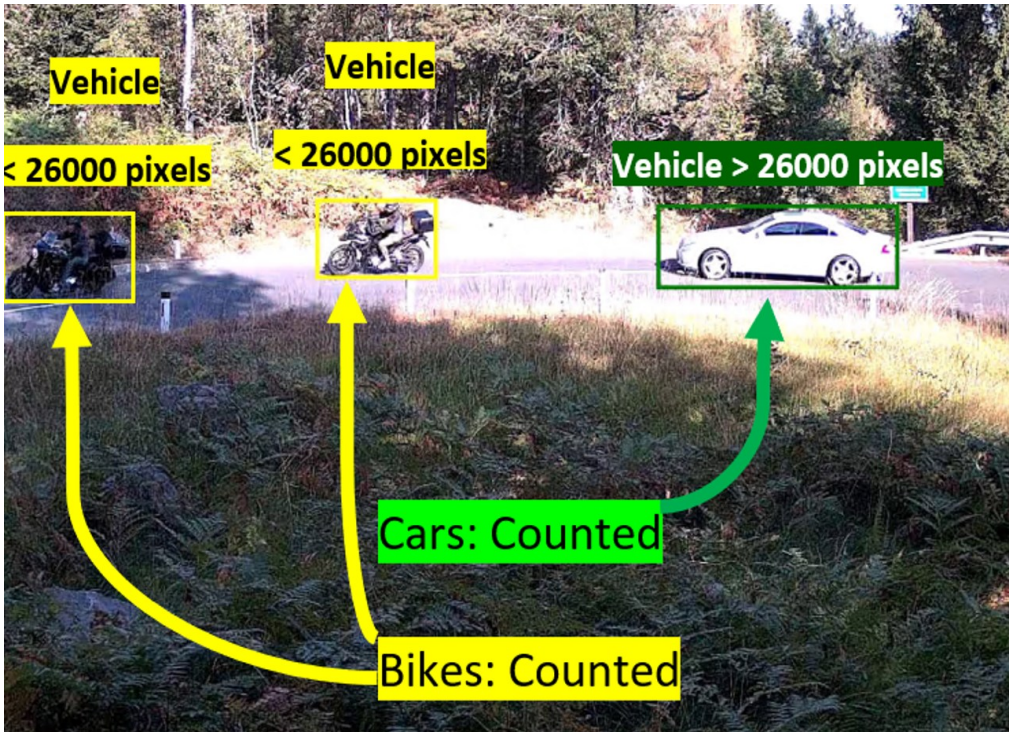


Figure 11 - MD result visualization.

As seen in Figure 11, it should be mentioned that MD has no built-in capacity to further classify the type of the vehicle after the “bike-size threshold” analysis. Meaning a “larger vehicle” could be a car, bus or a truck and a “bike” could be a bicycle or a motorbike without certainty on which class is present.

5 Results Visitor Analysis in the Dobratsch Nature Park

5.1 Evaluation of the Visitor Survey

5.1.1 Basic Sociodemographic Data (e.g., Age, Gender, Place of Residence)

From 202 respondents, 41,6 % were male, 55,4 % female, 1,5 % diverse and 1,5 % without specification. The respondents were aged between 18 and 86 years, the average respondent's age was 46. Around 86 % of respondents were from Austria (174), 11 % from Germany (22). Furthermore, 4 respondents came from the Netherlands (4), as well as one Italian and one US citizen. Around 76 % of Austrian respondents (154) were from Carinthian municipalities. As illustrated in the map below, the majority of respondents came from the district of Villach and Villach Land as well as Klagenfurt / Klagenfurt Land.

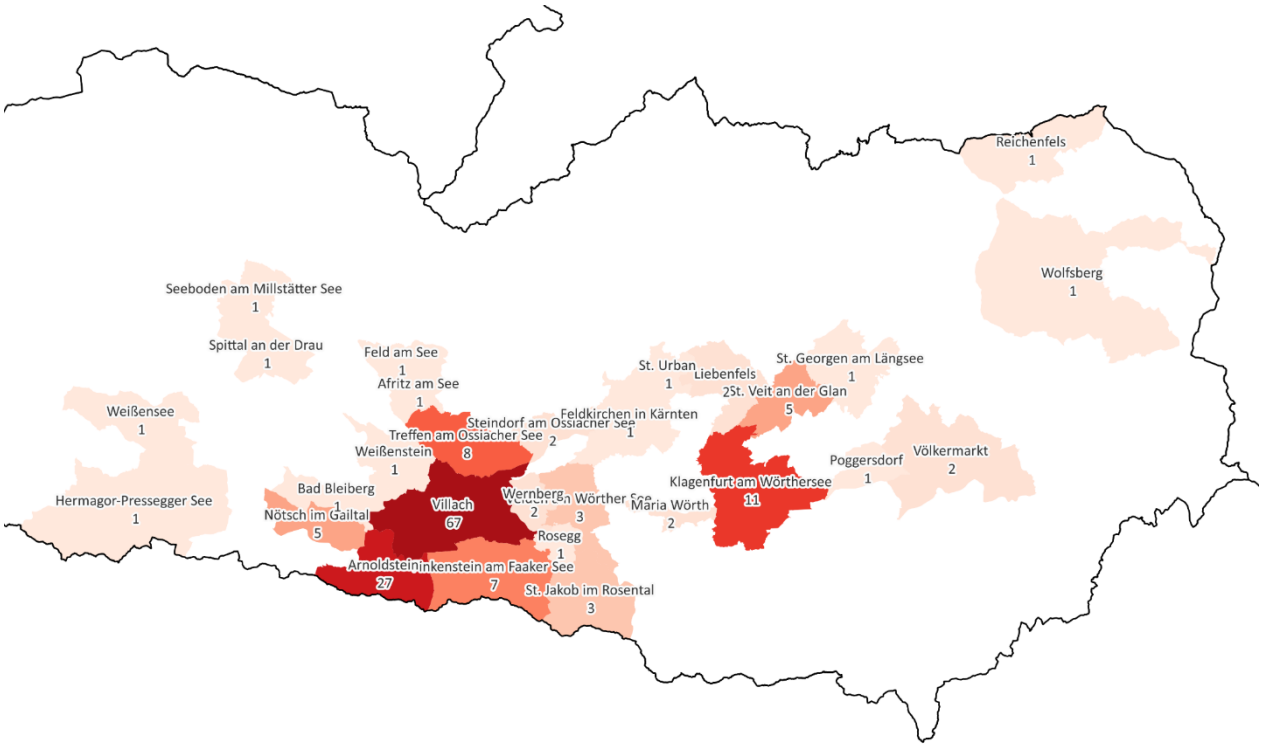


Figure 12 - Carinthian visitor distribution.

5.1.2 Visitors' Destination and Travel Mode within the Region

Destination

We reached 80 respondents visiting Dobratsch, 72 respondents not planning any outdoor activities on the day of the survey, 11 respondents taking the Dobratsch Circular Hike, 17 visiting the Dreiländereck, 10 visiting the Baumgartnerhöhe as well as 12 visiting other areas within the broader region (Gerlitzen, Ossiacher See, Mt. Luschari).

For the further analysis, the visitors were grouped into three groups: (1) Dobratsch visitors (80), (2) Other areas visitors (50), (3) no visit planned (73).

Transportation

Most of the respondents used a private car to visit the area of Dobratsch (85,2 %). A total of 7 respondents used the Nature Park Bus (8,6 %) to reach the area. The rest of the visitors either arrived on motor bikes or bicycles.

For other areas 69 % of visitors used their private car, 19 % arrived by bicycle and 8,6 % arrived by e-bike to their destination.

5.1.3 Information About the Area and Planning of Outdoor Activities

Visitor Familiarity

The majority of visitors (57.89%) reported that they live in the region. This indicates that Dobratsch is primarily a local attraction, drawing significant interest from nearby communities. Its accessibility and familiarity likely make it a popular choice for regional residents.

Recommendations from friends and acquaintances accounted for 18.42% of responses. This highlights the importance of personal connections and word-of-mouth as a key driver for attracting visitors. Positive experiences shared by others play a significant role in promoting the area.

Traditional print media continues to be an important source of information for the Nature Park. Other print materials, such as brochures, books, and hiking maps, influenced 11.84% of visitors, while newspaper reports and magazines (both print and digital) accounted for 5.26%. These findings suggest that printed resources remain a trusted and effective way to reach potential visitors.

Digital platforms also play a role, though they are less influential compared to local knowledge and word of mouth recommendations. Internet searches and websites were cited by 10.53% of visitors, while social media platforms like Instagram and Facebook contributed 2.63%. Digital maps, such as Google Maps, were mentioned by only 1.32% of respondents, indicating that while these tools are useful for navigation, they are not a primary source for discovering Dobratsch.

The Kärnten Card, a regional tourism card, was responsible for 7.89% of visitors learning about Dobratsch. This demonstrates that organized tourism initiatives in promoting the area can be effective. Additionally, nature park rangers and recommendations from accommodation providers each contributed 2.63%, showing the value of on-the-ground efforts to engage visitors.

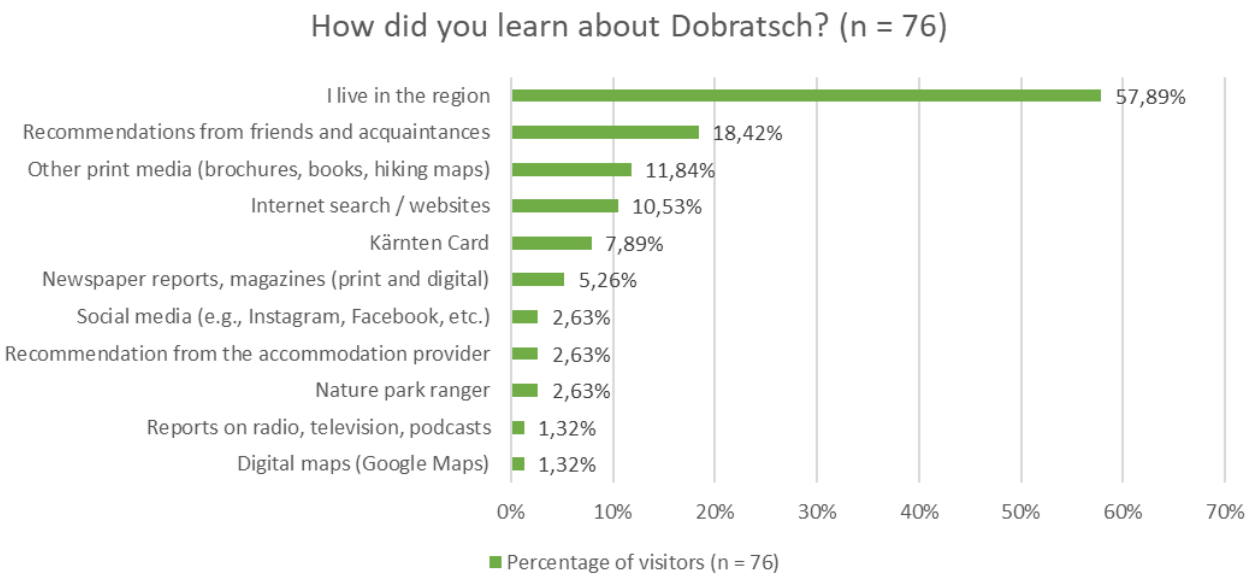


Figure 13 - Visitors informed about the Dobratsch Nature Park.

Frequency of Visits and Typical Activities

Around 34 percent of respondents visited Dobratsch for their first time, 32 percent of them visited the area between 2 and 10 times in the last five years, and around 33 percent visited the area more than 10 times in the past five years.

Visitors were asked which activities they planned to carry out on the day they took the survey. Dobratsch appears to be a destination mostly focused on walking/hiking and leisure activities, while the surrounding areas are more popular for cycling (Baumgartnerhöhe, Gerlitzen, Ossiacher See). The higher percentages for leisure/gastronomy and culture/education at Dobratsch suggest that it has a better developed infrastructure for tourism and recreation compared to the surrounding areas.

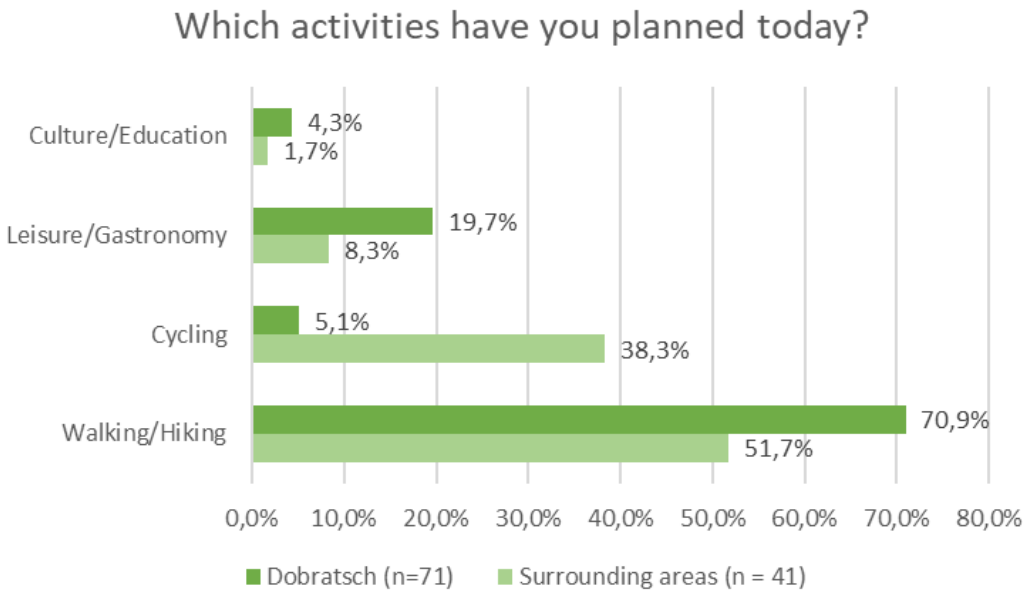


Figure 14 - Frequency of activities at Dobratsch and surrounding areas on the day of survey.

Next, survey participants were asked which activities they usually carry out in the area. They could choose on a scale from 0 to 6 (*0 = never; 1 = once, 2 = sometimes; 3 = once per month, 4 = multiple times per month, 5 = once per week, 6 = multiple times per week*). Also here, the data highlights that Dobratsch is primarily a destination for hiking and walking, with some engagement in leisure and gastronomy. Other areas offer a wider variety of activities, particularly cycling (especially mountain biking and e-biking). Participants that were not visiting a specific area on the day of the survey, were asked which activities they usually carry out in the region of Villach. Walking/hiking and leisure activities dominate, probably reflecting their integration into daily life.

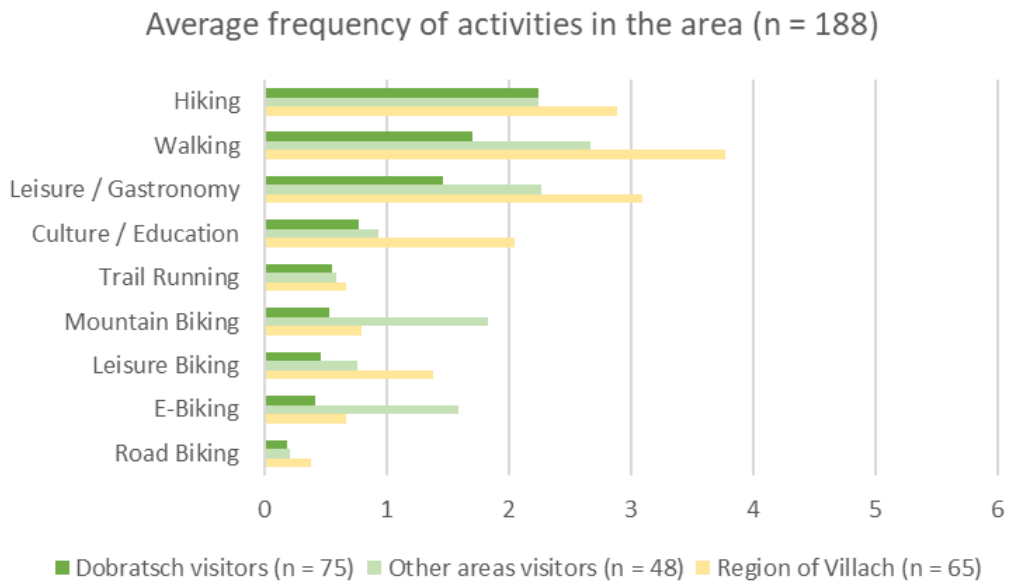


Figure 15 - Frequency of typical activities at Dobratsch and surrounding areas.

Frequency of Using Information Sources for Planning Outdoor Activities

The next question provides insights into the various sources of information or tools used by participants (n = 185) when planning outdoor activities. The results highlight the importance of digital tools (e.g., internet searches, digital maps, and social media) and personal recommendations in planning outdoor activities.

Kärnten Card as well as information boards on site reach a score of 1,05 and 1,00 (mean value), which indicates a moderate usage. Outdoor platforms and apps as well as social media, like Instagram, reach average scores of 0,93 and 0,90 showing that they are also contributing to the planning of outdoor activities.

Traditional sources such as print media and reports on radio or television are less frequently used.

The correlation between gender, age and the use of digital planning tools was considered investigating a Spearman correlation:

Not surprisingly, younger individuals are more likely to use digital tools such as Google Maps, social media, and internet searches/websites for leisure planning. Age is negatively correlated with the use of Google Maps ($r = -0{,}197$; $p = 0.009$), social media ($r = -0.207$; $p = 0.006$), and internet searches/websites ($r = -0.214$; $p = 0.004$).

Strong to moderate positive correlations exist between the use of the various digital tools, suggesting that individuals who use one type of tool are likely to use others as well. For example, respondents using Google Maps are very likely to use other outdoor platforms and apps ($r = 0.655$; $p < 0.001$). The strong interrelationships between the digital tools

suggest that cross-platform compatibility and integration could enhance user experiences and encourage broader adoption.

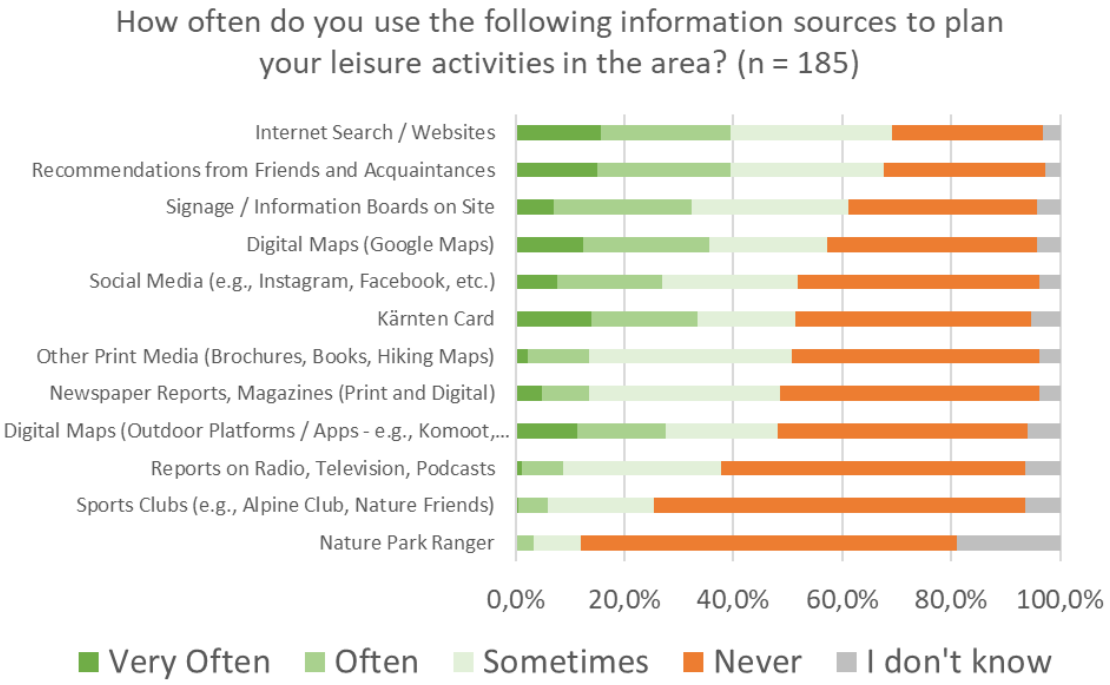


Figure 16 - Information sources to plan outdoor activities.

Information Sources Used to Learn about Nature and Behavioral Guidelines

The survey results show that signage and information boards on-site are the most commonly used sources for learning about nature and behavioral guidelines, cited by 17.9% of respondents. Internet searches and websites follow at 13.6%, while 11.2% of participants stated they do not seek such information at all. Other notable sources include recommendations from friends and acquaintances (8.0%), social media (7.8%), and print media such as brochures or hiking maps (7.8%). Less frequently used sources include newspaper articles (5.9%), digital maps (3.7–5.6%), and sports clubs (3.2%). Only a small portion rely on radio or television reports (2.9%) or Nature Park Rangers (2.7%). Overall, the data indicate that on-site and online resources play a key role in information-seeking about nature-related behavior.

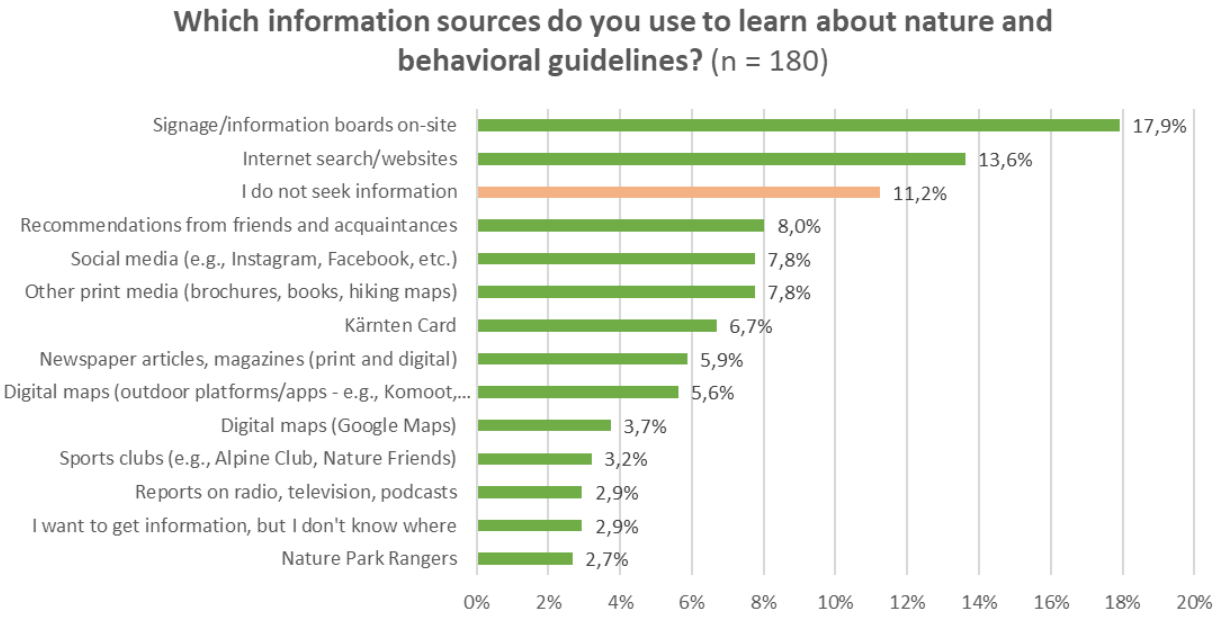


Figure 17- Information sources used to learn about nature and behavioral guidelines.

5.1.4 Use of Outdoor and Fitness Apps

The data provides insights into how respondents use various digital tools and features to plan and execute their outdoor activities in the area.

Google Maps and Bergfex are the most widely used tools for planning outdoor activities in the area, with high regular usage and low unfamiliarity. Tools like Outdooractive, Komoot, and Garmin are moderately popular but have higher levels of unfamiliarity. Specialized tools like Strava and Alpenvereins App are used by niche audiences, while tools like Wikiloc, Mapy.cz, and Alltrails are largely underutilized and unfamiliar to most respondents.

Recording Your Own Tour (Tracking) is the most frequently used feature, with 22.47% of respondents using it "Very often" and 9.55% "Often." Combined, 32.02% of respondents use this feature regularly, indicating its importance for users who actively track their activities.

Navigation in the Terrain is also popular, with 16.29% using it "Very often" and 17.42% "Often." Combined, 33.71% of respondents use this feature regularly, highlighting its utility for outdoor navigation.

Searching for Tour Suggestions (Planning) is another widely used feature, with 12.36% using it "Very often" and 18.54% "Often." Combined, 30.90% of respondents use this feature regularly.

Features related to sharing, such as Sharing Photos and Sharing GPS Tracks with Friends, are moderately popular. Features like Commenting on Tour Suggestions, Heatmaps, and Sharing POIs/Highlights are rarely used, indicating limited interest or awareness among respondents. Furthermore, sharing GPS tracks publicly is regularly used by only around 9,55% of respondents. However, 80.90% of respondents "Never" use this feature, indicating limited interest in public sharing.

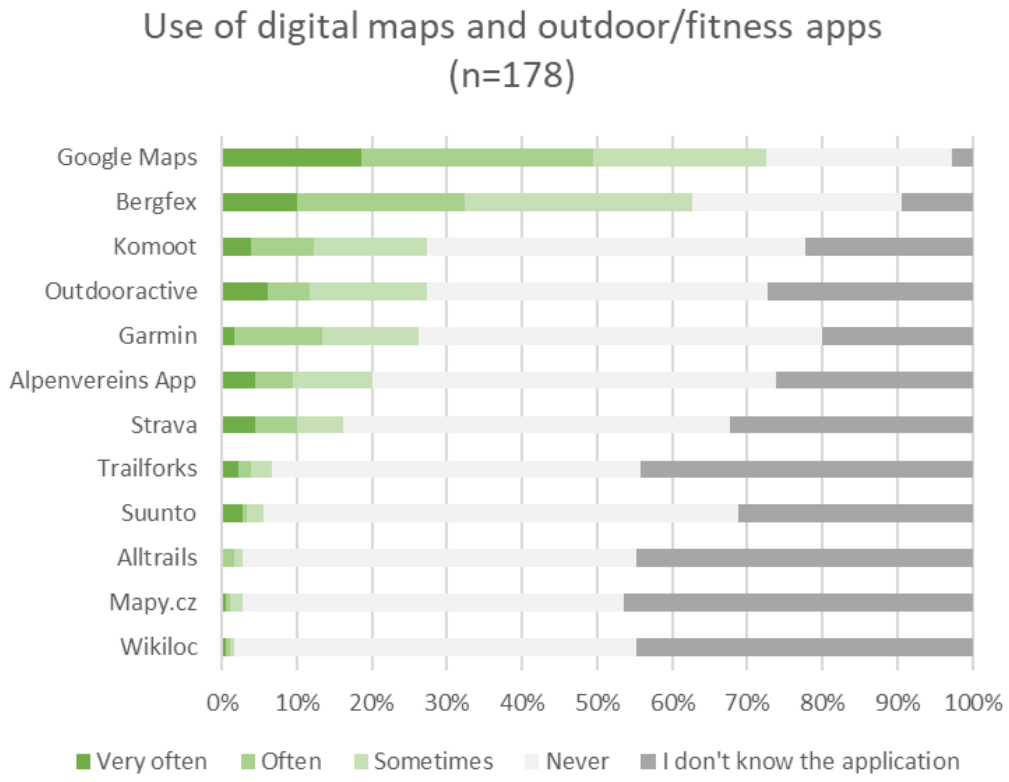


Figure 18 - Outdoor and fitness apps for planning, navigating and recording of outdoor activities.

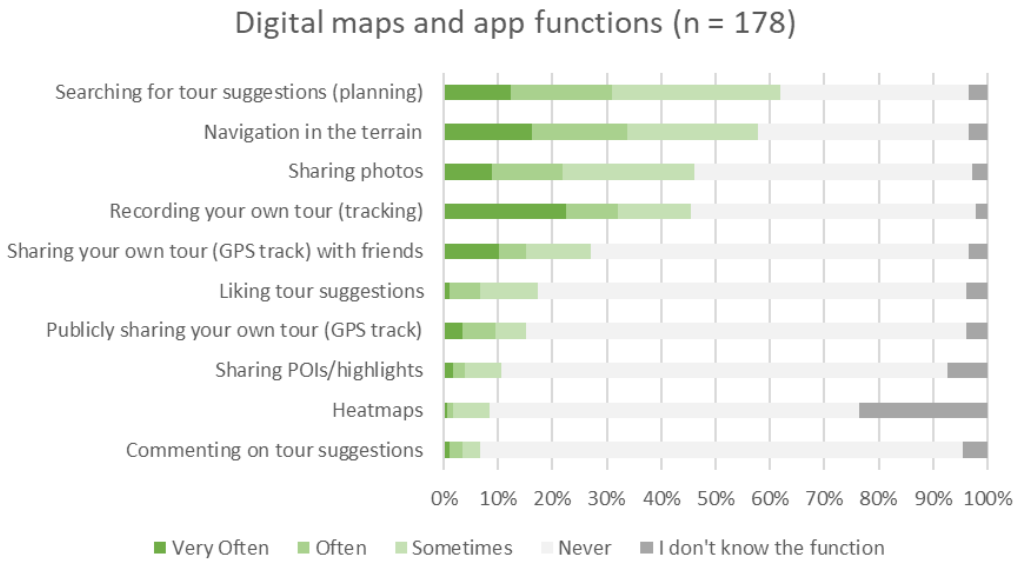


Figure 19 - Functions of outdoor and fitness apps.

5.1.5 Opinions About Touristic Offers in the Region of Villach

Evaluation of Tourist Attractions around Dobratsch Nature Park

The data provides insights into how visitors rate various tourist attractions in and around the border triangle and the Dobratsch Nature Park. Visitors rated the attractions on a scale ranging from "Very good" to "Not at all," with an additional category for "I don't know."

The data highlights a clear distinction between highly rated, well-known attractions and those with lower ratings or limited awareness. Key attractions such as the Villach Alpine Road, Summit Area of Dobratsch, and Viewing Platform / Ski Hiking Trail on Dobratsch (P6) are highly appreciated.

Conversely, attractions like the Cultural Hiking Trail in Arnoldstein and the Exhibition “The Bird World of Dobratsch Nature Park” require targeted marketing to increase awareness and improve visitor reception. Additionally, attractions with moderate ratings and high "I don't know" responses, such as the Geological Educational Trail on Dobratsch and the Mining Tunnel Hiking Trail in Bad Bleiberg, may benefit from enhanced visibility and development efforts.

The Chairlift Dreiländereck received 21.97% "Very good" ratings and a combined positive rating of 37.58%. However, it also had relatively high negative ratings, with 9.83% rating it "Little" and 12.14% rating it "Not at all." During the summer season when the survey was conducted, the municipality of Arnoldstein was in the process of searching for a new operator for the chairlift. As a result, the chairlift was not operational, which likely contributed to dissatisfaction among respondents. The lack of availability may have negatively influenced the ratings, as visitors were unable to experience the attraction during their visit.

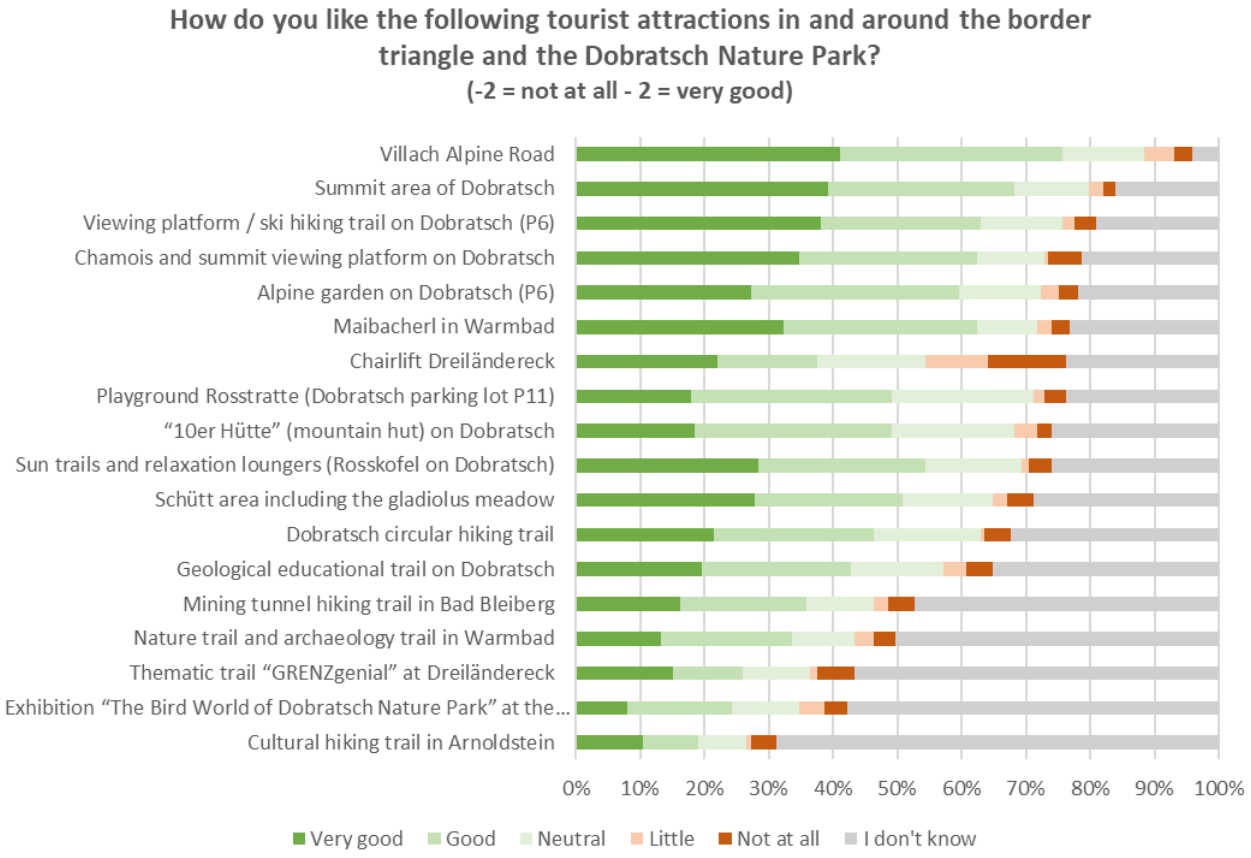


Figure 20 - Opinions about touristic offers in the region of Villach.

Importance of Chairlift at Dreiländereck

We asked respondents how important the chairlift at Dreiländereck (n=60) is for them. The data indicates that the chairlift at Dreiländereck is considered important by the majority of respondents (58.34%), with a smaller group (18.33%) viewing it as unimportant or unnecessary. The relatively high percentage of neutral responses (23.33%) suggests that about one fourth of visitors may not have strong opinions about the chairlift, potentially due to its current

non-operational status during the survey period. This highlights the potential for increased importance and satisfaction if the chairlift becomes operational again.

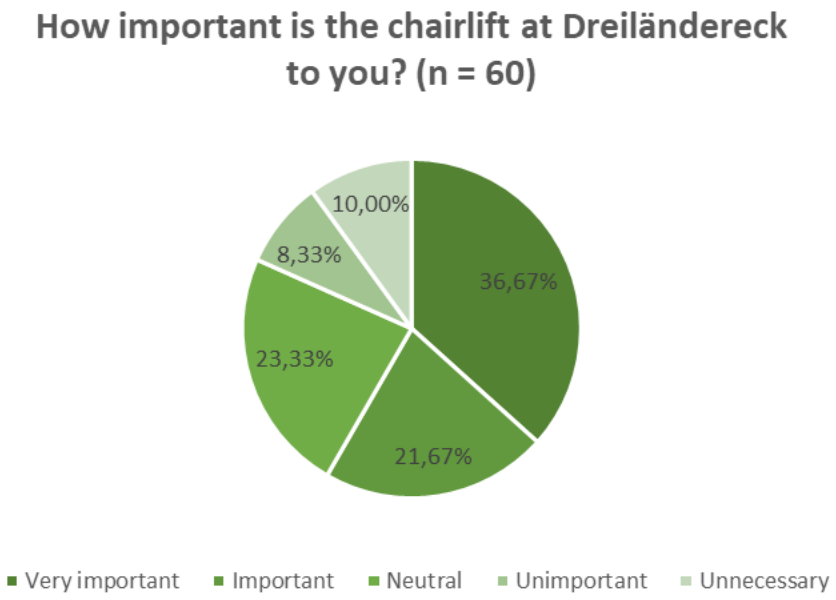


Figure 21 - Importance of the chairlift at Dreiländereck.

5.1.6 Social Carrying Capacity

Evaluation of Visitor Numbers

A comparison was made between perceived crowdedness on Dobratsch during the summer season and the actual visitor numbers on the day the survey was conducted, with visitor numbers based on mobile phone data. A Spearman correlation analysis of 70 valid responses revealed a statistically significant positive but weak association between perceived visitor pressure and visitor numbers at Rosstratte ($r = 0.266$, $p = 0.026$). This suggests that increased visitor numbers tend to be associated with a higher perception of visitor pressure at the site.

Almost two-thirds of respondents (61%) perceived the Dobratsch area as quiet and uncrowded during their visit. Another quarter (24%) reported that there were some people around, but still plenty of space. Additionally, 6% experienced a moderate crowd, while 9% found the area to be very crowded — for some, even to the point of being unpleasant.

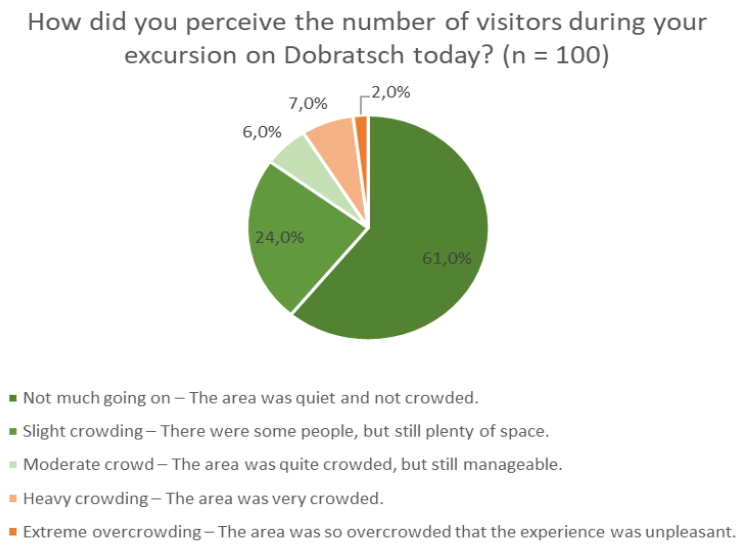


Figure 22 - Visitor carrying capacity

Destination Plan based on Visitor Numbers

Around 50% of respondents indicated they would be willing to choose a different destination if informed about high visitor numbers on the day of their planned visit. The remaining participants either would not change their behavior or were unsure how they would decide in such a situation.

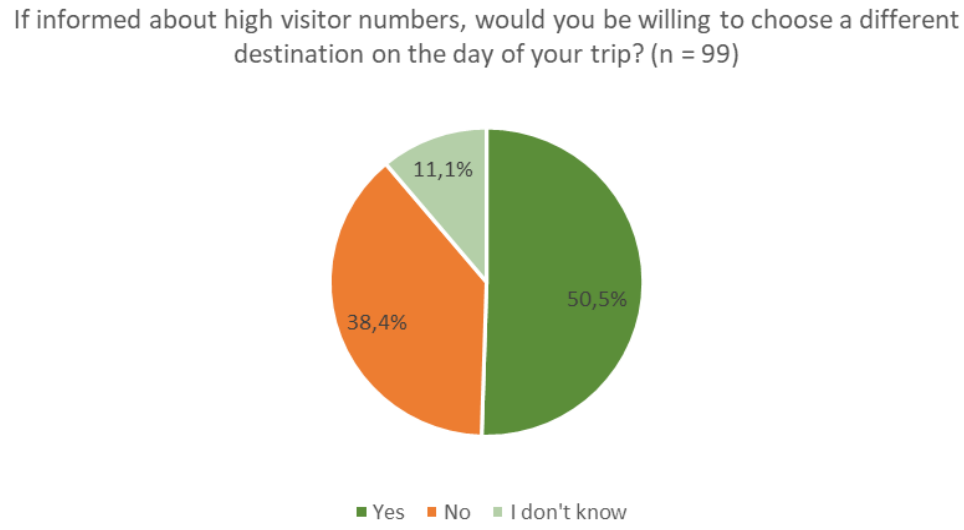


Figure 23 - Willingness to change destination based on visitor numbers.

Activity Plan based on Visitor Numbers

Almost half of the respondents (47.1%) stated they would continue visiting the area at the same time as before, without changing their behavior in response to perceived crowding. The remaining respondents indicated they would adjust their behavior — by visiting during the off-season, on weekdays, or at less busy times of the day (such as early mornings or late afternoons). Choosing alternative destinations was mentioned by only 2% of respondents, while 7.8% were unsure how they would decide.

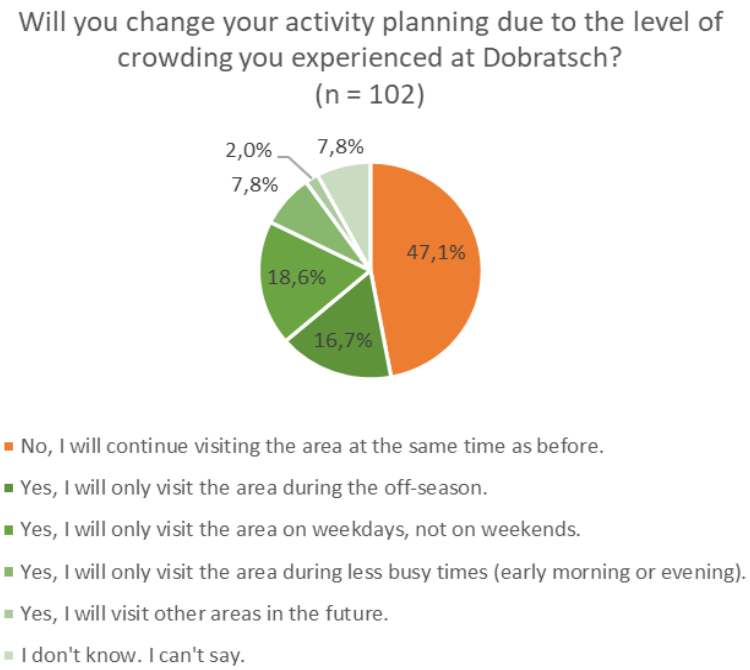


Figure 24 - Willingness to change activity plan based on visitor numbers.

5.1.7 Attitudes Towards Sustainability and Cross-Border Cooperation

Visitors and Nature Connection

The majority of respondents feel a strong connection to nature, with higher ratings (5, 6, and 7) being the most frequently selected. Very few respondents rated themselves as disconnected from nature (1 or 2), indicating that most people feel at least some level of connection to the natural environment. Dobratsch is particularly effective at fostering a deep connection to nature, with the highest proportion of respondents feeling "one with nature" (rating 7).

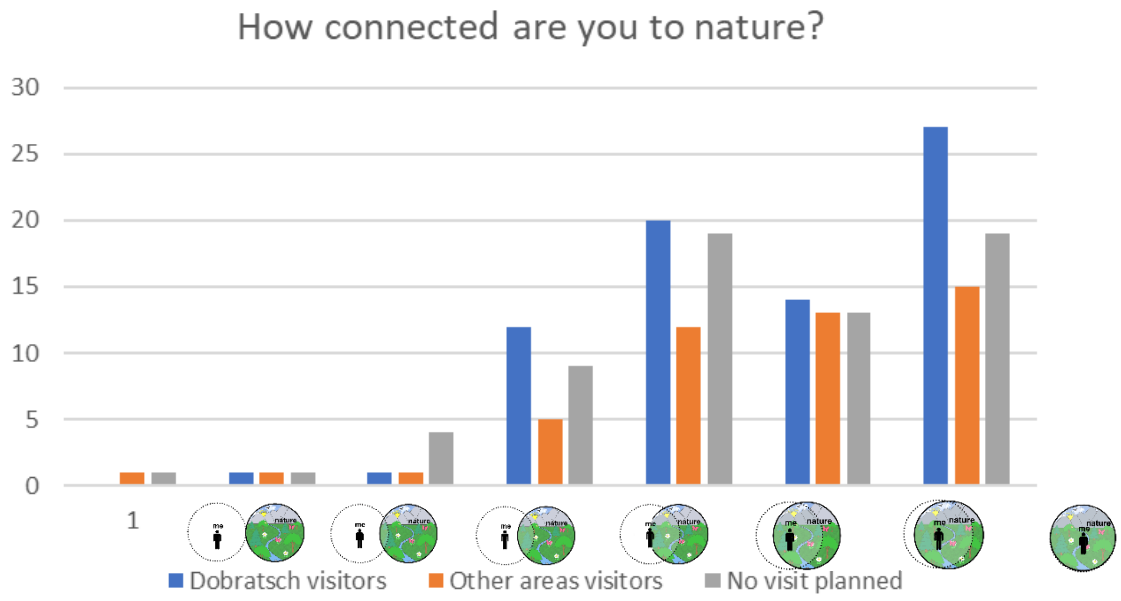


Figure 25 - Connection rate with nature on a scale from 1 (disconnected) to 7 (one with nature).

Creation of a Cross-Border Area (Peace Park)

More than 72% of the visitors are supporting the idea of a potential peace park between Austria, Italy and Slovenia. This is a really promising result for the future of the region.

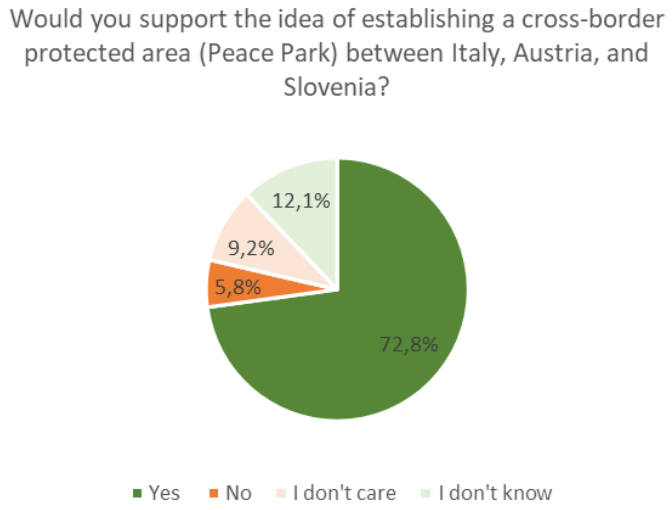


Figure 26- Opinion on cross-border protected area establishment.

Comments on the Peace Park

Figure 27- Awareness and understanding of a cross-border protected area between Austria, Italy and Slovenia.

Uncertainty/lack of knowledge (approx. 30–35% of responses): Many people say they have no idea or are unfamiliar with the concept (“I don't know,” “No answer,” “That's your idea!!!”).

Criticism/skepticism: Some consider the concept to be immature or superfluous (“pseudo-protected areas,” “not credible,” “not needed”).

High potential for the idea of a peace park, especially in the areas of nature conservation, international cooperation, and sustainable tourism.

Need for information and communication: The term needs to be explained more clearly and made more tangible.

Additional Comments

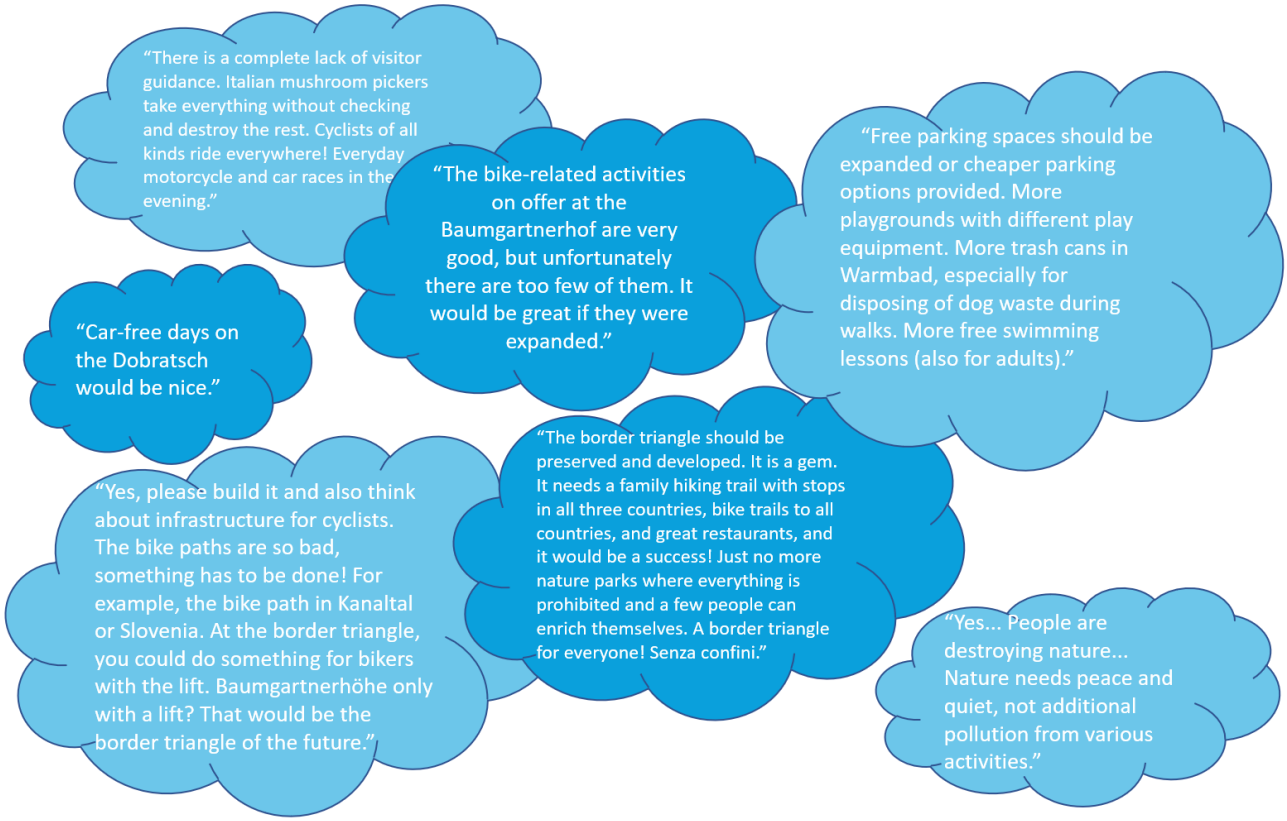


Figure 28 - Feedback to the survey.

5.1.8 Winter Qualitative Evaluation

The overall feedback reflects a strong emotional connection to the Dobratsch and a generally positive attitude toward the nature park. At the same time, there is clear criticism regarding the quality and accessibility of the summit lodge, as well as concerns about traffic—especially a desire for improved public transport and more sustainable mobility solutions.

Figure 29 - Feedback winter qualitative evaluation.

5.2 Evaluation of Visitor Counting Devices

Automatic visitor counters allow estimating the frequency of use of selected trails. Depending on the type of device they can provide information about the total number of passes, the direction of passes as well as the temporal distribution of passes. Some devices can differentiate between the user type (i.e., pedestrians, cyclists).

5.2.1 Accuracy Testing

Especially when setting up a new visitor monitoring system it is highly recommended to do an accuracy test. With the accuracy tests of visitor counting devices, we could show that the individual locations of automatic visitor counters play a significant role in the accuracy of data. Counts as they are cannot be trusted and need to be carefully evaluated and corrected to get a better estimation of visitor numbers.

Trail Camera Analysis - Jägersteig

We evaluated trail camera data in the period of the 30th July - 5th August and from 24th August - 28th August 2025. Manual counting was performed by our trainees and documented as passes per hour. For the period from the 30th July to the 5th August the counting did not consider the direction which is why we installed the camera for another period to understand the accuracy of directional counting.

Main results for total passes:

- For the period of evaluation 30th July - 5th August and from 24th August - 28th August 2025 the automatic visitor counter significantly overcounted passes. 232 pairs (hours) were recorded in the period. Pairs of 0 counts were removed from the analysis, the remaining 102 pairs were analysed;

- There is a strong positive correlation between the automatic counter and the manual counts: $r = 0.890$, $p < .001$;
- The linear regression model allows to explain 79,2 % of the variance ($R^2 = 0.790$). The standard error of estimate is 4.773 which means that the typical prediction error is around 5 people;
- The linear regression formula is *Manual Count=0.08+0.728×Ecocounter*;
- Since the intercept was not significant and, in terms of content, zero manual observations are to be expected with zero visitor counts, the model was calculated without an intercept.

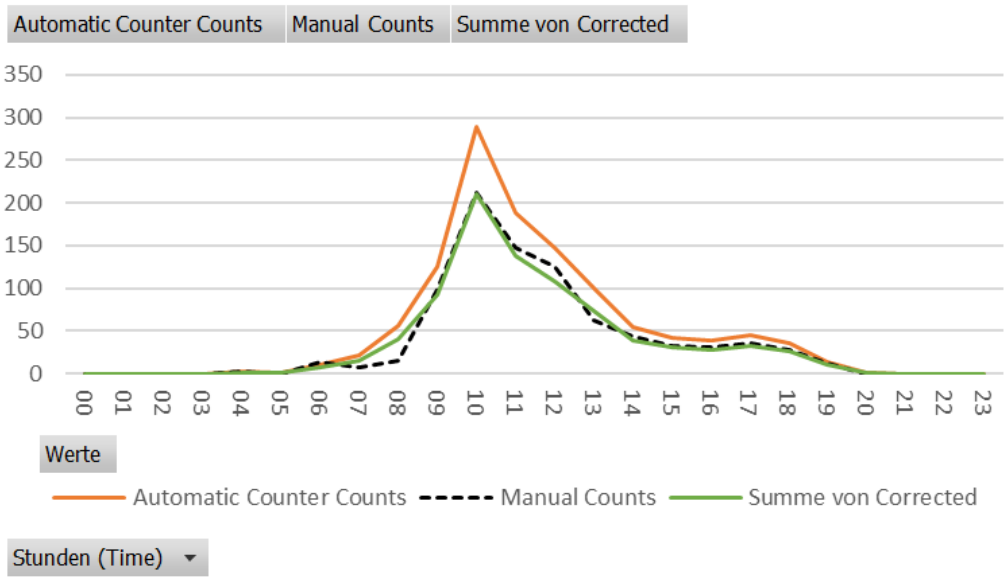


Figure 30 - Different results from automatic, manual and corrected counters.

Main results for directional passes:

- **Statistical tests (Wilcoxon signed-rank test and correlation analysis) strongly indicates that the counters direction is mixed up:**
  - The "Out" sensor (direction to Gamsblick) is picking up In movements;
  - The "In" sensor (direction to peak) partly overlaps with In counts, but does *not* capture Out counts correctly.
- Wilcoxon signed-rank tests revealed no significant differences between Manual_In counts and Eco_Gipfel ($Z = -1.68$, $p = .093$) or Eco_Gams ($Z = -0.46$, $p = .647$). In contrast, both Eco_Gipfel ($Z = -5.60$, $p < .001$) and Eco_Gams ($Z = -4.81$, $p < .001$) differed significantly from Manual_Out counts. Correlation analysis supported this pattern: Eco_Gams, intended to record outgoing movements, correlated most strongly with Manual_In ($r = .86$, $p < .001$), while Eco_Gipfel correlated moderately with Manual_In ($r = .65$, $p < .001$) and Manual_Out ($r = .57$, $p < .001$). These results suggest that the device misclassified directional movements;
- The device is not distinguishing the directions properly;
- Instead of one channel reflecting *incoming* and the other *outgoing*, both device streams behave like “In” counts.

Directional manual counts: The short observation period of 4 days indicates that most hikers use the Jägersteig in the direction of the peak. 326 hikers (86,47 %) walked in the direction of Dobratsch peak while 51 hikers (13,53 %) walked in the direction of Gams and Gipfelblick. A longer period of observation would be necessary to estimate the directional proportions correctly.

Qualitative field observations - manual counting

To get a first understanding of the accuracy of Rosstratte, Gipfelweg and Nepomukbrücke counters we send CUAS trainees to the field to manually observe visitor traffic at the counter locations. For further investigation during the INDIALPS project between the 26th September and 10th October 2025 we have installed trail cameras next to the counters to better estimate the miscount of the automatic counter and use a linear regression model to correct it.

Trail Camera Analysis - Rosstratte

For the period of two days, CUAS trainees (30th July and 5th August 2025 between 9.00 and 15.00) manually counted passing visitors at Rosstratte counter. Results from the manual counting document a total of 1.323 pedestrians passing in the direction of the peak, while 994 pedestrians were passing in the direction of the main parking area of Rosstratte during these two observation days.

A qualitative comparison between the counter counts and the manual counts for pedestrians reveals that:

- Seven percent overcount: more pedestrians were counted by the automatic visitor counter;
- Directional counting shows relatively consistent overestimation of the Out-sensor and inconsistent estimation of the In-Sensor (with underestimation in the morning and overestimation in the evening).

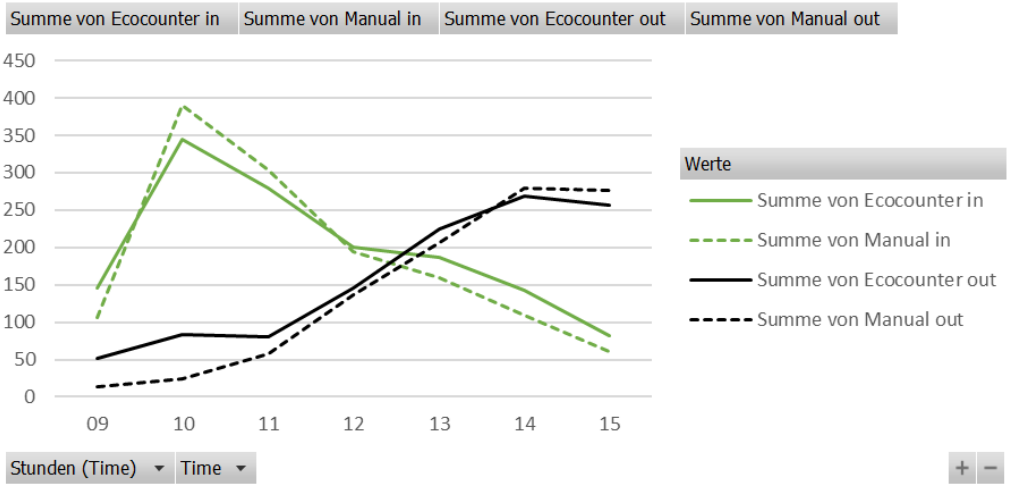


Figure 31- Pedestrian difference between automatic and manual counters including direction.

A qualitative comparison between the counter counts and manual counts for cyclists reveals completely wrong numbers of the visitor counter. The induction loop is most likely influenced by passing motor vehicles. While during the manual observation for the two days no single bicycle passed, the automatic counting device counted a total of 13 bicycles. During the same time 8 motor vehicles passed the counter.

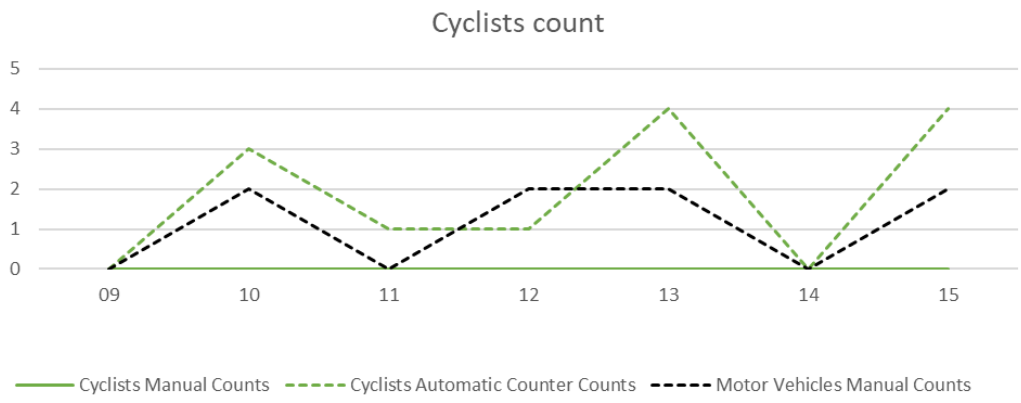


Figure 32 - Cyclist automatic and motor vehicles manual counter.

Trail Camera Analysis - Gipfelweg

During the same days CUAS trainees manually counted passing visitors at Gipfelweg counter:

- 30.07. - 11:00 - 15:00
- 05.08. - 10:00 - 15:00

A qualitative comparison between manual counts and automatic counter counts shows concerning variations between them. Around 17 percent of total passes are undercounted, 27,4 percent in the direction of the peak and 7,2 percent in the direction of the valley. Looking at the diagram below it shows that the undercounting is not consistent.

During the two days of manual observations 522 hikers passed in the direction of the peak and 578 hikers passed in the direction of the parking.

One reason for the undercounting could be an unsuitable position of the counter. It was positioned on an avalanche barrier next to the hiking trail one meter setback. The sensor is obscured in the direction of the peak which could be one reason for the undercounting and the misinterpretation of direction.

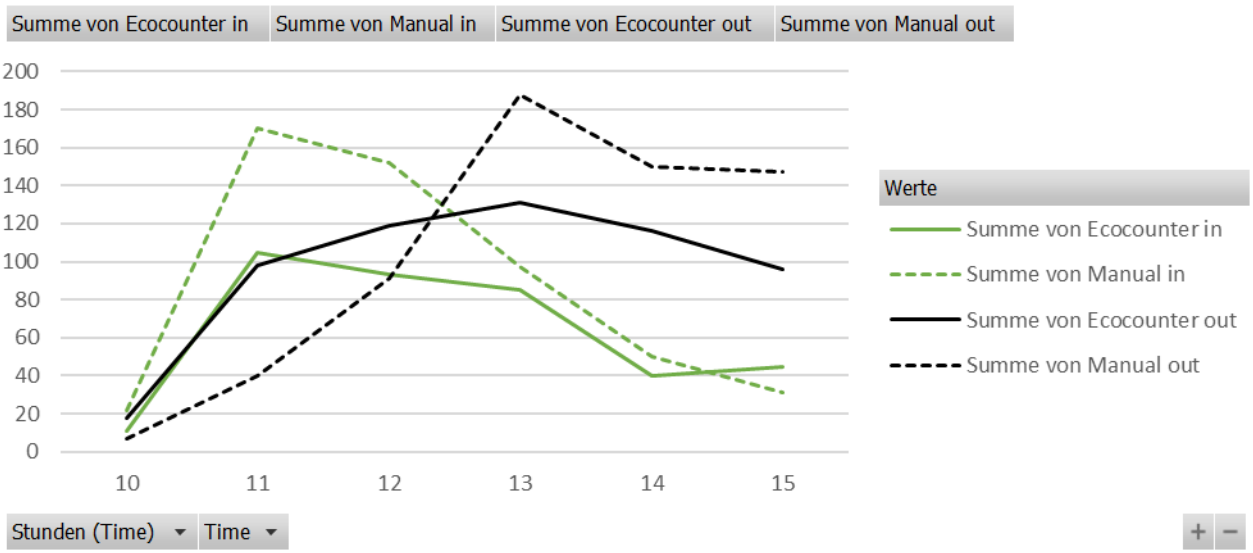


Figure 33 - Pedestrian difference between automatic and manual counters including direction.

Trail Camera Analysis - Almwirtschaft

On the 7th August 2025 between 9:00 and 14:00 CUAS trainees manually observed visitor traffic at the Nepomukbrücke counter. A qualitative comparison between manual counts and automatic counter counts of pedestrians shows quite accurate numbers with a slight overcount (Ecocounter = 52 total passes; Manual counts = 49 manual passes.

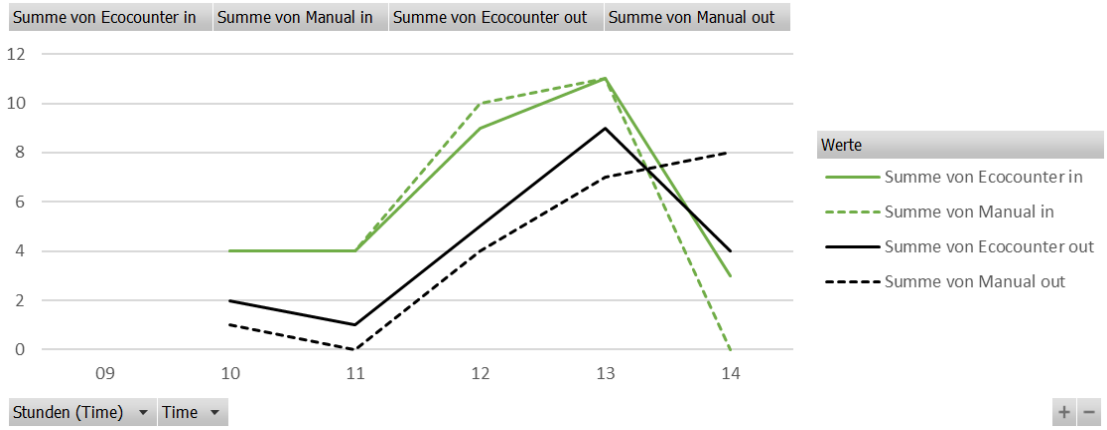


Figure 34 - Pedestrian difference between automatic and manual counters including direction.

Concerning cyclists 71,6 percent of the 222 manually counted cyclists were detected by the automatic counter. The diagram suggests a better fit of counts from incoming counters (towards Almwirtschaft) than in the other direction.

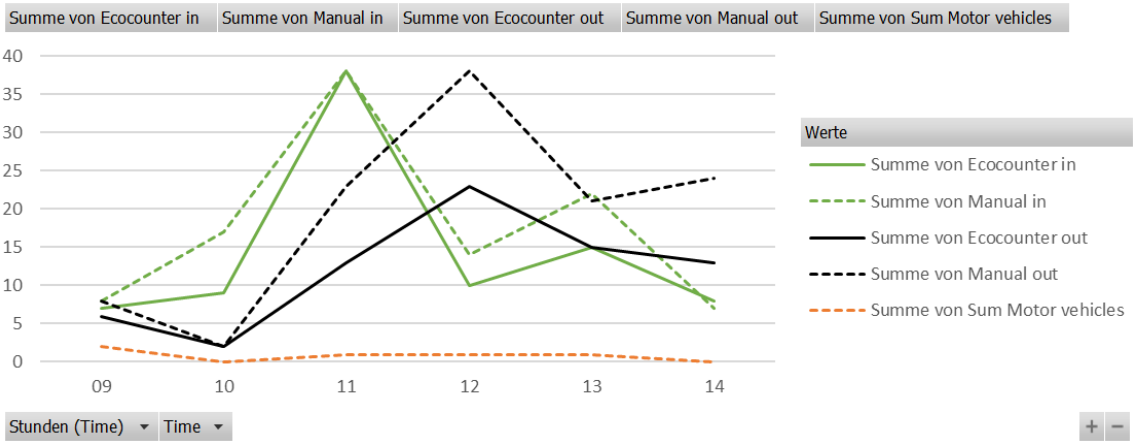


Figure 35 - Cyclists difference between automatic and manual counter including directions.

Corrections and Validation of Visitor Counting Data

Apart from potential over- and undercounting, validation of visitor counter data is necessary to correct outliers and miscounts that are directly related to maintenance or data retrieval activities at the counter. CUAS runs a field protocol that documents date and time when visitor counting devices were visited for these purposes. The information is also documented in the counter logs (data storage format). The EcoVisio dashboard allows users to correctly identify outliers and manually correct them.

5.2.2 Dobratsch Peak Visitors in 4 Seasons (Sep 2024 – Aug 2025)

Visitors at Dobratsch Peak area

Combining data from both counters, **a total of 55,000 visitors hiked towards the Dobratsch peak over the course of one year along the two main routes.**

- In winter (Dez-Feb), 14,340 visitors hiked towards the peak, only 5% of them took the Jägersteig route.
- Spring (Mar-Mai) marks the low season of the year (approximately 4,210 visitors) even though in May visitor numbers already rose.
- During the summer season (Jun-Aug), approximately 22,550 visitors reached the peak along the two main routes, with 24 % of them using the Jägersteig.
- Autumn (Sep-Nov) receives similar visitor numbers as winter season with around 13,880 visitors.

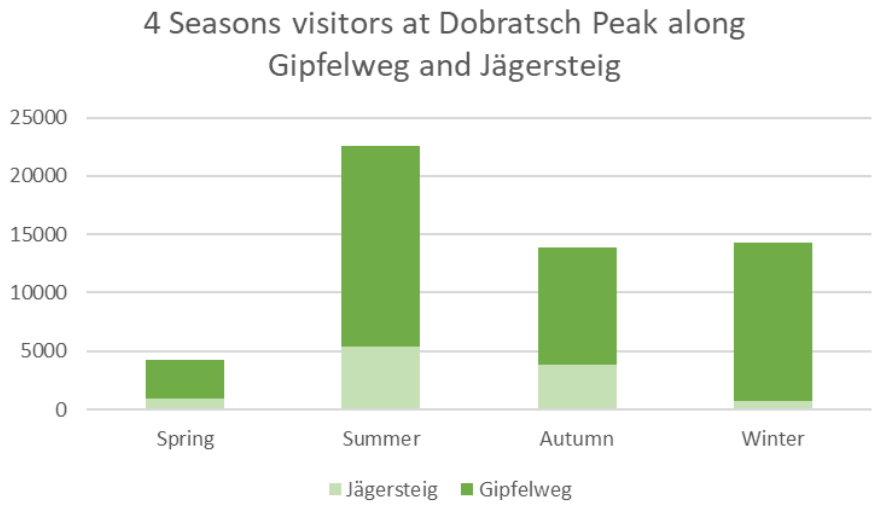


Figure 36 - Visitor number at Dobratsch Peak in the 4 seasons.

Gipfelweg

Note: Qualitative correction factor was used for interpretation (17 %). Data will be corrected and the report updated after the camera validation is finalized.

A total of 88,100 passes were recorded at the Gipfelweg counter positioned on the karst plateau at the height of the "Elferkogel", making up around 44,050 visitors of Dobratsch peak hiking along the Gipfelweg during one year. The strongest month was recorded in August with around 7,650 visitors.

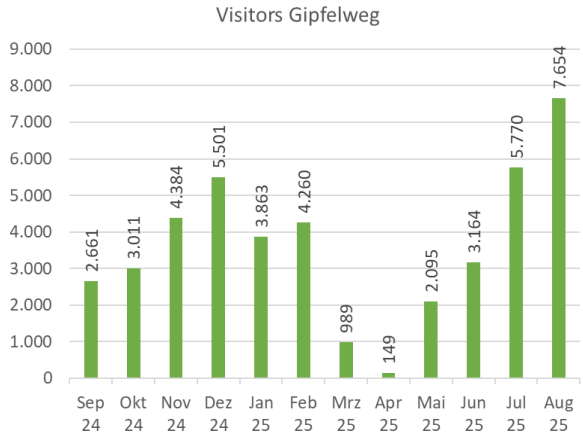


Figure 37 - Visitor number at Gipfelweg.

Jägersteig

On the Jägersteig, a total of 13,700 passes were recorded. Based on the Accuracy Testing, it is estimated that approximately 80% of visitors traveled in the direction of the Dobratsch peak, resulting in 10,900 visitors hiking to the peak via the Jägersteig.

The monthly distribution analysis indicates that visitor frequency was highest during the summer and autumn months, with August and November being the peak months. In contrast, winter months recorded significantly lower visitor numbers due to the alpine nature of the trail, which makes it particularly challenging under winter conditions.

Figure 38 - Visitor number at Jägersteig.

5.2.3 Dobratsch Peak and Alpine Zone Visitors in the Summer Season 2025 (Jul - Sep 2025)

Rosstratte

Note: No correction factor was used. Data will be corrected and the report updated after the camera validation is finalized. It is not possible to show yearly estimations, as the counter was installed in June 2025.

The Rosstratte counter, positioned after the Geological Trail and before entering the Alpine Zone, recorded approximately 72,300 passes during the period from July to September 2025. This corresponds to around 36,000 individual visitors entering the Alpine Zone from Parking 11 from July to September 2025.

August recorded the month with highest visitation rates, with approximately 17,000 visitors, accounting for 47% of the three months. Visitor frequency was highest on weekends, indicating a clear concentration of use during these days.

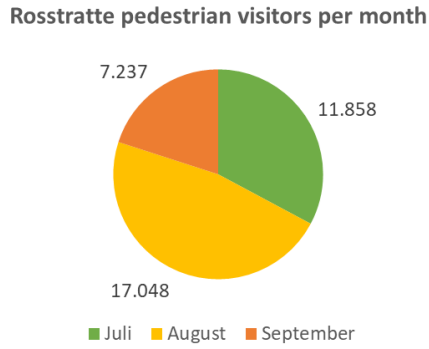


Figure 39 - Pedestrian visitors per month in Rosstratte.

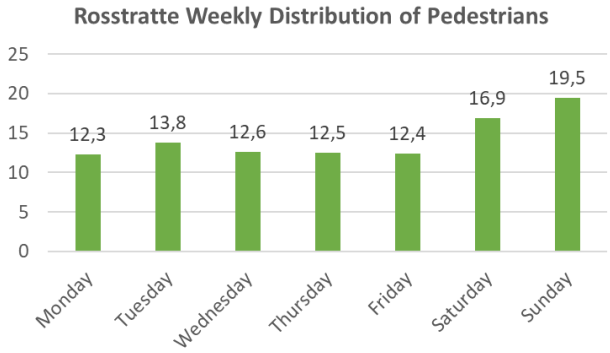


Figure 40 - Pedestrian visitors per day in Rosstratte.

General Visitor Trends

- Daily averages:
  Weekdays: approximately 365 visitors;
  Weekends: approximately 525 visitors.
- Peak visitation day:
  On 15 August (Almkirchtag), the counter recorded 1,150 visitors, marking the highest daily use of the season.

The hourly distribution of visitors shows a distinct peak in entries to the Alpine Zone between 09:00 and 12:00. The majority of visitors exited the area between 13:00 and 16:00.

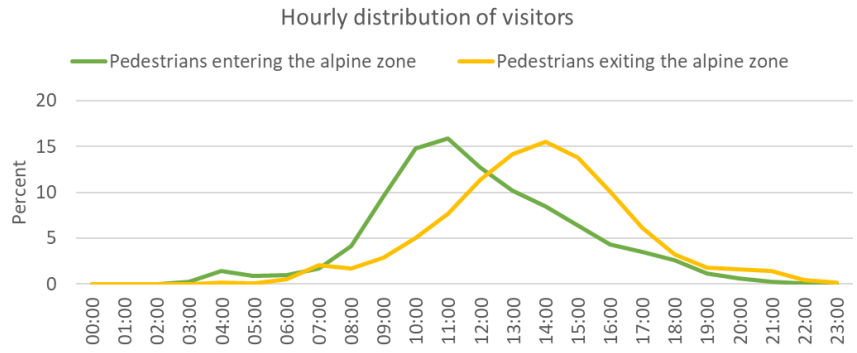


Figure 41 - Hourly distribution of visitors in Rosstratte.

Gipfelweg

The Gipfelweg counter recorded approximately 35,860 passes during the period from July to September 2025. This corresponds to around 17,930 individual visitors. These numbers correspond to 49,8 % of visitor numbers recorded at Rosstratte. Hikers can easily reach this part of the trail without passing Rosstratte counter for example by (1) starting their hike from Aichingerhütte, (2) starting at Heiligengeist, (3) starting at Bleiberg across the Alpenlahner.

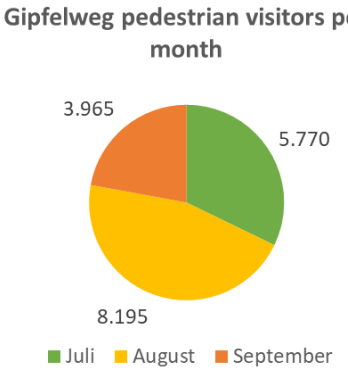


Figure 42 - Pedestrian visitors per month in Gipfelweg.

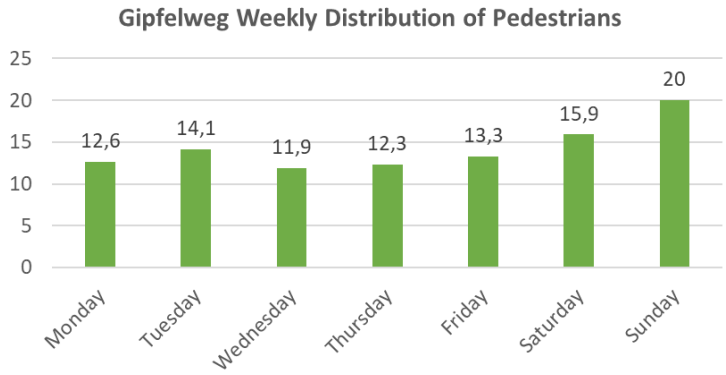


Figure 43 - Pedestrian visitors per day in Gipfelweg.

The monthly distribution follows a similar pattern to that recorded at the Rosstratte counter, with August accounting for 46% of all visits (approximately 8,200 visitors). While visitation is relatively evenly distributed from Monday to Saturday, Sundays stand out with a clear peak in visitor numbers.

General Visitor Trends

- Daily averages:
  Weekdays: approximately 181 visitors;
  Weekends: approximately 253 visitors.
- Peak visitation day:
  On 15 August (Almkirchtag), the counter recorded 615 visitors, marking the highest daily use of the season.

Jägersteig

Note: Linear regression model was used for correction of data. Directional estimation based on four-day trail camera observation.

A total of 7,191 passes were recorded along the Jägersteig counter, which is positioned around 150 meters after the Gams- and Gipfelblick viewpoint. Assuming around 80 percent of visitors pass the counter in the direction of the peak around 5,750 visitors reached the peak via Jägersteig and 1,400 visitors descended along the Jägersteig.

The following table gives a summary about estimated visitor numbers along the most popular hiking trails in the Alpine Zone and Peak Area of Dobratsch Nature Park in the summer season of 2025. Along the two main hiking paths - Gipfelweg and Jägersteig approximately 23,630 visitors reached the Dobratsch Peak in the period of July - September 2025.

Table 3 - Visitor counter results in both directions.

Counter	Rosstratte	Gipfelweg	Jägersteig
Total passes	72,300	35,860	7,190
Direction of peak	36,000	17,930	5,750
Direction of parking	36,000	17,930	1,440

5.2.4 Nighttime Visitors Alpine Zone and Dobratsch Peak (Summer Season 2025 - Jul - Sep)

Rosstratte

Nighttime visitors accounted for about 2% of total visitation of the Alpine Zone entering from the Parkplatz Rosstratte in the summer season of 2025.

- Entries (22:00–05:00): ~714 visitors
  The vast majority of nighttime visitors entered between 03:00–05:00, suggesting a strong sunrise hiking pattern. The hike to the peak takes around 1,5 hours from Rosstratte parking. The sun rises between 5:00 in the beginning of July until 6:50 at the end of September. On every 4th day between July and September more than 10 visitors entered the Alpine Zone at nighttime. Highest night visitors accounted for in August (484 visitors).
- Exits (22:00–05:00): ~375 visitors
  Most exits (~47%) occurred between 22:00–00:00.

Table 4 - Days with Nighttime visitors Jul – Sep 2025

Nighttime visitors	Days
Nights with one or more visitors	72
Nights with more than 10 visitors	24
Maximum	58
Minimum	1
Average	9,9

Gipfelweg

Nighttime visitors (22:00 - 6:00) account for about 5% of total visitation. In contrast to the Rosstratte counter we counted visitors as Nighttime visitors until 6.00 a.m. To reach the counter from the Rosstratte parking it takes approximately one hour, meaning that visitors started their hike in the darkness / dawn.

- Entries: ~865 visitors
  Most nighttime visitors passed between 03:00–06:00 toward the peak, indicating a strong sunrise hiking

trend. The higher Gipfelweg count compared to Rosstratte suggests some hikers might cover the distance between the counters in under one hour, being registered after 5:00 a.m. at the Rosstratte counter.

- Exits: ~182 visitors
  Most exits (~50%) occurred between 22:00–00:00.

Table 5- Days with Nighttime visitors.

Nighttime visitors	Days
Nights with one or more visitors	68
Nights with more than 10 visitors	33
Maximum	56
Minimum	1
Average	13

Jägersteig

Nighttime visitors accounted for about 1% of total visitation of Jägersteig, with 62 visitors passing in direction of the peak between 22:00 and 6:00.

5.2.5 Other Areas of Interest around Dobratsch

Kranzwandsteig (September 2024 - August 2025)

The Kranzwandsteig which leads through the Natura 2000 area of Schütt, starting at Almwirtschaft and ending at the Villacher Alpenstraße below the Alpengarten has a very low visitor frequency throughout the year. A total count of 411 passes has been recorded in the whole timespan.

Erlachgraben (September 2024 - August 2025)

The Erlachgraben which is part of stage two of the Dobratsch Circular Hike recorded 850 passes during the whole timespan. 488 passes occurred in direction of Nötsch, 362 passes in direction of Bad Bleiberg. The highest visitor numbers were recorded on the 6th October 2024, the day of the guided tour of Dobratsch Circular trail. Other than that on average 2 persons per day, on weekends 4 persons per day passed the counter.

Almwirtschaft (September 2024 - August 2025)

Note: Data from cyclists was corrected with the factor of 0,72 as a result of the qualitative field observations. The data will be reevaluated after the trail camera observation results are ready.

In one year the counter installed between the restaurant Almwirtschaft and Nepomukbrücke recorded around 20,900 passing pedestrians and 39,400 passing cyclists. The passes cannot be strictly divided in half, as many pedestrians and even more cyclists only pass the counter in one direction. Summer is clearly the most visited season of the year for both pedestrians and cyclists. For cyclists the 1st May 2025 was the most visited day, with 211 cyclists heading to Almwirtschaft and 199 cyclists heading to Nepomukbrücke. For pedestrians heading towards Almwirtschaft the 31st of December 2024 marked the peak day with 145 pedestrians counted.

The area around the position of the counter at Almwirtschaft is used as a paddock which can frequently lead to miscounts of pedestrians due to passing horses.

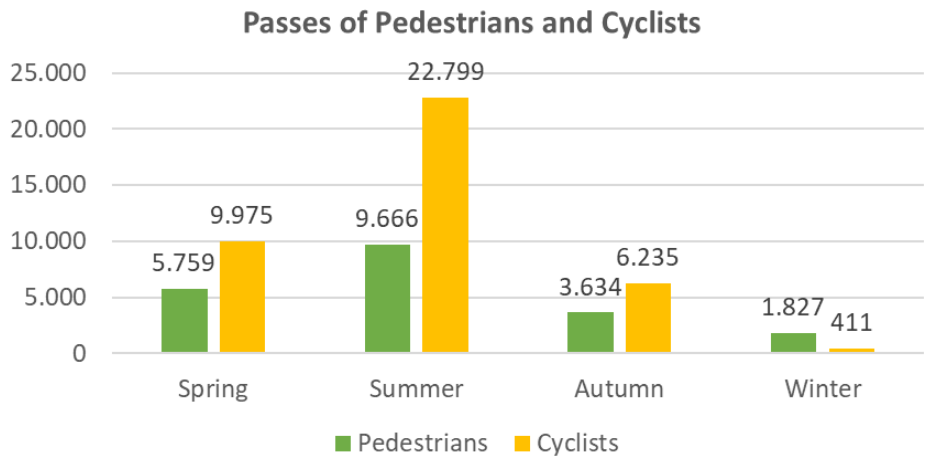


Figure 44 - Pedestrians and cyclists count at Almwirtschaft.

Mountain Bikers New Kids

The trail counter recorded activity during two periods:

- 5 August 2024 – 13 February 2025
- 22 July 2025 – 29 September 2025

Over the approximately nine months of active data collection, the counter registered a total of 525 passes. This corresponds to an average of 2 passes per weekday and 3 passes per weekend day.

The busiest day was a Thursday in November, when 22 cyclists were recorded.

Although data for the first five days of August 2024 is missing, the recorded figures indicate a noticeable decline in visitor numbers between 2024 and 2025 for August and September:

Table 6 - Visitor numbers changing between 2024 and 2025.

	2024 Passes	**2025 Passes**	**Change (%)**
August	123	88	-28,5 %
September	89	56	-37,1 %

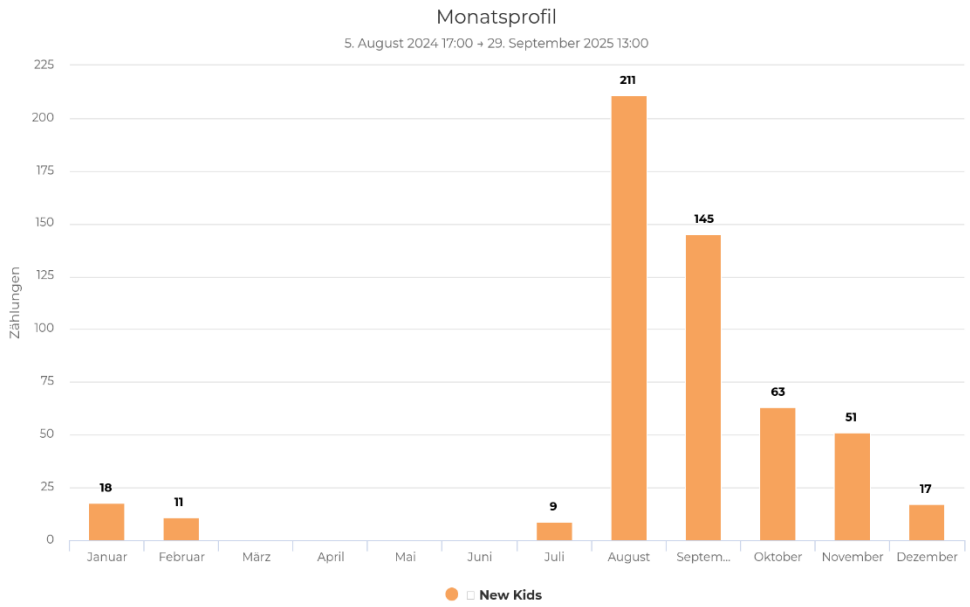


Figure 45 - Monthly mountain bikers in New Kids.

Mountain Bikers Schütt

The trail counter recorded activities from 15 April 2025 until 29 September 2025.

During these 5 ½ months 489 cyclists were recorded, with an average of 2 passes per weekday and 4 passes per weekend. A Monday in July marked the day with highest frequencies, counting 20 bicycles passing the counter location.

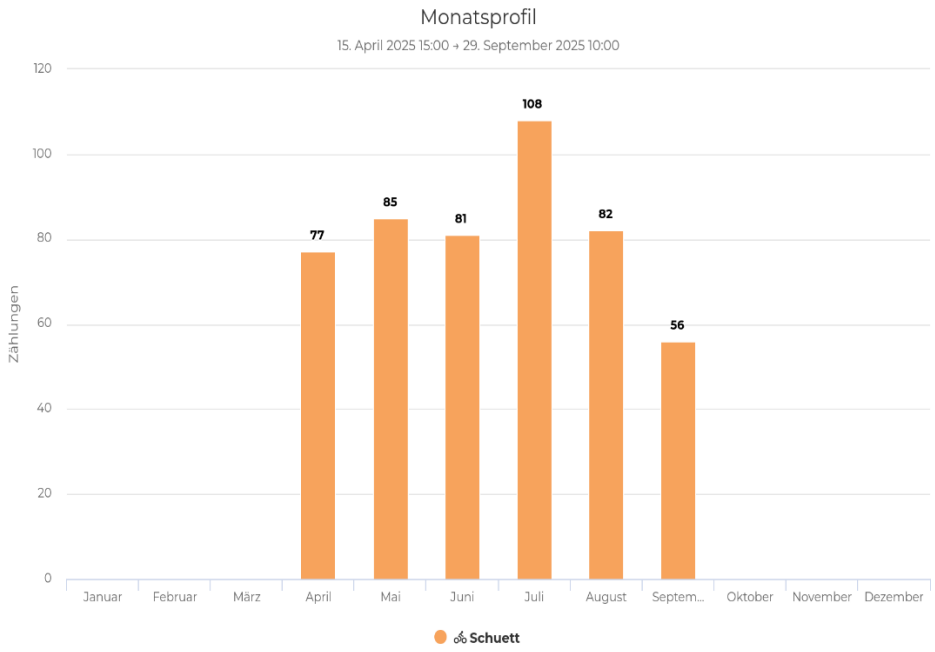


Figure 46 - Monthly mountain bikers in Schütt.

5.2.6 Dreiländereck (July - September 2025)

The visitor counter on Dreiländereck is positioned on the hiking trail west of the main peak coming from Maria Schnee. During the three-month period 13,947 passes have been recorded, 56 % of which are in the direction of the peak

(approximately 7,857 passes) and 44 % in the direction of the valley (approximately 6,090 passes). On average 87 visitors reached the Dreiländereck peak on this trail per day, on weekends this number rises to around 130 passes per day. Sunday, 14th September 2025 marked the peak day with 1,238 passes (742 visitors passing in the direction of the peak). The day celebrates the “Tour 3 Sternwanderung - Festa dell’Amicizia” - a yearly three countries border event.

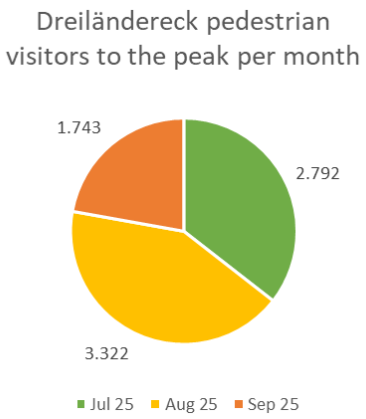


Figure 47- Pedestrian visitors per month in Dreiländereck.

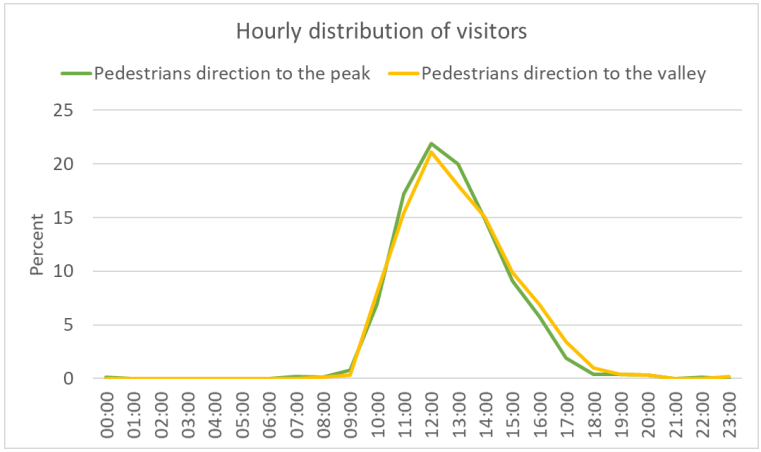


Figure 48 - Pedestrian visitors per hour in Dreiländereck.

5.3 Evaluation of Mobile Phone Data

This part of the results section summarizes visitor numbers at the areas of interest as well as interactions between them as they are provided by Location Insights.

In the next chapter Comparison Mobile Phone and Counter Data from the comparison between automatic counter data and mobile phone data are summarized.

5.3.1 Total Visitors

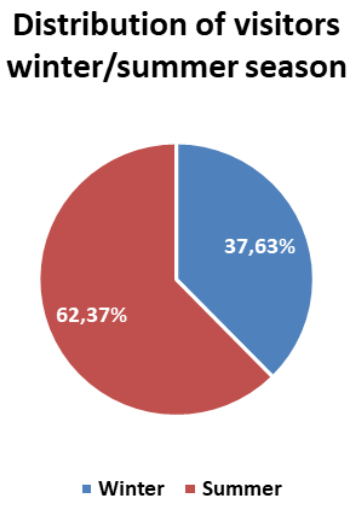


Figure 49- Visitor distribution in winter and summer season.

Around 38 % of visitors were visiting the areas in the winter season 23/24 and 62 % in the summer season. This numbers showcase a higher percentage of outdoor activities in the summer season (Figure 49).

As expected, the Gipfelzone (three areas of interest: Zehner Hütte, Gams & Gipfelblick, Gipfelhaus) as well as Warmbad (Napoleonwiese) received most visitors in the summer and winter season. The parking area of Rosstratte (P11) as well as its surrounding offers (Rodelhügel, Spielplatz, Sonnenliegen) recorded 72,650 visitors in the summer period (June-September) and 42,510 visitors in the winter period (December-February). These visitors came either solely to enjoy the restaurant Rosstratte and its surrounding offers or they stayed in the area before or after their visit to the Gipfelzone.

Monthly Distribution

In the summer season the highest concentration of visitors was recorded in August for most areas of interest.

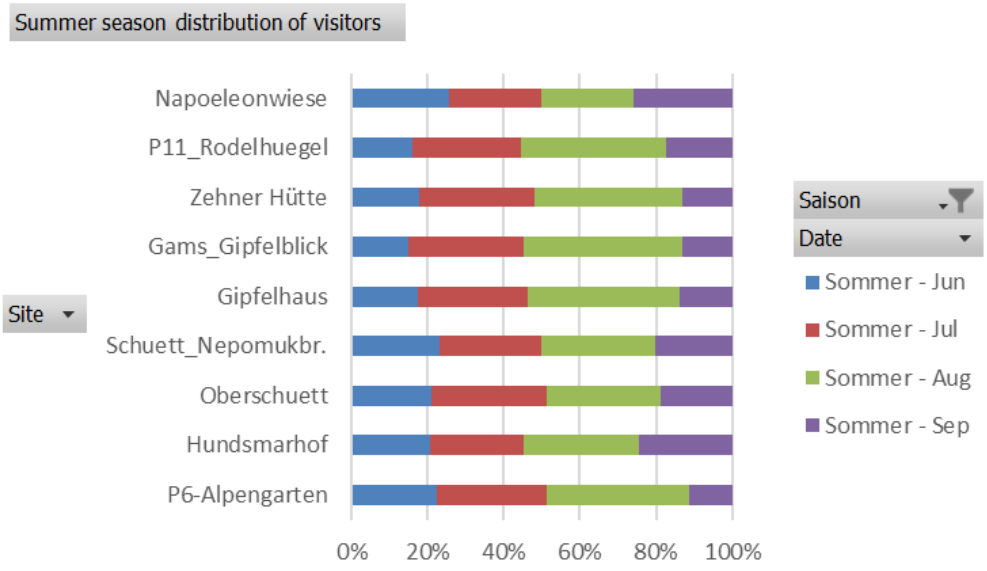


Figure 50 - Visitor distribution in summer season.

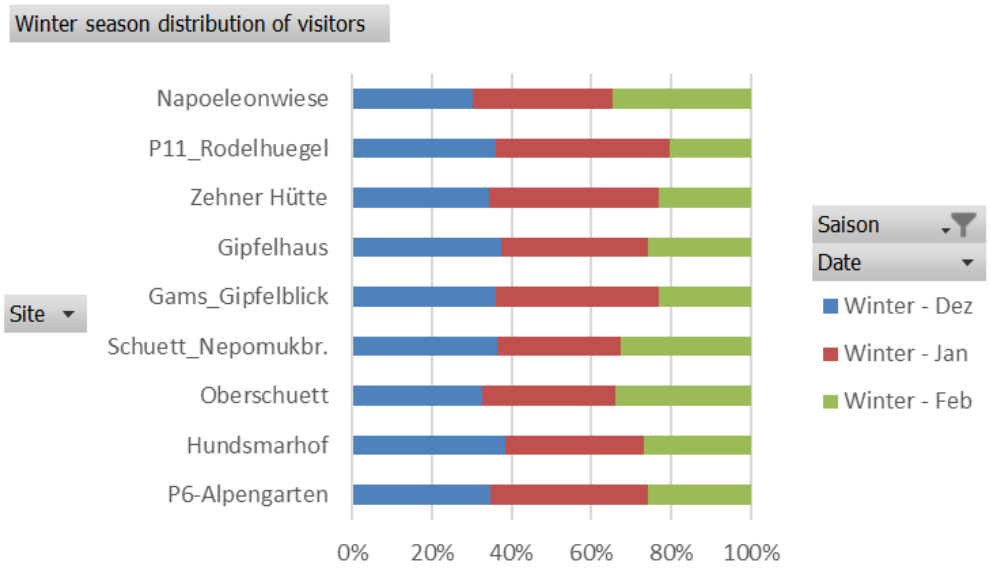


Figure 51 - Visitor distribution in winter season.

Weekly Distribution in Summer Season

The data shows an evenly weekly distribution of visitors at the Napoleonwiese, with the lowest visitor numbers on weekends. All other areas of interest show higher visitor numbers on weekends. At the Alpengarten and Hundsmarhof there was a second visitor peak on Wednesdays. At Napoleonwiese residents and staff from the Thermenhotels and Spa at Warmbad Villach may be counted as visitors, which may lead to these higher numbers on weekdays. Also, Napoleonwiese may serve as an after-work destination for Villach's residents as it is very close to the city.

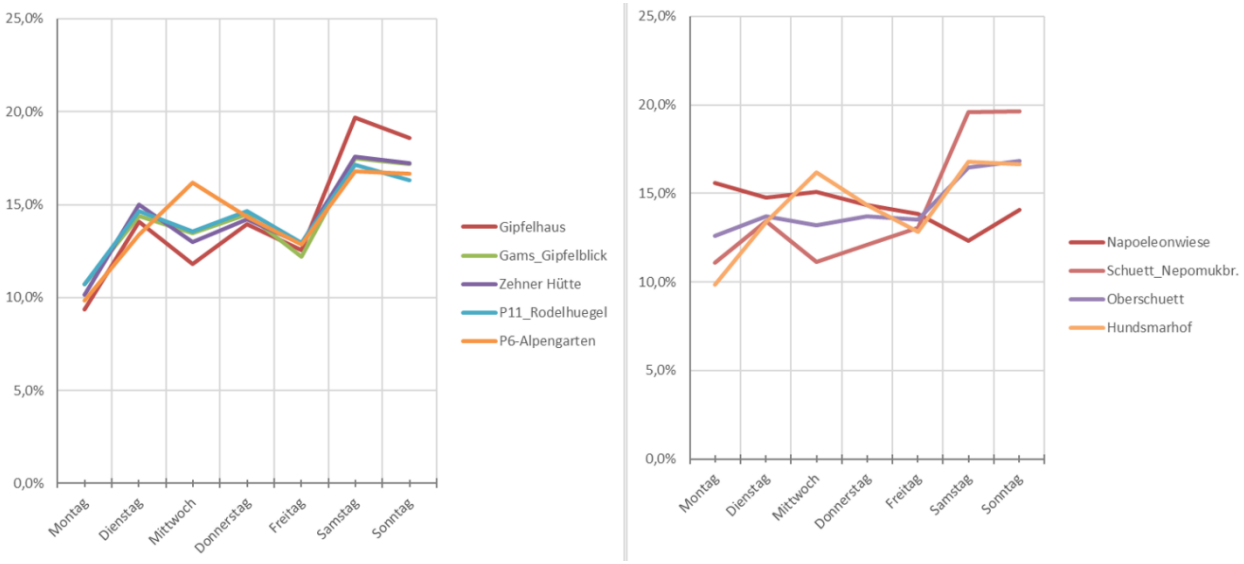


Figure 52 - Visitor weekly distribution in summer season.

There is a similar trend shown for the winter season. One exception is Hundsmarhof, with a second peak of visitors on Thursdays.

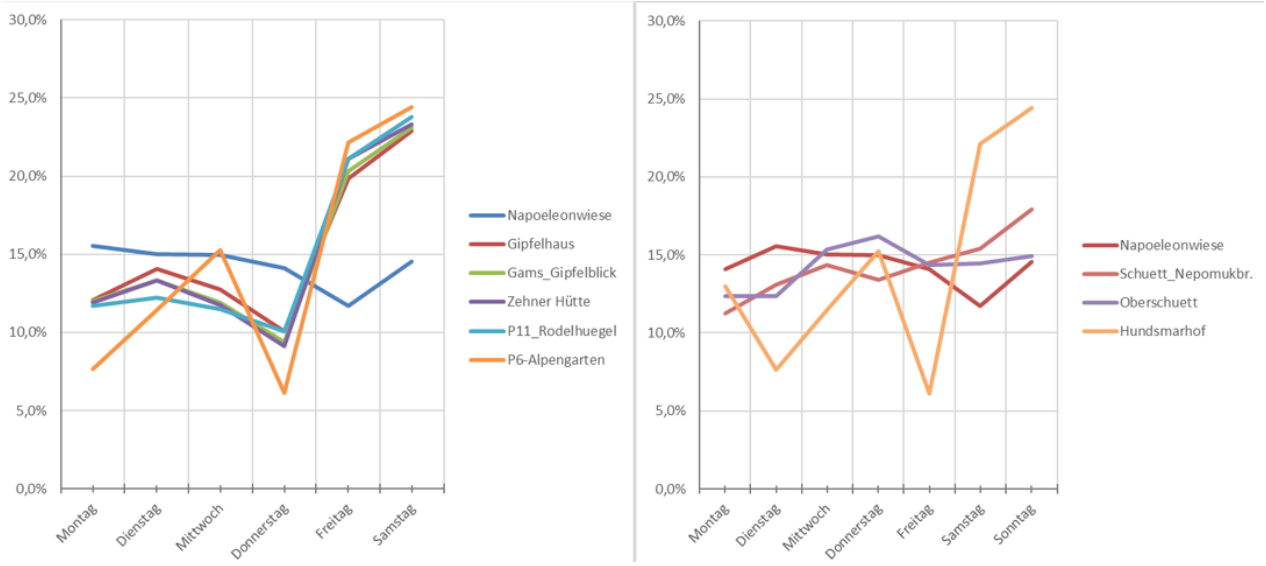


Figure 53 - Visitor weekly distribution in winter season.

5.3.2 Socio-Demographic Profiles of Visitors

Gender Distribution

while at Napoleonwiese and Hundsmarhof a higher percentage of female visitors was registered, the other areas of interest show a slightly higher percentage of male visitors.

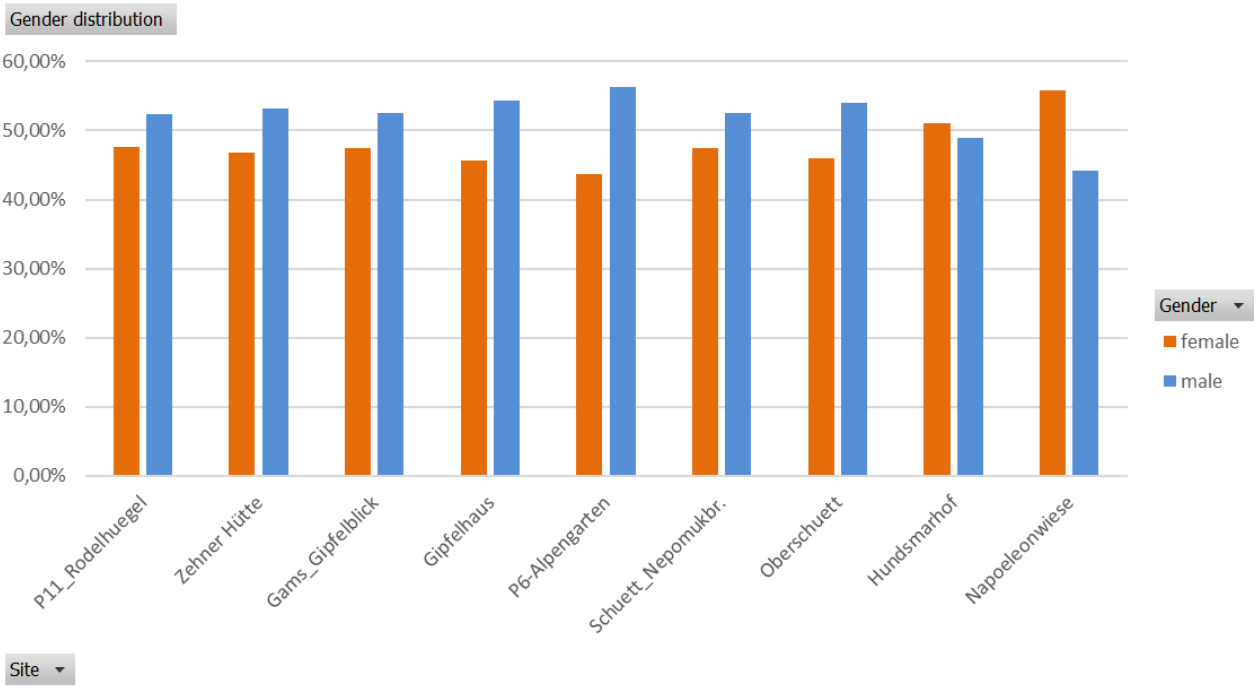


Figure 54 - Visitor gender distribution based on location.

Age Groups

The Gipfelhaus receives the highest number of younger visitors while the P6-Alpengarten receives the highest number of elderly visitors.

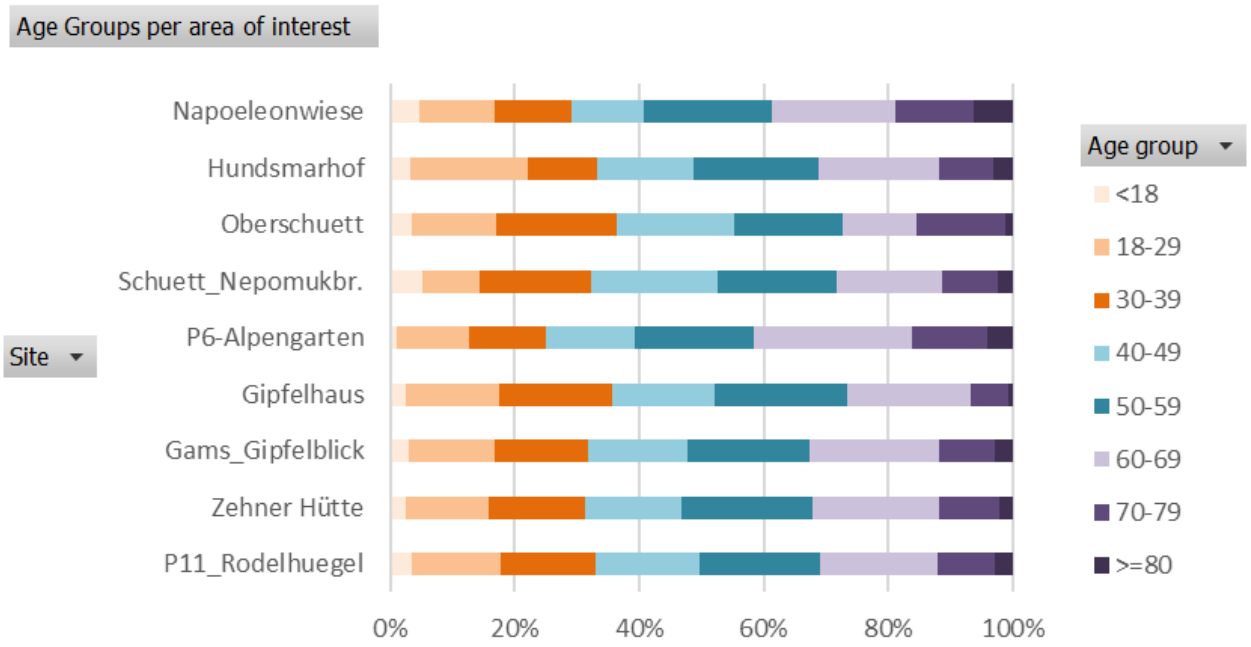


Figure 55 - Visitor age groups based on location.

Origin of Visitors

The percentage of foreign visitors varies significantly between the areas of interest. The Alpine Zone and Peak Area host many foreign guests. In areas close to the Villacher Alpenstraße and in short hiking distance from the P11 in the Alpine Zone (Gams- und Gipfelblick and Zehnerhütte) approximately every second guest was a foreigner. At the Gipfelhaus three of four guests are Austrian citizens. Surrounding offers, like the Napoleonwiese in Warmbad, Oberschütt and Hundsmarhof are mainly visited by Austrian guests. One exception is Schütt Nepomukbrücke, where one of 5 guests is from outside of Austria.

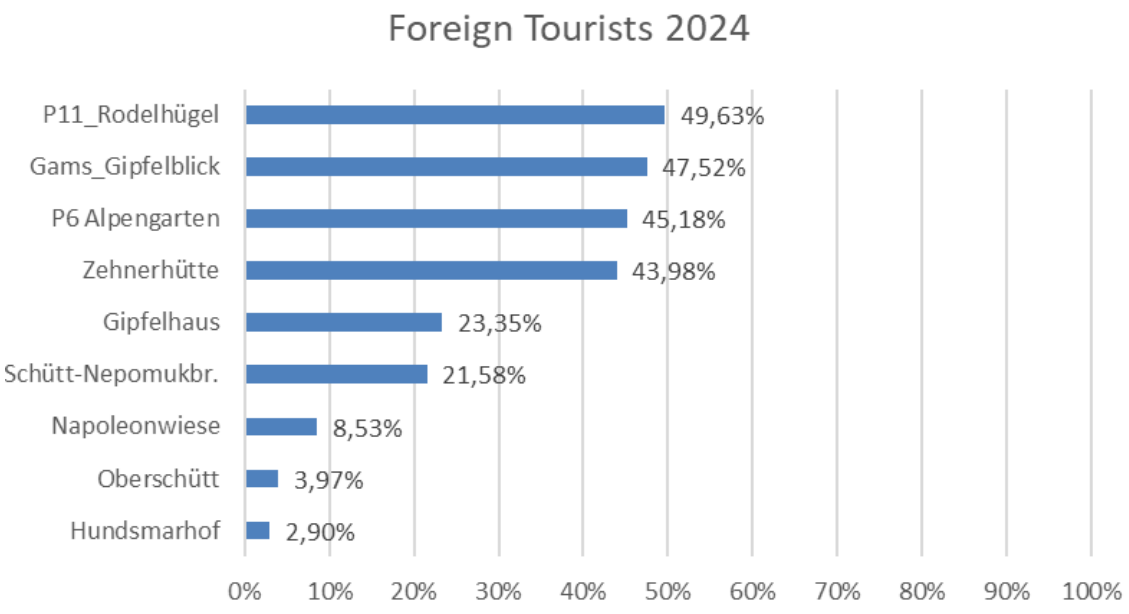


Figure 56 – Foreign tourists percentage based on location.

The summer season shows a significantly higher percentage of foreign visitors for all areas of interest along the Villacher Alpenstraße, the Alpine and the Peak zone.

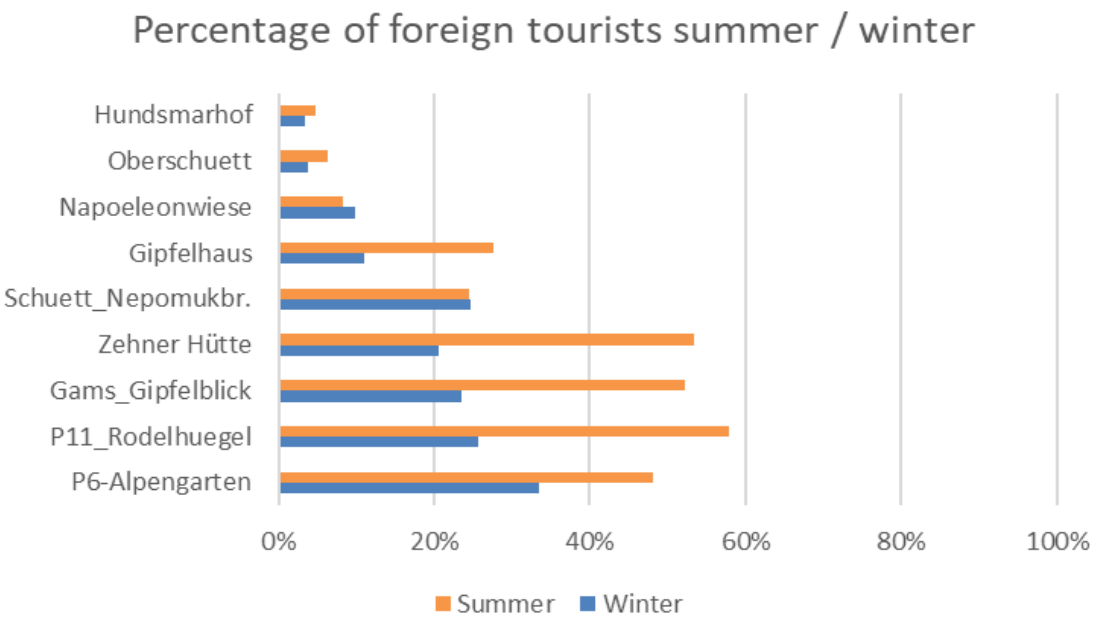


Figure 57 - Foreign tourists based on summer and winter.

The top 5 visiting countries at Nature Park Dobratsch are Germany (42,9 % of guests), the Netherlands (8,16 %), Czech Republic (6,5 %), Italy (6,3 %) and Hungary (5,8 %). The amount of foreign visitors varies significantly between area of interest.

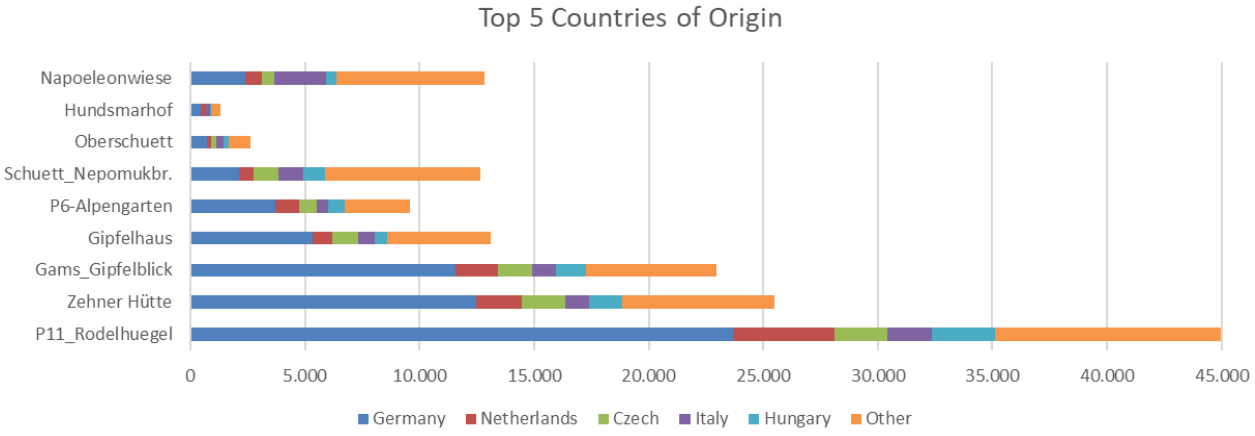


Figure 58 -Visitor origin distribution based on location.

5.3.3 Overnight Stay of Nature Park visitors

Data from mobility insights shows, in which municipality visitors woke up before visiting Nature Park Dobratsch. The majority of Austrian visitors came from Carinthia (95 %). Austrian visitors from outside of Carinthia mainly came from Styria, Salzburg, Vienna and Lower Austria, meaning that they travelled the same day from their place to visit Nature Park Dobratsch. The data on the Carinthian district level emphasizes the importance of Dobratsch for tourists and locals of Villach and surrounding municipalities.

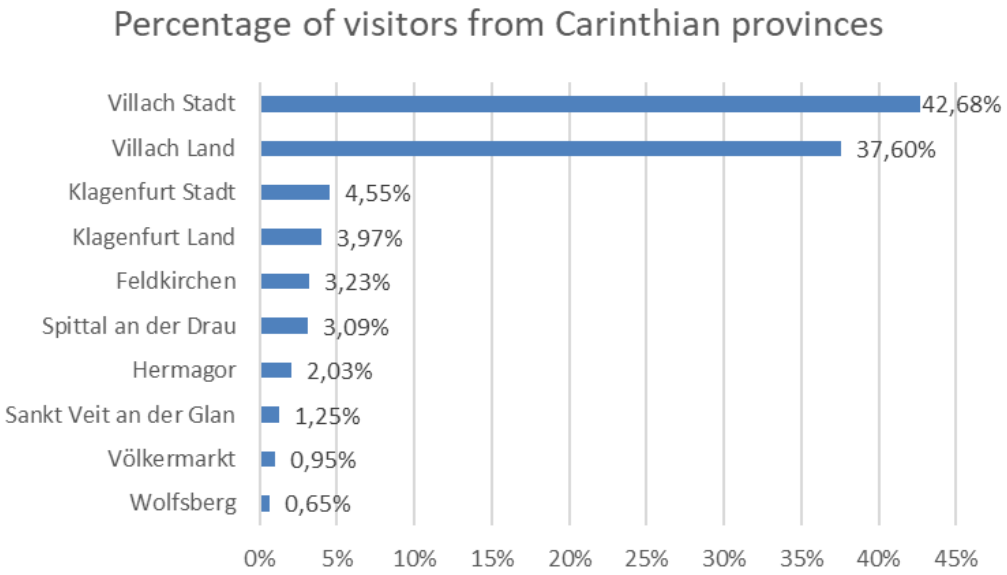


Figure 59 - Visitors from Carinthian provinces and municipalities.

5.3.4 Duration of Stay

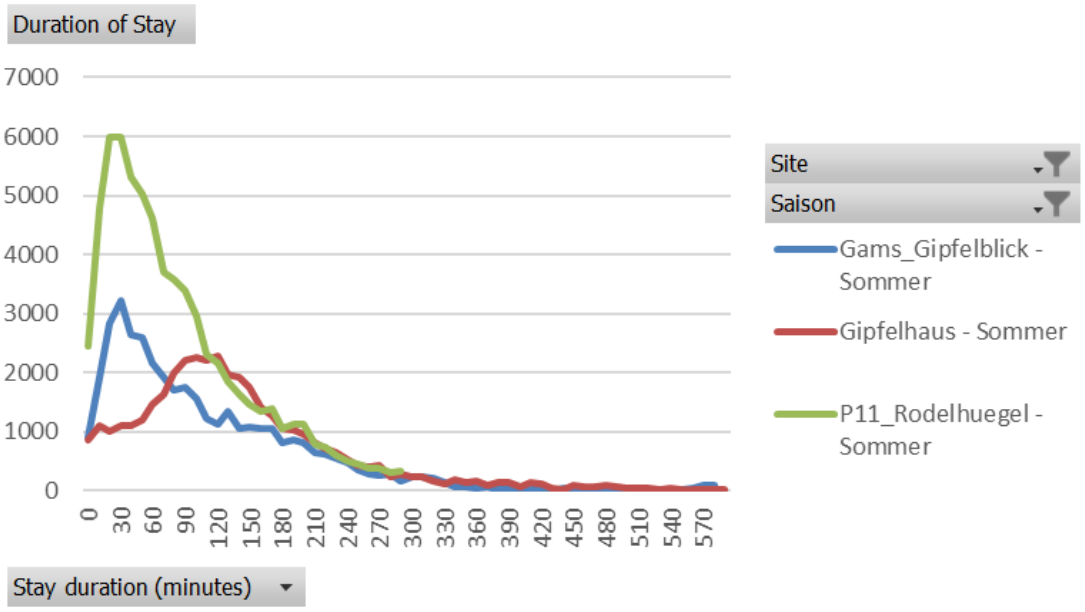


Figure 60 - Summer duration of stay.

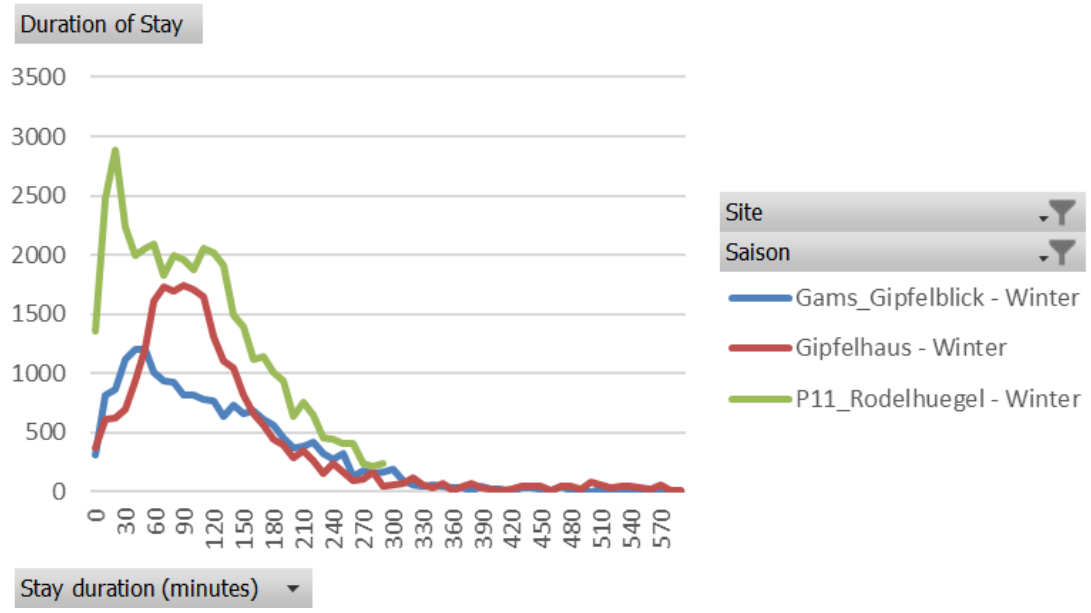


Figure 61 - Winter duration of stay.

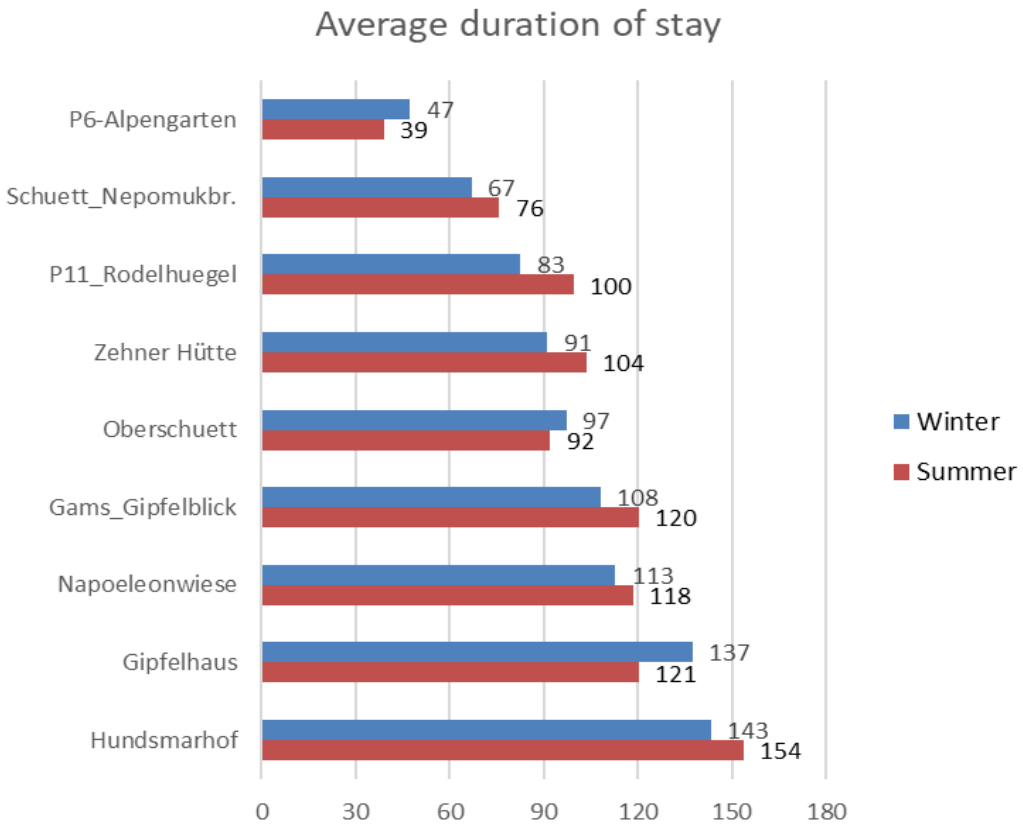


Figure 62 - Average duration of stay in summer and winter.

5.3.5 Dobratsch Alpine and Peak Zone Summer Season 2024

Four areas of interest (POIs) have been defined in the Alpine and Peak Zone of Nature Park Dobratsch to understand visitor numbers of the area:

- P11 and Rodelhügel;
- Gams and Gipfelblick;
- 10er Hütte;
- Gipfelhaus.

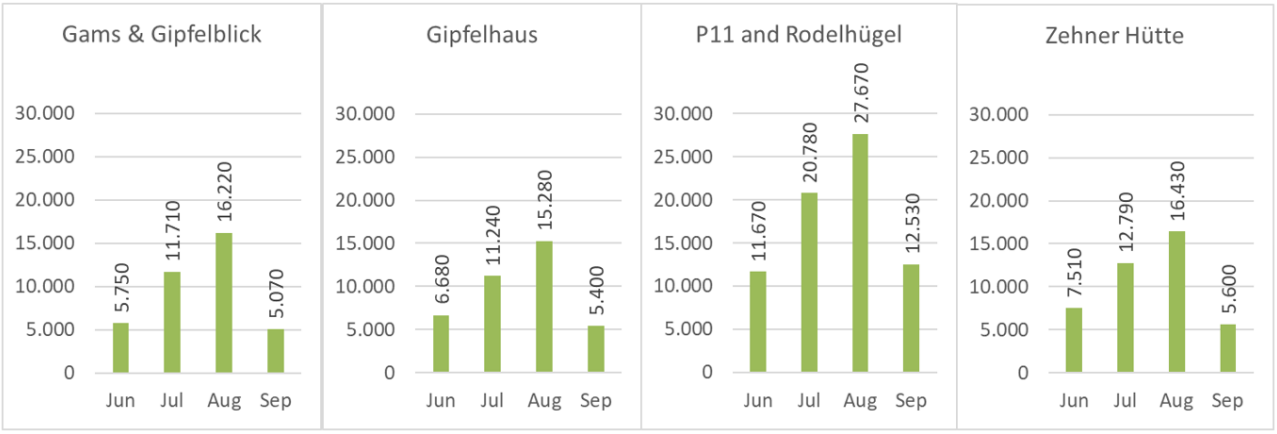


Figure 63 - Visitor number in summer season based on location.

From the 38.600 visitors recorded from June - September 2024 at Dobratsch Gipfelhaus, 18.000 have also been registered at other POIs in the Alpine zone prior to their visit to the peak. The other 20.600 visitors have not been registered at other POIs, indicating that they have directly hiked towards the peak, not having stayed the minimum defined length at the other areas of interest to be counted. P11 - Rodelhügel has a defined minimum length of stay of one minute. All visitors parking their car at P11 and moving towards the Alpine Zone should be counted at P11, because this process takes more than one minute. The data suggests that only 13.3 percent of visitors to the peak have been previously counted at P11. This indicates problems with bad network coverage, as the reality shows that most visitors start their hike from P11 toward Dobratsch peak.

From 72.650 visitors counted at the P11 and Rodelhügel, 27,8 % have visited other areas of interest within the Dobratsch Nature park. Most of them are connected to the Gams- and Gipfelblick, followed by the Zehnerhütte and the Dobratsch Gipfelhaus. According to the data only 2,6 % of visitors stopped at P6 and Alpengarten before arriving at P11 and 3% stopped there on their way to the valley.

Map 64 shows the interactions between the areas of interest in the summer month of June - September 2024 from Mobility insights.

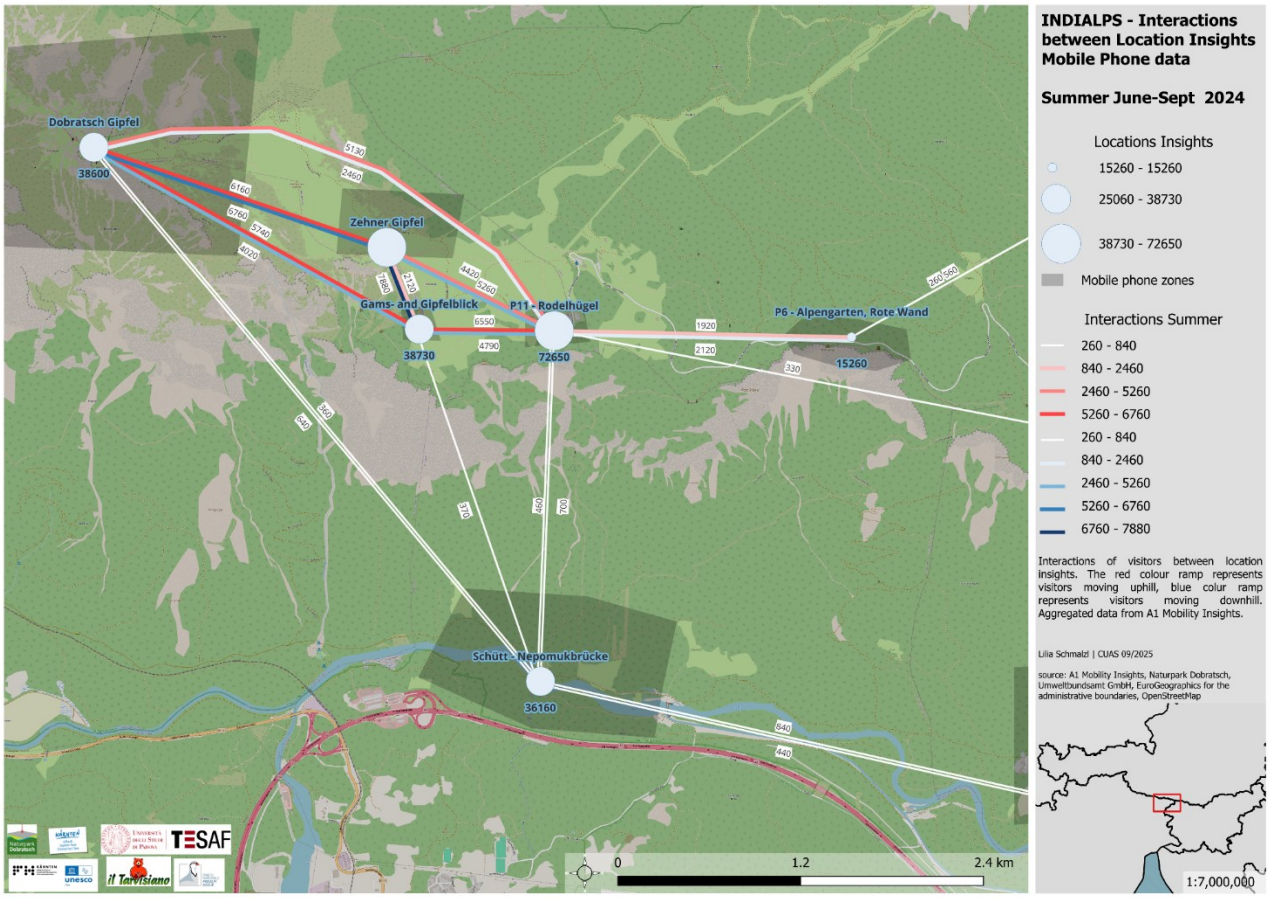


Figure 64 - Interactions between location insights mobile phone data.

5.4 Comparison Mobile Phone and Counter Data

5.4.1 Dobratsch Peak

For the Gipfelbereich, a Spearman correlation revealed a very strong and statistically significant positive relationship between the manual visitor counts at *Gipfelweg_Jaegersteig* and the mobile data at *Gipfelhaus_Mobilfunkauswertung* ($\rho = 0.961$, $p < .001$). This indicates a nearly perfect monotonic association between the two measurement methods.

A simple linear regression was conducted to predict *Gipfelhaus_Mobilfunkauswertung* based on *Gipfelweg_Jaegersteig*. The model was statistically significant ($p < .001$) with a standardized coefficient $\beta = 0.961$, confirming a strong predictive power. The resulting regression equation is:

$$Mobile\_Data = 6.740 + 2.029 \times Visitor\_Count$$

This means that for each additional visitor counted at the Jaegersteig, the mobile data value increases by approximately 2.03 units.

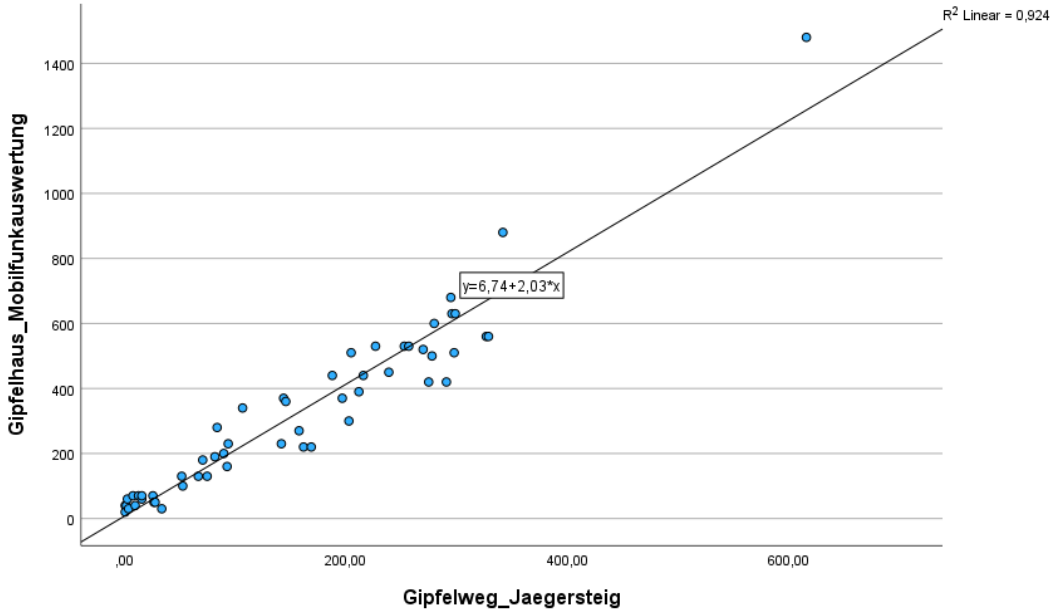


Figure 65 - Positive relationship between the manual visitor counts and the mobile data.

5.4.2 Nepomuk Bridge – Almwirtschaft

For the Almwirtschaft, a significant and strong positive linear relationship was also found between *Almwirtschaft_B_P_In* and *Nepomuk_Mobilfunkauswertung*. The regression analysis yielded a statistically significant model ($p < .001$) with $\beta = 0.787$, indicating a strong association.

The regression formula is:

$$Mobile\_Data = 173.890 + 0.967 \times Visitor\_Count$$

This suggests that for every additional visitor counted at the Almwirtschaft, the mobile data at the Nepomuk location increases by about 0.97 units.

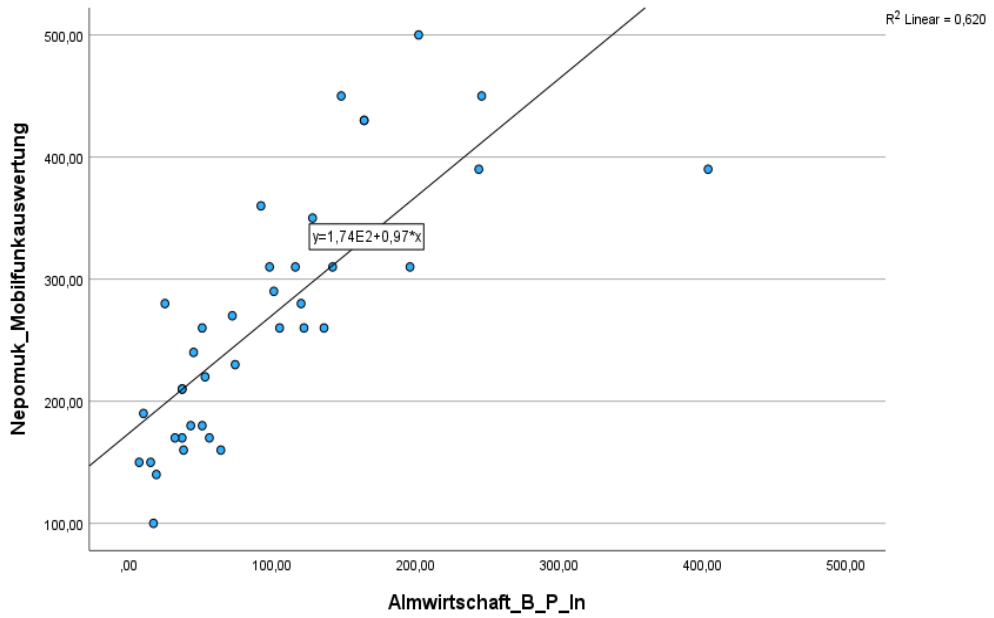


Figure 66 - Positive relationship between the manual visitor counts and the mobile data.

5.5 Trail Camera Analysis Results

5.5.1 Villacher Alpenstraße

For Villacher Alpenstraße, video capturing started at 18:05 on 01/09/2024. We were able to collect videos from 01/09 to 07/09 and from 12/09 to 14/09. Table 7 summarizes video count per day of recording.

Table 7 - Video count distribution per day of recording.

Date	Count of Videos	Number of videos from 6 a.m. to 6 p.m.
01/09/2024	24	0
02/09/2024	346	322
03/09/2024	408	381
04/09/2024	795	705
05/09/2024	523	497
06/09/2024	360	293
07/09/2024	752	724
12/09/2024	111	70
13/09/2024	226	177
14/09/2024	265	258
Total	**3810**	**3409**

Figure 67 - Camera View at Villacher Alpenstraße.

Also, toll station report from official management on the days of recording was acquired. This report represents the ground truth needed to validate against. Table 8 represents the toll station record.

Table 8 - Toll station counting.

Class	Toll Station
Bicycle	Not Counted
Car	1713
Motorbike	1539
Bus	25

Although, it should be mentioned here that there are some key considerations as we validate against these reports.

- Day 01/09/2024 will not be included in the validation as the camera was installed after ticketing hours.
- The camera recorded continuously for days but the toll station reports only include visitors from 06:00 to 18:00. This means we will only validate with videos taken at that range;
- The vehicles recorded in the ticketing reports indicate payment at the entrance but not necessarily passing through the frame at which the camera is installed. So, it is essential to assume that each recorded vehicle has passes the camera view for validation purposes;
- Validation of the toll station data only makes sense using YOLO approach as it provides a class breakdown of car, motorbike and bus;
- The toll station data is recorded one way (going up). In contrast, YOLO will count each vehicle twice (up and down) assuming each vehicle will pass the camera going up after from 6a.m. and leaves going down before 6p.m. and therefore we will divide the counting by 2. Minimal bias may arise from the fact that visitors stay overnight in one of the mountain huts. There are also a small number of private mountain huts where also persons may stay multiple days. So, in these special scenarios the assumption that a car is always going up & down the same day and therefore counted twice is not valid;
- As for the bicycle counting, the toll station has no ground truth as bicycles can go through the gate for free. Therefore, manual ground truthing should be done in order to validate the counting performance for class “bicycle”.

Validation of YOLO Counting vs Toll Station at Villacher Alpenstraße

Results are summarized in tables for each location and confidence threshold. Counts reflect the aggregated unique (class, ID) pairs across all videos divided by 2.

Table 9 - YOLO counting (divided by 2) vs toll station ground truth data

Class	Count 0.25	Count 0.4	Count 0.5	Count 0.6	Count 0.7	Toll Station
Car	*1991*	*1812*	*1191*	*664*	*468*	*1713*
Motorbike	*2339*	*2099*	*1339*	*602*	*90*	*1539*
Bus	*111*	*98*	*51*	*33*	*22*	*25*

Looking at YOLO counts, we can see that there is a sharp decline of detections as we increase the confidence. Cars count decrease from 1991 at 0.25 to 468 at 0.70, with the 0.40 threshold (1812) closest to the ground truth. As for motorbikes they count 1339 at 0.5 and 602 at 0.6 bracketing the ground truth but still showing overcounting and undercounting. Buses, with counts from 111 (0.25) to 22 (0.70), align best at 0.70, closest to the ground truth, reflecting more confidence by YOLO due to their distinct appearance, though lower thresholds inflate counts as for all other classes.

In summary, YOLO doesn't provide a single reliable threshold where counts are accurate for the listed classes. Instead, different confidence thresholds work better for each class.

5.5.2 Dobratsch

Total number of videos for this location is 7010 videos over two periods:

- 7th to 12th August 2023 (4288 videos);
- 23rd to 29th of August 2023 (2722 videos).

Figure 68 - Camera view at Dobratsch.

It is apparent that the camera view at Dobratsch provides closer look on the type of vehicle as the camera is installed relatively close to the track which can potentially increase detection confidence.

Manual Bicycle Ground Truthing and Performance Validation of YOLO and MD on Villacher Alpenstraße and Dobratsch.

To select videos for the ground truth across the two locations, an initial run was performed using the YOLO configured specifically for the "bicycle" class on all available video footage from both sites. Videos containing at least one detected bicycle at confidence 0.25 were compiled into a list. From this list, a subset was manually chosen to represent varying bicycle amounts, ensuring a validation set that captures different densities. This resulted in 40 videos for Villacher Alpenstraße and 79 videos for Dobratsch.

The metrics used to assess performance in each table are as follows:

- Total Bike Count: The sum of bikes across all videos or entries;
- Exact Matches: The number of videos where the method's count exactly matches the ground truth;
- Overcounts: The number of videos/entries where the method's count is higher than ground truth;
- Undercounts: The number of videos/entries where the method's count is lower than ground truth;
- Bias: A positive bias indicates a tendency to overcount (e.g., a bias of +2.175 means the method, on average, detects about 2.175 more bikes per video than actually present. A negative bias indicates a tendency to undercount (e.g., -1.275 means missing about 1.275 bikes per video on average.

Tables 10 and 11 represent the results of the bike counting performance for YOLO (at various confidence thresholds) and MegaDetector for Villacher Alpenstraße (40 videos) and Dobratsch (79 entries), respectively, summarizing total bike counts, exact matches, overcounts, undercounts, and bias.

Tables 10 and 11 summarize performance statistics for the bike counting methods across the two locations.

Table 10 - Bicycle counting performance validation Villacher Alpenstraße.

Metric	GROUND TRUTH	YOLO 0.25	YOLO 0.40	YOLO 0.50	YOLO 0.60	YOLO 0.70	MD
Total Bicycle Count	*65*	*180*	*152*	*88*	*45*	*14*	*69*
Exact Matches	-	*2.50%*	*5.00%*	*20.00%*	*32.50%*	*20.00%*	*45.00%*
Overcount	-	*95.00%*	*92.50%*	*55.00%*	*22.50%*	*2.50%*	*30.00%*
Undercount	-	*2.50%*	*2.50%*	*25.00%*	*45.00%*	*77.50%*	*25.00%*
Bias	-	*2.875*	*2.175*	*0.575*	*-0.5*	*-1.275*	*0.1*

Table 11 - Bicycle Counting performance validation Dobratsch.

Metric	GROUND TRUTH	YOLO 0.25	YOLO 0.40	YOLO 0.50	YOLO 0.60	YOLO 0.70	MD
Total Bicycle Count	*34*	*127*	*84*	*46*	*22*	*6*	*23*
Exact Matches	-	*10.13%*	*39.24%*	*58.23%*	*70.89%*	*69.62%*	*73.42%*
Overcount	-	*88.61%*	*55.70%*	*26.58%*	*10.13%*	*1.27%*	*7.59%*
Undercount	-	*1.27%*	*5.06%*	*15.19%*	*18.99%*	*29.11%*	*18.99%*
Bias	-	*1.177*	*0.633*	*0.152*	*-0.152*	*-0.354*	*-0.139*

The results reveal several limitations in both methods, highlighting their unreliability for precise bicycle counting without custom training. YOLO's threshold sensitivity is a major flaw: low thresholds (0.25-0.40) lead to overcounting and high positive bias in both locations, which inflated traffic estimates.

Higher thresholds (0.60-0.70) swing to undercounting with negative bias, missing up to 82% of bicycles and potentially underreporting usage in safety analyses. At confidence thresholds around 0.50-0.60, exact matches are inconsistent (20-71% across locations).

MegaDetector performs better overall with lower bias and higher exact matches at 45% in Villacher Alpenstraße and 73% at Dobratsch, but has a significant under counting at both locations.

Another limitation related to MD approach is that validation videos were selected with prior knowledge that bicycles appear in the scene using YOLO. However, if MD was run in scenarios where both bicycles and motorbikes pass by the frame, they both will be classified as bikes due to both types having almost exact bounding box sizes.

Both methods are biased toward errors in sparse scenes, amplifying inaccuracies. It could be noticed that both approaches perform worst when the target objects are further from the camera (e.g. Villacher Alpenstraße). This is evident in the higher rates of undercounts and overcounts in Villacher Alpenstraße, where bicycles may appear smaller and more distant, leading to detection challenges such as incomplete bounding boxes or confidence scores falling below thresholds. In contrast, at Dobratsch models show relatively better performance, with MegaDetector achieving 73% exact matches compared to 45% in Villacher Alpenstraße, possibly due to closer proximity of objects to the camera in those scenes. Overall, the results underscore the unreliability of off-the-shelf models like YOLO with default COCO weights and MegaDetector's vehicle class for precise bicycle counting, particularly without domain-specific fine-tuning.

Moreover, several limitations should be noted:

- Same vehicle on multiple videos: Since counting is performed per video, the same vehicle appearing in consecutive clips (e.g., a parked car) will be counted multiple times.
- Class Confusion: For MD, motorbikes may be misclassified as bicycles (or vice versa) due to similar bounding box sizes, as the area threshold fails to distinguish between them; this issue is compounded in validation sets pre-selected via YOLO detections, where mixed vehicle types could lead to false positives. For YOLO, bicycles can be confused with small objects with wheels such as a stroller due to visual similarities as seen in Figure 69.
- Detection Degradation: Performance can suffer if the camera activates mid-event, capturing vehicles only at frame edges or for brief durations, leading to incomplete tracks or missed detections; this is particularly problematic in sparse, motion-activated footage where partial views dominate.
- Threshold Trade-offs: Selecting an optimal value remains context-dependent, varying by location, and target class; YOLO's sensitivity here results in trade-offs between overcounting (e.g., +2.875 bias at 0.25 in Villacher Alpenstraße) and undercounting (e.g., -1.275 at 0.70), making it challenging for automated deployment.

Figure 69 - Stroller detected as a bicycle at Dobratsch.

These limitations highlight broader challenges in applying general-purpose detectors to specialized tasks like bicycle counting in wildlife or traffic cameras.

5.6 Consolidation and Interpretation of Results

The consolidation and interpretation of results for the Dobratsch Nature Park and Carinthian Region are based on a combination of onsite and online surveys, as well as data from automatic counters, mobile phone tracking, and user-generated app data. The analysis reveals that visitors to the nature park have a strong connection to its natural beauty, tranquility, and opportunities for outdoor activities. Many visitors identified hiking, relaxation, and nature immersion as their primary motivations for visiting. This group tends to plan longer stays, exploring the summit area, hiking trails, and attractions such as the Alpine Botanical Garden and Rosstratte.

Weekly distribution patterns indicate higher visitor numbers on weekends, except for specific locations like Napoleonwiese, which experience lower activity during weekends. Mobile phone data also revealed interactions between key areas, such as the Dobratsch summit and surrounding locations like P11 and Rodelhügel. Visitors often combine multiple points of interest during their trips, emphasizing the importance of integrated visitor experiences. Heatmaps and app-based data identified hot spots such as the summit area and Warmbad, which consistently attract the highest visitor numbers.

The consolidated findings emphasize several priorities for sustainable tourism management in the Dobratsch Nature Park. Improving infrastructure and mobility through expanded public transport, and cycling routes can reduce environmental impacts and enhance visitor experiences. Strategies to alleviate pressure on hot spots and redistribute visitor flows, such as parking management and real-time visitor guidance, can help promote lesser-known locations. Promoting environmental education and awareness through digital tools and mobile applications that provide real-time trail information and encourage responsible behavior can deepen connections to nature and sustainability. Establishing a permanent data observatory to integrate visitor, environmental, and mobility data will support evidence-based decision-making and adaptive management.

By integrating data from multiple methods, this analysis provides a comprehensive understanding of visitor dynamics in the Dobratsch Nature Park. The findings highlight the importance of aligning tourism management strategies with visitor profiles, motivations, and constraints. Key priorities include improving sustainable mobility, enhancing environmental education, and diversifying low-impact visitor services.

6 Visitor Analysis in the Prealpi-Giulie Nature Park

6.1 Visitor Survey

The main goals of this project are twofold: first, to understand tourists' preferences and assess the value of the park's services; and second, to analyze tourist flows using innovative methods in order to identify areas of both high and low visitor concentration. These insights aim to support a balanced approach between environmental conservation and sustainable tourism development. To achieve these objectives, we adopted a mixed-methods approach. Specifically, we conducted a comprehensive survey both online and on-site to capture detailed information about visitors' experiences, preferences, and perceptions. Additionally, we integrated data from physical visitor counters and mobile phone data (telephone big data) to track tourist movements across different areas of the park. This multi-source data strategy allows us to generate a rich and detailed understanding of visitor behavior, spatial distribution, and service valuation.

6.1.1 Visitor Survey On-site

The first questionnaire, conducted on-site, was given to a sample of 294 Park visitors through a mix of face-to-face interviews and an online survey. The questionnaire starts with a concise introduction that outlined the study aims and provided a general overview of the questions. The initial section gathered demographic information and insights into respondents previous experiences at the Park, such as whether they had visited before, their companions during the visit, and the mode of transportation used to reach the Park. The subsequent section featured questions aimed at examining visitors' recreational habits and their perceptions of the overall experience at the Park. This included inquiries about the services utilized during their last visit, the activities they engaged in, the motivations behind their visit, and their satisfaction with the recreational experience.

Additionally, one question in the second section addressed the "Sella Carnizza" road. Sella Carnizza is a significant thoroughfare that traverses the park, linking the upper Torre valley with the Resia valley. During the summer months, it faces considerable traffic congestion. Respondents were asked if they would be willing to contribute to the costs associated with maintaining this road by paying a transit fee. If respondents indicated a willingness to pay the transit fee, a follow-up question asked them to specify the maximum amount they would be willing to pay, ranging from 2 to 10 euros. Conversely, if they responded negatively, they were prompted to provide a justification for their answer. The final section of both questionnaires focused on collecting socio-demographic data to create a profile of the respondents, including questions regarding gender, age, education, and income.

To obtain a more profound understanding of the psychological and environmental perspectives of respondents, the questionnaires included two essential psychological constructs: The Environmental Attitude Scale (EA) and the Inclusion of Nature in Self Scale (INS). The Environmental Attitude Scale (EA) is a recognized tool in environmental psychology that assesses an individual's inclination to view the natural environment positively or negatively

(Milfont & Duckitt, 2010). This construct is vital for comprehending individuals' ecological concerns and their connection to the environment. The Inclusion of Nature in Self Scale (INS), created by Martin and Czellar (2016), evaluates the extent to which a person feels a personal bond with nature. Together, these constructs offer significant insights into the psychological elements that shape visitor's attitudes toward the Park and their subsequent behaviors.

6.1.2 Visitor Survey Online

The second questionnaire, which included a Discrete Choice Experiment (DCE), was entirely administered online to a representative sample of 750 residents from the Friuli Venezia Giulia region, where the Park is situated, by a professional marketing research firm. This questionnaire was developed in two versions: one for individuals who had previously

visited the Park and another for those who had not. Respondents who had never visited the Park were asked about their potential future visits and their interest in certain activities and services that they might take advantage of, while those with prior experience were questioned about their past visits. This methodology ensured that insights were gathered from both current and prospective visitors, facilitating a comprehensive analysis of visitor preferences and behaviors. The structure of the online survey was exactly the same used onsite, simply in the online questionnaire the choice experiment was added; otherwise, the structure and contents of the questions remained the same.

Choice Experiment

The online survey incorporated a Discrete Choice Experiment (DCE) designed to evaluate visitors preferences regarding various Park services, as well as to gauge their willingness to pay for potential improvements to current offerings and the introduction of new services. In this DCE, five non-monetary attributes were included, each corresponding to a distinct recreational service (as detailed in Table 12): (i) guided tours of agricultural sites, (ii) shelters and "casere" (self-managed, always accessible structures), (iii) a shuttle service facilitating access to the Parks remote areas, (iv) bicycle rental options featuring both traditional and pedal-assisted electric bicycles, and (v) dining establishments, taverns, and bars that have received the Park Quality Mark, a certification that acknowledges their dedication to sustainability and quality. The final attribute in the DCE was the payment mechanism, specified as an entrance fee to the park.

Table 12 - Five non-monetary attributes of the DCE.

	STATUS QUO	1° IMPROVEMENT	2° IMPROVEMENT			
GUIDED VISITS TO FARMS	Currently not available	Once a season	Twice a season			
RICOVERI AND CASERE	Presence of overnight accommodation facilities and seasonal grass cutting	Wood is delivered at the beginning and end of the summer season and is not replenished when it runs out	The wood supply is monitored monthly between spring and autumn and replenished as necessary to ensure that there is never a shortage. There is no monitoring during the winter months or when there is late snow or ice			
SHUTTLE SERVICE	Only available during events	Guaranteed line every Sunday in summer	Addition of a second line: departure from Resiutta and arrival at Val Alba Nature Reserve. Both lines are guaranteed every Sunday in summer			
BIKE RENTAL POINTS	Rental points are at the Resiutta and Chiusaforte stations	+ 1 Rental Point (Prato di Resia)	+ 2 Rental Points (Prato di Resia and Alta Val Torre)			
RESTAURANTS, TAVERNS AND BARS	Variable opening hours during the week and at weekends, and a lack of evening activities	Lunch and dinner cover at weekends in structures with the Park's Seal of Quality	Daily lunch and dinner coverage in structures with the Park's Seal of Quality			
ENTRANCE FEE	No entrance fee	2 €	4 €	6 €	8 €	10 €

To ensure robust and efficient estimation of visitors preferences, a D-efficient experimental design was used to create the choice sets. Each choice set consisted of three alternatives: the first two represented potential improvements to the Park's services, while the third alternative depicted the status quo—i.e., maintaining current services without any additional investment. The experimental design generated a total of 64 unique choice sets, which were divided into eight blocks. As such, each respondent was presented with a subset of eight choice sets (see Table 13 below for an example).

Table 13 - DCE Eight choice sets.

	Alternative 1	Alternative 2	Alternative 3
Guided visits to farms	Available once a season	Not available	No visit
Ricoveri and casere	Additional wood supply at the beginning and end of the season	Overnight and seasonal grass cutting equipment	
Shuttle service	Only during events	Only during events	
Bike rental points	Two points: Resiutta and Chiusaforte	Addition of two points (4 total)	
Restaurants, Taverns and Bars	Variable hours	Variable hours	
Entrance fee	4€	2€	
	O	O	O

6.2 Visitor Counting Devices

Visitor counting devices have proven to be one of the most effective tools for data collection within the Julian Prealps Nature Park. As highlighted by other monitoring tools described in this report, data from mobile applications such as Strava, Komoot, or Outdoor Active are scarce in the area. Furthermore, mobile phone data provide only limited information due to poor or nonexistent network coverage within the park. Consequently, although visitor counting devices do not provide information on visitor type, they offer a reliable estimate of the actual number of passages along a given trail, cycle path, or road. It should be noted, however, that eco-counters have a margin of error that manifests especially when many passages occur simultaneously. It was not possible to estimate this error due to a lack of field analyses. In addition, due to some hardware and software issues, some eco-counters have shown substantial temporal gaps: in some cases, a few days, in others entire months in certain years. For this reason, the activation date of each eco-counter is reported, but we note that the analyses presented in the following paragraphs were carried out starting from 1 January 2018 to ensure a broader basis for comparison. Thanks to the INDIALPS project, three new eco-counters (highlighted in yellow) were purchased and installed during spring 2025; therefore, the considered time period is very short. For this reason, we have also deemed it appropriate to consider the other instruments purchased and installed by the Park Authority in previous years.

Currently, eleven eco-counters are active within the park: seven placed on official CAI hiking trails, one on a cycle-pedestrian route, and three on paved roads. Some eco-counters record both entries and exits based on travel direction, allowing a more precise identification of preferred movement directions along the monitored routes. Others provide an additional level of information by distinguishing the type of passage (bicycle vs. pedestrian, or car vs. heavy vehicle). Eco-counters whose names begin with "CAI" were installed on some of the most significant trails in the Julian Prealps Park, often near closed valleys or where the route is compulsory, thus providing reliable data on how many actual passages occur at the location. Road eco-counters, on the other hand, were placed on roads that provide access to two agritourism mountain huts and near where other hiking trails start. The eco-counter on the Strada Sella Carnizza–Uccea is positioned on a road of primary importance for access to the park from Slovenia and also shows high management costs due to frequent hydrogeological instability. For this reason, the eco-counter was installed to collect data for the preparation of a feasibility study on a paid management of the road (Deliverable WP 4.3).

Thanks to the INDIALPS project, three new eco-counters (highlighted in yellow) were purchased and installed during the spring of 2025, so the time period considered is very short. For this reason, we considered it valid to also take into account the remaining instruments purchased and installed by the Park Authority in previous years.

Table 14 - Eco-counters list based on location, type and date.

Eco-counter	Type	Active since
CAI 450 - Val Alba	Pedestrians	26 November 2017
CAI 632 - Sentiero Botanico "Bila Peč "	Pedestrians	10 August 2022
CAI 642 - Malga Coot	Pedestrians	30 September 2010
CAI 662 - Ta Lipa Pot	Pedestrians	10 May 2024
CAI 702 - Valle del Resartico	Pedestrians	2 July 2025
CAI 703 - Rio Nero	Pedestrians	24 November 2017
CAI 719 - Valle Musi	Pedestrians	20 June 2022 11 October 2011 - 28 August 2019 (old gear)
Cicloturistica Val Resia	Pedestrians and bikers	2 April 2025
Strada Coot	Car and huge vehicles	2 April 2025
Strada Malga Confin	Car and huge vehicles	2 April 2025
Strada Sella Carnizza - Uccea	Cars	7 May 2015 5 May 2010 – 25 January 2012 (vecchio modello)

6.3 Mobile Phone Data

Mobile phone data, provided by a telephone company, offers a powerful source of information for tracking people's movements. By monitoring mobile devices, it becomes possible to analyze tourist flows across time and space with high accuracy and granularity. In this project, big data is used to study tourist mobility patterns within selected municipalities during the years 2024 and 2025. The spatial focus includes multiple municipalities, such as Chiusaforte, Resia, Tolmezzo, Tarvisio, and others, as well as specific ad hoc areas like the Resia Valley and Sella Nevea.

Users are classified based on their behavior and residency status:

- Habitual residents: users who spent most nights in the analyzed area;
- Habitual users: individuals registered in the municipality for at least six months;
- Overnight tourists: visitors who stayed overnight in the area of interest;
- Day excursionists: visitors who came to the area but did not stay overnight.

The mobile phone company provides a set of detailed analyses that allow for an in-depth understanding of tourism dynamics, including: Daily unique presences; User base; Length-of-stay analysis; Entry and exit point analysis; Co-visit analysis; Visitor behavior analysis. These analyses offer a comprehensive picture of how different visitor types move through and interact with the area.

6.4 Regression Analysis

This chapter presents an analysis of visitor trends in relation to environmental variables such as precipitation, temperature, and seasonality. The investigation was carried out using two complementary data sources: the counts recorded by eco-counters installed in the park and the estimated visitor flows derived from big data. By integrating these datasets with meteorological information from local weather stations, the aim is to better understand how environmental conditions influence visitor numbers.

6.4.1 Effects of Rain, Temperature and Seasons on Eco-Counter Counts and Visitors Counts from BigData

For a more detailed analysis, eco-counter data were examined in conjunction with weather information from meteorological stations located within the park. For each of the 10 counters installed in the park, the nearest weather stations were identified.

Based on this data, total precipitation and average temperature were used as weather variables. Additionally, seasons were included as categorical variables. The number of people recorded by each counter served as the dependent variable in the regression analysis.

A similar regression analysis was conducted using visitor data derived from Big Data sources. Specifically, the total number of visits was extracted from the dashboard provided by the mobile phone company. The data were aggregated by municipality, including the municipalities in which each eco-counter is located. These visit numbers were used as the dependent variable in the regression analysis, while the same independent variables were considered: total precipitation, average temperature, and season. The table below shows the correspondence between each counter and the nearest weather station associated with it. Moreover, the third column shows the municipality where the respective meter is located and, therefore, the municipality from where the BigData was downloaded to do the regression analysis.

Table 15 - Big data extraction.

	Ecocounters	Weather station	Municipality BigData
1	Sentiero Botanico "Bila Pec"	Livinal Lunc	Chiusaforte
2	Sentiero Malga Coot	Uccea	Resia
3	Strada Sella Carnizza	Resia	Resia
4	Ta Lipa Pot	Resia	Resia
5	Sentiero Rio Nero	Resia	Resia
6	Sentiero Val Alba	Bivacco Bianchi	Moggio Udinese
7	Sentiero Valle Musi	Musi	Lusevera
8	Ciclabile Val Resia	Resiutta	Resiutta
9	Strada malga Confin	Malga Cjariguart	Venzone
10	Strada malga Coot	Uccea	Resia

6.5 Monthly Proportion of Visitors Engaging with Trail Networks: Eco-Counter Usage Relative to Total Municipal Presence (Jan 2024 – Apr 2025)

To assess the relative use of trail infrastructure, we compared eco-counter data with Big Data visitor counts at the municipal level. For each eco-counter and its corresponding municipality, we aggregated the total number of visits per month from January 2024 to April 2025. We then calculated the monthly percentage of trail users by dividing the eco-counter values by the total Big Data visits in the same municipality and month, providing an estimate of the proportion of overall visitors engaging with specific trail.

7 Results Visitor Analysis in the Prealpi-Giulie Nature Park

7.1 Visitor Insights: A Multi-Methodology Analysis

Prior to the detailed description and interpretation of the subsequent results, it is imperative to consider several pivotal concepts. In order to acquire more granular information regarding visitor flow, a multi-methodological approach was adopted. This involved the administration of two questionnaires (an online survey and an onsite survey, collectively collecting over 1,000 responses) to both visitors and non-visitors, supplemented by big data and counter readings. The collected information was then subjected to analysis from a harmonised perspective, facilitating a more comprehensive understanding through cross-referencing with meteorological data. This holistic strategy was selected to yield comprehensive insights and to mitigate challenges encountered with telephone data coverage, attributable to the geographical characteristics of the area.

To introduce the results section of the survey, the gender distribution across the different respondent groups is summarized below: all online respondents, including both those who visited and those who did not visit the park, 54% identified as female and 45% as male. Focusing on online respondents who actually visited the park, 52.8% were male and 46.9% were female. In contrast, among online respondents who did not visit the park, 59.1% were female, 40.5% male. As for the onsite respondents, the gender balance was similar to the overall online sample, with 54% identifying as female, 44% as male.

Following the gender breakdown, we now turn to the age distribution of the respondents. Among onsite participants, the age group most represented was 55–64 years old, accounting for 27% of the sample. This was followed by those aged 45–54 at 23%, and 65+ at 16%. Middle-aged and senior visitors made up the majority of the onsite respondents. The younger age groups were less represented, with 25–34 years at 15%, 35–44 years at 13%, and the 18–24 group forming just 5% of the total. For online respondents, the age distribution was more evenly spread across the middle-aged categories. The 45–54 group comprised 22%, followed closely by 35–44 at 20%, and 25–34 at 19%. Younger adults aged 18–24 and older adults aged 55–64 both represented 15% each, while the 65+ group was the least represented online at 9%.

Now turning to the respondents' province of origin, data show that onsite visitors were mainly from Udine (36.3%), with a significant portion also coming from abroad (32.1%), likely representing foreign visitors. Pordenone, Trieste, and Gorizia contributed 13.1%, 10.1%, and 8.3% respectively. Online respondents followed a similar pattern, with Udine again being the most represented province at 50.8%, followed by Pordenone (20.5%), Trieste (19.2%), and Gorizia (9.5%). The online survey was distributed among a sample of Friuli Venezia Giulia residents, so, this is the reason why we don't have any people coming from abroad.

7.2 Evaluation of the Visitors Survey

In this section, we will present the number of respondents who have actually visited the park, based on both the online and onsite surveys. A total of 294 onsite respondents participated, which was reduced to 287 after data cleaning. As for the online survey, we had 750 respondents in total, 288 (38%) of whom reported visiting the park in the last five years. The following results refer to the questions answered by these visitors.

7.2.1 Visitor´s Destination and Travel Mode within the Region

Destination

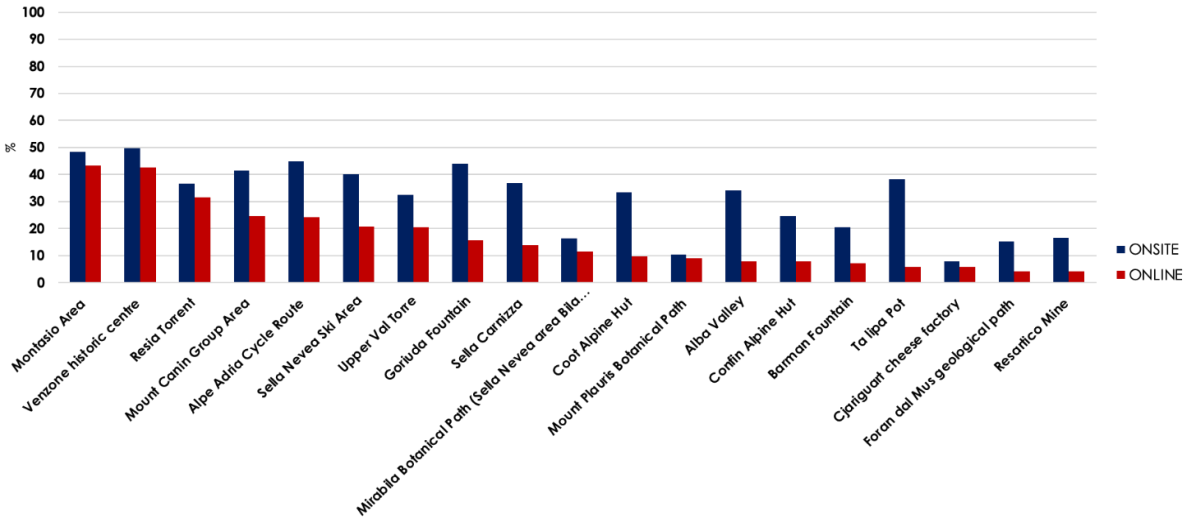


Figure 70 - Area/site visited.

This graph shows which park areas visitors reported having visited over the past five years, comparing onsite (blue) and online (red) respondents. The most frequently visited sites for both groups were the Montasio Area and Venzone Historic Centre, each reaching over 45%, showing they are key attractions. Onsite respondents generally reported visiting more areas and with higher frequency than online respondents, particularly places like Sella Nevea Ski Area, Goriuda Fountain, Sella Carnizza, and Ta Lipa Pot, which had strong onsite engagement but significantly lower online figures. Less-visited areas like Cjarniguart cheese factory, Foran dal Mus geological path, and Resartico Mine saw very low percentages, especially among online participants.

Transportation

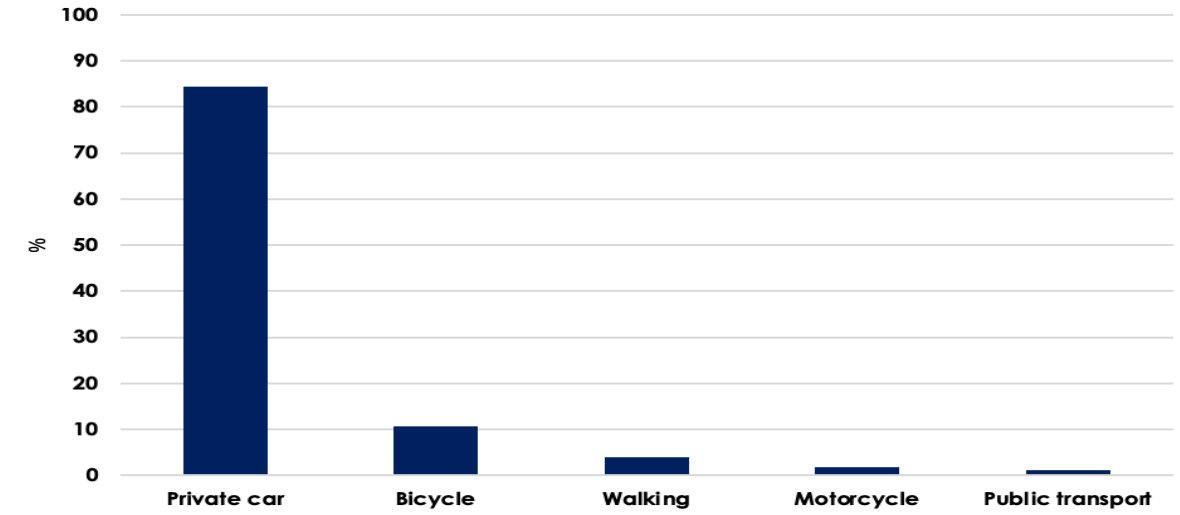


Figure 71 - Type of transportation used.

This bar chart displays the modes of transport used by respondents who answered the survey onsite. The data shows a clear dominance of the private car, used by approximately 84% of onsite respondents. This indicates a strong dependence on private vehicles for accessing the location. The second most common mode is the bicycle, used by about 10%, followed by walking at around 4%. Motorcycles and public transport each account for very minimal shares, close to 1% or less. These figures suggest that sustainable or shared transport options are significantly underutilized by visitors to the area.

7.2.2 Information About the Area

Visitor Familiarity

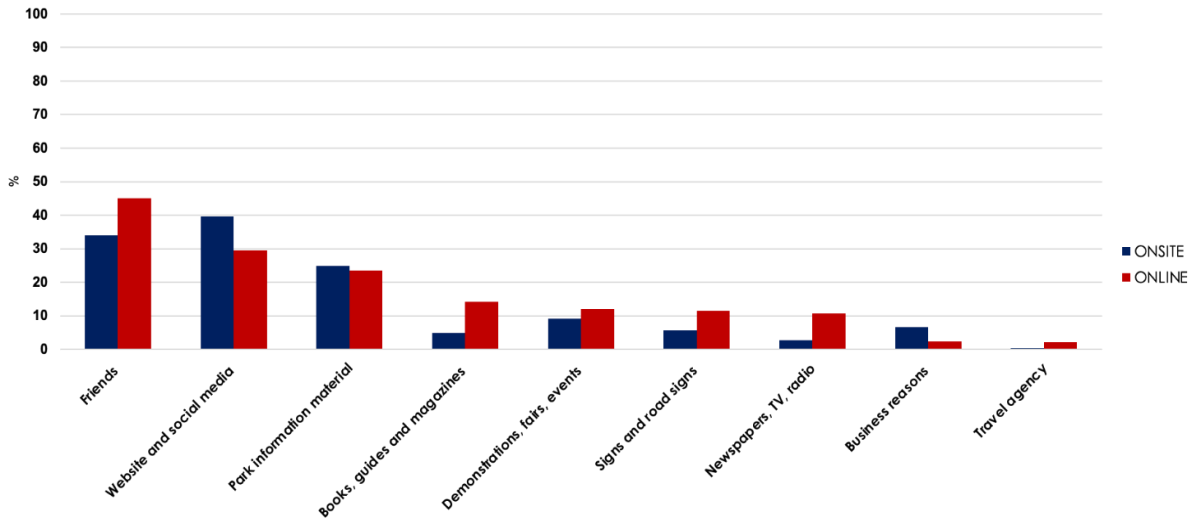


Figure 72 – Information channels used to be aware about the park.

This graph compares how onsite and online respondents learned about the park. The most cited source was "Friends", especially among online respondents (45%). "Website and social media" followed, more commonly mentioned by onsite visitors (40%), suggesting digital tools help attract physical visits. Park information materials were similarly used by both groups. Online respondents reported higher use of books, events, signs, and traditional media. Business reasons and travel agencies had minimal influence. Overall, personal networks and online channels are key communication tools, with slight differences in how each group accesses park information.

Motivations for Choosing the Location

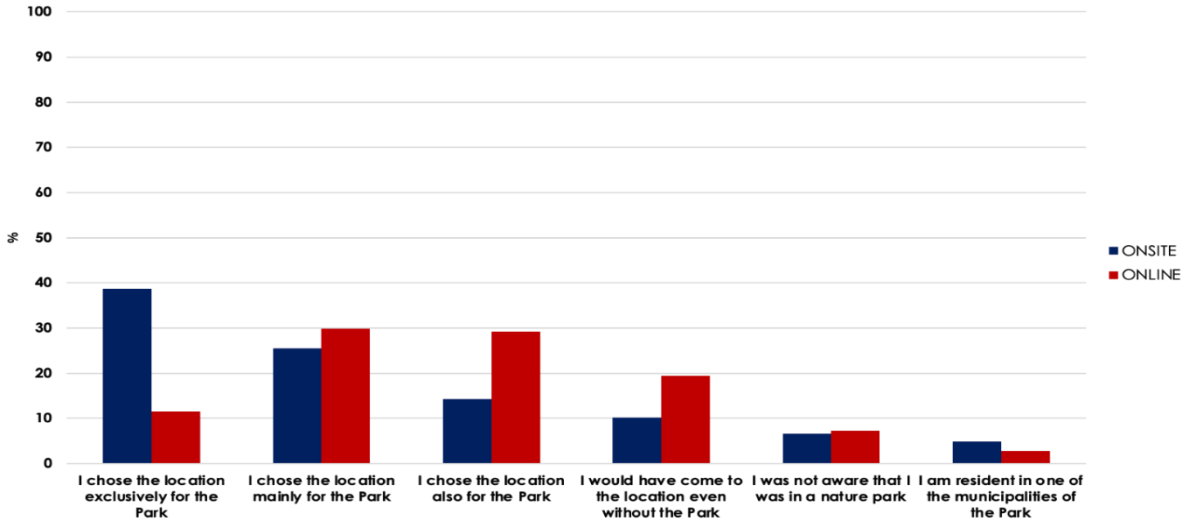


Figure 73 – Factors influencing the location selection.

This bar chart compares responses from ONSITE (blue) and ONLINE (red) visitors regarding their reasons for choosing a specific location in relation to a nature park. The most striking difference is observed in the first category, where nearly 40% of onsite respondents stated they chose the location exclusively for the park, compared to only about 12% of online respondents, indicating a stronger park-related motivation among those surveyed in person. Conversely, online respondents were more likely to say they chose the location also for the park or would have come even without the park, suggesting a broader range of motivations beyond the park itself. For instance, around 30% of online respondents said they chose the location also for the park, almost double the percentage of onsite respondents in this category. Similarly, the percentage of online participants who would have come to the location even without the park is about 18–20%, compared to about 10% of onsite visitors. Overall, onsite respondents appear more park-focused, while online participants show a more diversified set of motivations for visiting the location.

Motivations for Visiting the Park

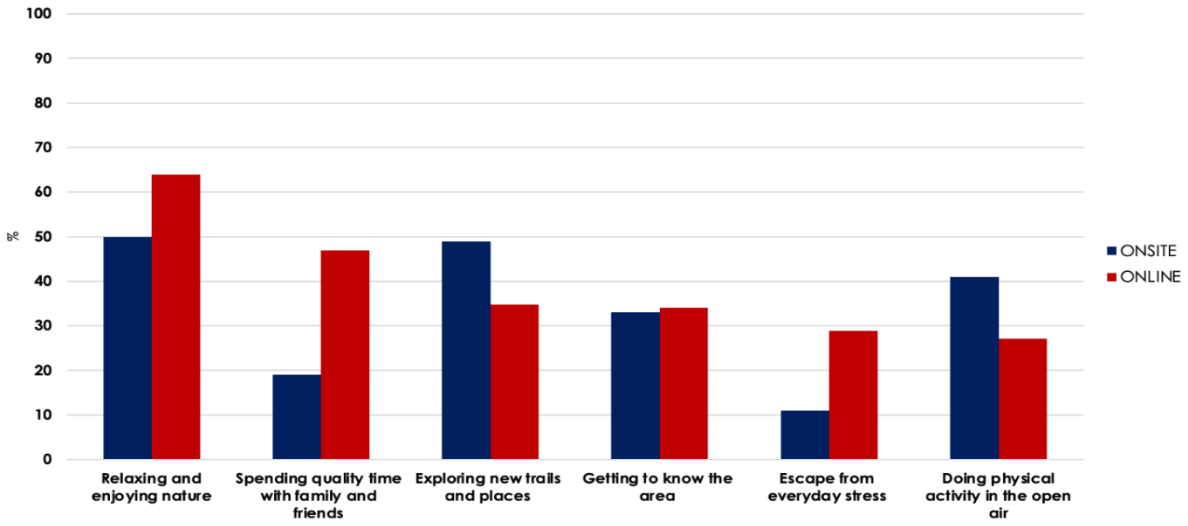


Figure 74 - Reason associated with park visit.

This chart compares the motivations of onsite and online respondents for visiting the park. The most frequently mentioned motivation overall is relaxing and enjoying nature, especially among online respondents (around 65%), followed by onsite visitors (50%). This suggests that the park's natural environment plays a central role in attracting visitors, particularly those reflecting on their experience remotely. Exploring new trails and places is a stronger motivation for onsite visitors (around 49%), compared to about 37% of online participants, which may reflect the more spontaneous or experience-driven nature of in-person visits. Similarly, doing physical activity in the open air was much more emphasized by onsite respondents (around 42%), while online visitors (around 30%) reported this less frequently. A significant difference also appears in spending quality time with family and friends, where online respondents (47%) far exceed onsite ones (18%). Getting to know the area was a fairly balanced motivation, cited similarly by both groups (around 34%), while escaping everyday stress was more frequently mentioned by online participants (28%) than onsite ones (11%). Overall, onsite visitors prioritize activity and exploration, while online participants emphasize relaxation, social connection, and emotional well-being.

Typical Activities Practiced

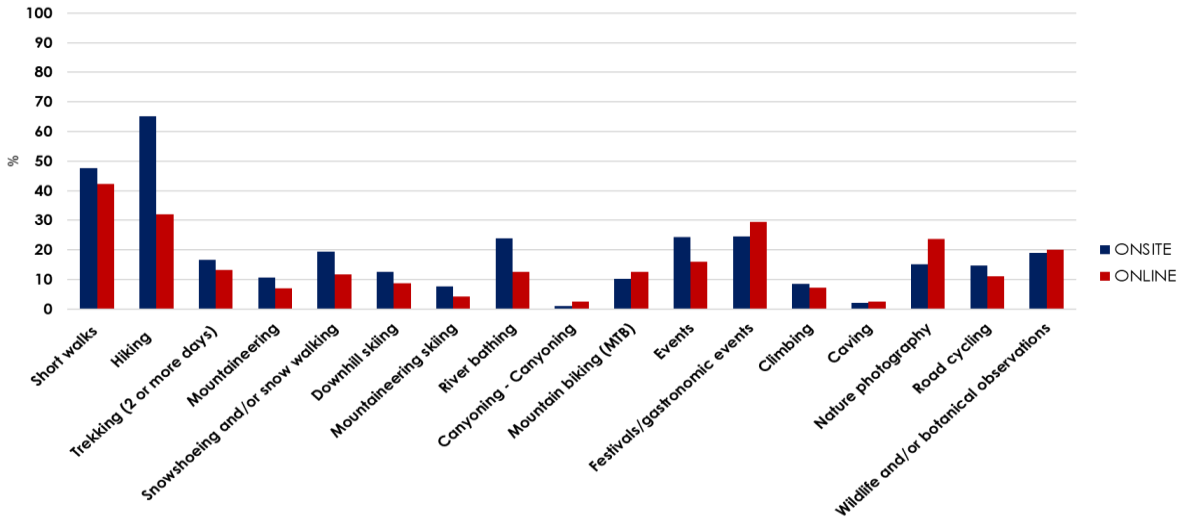


Figure 75 - Percentage of activity current practiced in the park.

This graph shows how often visitors, distinguishing between onsite and online respondents, practised various activities in the park over the past five years. The most frequently practised activities for both groups were Short walks and Hiking, with higher participation among onsite respondents, particularly in hiking, which showed a significant difference. Activities such as Mountaineering, Snowshoeing and/or snow walking, Downhill skiing, and Mountaineering skiing were practised less frequently overall, but still showed slightly higher engagement among onsite respondents. Interestingly, Festivals/gastronomic events saw the highest rate of participation among online respondents, even slightly surpassing the onsite group.

7.2.3 Use of Outdoor and Fitness App

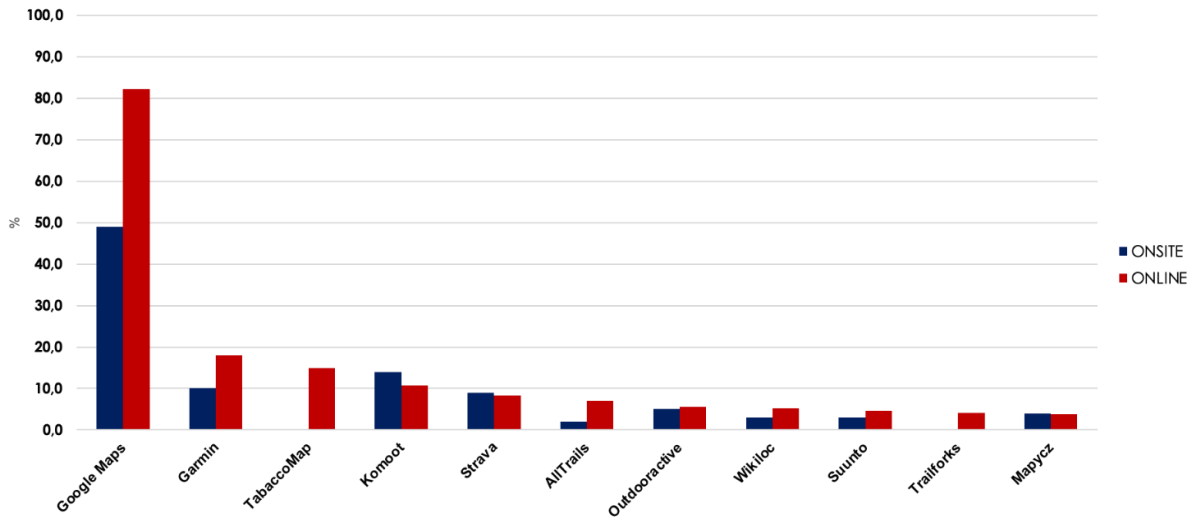


Figure 76 - Apps used in the park activities.

This graph highlights which apps respondents used to navigate to the park. Google Maps was by far the most used app across both groups, especially among online respondents (over 80%), compared to around 50% for onsite visitors. This shows Google Maps is the dominant navigation tool. Other apps such as Garmin, TabaccoMap, and Komoot were used to a much lesser extent, though still slightly more popular among online respondents. Usage of specialized trail apps like Strava, AllTrails, Outdooractive, and Wikiloc remained relatively low and consistent across both groups.

7.2.4 Opinions About Touristic Offers

Services that are Currently Used

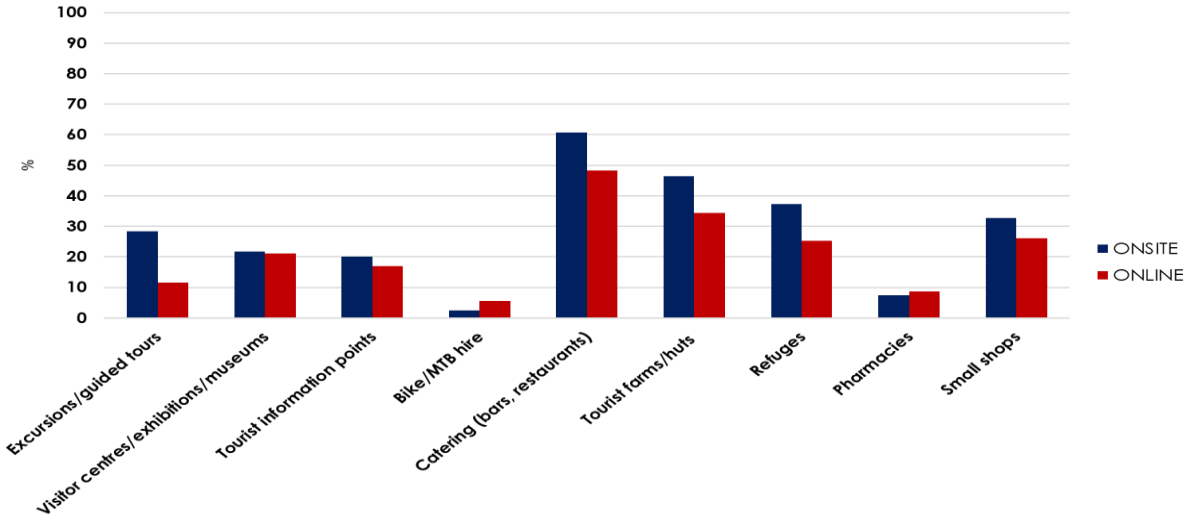


Figure 77 - Services used during park visit.

The graph compares the frequency of use of various services within the park over the past five years, distinguishing between onsite and online respondents. The most frequently used services by both groups were Catering (bars, restaurants), Tourist farms/huts, and Visitor centres/exhibitions/museums, with onsite respondents reporting notably higher usage. Tourist information points and Excursions/guided tours were also more commonly used by onsite visitors, suggesting that those physically present in the park were more likely to engage with informational and interpretive services. Bike/MTB hire showed relatively low overall usage, although slightly more online respondents reported using this service compared to some other categories. Refuges and Pharmacies were used less frequently across both groups, but again, onsite visitors reported slightly higher engagement in most cases.

A Comparison of Importance and Satisfaction in Park Services

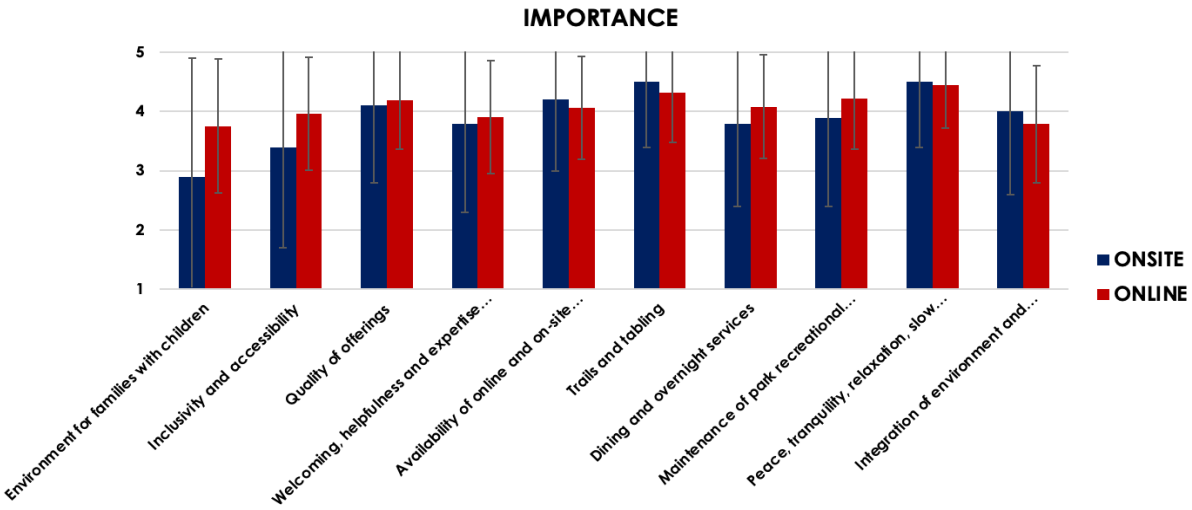


Figure 78 – Importance of park services.

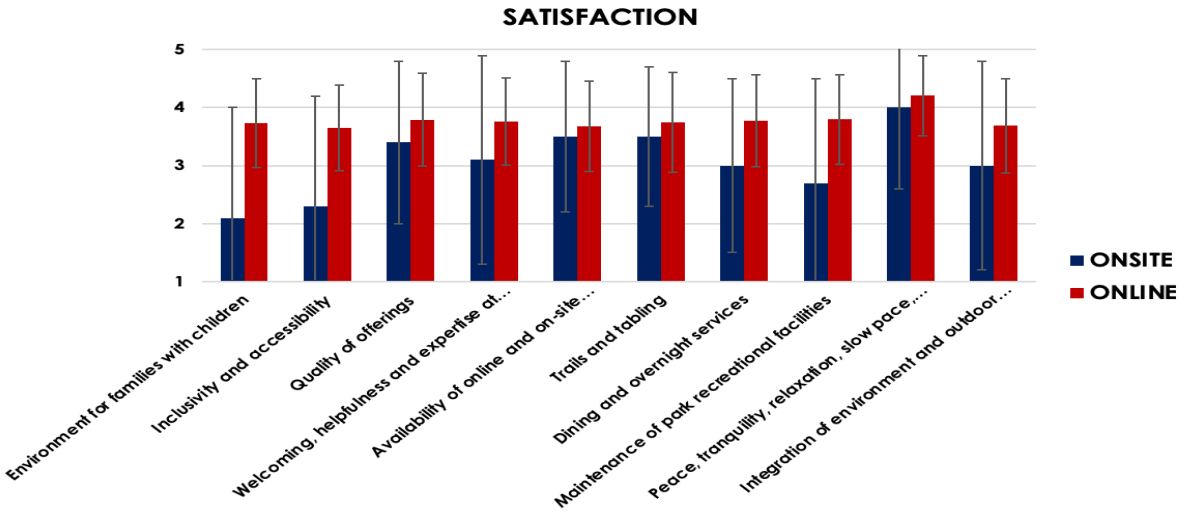


Figure 79 – Satisfaction of park services.

The first graph shows how onsite and online respondents rated the importance of various park features. Both groups placed the highest importance on elements related to nature, such as trails and tabling, peace and tranquility, and the integration of environment and outdoor activities, with onsite respondents rating these particularly high. Aspects like helpfulness of staff, quality of offerings, and availability of information were also valued, though slightly less. In contrast, family-friendly services and accessibility were rated lower, especially by onsite visitors. Notably, online respondents consistently gave higher importance ratings across most features, suggesting broader expectations. The second graph presents satisfaction levels for the same features. Again, peace, tranquility, and nature-related services stood out with the highest satisfaction, especially among online participants. Satisfaction also aligned well with importance for trails and outdoor integration, showing the park delivers well on key expectations. However, satisfaction was lower for accessibility, family services, and maintenance of recreational facilities, especially for onsite visitors. Comparing the two graphs, there is a strong match between what visitors value most and what satisfies them, particularly in nature-related experiences. However, there are clear gaps in areas like accessibility and infrastructure, where satisfaction falls short of importance.

7.2.5 Visitor´s Habits and Social Carrying Capacity

Preferred Seasons for Visiting

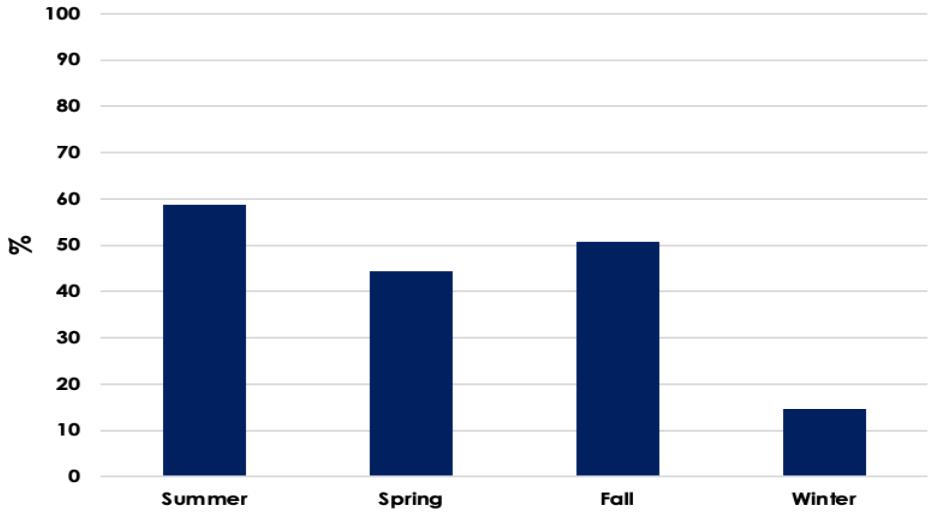


Figure 80 - Percentage of visitors based on the season.

This bar chart displays onsite respondents' preferences for the season in which they most enjoy visiting the park. Summer stands out as the most preferred season, chosen by 59% of participants. This suggests that warmer weather and longer days are particularly appealing for park visitors, likely due to ideal conditions for outdoor activities such as hiking and nature observation. Fall follows with 51%, showing it is also a highly appreciated season possibly due to milder temperatures, lower tourist presence, and scenic foliage. Spring is close behind at 44%, reflecting visitors' interest in the park's natural renewal, flowers, and wildlife during this season. In contrast, winter is the least preferred season, with only 15% of respondents indicating it as their favorite time to visit. We asked respondents from both surveys whether they would be interested in visiting the park again in the future. In the onsite survey, 99% answered "yes" and only 1% responded "no." The online survey showed identical results.

Park Visits Companions

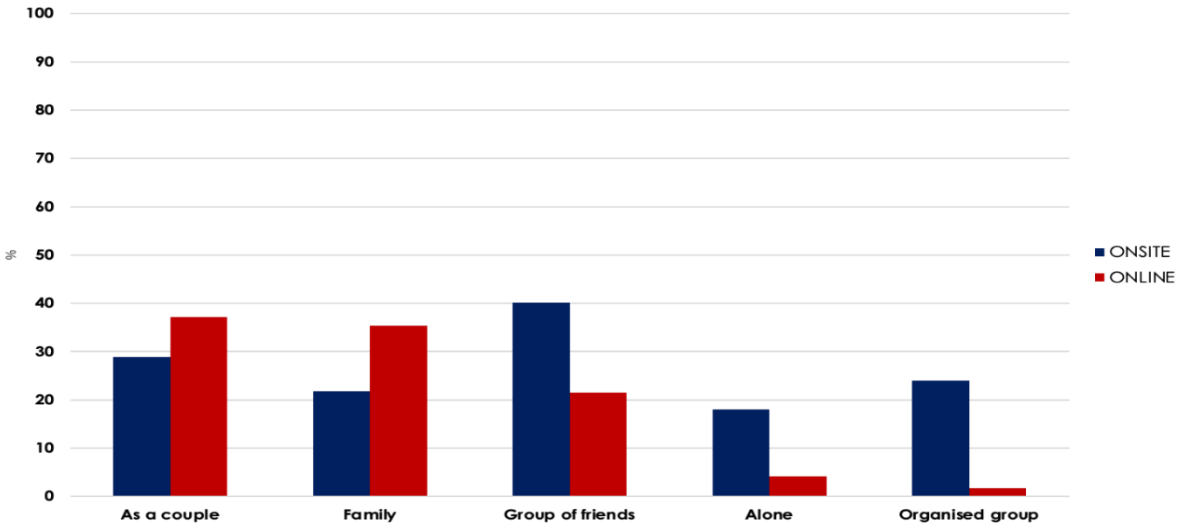


Figure 81 - Companion for the park visit.

This bar chart illustrates how onsite and online respondents answered the question “With whom did you visit the park?” Clear differences emerge between the two groups. Onsite respondents most commonly visited the park with a group of friends (40%), significantly higher than the 21% reported by online participants, indicating that in-person visitors are more likely to experience the park as part of a social group. In contrast, online respondents were more likely to visit as a couple (38%) or with family (36%), both notably higher than onsite respondents (29% and 22%, respectively). Visiting the park alone was also more common among onsite respondents (17%) compared to only 5% of online respondents, while organized group visits were largely reported by onsite visitors (24%), with only about 2–3% of online respondents selecting this option. These results suggest that onsite visitors tend to engage in more social or structured group experiences, while online respondents more frequently represent private visits with family or partners.

Types of Accommodation

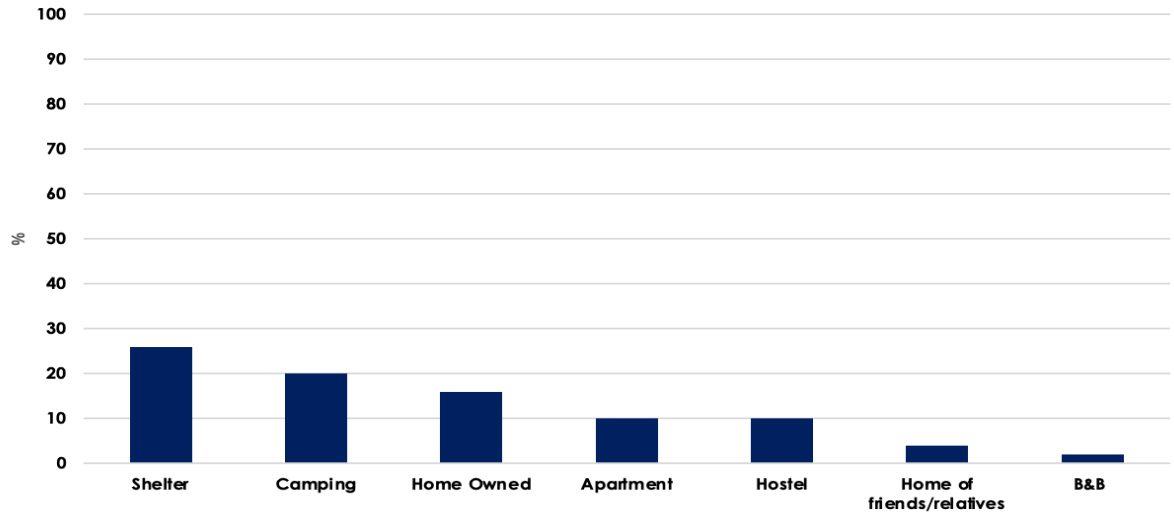


Figure 82 - Type of accommodation.

The most common accommodation type among onsite respondents was a mountain hut, chosen by 26% of participants, reflecting a strong preference for nature-immersive. Campsites were also popular, accounting for 20% of stays, indicating that a significant portion of visitors favor outdoor experiences. Owned homes were selected by 16% of respondents. Apartments and hostels were chosen by 10% each, showing moderate use of rental and budget accommodations. Only a small share of respondents stayed with friends or relatives (4%) or in a bed and breakfast (2%), indicating these options are the least used among visitors surveyed onsite. Overall, the data points to a visitor base that values autonomy and proximity to nature during their stay.

Duration of the Visit

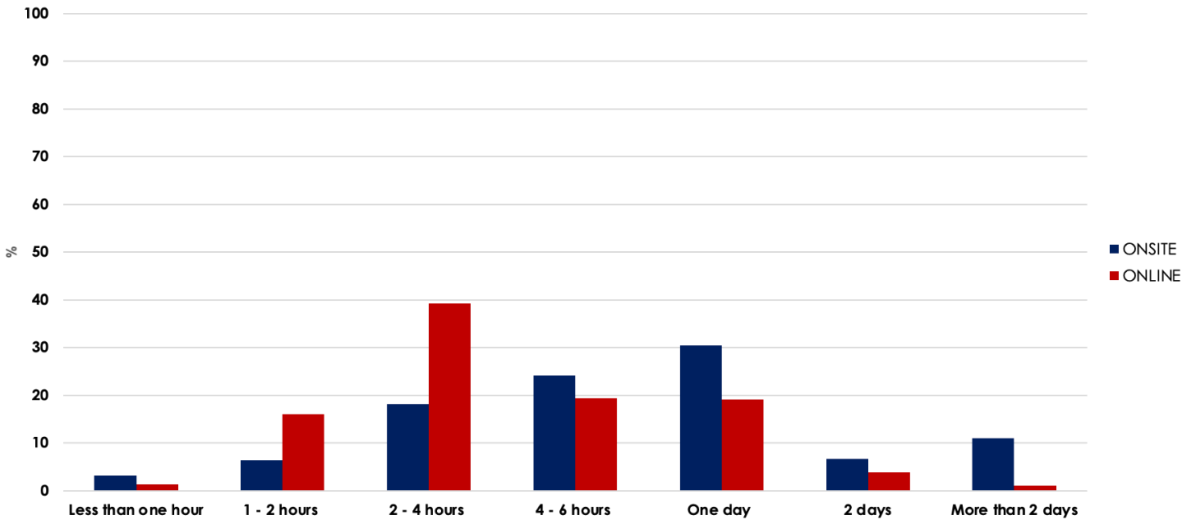


Figure 83 – Duration of the visit.

This graph shows how long visitors stayed in the park, comparing onsite and online responses. The most common duration for online respondents was 2–4 hours (almost 40%), while onsite visitors mostly stayed one full day (around 30%). Shorter visits (under 4 hours) were more frequent among online participants. In contrast, onsite respondents were more likely to spend longer periods, including 4–6 hours, one day, or more than two days, indicating deeper engagement.

Perception of Congestion

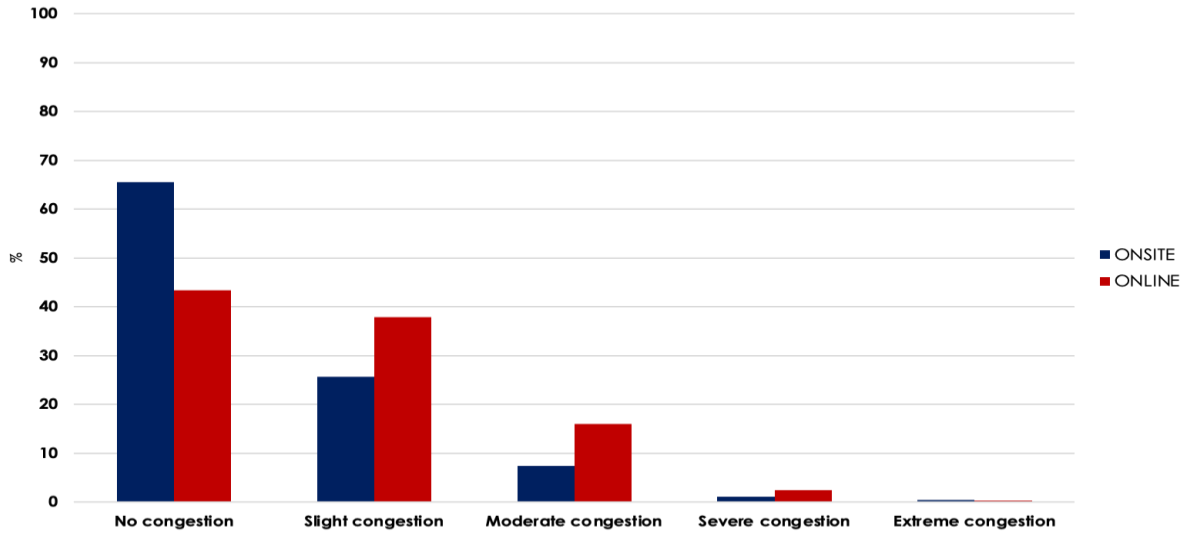


Figure 84 - Perception of congestion.

This bar chart compares onsite and online respondents' perceptions of congestion in the park. The majority of onsite respondents (around 65%) reported experiencing no congestion, a significantly higher percentage than online respondents (about 44%). On the other hand, online respondents were more likely to report experiencing slight to moderate congestion. About 38% of them perceived slight congestion, compared to only 25% of onsite visitors. Similarly, moderate congestion was reported by about 17% of online respondents, which is more than double the onsite share (less than 10%). For the categories of severe and extreme congestion, the values are low for both groups, though still

slightly higher for online participants, indicating that while crowding is generally not a major issue, it may be perceived as more problematic by those answering online, possibly because they visited during peak periods. In summary, onsite respondents generally perceived a more relaxed and open park environment, while online respondents had a more mixed or a slightly negative view regarding visitor density. This difference may reflect actual variation in experience or differing perceptions influenced by context, timing, or expectations.

7.2.6 Attitudes Towards Sustainability and Cross-Border Cooperation

Visitor's Knowledge of the Park's Conservation and Biodiversity Needs

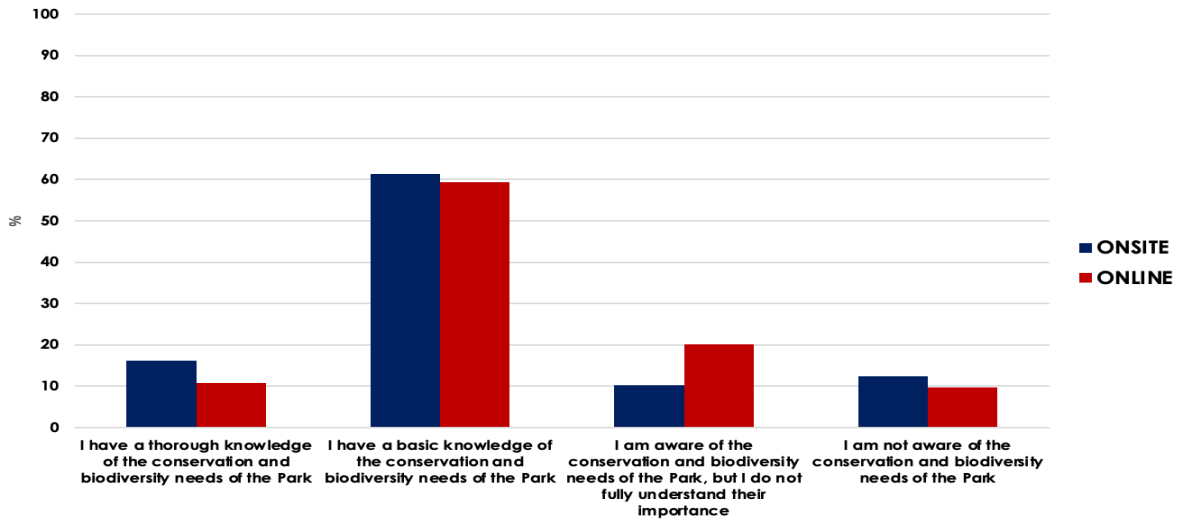


Figure 85 - Visitor knowledge about park´s conservation and biodiversty beeds.

This bar chart compares onsite and online respondents' levels of knowledge regarding the conservation and biodiversity needs of the Park. The vast majority of both groups, over 60% of onsite respondents and just under 60% of online respondents, report having a basic knowledge of these issues. This suggests that general awareness is relatively widespread, though perhaps not deeply rooted. A smaller portion of respondents, around 16% onsite and 10% online, claim to have a thorough understanding of the Park's conservation and biodiversity needs. This indicates that in-depth knowledge is limited, though slightly more prevalent among those who visited the park in person. Interestingly, 20% of online respondents say they are aware but do not fully understand the importance of these issues, compared to only 10% of onsite visitors. Finally, about 10–12% of both groups admitted they are not aware at all of the park's conservation and biodiversity needs, suggesting a residual lack of awareness. In summary, while most respondents have at least a basic level of awareness, there is a clear opportunity to enhance deeper knowledge and understanding, especially among those less directly engaged with the park.

Terms Associated with the Park

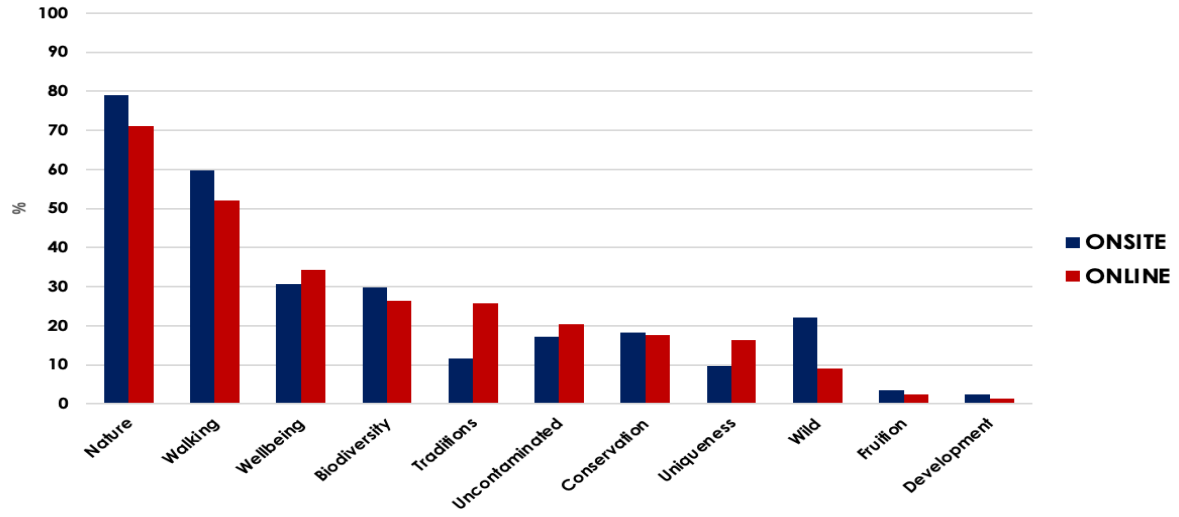


Figure 86 - Services associated with the park.

This chart shows the terms most frequently associated with the park by onsite and online respondents in response to the question: "What word or concept do you associate with the park?". The most commonly associated word for both groups is nature, selected by nearly 80% of onsite and 70% of online respondents, highlighting a strong, shared perception of the park as a natural space. Walking follows, especially prominent among onsite visitors (about 60%), reflecting their direct, physical experience of the landscape. Wellbeing, biodiversity, and conservation also rank among the more frequently chosen terms by both groups, though online respondents slightly emphasized wellbeing, traditions, and uncontaminated landscape more than those interviewed onsite. Notably, wildness was significantly more associated with the park by onsite respondents (over 20%) compared to online participants (under 10%). Terms like uniqueness, fruition (use or enjoyment), and development were among the least cited by both groups, suggesting they are less strongly linked to the park's identity in the minds of visitors. Overall, the results indicate that while both groups strongly connect the park with nature, onsite respondents emphasize more sensory and immersive experiences, whereas online respondents highlight conceptual and cultural associations.

Creation of a Cross-Border Area (Peace Park)

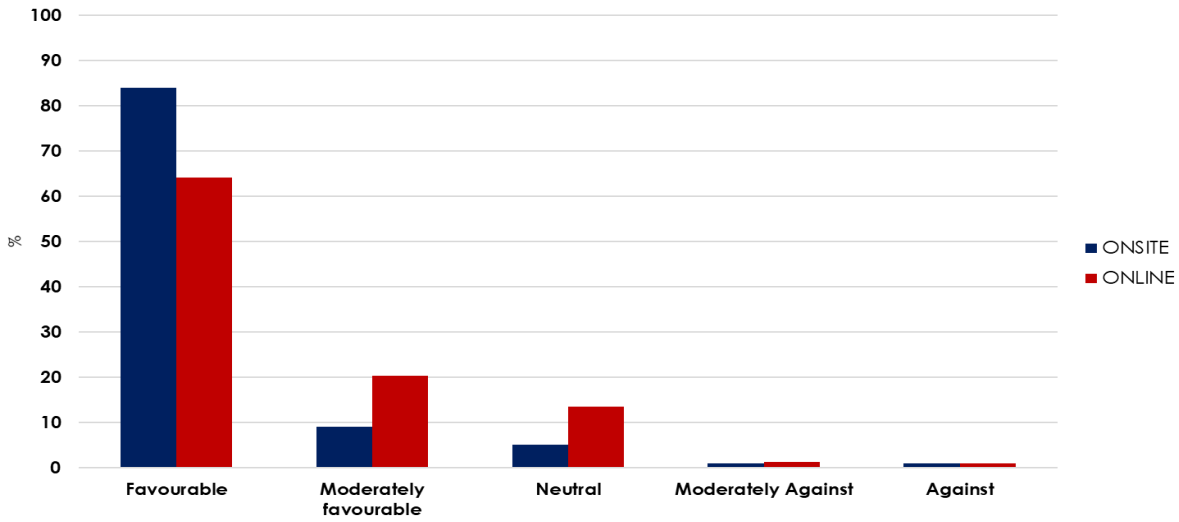


Figure 87 - Opinion about cross-border area.

Another important aspect explored was the perception of the park's cross-border area, a key objective of the investigation. The graph shows respondents' opinions on the idea of establishing a cross-border protected area (Peace Park) between Italy, Austria, and Slovenia. The results reveal a highly favourable perception of the initiative, particularly among onsite participants. This suggests that those with direct, physical experience of the park may better appreciate the value of cross-border cooperation for nature protection and cultural connection. Only minimal percentages expressed that they were against such a proposition. In conclusion, support for the Peace Park is strong, this finding underscores the strategic importance of the park's geographic location and highlights its significance as a symbol of cooperation and conservation.

7.2.7 Future Prospective

Interest in Future Services

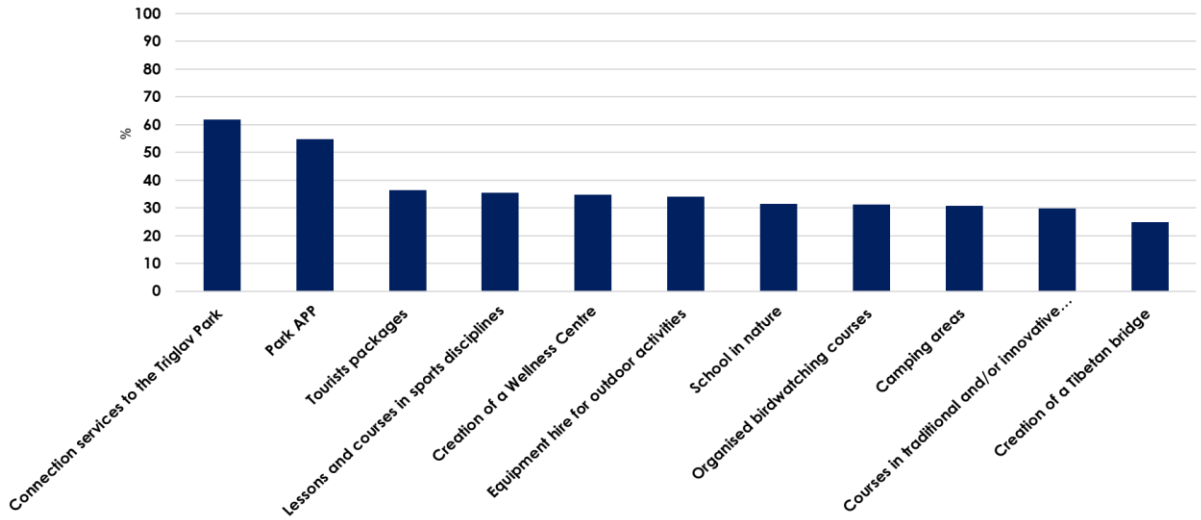


Figure 88 - Interest in future service implementation.

This graph presents only onsite visitors' interest in various new services the park may offer in the future. The most favored option was Connection services to the Triglav Park, suggesting a strong desire for improved cross-border accessibility or collaboration. This was followed closely by high interest in a Park APP, highlighting the value visitors place on digital tools for navigation, information, or planning. Moderate levels of interest were observed for Tourists packages, Lessons and courses in sports disciplines, and the Creation of a Wellness Centre, all of which suggest that visitors are also attracted to activity-based and wellness-oriented experiences. A similar degree of interest was shown for Equipment hire for outdoor activities, School in nature, and Organised birdwatching courses, reflecting a preference for nature-based learning and self-guided exploration. Slightly lower interest was expressed for Camping areas , which still indicate niche demand. The Creation of a Tibetan bridge was the least popular option, suggesting visitors may be less enthusiastic about infrastructure-heavy or novelty developments. Overall, the data show that onsite respondents prioritize meaningful connections, digital innovation, and experiential learning opportunities over more dramatic or structural interventions.

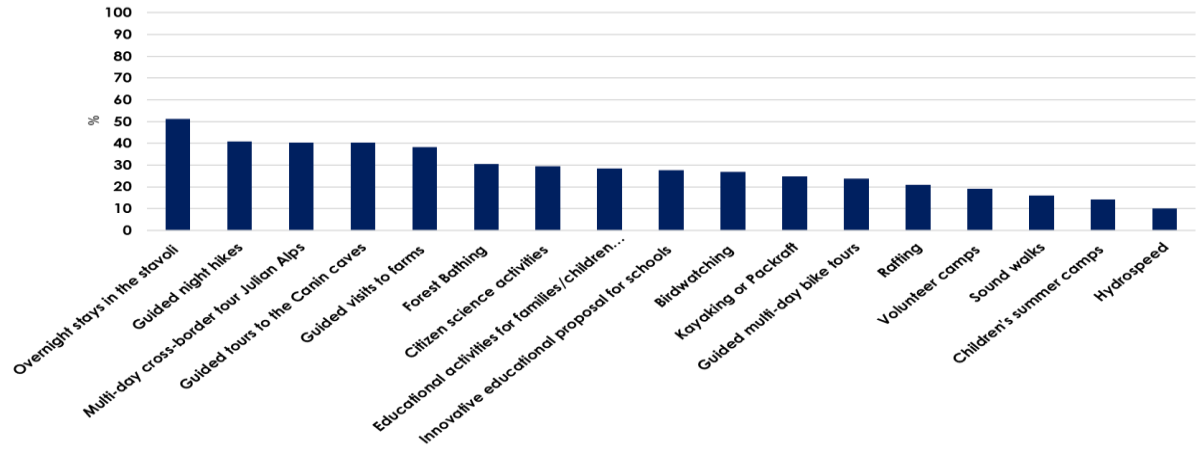


Figure 89 - Interest in future activities implementation.

This graph displays the level of interest expressed by onsite respondents in a series of potential new activities that the Park may introduce. The most popular option was Overnight stays in the stavoli, followed closely by Multi-day guided hikes and Guided night hikes, each garnering significant interest from visitors. Cross-border tour Julian Alps, Guided tours to the Canin caves, and Guided visits to farms also received high levels of support, indicating strong enthusiasm for immersive, guided, and locally rooted experiences. A moderate number of respondents showed interest in Forest bathing, Citizen science activities, educational activities for families/children, and Innovative educational proposal for schools, reflecting a notable demand for educational and wellness-oriented activities. Further down the list, Birdwatching, Kayaking or Packraft, and Guided multi-day bike tours received moderate but meaningful attention. Activities such as Rafting, Volunteer camps, Sound walks, Children's summer camps, and particularly Hydro-speed attracted less interest overall, suggesting these may appeal to smaller or more specific segments of the park's visitors. In summary, the onsite data reveals that visitors are most interested in nature-immersive, educational, and cross-border experiences, especially those that involve longer stays or local discovery, while extreme sports or highly niche activities tend to attract less demand.

7.3 Evaluation of the Non-Visitors Survey (Online Survey)

This section presents and analyses data collected from individuals who have never visited the Park, based on responses gathered through the online survey involving 462 participants. The aim was to understand the barriers to visitation, levels of awareness, and potential interest in future services or activities offered by the Park. By examining the perspectives of non-visitors, this section provides valuable insights into what currently prevents people from engaging with the Park and what might encourage them to do so in the future.

7.3.1 Reasons of Non-Visit

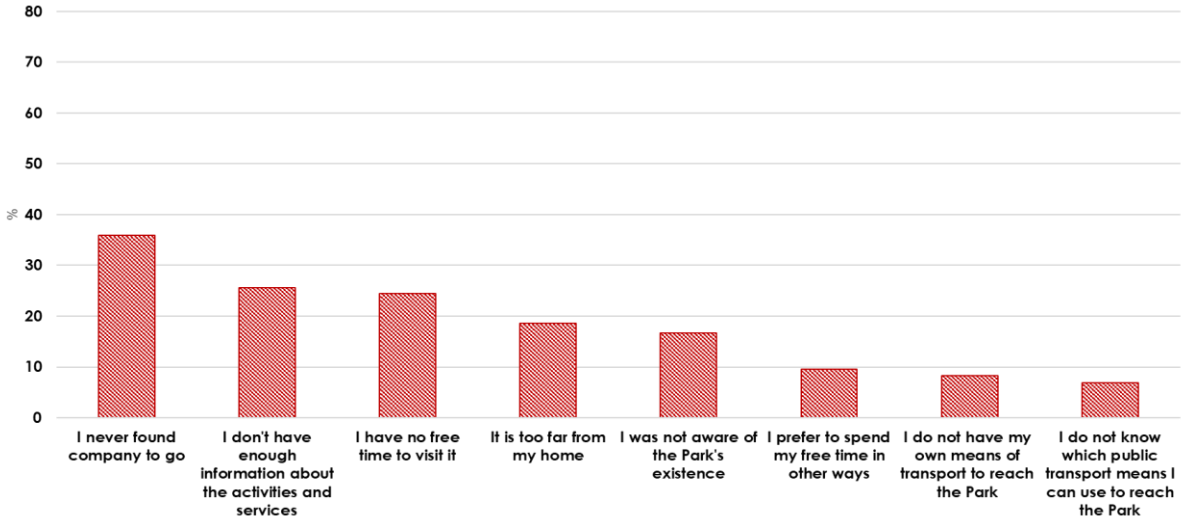


Figure 90 - Reasons of non-visit.

This graph illustrates the reasons given by online respondents who stated they had never visited the Park. The most common reason, selected by the largest proportion of respondents, was "I never found company to go", indicating that the lack of a companion or group may be a significant barrier to first-time visitation. This was followed closely by "I don't have enough information about the activities and services" and "I have no free time to visit it", both of which suggest that limited awareness and time constraints also play major roles in preventing visits. Other notable reasons include "It is too far from my home" and "I was not aware of the Park's existence", both pointing to geographical and informational accessibility challenges. Finally, transportation-related issues were cited by a minority of respondents, with "I do not have my own means of transport to reach the Park" and "I do not know which public transport means I can use to reach the Park" being the least common barriers. Overall, the results highlight that social, informational, and logistical factors are the main barriers for those who have never visited the Park, with practical issues like lack of information, time, or transport access outweighing opposition or disinterest. These insights point to clear opportunities for the Park to improve communication, promote accessible experiences, and consider initiatives aimed at solo or first-time visitors.

We asked non-visitors if they would be interested in visiting in the future, and 90% of them responded positively.

7.3.2 Visitor´s Habits

Duration of the Visit

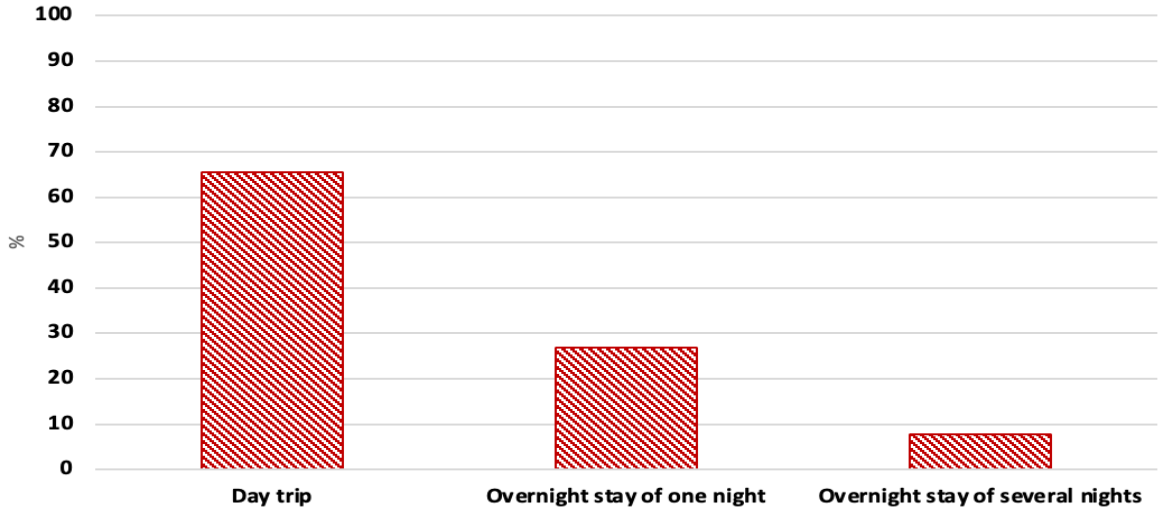


Figure 91 - Visit duration.

The results show a strong preference for a one-day trip, with approximately 65% of respondents selecting this option. This suggests that the majority of potential visitors see the park as a destination suitable for short-term, possibly spontaneous visits, rather than extended stays. Around 25% of respondents indicated they would prefer to stay for one night, showing some interest in spending a bit more time in the park, perhaps to engage more deeply with its offerings. Only a small portion, approximately 8%, expressed interest in staying multiple nights. The findings imply that the park may be perceived primarily as a day-use destination by those who have not yet visited.

Park Visit Companions

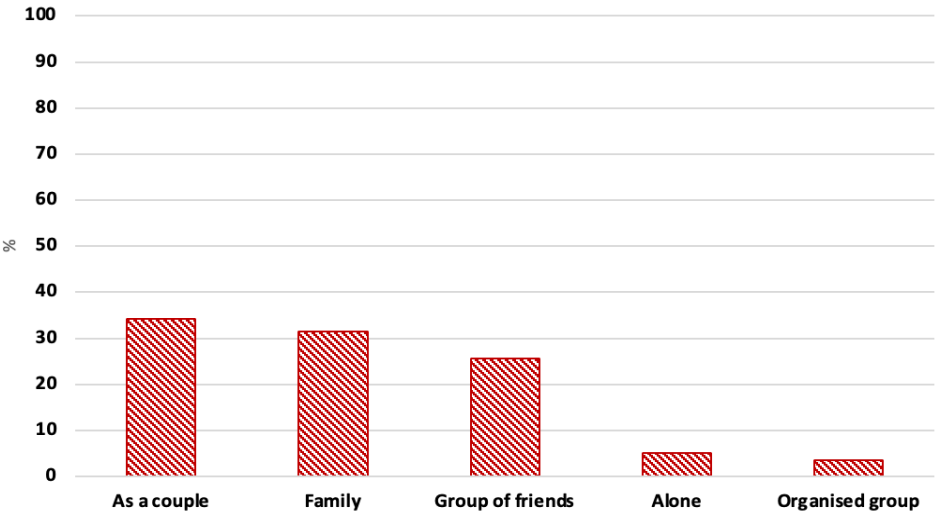


Figure 92 - Companion for the park visit.

This bar chart shows how non-visitors responded to the question: “With whom do you plan to visit the park?”The most frequent answer was as a couple, chosen by approximately 34% of respondents. This was followed closely by those who plan to visit with their family (around 31%), and with a group of friends (approximately 26%). These results suggest that most potential visitors view the park as a shared social experience, family-oriented. Only a small portion of respondents,

around 5%, said they plan to visit alone, and an even smaller percentage (about 4%) intend to come as part of an organised group. This indicates that solitary or structured group visits are far less common in the intentions of non-visitors, reinforcing the idea that the park is perceived mainly as a place to enjoy with familiar company.

7.3.3 Information About the Area

Motivations for Visiting the Park

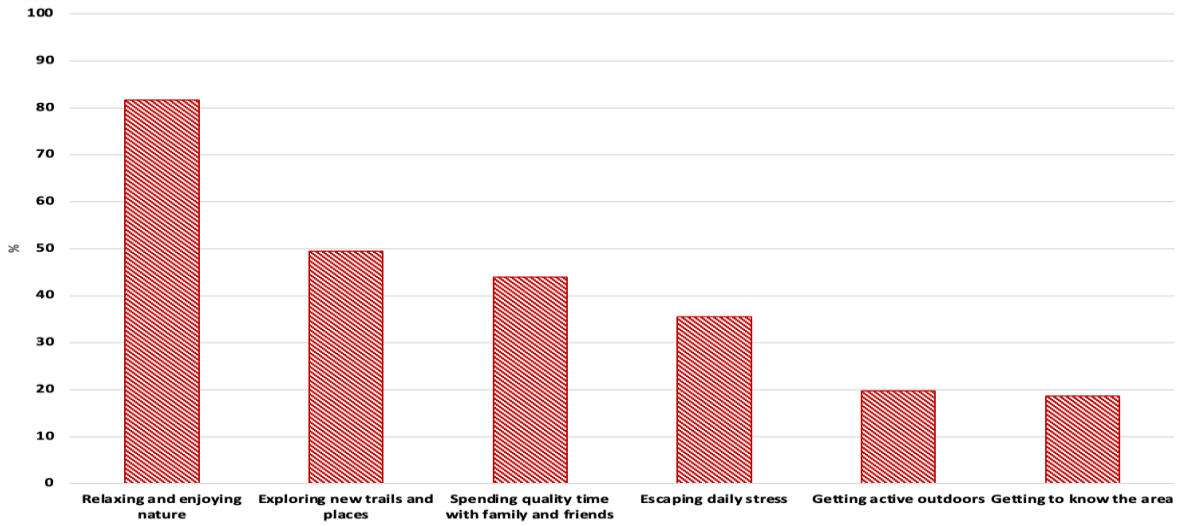


Figure 93 - Motivation for park visit.

This bar chart displays responses from non-visitors to the question: “What would be your motivations for visiting the park?” The most frequently cited motivation was relaxing and enjoying nature, chosen by over 80% of respondents. This highlights that potential visitors are primarily drawn to the park for its tranquil and restorative natural environment. Following that, nearly 50% of respondents said they would be motivated by exploring new trails and places, showing strong interest in discovery and adventure. Additionally, around 45% indicated a desire to spend quality time with family and friends, emphasizing the park’s role as a setting for shared social experiences. Roughly 35% mentioned the need to escape from daily stress as a motivator. Less common motivations included doing physical activity in the open air (around 20%) and learning more about the local area (slightly under 20%). These suggest that while some are interested in active or educational elements, the dominant appeal remains nature immersion and emotional benefit. In summary, non-visitors are most motivated by opportunities to relax, connect with nature, and spend time with others, while physical exercise and territorial knowledge are secondary considerations.

Typical Services Used

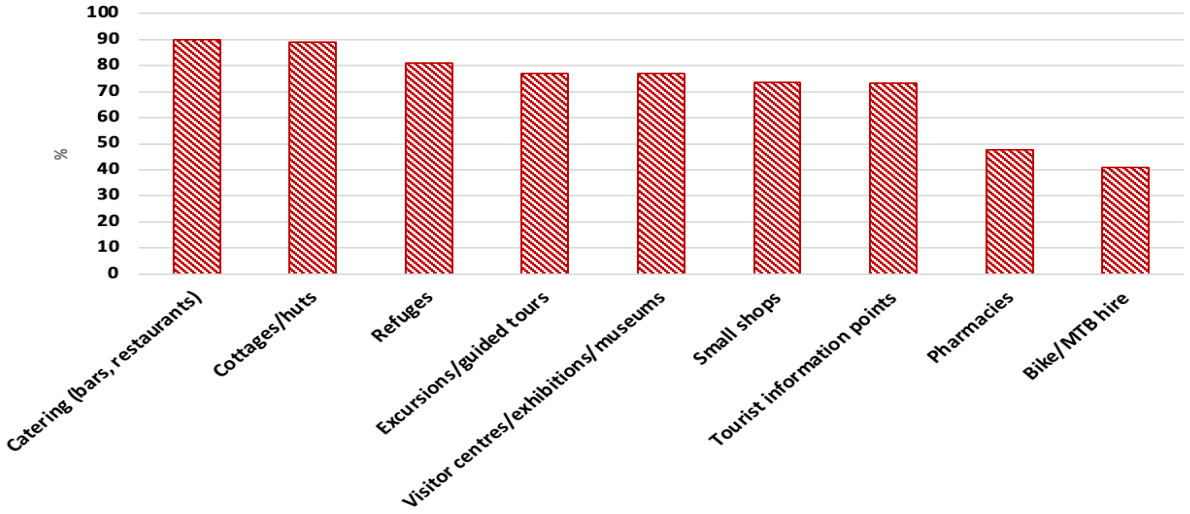


Figure 94 - Percentage of interest in the current activities in the park.

This bar chart displays responses to the question: "Which existing services in the park are you interested in using?". The most highly preferred services are restaurants and bars, and farm stays or mountain huts, both selected by around 90% of respondents. This reflects a strong interest in local food, hospitality, and cultural immersion. Following closely are mountain shelters (refuges) and guided hikes or excursions, which attracted over 75% of respondents. These results highlight a widespread interest in structured outdoor experiences and safe, accessible ways to explore the park's natural environment. Visitor centers, exhibitions, and museums, along with small local shops, and tourist information points, were also popular, with approximately 70–75% expressing interest. This shows that visitors value informative and interpretive services that enhance their understanding and experience of the area. On the lower end of the spectrum, pharmacies and bike/MTB rental services received the least interest, about 45% and 40% respectively.

Typical Activities Practiced

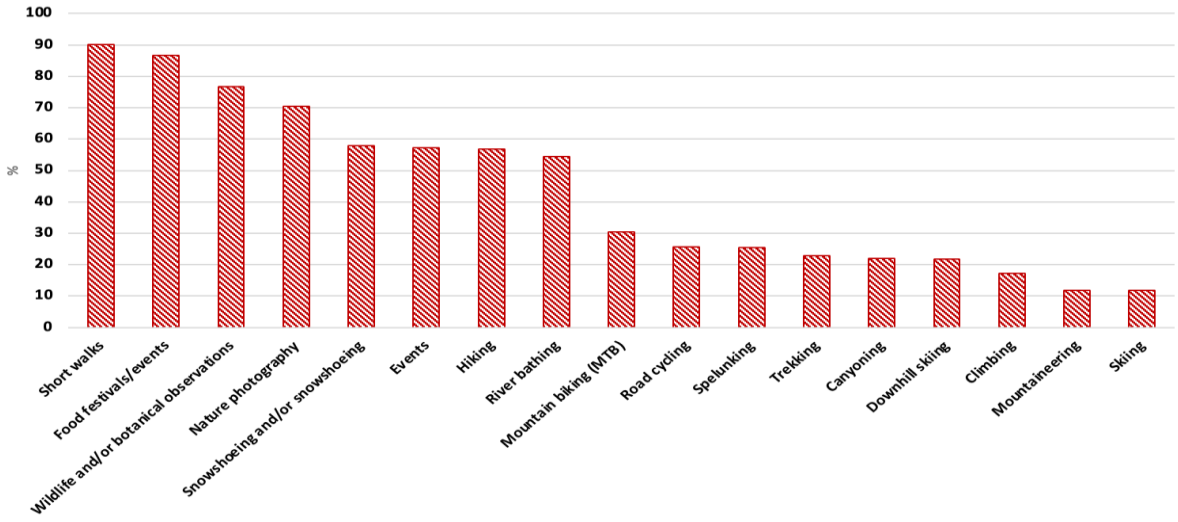


Figure 95 - Percentage of interest in the activities of the park.

This bar chart presents the responses to the question: "Which activities would you be interested in doing in the park from the list of existing ones?". The most popular activity by far is short walks, chosen by nearly 90% of respondents, showing a strong preference for easy, accessible, and low-intensity experiences. Closely following are local festivals and food events, with about 85% indicating interest, reflecting the appeal of cultural and culinary experiences in a natural

setting. Wildlife and/or plant observation and nature photography also attracted strong interest (around 75%–78%). These are followed by snowshoeing or winter walks, and event participation, each capturing interest from more than 60% of respondents. Hiking, swimming in the river, and mountain biking (MTB) also received considerable attention (around 55%–60%), demonstrating that a sizable group of visitors is also drawn to moderately adventurous or physically engaging activities. Lower on the interest scale were more specialized or physically demanding activities such as road cycling, caving, trekking, and canyoning, with interest levels ranging from 20% to 35%. The least popular options were skiing (both downhill and alpine) and mountaineering, each selected by fewer than 15% of respondents. In summary, non-visitors show the highest interest in easy and immersive nature experiences, local events, and gentle adventure.

Previous Visits to other Nature Parks

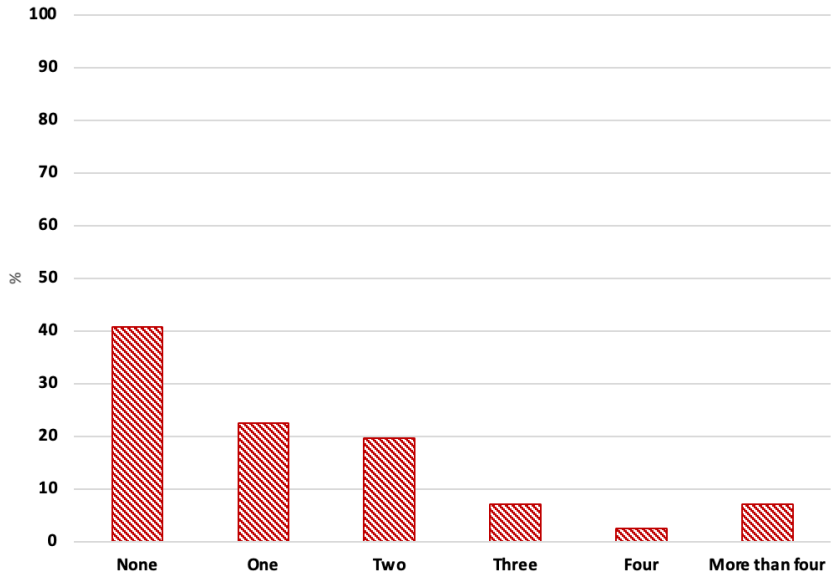


Figure 96 - Park visit to other nature parks.

This bar chart shows how non-visitors responded to the question: “How many visits have you made to other nature parks?”. The largest share of respondents, over 40%, answered “None”, indicating they have never visited a nature park before. This suggests a general lack of prior experience with nature-based tourism among a significant portion of non-visitors, which could reflect lack of awareness. About 23% of respondents reported visiting one nature park, while approximately 19% had visited two. These figures show that a notable share has some prior contact with nature tourism, though mostly at a minimal level. Only small percentages of respondents reported visiting three (around 7%), four (about 2–3%), or more than four parks (roughly 6%). This confirms that frequent visitation to nature parks is quite rare among this group. Overall, the results suggest that most non-visitors either have no experience or very limited exposure to nature parks, which highlights the importance of awareness campaigns, first-time visitor incentives, and beginner-friendly experiences to attract and engage this audience.

7.3.4 Use of Outdoor and Fitness App

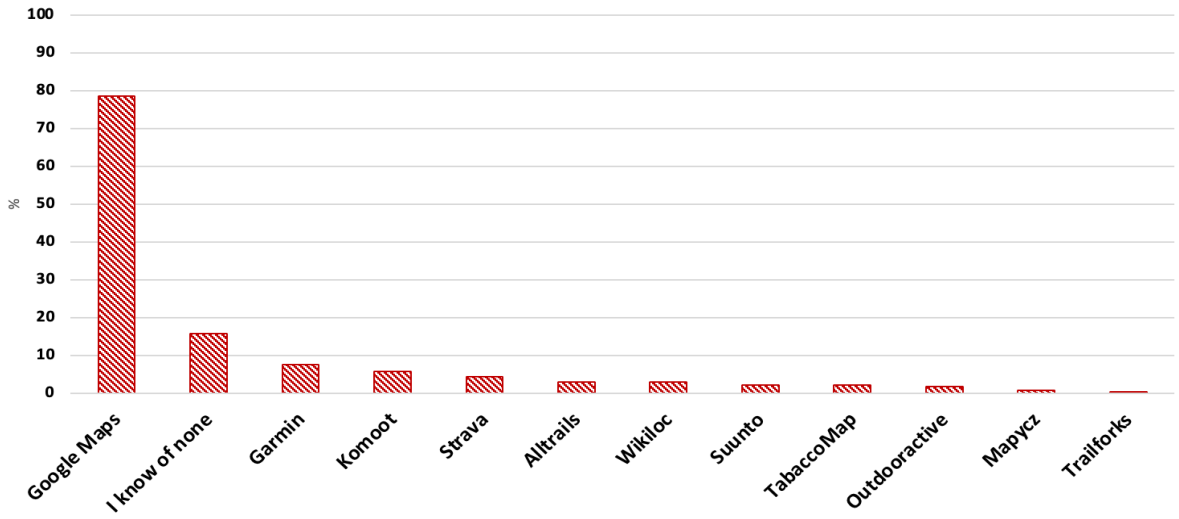


Figure 97 - Application used during park activities.

The overwhelming majority of respondents—nearly 80%—selected Google Maps as their preferred application for navigating the park. This indicates a strong reliance on mainstream, general-purpose navigation tools rather than specialized outdoor or trail apps. Following Google Maps, about 14% of respondents stated they do not know or use any app, highlighting a considerable share of visitors who either lack familiarity with digital tools for outdoor exploration or prefer not to use them. All other apps—such as Garmin, Komoot, Strava, AllTrails, Wikiloc, Suunto, TabaccoMap, Outdooractive, Mapy.cz, and Trailforks—were selected by very small percentages, each ranging between approximately 1–7%, showing very limited adoption of specialized hiking or trail mapping platforms. This pattern was consistent across both onsite and online respondents, who showed almost identical response distributions. This confirms that regardless of how the survey was taken, Google Maps remains the dominant navigation choice, suggesting both convenience and brand familiarity outweigh app specialization when it comes to park visits.

7.3.5 Future Prospective

Interest in Possible Future Activities

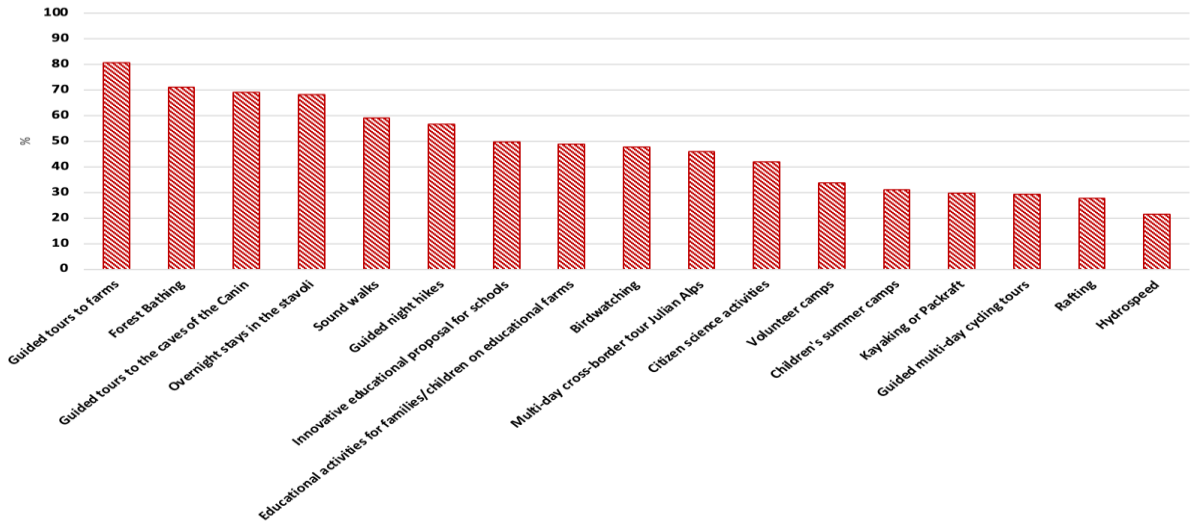


Figure 98 - Percentage of interest in possible future activities.

This bar chart displays responses to the question: “Which activities would you be interested in doing in the future?”. The most popular future activity is guided visits to local farms, selected by nearly 80% of respondents. Forest bathing, a wellness-focused nature immersion practice, also scored highly (over 70%), indicating growing interest in restorative experiences. Following closely are guided tours of the Canin cave, overnight stays in traditional shepherd huts, and sound walks, each attracting around 65–70%. Also notable is interest in night hikes and educational experiences for families and schools, both ranging around 55–60%. Respondents also expressed future interest in hands-on and learning-focused activities, including educational farm visits, birdwatching, citizen science, and cross-border tours in the Julian Alps, showing an openness to both knowledge-sharing and collaborative exploration. At the lower end of the chart, more physically demanding or adventure-focused activities such as volunteer camps, summer camps for kids, kayaking or packrafting, multi-day bike tours, rafting, and hydrospeed drew less interest—generally ranging from 20% to 35%.

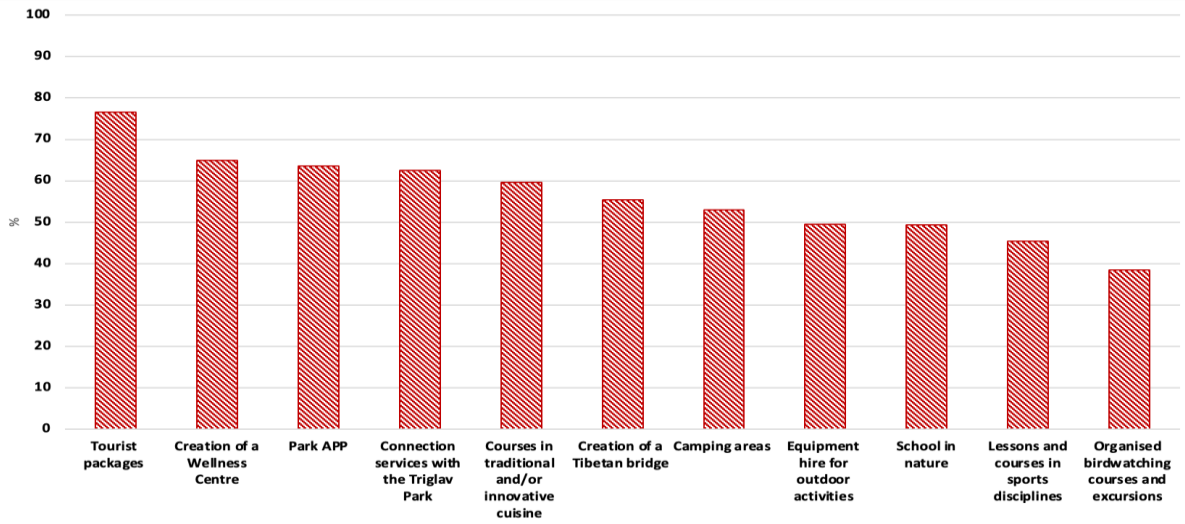


Figure 99 - Percentage of interest in future service implementation.

This graph reflects the preferences of online respondents who have never visited the Park regarding potential future services. Among this group, the most favoured option was Tourist packages, followed by Creation of a Wellness Centre, Connection services with the Triglav Park, and the Park APP. These results suggest that non-visitors are most interested in structured, accessible, and supportive services that could simplify and encourage a first visit. Moderate interest was expressed in creation of a Tibetan bridge, and Camping areas, while lower levels of interest were seen for more specific or hands-on options such as Equipment hire for outdoor activities, Lessons and courses in sports disciplines and School in nature.

7.4 Evaluation of all Respondents (Online and On-site Surveys)

In this section we will present all last results of all the respondents (those who visited and those who did not), who are both from onsite and online surveys.

7.4.1 Perceived Main Functions of the Park

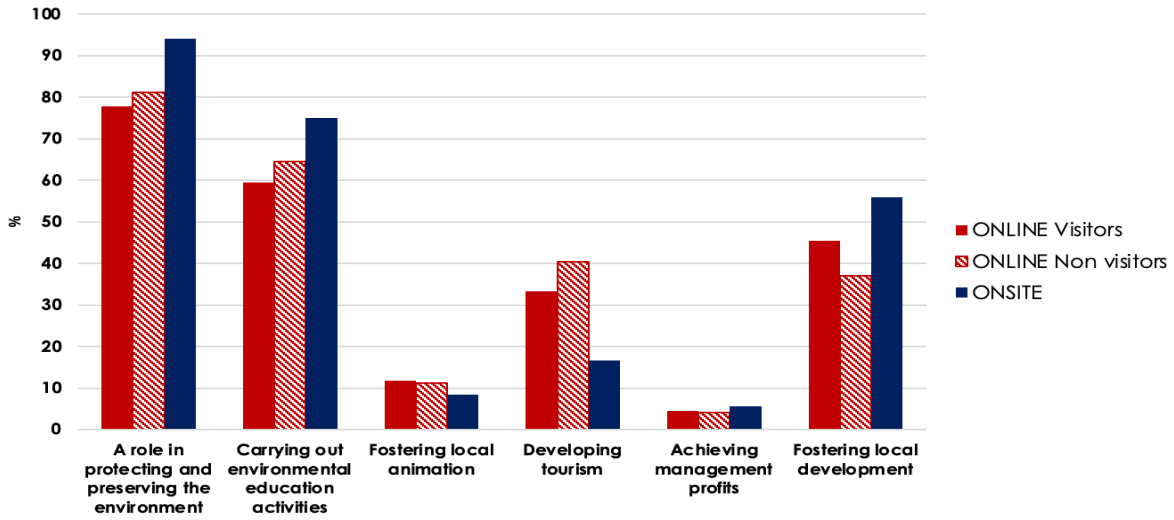


Figure 100 - Percentage of perceive park functions.

This bar chart displays responses to the question: "What is the main function of the park for you?". It compares perspectives from onsite visitors, online visitors, and online non-visitors. The most widely agreed-upon function across all three groups is protecting and preserving the environment. This role was emphasized most strongly by onsite visitors (around 93%), followed by online non-visitors (approximately 80%), and then online visitors (about 76%). This demonstrates that, regardless of experience with the park, there is a broad consensus that environmental conservation is the park's primary mission, particularly among those who have experienced it firsthand. The second most recognized function is carrying out environmental education activities, again rated highest by onsite visitors (about 75%), followed by online non-visitors (around 65%) and online visitors (roughly 59%). Fostering local development was notably more appreciated by onsite visitors (nearly 60%) than both online visitors (approx. 45%) and non-visitors (under 40%), indicating that physical presence at the park may enhance awareness of its contribution to local communities. In contrast, developing tourism was more strongly associated with the park by online non-visitors (40%), compared to online visitors (around 32%), and especially onsite visitors (just under 20%). This could suggest that those less familiar with the park view it more as a tourist asset, while those who visit see it as more than just a destination. Functions like fostering local animation and achieving management profits received low ratings from all groups, hovering around 5–10%, indicating that these are seen as secondary or less relevant goals of the park.

7.4.2 Level of Involvement or Interest in Environmental Conservation Issues

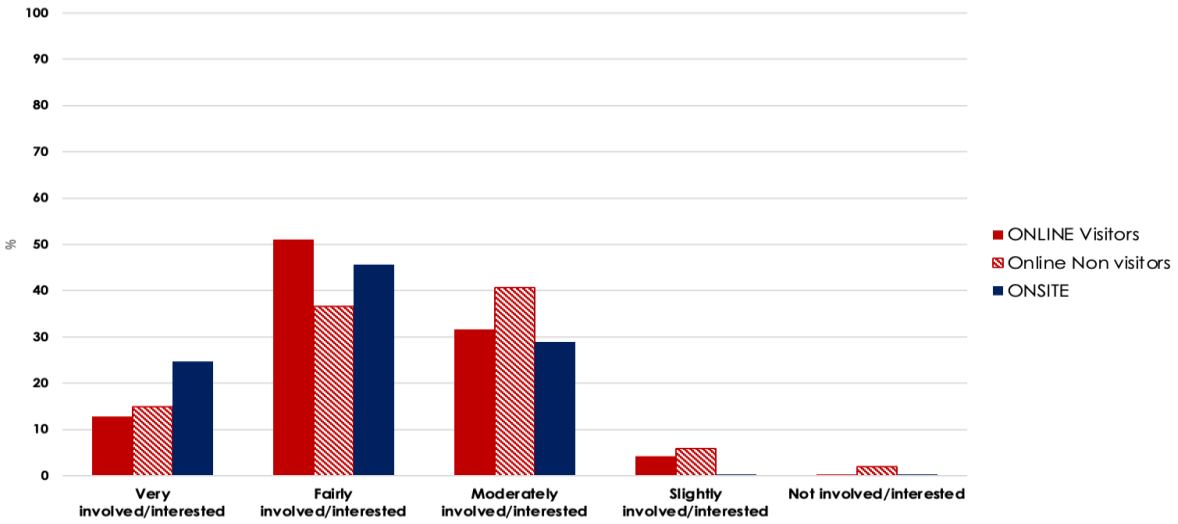


Figure 101 - Percentage of involvement/interest in the conservation issues.

This bar chart presents responses to the question: “What is your level of interest in conservation themes?”. The most frequent response across all groups was "Fairly involved/interested", particularly among online visitors (over 50%) and onsite visitors (around 45%), followed by online non-visitors (about 37%). This suggests that most people, regardless of their relationship with the park, express a moderate to strong engagement with conservation issues. In the "Moderately involved/interested" category, online non-visitors stand out, with about 41% selecting this option, more than both online visitors (about 32%) and onsite visitors (around 29%). This may indicate that while this group may lack direct park experience, they still show a conceptual interest in conservation. Notably, onsite visitors show the highest percentage in the "Very involved/interested" category, at around 24%, compared to only 14% of online non-visitors and 13% of online visitors. This suggests that being physically present in the park might deepen one’s connection and commitment to conservation themes. At the lower end of the scale, very few respondents declared being "Slightly involved/interested" or "Not involved/interested", with each of these category’s accounting for less than 6% across all groups. This reflects a generally high level of concern and interest in conservation among the surveyed populations.

7.4.3 Authorities Responsible for Environmental Protection

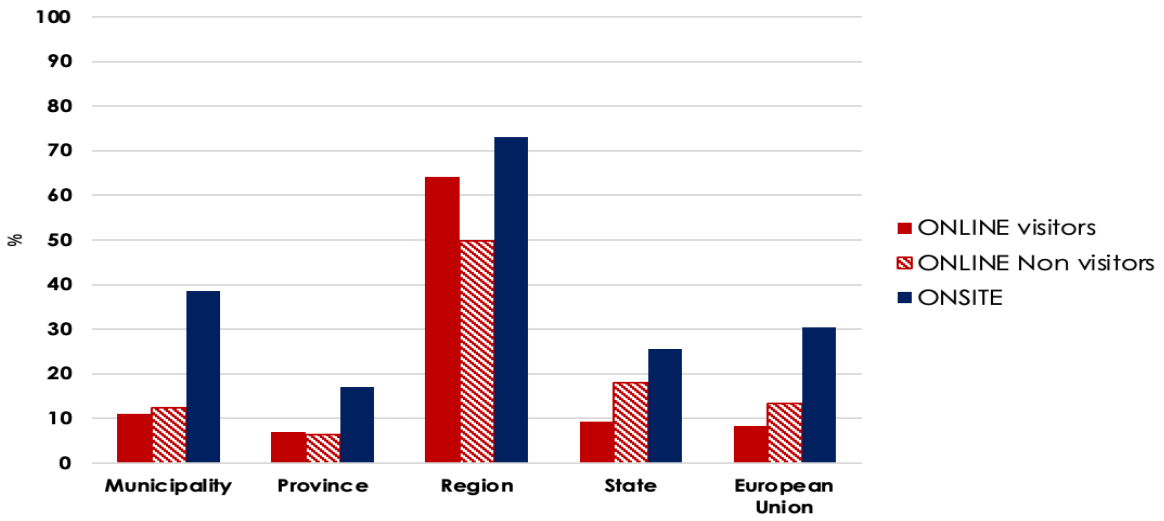


Figure 102 - Percentage of perceive authorities responsible for environmental protection.

This bar chart presents the responses to the question: "Which authority do you think is responsible for environmental protection?". Notably, onsite respondents were allowed to select two answers, which explains their higher percentages across the board. Across all groups, the Region is seen as the primary authority for environmental protection. This view is held by over 73% of onsite visitors, followed by 65% of online visitors and 50% of online non-visitors. The consistent ranking of the Region suggests a widely shared perception that environmental responsibility lies largely at the regional level. The Municipality comes second among onsite respondents (about 38%), showing much greater trust in local-level responsibility than either online visitors or non-visitors (both around 12%). The State was more frequently chosen by online non-visitors (about 18%) compared to online visitors (9%) and onsite respondents (approximately 25%). This could indicate that those who have never visited the park tend to assign environmental responsibility to higher-level institutions due to less familiarity with local structures. The European Union was selected by 30% of onsite respondents, compared to 13% of non-visitors and 9% of online visitors. The province ranked lowest across all groups, although onsite visitors still showed more recognition (17%) than online participants (around 6–7%).

7.4.4 Preferred Travel Experience

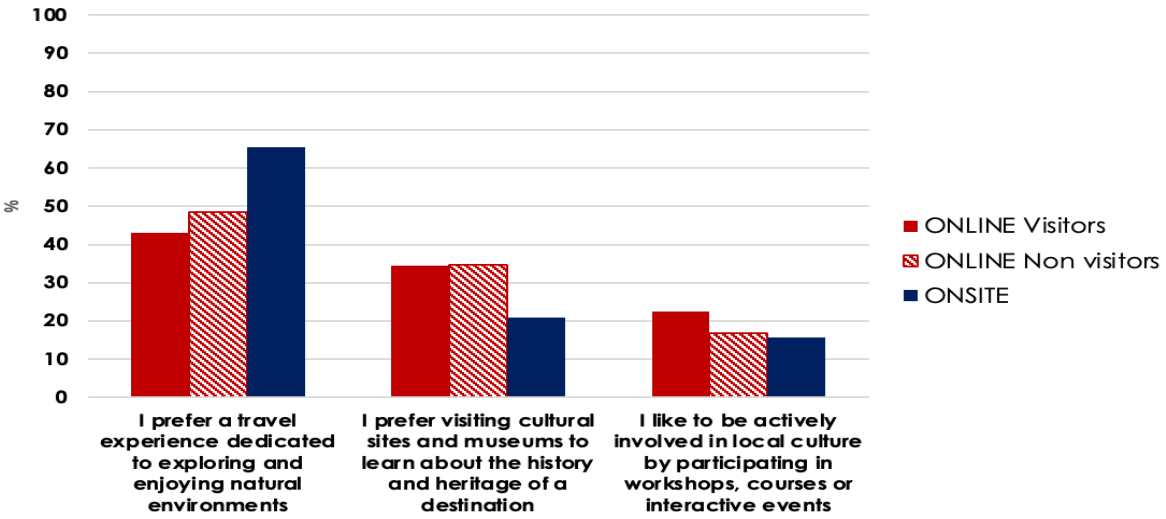


Figure 103 - Percentage of travel experience.

This bar chart illustrates preferences for different types of travel experiences among the three respondent groups. The most preferred travel experience overall is one dedicated to exploring and enjoying natural environments. This preference is strongest among onsite visitors, with approximately 65% selecting this option, indicating a strong alignment with nature-based tourism. Online non-visitors follow with about 48%, and online visitors slightly behind at 43%. The second most popular choice is visiting cultural sites and museums to learn about the history and heritage of a destination, chosen by around 35% of both online visitors and non-visitors, but only 20% of onsite visitors. This suggests that cultural and heritage tourism holds stronger appeal for those less directly engaged with the park. The least chosen option across all groups is active participation in local culture through workshops, courses, or interactive events. Even so, online visitors show the highest interest (approximately 23%), compared to 17% of non-visitors and 16% of onsite visitors. While this type of experiential tourism is less popular overall, it may still hold niche appeal for more engaged or curious travelers. In summary, nature immersion is the dominant travel interest, especially among onsite visitors, while cultural tourism and participatory activities are more modest in appeal, but still valued by specific segments.

To conclude, the results of the two psychological scales are presented below.

7.4.5 Environmental Attitude Scale (EA)

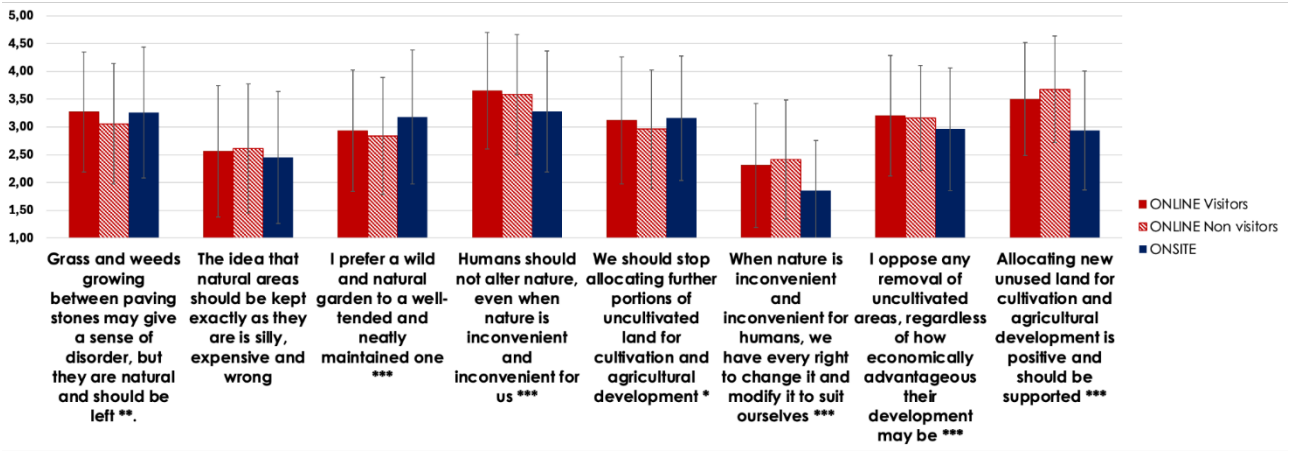


Figure 104 - Environmental attitude scale.

The graph reports the responses from the Environmental Attitude Scale (EAS), the purpose of which is to assess people's attitudes towards the natural environment. The results of the online (the ones who have actually visited the park and the ones who had never visited the park) and on-site surveys are compared. The graph illustrates the mean levels of agreement, on a scale of 1 to 5, with various statements pertaining to environmental attitudes, as determined by analyzing questionnaires completed online and on-site. With regard to the contradictory pair of statements “One should stop allocating additional portions of uncultivated land to cultivation and agricultural development” and “Allocating new uncultivated land to cultivation and agricultural development is positive and should be supported”, the findings demonstrate a discrepancy between the two modes of administration. Specifically, on-site participants exhibited less consistent responses between the two statements, likely attributable to fatigue associated with completing the questionnaire, given its placement towards the end. In contrast, the online responses manifested greater variability, reflecting the divergent nature of the statements. The responses to the statements “When nature is inconvenient for human beings, we have every right to change it and modify it to suit ourselves” and “Human beings should not modify nature, even when nature is inconvenient and inconvenient for us” were found to be more divergent in the online responses. Generally, the participants expressed disagreement with the notion of modifying nature to adapt it to human beings, instead advocating for its preservation, thereby demonstrating a predominantly conservative attitude.

7.4.6 Inclusion of Nature in Self-Scale (INS)

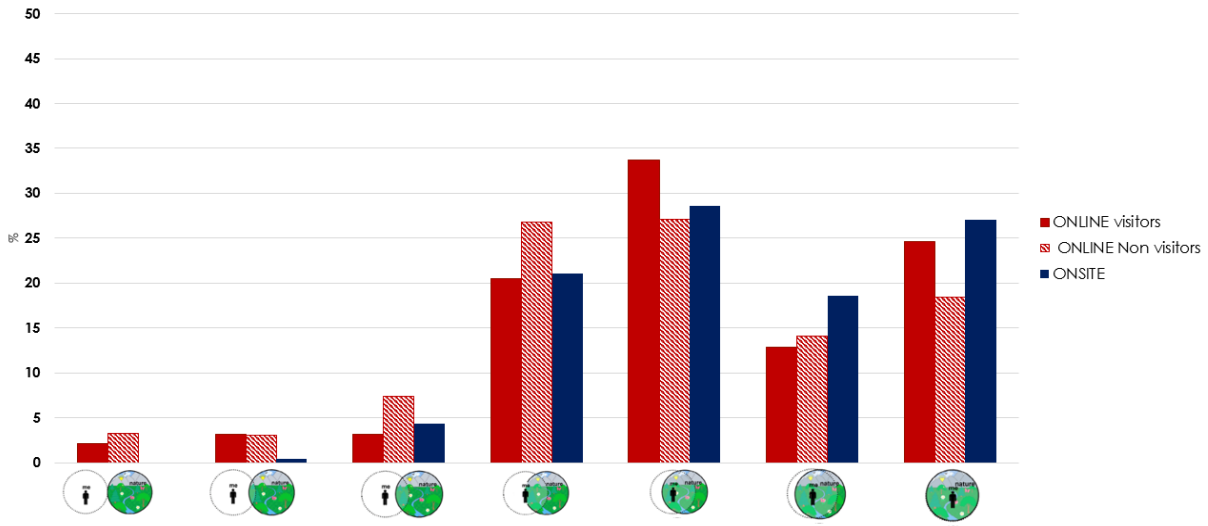


Figure 105 - Inclusion of nature in self-scale.

The Inclusion of Nature in Self (INS) scale is a psychological tool used to assess how strongly individuals feel connected to the natural world. Participants choose between a series of overlapping circles representing "self" and "nature," with greater overlap indicating a stronger sense of inclusion and connectedness with nature. This graph displays the INS responses for three groups: onsite visitors, online visitors, and online non-visitors. Overall, onsite visitors show the strongest connection with nature, particularly the final two options. Online visitors follow closely behind, also showing a strong affinity with nature. In contrast, online non-visitors display a significantly lower sense of connection to nature. Their responses are more evenly distributed across the scale, with a notable share choosing the options with minimal or no overlap between self and nature, something virtually absent in the onsite group. These results suggest a clear pattern: physical experience in nature (i.e., park visitation) is associated with a stronger psychological inclusion of nature in one's identity. The findings highlight that actual engagement with natural environments can reinforce emotional and cognitive bonds with nature, while lack of contact, as seen among non-visitors, may weaken this connection.

7.4.7 Economic Valuation of Recreational Services

The survey also addressed the question of whether visitors would be willing to pay a transit fee to maintain accessibility to Sella Carnizza Road.

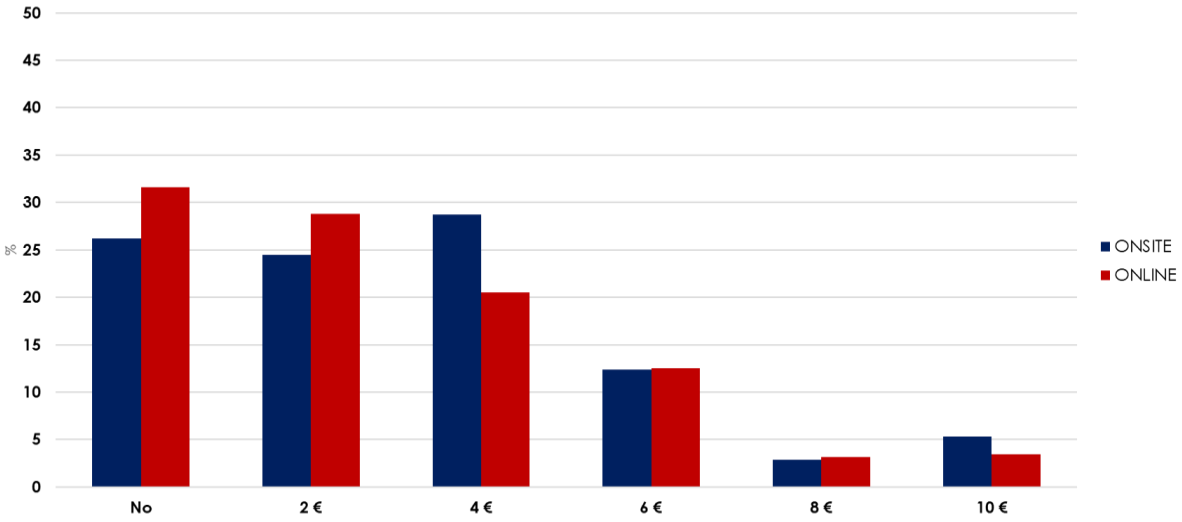


Figure 106 - Percentage of economic value for recreational services.

The graph shows that most respondents are willing to pay lower amounts for access to the Sella Carnizza road, with €2 and €4 being the most frequently selected options. Among all participants, only 32% of online respondents and 23% of onsite respondents stated that they would not be willing to pay. Despite this, the majority chose lower amounts, particularly €2 and €4, while support for higher fees like €6 and €10 was significantly lower in both groups. The onsite respondents however, were the ones who were ready to pay the highest amounts more when compared to the online respondents. These results suggest that although willingness to pay exists, it is concentrated around modest, affordable fees. Additionally, the data indicates that most respondents believe that paying a fee facilitates access to the Sella Carnizza road, implying a general understanding that such contributions can support road maintenance and infrastructure improvements. We also investigated possible improvements to existing and non-existent park services using a discrete choice experiment.

Table 16 - Discrete choice experiment.

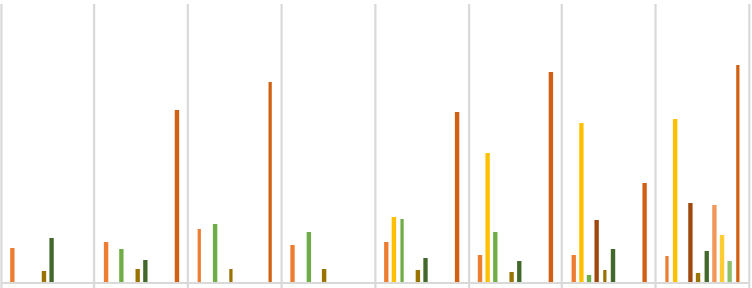
Attribute	Estimate	s.e.	|t|
Guided visits to farms - once a season (baseline: not available)	3.467	0.585	5.93
Guided visits to farms - twice a season (baseline: not available)	4.027	0.634	6.36
Shelters - Wood provided once at the beginning of summer(baseline: no wood available)	-0.729	0.480	1.52
Shelters - Wood provided monthly (baseline: no wood available)	0.782	0.475	1.65
Shuttle service - every Sunday during summer (baseline: only during events)	3.648	0.576	6.33
Shuttle service - every Sunday during summer + new line (baseline: only during events)	4.035	0.577	6.99
Bike rental point - one new point (baseline: no new points)	0.199	0.510	0.39
Bike rental point - two new points (baseline: no new points)	-0.554	0.522	1.06
Restaurants and bars - always open during weekends (baseline: variable opening)	2.990	0.535	5.59
Restaurants and bars - always open (baseline: variable opening)	4.837	0.569	8.51
Entrance fee/scale	0.092	0.008	11.60
Status quo	-0.556	0.076	7.33
Number of observations: 6,000; Log-likelihood: -6,080.82			

The table reports the results of a Multinomial Logit Model (MNL) model in WTP space which was estimated for a preliminary analysis of the CE data. Guided farm visits are highly valued, with WTP estimates of €3.467 for one visit per season and €4.027 for two visits, both statistically significant, thus indicating that increasing the frequency of such visits increases visitors' utility. The provision of wood for shelters shows mixed results: while monthly wood provision has a positive and statistically significant at 90% level effect (€0.782, |t| = 1.65), a one-time provision at the beginning of summer is negatively perceived, this suggesting that visitors prefer consistent availability over a one-time resource. Shuttle service availability significantly influences visitor preferences, with WTP estimates of €3.648 for weekly service and €4.035 when an additional line is introduced, both highly significant, highlighting strong demand for improved transportation. The coefficients for bike rental points do not show significant effects, suggesting that expanding bike rental facilities does not affect individuals' preferences. The availability of restaurants and bars is an important factor, with a WTP of €2.990 for guaranteed weekend openings and a substantially higher WTP of €4.837 for full availability, emphasizing the preference for consistently open food services. Finally, the negative status quo coefficient suggests a strong preference for improved park facilities over maintaining the current state.

7.5 Evaluation of Visitor Counting Devices

In this section we present the evaluations of the counters, showing the various analyses carried out during the INDIALPS project. The eco-counter named "CAI 702 - Valle del Resartico" will be excluded from the analyses due to the extremely limited amount of data.

Before proceeding with the analyses of individual counters, let's look at the general situation.



	2018	2019	2020	2021	2022	2023	2024	2025
CAI 450 - Val Alba	3135	3603	4849	3409	3691	2479	2487	2388
CAI 632 - Sentiero Botanico "Bila Pec"					5919	11633	14279	14719
CAI 642 - Malga Coot		2998	5259	4571	5736	4549	644	
CAI 662 - Ta Lipa Pot							5579	7167
CAI 703 - Rio Nero	1083	1202	1220	1271	1164	951	1170	891
CAI 719 - Valle Musi	3971	1991			2224	1977	3013	2868
Cicloturistica Val Resia								6956
Strada Coot								4305
Strada Malga Confin								1921
Strada Sella Carnizza - Uccea	0	15492	18030	0	15347	18871	8968	19520

Figure 107 - Yearly total passages per eco-counter.

The time window considered starts from 1 January 2018 until the following dates for each device:

- CAI 450 - Val Alba - 31/10/2025
- CAI 632 - Sentiero Botanico "Bila Peč"- 31/10/2025
- CAI 642 - Malga Coot – 05/06/2024
- CAI 662 - Ta Lipa Pot – 31/10/2025
- CAI 703 - Rio Nero – 27/08/2025
- CAI 719 - Valle Musi – 31/10/2025
- Cicloturistica Val Resia – 31/10/2025
- Strada Coot – 31/10/2025
- Strada Malga Confin – 31/10/2025
- Strada Sella Carnizza - Uccea - 31/10/2025

Additional specifications:

- Strada Sella Carnizza - Uccea — Data missing from 20/09/2018 to 18/06/2019, from 07/04/2021 to 27/04/2022, and from 16/08/2024 to 30/01/2025;
- CAI 719 - Valle Musi — Data missing from 16/04/2019 to 12/06/2019, and from 28/08/2019 to 19/06/2022;

- CAI 703 - Rio Nero — Data missing from 28/10/2022 to 22/05/2023. Due to a device issue, it was not possible to download data up to October 31, 2025;
- CAI 642 - Malga Coot — Data missing from 01/01/2018 to 30/05/2019 and from 05/06/2024 onwards.

7.5.1 Eco-counter CAI 632 - Botanical Trail "Bila Peč "

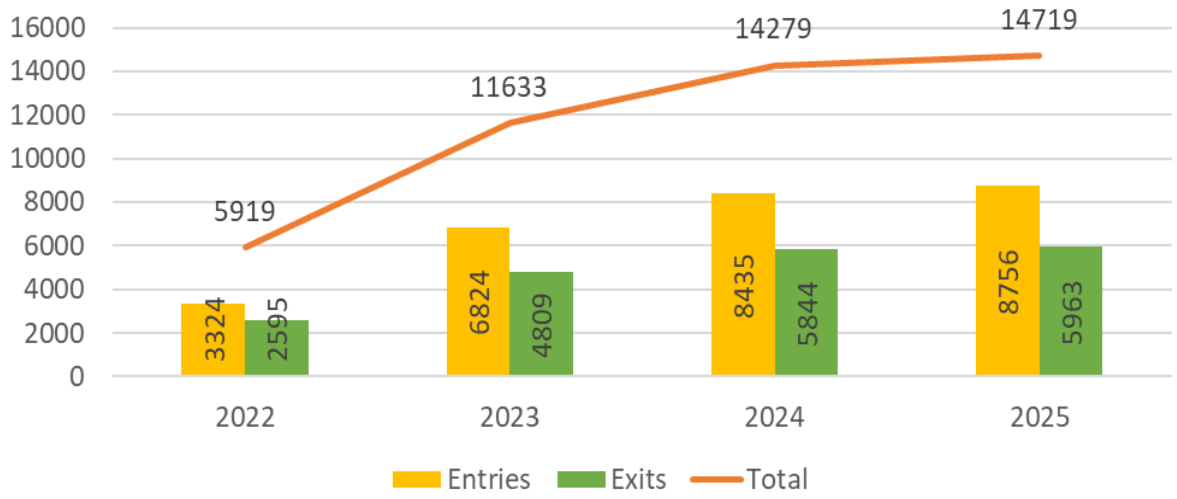


Figure 108 - Total number of passages and the differences between entries and exits for all years under analysis.

As highlighted by the “Total” line, a consistent increase can be observed over the years under analysis: more than 2,600 additional crossings from 2023 to 2024, followed by a further increase of 440 crossings in 2025. It should be noted that the count for October, November, and December 2025 is missing; however, crossings during these months are expected to be very limited or unrecorded due to snow.

It is noticeable, as highlighted by the "Total" line, that there is a slight increase in the total number of accesses. It should also be remembered that the entire month of September 2025 is missing from the count.

There is also a discrepancy between entry and exit counts. This indicates that most people ascend in the direction of Sella Bila Peč (entry) but descend using other trails, thus performing loop routes across the Canin massif. CAI trail 632 appears to be the preferred access route for the Via Ferrata Julia, which allows reaching the summit of Mount Canin and is heavily frequented by both local and foreign hikers (anecdotal evidence).

The eco-counter CAI 632 — Botanical Trail "Bila Peč " is clearly the one with the highest number of passages compared to the other eco-counters placed on hiking routes, also considering that it is active only during the summer months as it is covered by snow earlier in the year. In light of these results, the area's strong tourism vocation is confirmed.

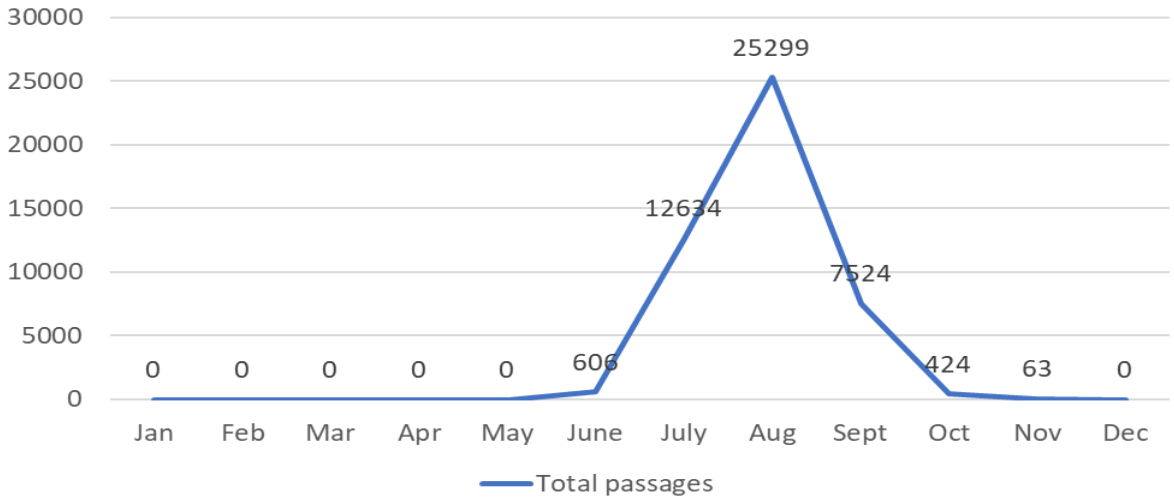


Figure 109 - Monthly total passages.

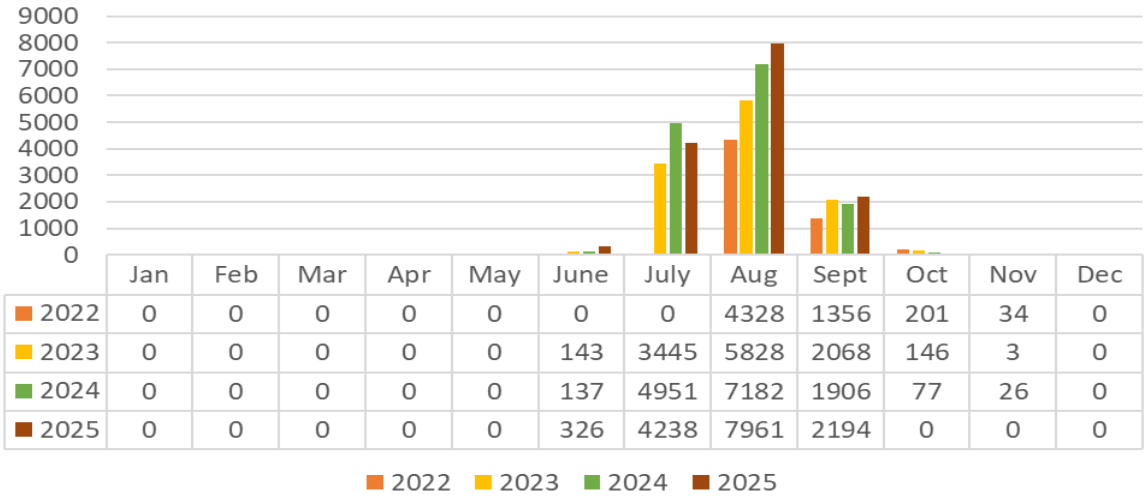


Figure 110 - Yearly total passages.

The monthly trend and monthly breakdown for the three years of device activity are shown in these charts. As mentioned previously, winter and spring months often report zero because the eco-counter is covered by snow. The table also reports percentage increases compared with the previous year.

August is the month with the largest numbers and shows an annual percentage increase. The decrease in July 2025 can instead be attributed to the persistent bad weather that affected the area during that period; however, without further analysis this cannot be stated with absolute certainty. It should also be considered that the largest number of accesses occurs in July and August — the period during which the Monte Canin Cable Car operates daily; in September its operation is limited to weekends.

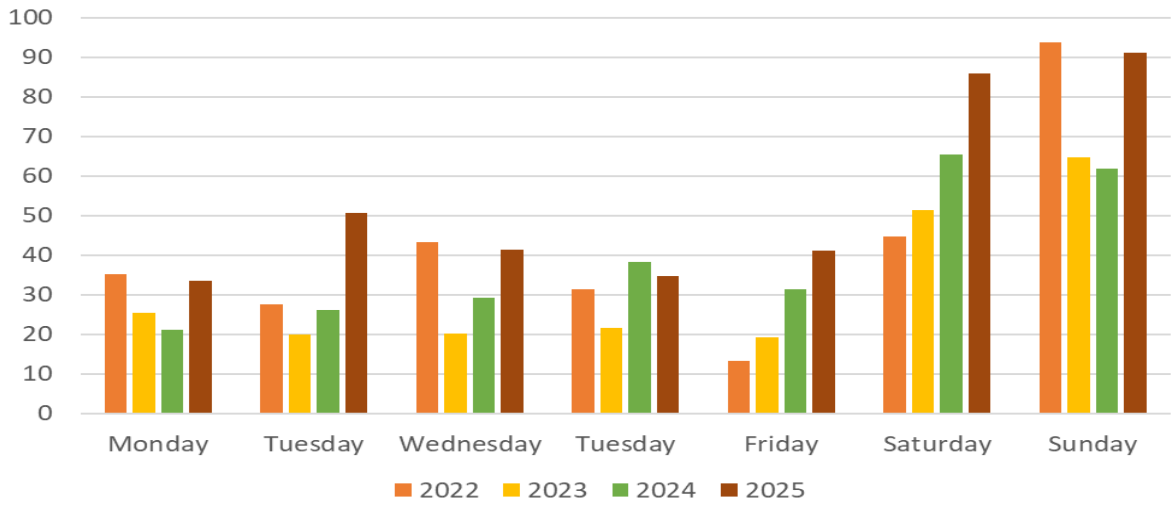


Figure 111 - Weekly total passages.

A further analysis was carried out on the days of the week with higher frequency. The y-axis value represents the average daily number of passages for each weekday. The weekend is shown to be, on average, the most visited period.

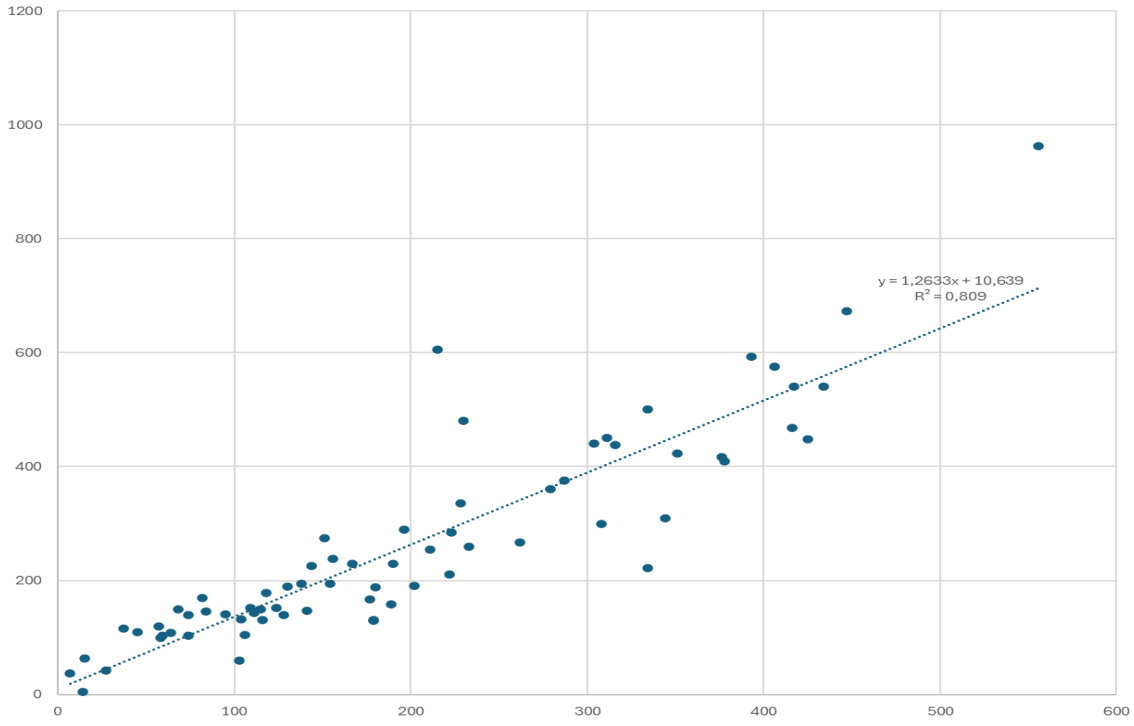


Figure 112 - Correlation between eco-counter and accesses to the Monte Canin Cable Car.

A correlation was sought between the passages recorded by the eco-counter and the accesses to the Monte Canin Cable Car. This was possible thanks to support from the Statistics Office of Promoturismo FVG, which provided data for the summer 2024 and winter 2024–25 seasons.

Linear regression showed a strong positive correlation ($R = 0.90$; $R^2 = 0.81$; $p < 0.001$) between the number of entries recorded by the counter and the number of tickets sold for the cable car. The model obtained ($y=1.25x+10.04$) indicates that, on average, each increase in one entry on the route corresponds to approximately 1.25 additional tickets sold for

the cable car. This result supports the hypothesis that most people who use the cable car actually travel along the path monitored by the counter.

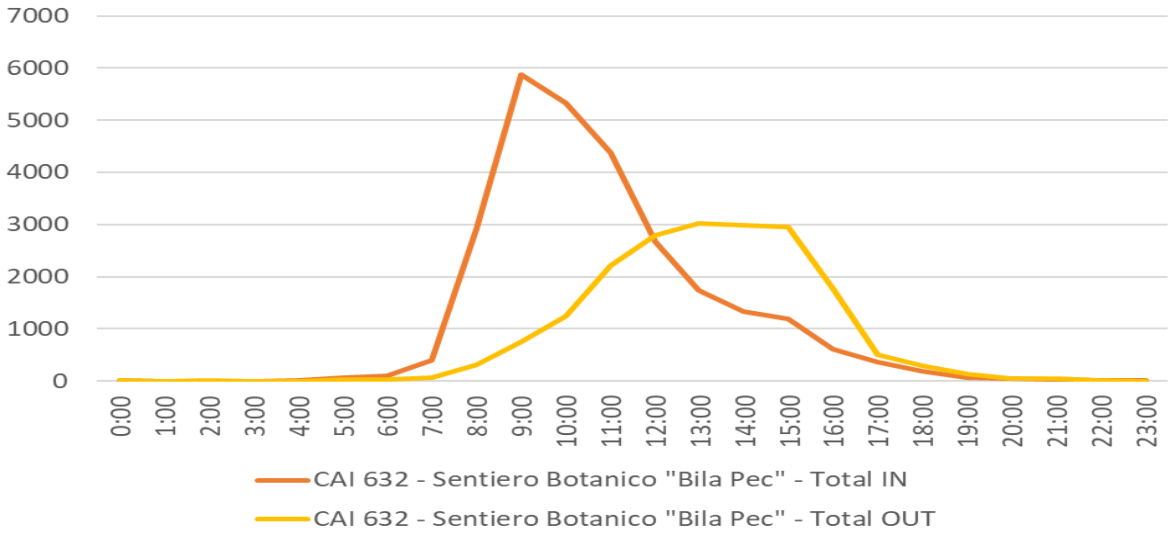


Figure 113 - Distribution of total entries and exits by hour of the day.

The chart shows the distribution of total entries and exits by hour of the day. A clear gap between the two categories can be observed: the peak in entries corresponds to the opening time of the Monte Canin Cable Car (08:30). As for exits, there is a substantial decrease after 16:00, when the infrastructure closes (17:30).

7.5.2 Eco-counter CAI 450 - Val Alba

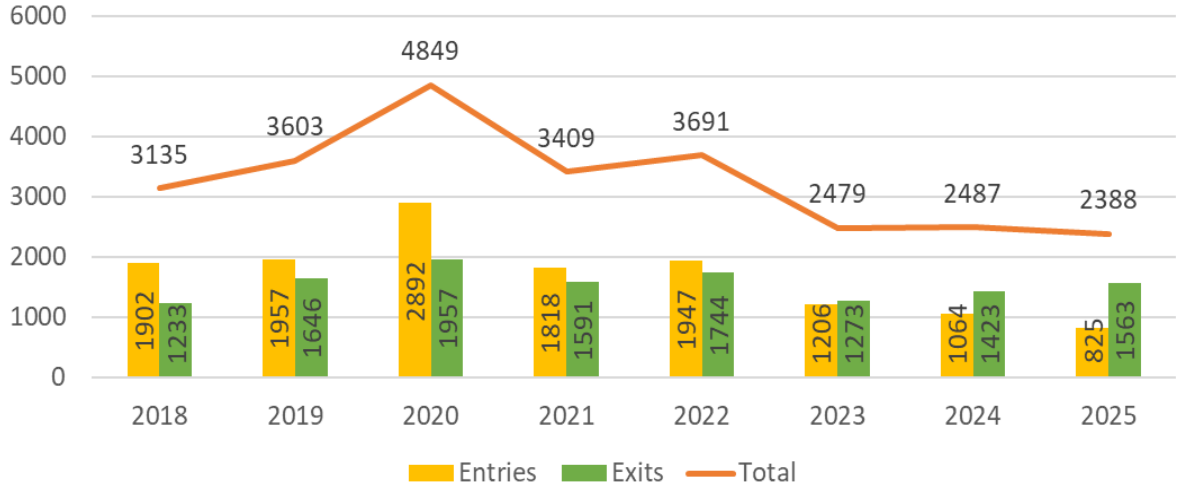


Figure 114 - Yearly number of passages linked with entries and exits.

Overall, trail usage has not undergone major changes over the years, with the exception of 2020, which is a peak year: this can be traced back to the SARS-CoV-2 pandemic and the related lockdowns that imposed several restrictions, including bans on leaving one's municipality of residence, thus leading to high local use. It is also noticeable that from 2023 there is a reversal in trend with exits exceeding entries: this can be explained by the closure of trail CAI 450 due to a landslide risk and the consequent signage placed at the starting parking area. Despite this, closure signs along the return path are not very visible and/or are not heeded, leading many people to return to the parking lot using the trail.

Please note that the year 2025 is not complete (November and December data are missing); therefore, no conclusions can be drawn regarding increases or decreases compared to previous years. This is particularly relevant given that the area is also visited during the autumn months, as highlighted in the charts below.

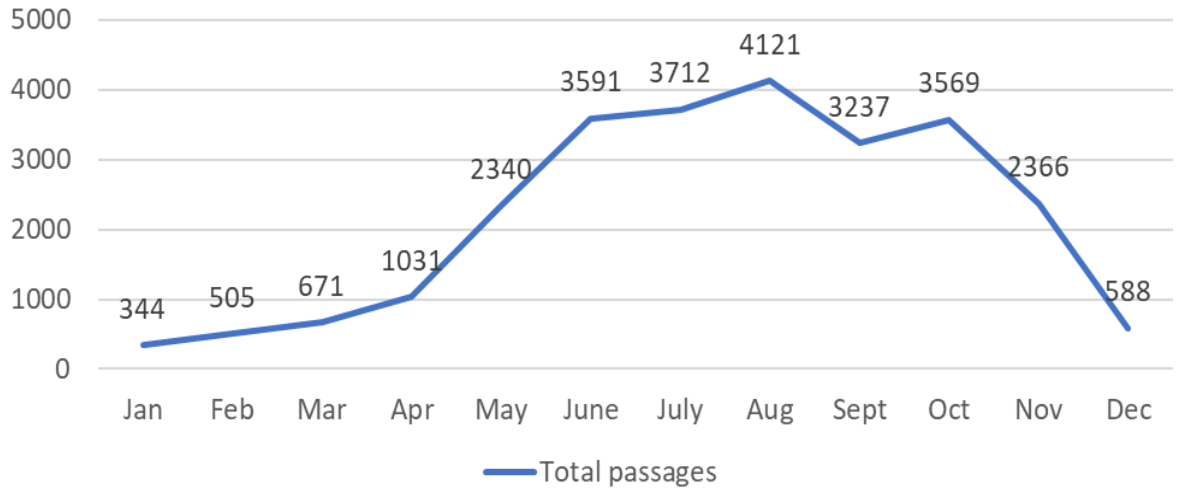
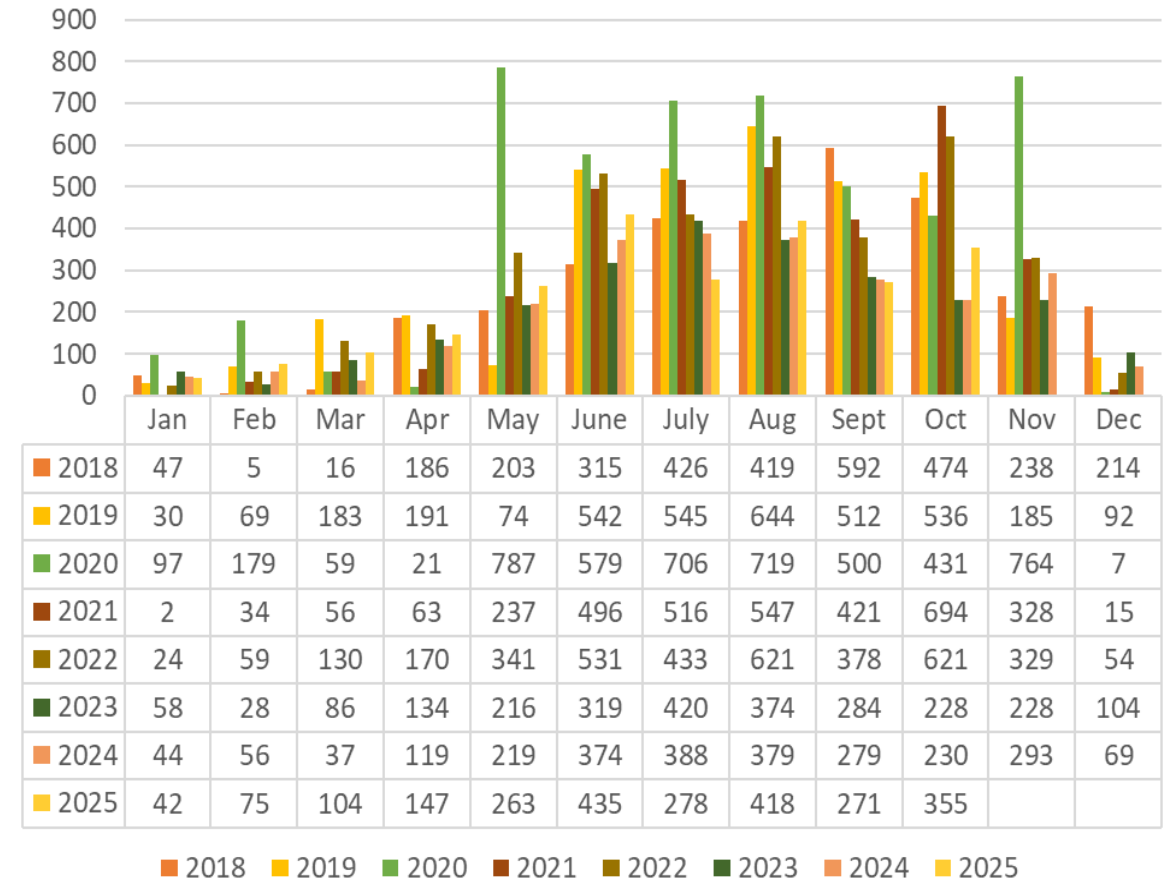


Figure 115 - Yearly total passages.



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2018	47	5	16	186	203	315	426	419	592	474	238	214
2019	30	69	183	191	74	542	545	644	512	536	185	92
2020	97	179	59	21	787	579	706	719	500	431	764	7
2021	2	34	56	63	237	496	516	547	421	694	328	15
2022	24	59	130	170	341	531	433	621	378	621	329	54
2023	58	28	86	134	216	319	420	374	284	228	228	104
2024	44	56	37	119	219	374	388	379	279	230	293	69
2025	42	75	104	147	263	435	278	418	271	355		

Figure 116 - Total passages by months and years.

In general, the most visited months are both summer and autumn. While summer peaks are common across all eco-counters, the autumn peaks are an exception likely linked to the foliage phenomenon, which is particularly notable in

Val Alba. Winter months show very low numbers due to the natural drop in visits and because the eco-counter could occasionally be covered by snow.

Looking at individual years, and particularly 2020, some months show unusual patterns with peaks (May and July) and months with almost zero counts like March and April. These anomalies can be attributed to the ordinances issued to counter the pandemic that either banned leaving home or limited movement to the municipal area only.

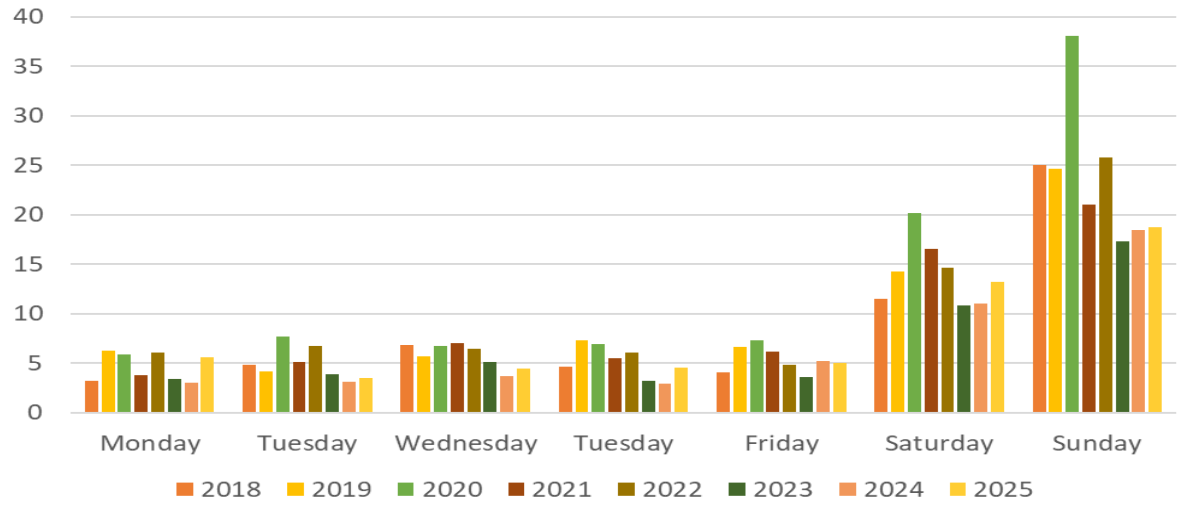


Figure 117 - Distribution of average passages across weekdays.

The chart shows the distribution of average passages (entries + exits) across weekdays. Weekdays have a largely homogeneous frequency, whereas there is a peak at the weekend, especially on Sundays. There are no significant differences between years, including 2020 which, as mentioned earlier, presents some anomalies.

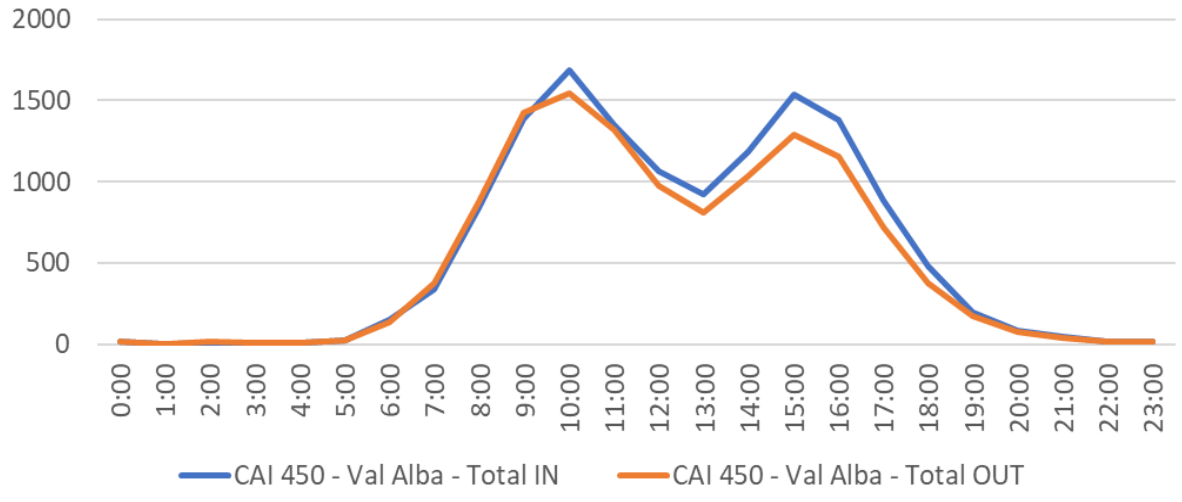


Figure 118 - Entries and exits by hours.

The chart displays entries and exits over the hours of the day. The pattern is comparable between entries and exits with two peaks at 09:00 and 16:00. One would have expected a stronger morning peak in entries and an afternoon peak in exits, but it should be noted that there are three shelter structures in the valley that can attract sizable numbers of people who stay overnight.

7.5.3 Eco-counter CAI 642 - Malga Coot

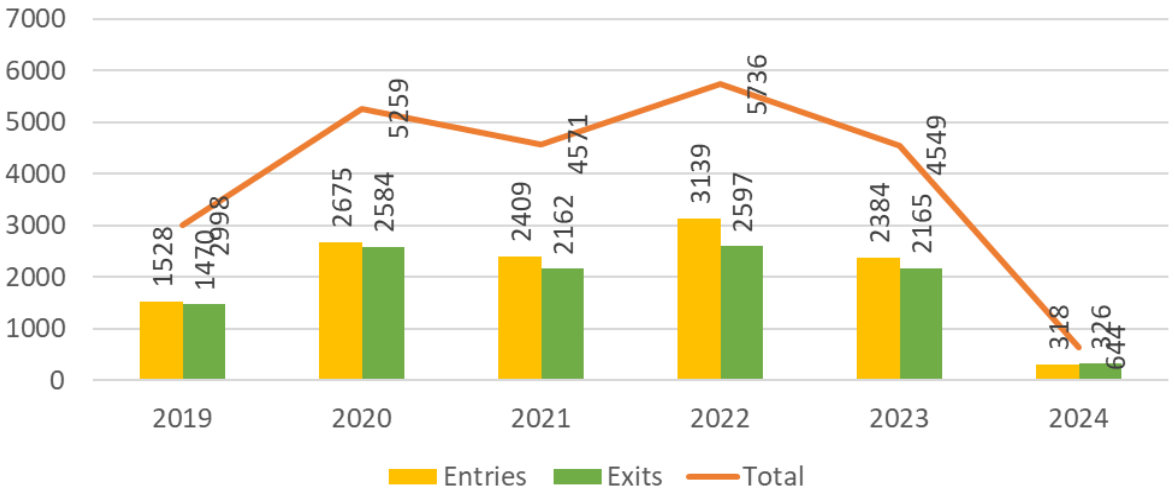


Figure 119 - Total entries and exits by years.

The eco-counter was reactivated on 17/06/2019 while from 05/06/2024 it stopped functioning again and, despite inspections carried out by technicians in April 2025, the problem has not yet been fixed. With this premise and thus excluding the years 2019 and 2024 from consideration, there is no major variation in visitor numbers in the remaining years. The slight discrepancy between entries and exits can be attributed to the possibility of performing loop hikes (including the Malga Coot–Monte Guarda loop), which imply a different descent route.

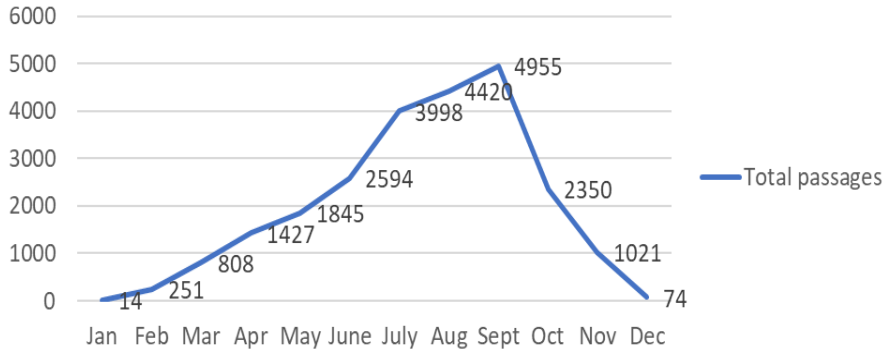


Figure 120 - Total passages by months.

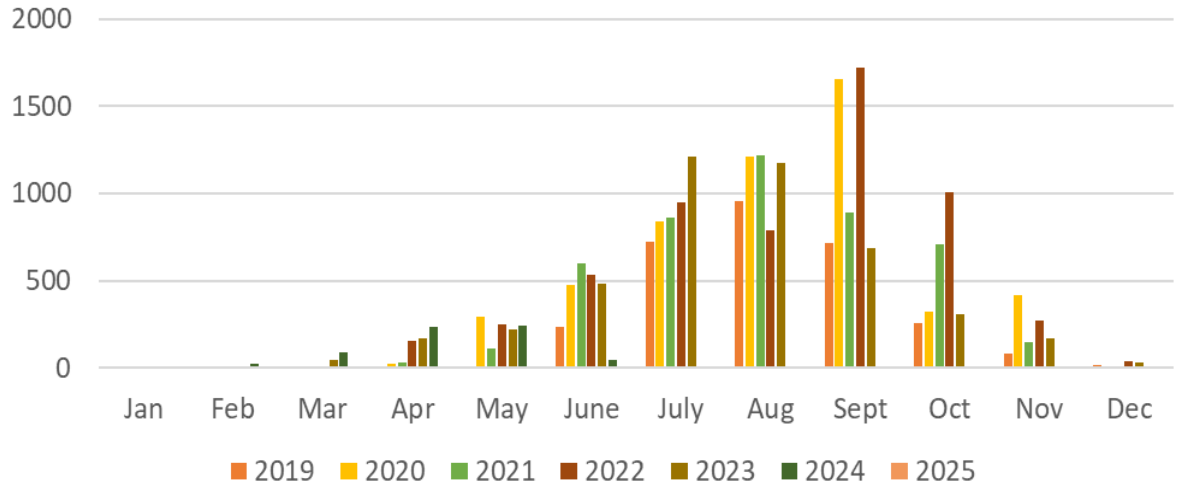


Figure 121 - Total passages by months and years.

There is a steady increase over the months with a peak in September, followed by a rapid decline in subsequent months. The high number of visitors in September, which sometimes continues into October, is likely attributable to the foliage phenomenon. Winter months see an almost total absence of passages, both due to reduced visits and possible snow coverage on the ground.

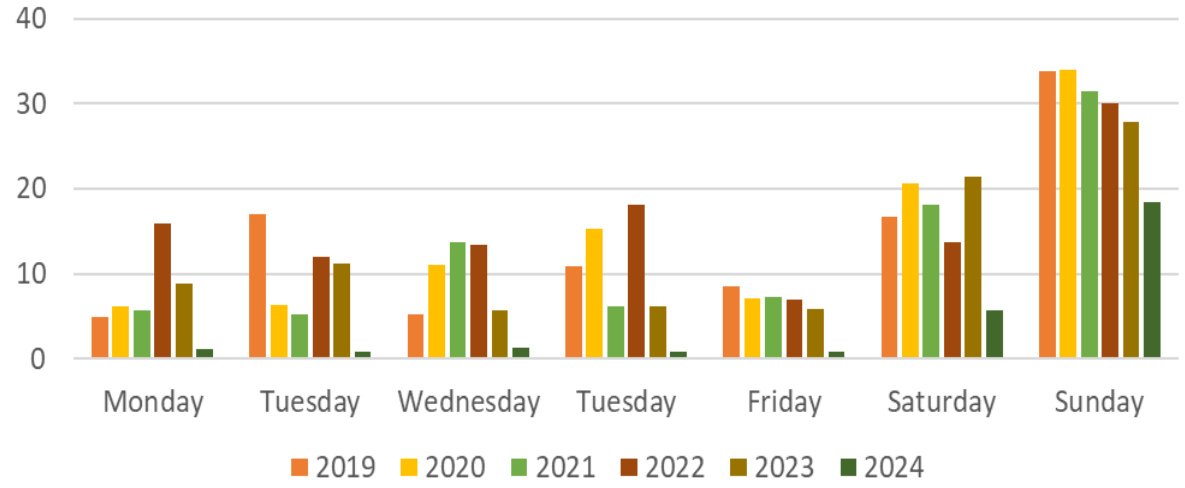


Figure 122 - Weekly visitor count by year.

The weekly distribution chart shows that the busiest day each year is Sunday, followed by Saturday, with minor differences in some cases. Weekday counts show no major variations.

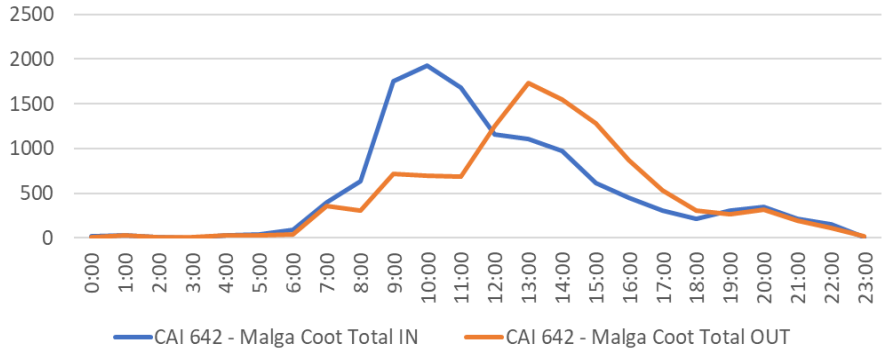


Figure 123 - Hourly total passages.

The hourly distribution of entries and exits shows a clear temporal discrepancy between the two peaks: the first corresponds to 10:00 and is also the highest value, which can be interpreted as accounting for both hikers who complete the aforementioned loop and those returning along the same trail. The exit peak corresponds to 14:00 and plausibly includes some hikers who had reached morning destinations such as the Casera Monte Canin shelter or Monte Baba Grande.

7.5.4 Eco-counter CAI 662 - Ta Lipa Pot

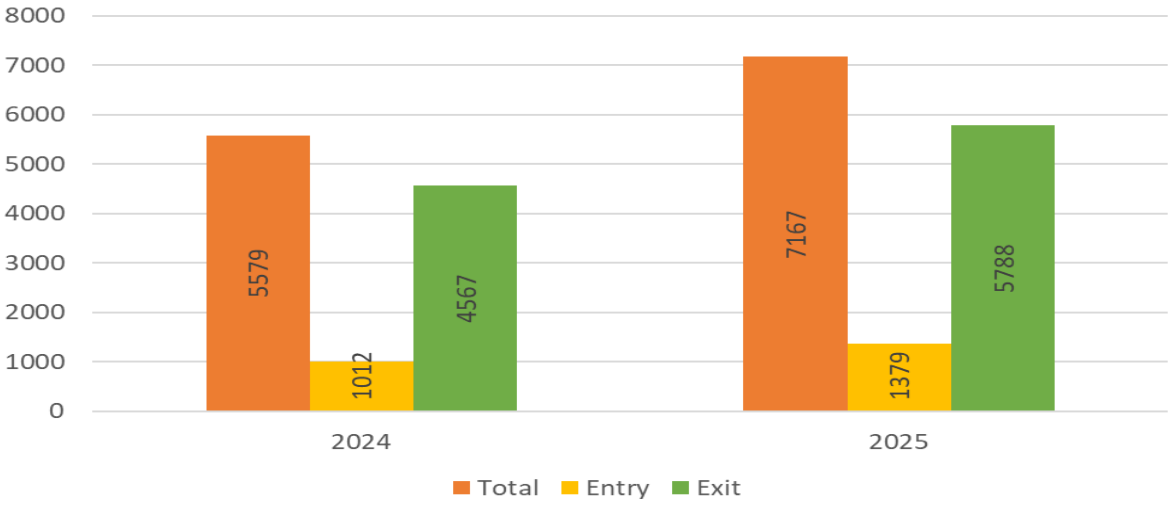


Figure 124 - Visitor passages for 2024 and 2025.

The chart shows total entries and exits for the two years the eco-counter has been active. Although neither year is complete, this device ranks as the second by number of passages after "CAI 632 – Botanical Trail Bila Peč ." The route proves to be one of the most frequented in Val Resia and the clear discrepancy between entries and exits indicates that most people prefer to traverse it counter-clockwise, starting from Stolvizza and proceeding on the right side of the watershed.

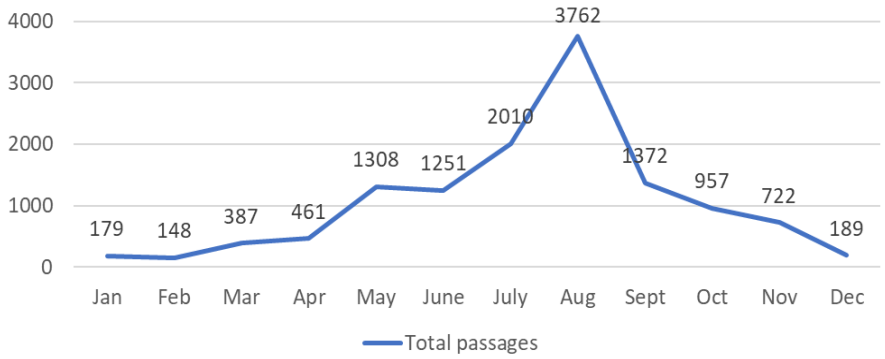


Figure 125 - Monthly total passages.

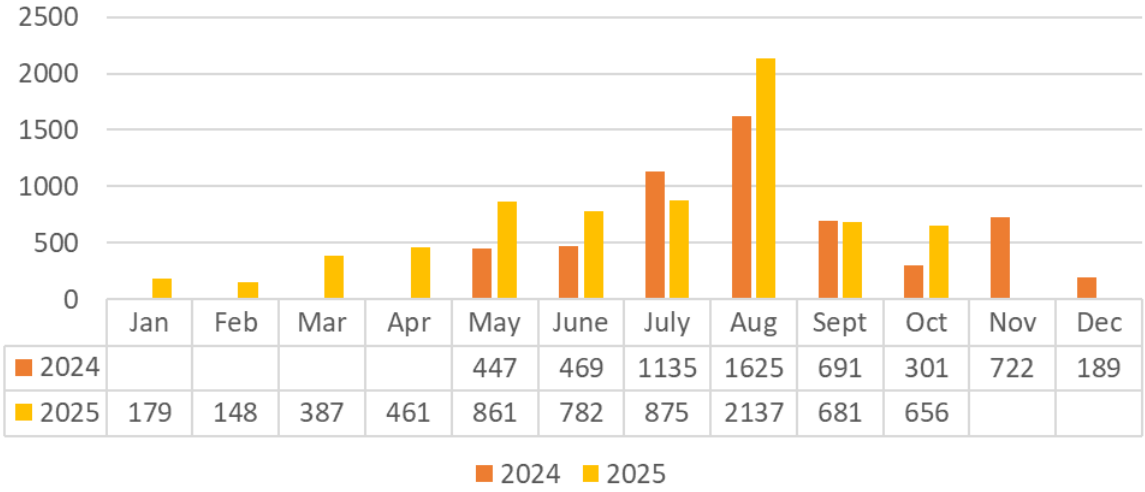


Figure 126 - Monthly total passages in 2024 and 2025.

In the two charts—one showing total passages and the other showing monthly passages split across the two years—it can be observed that the summer months are again the most frequented, with August recording the highest values. Comparing June, July, and August, both increases and decreases are noticeable: for July, the frequent bad weather in 2025 likely led to lower visitation along the route. In contrast, August 2025 shows a significant increase in crossings, as does October 2025, which more than doubled.

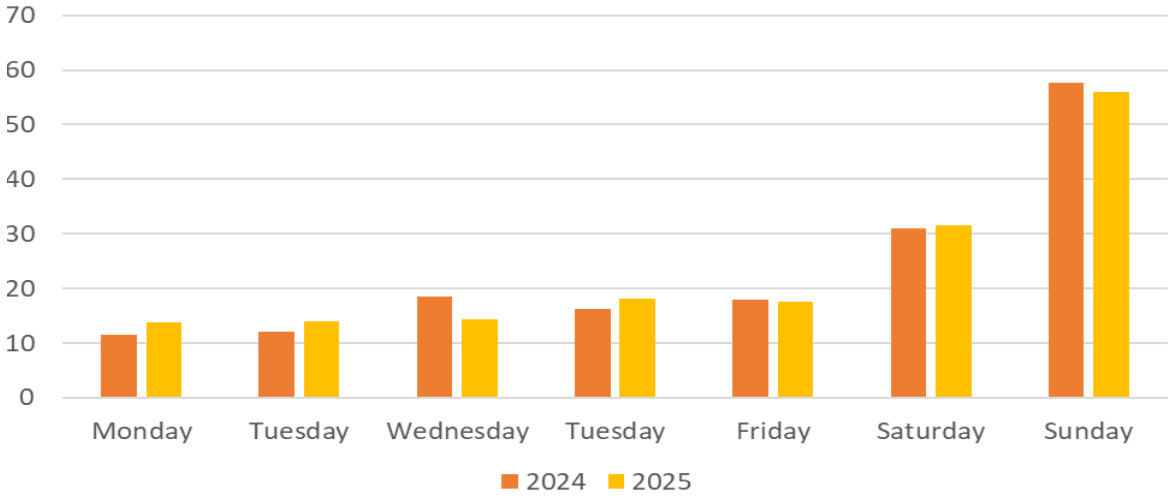


Figure 127 - Weekly total passages in 2024 and 2025.

The weekday distribution of average passages (entries + exits) again shows a clear prevalence of higher values at the weekend compared to weekdays.

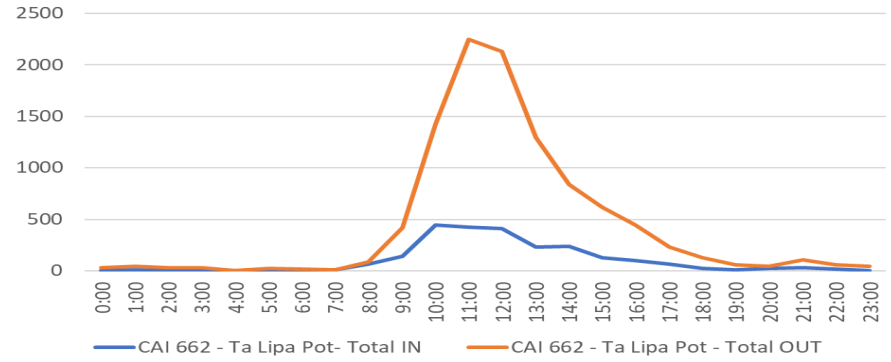


Figure 128 - Hourly total passages.

The hourly distribution of entries and exits does not show large differences between the two trends. The busiest hours range from 09:00 to 14:00, but there are also a number of passages extending into the late afternoon and evening, with even some counts at 21:00. It should be noted, however, that the marked difference between IN and OUT passages is due to the preferred direction of travel on the trail, as previously discussed.

Apart from potential wildlife detections, this latter observation could be explained by visitors staying overnight at the "Al Ranch" campsite nearby (unofficial building) or young participants in camps organized at the "Casa Resiana" facility managed by a local association.

7.5.5 Eco-counter CAI 703 - Rio Nero

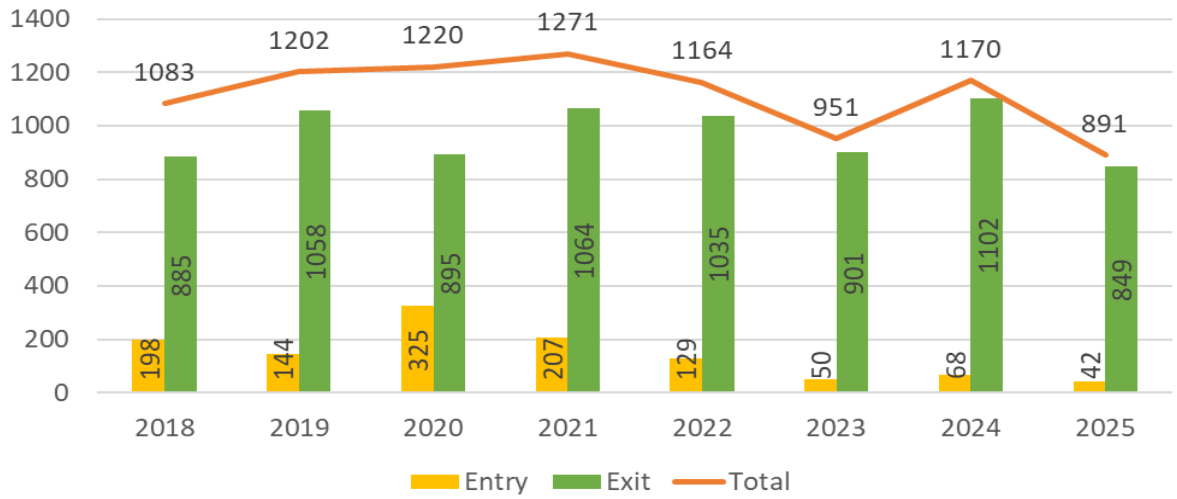


Figure 129 - Yearly total passages.

The chart shows total entries and exits divided by year. The large discrepancy between entries and exits initially raised doubts about the accuracy of the data. An inversion of IN and OUT counts was hypothesized but subsequently checked and ruled out. The data does not appear reliable, as the trails in the exit direction are long and not easily navigable. It is therefore assumed that there was a data collection issue during descents. This prevents drawing any concrete conclusions regarding entry and exit preferences, so we limit ourselves to reporting the raw data without further commentary.

However, a slight decrease in crossings over the years can be observed, with 2023 being the least frequented year, followed by 2025, although data from September onwards is missing for that year.

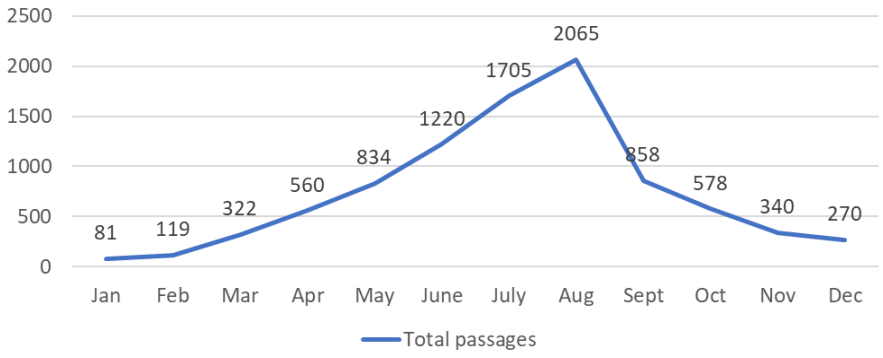
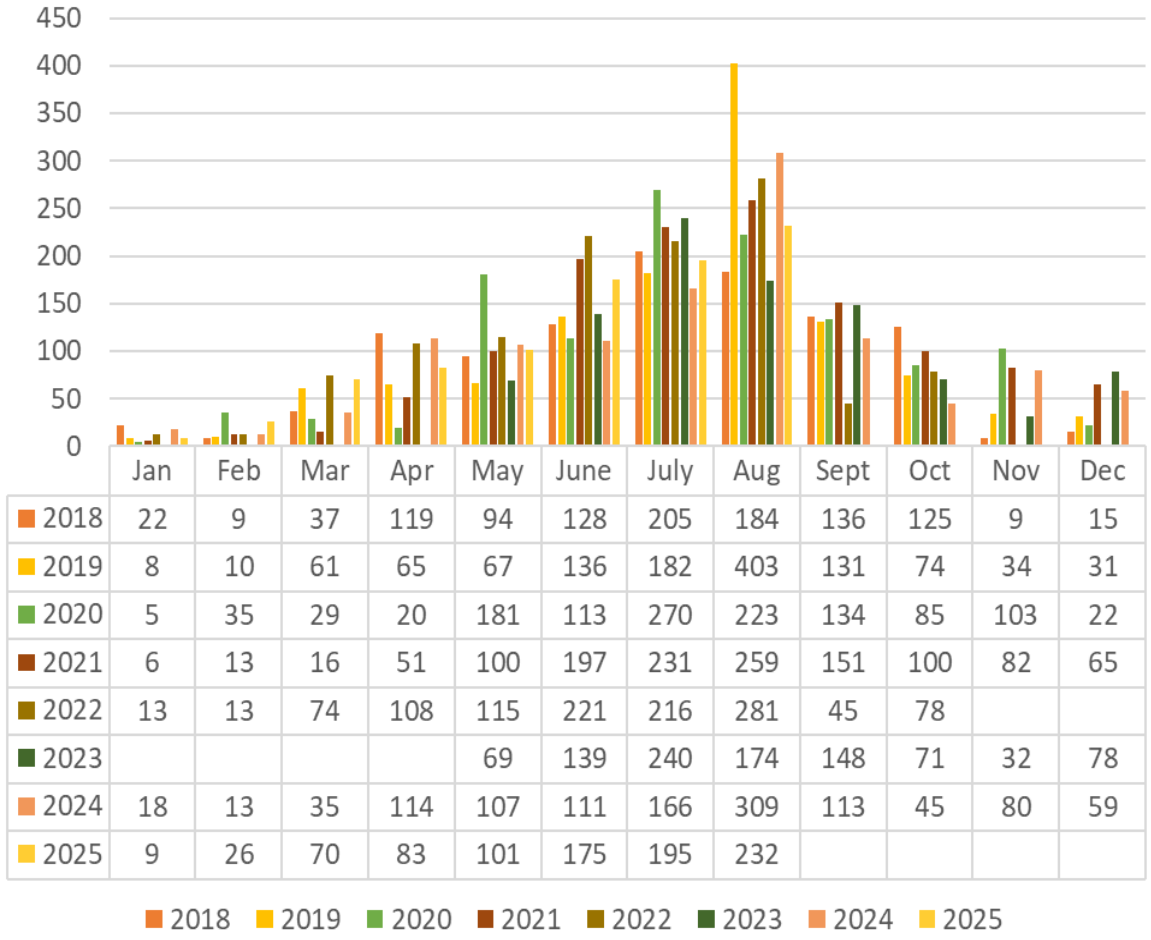


Figure 130 - Monthly total passages.



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2018	22	9	37	119	94	128	205	184	136	125	9	15
2019	8	10	61	65	67	136	182	403	131	74	34	31
2020	5	35	29	20	181	113	270	223	134	85	103	22
2021	6	13	16	51	100	197	231	259	151	100	82	65
2022	13	13	74	108	115	221	216	281	45	78		
2023					69	139	240	174	148	71	32	78
2024	18	13	35	114	107	111	166	309	113	45	80	59
2025	9	26	70	83	101	175	195	232				

Figure 131 - Total passages by months and years.

As with other devices, the eco-counter on trail CAI 703 shows higher numbers of passages in July and August, with an increase starting in March and then a decline from September onward. Winter passages are almost null, especially in January and February, since the trail freezes and the route become dangerous.

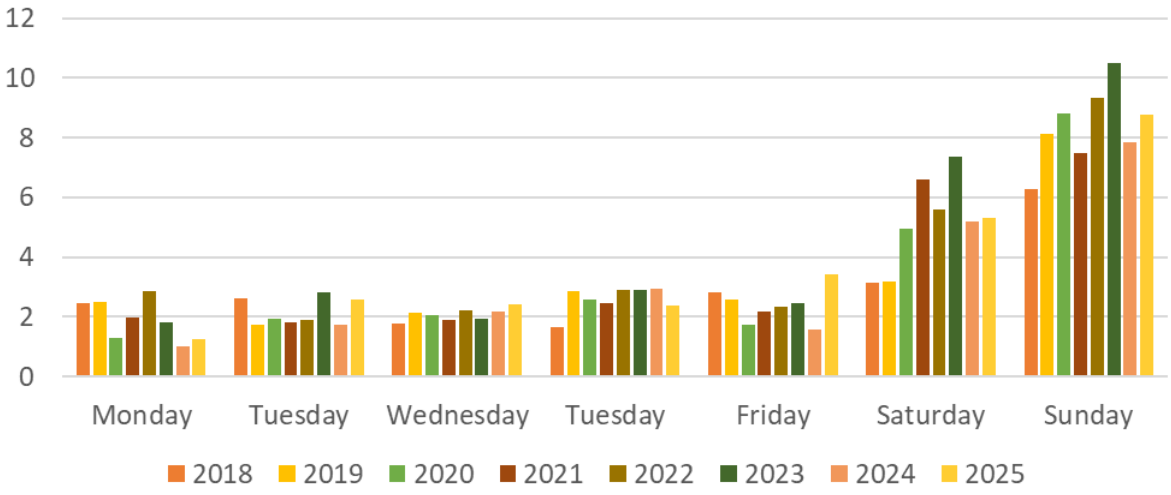


Figure 132 - Weekly total passages.

The same dynamic applies to the average weekday passages, where the weekend clearly predominates and weekday counts are relatively low. No obvious differences in trends are observed between the years analyzed.

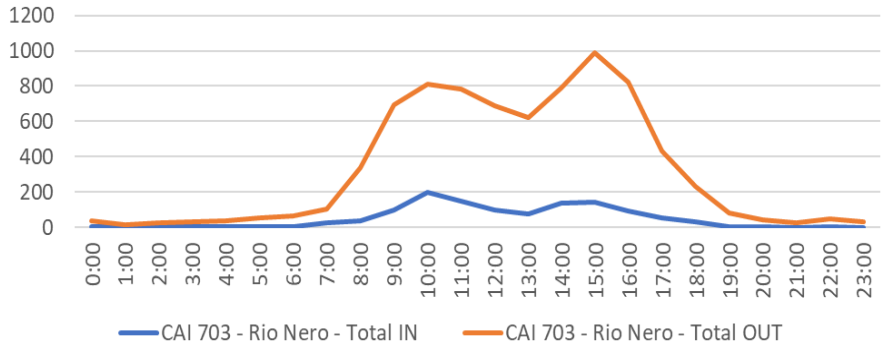


Figure 133 - Hourly total passages.

The chart shows the trend of total entries and exits throughout the hours of the day. Considering the points mentioned above, the entry data is deemed unreliable, and therefore only exit data will be discussed.

Regarding exits, the peak at 10:00 may correspond both to people completing short loops starting from the Lischiazze hamlet and to those staying overnight at the Ricovero Casera Rio Nero located in the valley. The peak between 15:00 and 16:00, on the other hand, may correspond to hikers undertaking longer routes, for example via the summit of Monte Cuzzer, or to those who enter the valley in the morning and descend in the afternoon.

7.5.6 Eco-counter CAI 719 - Valle Musi

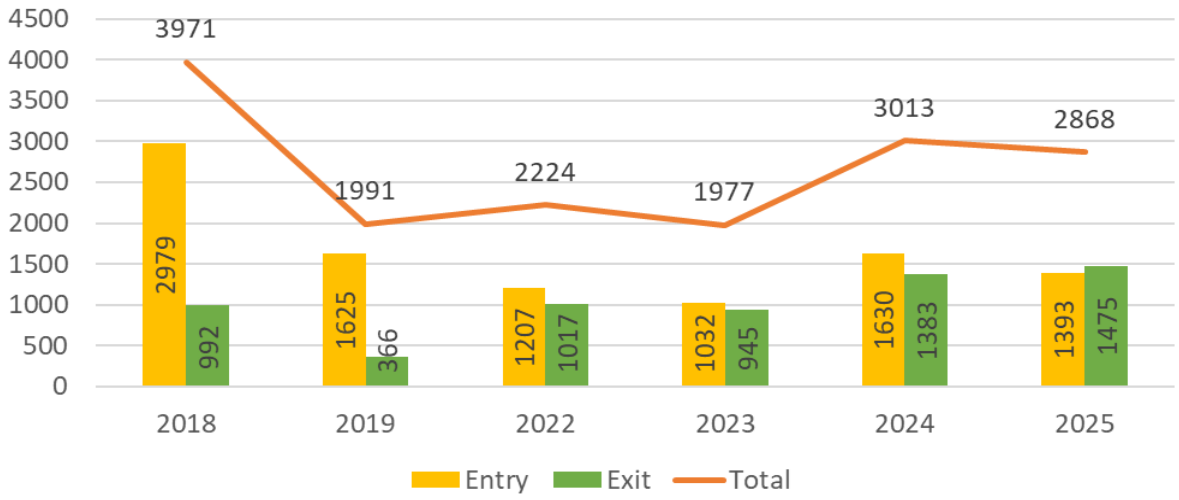


Figure 134 - Yearly total passages.

The chart reports total entries and exits divided by year, excluding 2020 and 2021 due to lack of data. A large decrease after 2018 is noticeable; this can be closely linked to device problems that caused data loss in 2019, 2022 and 2023. In light of this, it is not possible to assert with absolute certainty that there has been a true decline in visitation.

It is interesting to note how entry-exit differences are initially more substantial but almost equalize from 2022 onward, with exits exceeding entries in 2025 (noting that data for 2025 are incomplete). The entry measurement records movement along the Valle Musi Nature Trail in the W–E direction, i.e., from the trailhead in the hamlet of Simaz toward the Pian dei Ciclamini refuge, while exits are vice versa. This smoothing and partial inversion in 2025 could be explained by the reopening of the cited refuge, which may have become a preferred starting point for hikers.

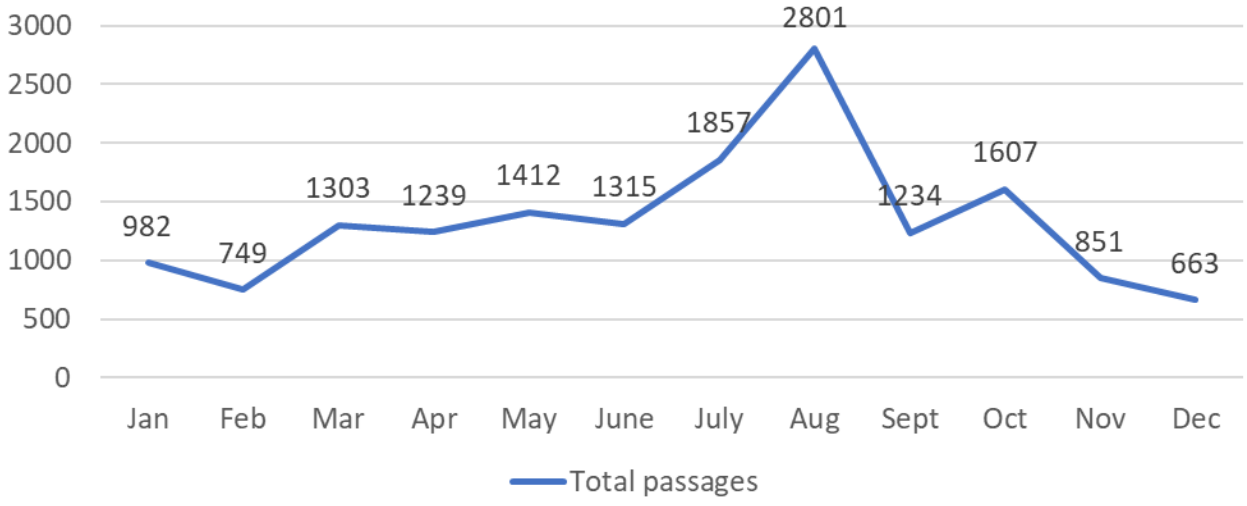


Figure 135 - Total passages by month.

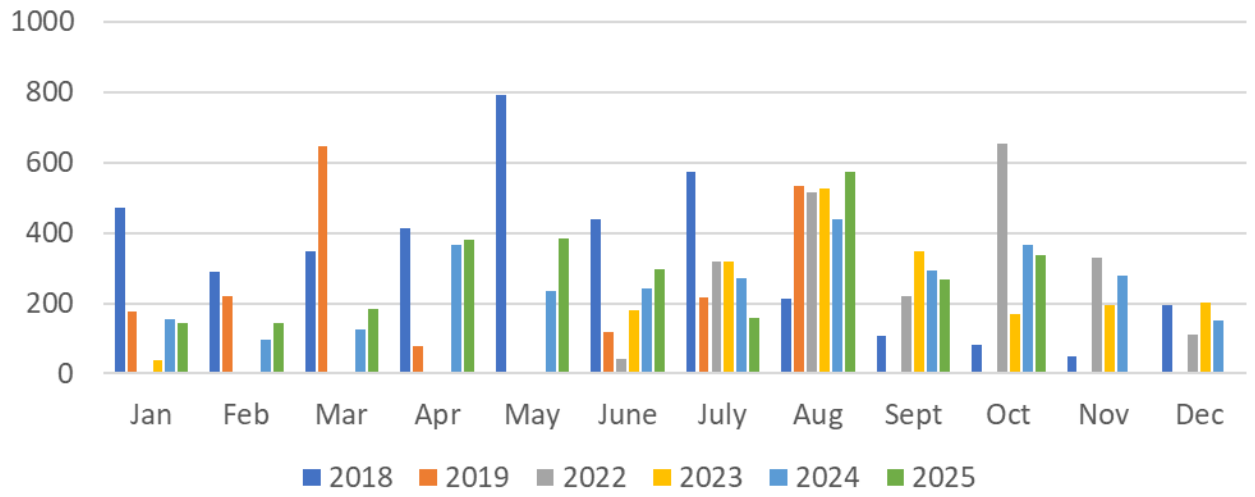


Figure 136 - Total passages by month and year.

In this case the monthly total passages chart differs significantly from other devices. The years 2019, 2022, 2023 and 2025 show only partial data while 2020 and 2021 are absent because the eco-counter was not operational. Numbers are relatively low compared to other eco-counters, with no month exceeding 800 passages. The monthly distribution is also distinct from other devices, with no single month standing out except for a physiological summer increase. One possible explanation is lower use of the route by seasonal hikers and higher use by locals and educational outings occasionally organized by the Park Authority.

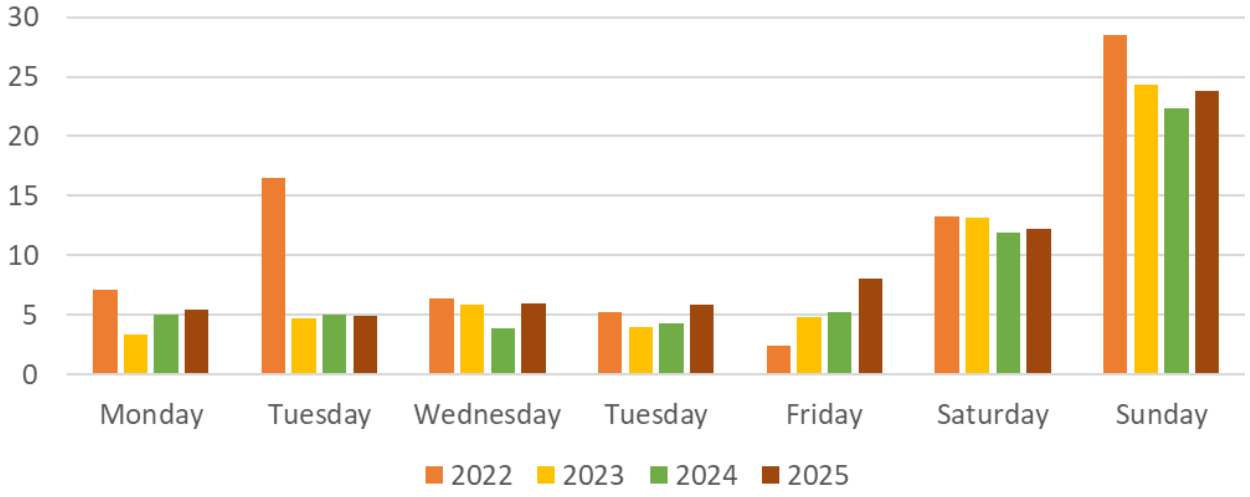


Figure 137 - Weekly total passages by year.

This chart provides a breakdown of entries and exits for the two categories considered. Due to a placement error, the entry counts actually represent exits from the valley (Resia–Resiutta direction), while the exit counts represent the opposite. With this clarification in mind, a discrepancy between entries and exits is noticeable in the cyclist category. Initially, most cyclists used the trail downhill, likely returning via the provincial road, whereas from August onwards, the trend reversed. This could be explained by higher usage by Val Resia residents at the beginning, followed by an increase in non-resident visitors traveling the cycle-pedestrian path from the hamlet of Povici into the valley. Without further investigation, this cannot be confirmed and remains a hypothesis.

Focusing on pedestrian entries and exits, the trend favoring downhill travel remained more or less consistent throughout the active months, with a reversal only in September.

Finally, it is worth noting that in April and October, pedestrian crossings exceeded bicycle crossings.

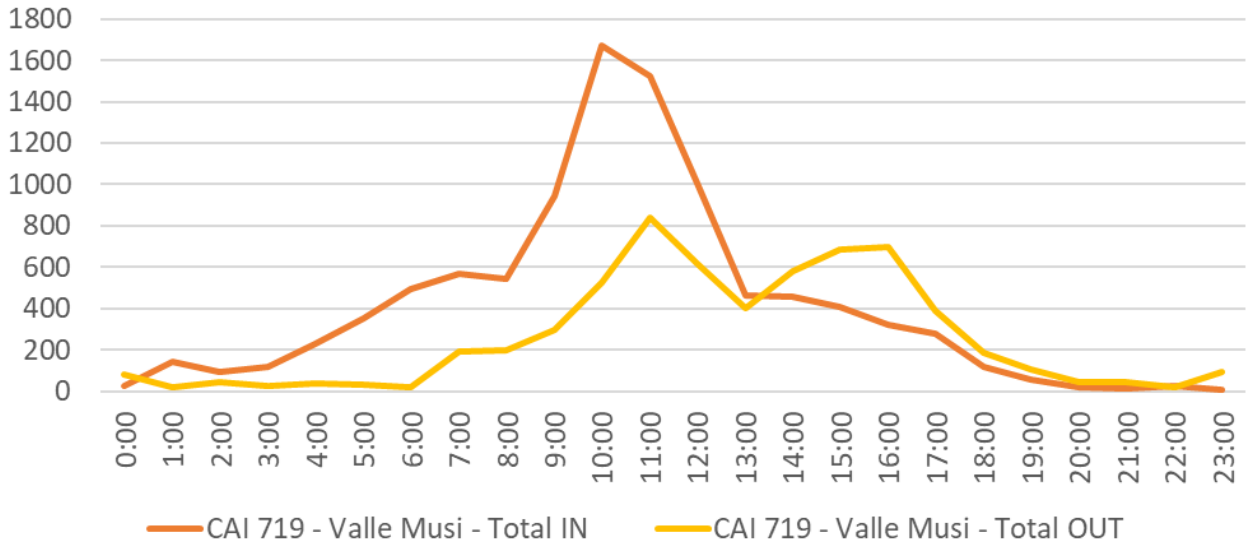


Figure 138 - Hourly total passages.

The hourly distribution of entries and exits shows the expected peaks at 10:00–11:00 for incoming traffic (people doing the Valle Musi Nature Trail starting from Simaz) and in the afternoon at 15:00–16:00 for returning traffic. The exit peak at 11:00 could correspond to people doing the trail in the opposite direction starting from the Pian dei Ciclamini refuge. Night-time counts may partially reflect detections of wild fauna.

7.5.7 Eco-counter Cicloturistica Val Resia

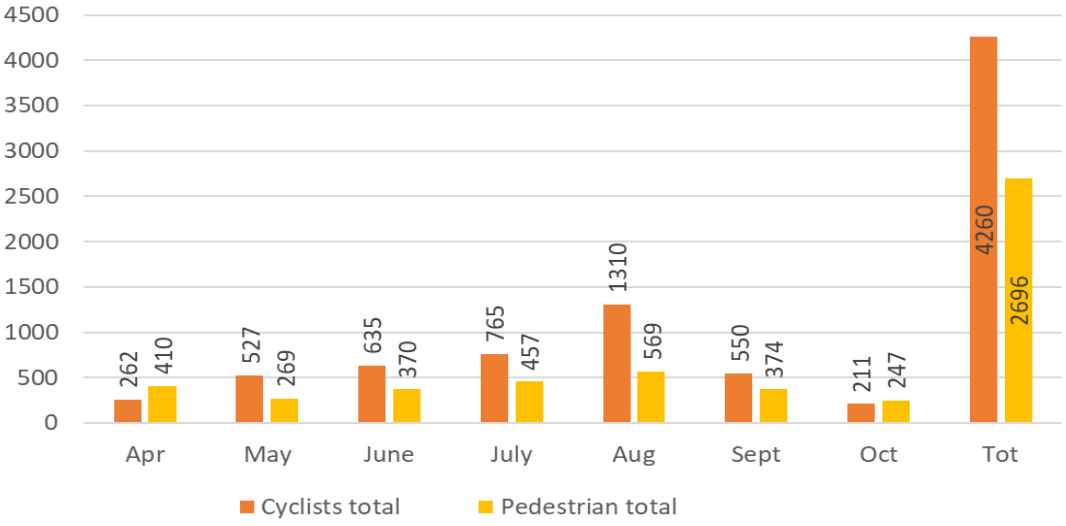


Figure 139 - Pedestrians and cyclists total passages by month.

The chart shows total passages and the differences between cyclists and pedestrians on a monthly basis. Data from 02 April and 09 June were excluded from processing because they produced biased results: in the first case due to the device being grounded, in the second due to the passage of a flock of sheep.

The Val Resia cycle-pedestrian path was inaugurated in 2024 and the eco-counter was placed on 02 April 2025. Despite the short operational period, the total counts are fairly substantial, with a pronounced discrepancy in favor of bicycles. In just seven months, nearly 7,000 passages were recorded, including over 1,300 bicycles in August alone. This figure clearly highlights the attractiveness of the infrastructure for both tourists and locals, particularly from a cycle tourism perspective.

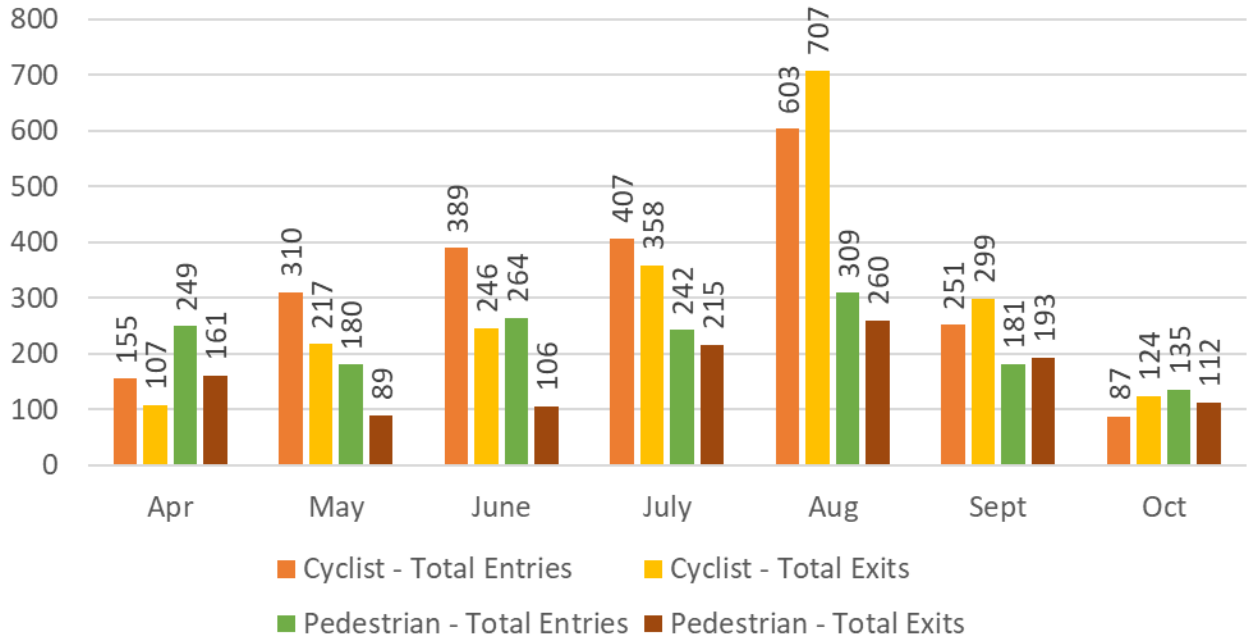


Figure 140 - Entry/ Exit pedestrian and cyclists passages by month.

The detailed chart shows entries and exits for the two categories. Due to an installation error, the entry counts show what are actually exits from the valley (direction Resia–Resiutta), while the exit counts show the opposite. With this clarification, a discrepancy is visible among cyclists between entries and exits. This suggests that, except for August when the trend reversed, most cyclists use the route downhill and likely return via the provincial road. This could indicate higher use by locals, whereas August may see a higher presence of tourists. Without further investigation this remains only a hypothesis.

Focusing on pedestrian entries and exits, the downhill trend appears roughly consistent across the months of operation.

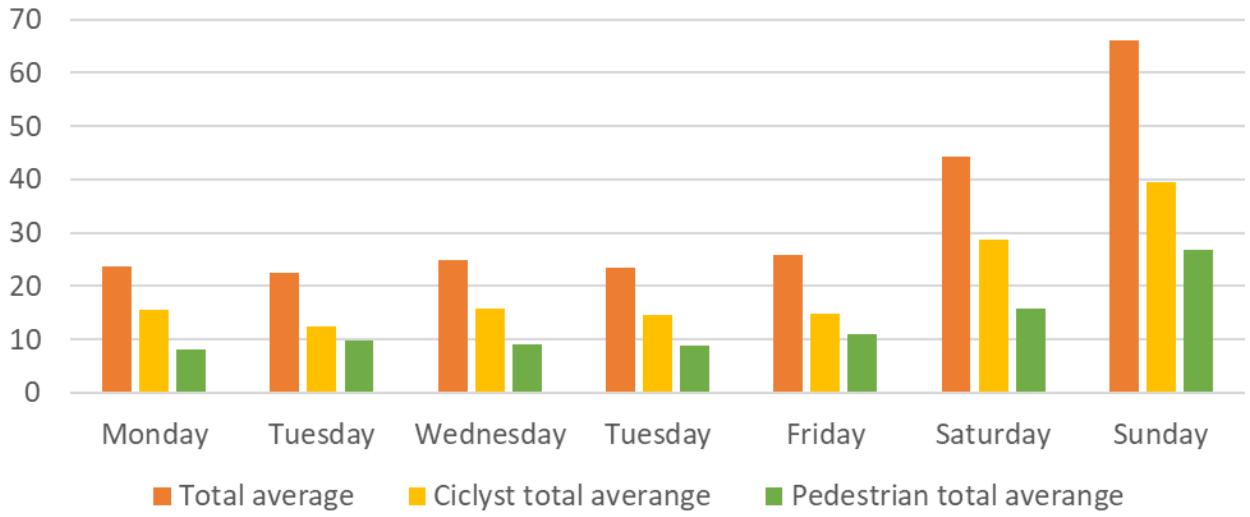


Figure 141 - Weekly total passages.

The chart of average passes aggregated and divided by category (cyclists and pedestrians) by weekday shows relatively steady numbers during weekdays and an increase at the weekend, with Sunday recording the highest counts.

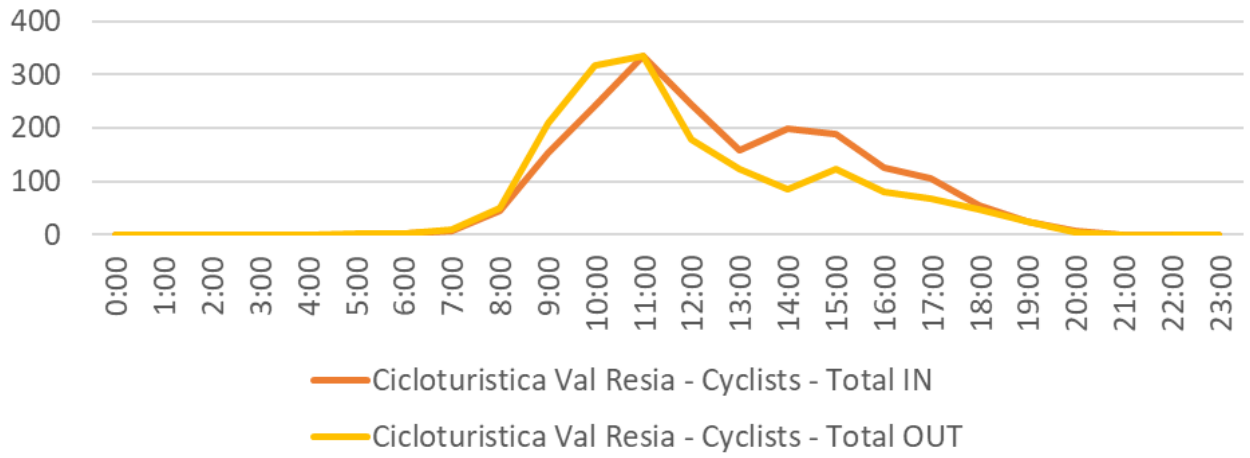


Figure 142 - Hourly cyclists total passages.

The hourly distribution for cyclists (excluding 02 April and 09 June) shows a morning peak, a slight dip between 12:00 and 14:00 and a second peak at 15:00. Counts occur until approximately 20:00, likely reflecting use of the route by valley residents, while there are no cyclist passages during night hours.

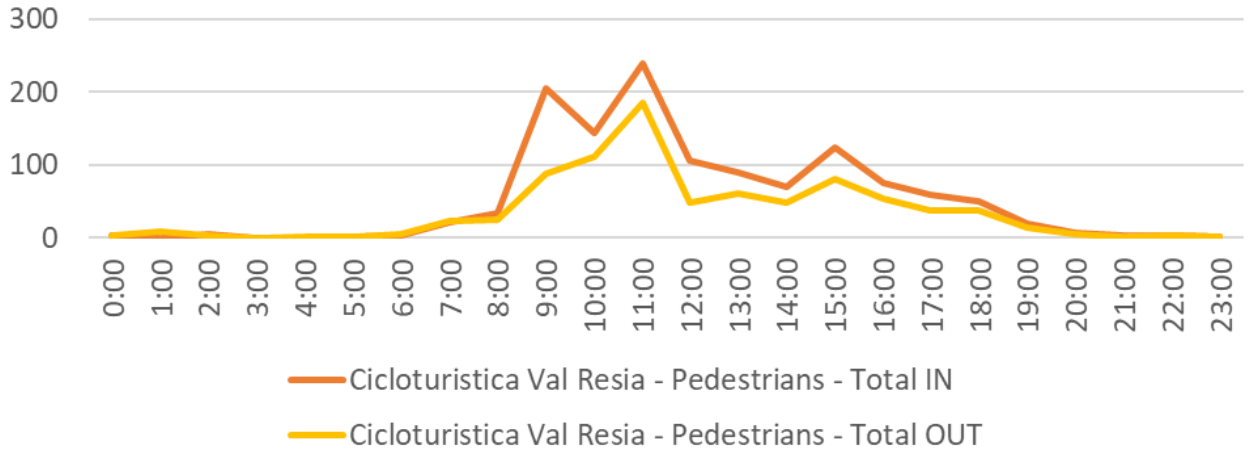


Figure 143 - Hourly pedestrian total passages.

The hourly distribution for pedestrians (excluding the two dates mentioned) shows that pedestrian activity begins earlier in the morning, with a sharp increase from 08:00, a dip between 12:00 and 14:00 and a second peak in the afternoon. The last passages are recorded around 21:00; a few night-time counts (around 01:00) could be due to wildlife detection.

7.5.8 Eco-counter Strada Coot

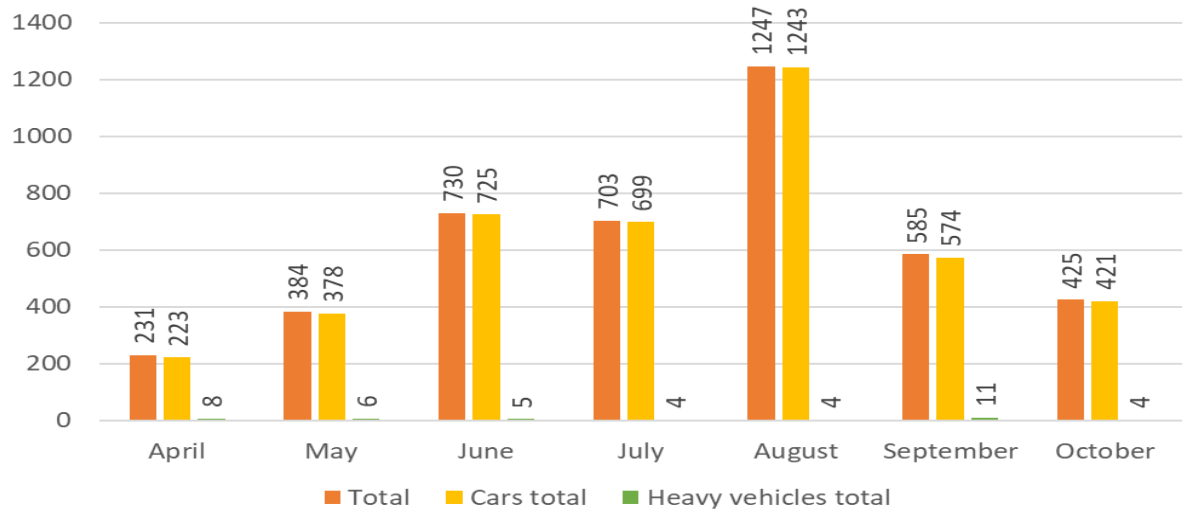


Figure 144 - Monthly car and heavy vehicles passages.

The chart shows total passages divided by category (cars and heavy vehicles) over the three months of activity. Data for June are incomplete since the last available date is 12/06. Given the limited timeframe, no monthly or yearly considerations can be made; the only clear result is the marked predominance of cars over heavy vehicles (buses, vans, tractors, trucks).

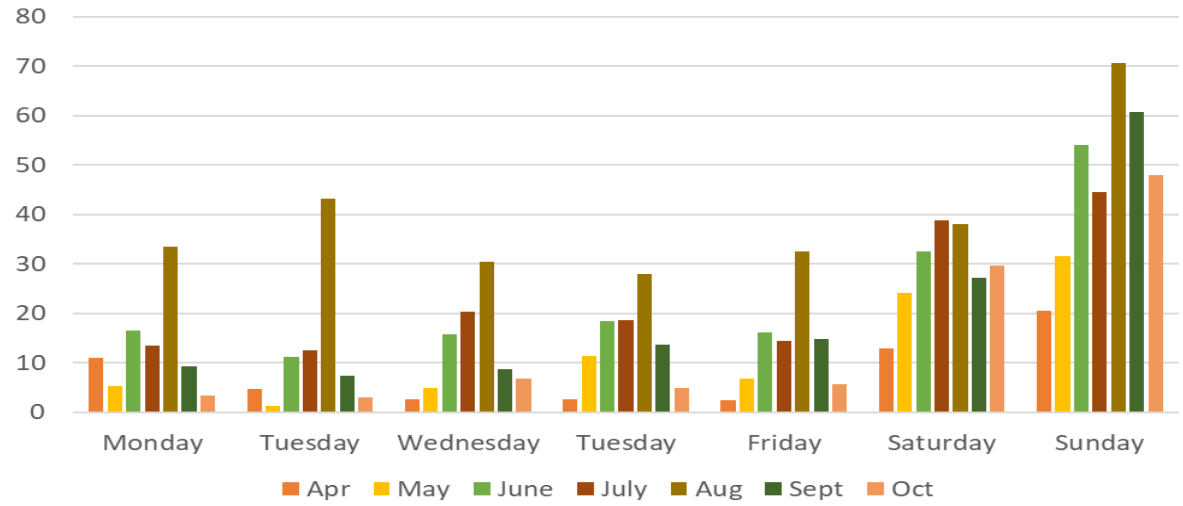


Figure 145 - Weekly total passages.

The distribution of average daily passages by weekday for single months also does not allow major conclusions due to the scarce availability of data. It can be noted that, similar to other devices, the average number of passages is higher on Saturdays and Sundays. An exception is the data for Tuesdays in August, which exceeds that of Saturdays. This could be due to specific events held at the nearby agriturismo, but no more detailed analysis is possible.

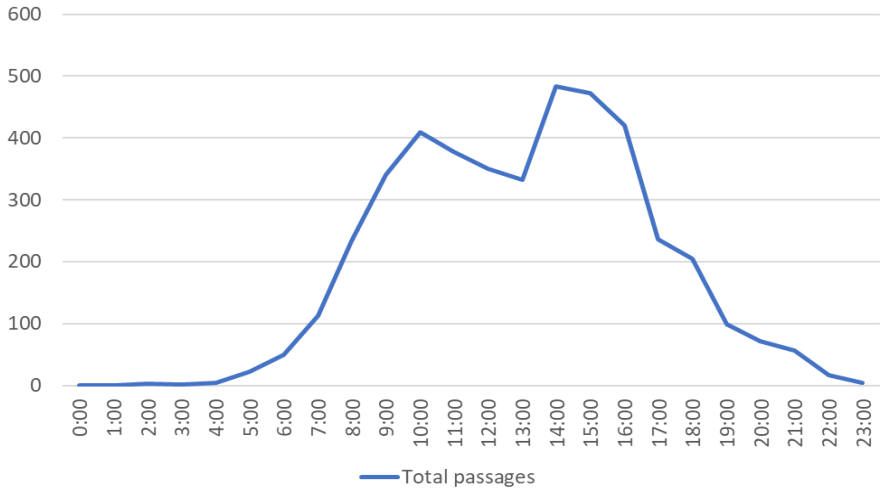


Figure 146 - Hourly total passages.

Despite the limited data available, it is interesting to observe how the total crossings are distributed throughout the day. There is a marked increase in the morning, when people arrive at the parking lot at the end of the road, followed by a decrease between 10:00 and 13:00, and then a new rise in the afternoon, peaking at 14:00.

7.5.9 Eco-counter Strada Malga Confin

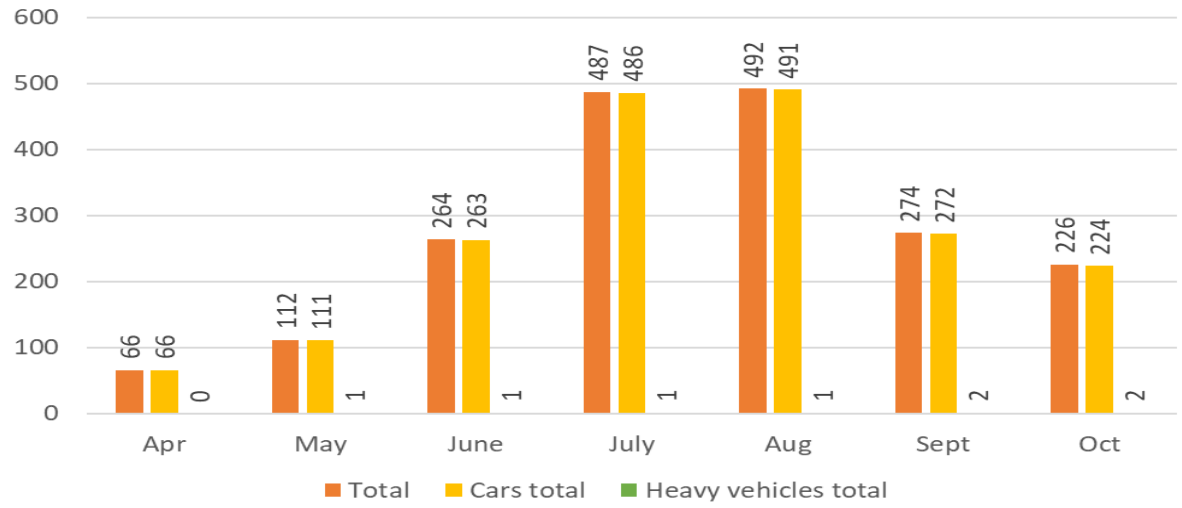


Figure 147 - Monthly car and heavy vehicles passages.

As with the previous device, the one positioned on the access road to Malga Confin also provides a limited amount of data. Considering this, it can be observed that the distribution of total crossings and of the two categories (cars and heavy vehicles) over the months under review shows an increase as the summer progresses, with peaks occurring in July and August. This is due to two factors: first, the malga opens at the end of May, so earlier access is limited to people with permits; second, the natural increase in traffic during the high season. The individual heavy vehicle crossings likely correspond to vehicles used by the malga operators for transporting livestock and other materials.

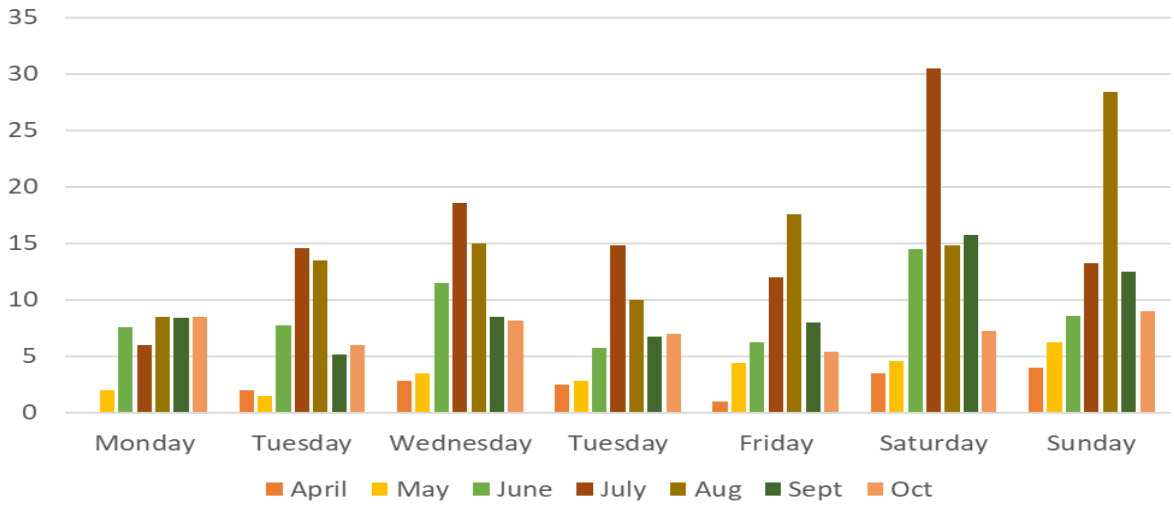


Figure 148 - Weekly total passages.

The chart showing the average crossings on different days of the week on a monthly basis displays a pattern different from the other eco-counters. Again, the limited availability of data, both in terms of quantity and temporal range, affects the results. The high number of crossings on Saturdays, and particularly on Wednesdays in June and July, can be attributed to summer camps for children organized by a local association in collaboration with the malga operators. These camps take place from Wednesday to Saturday and require parents to accompany the children directly to Malga Confin. On Saturdays, however, the usual increase in visitors should also be considered, which is partly reflected on Sundays as well.

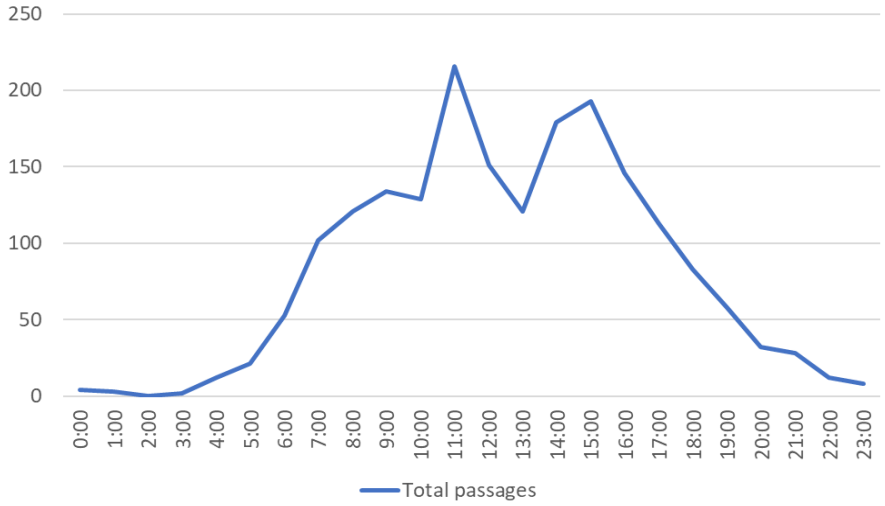


Figure 149 - Hourly total passages.

The distribution of total crossings on an hourly basis shows a pattern very similar to that of the previous eco-counter. However, some crossings are recorded as early as 04:00, likely corresponding both to malga staff who occasionally visit during the day and to volunteers from the bird ringing station operating at the malga since September. The first peak occurs at 11:00, which may also be related to the summer camp mentioned in the previous paragraph. Unlike other cases, there is just a small decrease between 12:00 and 14:00, while a new peak occurs at 15:00, likely corresponding to people coming for afternoon walks or dinner. Once more data are collected, it would be interesting to compare hourly crossings across individual days of the week to better highlight any patterns.

7.5.10 Eco-counter Strada Sella Carnizza - Uccea

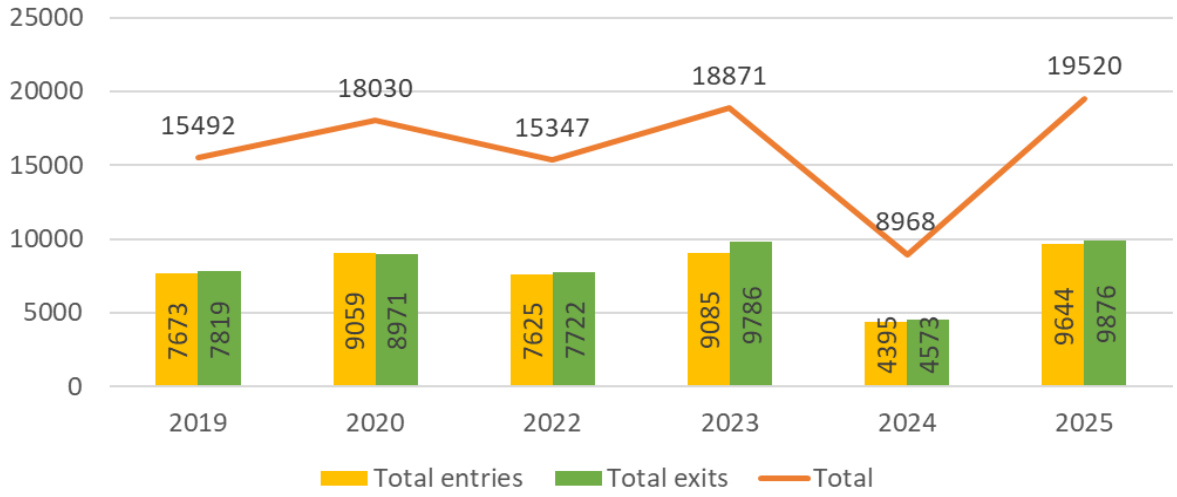


Figure 150 - Yearly total passages.

The chart reports total entries and exits by year (excluding 2021 due to lack of data). The trend remained fairly stable from 2019 to 2023, always showing substantial numbers and without major differences between entries and exits. This demonstrates that the Carnizza–Uccea road is a key route for accessing Val Resia, especially from Slovenia. Unfortunately, the device does not differentiate between types of motor vehicles, making it impossible to determine the number of cars versus motorcycles or heavier vehicles (vans, trucks, etc.). It should be noted that 2025 is not complete and that the device stopped recording data from 14/08/2024 to 01/01/2025 due to software problems.

Despite this, 2025 appears to be the year with the highest number of recorded passages, showing a trend similar to that observed with other eco-counters.

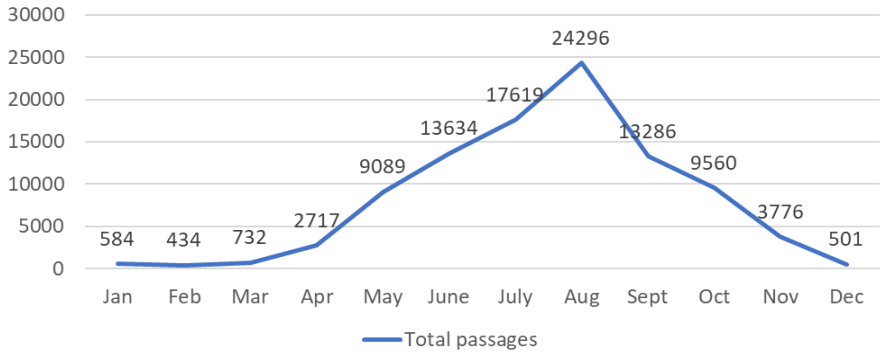


Figure 151 - Monthly total passages.

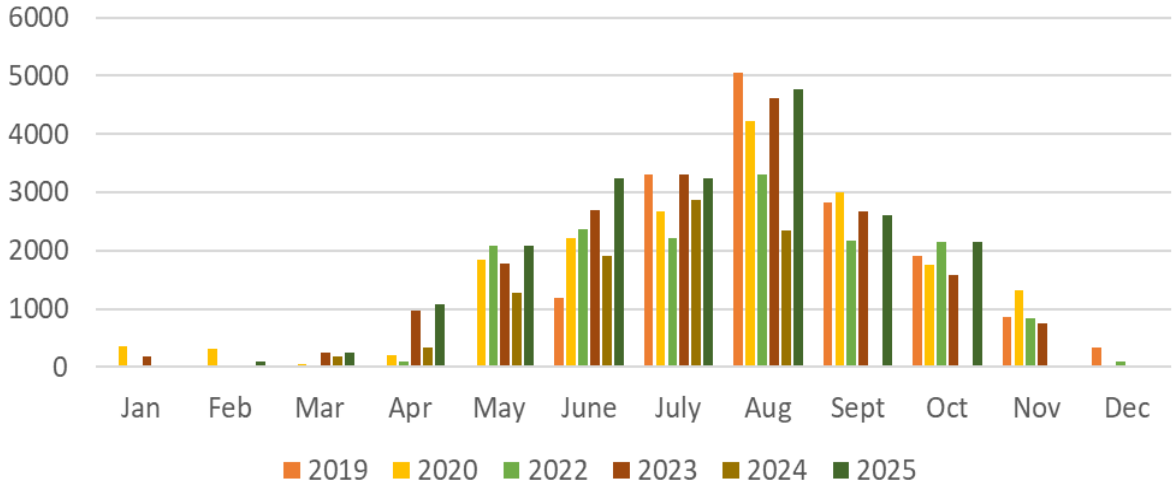


Figure 152 - Total passages by months and years.

The monthly distribution of total passages with detail by year (excluding 2021) again shows a consistent increase from spring, peaking in August. Winter months show almost zero passages since the road is closed by municipal ordinance. Some decreases in monthly counts across years can be explained by road closures resulting from hydrogeological instability.

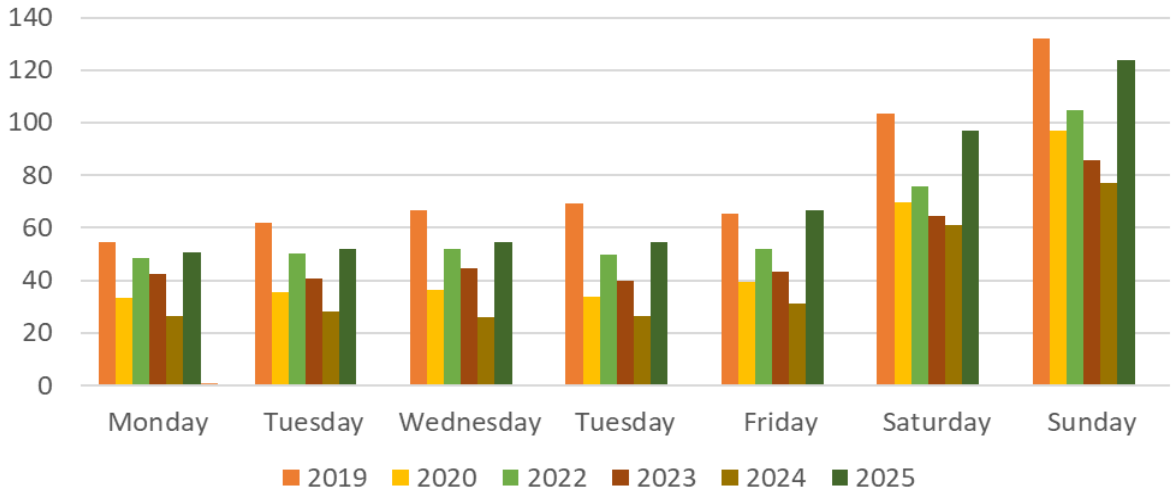


Figure 153 - Weekly total passages.

The chart of average daily passages by weekday across years shows a pattern similar to other cases: relatively stable midweek numbers with a clear increase at the weekend.

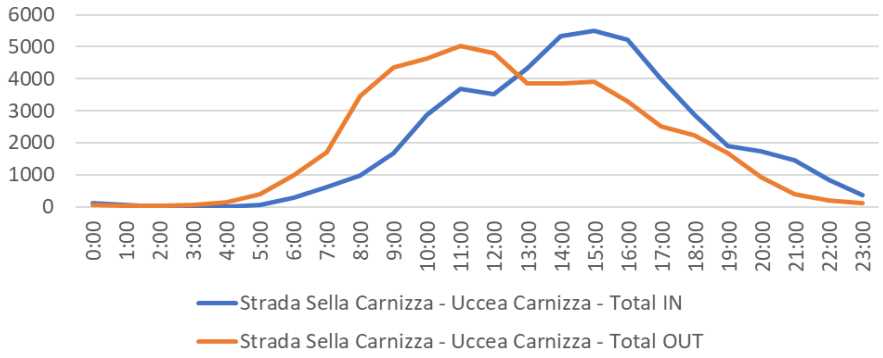


Figure 154 - Hourly total passages.

The hourly distribution of total entries and exits shows a higher number of exits (direction Uccea) already from early morning, which may be explained by residents of Val Resia traveling for various reasons. An increase in entries is observed from 06:00 to 15:00, which can be explained by visitors (both Slovenian and non-Slovenian) entering the valley and by locals returning in the afternoon. Passages continue until around 23:00 and then fall to zero in the 00:00–03:00 time window.

7.6 Evaluation of Mobile Phone Data

For the big data analysis, the Vodafone company provided us with an interactive dashboard where we could view the results including the flow of tourists and non-tourists (including residents and regular visitors).

We now focus on the daily visits, first considering all the municipalities within the biosphere reserve, followed by those within the park. It's important to note that the park's municipalities are a subset of those in the biosphere reserve.

7.6.1 Spatiotemporal Analysis of Tourist and Same-Day Visitor Flows in the Julian Prealps Area - Biosphere Reserve (January–December 2024)

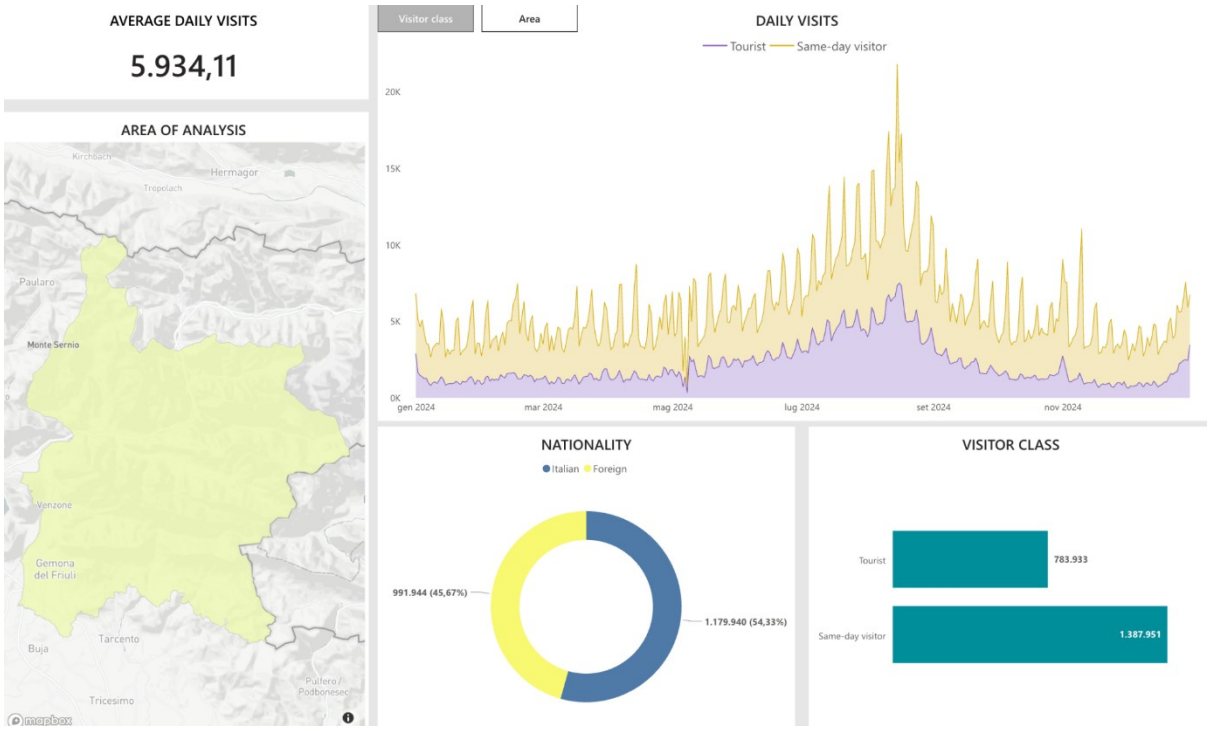


Figure 155 - Spatiotemporal analysis of tourist and same-day visitor flows in the Julian Prealps Area.

The Vodafone mobility data provides a comprehensive view of tourist dynamics within the project area from January to December 2024. This area represents the 11 municipalities covered by the Biosphere Reserve. This analysis focuses exclusively on tourists and same-day visitors, offering valuable insights into visitation patterns, nationalities, and user classifications across the entire year. The average number of daily visits to the area stands at 5934, reflecting steady interest throughout the year. The time-series graph shows distinct seasonality in visitor flows. From January through early May, the area experiences moderate daily visitation, fluctuating between 2,000 and 4,000 individuals. A sharp increase is observed starting in late May, peaking in August and early September with daily counts exceeding 20,000, which corresponds with the summer holiday season and likely school vacations. After this peak, a gradual decline follows, stabilizing again at lower levels during the autumn and early winter months. The data classifies visitors into two groups: tourists (those who stay overnight) and same-day visitors. The majority of the recorded visits fall under the latter, with 1387,951 same-day visitors, compared to 783,933 tourists. This significant disparity suggests that the area primarily attracts short-term visitors, possibly due to its accessibility, the availability of day-trip opportunities. The nationality breakdown reveals that 54.33% of the visitors are Italian (1.179.940 visits), while 45.67% are foreign (991,994 visits). This indicates a strong domestic appeal of the region, with local tourism playing a dominant role. However, the presence of a substantial share of foreign visitors also highlights the area's international attractiveness.

7.6.2 Spatiotemporal Analysis of Tourist and Same-Day Visitor Flows in the Municipalities of the Julian Prealps Area (January–December 2024)

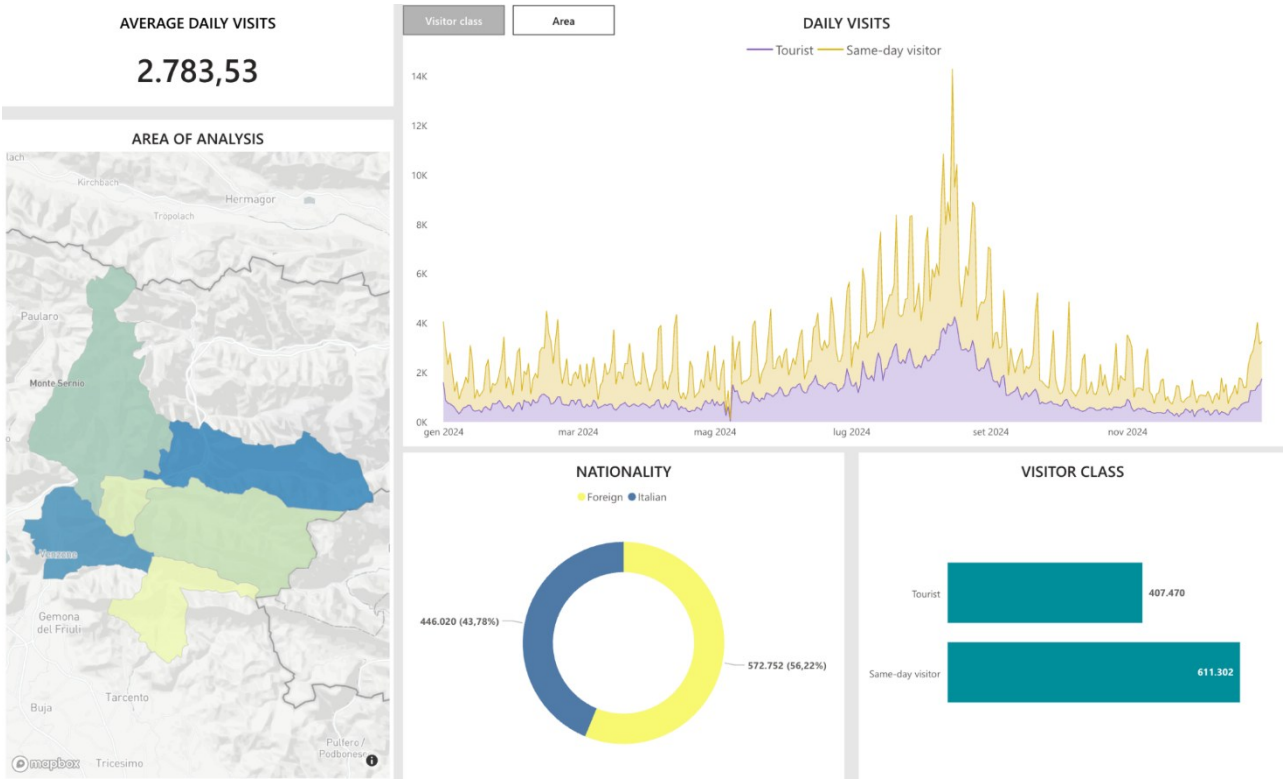


Figure 156 - Spatiotemporal analysis of tourist and same-day visitor flows.

This image represents tourism data exclusively for the municipalities within the Nature Park (Venzone, Moggio Udinese, Resiutta, Resia, Chiusaforte, and Lusevera). The average daily visits amount to 2.783,53, with a notable majority of visitors being same-day visitors (611,302) compared to tourists (407,470). In terms of nationality, the distribution is relatively balanced but slightly skewed toward foraging visitors (56,22%) over Italians (43,78%). The line chart illustrates seasonal trends in 2024, with a visible peak during the summer months, especially around August, aligning with typical tourism patterns. This peak shows heightened same-day visits, while tourist numbers also increase but remain consistently lower.

Compared to the previous image, which includes the 11 municipalities of the biosphere reserve, we can observe a consistent pattern in both the nationalities of the visitors and the timing of their visits, with a clear peak during the summer months in both cases.

Below is the distribution of visits across all the municipalities in the park.

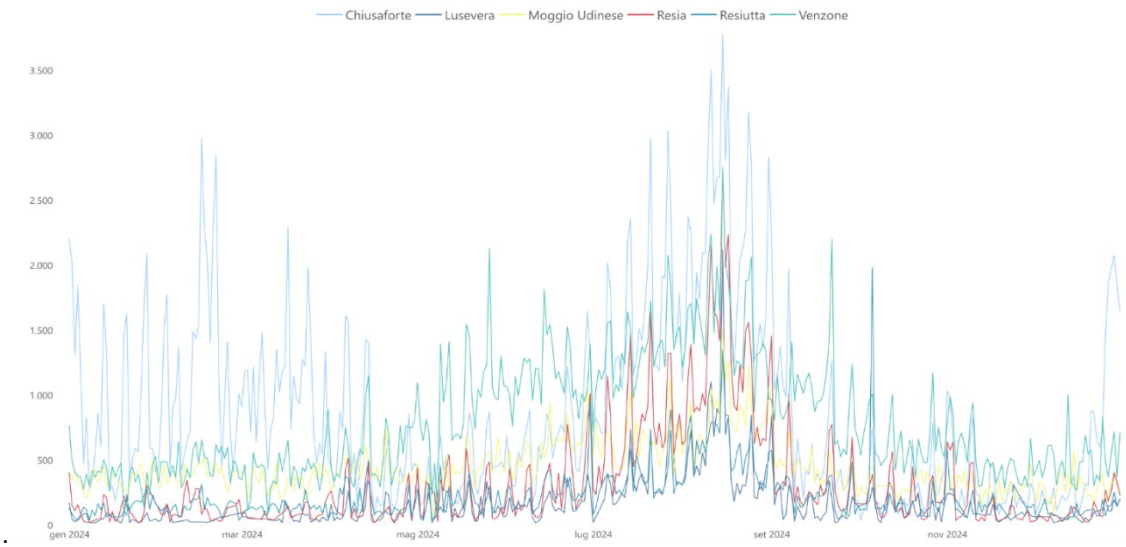


Figure 157 - Distribution of visits across all the municipalities in the park.

Now we focus on the most relevant municipalities, trying to have a deeper understanding of the tourist flow:

Artegna

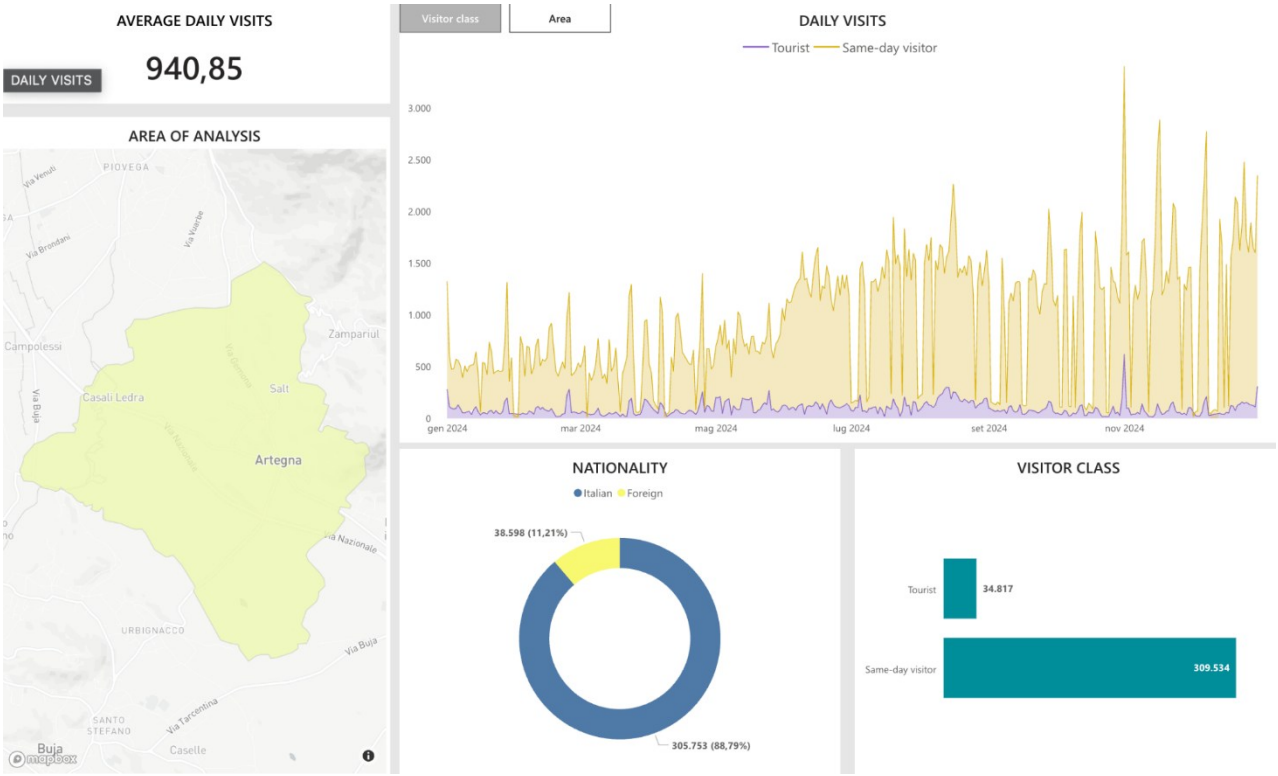


Figure 158 - Deeper understanding of the tourist flow.

The municipality of Artegna recorded a modest average of 940.85 daily visits in 2024, with an overwhelming majority being same-day visitors (309.534) compared to just 34.817tourists. Visitation peaked in summer, autumn and early winter following a seasonal trend. The population of visitors is predominantly Italian (88.79%), with foreigners representing only 11.21%, highlighting a highly local visitor base. The peak in November could be due to the 'Purcit in Staiare' event held in the municipality on weekends (15-16-17 and 22-23-24 November 2024).

Chiusaforte

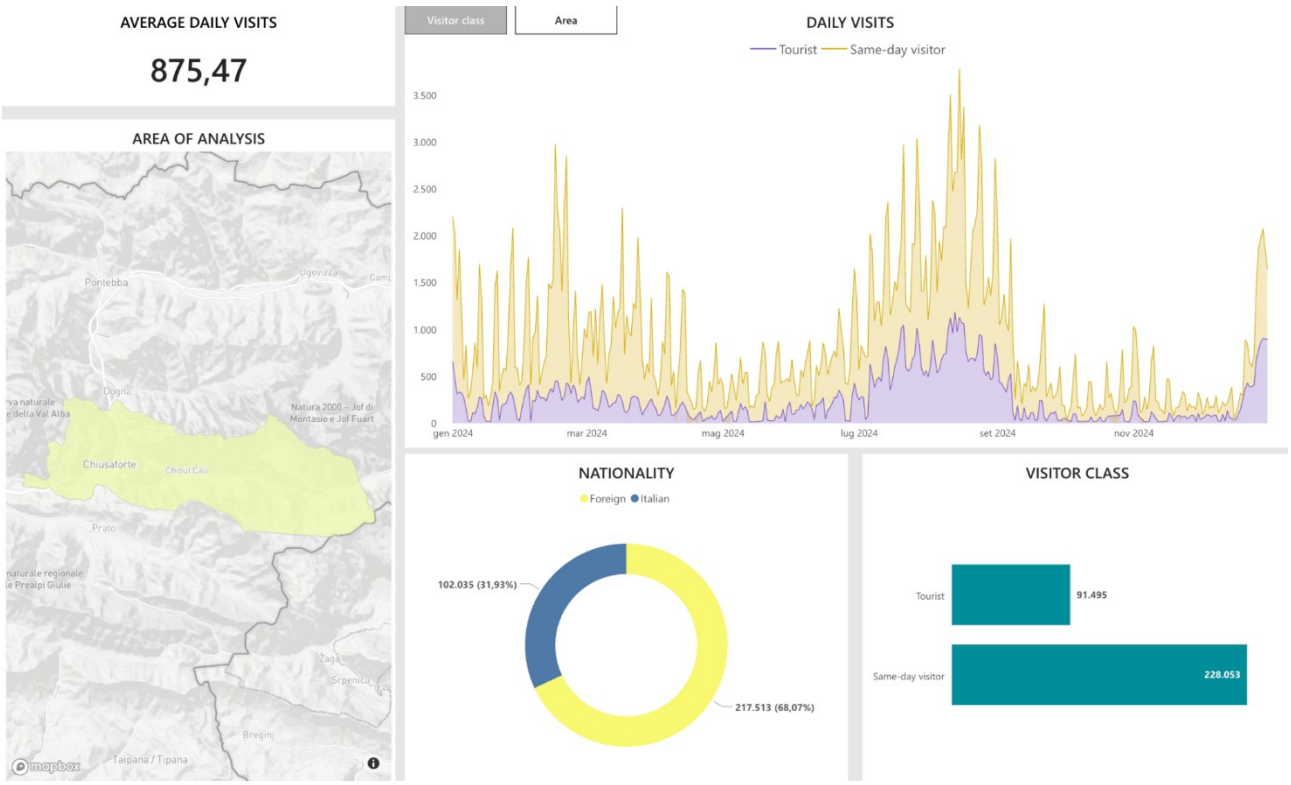


Figure 159 - Deeper understanding of the tourist flow.

The municipality of Chiusaforte recorded an average of 875.47 daily visits in 2024, with the vast majority being same-day visitors (228.053) and a smaller portion as tourists (91.495). Visitation peaked during the summer, particularly in August, and during the winter months. The majority of visitors were foreign (68.07%), while Italians made up 31.93%. The winter peak is due to the presence of the Sella Nevea ski resort, which is located in the municipality. The high summer numbers are due to both visitors to the local mountains and cyclists using the Alpe Adria cycle route.

Dogna

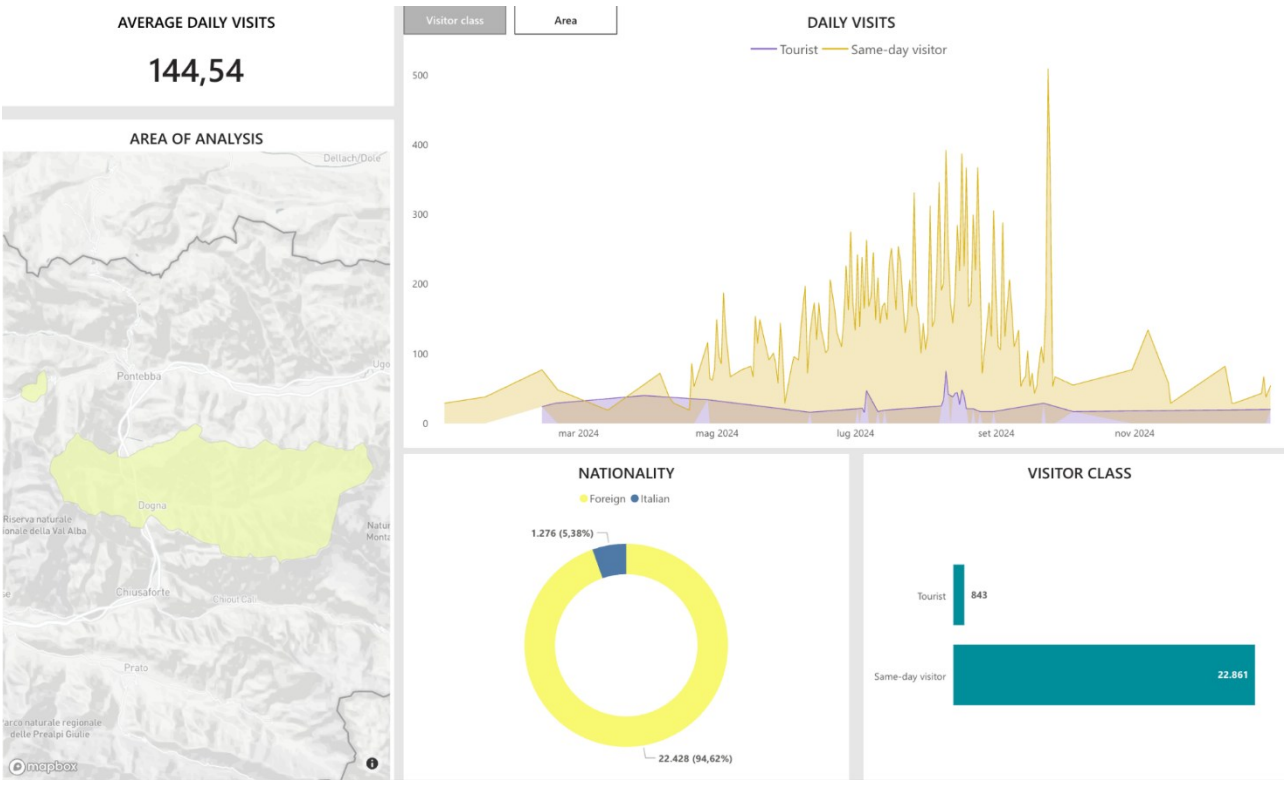


Figure 160 - Deeper understanding of the tourist flow.

The municipality of Dogna saw very low visitation in 2024, with an average of just 144.54 daily visits. The vast majority were same-day visitors (22,861) compared to only 843 tourists. Peaks occurred occasionally in late summer and early autumn. The visitor base was overwhelmingly foreign (94.62%), with Italians accounting for only 5.38%. Once again, the high number of foreign visitors can be attributed to the Alpe Adria cycle route.

Gemona del Friuli

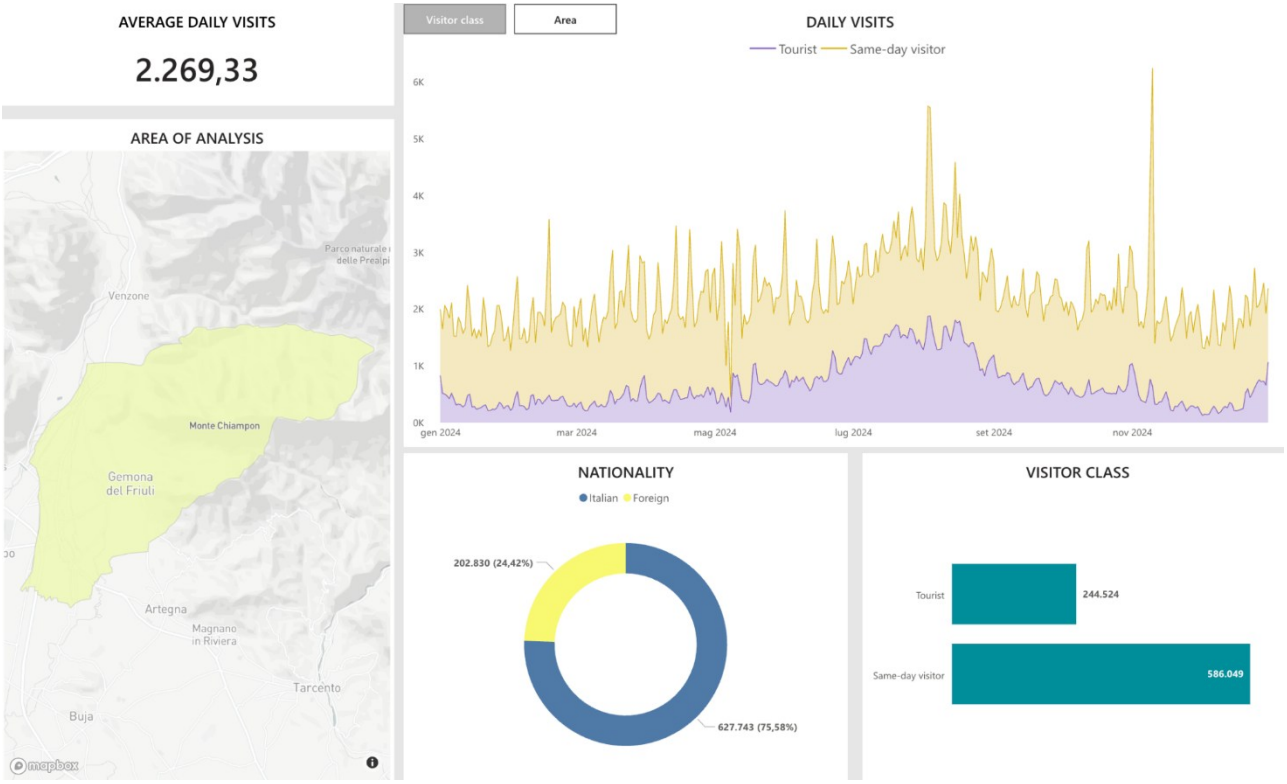


Figure 161 - Deeper understanding of the tourist flow.

The municipality of Gemona del Friuli recorded a solid average of 2.269,33 daily visits in 2024, with a strong majority of same-day visitors (586.049) and a smaller portion of tourists (244,524). Visitation was consistent throughout the year with peaks during the summer and early fall. The visitor base was predominantly Italian (75.58%), while foreigners made up only 24.42%, indicating strong domestic interest with limited international inflow. The peak in November can be attributed to the 'Cheese Festival' event held from the 8th to the 10th of that month.

Lusevera

The municipality of Lusevera experienced low visitation in 2024, with an average of 185.92 daily visits, mostly from Italian same-day visitors, indicating limited tourist attraction and minimal foreign presence.

Moggio Udinese

The municipality of Moggio Udinese had an average of 447.26 daily visits in 2024, with the majority being tourists (92.498) and same-day visitors (70.752). The visitor flow peaked in the summer months, and the nationality split was also relatively even, with foreign making up 60.91% and Italians 39.09%, reflecting a strong appeal to both local and international visitors.

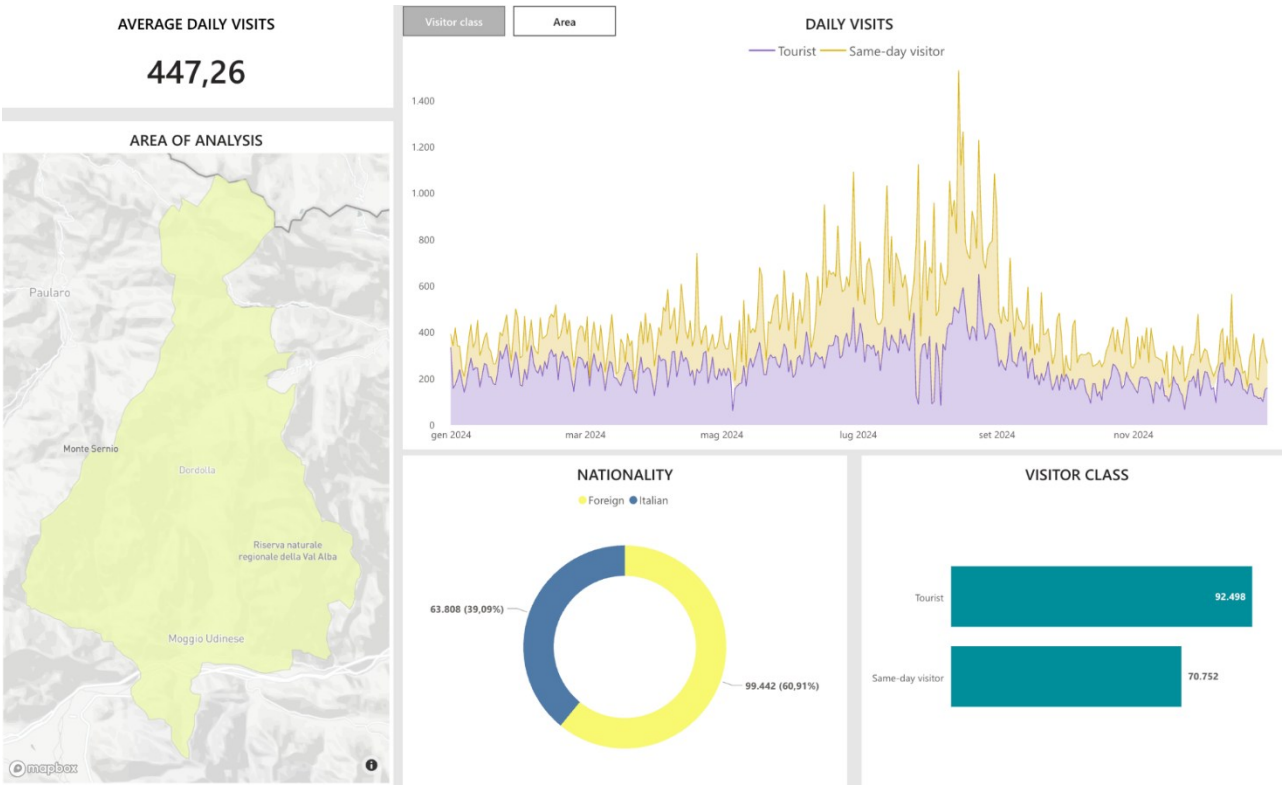


Figure 162 - Deeper understanding of the tourist flow.

Montenars

The municipality of Montenars had very low visitation in 2024, with an average of 72.30 daily visits, almost entirely made up of same-day visitors (15.780) and only 121o tourists. The visitor profile was predominantly Italian (88.42%), with foreigners accounting for just 11.58%, and peaks were sporadic, mainly during the late summer and early autumn.

Resia

The municipality of Resia saw a moderate average of 345.01 daily visits in 2024, largely composed of same-day visitors (69.195), with tourists totaling 41.899. Visits peaked notably in summer, particularly in August. The majority of visitors were Italian (56.85%), while foreigners made up 43.15%.

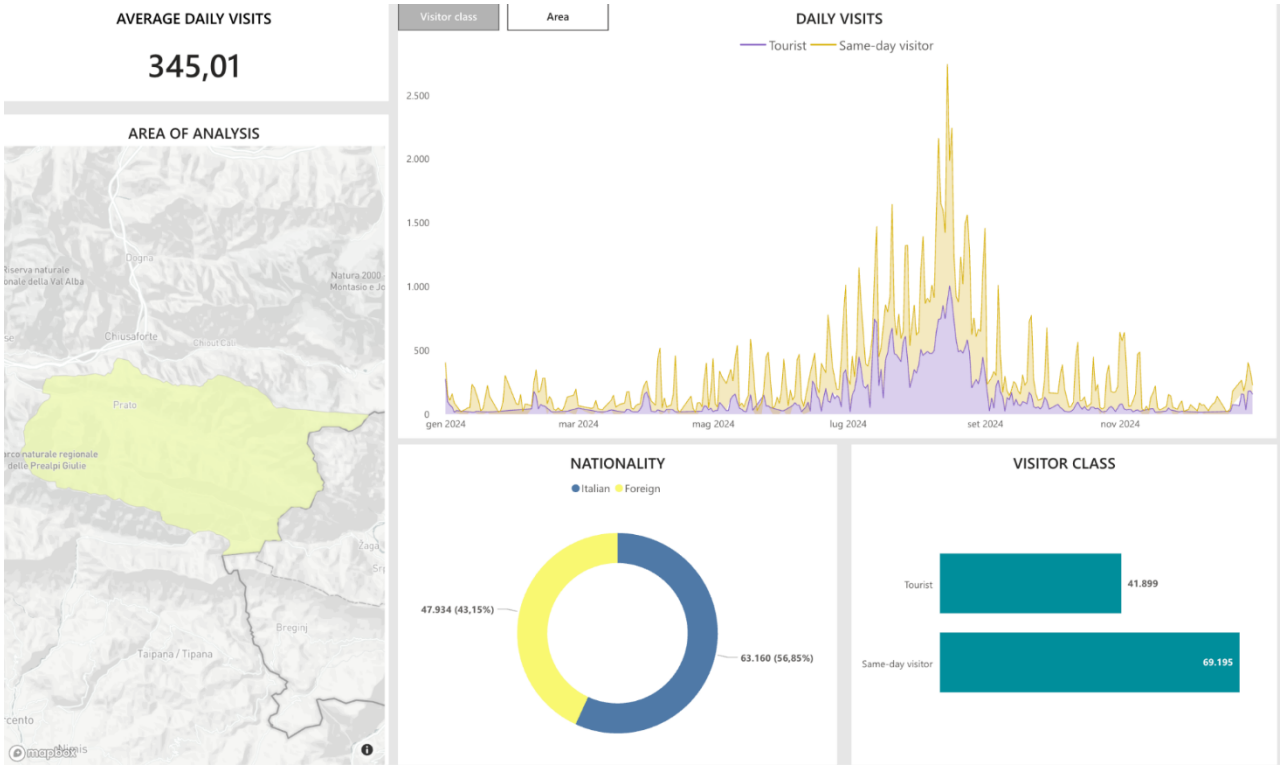


Figure 163 - Deeper understanding of the tourist flow.

Resiutta

The municipality of Resiutta registered an average of 229.28 daily visits in 2024, with slightly more same-day visitors (40.246) than tourists (38.855). The nationality split was nearly even, with Italians at 47.48% and foreigners at 52.52%, highlighting a balanced domestic and international appeal. Visitation peaked in summer, particularly around August.

Taipana

The municipality of Taipana recorded an average of 189.55 daily visits in 2024, primarily consisting of same-day visitors (31.478) compared to 28.800 tourists. The visitor base was mostly Italian (55,25%), with foreigners representing 44.75%. Peaks occurred mainly in summer, with relatively low but steady visitation throughout the year.

Venzone

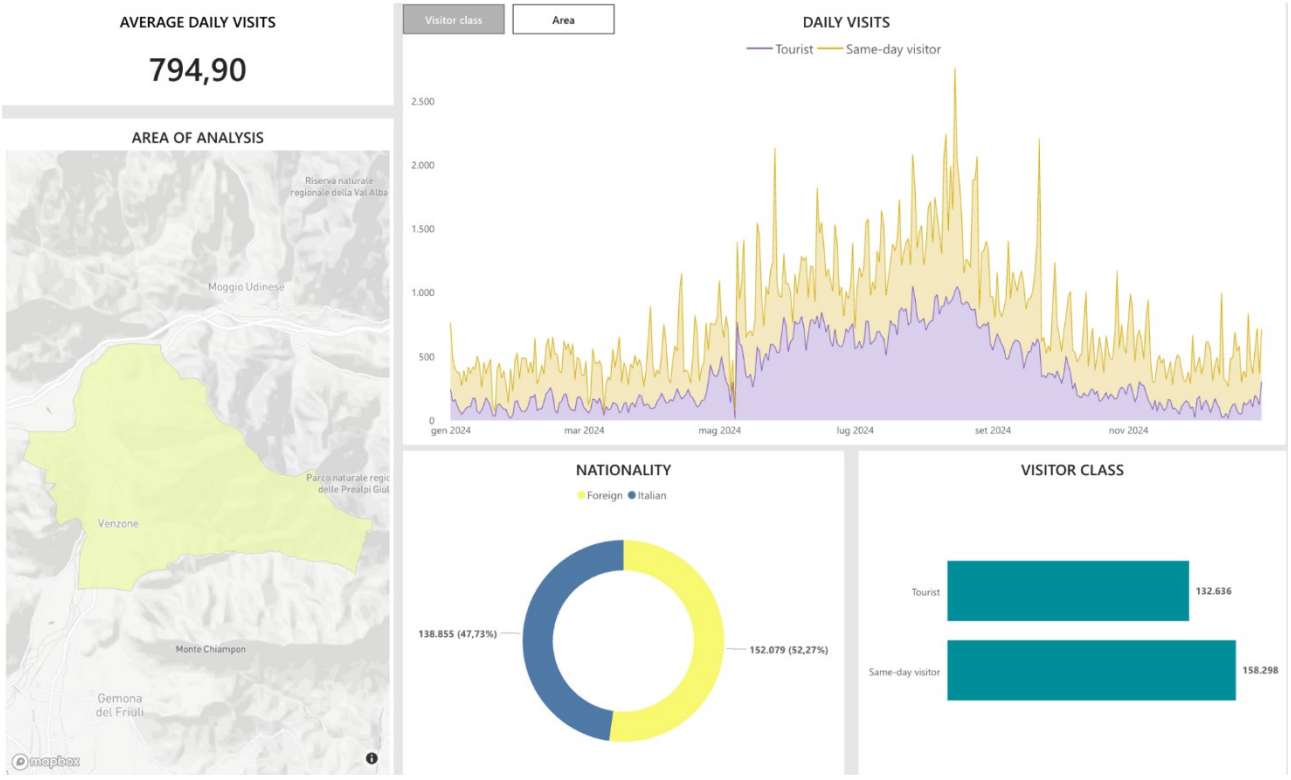


Figure 164 - Deeper understanding of the tourist flow.

The municipality of Venzone recorded an average of 794.90 daily visits in 2024, with a higher number of same-day visitors (158.298) compared to tourists (132.636). The peak period occurred during the summer months, with steady visitation year-round. The majority of visitors were foreign (52.27%), while Italians represented 47.73%. Venzone is a popular tourist destination and one of the main stops for those travelling along the Alpe Adria Cycle Route.

7.6.3 Spatiotemporal Dynamics of Tourist and Same-Day Visitor Flows in Val Resia

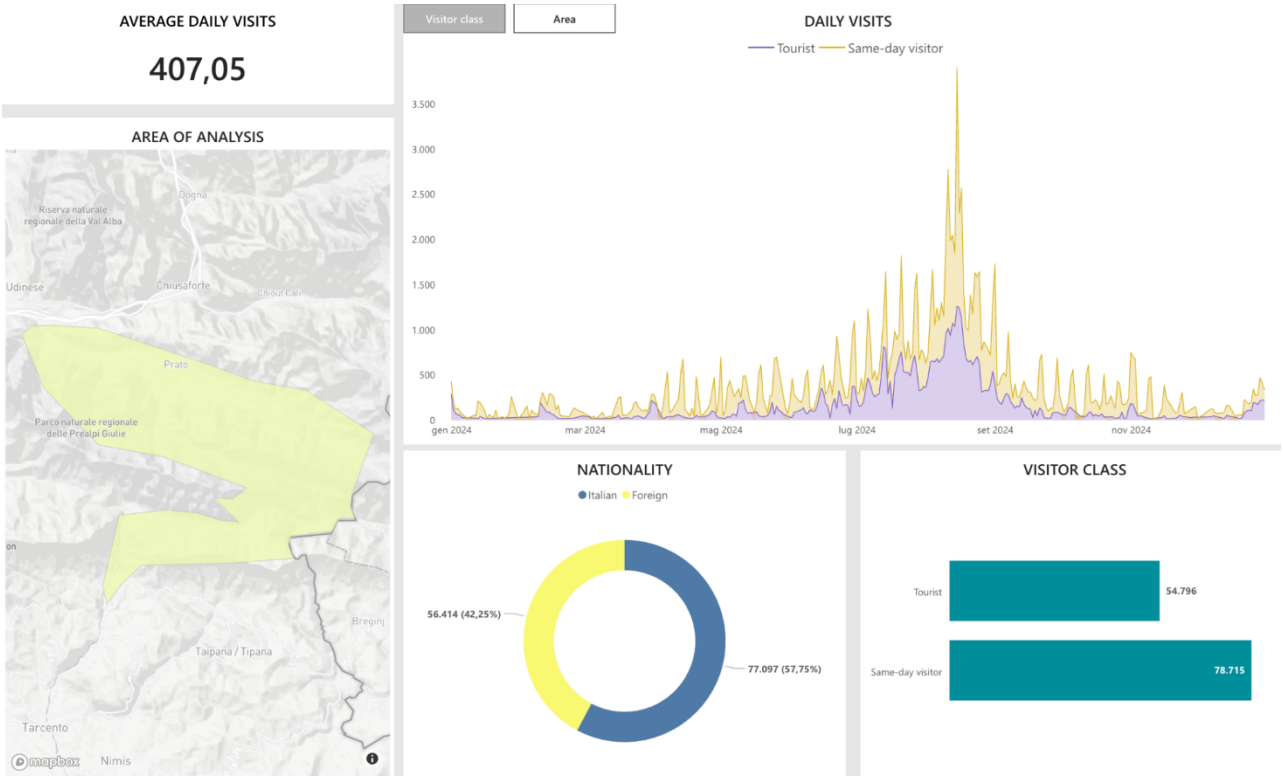


Figure 165 - Deeper understanding of the tourist flow.

The data derived from Vodafone mobile tracking provides a detailed picture of visitation patterns in Val Resia throughout 2024. The average number of daily visits is relatively modest at 407.05. The temporal graph of daily visits shows that same-day visitors consistently outnumber tourists, with sharp peaks during the summer months, particularly July and August, indicating strong seasonal concentration, likely tied to natural attractions, festivals, or events. The highest spike occurs in August, coinciding with traditional vacation periods in Italy and neighboring countries. In terms of visitor typology, same-day visitors are the majority, accounting for 78.715 visits, compared to 54.796 tourist visits. Regarding nationality, Italians represent 57.75 % of visitors, while foreign visitors constitute 42.25%. This distribution reflects a strong domestic appeal, though the foreign segment remains significant. Overall, the data illustrates that Val Resia serves primarily as a day-visit destination with strong appeal during the warmer months. While international presence is not negligible, the valley predominantly attracts Italian visitors.

7.6.4 Spatiotemporal Dynamics of Tourist and Same-Day Visitor Flows in Sella Nevea

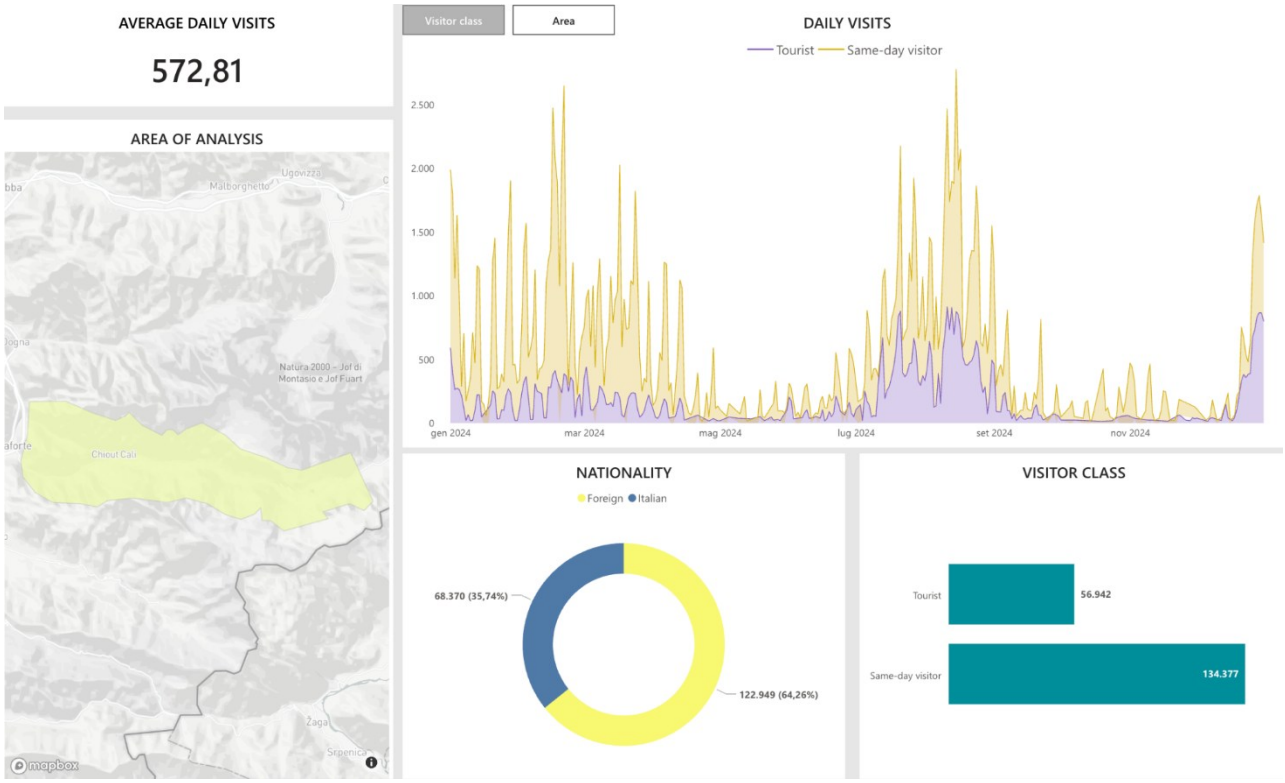


Figure 166 - Deeper understanding of the tourist flow.

The mobility data provided by Vodafone for 2024 reveals significant insights into the spatial and temporal patterns of visitation in Sella Nevea Valley, also known as a destination for winter sports. The average daily visits stand at 572.81. The daily visits trend exhibits pronounced peaks during the winter months, especially in January, February, and again toward the end of December, strongly suggesting that Sella Nevea's ski facilities and winter tourism infrastructure are key drivers of visitor traffic. A second cluster of activity is visible during summer months (July to September), which may reflect interest in hiking and alpine experiences outside the ski season. The visitor class distribution shows a strong skew toward same-day visitors, who represent 134.377 of the recorded visits, compared to 56.942 tourists staying overnight. With regard to nationality, the data reveals that Italians make up 35.74% of the visitors, while foreign nationals account for 64.26%. This substantial international presence likely reflects the transboundary nature of the Julian Alps and the valley's reputation within the broader Alpine tourism circuit, attracting visitors from Austria, Slovenia, and beyond. In conclusion, the Sella Nevea Valley demonstrates a clear dual-season tourism model, anchored in winter sports but sustained in summer by nature-based recreation.

Now we're going to compare, based on the nationality (italians and foreigners), the difference between tourist and same-day visitors, in all the municipalities of the reserve.

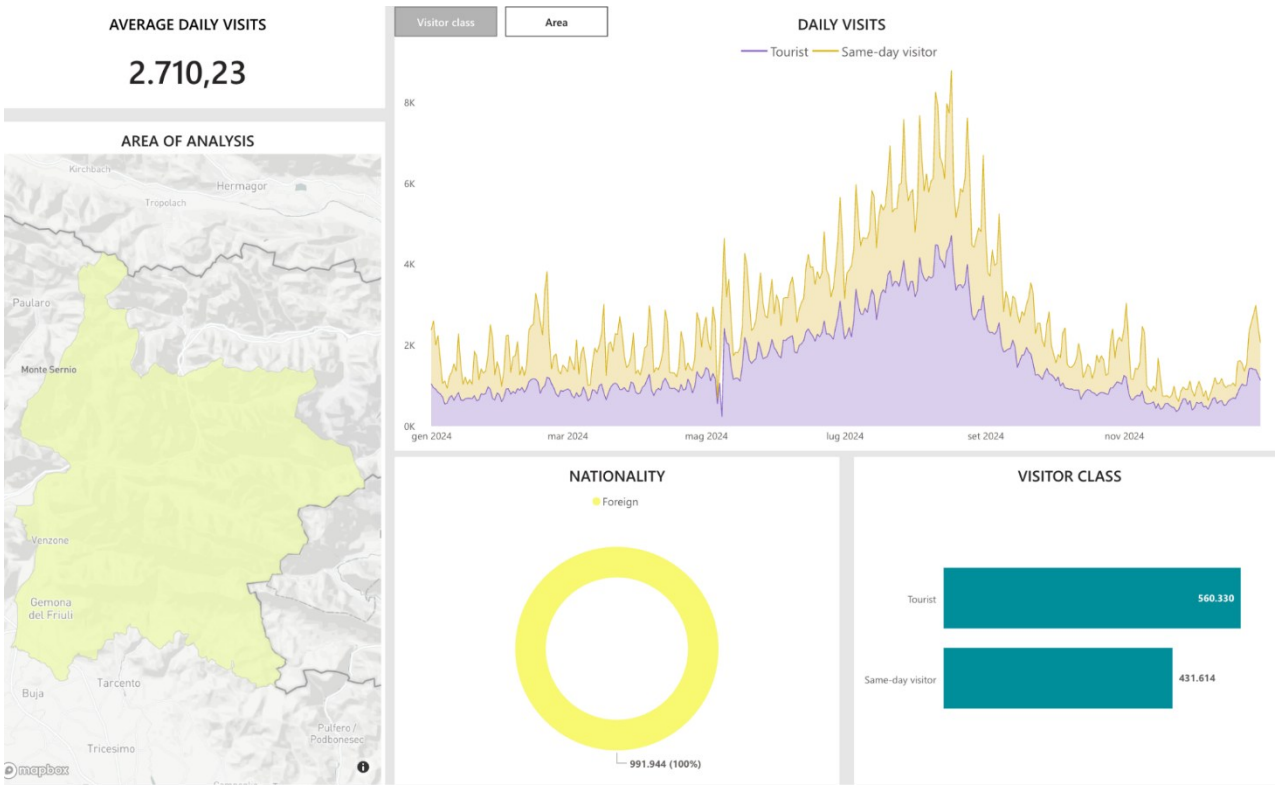


Figure 167 - Deeper understanding of the tourist flow.

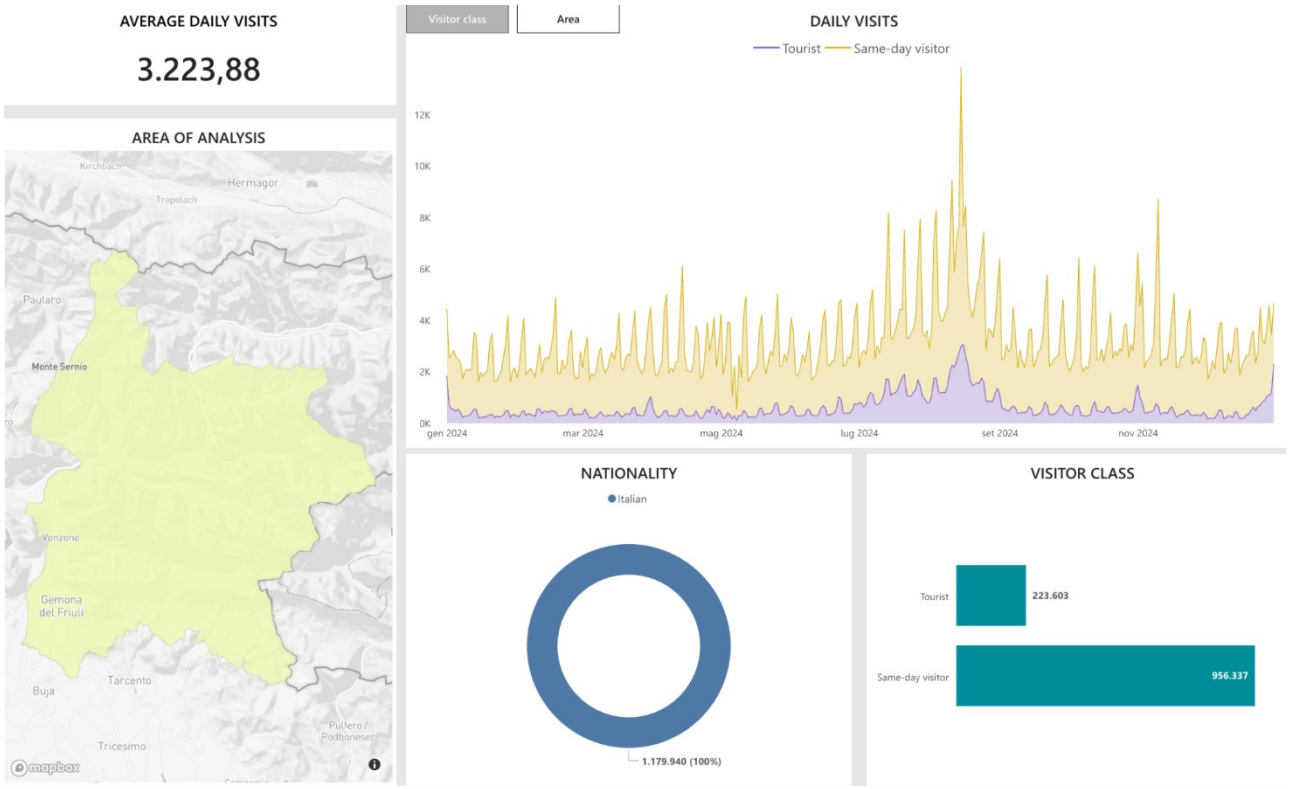


Figure 168 - Deeper understanding of the tourist flow.

The two images compare tourist and same-day visitor data by nationality within the same area, distinguishing between foreigners (yellow) and Italians (blue). Foreign visitors averaged 2710.23 daily visits in 2024, with a relatively balanced

distribution between tourists (560.330) and same-day visitors (431.614), indicating a stronger tendency to stay overnight. In contrast, Italians contributed to a significantly higher average of 3,223.88 daily visits, with the majority being same-day visitors (956.337) and fewer tourists (223.603), highlighting a preference for short visits. Both groups followed similar seasonal peaks, particularly in summer, but Italians drove overall volume through frequent, shorter visits, while foreigners showed greater engagement with longer stays.

Again, we're going to compare, based on the nationality (italians and foreigners), the difference between tourist and same-day visitors, in all the valleys considered.

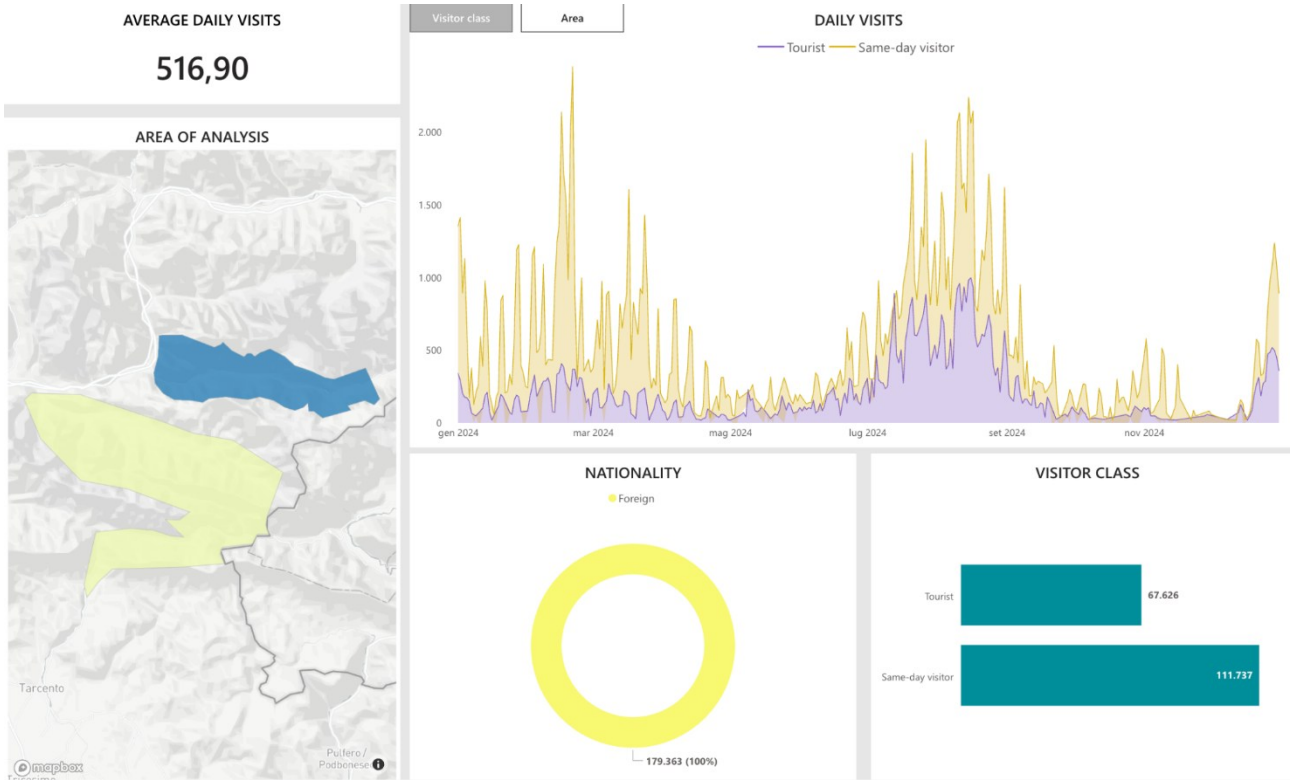


Figure 169 - Deeper understanding of the tourist flow.

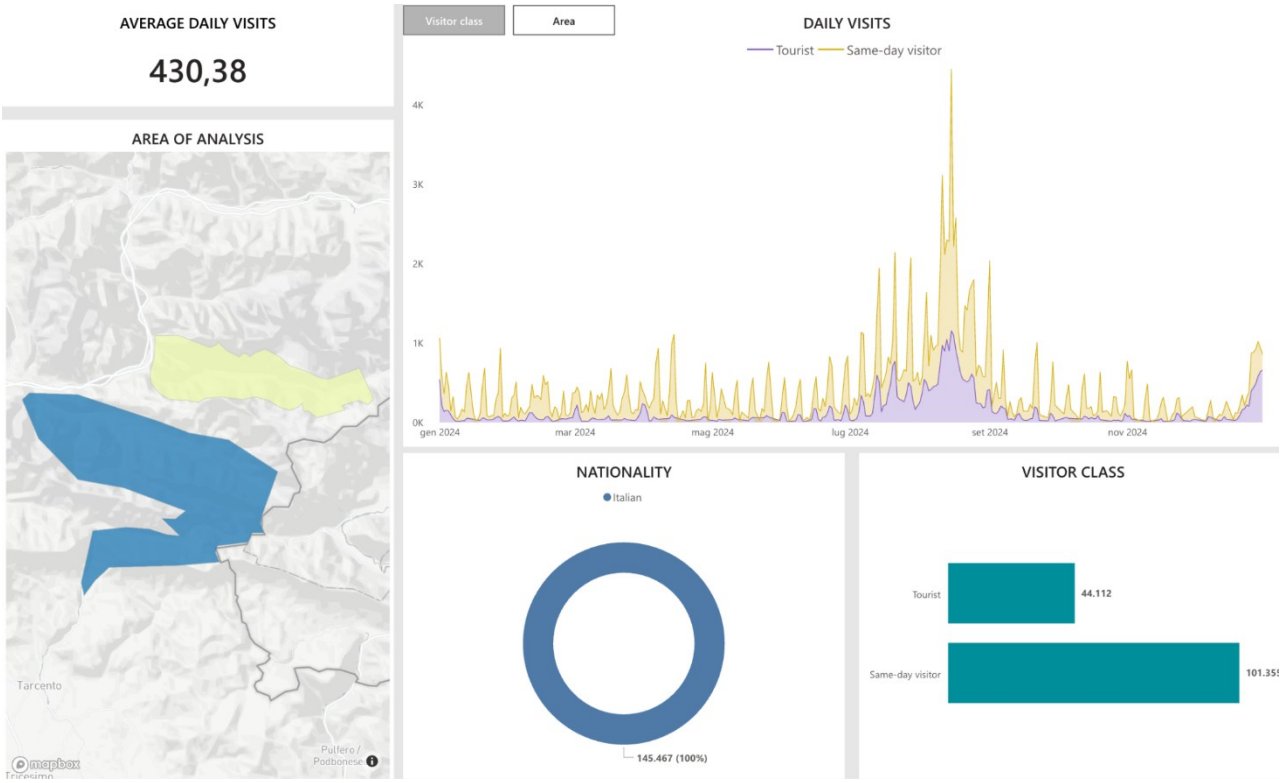


Figure 170 - Deeper understanding of the tourist flow.

The comparison between the two valleys reveals distinct visitor dynamics based on nationality. The Italians average daily visits were 430.38 in the valleys, with the vast majority being same-day visitors (101.355) and a smaller portion of tourists (44.112). In contrast, the foreigners recorded a higher average daily visit count of 516.90, driven by 111,737 same-day visitors and 67.626 tourists. Both visitor types show a predominance of same-day visitors. For the Italians we found a peak during the summer months while for the foreign the distribution is more spread all over the year.

Lastly, regarding the locals we are able to distinguish between inhabitants and habitual visitors. In the following graph we can see the average daily visitors in all the municipalities.

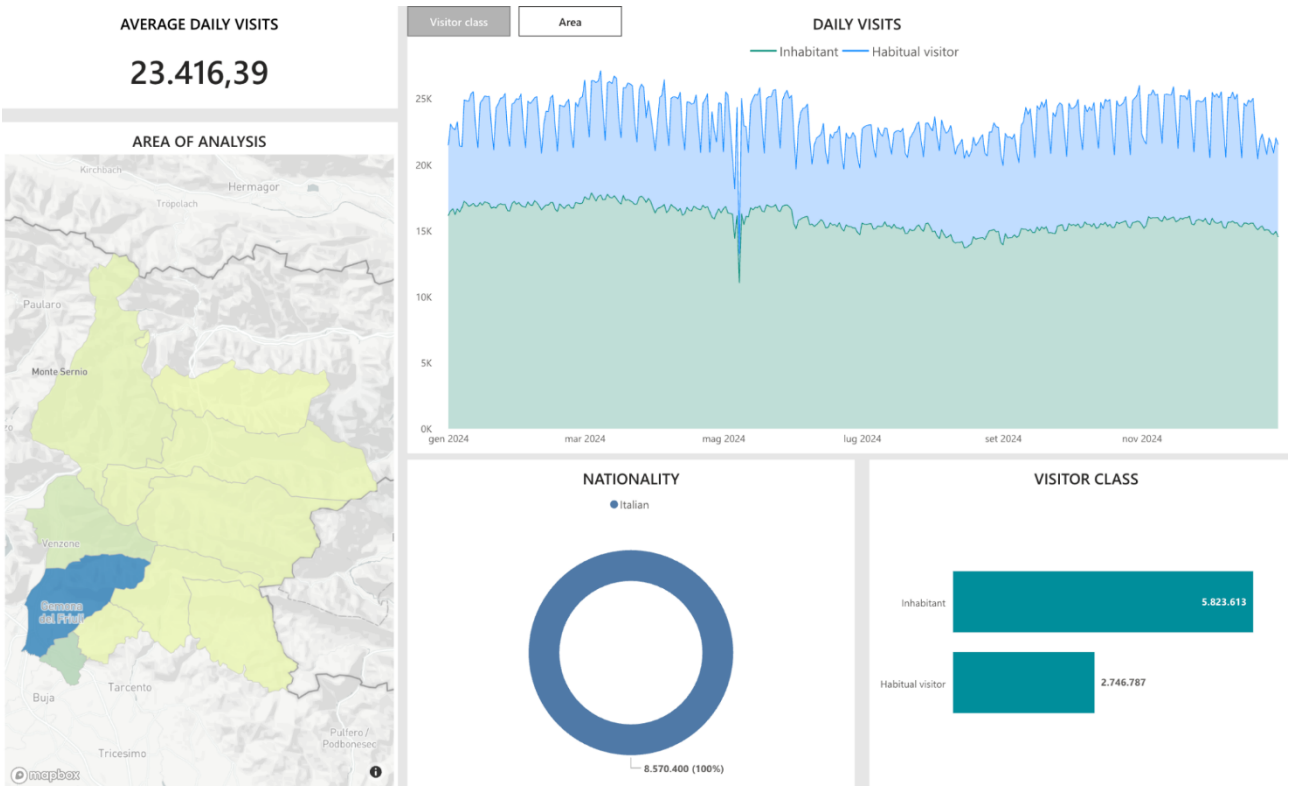


Figure 171 - Deeper understanding of the tourist flow.

This visualization summarizes data from all municipalities in the area, focusing exclusively on inhabitants and habitual visitors. The average daily visits reached 23.416,39, with a total of 5.823,613 visits from inhabitants and 2.746,787 from habitual visitors, all of whom are Italian nationals. The daily visit trend remains consistently high throughout the year, showing a steady base of local engagement with minor seasonal fluctuations. This indicates a strong, regular presence in the area from both residents and returning visitors, underscoring the importance of local dynamics in sustaining activity year-round.

This second part is an analysis that includes the study of unique monthly presences within the perimeter areas, profiling users based on their origin, gender, age group, digital engagement level, and visit frequency.

7.6.5 Catchment Area Dynamics (2024): Monthly Reach and Visitor Composition in the Park's Municipalities

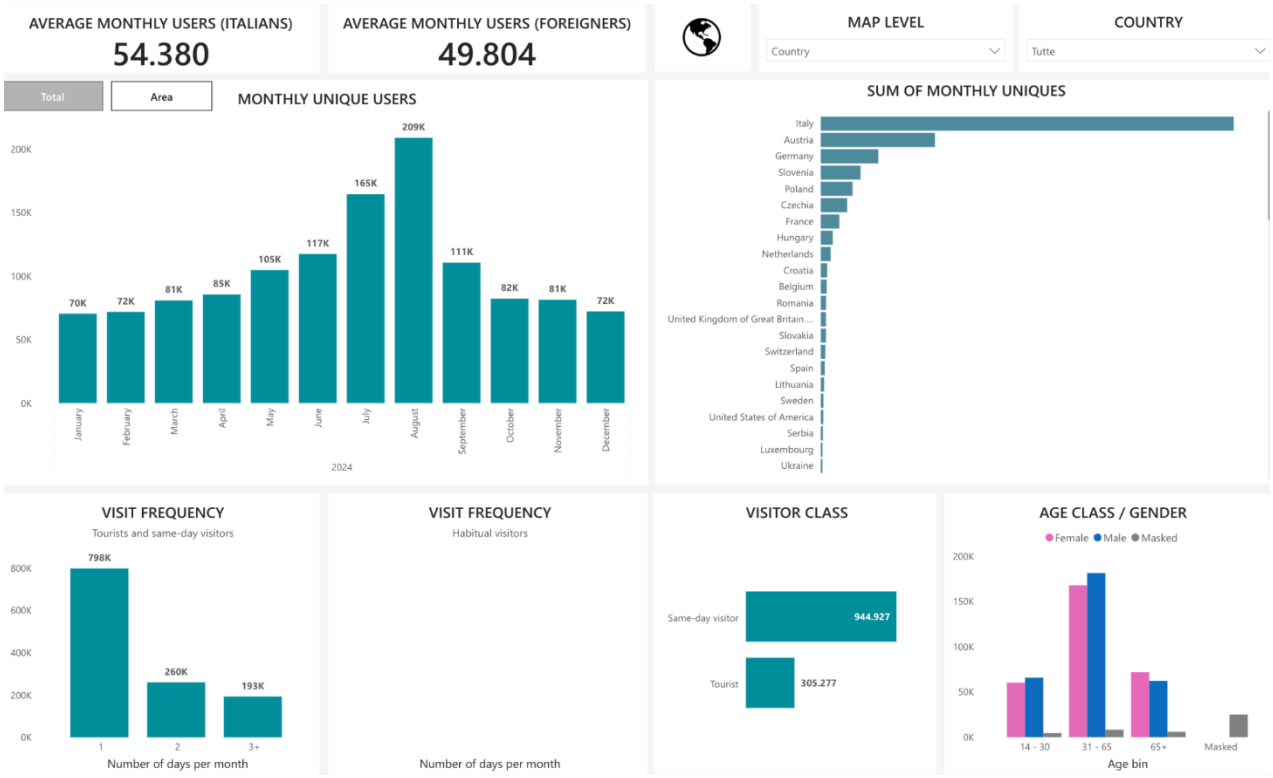


Figure 172 - Catchment area dynamics: monthly reach and visitor composition in the park´s municipalities.

The catchment analysis for the year 2024 provides a comprehensive overview of the monthly unique presence of both tourists and same-day visitors across all the 11 municipalities of the Biosphere Reserve. The data shows an average monthly presence of 54.380 Italian users and 49.804 foreign users, reflecting a solid blend of domestic and international interest throughout the year. The monthly distribution highlights a strong seasonal trend. The visitor flow begins steadily in the first quarter (January to March), ranging from 70K to 81K unique users, and then gradually increases toward summer. The highest peaks are recorded in July (165K) and August (209K), underscoring the summer season as the primary tourism window, followed by a drop in the autumn months (September to December), where the figures stabilize at around 80-90K per month. From a nationality perspective, Italians dominate the inflow, with Italy showing the highest cumulative unique presence, followed by Austria, Germany, and Slovenia. This aligns with geographic proximity and established travel patterns, indicating strong cross-border interest from neighboring countries. Looking at visit frequency, the majority of users (798,000) visit only once per month, revealing a predominance of occasional visitors. A smaller group visits two (260,000) or more (193,000) times per month. The visitor class breakdown reveals a clear majority of same-day visitors (944,927) compared to tourists who stay overnight (305,277). The age and gender distribution further enriches the demographic profile. The largest visitor segment is aged 31–65, followed by 65+ and 14–30, suggesting the park appeals most to working-age and older adults. Males slightly outnumber females in each category.

If we go into detail trying to understand how the variables of age and gender influence our results, we realise that there are no significant differences. In all cases, August remains the month with the most visits and day visitors are always predominant.

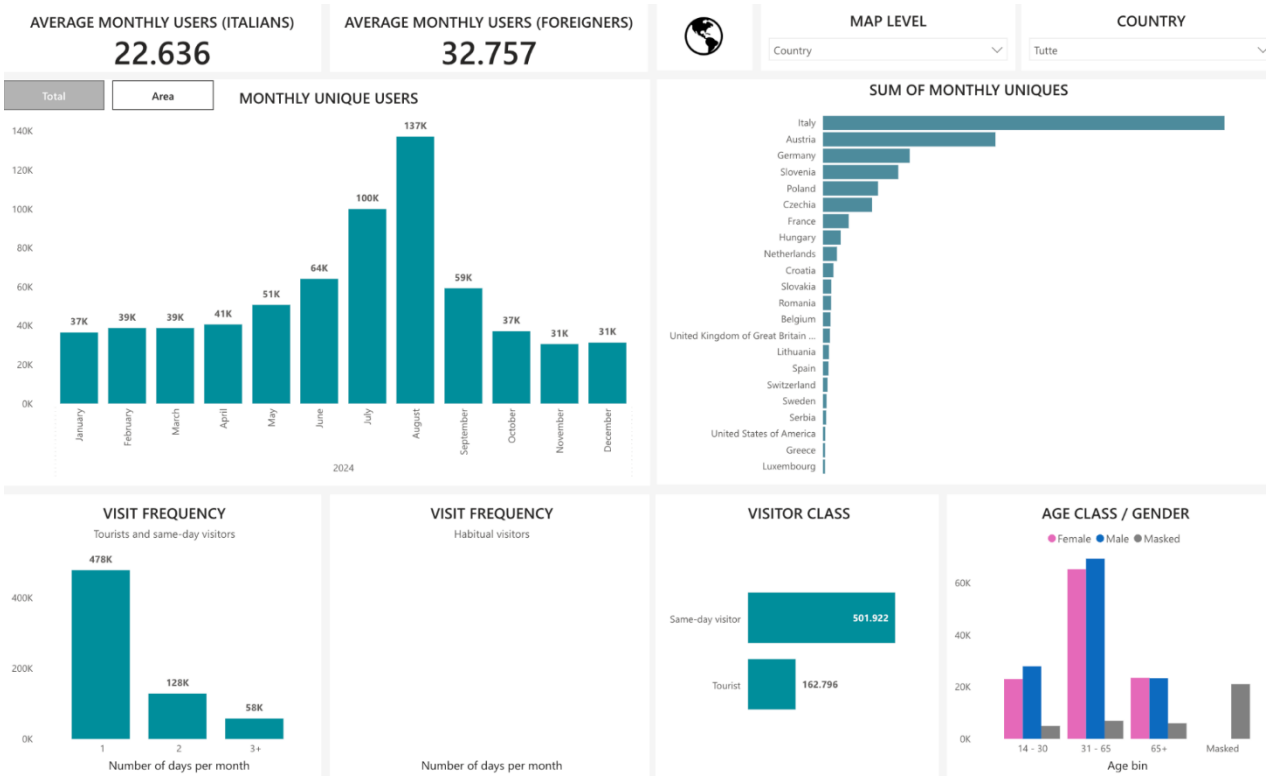


Figure 173 - Catchment area dynamics: monthly reach and visitor composition in the park´s municipalities.

This dashboard presents detailed analytics for the municipalities within the Nature Park (Venzone, Moggio Udinese, Resiutta, Resia, Chiusaforte, Lusevera). The average monthly unique users amount to 22.636 Italians and 32.757 foreigners, showing a slightly higher international interest in these areas. Visitor numbers peak in August (137K) and July (100K), reflecting strong summer tourism. Italy, Austria, and Germany are the top three contributing countries, with Italy leading by a large margin. In terms of visit frequency, the majority of tourists and same-day visitors come only once a month (478K). The visitor class shows a strong dominance of same-day visitors (501.922) compared to tourists (162.796). Regarding age and gender, the largest group is males aged 31–65, closely followed by females in the same age bracket, indicating a strong middle-aged demographic. There is also a noticeable presence of older adults (65+).

Delving deeper into the analysis of individual municipalities yields results consistent with the previous analysis of daily visits, as far as peak influx is concerned. Reason being, we chose to investigate only those municipalities where the percentage of foreign tourists was higher than Italian tourists (Chiusaforte, Dogna, Moggio Udinese, Resiutta) in order to go into more detail about where they came from.

Chiusaforte

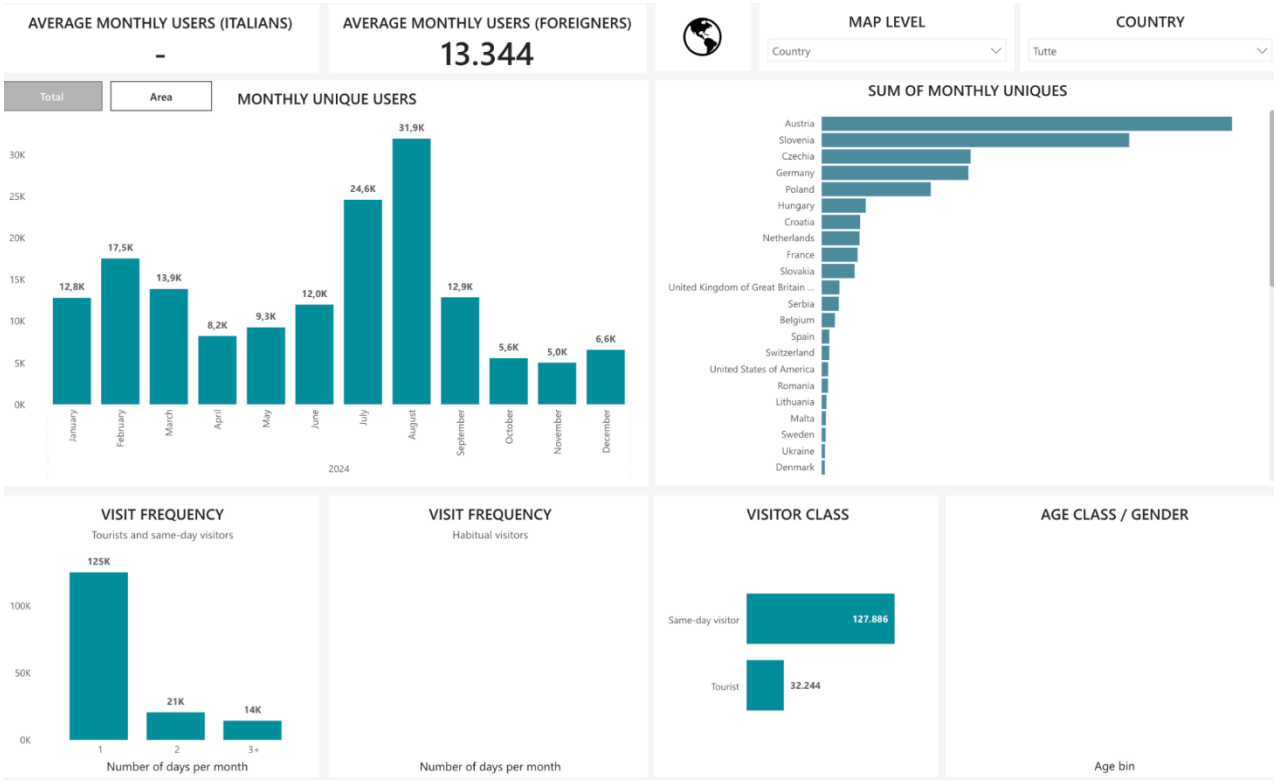


Figure 174 - Catchment area dynamics: monthly reach and visitor composition in the park´s municipalities.

Dogna

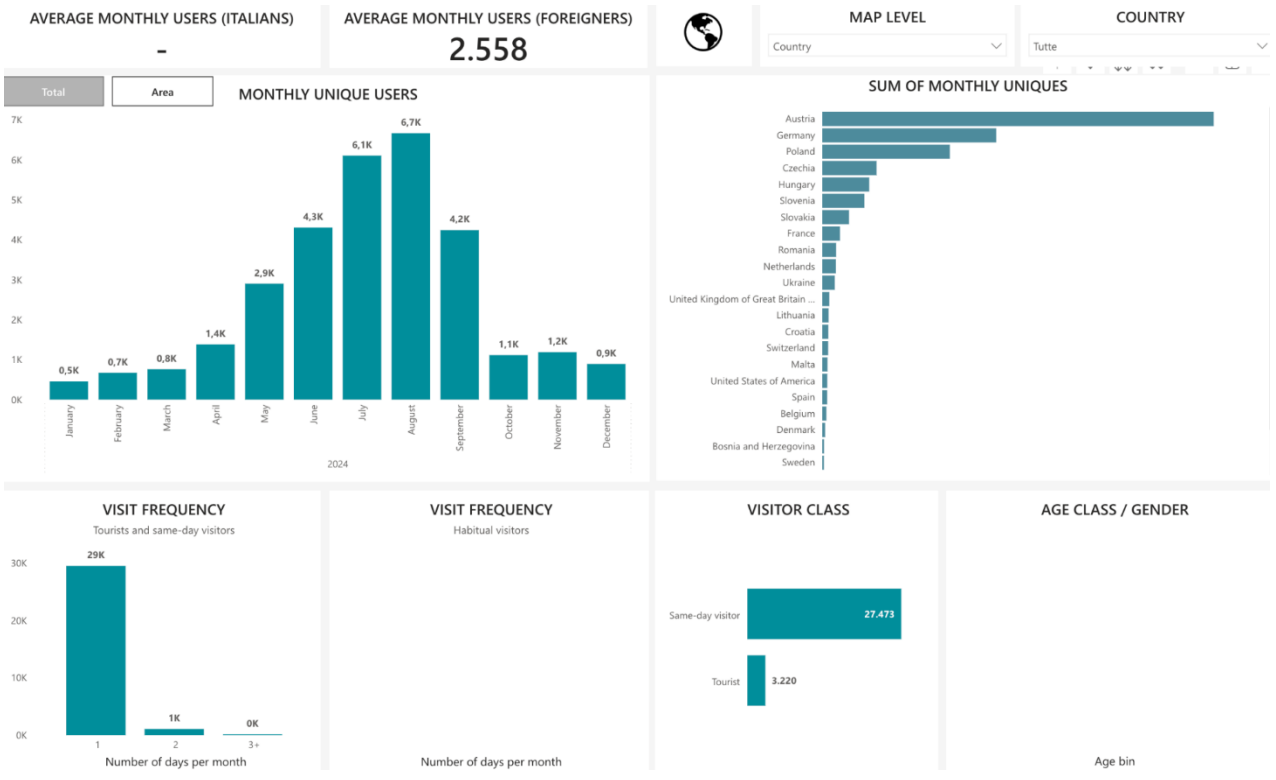


Figure 175 - Catchment area dynamics: monthly reach and visitor composition in the park´s municipalities.

Moggio Udinese

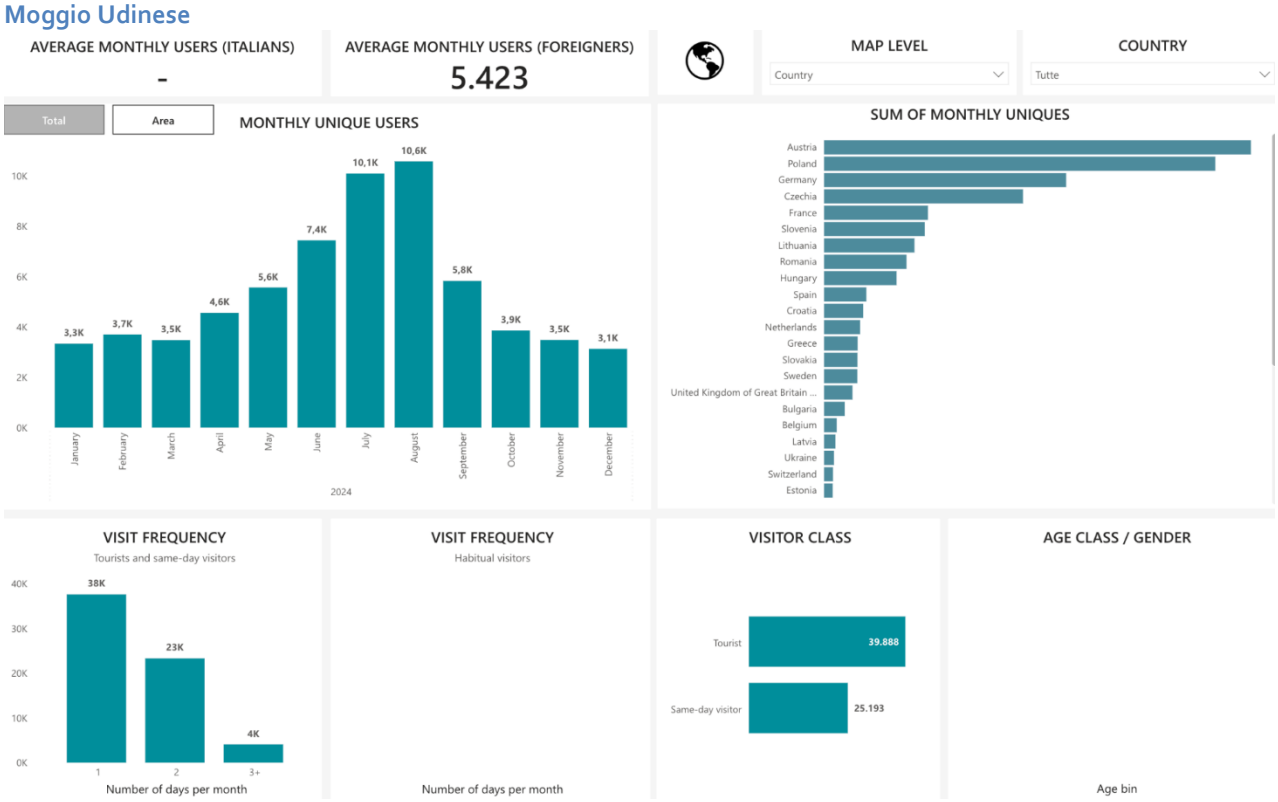


Figure 176 - Catchment area dynamics: monthly reach and visitor composition in the park´s municipalities.

Resiutta

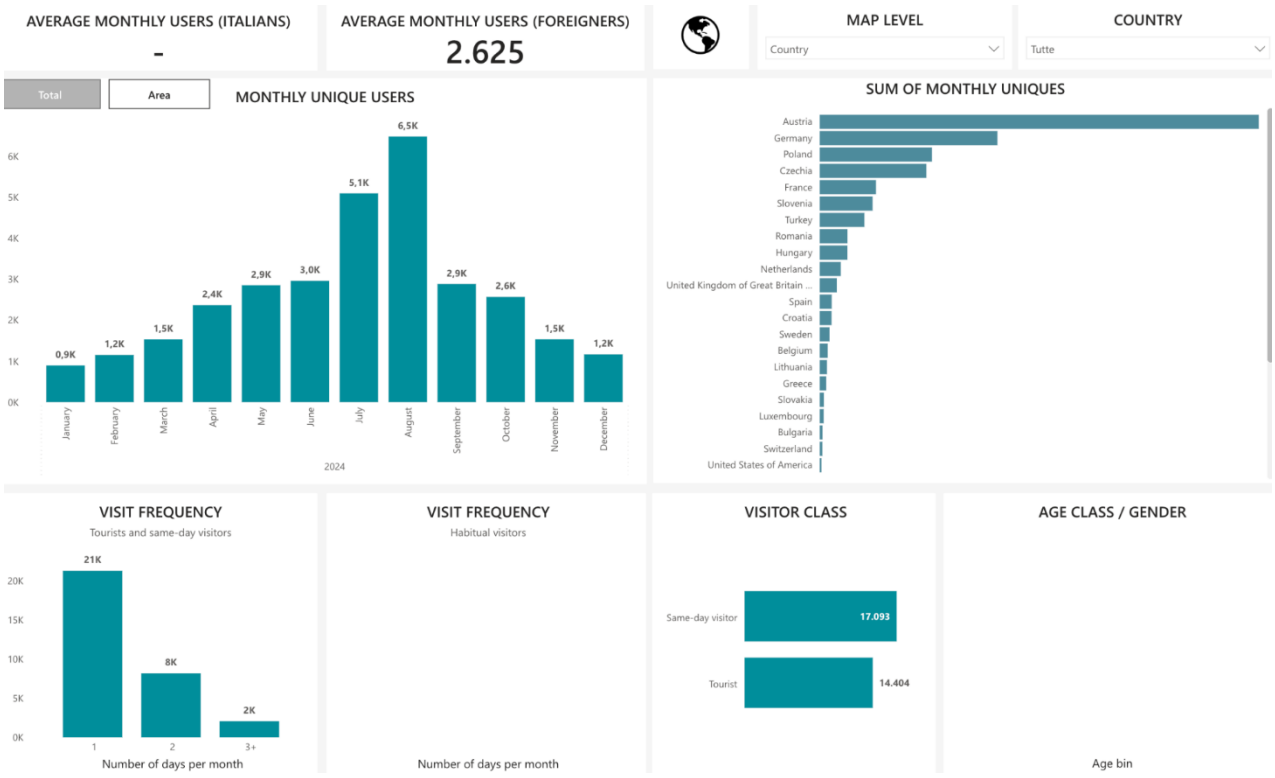


Figure 177 - Catchment area dynamics: monthly reach and visitor composition in the park´s municipalities.

The dashboards present a comparative analysis of four municipalities (Chiusaforte, Dogna, Moggio Udinese, Resiutta) where foreign visitors surpass Italian ones in terms of overall presence. Chiusaforte stands out as the most internationally frequented, with an average of 13,344 monthly foreign users, peaking significantly in August and showing a high share of same-day visitors over tourists. The primary source countries are Austria, Slovenia, and Czechia. Dogna, while much smaller in volume with only 2558 foreign users per month, experiences a concentrated peak in July and August, and shows an overwhelming majority of same-day visits. In Moggio Udinese, foreign activity rises with 5423 average monthly users, a notable increase in tourist stays over same-day visitors, implying it may serve as a base for longer stays. The leading nationalities here are Austrian, Polish and German. Finally, Resiutta reports 2625 monthly foreign visitors, with slightly more same day visitors (17.093) than tourists (14.404), suggesting mixed-use tourism. Austria dominates the origin data here as well, followed by Germany and Poland. Across all four municipalities, the top three countries of origin are consistently Austria, Germany, and Poland, confirming the area's strong connection with Central European tourism, particularly in the summer season.

If we consider only foreign tourists who stayed more than 3 days per month within the reserve municipalities we see how the states of origin change, as shown in the graph below.

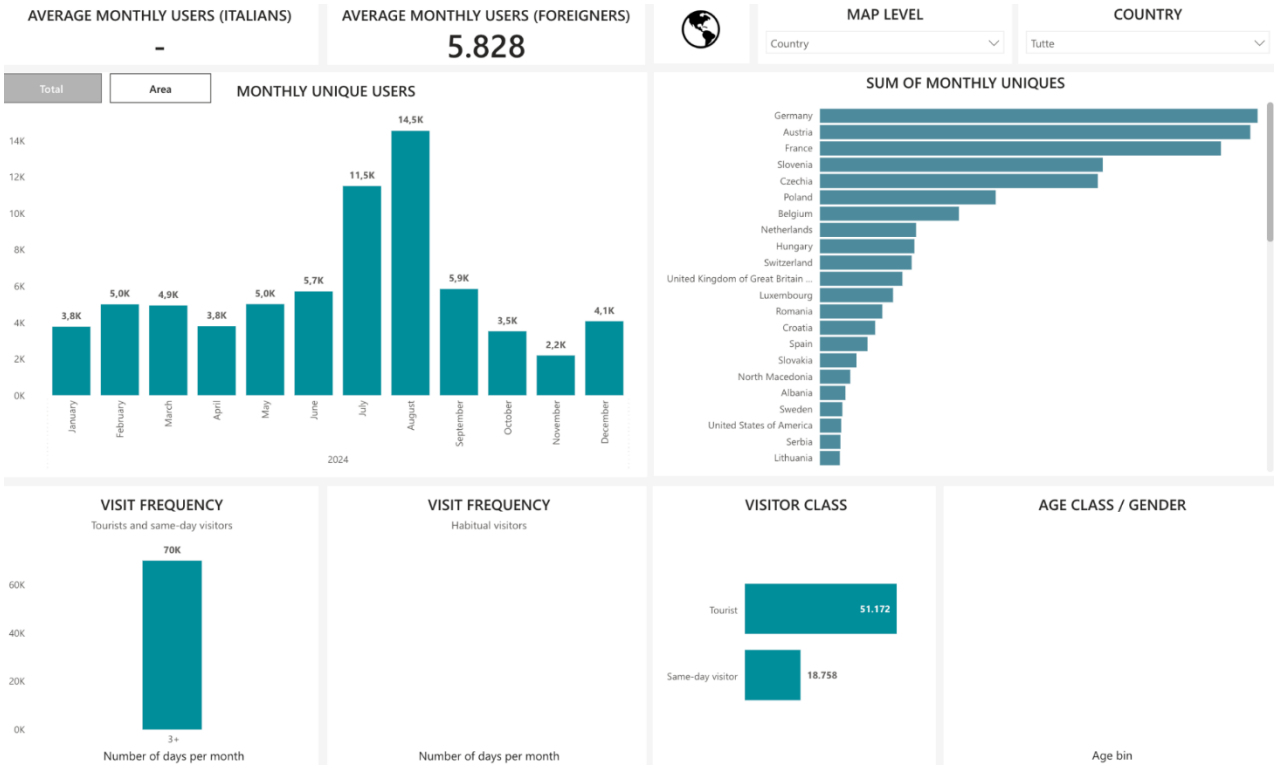


Figure 178 - Catchment area dynamics: monthly reach and visitor composition in the park´s municipalities.

When focusing solely on foreign tourists who stayed more than 3 days per month within the reserve municipalities, the profile of countries of origin shifts. The data shows an average of 5828 monthly foreign users, with a clear summer peak in July (11.5K) and August (14.5K). The majority of visitors fall into the tourist category (51.172) rather than same-day visitors (18.758), aligning with the selection of long-staying individuals. Interestingly, the top countries change compared to broader datasets: Germany now leads in visitor volume, followed by Austria, France and Slovenia.

If we conduct the same analysis from an Italian perspective, focusing on the visitors' regions of origin, we find that they consistently come from Friuli Venezia Giulia, Veneto, and Lombardy, with Lazio and Marche also appearing with some regularity. Below we insert the general table of regions of origin of all Italian visitors within all municipalities of the reserve. We have the same results if we consider only park and valley municipalities.

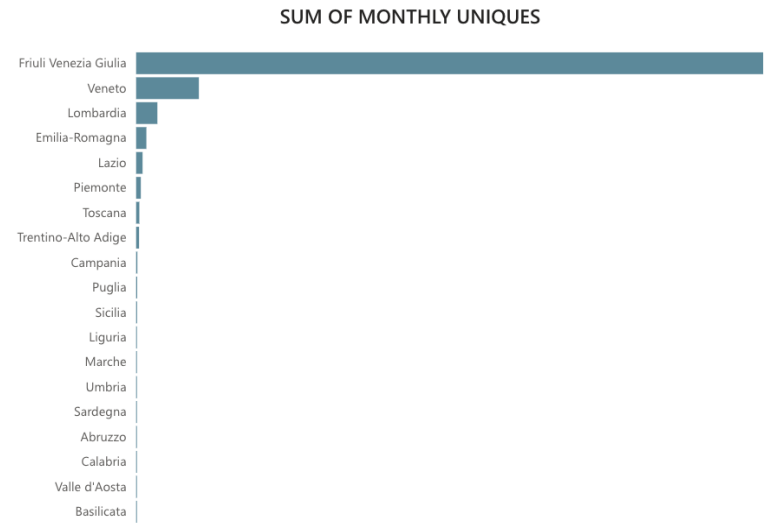


Figure 179 - Visitor region of origin.

The next results concern the catchment areas of the two valleys, Val Resia and Sella Nevea.

7.6.6 Catchment Analysis of Val Resia (2024): Visitor Profiles

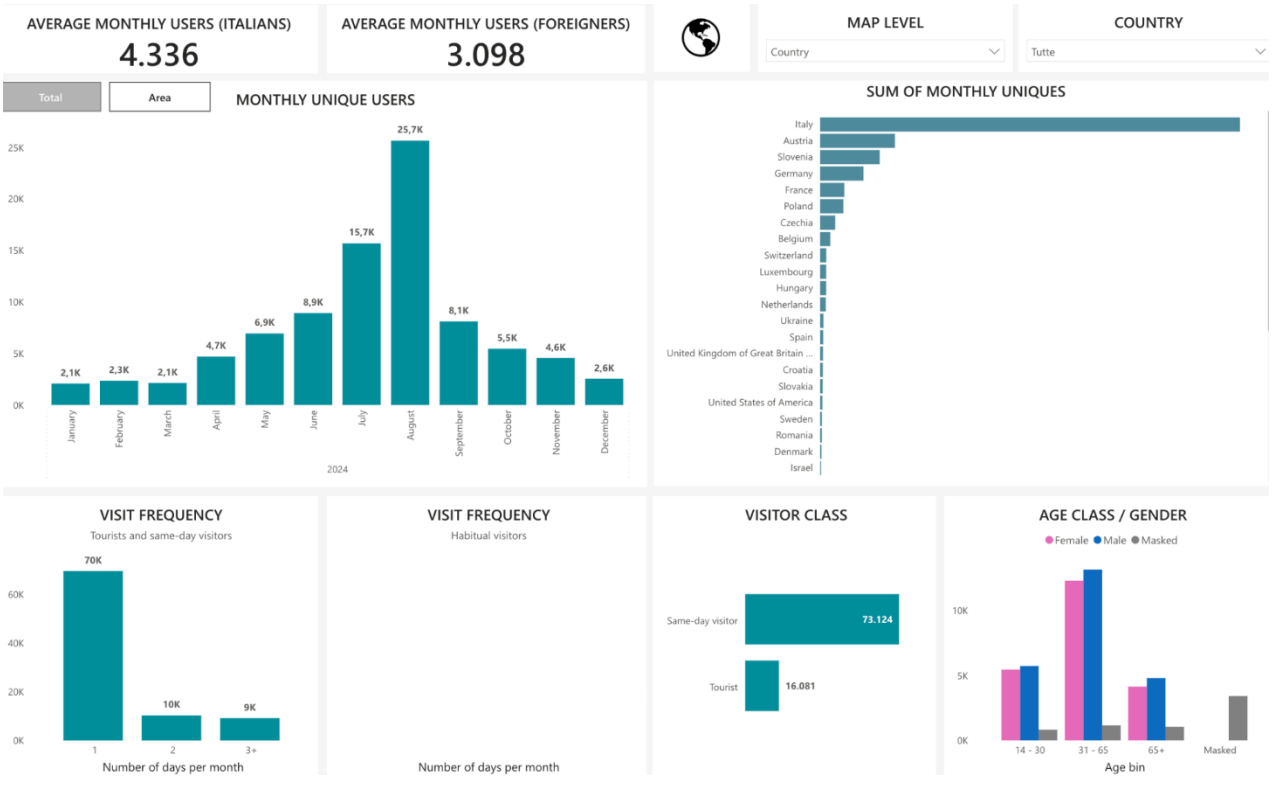


Figure 180 - Catchment Analysis of Val Resia: Visitor Profiles.

The data considers only tourists and same-day visitors, based on mobile network activity. The average monthly presence shows 4,336 Italian users and 3098 foreign users, underscoring a clear majority of domestic visitors. Monthly presence increases progressively from spring into the summer, peaking in August (25.7K unique users). The months of July (15.7K) and June (8.9K) also show heightened activity, aligning with typical seasonal tourism. Winter months (January to March) and the end of the year (October to December) register lower mobility, indicating limited winter tourism in contrast to

other valleys such as Sella Nevea, as shown later. From the nationality breakdown, Italy leads by a wide margin, followed by Austria, Slovenia, and Germany, suggesting that cross-border tourism is present. The long tail of international origins includes a wide range of European countries, with minimal presence from North America and Eastern Europe. In terms of visit frequency, the data confirms that most users (70,000) visited only once per month, with significantly smaller numbers for two (10,000) or three or more visits (9,000). The visitor class distribution confirms this, with same-day visitors (73.124) far outnumbering overnight tourists (16.081). This supports the notion that Val Resia is not currently a major overnight destination. The age and gender profile is dominated by the 31–65 age group, with males slightly more represented than females. The 14–30 and 65+ brackets are significantly smaller.

7.6.7 Catchment Analysis of Sella Nevea (2024): Visitor Profiles

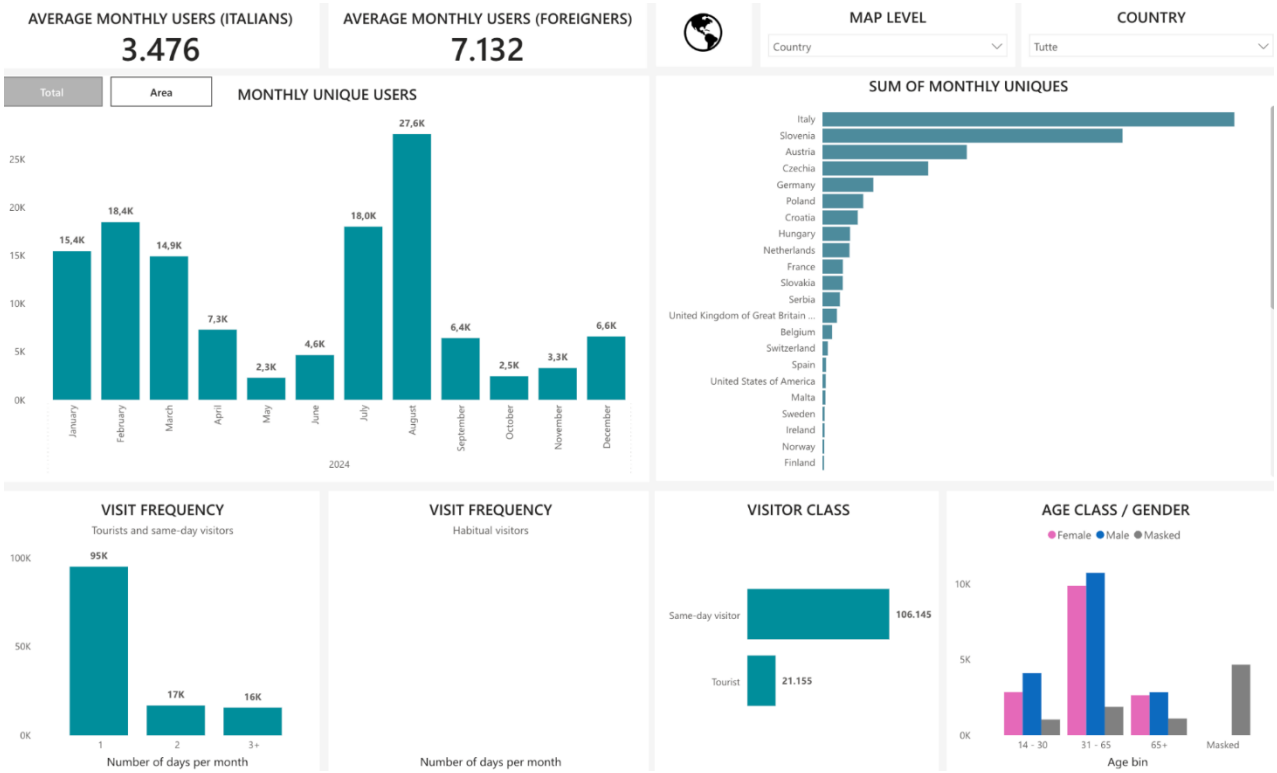


Figure 181 - Catchment Analysis of Sella Nevea: Visitor Profiles.

This catchment analysis captures both seasonal variation and user typologies across the full calendar year. The average monthly unique presence includes 3.476 Italian users and 7.132 foreign users, showing a notable prevalence of foreign mobility compared to other areas such as Val Resia. This aligns with the valley's identity as a cross-border alpine destination, attractive to nearby Slovenia and Austria. The monthly unique visitor trend reveals two main peaks: one in February (18.4K) and another in August (27.6K). This dual-seasonality reflects Sella Nevea's strength as a winter ski destination, especially for ski touring even in winters with little snowfall, and a summer alpine retreat, supported by infrastructure for snow sports and mountain excursions. Unlike Val Resia, Sella Nevea maintains higher winter traffic, making it a key area for year-round tourism. International visitors play a crucial role. The nationality breakdown shows Slovenia, Austria, and Czechia as the top foreign markets after Italy, confirming the transboundary tourism potential and the valley's strategic location near the border. In terms of visit frequency, the vast majority (95K users) visited once per month, while 17K visited twice, and 16K three or more times. The visitor class data further supports this, with 106.145 same-day visitors far exceeding the 21.155 overnight tourists. This pattern implies that although the valley has facilities for overnight stays, it is predominantly accessed for day excursions, possibly from nearby towns or cross-border areas. From a demographic perspective, the dominant age group is again 31–65, with males slightly outnumbering

females. The younger (14–30) and older (65+) groups are less represented, though still present. In conclusion, Sella Nevea emerges as a bi-seasonal, cross-border tourism hub, characterized by a relatively balanced mix of Italian and foreign users, a strong winter presence likely tied to skiing infrastructure, and a significant volume of single-day visits.

7.6.8 Stay Duration Distribution

By nights

In the following section, we present the distribution of stay durations, broken down by month. This includes the number of nights spent by tourists and the daily hours spent by same-day visitors in the analyzed areas. We will first focus on tourists, followed by an analysis of same-day visitors.

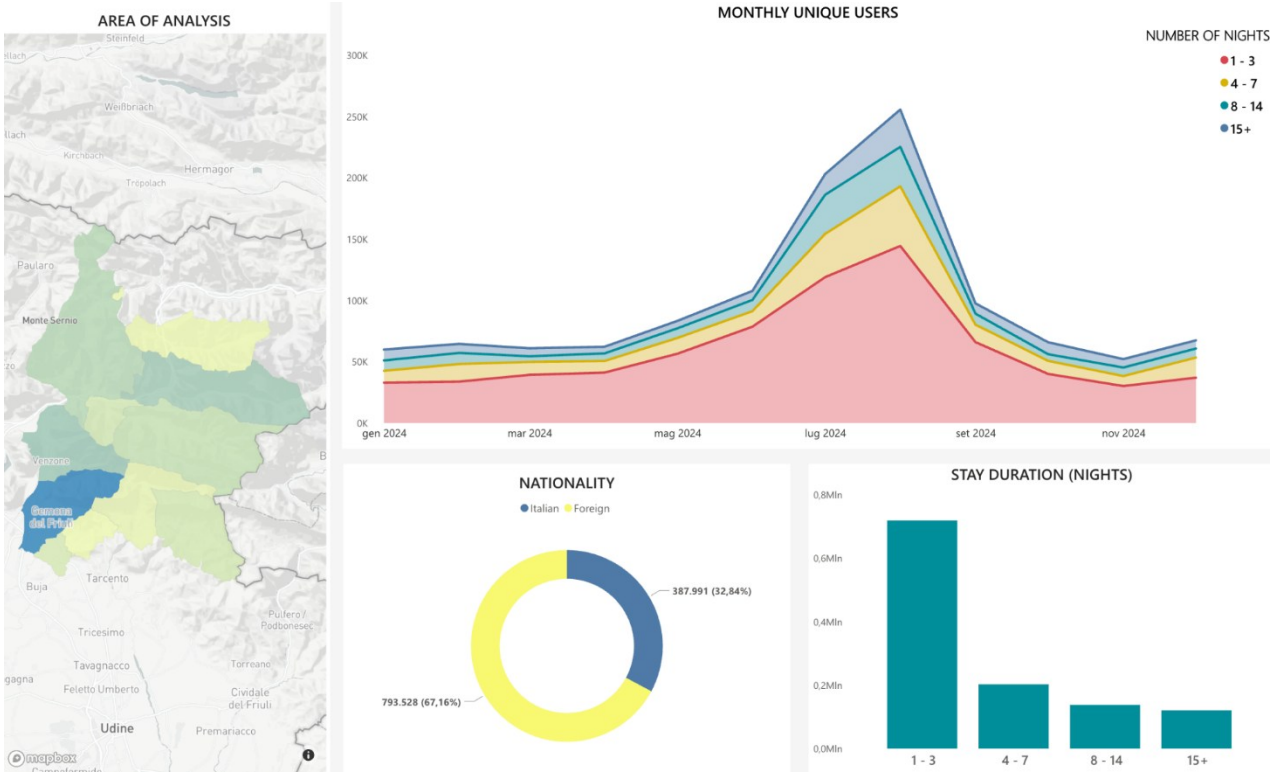


Figure 182 - Distribution of the stay duration across all biosphere areas in nights.

The image presents an overview of tourist stay durations and visitor patterns in the entire biosphere area for the year 2024. The monthly unique users graph shows a clear seasonal trend: visitor numbers are relatively low from January to May, peak in the summer months (July and August), then decline from September onward, with the lowest numbers in winter. The colored areas indicate that short stays of 1–3 nights dominate throughout the year, while longer stays (4–7, 8–14, and 15+ nights) make up a smaller proportion but increase slightly during the summer peak. The nationality chart reveals that 67.16% of tourists are foreigners, while 32.84% are Italian, highlighting the area's strong appeal to international visitors. Overall, the data illustrate that tourism is highly seasonal, mostly short-term, and predominantly driven by foreign visitors, with a clear concentration of activity in the summer months across multiple towns in the biosphere area.

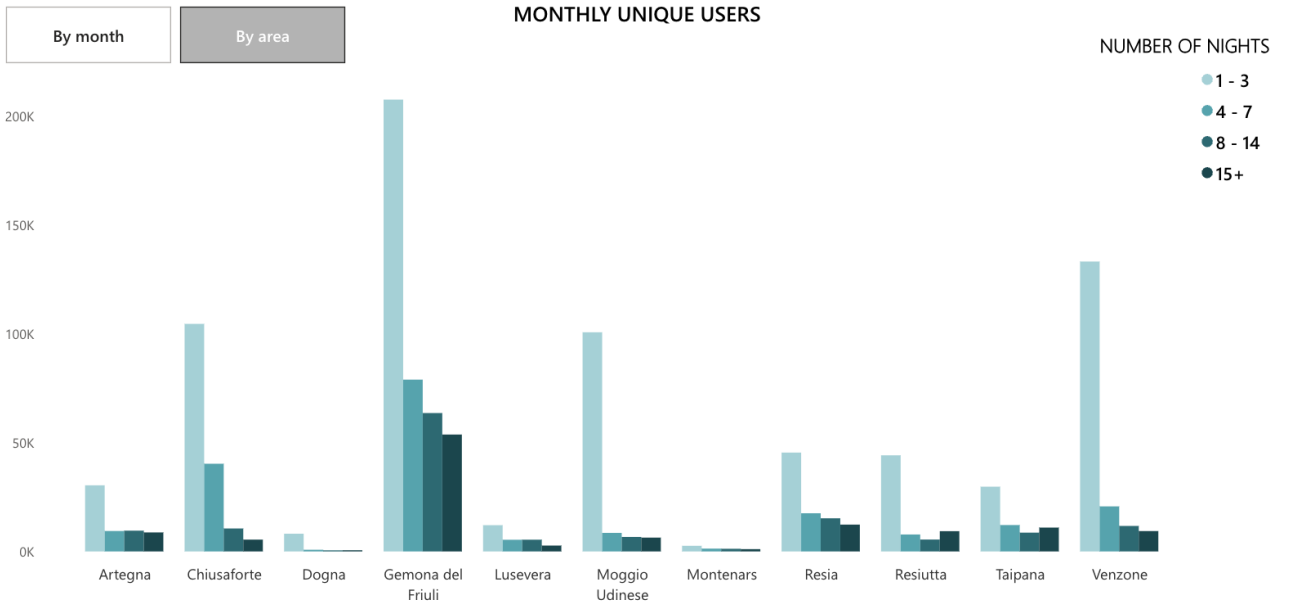


Figure 183 - Distribution of the stay duration by location.

The second image illustrates the stay duration of tourists across all the park municipalities (Venzone, Moggio Udinese, Resiutta, Resia, Chiusaforte, and Lusevera).

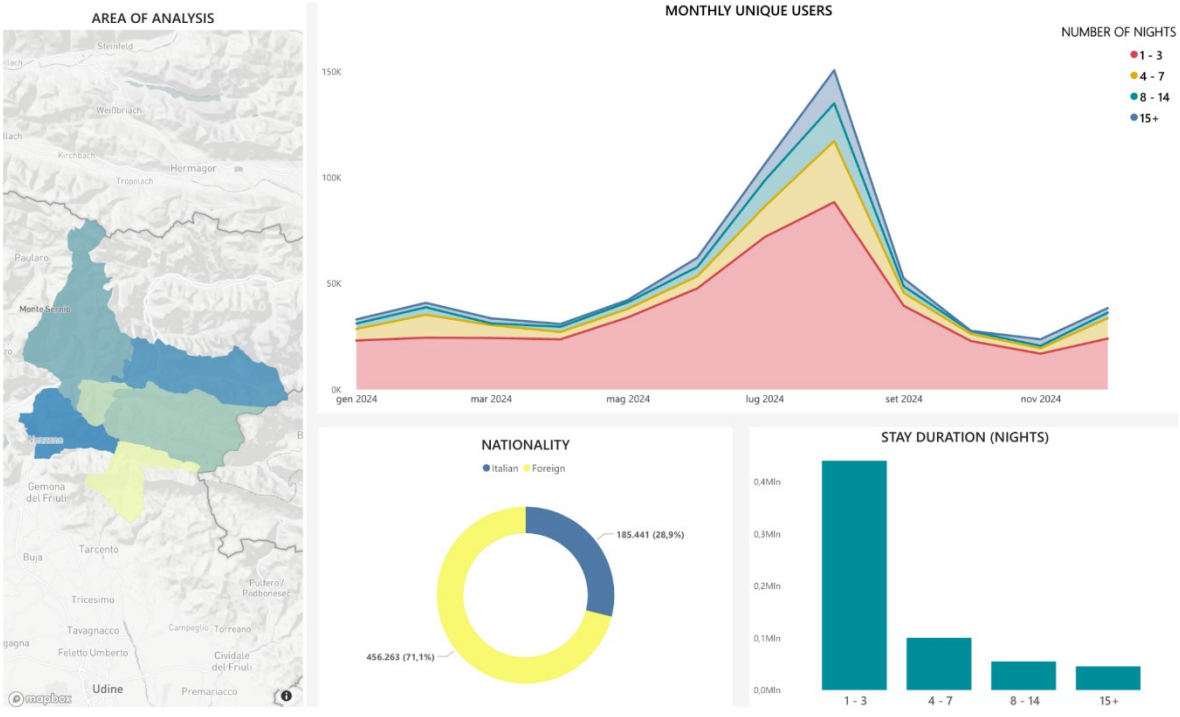


Figure 184 - Distribution of the stay duration across all the park municipalities in nights.

The image presents an overview of tourist stay durations and visitor patterns specifically for the municipalities within the park for the year 2024. The monthly unique users graph shows a similar seasonal pattern to the whole area but at lower volumes, with a clear peak in the summer months (July and August). The color segments reveal that short stays of 1–3 nights remain overwhelmingly dominant throughout the year, while longer stays (4–7, 8–14, and 15+ nights) contribute marginally and slightly increase during the peak season, as before. The nationality chart indicates that, within the park municipalities, foreign visitors make up the majority with 71.1%, whereas Italian tourists account for 28.9%.

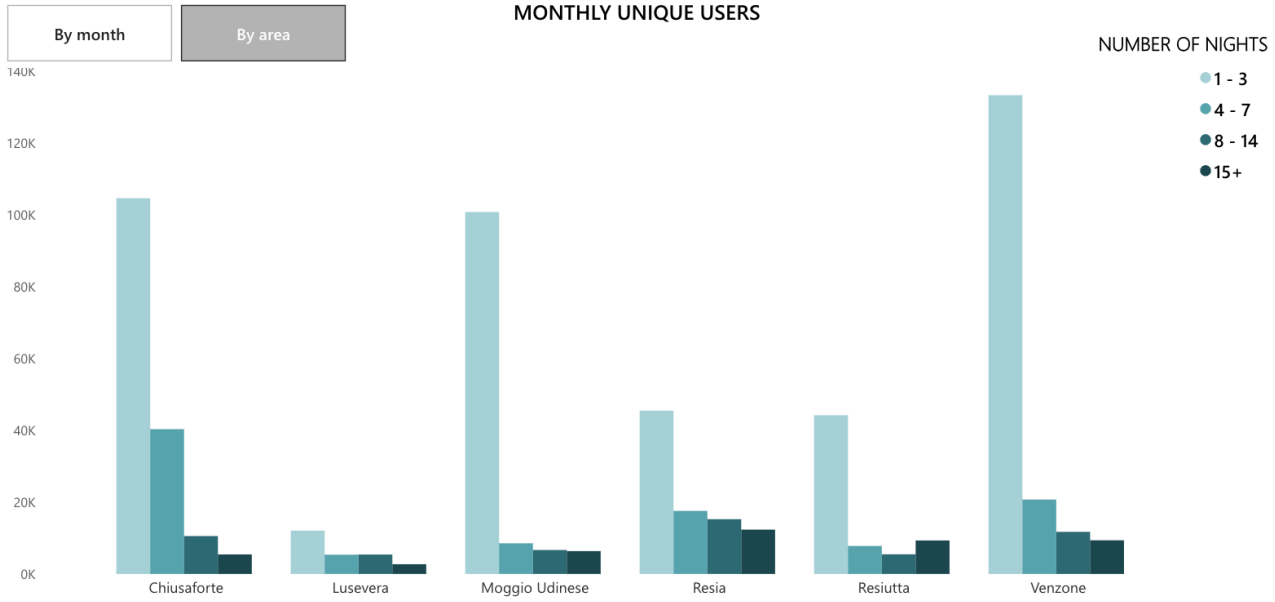


Figure 185 - Distribution of stay duration by focus location.

Looking at each municipality individually, we can observe some common patterns: there is generally a peak in tourist presence during the summer months, along with a clear preference for shorter stays of 1–3 nights. In all municipalities, the percentage of foreign tourists is consistently higher than that of Italian tourists. Foreign visitors across all areas show a strong preference for shorter stays, and the same trend is observed among Italian tourists, with one exception: in the municipality of Taipana, stays of 15 nights are more common than those of 4–7 or 8–14 nights.

This image provides an overview of tourist stay durations and visitor patterns specifically for the valleys within the area (Sella Nevea and Val Resia) for the year 2024. The Monthly Unique Users graph shows visitor numbers gradually rising from May, peaking in July and August reaching just almost 70,000 unique users, then declining steeply in September and remaining low until a smaller rise in November. The nationality chart indicates that these valleys attract more foreign visitors than Italians, with 62.51% (142,253 visitors) being foreigners and 37.49% (85,327 visitors) being Italian.

The Stay Duration bar chart confirms that the majority of stays are short, followed by fewer stays of 4–7 nights and a significantly smaller number in the 8–14 and 15+ nights categories.

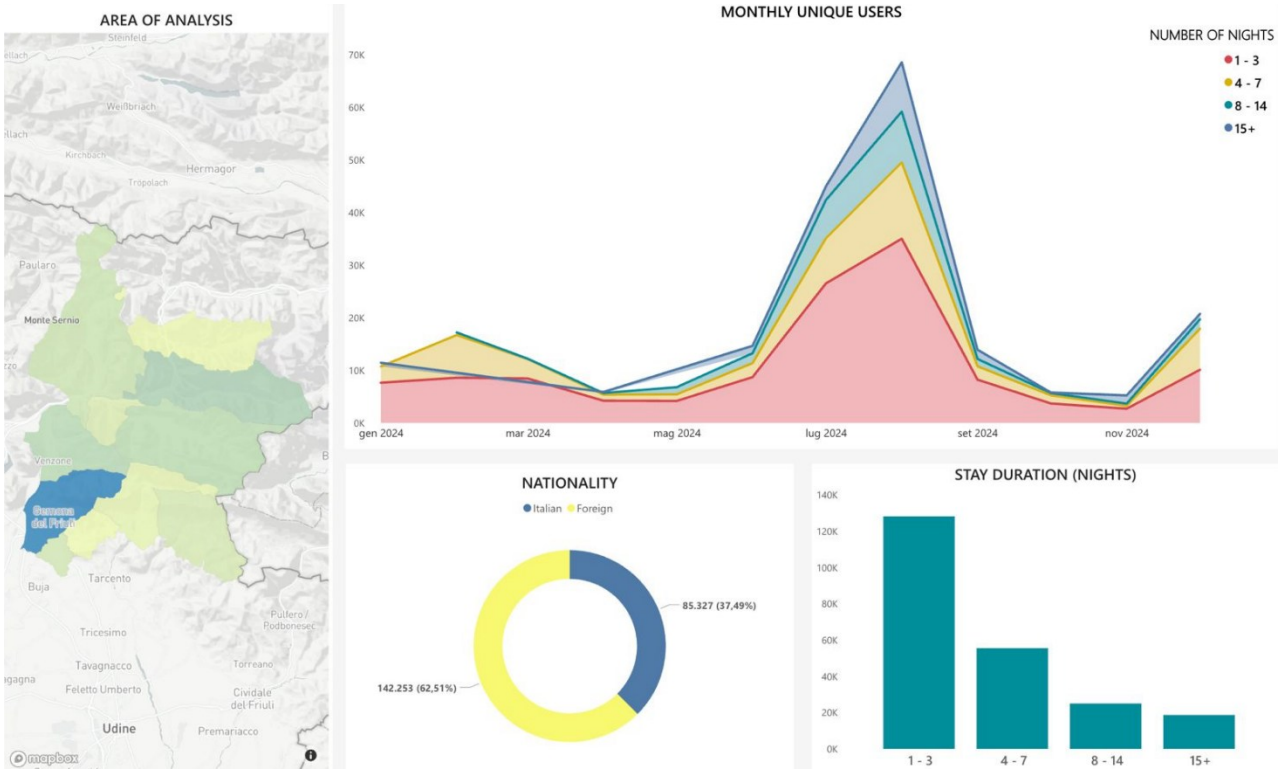


Figure 186 – Distribution of stay duration of tourists across all the two valleys in nights.

By hours

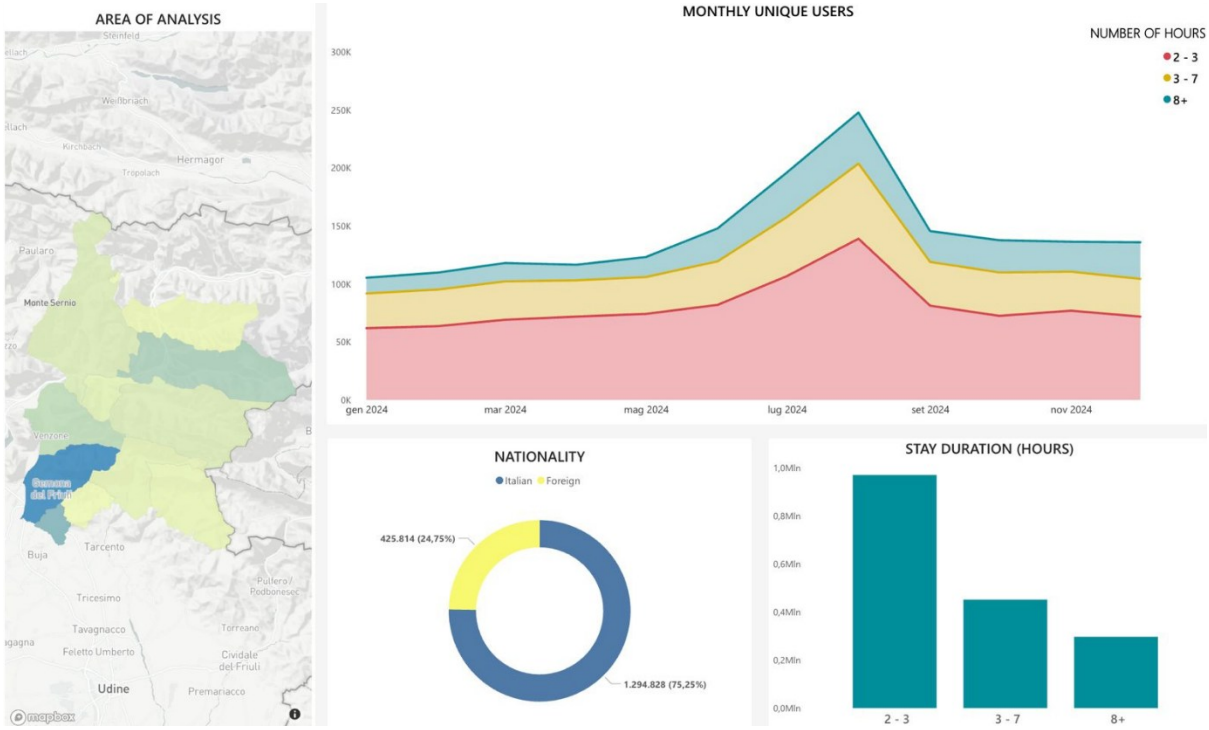


Figure 187 - Distribution of stay duration of tourists across all the two valleys in hours.

This image provides an analysis of same-day visitors for all municipalities of the Biosphere Reserve in 2024. The Monthly Unique Users graph shows the number of same-day visitors throughout the year: gradually increase in spring, and peak significantly in the summer months (July–August). The majority of same-day visitors stay 2–3 hours (red area), followed by 3–7 hours (yellow) and a smaller proportion staying 8+ hours (blue). This shows that quick visits of 2–3 hours are by far the norm, with only a minority spending an entire day. The nationality chart reveals that same-day tourism is dominated by Italians: 75.25% (1,294,828 visitors) are domestic visitors, while only 24.75% (425,814 visitors) are foreigners. This reflects that short local trips are more common for residents and nearby Italians, whereas foreign tourists are less likely to visit for just a few hours. The Stay Duration (Hours) bar chart confirms this pattern clearly.

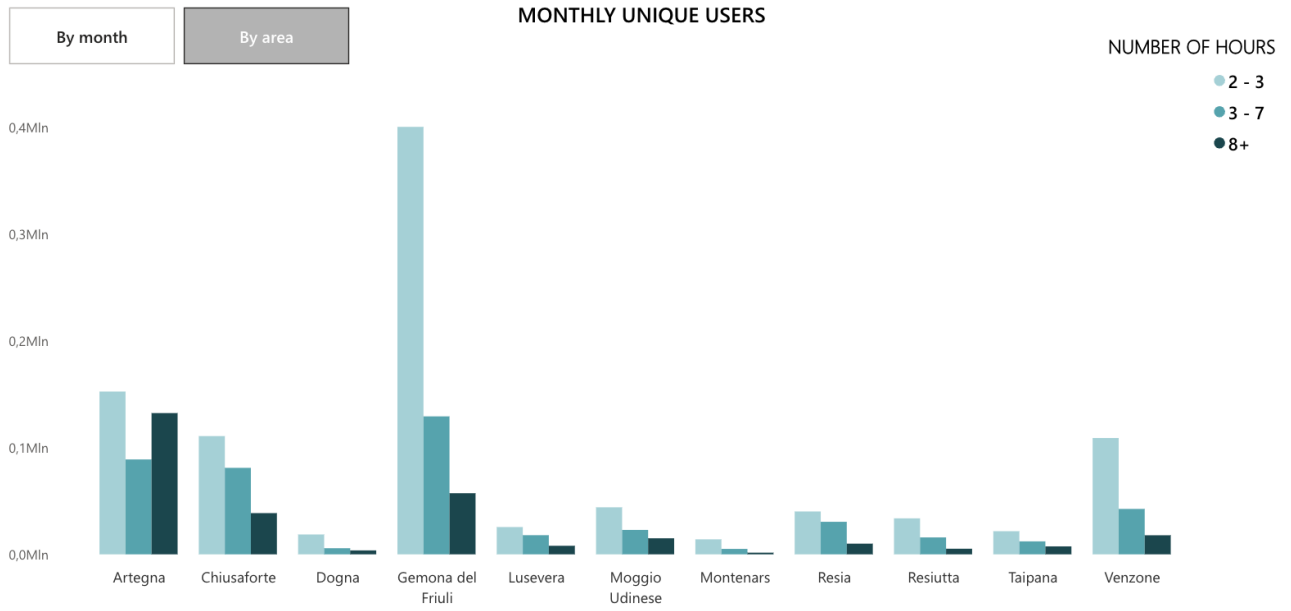


Figure 188 - Distribution of the stay duration by location in hours.

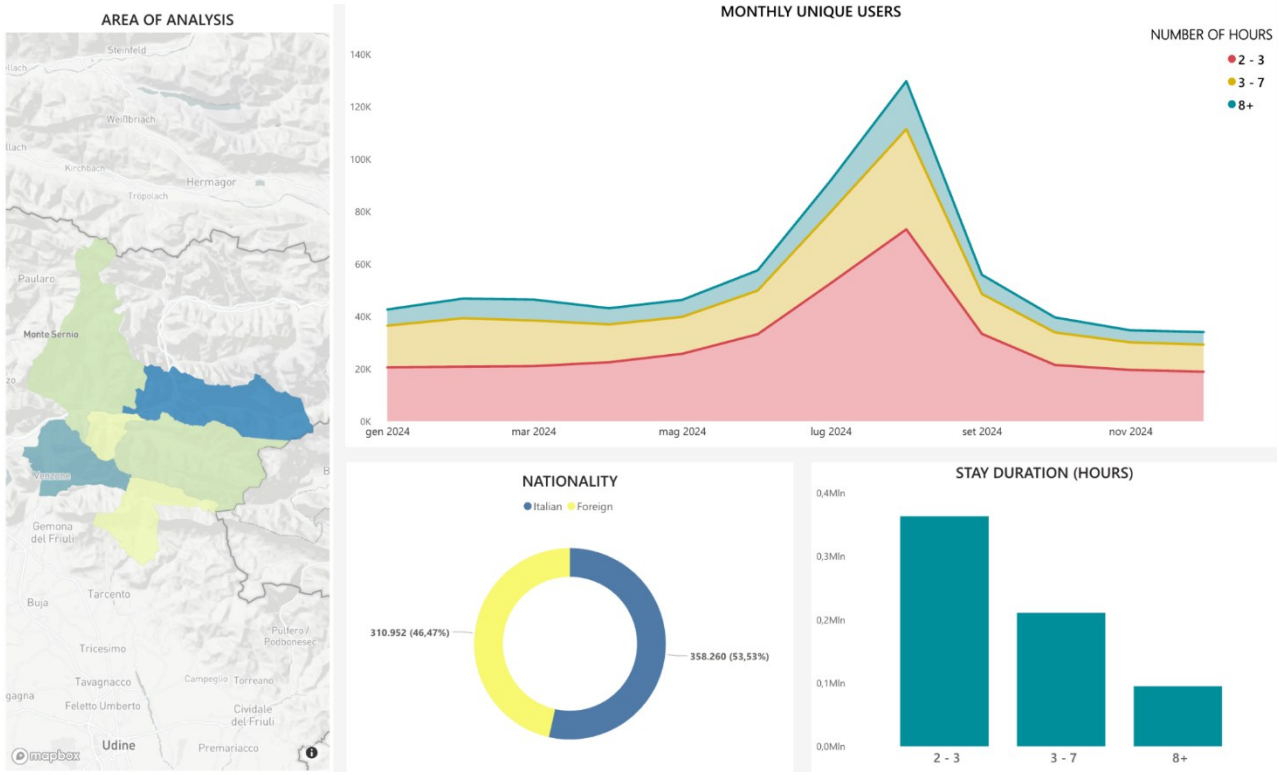


Figure 189 - Distribution of the stay duration across all the two valleys in hours.

We can observe the same pattern and results if we consider only the park municipalities.

Looking more closely at each municipality, same-day visitors in Artegna tend to stay longer than in other areas, with many spending more than 8 hours in the park. In contrast to the general trend, Dogna stands out for having mainly foreign visitors, whereas all other municipalities are predominantly visited by Italians. We can hypothesize that this situation is due to the Alpe Adria Cycle Route, which passes through the municipality of Dogna and is traveled each year by a significant number of people, especially foreigners. These visitors are recorded by the system as same-day visitors

in the 2–3 hour category. In this case, the number of Italian visitors appears lower, as Dogna is less attractive compared to other municipalities in the area.

A common pattern across the remaining municipalities—aside from Artegna and Dogna—is that most same-day visitors tend to stay for a short duration of 2–3 hours.

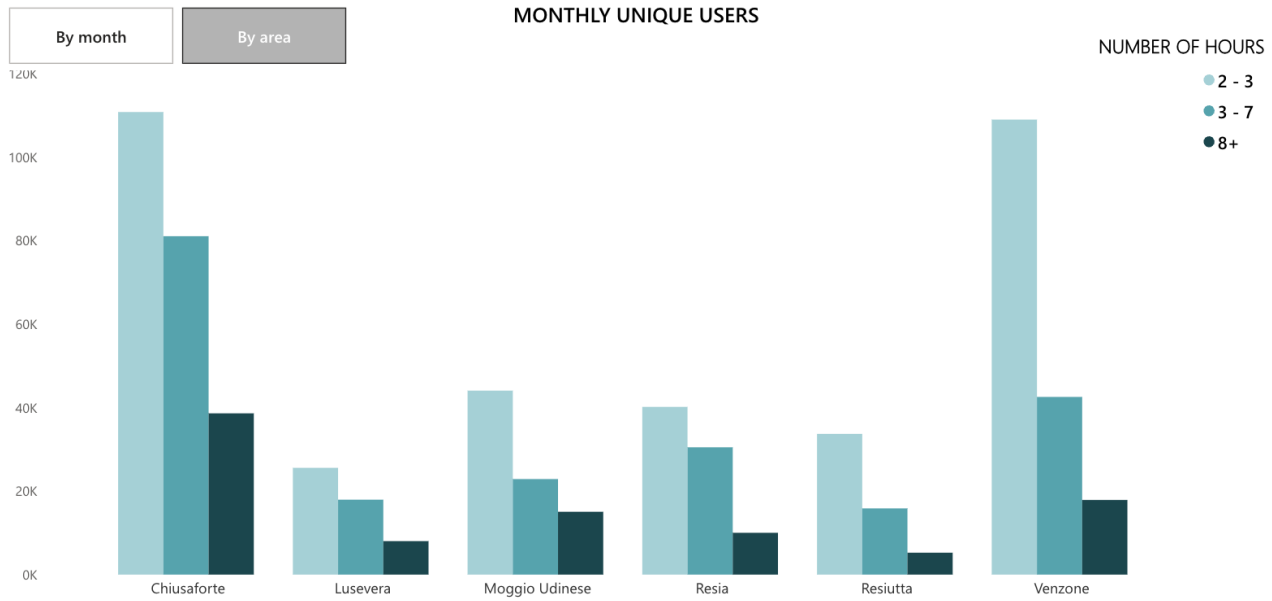


Figure 190 - Distribution of stay duration by focus location in hours.

This image presents an analysis of same-day visitors specifically for the two valleys (Sella Nevea and Val Resia). The Monthly Unique Users graph shows that same-day visits to these valleys follow a clear seasonal trend: peak in the summer months (July–August), then drop quickly from September onward, maintaining lower levels through autumn. Visits lasting 2–3 hours (red) are the most common, especially during peak season, while 3–7 hours (yellow) also make up a significant share, and visits of 8+ hours (blue) are the least common. The Nationality chart indicates a relatively balanced mix of domestic and foreign same-day visitors overall in the valleys, with 53.25% (122,938 visitors) being foreign tourists and 46.75% (107,952 visitors) being Italians. However, it's important to note the difference between the two valleys: Val Resia attracts more Italian same-day visitors, while Sella Nevea attracts more foreign same-day visitors.

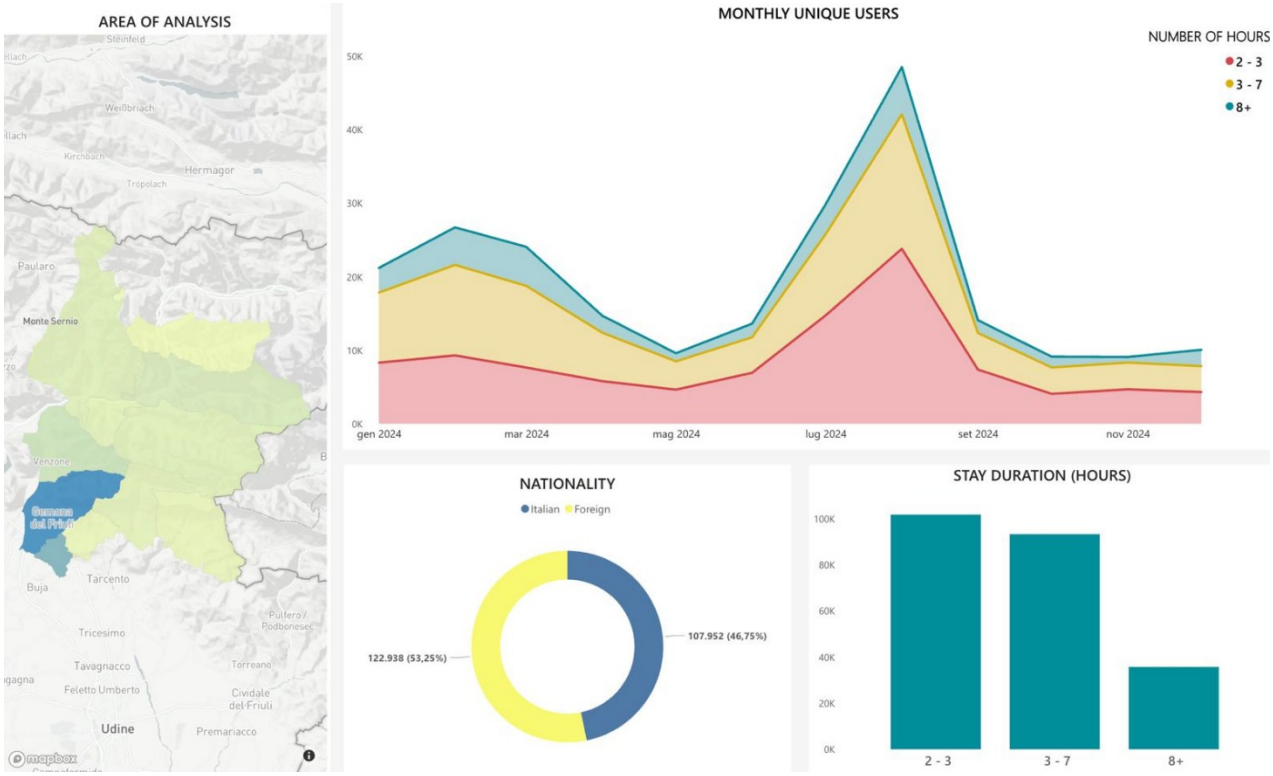


Figure 191 - Distribution of stay duration across all the two valleys in hours.

Overnights

This analysis describes each visitor's behavior within the territory, reporting the municipality where the visitors stayed the night before and the night after the visit.

In the Biosphere Reserve, we had an average of 17,770 Italian visitors per month who spent the night there before, along with 18,448 foreign visitors. On the following night, the average number of overnight stays dropped to 10,864 for Italians and 4,995 for foreigners. This clearly shows that both Italian and foreign visitors prefer to stay overnight in the municipalities of the reserve the night before their visit.

If we consider only the park municipalities (Venzone, Moggio Udinese, Resiutta, Resia, Chiusaforte, and Lusevera), a monthly average of 8,112 Italian visitors stayed there the night before, along with 11,667 foreign visitors. The following night, the numbers dropped to 4,167 for Italians and 2,162 for foreigners.

Most of these overnight stays naturally took place in the Friuli Venezia Giulia region.

If we focus on one of the most important municipalities of the reserve, Gemona del Friuli, we can see that, covering the full year 2024, on average, there are about 6,987 Italian visitors and 3,946 foreign visitors per month. The monthly trend highlights a clear seasonality, with the lowest numbers in January and the highest in August (around 23,900), showing that summer months attract the most visitors. In Gemona, we have almost half of the total people that slept in the reserve.

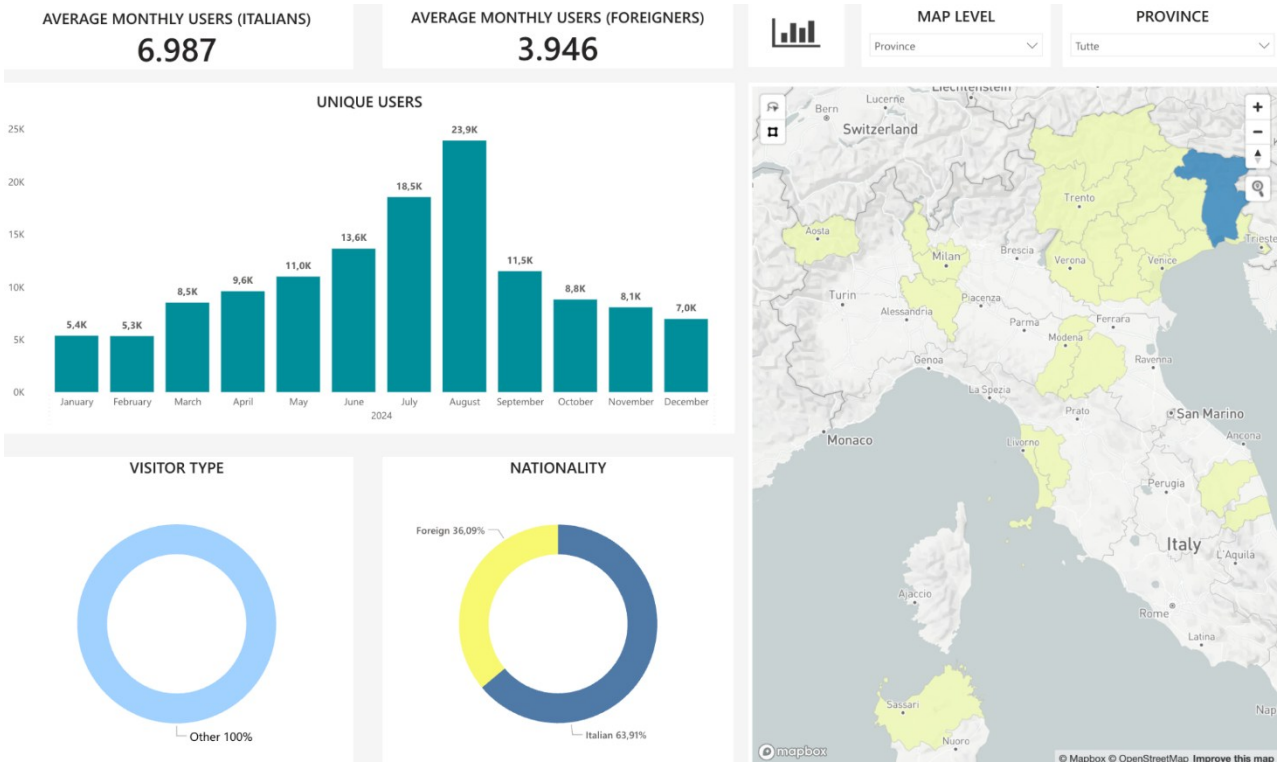


Figure 192 - Distribution of overnights.

This second dashboard shows the overnight stays for Gemona del Friuli for the following night, also covering the entire year 2024. For this scenario, the average monthly overnight users drop to about 4,430 Italians and 1,351 foreigners, indicating fewer people stay the next night compared to the previous night. The monthly trend is similar in pattern but lower in numbers, with January starting around 3,400 unique users and peaking in August at about 13,500, then declining again towards the winter months.

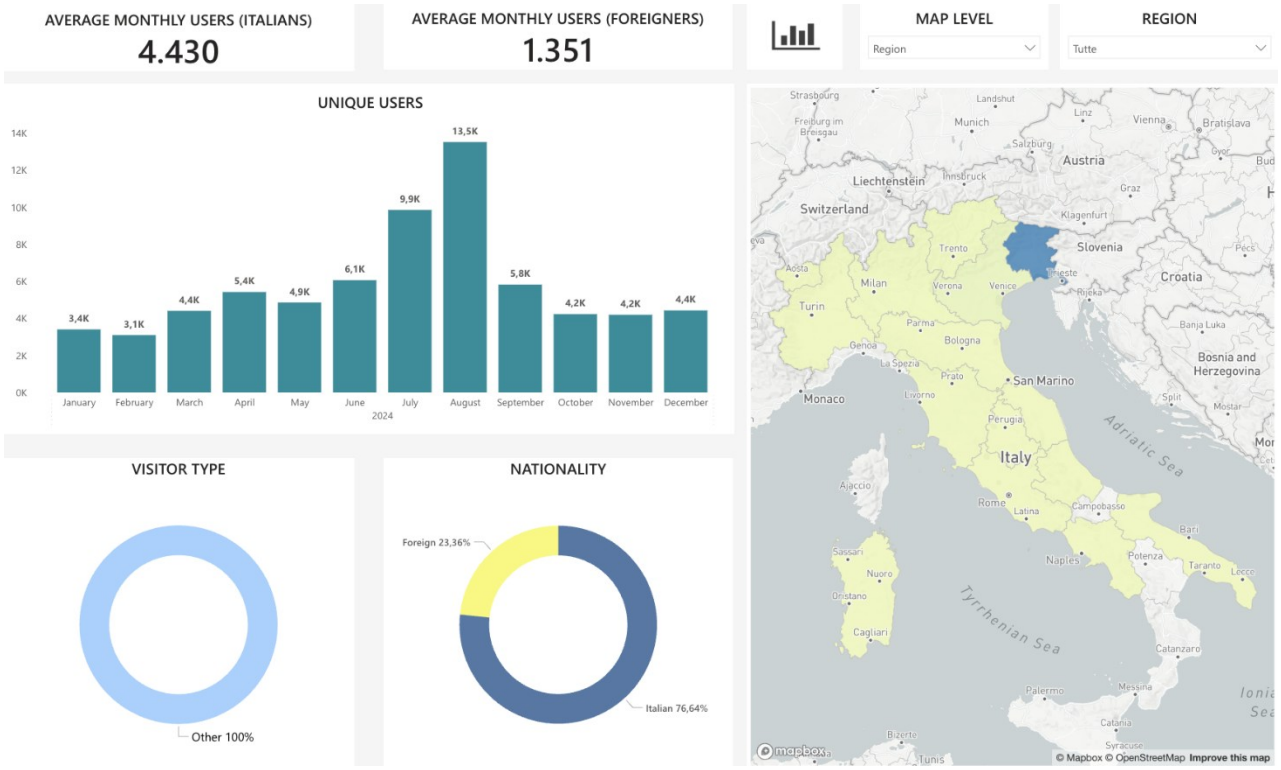


Figure 193 - Distribution of overnights.

Compared to the previous night, Gemona del Friuli has fewer overnight stays the following night, with a sharper drop in foreign visitors and an even higher proportion of Italian tourists, highlighting that most guests tend to stay only one night. This could be due not so much to greater attractiveness in itself as to the fact that Gemona has more beds than the other municipalities in the Reserve.

Considering the valleys, in the previous night, the average monthly overnight stays are about 3,172 Italians and 1,903 foreigners, with a clear peak in August (about 20.4k users).

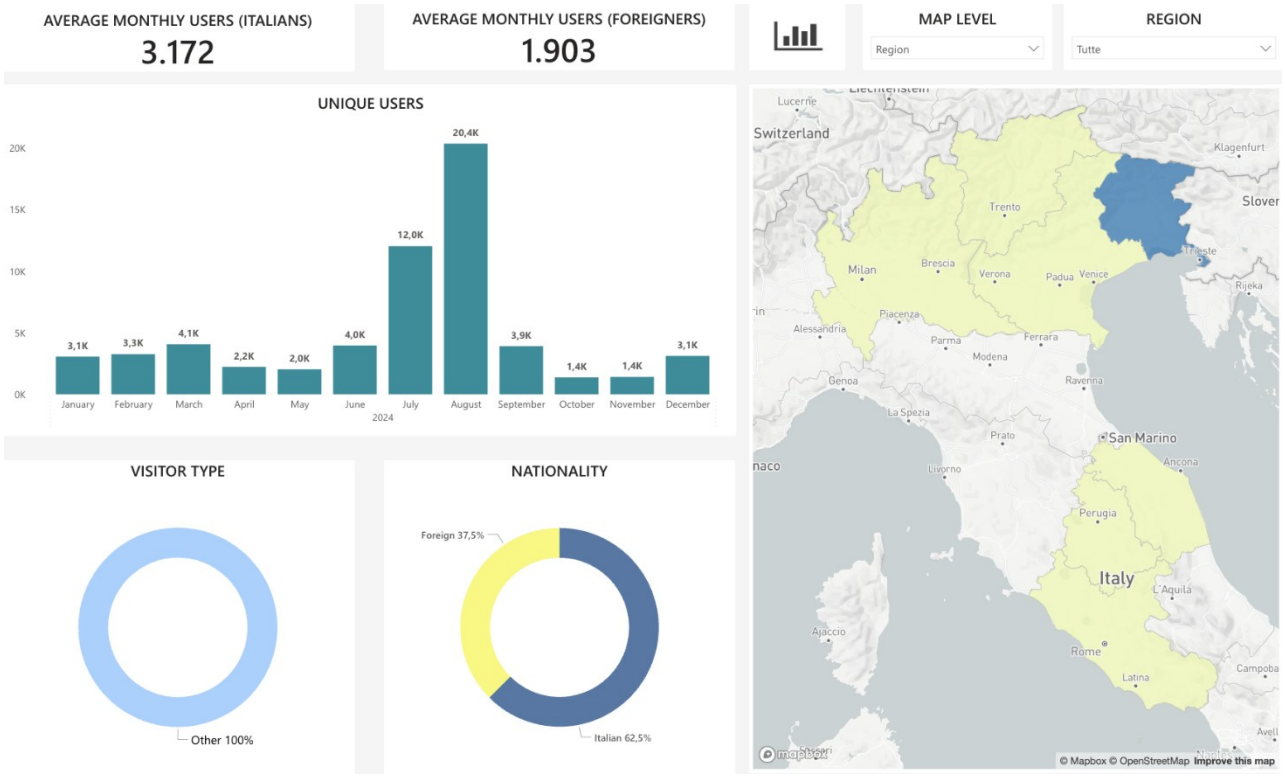


Figure 194 - Distribution of overnights.

Considering the following night the average monthly overnight stays drop further to about 1,673 Italians and 534 foreigners, showing a clear decrease compared to the previous night. The unique user trend again peaks in August at about 10.5k users, but numbers stay much lower in other months (around 1,000–1,600).

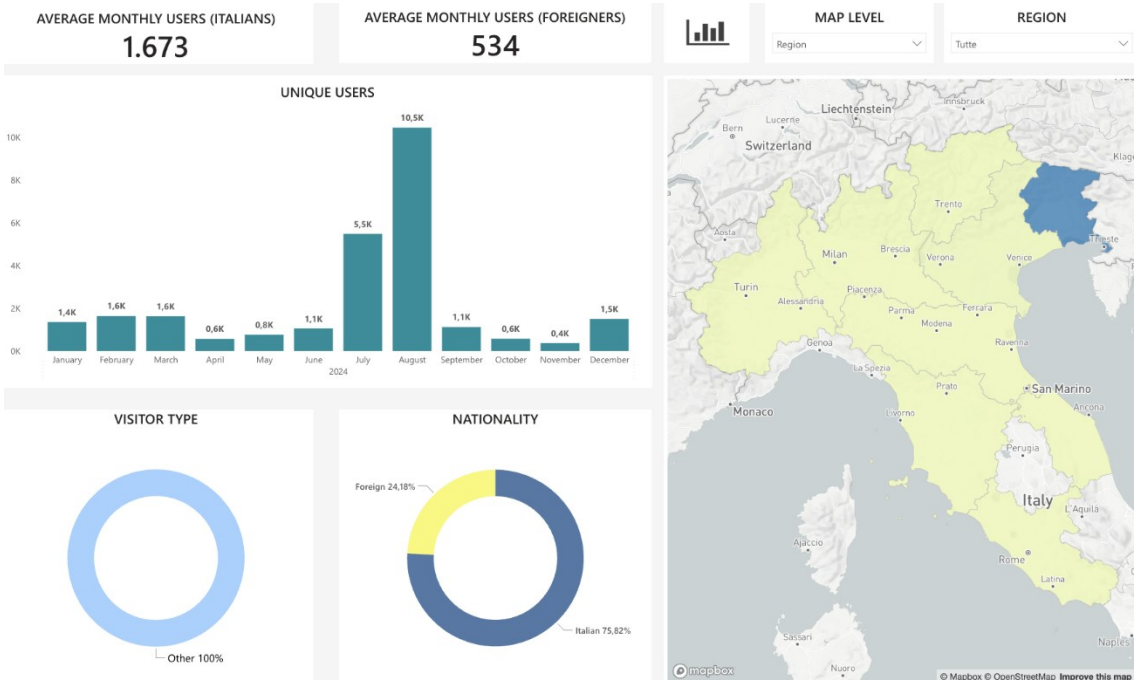


Figure 195 - Distribution of overnights.

If we consider the valleys alone, Sella Nevea shows a more consistent distribution of visitors throughout the year.

7.6.9 Transits in the Valleys

The following image analyzes daily transits for Sella Nevea and Val Resia in 2024, where transits are defined as users spending between 15 minutes and 2 hours in the area. The data shows a total of 399,598 transits for the year, with an average of 1,142 per day, and a clear seasonal pattern: very low in winter, rising in spring, and peaking sharply in summer (July–August) with daily peaks over 5,000–7,000, before declining in autumn. The world map highlights that while Friuli-Venezia Giulia is the main source region, there is presence from other European countries and even distant regions. The nationality breakdown reveals that 68.2% (272,509) of transits are by foreigners and 31.8% (127,089) by Italians, indicating strong cross-border and international pass-through traffic. The provenance chart shows that 71.79% (286,871) of these short transits come from outside Friuli-Venezia Giulia, while only 28.21% (112,727) are local, confirming that the valleys serve as key stopovers or quick excursion points for travelers from other regions and countries.

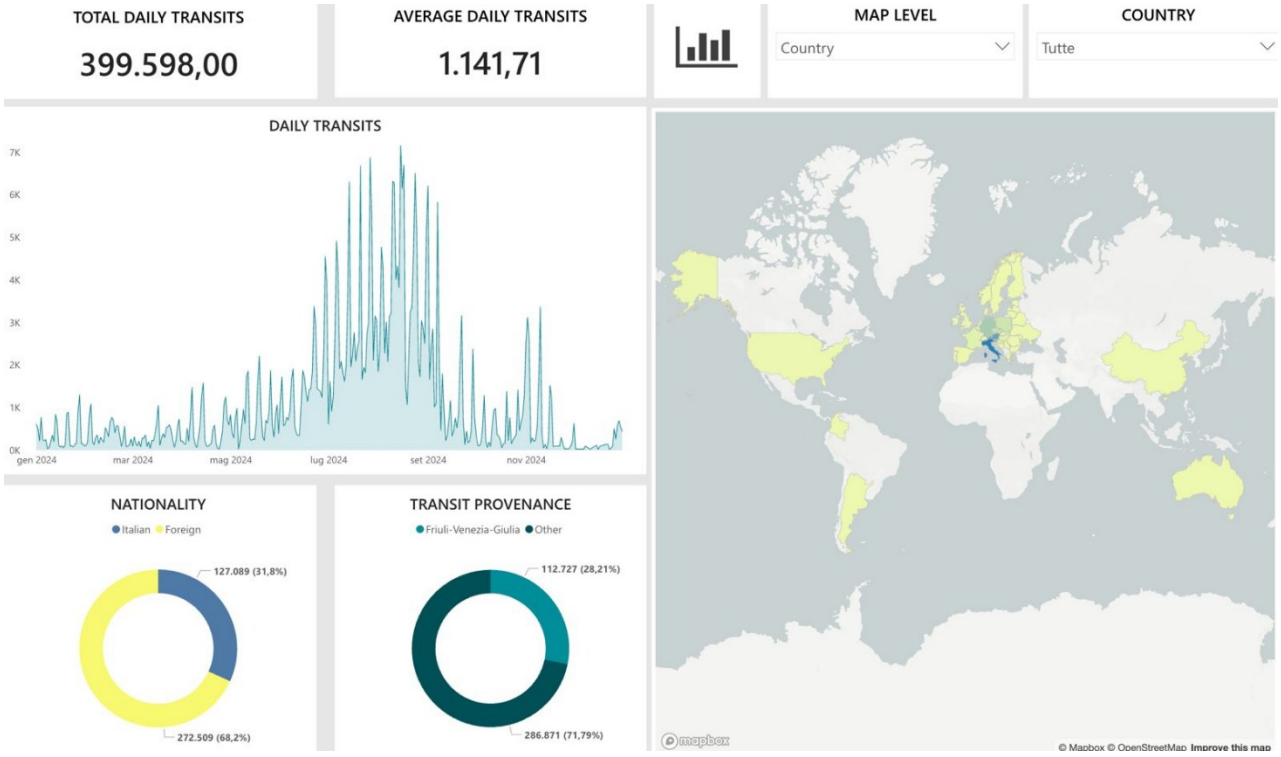


Figure 196 - Daily transit in the valley.

When considering the two valleys separately, Sella Nevea recorded the highest number of total daily transits (233,807), while Val Resia had the lowest total number of total daily transits (165,791). Looking at the nationalities, the data confirms the chart: there were a total of 127,089 daily transits by Italian visitors and 272,509 by foreign visitors.

The following image presents the same data at a monthly level. The same pattern emerges: the percentage of foreign transits remains higher, and most short transits originate from outside the Friuli-Venezia Giulia region.

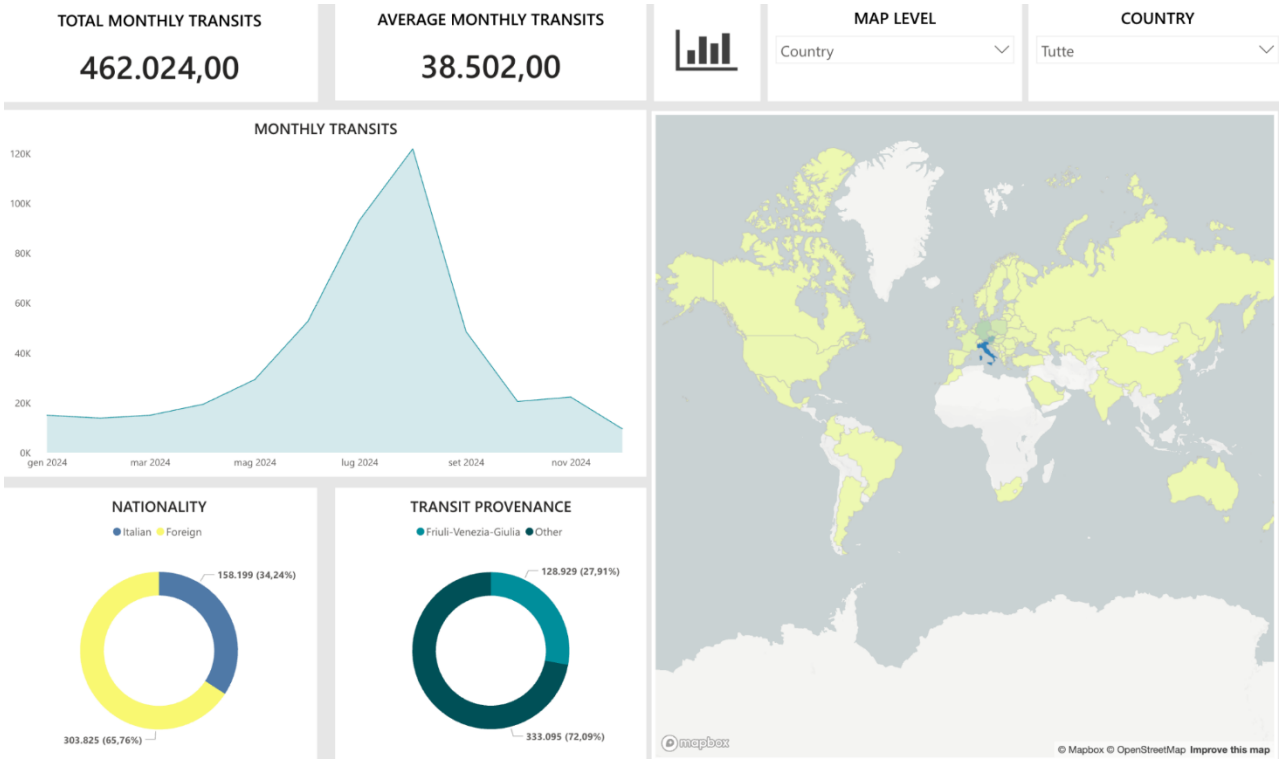


Figure 197 - Monthly transit in the valley.

Even here when considering the two valleys separately, Sella Nevea recorded the highest number of total monthly transits (256,324), while Val Resia had the lowest total number of monthly transits (205,700).

7.6.10 Entry/ Exit Checkpoint Analysis

The special areas of Val Resia and Sella Nevea are monitored in this analysis, providing the number of visitors based on the entry and exit points of the valleys.

Regarding **Val Resia** the entry and exit point that we take in consideration were: Lusevera, Resiutta and Slovenia.

Looking at the overall distribution of entry and exit points, Resiutta has the highest transit percentage (74.13%), followed by Lusevera (24.74%) and, lastly, Slovenia (1.12%).

Starting with Resiutta as an entry point, the data show that visitors used the same point as their exit in 99.75% of cases, while only 0.24% exited through Lusevera. The majority were Italian (78.41%), with the remaining 21.58% being foreign visitors. Most were same-day visitors, as shown in the graph below.

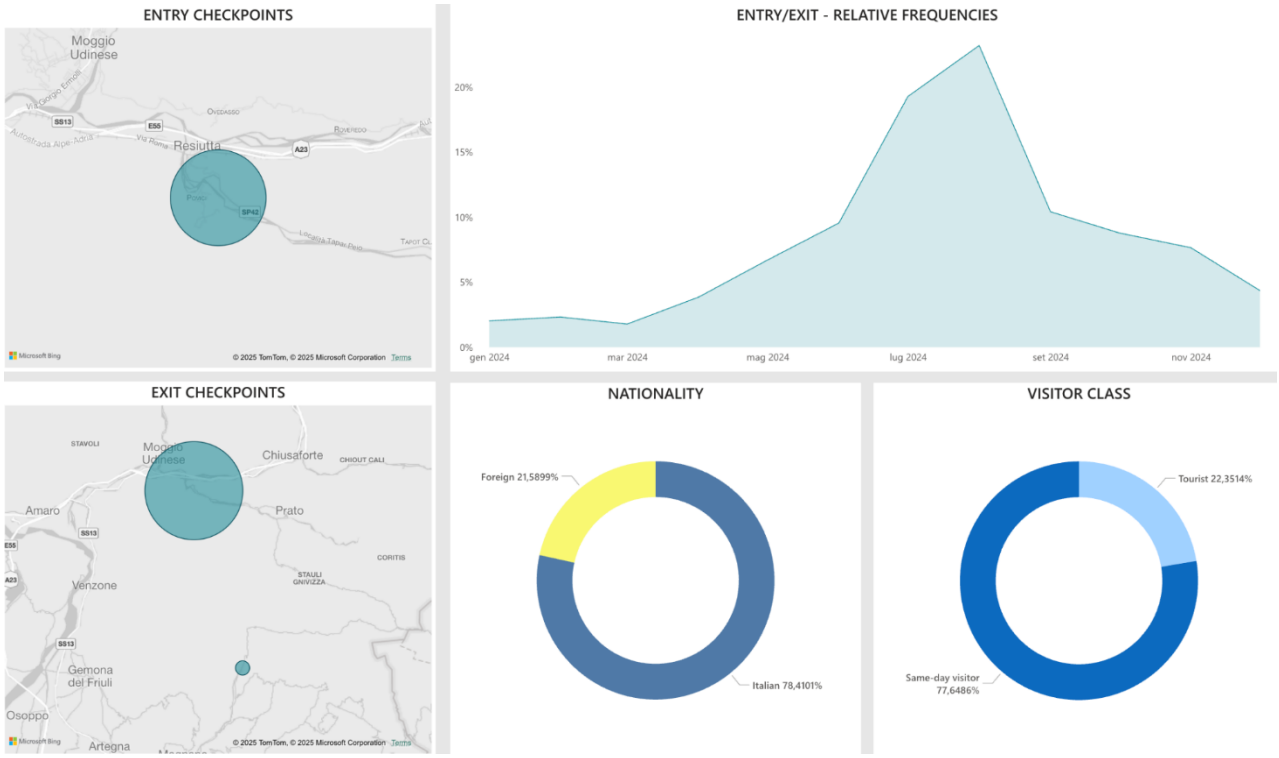


Figure 198 – Entry/ Exit checkpoint analysis.

If we consider Lusevera as an entry point, we observe a similar pattern: 99.04% of visitors used the same point for their exit. A comparable trend is also evident in terms of nationality and visitor type.

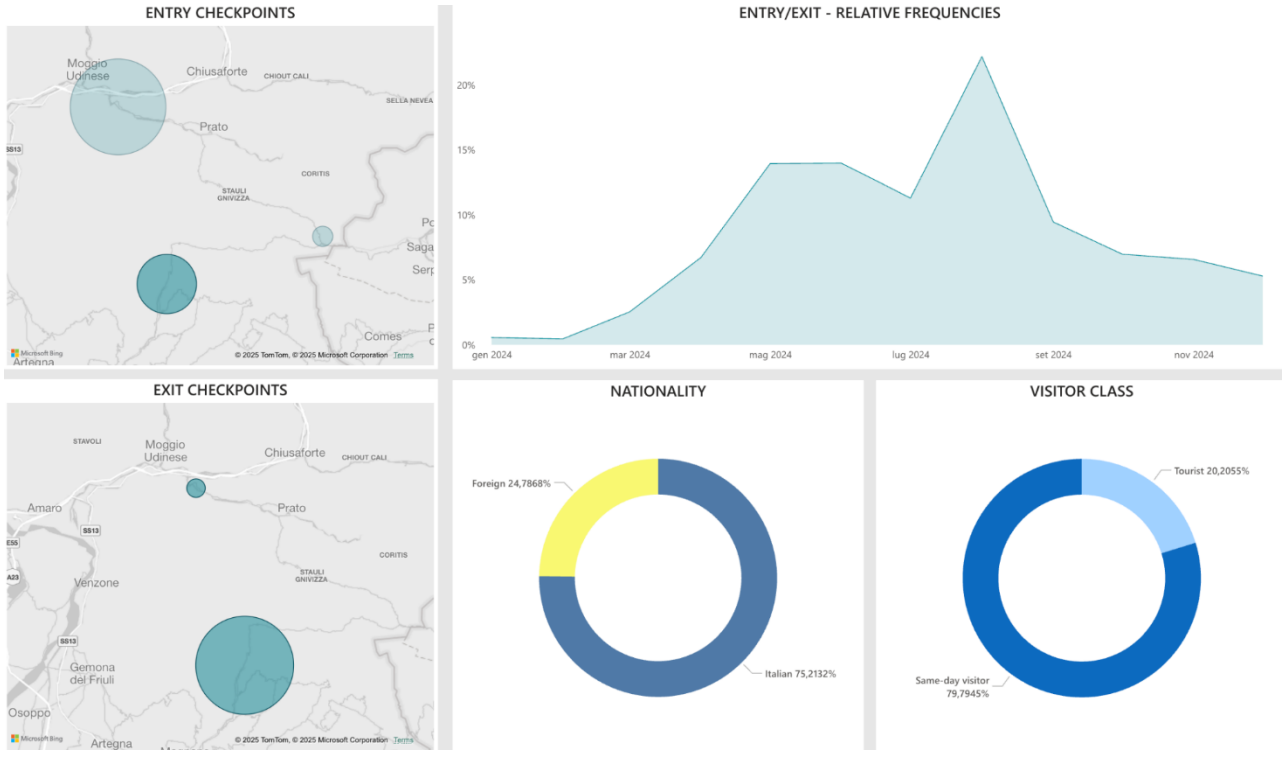


Figure 199 – Entry/ Exit checkpoint analysis.

Lastly, if we consider Slovenia as an entry point, 98.77% of tourists also used it as their exit point. However, in this case, the majority of visitors were foreign nationals. The majority of visitors opted for a one-day trip (92,81%).

Looking at the monthly distribution for the three entry and exit points described above, a clear preference for the summer months emerges, with Lusevera also showing slightly higher visitation during the spring.

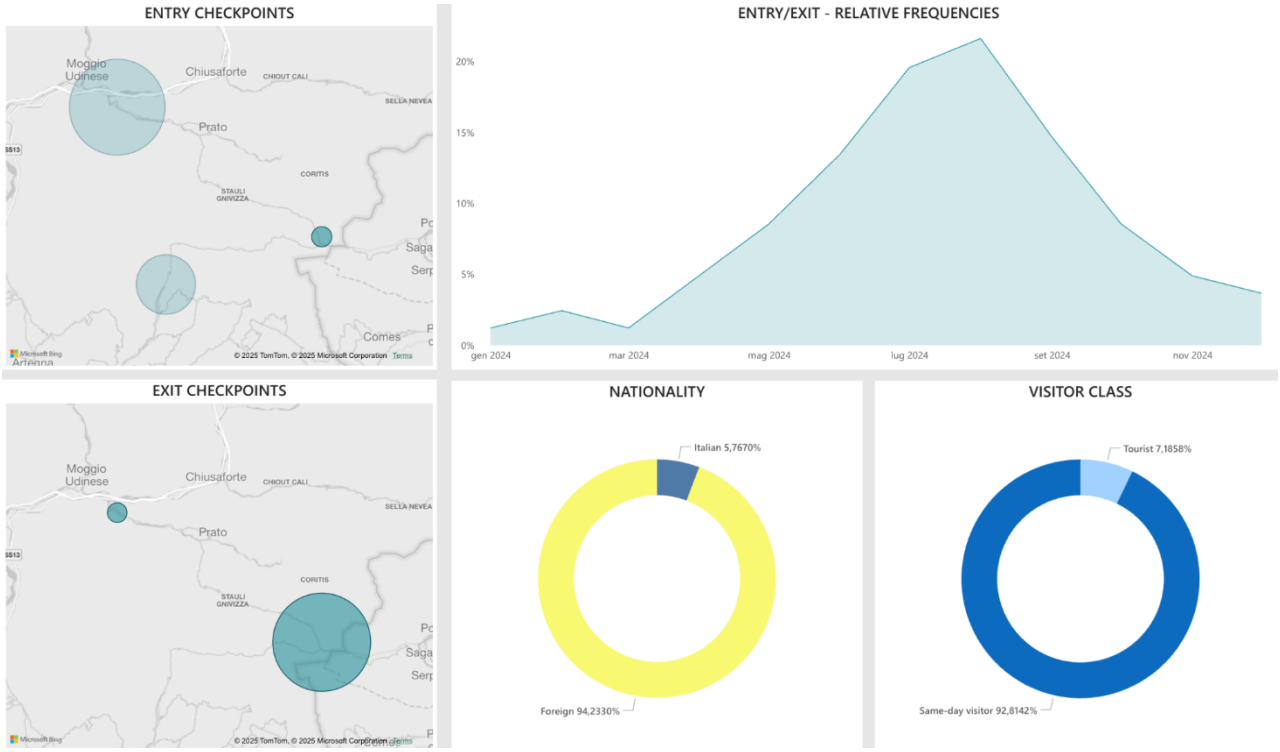


Figure 200 – Entry/ Exit checkpoint analysis.

Regarding **Sella Nevea**, the entry and exit points considered were the eastern and western access points. Looking at the overall distribution, the eastern point recorded the highest transit percentage (88.12%), followed by the western point (11.87%).

If we consider the eastern point as an entry point, 99.05% of visitors exited from the same location. The relative frequency chart highlights a strong seasonal pattern, with peak entries and exits in July and August 2024, indicating a surge in summer visitation. A secondary peak is also evident during the winter months (January, February, and March). Nationality data show that the majority of visitors are foreign (70.3%), while only 29.7% are Italian. Additionally, most visitors (76.97%) are same-day visitors, with only 23.03% staying overnight.

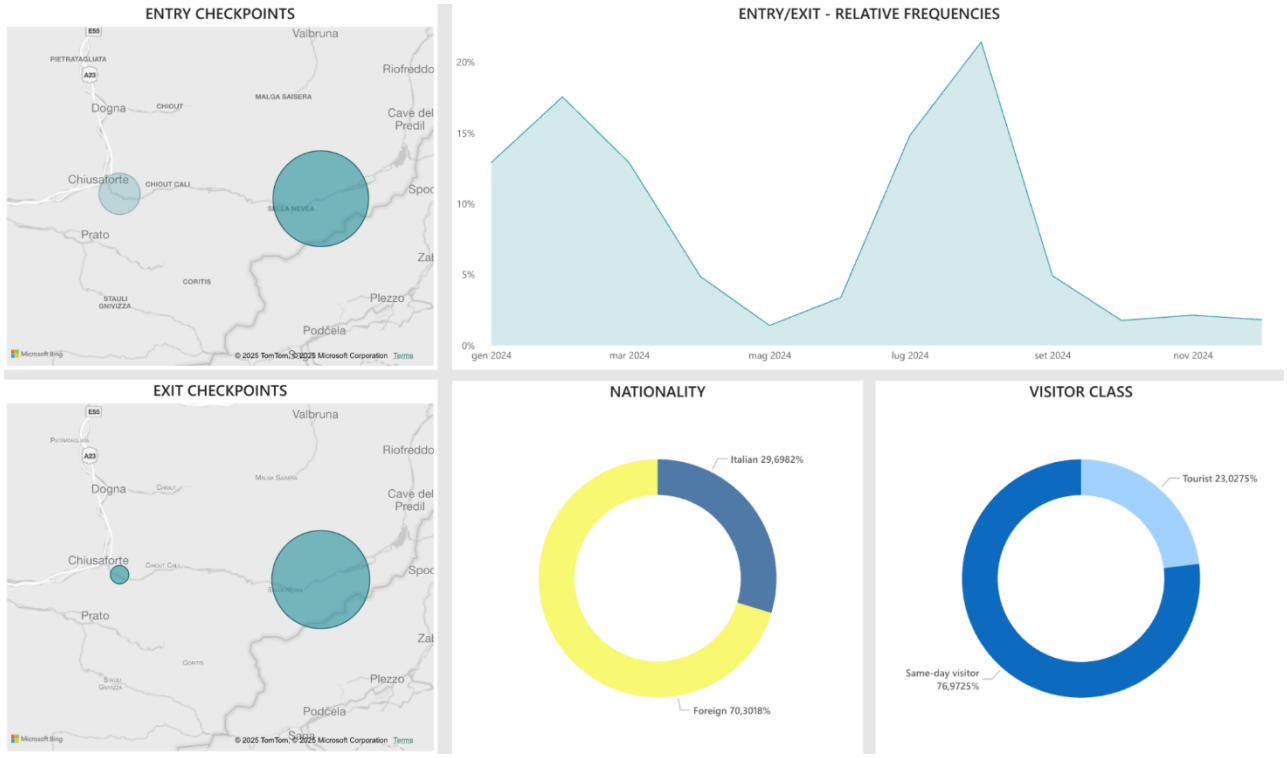


Figure 201 - Entry/ Exit checkpoint analysis.

If we consider the western point as an entry point, 91,89% of visitors exited from the same location, while 8,10% from the eastern point. Visitor numbers peak strongly in July 2024, mirroring the summer high season. The visitor profile here is predominantly Italian (79.63%), and the majority are same-day visitors (79.24%), with a smaller proportion (20.76%) staying as tourists.

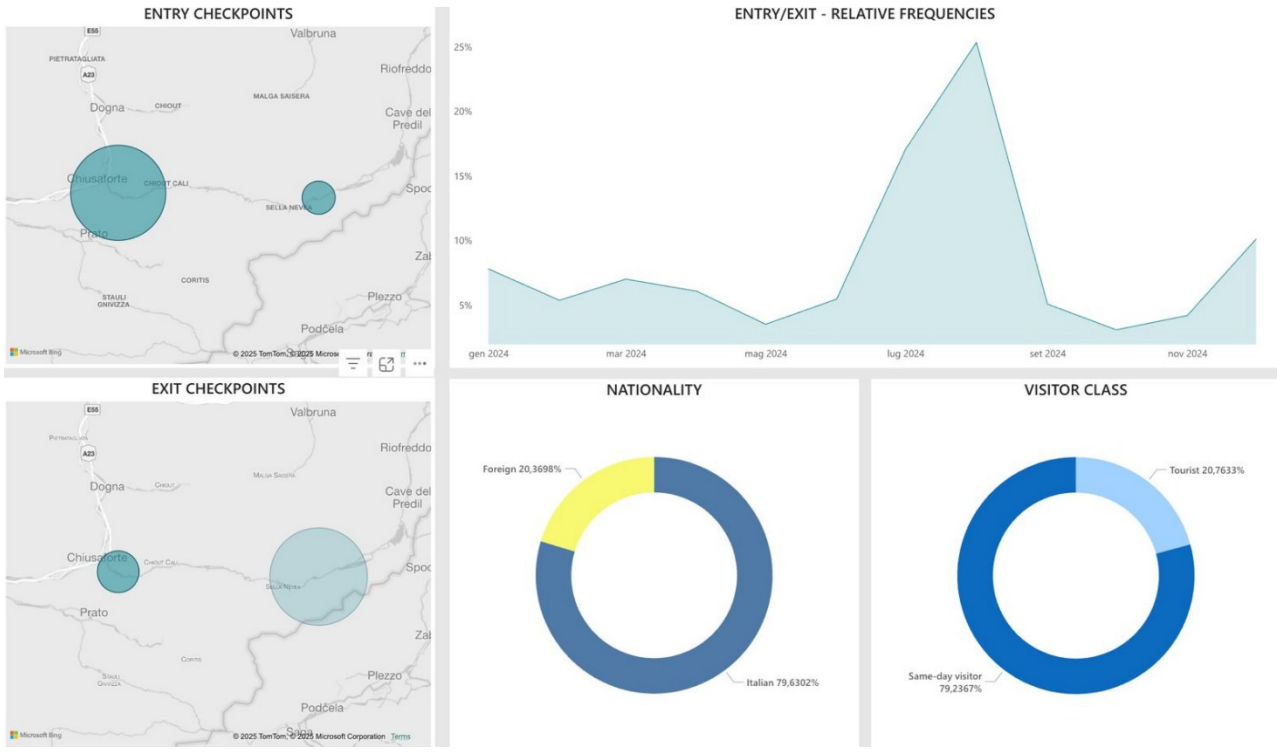


Figure 202 - Entry/ Exit checkpoint analysis.

When compared to the eastern region, the two areas share similar seasonal peaks only during the summer, because the eastern point attracts visitors also in winter. Nationality distribution also contrasts significantly: while the west attracts mostly Italians, the east draws a predominantly foreign crowd (70.3%). In both regions, same-day visits are the dominant visitor type.

7.6.11 Covisits

For all users detected in the analyzed areas, a study is carried out regarding co-visits with seven specific areas of interest identified. It was defined as paired visits between locations within the park's municipalities and specific neighboring predefined by the park. This analysis is provided on a monthly basis. The seven specific areas of interest are:

- Austria
- Slovenia
- Casa delle farfalle
- Laghi di fusine
- Lago dei 3 comuni
- Monte santo di Lussari
- Cividale del Friuli

The general pattern of the monthly visits by covisits area in all the municipalities of analysis are the one in the following image. This can be explained by the fact that Slovenia is geographically closer to the park than Austria, highlighting the park's strong transboundary potential.

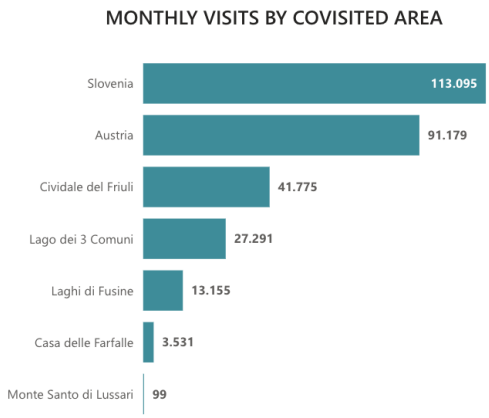


Figure 203 - Monthly visits by covisits area in all the municipalities.

The image below described the covisit in Austria. It focused solely non-inhabitants of the covisit area and considering all the municipalities of the biosphere reserve as areas of analysis. The clear peak in visits during August (22.1K) aligns with typical summer vacation patterns in Italy.

A positive number in the number of days between visits and covisits indicates that the visit occurred first and then the covisit. A negative number, conversely, indicates that covisit and then visit occurred first. 0 indicates that visit and covisit occurred on the same day. When examining this number of days between visit and covisit, a notable spike occurs at 0 days (19.1K), indicating that most people visit both locations on the same day. This implies day-trippers or tightly planned excursions, likely influenced by the geographical proximity and ease of movement across the border. Day +1 (11K) and day -1 (9.2K) also show high values, highlighting a pattern of overnight stays or tightly sequenced itineraries. The decline in numbers for visits spaced by more than two weeks (≥15 days = 4.9K) suggests that the majority of covisits are part of short-term travel plans rather than longer-term tourism cycles.

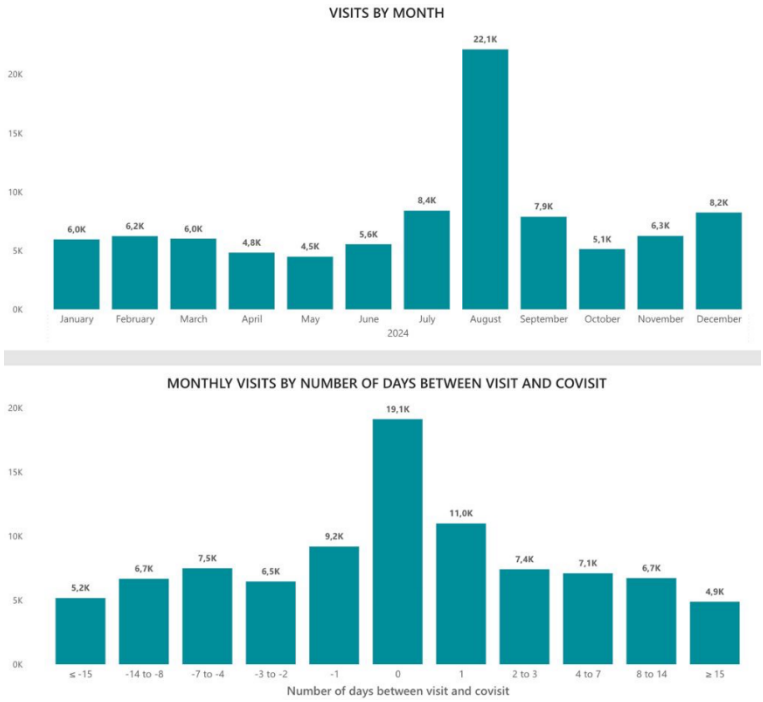


Figure 204 - Monthly distribution of covisited area in Slovenia

When analyzing the time lag between visit and covisit, we again see that the highest frequency (17K) corresponds to 0 days, implying same-day travel between the park's municipalities and Slovenian destinations. This underlines Slovenia's strong appeal as a day-trip destination, likely due to its proximity, accessibility, and perhaps well-connected cross-border routes. Substantial figures are also seen across surrounding intervals, such as +1 day (9.5K) and -1 day (9.6K), which together suggest that many visitors plan their itineraries to cover both areas in short succession, either staying overnight or continuing their trip across the border. Notably, the presence of high visit volumes across all intervals, even for longer separations like -7 to -4 days (11.3K) and 4 to 7 days (10.8K), indicates that the park and Slovenian sites are often linked within broader travel itineraries, not only spontaneous or immediate trips.

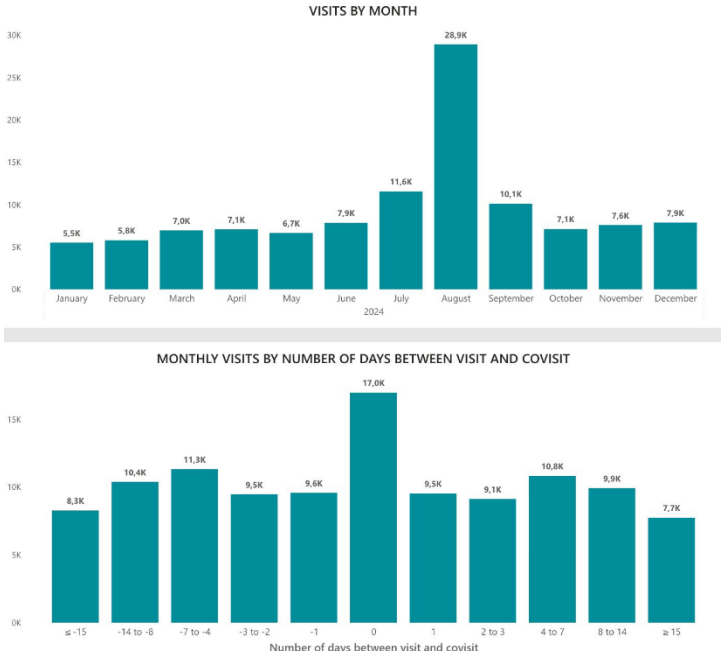


Figure 205 - Monthly distribution of covisit destination.

We are now moving to the valleys. The general pattern of the monthly visits by covisits area in all the valleys of analysis are the one in the following image.

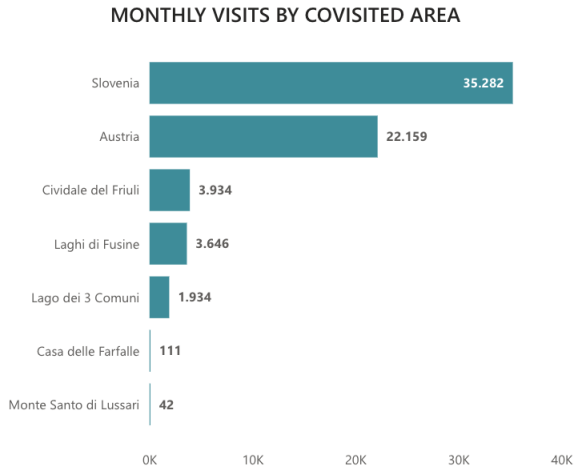


Figure 206 - Monthly visits by covisits area in all the valleys.

The image below described the covisit in Austria. It focused solely non-inhabitants of the covisit area and now considers Val Resia as areas of analysis. This dashboard provides a focused analysis of covisits from Val Resia to Austria, revealing a markedly limited but sharply seasonal mobility pattern. The monthly visits chart shows very low activity throughout most of the year, with near-zero figures from March to May and only modest increases in June (0.6K) and July (0.9K). However, there is a dramatic surge in August (4.0K). Although the most frequent lag time is -7 to -4 days (890 visits), suggesting that visitors often go to Austria a few days before visiting Val Resia, the distribution is fairly even across intervals, without one dominant behavioral pattern. This spread suggests that visits are not concentrated on the same day (as in Slovenia), but rather embedded within broader, flexible travel itineraries. The value of 0-day covisits (767) is relatively high, but not predominant, meaning that while day-trips are part of the picture, they are not the main mode of cross-border travel here.

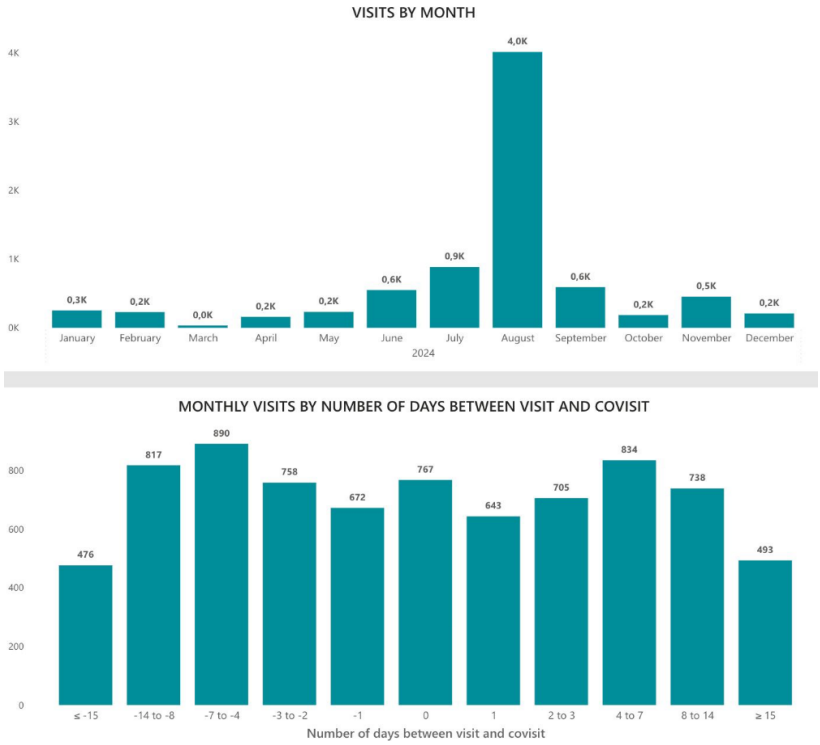


Figure 207 - Monthly distribution of covisited area in Austria.

This visualization presents covisitation patterns from Val Resia to Slovenia during 2024 and reveals a strong seasonal and behavioral structure. There is a clear and dominant peak in August (5.9K visits). A gradual increase starts from May (1.0K), continuing through June (1.4K) and July (2.2K), confirming a buildup of tourism toward the summer climax. After August, numbers drop but remain notable in September (1.4K), suggesting some late-summer tourism.

The "Monthly Visits by Number of Days Between Visit and Covisit" chart provides further behavioral insight. The most frequent scenario is same-day covisits (0 days, 2.6K visits), which suggests that Val Resia and Slovenian destinations are very closely connected geographically and functionally, making them ideal for day-trips or joint itinerary stops. However, the surrounding time intervals also show substantial numbers: -7 to -4 days (1.7K), -14 to -8 (1.5K), and +8 to +14 days (1.6K). These peaks suggest that a significant number of visitors travel between the two areas as part of longer cross-border vacations, integrating both sides of the border into a multi-day plan. Notably, pre-visits (negative days) show slightly higher volumes than post-visits in the same ranges, which may indicate Slovenia is often visited before Val Resia, potentially as a starting point or transit route.

Moving to the other valley, Sella Nevea, the covisit data from Sella Nevea to Austria in 2024 shows a distinct bimodal distribution of visitor flows, with two notable peaks. The first occurs in March (2.1K visits), likely tied to winter sports tourism, while the second and most prominent peak is in August (4.6K visits), clearly reflecting summer holiday travel. The "Monthly Visits by Number of Days Between Visit and Covisit" chart shows that the majority of visits happen on the same day (2.6K), underscoring a strong pattern of same-day cross-border mobility, likely facilitated by proximity and accessible roads or passes. Substantial volumes are also observed at +1 day (1.8K) and -1 day (1.5K), indicating that many travelers move between Sella Nevea and Austria within a tight timeframe, either before or after visiting the other.

A gradual decline in visits beyond ±3 days suggests that while Austria is mostly part of short-term tourism loops, it is also occasionally included in longer itineraries.

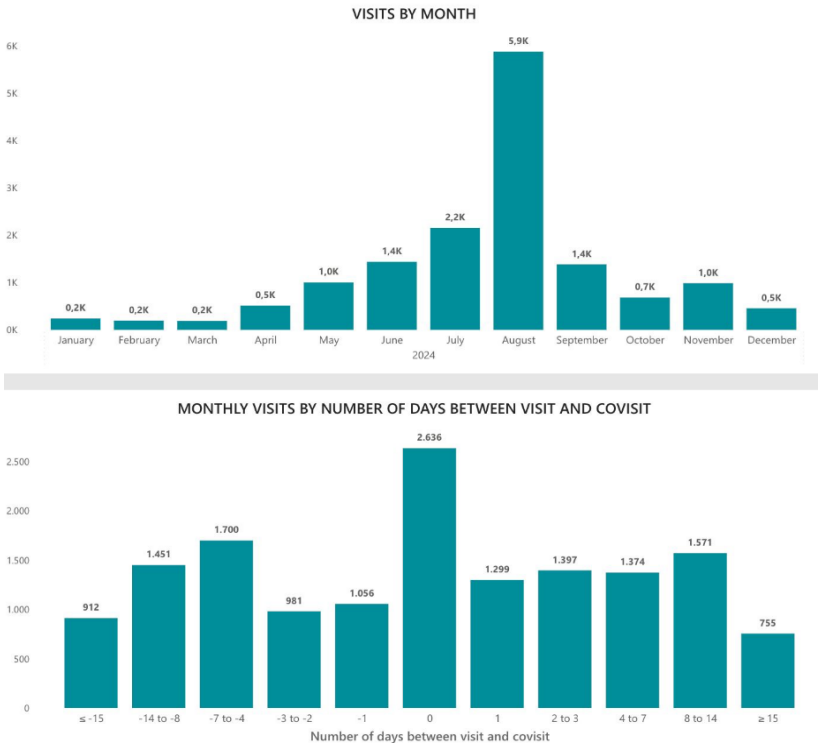


Figure 208 - Monthly distribution of covisited area from Sella Nevea to Slovenia.

This image displays the covisit trends from Sella Nevea to Slovenia in 2024. The "Visits by Month" chart shows one prominent peak in August (6.8K visits). The "Monthly Visits by Number of Days Between Visit and Covisit" chart shows that the majority of visits (6.1K) occur on the same day (0 days), confirming that Sella Nevea and Slovenian destinations are strongly connected as day-trip or same-day tourism options. A significant portion of visitors also travel within a short window before or after: -1 day (2.1K) and +1 day (1.9K), with consistent activity between -7 to -4 days (1.6K) and 2 to 7 days (1.5K each). This distribution reflects a pattern of short, flexible cross-border itineraries, typical of areas where

geographical proximity, accessibility, and shared attractions support fluid movement. The balanced spread on either side of the visit indicates Slovenia is both a starting point and a follow.

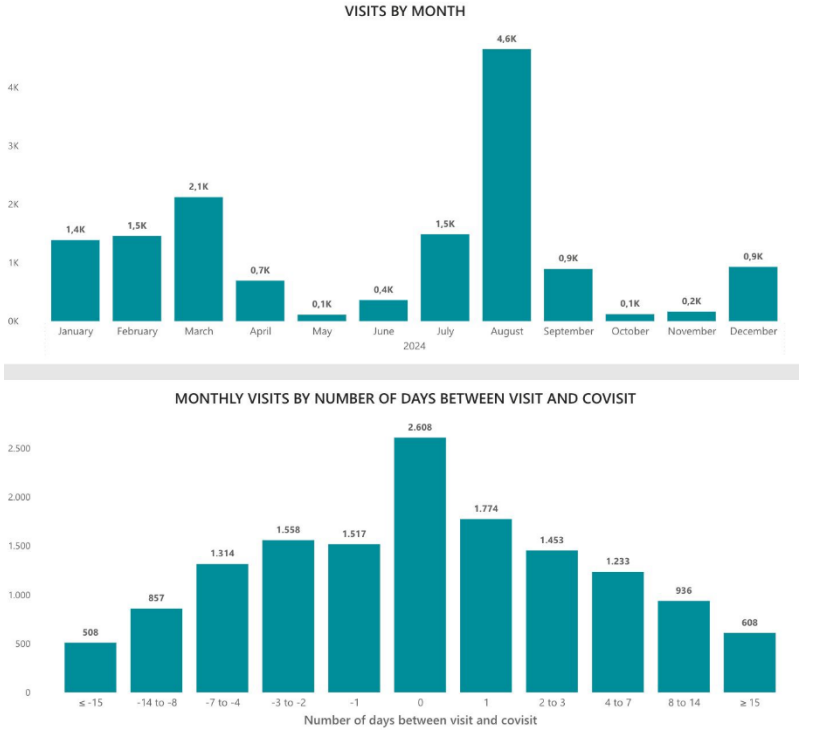


Figure 209 - Monthly distribution.

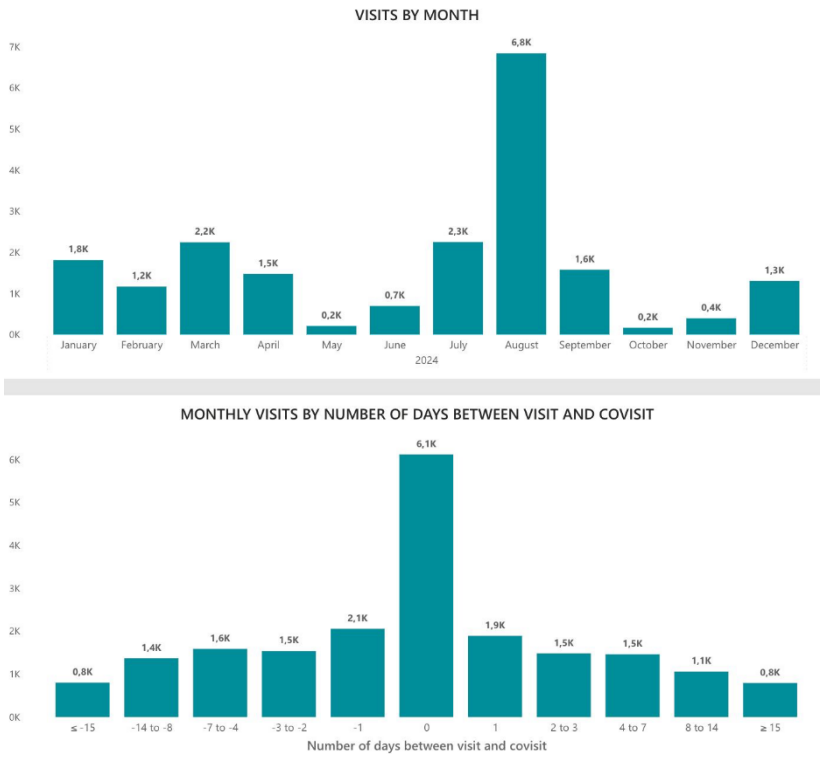


Figure 210 - Monthly distribution.

7.7 Regression Analysis Results

Table 17 - Effects of rain, temperature and seasons on visitors counts (from Eco-counters).

Regression results: effects of rain, temperature and seasons on eco-counter counts										
Ecocounters Weather station	Sentiero Botanico "Bila Pec" Livinal Lunc	Sentiero Malga Coot Uccea	Strada Sella Carnizza Resia	Ta Lipa Pot Resia	Sentiero Rio Nero Resia	Sentiero Val Alba Bivacco Bianchi	Sentiero Valle Musi Musi	Ciclabile Val Resia Resiutta	Strada malga Coot Uccea	Strada malga Confin Malga Cjariguart
Total precipitation (mm)	-0,366***	-0,054	-0,044	-0,110*	-0,010*	-0,185***	-0,068***	0,493	0,415	
Average temperature (°C)	4,511***	1,628***	4,238***	1,534***	0,249***	0,633***	0,379***	0,092*	0,001***	
Spring	-15,715**	-9,514***	-7,685**	-0,049	-0,023	1,839**	-1,930		0,018**	
Summer	62,881***	-3,158	26,439***	0,996	1,817***	6,059***	0,600		0,618	
Autumn	-6,606	5,082	18,706***	2,167	-0,023	7,736***	4,319***		0,003***	
R squared	0,381	0,148	0,515	0,179	0,146	0,205	0,081	0,103	0,112	
Observations (N)	1003	1003	1591	363	2103	2314	1044	36	1827	

To explore the influence of environmental conditions on park visitation, a regression analysis was conducted using eco-counter data as the dependent variable and weather variables (total precipitation and average temperature), along with seasonal indicators, as explanatory factors. Each of the 10 eco-counters was paired with its closest meteorological station(s) to ensure accurate spatial representation of climate conditions. The analysis revealed substantial variability in the effects of weather and seasonal conditions across locations. Total precipitation generally showed a negative correlation with visitor numbers, being statistically significant in locations such as "Sentiero Botanico 'Bila Peč'" (coefficient = –0.37) and "Sentiero Val Alba Bivacco Bianchi" (coefficient = –0.18), indicating reduced visitation during wetter periods.

The regression analysis focusing on average temperature reveals a predominantly positive and statistically significant relationship with visitor numbers across most eco-counter locations. Warmer temperatures appear to encourage higher visitation, particularly at Sentiero Botanico "Bila Peč " – Livinal Lunc (coefficient = 4.51), Strada Sella Carnizza – Resia (coefficient = 4.24), and Ta Lipa Pot – Resia (coefficient = 1.53).

Seasonal trends played a key role, with summer having a consistently strong and positive influence on eco-counter counts across most sites, notably in "Sentiero Botanico 'Bila Peč '" (coefficient = 62.88) and "Strada Sella Carnizza - Resia" (coefficient = 26.44).

Spring and autumn effects were more variable and site-specific.

For the site Ciclabile Val Resia - Resiutta, the regression analysis was conducted using only total precipitation and average temperature as explanatory variables. This is because only 36 observations were available, all from spring 2025, which did not allow for the inclusion of seasonal variables due to insufficient temporal variability.

The explanatory power of the models, as indicated by the R-squared values, ranged from low (e.g., 0.081 for "Sentiero Valle Musi - Musi") to moderate (e.g., 0.515 for "Strada Sella Carnizza - Resia"), suggesting that while weather and seasons contribute meaningfully to visitor trends, other factors may also play a role. Overall, the results underscore the importance of considering both spatial and temporal variation when assessing how environmental conditions affect park usage.

Table 18 - Effects of rain, temperature and seasons on visitors counts (from BigData).

Regression results: effects of rain, temperature and seasons on Big Data									
Big Data (municipalities) Weather station	Chiusaforte Livinal Lunc	Resia Uccea	Resia Coritis	Resia Resia	Resia Resiutta	Moggio Udinese Bivacco Bianchi	Lusevera Musi	Resiutta Resiutta	Venzone Malga Cjariguart
Total precipitation (mm)	-3,637***	-0,829**	-0,674	-0,838	-0,922	-0,492	-0,724***	-0,679*	0,533
Average temperature (°C)	46,238***	25,070***	25,357***	22,872***	20,365***	10,810***	15,962***	10,394***	27,509***
Spring	-465,847***	-159,401***	-147,481***	-140,546***	-133,717***	-32,559**	-51,459***	-41,875*	20,862
Summer	-165,128	226,029***	230,236***	263,688***	300,302***	187,181***	16,152	102,561***	518,227***
Autumn	-769,699***	-33,342	-36,138	-17,742	-3,781	-64,419***	-54,763**	9,186	97,998**
R squared	0,332	0,537	0,533	0,523	0,515	0,554	0,439	0,373	0,639
Observations (N)	486	486	486	486	486	486	486	486	486

The table presents the results of regressions conducted for different municipalities within the region, using weather-related variables to explain variation in Big Data visitor counts between the beginning of 2024 and April 30, 2025. Each regression corresponds to a specific weather station associated with a municipality, and the dependent variable is the number of people visiting that municipality, while the independent variables include total precipitation (in mm), average

temperature (°C), and seasonal dummies (Spring, Summer, and Autumn; Winter is likely the omitted baseline category). The results indicate that precipitation generally has a negative effect on visitor numbers, with statistically significant coefficients in most regressions, particularly for Chiusaforte (coefficient = -3.637), Resia-Uccea (coefficient = -0.829), and Lusevera-Musi (coefficient = -0.724). This suggests that wetter conditions tend to discourage visitation. However, an exception is seen in Venzone-Malga Cjariguart where the coefficient is positive (0.533), though not statistically significant.

In contrast, average temperature shows a strong and consistent positive effect on visitation, with highly significant coefficients across all municipalities, such as in Chiusaforte (coefficient =46.238), Resia-Coritis (coefficient = 25.357), and Venzone (coefficient = 27.509). This suggests that warmer weather is a key driver of human mobility likely enhancing outdoor accessibility and comfort. Regarding seasonal effects, Spring consistently shows a negative and significant effect, especially in Chiusaforte (coefficient = -465.847), Resia-Uccea (coefficient = -159.401), and Resia-Resiutta (coefficient = -133.717), implying that despite rising temperatures, early-season conditions may still limit visitor flows, possibly due to residual snow or less favorable trail conditions. Summer demonstrates a strong and significantly positive impact on visitor numbers in all areas where it is significant, particularly in Resia-Resiutta (coefficient = 300.302) and Venzone (coefficient = 518.227), underscoring the peak tourist season. Conversely, Autumn exhibits mixed effects, with strong negative coefficients in Chiusaforte (coefficient = -769.699) and Moggio Udinese (coefficient = -64.419), while positive and significant impacts are found in Venzone (coefficient = 97.998), suggesting geographic and activity-specific preferences for fall travel.

All models include 486 observations, ensuring comparability. Overall, the findings confirm that weather variables, particularly temperature and season, are significant predictors of visitor numbers, though the magnitude and direction of effects vary by municipality, reflecting local climatic, geographical, and infrastructural differences.

7.7.1 Comparison between the Two-Regression Analysis

The two regression tables provide valuable insight into how weather variables (precipitation, temperature, and seasons) influence outdoor human activity in the Julian Alps region. The first table uses eco-counter data (visitor counts at specific trails and paths) as the dependent variable, while the second table uses Big Data-based municipal visitation as the dependent variable. Across both models, average temperature is a consistently positive and highly significant predictor of human presence. In both eco-counters and Big Data regressions, higher temperatures strongly correlate with increased visitation, confirming that warm conditions favor outdoor recreational activity and mobility. For example, coefficients for average temperature are significant in almost all locations. This coherence underlines temperature's pivotal role in promoting mountain tourism and trail usage. Regarding precipitation, both models generally show a negative relationship with visitation, though the effect is a little bit stronger in the Big Data regressions. Significant negative coefficients indicate that rain deters broader regional travel. In the eco-counter regressions, this effect is weaker and often statistically insignificant. A major difference between the two tables lies in the strength of the seasonal effects. In the Big Data model, Summer has an overwhelmingly positive and highly significant influence on visitation in nearly all municipalities highlighting that summer is the peak tourist season. By contrast, the seasonal effects in the eco-counter model are more inconsistent: while Summer is positive in a few trails, it is insignificant or even negative in others. This suggests that while summer may attract people to municipalities, it does not necessarily result in equivalent use of trails, potentially due to microclimatic factors, trail difficulty, or crowding. The spring and autumn seasons have been observed to yield adverse or equivocal outcomes in both models, with spring exhibiting a marked negative effect in numerous instances, possibly attributable to the persistence of snow, the inaccessibility of trails, or the inherent uncertainty characteristic of the early season. Autumn exhibits a robust negative impact on Big Data regressions; however, its effect is more nuanced in the eco-counter model, ranging from significant to insignificant or even positive

in various instances. This suggests that while there is a general decline in travel during the autumn months, specific trails may still attract niche visitors who are drawn to activities such as viewing foliage or collecting mushrooms.

7.8 Monthly Proportion of Visitors Engaging with Trail Networks: Eco-Counter Usage Relative to Total Municipal Presence (Jan 2024 – Apr 2025)

Table 19 - Monthly percentages from January 2024 to April 2025.

	Sentiero Botanico Bila Pec - Chiusaforte (BigData)	Sentiero Malga Coot - Resia (BigData)	Strada Sella Carnizza - Resia (BigData)	Ta Lipa Pot - Resia (BigData)	Sentiero Rio Nero - Resia (BigData)	Sentiero Val Alba - Moggio Udinese (BigData)	Sentiero Valle Musi - Lusevera (BigData)	Ciclabile Val resia - Resiutta (BigData)		Strada malga Coot - Resia (BigData)
2024-01	0,00	0,04	1,03	-	0,71	0,40	11,57	-		0,04
2024-02	0,00	0,82	0,63	-	0,41	0,49	15,60	-		0,82
2024-03	0,00	4,61	9,06	-	1,77	0,35	9,94	-		4,61
2024-04	0,00	6,03	8,85	-	2,90	0,94	10,54	-		6,03
2024-05	0,00	3,81	20,09	6,98	1,67	1,71	5,71	-		3,81
2024-06	0,67	0,47	19,97	4,92	1,16	2,07	5,25	-		0,47
2024-07	10,44	-	12,74	5,06	0,74	1,94	2,80	-		-
2024-08	10,71	-	6,20	4,30	0,82	1,47	2,52	-		-
2024-09	8,80	-	-	6,65	1,09	2,07	6,25	-		-
2024-10	0,93	-	-	5,69	0,85	2,39	9,55	-		-
2024-11	0,27	-	-	15,41	1,71	3,34	12,88	-		-
2024-12	0,00	-	-	6,46	2,02	0,77	8,38	-		-
2025-01	0,00	-	-	10,65	0,54	0,47	11,39	-		-
2025-02	0,00	-	6,36	9,91	1,41	0,65	11,29	-		-
2025-03	0,00	-	24,13	37,50	6,78	1,23	-	-		-
2025-04	0,00	10,99	51,74	21,94	3,95	1,54	-	20,78		-

The table presents monthly percentages from January 2024 to April 2025, representing the proportion of individuals who passed through 10 different eco-counters located along key hiking and recreational paths within the Julian Alps region, relative to the total number of people detected via Big Data in the corresponding municipalities. This analysis enables the evaluation of how much of the visitor flow is captured through direct trail usage, thereby reflecting engagement with nature-based infrastructure.

A seasonal pattern emerges, with the majority of eco-counters showing very low or no trail usage during the winter months (January, February, December), reflecting either poor weather conditions, limited accessibility.

Usage increases notably between May and September, with peaks in July and August, aligning with typical summer tourism patterns. In particular, the Sentiero Botanico Bila Peč reached 10.44% in July and 10.71% in August 2024, while Strada Sella Carnizza – Resia recorded 20.09% in May and 19.97% in June. This suggests that during peak summer months, a substantial share of the general visitor population is engaging with trails, possibly due to favorable weather, vacation periods. Some eco-counters show particularly high engagement in early spring 2025, notably Strada Sella Carnizza – Resia, with a sharp increase to 24.13% in March and 51.74% in April 2025, possibly due to earlier snowmelt or increased promotional activity. Similarly, Ta Lipa Pot – Resia and Sentiero Rio Nero – Resia also showed a late-season surge in March–April 2025. This sharp rise may be indicative of shifting seasonal patterns or improved trail conditions earlier in the year. However, such spikes should be interpreted cautiously and further contextualized with weather data and local events. On the other hand, certain trails show persistently low levels of recorded activity. For example, Sentiero Val Alba – Moggio Udinese and Ciclabile Val Resia – Resiutta consistently report usage rates below 3%, with sparse data availability. These low percentages may be attributed to low trail visibility, limited accessibility, or less appealing experiences for casual visitors.

A salient issue in the present analysis is the presence of dashes (–) in the dataset. These dashes denote missing eco-counter data, and they introduce gaps that limit full temporal continuity in the analysis. However, the consistent detection of trail activity during the warmer months and the resurgence observed in early 2025 offer critical insights into visitor behavior in relation to natural trail infrastructure. These figures underscore the necessity to align trail

maintenance, marketing, and services with seasonal dynamics. Furthermore, they support the development of targeted mobility and conservation strategies to optimize visitor distribution and enhance the use of eco-tourism assets.

7.9 Consolidation and Interpretation of Results

The visitor profiling, which was conducted through a combination of onsite and online surveys, revealed a variety of engagement patterns with the Julian Prealps Nature Park. Onsite visitors exhibited a stronger sense of connection to the park's core values and natural environments. Many of them identified nature, walking, and biodiversity as central motivations for their visits. This group has been observed to engage in a greater number of immersive experiences, including extended stays, organized excursions, and accommodations situated within natural environments, such as mountain huts and campsites. Conversely, online respondents—particularly those who had not yet visited—expressed a more expansive array of motivational profiles, emphasizing relaxation, emotional well-being, and social dimensions such as family or couple-based leisure. However, a recurrent theme across both groups was the pursuit of relaxation and enjoyment in nature, thereby underscoring the park's function as a restorative natural space. However, onsite visitors more frequently associated their visits with physical activity and exploration, indicating a deeper level of interaction with the park's natural offerings. Patterns of access and mobility further illustrate the current limitations and opportunities in sustainable park visitation. The data demonstrate that a majority of onsite respondents, exceeding 84%, rely on private vehicles for transportation, while alternative methods such as public transit and cycling remain underutilized. This phenomenon is corroborated by big data analyses, which reveal a high prevalence of same-day visits, particularly among Italian visitors. These findings imply that access to the park is predominantly influenced by factors such as convenience, flexible scheduling, and minimal travel distances. The limited adoption of shared or public mobility options underscores the presence of existing infrastructural or perceptual barriers, thereby emphasizing the pressing need to allocate resources towards the development of integrated transportation solutions. The discrete choice experiment corroborates this need, as enhanced shuttle services received one of the highest willingness-to-pay values among surveyed visitors, reflecting strong interest in accessible and sustainable travel options. The incorporation of spatial and temporal dynamics serves to further refine the comprehension of visitor flow and distribution. The data reveal a pronounced seasonality, with peak visitation occurring during July and August. While the broader biosphere reserve attracts a mixture of domestic and international visitors, municipalities such as Sella Nevea and Chiusaforte exhibit a notably high proportion of foreign tourism, particularly from neighboring countries such as Austria, Slovenia, and Germany. It has been observed that other municipalities, such as Artegna and Gemona del Friuli, continue to demonstrate a greater degree of reliance on local and regional visitors. Within the park's valleys, distinctive patterns emerge. Val Resia demonstrates a stronger appeal among domestic, same-day visitors, while Sella Nevea exhibits a dual seasonal character, attracting winter and summer tourists who typically engage for longer durations. Despite these variations, short visits lasting 2–3 hours predominate among same-day guests, indicating a demand for more lightweight yet high-quality interpretive services and infrastructure to support meaningful but time-limited experiences. Cross-border tourism has emerged as a strategic asset of the Julian Prealps. An analysis of visitation patterns reveals a robust correlation between the park and Slovenian destinations, with a notable proportion of paired visits occurring on the same or subsequent day. The facilitation of these flows is attributed to geographic proximity and the presence of shared cultural or environmental assets, which collectively contribute to the area's high degree of suitability for cross-border itineraries. Austrian destinations emerge as more prominent components within the broader framework of transnational circuits. The prevalence of cross-border tourism underscores the significance of Peace Park initiatives and necessitates enhanced alignment in infrastructure, communication strategies, and promotional endeavors. The significant interest in connections to Triglav National Park and long-distance trail systems indicates a growing demand for integrated, cross-boundary nature experiences. Visitor preferences regarding future services and infrastructure provide further guidance for sustainable planning. The discrete choice experiment revealed a high willingness to pay for guided farm visits, enhanced food availability, and reliable shuttle connections. These features combine nature

immersion with comfort and cultural enrichment. Conversely, amenities such as bicycle rentals or firewood bundles exhibited diminished utility, indicating a limited appeal within their current configuration. The increasing interest in wellness services, educational opportunities, and transnational packages indicates a shift toward multifunctional tourism, where recreational, cognitive, and emotional needs are met simultaneously. These findings provide a valuable roadmap for diversifying park offerings without compromising ecological integrity.

The incorporation of regression analysis findings into the broader exchange of ideas provides significant insight into the extent to which environmental factors influence park visitation dynamics. The utilization of eco-counters and Big Data as dependent variables in both models serves to underscore the pivotal role of average temperature as a consistent and substantial driver of visitor presence. The observed positive relationship across nearly all sites and municipalities confirms that warmer temperatures play a facilitating role in promoting outdoor recreation and trail engagement. This phenomenon is further substantiated by a seasonal analysis, which consistently reveals summer as the most active period across various locations. However, the magnitude and consistency of seasonal effects vary, particularly between municipal-level visitation and trail-level usage, suggesting nuanced behavioral patterns depending on the scale and nature of the visit. The cross-referencing of monthly eco-counter percentages with municipal visitation further validates these trends. The months of July and August, which correspond to the peak summer season, have been observed to demonstrate a consistent increase in trail engagement rates. However, it is noteworthy that certain spring months, such as April 2025, have also been observed to exhibit unexpected spikes in trail usage. This phenomenon underscores the importance of favorable weather conditions and underscores the necessity of monitoring the evolving seasonal dynamics, which may be influenced by climate change or shifting visitor preferences. Concurrently, the persistent underperformance of certain trails indicates underlying issues concerning accessibility, visibility, or marketing reach, thereby underscoring the necessity of site-specific infrastructure planning and communication strategies. The alignment of visitor trends with weather patterns, as well as the disparities between general visitation and trail usage, offer key guidance for developing resilient, responsive, and targeted tourism strategies across the park region.

Taken together, this integrated analysis underscores the importance of aligning tourism management strategies with the behavioral profiles, motivations, and constraints of visitors. Key priorities for the sustainable development of the Julian Prealps Nature Park include expanding cross-border collaboration, improving sustainable mobility, enhancing environmental education, and diversifying low-impact visitor services. The park's unique value as a nature-connected and emotionally meaningful space must be preserved while new opportunities are explored to broaden its reach. Crucially, continuous monitoring using a mix of surveys, big data, and automated counters should remain central to adaptive park governance, ensuring that decisions remain evidence-based and responsive to evolving visitor dynamics.

8 Findings from the Data Interpretation in Italy and Austria

8.1 Findings from the Data Interpretation in Italy

The analysis of visitors to the Julian Prealps Nature Park highlights diverse profiles and motivations. Onsite visitors showed stronger connections to nature, biodiversity, and physical activity, often engaging in longer and more immersive stays, while potential or online respondents emphasized relaxation, social activities, and emotional well-being. A common theme across all groups was the park's role as a restorative natural space. Mobility emerged as a key challenge, with most visitors relying on private cars and showing interest in more accessible and sustainable transport options. Seasonal patterns were clear, with peaks in summer and differences across municipalities and valleys, ranging from strong domestic day trips to longer stays, particularly in cross-border areas with Slovenia and Austria. This underlines the park's strategic position within wider regional and international tourism flows. Visitor preferences also pointed to interest in combining nature with cultural, educational, and wellness experiences, while more basic amenities appeared less relevant. Environmental conditions, especially favorable weather, strongly influenced visitation, with clear peaks but also unexpected increases outside the main season. Overall, the findings suggest priorities for sustainable development: improving mobility, strengthening cross-border cooperation, diversifying low-impact services, and enhancing educational and cultural opportunities, while ensuring the park's natural and emotional values remain central.

8.1.1 Recommendations for the Julian Prealps Nature Park

Based on the integrated results from surveys, mobility data, and behavioral analyses, several strategic recommendations can be drawn for the Natural Park of the Julian Prealps to enhance sustainable tourism management and strengthen its regional role as a model for nature-based tourism.

The findings reveal that visitors are primarily motivated by the Park's natural beauty, tranquility, and outdoor recreation opportunities, suggesting that maintaining and communicating the Park's ecological authenticity should remain a core priority. The Park should therefore invest in conservation-oriented visitor management, ensuring that increased visitation does not compromise ecosystem integrity, particularly in sensitive biodiversity zones. The analysis of visitor profiles highlights distinct groups, from local day visitors and nature enthusiasts to longer-stay tourists seeking cultural and cross-border experiences, requiring targeted communication and diversified visitor services, such as thematic trails, guided eco-tours, and interpretive zones that link nature and culture. The Big Data and eco-counter results show strong seasonality and concentration along specific access points, indicating the need for spatial and temporal diversification strategies to distribute visitor flows more evenly and reduce pressure on the most frequented areas. Expanding soft mobility options like cycling routes, electric shuttles, and integrated public transport would further reduce environmental impacts and improve accessibility. The Park could also develop digital tools and mobile applications to provide real-time trail information, educational content, and interactive features that foster environmental awareness and responsible behavior among visitors. Moreover, survey and choice experiment results indicate a positive willingness to pay for conservation, suggesting the feasibility of voluntary eco-contribution mechanisms, with revenues reinvested in habitat restoration, local products, and community-led projects. Partnerships with local businesses could further promote sustainable regional products and circular economy initiatives, enhancing local livelihoods while reinforcing the Park's identity as an authentic Alpine destination. To sustain these actions, the Park should establish a permanent monitoring and data observatory, integrating visitor, environmental, and mobility data to guide adaptive management and evidence-based policymaking. Finally, fostering stronger cross-border cooperation with Slovenia and engaging local schools, residents, and citizen science initiatives will deepen shared stewardship, ensuring that the Natural Park of the Julian Prealps continues to thrive as a resilient, inclusive, and exemplary model of sustainability in the Alpine region.

8.2 Findings from the Data Interpretation in Austria

The analysis of visitors in the Dobratsch Nature Park and the region surrounding reveals diverse profiles and motivations, similar to those observed in the Julian Prealps Nature Park. Visitors to the park are primarily motivated by its reputation as a local retreat, offering opportunities for relaxation, outdoor activities, and connection to nature. Hiking remains the most popular activity, with many visitors exploring the summit area, the Rosstratte, and the Alpine Botanical Garden. The park's role as a "Hausberg" for the nearby city of Villach is evident, as a significant proportion of visitors are local residents who view the park as an accessible and familiar destination for leisure and recreation. This contrasts with visitors from other Austrian regions, who tend to visit less frequently and often for shorter durations.

Mobility patterns reveal a strong dependence on private vehicles, with public transport and cycling routes being underutilized. This reliance on cars is particularly pronounced among local visitors, who often make same-day trips to the park. Mobile phone data confirms that the majority of visitors originate from Carinthia, with smaller numbers traveling from Styria, Salzburg, Vienna, and Lower Austria and from abroad.

The findings emphasize several priorities for sustainable development in the Dobratsch Nature Park. Addressing mobility challenges through improved public transport, electric shuttles, and cycling infrastructure is essential to enhance accessibility and reduce reliance on private vehicles. Strengthening cross-border cooperation with neighboring regions, such as Slovenia and Italy, can further integrate the park into transnational tourism circuits, leveraging its strategic location within the Alps-Adriatic region. Diversifying visitor services to include low-impact activities and enhancing educational and cultural opportunities will help meet evolving visitor needs while preserving the park's natural and cultural values. Continuous monitoring and adaptive governance will be crucial to ensuring the park's long-term sustainability and its role as a leading example of sustainable tourism in the region.

8.2.1 Recommendations for the Dobratsch Nature Park

The recommendations for the Dobratsch Nature Park focus on sustainable tourism management, visitor guidance, and strengthening the park's role as a model for nature-based tourism. To address issues such as excessive tourist pressure in certain areas and under-utilization in others, strategies should be implemented to manage visitor flows and distribute tourism activities more evenly across the park. Expanding soft mobility options, such as cycling routes, alternative ways of transport and integrated public transport, is essential to reduce environmental impacts and improve accessibility.

Digital tools and mobile applications should be developed to provide real-time trail information, educational content, and interactive features that foster environmental awareness and responsible visitor behavior. Harmonizing and upgrading digital platforms with shared content and multilingual accessibility will further enhance the visitor experience. Infrastructure improvements are necessary to elevate the overall tourist experience and effectively manage visitor flows, while diversifying and improving accommodation options can extend visitor stays and support the local economy.

Local communities should be actively involved in decision-making processes and tourism planning through participatory governance. An annual cross-border forum rotating between Austria, Italy, and Slovenia could focus on themes such as biodiversity, sustainability, and cultural heritage.

Strengthening cross-border collaboration with Slovenia and Italy is vital to align conservation efforts with sustainable tourism development. Establishing a joint cross-border governing body with representatives from Austria, Italy, and Slovenia can help coordinate actions and share resources effectively. These recommendations aim to balance tourism development with nature conservation, ensuring the park remains a resilient and exemplary model of sustainability in the Alpine region.

9 Cross-Border Recommendations for Action on the Way to a Cross-Border Visitor Management System (VIMASY)

The development of a sustainable and harmonized visitor management system (ViMaSy) for the Alps-Adriatic region is both a strategic necessity and an opportunity to strengthen cross-border cooperation. Protected areas and tourism destinations in this region share interconnected ecosystems, visitor flows, and cultural landscapes that transcend national borders. Effective visitor management, therefore, cannot be achieved in isolation. It requires a coordinated approach that balances the protection of natural and cultural heritage with the provision of high-quality visitor experiences and the promotion of regional identity.

Chapter 9 of the INDI ALPS final report presents cross-border recommendations for action that build on the findings of a comprehensive visitor analysis and the collective expertise of project partners, protected area managers, tourism organizations, and other stakeholders. These recommendations aim to address shared challenges—such as seasonal overcrowding and uneven service standards—while unlocking new potentials for sustainable tourism development.

The foundation for this chapter was laid during a dedicated full-day workshop on 6 June 2025 at the Carinthia University of Applied Sciences in Villach, Austria. The workshop brought together stakeholders from Austria, Italy, and Slovenia to jointly identify strategic priorities, consolidate best practices, and explore innovative solutions for cross-border visitor management.

The chapter not only outlines actionable measures for the near future but also formulates a shared strategic vision for 2030: a connected, well-managed cross-border tourism landscape where conservation and visitor experience reinforce each other, local communities are actively involved, and the region's unique natural and cultural values are safeguarded for generations to come.

9.1 Description of Cross-Border Recommendations for Action Workshop Format

Workshop on Cross-border Recommendations for Action (Chapter 5)

- Date: June 6, 2025;
- Time: 10:00 AM – 4:00 PM;
- Location: CUAS – Carinthia University of Applied Sciences, Europastraße 4, 9524 Villach, Austria - Campus Villach - T01: Konferenzraum(NT 3.16c);
- Facilitation: CUAS, Elisabeth and Lilia.

Workshop Objectives

This full-day workshop is dedicated to the co-development of Chapter 5 of the INDI ALPS final report, which focuses on cross-border recommendations for a sustainable visitor management system (ViMaSy) in the Alps-Adriatic region. The aim is to bring together all project partners and relevant stakeholders to reflect on the findings of the visitor analysis, identify shared challenges and opportunities, and collaboratively shape actionable strategies that strengthen cooperation between protected areas and tourism stakeholders.

The workshop will also serve as a platform to consolidate common standards, explore best practices, and brainstorm innovative cross-border tourism products and services. The goal is to lay the foundation for a harmonized and institutionalized approach to visitor management that aligns with long-term sustainability goals and regional identity.

10:00 – 10:15 | Welcome, Coffee & Introduction

- Welcome round and overview of the day's agenda. The relevance of Chapter 5 within the broader INDI ALPS final report will be briefly explained.

10:15 – 10:30 | PLAN to Connect

10:30 – 11:00 | Regional Inputs: Where We Stand

- Short statements from project partners (5–7 minutes each);
- What are the key findings from the visitor analysis?;
- What challenges and opportunities do we see for cross-border visitor management?.

11:00 – 12:15 | Session 1: Building the Foundations of ViMaSy

This session will use a World Café format with three rotating discussion tables, each focusing on a key component of the future ViMaSy system:

- Cooperation and Governance: What structures are needed for long-term cross-border collaboration?;
- Standards and Best Practices: Which tools and practices can be shared and standardized?;
- Communication and Guidelines: How can we jointly inform visitors and foster responsible behavior (e.g., Digitize the Planet)?;
- 8 Min pro Table, 15 min Presentation;
- After the rotations, each group will report their key takeaways in a plenary session to build a collective understanding.

12:15 – 13:15 | Lunch Break

13:15 – 14:15 | Session 2: Identifying Hot Spots, Low Spots and Potentials (Karten Plot: SG, Heatmaps, POIs, Infrastructures)

In this session, participants will work in small groups using regional maps, data visualizations (e.g., heatmaps), and short area profiles. The task is to identify on 3 Tables:

- Undervalued tourism potentials - POIs Map;
- Areas under pressure or showing signs of conflict - SG Map;
- Missing infrastructure or services - Infrastructure Map;
- 20 Minuten, 8 Minuten Präsentation pro Tisch;
- For all tables Specific action points to improve visitor flow and reduce impact.

14:15 – 15:15 | Session 3: Open Box for Solutions and Strategic Vision

Participants come together to share and prioritize ideas. Using interactive tools (e.g., physical pinboards or digital tools like Mentimeter), they will:

- Collect and cluster the offers;
- Evaluate short-term vs. long-term feasibility;
- Formulate a shared vision for ViMaSy in 2030;
- This session is aimed at consolidating the recommendations into a structured and strategic direction for Chapter 5.

15:15 – 15:45 | Wrap-up & Next Steps

- Joint summary of workshop outcomes;
- Explanation of how the results will be integrated into Chapter 5;

- Overview of next steps in the editorial process;
- Invitation to participate in the upcoming feedback round;
- 22.01. INDI ALPS FINAL Event.

15:45 – 16:00 | Closing

- The workshop concludes with an informal coffee and networking opportunity, allowing participants to follow up on open topics and strengthen cross-border connections;
- Europarc Conference Discussion for presenting the results.

9.2 Cooperation between the Participating Parks and Tourism Organizations

The previously delineated workshop assists the project in developing all the suggestions and guidelines that are presented in the following section.

9.2.1 Open Box for Ideas at Transboundary Stakeholder Workshop

In a collaborative brainstorming exercise designed to identify and prioritize the most crucial actions for strengthening cross-border cooperation within the trilateral biosphere reserve participants were encouraged to freely share ideas and perspectives based on their experiences and local insights. The discussion generated a variety of concrete suggestions aimed at improving governance, inclusivity, community engagement, and long-term strategic alignment among the three countries involved. Key proposals included establishing a clear and predictable framework for regular cross-border meetings to maintain continuous dialogue and build trust among the parks and then the stakeholders, providing a formal space for shared decision-making and coordination. It was strongly emphasized the importance of ensuring that local inhabitants are not overlooked in decision-making processes, recognizing that their daily lives and economic activities are directly connected to the success of the biosphere reserve. Another major proposal was to organize an annual forum, rotating its location each year among the three participating countries to ensure balanced representation and shared ownership. Each forum would be structured around a central unifying theme, such as biodiversity, nature conservation, or sustainable development, to stimulate focused discussions and foster practical solutions relevant to the region's unique cross-border context. In addition, agreement on the need to actively involve local stakeholders and small business owners, recognizing them as both residents and vital contributors to the local economy and cultural identity. There was also consensus on the benefit of inviting technical experts with direct field knowledge, whose practical insights could help ground discussions in reality and minimize the influence of political agendas. However during the workshop, perspectives varied regarding political engagement: while some advocated for limiting it to avoid bureaucratic delays, others argued for the active involvement of municipal representatives to ensure political support and to keep local authorities well-informed and supportive of ongoing initiatives. To overcome language barriers and ensure inclusive participation for all nationalities, the provision of high-quality translation services and facilitation of effective multilingual communication were also highlighted as priorities. The previous diverse inputs were organized into four thematic clusters that will guide future action: Communication, emphasizing the need for clear, transparent, and multilingual information flow; Awareness and Ownership, focusing on fostering a sense of shared responsibility and local engagement; Peace Park, reflecting the vision of the biosphere reserve as a cross-border symbol of harmony and cooperation; and Guidance System and Monitoring System, aimed at establishing robust frameworks for continuous evaluation, adaptation, and governance. This collective input forms the foundation for developing a shared strategic vision and concrete action plan to strengthen cross-border collaboration, preserve the natural and cultural heritage of the area, and ensure that local communities remain at the heart of the biosphere reserve's sustainable future.

9.2.2 Common Standards and Exchange of Best-Practices

Practical methods and tools were identified that could be adopted jointly across the biosphere reserve to harmonize operations, promote mutual learning, and enhance the overall visitor and community experience. The discussion brought forward several concrete proposals aimed at creating shared frameworks and fostering stronger cross-border relationships. One key recommendation was to implement staff exchange programs among the protected areas and relevant institutions. Such exchanges would allow personnel from different countries to gain firsthand experience of each other's management practices, build professional relationships, and deepen cultural understanding, ultimately strengthening day-to-day collaboration and problem-solving across borders. It also highlighted the importance of collaborating closely with local schools and actively engaging young people in activities related to the biosphere reserve. By fostering youth awareness and participation, the initiative would help cultivate a new generation that is informed about conservation, sustainability, and the unique value of living in a cross-border protected area. To support this goal, the group proposed organizing bilateral or trilateral summer camps, which would bring together students from the three countries for shared learning experiences, outdoor activities, and intercultural exchange. These camps would not only build connections among young people but also help instill a sense of shared management for the region's natural and cultural heritage. Another priority identified was the need to develop and upgrade websites and digital applications for the biosphere reserve. Enhanced online platforms would improve how information is communicated to visitors and residents, make planning visits easier, and provide educational resources that reflect the area's transnational dimension. Finally, it was stressed the need to place greater emphasis on the Digitize the Planet initiative, recognizing the importance of making detailed digital information about the protected area accessible, up-to-date, and easy to use. This would support better visitor management, enrich interpretation efforts, and ensure consistent information standards across all sites.

9.2.3 Cooperation and Governance

Key actions were collaboratively identified to ensure that the biosphere reserve offers coherent, high-quality products and services across all three countries while fostering strong cross-border cooperation. One of the primary suggestions was to establish a mixed team and a common governing body, which would bring together representatives from each country to coordinate activities, align priorities, and make joint decisions, ensuring balanced representation and a unified strategic direction. To support this structure, the group emphasized the importance of creating a formal institutional framework that clearly defines roles, responsibilities, and procedures for effective coordination and transparent governance. Recognizing that face-to-face interaction is crucial for building trust and fostering genuine collaboration, participants agreed on the need to organize at least one in-person meeting per year, providing an opportunity to review progress, address challenges, and reinforce partnerships. In addition to governance measures, the group highlighted the necessity of implementing effective advertising and marketing strategies to consistently promote the biosphere reserve's unique offerings and values to both local communities and international visitors. This would help enhance the area's visibility, attract sustainable tourism, and support local businesses. Another innovative idea discussed was the possibility of developing a shared certification or brand that would serve as a recognizable mark of quality and sustainability for products and services originating within the biosphere reserve, strengthening market identity and consumer trust. Finally, to ensure consistency in delivery and messaging, the group stressed the need to align and share common guidance, principles, and core concepts among all stakeholders involved. This would guarantee that everyone, from local producers and service providers to park managers and municipal partners, works toward shared standards and communicates a cohesive image of the biosphere reserve.

9.3 Recommendations for Visitor Guidance and Management based on the Visitor Analysis

9.3.1 Identification of Tourist Potentials and Areas of Conflict

Exploiting the area's tourism potential sustainably and addressing these pressures, a range of actionable recommendations was put forward. Developing a comprehensive marketing strategy was seen as essential to attract visitors while promoting responsible behavior and balanced use of the landscape. Improving infrastructure was highlighted as a priority to elevate the overall tourist experience, help manage visitor flows more effectively, and alleviate overcrowding in the most popular spots. Expanding and upgrading mobility options, including accessible transport and clear signage, would make it easier for visitors to explore less frequented areas, thus distributing pressure more evenly. It also stressed on the need to clearly define original trails, particularly in Italy, to prevent habitat disturbance and ensure visitor safety. Establishing a governing institution was proposed to oversee the implementation of management rules, monitor tourism impacts, and enforce regulations consistently across the cross-border area. To support this, targeted advertising and awareness campaigns would promote sustainable practices and highlight the region's unique offerings. Enhancing the variety and quality of accommodation options was also recommended to extend visitor stays and support local economies. Finally, the creation of a shared digital platform was suggested to unite the three countries in presenting coherent information, booking services, and educational resources for tourists, fostering a well-managed and attractive cross-border destination.

In addressing the identification of tourist potential and areas of conflict, the workshop team first focused on recognizing zones currently under pressure and potential conflict within the biosphere reserve. The shared map provided valuable insights. Key points of concern included areas with reliable snow conditions suitable for skiing and ski touring, such as the Montasio side, which attract seasonal visitors and may face overuse without proper management. The Fusine Lakes area was singled out for experiencing significant crowding, particularly on Sundays and during organized events, which can lead to environmental degradation and strain on local infrastructure. Additionally, zones commonly used for hunting and canoeing were noted as potential sites of conflicting recreational interests. Areas frequented by nature photographers also emerged as sensitive spots, with specific worries about unethical practices like feeding wildlife to capture better images. Furthermore, an increase in wolf presence has raised concerns among local stakeholders.

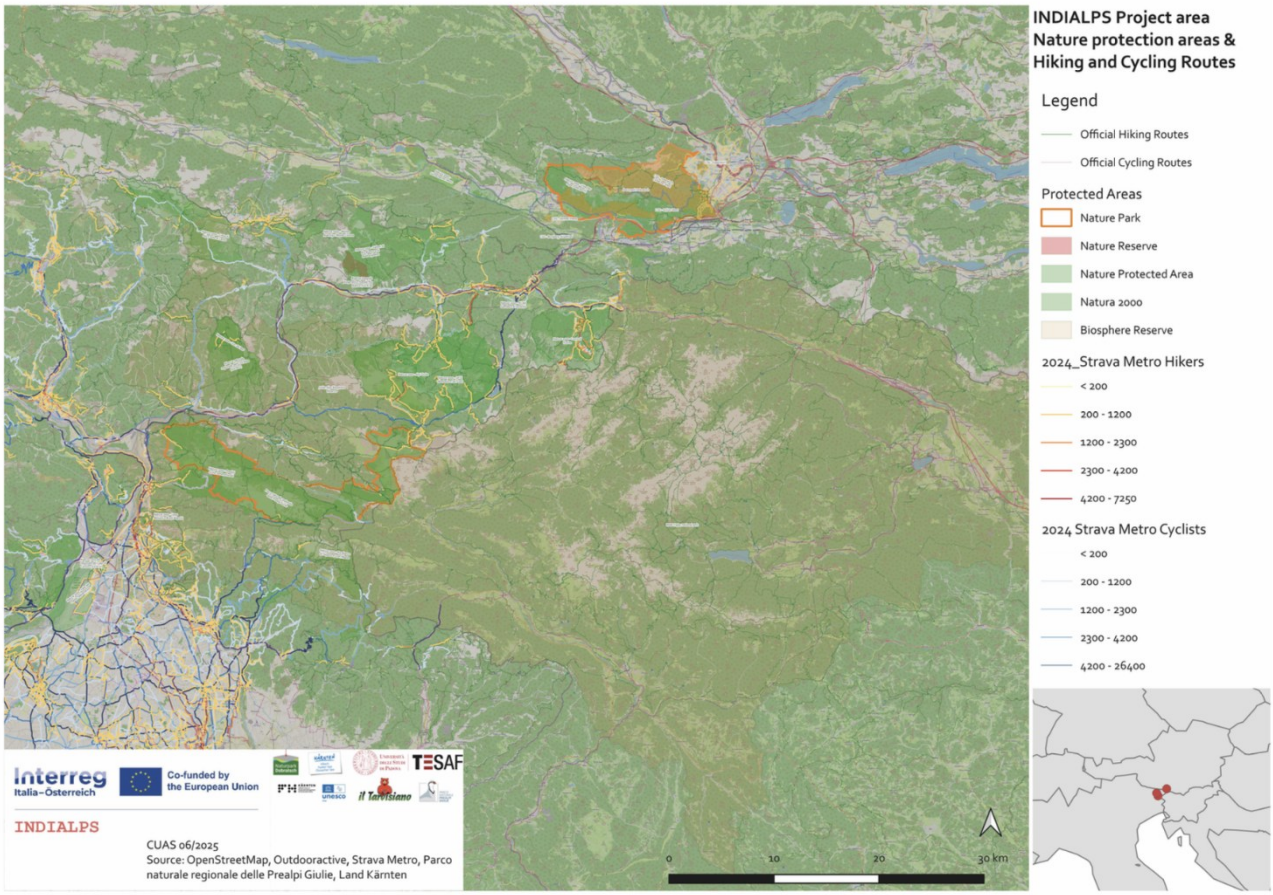


Figure 211 - Protected areas and hiking/biking routes.

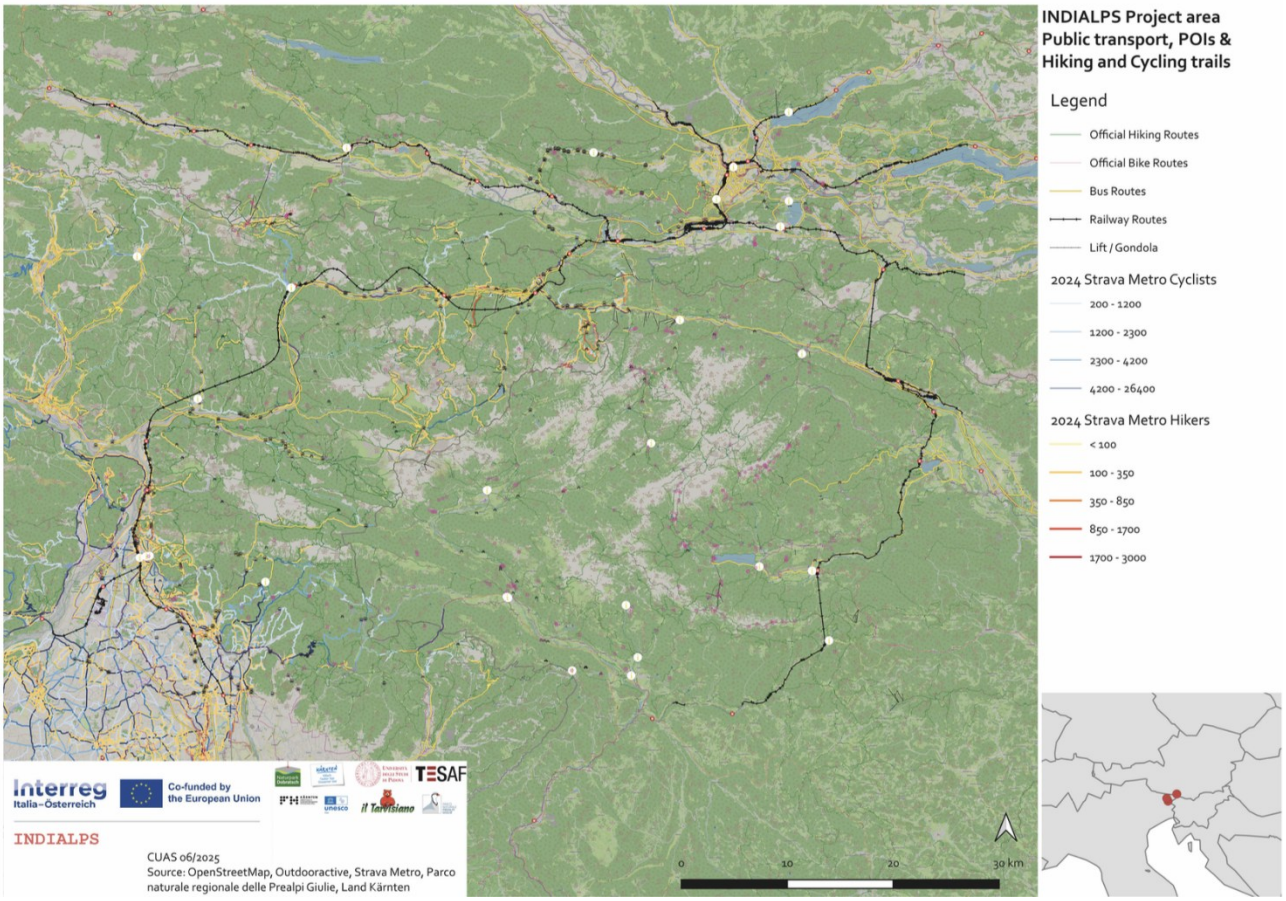


Figure 212 - POIs, protected areas and hiking/biking routes.

9.3.2 Proposals for Measures to Relieve Visitor Hot Spots

To address the issue of relieving pressure on visitor hot spots and to enhance the overall visitor experience sustainably, it was proposed a comprehensive set of measures focusing on improving infrastructure and services across the cross-border biosphere reserve. A key starting point identified was the need to conduct a thorough analysis of existing parking facilities, including their locations, capacity, pricing, and ownership, to better manage traffic flow and prevent overcrowding in sensitive natural areas. Building on this, it was emphasized the importance of encouraging visitors to park their vehicles outside core conservation zones and use well-connected hiking and biking trails, supported by convenient and reliable public transport options. To make this feasible and attractive, it was recommended expanding and actively promoting shuttle services, ensuring they are easily accessible, well-advertised, and synchronized with visitors' schedules.

Improving visitor information services was also seen as crucial, both through an increased number of on-site info points and by enhancing digital access to up-to-date maps, trail conditions, and site rules. Better coordination between train and bus timetables was highlighted as an effective way to promote sustainable travel and reduce the reliance on private cars. Introducing entrance fees for popular sites was proposed as a way to generate dedicated revenue to reinvest in maintaining and upgrading infrastructure and services. To reinforce the area's cross-border identity, the team stressed the importance of strengthening transboundary transport connections, giving visitors the sense of a seamless, unified destination regardless of national borders. Expanding and diversifying accommodation options was highlighted as an area needing immediate improvement, particularly the current lack of offerings for luxury tourism. Similarly, enhancing the variety and capacity of local restaurants would help provide different visitor preferences and extend stays. It also underlined the necessity of ensuring essential supporting infrastructure, such as reliable electricity supply, effective wastewater treatment, and robust waste management systems, to maintain environmental quality as visitor numbers grow. Specific actions to manage camping were also addressed, including the recommendation to increase the number of legal campsites while strictly regulating their operation to prevent illegal camping, which can damage sensitive habitats. To encourage sustainable transport choices, a unified tourist pass covering public transport across the three countries was suggested, ideally issued digitally as a QR code to reduce production costs and simplify use. Moreover, organizing guided tours led by certified local guides with clear, standardized pricing would help manage visitor flows responsibly and enhance educational value. It was further suggested offering discounted prices for local residents, ensuring the benefits of tourism remain fair and accessible to host communities. The use of Feratel was proposed as a common digital management system for coordinating tourism data and services across the region. Finally, improving train infrastructure to better accommodate bicycles would support eco-friendly mobility and attract cycling enthusiasts. Together, these integrated measures aim to distribute visitor pressure more evenly, elevate service quality, and ensure that tourism contributes positively to the region's environmental, social, and economic sustainability.

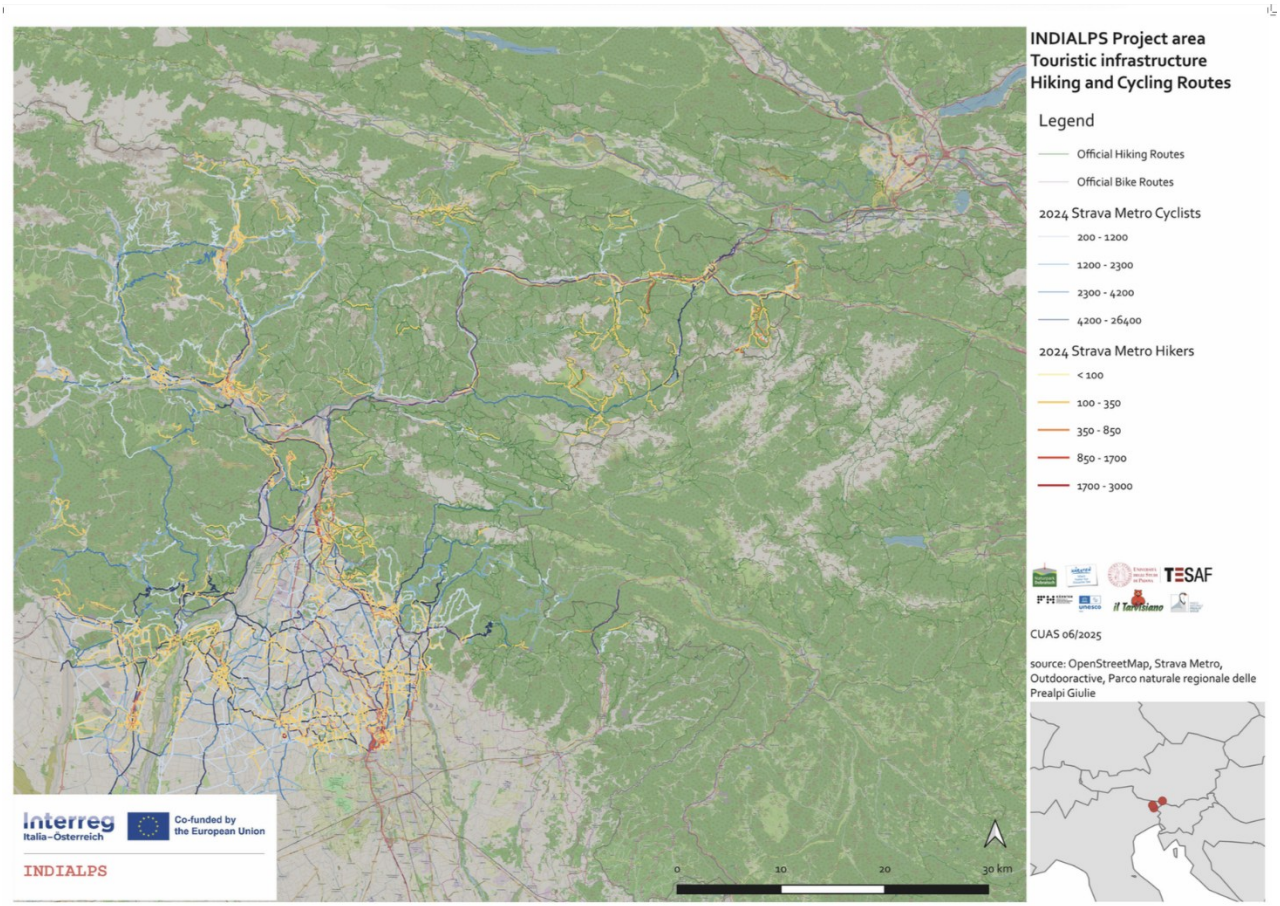


Figure 213 - Infrastructure and hiking/biking routes.

9.4 Transboundary Sustainable Tourism Offers

As part of the WeNaTour Project Summer School, a workshop on Transboundary Sustainable Tourism Management was organized within the frame of the INDIAlps Project. The session brought together tourism experts and practitioners from various countries to exchange experiences and co-develop practical solutions for more integrated and sustainable tourism across borders.

The workshop focused on the tri-border region of Italy, Austria, and Slovenia. The aim was to identify strategies that could strengthen cross-border collaboration, foster local identity, and enhance the region's long-term resilience.

Participants were divided into four thematic groups, each exploring a different dimension of transboundary tourism management – from collaborative governance and destination identity to culinary heritage, sustainable mobility, and inclusive tourism experiences. The results of these discussions provide valuable input for ongoing and future initiatives within the INDIAlps Project, contributing to a shared vision for sustainable tourism development in the Alpine and cross-border regions.

Figure 214 - WeNaTour Project Summer School.

9.4.1 Results from Group 1 – Transboundary Collaboration and Sustainable Tourism

The group identified several challenges related to overly strict legislation, fragmented cooperation among destinations, and weak transport connections between the regions. It was emphasized that tourism volumes could be better balanced and that there is a strong need to strengthen transborder collaboration. The participants see many untapped opportunities and believe that the inclusion of diverse areas could enhance the region's overall offer.

To address these challenges, the group proposed three main strategies. First, to identify and select three DMOs per country that already manage their destinations in a sustainable way, bringing them together in a dedicated working group. Second, to establish a transboundary working group that fosters collaboration and knowledge exchange between countries. And third, to identify the main attractions across borders and promote them jointly, positioning the three countries as one interconnected tourism entity.

As concrete actions, the group suggested initiatives such as developing a navigation system for live tourist flows, organizing a cross-border culinary contest, and launching a "Tour des Alps" sports competition. Additional ideas included a vintage train route with small discovery stops, "Games Without Borders" to encourage friendly regional competition, the promotion of slow food concepts, and the creation of thematic touristic corridors linking key sites.

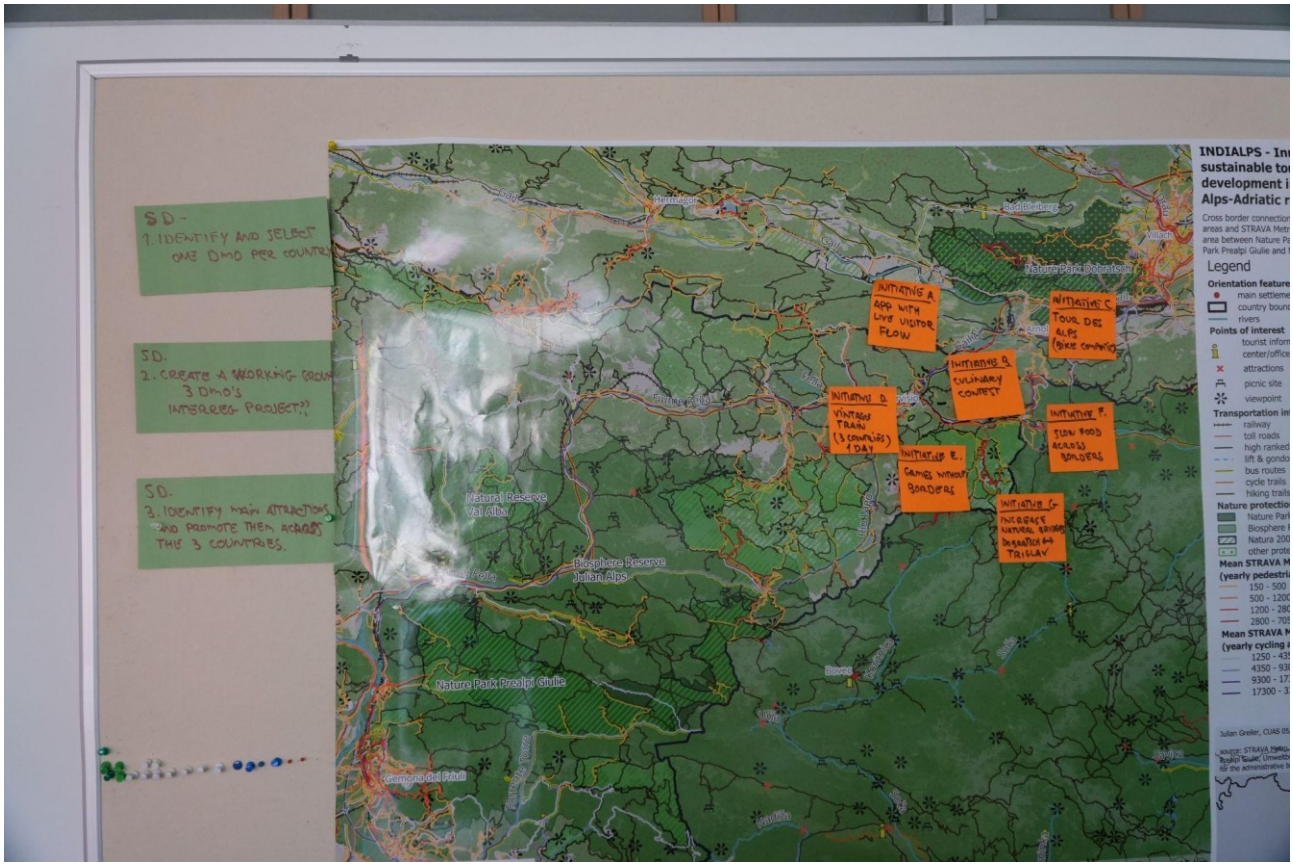


Figure 215 - Result from group 1.

9.4.2 Results from Group 2 – Tri-Country Identity and Sustainable Mobility

This group focused on the need to overcome existing boundaries and technical barriers, such as differing regulations and roaming charges, that still separate the three countries. A key idea was the creation of a Tri-Country DMO – a joint destination management structure with a shared identity, supported and lived by local communities. Such an organization would be responsible for marketing, management, and strategic coordination across the full cross-border area.

To complement this, several practical initiatives were discussed. These include targeted marketing for the shoulder season, particularly around thermal spa experiences, and the development of a certified partner map showcasing sustainable accommodation providers. Harmonizing multilingual signage along hiking routes and standardizing regional rules were also seen as priorities. The group proposed an updated eco-map that integrates sports and nature offers, and the introduction of a multi-country visitor card similar to the Kärnten Card. Additional ideas include a smart parking system using a traffic-light principle and the implementation of wildlife corridors with designated viewing points to strengthen the connection between ecological preservation and visitor experience.

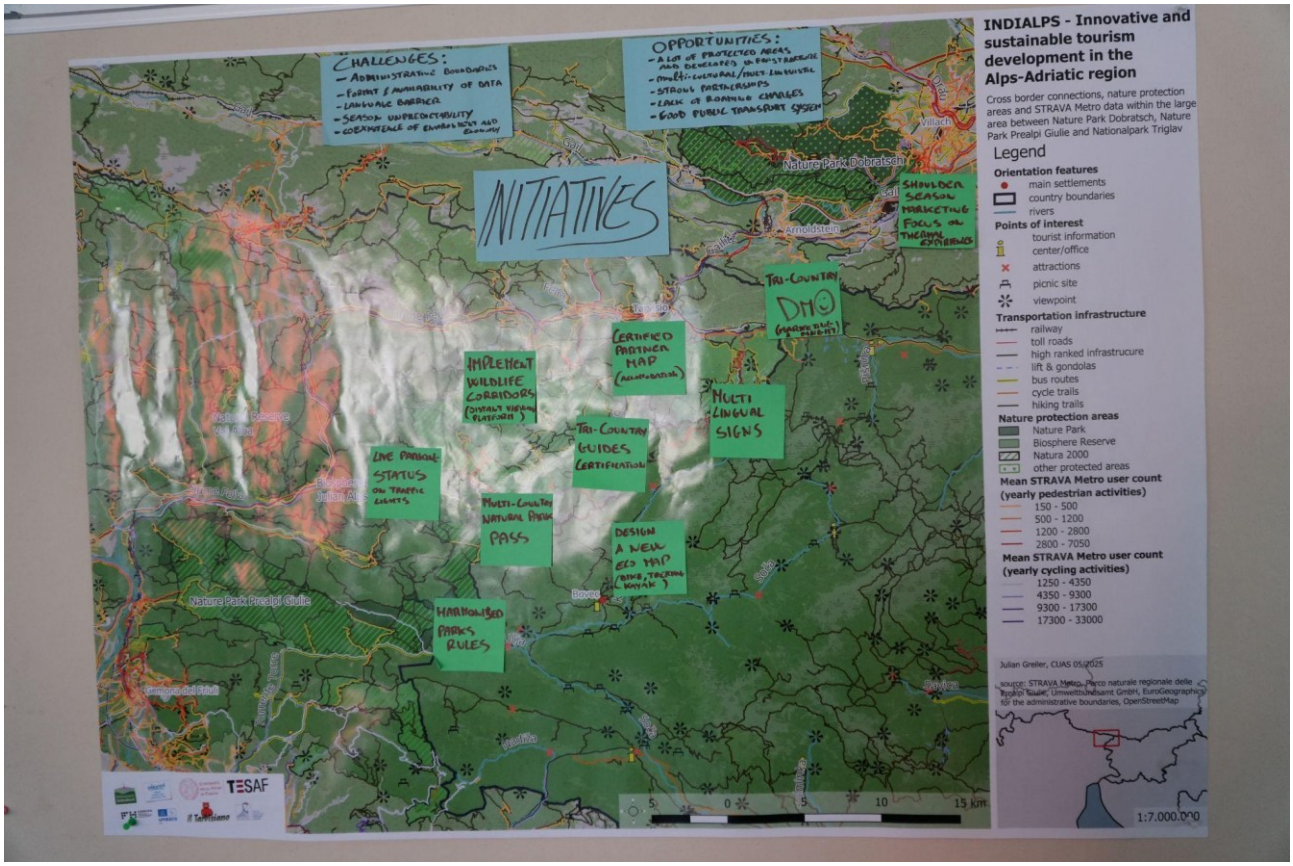


Figure 216 - Result from group 2.

9.4.3 Results from Group 3 – Culinary Trail and Food Heritage Development

Group 3 worked on the idea of a transboundary culinary trail as a concrete step towards more sustainable and culturally rooted tourism. The proposal revolves around creating a cross-border hiking trail loop that connects culinary experiences with cultural and natural attractions. The concept includes mapping existing routes and points of interest, defining clear entry points, and establishing a visitor management system to balance tourism flows.

The trail would help promote less-visited areas while giving value to the rich culinary traditions of the region. The group underlined the importance of valorizing both the tangible and intangible cultural heritage linked to food, strengthening local identity in the process. Collaboration between local communities and stakeholders from all three countries was seen as essential, especially in connection with a potential Food Action Plan. Furthermore, the group emphasized the development of skills and competences through “living labs” to encourage local ownership and ensure that the project grows from within the communities themselves.

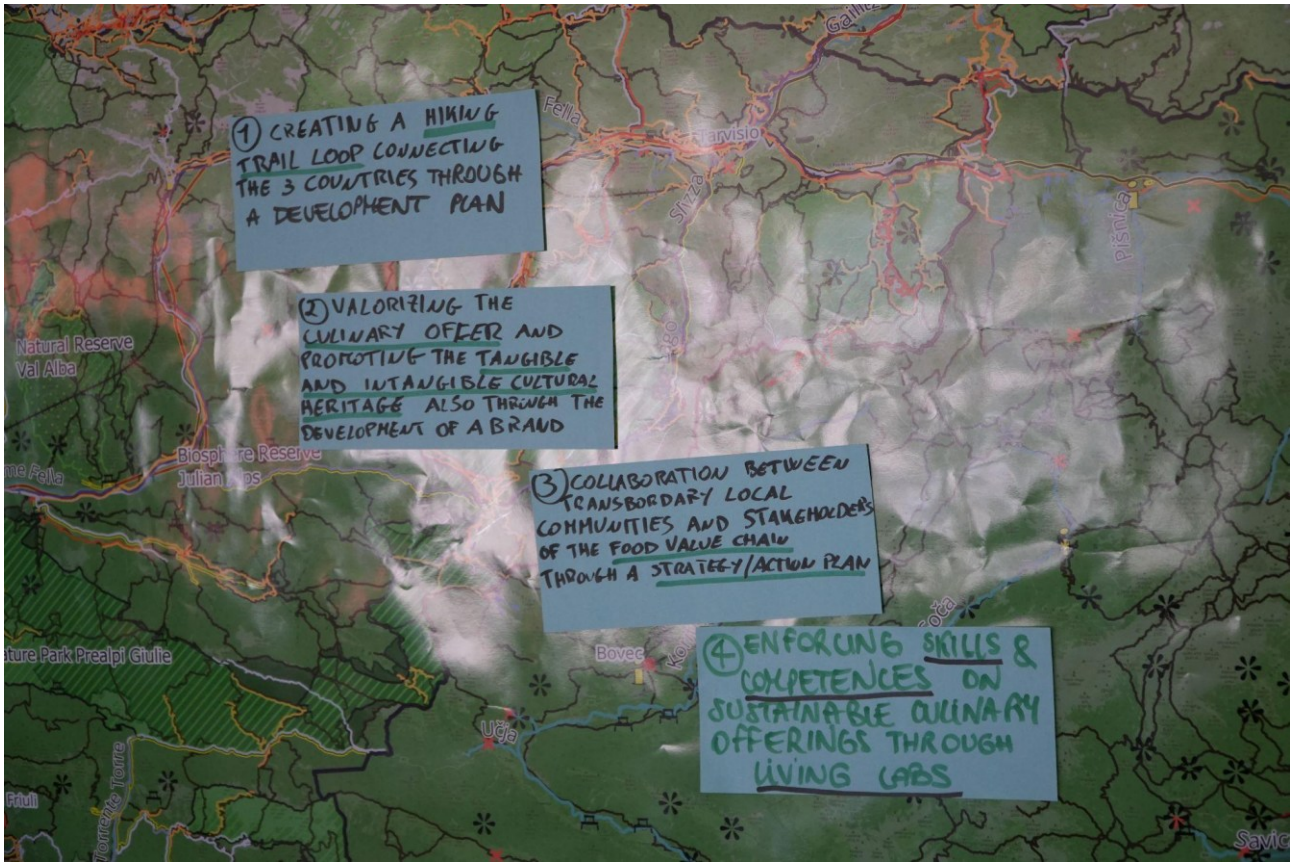


Figure 217 - Result from group 3.

9.4.4 Results from Group 4 – Sustainable Mobility and Inclusive Routes

The fourth group addressed mobility challenges and accessibility issues within the region. Limited train connections and a high reliance on cars were identified as major weaknesses, alongside the difficulty of crossing mountain areas on foot. However, the group also recognized significant opportunities, such as the attractions around Monte Lussari, the Laghi di Fusine, local museums, and both winter and summer sports offers.

Building on these assets, the group proposed developing a sustainable tourism route connecting Villach and Gemona. The so-called “Chamoix Route” would be designed to be accessible for families and people with disabilities, combining natural beauty with inclusivity. A complementary bike trail and a regular train service between Gemona and Villach were also suggested to improve mobility and reduce emissions. To strengthen the sustainability dimension, the use of solar energy and rainwater collection systems was recommended. Finally, the group proposed introducing a “Natural Passport” – a symbolic or digital tool allowing visitors to collect experiences along the route and engage more deeply with the cross-border region.

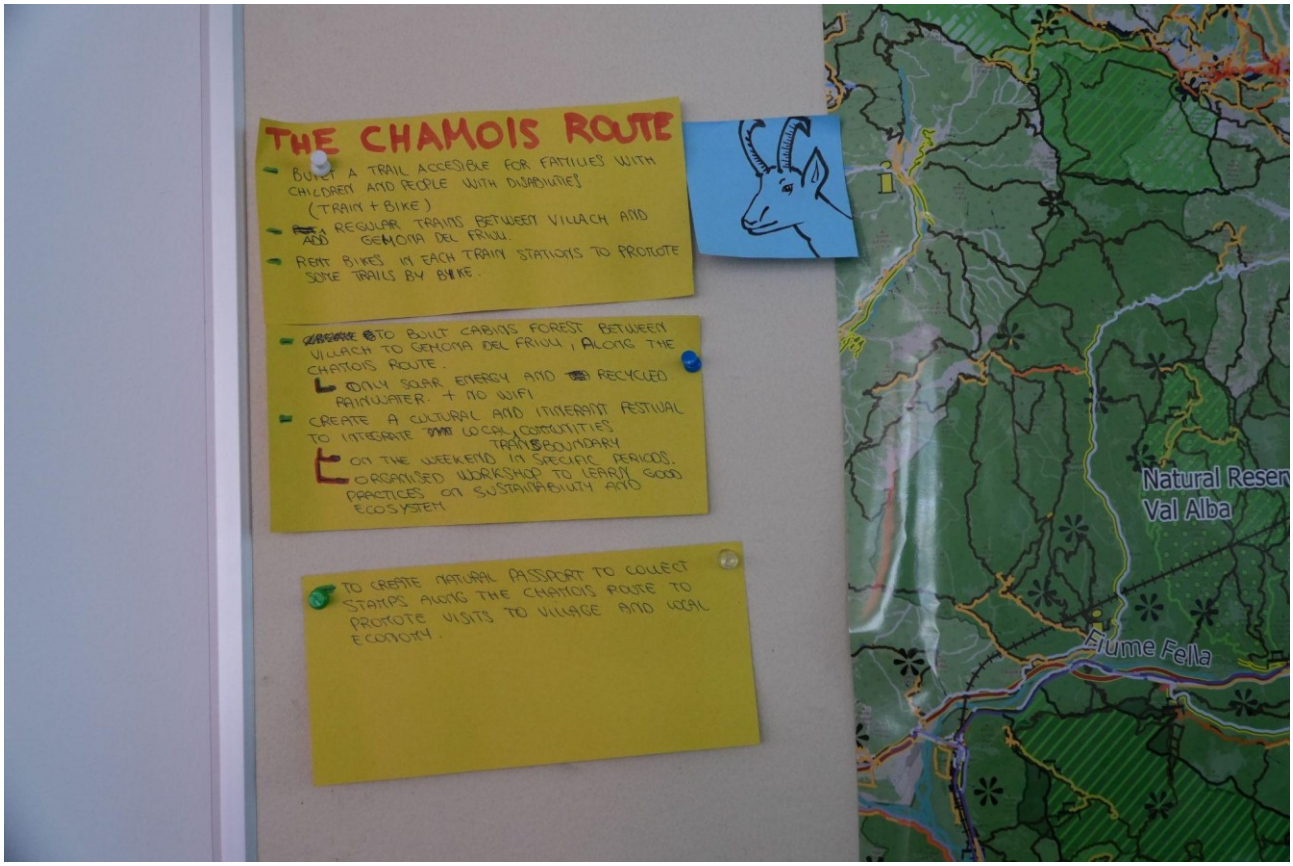


Figure 218 - Result from group 4.

9.5 Communication about Rules of Conduct in Nature

9.5.1 Digitize the Planet

Digitize the Planet is an innovative digital initiative aimed at making comprehensive, up-to-date information about protected natural areas easily accessible to the public, stakeholders, and visitors. By collecting and sharing detailed data on rules, visitor guidance, recreational opportunities, and conservation goals, Digitize the Planet helps harmonize information across different regions and countries, supporting sustainable tourism and responsible outdoor activities. The platform serves as a reliable, centralized source for visitors to understand what is permitted and how to enjoy natural spaces while minimizing environmental impact.

As of now, the Digitize the Planet platform features information on 15 protected areas in Austria, demonstrating strong national adoption and a commitment to transparent visitor guidance. In Italy, the initiative includes one reserve, which is the Julian Prealps Biosphere Reserve (Riserva della Biosfera Alpi Giulie). This inclusion highlights the reserve's forward-thinking approach to digital communication and its role as a model for other Italian and cross-border protected areas to join this shared digital framework in the future.

9.6 Shared Vision 2030 – Our Aspiration for a Cross-Border Visitor Management System

Looking ahead to 2030, the INDIALPS project imagines a future in which the Alps-Adriatic region is experienced and managed as a truly connected landscape. Our aspiration is to see a cross-border visitor management system (ViMaSy) that reflects both the diversity and the unity of Austria, Italy, and Slovenia, balancing the protection of nature with the use of visitors and the well-being of local communities.

In this vision, borders can become meeting points. Visitors move effortlessly across countries, guided by coherent information, shared rules of conduct, and sustainable mobility options. They discover the region as a whole—its landscapes, cultures, and stories—without losing sight of the unique character of each place.

The project team wishes for a 2030 in which:

- Cooperation is the norm – Parks, tourism bodies, and communities work together regularly and constructively, sharing knowledge, resources, and decision-making responsibilities across borders;
- Quality feels consistent – Whether in infrastructure, visitor guidance, or service standards, experiences are coherent and reflect a shared understanding of excellence;
- Visitor flows are balanced – Seasonal peaks are managed, lesser-known areas are made accessible, and pressure on sensitive sites is reduced through thoughtful planning and communication;
- Digital tools connect us – Platforms like Digitize the Planet provide up-to-date, multilingual information that helps visitors plan and behave responsibly;
- Communities are engaged – Local residents see themselves as active partners in shaping tourism, benefiting from it economically while preserving their traditions and environment;
- This vision is not a fixed plan, but a shared direction—a guiding picture that inspires our joint efforts. It reflects the hope that, by working together, we can shape a future in which the Alps-Adriatic region is known internationally as a model for cross-border cooperation, sustainable tourism, and the harmonious coexistence of people and nature.

10 Conclusions and Outlook

10.1 Cross-Border Implementation Checklist for Dobratsch Nature Park & Julian Prealps NaturePark

The Alps-Adriatic region is a landscape of shared natural and cultural heritage that extends across Austria, Italy, and Slovenia. Its ecosystems, visitor flows, and cultural traditions are interconnected and cannot be managed in isolation. To safeguard this richness while providing high-quality visitor experiences, a coordinated, cross-border approach to visitor management is essential.

The following recommendations present common priorities for the entire region. They focus on strengthening cooperation and governance, establishing shared standards and digital tools, improving visitor guidance and infrastructure, and actively involving local communities. By aligning conservation with sustainable tourism development, these measures aim to create a balanced and resilient cross-border destination where people and nature thrive together.

Cooperation & Governance

- Establish a joint cross-border governing body with representatives from Austria, Italy, and Slovenia.
- Develop a clear institutional framework defining roles, responsibilities, and transparent decision-making procedures.
- Organize regular cross-border meetings to review progress, and coordinate joint actions.
- Develop a shared brand or certification for sustainable products and services across the parks.
- Launch coordinated marketing strategies to position Dobratsch and Julian Prealps as part of a model cross-border sustainable tourism region.

Common Standards & Best Practices

- Upgrade and harmonize digital platforms (websites & apps) with shared content and multilingual accessibility.
- Actively use Digitize the Planet to provide standardized rules, visitor guidance, and trail information.

Visitor Guidance & Infrastructure. Hot spot management through

- Expanded shuttle and public transport services, supported by a joint potential digital visitor pass valid across borders.
- Parking management (location, capacity, pricing) to reduce car pressure in sensitive areas.
- Creation of additional legal, regulated campsites to prevent environmental damage from illegal camping.
- Unified or explain trail signage and guidance systems, consistent and multilingual.
- Diversify and improve accommodation offers.
- Strengthen local gastronomy capacity to extend visitor stays.

Visitor Information & Communication

- Provide clear, multilingual rules of conduct in nature, both online and on-site.
- Establish additional visitor info points and improve digital access to real-time maps, trail conditions, and regulations.
- Develop transboundary guided tours
- Use data visualizations (heatmaps, flow maps) to monitor, communicate, and adapt visitor flows.

Conflict Prevention & Potential Development

- Identify and address conflict zones (e.g., hunting, canoeing, camping, hiking, biking).
- Promote underused tourism potentials
- Cross-border hiking and cycling offers as flagship products.

- Innovative eco-tourism and cultural experiences linked to local identity.

Community Involvement & Participation

- Actively involve local communities in decision-making processes and tourism planning - participatory governance.
- Establish an annual cross-border forum, rotating between Austria, Italy, and Slovenia, with a thematic focus (e.g., biodiversity, sustainability, cultural heritage).

10.2 Outlook for Future Measures and Projects (After-Interreg)

Further Development and Improvement of ViMaSy

After the conclusion of the Interreg project, the further development of ViMaSy will be essential to ensure that the established structures and approaches evolve into a fully operational and institutionalized system. This includes refining governance mechanisms, strengthening cross-border data collection and monitoring, and expanding the integration of digital tools such as *Digitize the Planet* and Feratel to cover all participating areas. Special emphasis should be placed on making visitor management more adaptive and resilient to emerging challenges, such as climate change, shifting mobility patterns, and changing visitor expectations. Future projects could also focus on piloting innovative mobility solutions, harmonizing cross-border training programs for staff, and embedding ViMaSy within long-term regional policies. By moving from a project-based initiative to a permanent system, ViMaSy can become a cornerstone of sustainable tourism management in the Alps-Adriatic region.

Advantages of a Cross-Border Peace Park

The idea of establishing a cross-border Peace Park offers a unique opportunity to translate cooperation into a strong and symbolic identity for the Alps-Adriatic region. Beyond its ecological and touristic dimensions, such a park would embody values of dialogue, cultural exchange, and peaceful coexistence, positioning the trilateral biosphere reserve as a reference model of international collaboration. A Peace Park could enhance visibility at the European and global levels, attract funding and research opportunities, and provide a unifying framework for joint activities in conservation, education, and sustainable tourism. It would also serve as a platform for fostering community engagement and strengthening regional pride, offering residents and visitors alike a sense of shared ownership and belonging. By linking natural protection with peacebuilding and cultural connection, the Peace Park would not only safeguard landscapes but also contribute to a stronger collective identity that transcends borders.

Project Proposal Interreg CE

Building on the results of INDI ALPS and the foundations laid through ViMaSy, a follow-up project within the Interreg Central Europe (CE) framework could provide the necessary support to scale up and institutionalize cross-border visitor management. Such a proposal should focus on consolidating governance structures, advancing digital integration, and piloting innovative solutions in mobility, visitor guidance, and community engagement. By leveraging the strengths of the Central Europe programme, the project would enable broader transnational cooperation beyond the immediate Alps-Adriatic region, fostering exchange with other mountain areas and protected landscapes. This would not only enhance the resilience and visibility of ViMaSy but also strengthen its role as a transferable model of sustainable cross-border tourism management. A dedicated Interreg CE project would thus represent a crucial step towards ensuring long-term continuity, financial stability, and broader political recognition of the achievements initiated under INDIALPS.

11 Appendix

11.1 List of Figures

11.2 List of Tables