Title: Analysis of the use and impact of the Nature Trails Network of Spain. An exploration based on new data sources.

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Theme: S58 Measuring the Social Impact of Tourism in the European Union

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1. Introduction

As sustainability becomes a key pillar of European tourism, Spain's Nature Trails Network (Red de Caminos Naturales de España) stands out as an initiative that promotes eco-tourism while generating positive social impacts. Since 1993, the Government of Spain has restored over 10,800 km of disused infrastructures, fostering sustainable tourism that aligns with EU development goals (Caminos Naturales, 2024).

By redistributing visitors to rural areas, the Nature Trails Network helps decentralize tourism, reducing pressure on overcrowded destinations. At the same time, it preserves cultural and natural heritage by maintaining historical paths, former railway tracks, and traditional infrastructure. This initiative also strengthens local economies, creating employment opportunities in tourism, hospitality, and related services, which contributes to the sustainable development of rural communities.

The network provides a unique and sustainable travel experience, allowing visitors to engage with nature and local culture in an educational and responsible way. It encourages outdoor activities such as hiking and cycling, promoting health and well-being while meeting the increasing demand for authentic, personalized tourism experiences. By offering an alternative to mass tourism, it fosters a more balanced interaction between tourists and the destinations they visit.

For tourism professionals, the initiative generates new job opportunities in ecotourism, environmental education, and trail management. It also enhances skills and training in sustainable tourism, equipping workers with valuable expertise for the evolving tourism industry. By promoting long-term employment in rural areas, the network helps reduce job seasonality, ensuring more stable and sustainable livelihoods.

The Nature Trails Network serves as a model for sustainable tourism, balancing economic growth, environmental conservation, and social well-being. Measuring its social impact through specific indicators could provide valuable insights for future tourism policies, fostering a more inclusive and sustainable tourism ecosystem in Spain and across Europe. For this reason, the Nature Trails Network Program has been promoting studies to assess the use and impact of the network in recent years. Previous studies (Ministerio de Agricultura, Pesca y Alimentación., 2019) primarily relied on data collected from various trail managers through questionnaires— a methodology that had certain advantages but also significant limitations. One advantage was that some managers gathered relevant data on trail usage, for instance, through pedestrian and cyclist counters, tourist surveys, or employment figures directly or indirectly linked to the network. However, there were notable drawbacks: many managers did not report any data due to a lack of resources, data collection occurred only every five years, and the inconsistency in

data availability made it challenging to gain a comprehensive view of the network's overall performance or to compare the use and evolution of different trails over time.

2. Objectives

In this context, the Spanish Ministry in charge of the Nature Trails Network decided to launch research aimed to improve previous studies, by exploring how the analysis of new data sources could complement previous studies and overcome their limitations.

The main objectives of this study are

1. To collect quantitative and qualitative information on the Economic and Social Impact of the Nature Trails Network during the period from late 2019 to August 2024. This information will come from both conventional and new data sources.
2. To provide the Government of Spain with updated information on the characteristics and impact that a selection of the Nature Trails is generating on Spanish territory and nearby populations.
3. To develop an online viewer or dashboard that enables dynamic visualization and exploration of the obtained results.

3. Methodology

The methodology for carrying out the study is organized into two stages. The first stage presents the data obtained from surveys conducted with the network managers, which, in some cases, include data from traffic counters, along with information gathered from Geographic Information Systems.

The second stage involves utilizing new data sources to characterize and quantitatively assess the Natural Trails based on usage typologies, seasonality, and, in some cases, spatial behavioral patterns of tourists in these areas and in rural population centers where these infrastructures exert some degree of socioeconomic influence.

Figure 1: Scheme of different data sources used in the study. Source: Own Elaboration.

In the first stage, web surveys are designed and distributed to the promoters of the selected Natural Trails for the study (public entities responsible for maintenance, management,

promotion, and development of the different routes), based on questionnaires from previous studies. The objective is to identify key trends in tourism supply, demand, usage, management, and local impact of the trails, linking part of the current information with that from previous studies. Additionally, through the data obtained and the use of geospatial tools, the correlation between the data and certain defined indicators for the trails included in the PNDR is analyzed.

In the second stage, certain spatial and temporal usage patterns of the selected trails are explored through the analysis of large volumes of data from social media and web applications such as Flickr, Wikiloc, and Google Popular Times, within what was considered the area of influence of the Nature Trails (a buffer of 1 km). The goal is to obtain a multiscale perspective of both the study subject and the data, as well as their potential for aggregation and disaggregation, applying a similar approach to the research developed by García-Palomares et al. (2015) and explained in the review carried out by Romanillos and Barros-Sulca (2020).

From Flickr data, information is obtained on the popularity of specific routes at different times of the day, week, month, or year, based on the number of photos uploaded to the platform (Flickr, 2024). Meanwhile, Wikiloc routes help identify the predominant sports activities, such as trekking, cycling, and running, along with the most common distances for each activity and their popularity throughout different months of the year (Wikiloc, 2024). Additionally, using POIs (Points of Interest) from networks like Foursquare and Google Places, combined with Google Popular Times, the number, type, and peak visit hours of consumption spaces within the influence area of the Natural Trails are recorded. Mobile phone data was used for the analysis of a single Nature Trail, finally not included in this study.

4. Results

Spain's Natural Trails Network consists of more than a hundred routes, of which 69 were selected by the Government of Spain for the study. The total number of responses was 26, representing 38% of the total. Additionally, many of the analyzed categories did not receive feedback, further reducing the sample size for certain topics. Because of this low data sample, this abstract is focused on the results of the analysis carried out based on the new data sources rather than in the surveys.

As previously mentioned, this study includes the development of an online viewer that allows users to dynamically visualize and explore the results. The goal of this viewer is to enable users to navigate an online map of the Natural Trails Network at different scales, providing various levels of information on the trails and the analyzed layers of interest (completed routes, route origins and destinations, points of interest, photos, etc.). This dynamic exploration offers valuable insights in a simple manner, benefiting both Natural Trails managers and users.

To achieve this objective, a Dashboard-type viewer has been developed, integrating an online map with additional control panels that present results through indicators and graphs. The following section describes its components and explains the functionality of each element.

The viewer has been structured according to the components outlined in Figure 2, consisting of a header, an information panel summarizing the data displayed on the map, a central window displaying the online map, a toolbar or widgets allowing interaction with the map, and a secondary pop-up information panel providing data on selected map elements.

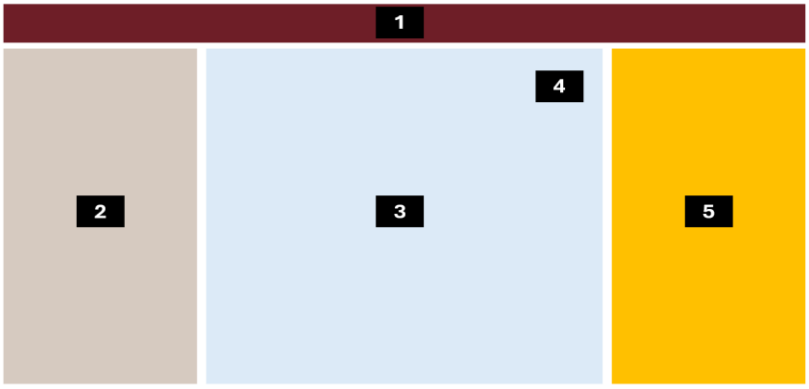

Figure 2: Diagram of the structure of the online viewer/dashboard and its components.

Based on this structure, the viewer has been developed with specific functionalities assigned to each of its components. The following section explains how to access the viewer, describes the functionality of its various components, and outlines their specific features. The viewer is accessible through the following link (URL): https://www.arcgis.com/apps/dashboards/f242c552e129420cbdd73e4dafa56136

Once the welcome window is closed, the initial view of the viewer is accessed. In this view, the map will display the Natural Trails across the national territory, and the map information panel (component 2) will show a summary of the information related to the displayed territorial extent. This means that the panel is dynamic, and the values of its indicators and graphs change as the map is navigated.

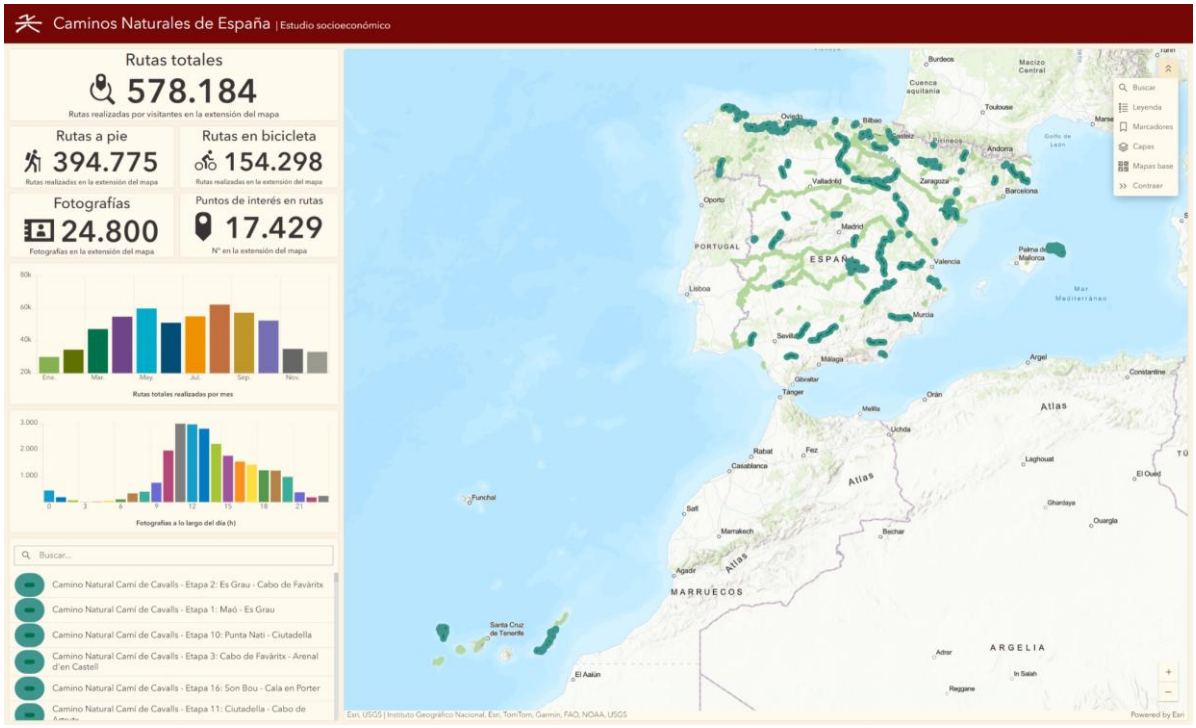

Figure 3: Initial view of the dashboard

Thanks to this functionality, it is possible to analyze the seasonality of each Natural Trail (usage throughout the year). An analysis of routes in Andalusia (Fig. 4), for example, shows a significant drop in summer, in contrast to the peak demand periods for coastal routes in Galicia (Fig. 5). The same analysis reveals that, in this case, since the routes are mainly traveled in summer, the demand extends further throughout the day.

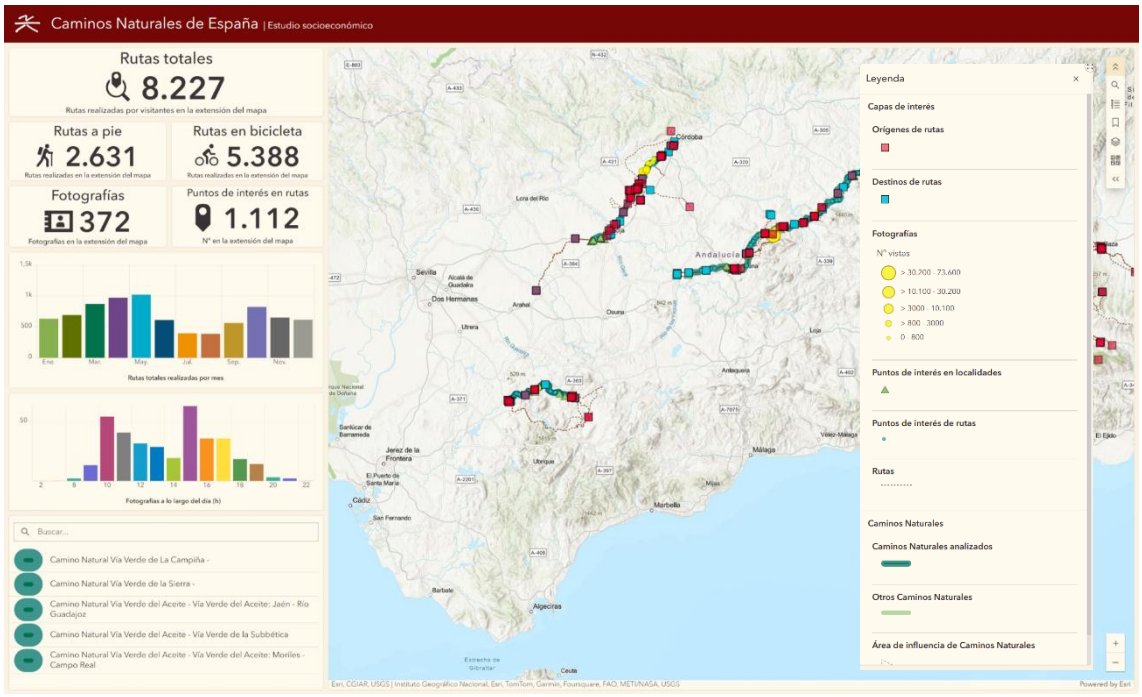

Figure 4: View of Natural Trails in Andalusia with a drop in demand during summer.

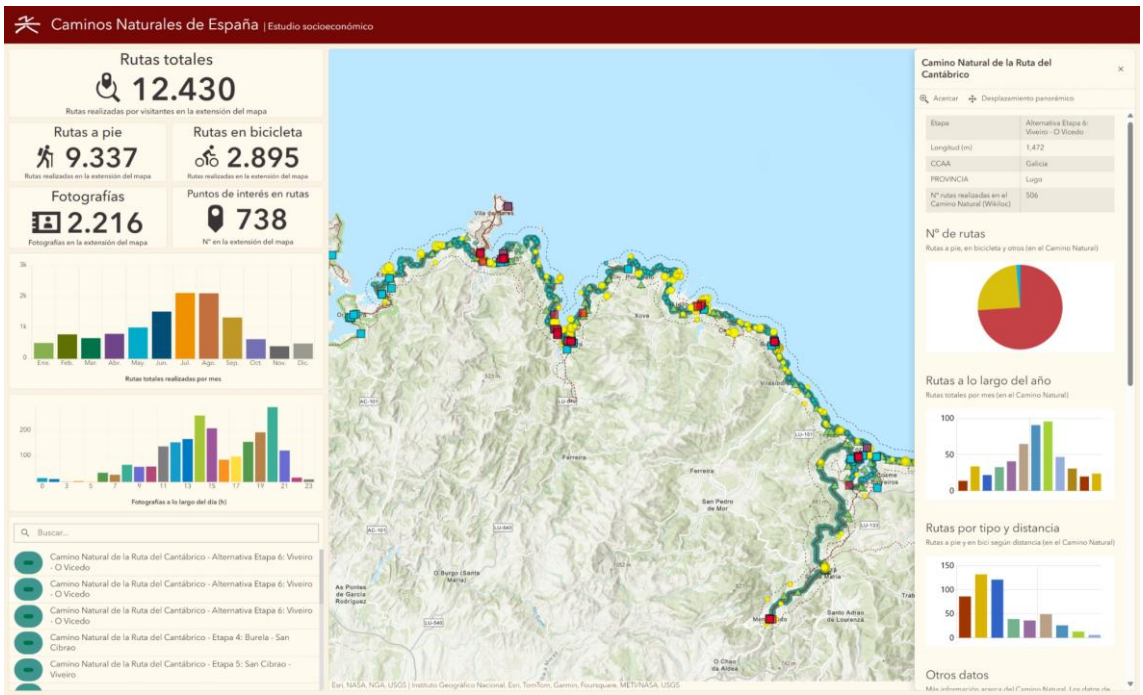

Figure 5: View of Natural Trails on the Galician coast, with an increase in demand during summer. View of the panel showing the particular data of the selected Nature trail.

The analysis of GPS track data from Wikiloc also allowed us to identify the origin and destination points of all routes (see Figure 4), highlighting the most significant clusters in specific villages or locations. This information could be useful for planning infrastructure such as parking areas or visitor centers. Additionally, this data source provides points of interest reported by app users, which complement the Points of Interest from Google Places. While Google Places POIs are typically not located along the trails, they are often found in the villages the trails pass through. Finally, the dashboard also illustrates the photos uploaded to Flicker, representing spots of high interest according to the number of views in the social media (see Figure 4 and 5).

5. Conclusions

Exploring Spain's Nature Trails Network through multiple data sources has provided a clearer picture of its usage over time and geography. Trail use varies seasonally, with peaks in autumn and spring in central and southern Spain, and in summer along the northern coast. Winter is the least popular season, as confirmed by both new data sources and manager surveys.

Trails are most visited on weekends, public holidays, and Easter break, rather than during summer and winter vacations. Most tourists, except in mass tourism areas, do not stay overnight. Activity is highest in the morning, though in summer destinations, longer daylight hours lead to afternoon peaks.

Wikiloc data shows a preference for short to medium hikes, typically starting at 9:00 AM and ending mid-afternoon, aligning with POI popularity and Flickr uploads. Nearby businesses are mainly shops, bars, and restaurants, with more accommodations in international tourist areas. The presence of outdoor activity-related POIs suggests they should be considered in future studies.

The study identified the most popular itineraries and differentiated between local (Wikiloc) and international tourism (Flickr). Understanding these patterns helps optimize underutilized routes and sustain high-demand ones. Some trails, like Vía Verde del Aceite, see more visitors in winter than summer due to extreme temperatures, highlighting the value of integrating diverse data sources.

A key limitation is data availability and sample size, as the collected data represents a fraction of users. While it does not reveal exact visitor numbers, it helps identify general spatiotemporal trends.

6. Acknowledgments

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7. References

Caminos Naturales (2024). Red de Caminos Naturales de España. Recuperado de: https://caminosnaturales.es/es/red-de-caminos-naturales

Flickr (2024). About Flickr. Retrieved from: https://www.flickr.com/about

García-Palomares, J. C., Gutiérrez, J., & Mínguez, C. (2015). Identification of tourist hot spots based on social networks: A comparative analysis of European metropolises using photo-sharing services and GIS. Applied Geography, 57, 112-122. https://doi.org/10.1016/j.apgeog.2015.08.002

Ministerio de Agricultura, Pesca y Alimentación. (2019). Estudio sobre el nivel de uso e impacto socioeconómico de los Caminos Naturales y Vías Verdes Españolas incluidos en el Programa Nacional de Desarrollo Rural.

Romanillos Arroyo, G., & Barros Sulca, D. C. (2020). La revolución de los datos: explorando la actividad turística desde una nueva perspectiva. In El valor de los datos turísticos, 2020 (pp. 211-234). ISBN 978-84-17973-44-5

Wikiloc (2024). Wikiloc's history. Retrieved from https://es.wikiloc.com/wikiloc/about-us.do#history