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New Approach to Landscape-Based Spatial Planning Using Meaningful Geolocated Digital Traces

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Abstract: The integration of landscape-based approaches into regional and town planning policies is one of the main objectives of the European Landscape Convention. In the twenty-first century, the traditional discipline of city spatial-planning has gradually been incorporating two types of tactics linked to a landscape-based approach: nature-based strategies, which focus on sustainable goals; and people-based strategies, which integrate a social dimension into decision-making processes. A backbone of landscape-based spatial planning challenge consists of reshaping consolidated urban areas to improve quality of life, encouraging people's physical activity, and supporting healthier urban lifestyles. This study assumes that physical activity is further encouraged by itineraries that incorporate both landscape features—i.e., natural assets and sense of place—and functional diversity associated with urban activities—i.e., public facilities. A methodology was elaborated to define a preliminary landscape-based spatial planning approach, centering on the analysis of walking-related activity in urban and peri-urban areas. For this purpose, geolocated digital traces are intertwined: official city routes, urban facility locations, users' Wikiloc trails, and Google Places API data. Once applied to selected medium-sized European cities in the Mediterranean area, these data sources lead to the identification of intangible values and dynamics in places where landscape-based spatial planning solutions could be enhanced. As a result, the present work shows the suitability of interrelating these geolocated data sources, permitting to identify landscape features as key components of spatial planning, which permit balancing individual goals, the aims of local communities, and administrative functions.

Keywords: landscape-based planning; cultural ecosystem services; peri-urban transects; geolocated social-media data; LBSN; Wikiloc routes; Google Places API; people-based spatial planning; medium-sized cities; sustainable urban development

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1. Introduction

1.1. Facing Urban Issues through a Landscape-Planning Lens

The history of urban planning has shown us repeatedly how new ways of planning, designing, or transforming the urban tissue have had a direct impact on citizens' health and quality of life. Urban planning, the practice of designing cities, was born when health problems emerged in urban areas during the Industrial Revolution [1,2]. In the mid-nineteenth century, "urban inner-city reform" processes, "urban expansion" projects, or the conception of the "garden city" appeared as expressions of a change in mindset that sought to solve the urban issues generated by the Industrial Revolution. The impact of the new plans on the health of cities and of their local communities—Berlin 1862, Paris 1853, the Garden city 1898, to mention but a few examples—show that citizens' lives could indeed be improved by the new spatial configuration of their cities. Nineteenth-century challenges were mainly linked to planning ahead for future growth. In the twenty-first century, however, challenges primarily concern the need to reconfigure consolidated urban areas. Thus, the integration of landscape-based spatial planning approaches into regional and town planning policies is one of the main objectives. The topic of healthy living contexts has been the driving force behind many planning policies throughout history and currently continues to be one of the key issues for cities.

Recently, given its holistic and integrated approach to achieving sustainable development, landscape-based spatial planning has emerged as a central matter linked to citizens' health, particularly in the wake of the latest COVID-19 health crisis [3,4]. This planning tactic balances the needs of society with the preservation and enhancement of the natural environment and cultural values at multiple scales, enriching planning strategies and policies through a landscape features' perspective and promoting a balance between economic development, environmental conservation, and social wellbeing.

This approach to spatial planning has become a focal point in the development of new public health strategies for the design of public spaces [5] and urban morphology [6]. These strategies encompass various perspectives, such as environmental, social, or economic viewpoints, linked to landscape features that can provide a more effective response to the challenges of contemporary cities. For instance, Louis Rice emphasizes the importance of prioritizing our relationship with nature, proposing urban design as "spatial medicine," and compiling design features that promote healthier urban lifestyles [4]. Similarly, José Fariña-Tojo unpacks the Spanish Urban Agenda's commitment to actions aimed at making cities healthier by creating physical and stable structures that also educate residents on health and wellbeing [2]. The targeted approach of Kleinschroth and Kowarik, who tracked Google Trends changes on users' online searches during the COVID-19 lockdowns, demonstrated the urgent need for public open spaces in urban areas [7]. Additionally, researchers in environmental psychology have studied the emotional response of walkers in various urban contexts, including green spaces, showing the positive mood-enhancing impact of natural areas on people's emotional states [6,8].

Broadly, there are several lines of research in the scientific literature delving into landscape-based planning perspectives, e.g., how the urban environment and natural areas enhance community wellbeing and nature performance. Some studies have found that people do not actually use major green locations to any significant degree, greenbelts or attractive open-space areas, despite existing opportunities in the town context, and one possible explanation presented is the time that it takes to reach these areas and the limited opportunities to develop activities in them [9]. Following this argument, the question arises as to whether it would not be more effective to know the interests, aspirations, and willingness of people to develop a landscape-based spatial planning with the greatest impact.

Although landscape-based spatial planning perspectives are increasingly being incorporated into general urban planning, there is still a data gap on how people use and access natural areas in urban contexts. In order to develop effective planning strategies that integrate landscape features, landmarks, and elements of landscape identity, it is crucial to first understand 'what goes on' in consolidated urban areas. In fact, evidence of user activities and habits at the urban level—including both quantitative and qualitative data—is highly useful for making decisions that are more responsive to people's interests and dynamics or that address imbalance in use and access.

Participation in the planning process can take many forms, including public hearings, consultations, workshops, and stakeholder meetings. In this study, we explore a complementary approach to gathering information about the diverse interests and dynamics at the local level: the analysis of people's geolocated digital traces, which are openly shared online. This approach provides additional insights into community values, needs and habits in a way that complements more traditional forms of public participation. By taking people's habits and interests into account, planning strategies can have a more effective impact on the local community by incorporating new alternatives that are better integrated with landscape features. Our study intertwines different sources of geolocated data from both users and administrations to reveal intangible evidence linking landscape spatial features with people's most frequented or preferred itineraries.

1.2. The Need to Address (Again) Urban Open Space in Medium-Sized Cities: Landscape Features, Physical Activity and Community Ties

According to urban population statistics published by the World Bank in 2021, 57% of the world's population lives in urban areas, and the majority of cities world-wide are medium-sized [10]. In Europe, one of the most urbanized regions on the planet, the percentage rises to 75% on average [11]. The European Territorial Agenda 2020, adopted in 2011, stated the need to achieve polycentric and balanced development, highlighting the role that medium- and small-sized cities could perform at regional levels. In the case of so-called medium-sized cities, which range, in Europe, from 20,000 to 1 million inhabitants, the issue is less about the population threshold and more about their role in structuring the urban system and urban-rural links. The ease of interaction between citizens and local government, the human scale, or the identification with landscape features leads us to describe medium-sized cities as economic, physical, and cultural frameworks in which a satisfactory quality of life can be sought with limited resources [12]. Such characteristics reflect the versatility of medium-sized cities. Indeed, they have a greater capacity to design and implement high value-added strategies with a major positive impact at local levels, which, in turn, ultimately produce multi-scale effects at the city level. The objectives of the European Territorial Agenda 2030-"A Future for all Places", show that greater attention is being paid to issues that have an impact on the wellbeing of society. The development and implementation of place-based strategies and investments are, therefore, central issues in which the involvement of local communities is a key factor [13]. Once again, medium-sized cities appear to be a cost-effective asset allowing to achieve a better impact on local communities at a high level of granularity.

At present, public policies for sustainable urban development are mainly guided by the numerous challenges to be met in order to improve the quality of urban life. Particularly, three issues where landscape features perform a key role cut across the main aspects to be addressed: nature, pedestrian scale, and community ties. First, there is a clear convergence of opinion on the need for "greatly expanding the presence and function of nature in urban areas by rewilding cities, bringing back nature into everyday contact with urban residents, providing urban agricultural opportunities, implementing green infrastructure and planting billions of trees" [4] (p. 4). To this end, the definition of green infrastructure—henceforth, GI—embodying landscape-based planning strategies has become a key issue of twenty-first century city-planning [14–16]. Second, urban planning needs to be approached from a walkable city perspective, that is, returning to an urban model that allows most activities to be carried out on foot or by bicycle [17], which requires in-depth knowledge and identification of landscape features as a place-based validation. Third, in the pursuit of a more cohesive society, urban public spaces and public facilities need to be understood within a context of an increasingly complex urban system [18,19] linking people and place though a landscape-based perspective.

Researchers, experts in landscape-based spatial planning, and public administrations are increasingly paying more attention to the relationship between tangible physical space and intangible user awareness and/or willingness. In this way, geolocated social-media data, as digital traces of people activity, have become a highly effective means to study urban dynamics. The potential of geolocated social-media data to support landscape-based decision-making processes in spatial planning is a research topic of reference. Results in the field suggest that these methods may be subject to potential biases, i.e., poor representativeness of the different social groups. These working methods allow the handling of larger amounts of data and the application of multi-scale and temporal approaches using fewer resources than traditional methods. Yet, still little is known about their potential biases because they have only been incorporated into current lines of research relatively recently and because geolocated social-network data sources are wide-ranging. These sources show promising results in several fields and may lead to a better understanding of the dynamics of human behavior. In this regard, the research aims to demonstrate the potential of using location-based data generated by social media users as a means of expanding the range of useful sources for spatial planning. Specifically, the approach is related to the current need for implementing policies aimed at creating healthier cities which prioritize environmental and cultural preservation.

2. Aim and Objective

This study proposes a methodology to apply at a preliminary stage of introducing landscape-based features into spatial planning, specifically at city-scale. The study first assumption was that motivation for physical activity is enhanced when itineraries incorporate the landscape features with identity perspective—natural assets, sense of place—and the functional diversity associated with urban activities—public facilities—. This issue led to focus the scope of the work on the analysis of walking-related activity in urban and peri-urban areas with a people-based approach. A first distinction was introduced to discriminate between municipalities' officially proposed routes and those spontaneously shared by users over the Wikiloc social network [20], given the different nature of their conception.

The aim of this paper is to demonstrate the potential of using geolocated or location-based social network (LBSN) data as a complementary tool for integrating people's preferences into landscape-based spatial planning. The ultimate goal is to broaden the range of information used in spatial planning by incorporating a people-based approach. The main hypothesis is that although geolocated routes shared online by users may not be specifically created for planning purposes, their analysis, linked to the city's spatial and social configuration, offers a powerful tool to access users' viewpoints and spontaneous dynamics, particularly when considering public participation in decision-making processes and, more specifically, in landscape-based planning. The aim is to reflect on how traces of users' activity at city scale can better inform the knowledge of the local community for experts in landscape-based spatial planning. Specifically, in this case, Wikiloc routes provide clues that enable decision-making in line with users' preferences or habits. The hypothesis is that the intertwined analysis of Wikiloc trails and Google Places API data, selecting categories related to cultural and landscape aspects, will facilitate a more complex diagnosis of spaces with a greater overlap of activities and identify empty spaces of activities that could give rise to renewal projects for balancing different areas of the city.

Thus, three objectives were set out: (a) identifying LBSN data associated with urban-landscape features; (b) gathering information about the most popular itineraries by rank; and (c) suggesting a standardized methodology and criteria to assess: (i) how people preferences can contribute to decision-making planning processes; (ii) alternatively, to check the extent to which proposals made by spatial planners are aligned with people' interests; or (iii) additionally, to what extent this method may serve to balance the scales in stimulating urban dynamics linked to landscape features.

In line with previous studies, the present study builds on existing methodologies which delve deeper into the identification of spatial regeneration opportunities at urban level [21–23]. The following novel approaches were followed:

- **Testing LBSN for landscape-based spatial planning.** Testing the combination of different sources of geolocated data, such as Wikiloc users' trails and Google Places API. The aim is to show the potential of user-generated and openly shared information to better align landscape-based planning approach with citizens' interests and habits.
- **Assessing landscape-based planning opportunities.** Assessing the extent to which the number and variety of specific itineraries are related to landscape features providing opportunities linked to social, cultural, or ecological aspects in urban and peri-urban contexts.
- **Exploring the versatility of LBSN data to complement planning based on landscape identity features through the lens of a people-based approach.** Exploring the

versatility of using geolocated social media data as an indirect source of public participation. This could help to gain an initial insight into the spatial dynamics connected with local landscape features, public facilities, or other points of interest.

The main novelty of this study resides in verifying a potentially adequate method to identify landscape intangible values and dynamics in places that can be enhanced by landscape-based planning solutions—aligning them better with peoples' interests or customs. The method involved relating Wikiloc users' most popular trails, at an urban and peri-urban scale, with Google Places landscape-based categories.

Medium-Sized Cities as a Benchmark

Medium-sized cities are highly diverse, but they do share some common characteristics and qualities relating to landscape features, physical activity—walking—and community ties which are of special interest in this study. For example, the local economy is closely linked to the cultural landscape and the compactness and shorter distances of medium-sized cities allow them to prioritize the human scale more easily. This also increases the city's sustainability as an environmental, social, and economic system. Among all the possible areas of interest, the compact and dense urban fabric of European Mediterranean cities provides some common landscape features and public spaces that differ from that of more northern cities and that encourage physical activity.

Figure 1 shows a selection of medium-sized cities within the Mediterranean European Area, whose populations range between 150,000 and 800,000 inhabitants. These cities are located in Functional Urban Areas—FUA—which embrace the city and its commuting zone. Moreover, the degree of urbanization assigned by Eurostat [24] to each region reveals that all cases are in densely populated areas where at least 50% of the population lives in urban centers.

In the case of Spain, 81% of the population lives in consolidated urban areas, concentrated in 20% of the territory [11], mainly in the coastal fringe of the Iberian Peninsula. Furthermore, almost 350,000 ha of the first 10 km of the coastline are covered by artificial surfaces, representing 34% of the total artificial surface of the whole country. In addition, the traditional Spanish city configuration rests on a compact urban model that prevailed in Spain in the second half of the twentieth century [2]: a close city with a complexity of uses, services and facilities (p. 775). Today, the objectives of the Spanish Urban Agenda are aligned with the international agreements adopted by Spain in the context of international policy [25,26]. The agenda proposes a city model based on proximity to ensure both a more sustainable system and a positive impact on the population's health. All these reasons make coastal medium-sized Spanish cities an appropriate benchmark in this study.

This work focused on two specific cases located on the Spanish Mediterranean Arc: Alicante and Elche (Figure 2). These medium-sized cities are county capitals. In both cases, they are very active urban centers, highly dynamic in terms of the economy, tourism, and services. Neither city has an urban planning instrument based on landscape planning objectives, but in both cases, there are natural spaces of high ecological and cultural value embedded in the urban fabric, offering great opportunities for developing landscape-based planning strategies. Due to their size and the morphology of their urban centers, both cities can be considered as representative examples of cities in the Spanish Mediterranean Arc. Additionally, these two cities share a number of common morphological, spatial, and functional singularities. Both touch the urban edges of municipalities located at an elevation of 100 m. These areas, therefore, constitute strategic spaces affected both by the cities' own growth dynamics and by coastal city development. They generate high population density; scenic distortions within municipal borders due to conurbation effects in some points; and landscape features of high scenic, cultural, environmental, and production interest. These latter components are the basis of the city's identity and are located very near the town centers.

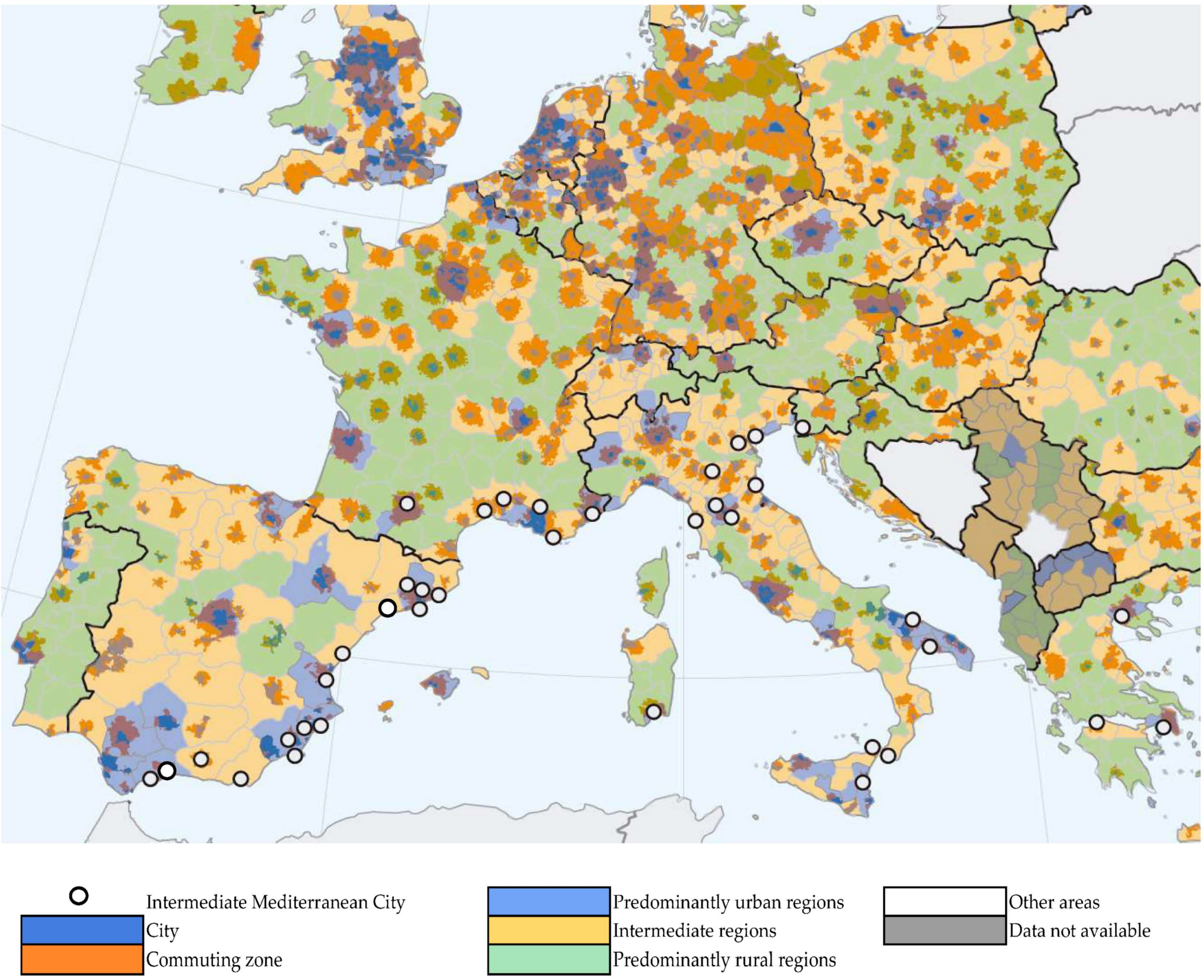

Figure 1. Medium-sized cities selected in the European Mediterranean Area. Location of selected medium-sized Mediterranean cities. Legend: "Predominantly urban region": population > 80% lives in urban clusters; "Medium-sized regions": 50% < population < 80% lives in urban clusters; "Predominantly rural region": at least 50% of the population lives in rural areas. Source base map Eurostat. "Cities and commuting zones" overlapped to "Degree of urbanization" Eurostat—GISCO,2022.

Wikiloc routes in medium-sized Mediterranean cities			
City	Country	Population (inhab. 2022)	Wikiloc urban routes
Valencia	Spain	792,000	12,290
Málaga		579,000	9,287
Murcia		462,000	5,295
Alicante		**338,000**	**12,366**
Hospitalet de Llobregat		265,000	2,792
Elche		**235,000**	**4,436**
Granada		228,000	10,366
Tarrasa		224,000	15,257
Badalona		223,000	3,613
Cartagena		216,000	4,277
Sabadell		215,000	5,623
Almería		199,000	2,554
Castellón		171,000	4,016
Marbella		150,000	1,335
Tarragona		135,000	5,284
Gerona		103,000	7,616
Toulouse	France	447,000	223
Niza		344,000	187
Montpellier		264,000	171
Tolón		163,000	110
Aix-en-Provence		140,000	71
Nimes		139,000	58
Bolonia	Italy	394,000	1,406
Florencia		359,000	2,558
Bari		312,000	226
Catania		293,000	115
Venecia		254,000	581
Mesina		224,000	41
Padua		207,000	584
Trieste		199,000	438
Prato		193,000	856
Tarento		188,000	67
Regio de Calabria		173,000	66
Ravena		157,000	482
Livorno		155,000	796
Cagliari		149,000	380
Salónica	Greece	315,000	534
Patras		168,000	72
El Pireo		163,000	372

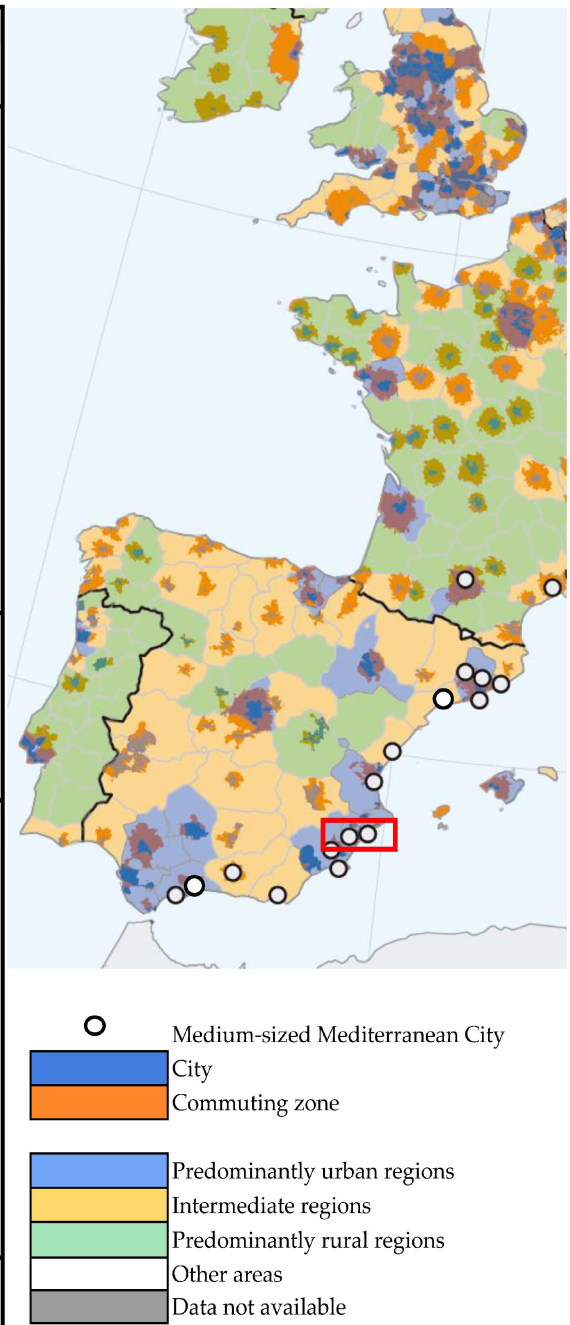

Figure 2. Study cases in the Spanish Mediterranean Arc. List of selected medium-sized Mediterranean cities [population range between 150,000 up to 800,000 inhabitants]. Wikiloc App. No. of urban routes at city-scale zoom, which follow the parameters selected in the methodology.

3. Materials and Methods

This section describes the sources, materials, and methods used to explore the potential of using digital walking activity traces across urban and peri-urban areas for landscape-based spatial planning.

3.1. Materials and Sources

Added to the official City Council websites, the main sources used in the present work were Wikiloc and Google Places API data.

Wikiloc is a Spanish website [20] that compiles geolocated routes freely shared by users. This location-based social network was initially created to share user-generated information on outdoor activities related to natural trails and sports. According to the website's updated information [20], Wikiloc has currently over 11 million members who have explored and shared more than 40 million routes and 71 million outdoor photos. This website is a collaborative project which is constantly fed by users' activities. It allows users to find routes within a given area and adjust specific requirements through filters: type of activity, accessibility, maximum distance, etc. Additionally, information about points of interest, difficulties, or specific features is included in the descriptions. It also provides a "trail rank" indicator that specifies the best rated trails with values ranging from 0 to 50 that can actually go up to 100 if well rated by users. Despite the urban scale approach of this study, the route information retrieved was not limited to urban centers.

Google Places API sources the Google Maps Platform with a listing of existing economic activities and relevant places in the city. Registers in this data base are classified by land-use category providing comprehensive information on the city's activities and urban spaces—places, types of land uses, working hours, etc. Data is retrieved by querying the Google Places API in specific locations—i.e., coordinates, addresses, or postal codes—according to each of the 108 Place types defined by the Google developers' places API [27]. The collected data offers updated information according to the date of retrieval. This source has already proven to be effective in research on the economic activity of cities [28], and the same fine-grain information is contained in the Places database for urban facilities, landmarks, and places in cities.

Following the methodological scheme synthesized in Figure 3, the approach is mainly based on the analysis of four different types of materials, namely:

1. City's officially proposed routes (Table 1)—health itineraries, tourist trails, and other routes were sourced from official listings/records published by the municipalities of Alicante [29–31] and Elche [31–33];
2. The city's popular routes. These itineraries are frequently used by the population according to the digital footprints generated by Wikiloc users and registered on that website [20];
3. Google Maps data to analyze existing urban activities that are connected by the routes or that take place in their surroundings. These data were sourced from Google Places API [27];
4. Lastly, baseline city maps that represent general types of urban areas—urban, peri-urban, and rural areas—were retrieved from Open Street Maps [34].

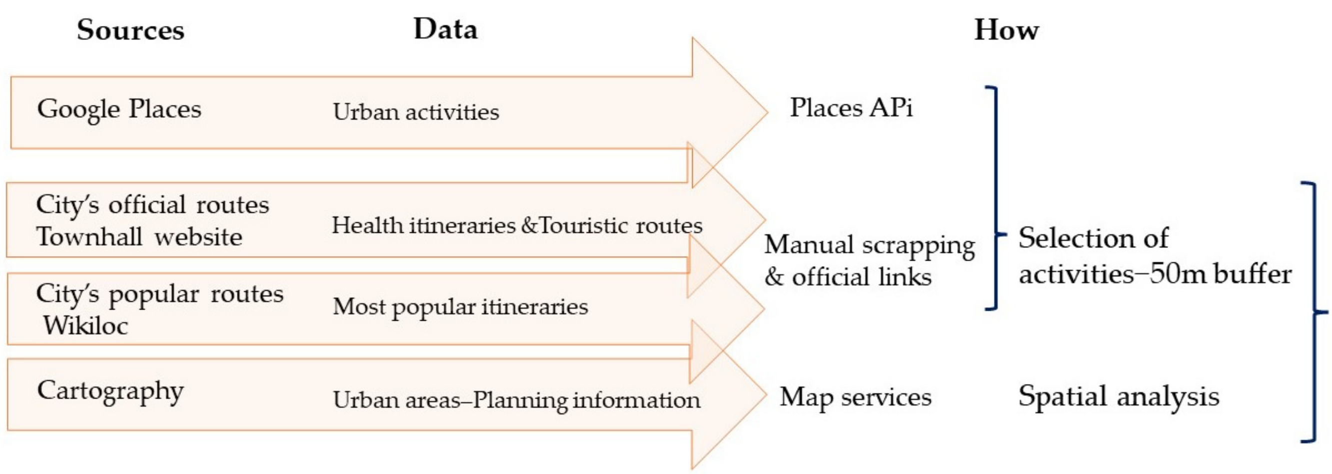

Figure 3. Methodological scheme.

Table 1. Alicante and Elche official routes.

	ALICANTE CITY					
Alicante City Council—Department of Mobility and Traffic & Department of Transport and Accessibility				https://www.alicante.es/es/noticias/camina-alicante (accessed on 19 February 2023)		
		route type	**km**	**accessibility**	**context**	**links**
1	Parque del Palmeral	circular route	2.30	accessible	urban	trail 16
2	Plaza Gabriel Miró	linear route	2.30	accessible	urban	trail 7
3	Explanada	linear route	4.00	accessible	urban	trail 7
4	Avd. Villajoyosa	linear route	2.60	accessible	urban	trails 11 & 13
5	Goleta	linear route	5.10	accessible	urban	trail 14
6	Bulevar del Plá	circular route	4.00	accessible	urban	
	Alicante City Council—Environment Department			https://www.alicante.es/es/contenidos/red-senderos-urbans (accessed on 19 February 2023)		
7	Paseos y árboles singulares en el Centro Tradicional de Alicante	circular route	3.00	accessible	urban	trail 2, 3 & 4
8	Itinerario ambiental Parque Lo Morant	circular route	1.50	accessible	urban	
9	Itinerario ambiental por La Ereta	circular route	1.60	medium-low	urban	trails 7 & 10
10	Senderos en el Benacantil	circular route	2.35	accessible	urban/periurban	trails 9 & 11
11	Sierra de San Julián. La Serra Grossa.	linear route	5.24	medium-low	urban/periurban	trails 10 & 12
12	Senderos en las Torres de la Huerta	circular route	12.20	accessible	urban/periurban	trails 11 & 15
13	Senderos en el Cabo de la Huerta	linear route	4.35	easy	urban/periurban	trail 11
14	Itinerario ambiental Parque Inundable La Marjal	circular route	1.00	easy	urban	SMelgares park
15	Senderos en el Monte Orgegia	linear route	3.50	easy	periurban	trail 12
16	Sendero Sierra de los Colmenares	circular route	4.90	easy	periurban	trail 1
17	Nueva Tabarca, patrimonio cultural y natural	circular route	1.58	easy	periurban	island
	Spanish Association Against Cancer—Alicante		https://www.contraelcancer.es/es/talleres/rutas-saludables-alicante (accessed on 19 February 2023)			
	Health improvement. Routes of max. 1h 30′.					
	Ruta Plaza Mar 2 shopping mall				urban	
	Ruta Casa del Mediterráneo				urban	
	ELCHE CITY					
	Elche City Council					
		route type	**min**	**accessibility**	**context**	**links**
1	Metrominuto Elche-R1	linear route	60 min	accessible	urban	R3 & R4
2	Metrominuto Elche-R2	linear route	35 min	accessible	urban	R3 & R4
3	Metrominuto Elche-R3	linear route	120 min	accessible	urban/periurban	R1 & R2 & R4 & R5
4	Metrominuto Elche-R4	linear route	50 min	accessible	urban	R1 & R2 & R3 & R5
5	Metrominuto Elche-R5	linear route	100 min	accessible	urban/periurban	R1 & R2 & R3 & R4
6	Ruta botánica Parque Municipal	circular route			urban	
7	Ruta de los puentes	circular route			urban	
8	Ruta geolófica por el río Vinalopó				periurban	
9	Ruta Av. de la Libertad				urban	
10	Ruta Palmeral urban				urban	
11	Ruta Elche musulmán				urban	
12	Ruta Pantano d'Elx				periurban/rural	
13	Ruta del ecosistema urbano				urban	
14	Ruta Alcudia	circular route	4.12 km	medium	periurban	
15	Ruta de los monumentos	linear route	1.8 km	accessible	urban	
16	Ruta de las palmeras singulares	linear route	5 km	accessible	urban	
	Spanish Association Against Cancer—Elche					
	Health improvement. Routes of max. 1h 30′. pax.					
17	Ruta Oficina de turismo-Palmeral					

The official routes with their main features from Alicante and Elche city council websites.

3.2. *Research Design and Method*

The method designed for this study consisted of a straightforward comparison of two types of information: official and informal information. This approach is not new, but what differentiated this study was the use of LBSN user-generated information to explore intangible values and people dynamics in relation to outdoor activity in urban contexts, looking for its relationship with landscape features which provide peoples' place-based perception or sense of place. The use of these novel sources, however, was not without difficulties. The processes of retrieval, filtering, and selection of valid data performed in this study are described and commented in this section. Some limitations are presented in Section 5. The adopted method consisted of three stages detailed below.

First, data from Wikiloc and Google Places API were collected, mapped, verified, and pre-processed. In the case of the official routes, the itineraries were mapped according to their description on the corresponding websites—Alicante [29–31] and Elche [31–33]—and the informal routes from Wikiloc were downloaded and mapped in a GIS software. The Wikiloc routes were selected by rank—"*Trail Rank*" from 50 up to 100—and filtered by activity—walking, hiking, running, riding (bike, e-bike, scooter), and flora observation (Table 2).

Table 2. Fixed parameters for the selection of trails on the Wikiloc website.

Route activity	Walking, hiking, running Road bike, eBike, scooter Reduced mobility, and blind people Flora observation
Route length	Up to 15 km
Type of route	Linear trail, including 'round trip'
Difficulty	Easy, medium, difficult
Heigh difference	800 m maximum

Criteria for trail selection using Wikiloc App filters to narrow down specific routes.

The city's official proposed routes were listed with their main features (Table 1) and manually collected from both Alicante and Elche's city council websites [29,30,32]. In the case of Alicante, the routes are elaborated by three different departments, which maintain some points of connectivity. In the case of Elche, information was lacking on the specific itinerary of a number of routes, but a route was inferred from the information provided by linking the specific locations that connect them [35]. Moreover, in both cities, several official itineraries linked to the Spanish Association Against Cancer [31] are promoted locally but no specific route details are given.

The cities' popular routes, or "informal" routes, were manually downloaded and mapped in a GIS software. To this end, the parameters shown in Table 2 were applied as a filter to all the routes offered by the Wikiloc website in order to obtain a selection of routes. The forty most popular, with the highest Trail Rank, were selected.

The urban activities and open public spaces were retrieved from the Google Places API [27], which was queried for the cities of Elche and Alicante. In the present work, only the following variables were selected, mapped, or analyzed: spatial coordinates—latitude and longitude— place name, and place category, which are descriptors of the type of venue. These place categories were relevant in this study as they provided information on the kind of urban activities taking place in areas surrounding the selected routes. The raw dataset was processed to eliminate duplicate data, validate the registers, and sort the place categories into APA Land Based Classification Standards categories according to levels 1, 2, and 3 [36]. This re-classification of categories allowed to properly select and discuss the existence of relevant activities in the context of the selected routes. A total of 22,373 unique places in both cities were verified and assorted—14,098 for Alicante and 8275 for Elche.

Second, a quantitative and qualitative analysis of the routes was performed, comparing the results of both cities. This analysis comprised: (1) a quantitative and qualitative comparison of official and informal routes; (2) a quantification of each type of route section running through urban, peri-urban, and rural areas in order to infer the proximity of the routes to population; and (3) an analysis of the land uses within a 50 m buffer around the selected—official and informal—routes. The choice of a 50 m buffer owed to the fact that the total buffer width was 100 m, i.e., approximately the social field of view [37]. The social field of view is the maximum distance at which it is possible to see and perceive a person or an urban activity. In addition, the implementation of a 'linear buffer method' allowed defining the spatial context that would influence walking directly alongside the route more accurately [38–40].

In the specific cases of Alicante and Elche, this measure was fairly similar to the average size of an urban block. Therefore, the study of an area of 50 m away from the buffer axis covered one block or the part of the block containing activity related to the selected route. This analysis enabled gathering information on how are articulated the most relevant spaces, landscape features, and/or facilities in the city related to the more relevant routes taken by users. A key objective of this study was to show the extent to which information obtained from social networks can facilitate both quantitative and qualitative analysis. In addition, the study compared the type of information reflected in the official routes to the data provided by Wikiloc application users.

In this regard, two groupings included in the APA Land Based Classification Standards were selected in order to delimit the types of activities that contributed to route attractiveness. These groups included urban activities related to arts, entertainment, and recreation—coded as 5000—and education, public administration, health care, and other institutions—coded as 6000. These groupings included activities related to culture—such as museums, theaters or exhibition centers, and historical or archaeological institutions; outdoors—amusement parks, recreation areas, or sports activities, among others; natural areas—parks, marinas, and natural geographical assets; and other urban public administration facilities—the townhall, courthouse, etc.; health care—hospitals and wellbeing centers; and education—schools of various education levels and higher education centers.

Finally, the quantitative and qualitative information obtained from the analysis was perused and thoroughly analyzed. Local knowledge of both cities was factored, allowing this procedure to be performed effectively. The main results and discussion are presented in the following section.

4. Results

This study does not focus on the search for the best route or on the singular characterization of routes. The main results are focused on finding out whether the selected sources provide specific information that contributes to a more precise knowledge of which landscape features or main landmarks are most present in relation to users' preferred routes at the urban scale.

There are sources of information which, without having been created for any purpose related to spatial planning or analysis, are nevertheless, by their nature, a plausible source of complementary knowledge applicable to spatial planning. In this case, the focus is on landscape features or spatial components linked to the identity of the place, whether natural or cultural. From the point of view of the results obtained, this is the case of the data sources intertwined in the study conducted.

4.1. Users' Informal Wikiloc Trails Provide a Dense Network of Urban-Routes with High Value for Landscape-Based Spatial Planning Decision-Making

A first result regarding the number of routes was that most of the route stretches shared by Wikiloc users were of an urban nature, and all of them were directly connected to several landscape features—natural, visual, and/or cultural—and some urban facilities. Thus, although the study focused on urban trails, some of the fix parameters incorporated features traditionally associated with peri-urban and rural area activities, such as hiking or flora observation. Therefore, remarkably, the evidence on informal routes proved that people's preferences regarding trails that pass through urban areas were relevant.

Results on the scope of the routes or stretches of route are summarized in Table 3, which shows the type of itinerary—urban, peri-urban, or rural—and the total number of km for each category.

Table 3. Summary of itineraries according to scope and length.

City	Itinerary Type	Scope	Length (km)		Total Length (km)	
Alicante	Official	Urban	51.9%	17.77	9.6%	34.23
		Peri-urban	17.7%	6.05		
		Rural	30.4%	10.41		
	Wikiloc	Urban	62.0%	200.84	90.4%	323.59
		Peri-urban	20.0%	64.42		
		Rural	18.0%	58.33		
Elche	Official	Urban	84.5%	48.10	13.9%	56.93
		Peri-urban	15.5%	8.83		
		Rural	-	-		
	Wikiloc	Urban	46.2%	162.98	86.1%	352.93
		Peri-urban	19.8%	70.03		
		Rural	34.0%	119.92		

Comparative analysis of the route distribution according to their scope—areas through which they pass—and length.

Additionally, the analyzed itineraries presented connectivity between different landscape contexts in both cities. Moreover, Wikiloc routes represented a network that was ten times larger and more diverse across all categories than the city's official routes. Worthy of note, the selection criteria of Wikiloc routes were restrictive (Table 2), and only the first 40 routes with a "TrailRank" value above 50 were used in this study.

In the case of Alicante, more than 50% of both official and Wikiloc trail layouts ran within consolidated urban areas. The peri-urban fringe was a transitional area where few stretches were represented. Surprisingly, the rural scope obtained higher values in the case of Alicante because of the presence of a coastal mountain range within the urban borders. The latter constitutes a substantial natural asset that was previously classified as rural due to its physical characteristics.

Elche itineraries presented a clearly urban scope, making up 84.5% of the official routes. However, Wikiloc trails showed a more balanced situation, running through urban, peri-urban, and rural stretches. The transitional areas between urban and rural lands in Elche are very narrow; thus, the under-representation of a peri-urban fringe derives from Elche's urban configuration.

4.2. Users' Informal Wikiloc Trails Intertwined with Official Routes Provide Rich and Accurate Information about Landscape-Features, Cultural Assets, and Urban Facilites Connectivity

The qualitative analysis of the location of urban facilities and other relevant elements, which constitute local landscape features, in the buffer areas surrounding the selected routes revealed differences according to the type of itineraries. The broad diversity of urban facilities linked to all routes, both official and Wikiloc routes, are shown in Figure 4a,b and Figure 5a,b. The official routes in Figures 4a and 5a are highly connected to urban facilities and cultural assets in the city centers. In contrast, Wikiloc itineraries offer a wider range of elements related to natural landmarks and landscape assets, even when these urban trails coincide with the official routes in some sections (Figures 4b and 5b). The data provided evidence of the number of different routes that passed through the same landmark or facility (Table 4). This allowed the revealing of the significance of some elements and highlighting of the elements present in the broader collective consciousness.

Figure 4. Methodological stages for Alicante city. (**a**) Official routes with related POIs and 50 m buffer areas; (**b**) Wikiloc selected routes with related POIs and 50 m buffer areas; (**c**) Overlapped official and Wikiloc buffer routes and Google activities located in the catchment area of route buffers.

In the case of Elche, the bridges and footbridges were revealed to be key components of many routes (Table 5). Moreover, these urban spaces were among the best rated in Google Maps, considering their role as landscape features that are core landmarks of the city's image and identity.

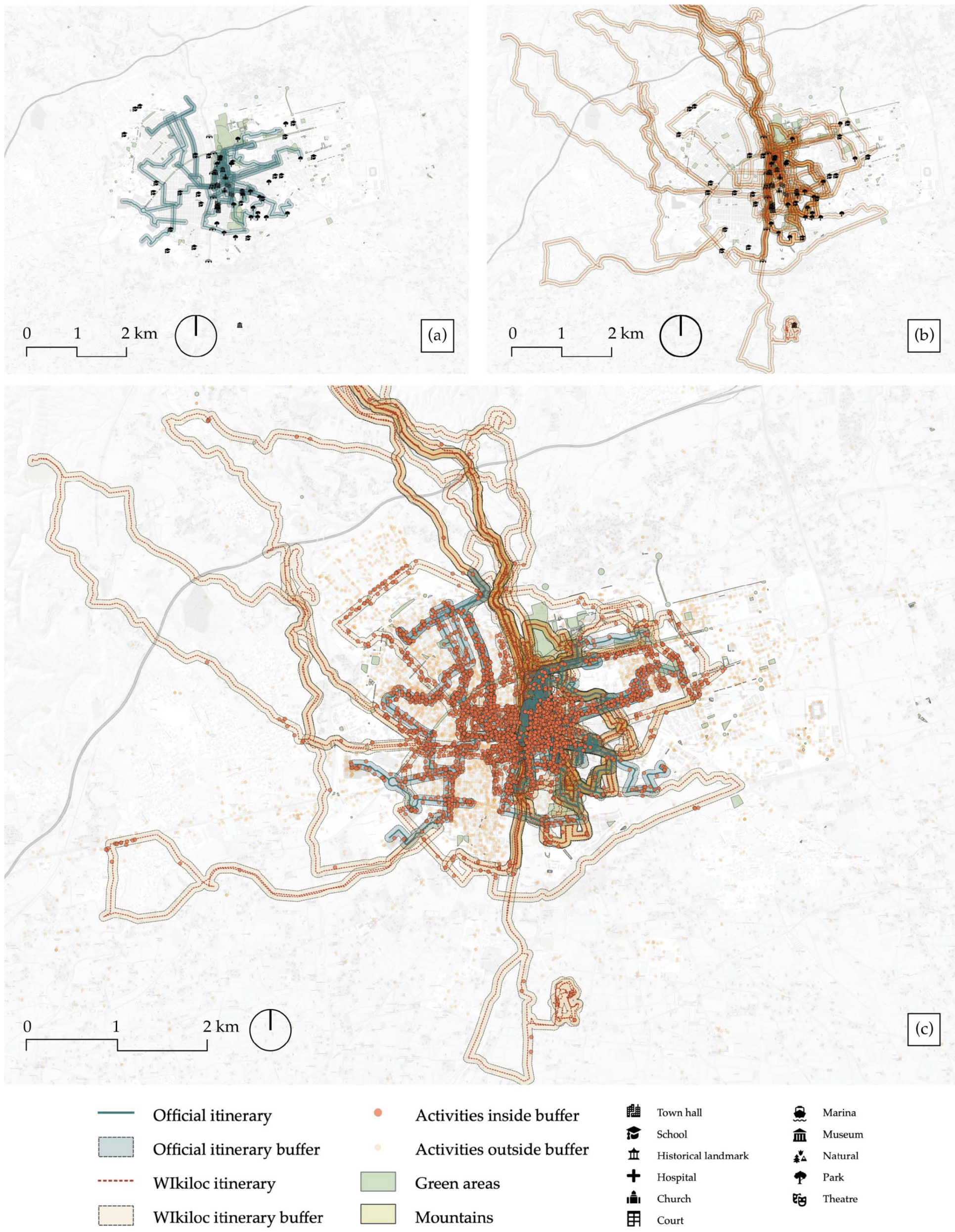

Figure 5. Methodological stages for Elche city. (**a**) Official routes with related POIs and 50 m buffer areas; (**b**) Wikiloc selected routes with related POIs and 50 m buffer areas; (**c**) Overlapped official and Wikiloc buffer routes and Google activities located in the catchment area of route buffers.

4.3. Google Places API Data Make It Possible to Complete Information on Landscape Features and Elements Related to Cultural, Natural, and Leisure Activities at Different Scales

Considering the data obtained from the Google Places API, it was also possible to perform a fine-grained identification of all the activities, focusing, in this case, on those that could contribute to a landscape-based planning analysis. The classification of the activities within the 50 m buffer of all the selected routes in Alicante (Table 6) and in Elche (Table 7) correspond to the APA Land Based Classification Standard of the grouping codes 5000 and 6000. These urban activities are broadly connected with cultural, leisure, health, and nature land-uses. Both tables present the percentage of urban activities that are outside the route catchment areas compared to the total number of activities retrieved—43% of the total in Alicante and 27% of the total in Elche—. The latter is represented in Figures 4c and 5c, where the dark-orange dots correspond to the activities that are in the catchment areas, and the light-orange dots to those outside the scope of the 50 m route buffer. Activities are concentrated in the urban centers and scattered in peri-urban and rural areas.

Table 4. Synthesis of main landscape features, linked routes, and overlapping route catchment area.

	Alicante City Landscape Features			
APA level 3		No.	Routes linked	No. routes Overlapping catchment area
5110	Theatre	3	2	9
5110	Auditorium	1	2	3
5130	Calisthenics Park		6	5
5210	Museums and Art places	33	9	4 to15
5220	Historical or archaeological institutions or landmarks	32	10	several
5230	Monumental trees	4		15
5360	Marina and Port facilities	4		4
6210	Alicante Townhall	1	20	20
6560	Health centres and Hospital	18	18	
	Elche City Landscape Features			
APA level 3		No.	routes linked	No. routes Overlapping catchment area
5110	Congress Centre	1	11	
5110	Theatre	1	11	7
5110	Cinema	1		9
5110	Agora Heliketana outdoor	1	15	
5130	Calisthenics Park	2	2	
5200	Graffiti places and other tourist landscape features			
5210	Museums and other art places	23		15 to 19
5220	Historical or archaeological institutions or landmarks			several
5230	Botanical garden	1	13	13

Main city landscape features or POIs and their linkage to several routes as a main point of the itinerary or located in the catchment area of nearby routes.

Table 5. Bridges in the city of Elche and the number of routes that run through.

Name of the Bridge	Type of Bridge	Number of Informal/Wikiloc Routes That Run through
Pont de la Plaça de Baix	Bridge	20
Passarella del Mercat	Footbridge	18
Pont de Santa Teresa	Bridge	17
Pont del Ferrocarril	Bridge	13
Puente De Altamira	Bridge	12
El Valle Trenzado	Footbridge	9
Pont de la Generalitat	Bridge	6
Pont de Barrachina	Bridge	3

Bridges are identity landmarks in Elche city. The confluence of several routes explains their relevance from a people-based perspective.

Table 6. Number of activities within the 50 m buffer of all the selected routes in Alicante according to their type.

Level 1	Level 2	Level 3	Total Activities (per Category)	Activities within Official Routes (Total per Cat.)	Activities within Official Routes %	Activities within Wikiloc Buffer (Total per Cat.)	Activities within Wikiloc Buffer %
5000 Arts, entertainment, and recreation.	5100 Performing arts or supporting establishment	5110 Theater, dance, or music establishment	87	11	12.6%	44	50.6%
		5120 Sports team or club	5	0	0.0%	4	80.0%
		5130 Racetrack establishment	10	2	20.0%	5	50.0%
	5200 Museums and other special purpose recreational institutions	(*mainly tourist attractions that have no specific code as other recreational places)	43	15	34.9%	28	65.1%
		5210 Museum	54	14	25.9%	33	61.1%
		5220 Historical or archeological institution	133	**42**	31.6%	**87**	65.4%
		5230 Zoos, botanical gardens, arboreta, etc.	8	2	25.0%	**4**	50.0%
	5300 Amusement, sports, or recreation establishment	5310 Amusement or theme park establishment	17	3	17.6%	4	23.5%
		5360 Marina or yachting club facility operators	5	0	0.0%	4	80.0%
		5390 Skating rinks, roller skates, etc.	3	0	0.0%	2	66.7%
	5400 Camps, camping, and related establishments		35	9	25.7%	**13**	37.1%
	5500 Natural and other recreational parks		191	29	15.2%	**61**	31.9%
6000 Education, public admin., health care, and other institutions	6200 Public administration	6210 Legislative and executive functions	46	7	15.2%	19	41.3%
		6220 Judicial functions	20	1	5.0%	1	5.0%
	6500 Health and human services	6530 Hospital	72	6	8.3%	17	23.6%
		6560 Social assistance, welfare, and charitable services	37	2	5.4%	12	32.4%
	6600 Religious institutions		141	11	7.8%	29	20.6%
	Total No. Activities within buffer intersection		**907**	**154**	**17.0%**	**367**	**40.0%**
	Total No. Activities out of buffer intersection		386	43%			

Identification and classification of activities linked to natural elements, facilities and outdoor recreational opportunities, and unique registers in Google Places API within the area of study in Alicante. Comparison between activities located in the 50 m buffer of the official routes and Wikiloc urban trails.

Table 7. Number of activities within the 50 m buffer of all the selected routes in Elche according to their type.

Level 1	Level 2	Level 3	Total Activities per Category	Activities within Official Routes (Total per Cat.)	Activities within Official Routes %	Activities within Wikiloc Buffer (Total per Cat.)	Activities within Wikiloc Buffer %
5000 Arts, entertainment, and recreation	5100 Performing arts or supporting establishment	5110 Theater, dance, or music establishment	49	19	38.8%	20	40.8%
		5120 Sports team or club	6	0	0.0%	1	16.7%
		5130 Racetrack establishment	12	1	8.3%	2	16.7%
	5200 Museums and other special purpose recreational institutions	(*mainly tourist attractions that have no specific code as other recreational places)	43	18	41.9%	23	53.5%
		5210 Museum	34	20	58.8%	23	67.6%
		5220 Historical or archeological institution	87	38	43.7%	49	56.3%
		5230 Zoos, botanical gardens, arboreta, etc.	12	1	8.3%	**2**	16.7%
	5300 Amusement, sports, or recreation establishment	5310 Amusement or theme park establishment	14	3	21.4%	2	14.3%
		5360 Marina or yachting club facility operators	0	0	0.0%	0	0.0%
		5390 Skating rinks, roller skates, etc.	1	1	100.0%	1	100.0%
	5400 Camps, camping, and related establishments		20	0	0.0%	0	0.0%
	5500 Natural and other recreational parks		134	40	29.9%	**53**	39.6%
6000 Education, public admin., health care, and other institutions	6200 Public administration	6210 Legislative and executive functions	24	11	45.8%	9	37.5%
		6220 Judicial functions	7	5	71.4%	0	0.0%
	6500 Health and human services	6530 Hospital	31	20	64.5%	5	16.1%
		6560 Social assistance, welfare, and charitable services	25	8	32.0%	7	28.0%
	6600 Religious institutions		89	27	30.3%	20	22.5%
	Total No. Activities within buffer intersection		**588**	**212**	**36.0%**	**217**	**37.0%**
	Total No. Activities out of buffer intersection		159	27%			

Identification and classification of activities linked to natural elements, facilities and outdoor recreational opportunities, and unique registers in Google Places API within the area of study in Elche. Comparison between activities located in the 50 m buffer of the official routes and Wikiloc urban trails.

In Alicante, the total percentage of activities corresponding to APA Level 1: group 5000 Arts, entertainment and recreation located in the route buffer areas was 46%. This group included a remarkable share of natural parks, gardens, and other activities directly connected to nature. In this way, Level 2—5400 camps, camping and related establishments, 5500 Natural and other recreational parks—and Level 3—5230 zoos, botanical gardens, arboreta, etc.—were thoroughly analyzed. They ultimately accounted for 28% of the total number of activities. Moreover, there were twice more of these activities in the Wikiloc route buffers than in the official routes. Indeed, a greater quantity and diversity of urban activities and natural places was found in almost all categories due the greater length of the Wikiloc routes. Regarding APA Level 1 group 6000 Education, Public administration, Health Care and Other Institutions, the percentage of activities included within the route buffer was 12%. This means that citizens' everyday activities are situated close to these routes, enhancing their role of attractive connectors.

Next, in the case of Elche, the total percentage of activities corresponding to APA Level 1: group 5000 arts, entertainment, and recreation included within the route buffer areas was 54%. In this case, the proportion of natural parks, gardens, and other activities directly connected to nature, considering Level 2—5400 camps, camping and related establishments, 5500 natural and other recreational parks—and Level 3—5230 zoos, botanical gardens, arboreta, etc.—amounted to 30% of total activities. In this case, the proportion of natural or green places was similar when comparing official and informal routes considering these groupings (Table 7). The differences accounted for around 10% more activities in the case of Wikiloc routes. In relation to APA, Level 1 group 6000 education, public administration, health care, and other institutions, the percentage of activities included within the routes' buffer was 19%. In the case of Elche, if we compare the column of activities included in the official routes buffer with those of Wikiloc, the figures are more balanced compared to Alicante. Indeed, the itineraries coincide to a much larger extent with each other and, therefore, the areas of influence overlap.

5. Discussion

The methodology applied in this study permitted overlapping and comparing different sources of geolocated information—official city routes and urban facilities location, Wikiloc trails and Google Places API—leading to a richer analysis and interpretation of the city with the integration of a people-based approach as a tool for developing a better-informed landscape-based analysis. Generally, the sources used were not developed as a direct resource linked to spatial planning or as a landscape features data provider. Nevertheless, our findings show all the potential of intertwining these geolocated data as a useful first insight to detect city dynamics from virtual traces which are meaningful for the local community. The assumption that physical activity is further encouraged by itineraries that incorporate both landscape features—i.e., natural assets and sense of place– and functional diversity associated with urban activities—i.e., public facilities—is reinforced by the obtained results.

It is important to clarify that this study is focused on exploring ways for approaching landscape-based spatial planning by introducing digital traces of local community activity. Moreover, it is about experimenting with the suitability of certain types of geolocated data sources. In this case, in line with the objectives of healthy cities promoted by local administrations, it seemed to be appropriate to search for tools that can show what activities are users undertaking in relation to healthy routes, and what types of actions are being implemented by the local administration. The fact is that Wikiloc users show more varied routes, better explained than the official ones, and with more potential for combining natural and cultural elements with other types of urban facilities. What this demonstrates is that the use of geolocated data of various kinds—Wikiloc, Google Places API—always provides a richer portrait, uncovering virtual traces that could not be detected by traditional fieldwork or surveys. This type of work does not replace the former, but it does provide an additional layer of relevant information.

As has been shown to be the case, Wikiloc routes offer users' generated content in a spontaneous way, freely shared through an online platform. The selected routes are with-in the best valued among users and related to urban and peri-urban contexts. Thus, there is a direct access to a type of geolocated outdoor activity data, connected to a healthy lifestyle that is already taking place spontaneously and is supported by part of the local community. More specifically, the approach is to what extent these routes connect places that have a landscape-based projection to be considered in the city's decision-making planning processes.

Regarding the sources of information used in this study, the urban route information that Alicante and Elche municipalities had at their disposal was far from accurate even though both city councils are working on the implementation of "healthy routes" at different levels. In contrast, the Wikiloc website provided detailed information, offering a clear overview of the different routes, whether individually or as a set of itineraries. User-uploaded photographs were also included. They were not studied at this stage, but that promise great potential for future work on landscape perception and preferences.

The study presented a number of limitations. The first was the fact that even though Wikiloc is used internationally by a large community of users, who freely contribute with their ratings and routes, the regional coverage is uneven. Though the Wikiloc app has proven to be a reliable source of data that allows a people-based approach, it does not support automated route downloads because the routes remain the intellectual property of the users who create them. This means that data collection is manual and complex for large sets of data. The methodology could be replicable using alternative online platforms, as long as they allow the retrieval of geolocated routes, and the users contribute voluntarily to ensure that the information is not biased by a company's interests.

Testing LBSN for place-based planning: although the working sample was limited to a maximum of forty Wikiloc routes and a restricted urban environment, the results revealed a diversity of activities along the routes that linked cultural, environmental, and social-interest aspects to public facilities and services. Therefore, even if the routes were not "designed" according to strategic spatial planning, they ultimately become itineraries that coordinate activities. The diversity of the integrated activities seems, a priori, a positive aspect that increases the resilience of these spaces. Moreover, the diversity of actors involved—from the private sector and public administration to residents, users, and visitors—provides an encouraging operational framework. The place-based perspective permits developing an analysis of landscape features and morphological characteristics [35], but user-generated data constitutes a more complex and difficult-to-obtain information approach that complements the understanding of the site by adding relevant nuances [22,41].

Assessing landscape-based planning opportunities: The fact that some of the routes have urban and peri-urban stretches and, in some cases, even develop a rural section (Table 3), reveals the existence of potential transects whose corridors could be better aligned with itineraries that are recognized by locals. What is more, these routes are connected to ecological assets, which, in turn, enhance links to ecosystem services, increasing the resilience and interest of the routes from a multi-scalar approach. Another relevant aspect is the existence of itineraries linked to the practice of sport or routes for visiting and recognizing heritage assets. The identification of these routes would help to design connections that ensure a continuity with the main urban itineraries in the vicinity, public transport, or existing facilities. It would also help to integrate peoples' preferences in decision-making planning processes and, therefore, constitutes a strategy for developing landscape-planning through the lens of a people-based approach.

A growing trend in the scientific literature is to recommend the integration of Ecosystem Services—ES—into planning strategies and the adoption of a multiscale, both territorial and urban approach [16,42–44]. Personal choices and social dynamics can be central to the presence and liveliness of specific areas, and intertwining these databases proved to be a valid method to uncover traces of people' activity and preferences. In Europe, landscape ecology principles have been implemented into landscape planning to address urban problems [45]. Under the umbrella of the emerging field of ES, several studies have assessed the environmental performance of landscape-based spatial planning, providing a "solid ground for the incorporation of the civil society through participatory planning processes" [19,45,46]. Specifically, Cultural Ecosystem Services (CES), including educational, recreational, heritage, and sense of place services, are unique at a local level. They are linked to the expectations and feelings of the local community, which implies dealing with subjective and intangible data [47]. Despite being an emerging field of research, assessing CES entails gathering users' opinions, preferences, and values, among other individual interpretations. A general approach to methods used to assess CES is presented by Cheng et al. [48]. Most techniques depend on voluntary participation and the targeted registration of specific samples of the population, through both web-based means (that reach a broader audience with less implication) and face-to-face interviews (less participants, but more accurate responses). Our study has shown a complementary way of unveiling people preferences and dynamics following their openly shared geolocated digital traces.

Surprisingly, one unanticipated finding was that these Wikiloc trails crossing through varying urban contexts are directly connected with the concept of urban transect, devised as an urban planning tool by Duany and Talen [49]. The idea beyond the identification of these routes is the possibility of detecting which one of them provide an "immersive local-landscape experience" based on community habits. Intrinsic to the transect concept are the values of public space promotion, pedestrian oriented, walkability, and connectivity. Moreover, transect planning looks after balancing urban and natural environments, applying diversity in varying degrees of urban activities in order to promote the interest and attractiveness along the routes. In this regard, the combination of Wikiloc routes and Google Places API facilitates the recognition or coding of the more active or relevant transects, as a first approach to city's landscape-based planning diagnosis.

6. Conclusions

Currently, a landscape-based spatial planning approach performs a central role in the way cities must face twenty-first century environmental and social challenges. Landscape-based spatial planning offers a broad perspective than considers not only the natural and ecological features of a landscape but also its cultural and social identity and sense of place.

Using the LBSN data sources, we were able to uncover previously unseen intangible values and dynamics within specific sites, which provide valuable opportunities to enhance landscape-based planning solutions. In this respect, the use of CES, combined with users' digital traces focused on landscape features, can perform a key role in promoting landscape-based spatial planning. Such an approach can help to identify people's dynamics, thereby contributing to the development of a sense of spatial belonging for the local community and the identification of experiential scenarios that are aligned with people's preferences. These factors are key motivators that can help landscape-based planning initiatives to promote physical activity and increase engagement.

The Incorporation of landscape features, such as natural assets and sense of place in networks of itineraries, enhances their connectivity and functionality, particularly when linked with urban activities and public facilities. Results from the two case studies showed that user habits can be used to identify valuable routes that connect different city areas, thereby promoting the integration of people' perspectives through landscape-based spatial planning.

The next step of the study is to explore additional combinations of geolocated social-media data, which can provide complementary information for landscape-based decision-making processes in urban and peri-urban contexts. By combining tangible spatial elements, such as landscape features, intangible urban dynamics, and people's preferences and perceptions, medium-sized European cities can serve as an appropriate benchmark for the definition of a strategic network to increase community awareness regarding landscape-based integral planning.

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