Tourism as a Spatially Structured Territorial System: A STESY-Based Interpretation of the Bay of Cádiz Tourism Ecosystem

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Abstract. The Bay of Cádiz represents a complex coastal tourism system in which tourism appears deeply embedded in the territorial structure and local economy. Rather than being concentrated in a single urban destination, tourism-related functions are distributed across a polycentric metropolitan area characterized by differentiated roles, short-stay dynamics, and high levels of spatial interdependence. This study applies the STESY framework to interpret the Bay of Cádiz as a structured tourism ecosystem, focusing on the spatial relationship between attractors, services, and accessibility. The methodology combines territorial analysis, mapping of tourism-related points of interest, cluster-based classification, and the use of composite indicators, including the Balanced Tourism Supply Index (BTSI), Attraction Potential Index (API), and Diversity Reachability Index (DRI). The results suggest that the tourism system is not simply organized around isolated destinations, but rather around a set of complementary territorial functions distributed across municipalities. The study contributes to a spatial reading of tourism as a territorially organized system and supports the definition of planning strategies aimed at improving integration, mobility, and long-term sustainability in coastal metropolitan areas.

Keyword: Sustainable tourism planning; · spatial analysis; · cluster analysis

1 Introduction

Sustainable tourism becomes more and more a core argument in territorial development debate defining local multi-stakeholders' perspectives and global framework for innovation and better management of such complex phenomena [1, 2]. Today tourism is recognized as a dominant driver of economic growth in coastal and heritage destinations, yet its rapid expansion has also generated critical spatial and temporal imbalances [3]. In the perspective of the authors, tourism opens to relevant debate in urban and regional planning research as the decision making process connected with tourism management represent a comprehensive framework in which sustainable urban regeneration

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and transformation, landscape protection actions, economic development issues interacts generating an effective environment to apply sustainable urban development principles, methods and agendas for short term and strategic territorial design [4–8]. Those applications are also oriented to improve the competences of students in academic curricula dealing with territorial design professionals, and this paper comes as a result of a studio in architectural classes following the research tradition [9–14] of sustainable urban planning and design at UNIBAS [15–18].

Tourism as a spatial phenomenon is a multidisciplinary domain where spatial dimension represents a robust analytical dimension for managing information and designs, applying collaborative approach for strategic planning [19–25].

Within this perspective, tourism may be interpreted not only through the volume of visitors or the intensity of seasonal flows, but also through the territorial structures that support, enable, and organize tourism-related activities.[26].

The Bay of Cádiz offers a relevant case for investigating these dynamics. The area is characterized by a polycentric territorial structure in which tourism-related functions are distributed across multiple municipalities, each contributing differently to the overall organization of the system. Rather than corresponding to a single dominant destination, the tourism ecosystem appears to be articulated through a set of complementary roles involving accommodation, gastronomy, heritage, leisure, mobility, and accessibility [24].

In this context, the study does not aim to frame tourism solely as a pressure or imbalance to be corrected. Instead, it proposes an interpretation of tourism as a territorial system whose internal structure can be analyzed in order to better understand its functioning, spatial logic, and planning implications [27].

This paper aims to develop a spatially informed planning framework capable of supporting the transition from a short-duration, high-pressure tourism model toward a more balanced system based on extended stays and territorial redistribution. The study proposes an integrated methodological approach combining spatial analysis, cluster-based interpretation, and policy-oriented design strategies in compliance with NUA principles. The contribution lies in bridging analytical diagnosis and operational planning within a coherent framework transferable to similar tourism destinations.

2 Study Area

To understand the study area, it is essential to recognize that the Bay of Cadiz is not a traditional urban center, but rather a polycentric metropolitan area heavily conditioned by its geography: a collection of cities interwoven by the Atlantic Ocean and separated by salt marshes. In this context, tourism in the Bay of Cadiz is a strategic destination that relies on the balance between natural resources and a historical urban structure. The influx of visitors drives the improvement of public spaces, infrastructure, and services, reinforcing a tourism model linked to leisure, the landscape, and culture. At the same time, it acts as an engine for economic and urban transformation, generating both opportunities and challenges related to sustainability and coastal preservation. To understand the true impact of this model on the territory, it is key to compare the local population with the arrival of visitors. The following graphs show the stark contrast between the number of residents and tourists, as well as their length of stay (Fig. 1).

The demographic analysis shows that Jerez de la Frontera is, by far, the municipality with the highest number of residents in the study area, exceeding 200,000 inhabitants. It acts as the main logistics hub and the major "commuter town" of the region. Meanwhile, the capital, the city of Cadiz, stands at around 110,000 to 120,000 inhabitants, a figure very similar to that of the municipality of San Fernando. On a second tier, Chiclana de la Frontera, El Puerto de Santa Maria, and San Fernando form a ring of demographic importance ranging between 80,000 and 100,000 inhabitants. This distribution highlights a clear territorial dynamic: the population resides mostly inland (Jerez), but the flow of work and leisure shifts daily toward the coast. This spatial dissociation forces a constant and massive use of private vehicles.

A drastic drop is observed in 2020 due to COVID, falling to 2.1 million visitors. However, the recovery has been highly positive, approaching the 4 million mark in 2024 and surpassing the record levels of 2018–2019.

Cross-referencing this data exposes the reality of a highly stressed territory. The sum of the entire resident population in the analyzed area does not even reach one million inhabitants; however, the territory bears the burden of more than 3.5 million tourists. This represents a ratio of more than 4 to 5 visitors for every resident. Consequently, basic infrastructures, which are scaled for the local population, must support a floating multitude that multiplies the actual pressure. This transforms the cities into giant weekend "hotels," overwhelming public services and hindering habitability for regular residents.

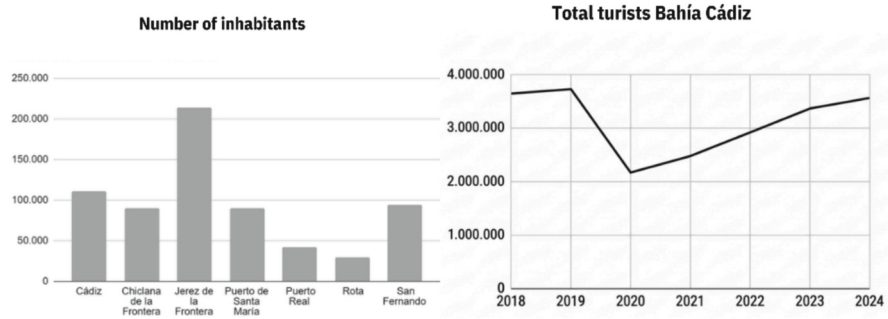

Fig. 1. Comparative overview of tourism dynamics in Bay of Cadiz. Source: personal elaboration of INE (https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736177095&menu=ultiDatos&idp=1254735572981)

3 Territorial Analysis

The approach adopted in this study is based on the STESY framework [28] conceived as an integrated analytical and interpretative tool for the identification of territorial imbalances and the support of evidence-based planning strategies.

The first phase consists of a contextual analysis of the study area, focusing on the identification and classification of key georeferenced components (PoIs) of the tourism system, including attractors, services, and reachability (Fig. 2). The most striking data is the "Restaurants" category, with 317 recorded points. This indicates that the Bay's

tourism supply is based around the food sector. “Attractors Monuments” make up the second largest group with 130 points.

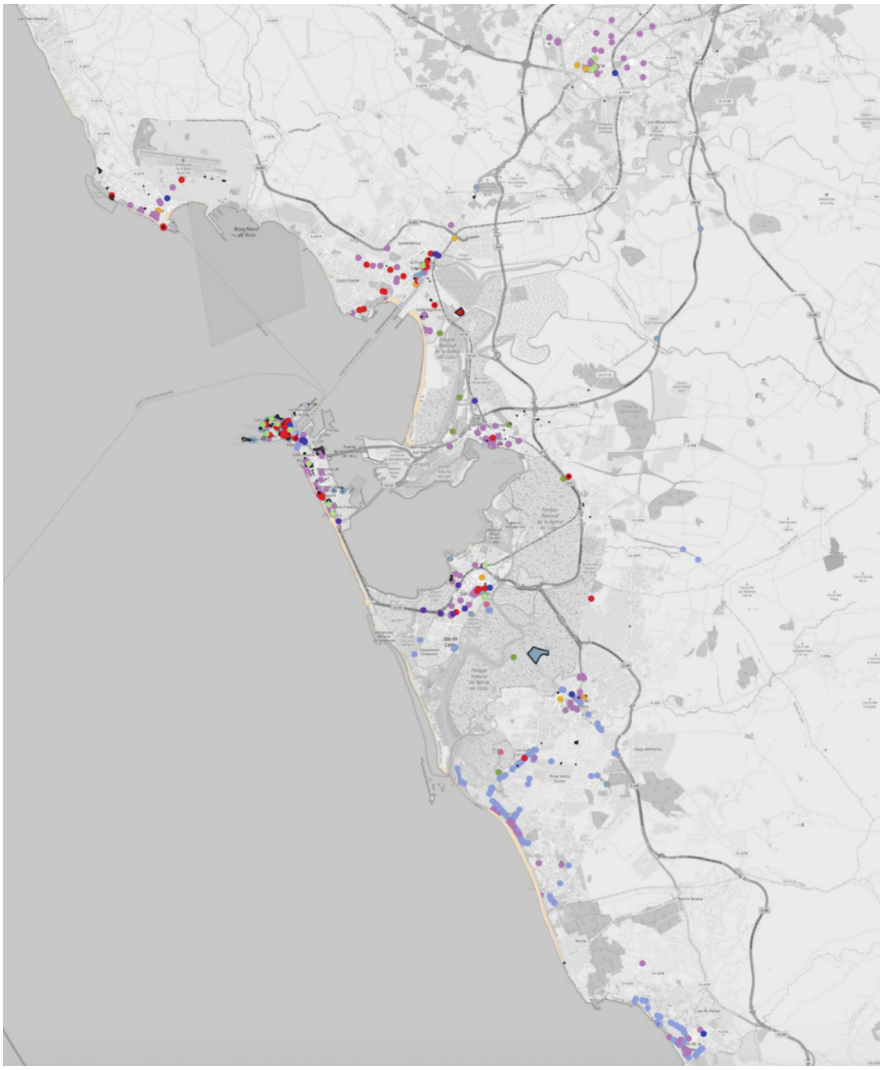

Fig. 2. Distribution of Attractors, services and reachability.

The second phase involves the spatial interpretation of these components through a cluster-based approach in order to identifying the Destination Areas of the tourism system in the case study. The territorial system is divided into homogeneous clusters using GeoDA software[29] aimed at identifying distinct spatial patterns. The optimal number of clusters is determined through the application of the Elbow Method[30], ensuring a balance between analytical detail and interpretative clarity (Fig. 3).

To quantify the characteristics of each cluster, three composite indicators are employed (Fig. 3). The Balanced Tourism Supply Index (BTSI) measures the relationship between accommodation capacity and consumption services, distinguishing between overnight-oriented and day-trip-oriented areas. The Attraction Potential Index (API) evaluates the strength of attractors based on their relevance and scale, while the Diversity Reachability Index (DRI) assesses accessibility and intramodality within the transport system.

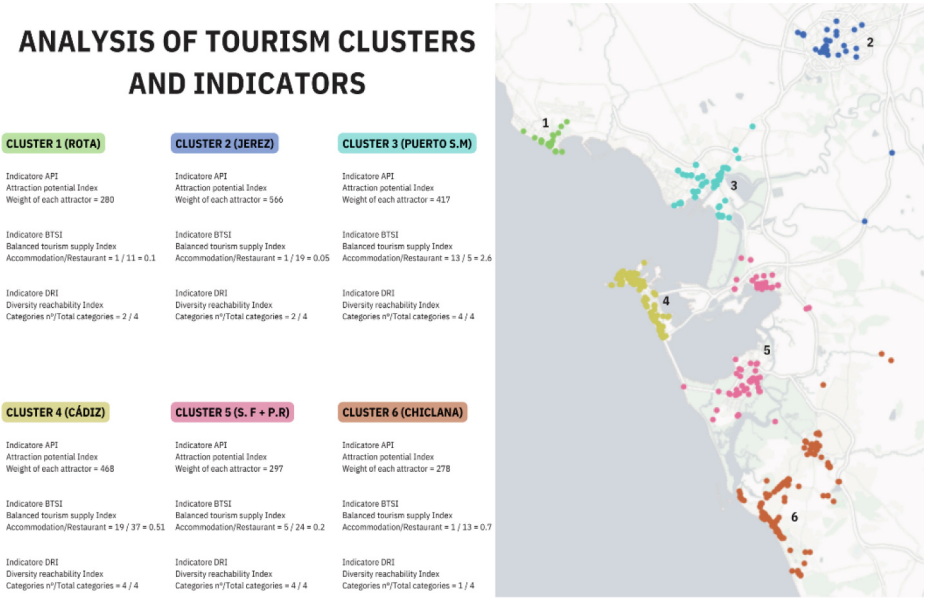

Fig. 3. Clusters and indicators of Attractors, services and reachability.

The tourism structure of the Bay of Cádiz reveals a markedly differentiated territorial organization, in which the municipalities do not perform the same role within the regional tourism system. Some areas appear to be primarily oriented toward attraction and daily consumption, while others are more clearly specialized in accommodation and longer stays. In this sense, Jerez de la Frontera emerges as the municipality with the strongest attraction capacity, followed by Cádiz, both characterized by a high concentration of cultural, gastronomic, and urban functions. However, in both cases the accommodation offer appears comparatively limited in relation to their attraction potential, suggesting a tourism model strongly based on short visits and daily inflows, rather than on prolonged stays. A similar, though less intense, condition can be observed in Rota, which also appears to operate mainly as a short-stay or excursion-oriented destination. By contrast, El Puerto de Santa María stands out as the most balanced and structurally mature tourism cluster, combining a strong accommodation base with a diversified offer of activities and services, thus supporting a more autonomous and stable stay experience.

A different role is instead played by San Fernando and Puerto Real, which seem to function as intermediate or service-support areas within the wider bay system, providing complementary urban functions but showing a more limited tourism centrality in terms of both attraction and overnight capacity. Chiclana de la Frontera, on the other hand, appears to be characterized by a more specialized and seasonal tourism profile, largely dependent on coastal and beach-related demand, with a comparatively weaker diversification of tourism functions. Overall, these patterns suggest that the Bay of Cádiz should not be interpreted as a homogeneous tourism destination, but rather as a spatially fragmented and functionally specialized system, where tourists are encouraged to move continuously between municipalities in order to combine accommodation, leisure, cultural consumption, and coastal experiences. In this framework, one of the main critical issues concerns mobility and accessibility, as the current territorial articulation seems to generate a high dependence on road-based travel, with significant implications in terms of congestion, seasonal pressure, and the overall efficiency of the tourism system.

4 Discussion and Planning Strategy

The findings of the analysis support the development of a multi-scalar planning strategy aimed at transforming the existing tourism system. The downscaling of NUA [31, 32]compliance assessment supports the definition of spatial strategies aimed at rebalancing tourism flows and enhancing the sustainability of the territorial system. The proposed approach is based on the combination of hard interventions, designed to influence both visitor behavior and spatial organization.

The results suggest that tourism should not be read exclusively in terms of localized concentration or isolated destinations, but rather as a broader territorial organization in which multiple municipalities contribute to the overall performance of the system.

Within this perspective, one of the main planning issues concerns not only the quantity of tourism-related activities, but the degree of integration between the different components of the system. The analysis highlights the importance of improving the relationships between attraction poles, accommodation areas, consumption spaces, and mobility infrastructures in order to support a more coherent territorial functioning.

Mobility therefore emerges as a key planning dimension. Given the fragmented geography of the Bay and the differentiated specialization of municipalities, accessibility and intermodality play a central role in shaping the usability and efficiency of the tourism ecosystem. The territorial structure appears to rely significantly on movement between municipalities, suggesting that the quality of connections may influence not only visitor experience but also the capacity of the system to function as an integrated tourism area.

In this regard, the proposal developed in the original report introduces a mobility-oriented strategy aimed at strengthening intermodal connectivity through the integration of existing railway systems, tram extensions, tram-bus solutions, cycling infrastructure, and enhanced maritime transport. Rather than simply increasing transport supply, this strategy may be interpreted as an attempt to improve the territorial cohesion of the tourism system and to better connect its differentiated components (Fig. 4).

The strategy include two main intervention:

- The Intermodal Ring: It will be organized through the introduction of a Tram-bus in a dedicated lane and the development of bike lanes. The already existing heavy rail infrastructure will be leveraged, complementing it with branch lines from the current Bay Tram. By integrating the tram into this 'Intermodal Ring', we are not only solving traffic jams and the natural barrier of the marshes; we are guaranteeing that the Bay grows without destroying its fragile environment*, and ensuring that the residents who have left can recover their neighborhoods thanks to genuine urban improvement. We want transportation to be the tool that restores our unique identity and protects our natural surroundings, turning the Bay of Cádiz into a benchmark for sustainable mobility for the future.
- New Maritime Infrastructure: Upon analyzing the maritime transport situation in the area, we realized that the current network is quite limited, as we only have the ferry service connecting Cádiz with Rota and El Puerto de Santa María, which leaves out key points of our geography. For this reason, our strategy focuses on expanding these connections through the creation of two new seaports in Puerto Real and San Fernando. This measure will allow us to develop many more routes and increase frequencies so that boats become a real and efficient alternative for moving directly throughout the entire Bay of Cádiz.

In conclusion, the creation of an integrated transport system that provides a circular connection is proposed. This initiative aims to optimize travel, reduce traffic congestion, establish a strong connection between the various natural parks, and encourage the use of public transport, ultimately improving citizens' quality of life and promoting environmental sustainability. The transport system would feature intermodal stations strategically located at key points in each municipality, allowing for quick and efficient transfers between different modes of transport. It is proposed to leverage the existing railway infrastructure, complementing it with the extension of the Bay Tram. Additionally, dedicated paths for bicycles and pedestrians could be developed, promoting healthier and more accessible mobility.

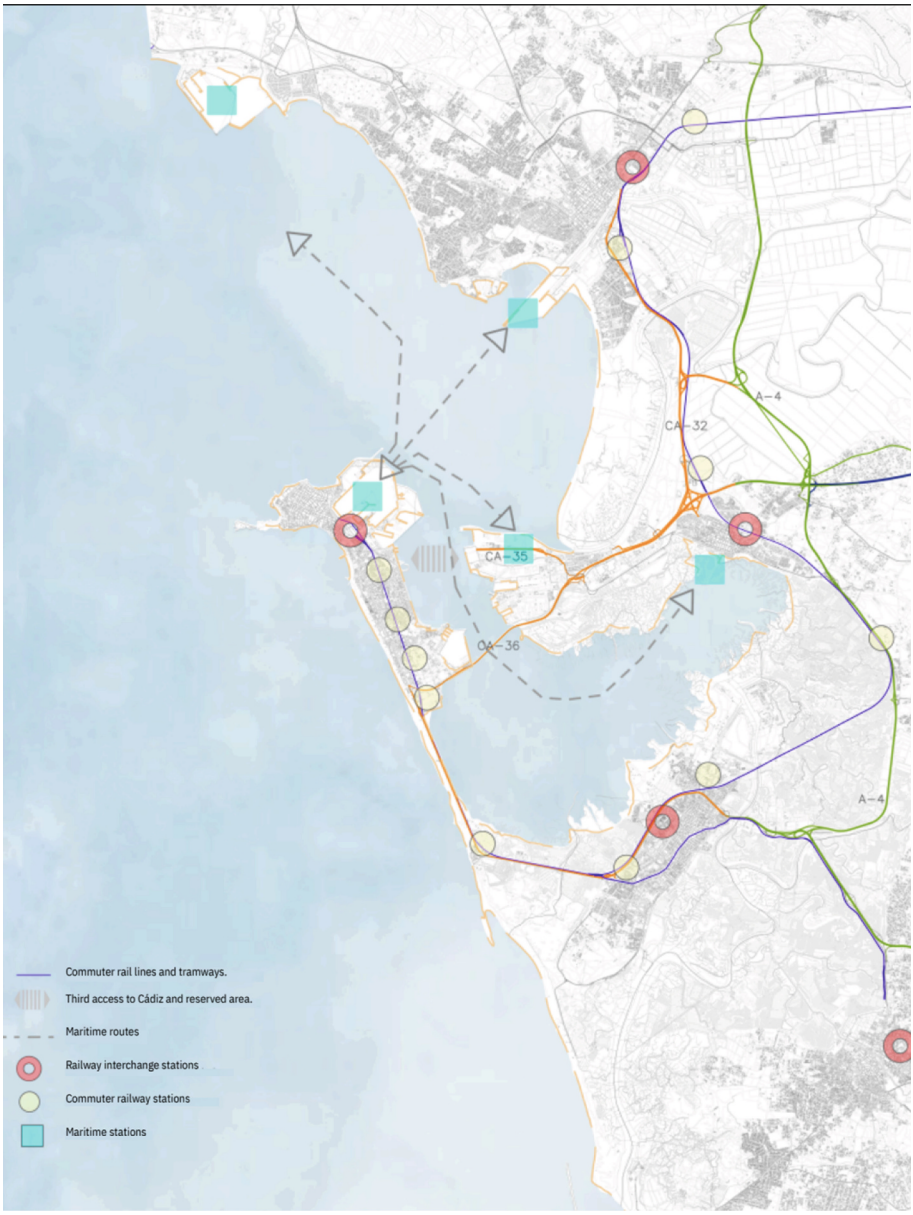

Fig. 4. Map of the interventions.

5 Conclusions

This study has proposed a spatial interpretation of the Bay of Cádiz tourism ecosystem through the application of the STESY framework. The analysis has shown that tourism in the area may be more effectively understood as a territorially structured system rather than as a set of isolated destinations or localized concentrations of visitors.

The results suggest that the Bay of Cádiz is characterized by a differentiated and functionally articulated tourism organization, in which municipalities contribute through distinct but complementary roles. Cultural, gastronomic, coastal, logistical, and accommodation-related functions are distributed across the territory, contributing to a tourism system that appears both spatially extensive and internally specialized.

This allows tourism to be interpreted as a relevant component of territorial structure and not only as a temporary or external dynamic.

The whole application is structured on the STESY framework [28, 33, 34]: a robust spatial analytical framework driving from the early stages the strategic design in sustainable tourism for a specific destination area. The framework had been applied in a number of local studies selected among major destinations (i.e. EU Capitals, UNESCO Sites, Environmental global attractors etc.) [35, 36], minor inland tourism areas (i.e. Vulture, Pollino national Park) [37, 38] and niche tourism sites (i.e. Islands) [39–41].

In this paper the main limitation comes from the lack of discussion with local stakeholders. In facts the research was fully development on desk and remotely. It is also relevant to point out how the STESY method effectively supported the process providing a guide to students to start with effective local analysis, to perform meaningful spatial interpretation of a complex phenomenon, to identify design options/solution for a strategic proposal compliant with NUA international principles [42–49].

The indicator dashboard included in the STESY platform allows to compare this application with other case study in a significant and effective way, supporting the decision making process in identifying intervention priority to better plan tourism sector locally benefitting of multi scale assessment options and accountability management of global objective for sustainable and climate responsive design [50–52].

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