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## A Methodological Approach to Non-Motorized Itineraries with Greater Potentiality for the “Train+Bike” Intermodality in Andalusia

Isabel Aránzazu García-Bello

[jargarbel@alum.us.es](mailto:jargarbel@alum.us.es)  <https://orcid.org/0000-0001-9239-4331>

Universidad de Sevilla, SigTam Consultores. C/ Gonzalo Bilbao 33, bajo 2 41003 Sevilla

Jesús Ventura-Fernández

[jventura@us.es](mailto:jventura@us.es)  <https://orcid.org/0000-0002-8271-1011>

Universidad de Sevilla. Dpto. de Geografía Física y Análisis Geográfico Regional.

C/ María de Padilla s/n. 41004 Sevilla

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### 1. SUBJECT

The boom of cyclo tourism and recreational activities in nature through the use of non-motorized itineraries combined with public transport favors a new tourism typology that makes possible the dynamisation of rural areas, giving rise to a sustainable economic model, especially in European countries such as France, Germany and Switzerland. The mobility studies contemplate, as an essential part, the intermodality between different types of transport, especially those of a public nature, which are not very polluting and collective, as in the case of the railroad.

In Andalusia, there is also a great variety of non-motorized itineraries associated with areas of great landscape and heritage value, showing therefore great potential which they present for the development of contact activities with nature. The choice of these non-motorized itineraries will be linked to the distance that exists between the intermodal urban areas, mainly working train stations of different types.



## 2. OBJECTIVES AND METHODOLOGY

The presumption is that to understand the potential of the intermodality of the railway lines with non-motorized itineraries for the practice of bicycle touring, everything will depend, at least to a large extent, on the distance of travel or proximity between train stations and access to these itineraries. Emili Mató and Xandra Troyano (2014) consider that the distance traveled in ten minutes by the cyclist is the acceptable limit to arrive from a public transport station at the beginning of an itinerary, so that beyond that time, the route begins to become deterrent. That is why to the user of the bicycle the maximum distance to travel before starting the itinerary proper would be 3.2 km, which implies an average speed of 19.2 km/h.

The proximity study will be completed here with another accessibility through the ArcGIS Network Analyst extension, which allows to establish different isochrones from the railway station in use according to their type of interest for this work (neighborhood, circulation and mixed). In this case, the average speed has been reduced to a value closer to that of a new cyclist or with a possible load in their panniers, that is, at 15 km/h, although the critical time has been increased to 15 minutes, according to the usual way in different studies on accessibility.

Ultimately, through the present research aims to achieve two fundamental objectives:

- a. Identify the intermodal urban nucleus with greater opportunities for the development of cycling activities, as well as the non-motorized itineraries that are in the vicinity of the railway stations.
- b. Determine which routes could be the most attractive, being able to subsequently design itineraries both for one day and others that involve several overnight stays.

Andalusia has a very dense network of cattle trails (the ones that stand out for their width are the main drovers' roads known as *cañadas reales in Spain*), trails (some of them classified as Long-Distance) and disused railway lines, known as rail trails when properly conditioned; what represents a great potential for the practice of bicycle touring.

Accordingly, those train stations have been selected for the transport of passengers that are at a distance of less than 3 km from these non-motorized itineraries, by means of Buffer Geoprocessing, in coherence with the 3.2 km as a critical distance previously indicated.

The Geographic Information Systems, which contain spatial information, plus the use of different criteria (distance, accessibility in time ...), will allow us to give various interrelations between the different layers or variables of the study, being able to verify the potential of the method and the ability to analyze the connections of the elements that are distributed in the territory.

The fundamental source of this study will be DERA (Spatial Reference Data of Andalusia), which is a repertoire of cartographic bases of different geometric nature (points, lines, polygons) referring to the Andalusian territory.

## 3. MAIN RESULTS AND TECHNICAL DISCUSSION

Regarding the main results, we must point out that the non-motorized itineraries in which these initiatives have already been launched are the following rail trails: del Aceite, with a distance of 127.36 km, beginning its route in Puente Genil, in the province of Córdoba, and ending in the city of Jaen; of the Campiña, with a route of 91,92 km, that begins in the town of Marchena, in the province of Seville, and reaches the vicinity of the city of Cordoba; those of Linares and Guadalimar, with a first route of 6.61 km and the second of 15.31 km on the old line of the Baeza-Utiel line; the Sierra Norte de Sevilla, which is accessible from the commuter station of Cazalla-Constantina, and which has a distance of 18.28 km, all inserted in a protected natural area; those of Puerto Real-San Fernando and Matagorda, which are located in the Bay of Cadiz, the first having a route of 8.25 km, and the second of 3.55 km; and that of Itálica, which has a distance of only 1.7 km, and which can be accessed from the La Cartuja railway station, in the city of Seville, and also by the Camas station.



We must also reflect the potential of the disused railway section between Guadix and Baza, all of it in the province of Granada, belonging to the abandoned line between Guadix (Granada) and Almendricos (Murcia), where various actions have already been carried out of adaptation to upgraded rail trails: Sierra de Baza, Valle del Almanzora and Huércal-Overa (the last two in the province of Almería).

The network of the main drivers' roads increases between the stations of Bobadilla and Antequera; the existing ones between the stations of Jimena de la Frontera and Ronda are significant; and the Cañada Real de Soria, which departs from the Posadas station to Córdoba.

Concerning the unrestored disused railway lines, the following stand out: from the Jerez de la Frontera station, corresponding to the so-called Sierra Railroad, which runs to Almargen (in Málaga), where a citizen platform promotes recovery as a rail trail of the section that goes to Arcos de la Frontera; from Granada station, Sierra Nevada, La Zubia, and Armilla-Dúrcal; from the station of San Julián in city of Málaga to Coín; and from Almería to El Chorrillo.

From the intersection between the buffer of 3 km of proximity and the referred isochrone of 15 minutes of accessibility, the itineraries have been selected that, fulfilling both requirements, exceed 15 km in length, a distance that, in the usual case of not having a circular character, represent, at least, 30 km between a round trip, and that is understood as an attractive distance for the average cyclist.

This implies the simplification to 44 records of the relationship that can be obtained without the double condition, that is, only with the buffer of 3 km away, and that incorporates 10 more itineraries. Finally, as a result of the latter, The main urban nucleus are established for the implementation of the "train+bike" intermodality that we find today in Andalusia, as well as a series of non-motorized itineraries linked to them with their different characteristics, derived from the GIS that have been used as a methodological support for this investigation, provided that, as a whole, they exceed 20 km and moreover they start from the vicinity (with distance never greater than 3 km) from the stations corresponding to localities attached to the urban categories of provincial capitals and county centers.

Nonetheless, from the review of the 10 itineraries that only met the condition of starting less than 3 km from the railway station but are not within 15 minutes of access from it, we observed two exceptional and significant cases, such as they are those that correspond to Marchena, where the *Vía Verde de la Campiña* begins to only 364 m from the station; and the commuter train of San Julián (in Málaga), 106 meters from the disused Málaga-Coín railway. The fact that they do not appear in the selected isochrone is considered an anomaly as a consequence of the source layer used, which has led to the incorporation of these two stations, less than 500 m from the beginning of their itineraries, among those linked to the 16 routes finally selected.

Nevertheless, the execution of these possible itineraries, in case they are not yet active, will depend, finally, and with the independence of the human resources, on the series of requirements for the realization of cycling and recreational activities, fundamentally, which implies further studies in greater detail.

#### 4. CONCLUSIONS OF WORK

In Andalusia it has been detected how, less than 3 km away from railway stations in operation, a series of different types of routes (drivers' roads, paths, rail trail and disused railway lines) that reach more than 3,400 km begins with a proportional distribution that oscillates between the 36.74% that represents the trails to the 28.63% of the abandoned railway lines.

Of these routes, 54 of them exceed 15 km in length. But to measure its real operability, a second condition has been added to the study, such as access to them in less than 15 minutes, from the road network (excluding double-track) and roadways provided by DERA files, with a mesh of 57,717.82 km. In that case the itineraries are reduced to 44.

With these approaches, and subsequently raising the minimum route to 20 km, but with the possibility of adding itineraries of different types that have obvious contiguity in the Geographic Information System prepared for this purpose, the 16 most favorable itineraries have been selected to promote bicycle train intermodality in Andalusia, some already in service, as in the so-called rail trails (del Aceite, La Campiña, Sierra Norte...).



In essence, the contribution of this research lies in the realization of an analysis that has come to combine different variables through a GIS, where items of different types have been used together with a cartographic support that has served as a model of interrelation of these to generate a map and a tabulation that helps the decision making by means of a diagnosis of the initial situation.