



**Proceedings of the
2nd International Conference on
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14-15 March 2019**



**Edited by
Cristina Sousa, Isabel Vaz de Freitas
and Jorge Marques**

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Development of Bike Touring Routes in the Aveiro Region Using Geographical Information Systems

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Abstract: Cycle tourism is considered as an emerging niche market and has caught the attention of several key stakeholders in the decision-making process regarding territorial and tourism development strategies. Therefore, the use of the bicycle has been included in various strategies to promote cycling practices in both local communities and visitors, enabling to combine sustainable mobility with tourism activities that promote well-being and can contribute to innovation in various tourism destinations. It is vital, though, that the information on the existence of cycling routes is conveyed to visitors of these destinations. For this, it is necessary not only to map the routes, but also to identify points of interest with associated tourist information. Geographical Information Systems (GIS) are an excellent tool, not only in the tourism planning process, but also in displaying the required information in a visually appealing way to visitors. The orographic characteristics of the Region of Aveiro, along with the interest of several municipalities in promoting tourism and the use of the bicycle, allowed the development of a research project that resulted in the definition of a set of intermunicipal bike touring routes. To this end, firstly the points of tourist interest to be included in the routes were identified to, in a second stage, define the ideal cycling routes, using GIS. Based on the literature review, several criteria were used to define the ideal routes, namely length, slope, speed limit, track capacity, landscape and distance to industrial areas. In this process, the Network Analyst extension of the ArcGIS software was used. The result is ten short, six medium and four long haul routes, which allow the various market segments to visit the selected points of interest and to know the Region of Aveiro.

Keywords: Cycle tourism, GIS, Tourist routes, Aveiro region

1. Introduction

Cycling is fashionable nowadays. From a simple mean of transportation, it has been transformed in an important physical and leisure activity, promoting wellness and improving quality of life. According to a study carried out for the European Commission (Weston et al., 2012), it is estimated that 2,295 billion trips per year are made related to cycling tourism in the European Union, generating more than 44 billion Euros. The estimated number of overnight stays is 20.4 million Euros. The benefits of this activity are not only economic but also environmental, as it has a lesser negative impact than other forms of tourism and is a good example of carbon reduction. Social benefits are also highlighted, with an impact on the health of the practitioners and the inclusion of people who do not have the income to use other means of transportation. The aforementioned study focuses on the EuroVelo project, a network developed at the European level, recently extended along the Portuguese west coast, crossing the Region of Aveiro. This study indicates that cycling tourism is growing in countries such as France, Austria, Poland and the Czech Republic, while Denmark, Germany, the Netherlands and Switzerland are likely to have reached a saturation point (Weston et al., 2012). In the case of Portugal it is mentioned that this practice represents only a small niche market. In this sense, it is relevant to carry out studies that allow the development of cycling tourism in the country.

The Region of Aveiro has been promoting tourism and the use of the bicycle, which is part of the history and tradition of this region. The use of the bicycle as a means of transport is higher than the Portuguese average, with Murtosa being the municipality with the highest percentage registered at national level. Several stakeholders in the region have already developed some projects for the promotion of the use of the bicycle, either through the development of infrastructures, such as bike pathways, or services, such as free use bicycles, and other similar projects. In addition, the bicycle is the central focus of projects such as CicloRia, between Estarreja, Murtosa and Ovar, and is present in plans such as the Intermodal Mobility and Transport Plan of the Region of Aveiro. It is this type of initiatives associated with the physical characteristics of the region, namely in its coastal area, which demonstrates the potential use of bicycle in the Region of Aveiro.

Furthermore, tourism is currently a key sector in Portugal and also in the Region of Aveiro, which has in Ria de Aveiro its main resource and its brand image. In the region there are also the beaches, in more than 50 kilometers of coastline; cultural heritage, such as Art Nouveau or tiles; and gastronomy, such as cod, eels or suckling pig and Bairrada wines. This work proposes to integrate the continuous bet on the promotion of bicycle and tourism, filling a gap in the region, which is the lack of a cycling tourism offer on an intermunicipal scale. For its development it is necessary the definition of routes that allow tourists to visit the destination and to know the different points of interest. To implement and to define those routes, Geographical Information Systems (GIS) work out as important tools, combining different criteria and different layers, allowing the integration of information and displaying and visualization for tourism purposes.

This work aims to fill in the gap by defining bike touring routes at the regional level. First, a literature review about cycling tourism and GIS is presented. In terms of methodology, in a first stage, points of interest in the region were selected, according to existing territorial management tools and the municipalities' interests and strategies. GIS play an important role in finding the best route to travel through points of interest, combining elements that influence the cycling experience. Therefore, the Network Analyst extension from ArcGIS was used, taking into account the length, slope, speed limit and road capacity, as well as the landscape and the distance to industrial areas. The result is the development of several routes, which allow different market segments to visit points of interest and discover the Aveiro region, in a socially, economically and environmentally sustainable way.

2. Literature review

2.1 Cycle tourism research

The interest in cycle tourism is increasing in the last few decades. Lee, Chen and Huang (2014, p. 291) mention that "the rapidly of growth makes it particularly important to develop a guiding framework to assist industry and government sectors to maximize destination attractiveness and achieve long-term sustainability". Bowles et al. (2011) also state that cycling is an activity that promotes economic, social and personal benefits, contributing in this way to boost community identity.

Nevertheless, it is still difficult to define cycle tourism, due to the scarce literature and due to its segmentation. There are several definitions of this type of tourism, presented both for academics or institutions related to cycling activity (Centre for the Promotion of Imports from developing countries [CBI], 2015; Deenihan, Caufield & O'Dwyer, 2013; Lamont, 2009; Pratte, 2006; Ritchie, 1998; Ritchie, Tkaczinski & Faulsks, 2010; Simonsen, Jorgensen & Robbins, 1998; Sustrans, 1999; Weston et al., 2012;), being one of the objectives to understand the extent of analysis of this activity. According to these authors, all of them consider that cycle tourism (or bicycle or cycling tourism) is a tourism activity, thus, involving at least one overnight away from home, where bicycle is a component of the tourism experience. Despite this being consensual, several other aspects are still in discussion, which makes it difficult to present a common definition, namely the involvement in cycling (passive or active); the use of bicycle as a mode of transportation or the use of the bicycle for leisure or for competition.

Since cycle tourism has a wide variety of aspects to be analysed, it is still not possible to set a conduct line of research under this theme. Literature review has found a set of the most common aspects that are being studied by the different researchers. One of the research lines is related to the main characteristics of cycle tourism and cycle tourist, namely the segmentation and motivations of cycle tourists, in the demand side approach; and the attractiveness of a cycle tourism destination, on the supply side approach. Thus, according to segmentation, Ritchie (1998) points out different types and characteristics of recreational cyclists and cycle tourists. He segmented cycle tourism in home based; mountain bikers; day events; casual holidaymakers; independent and organized users. More recently, Lamont (2009) identified one more segment: the cycle events' observers/competitors. He also analysed the relation between the whole tourism system and one of the segments of cycle tourism: the independent cycle tourist. In this research, he realized that there is a need to reconceptualise some of the components of the whole tourism system, namely the tourist destination region and transit route concepts, to be used by the independent cycle tourism segment.

Tourist motivations to use bicycle for recreational and leisure activities are analysed by Ritchie et al. (2010). They carried out a research to understand the motivations of cycle tourists, applying the concept of enduring involvement. These authors presented a clustering of cycle tourists based on their level of enduring

involvement with bicycle. Deenihan and Caulfield (2015) analysed tourists' preferences considering different cycle infrastructures, having in account different attributes, namely the type of facility, time, weather and route slope.

The supply side approach is discussed by Pratte (2006), referring that this niche market has a very high potential of growing and that can include heritage, adventure and sustainable tourism, promoting, in this way an integration of different types of resources. More recently, Lee, Chen and Huang (2014) used an analytic hierarchy process method to identify the determinants of attractiveness of a cycle tourism destination. They conducted this study in Taiwan, so as to find out the attractiveness of this destination for cycle tourism.

Considering cycle tourism planning, researchers developed their analysis considering different components. Cope, Doxford and Hill (1998) analysed the National Cycle Network in the United Kingdom (more precisely the Coast to Coast cycle network), to recognize the profile and number of users, their spatial and temporal distribution and to quantify the economic impacts. This research concluded that planners and decision makers should be organised to manage and to monitor cycle tourism, in order to improve cycle tourism planning.

Lumsdon (2000) and Chen and Cheng (2016) are more concerned with the sustainability of the transport system to tourism activity, which led them to present two strategies. Lumsdon (2000) presented a model for cycling tourism, in order to improve the demand side, by offering a relaxing and well-being tourism experience. He also stated that cycle tourism can contribute to reduce motor vehicle use, if an integrated approach is adopted, where combined forms of transport can be achieved. Chen and Cheng (2016) focused on the preferences for an integrated bike-rail transport service for cycle tourism. They referred that one major concern of cycle tourism is that "such tourism might generate additional car journeys, as cycle tourists often put their bikes in cars and drive to the location where their cycling will take place" (Chen and Cheng, 2016). In their research, they consider that an integrated bike-rail transport service should be considered in order to contribute to the sustainability of cycle tourism.

As it is possible to recognise, cycle tourism still needs more research in order to define this construct and the scope of analysis. It is still not possible to consider a conduct line of research, which turns difficult the definition of strategies to improve this new tourism segment. Also, it is still necessary to identify tools and methods that could effectively improve cycle tourism. Having this in account, it was conducted a research to understand the main advantages of using GIS in the development of cycle tourism, considering that it is important for cycle tourists to have defined routes with tourist information, combining in this way, the enjoyment of bicycle activity with the knowledge and discovery of new places, trough tourism activity.

2.2 GIS applied to cycle tourism and bicycle practice

The use of GIS for cycle tourism is a subject that is still undeveloped. These tools have already been used for several tourism projects and applications, but it is still scarce the literature combining GIS and cycle tourism (e.g. Bíl, Bilová, & Kube, 2012; Schuett & Holmes, 1996). Based on that constraint, the literature review performed for this research has considered also the application of GIS in the planning of bicycle facilities and infrastructures, which is related to several areas, namely the analysis of the chosen route by the cyclist, the identification of risk areas for the cyclist, the planning and development of infrastructures that support bicycle practice and the selection of the most suitable routes for that practice. Table 1 presents the studies that have used GIS in examining bicycle use, which have been published in a wide range of journals in various disciplines.

Table 1: GIS applied to bicycle practice

Authors	Title
Huang and Ye (1995)	Selecting bicycle commuting routes using GIS
Schuett and Holmes (1996)	Using a collaborative approach to developing a regional bicycle tourism plan
Aultman-Hall and Kaltenecker (1999)	Toronto bicycle commuter safety rates
Ferrigno (2003)	Promoting exercise using GIS: The Williamson County bicycle map project
Menghini, Carrasco, Schüssler and Axhausen (2010)	Route choice of cyclists in Zurich
Rybarczyk and Wu (2010)	Bicycle facility planning using GIS and multi-criteria decision analysis
Bíl, Bilová and Kube (2012)	Unified GIS database on cycle tourism infrastructure
Winters, Brauer, Setton and Teschke (2013)	Mapping bike ability: A spatial tool to support sustainable travel
Krenn, Oja and Titze (2014)	Route choices of transport bicyclists: A comparison of actually used and shortest routes
Wuerzer and Mason (2015)	Cycling willingness: Investigating distance as a dependent variable in cycling behavior

Authors	Title
	among college students
Milakis and Athanasopoulos (2014)	What about people in cycle network planning? Applying participative multicriteria GIS analysis in the case of the Athens metropolitan cycle network
Pereira Segadilha and Penha Sanches (2014).	Analysis of bicycle commuter routes using GPSs and GIS
Jestico, Nelson and Winters (2016)	Mapping ridership using crowdsourced cycling data
Tracy and Lohb (2017)	Quantifying bicycle network connectivity
Kabak, Erbaş, Çetinkaya and Özceylan (2018)	A GIS-based MCDM approach for the evaluation of bike-share stations

Source: Based on Pedrosa (2016)

3. Definition of bike touring routes in the Aveiro region

We attempt to define attractive routes, combining different types of attractions through the whole region. The work's main goal is to define cycling routes for tourists, connecting points of interest (POI) throughout the Aveiro region (Figure 1), showcasing this region as a whole and not as a group of individual municipalities.

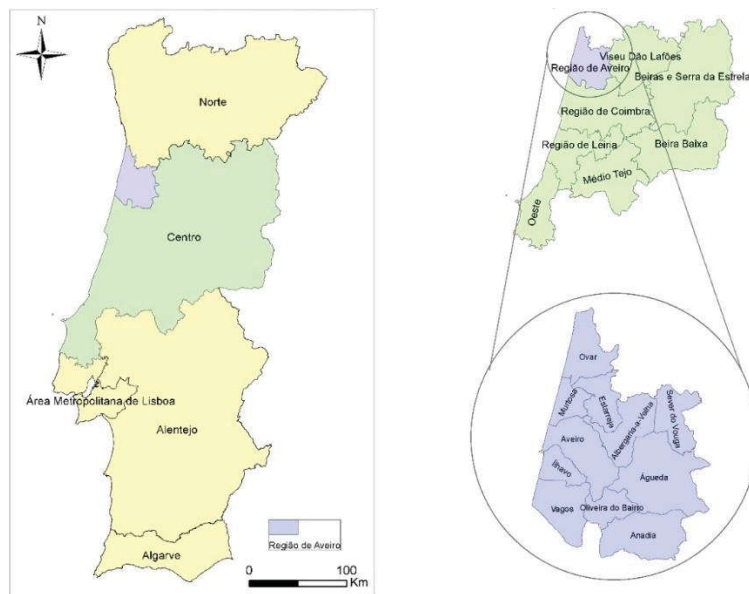


Figure 1: Aveiro region location

Source: Pedrosa (2016)

To achieve this goal, we set three phases to develop this project (Table 2), each one with different tasks. The first one consists on selecting points of interest and defining how many routes are needed and where. The second phase focuses on choosing the best route to connect those points of interest, according with a set of criteria that are considered to influence the cycling tourist experience. The last one, still under development, tries to validate and test the routes and then present them to the visitors of Aveiro region. GIS will play an important role in every phase.

Table 2: Project phases and related tasks

Project phases	Task
1. Selection of points of interest and route implementation area	Selection of points of interest
	Definition of the number and location of each route
	Individual meeting with stakeholders from each municipality
2. Route definition	Selection of a set of criteria which influence the cycling tourist experience
	Geographic data processing
	Route definition using <i>Network Analyst (ArcGIS)</i>
3. Validation, test and communication	Validation of routes by municipalities
	Test of the routes
	Routes communication to visitors

Source: Pedrosa (2016)

3.1 Phase 1: Points of interest and routes implementation area selection

At the first stage, programs and strategies regarding tourism and cycling in the Aveiro region were considered at national, regional, inter-municipal and local levels, so the routes could be developed accordingly. Also, the webpages of the regional tourism board, inter-municipality community and all municipalities were analyzed in order to identify relevant products to be included in the routes. Additionally, to all programs and strategies, the analysis also considered the Web-GIS “Ria de Aveiro” that was developed by the regional tourism board in cooperation with the inter-municipality community and its municipalities. The Web-GIS shows tourism resources within the Aveiro region, geo-referred and displayed by categories, such as cultural and natural heritage. This map also identifies equipment and services supporting tourism activities.

There was a need to adapt cycling routes to different market segments, therefore routes were divided in classes (Table 3). The point is to have routes for all type of visitors, according with their cycling experience and physical preparation.

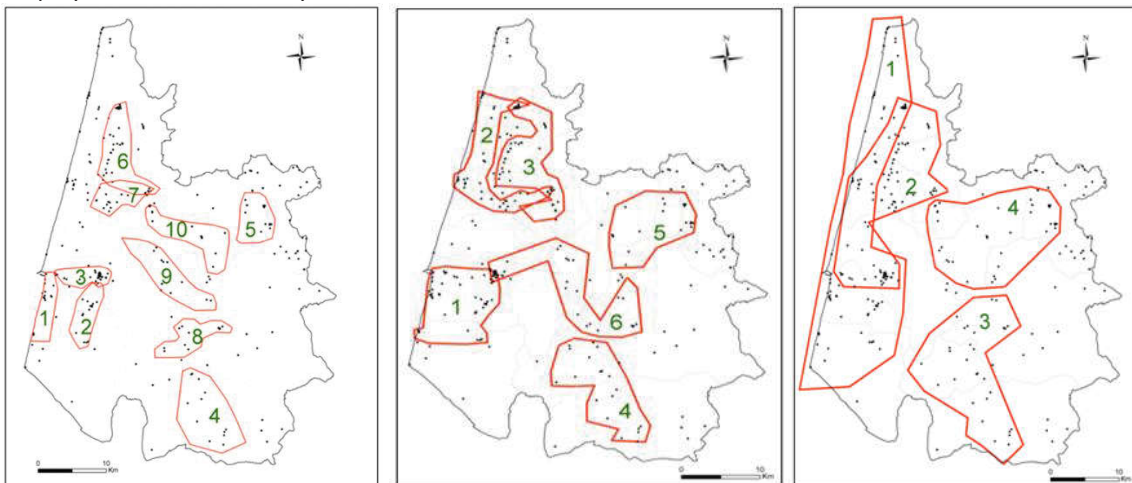
Table 3: Types of routes and target

Routes	Maximum distance (approximately)	Characteristics of tourists
Short-haul	25 km	People who barely use a bicycle, however as a tourist they can ride along Aveiro region.
Medium-haul	50 km	People who like to ride a bicycle, doing it occasionally and with some experience and physical preparation.
Long-haul	100 km	People with experience in this activity, who used to travel by bicycle.

Source: Pedrosa (2016)

The routes were divided in three categories: short-haul, medium-haul and long-haul. This division was made so we could reach a wider range of tourism segments, through different lengths, and changing the importance of each criteria, present on phase 2, according to the route category. Considering different categories and points of interest, importance and location, we decided to implement 10 short-haul routes, 6 medium-haul routes and 4 large-haul routes, combining 20 cycling routes (Figures 2, 3 and 4). Those connections considered also the territorial dynamics of the Aveiro region, showed on the inter-municipality plan for mobility and transports.

During this process, individual meetings with each municipality were arranged to determine, in consensus with their interlocutors, which points of interest should be incorporated in the routes, based on their importance, location and the route target profile. All routes start and finish at the same place (circular) or at train stations to simplify the visitors’ mobility.



Figures 2, 3 and 4: POI and routes implementation area for short, medium and long-haul routes

Source: Pedrosa (2016)

3.2 Phase 2: Route definition

This second phase aims to find the best route to connect points of interest for each route planned. It considers a set of criteria, which influences the cycling tourist experience (Table 4), based on the studies analysed in the literature review. criteria were excluded due to lack of geographic data, like length of roadsides or pavement type and conditions.

Table 4: Selected criteria, data and source

Criteria	Geographic data	Source
Length	Road network	Inter-municipality Plan for Mobility and Transportation (PIMT-RA)
Cycling paths	Cycling paths	
Traffic speed	Speed limit	
Traffic volume	Road capacity	
Distance to industrial areas	Industrial areas	
Landscape	Land Cover	Corine Land Cover 2012
	Classified areas	Institute for Nature and Forest Conservation (ICNF)
Slope	Altitude	Digital Elevation Model Aster

Source: Pedrosa (2016)

Regarding different the types of routes and their specificities, a weight ponderation has differences to fit needs from specifics market segments (Table 5). As an example, slope is less important in long-haul routes than in short-haul routes and some criteria related with safety have a higher weight in short-haul routes.

Table 5: Weights, in percentage, by category for each criteria

Criteria	Short (%)	Medium (%)	Long (%)
Length	20	25	25
Slope	20	20	15
Cycling pathways	20	20	20
Speed limit	15	10	12.5
Road capacity	15	10	12.5
Landscape (Classified area + land cover)	5	10	10
Distance to industrial areas	5	5	5

Source: Pedrosa (2016)

With the ArcGIS software, from ESRI, we processed geographical data representing those criteria to attribute to each road segment a classification between 0 and 1, if it was more or less inappropriate for cycling, which allowed us to combine them in a unique index. Therefore, the index created was used as a value to find the best route with the Network Analyst extension from ArcGIS. Through the New Route tool, it was possible to find the path with less index value to travel between points of interest, which means that it is the easiest path according to these criteria.

3.3 Phase 3: Validation, test and communication

The last phase should be the validation of all the routes, test them and then create a complementary information to show to the visitors of Aveiro. It starts by getting in touch with all municipalities to validate the routes according with their own strategy. At the same time, the municipality interlocutors should confirm the routes, mainly because there are no data specifying road directions. They are able to find other data errors or make suggestions to improve routes, make them easier or more pleasant for visitors, and indicate the duration of the visit to attractions in order to calculate final time for each route.

The last step is to produce information to promote bike touring routes:

- Routes' mapping and identification;
- Routes' description, category information, distance, time needed, information regarding local gastronomy;
- Points of interest's description, location and reference to other points along the route;

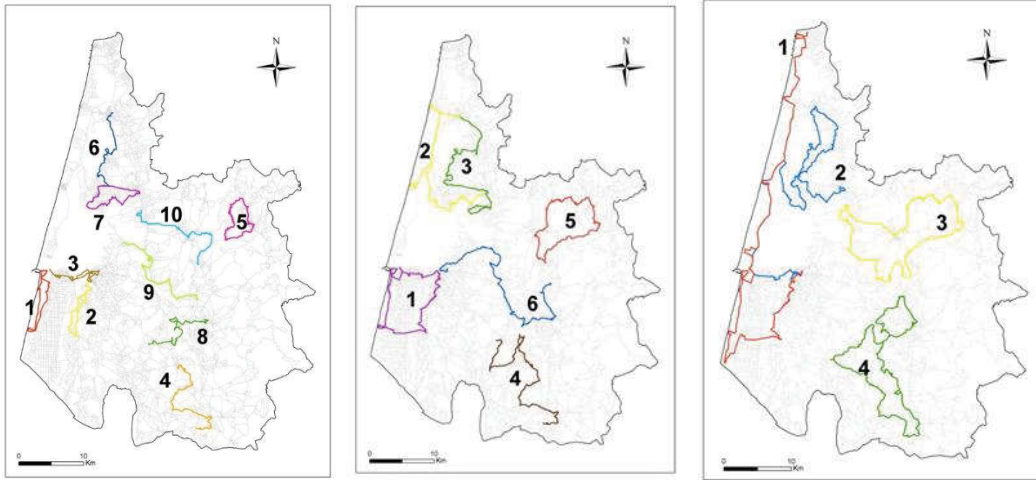
- Routes' directions;
- KML or GPX file;
- Other information: safety and other recommendations, type of bike; rent-a-bike shops; tourist information centres.

In this last phase, GIS can be used to produce information, such as informative maps, route directions extracted from Network Analyst, time and distance information, and KML or GPX files.

3.4 Results

The result is the development of 10 short-haul routes, 6 medium-haul routes and 4 long-haul routes (Figure 5, 6 and 7), which allow different market segments to visit POI and discover the Aveiro region. The third and last step is still in progress, requiring the municipalities' approval, in order to make the routes available to visitors.

The cycling routes allow the inter-municipality community to promote cycling and tourism in the region.



Figures 5, 6 and 7: Short, medium and long-haul routes map

Source: Pedrosa (2016)

It was defined 10 short-haul routes for tourists who barely ride a bike. The table 6 shows information by municipalities along each short-haul route, the POI that can be visited, the start and finishing points, cost according to the index created, which allows us to compare the difficulty between all routes, time without stops with 15km/h speed, and length in kilometres.

Table 6: Short-haul routes identification

Nº	Municipality	Start	POI	Finish point	Cost (index)	Time	Length (km)
1	Ílhavo; Vagos	Barra lighthouse	Cais da Bruxa/ Caminho do Praião; Praia/ Mercado do Peixe da Vagueira; Palheiros da Costa; Nova Farol/ Praia da Barra.	Barra Lighthouse	125,90	1 hour e 44 minutes	25,760
2	Aveiro; Ílhavo; Vagos	Aveiro University	Universidade de Aveiro; Complexo da Vista Alegre; Museu do Brincar; Quinta do Ega; Marinha Santiago da Fonte.	University of Aveiro	193, 19	1 hour e 45 minutes	26,028
3	Aveiro; Ílhavo	Aveiro train station	Capela de São Gonçálinho; Canal Central; Ecomuseu Marinha da Troncalhada; Jardim Oudinot/Navio Museu Santo André; Parque Infante D. Pedro; Estação de Aveiro.	Aveiro train station	177, 85	1 hour e 39 min	24,552
4	Oliveira do Bairro; Anadia	Oliveira do Bairro train station	Parque dos Pinheiros Mansos; Aliance Underground Museum; Lagoa do Paul de Ancas; Estação da Curia/ Rota da Bairrada.	Curia train station	193, 01	1 hour e 43 minutes	25,638

Nº	Municipality	Start	POI	Finish point	Cost (index)	Time	Length (km)
5	Sever do Vouga	Paradela Ecocafe	Ecocafé Paradela; Ponte do Poço de São Tiago (Ecopista); Parque Municipal de Sever do Vouga/ Museu Municipal; Praia Fluvial Quinta do Barco.	Paradela Ecocafe	164,91	1 hour e 40 minutes	24,975
6	Ovar; Murtoza; Estarreja	Ovar train station	Museu de Ovar; BIORIA: Percurso das Ribeiras de Pardilhó; Casa Museu Custódio Prato; Parque Municipal de Antuã.	Estarreja train station	141,74	1 hour e 41 minutes	25,114
7	Estarreja; Murtoza	Estarreja train station	Percurso das Ribeiras de Veiros; Centro de Educação ambiental da Ribeira de Pardelhas; COMUR Museu Municipal; Casa-Museu Marieta Solheiro Madureira.	Estarreja train station	131,83	1 hour e 39 minutes	24,719
8	Águeda; Oliveira do Bairro	Águeda train station	Rua Luís de Camões; Parque da Pateira - Óis da Ribeira; Parque do Carreiro Velho; Igreja de Oiã.	Oiã train station	188,95	1 hour e 37 minutes	24,412
9	Águeda; Albergaria-a-Velha; Aveiro	Mourisca do Vouga train station	Igreja da Trofa e Padrão de Lemos; Moinho da Maia; Pateira de Frossos; Parque do Areal.	Cacia train station	166,14	1 hour e 41 minutes	25,154
10	Estarreja; Albergaria-a-Velha; Águeda	Salreu train station	BIORIA: Percurso do Rio Jardim; Mamoas do Taco; Moinho Chão do Ribeiro; Núcleo Museológico Macinhata do Vouga.	Macinhata do Vouga train station	179,56	1 hour e 42 minutes	25,257

Source: Pedrosa (2016)

The same was realized for the medium-haul routes and long-haul routes. Medium-haul routes have, as target, people who like to ride a bike, doing it occasionally and with some experience and physical preparation. Long-haul routes were specifically designed for people with experience in travelling by bicycle and that want to come to Aveiro to visit the region by bicycle.

There is a general tendency to concentrate routes in the coastal area of the Aveiro region, which is justified by a higher density of points of interest and cycling paths, but also because the land is flatter than the inland.

4. Conclusion

Cycle tourism is a product that is still in an early stage of development. However, it was already possible to conclude some preferences of cycling tourists through the literature review. It was possible to understand that cycling tourists prefer to use cycle pathways in independent routes, physically separated of roads, or in a cycle pathway along the roads. When these conditions are not possible, the preference is to use roads with larger roadsides or to choose roads with less or lower volume traffic. Concerning to natural environment, slope is one of the most mentioned factors that most problems causes to the use of bicycles, because when slope is higher, it is more demanding for the cyclist. The beauty of the landscapes is also a factor that is mentioned as one of the reasons to practice cycling tourism. It was also possible to conclude that it is essential for the user the existence of tourist information, such as the description of a route and its main points of interest, and navigation, such as signage of the places or cycle maps.

The use of GIS to analyse cycle tourism in this study allowed to cross several geographical data, relating the identified criteria in the definition of the routes, to find the ideal routes for cycle tourists and also to produce essential information such as maps, KML files and route directions. It was possible to identify the potential of GIS in tourism planning and management, as well as the advantages that the use of these tools have to tourism, either in the promotion or management of resources, in the management of visitors or in the identification, monitoring and forecasting of their impacts. GIS are particularly relevant in cycle tourism, or cycling, as evidenced by this approach to defining cycling tourist routes.

In this study it was considered cycle tourists all visitors (tourists or visitants) who are willing to use the bicycle at any given time, even if combined with other means of transport. For this reason, the routes are connected to other terrestrial means of transportation, like railroad, road and fluvial. Within the target audience, the routes defined for Aveiro Region were divided into three categories (short, medium and long-haul), to understand all cycle tourist profiles, regardless of their motivation and frequency of bicycle use, from people

who do not use the bicycle to those who use it as a mean of transportation in their daily lives. The courses were designed for people who want to take a bike ride, starting from a base, and its use does not serve the pretensions of those who use it to make linear movements, as in the case of EuroVelo.

The Aveiro region has very favourable conditions for the development of cycle tourism, although there are some differences in the density of cycling routes or points of interest and relief between the coastal area and the inland area of the region. The latter has less suitable characteristics for the use of the bicycle, due to the greater dispersion of the territory, a smaller cycling network and more pronounced slopes. Cycling mobility has been a bet of the region, as evidenced by the kilometres of cycling pathways built, the initiatives developed to promote the bicycle and the presence of the bicycle in the various instruments of territorial management and planning.

The main contribution of this work lies precisely in the definition of several bike touring routes, something that did not exist in Aveiro region on an intermunicipal scale. In addition, the municipalities themselves can thus promote their territory by providing an innovative product. In the case of the attractions that are part of the routes, they benefit from greater visibility, and the visitors themselves can enjoy these routes to get to know better the region. On the other hand, the information present in the classification index of the road network can be used by the inter-municipal community to see which areas are more suitable for the use of the bicycle and where this issue can be improved. It is also considered that the methodology used in this study can be applied in other territories and adapted to other scales.

Finally, it is considered that there is a possibility to develop a set of future works that can contribute to the affirmation of both the territory and the use of the bicycle for tourism purposes. Studies on the preferences of cycle tourists, the development of an online platform that allows visitors to choose the points of interest they want to visit, the development of thematic routes, are some of the suggestions that may be developed.

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