

Multicriteria analysis a proposal of revitalization of the ancestral trails of the Serra da Estrela Natural Park (PNSE)

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Introduction

Ancestral humanization of natural spaces is a mark of the Mediterranean protected areas. The economic, social and cultural relations developed in these territories generated a patrimonial legacy that provides them singular landscapes with high biodiversity and established conservation status.

From the 1970s onwards, the demographic and socio-economic reconfiguration of these spaces has led to the decline of traditional structures and activities, compromising their role in regulating and balancing ecosystems.

More recently, touristic and recreational activities demand for natural spaces has been seen as an opportunity to revitalize these natural landscapes providing these territories with new functionalities and allowing the maintenance of its historical meaning, while conserving their identity.

This study proposes the development of a methodology based on multicriteria analysis and Geographical Information System (GIS) that takes into account different levels and types of information, to design a recreational network for Serra da Estrela Natural Park suitable to accommodate both conservation needs and visitors and users demand.

Study Area

Created in 1976, *Serra da Estrela Natural Park (PNSE)* is the second largest protected area in Portugal. Located on the mountainous area of the *Cordilheira Central*, it has the highest altitude point (1.993 m) of Portugal mainland.

The patrimonial complex is composed by traces derived from quaternary period glaciations, as well as important elements of fauna, flora and exclusive endemism's being part of *Natura 2000* (PTCON0014) and RAMSAR reserves.

In the park area, territorial humanization is constricted by the presence of snow which imposed the development of less favourable agricultural practices, leading in its extreme to transhumance - seasonal movements of populations.

These movements contributed to the development of an extensive network of paths, has it happens in other European mountain areas known as *calles* (in Italy), *cañadas* (in Spain) and *Canadas* (in Portugal). These elements result from the traditional management and regulation of grazing, structured in the form of marked paths for the movement of cattle. Nowadays these movements subsist in a residual form, being carried out in a smaller scale and frequency which as lead to the decline and abandon of these structures.

Methodological Approach

A GIS based model was designed using a two-step approach (figure 1). Part I mixes users preferences (evaluated from Volunteer Geographical Information - VGI), environmental characteristics, historical cartography, land management plan, etc. (Bizarro *et al.*, 2016), and

Part II generates optimal paths according to a flexible multi-criteria analysis outputs, depending on stakeholders preferences.

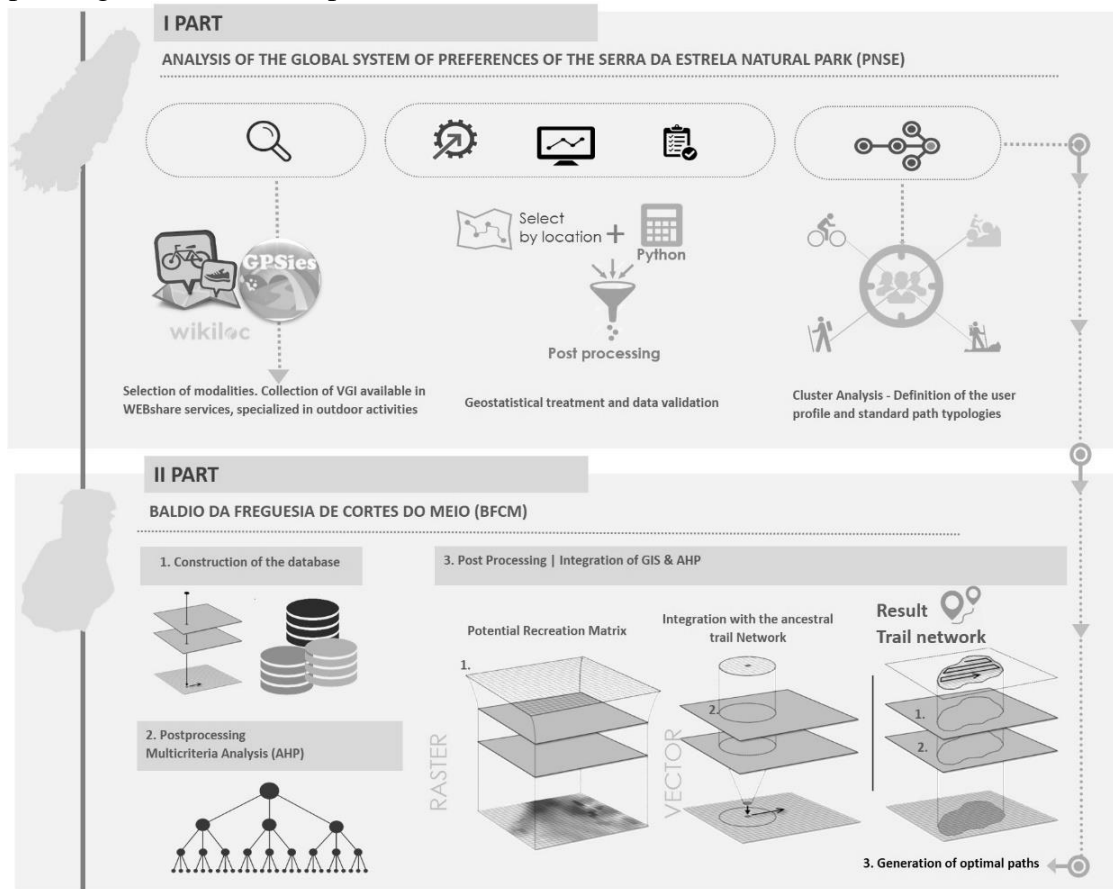


Figure 1 - Methodological Approach

First part focuses on assessing the overall diagnosis of user preferences (within PNSE) regarding the most popular outdoor activities. Inspired by Nogueira Mendes et al (2012, 2014) the diagnosis took into account the selection and collection of variables based on available VGI through on-line platforms for mountain bike, cycling, hiking and trail running. Subsequently, the collected information was integrated in a database for validation, statistical treatment and spatial modelling.

To conclude the first step, a cluster analysis allowed the definition of path typologies according to users' profile.

Thus providing a set of basic elements for the second part, developed at a higher scale consisting in criteria definition for obtaining pedestrian and cycle paths that enable the redefinition of the ancestral rails network in the community area of *Baldios de Cortes do Meio* (Bizarro, 2017). Besides the above mention elements other dataset were loaded, such as altimetry, land management plan, land use, etc. The key element of this phase is a multicriteria analysis, using the Analytic Hierarchy Process (AHP) method as a tool for defining criteria weights. These can be adjusted according to several criteria such as landscape, habitats sensitivity, activity, user profile, path difficulty or ease of access, etc. Then, through GIS integrated operations, it was possible to extract a grid of potential recreational value of the territory. In this coverage, each cell is assigned with a value expressing its suitability, which is then linearized through aggregation functions, hierarchizing the zonal value of each section of the pre-existing road network, according to its legal and recreational ability.

Conclusions

Tourism and recreation in protected areas is a growing global phenomenon demanding for better and quicker methods not only for monitoring but also to build a structured offer for visitors and users. Also the availability of information generated by the massive use of new technologies and social media, the incorporation of open source data and VGI, constitutes relevant and dynamic data sources, whose value and consistency should be reinforced.

Accordingly, the proposed methodological approach fits the actual needs for managing recreation and protected areas, providing a flexible and effective model that can be modified according to different users, objectives (ex. accessible routes for people with reduced mobility) and easily applied by different organizations to other territorial contexts, adapting to the existent demand.

Regarding the incorporation of the AHP method, it should be noted that this method has its own characteristics that guarantee consistency of decision processes, proving to be a suitable procedure for the proposed spatial analysis typologies.

For this specific case study, the option of establishing routes based on the revitalization of the ancestral road network reveals benefits in minimizing issues related to legal conflicts, safety and carrying capacity.

The proposed process enables the construction of an adaptive model for managing protected areas, which promotes the improvement of policy making ensuring its sustainable development.

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