Network of Urban Parks and Green Corridors in the City of Braga, Portugal

MARTINHA E. R. R. ROCHA[1], RUI A. R. RAMOS[2]
Department of Civil Engineering, C-TAC Centre for Territory, Environment and Construction
University of Minho – Engineering School
Campus de Gualtar – 4710-057 Braga
PORTUGAL
(1) eng.martinharocha@gmail.com, (2) rui.ramos@civil.uminho.pt, www.civil.uminho.pt/c-tac/

Abstract: - The quality of life in urban areas is increasingly becoming a competitive factor for cities. In addition to access to goods and services, access to green spaces and the existence of a sustainable urban environment are key factors to ensure high levels of quality of life in cities. In this context, the present study focuses on the analysis of green spaces integrated in measures promoting urban sustainability. So, it is pertinent that green spaces of a city will be integrated in the city development process, enhancing the respective use. Therefore, it is essential to identify the basis for the creation of connectivity corridors between green spaces, enhancing the interaction between inhabitants and natural landscape, even in urban areas.

After a theoretical context of the subject under review, presents the study carried out with the aim of creating an urban green corridors network to the city of Braga, Portugal. One of the major goals is to allow some mitigation of the negative environmental impacts of the city and mobilizing people to leisure, to practice sports, and more sustainable mobility's, on a daily basis. The study conducted in the city of Braga identifies the viability of creating this urban green corridors network as a way to boost the movement by seeking soft ways and promote an improvement in the quality of the urban environment. Thus, it is concluded that it is possible to adapt the urban space to a new reality, more conscientious at an environmental level.

Key-Words: Environmental Sustainability, Urban Green Corridors Network, Braga, Portugal

1 Introduction

The industrial revolution imputed numerous changes in the populations of the eighteenth and nineteenth centuries. People in rural areas have moved to cities in search of a better quality of life, abandoning their life in the field. The movement and reception of population demanded an urban growth leading to excessive consumption of soil. Those days reality of landscape was totally transformed with the building of cities, industrial areas and communication routes. The appearance of this edified structure created barriers to the natural functioning of ecosystems promoting defragmentation of habitats, with consequences for biodiversity, wildlife, the amount of soil available for water storage and purification, the existing vegetation as air filter, among other factors.

In terms of urban sustainability, the existence of quality green spaces, can assume the role of "purification" of the environment. However, these spaces are usually isolated and disjointed from the surrounding areas uses, eventually fading within the buildings. The urban green spaces are a fundamental support for ecological and environmental sustainability of a city. Establish your connection through corridors that emphasize movement by soft modes, containing extensive forested tracks, boosts urban sustainability, enhancing urban ecological structure, since they promote the *continuum naturale* [1] At the same time, mitigate the effects one of the main city pollution sources, car traffic, acting as a particle filter and air purifier. In addition, they contribute to the adoption of healthier lifestyles, promoting sports practice.

The implementation of green corridors inserted on a proposal of ecological structure promotes environmental restoration and landscape planning, through implementation of objectives underlying its creation, such as the protection of natural resources, their use for recreation and leisure, promotion of the ecological stability, the redevelopment of the remainder of the cultural and agricultural landscape, and the protection of natural and built heritage.

The theme developed in this study is supported by the analysis of the possibility of adapting the concept of the ecological corridor to urban areas, linking systems with the potential to build an Ecological Structure, seeking to contribute to the

environmental sustainability of the city of Braga. The proposal aims to present the main guidelines for the establishment of a green corridors network between urban parks in the city of Braga, in order to promote the concept of *continuum naturale* connectivity, and implement improvements in urban environmental quality. The study also seeks to analyze and discuss the compatibility of green corridors with some other urban functions, including: (i) the creation of appropriate spaces for sports and leisure; (ii) access, through soft ways, to equipment and support services to the population as well as access to some commercial units, which are located near the network of green corridors.

2 Urban Green Corridors

In natural areas, the ecological corridors are associated to a natural space little or nothing changed by human action, such as the banks of rivers or large forest areas of untouched vegetation, among others. In these natural areas, the genetic exchanges between plant species and the promotion of biodiversity and fauna are significant, in addition to functioning as air filter and water, as they promote water and particles retention.

But, in urban context, the concept of ecological corridor will not apply since the human presence is predominant. So, in urban environment, the concept of urban green corridor allows, at first, to contribute to the improvement of urban environmental quality. Problems such as air pollution, noise and temperature are mitigated by the effect of vegetation in urban areas, as well as the fact that these corridors promote mobility by soft ways. Beyond the impact on improving the quality of urban environment, urban green corridors provide in urban environment, analogous conditions to ecological corridors, in other words, promote the increase of biodiversity, the free movement of species, water infiltration, among others.

The first generation of green corridors, often referred in English literature as Greenways, had as main objective the protection of green space surrounding urban areas, promote sport and recreation and contribute to the protection and/or improvement of the air quality [2]. From the perspective of territorial planners, these corridors allow structuring the rural and urban landscape. From the political point of view, the creation of these corridors promotes the image of the city, making it more attractive and competitive. Currently, the concept of Greenways has been implemented in urban context in a multifunctional application scope.

In the city of Freiburg, Germany, the main connection of cyclists and pedestrians crosses the city along the river for 9.5 miles and acts as multifunctional green corridor. In London, the London Greenways are a set of projects that are an attractive and functional network for cyclists and pedestrians, improving access to green spaces [3]. In the city of Vancouver, Canada, the proposed network of Greenways includes 16 routes and a total of 140 km [4]. The existence of these corridors provides to citizens alternatives to their usual mode of travel. Apart from improvements in the quality of the urban environment, it also increases the attractive potential of cities, turning available to the citizens other kind of uses, outdoors and in touch with nature.

In Portugal, this concept has been implemented in various forms, since the adaptation of inactive rail lines, the paths on the banks of watercourses, over the dunes along the sea coast or even as trails on the mountain, regardless crossing urban or nonurban spaces. All these examples emphasize the movement by soft modes and in most cases these halls are converted into bike lanes [5].

This section provides a short overview of literature developed under a Master Thesis that exposes this study in a more detailed way [6].

3 Case Study

The first part of this section briefly presents the geographical location, socio-economic analysis and environmental context of the municipality of Braga, Portugal. The second part describes the methods and procedures used in developing the study. The following three subsections present the proposed network of urban parks and the respective connectivity by urban green corridors.

The municipality of Braga, with a total area of 184 km^2, is located in the northwestern region of Portugal and belongs to the NUT II - North and NUT III - Cávado. The buildings throughout the city predominate on the slopes of the valleys, becoming scattered and giving the landscape a landscape typical of Minho sub-region of the North of Portugal. The platform where the city center is placed is located at a higher elevation than the North and South of the municipality territory. The city center is compact, dense and centripetal, making the landscape totally different from the involving rural area. Also, Braga is the Portuguese city with the largest increase in population in the last 10 years, from 164,192 to 181,819 inhabitants. This increase

in population can be justified by the attractive potential of the city in result of the socio-economic characteristics and population with a high percentage of young inhabitants.

The fact that the city provides a good standard of living because of the existing infrastructures, services, equipment and a wide range of business units, the city has become more appealing managing to secure the younger population. Naturally, the population growth has positive and negative aspects. The socio-economic development over the past decades was reflected in an expansion of the urban tissue that, although respected the urban standards of that time, didn't aware of the environmental and ecological issues of an eminent social and economic development. Therefore, the uncontrolled occupation of the territory compacted it too much, fragmenting the existing rural and green spaces. The city generally presents good urban environmental quality [7]. However, it is necessary to preserve the urban environment while safeguarding their quality for the future.

The methodology used in developing the case study consisted primarily in the analysis of the territorial spatial information. The first step consisted in the treatment of cartographic information provided by specific municipality department and subsequent integration into Geographic Information System (GIS). In GIS were identified the main green spaces with the potential to integrate a network of urban parks. Then, was analyzed the possibility of implementation of green corridors in the current structure of the city, based on the main roads connecting the identified city parks and its compatibility with soft modes of transport (walking and cycling). After defining the network of parks and urban green corridors, we proceeded to a brief analysis of its feasibility. Finally, we evaluated the coverage rate of the urban network of green corridors, mainly in the city center, to see if they can provide an alternative to the use of car in the city center.

The last step began by analyzing the influence area of each proposed corridor, considering the distances of 100, 200 and 500 meters as those that the user is willing to walk. To generate the influence area of each corridor it was used the spatial buffer operation in GIS establishing a distance of 100, 200 and 500 meters on each side of the proposed corridors. Whereas the average speed of a person walking can vary between 1.0 m/s and 1.7 m/s [8], a person to move from the axis of each proposed corridor up to the limit of the buffer 100 m (perpendicularly) will take about 1 to 1.4 minutes, where buffer 200m will take 1.9 to 2.8 minutes and in the buffer 500 m, it will take between 4.9 and 7 minutes.

3.1 Urban Parks Network

The selection of the areas proposed in this study as urban parks was based on the following assumptions: its natural character, the presence of untouched vegetation, proximity to water lines, proximity to urban centers and other characteristics and values compatible with the Urban Ecological Structure. This analysis was based on guidelines established by various agencies of Portugal with environmental responsibilities, which define what type of areas to include in a proposal for Urban Ecological Structure, and their contribution to the sustainability of cities in terms of planning and territory management.

The various identified sites as parks, proposed and existing present very different typologies and distinct functions. In a way, their use is at the discretion of the population that uses them according to their own interests. The analysis carried out consisted of a description of each place to be an urban park, functioning as the network node of urban greenways.

Figure 1 shows the proposed network of urban parks. The proposal considers the inclusion of five areas located within the city limits of the city. Some parks consist of areas characterized as existing parks, others as proposed by the city of Braga, and others proposed in this study, which is believed may come to constitute the network of urban parks.

3.2 Urban Green Corridors Network

The aim of creating a network of parks and urban green corridors that link parks together is to design the spaces with potential to be a possible ecological structure of the city of Braga. In addition, it is intended that the network of green corridors promote urban mobility through soft ways and serve as an alternative when traveling to the city center and increase the vegetation in the tissue built to an improvement in the quality of the urban environment.

Given the geographical position of the various parks, the green corridors proposed coincide mostly with the ways of communication that link them. Therefore, the proposals are based mainly on the changing profile of the tracks, in order to introduce whenever possible, pedestrian and bike lanes segregated from car traffic by vegetation belts. The route usually dedicated to car traffic is reduced compared to the solution proposed in urban streets, and thus it is possible to use the remaining circulation profile for walking and cycling, putting

even vegetation to separate the track dedicated to cars from the intended for soft ways.

Figure 2 shows the proposed urban axis that can integrate the urban network of green corridors in order to make the connection between the proposed urban parks.

Although not constituting a closed loop, the proposed network meets the goal of linking Urban Parks, while it is a green belt in the heart of the city. This ensures the promotion of urban *continuum naturale* through the creation and revitalization of many green spaces. In addition, the proposed green corridors offers the population the primary means of movement by soft modes, reducing energy consumption, air pollution and noise.

3.3 Spatial coverage of the Urban Green Corridors Network

This subsection analyzes the spatial coverage provided by the green corridors network that allows to walk or to ride bike. Thus, it is demonstrated the validity of the network to provide the circulation by soft modes in order to gain access to key services, equipment, and commercial units that are located in the city center, such as administrative buildings, health centers, pharmacies, sports equipment, street shops, among others.

In accordance with the methodology described above were generated buffers of 100, 200 and 500 meters from the axis of each proposed urban green corridor. Overlapping defined areas by these buffers and the city plan allows identifying the urban area that can be effectively served by the network of urban greenways.

For the analysis of Figure 3 you can see that the buffers generated intersect most equipment, services and trade within the urban area.

Therefore, the network fulfills the purpose of allowing access to various types of services, equipment and commercial units. However, requires the user to move more than 500 meters and an 8.3 minutes longer path to reach the majority of services, equipment and commercial units, considering only linear distances. However, these values of time and distance may be superior because the network is implanted in the urban center of the city and transpose some physical obstacles.

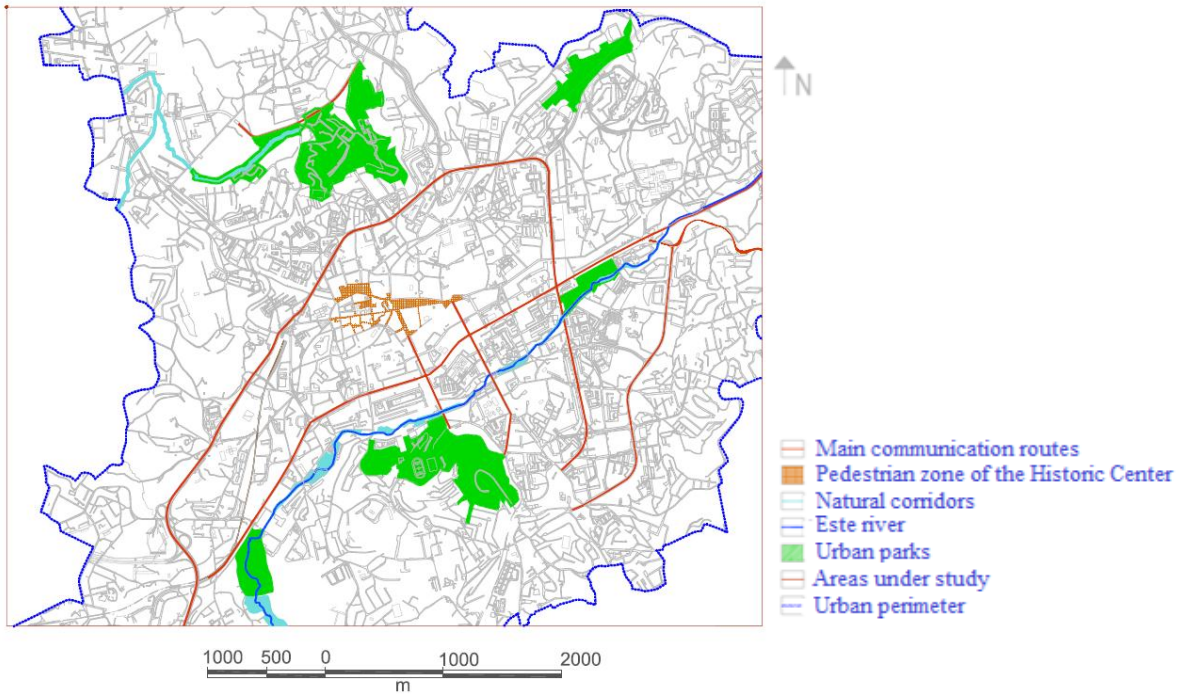

Figure 1: Proposed network of urban parks for the city of Braga

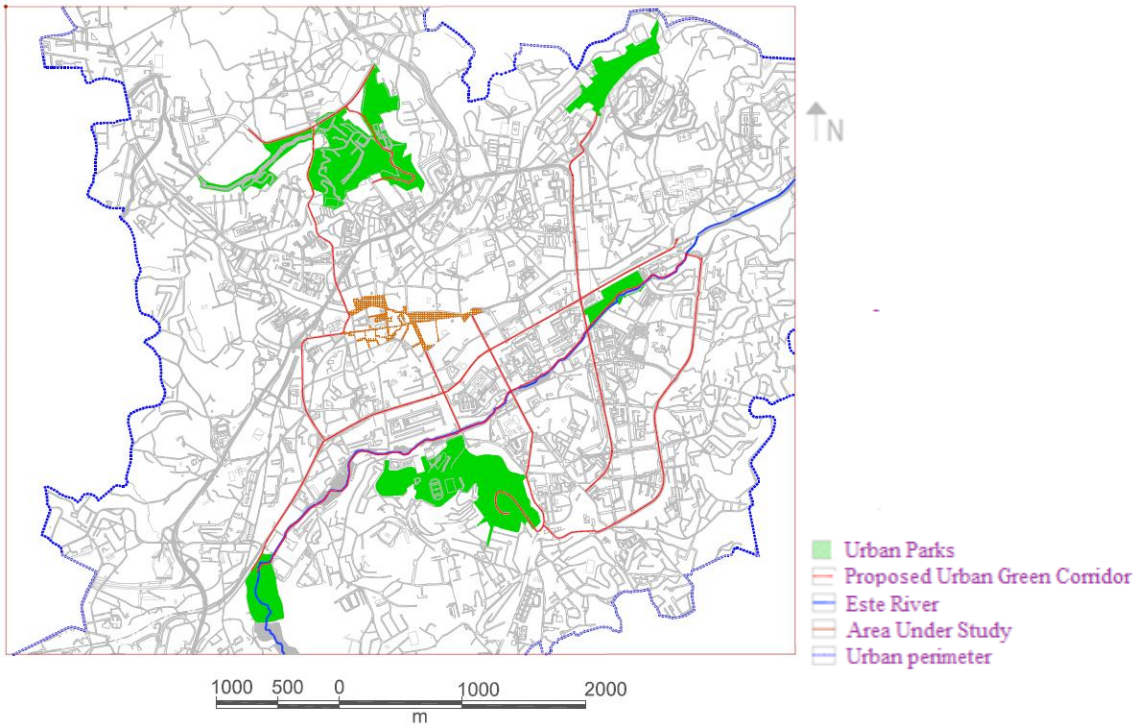

Figure 2: Proposed Urban Green Corridors Network for Braga

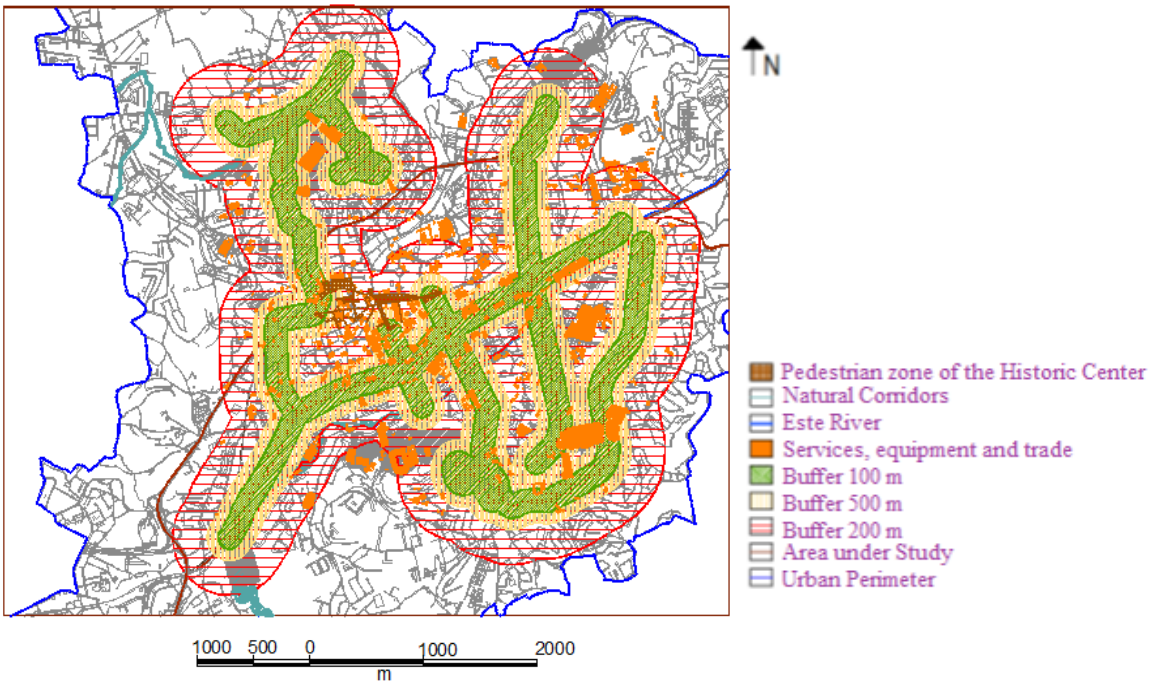

Figure 3: Spatial Coverage of Urban Green Corridors Network for the city of Braga

4 Conclusion

There are several authors who argue that interventions in small territorial scales, such as cities, are the basic principle for changing the effects observed globally by intense growth of the areas occupied by the population, according to intensive standards of industrialization and urbanization. So, this excessive growth makes cities more polluted, reducing its urban environmental quality, and therefore, the citizens quality of life.

As described throughout this article, urban green spaces execute depurative functions on the cities

environment and, as it, their interconnection and utilization becomes essential.

The proposed network of urban parks and green corridors to the city of Braga arises to promote its use by the city inhabitants. These spaces exist, but their use in environmental and social terms is diminished as a result of their disorganization and lack of connection with routine activities.

The analysis carried out in the territory concluded that it is possible to adapt the concept of the urban ecological corridor, linking some systems compatible with a possible ecological structure. However, several changes are needed in the actual planning of the city to the proposed network succeed, both in terms of environmental input to the city, or in terms of operation of the network itself, especially regarding the possibility of adapting the proposed corridors for movement by soft modes.

The layout of the network given the location of the major equipment, services and business units within the study area allows the movement of citizens by soft ways instead of using cars. However, this proposal will have to be coordinated with a mobility plan and a strategy of integrated planning that adopt new modes of displacement for population, but at the same time allows them to easily reach the place where they work, where they live and the different services in the city center. A good solution can more easily promote a change in attitudes and habits among citizens.

With the reduction of crossing traffic is expected to decrease energy consumption and emissions of greenhouse gases, translating into a better quality of urban environment and fostering improvements in the quality of life of citizens.

In addition to the environmental benefits of increasing and structuring of urban green spaces, the proposed changes will lead to a city beautification, promoting their image and making it more competitive and attractive.

As future work, we propose the extension of the proposed network of urban parks and green corridors to the entire area of the city, encompassing new systems with environmental and nature protection in the urban periphery.

It is further considered in the future to make a more detailed analysis of the network, analyzing case by case the profiles to adapt to each urban green corridor. To do this analysis will be necessary to conduct a survey of all the physical characteristics of existing pathways and study their adaptation to the structure of urban green corridor, promoting its connection to the remaining local access network.

Also, for monitoring the urban green corridor network is considered relevant a survey using GPS equipment throughout the network in order to design a database that allows network maintenance, observing its operation in terms of use, simple utilization and contribution to improving the quality of the urban environment.

Acknowledgements: The authors acknowledge C-TAC - Centre for Territory, Environment and Construction, a R&D unit of University of Minho, and FCT - *Fundação para a Ciência e a Tecnologia*, for the support.

References:

[1] Cangueiro, J., *A estrutura ecologia e os instrumentos de gestão do território*, Porto: CCDRN, 2006.

[2] Fábos, J., Robert, L., An introduction to greenway planning around the world. *Landscape and Urban Planning* (76), 2006, pp.1–6.

[3] Sustrans, *London Greenways*. Accessed in July of 2011 http://www.sustrans.org.uk/what-we-do/london-greenways

[4] Vancouver Engineering Services, *Greenways Program - City Greenways*. Accessed in July of 2011 http://vancouver.ca/engsvcs/streets/greenways/city/index.htm

[5] Ciclovia, *Ciclovias, Ecovias e Ecopistas em Portugal*. Accessed in July of 2011 http://www.ciclovia.com.pt/.

[6] Rocha, Martinha E. R. R., *Rede de corredores verdes urbanos: uma proposta para a cidade de Braga*. MSc Dissertation in Urban Engineering, University of Minho, Portugal, 2011.

[7] Smarbraga, *Sistema de informação e monitorização do ambiente urbano da cidade de Braga*. Accessed in July of 2011 http://www.smarbraga.com/

[8] Seco, A., Macedo J., Costa, A., *Manual do planeamento de acessibilidades e transportes*. Porto: CCDRN, 2008.