

---

# Green space typologies in the city of Porto

EURAU'12

---

**ABSTRACT.**

*Green spaces are vital landscape components for promoting and preserving biodiversity in urban areas. Due to its geographical, social and environmental context, as well as the diversity of built environments, the city of Porto presents itself as an interesting case study for a research on the effects of green space morphology on Biodiversity. The approach starts with an outline of green space typologies, as in 2012, thus allowing a deeper understanding on the multiplicity and spatial distribution of urban green spaces of Porto. This was followed by a selection of urban green spaces where in-depth surveys are to be performed to access the relation between the two main sets of variables in study: morphology and biodiversity.*

*This paper presents a reflection about the first part of this study, aiming at contributing to the following research question: What are the green space typologies present in the city of Porto and their defining characteristics? A sample on the sites to be surveyed is also presented, highlighting its spatial organization and ecological features. This selection allows a more refined and quality of data to be acquired and set the departure point of our future research.*

**KEYWORDS:** *Urban Biodiversity; Green Space Morphology; Public Green Spaces*

---

**Paulo Farinha-Marques\* \_ Cláudia Fernandes\*\* \_ José Miguel Lameiras\* \_ Sara Silva\*\* \_ Isabel Leal\*\* \_ Filipa Guilherme\*\***

*\*Faculdade de Ciências da Universidade do Porto  
Rua do Campo Alegre 687 | 4169-007 Porto, Portugal  
00351 220402719*

*\*\* Research Center in Biodiversity and Genetic Resources  
Campus Agrário de Vairão | R. Padre Armando Quintas |4485-661 Vairão, Portugal  
00351 220402992*

## **1. Context and Location**

This project takes place in the city of Porto - Portugal, the heart of a metropolitan area with a population of close to two million. It is the second largest Portuguese city, with a mild Atlantic climate, a significant variety of closely related natural habitats (the Douro River and its estuary, the ocean front, streams still with open-air stretches and cliffs) as well as various habitats of human origin with different features, dimensions, location and connectivity (parks, gardens, small woodlands, residual farming areas, derelict industrial areas and ruderal spaces). Porto reveals to be a very interesting urban ecosystem in a transition area between the temperate and Mediterranean regions.

## **2. Methodology**

The work process for this research is organized into three stages:

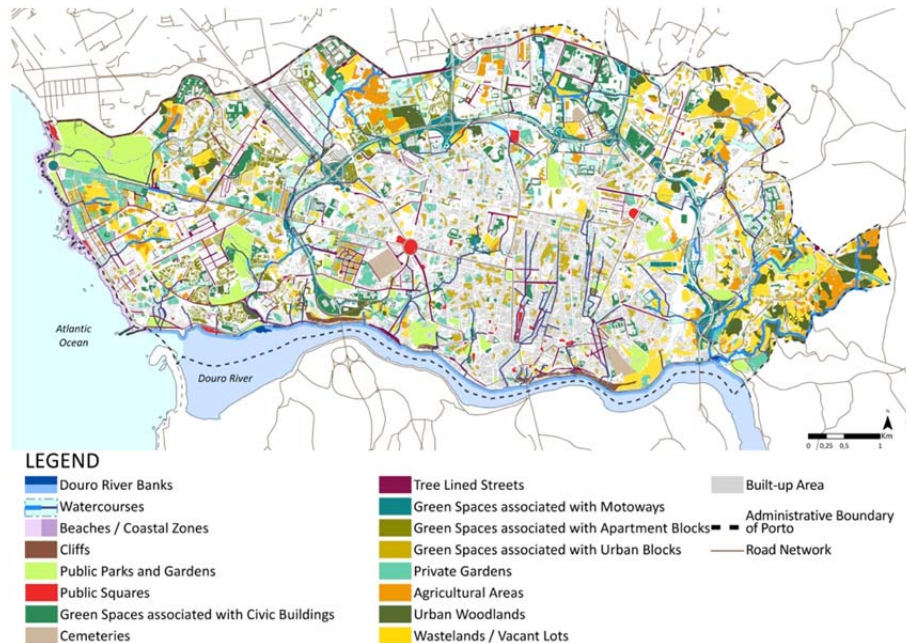
1) Stage one involved creating a database which comprised gathering and preparing theme-based cartography for the field of study, along with bibliographic research, subject to the following topics: urban biodiversity, methods for its assessment, urban planning, design and space management.

2) Stage two focused on the area's biophysical and cultural characteristics, namely topography, geology, hydrology, slope gradient, sun exposure, land use, road network and urban pattern. With a mapping-related basis as a starting point, and especially using updated satellite imaging, an inventory of the city's green space typologies (green structure) was achieved.

3) Stage three, concentrated on designed public green spaces - typology *Parks, Gardens and Garden Squares with Public Access*. To obtain a representative sample of this group, the spaces were systematically described according to their function, morphology and character, followed by statistical analysis that allowed the selection of a representative set.

## **3. Green Space Typologies**

Green areas existing in the urban matrix have been increasingly attracting the attention of researchers, especially since the accelerated process of urbanization that occurred in Portugal from the latter decades of the 20<sup>th</sup> century. The identification of green space typologies varies with the specific needs of each research (Loboda & De Angelis, 2005) and each research team adopts those that more clearly help to define the green structure of a city. The typologies defined for Porto as presented on Fig 1., and described as follows:



**Fig. 1** Green space typologies

Douro River Banks: set of spaces comprising immersed rocky outcrops, small beaches, embankment walls, estuary, and the mouth of its main tributaries (Granja Stream, Tinto and Torto Rivers).

Watercourses: streams and waterway drainage lines with associated flooding areas (alluvial soil deposits). Today, most of their stretches are no longer in the open-air, as they are piped.

Beaches / Coastal Zones: refers to beaches and adjacent areas including dunes, rocky outcrops and patches of vegetation subject to tides. This category also includes the section of sandbank at the Douro River estuary intersected by the administrative boundary of Porto.

Cliffs: areas with a slope of at least 45°. Whenever discontinuities occurred, their inclusion in this category was subject to a more detailed assessment using complementary sources of information (ex.: Google Earth, military maps and *in loco* observation).

Public Parks and Gardens: outdoor designed spaces, dominated by the presence of vegetation, accessible to the public and with a vegetation cover on permeable soil that was at least 40% (35% was acceptable in transition situations).

Public Squares: mainly paved open spaces, commonly surrounded by built up structures, for direct public use, and with permeable area less than 40%. This category was also divided into the following subcategories: *Mineral Squares*, *Squares with Trees*, and *Green Squares*, whose permeability respectively corresponds to the intervals 0-5%, 5-15% and 15-40%.

Green Spaces associated with Civic Buildings: vegetated outdoor spaces located in the adjacent area of public buildings, such as schools, hospitals, churches, universities, barracks, precincts, sport complexes and public administration buildings (parish council buildings, city halls, etc.). The diversity of such spaces could force it to be included in any of the previous categories. For instance, the green areas linked to some universities could fall under the category *Parks and Gardens for Public Access* (ex: the Garden of the Faculty of Fine Arts, University of Porto).

Cemeteries: corresponds to the existing public graveyards with expressive green areas or tree groups.

Tree Lined streets: corresponds to roadways (avenues, alleys and streets) with trees, either in a row or dotted here and there.

Green Spaces associated with Motorways: corresponds to green areas, mainly developing on motorway banks and intersections.

Green Spaces associated with Apartment Blocks: comprises all green spaces articulated with multi-story modern buildings

Green Spaces associated with Urban Blocks: includes every outdoor green spaces without public access within blocks of streets comprising continuous patches, regardless of its use; excluded from these are small, isolated patios and gardens, with no historical or floristic relevance.

Private Gardens: designed green spaces associated with private buildings (including historic farms), with distinct floristic composition and historic interest.

Agricultural Areas: includes cultivated spaces with an area over 5000 m<sup>2</sup>; spaces shown as having been used as farmland but which are currently abandoned must be included under Wastelands/ Vacant Lots.

Urban Woodlands: green spaces with no clear spatial organization nor explicit design, whose percentage of tree cover (forest phanerophyte cover) is at least 70%.

Wastelands/ Vacant Lots: non-built-up urban spaces, eventually either left over or abandoned, public or private, apparently with no currently planned occupation or clear human use. They result from an incomplete process of urbanization or abandoning of outdoor spaces linked to private houses or farmsteads. They normally show a ruderal vegetation cover in the early stages of ecological succession later developing to patches of shrubs and few trees; their origins vary greatly, ranging from areas planned for green spaces that were not implemented, to parcels of land awaiting construction, to farmland and derelict industrial areas, etc; this undefined status from the standpoint of human use allows for the spontaneous colonization by indigenous or pioneer exotic vegetation, which will gradually take up the entire area, making up typical plant communities and interesting habitats for wildlife in the city; they can be subject to disturbances and marginal activities, as they become dumpsites and improvised parking lots or illegal campsites.

#### 4. Parks, Gardens and Green Squares in the City of Porto

Aiming at studying the relation between morphology and biodiversity, a number of spaces where surveys need to be made were selected, according to the feasibility in our project time schedule. A selection of *Parks*, *Gardens* and *Green Squares* was made, as they are especially relevant typologies for understanding the relationship between their spatial features and flora and fauna-related contents due to its intentional design and management.

Regarding the typology *Public Squares*, only the sub-typology *Green Squares* was considered, due to its higher permeability rate and vegetation cover which are supposed to provide more favorable conditions for supporting a larger number of plant and animal species.

These typologies also involve a more significant human use and therefore a more explicit direct influence on biodiversity; this relationship is evident in matters regarding spatial organization, materials, maintenance and in the pressure imposed by the use of the space (access, recreation, traffic, human facilities and artifacts, etc.)

*Parks, Gardens and Green Squares with Public Access* comprise a set of 95 green spaces; 74 are included under the typology of *Public Parks and Gardens*, with the remaining 21 under the sub-typology *Green Squares*.

Considering the large number of green spaces under the defined group and the limited research resources, a smaller but representative group of green spaces was identified for the purpose of biodiversity survey. The method chosen for this process involved the creation of a classification matrix where each of the 95 spaces was assessed according to a set of variables (morphological, functional, biophysical and spatial) and on which a statistical analysis was performed.

#### 5. Selecting Study Sample

With the aim of identifying a sample of representative spaces of the population under study, a classification matrix was devised, using variables of spatial character, size, function, permeability, vegetation cover, water surface, distance to nearest habitats, age, maintenance, etc. This was the base for a statistical procedure that allowed the grouping of the 95 green spaces according to their similarities. The statistical validation certifies the ability of any green space to be represented in the sample selected. This allowed the selection of 29 spaces, four of which are presented as follows with a synthetic description of their most significant qualities.

##### **Passeio Alegre Garden**

Overlooking the mouth of Douro River, Passeio Alegre is one of most relevant public historic gardens of Porto.

Its construction began in 1888, under the guidance of Jerónimo Monteiro da Costa, who was also its landscape designer. This *woodland garden* with a geometric layout, comprising an area of nearly 4 ha, has a permeability index of 53%, 76% plant cover and 1% water surface. It displays imposing alignments of Canary Island Date Palm (*Phoenix canariensis*), Norfolk Island Pine (*Araucaria heterophylla*) and Hybrid Plane Tree (*Platanus x acerifolia*), as well as two lakes decorated with sculptures. Although playing a significant leisure-related function, it also represents an important referential landscape of the city, including a very relevant collection of

unique registered trees: 63 *Phoenix canariensis*, 28 *Araucaria heterophylla* and 2 *Metrosideros excelsa*. Generalist species find shelter in the garden, such as, the following bird species Spotless Starling (*Sturnus unicolor*), Eurasian Collared-dove (*Streptopelia decaocto*), European Goldfinch (*Carduelis carduelis*). The garden also presents a few interesting architectural elements such as the Swiss chalet (municipal interest), the fountain (National Monument) and the obelisks designed by Nicola Nasoni in the 18<sup>th</sup> century, for Quinta da Prelada.



**Fig. 2** Masterplan of Passeio Alegre Garden.

### Carregal Garden

This constitutes another *woodland garden* also designed by Jerónimo Monteiro da Costa, from the late 19<sup>th</sup> century (1888-1889). Despite its small size (0,6 ha) this is the sample space with the highest percentage of area taken up by water (8,5%). It also has a permeability index of 56% and 82% plant cover. The garden is of naturalist character, both given by its planimetric outline and its planting scheme. It plays important roles regarding recreation and conservation, as it contains an extraordinary collection of conifers: Giant Sequoia (*Sequoiadendrom giganteum*), Coast Redwood (*Sequoia sempervirens*), China Fir (*Cunninghamia lanceolata*), Douglas-Fir (*Pseudotsuga menziesii*), Lebanon Cedar (*Cedrus libani*), Atlas Cedar (*Cedrus atlantica* 'Gluca'), Lawson Cypress (*Chamaecyparis lawsoniana*), Bunya Pine (*Araucaria bidwillii*), flanking a lake that is crossed by a small bridge. In terms of fauna, besides the urban generalists it is possible to find small forest birds. The most representative are Short-toed Treecreeper (*Certhia brachydactyla*), Coal Tit (*Parus ater*), Wren (*Troglodytes troglodytes*). This green area represents perhaps Porto's last garden from the romantic/eclectic period, as it retains most of its late 19<sup>th</sup> century features.



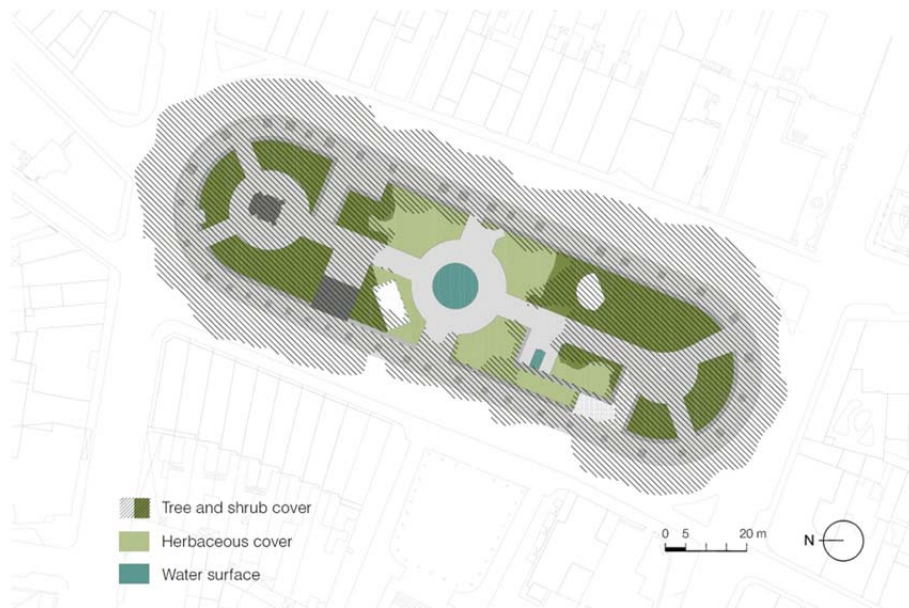
**Fig. 3** Masterplan of Carregal Garden

### Marquês de Pombal Garden

Previously known as Aguardente Square (Fire water square) this outdoor space has been called Marquês de Pombal since 1882. Created by the prominent landscape designer Jerónimo Monteiro da Costa, it was built in 1898. It mainly consists of a dense plane tree grove (*Platanus X acerifolia*) with a geometric layout emphasized by shrub masses of Boxwood (*Buxus sempervirens*), some *Camellia japonica* and herbaceous cover of *Ophiopogon japonicus*. In what concerns bird species it is dominated by opportunists well adapted to urbanization, such as Rock Pidgeon (*Columba livia*), Yellow-legged Gull (*Larus michahellis*). It has an area of 0,7 ha, permeability index of 43%, 1,6% of water surface and 130% of plant cover (the highest among the sample group, reflecting the significant height and spread of the plane tree crowns). A characteristic iron bandstand marks its northern end. In 1931 an Art Deco concrete kiosk was set up in the garden (Municipal Interest).

The garden has undergone several renovations over time, most recently in 2006, when it was significantly modified resulting from construction of the Porto Metro. A fountain was brought over from D. João I Square, and some of the shrub and flowerbeds were reduced to provide access to the Metro station and make room for the ventilation system.

The place still remains significant for recreational and amenity purposes, as well as an important landmark in the history of the city's urban development.



**Fig. 4** Masterplan of Marquês de Pombal Garden



## Pasteleira Park

This *glade-woodland* park, designed by the landscape architect Marisa Lavrador, was built between 2004 and 2009. It has an area of 7 ha, with 79% of permeability index, 87% plant cover and 2,6% of water surface. Its outline and green structure organization is dominantly naturalistic emphasized by the pre-existing maritime pine woodland spotted with cork oaks (*Pinus pinaster* and *Quercus suber*). Maritime pine woodlands were common at this seaside landscape but today only a few relic patches remain as a result of intensive urbanization of the area. The newly planted areas make use of a wide variety of native and exotic plant species such as Common Hawthorn (*Crataegus monogyna*), Strawberry Tree (*Arbutus unedo*), Laurustinus (*Viburnum tinus*), Bay Tree (*Laurus nobilis*), Portuguese Laurel (*Prunus lusitanica*), Crape Myrtle (*Lagerstroemia indica*), Azalea (*Rhododendron indica*), Japanese Pittosporum (*Pittosporum tobira*), Stone Pine (*Pinus pinea*), Silver Maple (*Acer saccharinum*), Sweetgum (*Liquidambar styraciflua*), Poplar (*Populus* sp.), Red Oak (*Quercus rubra*), Weeping Golden Willow (*Salix x chrysocoma*) and Tuliptree (*Liriodendron tulipifera*).

All sampled fauna groups are present, as follows: mammals - Western Mediterranean Mouse (*Mus spretus*), exclusive from the Iberian peninsula, north of Africa and south of France, usually linked to agricultural / rural areas; Birds - Eurasian Jay (*Garrulus glandarius*) and Eurasian Hoopoe (*Upupa epops*), both forest birds that require a large habitat area and Common Kingfisher (*Alcedo atthis*) linked to aquatic environments; amphibious - Perez's Frog (*Pelophylax perezii*); butterflies - Swallowtail (*Papilio machaon*), the largest butterfly in Portugal.

The park is mainly used for recreational purposes, including leisure-related structures such as a bicycle path, children's playgrounds and a picnic area. It also plays an important conservation role especially regarding native vegetation and wild birds. The park is divided in two halves by Afonso de Paiva Street that runs through it; three wooden float bridges connect the east and western sides. The western side contains a small formal garden, an extensive naturalistic central area mainly shaped by a large glade edged by clusters of trees and shrubs and a lake that attracts waterfowl. The eastern part is mainly wooded patched with smaller clearings and dotted with leisure equipment.



**Fig. 5** Masterplan of Pasteleira Park

## 6. Summary and Future Outlook

This study started with a much-needed update on Porto's green structure. Due to unceasing urbanization the city's green structure is continuously changing. Based on updated satellite imagery, available cartography and fieldwork we were able to map the city's green spaces as in 2012. This required the identification of green space typologies present in Porto, as well as its accurate description so that this methodology could be replicated.

One good example on the need for such clarity is the definition of "Public Parks and Gardens" and "Public Squares". Often, sites with similar areas are named park or plaza by different authors/ site users/ toponymy. Through the analysis made on the main characteristics of a park or a square, we were able to propose a simple identification method based on the percentage of site permeability (<40% Square | >40% Park).

This task ended with the creation of a geospatial database aiming at containing the total of Porto's green spaces. Not only it deepened the knowledge on how distinctive typologies are distributed in the city, but also how they relate to each other. This also provided the cartographic support needed for the upcoming research.

The four examples above presented, intend at showing a fragment of the diversity and richness of public green spaces in Porto. Ranging from large spaces such as the *Pasteleira* Park containing numerous man-made habitats, to smaller ones such as *Marques de Pombal Garden*, where more simplified habitats occur, very much influenced by the urban context.

This research will now progress towards a more improved analysis of each green space, based on habitat mapping, species richness survey and morphological description. The results aim at contributing to the definition of a set of guidelines and recommendations to planning, design and management procedures to the city's public green spaces.

## Bibliography

Alves, FMB 2003, Avaliação da Qualidade do Espaço Público Urbano. Proposta Metodológica. Fundação Calouste Gulbenkian. Fundação para a Ciência e Tecnologia. Ministério da Ciência e Ensino Superior.

Andresen, T, Carvalho, LG, Andrade, G, Curado, MJ, Silva, I, Silva, V, Lemos, IV 2009, Rede de Parques Metropolitanos na Grande Área Metropolitana do Porto - Relatório Final, Fevereiro.

Andresen, T e Marques, TP 2001, Jardins Históricos do Porto, Coleção Portucale. Edições Inapa, pp. 107 – 151.

Andrade, M e Magalhães, A de 2001, Plantas Antigas da Cidade. Publicações da Câmara Municipal do Porto, 2008, pp. 111-11.

Araújo, I 1962, Arte Paisagista e Arte dos Jardins em Portugal, vol. I , Direção Geral dos Serviços de Urbanização, Centro de Estudos de Urbanismo, Lisboa, pp. 244-245.

Farinha-Marques, P., Fernandes, C., Lameiras, J.M., Silva, S., Guilherme, F., 2011. Morfologia e Biodiversidade nos Espaços Verdes da Cidade do Porto, Livro 1 – Selecção das Áreas de Estudo. CIBIO, Porto. ISBN:9 789899 741805

Farinha-Marques, P., Lameiras, JM, Fernandes, C, Silva, S, Guilherme, F 2011, Urban Biodiversity: a review of current concepts and contributions to multidisciplinary approaches. Innovation - The European Journal of Social Science Research 24(3): 247-272.

Gilbert, OL 1991, The ecology of urban habitats. London: Chapman and Hall.

Goddard, MA, Dougill, AJ, et al. 2010, Scaling up from gardens: biodiversity conservation in urban environments. Trends in Ecology & Evolution 25(2): 90-98.

Godefroid, S and Koedam, N 2007, Urban plant species patterns are highly driven by density and function of built-up areas. Landscape Ecology 22(8): 1227-1239.

Lamas, JMRC 2004, Morfologia Urbana e Desenho da Cidade. Fundação Calouste Gulbenkian. Fundação para a Ciência e Tecnologia. Ministério da Ciência e Ensino Superior.

Loboda, CR & De Angelis, BLD 2005, Áreas verdes públicas urbanas: conceitos, usos e funções, *Ambiência*, vol.1, no.1, pp. 125-139.

Madureira, H 2001, Processos de Transformação da Estrutura Verde do Porto, *Revista da Faculdade de Letras — Geografia*, I série, vol. XVII-XVIII, Porto, pp. 137-218.

Madureira, H, Andresen, T, e Monteiro, A 2011, Green structure and planning evolution in Porto, *Urban Forestry & Urban Greening*, vol. 10, no. 2, pp. 141-149.

Pauleit, S and Duhme, F 2000, Assessing the environmental performance of land cover types for urban planning. *Landscape and Urban Planning* 52: 1-20.

Werner, P and Zahner, R 2010, Urban Patterns and Biological Diversity: A Review in Müller, N., Werner, P., Kelcey, G. (eds). *Urban Biodiversity and Design*, Wiley-Blackwell

## 7. Biography

**Paulo Farinha Marques**, is an Associate Professor at the University of Porto where currently develops teaching and research in the landscape architecture field – landscape design, landscape planting, ecological park design, design and restoration of natural and manmade habitats and biodiversity promotion in historic landscapes.

**Cláudia Patrícia Fernandes** is an Landscape Architect with a previous formation in Agricultural Engineering and Natural Resources Management. At this time is an invited Assistant Professor at the University of Porto developing her research interests in Biodiversity Patterns in Urban Environments.

**José Miguel Lameiras** is an assistant lecturer at the University of Porto currently involved in teaching and researching in the field of landscape architecture. His main interests of research include landscape design, design theory, information technologies, GIS and ecology.

**Sara Silva** has a master degree in Landscape Architecture. Her master focused on the design of productive gardens for the urban landscape. In the last two years she has been working at CIBIO Research Center, under the research topics of spatial planning of the urban green infrastructure, landscape design and promoting biodiversity by design.

**Isabel Filipa Leal** has a B.Sc. in Landscape Architecture, with a post-graduation degree in territorial planning legislation. She's been working as a landscape designer with an emphasis in public landscape and mobility. She has a special interest in sustainable environments, sustainable architecture, historical grounds, photography and image processing. Her research interests include landscape design, landscape regeneration and cultural landscapes.

**Filipa Guilherme** is a biologist with special interest in fauna and the impacts of human activities on animal species. She has a degree in Environmental Biology and a M.Sc degree in Conservation Biology. In her M.Sc research, she studied the effects of agricultural and pastoral practices on small mammal.