

Chapter 12

Building Other Landscapes: Renaturing Cities



Camila Gomes Sant'Anna

Abstract In the context of the European community, green infrastructure emerged as a tool for planning the landscape in the face of a series of significant contemporary imperatives. Its implementation in Spain, for example, took place through strategies for the renaturalisation of cities aimed not only at environmental conservation, but also at fostering sustainable urbanisation adapted to climate change. In the case of Barcelona's territory, its design is multiscale and translated into green corridors at the regional scale and the greening of 'opportunity areas', mostly unoccupied ones, of different types and sizes at the local scale. Beyond this perspective, physical and ecological connectivity is favoured, ensuring not only biodiversity, but also art, agricultural production and leisure improvements are discussed. The objective of this chapter is to understand how green infrastructure strategies have been incorporated into Barcelona's territory; for this purpose, the methodological implementation strategy, from the regional to the local scale, undergoes analysis. Out of this process arise considerations of a new green and productive metropolitan development paradigm, known as green infrastructure.

Keywords Landscape · Green infrastructure · Renaturing cities · Hybrid infrastructures

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of different types and sizes at the local scale. Within this perspective, physical and ecological connectivity is favoured, ensuring that not only biodiversity but also art, agricultural production and leisure improvements are discussed. The objective of this chapter is to understand how green infrastructure strategies have been incorporated into Barcelona's territory; for this purpose, the methodological implementation strategy, from the regional to the local scale, undergoes analysis. Out of this process arise considerations of a new green and productive metropolitan development paradigm, known as green infrastructure.

12.1 Introduction

Green infrastructure (GI) has been the subject of numerous academic studies and policies developed by international agencies to aid technical cooperation and delivery. Each uses the theoretical discourse surrounding GI, as discussed by Mell and Clement (2020), as a way to design for climate change, promoting a renaturing of cities that ensures ecosystem services, ecological resilience and the creation of connected and equitable landscapes. In this chapter, GI is understood to be the planning and design of the landscape of a territory in an integrated way, structuring and connecting its green and blue systems and valuing its material characteristics (urban occupations, vegetation, water bodies, soil characteristics and fauna and flora), as well as its intangible ones (aesthetics, culture and heritage) (Sant'Anna, 2020: 101). Therefore, landscape planning with GI:

[...] entails a design vision that translates planning strategy into physical reality while heeding the ecological and cultural characteristics of a particular locale – whether a region or individual building site. It is, by necessity, an approach that involves aesthetics: what a place should look like as informed by the people who live on the land, their past, and their aspirations. (Rouse and Bunster-Ossa, 2013: 174)

The basis for the development of this form of planning is the regional scale, as it allows for an elevation of thinking regarding the ecological matrix of metropolitan areas to a number of scales (global, regional and local) (Battle, 2011). At the regional scale, according to Rouse and Bunster-Ossa (2013), each zone of GI assumes a different spatial translation:

[...]green infrastructure in rural contexts corresponds to either the Rural Preserve (as wilderness) or to the Rural Reserve (as “working lands with conservation value” [Benedict and McMahon, 2006]). In more-developed suburban contexts, green infrastructure takes on forms such as nature preserves surrounded by development, parks with active recreational facilities, and private gardens. Green infrastructure merges with the built environment in dense urban contexts (Urban Center and Urban Core), where it is expressed in streetscapes, urban parks and public gathering spaces, green stormwater infrastructure, and so on. (Rouse & Bunster-Ossa, 2013: 23)

The first methodological strategies for landscape planning and design with GI were initially developed in the US states of Florida and Maryland in 1994. There, Greenways Planning Initiatives proposed the implementation of a statewide

greenway system. This proposal aimed to connect a set of existing GI elements, whether at the local or regional scale, with the structuring of “conservation lands, trails, urban open spaces, and private working landscapes” (Benedict & McMahon, 2006: 35).

Initially, GI strategies focused on reviewing more traditional environmental conservation actions, engaging primarily with protecting areas of environmental interest – especially those that are part of green corridors – with less discussion of their role as multifunctional urban infrastructure capable of guiding a territory’s landscape planning (Firehock & Walker, 2019; Rouse & Bunter-Ossa, 2013).

However, European experiences, which are comparable to North American ones, have used a systemic approach that takes into account additional dimensions of the landscape, be they social, cultural, economic or ecological. Within this context, albeit recently, the Spanish experiences have been developed as regional and local strategies, updating landscape planning and design by incorporating concepts, such as the garden city and green belts, to meet contemporary demands of adaptation to climate change. Therefore, they were taken as the subject of a case study in the following chapter.

The purpose of this chapter is to better understand how the methodological discussions of landscape planning and design have incorporated GI and under what values they are consolidated in the territory of Barcelona’s metropolitan region. This reflects on the idealisation of the sociocultural and ecological network and moves on to examine its reverberation in terms of urban design at a local scale in the city of Barcelona.

12.2 Green Infrastructure in the Construction of Resilient and Equitable European Landscapes

To frame the discussion in Barcelona, it is important to locate GI geographically in a European context in order to assess local-level action. The European Commission defines GI as:

a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings. (European Commission, 2013: 4)

This definition of GI – still focused on its ecological contribution – influenced the initial understanding of the concept as an innovative strategy for environmental conservation, taking into account the loss of biodiversity, especially related to climate variations:

When appropriate, such approaches use GI solutions, because they use biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to or mitigate the adverse effects of climate change. (European Commission, 2013: 4)

In this context, according to the European Commission, there was an urgent need to scientifically explore the concepts, principles and methodologies of urban, peri-urban and rural planning associated with GI to assess its contribution and integrate it into the agenda for managing the risk of natural disasters and adaptation to climate change (European Commission, 2015). The debate on GI in Europe then started to address sustainable strategies on multiple scales. In 2013, in order to define a European Green Infrastructure Strategy, the European Union established two complementary work groups, which responded to the environmental and urban agendas: the *European Green Infrastructure Policy* and the *Nature-Based Solution (NBS)* groups. In the beginning, the NBS came out of the GI debate as a concept to define the urban elements of GI, but nowadays its position in Europe is very different.

The first group aimed to build an understanding of how GI planning could be implemented. The second was tasked with mapping, developing and disseminating the evidence supporting NBS to translate this into projects and GI strategies, especially with regard to their dialogue with existing traditional grey infrastructure. Consequently, there is an understanding that 'NBS have an important role to play, for instance, through supporting the implementation and optimization of green, blue and grey infrastructure' (European Commission, 2015:18).

In response to this, guidelines and projects that focused on GI were proposed, supporting a view of landscape planning and design that expands upon the initial perspective centred on biodiversity into a more holistic view, engaged with socio-cultural values. Thus, although the rationale for GI planning was based on natural processes, it should also be thought of as a 'place-based' approach, promoting green urban-economic development and, at the same time, conserving the natural values of the place (European Commission, 2013).

However, most of the proposals that emerged to date have guidelines for implementing GI that remain very general and technical, centred on physical and ecological connectivity. The specific territorial context may not be considered in a systemic and multi-scalar approach for analysis, thus failing to account for their specific characteristics in terms of development in line with nature and culture. GI has emerged as a tool to build connected and equitable landscapes. Thus, it provides an opportunity to translate the desire for environmental justice and liveable spaces into reality.

Nonetheless, even though there is considerable knowledge exchange between various European countries on the theoretical and practical experiences related to GI, the planning and design of the landscape ends up being constrained by the political-administrative limits of each country, rather than as a consideration of the information about the landscape, for instance, its hydrographic basin.

In addition, there is no consensus on the methodological basis on which landscape planning and design with GI can, or should, be implemented in different locations, in the context of a specific plan or in infrastructure plans of a broader character and its spatial translation in terms of urban design. Concerning the incorporation of landscape planning and design with GI and matching this with the political-administrative boundaries of each country (Spirm, 1995), there remains little

consensus. Neither the methodological basis on which it would be implemented and adapted nor the spatial translation in terms of urban design are easily defined. When reviewing the existing European Commission guidelines, it is clear that the definition of which elements comprise GI in the planning and design stages in terms of constraints, processes and success factors remains broadly outlined and has no specific detail on how best to spatialise them. At the national level, particularly in the case of Spain, gaps in methodological strategies have been addressed through the use of a systemic approach that includes multi-scale aspects of planning, ranging from guidelines to landscape design.

12.3 GI Renaturalising the Different Spanish Landscapes

In Spain, renaturing cities is not a new concept. It has been translated into practice over the centuries in different ways, lately with the green corridor and green belt schemes reinforcing the importance of landscape ecology. The development of GI plans is relatively recent (post-2000), but these are now taking off as the result of a partnership between universities, the third sector, communities and the government, as a regional and local strategic partner. In support of this, Tojo (2008,107) proposes infrastructure as an articulating element between ecological networks and city systems (Valladares et al., 2007). The topic of GI has been adopted into national legislation in numerous places in Spain, such as Madrid, Valencia and Vitoria-Gastiez, while it still remains closely linked to the integrated environmental conservation of 27% of the country's protected green space. Following the guidelines on protected natural spaces, primarily linked to the Natura 2000 Network and natural heritage areas protected by UNESCO and World Heritage, Law 33/2015, from 21 September 2015, which replaces Law 42/2007 from 13 December 2007, on Natural Heritage and Biodiversity, reinforces this fact (Chap. III, title I), concerning the State Strategy for GI and ecological connectivity and restoration:

[...] for the territorial and sectoral planning carried out by public administrations to permit and ensure ecological connectivity and the functionality of ecosystems, mitigation and adaptation to effects of climate change, defragmentation of strategic areas for connectivity and restoration of degraded ecosystems. (SPAIN, 2015, Chapter 3, Art. 15, § 2)

This strategy incorporates the European Commission's guidelines on GI – Enhancing Europe's Natural Capital (2013), giving the municipalities of each Spanish autonomous community a period of 3 years to develop their own GI strategy, taking into account the guidelines of the European Landscape Convention from 2000 (Sanchez, 2018). The definition of a proposal for a GI network adds to the Greenery and Biodiversity Plan and the Spanish National Climate Change Adaptation Municipality Plan, as well as providing protective measures for national and international heritage. Moreover, strategies emerge as a way to promote the process of renaturalisation of landscapes in Spanish cities and the appreciation of the 'green' perspective in the city's urban development:

The concept of naturalisation has an urban character that starts from intervening in spaces that have been artificialized. Interestingly, it involves human intervention to obtain results in favour of natural processes. On the contrary, artificialization would advance. It could be an acknowledgment from the city that the grey urban plot is excessive for the requirements of human life. The concept of naturalisation, close to ecological restoration, being urban stands out for its social dimension and also for the search for a more ecological aesthetic. Thus, with the ecological processes, human desires and values are mixed. (Pares & Rull, 2019: 277)

Within this perspective of cities' renaturalisation, GI

[...] is not presented as a new figure for the protection of natural heritage, but as an integrating tool that aims to ensure the processes originated in ecological systems and whose benefits revert to the human being (in relation to the increase in the efficiency of natural resources, climate change mitigation and adaptation, disaster prevention, water, soil and land management, agriculture and forestry, investment and employment, health, etc.) (Sanchez, 2018: 52)

Additionally, from regional to local:

[...] on the one hand, to solve the pressures on the environment by protecting the processes that occur in nature as a guarantee of ecosystem services and, on the other hand, to stop the growing loss of biodiversity in its territory; and, to achieve them, it emerges as an ecological network of spaces designed and managed to promote the improvement, maintenance and restoration of ecological connectivity between habitats. [...] (Sanchez, 2018: 52-53)

Furthermore, in 2015, a group of specialists met and created a working group that was to think about the methodological strategies for the incorporation of GI as a tool for landscape planning and design. As a result, in 2017 the book 'Scientific-technical bases for State Strategy for GI and connectivity and ecological restoration' was published. However, this book did not articulate how these strategies would be developed, which ended up being the responsibility of each municipality where GI would be implemented. In order to better understand how these methodological strategies could take shape on a regional and local scale, the next section discusses how these strategies occurred in Barcelona – a diffuse metropolis of 3.2 million inhabitants.

From the Plan to the Local Context: The Planning and Design of Barcelona's Green Metropolitan Infrastructure.

The region of Barcelona is located in northeastern Spain on the Mediterranean Sea and is one of the densest regions of Europe. It has 5.04 million inhabitants in an area of 3.244 km², 164 municipalities, of which Barcelona (1.61 million inhabitants) is the most important.

The 2017 GI plan and design for the sprawling metropolitan territory consisting of 36 municipalities, including Barcelona, seeks to enhance its rich variety of natural habitats with high ecological value, including the Mediterranean forest (1181, 56 km², 36, 5%), by reviewing the physical and ecological connections through its GI network, the urban-rural fringes, and assessing the fragmenting of its green structure by unplanned development. The intention of the plan was to reflect on a holistic design of the territory that also considers the landscape units, nearly 70% of protected environmental interest areas, including, completely or partially, 14 areas

of environmental interest to the Natura 2000 network, as well as [Spain's sustainable forest management](#) planning areas.

The GI strategy deepens the readings and strategies developed for the elaboration of the Plan del Verde y de la Biodiversidad (2012–2020), which is part of the Metropolitan Urban Master Plan (PDM), also dialoguing with the 2017 Urban Green Infrastructure Impulse Program. This plan foresaw that Barcelona in 2050 would be 'a city where nature and urbanity interact and enhance one another by ensuring the connectivity of green infrastructure'. The plan established 10 strategies that were guided by two main concepts: *renaturalisation* and *physical and ecological connectivity*.

As a consequence, the plan developed from a 'layer cake analysis' of the territory, organised in workshops, which had included participation of the local population in its elaboration and were disseminated through lectures and exhibitions, as can be seen in the most recent exhibition, the itinerant 'Metropolis Verda'. Initially, the readings focused on understanding the geography and history of the territory and the land use process to create a series of thematic maps. Then, the objective was to identify, catalogue and organise the performance of the urban systems of the metropolis, from the analysis of its occupation model, its renewable resources, its efficiencies and the integration of all these attributes, with the help of the tool Territorial Information System for the Network of Open areas in the province of Barcelona (Sitxell, [www. Sitxell.eu/en](http://www.Sitxell.eu/en)).

A principle of extreme importance that emerges in this analysis is that of 'habitability', understood as the set of physical, sociocultural, economic and psychological values that guarantee the quality of life in the place. From the water perspective, it is possible to observe how this principle, as well as the other values presented, is considered. The treatment of the data seeks to indicate possible directions, the mapping of biodiversity hotspots and where it would be interesting to promote GI to expand the potential functionality of Barcelona's urban metabolism.

After all the layers of thematic analysis had been superimposed, the next step was to think about the territory at different scales: its environmental matrix (considered an important biodiversity hotspot for the European territory), its system of open spaces and its structure of public spaces.

The metropolitan ecological matrix is the result of deliberately overlapping the environmental matrices that are promoted through ecology, the systems of parks defined by landscaping and the structures of civic spaces built under traditional urban planning. It is a system that has to have environmental at the same time as social values and that has to help us build the right relationship between the urban fabric and the open spaces; A strategy to be developed at all scales: from the Metropolitan to each town, from each neighbourhood to each individual. (Area Metropolitana de Barcelona, [2014a, b](#): 10)

In these proposals, this multi-scale understanding is developed, anchored on three scales and their structuring elements of the ecological network – nodes and accesses, infiltration points, membranes, urban connections, centralities and points of ecological interest. Then, the main physical and ecological connections in the territory are identified. They are characterised as or could produce green corridors

(composed of a blue network), which together with the productive landscape regions structure the GI network of Barcelona.

In this context, the urban fringes characterise about 12.8% of the territory. Its fragmented areas and their physical and ecological critical connective points are mapped (listed using symbols to represent the various fragmentations that could occur). Vacant and obsolete land emerges as strategic in promoting ecological areas and in improving the green areas in low-income neighbourhoods in this process.

This Biodiversity potential analysis is complemented by an examination of the condition of the territory's productive landscapes in pastoral areas, agricultural plots and vegetable gardens. The investigation revealed the loss of 75% of productive landscapes from 1956 to 2009. Moreover, the region's loss of biodiversity was also considered, relating to habitats, concentration of biodiversity and agroforestry mosaic.

Following a general mapping of biodiversity, a complementary investigation of the living species – fauna and flora – linked to ecology and biology was conducted. The main species of flora (172 trees, shrubs and climbing plants) and fauna (103 autochthonous vertebrate species, including 72 protected by law, 2 amphibians, 8 reptiles, 55 birds and 7 mammals) were surveyed in these studies. The overlapping of all these readings allowed the definition of 46 points of ecological and physical fragility. Subsequently, a map was drawn with physical and ecological connectivity, articulating soil permeability and the lack of connectivity and the points where this lack is critical. In order to think of a GI strategy that would not approach ecological values (naturalness, diversity, complexity and connectivity) in isolation, a second analysis related these values to sociocultural ones (health, beauty, culture, well-being, connectivity and landscape).

The open spaces of Barcelona's metropolis were investigated for this purpose in order to better understand their characteristics and functions. As the information became more detailed, the 20 most important public spaces in the territory were highlighted and analysed according to the following criteria (guided by ecosystem services): environmental education, drainage, peri-urban planning, ecosystem functionality, thermal regulation, carbon retention, improvement of air quality, infiltration and permeability, artistic inspiration, identity and history, reflection and rest, urban landscape, bond with nature, walk, outdoor games, tourist visit, appreciation of private villas and palaces, appreciation of activities, contribution to mental health, physical health benefits, active ageing and allergy and adaptations to the global impacts of climate change.

After that, mobility networks were identified, for example, mapping the purification channels, historical routes and cycling paths. The concentration of green areas was inventoried and mapped, using 'normalised difference vegetation index' (NDVI), which is an index of green areas created using multi-spectral satellite images. Based on this process, a GI network to aid the recovery and expansion of the ecological, environmental, sociocultural and economic services of 52% of the metropolitan area was planned. In this process, metropolitan leisure spaces, neighbourhood parks and marginal and interstitial spaces were also considered.

In the development of the GI strategy for Barcelona, four elements were presented as the physical limits of the city: the natural park of Serra de Collserola (part of the Natura 2000 Network), the Llobregat and Besós rivers and the coast. From this structure, under the heading of 'biodiversity', different membranes (typologies of GI elements) of the territory were identified; among them were areas of environmental interest (biodiversity hotspots) and areas of historical interest, such as Park Güell, Parc de la Ciutadella, Park of the Labyrinth of Horta, the Pedralbes Palace, the Turó Park and the Tamarita Gardens, all of which are included in the Barcelona City Hall Architectural Heritage Catalogue (a total of 27) (Ajuntament de Barcelona, 2013:18). Areas of interest for afforestation and vegetation under construction, i.e., green walls, balconies, terraces and roof gardens, and associated fauna were also identified (Ajuntament de Barcelona, 2013: 18).

Afterwards, the strategic axes of GI connecting these elements were defined. These take the form of green corridors that perform multiple functions, ordering the metropolitan landscape of Barcelona at the eye level of pedestrians. The areas labelled as green 'infiltrating points', which comprise this corridor, are areas that require renaturalisation, anchored in the aforementioned discussion of NBS, with sociocultural dimensions.

On a regional scale, Barcelona's metropolitan GI network has green corridors, characterised by public and private areas. This network is planned to ensure that a comprehensive need program is fulfilled, considering the target audience and areas of action within and across the metropolitan area. It promotes accessibility and sustainable mobility, as well as the green economy in public spaces. The corridor that integrates the Collserola park area with that of the Monjuïc park and the Ciutadella park, for example, operates at different scales and embodies multifunctional designs of public spaces from the most naturalised to the most geometrised, exploring multisensory solutions based on nature, expected to boost biophilic relationships.

Planning the GI Landscape Within the Definition of the City of Barcelona's Urban Design: An Example of Transit Between Scales.

Within the corridor linking Collserola park (one of the main structuring elements of Barcelona's GI network) with Monjuïc and Ciutadella, one of the proposed projects is the green island of Jardíns del Doctor Pla i Armengol, which was developed as the result of mobilisation in the local population. The garden houses the Instituto Ravetllat-Pla, which exhibits Ramón Pla i Armengol's collection of furniture and objects. The garden interacts with its surroundings, functioning as an articulating node for Mar de Monte Serrat Avenue, Cartagena Street, Les Aigües Park and the gardens of Guinardó, through greened paths and routes. The plant physiognomies create different vertical and horizontal visual perspectives due to the background formed by their different shapes, heights, textures and colours. Immersed in this landscape, the passerby is invited to enter the 'green island' that appears at the vanishing point at the end of the route.

The proposal for urban design and landscape intervention in the area is based on a layered reading that seeks to value not only the area's physical attributes but also its sociocultural values, with a focus on heritage. The project aims to interact with the terrain's morphology by including various levels that introduce natural

solutions, such as sustainable drainage systems (SuDS), green beds and filter gardens. These levels are interconnected by paths that invite users to experience culture and nature while learning about various plant groups, both with and without water.

In this way, in this process of renaturalisation of the metropolitan region of Barcelona, the value of public spaces is reinforced, according to López, 2014:16: 'Thus, it is recognized that the design of public spaces and the road must guarantee the functionality of the GI and the maintenance of the views and perspectives that characterise it'.

12.4 Conclusion

In the Spanish case, autonomous communities are more independent of central government, and the concept of landscape is more developed, having an identified localised meaning. This is a consequence not only of a more consolidated practice of urban design but also of a greater openness in management bodies. With the deepening and dissemination of the debate on the Spanish methodological strategies of planning and design with GI, there is an evolution of the perspective, from a practice focused on environmental conservation to the understanding of GI as a tool that acts in the planning of the territory at different scales. This tool aimed to promote renaturation and connectivity, through green corridors at the regional scale and greening 'opportunity areas', mostly unoccupied, of different types and sizes at the local scale.

Associated with these actions are the expansion of biodiversity and gains of various kinds, for example, in the quality of art, ecology, agricultural productivity and leisure in the proposed landscape experiences, planned from the development of public policies to their spatial translation into urban design. This multi-scale proposal introduces a new paradigm to the metropolitan approach, concomitantly incorporating ecological and sociocultural dimensions in its decision-making about the future of the region, as well as seeking to understand GI as the fundamental urban infrastructure for landscape planning of the territory along with the plans for mobility and housing, among others. There is a positive effort to respond to contemporary needs, for example, investigating methodological paths that explore the construction of green urban infrastructures supporting a dialogue the grey/built infrastructure, thus making *hybrid infrastructures* that are resilient in the face of climate change at different scales.

Concerning the strategy for the Barcelona region, this proposes greater articulation between the urban and rural areas, reviewing the reduction of foodscapes in the territory and the understanding of rural areas as places for food production and no longer in contact with nature. The renaturalisation process values agrarian areas of high ecological value as well as historical, leisure and artistic significance.

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