

APPROACH TO THE CARTOGRAPHY OF GRANADA WITH ECOSYSTEM APPROACH: FOUNDATIONAL TRAIT, URBAN FABRIC, GREEN INFRASTRUCTURE AND HABITABILITY

DOI: https://doi.org/10.18485/arh_pt.2024.8.ch19

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ABSTRACT

The formation of heat islands, poor air quality, loss of biodiversity and high motorization, among others, have been aggravating pollution levels in the city of Granada for a long time. Meanwhile, the government, the regional and local administrations and most of civil society have been disconnected from the problem. For this reason, it was decided to carry out a study on these problems and on how certain cities, both nationally and internationally, have adopted ecosystem mechanisms that contribute to the fight against climate change. In this way, an inventory of urban elements that make the green infrastructures of cities more resilient to the urban heat island phenomenon and function as a refuge for biodiversity is obtained. After several tables have been compiled, we systematise eight initial criteria for categorising spaces with ecosystem functions in three groups of urban facts, corresponding to three cartographic moments and an extra chapter: foundational trait, urban fabric, green infrastructure, and liveability. Being represented together and mixed, three colours' codes -red, green, and blue-, are speaking to us of the need to make diverse and plural the look at the three times of the city: the legacy of the past, the concerns of the present, and the planning future. The point would be transforming and mobilising awareness of the time we are facing and preparing future reflections and interventions involved in a real possibility to tackle the serious environmental and health threats. With preliminary results presented, the focus would be, mainly, to understand the special and urban capacity of the city to strengthen itself eco-systemically, prepare for real policies of decarbonization and improvement of urban health and well-being of people.

KEYWORDS _ *urban ecosystem, mapping, urban form, urban planning, climate change*

INTRODUCTION

Located in Andalusia, the city of Granada benefits from a privileged settlement in this semi-desert territory in southern Spain. The historical functional domestication of the Genil, Darro, Beiro and Monachil rivers by the network of ditches allowed the flourishing of great civilizations. However, the morphology of its territory is being a catalyst for contamination in our current situation. According to the report of the Observatory of Sustainability 2020 "The orography of the Metropolitan Area or the burning of biomass in the Vega, the agricultural area of the geographical depression, aggravate the effects of the emission of polluting gasses", placing Granada in second place in the ranking of the most polluted cities in Spain (Polo, 2021).

The city is in a space of transition and meeting point between the ecosystem of the Sierra Nevada and that of the agricultural plain of Granada. The urbanized hillside on which Granada and other centers of the metropolitan area are located, fulfill an important ecosystem function.

THE CURRENT URGENT SITUATION: THE LOSS OF URBAN RESILIENCE

Problematic situations caused by climate change have been overlapped by the disconnection of administration, its inability to overcome a conceptually outdated planning. There are only some worthy segments of civil society fully aware of the urgency of reversing the loss of urban resilience to fight or mitigate the many effects of climate change, among which we would highlight: heat island effect, decreased humidity, poor air quality, decrease in rain, biodiversity loss or excessive motorization.

As we can observe in Figure 1, there could be a decrease in the rain and desertification in the Iberian Peninsula. The average annual rainfall could decrease by up to 42% by the end of this century because of climate change. In the evolution of the climate modeled in the projections for 2040-2070 and 2071-2100 were confirmed, the desertification trend would be clearly upward, with the area affected at the regional level, going from 9.57% in 2003 to 13.32% in the 2010 (Argüeso et al., 2012).

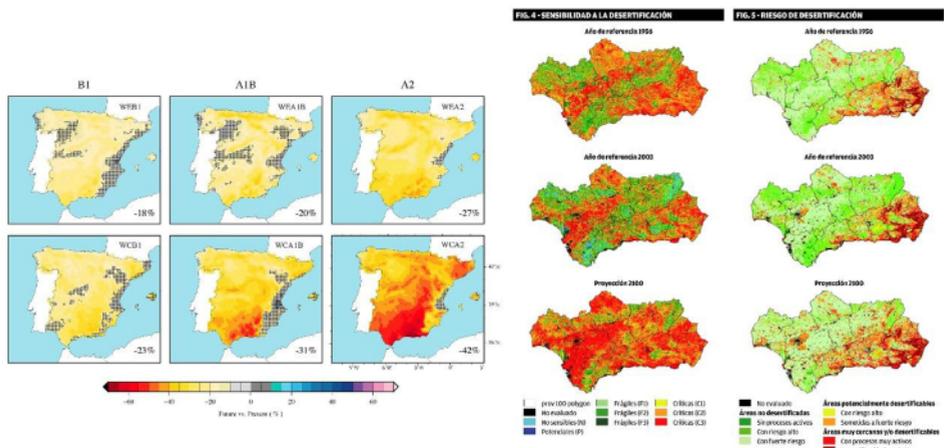


Figure 1: (Left) Projected changes in the annual mean precipitation (2070–2099 versus 1970–1999) for the different WRF simulations. Areas with black dots indicate that changes are not significant using a two-sided Student's t-test at the 95% confidence level. The spatially averaged changes over Spain are shown in the bottom right corner of each panel; (Right) Desertification Sensitivity and Desertification Risk. Source: (Left) Argüeso et al., 2012, p. 6; (Right) Moreira & Rodríguez, 2008, p. 20.

Considering the problem of excessive motorization rate, number of trips, etc., private transport by car, which is one of the most polluting means, accounted for almost 50% of total trips in October 2019 in the metropolitan area of Granada. On the contrary, public transport accounted for 9.46%, cycling for

3.44% and walking for 38.65%. (Junta de Andalucía, 2021). In addition to the above, more than a third of the vehicles registered in Granada are highly polluting (Morales, 2022), and it has been proven that one of the main sources of respiratory diseases in the urban area of Granada is due to poor air quality (Abuín, 2019; Rodríguez-Acosta, 2022).

OBJECTIVES AND RESEARCH METHODOLOGY

How to make green infrastructures more resilient in the face of the urban heat island phenomenon and refuge for biodiversity?

The objective of this research aims to identify the elements of the city and its surroundings that would make up, at the same time, the ecosystem structure of Granada. The research work is based on the prospective vision of the metropolis, considering public and private spaces as functional elements of a complex system of overlapping scales, focusing on improving the quality of life and the health of its citizens. The research methodology includes a previous regulation analysis, and a definition of basis and elements, followed by an assessment of the laboratory of certain cities, to subsequently establish a criterion for ecosystem mapping which permits us to cartography Granada's Ecosystem. This methodology is based on various phases, which are:

PHASE I: ANALYSIS OF PRIMARY SOURCES

Primary Source I – Theoretical Approach

First phase consists of a theoretical approach to the ecosystem city, as a project, based on seven categories of urban elements with ecosystem potential.

“The city, as an object of architecture, is always a rewriting of a previous city [...] At another level, we are also faced with the urban plan, which can be seen as the ground on which traces are engraved and retained indefinitely while everything else changes” (Gandelonas, 1999).

The disconnection between urban form and context, arising from not considering the conditions of the supporting geography, leads to a huge range of functional and formal deficiencies. Urban planning always tries to recompose complex entities through the analysis of specific elements. It often uses a constructive method that, by observing parts or components of the whole, serves to value their prominence and generate hierarchies.

Recognizing urban identity as an essence that is renewed and constructed precisely through human decisions, it is worth asking about the urban elements or concepts that give meaning to urban identity (Rivas-Navarro, 2009). This approach would be based on a morphological analysis, a typological classification of elements and their relationship and spatial and temporal intertwining between them. Without the intention of looking for a common trunk that turns the parts into a structure, the following seven categories of components are identified as relevant in the open process of building an ecosystem urban identity. This new identity would be understood as a new organization, characterized, in the words of Carlo Aymonino, by *“a multiplicity of hierarchical, interdependent and intensely selected relationships”* (1981):

1. The meaning of cities
2. The importance of topography and geography
3. Collective structures
4. The participation of individual forms
5. Urban and territorial links
6. Essential corners
7. Synthesis of essential forms

8. To which we add a supplementary category:
9. Citizen initiatives, as a qualitative criterion.

Primary sources II – Study of real cases

The analysis of primary sources is followed by the study of cities that show in their urban planning an ecosystem commitment with the logic of their existing fabric. In the spatial fabric of cities, this combination of opportunities and challenges requires integrated strategies for a friendly environment, sustainable transport, reduced air pollution and increased biodiversity, closer access to green spaces, more productive and connected communities, etc. (Dijkstra, 2017).

The main capital for strengthening urban ecosystems and green infrastructure is free urban space, especially public space. This is why it is necessary to understand its current state and its increasingly diverse dimensions to realize this regenerative capacity. Furthermore, incorporating biodiversity ideas into urban planning changes priorities, bringing urban open spaces into the spotlight. Evidence for this is his view of the interrelated components that guide the integration of sustainable urban development into the New Urban Agenda (United Nations, 2017), and the central role that public spaces play in social and economic development (Mehaffy et al., 2019).

To understand the ecosystem functions of urban open spaces and the components of potential green infrastructure, connectivity must be sought to integrate into networks that provide systemic capacity to diverse spatial and territorial resources (Feria et al., 2020).

Based on various urban and environmental reconsiderations that other cities have been facing, through *field work*; *ecological reading of the support territory*; *unoccupied space analysis*; *cartographic interpretation*; *morphology of the urban present*; *history*; and *current urban dynamics*.

PHASE II: BUILDING OF THE CARTOGRAPHIC'S LEGEND AND URBAN PURPOSE

With the aim to obtain a new meaningful image of the city, territorial resources, current ecosystem services and potential green infrastructure are carefully identified and categorized at that second phase, considering elements from the city and its surroundings. Ecosystem structure for Granada is revealed using two complementary perspectives. On one hand, the registration of urban-ecological elements belonging to the founding of the original settlement. On the other hand, the consideration of future urban project and urban policy logics to identify possible systems and urban patterns according to sustainable development.

Study of real cases of implementation of ecosystem policies. To compile information about ecosystem policies applied to real cities, it's fundamental to establish a criterion for ecosystem mapping. To meet with this research phase, it was to study real cases of implementation in various NATIONAL AND INTERNATIONAL CITIES: Lleida. *Municipal Plan for Urban and Territorial Planning 1995-2015*.

- Barcelona. *Green Plan and Biodiversity of Barcelona 2020*
- Vitoria. *Green Belt of Vitoria-Gasteiz, 1993*.
- Granada. *Paseo del Salón Rehabilitation Competition, Genil Central proposal, Rivas & Cabrera, 2005*.
- Madrid. *Metropolitan Forest Project, 2020; Madrid Río Project, 2004*.
- Girona. "Las veras de Girona". *Design and management laboratory for an urban green infrastructure in Girona., EMF Arq, 2014*.
- Salamanca. *Special Plan for the Protection of the green infrastructure and biodiversity of Salamanca 2019*.
- New York. *City Street Trees by Species*.

- Frankfurt. *Integrated Urban Development Plan for Frankfurt 2030, 2017.*
- Lyon. 2021-2026: *Relance écologique et solidaire. La Métropole du Grand Lyon.*

RESULTS

Assessment of the laboratory of cities according to the 8 basis and elements of the ecosystem identity

Once the cities mentioned are known and studied, we proceed to make comparative analysis that consolidate all the information obtained. The ensuing synthetic information table try to exhibit the qualities of the national cities we've just mentioned, regarding the seven categories of urban elements with ecosystem potential listed above. Each criterion is broken down into several tangible urban elements who can be assessed according to their values: *ecosystemic*, structuring, aesthetic, functional, identity, singularity, sociocultural, historic, health, comfort, geopolitical, economic, and educational. In this manner it allows us to understand why certain cities became pioneers in the fight against climate and what tools they have been using for this purpose.

Table 1: Multidimensional assessment of the "Cities laboratory" according to the eight basis to address the Ecosystem Identity.

ASSESSMENT OF THE LABORATORY OF CITIES ACCORDING TO THE 8 BASIS AND ELEMENTS OF THE ECOSYSTEM IDENTITY

		LLEIDA	VITORIA	GRANADA	BARCELONA	MADRID	GIRONA
1	MEANING OF CITIES						
2	IMPORTANCE OF RELIEF AND GEOGRAPHY						
3	COLLECTIVE STRUCTURES						
4	PARTICIPATION OF INDIVIDUAL FORMS						
5	URBAN AND TERRITORIAL LINKS						
6	ESSENTIAL CORNERS						
7	SYNTHESIS OF ESSENTIAL FORMS						
8	CITIZEN INITIATIVES						

ECOSYSTEMIC	AESTHETIC	IDENTITY	SOCIOCULTURAL	HEALTH	GEOPOLITICAL
STRUCTURING	FUNCTIONAL	SINGULARITY	HISTORY	CONFORT	ECONOMIC
				EDUCATIONAL	

Mapping of Granada through an ecosystem approach: Proposal in a transversal framing

Spatial categories with ecosystem function. We propose three groups of urban facts related to three cartographic moments. The experimental drawing appeals to the urban landscape that has been traveled, inhabited, legislated, politicized within the chronological process of the territory transformation.

FOUNDATIONAL TRAITS. Domesticating and sewing. Identifying primary elements of natural origin with ecosystem potential.

URBAN FABRIC. Settling down and defining the legacy. Built elements that speak of the objective transformation of territory from the foundation of the settlement to the present.

GREEN INFRASTRUCTURE. Suture and reproduction. Prospective of the spatial potential of the Granada through Ecosystem approach considering its territory as a place of opportunities.

[extra] HABITABILITY. Realistic sustainability. Evaluation of qualitative performance of the proposal highlighting fundamental values.

Transversal framing of Granada with ecosystem approach, experimental cartography

Being represented together and mixed, three colors codes -red, green, and blue-, are speaking to us of the need to make diverse and plural the look at the three times of the city: the legacy of the past, the concerns of the present, and the planning future.



Figure 2: Legend of the laboratory-framing of the mapping of Granada with ecosystem approach according to thematic blocks or times of the territory. Source: Own elaboration.

CONCLUSIONS

This research is being developed through: (1) referential national and international case studies; (2) a local field work in depth; (3) an ecological reading of territory, considering an analysis of unoccupied space; and (4) a multiscale and multidimensional cartographic interpretation of the city of Granada, its urban history, and current urban dynamics. The point would be transforming and mobilizing awareness of the time we are facing, with a huge climatic crisis with locally palpable effects. The aim is to prepare future reflections and interventions involved in a real possibility to tackle the serious environmental and health threats.

The fight against climate change takes place in the urban scenarios of the city, and the spatial dimension of physical resources plays a fundamental role as dissipator, enhancer, blocker, or enabler of urban strategies of more positive response of cities to local effects of the climate emergency.

The approach of mapping of the Granada with ecosystem approach is just a starting point. As a foundational gesture, the research is setting the basis for further development, but it is mainly rescuing historical values that may be part of a much better relationship between the city and its

geographical environment. The possibility that it is opened would be to establish an eco-structure that implies a lot of urban fabrics and the assignment of different roles to urban facts (streets, blocks, public space, collective facilities, etc.)

It would also mean increasing the collective and public space dimension of urban space for geographical support, in a more resilient way and creating a positive network to guide future steps.

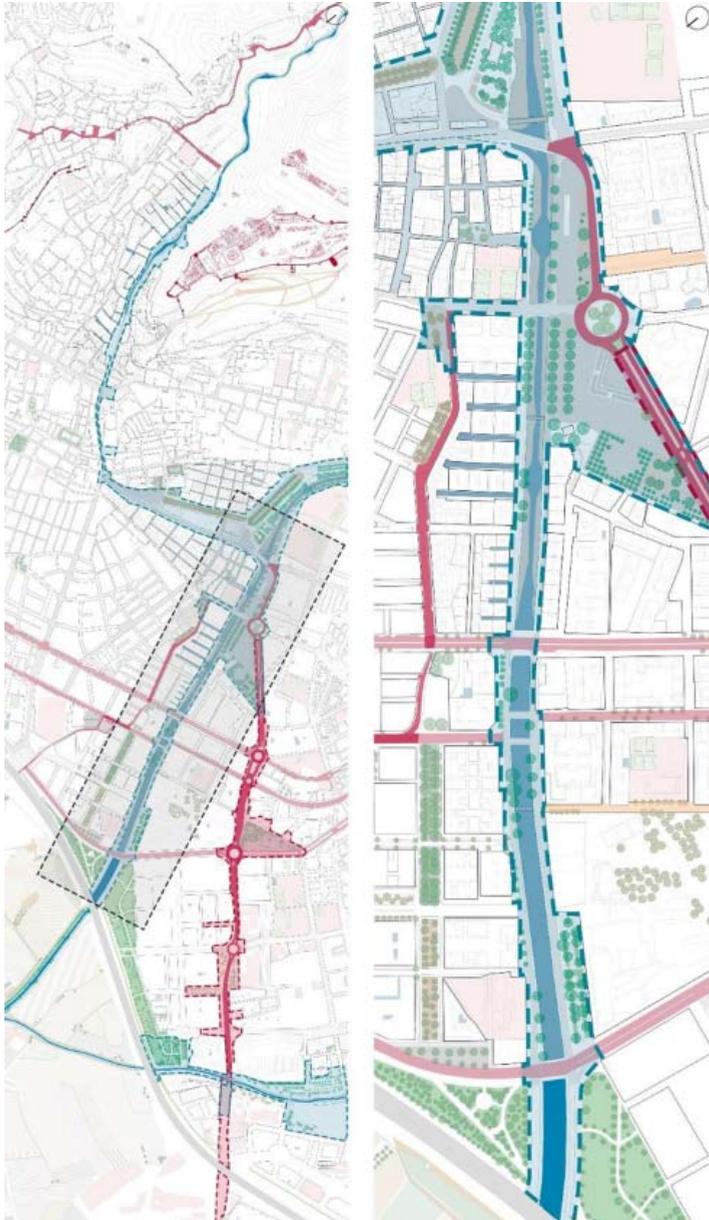


Figure 3: (Left) "Laboratory-framing" of the mapping of Granada with ecosystem approach; (Right) Zoom applied to the central urban area around the Genil River. Source: Own elaboration.

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