Which local approaches for European green infrastructures concept?
Case analysis of the Angers and Porto

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Introduction

In the last fifty years European cities has been experiencing high dynamics of landscape change. The environmental and social impacts of urban sprawl are widely discussed among researchers. There is a growing pattern of population movement into suburban areas, and a commonly cited reason is the attraction to rural areas because of the associated aesthetics of the landscape. Indeed, for them, naturalness is the most attractive value of this landscape. The periurban nature is predominantly characterized by a rural matrix (90% of suburban areas) (Cavailhès, 2009). Paradoxically, at the same time that urban sprawl is affecting surrounding rural landscapes, suburban landscapes continue to attract new residents. The consequences of urban sprawl and landscape fragmentation have becomes problematic for planners. Urban sprawl has been linked to an array of economic and social costs for communities wanting to meet the quality of life expectations of their citizens. Furthermore, urban sprawl is increasing seen as one crucial contributor to the disappearance and fragmentation of natural areas and to biodiversity losses (Mcdonald *et al,* 2008). In order to answer to current ecological crisis, European Union has been adopting diverse environmental policies, including biodiversity conservation strategies. The term "green infrastructure" is being adopted by the European urban policy deliverables and becomes the subject of increasing research projects. Green infrastructure is a recent term, but it has roots in planning and conservation efforts that started a hundred and fifty years ago, including greenways, ecological corridors or ecological networks.

In France, since late 1990s, the concept of greenways is increasingly being recognized in planning. It was first used in a broad social and environmental perspective. However, the global recognition of the disastrous results of biodiversity loss has led to increasing efforts to combat the landscape fragmentation. Based on the theories of landscape ecology, the ecological corridor concept emerges as a means to fight against landscape fragmentation. With the adoption of the laws Grenelle 1 and 2 (2009 and 2010), the green infrastructure concept embodies the importance of ecological connectivity. Thus, each metropolitan area has to "take into account" the green infrastructures in its local project planning (SCoT and PLU).

Having creating the "Reserva Ecologica Nacional" (National Ecological Reserve) in 1983, Portugal is at the forefront in the design and application of the concept of ecological network (Andresen *et al*, 2005). At local level, however, more recent regulations (2005) calls for the delimitation of a municipal ecological network in the master plan based on both ecological and cultural values. The municipal ecological network favors multi-functionality and connectivity of

green areas, representing clear progress in terms of a holistic concept of the city's green structure.

2/ Background and literature review

The concept of green infrastructure has been receiving widespread attention among both researchers and practitioners on open spaces planning. Two main key principles are often associated with the green infrastructure concept. Despite the difficulties in achieving a single definition of green infrastructure, it is possible to identify some underlying features, such as connectivity and multifunctionality. On a theoretical perspective, we will focus on these two key concepts to understand its dissemination in open spaces planning approaches.

The idea of connecting open spaces knows a history of more than a hundred years and, in fact, is not a new idea in urban planning thinking. However, the motivations and objectives for connecting open spaces changed over time. If today connectivity of open spaces has, especially in Europe, a strong ecological connotation, it was originally envisioned for aesthetic and social purposes. Having developed the parkway concept in late 19th century, Olmsted is usually claimed as a pioneer in this concept. With a system of connected open spaces, users could travel throughout the system without leaving the natural atmosphere. The concept was exported to Europe and especially to France by Forestier in the late 19thcentury. The open spaces spatial continuity idea was also explored during the 20th century with the aim of containing urban development, following the "garden cities" theories developed by the British urban planner Ebenezer Howard (late 19th century). "Green belts" plans were developed in several European cities, as London green belt (1944) or Paris green belt (1976), with the objective of confining the urbanization of cities (Laruelle et al., 2008). In addition, with the rise of environmental concerns in the second half of the 20th century, the connectivity concept embraced a new meaning. It no longer meets anthropocentric objectives but biocentric objectives. Indeed, scientists and naturalists have been highlighting the effects of terrestrial fragmentation on biodiversity decline. The fragmentation of natural and semi-natural areas as a result of urbanization is seen as key process on ecosystem degradation. In order to answer to this ecological crisis, landscape ecology science has been advocating the restoration of functional ecological connectivity between hotspots of biodiversity and habitats through corridors. Europe as promptly incorporated this concept in several legal frameworks. Indeed, in 1995, several European countries have endorsed the Sofia Convention, that provided the creation of a Pan-European Ecological Network[3] in order to halt biodiversity loss. The ratification of the convention by the European countries induces the

[*] The word "eco-museum" comes from two Greek words: oikos, which means "house" in a symbolic sense, meaning the environment, and which corresponds to today's concept of "small homeland", and museion - set of things, a collection. Eco-museum connects the tangible and intangible heritage related to the place of origin and the life of real people.

development of public policies in order to introduce ecological networks at national scale. Thus, whether in an anthropocentric vision or in a biocentric vision, open space connectivity appears, for more than one century, as a key element of urban and landscape planning.

The second associated with the green infrastructure concept is The second key principle associated with the green infrastructure concept is multifunctionality.For most European cities the second half of twentieth century was marked by an unprecedented planning paradigm closely supported in the spirit of the Charter of Athens (1933). Functionalist planning produced mono-functional territories based on the spatial separation of industrial, housing or recreational functions. Social and environment crises led to a diametrically opposite repositioning of urbanism vision. A space couldn't be reduced to a single function and must support multiple issues. At the time that was being developed the sustainable development principles, the Aalborg Charter (1994) suggests the implementation of transversal urban policies that encompass planning impacts - ecological and social - on environment at multiple scales (Emilianoff, 2004). It focuses on the potential ability of cities to solve some environmental and social problems. Open spaces are increasing perceived by its multiple benefits and functions, which planners have to take into account in a global vision for the city.

Social functions most frequently cited in literature include the biological human need of nature, that what Edward Wilson calls "biophily" (Beatley, 2010). Thus, the accessibility to open spaces becomes a major concern in cities. They respond to the growing demand for recreational areas and recreational nature in the city (Berque, 2002; Emelianoff, 2010; Madureira et al., 2011). The presence of open spaces in residential areas is also associated with a greater social cohesion. The frequency of public green spaces encourages social interactions and the community sense of place (Tzoulas et al., 2007). In addition, numerous studies have shown positive effects of green spaces proximity on human health: sports practice and physical activity, reduction of blood pressure, health benefits on Alzheimer patients…

Researchers also attribute many environmental functions to open spaces in cities. They contribute to foster and develop urban resilience. Urban areas are often considered as degraded ecosystems. Thus, open spaces allow large environmental benefits: preservation of biodiversity, atmospheric purification, mitigation of the effects of urban heat islands and heat waves, or restoration of the urban water cycles.

Finally, open spaces play an important role in the urban structure and contribute to an attractive image of cities (Blanc, 2008). In fact, numerous studies demonstrate the increase of property values near green spaces.

3/ Goals and objectives

Connectivity and multifunctionality concepts take a central role in the emergence of green infrastructure concept. Multifunctionality meets multiple ecological and social functions of urban open spaces. Connectivity seeks to increase the social perception of urban nature and to promote

the ecological processes. In spite of these concepts being discussed and implemented by the EU and national authorities, the implementation at the local level reflects different interpretations of the "concepts". The aim of this paper is to evaluate and discuss the incorporation of concepts concerning connectivity and multifunctionality in local planning. Using the examples of two different European cities, Angers (France) and Porto (Portugal), we discuss the issues of transferability and specificity in local green infrastructure plans implementation.

4/ Methods

For the purpose of evaluating and discussing the incorporation of concepts concerning connectivity and multifunctionality in local planning, two methodological steps were taken.

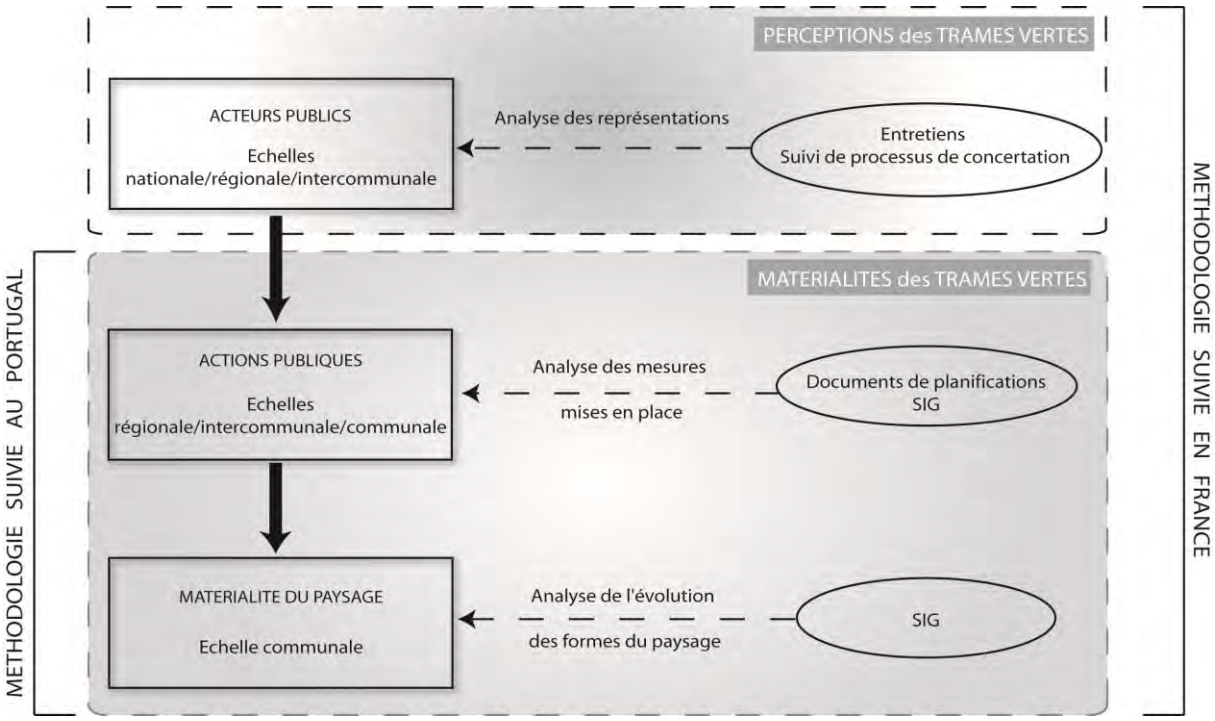
First, we evaluated the incorporation of the principles of connectivity and multifunctionality on French and Portuguese legal frameworks in a multi-scalar approach. In fact, these principles have in both cases a declination at national, regional and local levels.

Second, we evaluate the incorporation of the principles of connectivity and multifunctionality in local planning using the examples of Angers (France) and Porto (Portugal).

For both case studies we analyzed the local regulatory instruments and planning tools as well as its declination on the national legal framework; using a GIS, we inferred the local strategies for the green infrastructure.

It is important to note that analytical approach adopted by researchers in both countries, to respond to this research problem, does not follow exactly same methodology. Without making a strict comparison between sites, this reflection however try to understand mechanisms of a similar urban policy in two European countries. This research allows us to identify blocking factors inherent to consideration of green infrastructure concept locally.

Regarding the French analysis, methodology developed here, with Angers metropolitan case study, is based on thesis works conducted between 2008 and 2011. The joint study of the physical structure of the landscape, planning documents and representations of public actors, allows us to analyze actors' discourse and materiality areas affected by a green infrastructure plan. Therefore, our analysis focuses both on stakeholder’s perception and regulatory implementation of green infrastructure. We summarize our approach with the following figure.



5/ Results

Neither France nor Portugal has the designation of "green infrastructure" in their legal framework. In this article, we focus on instruments or regulations that can be considered closer to the concept of green infrastructure. In the French case, we focus on the recently implemented "Trame Verte et Bleue" (2009), while in the Portuguese case we selected the “Reserva Ecológica Nacional” (National Ecological Reserve) and the “Estrutura Ecológica” (Ecological Structure) (Figure 1).

A comparative analysis of the integration modes of the principles of connectivity and multifunctionality in France and Portugal leads us, first of all, to the need to differentiate the legal frameworks. France started in recent years a reformulation of nature conservation policies in order to establish integrated instrument to be applied at multiple scales: the “trame verte et bleue”. By contrast, Portugal is characterized by a wider range of instruments in the field of nature conservation. Despite these differences, we can systematize some key ideas about the integration of the principles of connectivity and multifunctionality in France and Portugal.

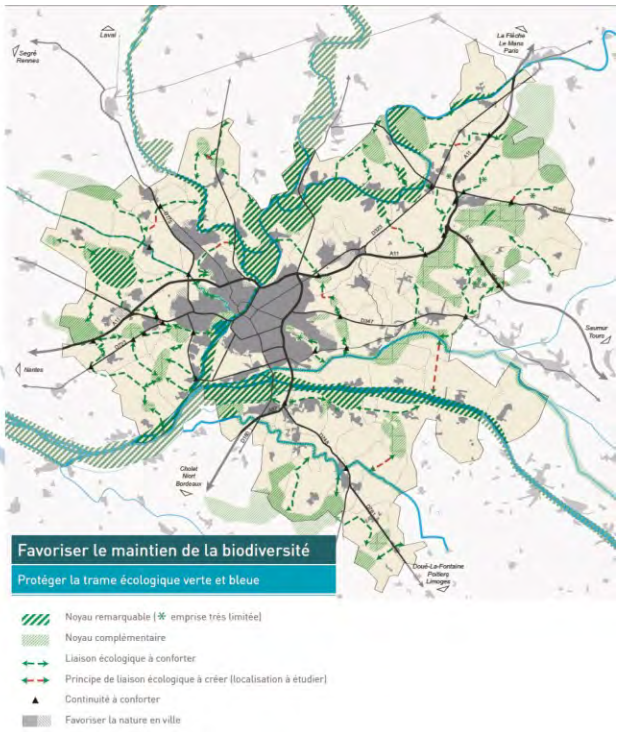
The recognition of the importance of ecological connectivity is clearly explicit on the analyzed policies and tools. We can even state that the establishment or the maintenance of ecological connectivity is currently one of the main goals of nature conservation policies in France and Portugal. The French “Trame Verte et Bleue” is expected to be a key planning tool to limit biodiversity loss throughout the creation of protected areas and ecological networks. The protection of core natural areas and the promotion of ecological connectivity are defined as the main strategies to combat biodiversity loss. It is applied over different spatial scales, namely the

regional and municipal scales. The Portuguese “Reserva Ecológica Nacional” is also addressed as a primary tool to establish the connectivity between the national protected areas under the national strategy to combat biodiversity loss, and is also applied over different spatial scales. Both the tools follow the general trend of moving from isolation to connection and from a concentric to a peripheral approach (Jongman and Pungetti 2004). The challenge is to maintain consistency between national guidelines and priorities and the definition of the “Trame Verte” or the “Reserva Ecológica Nacional” at the regional and local levels.

The integration of the principle of multifunctionality is not directly made explicit on the analyzed policies and tools. In fact, we identify a remarkable supremacy of the ecological dimension over the other services provided by green structures. It is just at the local scale that the larger scope of the planning tools opens the way to the presence of the multifunctionality principle. The aims of Portuguese the “Estrutura Ecológica Municipal” (Municipal Ecological Structure) and the implementation of the "trame verte" at the local level provide a wide range of interpretations to answer to a need of adaptation to specific territorial contexts.

In fact, if at the national scale the "trames vertes" are essentially interpreted in an ecological perspective, at local scale planners should take into account the concept in a more broadly way. The example of Angers Metropole shows the integration of multifunctionality at the metropolitan scale. The "trame verte” vision is inscribed in three dimentions at the metropolitan planning document (1996): a landscape dimension with the preservation of landscape identity; an urban dimension with regulation of urban sprawl; and a recreational dimension with the aim to create recreational open spaces. The integration of the “trame verte” in dense urban areas is done by public urban spaces: core areas are comprised by parks and green spaces, and continuity is held by tree-lines along driveways. This continuity reflects more landscape issues than environmental issues. But since 2010, the new metropolitan urban plan integrates the “trame verte” concept with an ecological perspective. This focal change is due to debates generated by the Grenelle Environment Forum. However the document uses another term, “armature verte”, expressing the idea of green infrastructure. By using a distinct vocabulary than “trame verte”, which is now strongly linked to planning dispositions, it allows a wide range of interpretation for planners, particularly in terms of mobilized resources, management disposition, and affected areas. Thus, multifunctionality is ensured in a more effective way by this kind of semantic variation of “trame verte”.

Metropolitan urban plan (1996)



Metropolitan urban plan (2010)

The Porto Master Plan (2006), which is currently in force, reflects the recent regulations for the delimitation of a Municipal Ecological Structure in the master plans. We can argue that the principle of multifunctionality is partially incorporated by the diversification of the comprised green areas categories: in addition to the traditionally valued public parks, other categories were defined, like agricultural or forested structures, private green areas or green areas along transport corridors. On the other hand, we can point out an attempt of incorporation of the connectivity principles. The plan introduces linear spaces in order to establish the connectivity between the main green areas. However, connectivity is only artificially assured along transport corridors, specifically, straight green corridors related to the high-speed roads that cross the city.

There is thus a mismatch between the general legal frameworks focused on ecological issues and the local applications focused primarily on recreation and aesthetics issues. Despite recent efforts to introduce ecological approaches, namely the principle of connectivity, there remains the difficulty to apply at local scale the ecological principles that have been primarily developed and applied to broader scales (Cormier *et al*., 2010).

The effective implementation of the principles of multifunctionality and connectivity needs therefore to be supported by local assessments that inform about the relevance and the effectiveness of these principles in specific local contexts.

6/ Discussion and conclusion

The concepts of multifunctionality and connectivity are recognized as being closely related to the notion of green infrastructure. They aim is to go beyond the logic of territorial fragmentation between public and private spaces and to incorporate a broader thinking about open spaces. In addition, these two concepts allow recognizing the environmental issues at the same level of the economic, housing or travel issues that have traditionally prevailed in territorial planning. Open spaces should not be only protected by its individual exceptional value, but for their ability to ensure the resilience of all the system.

In this regard, open spaces become common goods, so that the functions and services that they deliver must be useful for human society. This paradigm shift is the evidence of an evolution taking into account the valorization of the environmental issues in the urban production processes. However, many problems emerge in the local application of the concepts of multifunctionality and connectivity.

In spite of being widely recognized as a key concept of green infrastructures, its local application stills imprecise. Physical connectivity tends to supplant functional connectivity. The necessary simplification of the ecological model in order of its integration into spatial planning frameworks, has tended to reduce it to one schema patch/corridor. Linearity gradually became the only issue of the national and regional green infrastructure policies. Given the local constraints (urban structure, private space / public space) this linearity is justified with difficulty by the famous "Japanese steps". Functional connectivity then resurfaced timidly, while it should be the center of attention. If researchers in ecology have demonstrated the importance of connectivity for ecosystems preservation, the ambiguity lies in the impossibility to define a single continuity for all biodiversity (as in an urban plan). Each species has its own system of dissemination, which theoretically should match a suitable ecological continuity.

In addition, in both Portuguese and French study cases, the legal framework states regulatory tools for local green infrastructure implementation. That regulatory tools involves mapping, define limits. But the integration of multifunctionality requires some flexibility regarding the issues where limits are specific to each function. So we may ask about the usefulness of regulatory tools in the integration of multifunctionality principle in urban contexts. Should we not consider the project as a pertinent way to integrate multifunctionality on green infrastructures? The project doesn't fit its objectives within strict limits, but promotes both the mobilization of various tools (management, contractual, regulatory, sensibilization) and the co-production of territories.

Finally, ecological connectivity leads us to consider biodiversity as a flow of living beings dependent on each other, and both their sum and their interactions contribute to defining functional biodiversity. Biodiversity, as a scientific and mediatized concept, becomes a

"common natural resource" in the sense given by Elinor Ostrom (Nobel Prize in economics / 2009) (2010). Therefore she argues for a public goods management. The common interest becomes a collective interest, co-constructed, contextualized and dependent of the scales and arenas in which decision-making or actions are developed.

Collective interest leads us necessarily to think the multifunctionality of places, to integrate the various functions and actors operating on the territory. Implementation of governance processes becomes a key issue regarding green infrastructure implementation. In addition, the role of inhabitants and residents' associations is based on a growing claim of territory appropriation, namely territories with environmental values. So this patrimonialisation of nature, including the green infrastructures, contributes to strengthening the link between societies and their territories.

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