

OPEN SPACES AND CONNECTIVITY IN LANDSCAPE DESIGN

Introduction

The concept of connectivity, borrowed and reinterpreted from Landscape Ecology, has revealed its importance for environmental and landscape studies. It opens up a new range of possibilities in connecting biodiversity, cultural and natural values. Particularly concerning new strategies for low carbon city design, the connectivity concept is relevant for it enable new links between natural and cultural processes.

In this paper, a proposal for the implementation of urban vegetation and reforestation for the city of Nova Iguaçu, situated at Rio de Janeiro state, in Brazil, is discussed. Landscape connectivity is at the basis of this proposal, which main objective was the expansion of the existing vegetation within the urban tissue and the surrounding mountains.

The paper is organized as follows: it presents initially a discussion on connectivity concept, green corridors and the idea of low carbon cities. This is followed by the presentation of the concept applied in the Nova Iguaçu proposal, as well as the methodological approaches. It concludes stressing the role of urban green spaces in the construction of low carbon cities.

Connectivity, green corridors and low carbon cities

One of the challenges of planning and design considering low carbon cities is the interdisciplinary approach. The idea of low carbon cities is in fact very new. Planners, architects and landscape designers have received no training on this matter whatsoever. It means that it is a knowledge that is being constructed through collective experience and study. It is also accepted that one single field of knowledge cannot cope with the complexity of this task.

In a context of dialogues and permeabilities among different fields of knowledge, an important approach is being made among studies from Landscape Architecture and Landscape Ecology. (Ahern 1995, Thompson 1998, Ahendt 2004, Pellegrino *et alli* 2006). A systematic thinking over environmental structures compatible with sustainable environments has opened up the acknowledgment of relevant concepts for landscape design and planning studies. Among them, the concept of connectivity is one of the most promising.

Connectivity is an important concept to be understood and reinterpreted within landscape design and planning, particularly focusing on strategies in designing low carbon areas. In principle, it expands the role of private and public open spaces – a traditional focus in landscape studies -, bringing new functions either in urban or territorial scale. Tardin (2005, p. 57) stresses that, from it new functions, they “would occupy the place of a central spine either than perimeter”, highlighting their potential as landscape structuring elements. And since open spaces are the places where city trees are planted, a new function can then be added, for the role of urban trees in carbon storage and sequestration has been largely acknowledged (Nowak and Crane 2002, Nowak 1993).

Putting it simply, the connectivity concept is related to the mobility capacity of elements of nature in the context of a given landscape, at different temporal and physical scales (Hilty *et alli* 2006). This movement can either be linear or through specific areas spotted around the landscape, known as patches. When the movement occurs in a linear way, it forms a corridor. In this sense, a corridor is therefore one of the ways to achieve connectivity.

One of the ways to protect and value urban biodiversity would be to promote connectivity within the matrix – that is, within the landscape context which surrounds communities niches and native habitats. This connectivity might assume several forms and nominations, such as green corridors, ecological nets, among others. As Hilty *et alli* (2006) argue, there has been very little interpretation from research results in the format of design and planning directions to maintain and restore connectivity concerning landscape studies.

Ecological corridors seem to be one of the most debated typologies in the search for landscape connectivity. Fabos (2004) discusses methodological procedures for the implementation of green corridors in the US, although emphasizing ecological procedures only. Arendt (2004) presents a study which considers the green corridors concept in design proposals. He uses a methodology that contemplates future design sceneries, which are later discussed both with local communities and public authorities, aiming the implementation of green corridors network. In Brazil, Pellegrino *et alli* (2006), having as a case study a river basin in São Paulo, present a landscape and environmental recovery programme where open spaces are the basis for a green-infrastructure proposal.

Ahern (1995), in one of the seminar papers on green corridors, presents a comprehensive discussion on the different typologies of these corridors. In the conclusion, he argues that “green corridors must include social and cultural objectives beyond environmental protection” (1995, p. 152). This argument has been insistently defended by other studies (Jongman *et alli* 2004, Hilty *et alli* 2006). In this sense, connectivity should include more than biotic communities such as fauna and flora, in a direct relation to the cultural groups which interfere in their structure and integrity.

The connectivity concept, therefore, if focused through the perspective of the valuing of the relations between ecological and cultural processes, might largely expand its approach and its effectiveness concerning the idea of low carbon cities. It offers a conceptual approach to connect urban trees through different patterns, aiming an urban forestry with multiple functions. An understanding of connectivity as a possibility of mobility and flux not only biotic but also socio-cultural might bring new design and planning landscape opportunities to reduce atmospheric carbon within the urban fabric. These ideas will be discussed below, having the city of Nova Iguaçu, in the state of Rio de Janeiro, Brazil, as a case study.

Nova Iguaçu Proposal

Nova Iguaçu (see Fig.1) is one of the most important municipalities of the Rio de Janeiro Metropolitan Region, and it is situated in a region known as Baixada Fluminense (Fluminense Lowland). Having a population of more than 800 thousand inhabitants, the city of Nova Iguaçu, which in fact is the whole municipality, is nowadays regarded as the main Baixada Fluminense´s business and retail area. However, despite its regional relevance, it is a city presenting serious problems, specially concerning education, sanitation, and urban fragmentation, to name but a few (Pinto 2008, SMUMA 2004).

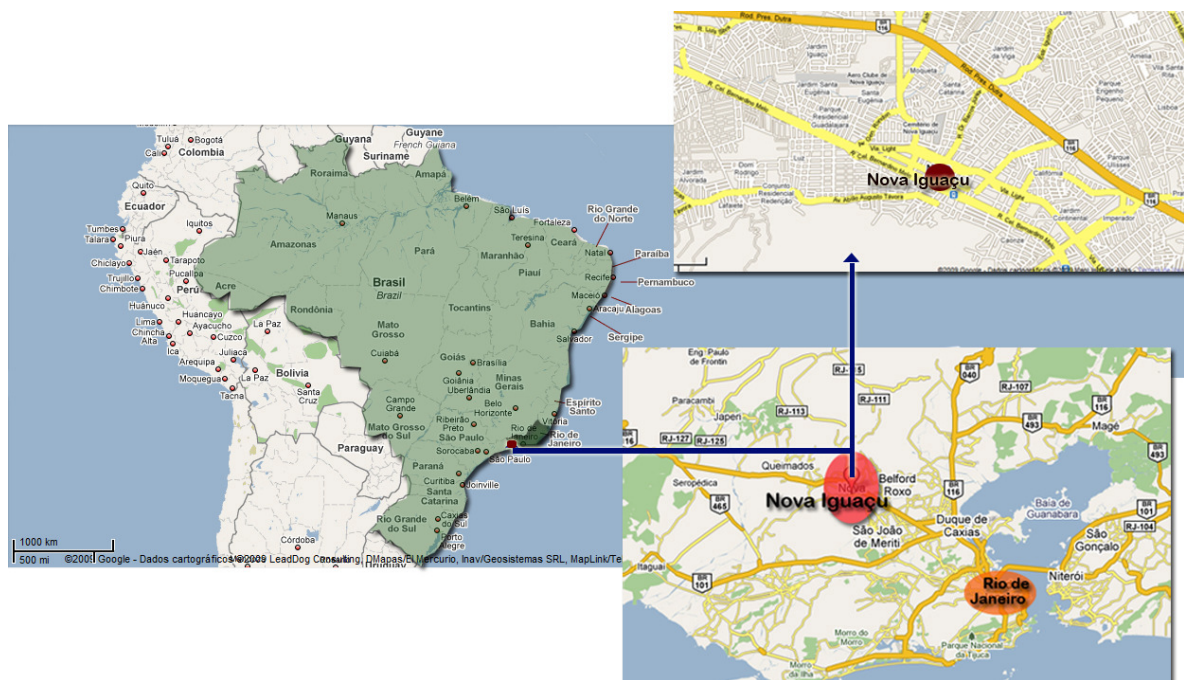


Fig. 1: Location of the City of Nova Iguaçu

Although Nova Iguaçu is the city which presents the highest number of public schools in the Baixada Fluminense, around 12% of the children had no access to formal education in 2005. Less than 50% of housing have access to sewage system and, those which have, discharge untreated sewage in the pluvial system, which in turn release it into local rivers and streams. Concerning its urban structure, Nova Iguaçu's neighbourhoods are poorly connected due to inefficient mobility system, and continuity of the urban tissue is interrupted in a number of situations (Pinto 2008, SMUMA 2004).

From the end of 2005 onwards, public authorities begin to face these and other issues from a different perspective, named Programa de Estruturação Urbanística de Nova Iguaçu – Bairro Escola (Nova Iguaçu Urban Structuring Programme – School Neighbourhood), or Programa Bairro Escola (School-Neighbourhood Programme), for short. This programme, conceived and coordinated by the architect Sergio Magalhães, had two strategic themes: the improvement of the quality of life by means of improving education; and the structuring, consolidation and qualification of the city, having urban design as the main tool (see Pinto 2008). As Magalhães (2008, p.9) notes: "A poor city, located at the metropolitan fringes, ill-treated for decades of dereliction and disdain, begins to strongly invest in its urban structure, and does it in close relation with education. Urban structure and education constitute a highly powerful binomial for the construction of a new and higher citizenship step."

One of the strategies of the School-Neighbourhood Programme for Nova Iguaçu was the participation of fourteen different teams in the process of bringing solutions to many of the city's problems. These teams involved architects, landscape architects, designers, and for each team a different area or neighbourhood was designated. This is the context in which the Urban Vegetation and Reforestry Plan for Nova Iguaçu is situated: it was conceived to propose general guidelines to all fourteen different areas that were being studied.

The general objective of the Urban Vegetation and Reforestry Plan is to define a preservation, maintenance and expansion proposal for the trees situated in the urban tissue and at the hillside of the city of Nova Iguaçu. Its relevance can be stressed when it is acknowledged that the provision and maintenance of public trees are essential urban services, which are responsibility of the public administration, and that directly reverberate in

the population quality of life. Besides, as it was already appointed, urban trees are acknowledged as one of the means to face problems generated by atmospheric carbon. Due to their capacity to reduce atmospheric carbon dioxide through their growth process, it is very important to find different ways to increase their participation in the urban landscape.

Specifically, this plan aims to subsidise the urban projects integrating the School-Neighbourhood Programme, developed by the Nova Iguaçu mayorship, as well as for the reforestation of the Madureira Hillside. The aim is to plant around 20 000 trees in Nova Iguaçu urban tissue, in the areas selected by Programa Bairro Escola, along a period to be defined by the public authorities.

The methodological approach for the Urban Vegetation and Reforestry Plan included the following activities: field work, specially in the areas initially selected by the Programme to receive the first urban projects, in order to study local vegetation and trees, as well as their landscape environment; meetings with the the Programe coordinator, technical team and public authorities; archival research; and contact with local population.

The field work, carried out in early 2006, revealed that the existing urban trees located in public spaces in the city of Nova Iguaçu were, in general, in an appalling state. The majority of them had no formal structure, were not consolidated, and were ill or physically deformed. A high number of public open spaces had no trees whatsoever, representing though a missing opportunity. The existing public trees, as a whole, had a poor presence in the urban landscape, being almost absent from landscape experience in the majority of visited neighbourhoods. On the other hand, the presence of trees in private areas such as backyards, schools, to quote but a few, was very strong. The private trees, as an assembly, actively participate in Nova Iguaçu's public landscape, since their canopy appears over the walls which delimitate public and private domains.

From an urban perspective, streets and avenues in Nova Iguaçu offer very little space for urban trees. Narrow sidewalks and aerial electric wires are the main obstacles for a healthy development of trees, bringing spatial conflicts were the tree is the first structure to be altered. From a botanic perspective, a great diversity of trees and palms were found. Fruit trees are found not only in private or semi-private areas, but also in public spaces such as sidewalks. As former studies have already demonstrated, this indicates that local people have been planting public trees themselves, since public authorities have been absent concerning this matter. So, from this appraisal, the collection of urban trees in Nova Iguaçu is not able to fulfil the variety of functions it is expected to in the urban tissue. They could not bring either landscape identity, nor environmental comfort. Besides, their capacity to face levels of atmosphere carbon was considerably low.

Reflecting on urban vegetation and reforestry means fundamentally reflecting on the landscape itself – understood as a cultural construction which materializes relationships between people and site, in a continuous process of transformation and interpretation. In this sense, in conceptual terms, landscape was the starting point for the construction of Nova Iguaçu's Urban Vegetation and Reforestry Plan. Nova Iguaçu's landscape as a whole was the main matrix which guided the directions for the trees planting and expansion (see Fig. 2).



Fig 2: Panoramic view of Nova Iguaçu City and the Mountains

The idea was that the trees situated at the two large massifs, which make two of the city limits, get down to the lowland where the urban tissue is situated. The trees would get down and spread over the city along the rivers and streams which begin at the hillsides. Water and forest would get down and spread themselves over the city through different types of public open spaces – such as sidewalks, squares, parks, protected areas, and the like -, as well as over backyards, private gardens, schools, public libraries, sport areas. The spatial connectivity, built through the vegetated open space system, would contribute to improve natural processes local dynamics, besides bringing a landscape identity to urban morphology. Local community involvement would be organized through the schools, and would participate in the construction of directions and strategies for trees planting and maintenance, following therefore the Neighbourhood-School Programme proposal (see Fig. 3).

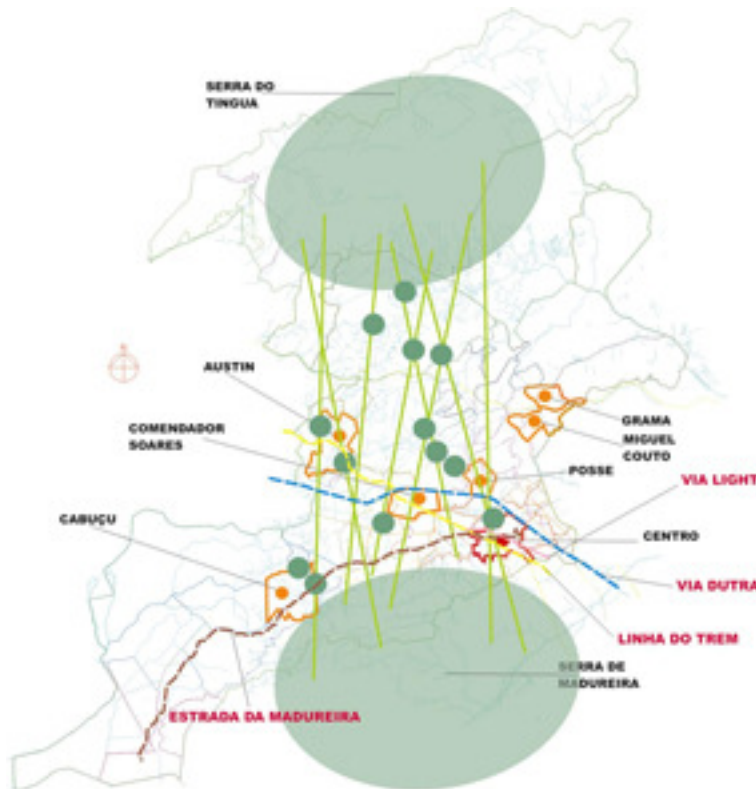


Fig. 3: the connectivity idea for Nova Iguaçu

The Vegetation Plan understands that the expansion of urban vegetation will occur from the existing one. Although acknowledging that it is, in general, in an appalling state, the existing urban trees represent the minimal basis from which the new is inserted in the landscape.

Considering spatial guidelines, urban vegetation connectivity is expected to occur through two main spatial structures: linear and patches. Linear structures are those areas located in sidewalks, railroads, river margins, and the like. Patches are those areas such as sportfields, squares, parks, hillsides, backyards, and the like. From these structures, green corridors and patches will participate more actively in the construction of the urban tissue (see Fig. 4).



Fig. 4: expanding water and trees on the urban tissue

Concerning botanical guidelines, the idea is that the neighbourhoods present initially a small selection of species. For example, each neighbourhood will expand its trees selecting up to five species to streets and avenues, which could be expanded up to more six tree species to the other typologies of public and private spaces. The main objective of the reduction of the trees botanic vocabulary it to seek a landscape identity for the neighbourhoods, through an emphasis on the tree structure or phenology. Besides, trees selection would be conducted through local community participation, organized through the Neighbourhood-School Programme strategies.

Finally, it should be noted the emphasis on the planting on river margins. Besides being protected by law, they are acknowledged as important biological corridors in the connection with the surrounding woods and forests. They are, therefore, strategic areas for the planting of urban trees in the middle of urban neighbourhoods. It is important, then, that river margins are regarded as part of the city open space system, specially where it is possible to consider public uses such as parks, as well as the planting of riparian vegetation. For these areas, it is suggested the intensive planting of fruit trees wherever possible. The use of river margins as urban orchards has been an alternative used in a number of Brazilian municipalities, as one of the ways to preserve its ecological integrity through public use.

Final comments

The implementation of the Neighbourhood-School Programme in Nova Iguaçu has been a very difficult task, particularly concerning funding. Initially, public authorities were counting with funding from the IDB (Inter-American Development Bank), specially for the reforestation of the nearby hillsteps. However, since this external funding did not occur, the Mayorship began to carry out the Programme with public funding, which meant a very low rhythm.

None of the studied areas was restructured as a whole, but many received partial improvements according to funding availability. The connection with local schools as a main strategy was never forgotten, and it is still a key note of the programme. Many of the urban interventions carried out so far focus on the pedestrian and on cycling, which is still an important way of mobility among neighbourhoods.

The concept of connectivity as one of strategies to implement tree planting will certainly not solve the complexity of problems present in the city of Nova Iguaçu. But the idea of urban trees in open spaces forming green corridors and patches is in fact an important means to deal with intensive urban development, to improve quality of life and biodiversity, as well as to enhance green space as a significant part of low carbon cities.

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Bibliography

Ahern, J. (1995). "Greenways as a planning strategy". *Landscape and Urban Planning* 33, 131-155.

Ahendt, R. (2004). "Linked landscapes: creating greenways corridors through conservation division design strategies in the northeastern and central United States". *Landscape and Urban Planning* 68, 241-269.

Fábos, J.G. (2004) "Greenway planning in the United States: its origins and recent case studies". *Landscape and Urban Planning* 68, 321-342.

Hilty, J.A.; Lidicker Jr., W.Z. & Merenleder, A.M. (2006). *Corridor Ecology: the science and practice of linking landscapes for biodiversity conservation*. Washington: Island Press.

Jongman, R.H.G.; Kulvick, M; Kristiansen, I. (2004). "European ecological networks and greenways". *Landscape and Urban Planning* 68, 305-319.

Magalhães, S. (2008) "Prefácio". In Pinto, A.L. *Urbanismo na Fragmentação: a resposta do Bairro-Escola*. Rio de Janeiro: PKT Livros, p. 9-10.

Nowak, D.J. (1993) " Atmospheric carbon reduction by urban trees" . In *Journal of Environmental Management*, 37, 3, p.207-217.

Nowak, D.J. and Crane, D.E. (2002) "Carbon storage and sequestration by urban trees in the USA". In *Environmental Pollution*, 116, 3, p.381-389.

Pinto, A.L. (2008) *Urbanismo na Fragmentação: a resposta do Bairro-Escola*. Rio de Janeiro: PKT Livros.

Pellegrino, P.R.M.; Guedes, P.P.; Pirillo, F.C. e Fernandes, S.A. (2006) “A paisagem da borda: uma estratégia para a condução das águas, da biodiversidade e das pessoas”. In Costa, L.M.S.A (org) *Rios e Paisagens Urbanas em Cidades Brasileiras*. Rio de Janeiro: Viana & Mosley/PROURB, p. 57-76.

SMUMA. (2004) *Atlas Escolar da Cidade de Nova Iguaçu*. Nova Iguaçu: PCNI.

Tardin, R. (2005) “Sistema de espacios libres y reestructuración de los territorios urbanos”. In Reimondi, I. (coord) *La Sustentabilidad Hoy*. La Plata: Fundación CEPA.

Thompson, I. (1998). “Environmental ethics and the development of Landscape Architecture theory”. *Landscape Research* 23, 2, p. 175-194.

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